Steel Check Report

Project::	**Lesson2 (C:\DCC\VersaFrame 6\Projects\Lesson2_Done)**	Company:	
Description:		User:	
Date:	**04/05/2013 03:22 PM**	Software:	**Digital Canal VersaFrame**

Design Procedure for Member 1: W10X49

Designed according to AISC ASD 13th Edition (2005)

Critical load effect at distance 12 feet under load combination Dead_Only

INPUT

PROPERTIES:

A (in^2)	14.4	b_f (in)	10	K_x	0.97	S_x(in^3)	54.6
I_x (in^4)	272	t_f (in)	0.56	K_y	3.02	S_y (in^3)	18.7
I_y (in^4)	93.4	d (in)	10	K_z	1	Z_x(in^3)	60.4
r_x (in)	4.35	t_w (in)	0.34	L_x (in)	144	Z_y(in^3)	28.3
r_y (in)	2.54	k (in)	1.06	L_y (in)	144		
J (in^4)	1.39	x_0 (in)	0	L_b (in)	144		
C_w (in^6)	2070	y_0 (in)	0	C_b	1		
α	0	x_{bar} (in)	5	C_{mx}	1	Welded	No
β	0	y_{bar} (in)	5	C_{my}	1	F_y (ksi)	50

LOAD EFFECTS:

P (kips)	M_x (ft-kips)	M_y (ft-kips)	V_x (kips)	V_y (kips)
8.828	1.184e-017	-0	-0	6.908e-019

SOLUTION

1. CHECK AXIAL STRENGTH

(a). Flexural & Local Buckling

Description	Formula	Value	Code
KL / r	$\max(K_xL_x / r_x, K_yL_y / r_y)$	171.2	
Q_s	for b / t <= 0.56 $(E / F_y)^{0.5}$ $Q_s = 1.0$	1	E7-4
Q_a	(for b / t < 1.49 $(E / f)^{0.5}$) $Q_a = 1.0$	1	E7.2.(a)
Q	$Q_s Q_a$	1	E7
F_e	$F_e = E \pi^2 / (KL / r)^2$	9.764	E3-4
F_{cr} (ksi)	(for F_e < 0.44 Q F_y) $F_{cr} = 0.877 F_e$	8.563	E7-3

(b). Flexural-Torsional Buckling

Description	Formula	Value	Code
F_e (ksi)	$F_e = (\pi^2 E C_w / (K_z L_z)^2 + GJ) / (I_x + I_y)$	120.8	E4-4
F_{cr} (ksi)	(for F_e >= 0.44 Q F_y) $F_{cr} = Q\ 0.658^{\ Q\ Fy/Fe}\ F_y$	42.05	E7-2

Note:

1). Q_a is computed with f= 8.563 ksi which is the smaller of Fcr for local buckling and flexural torsional buckling using a value of Q = 1.0

Axial Capacity: $P_n = F_{cr} A$ = 123.3 kips: $P_c = P_n/\Omega$ = 73.84 kips

2. CHECK FLEXURAL STRENGTH

(a). Strong Axis Yielding

Description	Formula	Value	Code
M_{nx} (ft-kips)	$M_{px} = F_y Z_x$	251.7	F2-1

(b). Lateral-Torsional-Buckling (LTB)

Description	Formula	Value	Code
L_p (in)	$L_p = 1.76 r_y (E / F_y)^{0.5}$	107.7	F2-5
L_r (in)	$L_r = 1.95 r_{ts} (E / (0.7 F_y) (J c / (S_x h_o))^{0.5} (1 + (1 + 6.76 (0.7 F_y S_x h_o / (E J c))^2)^{0.5})^{0.5}$	379.1	F2-6
M_n (ft-kips)	$M_n = C_b (M_p - (M_p - 0.7F_yS_x) (L_b - L_p) / (L_r - L_p))$	239.3	F2-2

(c). Flange Local Buckling

Description	Formula	Value	Code
λ_f	$b_f/2t_f$	8.929	Table B4.1
λ_{pf}	$0.38\ (E / F_y)^{0.5}$	9.152	Table B4.1
λ_{rf}	$1.0\ (E / F_y)^{0.5}$	24.08	Table B4.1
M_n	$M_{px} = F_y Z_x$	251.7	F2.2.(a)

Note:

1). $0.35 < k_c = 4 / (h/t_w)^{0.5} < 0.76 \Rightarrow k_c = 0.76$ (F3.2)

(d). Web Local Buckling

Description	Formula	Value	Code
λ	$(d - 2k)/t_w$	23.18	Table B4.1
λ_p	$3.76\ (E / F_y)^{0.5}$	90.55	Table B4.1
λ_r	$5.7\ (E / F_y)^{0.5}$	137.3	Table B4.1
M_n	Web is compact	251.7	NA

(e). Weak Axis Yielding

Description	Formula	Value	Code
M_{ny} (ft-kips)	$M_{py} = F_y Z_y <= 1.6 F_y S_y$	117.9	F6-1

(f). Weak Axis Flange Local Buckling

Description	Formula	Value	Code
λ_f	$b_f/2t_f$	8.929	Table B4.1
λ_{pf}	$0.38\ (E / F_y)^{0.5}$	9.152	Table B4.1
λ_{rf}	$1.0\ (E / F_y)^{0.5}$	24.08	Table B4.1
M_n	Flange is compact	117.9	NA

Flexural Capacity - Strong Axis: M_{nx} = 239.3 ft-kips: $M_{cx} = M_{nx}/\Omega$ = 143.3 ft-kips

Flexural Capacity - Weak Axis: M_{ny} = 117.9 ft-kips: $M_{cy} = M_{ny}/\Omega$ = 70.61 ft-kips

3. CHECK AXIAL AND FLEXURAL INTERACTION

Description	Formula	Value	Code
P_{e1x} (kips)	$P_{e1x} = EI_x\pi^2 / (MIN(1, K_x)L_x)^2$	3990	C2-5
B_{1x}	$B_{1x} = C_{mx} / (1 - \alpha P_r / P_{e1x}) >= 1.0$	1.004	C2-2
M_{rx} (ft-kips)	$B_{1x}M_{rx}$	1.188e-017	C2-1a
P_{e1y} (kips)	$P_{e1y} = EI_y\pi^2 / (MIN(1, K_y)L_y)^2$	1289	C2-5
B_{1y}	$B_{1y} = C_{my} / (1 - \alpha P_r / P_{e1y}) >= 1.0$	1.011	C2-2
M_{ry} (ft-kips)	$B_{1y}M_{ry}$	-0	C2-1a

Axial and Flexural Interaction: for $P_r/P_c < 0.20$: $P_r/(2P_c) + (M_{rx}/M_{cx} + M_{ry} /M_{cy}) = 0.05978$ (H1-1b) Note:

1). Moment magnification factor B_1 is conservatively applied to overall moment
2). Moment magnification factor B_2 is assumed to have been taken care of by P-Delta Analysis
3). $\alpha = 1.6$

AXIAL-FLEXURAL INTERACTION STATUS: OK

4. CHECK SHEAR STRENGTH

Description	Formula	Value	Code
k_v	for $h/t_w < 260$, $k_v = 5$	5.0	G2.1.(b)
C_v	$C_v = 1$	1.00	G2-2
A_w	$A_w = d\ t_w$	3.40	G2.1
V_{ny}	$V_{ny} = 0.6 F_y A_w C_v$	102.00	G2-1

For webs of rolled members with $h/t_w <= 2.24(E/F_y)^{0.5}$, Ω_v = 1.5 (G2-2)

Description	Formula	Value	Code
k_v	tee stems or flanges in shear	1.20	G2.1.(b) and G7
C_v	$C_v = 1$	1.00	G2-3
A_w	$A_w = 2\ b_f\ t_f$	11.20	G7
V_{nx}	$V_{nx} = 0.6 F_y A_w C_v$	336.00	G2-1 and G7

$V_{cy} = V_{ny}/\Omega$ = 68

V_{ry} = 6.908e-019

V_{ry} / V_{cy} = 1.016e-020

SHEAR-Y STATUS: OK

$V_{cx} = V_{ny}/\Omega = 201.2$

$V_{rx} = -0$

$V_{rx} / V_{cx} = 0$

SHEAR-X STATUS: OK

5. CHECK TOTAL LOAD DEFLECTIONS (Load Combination: Δ_x - Not Applicable, Δ_y - With_Wind)

Description	Formula	Value	Code
Allowable Δ_x	L/240	0.60	Not Applicable
Allowable Δ_y	L/240	0.60	Not Applicable

Note:

$\Delta_{x(Act.)} / \Delta_{x(All.)} = 0.00 / 0.60 = 0.00$

TOTAL LOAD DEFLECTION-X STATUS: OK

$\Delta_{y(Act.)} / \Delta_{y(All.)} = 0.00 / 0.60 = 0.00$

TOTAL LOAD DEFLECTION-Y STATUS: OK

6. CHECK LIVE LOAD DEFLECTIONS (Load Combination: Δ_x - Not Applicable, Δ_y - Just_Wind)

Description	Formula	Value	Code
Allowable Δ_x	L/360	0.40	Not Applicable
Allowable Δ_y	L/360	0.40	Not Applicable

Note:

$\Delta_{x(Act.)} / \Delta_{x(All.)} = 0.00 / 0.40 = 0.00$

LIVE LOAD DEFLECTION-X STATUS: OK

$\Delta_{y(Act.)} / \Delta_{y(All.)} = 0.00 / 0.40 = 0.00$

LIVE LOAD DEFLECTION-Y STATUS: OK