

COMPANY NAME

CALCULATION SHEET

Calc. No. CALC. NUMBER

Project No. PROJECT NUMBER

Project Title: Project Name
Subject: Steel beam calculation / Design for flexure / Lateral Torsional Buckling

Calc. By **Date** **Rev.**
 Author today 0

Section properties

Section	W14x30		
A =	8.85	in ²	beam cross-sectional area
I _y =	19.6	in ⁴	moment of inertia about Y axis
S _x =	42	in ³	elastic section modulus - major axis
r _y =	1.49	in	radius of gyration about minor axis
J =	0.38	in ⁴	torsional constant
C _w =	887	in ⁶	warping constant
Z _x =	47.3	in ³	

Braced length

L_b = 170 in

L_b - distance between points braced against lateral displacement of the compression flange or between points braced to prevent twist of the cross section

Steel properties

E =	29000	ksi	modulus of elasticity of steel	per Manual of Steel Construction (LRFD)
G =	11200	ksi	shear modulus of elasticity of steel	Chapter F Section 2.a
F _y =	50	ksi	minimum yield stress of the type of steel being used	
F _{yf} =	50	ksi	yield stress of flange	
F _{yw} =	50	ksi	yield stress of web	
F _r =	10	ksi	compressive residual stress in flange for rolled shapes F _r = 10 ksi, for welded shapes F _r = 16.5 ksi	
C _b =	1		bending coefficient dependent upon moment gradient G ₀ is permitted to be conservatively taken as 1.0	
φ _b =	0.9		resistance factor for flexure	

Yielding flexural design strength

M_p = F_y * Z_x = 197.08 kip-ft plastic section moment < 1.5 M_y
 1.5 * M_y = F_y * S_x = 262.5 kip-ft
 M_n = M_p = 197.08 kip-ft
 φ_b * M_n = 177.38 kip-ft Yielding flexural design bending moment

per Manual of Steel Construction (LRFD)
 Chapter F Section 1.

Lateral - torsional Buckling

L_r - limiting laterally unbraced length

L_p = 1.76 * r_y * sqrt(E/F_{yf}) = 63.16 in
 F_L = smaller of (F_{yf} - F_r) or F_{yw}
 F_L = 40 ksi
 M_r = F_L * S_x = 140 kip-ft
 X₁ = (π/S_x) * sqrt(EGJA/2) = 1748.06 ksi
 X₂ = 4 * (C_w/I_y) * (S_x/GJ)² = 0.0176 ksi⁻²
 L_r = (r_y * X₁ / F_L) * sqrt(1 + sqrt(1 + X₂ * F_L²)) = 164.79 in

per Manual of Steel Construction (LRFD)
 Chapter F
 Eq. F1-4 for I shaped members and channels

Eq. F1-7

Eq. F1-8

Eq. F1-9

Eq. F1-6

for L_b > L_r

Chapter F Section 2.b applies

M_n = M_{cr}
 M_{cr} = C_b * S_x * X₁ * sqrt(2) / (L_b / r_y) * sqrt(1 + X₁² * X₂ / (2 * (L_b / r_y)²)
 M_{cr} = 132.86 kip*ft
 φ_b * M_n = 119.57 kip*ft

References:

Manual of Steel Construction - American Institute of Steel Construction Inc., 2005