

sCheck v3.2

A Steel Analysis and Design Program
Copyright 2024, Computations & Graphics, Inc.
All rights reserved.

DISCLAIMER: COMPUTATIONS & GRAPHICS, INC. (CGI) HAS TAKEN EVERY EFFORT TO MAKE THE SOFTWARE RELIABLE AND ACCURATE. HOWEVER, IT IS THE END USER'S RESPONSIBILITY TO INDEPENDENTLY VERIFY THE ACCURACY AND RELIABILITY OF THE SOFTWARE. NO EXPRESS OR IMPLIED WARRANTY IS PROVIDED BY CGI OR ITS DEVELOPERS ON THE ACCURACY OR RELIABILITY OF THE SOFTWARE. IN NO EVENT WILL CGI OR ITS SUPPLIERS BE LIABLE TO YOU FOR ANY DAMAGES, CLAIMS OR COSTS WHATSOEVER OR ANY CONSEQUENTIAL, INDIRECT, INCIDENTAL DAMAGES, OR ANY LOST PROFITS OR LOST SAVINGS, EVEN IF CGI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH LOSS, DAMAGES, CLAIMS OR COSTS

Table of Contents

General Info	3
Section Property - W12X58	3
Design Input	3
Axial Capacity Calculation	3
Moment Magnification Calculation	4
Major Flexure Capacity Calculation	5
Minor Flexure Capacity Calculation	6
Flexural and Axial Interaction Calculation	6
Major Shear Capacity Calculation	7
Minor Shear Capacity Calculation	7

General Info

File Name	C:\CGInclsCheck3\Examples-LRFD16\Example03-AiscDesignExamples-F5.sck
Design Code	AISC 360-22 (16th edition) LRFD
Using Direct Analysis Method	Yes
Consider Multiplier B1 for P-delta Effect	Yes
Date & Time	11/27/2023 20:36

Section Property - W12X58

Property	Value	Unit	Property	Value	Unit	Property	Value	Unit
A = Ag	17	in ²	bf	10	in	tf	0.64	in
tw	0.36	in	d	12.2	in	h / tw	27	
Cw	3570	in ⁶	h0	11.6	in	rts	2.81	in
Zx	86.4	in ³	Sx	78	in ³	lx	475	in ⁴
rx	5.28	in	Zy	32.5	in ³	Sy	21.4	in ³
ly	107	in ⁴	ry	2.51	in	J	2.1	in ⁴

Design Input

Input	Value	Unit	Input	Value	Unit	Input	Value	Unit
Pu = Pr	0	kips	Mux = Mxr	0	kip-ft	Muy = Myr	113	kip-ft
Cmx	1		Cmy	1		Vux	0	kips
Vuy	30	kips	Fy	50	ksi	Cb	1	
Lb	15	ft	Kx	1		Ky	1	
Kz	1		Lx	15	ft	Ly	15	ft
Lz	15	ft						

* Lcx = Kx * Lx; Lcy = Ky * Ly; Lcz = Kz * Lz

Axial Capacity Calculation

Step	Equation	Value	Note
Checking flange slenderness			
	$b = bf / 2$	5 in	
	b / tf	7.8125	
	$\lambda_r = 0.56 \sqrt{\frac{E}{F_y}}$	13.487	
The section has non-slender flange element			
Checking web slenderness			
	$b / t = h / tw$	27	
	$\lambda_r = 1.49 \sqrt{\frac{E}{F_y}}$	35.884	
The section has non-slender web			
Compressive strength to account for flexural buckling			

	$\frac{K_x L_x}{r_x}$	34.091	
	$\frac{K_y L_y}{r_y}$	71.713	
	$\frac{KL}{r} = \max\left(\frac{K_x L_x}{r_x}, \frac{K_y L_y}{r_y}\right)$	71.713	
	$F_e = \frac{\pi^2 E}{\left(\frac{KL}{r}\right)^2}$	55.654 ksi	Eq.E3-4
	$4.71 \sqrt{\frac{E}{F_y}}$	113.43	
	$\frac{KL}{r} \leq 4.71 \sqrt{\frac{E}{F_y}}$		
	$F_n = \left(0.658 \frac{F_y}{F_e}\right) F_y$	34.329 ksi	Eq.E3-2
	$P_n = F_n A_g$	583.6 kips	Eq.E3-1
Compressive strength to account for torsional and flexural-torsional buckling			
	$F_e = \left(\frac{\pi^2 E C_w}{L_{cz}^2} + GJ\right) \frac{1}{I_x + I_y}$	94.6 ksi	Eq.E4-2
	$\frac{F_y}{F_e}$	0.52854	
	$\frac{F_y}{F_e} \leq 2.25$		
	$F_n = \left(0.658 \frac{F_y}{F_e}\right) F_y$	40.077 ksi	Eq.E3-2
	$P_n = F_n A_g$	681.31 kips	Eq.E4-1
	Flexural buckling controls: Pn	583.6 kips	
	$\phi_c P_n$	525.24 kips	

Moment Magnification Calculation

Step	Equation	Value	Note
Stiffness reduction parameter			
	$\alpha = 1.00(\text{LRFD})$	1	
	$P_r / P_{ns} = P_r / (F_y * A_e)$	0	
	$\alpha P_r / P_{ns} \leq 0.5$		
	$\tau_b = 1.0$	1	Eq.C2-2a
Moment magnifier B1 for P-delta effects in local x direction			

	$EI^* = 0.8\tau_b EI$	1.102e+07 ksi	
	$P_{e1} = \frac{\pi^2 EI^*}{(K_1 L)^2}$	3356.9 kips	Eq.A-8-5
	$B_1 = \frac{C_m}{1 - \alpha P_r / P_{e1}} \geq 1$	1	Eq.A-8-3
	Magnified Mux = Mux * B1	0 kip-ft	
Moment magnifier B1 for P-delta effects in local y direction			
	$EI^* = 0.8\tau_b EI$	2.4824e+06 ksi	
	$P_{e1} = \frac{\pi^2 EI^*}{(K_1 L)^2}$	756.18 kips	Eq.A-8-5
	$B_1 = \frac{C_m}{1 - \alpha P_r / P_{e1}} \geq 1$	1	Eq.A-8-3
	Magnified Muy = Muy * B1	113 kip-ft	
Mrx = Mux; Mry = Muy			

Major Flexure Capacity Calculation

Step	Equation	Value	Note
Web compactness:			
	$\lambda = \frac{h_c}{t_w}$	27	
	$\lambda_{pw} = 3.76 \sqrt{\frac{E}{F_y}}$	90.553	
	$\lambda_{rw} = 5.70 \sqrt{\frac{E}{F_y}}$	137.27	
Web is compact			
Flange compactness:			
	$\lambda = \frac{b_f}{2t_f}$	7.8125	
	$\lambda_{pf} = 0.38 \sqrt{\frac{E}{F_y}}$	9.1516	
	$\lambda_{rf} = 1.0 \sqrt{\frac{E}{F_y}}$	24.083	
Flange is compact			
Mnx to account for yielding			

	$M_n = M_p = F_y Z_x$	360 kip-ft	Eq.F2-1
Mnx to account for flange local buckling			
	$\lambda < \lambda_{pf}$		
	$M_n = M_p$	360 kip-ft	
Mnx to account for lateral-torsional buckling			
	$L_p = 1.76 r_y \sqrt{\frac{E}{F_y}}$	8.8658 ft	Eq.F2-5
	For I section, c	1	
	$L_r = 1.95 r_{ts} \frac{E}{0.7 F_y} \sqrt{\frac{Jc}{S_x h_o} + \sqrt{\left(\frac{Jc}{S_x h_o}\right)^2 + 6.76 \left(\frac{0.7 F_y}{E}\right)^2}}$	29.849 ft	Eq.F2-6
	$M_n = M_p = F_y Z_x$	360 kip-ft	Eq.F2-1
Since $L_p < L_b < L_r$			
	$M_n = C_b \left[M_p - (M_p - 0.7 F_y S_x) \left(\frac{L_b - L_p}{L_r - L_p} \right) \right] \leq M_p$	321.26 kip-ft	Eq.F2-2
	Controlling nominal flexural strength Mnx	321.26 kip-ft	
	$M_{cx} = \phi_b M_{nx}$	289.14 kip-ft	

Minor Flexure Capacity Calculation

Step	Equation	Value	Note
Mny to account for yielding			
	$F_y * Z_y$	135.42 kip-ft	
	$F_y * S_y$	89.167 kip-ft	
	$M_n = M_p = F_y Z_y \leq 1.6 F_y S_y$	135.42 kip-ft	Eq.F6-1
Mny to account for lateral-torsional buckling			
	$\lambda < \lambda_{pf}$		
	$M_n = M_p$	135.42 kip-ft	
	Controlling nominal flexural strength Mny	135.42 kip-ft	
	$M_{cy} = \phi_b M_{ny}$	121.88 kip-ft	

Flexural and Axial Interaction Calculation

Step	Equation	Value	Note
------	----------	-------	------

	$\frac{P_r}{P_c} = \frac{P_u}{\phi_c P_n}$	0	
	$\frac{P_r}{P_c} < 0.2$		
	$\frac{P_r}{2P_c} + \left(\frac{M_{rx}}{M_{cx}} + \frac{M_{ry}}{M_{cy}} \right) \leq 1.0$	0.92718	Eq.H1-1b
Axial-flexural strength: OK			

Major Shear Capacity Calculation

Step	Equation	Value	Note
	$A_w = dt_w$	4.392 in ²	
Computing Cv for major axis using G2.1			
	$k_v = 5.34$		
	h/t_w	27	
	$2.24\sqrt{E/F_y}$	53.946	
	$h/t_w \leq 2.24\sqrt{E/F_y}$		
	$C_{v1} = 1.0$		Eq.G2-2
Major shear strength			
	$V_n = 0.6F_y A_w C_{v1}$	131.76 kips	Eq.G2-1
	$h/t_w \leq 2.24\sqrt{E/F_y}$		
	$\phi_v = 1.00$		
	$\phi_v V_n$	131.76 kips	
	$\frac{V_u}{\phi_v V_n}$	0	
Shear strength (major axis): OK			

Minor Shear Capacity Calculation

Step	Equation	Value	Note
	$A_w = 2b_f t_f$	12.8 in ²	
Computing Cv2 for weak axis using G2.2			
	$k_v = 1.2$		
	$h/t_w = b/t_f$	7.8125	

	$1.10\sqrt{k_v E/F_y}$	29.02	
	$1.37\sqrt{k_v E/F_y}$	36.143	
	$h/t_w \leq 1.10\sqrt{k_v E/F_y}$		
	$C_{v2} = 1.0$	1	Eq.G2-9
Minor shear strength			
	$V_n = 0.6F_y b_f t_f C_{v2}$	384 kips	Eq.G6-1
	$\phi_v = 0.90$		
	$\phi_v V_n$	345.6 kips	
	$\frac{V_u}{\phi_v V_n}$	0.086806	
Shear strength (minor axis): OK			