Appendix C

(informative annex)

Calculation of External Load and Deflection for Steel Grid Plate

C.1 Design value of bending moment for flat steel bearing

C.1.1 Cross-sectional modulus of flat steel bearing

Calculate the cross-sectional modulus of the load-bearing flat steel using Equation (C.1).

$$Wb=bd^2/6$$ ....(C.1)

In the formula:

W_6 -The section modulus of the flat steel bearing, measured in cubic millimeters (mm^3); b-The thickness of the flat steel bearing, measured in millimeters (mm).

d-Width of the flat steel bearing element, measured in millimeters (mm).

C.1.2 Cross-sectional moment of inertia of flat steel load-bearing members

Calculate the cross-sectional inertia moment of the load-bearing flat steel using Equation (C.2).

$$Ib=ba^3/12$$ ... ...(C.2)

In the formula:

Ib — the moment of inertia of the cross-section supporting flat steel, measured in cubic millimeters (mm^4).

b-Thickness of the flat steel bearing plate, in millimeters (mm);

d-Width of the load-bearing flat steel, in millimeters (mm).

C.1.3 Design value of bending moment for load-bearing flat steel

Calculate the design bending moment value for the load-bearing flat steel using Equation (C.3).

$$M 1 fW$$ ....(C.3)

In the formula:

Mp – Design bending moment value for flat steel bearing, measured in newton-millimeters (N·mm);

f — Design value of flexural strength for steel materials, measured in Newtons per square millimeter (N/mm^2);

Wb — the section modulus of flat steel, measured in cubic millimeters (mm^3).

C.1.4 Bending stiffness adjustment coefficient for flat steel load-bearing members

The bending stiffness of load-bearing flat steel in composite steel grating should account for dimensional deviations of the load-bearing flat steel, the influence of its non-perpendicularity, and the effect of insufficient lateral support on the overall stiffness of the steel grating. The stiffness adjustment coefficient equals the product of all aforementioned reduction factors.

In this appendix calculation, the bending stiffness adjustment coefficient for flat steel members is set as follows:

$$y=0.729$$

C.2 Design value of central concentrated load on flat steel bearing

C.2.1 Design value of central concentrated load on flat steel bearing

Calculate the design value of the mid-span concentrated load for the load-bearing flat steel using Equation (C.4).

F_6 =4M/L, ...(C.4)

F_6 =4M/L, ...(C.4)

In the formula:

Fb — design value of mid-span concentrated load on flat steel, measured in Newtons (N);

M — design bending moment value for flat steel load-bearing members, measured in newton-millimeters (N·mm);

L — Span of the steel grid plate, measured in millimeters (mm).

C.2.2 Maximum allowable deflection value of flat steel members under concentrated load at mid-span design value

Calculate the maximum allowable deflection of the load-bearing flat steel under the design value of central concentrated load according to Equation (C.5).

$$D=F_6\ L^3/48yEI \qquad \text{.................. ....(C.5)}$$

$$D=F_6\ L^3/48yEI \qquad \text{.................. ....(C.5)}$$

In the formula:

D — The maximum allowable deflection of the load-bearing flat steel under the design value of concentrated load at the mid-span, measured in millimeters (mm).

F_6 — design value of mid-span concentrated load on flat steel members, measured in Newtons (N);

L, — Span of the steel grid plate, measured in millimeters (mm);

y — the bending stiffness adjustment coefficient for flat steel load-bearing members;

E — Elastic modulus of steel, measured in newtons per square millimeter (N/mm^2);

Ib — the moment of inertia of the cross-section supporting flat steel, measured in cubic millimeters (mm^4).

C.3 Design value of uniform load on flat steel bearing

C.3.1 Design value of uniform load for flat steel bearing

Calculate the design value of uniform load for bearing flat steel using Equation (C.6).

$$Qb=8Mb/L \qquad \text{.................. ....(C.6)}$$

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In the formula:

Q_6 — Design value of uniform load on flat steel, measured in Newton per millimeter (N/mm);

Mb – Design bending moment value for flat steel bearing, measured in newton-millimeters (N·mm);

L, — Span of the steel grid plate, in millimeters (mm).

C.3.2 Maximum allowable deflection under the design value of uniform load for flat steel bearing

Calculate the maximum allowable deflection under the design value of uniform distributed load for flat steel beams using Equation (C.7).

$$D_4=5Q_6\ L4/384\gamma EI \qquad \text{.................. ....(C.7)}$$

$$D_4=5Q_6\ L4/384\gamma EI \qquad \text{.................. ....(C.7)}$$

In the formula:

D_4 — the maximum allowable deflection value under the design value of uniform load acting on flat steel members, measured in millimeters (mm).

Q. — The design value of uniform load on flat steel, measured in Newtons per millimeter (N/mm);

L_5 — Span of the steel grating, measured in millimeters (mm);

y-Bending stiffness adjustment coefficient for flat steel load-bearing members;

E — Elastic modulus of steel, measured in newtons per square millimeter (N/mm^2);

Ib — The moment of inertia of the cross-section carrying flat steel, measured in cubic millimeters (mm^4).

C.4 Number of load-bearing flat steel bars per meter-wide steel grating

Calculate the number of load-bearing flat steel bars per meter width of steel grating according to Formula (C.8).

$$K=(10^3/P)+1 \qquad \text{.................... ......(C.8)}$$

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In the formula:

K — Number of load-bearing flat steel bars per meter of wide steel grating (integer value), measured in units per meter (1/m);

P — Center distance of flat steel bearing, unit: millimeter (mm).

C.5 Design value of central concentrated load on steel grid plates

C.5.1 Design value of central concentrated load on steel grid plates

Calculate the design value of the central concentrated load for steel grating according to Formula (C.9).

$$C=KF \quad \cdots\cdots(C.9)$$

C=KF ....(C.9)

In the formula:

C — Design value of concentrated load at mid-span for steel grid plates, measured in kilonewtons per meter (kN/m);

K — Number of load-bearing flat steel bars per meter of wide steel grating, measured in units per meter (1/m);

Fb— Design value of mid-span concentrated load on flat steel beam, measured in kilonewtons (kN).

C.5.2 Maximum Deflection Allowable Value under Design Value of Central Concentrated Load on Steel Grid Plate

Calculate the maximum allowable deflection under the design value of central concentrated load for steel grating plates using Equation (C.10).

$$D.=F_6 \ L^3/48yEI_6 \quad \cdots\cdots(C.10)$$

D.=F₆ L³/48yEI₆ ....(C.10)

In the formula:

D. — The maximum allowable deflection value under the design value of concentrated load at the center of the steel grid plate, measured in millimeters (mm).

F_6 — design value of mid-span concentrated load on flat steel members, measured in Newtons (N);

L, — Span of the steel grid plate, in millimeters (mm);

Y-the bending stiffness adjustment coefficient for flat steel load-bearing members;

E— Elastic modulus of steel, measured in newtons per square millimeter (N/mm^2);

I — The moment of inertia of the cross-section carrying flat steel, measured in cubic millimeters (mm^4).

C.6 Design value of uniform full-span load for steel grid plates

C.6.1 Design value of uniform full-span load for steel grid plates

Calculate the design value of full-span uniform distributed load for steel grating plates using Equation (C.11).

$$U=KQb \quad \cdots\cdots(C.11)$$

U=KQb ....(C.11)

In the formula:

U — Design value of full-span uniform distribution load for steel grid plates, measured in kilonewtons per square meter (kN/m^2);

K — Number of load-bearing flat steel bars per meter of steel grating width, measured in units per meter (1/m);

Q — Design value of uniform load on flat steel members, measured in kilonewtons per meter (kN/m).

C.6.2 Maximum Deflection Allowable Value under Design Load Distribution for Full Span of Steel Grid Plates

Calculate the maximum allowable deflection under full-span uniform load design values for steel grating plates using Equation (C.12).

$$D_n = 5QL'/384\gamma EI \qquad \text{(C.12)}$$

$$D_n = 5QL'/384\gamma EI \qquad \text{(C.12)}$$

In the formula:

D.— Maximum allowable deflection value under full-span uniform load design conditions for steel grid plates, measured in millimeters (mm);

Q — Design value of uniform load on flat steel, measured in Newton per millimeter (N/mm);

L, — Span of the steel grating, in millimeters (mm);

γ — the bending stiffness adjustment coefficient for flat steel bearing;