Building Codes and Standards

LOADS AND EFFECTS

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Applying to design of building structures and foundations, the present norms define basic rules and regulations of dead and live loads and effects as well as their combinations.
Loads and effects on non-standard building structures and foundations are allowed to be calculated under some special technical conditions.

Note 1: 1. Further on, wherever it is possible, the term "effect" is omitted and substituted with the word "load" as well as "buildings and structures" are substituted with "structures".
2. In the case of reconstruction design loads to be calculated according to examination results of the existing structures. At the same time, atmospheric loads may be adopted in accordance with the data provided by the State Hydrometeorogical Committee.

Contents

1. General

1.1. The design should take into account the loads arising in the course of construction and operation of buildings as well as in the course of production, storage and transportation of construction materials.

1.2. The loads listed in the present norms are characterized with their standard values.
The load of a particular kind is usually characterized with a single standard value. For loads affecting floors of residential, public and farm buildings due to people, animals and equipment as well as bridge crane loads, overhead crane loads, snow loads and temperature effects it is set two standard values: full and low (the latter is taken into account if it is required to check load duration, endurance and in other cases stipulated in the design norms of building structures and foundations).

1.3. Design load should be calculated as the product of its standard value and the γ_f load safety factor. The safety factor conformed to the given limiting state ought to be taken as follows:

a) in the case of analysis of strength and stability – according to items 2.2, 3.4, 3.7, 3.11, 4.8, 5.7, 6.11, 7.3 and 8.7;
b) in the case of endurance analysis – equal to one;
c) in the case of stiffness analysis – equal to one unless design norms of building structures and foundations imply other values;
d) in the case of analysis of other limiting states – in accordance with design norms of building structures and foundations.

If statistics are available, design loads may be calculated directly by their specified exceedance probability.

Upon calculations of structures and foundations that define construction conditions of buildings and structures, the calculated values of snow, wind, sleet loads and temperature effects should be reduced by 20%.

If it is required to make analysis of strength and stability in the case of fire, explosion effects, transport collisions with structural parts, load safety factor should be taken equal to one for all the loads allowed.

Note: As regards the loads having two standard values, the corresponding design values are to be calculated by one and the same load safety factor (for the given limiting state).

Classification of loads

1.4. Depending on load duration, loads may be divided into dead and live (sustained, short-term, special) loads.

1.5. The loads arising in the course of production, storage and transportation of structures as well as in the course of structure mounting should be adopted in calculations as short-term loads.
The loads arising in the course of building operation should be taken in accordance with items 1.6-1.9.

1.6. Dead loads include the following:

a) weight of structural parts including weight of bearing and enclosing structures;
b) weight and pressure of ground (mounds and fillings), rock pressure.

The prestressing forces remained in building structures and foundations should be adopted in calculations as dead load forces.

1.7. Sustained loads include the following:

a) weight of temporary partitions, grouts and concreting under equipment;
b) weight of fixed installations: machines, devices, engines, tanks, pipelines supplied with reinforcement, supports and insulation, belt conveyors, permanent hoists with their cables and guides as well as weight of liquids and solid substances filling the equipment;

c) pressure of gases, liquids and granular materials in tanks and pipelines; overpressure and air depression emerging in the course of shaft ventilation;
d) floor loads arising from stored materials and shelves in storerooms, cold stores, granaries, book depositories, archives and other similar rooms;
e) technological temperature effects of fixed installations;
f) weight of water layer of water-filled flat surfaces;
g) weight of occupational dust layer unless its accumulation is prevented with the relative measures;
h) loads due to people, animals and equipment affecting floors of residential, public and farm buildings having low standard values listed in Table No. 3;
i) vertical loads of bridge cranes and overhead cranes having a low standard value which is calculated by multiplication of the full standard value of the vertical load due to a single crane (see item 4.2) in each building span by the following coefficient: 0,5 – for groups of 4K-6K crane operation; 0,6 - for groups of 7K crane operation; 0,7 - for groups of 8K crane operation. The groups of crane operation to be adopted according to GOST 25546-82;
j) snow loads having a low standard value which is calculated by multiplication of the full standard value in accordance with the guidelines listed in item 5.1 by the following coefficient: 0,5 – for IV area; 0,6 – for V and VI areas;
k) temperature effects having low standard values that should be calculated in compliance with the guidelines listed in items 8.2-8.6 on the assumption of $\theta_1 = \theta_2 = \theta_3 = \theta_4 = \theta_5 = \theta$, $\Delta_I = \Delta_{VII} = 0$;
l) effects caused by defrosting of frozen ground and by ground deformations unaccompanied by a critical change of the ground structure;
m) effects caused by humidity change, shrinkage and creep of materials.

1.8. Short-term loads include the following:
a) equipment loads arising in startup, transient and test modes as well as during equipment replacement or substitution;
b) weight of people and repair materials in equipment service and maintenance areas;
c) loads due to people, animals and equipment affecting floors of residential, public and farm buildings having full standard values excluding the loads listed in item 1.7,a,b,d,e;
d) loads caused by movable lifting and transport machinery (loaders, electric cars, piler cranes, telphers as well as bridge cranes and overhead cranes with a full standard value);
e) snow loads with a full standard value;
f) temperature effects with a full standard value;
g) wind loads;
h) sleet loads.

1.9. Special loads include the following:
a) seismic effects;
b) explosion effects;
c) loads caused by abrupt breakdown in process, temporary malfunction or breakage of the equipment;
d) effects caused by foundation deformations accompanied by a critical change of the ground structure (upon soaking of subsiding ground) or ground settlement in mining areas or karstic fields.

Load combinations

1.10. Calculations of structures and foundations as regards limiting states of the first and second groups should be made considering adverse load combinations and their corresponding forces.

Such combinations are set according to real variant analysis of simultaneous effect of different loads for the given working stage of the structure or foundation.

1.11. Subject to the load structure allowed, there are the following load combinations:

a) basic load combinations consisting of dead, sustained and short-term loads;
b) special load combinations consisting of dead, sustained, short-term and one of the special loads.

Live loads with two standard values should be included into combinations as sustained loads – considering a low standard value, or as short-term loads – considering a full standard value.

The special load combinations comprising explosion effects or loads caused by transport collisions with structural parts may exclude short-term loads stipulated in item 1.8.

1.12. Considering the combinations containing dead loads and not less than two live loads, calculated values of live loads or the relative forces should be multiplied by combination coefficients equal to the following figures:

In basic combinations for sustained loads ψ_1=0,95; for short-term loads - ψ_2=0,9;

In special combinations for sustained loads ψ_1=0,95; for short-term loads - ψ_2=0,8, except for the cases stipulated in the design norms for seismic zones and in other design norms of structures and foundations. At the same time, special load is to be taken without reduction.

Considering the basic combinations containing dead loads and a live load (sustained or short-term), ψ_1 and ψ_2 coefficients should not be taken into account.

Note: In the basic combinations considering three or more short-term loads, their design values may be multiplied by ψ_2 combination coefficient which is to be adopted for the first (as regards degree of effect) short-term load – 1,0, for the second – 0,8 and for the rest – 0,6.

1.13. Allowing for the load combinations in accordance with the guidelines of item 1.12, the following loads should be taken as a live load:

a) load of a particular kind arising from a single source (pressure or depression in tank; snow, wind or sleet loads, temperature effects, loads caused by a loader, electric car, bridge crane or overhead crane);
b) load arising from several sources if their concurrent effect is taken into account in the standard and design values (load due to equipment, people and stored materials transferred to one or several floors considering ψ_A and ψ_n coefficients specified in items 3.8 and 3.9; load caused by several bridge cranes or overhead cranes considering ψ coefficient stipulated in item 4.17; sleet and wind load calculated in accordance with item 7.4).

2. Weight of structures and grounds

2.1. The standard weight of prefabricated structures should be calculated according to standards, shop drawings or ratings of manufacturing plants, other building structures and grounds - in compliance with design dimensions and specific gravity of materials and grounds considering their humidity degree in the course of construction and operation of structures.

2.2. γ_f load safety factors for the weight of building structures are listed in the Table 1 hereinbelow.

Table 1

Building structures and types of ground	γ_f load safety factor

Structures:	
steel	1,05
concrete (with the average consistency exceeding 1600 kg/m^3), reinforced concrete, masonry, reinforced masonry, wooden	1,1
concrete (with the average consistency 1600 kg/m^3 and less), insulation, smooth and finishing layers (plates, rolled materials, fillings, screeds etc.) that are	
prefabricated	1,2
produced at site	1,3
Grounds:	
of natural deposit	1,1
fill-up ground	1,15
Notes: 1. In the case of structure stability test and in the other cases when weight reduction of structures and grounds may deteriorate structure operation, the calculations should be made taking γ_f load safety factor for the weight of structures or its part equal to 0,9. 2. When calculating ground loads, the loads transferred to the ground due to stored materials, equipment and transport means should be taken into account. 3. For steel structures which dead weight forces exceed 50% of the total force - γ_f = 1,1.	

3. Loads due to equipment, people, animals, stored materials and products

3.1. The norms of the present paragraph apply to the loads transferred to building floors and ground floors due to people, animals, equipment, products, materials and temporary partitions.

Alternative transfers of the mentioned loads to building floors should be adopted in accordance with the particular conditions of construction and operation of the buildings. If at the design stage the data of such conditions are not sufficient, it is necessary to consider the following alternative loadings of different floors when calculating structures and foundations:

complete loading;

adverse partial loading upon calculation of the structures and foundations tolerant to such a loading pattern;

lack of live load.

At the same time, the total live load transferred to multi-storeyed building floors under the adverse partial loading should not exceed the load under the complete loading calculated with consideration of ψ_n combination coefficients which values are to be calculated by formulas (3) and (4).

Calculation of loads due to equipment, stored materials and products

3.2. The loads arising from equipment (including pipelines and transport means), stored materials products are set in building assignment on the ground of technological solutions. The building assignment should specify the following:

a) places and dimensions of equipment supports potential on every floor and ground floor, dimensions of material and product storing areas, places of potential equipment approach in the course of operation or replanning;

b) standard load values and load safety factors adopted in accordance with the guidelines of the present codes for dynamically loaded machines – standard inertial force values and load safety factors for inertial forces as well as other required characteristic.

If actual floor loads are substituted with the equivalent uniformly distributed loads, the latter ones should be calculated and differentiated for various structural members (slabs, secondary beams, collar beams, columns and foundations). The adopted equivalent loads ought to provide bearing capacity and rigidity of the structural members that are required under the conditions of their loading with actual loads. Complete standard values of equivalent uniformly distributed loads for production and storing premises should be taken as follows: for slabs and secondary beams – not less than 3,0 kPa (300 kgf/m^2), for collar beams, columns and foundations – not less than 2,0 kPa (200 kgf/m^2).

The prospective increase of loads due to equipment and stored materials may be considered during feasibility study.

3.3. The standard value of equipment weight including weight of pipelines should be defined in compliance with the standards or catalogues. As regards non-standard equipment, the mentioned value to be defined according to the ratings of manufacturing plants or shop drawings.

The dead load of equipment includes dead weight of an installation or machine (including driving gear, permanent devices, supporting installations, grouting and concreting), weight of insulation, equipment fillers that are eventual during equipment operation, the heaviest work piece, weight of goods transported which conforms to the nominal lifting capacity etc.

Equipment loads transferred to the floors and ground floors should be taken subject to the equipment placement and potential replacement during its operation. At the same time, it is required to allow for the activities excluding bearing structures reinforcement which may be caused by process equipment replacement during installation work and building operation.

Number of loaders and electric cars concurrently applied and their placement on the floor upon calculation of different members should be adopted under the building assignment according to technological solutions.

The dynamic force of vertical loads caused by loaders and electric cars may be calculated by multiplication of standard static loads by dynamic coefficient equal to 1,2.

3.4. γ_f load safety factor for equipment weight is specified in Table 2 hereinbelow.

Table 2

Weight	γ_f load safety factor
Fixed installations	1,05
Insulation of fixed installations	1,2
Equipment fillers (including fillers of tanks and pipelines);	
liquids	1,0
suspensions, slimes, granular materials	1,1
Loaders and electric cars (loaded)	1,2

Uniformly distributed loads

3.5. The standard values of uniformly distributed live loads transferred to floor slabs, staircases and ground floors are specified in Table 3.

3.6. The standard loads caused by the weight of temporary partitions and transferred to collar beams and floor slabs should be adopted subject to the type of member structure, placement and type of support of floors and walls. The specified loads may be considered as uniformly distributed additional loads, their standard values being calculated for supposed placement of partitions but not less than 0,5 kPa (50 kgf/m^2).

3.7. γ_f load safety factor for uniformly distributed loads should be taken as follows:

1,3 – in the case of complete standard value less than 2,0 kPa (200 kgf/m^2);

1,2 - in the case of complete standard value 2,0 kPa (200 kgf/m^2) and more.

The safety factor of the load caused by the weight of temporary partitions should be taken in accordance with the guidelines listed in item 2.2.

3.8. Upon calculation of beams, collar beams, slabs as well as columns and foundations reacting single floor loads, complete standard loads listed in Table 3 should be reduced subject to the load area A, m^2 of the particular member calculated by multiplication by ψ_A combination coefficient equal to the following figures:

a) for the rooms listed in items 1,2,12,a (if $A > A_1 = 9$ m^2),

$$\psi_{A_1} = 0{,}4 + \frac{0{,}6}{\sqrt{\frac{A}{A_1}}} \qquad (1)$$

b) for the rooms listed in items 4,11,12,b (if $A > A_2 = 36$ m^2),

$$\psi_{A_2} = 0{,}5 + \frac{0{,}5}{\sqrt{\frac{A}{A_2}}} \qquad (2)$$

note: Upon calculation of the walls reacting single floor loads, the load values should be reduced subject to the load area A of the calculated members (slabs, beams) supporting the walls.

3.9. Upon calculation of longitudinal forces required for calculation of columns, walls and foundations reacting the loads transferred from two or more floors, complete standard loads listed in Table 3 should be reduced by multiplication by ψ_n combination coefficient:

a) for the rooms listed in items 1,2,12,a

$$\psi_{n_1} = 0{,}4 + \frac{\psi_{A_1 - 0{,}4}}{\sqrt{n}} \qquad (3)$$

b) for the rooms listed in items 4,11,12,b

$$\psi_{n_2} = 0{,}5 + \frac{\psi_{A_2 - 0{,}5}}{\sqrt{n}} \qquad (4)$$

where ψ_{A1} and ψ_{A2} to be calculated according to item 3.8;
and n is a total number of floors (for the rooms listed in Table 3, items 1,2,4,11,12,a,b) which loads are considered on calculation of a particular section of column, wall or foundation.
Note: Upon calculation of flection moments of columns and walls, load reduction for the adjoining beams and collar beams should be taken considered in accordance with the guidelines mentioned in item 3.8.

Point loads and loads transferred to railings

3.10. The bearing members of floors, coverings, staircases and balconies (loggias) are to be checked as regards vertical point load transferred to the member in an adverse position on a square platform with the sides not exceeding 10 cm (under the lack of other live loads). Unless on the basis of technological solutions the building assignment provides higher standard values of point loads, they are to be equal to the following:

a) for floors and staircases – 1,5 kN (150 kgf);
b) for attic ceilings, coverings, terraces and balconies – 1,0 kN (100 kgf);
c) for surfaces that may be walkable only by ladders and foot-bridges – 0,5 kN (50 kgf).

The members that are applied to local loads caused by equipment or transport means which may arise during installation or structure operation, may avoid testing as regards the mentioned point load.

3.11. The standard horizontal loads transferred to railings of staircases and balconies should be taken equal to the following:

a) for residential buildings, infant schools, holiday homes, sanatoriums, hospitals and other health establishments – 0,3 kN/m (30 kgf/m);
b) for stands and sports halls – 1,5 kN/m (150 kgf/m);
c) for other buildings and rooms upon the lack of special requirements – 0,8 kN/m (80 kgf/m).

Table 3

Building and rooms	Standard load values p, kPa (kgf/m^2)	
	complete	reduced
1. Apartments of residential buildings, bedrooms of infant schools and boarding schools, living premises of holiday homes and boarding houses as well as hostels and hotels; wards of hospitals and sanatoriums; terraces	1,5 (150)	0,3 (30)
2. Offices and service rooms of administration, engineers and researchers of organizations and establishments; classrooms of educational institutions; amenity rooms (lockers, shower rooms, washrooms, WCs) of industrial plants, public buildings and constructions	2,0 (200)	0,7 (70)
3. Health facilities and laboratories; laboratories of educational and scientific institutions; computer rooms; kitchens of public buildings; technical floors; basement premises	not less than 2,0 (200)	not less than 1,0 (100)
4. Halls:		
a) reading halls	2,0 (200)	0,7 (70)
b) dining-rooms (in cafes, restaurants, canteens)	3,0 (300)	1,0 (100)
c) meeting-rooms, waiting-rooms, auditoriums and concert halls; sports halls	4,0 (400)	1,4 (140)
d) trading floors, show-rooms and expositions	not less than 4,0 (400)	not less than 1,4 (140)
5. Book depositories and archives	not less than 5,0 (500)	not less than 5,0 (500)
6. Show stages	not less than 5,0 (500)	not less than 1,8 (180)
7. Stands:		
a) with fixed seats	4,0 (400)	1,4 (140)
b) for standing audience	5,0 (500)	1,8 (180)
8. Attic premises	0,7 (70)	-
9. Surface cover in the following areas:		
a) in potentially crowded areas (exits from production areas, halls and rooms etc.)	4,0 (400)	1,4 (140)
b) in recreation areas	1,5 (150)	0,5 (50)
c) other areas	0,5 (50)	-
10. Balconies (loggias) considering the following load:		
a) strip uniform load in the area 0,8 m wide along balcony (loggia) railing	4,0 (400)	1,4 (140)
b) continuous uniform load on balcony (loggia) which effect is more adverse than the one calculated under the previous item 10,a	2,0 (200)	0,7 (70)
11. Equipment maintenance areas in production premises	not less than	-

	1,5 (150)	
12. Entrance halls, foyers, corridors and staircases (including relevant passageways) that adjoin the rooms listed in the following items:		
a) 1, 2 and 3	3,0 (300)	1,0 (100)
b) 4, 5, 6 and 11	4,0 (400)	1,4 (140)
c) 7	5,0 (500)	1,8 (180)
13. Station platforms	4,0 (400)	1,4 (140)
14. Livestock barns:		
small cattle	not less than 2,0 (200)	not less than 0,7 (70)
neat	not less than 5,0 (500)	not less than 1,8 (180)

Notes: 1. The loads specified in item 8 should be taken into account as regards the area free from equipment and materials.
2. The loads stipulated in item 9 are to be considered without snow load.
3. The loads specified in item 10 ought to be considered upon calculation of balcony (loggia) bearing structures and their restraining wall areas. Upon calculation of underlying wall area, foundations and basements, balcony (loggia) loads should be adopted as equal to the loads of basic adjoining rooms. The loads in view are to be consequently reduced considering the guidelines stated in items 3.8 and 3.9.
4. Standard load values for the buildings and rooms listed in items 3, 4.d, 5, 6, 11 and 14 should be taken under building assignment and in accordance with technological solutions.

As regards service platforms, bridges and roof railings meant for short-time stay of people, standard value of horizontal point load transferred to hand-rails is to be taken as 0,3 kN (30 kgf) (in any place along the hand-rail) unless a higher load value is required under the building assignment according to technological solutions.
It is required to adopt load safety factor as γ_f = 1,2 for the loads specified in items 3.10 and 3.11.

4. Loads due to bridge cranes and overhead cranes

4.1. Loads caused by bridge cranes and overhead cranes are to be taken subject to their operation mode groups set by GOST 25546-82 as well as drive type and weight suspension method. The approximate list of bridge cranes and overhead cranes of different operation mode groups is specified in Appendix No.1.

4.2. Complete standard vertical loads transferred by crane wheels to gantry rail beams as well as other data required for design are to be adopted according to the state crane standards; regarding non-standard cranes – in compliance with the data specified in passports issued by manufacturing plants.

Note: Gantry rail means two beams bearing a bridge brane or all the beams bearing an overhead crane (two beams in the case of singe-flight overhead crane; three beams - double-flight oevrhead crane etc.).

4.3. Standard horizontal load caused by the electrical crane bridge braking and directed along the gantry rail should be taken as equal to 0,1 of the complete standard vertical load transferred to braking wheels of the relative crane side.

4.4. Standard horizontal load caused by the electrical trolley braking and directed accross the gantry rail should be adopted as equal to the following:
for flexible suspension cranes – 0,05 of the sum of crane caring capacity and trolley weight;
for fixed suspension cranes – 0,1 of the sum of crane caring capacity and trolley weight.
The said load should be considered upon calculation of transverse building bents and gantry rail beams. At the same time, the load is supposed to be transferred to one side

(beam) of gantry rail and distributed uniformly among all crane wheels supporting the beam. The load may be directed both inside and outside of the given flight.

4.5. Standard horizontal load directed accross gantry rail and caused by skewing of bridge electric cranes and non-parallelism of gantry rails (side force) should be taken for every crane running wheel as 0,1 of the complete standard vertical load transferred to the wheel.

The mentioned load is to be considered only upon stability analysis of gantry rail beams and their connections to building columns regarding the cranes of operation mode groups 7K and 8K. The load is supposed to be transferred to the gantry rail beam by all the wheels of a crane side The load may be directed both inside and outside of the given flight. The load stipulated in item 4.4 shouuld not be taken into account along with the side force.

4.6. Horizontal loads caused by braking of bridge and crane trolley as well as side forces are considered as imposed in the connection of running wheels and rail.

4.7. Standard horizontal load directed along the gantry rail and caused by the crane blow upon teh track buffer stop should be calculated according to teh guidelines specified in obligatory Appenxi No. 2. The given load is to be taken into account only upon calculations of supports and their connections to gantry rail beams.

4.8. The load safety factor for crane loads should be taken as γ_f = 1,1.

Note: When considering local and dynamic effects of vertical point load caused by a crane wheel, the complete standard load value in view should be multiplied, upon stability analysis of gantry rail beams, by an additional coefficient γ_f equal to the following values:

1,6 – for 8K operation mode group with fixed weight suspension;
1,4 – for 8K operation mode group with flexible weight suspension;
1,3 - for 7K operation mode group;
1,1 – for other crane operation mode groups.

Upon testing the local stability of beam webs, the value of additional coefficient should be taken as 1,1.

4.9. Upon stability analysis of gantry rail beams and their bracings to bearing structures, the design values of vertical crane loads are to be multiplied by dynamic coefficient as follows:

In case the distance between columns does not exceed 12 m:

1,2 - for operation mode group of 8K bridge cranes;

1,1 – for operation mode group of 8K and 7K bridge cranes as well as for all overhead crane operation mode groups;

In case the distance between columns exceeds 12 m – 1,1 for operation mode group of 8K bridge cranes.

Design values of horizontal loads caused by bridge cranes of 8K operation mode group should be considered with the dynamic coefficient equal to 1,1.

In other cases the dynamic coefficient is taken as equal to 1,0.

The dynamic coefficient should not be taken in account upon calculations of structure endurance, test of gantry rail beams deflection and columns displacement test as well as in the case of local effect of vertical point load caused by a crane wheel.

4.10. Upon stability analysis of gantry rail beams, vertical loads should be considered due to not more than two most adverse bridge cranes or overhead cranes.

4.11. Upon stability analysis of frames, columns, foundations as well as basements in the buildings equipped with bridge cranes in several flights (in each flight on a single storey), vertical loads should be considered for each rail due to not more than two most adverse cranes. In case two cranes of different flights are combined in a range – due to not more than four most adverse cranes.

4.12. Upon stability analysis of frames, columns, rafter structures, subrafter structures, foundations as well as basements in the buildings equipped with overhead cranes on one or several rails, vertical loads should be considered for each rail due to not more than two most adverse cranes. In case two overhead cranes of different rails are combined in a range, vertical loads are to be adopted as follows:

due to not more than two cranes – for columns, subrafter structures, foundations and basements of the edge row in the case of two bridge cranes in a flight;

due to not more than four cranes:

for columns, subrafter structures, foundations and basements of the middle row;

for columns, subrafter structures, foundations and basements of the edge row in the case of three bridge cranes in a flight;

for rafter structures in the case of two or three bridge cranes in a flight.

4.13. Upon stability analysis of gantry rail beams, columns, frames, rafter structures, subrafter structures, foundations as well as basements, horizontal loads should be considered due to not more than two most adverse cranes placed on the same gantry rail or on different rails in the same range. At that, it is required to consider a single horizontal load (shearing or longitudinal) for each crane.

4.14. When calculating vertical and horizontal loads upon stability analysis due to bridge cranes placed on two or three storeys in a flight, and if overhead cranes and bridge cranes are placed concurrently in the same flight as well as in case overhead cranes meant for load transfer from one crane to another with the help of connecting gangways are applied, number of cranes should be taken upon the building assignment according to technological solutions.

4.15. While calculating vertical and horizontal deflections of gantry rail beams as well as horizontal displacements of columns, the load is to be considered due to the single most adverse crane.

4.16. In case it is available only one crane on the gantry rail and unless another crane is installed during the building use, the loads on the given rail should be considered due to the one crane.

4.17. If two cranes are taken into account, their loads ought to be multiplied by the following combination coefficient:

$\Psi = 0{,}85$ – for crane operation mode groups 1K-6K;

$\Psi = 0{,}95$ – for crane operation mode groups 7K and 8K.

If four cranes are taken into account, their loads ought to be multiplied by the following combination coefficient:

$\Psi = 0{,}7$ – for crane operation mode groups 1K-6K;

$\Psi = 0{,}8$ – for crane operation mode groups 7K and 8K.

If one crane is taken into account, its vertical and horizontal loads should be adopted without reduction.

4.18. Upon endurance analysis of electrical bridge crane rail beams and bracings of the mentioned beams to the bearing structures, it is required to consider reduced standard load values according to item 1.7,i. At the same time, to check endurance of beam webs in the area of vertical point load caused by a crane wheel, the reduced standard values of vertical wheel force should be multiplied by the coefficient considered upon the stability analysis of gantry rail beams according to the note specified in item 4.8. Crane operation mode groups that require endurance analysis are set by structure design standards.

5. Snow loads

5.1. The complete standard value of snow load transferred to the horizontal projection of surface s is to be calculated by the following formula:

$$s = s_0 \mu \qquad (5)$$

where s_0 – standard snow cover weight on 1 m^2 of horizontal ground surface; the mentioned value is to be adopted according to item 5.2;

μ – factor of conversion from snow cover weight to snow load transferred to the roof that is adopted according to items 5.3-5.6.

5.2. Standard value of snow cover weight s_0 on 1 m^2 of horizontal ground surface should be adopted subject to the snow region of USSR according to Table 4.

5.3. Snow load distribution patterns and μ factor values are to be adopted in compliance with obligatory Appendix No. 3, the intermediate values of μ factor being set by simple interpolation.

It is required to consider patterns of snow load effecting a half or a quarter of a span (for skylight roofs – in areas *b* wide) in case due to partial loading the structure members encounter more adverse state.

Note: If required, snow loads are to be calculated considering a further extension of the building.

5.4. The variants of high local snow loads listed in obligatory Appendix No. 3 should be considered upon calculations of slabs, coverings and roof spans as well as upon calculation of the bearing structure members (frames, beams, columns etc.) for that the specified variants define section dimensions.

Note: Upon calculation of structures it is possible to apply simplified patterns of snow loads equivalent to the load effects listed in obligatory Appendix No. 3. When calculating frames and columns of production buildings, it is allowed to consider only uniformly distributed snow load excluding roof level differences that require high snow load.

5.5*. The coefficients μ set according to schemes 1, 2, 5 and 6 of obligatory Appendix No. 3 - for flat roofs (with the slopes up to 12% or with $\frac{f}{l} \le 0{,}05$) of single-span and multispan skylightless buildings designed in the districts where the average wind speed for the three coldest months is $v \ge 2$ m/sec – should be reduced by multiplication by the coefficient $c_e = (1{,}2 - 0{,}1v\sqrt{k})(0{,}8 + 0{,}002b)$ where *k* is to be taken under Table 6; *b* – roof width taken as not exceeding 100 m.

For the roofs with the slopes from 12 up to 20% of single-span and multispan skylightless buildings designed in the districts where $v \ge 4$ m/sec, the coefficient μ set according to schemes 1 and 5 of obligatory Appendix No. 3 should be reduced by multiplication by the coefficient equal to 0,85.

The average wind speed *v* for the three coldest months is to be adopted under chart 5 of obligatory Appendix No. 5.

Snow load reduction allowed by the present paragraph does not cover the following issues:

a) roofs of the buildings located in the regions where the average monthly temperature in January is above -5ºC (see chart 5 of obligatory Appendix No. 5);
b) roofs of the buildings protected from the direct wind with higher neighboring buildings located at a distance less than $10h_1$ where h_1 – height difference between the neighbouring and designed buildings;
c) roof areas *b*, b_1 and b_2 wide near height level differences between the buildings and parapets (see schemes 8-11 of obligatory Appendix No. 3).

Table 4

Snow regions of USSR (adopted according to chart 1 of obligatory Appendix No. 5)	I	II	III	IV	V	VI
s_0,kPa (kgf/m^2)	0,5 (50)	0,7 (70)	1,0 (100)	1,5 (150)	2,0 (200)	2,5 (250)
Note: In highlands and insufficiently explored regions specified in chart 1 of obligatory Appendix No. 5 as well as in points exceeding 1500 m above the sea level and in places of complex relief standard weight of snow cover should be set according to the data submitted by Goskomgidromet. At that, the average volume of yearly maximum water resources defined upon the snow survey being made for not less than 10 years at the spot protected from wind						

is to be adopted as the standard weight value of snow cover s_0

5.6. When calculating snow loads for unheated roofs of high heat-evolution workshops with their roof slopes exceeding 3%, coefficients μ are to be reduced by 20% despite the reduction specified in item 5.5 to provide a proper drainage of water from melted snot.

5.7. As regards snow load, γ_f load safety factor is assumed as equal to 1,4. Upon calculation of roof members for which the ratio between the uniformly distributed standard load due to the roof weight (including fixed equipment weight) and the snow cover standard weight s_0 is less than 0,8, γ_f is to be assumed as 1,6.

6. Wind loads

6.1. Wind load is considered as the *set* of the following:

a) normal pressure w_e which is applied to the surface of structure or member;

b) frictional force w_f directed at a tangent to the surface and relative to the area of its horizontal (regarding double ridge or corrugated roofs as well as skylight roof) or vertical projection (walls supplied with loggias or similar structures);

c) normal pressure w_i which is applied to the internal surfaces supplied with permeable enclosures as well as opening or constantly opened apertures;

or as the *normal pressure* w_x, w_y resulting from the total strength of the construction along axes x and y and conditionally applied to the construction plan projection which is at right angle to the axis.

Upon calculation of high structures which relative dimensions meet the condition of h/d > 10, it is required to make a verifying calculation of vertical excitation (wind resonance); h – structure weight, d – minimum cross section at level 2/3h.

6.2.Wind load is to be calculated as the sum of average and pulsating components.

Upon calculation of internal pressure w_i as well as upon calculation of high buildings up to 40 m and one-storey buildings up to 36 m – in case the ratio between the height and the span is less than 1,5 – that are located in areas of A and B types (see item 6.5), the pulsating component of wind load may be omitted.

6.3.The standard average component of wind load w_m at the height of z over the ground surface is to be calculated under the following formula:

$$w_m = w_0 kc \qquad (6)$$

where w_0 – standard wind pressure (see item 6.4)

k – coefficient of wind pressure change in height (see item 6.5)

c – aerodynamic coefficient (see item 6.6).

6.4.The standard wind pressure w_0 should be adopted in accordance with the relative wind region of USSR under Table 5.

As regards mountainous and insufficiently explored regions marked at map 3, the standard wind pressure w_0 may be set according to the data provided by the weather stations of Goskomgidromet as well as building areas survey with assumption of field experience. At that, the standar wind pressure w_0 is to be calculated under the following formula:

$$w_0 = 0{,}61 v_0^2 \qquad (7)$$

where v_0 – numerically equal to a wind speed (m/sec) at the height of 10 m over the ground surface as regards the region of A type. The mentioned wind speed corresponds to 10-minute averaging interval and is exceeded once in 5 years on average (unless the technical conditions approved in accordance with established procedure consider other intervals of wind speed repetition).

6.5.The coefficient *k* considering wind pressure change in height *z* is set under table 6 subject to area type. The following area types are adopted:

A – open coasts of seas, lakes and storage ponds as well as deserts, steppes, forest-steppes and tundra;

B – urban territory, woodland and other lands covered with obstructions higher than 10 m;

C – urban territory holding buildings exceeding 25 m high.

Table 5

Wind regions of USSR (to be adopted according to map 3 of the obligatory Appendix No. 5)	Ia	I	II	III	IV	V	VI	VII
w_0, kPa (kgf/m[2])	0,17 (17)	0,23 (23)	0,30 (30)	0,38 (38)	0,48 (48)	0,60 (60)	0,73 (73)	0,85 (85)

The building may be considered as located in the given area if that area stretches on the windward side of the building at the distance of 30*h* – at the building height *h* up to 60 m and 2 km – at a bigger height.

Table 6

Height *z (m)*	Coefficient *k* for area types		
	A	B	C
≤ 5	0,75	0,5	0,4
10	1,0	0,65	0,4
20	1,25	0,85	0,55
40	1,5	1,1	0,8
60	1,7	1,3	1,0
80	1,85	1,45	1,15
100	2,0	1,6	1,25
150	2,25	1,9	1,55
200	2,45	2,1	1,8
250	2,65	2,3	2,0
300	2,75	2,5	2,2
350	2,75	2,75	2,35
≥ 480	2,75	2,75	2,75
Notes: Upon calculation of wind load the area types may vary for different design wind direction.			

6.6. The calculation of wind load components w_e, w_f, w_i, w_x, w_y requires use of the corresponding aerodynamic coefficients – external pressure c_e, friction c_f, internal pressure c_i and point resistance c_x or c_y that are adopted under the obligatory Appendix No. 3 where wind direction is pointed. Plus of c_e and c_i corresponds to a direction of wind pressure onto the relative surface; minus corresponds to a direction of wind pressure from the surface. Intermediate loads are to be defined by the simple interpolation.

The calculation of enclosing members' connections to bearing structures in the building corners and on the external contour of the roof requires assuming a localized negative wind pressure with aerodynamic coefficient $c_e = -2$, the given wind pressure being distributed upon the surfaces at the width of 1,5 m (draft 1).

In the cases beyond the obligatory Appendix No. 4 (other construction forms; assumption of other wind stream directions, on a proper ground, or components of total body resistance as regards other directions etc.) aerodynamic coefficients may be adopted according to reference or experimental data or on the ground of construction model air blowing in wind tunnels.

Note: It is required to apply aerodynamic coefficients of external pressure c_e or point resistance c_x when calculating wind load transferred to the surfaces of internal walls and partitions if the external enclosure lacks (at the installation stage).

Draft 1. Zones of increased negative wind pressure

6.7. The standard pulsating component of wind load w_p at the height z is to be set for the following:

a) for constructions (and their structural members) which first frequency of natural oscillations f_1 (Hz) exceeds the limiting value of natural frequency f_l (see item 6.8) – by the following formula

$$w_p = w_m \zeta v \quad (8)$$

where w_m – to be set according to item 6.3;

ζ – coefficient of wind pressure pulsations at the height z that is to be adopted under table 7;

v – coefficient of spatial correlation of wind pressure pulsations (see item 6.9);

Table 7

Height *z (m)*	Wind pressure pulsation coefficient ζ for area types		
	A	B	C
≤ 5	0,85	1,22	1,78
10	0,76	1,06	1,78
20	0,69	0,92	1,50
40	0,62	0,80	1,26
60	0,58	0,74	1,14
80	0,56	0,70	1,06
100	0,54	0,67	1,00
150	0,51	0,62	0,90
200	0,49	0,58	0,84
250	0,47	0,56	0,80
300	0,46	0,54	0,76
350	0,46	0,52	0,73
≥ 480	0,46	0,50	0,68

Draft 2. Dynamic coefficients

1 – for reinforced concrete and stone structures as well as for steel framed buildings if enclosing structures are available (δ = 0,3); 2 – for steel towers, masts, lined chimneys, column-type devices including ones on reinforced concrete bases (δ = 0,15).

b) for constructions (and their structural members) that may be considered as a system of a single freedom (cross frames of one-storey production buildings, water towers etc.) if $f_1 < f_l$ – by the following formula

$$w_p = w_m \xi \zeta v \quad (9)$$

where ξ – dynamic coefficient which is defined according to draft 2 subject to parameter $\varepsilon = \frac{\sqrt{\gamma_f w_0}}{940 f_1}$ and logarithmic decrement of oscillation δ (see item 6.8);

γ_f – load safety factor (see item 6.11);

w_0 – standard wind load, Pa (see item 6.4);

c) for buildings that are symmetric on plan and for that $f_1 < f_l$; besides, for all constructions where $f_1 < f_l < f_2$ (where f_2 is the second frequency of natural oscillation) – by the following formula

$$w_p = m \xi \psi y \quad (10)$$

where m – construction weight at the height z that is related to the surface area affected by wind load;

ξ – dynamic coefficient (see item 6.7,b);

y – horizontal displacement of construction at the height z by the first type of natural oscillation (for symmetric-on-plan buildings of a constant height the displacement due to uniformly distributed horizontally imposed static load may be adopted as y);

ψ – coefficient which is calculated by division of the construction into r zones; within the given zones wind load is to be adopted as constant by the following formula

$$\psi = \frac{\sum_{k=1}^{r} y_k w_{pk}}{\sum_{k=1}^{r} y_k^2 M_k} \qquad (11)$$

where M_k – weight of k construction part;

y_k – horizontal displacement of k centre;

w_{pk} – resultant force of the wind load pulsating component for k construction part; that is calculated by formula (8).

As regards multi-storeyed buildings of constant height, rigidity and weight as well as a constant width of their windward side, the standard pulsating component of wind load at a height of z may be calculated by the following formula

$$W_p = 1.4 \frac{z}{h} \xi W_{ph} \qquad (12)$$

where W_{ph} – the standard value of pulsating component of the wind load at the height h of the top calculated by formula (8).

6.8. It is necessary to determine limit value of the own vibration frequency f_l, hertz, by which it is possible to consider the inertia force that appear during vibration in compliance with corresponding proper form according to table 8.

Table 8

Wind regions of USSR (taken according to the map 3 of obligatory Annex 5)	f_l, hertz, if	
	$\delta = 0.3$	$\delta = 0.15$
Ia	0.85	2.6
II	0.95	2.9
III	1.1	3.4
IV	1.2	3.8
V	1.4	4.3
VI	1.6	5.0
VII	1.7	5.6
	1.9	5.9

The value of logarithmic decrement of vibrations δ is to be taken

a) for reinforced concrete and stone structures as well as for buildings with steel framework if there are walling structures $\delta = 0.3$;
b) for steel towers, masts, lined chimneys, column means including the ones on the reinforced concrete pedestals $\delta = 0.15$.

6.9. The coefficient of spatial correlation of pressure pulsation *v* must be calculated for design surface of the structure where the correlation of the pulsation is taken into account.

The design surface involves those parts of the surfaces of windward, leeward, lateral walls, roofs and structures like that from which the wind load is given to the calculated member of the structure.

If the design surface is close to be a rectangle which is oriented so that its sides are parallel to the main axes (draft 3), so the coefficient *v* must be determined according to the table 9 depending on the parameters ρ and χ taken according to the table 10.

Draft 3. Coordinate system when calculating the correlation coefficient *v*.

χ is the wind direction.

Table 9

ρ, m	The coefficient *v* if χ is in meters						
	5	10	20	40	80	160	350
0.1	0.95	0.92	0.88	0.83	0.76	0.67	0.56
5	0.89	0.87	0.84	0.80	0.73	0.65	0.54
10	0.85	0.85	0.81	0.77	0.71	0.64	0.53
20	0.80	0.80	0.76	0.73	0.68	0.61	0.51
40	0.72	0.72	0.70	0.67	0.63	0.57	0.48
80	0.63	0.63	0.61	0.59	0.56	0.51	0.44
160	0.53	0.53	0.52	0.50	0.47	0.44	0.38

Table 10

Main coordinate space parallel to which the design surface is	ρ	χ
zoy	*b*	*h*
zox	0.4*a*	*h*
xoy	*b*	*a*

When calculating the whole structure the dimensions of the design surface must be determined considering the obligatory Annex 4 instructions, at the same time for latticed structures it is necessary to take the measurements of design surface according to the outside bounding of the structure.

6.10. For the structures where $f_2 < f_1$ it is necessary to make dynamic calculations considering *s* of the first forms of natural vibrations. The value *s* is to be calculated by the condition

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

6.11. Safety factor regarding the wind load γ_f is to be taken as equal to 1.4.

7. Sleet load.

7.1. Sleet loads must be considered when designing of power lines, lines of communications, overhead contact system, trolley lines, mast antenna devices and similar structures.

7.2. Standard value of linear sleet load for the members of circular cross-section with diameter up to 70 mm inclusive (wires, lines, bridles, masts, vertical stays) *i*, H/m must be calculated by the following formula

$$i = \pi b k \mu_1 (d + b k \mu_1) \rho g \cdot 10^{-3} \qquad (13)$$

Standard value of surface sleet load *i,* Pascal, for other members must be calculated by the following formula

$$i' = b k \mu_2 \rho g \qquad (14)$$

In formulas (13) and (14):

b – the thickness of coating of ice, mm (exceeded once per 5 years), on the elements of circular cross-section with diameter 10 mm located at the height 10 m from ground surface, taken according to table 11, at the height 200 m and more – according to the table 12. For other periods of frequency the thickness of coating of ice must be taken according to the special technical conditions approved in accordance with established procedure;

k – coefficient considering the variety of the thickness of the coating of ice in vertical direction and taken according to table 13;

d – diameter of wire, line, mm;

μ_1 – coefficient considering the variety of the thickness of coating of ice depending on the diameter of the members of circular cross section and taken according to the table 14;

μ_2 – coefficient considering the ratio between the area of the member surface and total surface area, the coefficient is taken as equal to 0.6.

ρ – ice density equal to 0.9 gram per cubic centimeter;

g - acceleration of gravity, m/square centimeter.

Table 11

Ice regions of the USSR (taken according to the map 4 of obligatory Annex 5)	I	II	III	IV	V
The thickness of the coating of ice	No less than 3	5	10	15	No less than 20

Table 12

The height above the ground surface	The thickness of the coating of ice *b,* mm, for different regions of the USSR			
	Of the 1st ice region in Asian part of the USSR	Of the 5th ice region and highlands	Of the northern part of the USSR	Other

200	15	Is taken according to the special investigations data	Is taken according to the map 4, г of obligatory Annex 5	35
300	20	The same	The same according to the map 4, д	45
400	25	The same	The same according to the map 4, е	60

Table 13

The height above the ground surface	5	10	20	30	50	70	100
Coefficient *k*	0.8	1.0	1.2	1.4	1.6	1.8	2.0

Table 14

diameter of wire, line, cable, mm	5	10	20	30	50	70
Coefficient μ_1	1.1	1.0	0.9	0.8	0.7	0.6

Notes (*to tables 11 – 14*): 1. In the 5th region, highlands and insufficiently explored regions of the USSR marked on the map 4 of obligatory Annex 5 as well as in uneven terrain (on the tops of the mountains or hills, on the passes, in mountain planes, pits, deep hollows etc) the thickness of the coating of ice must be determined according to special investigations and examination data.

2. Middle values must be determined by means of linear interpolation.

3. The thickness of the coating of ice on the circular cross-section elements (wires, lines, cables) can be taken at the height of the location of their center of gravity.

4. To calculate the sleet load on the horizontal members of circular cylindrical form with diameter up to 70 mm it is necessary to decrease the thickness of the coating of ice given in table 12 by 10 percent.

7.3. Safety factor for γ_f load of sleet load must be taken as equal to 1.3 with the exception of the cases stipulated in other normative documents.

7.4. Load pressure on the elements covered with ice must be taken 25 percent of standard value of wind load w_0 calculated in compliance with item 6.4.

Notes: 1. In some districts of the USSR where there is a combination of high wind speeds and great coatings of ice it is necessary to take its thickness and density as well as the wind pressure in compliance with the actual information.

2. When calculating the wind loads of the structures at the height more than 100 m above the ground level the diameter of the ice-coated wires and cables taken considering the thickness of the ice coating given in table 12 must be multiplied by the coefficient 1.5.

7.5. Air temperature during ice covering independent on the height of the structure must be taken in highlands:

- 15 degrees Celsius below zero – at the elevation more than 2000 m
- 10 degrees Celsius below zero – at the elevation from 1000 to 2000 m

in other regions

- 5 degrees Celsius below zero – for the structures up to 100 m

- 10 degrees Celsius below zero – for the structures more than 100m.

Note. In the regions where there is the temperature lower than 15 degrees Celsius below zero during ice covering it is necessary to take it according to the actual values.

8. Temperature Climatic Effects

8.1. In cases provided in design norms documents it is necessary to consider the variety of average temperature at the time of Δt and temperature difference ϑ in the section of the member.

8.2. Standard values of the variety of average temperature in the section of member during warm Δt_w and cold Δt_c season must be calculated by the following formulas:

$$\Delta t_w = t_w - t_{0c} \quad (15)$$

$$\Delta t_c = t_s - t_{0w} \quad (16)$$

where Δt_w, Δt_c – standard values of average temperatures on the section of member during warm and cold season taken in compliance with item 8.3;

t_{0w}, t_{0c} – initial temperature during warm and cold season taken in compliance with item 8.6.

8.3. Standard values of average temperatures t_w and t_s and temperature difference in the section of member during warm ϑ_w and cold ϑ_c seasons for one-layer structures must be taken according to table 15.

Note. For multi-layer structures t_w, t_s, ϑ_w, ϑ_c are calculated. The structures made of several kinds of material which have resembling thermal characteristics can be considered as one-layer ones.

8.4. Mean daily temperatures of outside air during warm t_{ew} and cold t_{ec} seasons must be calculated by the following formulas:

$$t_{ew} = t_{VII} + \Delta_{VII} \quad (17)$$

$$t_{ec} = t_1 - \Delta_1 \quad (18)$$

where t_1, t_7 – long-term monthly mean temperatures in January and July, taken in compliance with maps 5and 6 of the obligatory Annex 5;

Δ_1, Δ_7 – deviation of mean daily temperature from the monthly mean temperatures (Δ_1 is taken according to table 7 of the obligatory Annex 5, $\Delta_{VII} = 6$ degrees Celsius).

Table 15

Structures of the building	Buildings and structures in use		
	Non-heated buildings (without technological heat sources) and open structures	Heated buildings	The buildings with artificial climate or with steady technological heat sources
The structures which are not defended from solar radiation (including outside walling structures)	$t_w = t_{ew} + \theta_1 + \theta_4$		$t_w = t_{iw} + 0.6(t_{ew} - t_{iw}) + \theta_2 + \theta_4$
	$\vartheta_w = \theta_5$		$\vartheta_w = 0.8(t_{ew} - t_{iw}) + \theta_3 + \theta_5$
	$t_c = t_{ec} - 0.5\theta_1$	$t_c = t_{ic} + 0.6(t_{ec} - t_{ic}) - 0.5\theta_2$	
	$\vartheta_c = 0$	$\vartheta_c = 0.8(t_{ec} - t_{ic}) - 0.5\theta_3$	
The structures which	$t_w = t_{ew}$		$t_w = t_{iw}$

are defended from solar radiation (including inside structures)	$\vartheta_w = 0$	
	$t_c = t_{ec}$	$t_c = t_{ic}$
	$\vartheta_c = 0$	

Symbols taken in table 15:

t_{ew}, t_{ec} – mean daily temperature of outside air correspondingly during warm and cold seasons, taken in compliance with item 8.4;

t_{iw}, t_{ic} – temperatures of the air inside the rooms correspondingly during warm and cold seasons, taken according to GOST 12.1.005-88 or according to the building statement on basis of the technological solutions;

θ_1, θ_2, θ_3 – increment of average in the section of member temperature and temperature difference from daily temperature variation of outside air, taken according to table 16;

θ_4, θ_5 – increment of average in the section of member temperature and temperature difference from solar radiation, taken in compliance with item 8.5.

Notes: 1. If there is initial data about the temperature of the structure in stage of use of the building with steady technological heat sources, the values t_w, t_c, ϑ_w, ϑ_c must be taken in compliance with this data.

2. For buildings and structure in stage of building t_w, t_c, ϑ_w, ϑ_c are calculated as for the non-heated buildings in stage of use.

Table 16

Structure of the building	Temperature increment θ, degrees Celsius		
	θ_1	θ_2	θ_3
Metal structures	80	6	4
Reinforced concrete, concrete, reinforced stone and stone structures			
less than 15 cm thick	8	6	4
from 15 to 39 cm thick	6	4	6
more than 40 cm thick	2	2	4

Notes: 1. In heated industrial buildings at the stage of use it is possible not to consider Δ_7 for the structures defended against the solar radiation.

2. In highlands and insufficiently explored regions of the USSR shown on the maps 5 – 7 of the obligatory Annex 5 t_{ew}, t_{ec} are calculated by the following formulas:

$$t_{ec} = t_{1,\min} + 0.5A_1 \quad (19)$$

$$t_{ew} = t_{VII,\max} - 0.5A_{VII} \quad (20)$$

where $t_{1,\min}, t_{VII,\max}$ – are average of absolute values correspondingly of minimum temperature in January and maximum temperature in July;

A_1, A_{VII} – average daily ranges of air temperature correspondingly in January and July by clear sky.

$t_{1,\min}, t_{VII,\max}$, A_1, A_{VII} are taken according to the State hydrometeorology committee.

8.5. Increment θ_4 and $\theta 5$ in degree Celsius must be calculated by the following formulas

$$\theta_4 = 0.05 \rho S_{\max} k k_1 \qquad (21)$$

$$\theta_5 = 0.05 \rho S_{\max} k (1 - k_1) \qquad (22)$$

where ρ – coefficient of solar radiation absorption by the material of the outside surface of the structure, taken in compliance with SNiP II-3-79*;

S_{max} – maximum value of total solar radiation (direct and scattered), watt per square meter taken in compliance with SNiP 2.01.01-82;

k – coefficient taken according to the table 17;

k_1 – coefficient taken according to the table 18.

Table 17

Kind and orientation of the surface (surfaces)	Coefficient k
Horizontal	1.0
Vertical, oriented to the:	
south	1.0
west	0.9
east	0.7

Table 18

Structures of the building	Coefficient k_1
Metal structures	0.7
Reinforced concrete, concrete, reinforced stone and stone structures	
less than 15 cm thick	0.6
from 15 to 39 cm thick	0.4
more than 40 cm thick	0.3

8.6. Initial temperature which conforms to the locking of the structure or its part into the completed system during warm t_{0w} and cold t_{0c} season must be calculated by the following formulas

$$t_{0w} = 0.8 t_{VII} + 0.2 t_1 \qquad (23)$$

$$t_{0c} = 0.2 t_{VII} + 0.8 t_1 \qquad (24)$$

Note. If there is information about the calendar time of the locking of the structure, about work order etc. the initial temperature can be calculated in compliance with this information.

8.7. Safety factor as regards the load γ_f temperature and climatic effects Δt and ϑ must be taken as equal to 1.1.

9. Other Loads

In necessary cases provided in normative documents or fixed depending on the conditions of the building and usage of structures it is necessary to consider other loads which are not included into the present norms (special technological loads; humidity and settlement effects; wind effects which cause aerodynamic vibrations like galloping, buffet).

10. Deflections and Transitions

The norms of the present chapter fix the limit deflections and transitions of load-carrying and walling structures of the buildings by the calculation as regards the second group of limit states independently on the building materials.

The norms do not apply to the hydraulic works, transport facilities, nuclear power-stations as well as to power line supports, open distribution devices and antenna communication constructions.

General Instructions

10.1. During calculation of the structures as regards the deflections and transitions it is necessary to meet the following condition

$$f \leq f_u \qquad (25)$$

where f – deflection and transition of the member of the structure (or the whole structure) calculated considering the factors which influence on the their value in compliance with items 1 – 3 of the recommended Annex 6.

f_u – is limit deflection and transition fixed by the present norms.

The calculation must be made according to the following requirements:

a) technological (provide technological and lifting equipment, control instrumentation service conditions);
b) constructive (provide connection integrity of structures, their members and joints, provide necessary inclining);
c) physiological (prevent deleterious effects, discomfort sense during vibrations);
d) aesthetic and psychological (provide beneficial impressions by outward appearance of structures, prevent danger sense).

Each of mentioned above requirements must be completed by calculation independently on the others.

The limitation of the vibrations of the structure must be fixed in compliance with normative documents of item 4 of the recommended Annex 6.

10.2. The design situations for which it is necessary to calculate the deflections and transitions, corresponding to them loads as well as the requirements concerning the building raising are given in item 5 of the recommended Annex 6.

10.3. Roof and floor structures members Limit deflections confined according to the technological, constructive and physiological requirements must be counted out of the bent axis from which the deflection is calculated and which corresponds to the state of the member at the moment of the load action; the deflections confined according to the aesthetic and psychological requirements are counted out of the straight line which connects the supports of these members (see also item 7 of the recommended Annex 6).

10.4. The members of the structures deflections are not confined according to the aesthetic and psychological requirements if they do not worsen the appearance of the structure (for example thin-shell roof, sloped sun shields, structures with weighed down or uplifted bottom chord) and if the members of the structure are concealed. The deflections are not confined in the buildings where people stay short-term period (for example transformer substations, attics).

Note. For all kinds of the floor structures the continuity of the roof covering must be provided by means of constructive measures (for example using compensators) but not by means of the increasing of the durability of the structure.

10.5. Safety factor of all considered loads and the dynamic coefficient of the loads from the loaders, electric carts, bridge cranes and overhead cranes must be taken as equal to one.

Safety factor according to the responsibility must be taken in compliance with the obligatory Annex 7.

10.6. For the members of the structures or buildings limit deflections and transitions which are not stipulated in the present or other normative documents vertical and horizontal deflections caused by dead loads, long-term loads and short-term loads must not exceed 1/150 part of the bay or 1/75 part of the console overhang.

Vertical limit deflections of the structure members

10.7 Vertical limit deflections of the structures members and loads from which it is necessary to calculate the deflections are given in item 6 of the recommended Annex 6.

10.8. The distance (the gap) from the top point of the bridge crane crab to the bottom point of deflected load-carrying structures of the roof (or objects connected to them) must be no less than 100 mm.

10.9. The deflections of the roof members must be so as to provide the slope of roof no less than 1/200 in one direction (except the cases stipulated in other normative documents).

Table 19

Members of the structure	**Requirements**	**Vertical limit deflections f_u**	**Load for the determination of vertical deflections**
1. Gantry rail beams for bridge cranes and overhead crane, operated: from the floor, including telphers, (chain blocks)	Technological	$l/25$	From one crane
from the crane cabin by the operating mode groups (according to the GOST 25546-82):	Physiological and technological		

1K – 6K 7K 8K		*l*/400 *l*/500 *l*/600	The same The same The same
2. Beams, frameworks, collar beams, slabs, coverings (including cross ribs of the slabs and coverings):			
a) of floors and roofs which are open for the observing if the bay *l* *l* ≤1 *l*=3 *l*=6 *l*=24 (12) *l*≥36 (24)	Aesthetic and psychological	 *l*/120 *l*/150 *l*/200 *l*/250 *l*/300	Dead loads and temporary sustained load
b) of the roof or of the floor if there are walls under it	Constructive	Taken in compliance with item 6 of the recommended Annex 6	The loads which cause the decreasing of the gap between the load-carrying members of the structures and the walls, located under the members.
c) of the roof and of the floor if there are members on them which are subjected to cracks (bracing wires, walls)	Constructive	*l*/150	The loads acting after the walls, floors and [[[are made.
d) of the roofs and of the floors if there are telphers (chain blocks), overhead cranes which are operated			
from the floor	Technological	*l*/300 or *a*/150 (the less one of two)	Temporary load considering the load from one crane or a telpher (chain block) on one rail.
Members of the structure	**Requirements**	**Vertical limit deflections f_u**	**Load for the determination of vertical deflections**
from the cabin	Physiological	*l*/400 or *a*/200 (the less one of two)	The load from one crane or telpher (chain block) on one rail
e) of the floors exposed to the effect of:	Physiological and technological		
moved cargos, materials, joints and equipment elements and other movable loads (including by the road transport)		*l*/350	0.7 of total standard values of temporary loads or of the load from one loader (the most adverse of two)

the loads from rail transport narrow-gauge broad-gauge		$l/400$ $l/500$	The load from one train on one rail The same
3. The members of the stairs (flights of the stairs, stair platforms, strings), balconies, loggias	Aesthetic and psychological	The same like in Position 2, *a*	
	Physiological	Are determined in compliance with item 10.10	
4. Floor slabs, stair platforms and flights of the stairs, to whose deflection the adjoining members oppose.	Physiological	0.7 mm	Point load 1 kN (100 kilogram-force) in the middle of the
5. Cross pieces and hinged plates above the window and door openings	Constructive	$l/200$	The loads that cause the decreasing of the gap between the load-carrying members and window or door filling, located under the members
	Aesthetic and psychological	The same like in position 2, *a*	

Symbols taken in table 19:

l – design span of the structure member;

a – beams or truss spacing to which the suspended crane rails are fixed

Notes: 1. For a console it is necessary to take its double overhang instead of *l*.

2. For middle values *l* in position 2, *a* the limit deflections must be calculated by means of linear interpolation considering the item 7 requirements of the recommended Annex 6.

3. In the position 2, *a* the numbers shown in brackets must be taken if the height of the rooms is up to 6 meters inclusive.

4. Peculiarity of the deflections calculation according to the position 2, *d* are shown in item 8 of the recommended Annex 6.

5. If the deflections are limited by aesthetic and psychological requirements so it is possible to take the span *l* as equal to the distance between the inside surfaces of the load-carrying walls (or columns).

10.10. The limit deflections of the floor members (beams, slabs), of the stairs, balconies, loggias, limit deflections of the rooms of apartment buildings and office blocks as well as limit deflections of amenity rooms of industrial buildings based on physiological requirements must be calculated by the following formula

$$f_u = \frac{g(p + p_1 + q)}{30n^2(bp + p_1 + q)} \qquad (26)$$

where g – acceleration of gravity

p – standard load from people who cause the vibration, taken according to the table 20

p_1 – decreased standard value of the load upon the floor slabs, taken according to tables 3 and 20

q – standard value of the load from the weight of the calculated member and the members bearing against it

n – frequency of the load during the walking of a person, taken according to table 20

b – coefficient taken according to table 20

Rooms, taken according to table 3	ρ, kPa (kilogram-force per square meter)	ρ_1, kPa (kilogram-force per square meter)	*n*, Hertz	*b*
Pos 1, 2, except class rooms and amenity rooms; Pos 3, 4*a*, 9*b*, 10*b*	0.25 (25)	Taken according to table 3	1.5	$125\sqrt{\frac{Q}{\alpha pal}}$
Pos 2 – class rooms and amenity rooms; Pos 4*b* – *g*, except dance rooms; Pos 9*a*, 10*a*, 12, 13	0.5 (50)	The same	1.5	$125\sqrt{\frac{Q}{\alpha pal}}$
Pos 4 – dance rooms; Pos 6, 7	1.5 (150)	0.2 (20)	2.0	50

Symbols taken in Table 20:

Q – the weight of one person taken as equal to 0.8 kN (80 kilogram-force);

α – coefficient taken as equal to 1.0 for the members calculated as regards the beam lay-out, and taken as equal to 0.5 – in other cases (for example if the slab is supported by three or four sides)

a – spacing of the beams, collar beams, the width of the slabs (coverings), in meters

l – design span of the structure member; in meters

The deflections must be calculated as regards the sum of the loads $\psi_{A1} p + p_1 + q$ where ψ_{A1} – is the coefficient calculated as regards formula (1).

Horizontal Limit Deflections of the columns and Brake Structures from the Crane Loads

10.11 Horizontal limit deflections of the building columns appointed with bridge cranes, crane trestles as well as the limit deflection of the crane rails and brake structures beams (beams or trusses) must be taken according to table 21 but no less than 6 mm.

The deflections must be checked at the elevation of crane rail head from the braking forces of one crane crab directed across the crane rail without considering the foundation slopes.

Table 21

Crane operating	Limit deflections f_u

mode groups	of columns		of crane rails beams and brake structures of the buildings and crane trestles (open and with a roof)
	of buildings and of crane trestle with a roof	of open crane trestle	
1K – 3K	$h/500$	$h/1500$	$l/500$
4K – 6K	$h/1000$	$h/2000$	$l/1000$
7K – 8K	$h/2000$	$h/2500$	$l/2000$

Symbols taken in table 21:

h – the height from the top of the foundation to the crane rail head (for one-story buildings and crane trestles – open and with a roof) or the distance from the floor collar beam axis to the crane rails head (for upper storeys of the multistory buildings);

l – design span pf the structure member (beam).

10.12. Horizontal limit approaches of crane rails of open trestles caused by horizontal and eccentric vertical loads from one crane (without considering foundation slope) limited according to technological requirements must be taken as equal to 20 mm.

Horizontal limit transitions and deflections of framework buildings, separate members of the structure and supports of conveyer galleries from wind loads, foundation careen and temperature climatic effects

10.13. Horizontal limit transitions of the framework buildings limited according to the constructive requirements (the filling of the framework with the walls, window and door elements) are given in table 22. The instructions concerning the determination of the transitions are given in item 9 of the recommended Annex 6.

10.14. Horizontal transitions of framework buildings must be determined considering the foundation slope (turning). At the same time the loads from the weight of equipment, furniture, people, stored materials and products must be considered only if the continuous load from them is evenly spread on all floors of the multi-storey building except the cases when if it is provided another loading according to the conditions of normal exploitation.

Foundation slope must be determined considering the wind load, taken at the rate 30 percent of the standard value.

For the buildings up to 40 m high (and supports of conveyer gallery of any height) located in wind regions I – IV it is possible not to consider the foundation slope caused by the wind load.

Table 22

Building, walls, internal walls	The fixing of the walls to the framework of the building	Limit transitions f_u

1. Multi-storey buildings	Any	$h/500$
2. One floor of multi-storey buildings	Yielding	$h_s/300$
a) walls and internal walls made of brick gypsum concrete, reinforced concrete panels	Hard	$h_s/500$
b) walls reveted with natural stone, made of ceramic blocks and made of glass	Hard	$h_s/700$
3. One-storey buildings (with self-supporting walls) with the height of the floor h_s, m:	Yielding	
$h_s \leq 6$		$h_s/150$
$h_s = 15$		$h_s/200$
$h_s \geq 30$		$h_s/300$

Symbols taken in table 22:

h – the height of multi-storey buildings which is equal to the distance from the top of the foundation to the axis of the roof collar beam;

h_s – the height of the floor of one-story buildings which is equal to the distance from the top of the foundation to the bottom of rafter structure; in multi-story buildings: for bottom floor – the height equal to the distance from the top of the foundation to the axis of the roof collar beam, for other floors – the height equal to the distance between the neighbor collar beams.

Notes: 1. For middle values h_s (according to pos. 3) horizontal limit transitions must be calculated by means of linear interpolation.

2. For upper floors of multi-story buildings designed using the members of the floors of one-story buildings the horizontal limit transitions must be taken the same as for one-storey buildings. At the same time the height of the top floor h_s is taken from the axis of the collar beam of the floor slab to the bottom of the rafter structure.

3. To the yielding fixing belong the fixings of the walls or internal walls to the framework which don't prevent the transition of the framework (without effect of the force which can cause the damages of constructive members); to hard fixing belong the ones which prevent the replacement of the frame work, walls or internal walls.

4. For one-storey building with hinge walls (as well as if there are no hard disk of the floor) and multistory structures the limit deflections can be increased by 30 percent (but taken no more than $h_s/150$)

10.15. Horizontal transitions of the buildings without framework caused by the wind loads are not limited if their walls, internal walls and joining members are calculated as regards the durability and crack strength.

10.16. Horizontal limit deflections of the columns and collar beams of the frame structure as well as of walls panels caused by wind loads which are limited according to the constructive requirements must be taken equal to $l/200$, where l is design span of the columns or panels.

10.17. Horizontal limit deflections of the columns of the conveyer galleries caused by wind loads and limited according to the constructive requirements must be taken equal to $h/250$, where h is the height of the column from the top of the foundation to the bottom of the frameworks or beams.

10.18. Horizontal limit deflections of the columns of framework buildings caused by climatic temperature and settlement effects must be taken as

$h_s/150$ – if walls and internal walls are made of brick, gypsum cardboard, reinforced concrete and suspended panels;

$h_s/200$ – if walls are reveted with natural stone, made of ceramic blocks or glass, where h_s is the height of the floor, for one-story buildings with crane bridge it's the height from the top of the foundation to the bottom of the crane rails beams.

At the same time temperature effects must be taken without considering the daily fluctuation in temperature of the outside air and fluctuation of temperature caused by solar radiation.

During determinations of the horizontal deflection caused by climatic temperature and settlement effects their values must not be added together with the deflections caused wind loads and foundation slope.

Limit flexure of the floor members caused by the prestress force

10.19. Limit flexures f_u of floor members limited according to the constructive requirements must be taken equal to 15 mm if $l \leq 3$ m and 40 mm if $l \geq 12$ m (for l middle values the limit flexures must be determined by means of linear interpolation).

Flexures f must be determined according to the prestress force, own weight of the floor members and weight of the floor.

Bridge and over-head cranes of all operating mode groups (model list)

Cranes	Operating mode group	Usage conditions
Hand cranes of all kinds	1K – 3K	Any
Cranes with drive suspended chain block and with suspended captures		Repair and load works

Cranes with winch truck and with suspended captures		Control room of power station, installation works, load works
Cranes with winch truck and with suspended captures Cranes with double-rope clamshells, magnetic-clamshells cranes Magnetic cranes	4K – 6K	Load works, engineering works in machine shops, finished product storage areas of the factories producing building materials, metal sell storage areas Compound storage areas, work with different loads Half-finished storage areas, work with different loads
Heat treatment, forging, pin, foundry cranes Cranes with double-rope clamshells, magnetic clamshells cranes Cranes with windlass load truck, and with suspended captures	7K	Work shops of metallurgical works Bulk cargo and scrap metal storage areas with similar cargo (during one or two shifts work) Adjusting cranes during round-the-clock operation
Cross-beam, mold-clamshell, mold-charging, ingot-stripper, pile-driving, cucopa, well cranes Magnetic cranes Cranes with double-rope clamshells, magnetic clamshells cranes	8K	Work shops of metallurgical works Work shops and storage areas of metallurgical works, large sources of metal with similar cargo Bulk cargo and scrap metal storage areas with similar cargo (during round-the-clock work)

The load due to the beat into the track buffer stop

Standard value of horizontal load *F*, kN, directed along the crane rail and caused by the beat of the crane into the track buffer stop must be calculated by the following formula:

$$F = \frac{mv^2}{f}$$

where v – speed of the crane at the moment of the beat taken equal to the half of the rated speed, meter per second;

f – possible maximum settlement of the buffer taken equal to 0.1 m for the cranes with flexible suspension of the cargo with weight-carrying ability no more than 50 tons of operation modes groups 1K – 7K; 0.2 m – in other cases;

m – crane reduced mass calculated by the following formula

$$m = \frac{m_b}{2} + \left(m_c + km_q\right)\frac{l - l_1}{l}$$

here m_b – the weight of crane bridge, ton;

m_c – the weight of the crab, ton;

m_c – weight-carrying ability of the crane, ton;

k – coefficient; $k = 1$ for cranes with hard cargo suspension;

l – span of the crane, m;

l_1 – approach of the crab, m.

Design value of the loan under review considering the safety factor γ_f (see item 4.8) is taken no more than limit values shown in the following table:

Cranes	Limit values of the loads F, kN (ton-force)
Suspended (hand and electric) and bridge hand cranes	10 (1)
Electric bridge cranes:	
of general purpose of operating mode groups 1K – 3K	50 (5)
of general purpose and specific of operating mode groups 4K – 7K as well as foundry cranes	150 (15)
special groups of operating mode 8K with: flexible suspension hard suspension	 250 (25) 500 (50)

Annex 3*

Obligatory

Snow loads lay-outs and coefficients μ

Number of the lay-out	Roof sections and snow load lay-outs	Coefficient μ and field of application of the lay-outs

1	Buildings with a single-pitch or a double-pitch roof	$\mu = 1$ if $\alpha \le 25^\circ$ $\mu = 0$ if $\alpha \ge 60^\circ$ Variants 2 and 3 must be considered for buildings with double-pitch roofs (section *b*), at the same time variant 2 – if 20◦ ≤ α ≤ 30◦; variant 3 – if 10◦ ≤ α ≤ 30 only if there are conning bridge or aeration structure along the ridge of the covering
2	A roof in form of lancet arches	If β ≥ 15◦ so it is necessary to use lay-out 1 *b* taking *l* = *l'*; if β < 15◦ - it is necessary to use lay-out 2
3	Buildings with longitudinal lights covered from above	$\mu_1 = 0.8$; $\mu_2 = 1 + 0.1\frac{a}{b}$; $\mu_3 = 1 + 0.5\frac{a}{b_l}$ but no more than 4.0 – for girders and beams if standard weight value of the covering 1.5 kPa and less; 2.5 – for girders and beams if standard weight value of the covering more than 1.5 kPa 2.0 – for reinforced concrete slabs with a span 6 m and less and for steel corrugated sheets; 2.5 – for reinforced concrete slabs with a span more than 6 m and for binding rafters independently on the span; $b_l = h_l$ but no more than *b*. When calculating the load at the end of the light for zone *B* the value of the coefficient μ must be taken equal to 1.0 Notes: 1. The lay-outs of the variants 1, 2 must be also used for double-pitch roofs and vaulted roofs of two or three span buildings with lights in the middle of the building. 2. The influence of wind deflectors on the snow load spreading near the lights must not be taken into account. 3. For platform roofs if *b* > 48 m it is necessary to consider local increased load near the light (see lay-out 8).
3'	Buildings with longitudinal lights open from above	$\mu_1 = 1 + m\left(2 + \frac{l_1}{h_1}\right)$; $\mu_2 = 1 + m\left(2 + \frac{l_1}{h_2}\right)$ Values *b* (b_1, b_2) and *m* must be determined in compliance with the instructions to lay-out 8; the span *l* is taken equal to the distance between the top edges of the lights.

4	Shed covering	The lay-outs must be used for shed coverings, including to ones with inclined glazing and vaulted roof
5	Double- and multi-flight buildings with double-pitch roofs	Variant 2 must be taken if $\alpha \geq 15\circ$
6	Double- and multi-flight buildings with vaulted roofs	Variant to must be taken if $\frac{f}{l} > 0.1$ For reinforced concrete roof slabs the value of the coefficients μ must be no more than 1.4
7	Double- and multi-flight buildings with double-pitch and vaulted roofs with a longitudinal light	For spans with a light the coefficient μ must be taken in compliance with the variants 1 and 2 and layout 3; for spans without any light the coefficient μ must be taken in compliance with the variants 1 and 2 and layouts 5 and 6
8	Buildings with height difference	Snow load for a top roof must be taken in compliance with the layouts 1 – 7, for bottom roof it must be taken in two variants: according to layouts 1 – 7 and a layout 8 (for buildings – section "a", for snow-sheds – section "b") Coefficient μ must be taken equal to: $$\mu = 1 + \frac{1}{h}\left(m_1 l'_1 + m_2 l'_2\right)$$ where h – difference height in meters, counted from the eaves of the top roof to the eaves of the bottom roof, if it is more than 8 m so it is taken as equal to 8 m when calculating the coefficient μ; l'_1; l'_2 – the length of the parts of the top (l'_1) and the bottom (l'_2) roofs from which snow is taken to the height difference zone, m; they must be taken: for a roof without longitudinal lights or with cross lights – $$l'_1 = l_1;\ l'_2 = l_2$$ for a roof with longitudinal roofs – $$l'_1 = l^*_1 - 2h'_1;\ l'_2 = l^*_2 - 2h'_2$$ (at the same time l'_1 and l'_2 must be taken no lea than 2). m_1; m_2 – the parts of the snow taken by wind to the height difference; their values from the top (m_1) and the bottom (m_2) roofs must be taken dependently on their section: 0.4 – for a platform roof with $\alpha \leq 20°$, for a vaulted roof with $f / l \leq 1.8$ 0.3 – for a platform roof with $\alpha > 20°$, for a vaulted roof with $f / l > 1.8$ and for a roof with cross lights. For low roofs which are a < 21 m wide the value m_2 must be taken:

		$m_2 = 0.5k_1k_2k_3$ but no less than 0.1, where $k_1 = \sqrt{\frac{a}{21}}$; $k_2 = 1 - \frac{\beta}{35}$ (by reverse slope shown in the drawing with dotted line, k_2 = 1); $k_3 = 1 - \frac{\varphi}{30}$ but no less than 0.3 (a – in meters; β, φ – in degrees). The length of the increased snow layer b must be taken: if $\mu \le \frac{2h}{s_0}$ $b = 2h$ but no more than 16 m; if $\mu > \frac{2h}{s_0}$ $b = \frac{\mu - 1 + 2m_2}{\frac{2h}{s_0} - 1 + 2m_2} 2h$ but no more than 5h and no more than 16 m. The coefficients μ taken for the calculations (shown in the lay-outs for two variants), must not exceed $\frac{2h}{s_0}$ (where h is in meters, s_0 is in kPa); 4 – if lower roof is the roof of the building; 6 – if the lower roof is a snow shed. Coefficient μ_1 must be taken $$\mu = 1 - 2m_2$$ Notes: 1. If d_1 (d_2) > 12 m so the value μ for the difference part which is d_1 (d_2) long must be determined without considering the light influence on the higher (lower) roof. 2. If the spans of the top (bottom) roof have different section so when determining μ it is necessary to take the corresponding value m_1 (m_2) for each span within l'_1 (l'_2). 3. Local load near the difference must not be considered if the height of the difference in meters between two neighbor roofs is less than $\frac{s_0}{2}$ (where s_0 is in kPa).
9	Buildings with two height differences	Snow load on top and bottom roofs must be taken according to lay-out 8. The values μ_1, b_1, μ_2, b_2 must be determined for each difference separately taking m_1 and m_2 in lay-out 9 (during determination of the loads near the differences h_1 and h_2) as corresponding to m_1 in layout 8 and m_3 (part of the snow taken by wind along the bottom roof) as corresponding to m_2 in layout 8. At the same time: $$b_3 = b_1 + b_2 - l_3;$$ $$\mu'_1 = (\mu_1 + 2m_3 - 1)\frac{b_3}{b_1} + 1 - 2m_3;$$ $$\mu'_2 = (\mu_2 + 2m_3 - 1)\frac{b_3}{b_2} + 1 - 2m_3$$

10	Roofs with parapets	The layout must be taken if $h > \frac{s_0}{2}$ (h – in meters; s_0 – in kPa) $\mu = \frac{2h}{s_0}$ but no more than 3
11	The parts of the roofs abutted upon the raising above the roof ventilation shafts and other additional structures	The lay-outs concern to the parts with additional structures with the base diagonal no more than 15 m. Depending on the calculated structure (roof slab, ceiling rafter) it is necessary to consider the worst position of the largest load (if angle β is random). Coefficient μ, constant within the mentioned zone must be taken equal: 1.0 if $d \leq 1.5$ m; $\frac{2h}{s_0}$ if $d > 1.5$ m; but no less than 1.0 and no more than 1.5 if $1.5 < d \leq 5$ m; 2.0 if $5 < d \leq 10$ m; 2.5 if $10 < d \leq 5$ m; $b_1 = 2h$ but no more than $2d$
12	Suspended roofs in form of cylinder	$\mu_1 = 1.0$; $\mu_2 = \frac{1}{b}$

Wind Loads Layouts and Aerodynamic Coefficients *c*

<table>
<tr><th>No of the layout</th><th>Layouts of buildings, structures, members of structures and wind loads</th><th>Determination of aerodynamic coefficients c</th><th>Notes</th></tr>
<tr><td>1</td><td>Detached platform continuous structures.
Vertical surfaces and surfaces deviated from the vertical ones no more than 15 degrees:
windward
leeward</td><td>$c_{в} = +0,8$
$c_{в} = -0,6$</td><td>–</td></tr>
<tr><td>2</td><td>Buildings with a double-pitch roof</td><td>
<table>
<tr><th>Coefficient</th><th>α, degrees</th><th colspan="4">Values $c_{в_1}, c_{в_2}$ if $\frac{h}{l}$ is</th></tr>
<tr><th></th><th></th><th>0</th><th>0.5</th><th>1</th><th>≥2</th></tr>
<tr><td>$c_{в_1}$</td><td>0
20
40
60</td><td>0
+0.2
+0.4
+0.8</td><td>-0.6
-0.4
+0.3
+0.8</td><td>-0.7
-0.7
-0.2
+0.8</td><td>-0.8
-0.8
-0.4
+0.8</td></tr>
<tr><td>$c_{в_2}$</td><td>≤60</td><td>-0.4</td><td>-0.4</td><td>-0.5</td><td>-0.8</td></tr>
</table>
<table>
<tr><th>$\frac{b}{l}$</th><th colspan="3">Values $c_{в_3}$ if $\frac{h_1}{l}$ is</th></tr>
<tr><th></th><th>≤ 0.5</th><th>1</th><th>≥ 2</th></tr>
<tr><td>≤ 1
≥ 2</td><td>-0.4
-0.5</td><td>-0.5
-0.6</td><td>-0.6
-0.6</td></tr>
</table>
</td><td>1. If wind is perpendicular to the end wall of the building so it’s $c_{в} = -0,7$ for the whole surface of the building.
2. During determination the coefficient v in compliance with item 6.9 $h = h_1 + 0.2l$ tgα.</td></tr>
</table>

<table>
<tr>
<td>3</td>
<td>Buildings with vaulted roofs</td>
<td>
<table>
<tr><td>Coefficient</td><td>$\frac{h_1}{l}$</td><td colspan="5">Values $c_{в_1}, c_{в_2}$ if $\frac{f}{l}$ is</td></tr>
<tr><td></td><td></td><td>0.1</td><td>0.2</td><td>0.3</td><td>0.4</td><td>0.5</td></tr>
<tr><td>$c_{в_1}$</td><td>0
0.2
≥ 1</td><td>+0.1
-0.2
-0.8</td><td>+0.2
-0.1
-0.7</td><td>+0.4
+0.2
- 0.3</td><td>+0.6
+0.5
+0.3</td><td>+0.7
+0.7
+0.7</td></tr>
<tr><td>$c_{в_2}$</td><td>Arbitrary</td><td>- 0.8</td><td>- 0.9</td><td>- 1</td><td>- 1.1</td><td>- 0.2</td></tr>
</table>
Value $c_{в_3}$ is taken according to layout 2
</td>
<td>1. See note 1 to layout 2.
2. During determination the coefficient v in compliance with item 6.9 $h = h_1 + 0.7f$.</td>
</tr>
<tr>
<td>4</td>
<td>Buildings with a longitudinal light</td>
<td>Coefficients $c_{в_1}, c_{в_2}$, $c_{в_3}$ must be determined in compliance with the instructions to layout 2.</td>
<td>1. When calculating cross frames of the building with a light and wind shields the value of total coefficient of head resistance of the system “light – shields” is taken equal to 1.4.
2. During determination the coefficient v in compliance with item 6.9 $h = h_1$.</td>
</tr>
<tr>
<td>5</td>
<td>Buildings with longitudinal lights</td>
<td>For the roof of the building on the part AB the coefficients $c_в$ must be taken according to layout 4.
For the lights of the part BC if $\lambda \leq 2$ $c_x = 0.2$;
if $2 \leq \lambda \leq 8$ for each light $c_x = 0.1\lambda$;
if $\lambda > 8$ $c_x = 0.8$, here $\lambda = \frac{a}{h_1 - h_2}$.
For other parts of the roof $c_в = -0.5$</td>
<td>1. For windward, leeward and side walls of the building the pressure coefficients must be determined according to the instructions to layout 2.
2. During determination the coefficient v in compliance with item 6.9 $h = h_1$.</td>
</tr>
</table>

6	Different height buildings with longitudinal lights	Coefficients c'_{e_1} c''_{e_1} and c_{e_2} must be determined in compliance with the instructions to layout 2 where during determination of c_{e_1} it is necessary to take the height of windward wall of the building for h_1. For the part *AB* c_e must be determined just as for the part *BC* of layout 5 where it is necessary to take the height of the building for $h_1 - h_2$.	See Notes 1 and 2 to layout 5.
7	Buildings with shed roofs	For the part AB it is necessary to determine c_e in compliance with the instructions to layout 2. For the part BC $c_e = -0.5$	1. Force of friction must be taken into account by arbitrary wind direction; at the same time $c_f = 0.04$. 2. See notes 1 and 2 to layout 5.
8	Buildings with zenith lights	For windward light the coefficient c_e must be determined in compliance with the instructions to layout 2, for another part of the roof the coefficient c_e must be determined as for the part *BC* of layout 5.	See Notes 1 and 2 to layout 5

9	Buildings permanently open from one side	If $\mu \le 5$ percent $c_{i1} = c_{i2} = \pm 0.2$; if μ ≥ 30 percent c_{i1} must be taken equal to $c_{в_3}$ determined in compliance with the instructions to layout 2; $c_{i2} = +0.8$	1. Coefficients $c_в$ on the external surface must be taken in compliance with the instructions to layout 2. 2. Walling structure permeability μ must be determined as the ratio of the total area of all spans to total area of the walling structure. For a waterproof building it is necessary to take $c_i = 0$. In the buildings shown in item 6.1, c, standard value of internal pressure on the light weight internal walls (if their density is less than 100 kg per m^2) must be taken equal to $0.2w_0$ but no less than 0.1 kPa (10 kilogram-force per m^2). 3. For each wall of the building sign "plus" and "minus" for the coefficient c_{i1} if $\mu \le 5$ percent must be determined according to the conditions of the worst loading variant.
10	Building ledges if α < 15 degrees	For the part *CD* $c_в = 0.7$. For the part *BC* $c_в$ must be determined by means of linear interpolation of the values taken in the points *B* and *C*. Coefficients $c_{в_1}$ and $c_{в_3}$ on the part *AB* must be taken in compliance with the instructions to layout 2 (where *b* and *l* – are the measurements on the plan of the whole building). For vertical surfaces it is necessary to determine coefficient $c_в$ in compliance with the instructions to layouts 1 and 2.	–

<table>
<tr>
<td>11</td>
<td>Sun shields</td>
<td>
<table>
<tr><th rowspan="2">Type of the layout</th><th rowspan="2">A, degrees</th><th colspan="4">Coefficients</th></tr>
<tr><th>$c_{в_1}$</th><th>$c_{в_2}$</th><th>$c_{в_3}$</th><th>$c_{в_4}$</th></tr>
<tr><td>I</td><td>10</td><td>+ 0.5</td><td>- 1.3</td><td>– 1.1</td><td>0</td></tr>
<tr><td></td><td>20</td><td>+ 1.1</td><td>0</td><td>0</td><td>– 0.4</td></tr>
<tr><td></td><td>30</td><td>+ 2.1</td><td>+ 0.9</td><td>+ 0.6</td><td>0</td></tr>
<tr><td>II</td><td>10</td><td>0</td><td>– 1.1</td><td>– 0.5</td><td>0</td></tr>
<tr><td></td><td>20</td><td>+ 1.5</td><td>+ 0.5</td><td>0</td><td>0</td></tr>
<tr><td></td><td>30</td><td>+ 2</td><td>+ 0.8</td><td>+ 0.4</td><td>+ 0.4</td></tr>
<tr><td>III</td><td>10</td><td>+ 1.4</td><td>+ 0.4</td><td>–</td><td>–</td></tr>
<tr><td></td><td>20</td><td>+ 1.8</td><td>+ 0.5</td><td>–</td><td>–</td></tr>
<tr><td></td><td>30</td><td>+ 2.2</td><td>+ 0.6</td><td>–</td><td>–</td></tr>
<tr><td>IV</td><td>10</td><td>+ 1.3</td><td>+ 0.2</td><td>–</td><td>–</td></tr>
<tr><td></td><td>20</td><td>+ 1.4</td><td>+ 0.3</td><td>–</td><td>–</td></tr>
<tr><td></td><td>30</td><td>+ 1.6</td><td>+ 0.4</td><td>–</td><td>–</td></tr>
</table>
</td>
<td>1. Coefficients $c_{в_1}, c_{в_2}, c_{в_3}, c_{в_4}$ must be referred to the sum of the pressures upon the top and the bottom surface of the shields.
For negative values $c_{в_1}, c_{в_2}, c_{в_3}, c_{в_4}$ the direction of the pressures on the layouts must be changed for the opposite one.
2. For the shields with corrugated covering $c_f = 0.04$</td>
</tr>
</table>

12 a

Sphere

β, degrees	0	15	30	45	60	75	90
$c_{в}$	+ 1.0	+ 0.8	+ 0.4	– 0.2	– 0.8	–1.2	+1.25

Continuing

β, degrees	105	120	135	150	175	180
$c_{в}$	– 0.1	– 0.6	– 0.2	+ 0.2	+ 0.3	+ 0.4

$c_x = 1.3$ if $\mathrm{Re} < 10^5$

$c_x = 0.6$ if $2\cdot10^5 \le \mathrm{Re} \le 3\cdot10^5$

$c_x = 0.2$ if $4\cdot10^5 > \mathrm{Re}$

where Re – Reynolds number

$$\mathrm{Re} = 0.88d\sqrt{w_0 k(z)\gamma_f}\cdot10^5;$$

d – sphere diameter;

w_0 – is determined in compliance with item 6.4, Pa;

$k\ (z)$ – is determined in compliance with item 6.5;

z – the distance in meters from the ground surface to the sphere center;

γ_f – is determined in compliance with item 6.11

1. Coefficients $c_{в}$ are given in compliance with the condition $\mathrm{Re} > 4\cdot10^5$.

2. During determination the coefficient v in compliance with item 6.9 $b = h = o.7d$.

12b — Structures with circular cylindrical surface

$$c_{e_1} = k_1 c_\beta$$

where $k_1 = 1$ if $c_\beta > 0$;

$\frac{h_1}{d}$	0.2	0.5	1	2	5	10	25
k_1 if $c_\beta < 0$	0.8	0.9	0.95	1.0	1.1	1.15	1.2

c_β must be taken if Re > $4 \cdot 10^5$ according to the diagram

Roof	Value c_{e2} if $\frac{h_1}{d}$ is		
	1/6	1/3	≥ 1
Platform, conical if $\alpha \le 5$ degrees, spherical if $\frac{f}{d} \le 0.1$	– 0.5	– 0.6	– 0.8

$\frac{h_1}{d}$	$\frac{1}{6}$	$\frac{1}{4}$	$\frac{1}{2}$	1	2	≥ 5
c_i	– 0.5	–0.55	– 0.7	– 0.8	– 0.9	–1.05

1. Re must be determined by the formula to layout 12 a, taking $z = h_1$.
2. During determination the coefficient v in compliance with item 6.9 it is necessary to take:
   $b = 0.7d$;
   $h = h_1 + 0.7f$.
3. Coefficient c_i must be considered by the roof pulled down (“ floating roof”) as well as if there is no roof

13 Prismatic structures

$$c_x = kc_{x\infty}; \; c_y = kc_{y\infty}$$

Table 1

$\lambda_{в}$	5	10	20	35	50	100	∞
k	0.6	0.65	0.75	0.85	0.9	0.95	1

$\lambda_{в}$ must be determined according to table 2.

Table 2

$\lambda_{в} = \frac{\lambda}{2}$	$\lambda_{в} = \lambda$	$\lambda_{в} = 2\lambda$

In table 2 $\lambda = \frac{l}{b}$, where l, b – are correspondingly maximum and minimum measurements of the structure or its member in the level which is perpendicular to the wind direction.

Table 3

Drawings of the sections and wind directions	β, degrees	$\frac{l}{b}$	$c_{x\infty}$
Rectangle	0	≤1.5 ≥ 3	2.1 1.6
	40–50	≥ 0.2 ≤ 0.5	2.0 1.7
Rhomb	0	≤ 0.5 1 ≥ 2	1.9 1.6 1.1
Regular triangle	0 180	– –	2 1.2

1. For the walls with loggias by the wind which is parallel to these walls $c_f = 0.04$.

2. For rectangular buildings if $\frac{l}{b} = 0.1 - 0.5$ and $\beta = 40 - 50$ degrees $c_{y\infty} = 0.75$;

resultant force of the wind load is applied in the point 0, at the same time eccentricity e = $0.15b$.

3. Re must be determined by the formula to layout 12 a, taking $z = h_1$, d – diameter of circumscribed circle.

4. During determination the coefficient v in compliance with item 6.9 h – the height of the structure, b – the dimension along axis y.

<table>
<tr>
<td>13</td>
<td>Prismatic structures</td>
<td>Table 4
<table>
<tr><th>Drawings of the sections and wind directions</th><th>β, degrees</th><th>n (number of the sides)</th><th>$c_{x\infty}$ if $\mathrm{Re} > 4 \cdot 10^5$</th></tr>
<tr><td>Regular polygon</td><td>Arbitrary</td><td>5
6–8
10
2</td><td>1.8
1.5
1.2
1.0</td></tr>
</table>
</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Structures and their members with circular cylindrical surface (tanks, cooling towers, chimneys), cables and ropes as well as round pipe and continuous members of through structures</td>
<td>$c_x = kc_{x\infty}$,
where k is determined according to table 1 of layout 13
$c_{x\infty}$ is determined according to the diagram:

For cables and ropes (including the ice-covered ones) $c_x = 1.2$</td>
<td>1. Re must be determined by the formula to layout 12 a, taking $z = h$, d – diameter of the structure.
Values Δ are taken: for wooden structures Δ = 0.005 m; for brick work Δ = 0.01 m; for concrete and reinforced concrete structures Δ = 0.005 m; for other structures Δ = 0.001 m; for cables and ropes with diameter d $\Delta = 0.01d$ m; for rib surfaces with ribs height b $\Delta = b$.
2. For corrugated roofs $c_f = 0.04$
3. For cables and ropes $d \geq 20$ mm without ice-covering value c_x can be decreased by 10 percent.</td>
</tr>
</table>

<table>
<tr>
<td>15</td>
<td>Separate flat lattice structures</td>
<td>

$$c_x = \frac{1}{A_k}\sum c_{xi}A_i$$

where c_{xi} – aerodynamic coefficient of i-member; for metal sections $c_{xi} = 1.4$, for pipe members c_{xi} must be determined according to the diagram of layout 14, at the same time it is necessary to take $\lambda_e = \lambda$ (see table of layout 13);
A_i – projection area of i-member onto the plane of the structure;
A_k – the area, bounded by the outline of the structure
</td>
<td>

1. Aerodynamic coefficients for layouts 15 – 17 are given for lattice structures with arbitrary form of the outline and

$$\varphi = \frac{\sum_i A_i}{A_k} \le 0.8$$

2. Wind load must be applied to the area bounded by the outline A_k
3. The direction of axis x coincides with the wind direction and is perpendicular to the structure plane.
</td>
</tr>
<tr>
<td>16</td>
<td>Row of flat, parallel located lattice structures</td>
<td>

For windward structure coefficient c_{x_1} is determined just as for layout 15.
For the second and the following structures $c_{x_2} = c_{x_1}\eta$
For girders made of pipes if $\mathrm{Re} \ge 4\cdot10^5$ $\eta = 0.95$

<table>
<tr><td rowspan="2">φ</td><td colspan="5">Value η for girders made of metal sections and pipes if $\mathrm{Re} < 4\cdot10^5$ and if $\frac{b}{h}$ is</td></tr>
<tr><td>$\frac{1}{2}$</td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>0.1</td><td>0.93</td><td>0.99</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>0.2</td><td>0.75</td><td>0.81</td><td>0.87</td><td>0.9</td><td>0.93</td></tr>
<tr><td>0.3</td><td>0.65</td><td>0.65</td><td>0.73</td><td>0.78</td><td>0.83</td></tr>
<tr><td>0.4</td><td>0.38</td><td>0.48</td><td>0.59</td><td>0.65</td><td>0.72</td></tr>
<tr><td>0.5</td><td>0.19</td><td>0.32</td><td>0.44</td><td>0.52</td><td>0.61</td></tr>
<tr><td>0.6</td><td>0</td><td>0.15</td><td>0.3</td><td>.04</td><td>0.5</td></tr>
</table>
</td>
<td>

1. See notes 1–3 to layout 15.
2. Re must be determined by the formula to layout 12 a, where d – average diameter of pipe line members; z – it is possible to take equal to the distance from the ground surface to the top belt of the girder.
3. *In the table to layout 16.*
h – minimum dimension of the bound; for rectangle and trapezoidal girders h – the length of the shortest side of the bounding; for round lattice structures h – their diameter; for elliptic structures h – the length of the less axis;
b – the distance between the neighbor girders.
4. Coefficient φ must be determined in compliance with the instructions to layout 15.
</td>
</tr>
</table>

<table>
<tr>
<td>17</td>
<td>Lattice towers and spatial girders</td>
<td>

$$c_t = c_x(1+\eta)k_1$$

where c_x – determined just as for layout 15;
η – determined just as for layout 16.

<table>
<tr><td>Drawings of the outline forms of the cross section and of wind direction</td><td>k_1</td></tr>
<tr><td></td><td>1.0</td></tr>
<tr><td></td><td>0.9</td></tr>
<tr><td></td><td>0.2</td></tr>
</table>
</td>
<td>1. See note 1 to layout 15.
2. c_t belongs to the area of the windward surface.
3. By the wind direction cornerwise of the tetrahedral towers the coefficient k_1 for steel towers made of single members must be decreased by 10 percents; for wooden towers made of constituents it must be increased by 10 percents.</td>
</tr>
<tr>
<td>18</td>
<td>Vertical stays and sloping pipe members located in the plane of the stream</td>
<td>

$$c_{x\alpha} = c_x \sin^2 \alpha,$$

where c_x is determined in compliance with the instructions in layout 14</td>
<td>–</td>
</tr>
</table>

Annex 5

Obligatory

The map of the USSR regions according to climatic characteristics

(see the insert)

Annex 6

Recommended

Deflections and Transitions Determination

1. During determination of the deflections and transitions it is necessary to consider all basic factors that have effect on their value (non-elastic deformations of the materials, crack formations, neighbor elements consideration, joints flexibility). By enough substantiation it is possible not to consider some factors or to consider them approximately.

2. For the structures made of the materials that have creep characteristics it is necessary to consider the deflections during the time. If the deflections are limited according to physiological requirements it is necessary to consider only short term creep that shows only after load applying, and according to technological and constructive requirements (except the cases when wind load is calculated) and aesthetic psychological requirements – full creep.

3. During determination of deflections of one-storey buildings and overpasses caused by horizontal crane loads it is necessary to take design layout of the columns considering their attachment taking that:

- In the buildings and enclosed overpasses the column has no horizontal displacement at the level of the top support (if the roof doesn't make a hard disc in the horizontal plane) it is necessary to consider the compliance of this support;
- In open overpasses the column is considered as a console.

4. If in the buildings (structures) there is technological and transport equipment that cause the vibration of the building structures and if there are other vibration sources so it is necessary to take limit values of vibrodisplacement, vibrospeed and vibroacceleration in compliance with the GOST 12.1.012–90; "Sanitary vibration norms at a work place" and "Sanitary allowable vibrations in dwelling houses" of USSR Ministry of Health. If there is high-precision equipment and devices vibration-intolerant structures so it is necessary to take limit values of vibrodisplacement, vibrospeed and vibroacceleration in compliance with specific technical conditions.

5. Design situations[1] for which it is necessary to determine the deflections and transitions and corresponding loads must be taken subject to the requirements according to which the calculation is made.

If the calculation is made according to technological requirements so design situation must conform to the action of the loads that effect on the technological equipment work.

If the calculation is made according to constructive requirements so design situation must conform to the action of the loads that can cause the damage of the neighbor structures as a result of significant deflections and transitions.

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[1] Design situation – the considered conditions complex that determines the structure design requirements.

Design situation is characterized by the structure design layout, kinds of loads and safety factors, limit conditions list that must be considered in the given situation.

If the calculation is made according to physiological requirements so the design situation must conform to the condition connected with the vibration of the structure and during design it is necessary to consider the loads that effect the vibration of the structure limited by the present norms instructions and instructions of normative documents mentioned in item 4.

If the calculation is made according to the aesthetic psychological requirements so the design situation must conform to the effect of dead loads and long term loads.

For the roof and floor structures designed with building hog by limiting of the deflection by aesthetic psychological requirements the calculated vertical deflection must be decreased by the measurement of the hog.

6. The roofs and floors members' deflections limited according to the constructive requirements must not exceed the distance (the gap) between the bottom surface of these elements and the top of internal walls, glass windows, window and door cases located under the load-carrying members.

As a rule the gap between the surface of the roofs and floors members and the top of internal walls located under the members must not exceed 40 mm. In the cases when the fulfillment of the mentioned requirements is connected with the increasing of the durability of the floors and the roofs it is necessary to avoid this increasing by means of constructive measures (for example by means of installing of the internal walls not under the bending beams but near them).

7. If there are main internal walls between the walls (almost with the same height as the walls) so the values l in position 2, a of the table 19 must be taken equal to the distance between the internal surface of the load-carrying walls (or columns) and these internal (or between the internal surfaces of the internal walls, drawing 4).

Drawing 4. The layouts for the determination of the values l (l_1, l_2, l_3) if there are main internal walls between the walls

a – one in the span; *b* – two in the span; *1* – load-carrying walls; *2* – main internal walls; *3* – floor (roof) before applying of the load; *4* – floor (roof) after applying of the load; *5* – refer line of the deflections; *6* – gap.

8. The deflections of the rafter structure caused by the suspended crane rails (see table 19, position 2, d) must be taken as a difference between the deflections f_1 and f_2 of neighbour rafter structures (drawing 5).

Drawing 5. The layout for the determination of rafter structures if there are suspended crane rails

1 – rafter structures; *2* – the beam of the suspended crane rail; *3* – suspended crane; *4* – original position of the rafter structure; f_2 – the deflections of the neighbored with the most loaded one rafter structures.

9. Horizontal displacement of the framework must be determined in the plane of the walls and internal walls, whose integrity must be provided.

By bracing frameworks of multi-storey buildings more than 40 m high the distortion of floor cells (that side with stiffening diaphragm) wich is $f_1/h_s+f_2/l$ must not exceed (see table 22): 1/300 for position 2, 1/500 – for position 2, *a* and 1/700 for position 2, *b*.

Drawing 6. The layout of the distortion of floor sells *2* which side with stiffening diaphragm *1* in buildings with bracing framework (original layout of the framework before applying of the load is shown with dotted line).

Annex 7*

Obligatory

Responsibility of the buildings and structures

1. There are 3 levels of responsibility for buildings and structures according to economic, sociological and ecological consequences of their failure: I – higher level, II – normal level, III – low level.

Higher responsibility level is taken for the buildings and structures whose failure can cause serious economic, sociological and ecological consequences (oil tanks with storage capacity 10000 cubic meters and more; supply pipe, industrial buildings with 100 and more meters wide spans, communication structures 100 and more meters high as well unique buildings).

Normal responsibility level must be taken for the buildings and structures of repetition building (civil, public, industrial, agricultural buildings and structures).

Low responsibility level must be taken for season or temporary purpose buildings and structures (hotbeds, greenhouses, summer halls, storage areas and structures like that).

2. When calculating the load-carrying structures and foundations it is necessary to consider the safety factor as regards the responsibility γ_n which is taken equal to: more than 0.95 but no more than 1.2 – for higher responsibility level; 0.95 – for normal responsibility level; less than 0.95 but no less than 0.8 – for low responsibility level.

Loading effect (internal forces and transitions of the structures and foundations caused by loads and effects) must be multiplied by the safety factor.

Note. The present item doesn’t apply to the buildings and structures whose responsibility level is not mentioned in corresponding normative documents.

3. It is also necessary to consider the responsibility levels during determination of the buildings and structures life; during determination range and volume of engineering investigations, statutory acceptance work order, test, use and technical diagnosis order of building projects.

4. Rating of the object and choosing of the coefficient γ_n value is fulfilled by General Designer under arrangement with the Customer.