

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
l _{flange}	b _f / (2t _f)	9.149	LRFD Table B5.1
l _{p(flange)}	65 / F _y ^{0.5}	9.192	LRFD Table B5.1
l _{r(flange)}	141 / (F _y - F _r) ^{0.5}	22.29	LRFD Table B5.1
l _{web}	h / t _w	26.22	LRFD Table B5.1
l _{p(web)}	(for P _u / (F _b P _y) ≤ 0.125) 640 (1 - 2.75 P _u / (F _b P _y)) / F _y ^{0.5}	69.61	LRFD Table B5.1
l _{r(web)}	970 (1 - 0.74 P _u / (F _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	
l _c	l _c = KL / (r _p) (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 / t ^{0.5}) Q _a = 1.0	1	
Q	Q _s Q _a	1	LRFD A-B5-17
F _{cr} (ksi)	(for l _c Q ^{0.5} > 1.5) F _{cr} = (0.877 / l _c ²) F _y	15.95	LRFD A-B5-16

(b). Flexural-Torsional Buckling

Description	Formula	Value	Code
F _e	F _e = (π ² EC _w / (K _z L _z) ² + GJ) / (I _x + I _y)	84.22	LRFD A-E3-5
l _e	l _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 l _e Q ^{0.5} ≤ 1.5) F _{cr} = Q (0.658) ^(Q^{0.5} - 1) 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 _{px} (ft-kips)	M _{px} = F _y Z _x ≤ 1.5 F _y S _x	161.7	LRFD F1-1
M _{py} (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
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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 $L_b \leq L_r$) $M_n = C_b (M_p - (M_p - M_r) (L_b - L_p) / (L_r - L_p))$	143.7	LRFD F1-2

Note:

- $X_1 = p / S_x (EGJA / 2)^{0.5} = 2714.55$ ksi (LRFD F1-8)
 $X_2 = 4 C_w (S_x / GJ)^2 / I_y = 0.0025064$ in⁴/kips² (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 $l < l_p$) $M_n = M_p$	161.7	LRFD Table A-F1.1

Note:

- $l = l_{(flange)}$, $l_p = l_{p(flange)}$, $l_r = l_{r(flange)}$
- $M_p = M_{px}$

(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 $l < l_p$) $M_n = M_p$	161.7	LRFD Table A-F1.1

Note:

- $l = l_{(web)}$, $l_p = l_{p(web)}$, $l_r = l_{r(web)}$
- $M_p = M_{px}$

(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 $l < l_p$) $M_n = M_p$	57.5	LRFD Table A-F1.1

Note:

- $l = l_{(flange)}$, $l_p = l_{p(flange)}$, $l_r = l_{r(flange)}$
- $M_p = M_{py}$

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)	$P_{e1x} = EI_x p^2 / (K_x L_x)^2$	3760	LRFD C1
B_{1x}	$B_{1x} = C_{mx} / (1 - P_u / P_{e1x}) \geq 1.0$	1.01	LRFD C1-2
M_{ux} (ft-kips)	$B_{1x} M_{ux}$	42.3	LRFD C1-1
P_{e1y} (kips)	$P_{e1y} = EI_y p^2 / (K_y L_y)^2$	176.9	LRFD C1
B_{1y}	$B_{1y} = C_{my} / (1 - P_u / P_{e1y}) \geq 1.0$	1.262	LRFD C1-2
M_{uy} (ft-kips)	$B_{1y} M_{uy}$	3.704	LRFD C1-1

Note:

- Moment magnification factor B_1 is conservatively applied to overall moment
- Moment magnification factor B_2 is assumed to have been taken care of by P-Delta Analysis

Axial and Flexural Interaction: $F = 0.85$; $F_b = 0.90$

for $P_u / (F P_n) \geq 0.20$

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

AXIAL-FLEXURAL INTERACTION STATUS: OK

5. CHECK SHEAR STRENGTH

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

Note:

- V_{nx} is based on yielding only

$F_v = 0.90$

$V_{uy} / (F_v V_{ny}) = 0.04581$

SHEAR-Y STATUS: OK

$V_{ux} / (F_v V_{nx}) = 0.001306$

SHEAR-X STATUS: OK

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

Description	Formula	Value	Code
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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