Steel Bar Grating Design Data

DESIGN NOMENCLATURE

b = thickness of rectangular bearing bar, inches

d = depth of bearing bar, inches

A_w = center to center distance between bearing bars in welded and press-locked gratings, inches

C = concentrated load at midspan = $4FS_w/L$ pounds per foot of width (pfw)

D_c = deflection under concentrated load = $CL^3/48\ EI_w$ inches

D_u = deflection under uniform load = $5UL^4/12(384)EI_w$ inches

E = modulus of elasticity, pounds per square inch (psi)

Steel:	E = 29,000,000 psi = 29 $(10)^6$
Stainless Steel:	E = 28,000,000 psi = 28 $(10)^6$
Aluminum:	E = 10,000,000 psi = $(10)^7$

F = allowable fiber unit stress, psi

ASTM A-1011:	F = 18,000 psi (Steel, Carbon Hot Rolled Sheet and Strip, Commercial Quality AISI 1020)
ASTM A-36:	F = 20,000 psi (Structural Steel (Bars only))
ASTM A167:	F = 20,000 psi (Type 304 and 316, Stainless Steel)
	F = 16,500 psi (Type 304L and 316L, Stainless Steel)
ASTM B-221:	F = 12,000 psi (6061-T6 Alloy)
	F = 10,000 psi (6063-T6 Alloy)

I_b = moment of inertia of a rectangular bar = $bd^3/12$ in^4

I_w = moment of inertia of grating per foot of width = KI in^4

K = number of bearing bars per foot of grating width = $12/A_w$

L = span of grating between reaction points, inches

M_b = maximum bending moment of bearing bar, in-lbs

M_w = maximum bending moment of grating per foot of width, in-lbs

M_u = maximum bending moment under uniform load = $FS_w = UL^2/96$ in-lbs

M_c = maximum bending moment under concentrated load = $FS_w = CL/4$ in-lbs

S_b = section modulus of a rectangular bar = $bd^2/6$ $in.^3$

S_w = section modulus per foot of grating width = KS_b $in.^3$

U = uniform load = $96fS_w/L^2$ psf = $96M/L^2$ pounds per square foot (psf)

SAMPLE CALCULATION: STEEL

Type of Grating = 19-W-4-63 welded carbon steel grating

Size of Bar = 1-1/2 x 3/16

Span = 54 inches

A_w = bearing bar spacing = 1.1875 inches

K = number of bearing bars in panel width = $12/A_w = 12/1.1875 = 10.105$

F = allowable fiber stress = 18,000 psi

E = 29,000,000 psi

S_w = section modulus of grating per foot of width = $Kbd^2/6 = 10.105 \times 0.1875\ (1.5)^2/6 = 0.711\ in.^3$

I_w = moment of inertia of grating per foot of width = $Kbd^3/12 = 10.105 \times 0.1875\ (1.5)^3/12 = 0.533\ in.^3$

M_w = maximum bending moment for grating per foot of width = FS_w = 18,000 x 0.711 = 12,800 in.-lbs.

Allowable Concentrated Load and Deflection for 19-W-4-63:

C = allowable load = $4M_w/L = 4 \times 12{,}800/54 = 948$ pfw

D_c = deflection = $CL^3/48EI_w = 948 \times 54^3/(48 \times 29 \times 10^6 \times 0.533) = 0.201$ inches

Allowable Uniform Load and Deflection for 19-W-4-63:

U = allowable load = $96M_w/L^2 = 96 \times 12{,}800/54^2 = 421$ psf

D_u = deflection = $5UL^4/4608EI_w = 5 \times 421 \times 54^4/(4608 \times 29 \times 10^6 \times 0.533) = 0.251$ inches