Steel Check Report

Project:: **L3_Done (C:\DCC\Frame15e\Projects\L3_Done)**
Description: **(New imported project)**
Date: **10/31/2002 02:55 PM**

Company:
User:
Software: **Digital Canal Frame Analysis & Design**

Code Check Results (LRFD)

CRITICAL STRESS SUMMARY

ID	Section Name	Status	Governing Criteria	Stress Ratio	Load Combination	Distance (ft)
1	W10x33	OK	Axial-Bending	0.6330	Comb1	12.000
2	W18x50	OK	Axial-Bending	0.4075	Comb1	11.000
3	W10x33	OK	Axial-Bending	0.6243	Comb2	0.0000
4	SC1	OK	Axial-Bending	0.5787	Comb2	11.664
5	SC1	OK	Axial-Bending	0.4076	Comb1	11.662
6	SC1	OK	Axial-Bending	0.4061	Comb1	13.994
7	SC1	OK	Axial-Bending	0.8596	Comb2	11.666
8	W10x33	OK	Axial-Bending	0.7260	Comb1	0.0000
9	W18x50	OK	Axial-Bending	0.4530	Comb1	11.000
10	W10x33	OK	Axial-Bending	0.5641	Comb1	12.000
11	W18x50	OK	Total Deflection X	0.0883	Total_Deflect	10.261
12	W18x50	OK	Total Deflection X	0.2897	Total_Deflect	12.588
13	W18x50	OK	Axial-Bending	0.4709	Comb1	5.0000
14	W18x50	OK	Axial-Bending	0.4750	Comb1	0.0000

SELECTED LOAD COMBINATIONS

Load Combination	Code Check	Total	Live	Dependent	Conditional
Comb1	x			-	-
Comb2	x			-	-
Total_Deflect	x	x		-	-
Wind_Deflect	x		x	-	-

Design Procedure for Member 1: W10x33

Designed according to AISC LRFD 2nd Edition (1994)

Critical load effect at distance 12 feet under load combination Comb1

INPUT

PROPERTIES:

A (in^2)	9.71	b_f (in)	7.96	K_x	0.79	$S_x(in^3)$	35
I_x (in^4)	170	t_f (in)	0.435	K_y	1.69	S_y (in^3)	9.2
I_y (in^4)	36.6	d (in)	9.73	K_z	1	$Z_x(in^3)$	38.8
r_x (in)	4.19	t_w (in)	0.29	L_x (in)	144	$Z_y(in^3)$	14
r_y (in)	1.94	k (in)	1.063	L_y (in)	144		
J (in^4)	0.58	x_0 (in)	0	L_b (in)	144		
C_w (in^6)	790	y_0 (in)	0	C_b	1		
a	0	x_{bar} (in)	3.98	C_{mx}	1	Welded	No
b	0	y_{bar} (in)	4.865	C_{my}	1	F_y (ksi)	50

LOAD EFFECTS:

P_u (kips)	M_{ux} (ft-kips)	M_{uy} (ft-kips)	V_{ux} (kips)	V_{uy} (kips)
36.7	-41.88	2.936	0.2441	-3.49

SOLUTION

1. CHECK SECTION COMPACTNESS

Description	Formula	Value	Code
$\lambda_{(flange)}$	$b_f / (2t_f)$	9.149	LRFD Table B5.1
$\lambda_{p(flange)}$	$65 / F_y^{0.5}$	9.192	LRFD Table B5.1
$\lambda_{r(flange)}$	$141 / (F_y - F_r)^{0.5}$	22.29	LRFD Table B5.1
$\lambda_{(web)}$	h / t_w	26.22	LRFD Table B5.1
$\lambda_{p(web)}$	(for $P_u / (\phi_b P_y) <= 0.125$) $640 (1 - 2.75 P_u / (\phi_b P_y)) / F_y^{0.5}$	69.61	LRFD Table B5.1
$\lambda_{r(web)}$	$970 (1 - 0.74 P_u / (\phi_b P_y)) / F_y^{0.5}$	128.7	LRFD Table B5.1

Note:
1). F_r = 10 ksi
2). h = d - 2k = 7.605 in
3). $k_c = k_c = 4 / (h / t_w)^{0.5}$ and $0.35 <= k_c <= 0.736$ (LRFD Table B5.1) = 0.736 in
4). $P_y = A F_y$ = 485.5 kips

2. CHECK AXIAL STRENGTH

(a). Local Buckling

Description	Formula	Value	Code
KL / r	$\max(K_x L_x / r_x, K_y L_y / r_y)$	125.4	
λ_c	$\lambda_c = KL / (r\pi) (F_y / E)^{0.5}$	1.658	LRFD E2-4
Q_s	(for $b / t <= 109 / (F_y / k_c)^{0.5}$) $Q_s = 1.0$	1	
Q_a	(for $b / t < 238 / f^{0.5}$) $Q_a = 1.0$	1	
Q	$Q_s Q_a$	1	LRFD A-B5-17
F_{cr} (ksi)	(for $\lambda_c Q^{0.5} > 1.5$) $F_{cr} = (0.877 / \lambda_c^2) F_y$	15.95	LRFD A-B5-16

(b). Flexural-Torsional Buckling

Description	Formula	Value	Code
F_e	$F_e = (\pi^2 E C_w / (K_z L_z)^2 + GJ) / (I_x + I_y)$	84.22	LRFD A-E3-5
λ_e	$\lambda_e = (F_y / F_e)^{0.5}$	0.7705	LRFD A-E3-4
Q	$Q_s Q_a$	1	LRFD A-B5-17
F_{cr} (ksi)	(for $\lambda_e Q^{0.5} <= 1.5$) $F_{cr} = Q (0.658)^{(Q \lambda_e^2)} F_y$	39	LRFD A-E3-2

Axial Capacity: $P_n = F_{cr} A$ = 154.9 kips

3. CHECK FLEXURAL STRENGTH

(a). Yielding - strong and weak axis

Description	Formula	Value	Code
M_{nx} (ft-kips)	$M_{px} = F_y Z_x <= 1.5 F_y S_x$	161.7	LRFD F1-1
M_{ny} (ft-kips)	$M_{py} = F_y Z_y <= 1.5 F_y S_y$	57.5	LRFD F1-1

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

Description	Formula	Value	Code

L_p (in)	$L_p = 300\ r_y / F_y^{0.5}$	82.31	LRFD F1-4
L_r (in)	$L_r = r_y X_1 / F_L (1 + (1 + X_2 F_L^2)^{0.5})^{0.5}$	236.9	LRFD F1-6
M_r (ft-kips)	$M_r = F_L S_x$	116.7	LRFD F1-7
M_{nx}(ft-kips)	(for $L_b > L_p$ and $L_b <= L_r$) $M_n = C_b (M_p - (M_p - M_r) (L_b - L_p) / (L_r - L_p))$	143.7	LRFD F1-2

Note:

1). $X_1 = \pi / S_x (EGJA / 2)^{0.5} = 2714.55$ ksi (LRFD F1-8)
$X_2 = 4 C_w (S_x / GJ)^2 / I_y = 0.0025064$ in^4/kips^2 (LRFD F1-9)
$F_L = F_y - F_r = 40$ ksi

(c). Flange-Local-Buckling (FLB) - About Strong Axis

Description	Formula	Value	Code
M_r (ft-kips)	$M_r = F_L S_x$	116.7	LRFD Table A-F1.1
M_{nx} (ft-kips)	(for $\lambda < \lambda_p$) $M_n = M_p$	161.7	LRFD Table A-F1.1

Note:

1). $\lambda = \lambda_{(flange)}$, $\lambda_p = \lambda_{p(flange)}$, $\lambda_r = \lambda_{r(flange)}$
2). $M_p = M_{px}$

(d). Web-Local-Buckling (WLB) - About Strong Axis

Description	Formula	Value	Code
M_r (ft-kips)	$M_r = F_y S_x$	145.8	LRFD Table A-F1.1
M_{nx} (ft-kips)	(for $\lambda < \lambda_p$) $M_n = M_p$	161.7	LRFD Table A-F1.1

Note:

1). $\lambda = \lambda_{(web)}$, $\lambda_p = \lambda_{p(web)}$, $\lambda_r = \lambda_{r(web)}$
2). $M_p = M_{px}$

(e). Flange-Local-Buckling (FLB) - About Weak Axis

Description	Formula	Value	Code
M_r (ft-kips)	$M_r = F_y S_y$	38.33	LRFD Table A-F1.1
M_{ny} (ft-kips)	(for $\lambda < \lambda_p$) $M_n = M_p$	57.5	LRFD Table A-F1.1

Note:

1). $\lambda = \lambda_{(flange)}$, $\lambda_p = \lambda_{p(flange)}$, $\lambda_r = \lambda_{r(flange)}$
2). $M_p = M_{py}$

Flexural Capacity - Strong Axis: $M_{nx} = 143.7$ ft-kips

Flexural Capacity - Weak Axis: $M_{ny} = 57.5$ ft-kips

4. CHECK AXIAL AND FLEXURAL INTERACTION

Description	Formula	Value	Code
P_{e1x} (kips)	$P_{e1x} = EI_x\pi^2 / (K_xL_x)^2$	3760	LRFD C1
B_{1x}	$B_{1x} = C_{mx} / (1 - P_u / P_{e1x}) >= 1.0$	1.01	LRFD C1-2
M_{ux} (ft-kips)	$B_{1x}M_{ux}$	42.3	LRFD C1-1
P_{e1y} (kips)	$P_{e1y} = EI\pi^2 / (K_yL_y)^2$	176.9	LRFD C1
B_{1y}	$B_{1y} = C_{my} / (1 - P_u / P_{e1y}) >= 1.0$	1.262	LRFD C1-2
M_{uy} (ft-kips)	$B_{1y}M_{uy}$	3.704	LRFD C1-1

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

Axial and Flexural Interaction: $\phi = 0.85$; $\phi_b = 0.90$

for $P_u / (\phi P_n) >= 0.20$

$P_u / (\phi P_n) + 8 / 9 (M_{ux} / (\phi_b M_{nx}) + M_{uy} / (\phi_b M_{ny})) = 0.633$ (LRFD H1-1a)

AXIAL-FLEXURAL INTERACTION STATUS: OK

5. CHECK SHEAR STRENGTH

Description	Formula	Value	Code
V_{ny} (kips)	(for $h / t_w <= 418 / F_y^{0.5}$) $V_n = 0.6 F_y A_w$	84.65	LRFD F2-1
V_{nx} (kips)	$(0.6 F_y) * 2 b_f t_f$	207.8	Not Available

Note:

1). V_{nx} is based on yielding only

$\phi_v = 0.90$

$V_{uy} / (\phi_v V_{ny}) = 0.04581$

SHEAR-Y STATUS: OK

$V_{ux} / (\phi_v V_{nx}) = 0.001306$

SHEAR-X STATUS: OK

6. CHECK TOTAL LOAD DEFLECTIONS (Load Combination: D_x - Total_Deflect, D_y - Total_Deflect)

Description	Formula	Value	Code

Allowable D_x	L/240	0.60	Not Applicable
Allowable D_y	L/240	0.60	Not Applicable

Note:

$D_{x(Act.)} / D_{x(All.)} = 0.03 / 0.60 = 0.05$

TOTAL LOAD DEFLECTION-X STATUS: OK

$D_{y(Act.)} / D_{y(All.)} = 0.08 / 0.60 = 0.13$

TOTAL LOAD DEFLECTION-Y STATUS: OK

7. CHECK LIVE LOAD DEFLECTIONS (Load Combination: D_x - Wind_Deflect, D_y - Wind_Deflect)

Description	Formula	Value	Code
Allowable D_x	L/360	0.40	Not Applicable
Allowable D_y	L/360	0.40	Not Applicable

Note:

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

LIVE LOAD DEFLECTION-X STATUS: OK

$D_{y(Act.)} / D_{y(All.)} = 0.02 / 0.40 = 0.05$

LIVE LOAD DEFLECTION-Y STATUS: OK