STRUCTURAL CALCULATIONS

FOR

TUSTIN FIELD GAS AND FOOD

17'-0" x 76'-8" Car Wash + Equipment Rm. Bldg.

LOCATED AT

3017 East Edinger Avenue
Tustin, California 92780

Latitude:33.707249, Longitude: -117.806996

REVISION 1
DATE: 11/22/2010
REVISED CALC PACKAGE PER ARCHITECTURAL CHANGE IN BUILDING DIMENSION

DATE: 7/15/2010
(ORIGINAL CALCULATION PACKAGE)

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11/23/10

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Calculation Sheets Submitted: | See calcs beginning w/ sheet

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Design Criteria

Structure: **17'-0" x 76'-8" Car Wash + Equipment Rm. Bldg.**

Location: 3017 East Edinger Avenue Tustin, California 92780

Codes: 2007 CBC, 2006 IBC
AISC Steel Construction Manual: ASD (9th Edition) & LRFD (2nd Edition)
AISI Cold-Formed Steel Design Manual

Roof Deck Load:

DL = 10 psf (# 20 ga. Roof Panel+# 20 ga. Flat Sheet Roof Overlay+Insulation+ACM Panels+ISO Board)

LL = 20 psf ($20R_1R_2$ psf (for A_t < 200 ft^2, R_1 = 1, R_2 = 1, m = *or* < 4" rise)

LL < 20 or > 12 ($20R_1R_2$ psf (for 200 ft^2< A_t < 600 ft^2, R_1 = 1.2-0.001A_t, R_2 = 1, m = *or* < 4" rise)

LL = 12 ($20R_1R_2$ psf (for A_t > 600 ft^2, R_1 = 0.6, R_2 = 1, m = *or* < 4" rise)

Wall Load:

DL = 8 psf (Metal Wall Panel+Insulation+ACM Panels Laminated with ISO Board)

Wind Design Pressures: (ASCE 7, Section 6)

Mean Height, h = 17.5 ft Equivalent Height, z = 17.5 ft Exposure C

Basic Wind Speed = 85 mph (3-second gust) z_{min} = 15 ft.

Building Occupancy Category II α = 9

Importance Factor (I) = 1.0 z_g = 900 ft.

Combined Height & Velocity Pressure

Exposure Coefficient , $K_z = 2.01(z/z_g)^{2/\alpha}$ = 0.84 ,K_{zt} = 1.0 , K_d = 0.85 and I = 1.0

Velocity Pressure $(q_z) = (q_p) = (q_h) = 0.00256K_zK_{zt}K_dV^2I$ = 13.2 psf (Evaluated @ Mean Height)

Wall Pressure Coefficients:

Windward Wall (for All Values of L/B), ($C_{pf\ wall}$) = 0.80

Leeward Wall (for Values of L/B = 0.0 -1.0, ($C_{pf\ wall}$) = -0.50

Parapet Wall Pressure Coefficients:

Comb. Net Pressure Coefficient for Fascia/Parapet, GC_{pn} = 1.5 (Windward)

Comb. Net Pressure Coefficient for Fascia/Parapet, GC_{pn} = -1.0 (Leeward)

Roof Pressure Coefficients:

Windward on Monoslope Roofs (for All Values of H/L) ($C_{p\ roof}$) = -0.30 and 0.20

Leeward on Monoslope Roofs (for All Values of H/L and θ) ($C_{p\ roof}$) = -0.60 and 0.00

Gust Effect Factors, G_h and G_z = 0.85

Internal Pressure Coefficient, GC_{pi} = 0.55 or -0.55

Wind Design Pressures: (ASCE 7, Section 6) (cont'd)

Primary System:

Maximum Lateral Wind Pressure on wall (MWFRS) :

(Windward) $P_{LAT} = q_z G_h C_{pf\,wall} - (q_h)(-Gcpi) =$ **16.19 psf**

$P_{LAT} = q_z G_h C_{pf\,wall} - (q_h)(Gcpi) =$ **1.71 psf** Suction

(Leeward) $P_{LAT} = q_h G_h C_{pf\,wall} - (q_h)(-Gcpi) =$ **1.65 psf**

$P_{LAT} = q_h G_h C_{pf\,wall} - (q_h)(Gcpi) =$ **-12.8 psf** Suction

Therefore, Controlling Design Wind Load = 16.19 psf - **1.65** ps = **14.55 psf**

Maximum Lateral Wind Pressure on Parapet Wall (MWFRS) :

(Windward) $P_{LAT} = q_p GC_{pn} =$ **19.7 psf**

(Leeward) $P_{LAT} = q_p GC_{pn} =$ **-13.2 psf**

Therefore, Controlling Design Wind Load = 19.7 psf - **-13.2** ps = **32.9 psf**

Maximum Wind Uplift on Roof (MWFRS):

(Windward) $P_{UPL} = q_h G_h C_{pf\,roof} - (q_h)(Gcpi) =$ **-10.6 psf** Upward

$P_P = q_h G_h C_{pf\,roof} - (q_h)(Gcpi) =$ **9.5 psf**

(Leeward) $P_{UPL} = q_h G_h C_{pf\,roof} - (q_h)(Gcpi) =$ **-14.0 psf** Upward

$P_P = q_h G_h C_{pf\,roof} - (q_h)(Gcpi) =$ **7.2 psf**

Design Criteria, cont.

Seismic on the Structure: (ASCE 7-05)

Design Category	D		Table 11.6-1
Occupancy Category	II		Table 11.5-1
Site Class =	D		Table 11.4-2
Importance Factor (I_E) =	1.00		Table 11.5-1
S_S =	1.455		Sect. 11.4.1
S_1 =	0.512		Sect. 11.4.1
F_a = 1.00 Table 1613.5.3(1), $S_{MS} = F_aS_s$ =	1.455		Sect. 11.4.3
F_v = 1.53 Table 1613.5.3(2), $S_{MI} = F_vS_1$ =	0.78		Sect. 11.4.3
$S_{DS} = 2/3S_{MS}$ =	0.970		Equation 11.4-3
$S_{D1} = 2/3S_{M1}$ =	0.522		Equation 11.4-4
Ordinary Steel Moment Resisting Frame R =	3.50		Table 12.2-1
Ω_o=	3.00	C_d = 3.00	Table 12.2-1

Period of structure (T) used for design: (ASCE 7)

Method A : $T = C_t(h_n)^{3/4}$ =	0.171 sec	Section 12.8.2.1 (Eq. 12.8-7)
Where: C_t =	0.020	Table 12.8-2
h_n =	17.5 ft	
Therefore design period of structure (T) =	0.171 sec	

Design Base Shear: (ASCE 7)

$V = [(2/3)S_{MS}/(R/I_E)](W)$ =	0.277 W	Section 12.8.1. (Eq. 12.8-2)
$V_{MAX} = [(2/3)S_{M1}/(R/I_E)T](W)$ =	0.872 W	Section 12.8.1. (Eq. 12.8-3)
Vmin = (0.01)(W) =	0.010 W	Section 12.8.1. (Eq. 12.8-5)
$V_{0.6g} = (0.5S_1)/R/I_E(W)$ =	0.000 W	Section 12.8.1. (Eq. 12.8-6)

Governing design base shear (V) = **0.277 W**

Area of Building, A_b = 2500 ft^2

Element story shear ratio, r_{max} = 0.25

Reliabilty/Redundancy Factor, $\rho = 2-\{20/[r_{max}(A_b^{1/2}]\}$ = 1.00

Reliabilty/Redundancy Factor, ρ = N.A.

Therefore, Earthquake Load, $E = \rho\, Q_E / 1.4$ = **0.198 W**

Where: $Q_E = V$

Design Lateral Force Transfer of Components & Elements to the Structure :

$F_p = \{[(0.4)(a_p)(S_{DS})(I_p) / R_p] (1+ 2z/h)/1.4\}\ W_p$ = **0.333 W_p** ***(GOVERN)***

$F_{p\ MAX} = (1.6)(S_{DS})(I_p)(W_p)/1.4$ = **1.109 W_p**

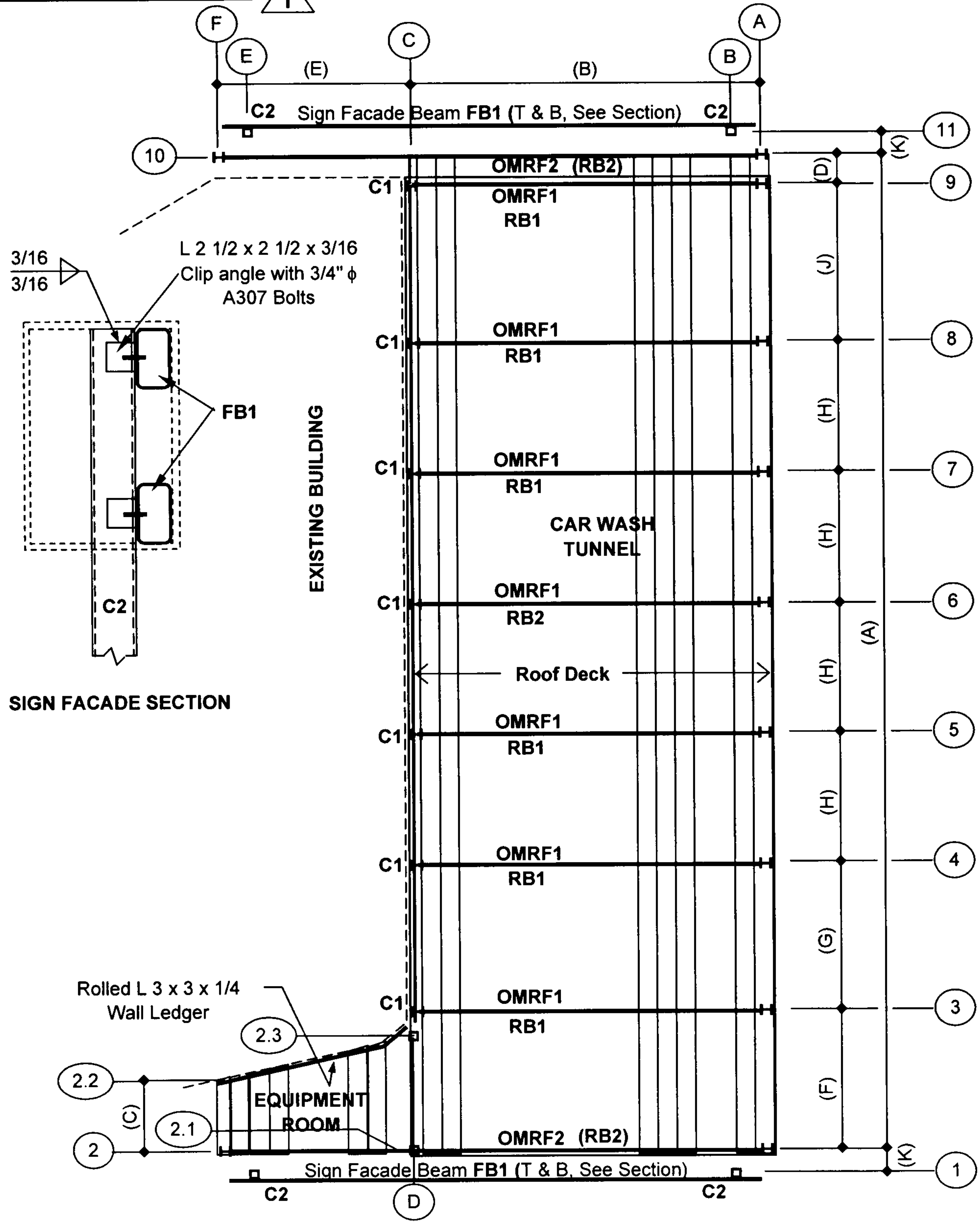
$F_{p\ MIN} = (0.3)(S_{DS})(I_p)(W_p)/1.4$ = **0.208 W_p**

Where:

a_p =	1.0
$S_{DS} = 2/3S_{MS}$ =	0.970
I_p =	1.0
R_p =	2.5
z =	17.50 ft
h =	17.50 ft

MADISON LOS ANGELES, PHOENIX, TULSA, ATLANTA	JOB NO.	W17283-10
	SHT 6 OF 72	
	DATE	11/22/2010
FOR TUSTIN FIELD GAS AND FOOD	DES. BY	ML
DESCRIPTION 17'-0" x 76'-8" Car Wash + Equipment Rm. Bldg.	CHKD. BY	

ROOF FRAMING PLAN 1



Summary of Car Wash Dimensions & Member Sizes

(See Sketch on prior page)

Car Wash Dimensions 1

(A) = 72.08 ft
(B) = 16.06 ft
(C) = 5.18 ft
(D) = 2.05 ft
(E) = 8.77 ft
(F) = 10.22 ft
(G) = 10.99 ft
(H) = 9.33 ft
(J) = 11.49 ft
(K) = 1.29 ft

Member Sizes

FB1 = TS6x4x3/16
RB1 = W 8x21
RB2 = W 8x10

C1 = W 8x21
C2 = TS6x6x1/4

Roof Deck = 20 Gauge Sheet Metal, 3 in. Ribs

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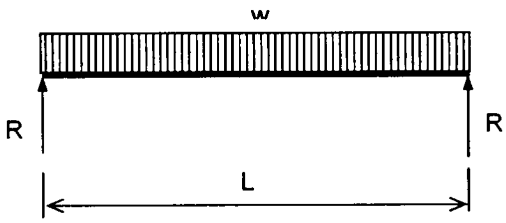
Roof Deck 1



DL = 10 psf
LL = 20 psf
Wind uplift load (enter negative number) = -14.0 psf
Deck Wt = 2.91 plf
Tributary Loading Strip = 1.33 ft
w_{DL} = 13.3 plf
w_{LL} = 26.6 plf
w_{DL+LL} = 39.9 plf
$w_{WIND\ UPLIFT}$ = -18.6 plf
$w_{SELF\ WEIGHT\ OF\ DECK}$ = 2.9 plf
L = 11.49 ft
R_{DL} = 76 lbs
R_{DL+LL} = 229 lbs
$R_{SELF\ WEIGHT+WIND}$ = -89.9 lbs

Positive Bending

Max. allowable moment for positive bending (DL+LL):

Per AISI Cold-Formed Spec. Sect. C3.1.1:

Procedure I - Based on Initiation of Yielding

(Procedure II strain check produces same result)

Nominal Moment (M_{np}) = $S_{ep}F_y$ = 15.623 in-k

Allowable Moment (M_{ap}) = M_{np}/Ω_f = 9.4 in-k

Where Ω_f = 1.67 (Factor of Safety)

Actual positive bending moment:

$m_{ap} = (w_{DL+LL})(L^2)/8 =$ 7.9 in-k

Since $m_{ap} < M_{ap}$, 20 Sheet Metal Deck is OK for Positive Bending

Negative Bending

Max Allowable Moment for negative bending (Wind Uplift):

Per AISI Cold-Formed Spec. Sect. C3.1.1:

Procedure I - Based on Initiation of Yielding

(Procedure II strain check produces same result)

Nominal Moment (M_{nn}) = $S_{en}F_y$ = 12.024 in-k

Allowable Moment (M_{an}) = $(1.33)(M_{nn}/\Omega_f)$ = 9.6 in-k

Where Ω_f = 1.67 (Factor of Safety)

Actual negative bending moment

$m_{an} = (w_{WIND\ UPLIFT} - w_{SELF\ WEIGHT})(L^2)/8 =$ 3.1 in-k

Since $m_{an} < M_{an}$, 20 Sheet Metal Deck is OK for Negative Bending

Selected Roof Deck Section: (See following pages for calculated properties)

Gauge of Deck Used = **20**

S_{ep} = 0.391 in^3

S_{en} = 0.301 in^3

Material = ASTM A653 Gr. 40

F_y = 40 ksi

E = 29000 ksi

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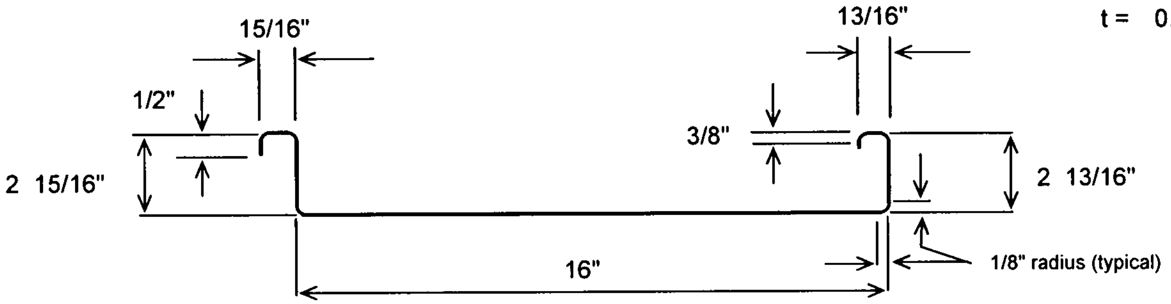
20 Gauge Deck, 3 in. Ribs -- Positive Bending

(Top Flange of Deck in Compression)

ASTM A653 Gr. 40
Fy = 40,000 psi
Fb = 24,000 psi
t = 0.036 in



	Previous Area	b	d	Theta	a	h	AREA	Y	AY	AY^2	Io
1	-	16.00	0.036	0	0.000	0.036	0.576	0.018	0.01	0.0	0.00
2	1	0.072	2.402	0	0.036	2.438	0.173	1.237	0.21	0.3	0.08
3	2	0.144	0.339	0	2.438	2.777	0.049	2.607	0.13	0.3	0.00
4	3	0.8125	0.036	0	2.777	2.813	0.029	2.795	0.08	0.2	0.00
5	4	0.072	0.089	0	2.813	2.902	0.006	2.857	0.02	0.1	0.00
6	5	0.9375	0.036	0	2.902	2.938	0.034	2.920	0.10	0.3	0.00
7	6	0	0	0	2.938	2.938	0.000	2.938	0.00	0.0	0.00
8	7	0	0	0	2.938	2.938	0.000	2.938	0.00	0.0	0.00
9	8	0	0	0	2.938	2.938	0.000	2.938	0.00	0.0	0.00
10	9	0	0	0	2.938	2.938	0.000	2.938	0.00	0.0	0.00
					TOTAL AREA =		0.867 in^2		0.55		1.2

TOTAL DEPTH = 2.938 in
CENTROID (Y) = SUM(AY)/SUM(AREA) = 0.634 in
C1 = Y = 0.634 in
C2 = DEPTH - Ybar = 2.303 in

I(total)= [SUM(AY^2)+SUM(Io)]-(AREA)(Y)^2 = 0.90 in^4
Sx1 = I/C1 = 1.418 in^3
Sx2 = I/C2 = 0.391 in^3 ← comp. flg.
Radius of gyration (r) = (I/A)^1/2= 1.019 in

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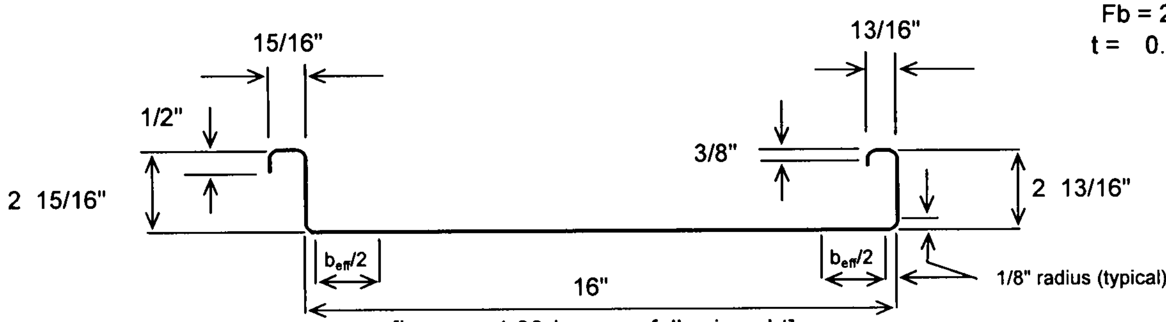
	DESCRIPTION 17'-0" x 76'-8" Car Wash + Equipment Rm. Bldg.	CHKD. BY

20 Gauge Deck, 3 in. Ribs -- Negative Bending

(Bottom Flange of Deck in Compression)

ASTM A653 Gr. 40
Fy = 40,000 psi
Fb = 24,000 psi
t = 0.036 in



[b_{eff} = 1.80 in -- see following sht]

	Previous Area	b	d	Theta	a	h	AREA	Y	AY	AY^2	Io
1	-	2.05	0.036	0	0.000	0.036	0.074	0.018	0.00	0.0	0.00
2	1	0.072	2.402	0	0.036	2.438	0.173	1.237	0.21	0.3	0.08
3	2	0.144	0.339	0	2.438	2.777	0.049	2.607	0.13	0.3	0.00
4	3	0.8125	0.036	0	2.777	2.813	0.029	2.795	0.08	0.2	0.00
5	4	0.072	0.089	0	2.813	2.902	0.006	2.857	0.02	0.1	0.00
6	5	0.9375	0.036	0	2.902	2.938	0.034	2.920	0.10	0.3	0.00
7	6	0	0	0	2.938	2.938	0.000	2.938	0.00	0.0	0.00
8	7	0	0	0	2.938	2.938	0.000	2.938	0.00	0.0	0.00
9	8	0	0	0	2.938	2.938	0.000	2.938	0.00	0.0	0.00
10	9	0	0	0	2.938	2.938	0.000	2.938	0.00	0.0	0.00
					TOTAL AREA =		0.365 in^2		0.54		1.2

TOTAL DEPTH = 2.938 in
CENTROID (Y) = SUM(AY)/SUM(AREA) = 1.483 in
C1 = Y = 1.483 in
C2 = DEPTH - Ybar = 1.454 in

I(total)= [SUM(AY^2)+SUM(Io)]-(AREA)(Y)^2 = 0.45 in^4
Sx1 = I/C1 = 0.301 in^3 ← comp. flg.
Sx2 = I/C2 = 0.307 in^3
Radius of gyration (r) = (I/A)^1/2= 1.106 in

Effective Uniformly Compressed Flange Width Of Gauge Metal Section with an Edge Stiffener

According to Cold-Formed Steel Design Manual, 2001 Edition

Stiffened Flange Width (w) = 15.75 in
Flange Thickness (t) = 0.0360 in
Web/Stiffener Depth (D) = 2.625 in

D/w = 0.17
w/t = 438

$S = 1.28*(E/f)^{1/2} =$ 34

Where: E = 29000000 psi
f = 40000 psi = F_y for A653 Gr. 40 material

Since w/t > S and D/w <0.25, use k-factor calculated per Case IIIb:

$Ia = t^4\{[115(w/t)/S]+5\} =$ 0.002460322 in^4

$Is = tD^3/12 =$ 0.054263672 in^4

k = min of
a) 3.57(Is/Ia)^n+0.43 = 10.44
b) 4.00
Where n = 0.333

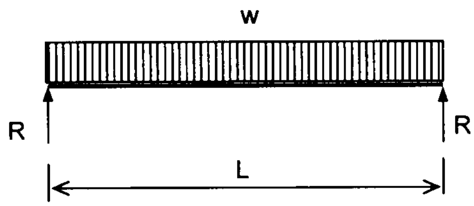
Therefore k = 4.00

$\lambda = (f/F_{cr})^{1/2} =$ 8.546
$F_{cr} = k[\pi^2 E/12(1-\mu^2)](t/w)^2 =$ 548
Where: $\mu =$ 0.3

$\rho = (1-0.22/\lambda)/\lambda =$ 0.1140

Since λ > 0.673, effective width (b) = ρw 1.80 in

Sign Facade Beam FB1 (DL+LL+ lateral wind)



DL =	5	psf
LL =	20.00	psf
Wind uplift load =	-14.0	psf
Lateral wind load =	16.2	psf
Beam Wt/Extra Load =	11.97	plf
Tributary Plan Loading Strip =	5.00	ft
Tributary Lateral Loading Strip =	1.50	ft
w_{DL} =	36.97	plf
w_{LL} =	40.00	plf
w_{DL+LL} =	136.97	plf
$w_{WIND\ UPLIFT}$ =	-69.8	plf
$w_{LATERAL\ WIND}$ =	24.3	plf
L =	20.00	ft
Max Unbraced Length Top Flange (L') =	20.00	ft
Max Unbraced Length Bottom Flange (L") =	20.00	ft
R_{DL} =	370	lbs
R_{DL+LL} =	1370	lbs
$R_{DL+WIND}$ =	-328	lbs

Stress Criteria:

Allowable Stresses:

F_{bx} -- positive bending* = min of :

1) 12000/[(L')(d/Af)] =	50.0	ksi
2) 0.6Fy =	27.6	ksi

F_{bx} -- negative bending = min of :

1) 12000/[(L")(d/Af)] =	50.0	ksi
2) 0.6Fy =	27.6	ksi

Allowable Weak Axis Bending Stress (F_{by}) = 27.6 ksi

* (positive bending = top flange in compression)

Actual Bending Moments:			Unity Checks
Case 1: Full DL + LL:	$Mx = (w_{DL+LL})(L^2)/8$ =	82.2 in-k	0.51
Case 2: DL + Wind Up:	$Mx = [(w_{DL}+w_{WIND\ UPLIFT})(L^2)/8]/1.33$ =	14.8 in-k	0.09
Case 3: DL + Lateral Wind:	$Mx = [(w_{DL})(L^2)/8]/1.33$ =	16.7 in-k	0.19
	$My = [(w_{LATERAL\ WIND})(L^2)/8]/1.33$ =	11.0 in-k	
For roof members check:	Is this a roof member? (y/n) y		
Case 4: DL + Pt. Load @ center:	$Mx = (w_{DL})(L^2)/8 + PL/4$ =	70.2 in-k	0.44

Where P' = (200 lbs) if tributary area < 200 ft^2 or (2000 lbs)

CASE 1 GOVERNS

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le Beam FB1 ,cont.

Deflection Criteria:

Max Allowable LL Deflection (Δ_{LL}) = L/360 = 0.67 in

Min Req'd I_x to not exceed $\Delta_{LL} = [5(w_{LL})(L^4)]/[384E\Delta_{LL}]$ = 7.4 in^4

Max Allowable DL+LL Deflection (Δ_{DL+LL}) = L/240 = 1.00 in

Min Req'd I_x to not exceed $\Delta_{DL+LL} = [5(w_{DL+LL})(L^4)]/[384E\Delta_{DL+LL}]$ = 17.0 in^4

Max Allowable DL Deflection (Δ_{DL}) = 0.33 in

Min Req'd I_x to not exceed $\Delta_{DL} = [5(w_{DL})(L^4)]/[384E\Delta_{DL}]$ = 13.8 in^4

Min Ix Req'd = 17.0 in^4

Selected Beam:

Type Beam Desired = t

Suggested Shape = TS6x4x3/16

Material = A500Gr.B

F_y = 46 ksi

Beam Used = **TS6x4x3/16**

Critical Unity Check = 0.51

I_x = 17.4 in^4

S_x = 5.81 in^3

S_y = 4.66 in^3

d/A_f = 1.00

δ_{LL} = 0.285 in

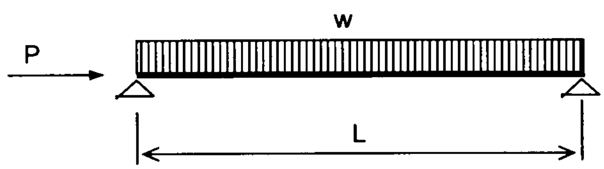
δ_{DL+LL} = 0.977 in

δ_{DL} = 0.692

Flange Stays:

Max spacing to use full F_b = 36.2 ft

Strut Beam ST1 △1



Pinned ends; axial load & bending
K = 1.0

Material
A36
F_y = 36 ksi
E = 29000 ksi

Geometry
$L_{unbraced}$ = 11.49 ft

Loads
P = 2.052 k
w_{DL} = 5 plf

Wind/seismic load included? (y/n) y

Try **L3x3x1/4**

A = 1.44 in^2
S_x = 0.58 in
r = 0.59 in

Actual axial stress (fa): $f_a = P/A =$ **1.43 ksi**

Allowable axial stress (Fa):
KL/r = 232.9
$C_c = [(2)(\pi)^2(E)/F_y]^{1/2} =$ 126.1
$F_a =$ **2.75 ksi**

Actual bending stress (fb): $f_b = M/S_x = w_{DL}L^2/8S_x =$ **1.7 ksi**

Allowable bending stress (Fb): Fb = 0.6Fy = **21.6** ksi

Unity Checks:
$F'_{ex} =$ 2.75
$C_{mx} =$ 1.0

Eq H1-1: $f_a/F_a + C_{mx}f_b/[(1-fa/F'_e)(F_b)] =$ 0.68 $\leq$ 1.33

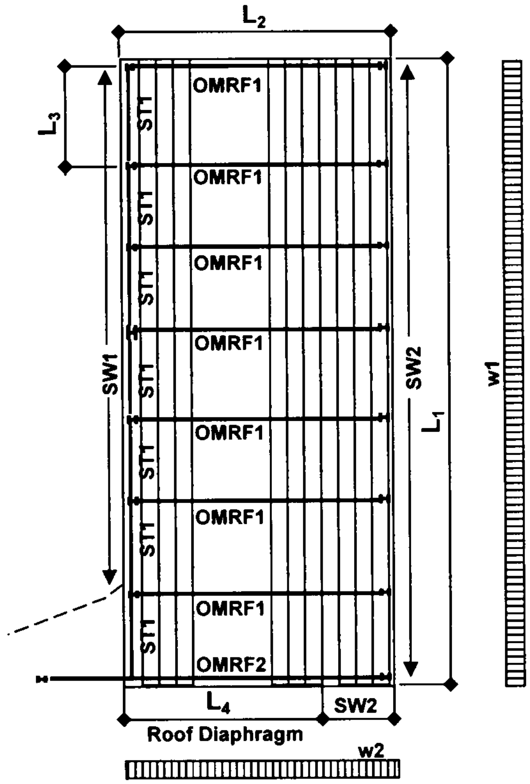
Eq H1-2: $f_a/[(0.6)(F_y)] + f_b/F_b =$ 0.15 $\leq$ 1.33

STRUT IS OK

	MADISON LOS ANGELES, PHOENIX, TULSA, ATLANTA	JOB NO W17283-10
		SHT 15 OF 72
		DATE 11/22/2010
	FOR TUSTIN FIELD GAS AND FOOD	DES. BY ML
	DESCRIPTION 17'-0" x 76'-8" Car Wash + Equipment Rm. Bldg.	CHKD. BY

Design Lateral Loads 1

Equivalent Rectangular Building Dimensions



CAR WASH TUNNEL

N-S Length (L_1) = 72.08 ft

E-W Length (L_2) = 17.00 ft

Max. Distance Between OMRF (L_3) = 11.49 ft

Effective Diaphragm Width (L_4) = 11.50 ft

Mean Wall Height to Roof (H_{CW}) = 17.25 ft

Tributary Seismic Building Weight (Upper 1/2 of Bldg)

Roof +Ceiling DL = 10 psf

Wall DL = 8 psf

Column & Beam DL Car Wash Tunnel = 6127 lbs

Therefore W_{CW} = 30675 lbs

LATERAL WIND:

Wall Pressure (Pw) = 14.55 psf

$w1 = (Pw)(H_{CW}/2)$ = 125.5 plf

$w2 = (Pw)(H_{CW}/2)$ = 125.5 plf

LATERAL SEISMIC:

Load (V_{CW}) = 0.198 W_{CW} = 6072 lbs {Working}

$w1 = V_{CW}/L_1$ = 84.2 plf

$w2 = V_{CW}/L_2$ = 357.2 plf

Design Lateral Loads

E-W Seismic: w1 = 84.2 plf

Diaphragm Moment (M_d) = $(w1)(L_3)^2/8$ = 1390 ft-lbs

$Vx = (w1)(L_3)/2$ = 483.9 lbs

E-W Wind: w1 = 125.5 plf

Diaphragm Moment (M_d) = $(w1)(L_3)^2/8$ = 2070 ft-lbs

$Vx = (w1)(L_3)/2$ = 721 lbs

N-S Seismic: w2 = 357.2 plf

Diaphragm Moment (M_d') = $(w2)(L_4)^2/8$ = 5894 ft-lbs

$Vy_{(CW)} = (w2)(L_4)/2$ = 2052 lbs

N-S Wind: w2 = 125.5 plf

Diaphragm Moment (M_d') = $(w2)(L_4)^2/8$ = 2070 ft-lbs

$Vy_{(CW)} = (w2)(L_4)/2$ = 721 lbs

Max. allowable shear per foot of panel = $v_a = [(V_a)(12\text{ in/ft})]/(16\text{"/panel})$ = **179.5** plf

Where: **Va**, (See following sheet for calculated value) = **239.3** lbs

Max. actual Diaphragm shear per foot = $v = [(Vx)/(L_2)]$ = **28** plf **<** **179.5** plf **OK**

Design Lateral Loads (Cont)

Roof Diaphragm and Horizontal Shear Wall SW2 Connections

Shear Transfer between Individual Deck Ribs

Use #12 DARTS Sheet Metal Screws to transfer shear:
(see attached product data sheet SMS-1)

Allowable shear value, v_{st} = 232 lbs/screw

Max shear flow between deck ribs due to w1, (q) = (V)(Q/I) = 32 plf

Q/I = $(L_4)^2/2(12)/2(L_4)^3$ = 0.065 per ft.

V = Vx = 484 lbs

Max. spacing of #12 DARTS sheet metal screws

1) Due to w1 shear flow: $(V_{st})/(q)$ = 7.34 ft
2) Due to w2 edge shear: $(V_{st})(L_2)/Vx$ = 8.15 ft

Use #12 DARTS Screws @ 32.0 in O.C.

Shear Transfer between Deck and Longitudinal Chords:

Use #12 DARTS Sheet Metal Screws to transfer shear:

Allowable shear value, v_{st} = 232 lbs/screw

Vy = 2052 lbs
Ty = 82 lbs

Max. spacing of #12 DARTS sheet metal screws = min of:

1) Due to w1 shear flow: $(V_{st})/(q)$ = 7.34 ft
2) Diaphragm tension/compression due to w1: $(0.5)(L_2)(V_{st})/Ty$ = 24.1 ft
3) Edge shear due to w2: $(V_{st})(L_1)/Vy$ = 8.1 ft

Use (2) #12 DARTS Screws per Deck Panel

Shear Transfer between Deck and Transverse Chords:

Use #12 DARTS Sheet Metal Screws to transfer shear:

Allowable shear value, v_{st} = 232 lbs/screw

Vx = 721 lbs
Tx = 82 lbs

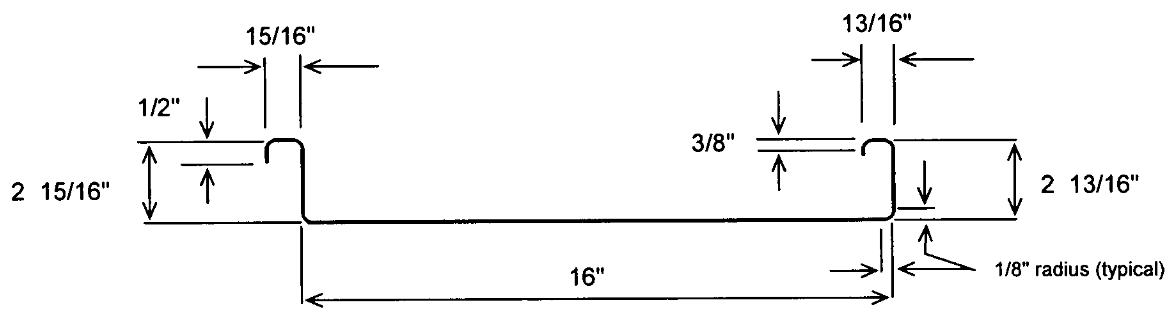
Max. spacing of #12 DARTS sheet metal screws = min of:

1) Diaphragm tension/compression due to w2: $(0.5)(L_2)(V_{st})/Ty$ = 102 ft
2) Edge shear due to w1: $(V_{st})(L_3)/Vx$= 3.70 ft

Use #12 DARTS @ 32.0 in O.C.

Design Lateral Loads (Cont)

Horizontal Diaphragm/Shear Wall SW2 Design



Typ # 20 Gauge Galvanized Wall Panel Section

Material = ASTM A446 Gr. D
F_y = 40000 psi
F_b = 24000 psi
t = 0.036 in

Design Code: 2001 Edition AISI Specification for the Design of Cold-Formed Steel Structural Members

Allowable Shear:

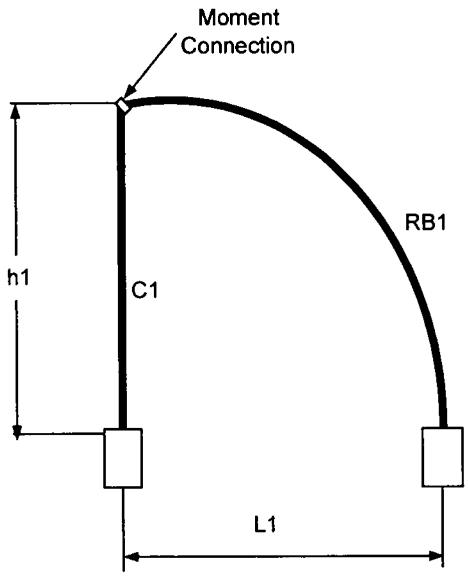
h/t = 444.4

$A = 1.38[(E)(k_v)/F_y]^{1/2} =$ 85.87
Where: $k_v =$ 5.34

Since h/t > A, allowable shear on panel $(V_a) = 0.53Ek_vt^3/h =$ 239 lbs

OMRF1 - Moment Resisting Frame (Lateral Load Resisting system Transverse Direction)

1



TRIBUTARY LOADING STRIP:
Vertical Load = 10.60 ft
Horizontal load = 10.60 ft

GRAVITY LOADS:
Roof Dead Load = 10 psf
w_{DL} = 126 plf
Roof Live Load = 20 psf
w_{LL} = 222 plf

LATERAL WIND LOAD:
(Windward) P_{LAT} = 16.19 psf
(Leeward) P_{LAT} = 1.65 psf

w_{WIND} on RB1 = 180.0 plf
w_{WIND} on C1 = 18.00 plf

Load Combination for maximum Stress
DL+w_{WIND} (Allowable Stress Level)

LATERAL SEISMIC LOAD:
Seismic Load, Eh = 0.198 w_{DL}
Seismic Load, Eh = 22.0 plf
Where: ρ = 1.0
S_{DS} = 0.97
Ω_o = 3
C_d = 3

GEOMETRY:
h1 = 17.25 ft
L1 = 16.5 ft

Member Sizes:
C1 = W 8x21
RB1 = W 8x21

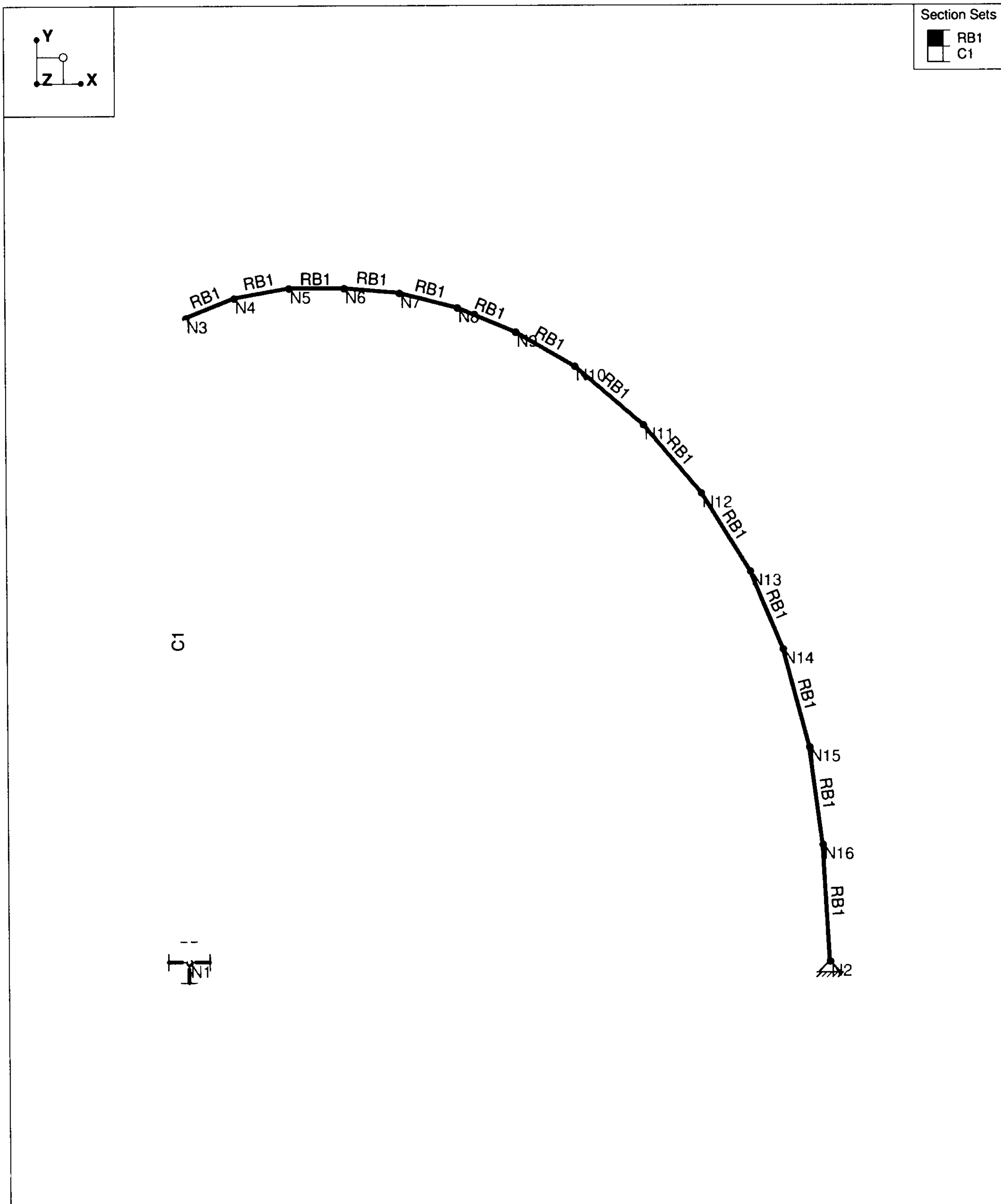
Load Combination for maximum Stress
$(1.0+0.14S_{DS})DL+Eh$ (Allowable Stress Level)

Load Combination for Maximum Force @ Connection.
$0.9D+\Omega_o\rho Eh$ (Allowable Stress Level)

Load Combination for maximum Story Drift Δ_s
$0.9D+1.4\rho Eh(C_d)$ (Strength Level)

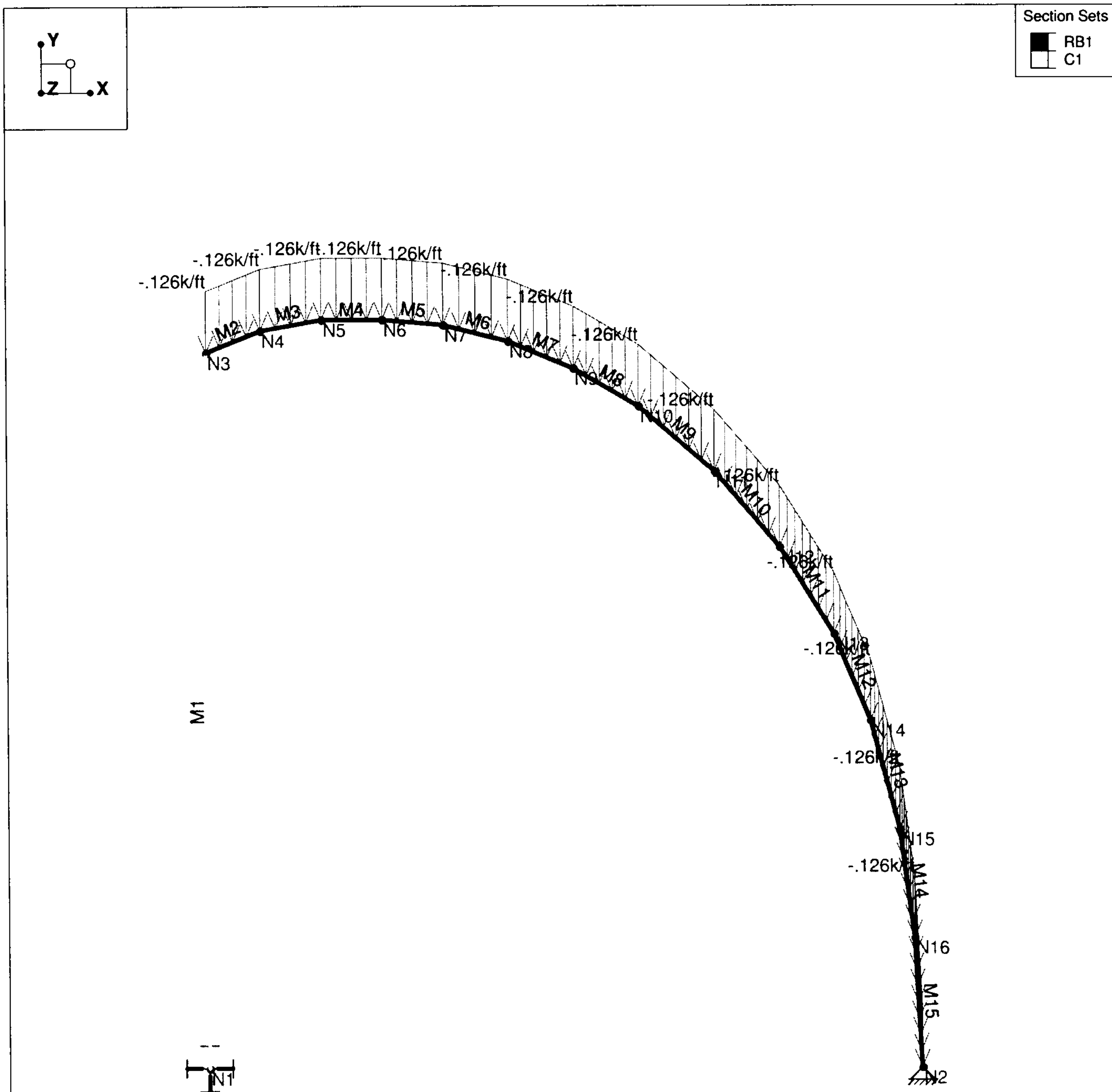
Max. elastic displacement, δ_e = 0.565 inches (from RISA result sht. 38)
Max. calculated Story Drift, $\Delta s = (C_d)(\delta_e)$ = 1.70 inches < 5.18 inches ok
Max. Allowable Story Drift, Δs = (h1)(0.025) = 5.18 inches

(See Pages Following for result of RISA Analysis)



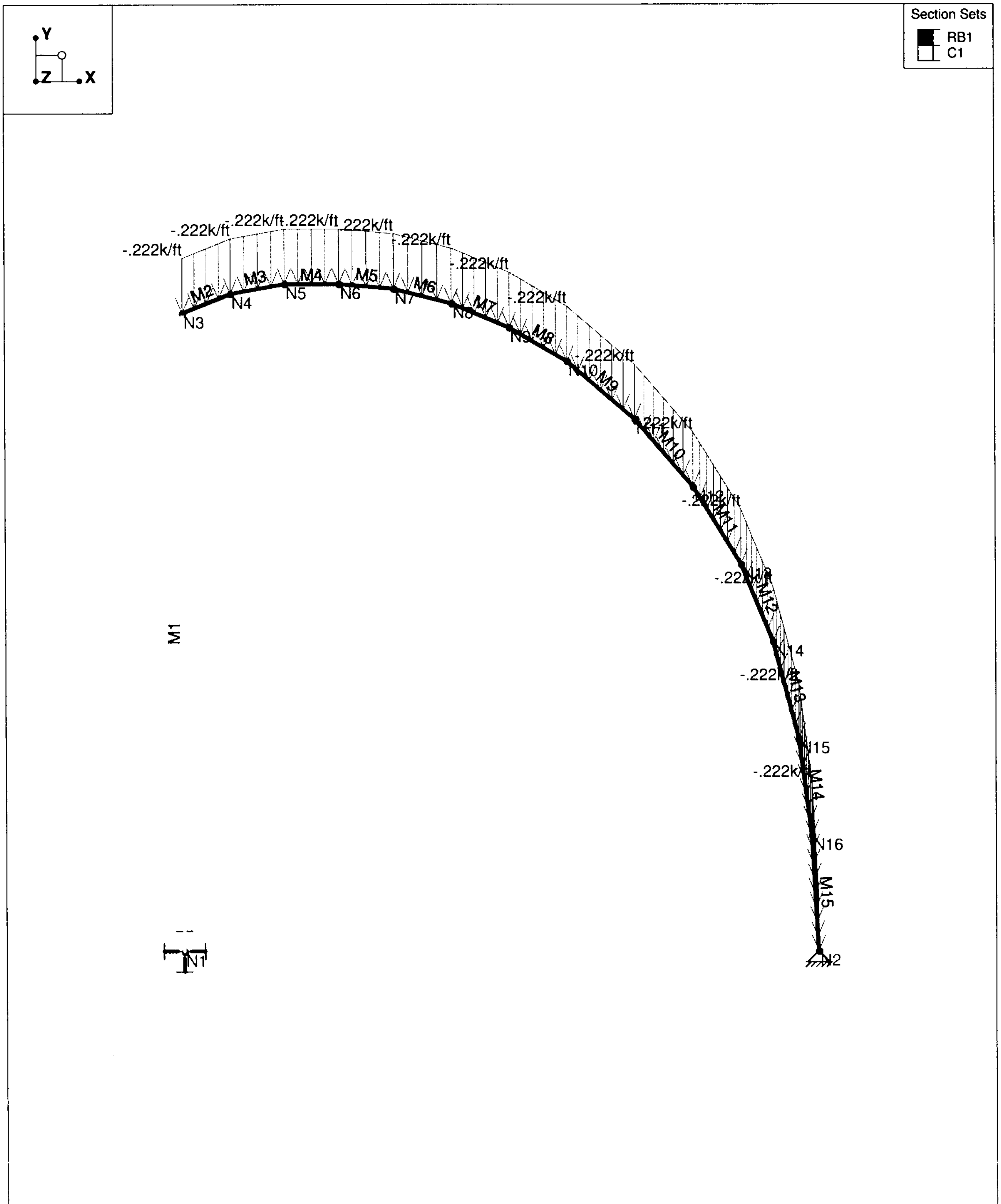
Results for LC 5, DL+Lateral WL

Madison Industries	OMRF1 Moment Frame At Lines 3, 4, 5, 6, 7, 8 & 9	
ML		July 14, 2010 at 7:42 PM
W17283-10 Sht. 19		TUSTIN CW OMRF1.r3d



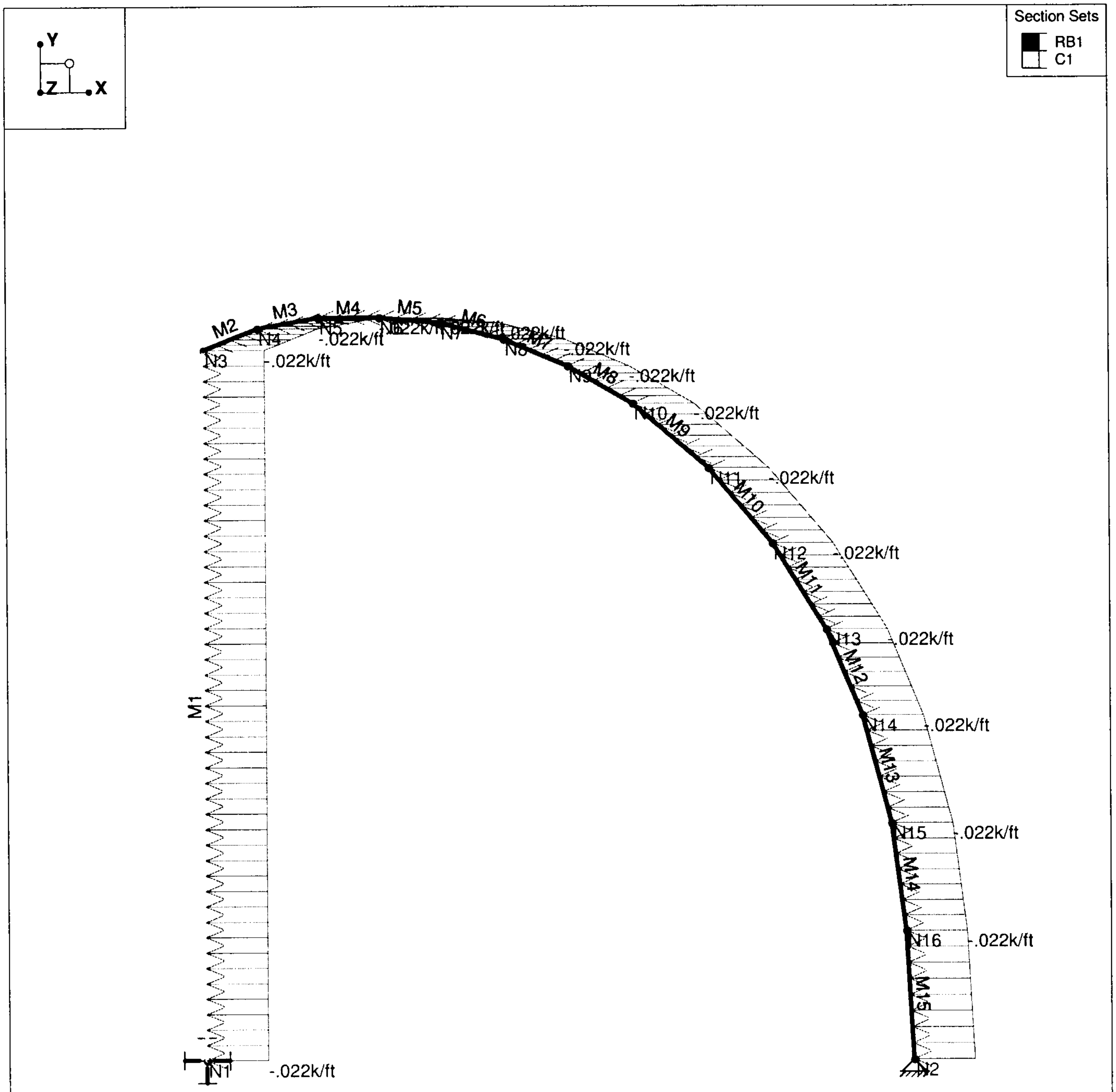
Loads: BLC 1, Dead Load

Madison Industries	OMRF1 Moment Frame At Lines 3, 4, 5, 6, 7, 8 & 9	
ML		July 14, 2010 at 7:53 PM
W17283-10 Sht. 20		TUSTIN CW OMRF1.r3d



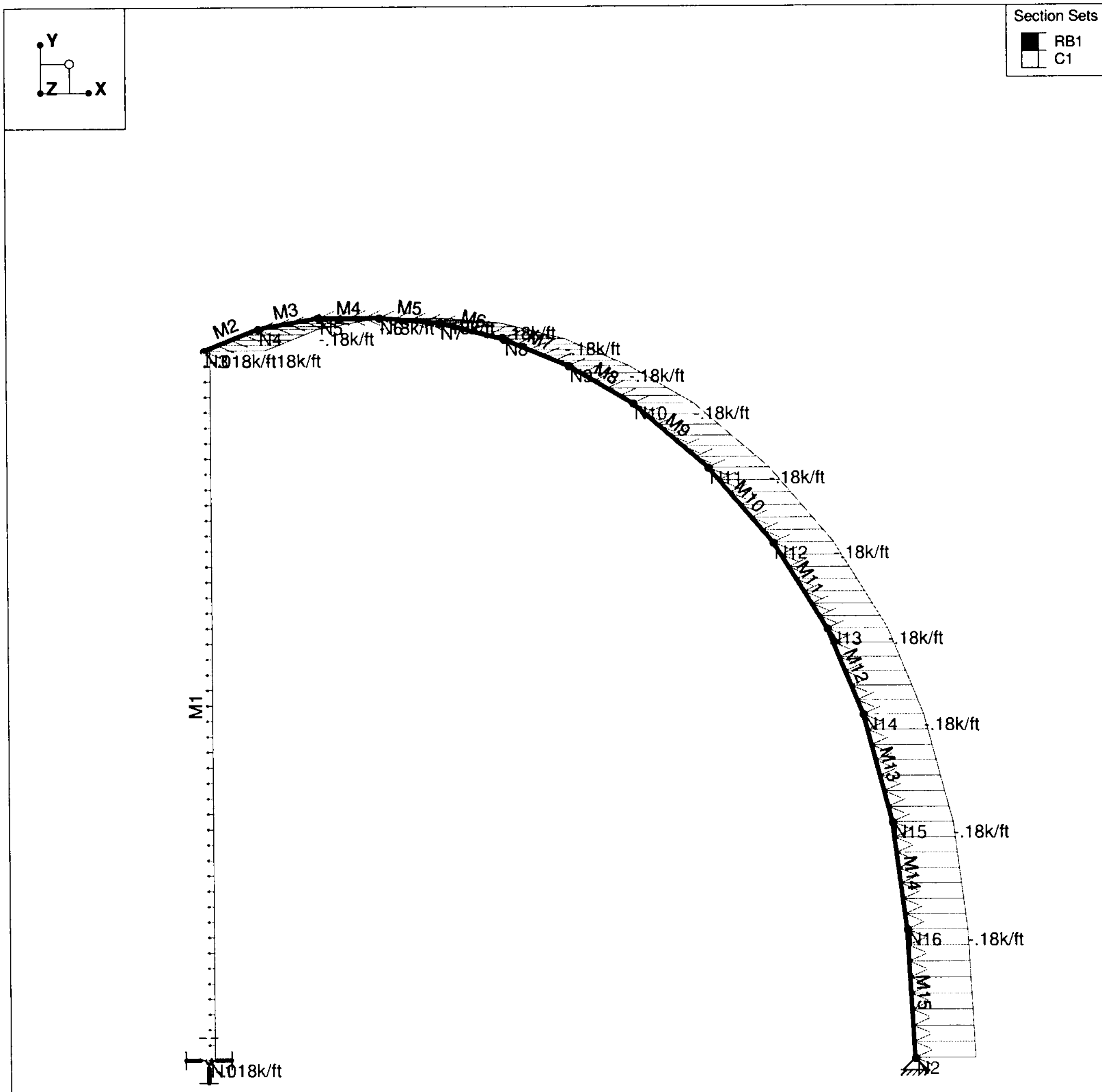
Loads: BLC 2, Live Load

Madison Industries	OMRF1 Moment Frame At Lines 3, 4, 5, 6, 7, 8 & 9	
ML		July 14, 2010 at 7:54 PM
W17283-10 Sht. 21		TUSTIN CW OMRF1.r3d



Loads: BLC 3, Earthquake Load

Madison Industries	OMRF1 Moment Frame At Lines 3, 4, 5, 6, 7, 8 & 9	
ML		July 14, 2010 at 7:54 PM
W17283-10 Sht. 22		TUSTIN CW OMRF1.r3d



Loads: BLC 4, Wind Load

Madison Industries	OMRF1 Moment Frame At Lines 3, 4, 5, 6, 7, 8 & 9	
ML		July 14, 2010 at 7:54 PM
W17283-10 Sht. 23		TUSTIN CW OMRF1.r3d

Global

Display Sections for Member Calcs	3
Max Internal Sections for Member Calcs	99
Include Shear Deformation	Yes
Include Warping	Yes
Area Load Mesh (in^2)	144
Merge Tolerance (in)	.12
P-Delta Analysis Tolerance	0.50%
Vertical Axis	Y

Hot Rolled Steel Code	AISC: ASD 9th
Cold Formed Steel Code	AISI 99: ASD
Wood Code	NDS 91/97: ASD
Wood Temperature	< 100F
Concrete Code	ACI 1999

Number of Shear Regions	4
Region Spacing Increment (in)	4
Biaxial Column Method	PCA Load Contour
Parme Beta Factor (PCA)	.65
Concrete Stress Block	Rectangular
Use Cracked Sections	Yes
Bad Framing Warnings	No
Unused Force Warnings	Yes

Hot Rolled Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (\1E5 F)	Density[k/ft^3]	Yield[ksi]
1	A36	29000	11154	.3	.65	.49	36
2	A572Grade50	29000	11154	.3	.65	.49	50
3	A992	29000	11154	.3	.65	.49	50
4	A500_42	29000	11154	.3	.65	.49	42
5	A500_46	29000	11154	.3	.65	.49	46

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rules	A [in2]	Iyy [in4]	Izz [in4]	J [in4]
1	RB1	W8X21	Beam	Wide Flange	A992	Typical	6.16	9.77	75.3	.28
2	C1	W8X21	Column	Tube	A992	Typical	6.16	9.77	75.3	.28

Hot Rolled Steel Design Parameters

	Label	Shape	Length...	Lbyy[ft]	Lbzz[ft]	Lcomp to...	Lcomp bo...	Kyy	Kzz	Cm-yy	Cm-zz	Cb	y sway	z sway	Function
1	M1	C1	16.5												Lateral
2	M2	RB1	1.346			2									Lateral
3	M3	RB1	1.439			2									Lateral
4	M4	RB1	1.416			2									Lateral
5	M5	RB1	1.423			2									Lateral
6	M6	RB1	1.546			2									Lateral
7	M7	RB1	1.625			2									Lateral
8	M8	RB1	1.737			2									Lateral
9	M9	RB1	2.305			2									Lateral
10	M10	RB1	2.305			2									Lateral
11	M11	RB1	2.358			2									Lateral
12	M12	RB1	2.167			2									Lateral
13	M13	RB1	2.587			2									Lateral
14	M14	RB1	2.522			2									Lateral
15	M15	RB1	3.005			2									Lateral

Member Primary Data

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
1	M1	N1	N3			C1	Column	Tube	A992	Typical
2	M2	N3	N4			RB1	Beam	Wide Flange	A992	Typical
3	M3	N4	N5			RB1	Beam	Wide Flange	A992	Typical
4	M4	N5	N6			RB1	Beam	Wide Flange	A992	Typical
5	M5	N6	N7			RB1	Beam	Wide Flange	A992	Typical
6	M6	N7	N8			RB1	Beam	Wide Flange	A992	Typical
7	M7	N8	N9			RB1	Beam	Wide Flange	A992	Typical
8	M8	N9	N10			RB1	Beam	Wide Flange	A992	Typical
9	M9	N10	N11			RB1	Beam	Wide Flange	A992	Typical
10	M10	N11	N12			RB1	Beam	Wide Flange	A992	Typical
11	M11	N12	N13			RB1	Beam	Wide Flange	A992	Typical
12	M12	N13	N14			RB1	Beam	Wide Flange	A992	Typical
13	M13	N14	N15			RB1	Beam	Wide Flange	A992	Typical
14	M14	N15	N16			RB1	Beam	Wide Flange	A992	Typical
15	M15	N16	N2			RB1	Beam	Wide Flange	A992	Typical

Load Combinations

	Description	Sol...	PD...	S...	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	DL+LL	Yes			Y	1	1	1	2	1										
2	(1.0+0.14Sds)DL+Eh	Yes			Y	-1.12	1	1.12	3	1										
3	(0.90)DL+1.4Eh	Yes			Y	-.9	1	.9	3	1.4										
4	(1.0+0.14Sds)DL+Omega...	Yes			Y	-1.12	1	1.12	3	3										
5	DL+Lateral WL	Yes			Y	1	1	1	4	1										

Joint Reactions (By Combination)

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	1	N1	.495	2.731	0	0	0	0
2	1	N2	-.495	6.008	0	0	0	0
3	1	Totals:	0	8.739	0			
4	1	COG (ft):	X: 11.343	Y: 11.552	Z: 0			

Member Section Forces

	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Moment[k-...	z-z Moment[k-...
1	1	M1	1	2.731	-.495	0	0	0	0
2			2	2.904	-.495	0	0	0	4.087
3			3	3.077	-.495	0	0	0	8.174
4	1	M2	1	1.603	2.673	0	0	0	8.174
5			2	1.521	2.469	0	0	0	6.443
6			3	1.439	2.264	0	0	0	4.85
7	1	M3	1	.946	2.511	0	0	0	4.85
8			2	.905	2.279	0	0	0	3.127
9			3	.864	2.047	0	0	0	1.571
10	1	M4	1	.495	2.166	0	0	0	1.571
11			2	.495	1.935	0	0	0	.119
12			3	.495	1.703	0	0	0	-1.168
13	1	M5	1	.344	1.74	0	0	0	-1.168
14			2	.364	1.508	0	0	0	-2.324
15			3	.385	1.277	0	0	0	-3.314
16	1	M6	1	.18	1.321	0	0	0	-3.314
17			2	.242	1.076	0	0	0	-4.241
18			3	.303	.831	0	0	0	-4.978
19	1	M7	1	.176	.866	0	0	0	-4.978
20			2	.278	.621	0	0	0	-5.582
21			3	.38	.376	0	0	0	-5.987
22	1	M8	1	.327	.423	0	0	0	-5.987
23			2	.47	.178	0	0	0	-6.248
24			3	.613	-.067	0	0	0	-6.296
25	1	M9	1	.615	.044	0	0	0	-6.296
26			2	.86	-.242	0	0	0	-6.181
27			3	1.106	-.529	0	0	0	-5.737
28	1	M10	1	1.173	-.353	0	0	0	-5.737
29			2	1.46	-.599	0	0	0	-5.188
30			3	1.746	-.844	0	0	0	-4.357
31	1	M11	1	1.852	-.573	0	0	0	-4.357
32			2	2.179	-.778	0	0	0	-3.56
33			3	2.506	-.982	0	0	0	-2.523
34	1	M12	1	2.633	-.56	0	0	0	-2.523
35			2	2.96	-.696	0	0	0	-1.842
36			3	3.287	-.832	0	0	0	-1.014
37	1	M13	1	3.369	-.386	0	0	0	-1.014
38			2	3.778	-.495	0	0	0	-.444
39			3	4.186	-.604	0	0	0	.267
40	1	M14	1	4.229	-.064	0	0	0	.267
41			2	4.638	-.118	0	0	0	.382
42			3	5.047	-.172	0	0	0	.565
43	1	M15	1	5.045	.215	0	0	0	.565
44			2	5.536	.188	0	0	0	.262
45			3	6.026	.161	0	0	0	0

Member AISC ASD Steel Code Checks (By Combination)

	LC	Member	Shape	UC Max	Loc[ft]	Shear U...	Loc[ft]	Dir	Fa[ksi]	Ft[ksi]	Fby[ksi]	Fbz[ksi]	Cb	Cmy	Cmz	Eqn
1	1	M1	W8X21	.282	16.5	.012	0	y	6.041	30	37.5	27.002	1.75	.6	.6	H1-3
2	1	M2	W8X21	.172	0	.065	0	y	29.006	30	37.5	33	1.233	.6	.85	H1-2
3	1	M3	W8X21	.102	0	.061	0	y	28.924	30	37.5	33	1.441	.6	.85	H1-2
4	1	M4	W8X21	.034	0	.052	0	y	28.945	30	37.5	33	2.3	.6	.85	H1-2
5	1	M5	W8X21	.068	1.423	.042	0	y	28.939	30	37.5	33	1.417	.6	.85	H1-2
6	1	M6	W8X21	.101	1.546	.032	0	y	28.828	30	37.5	33	1.184	.6	.85	H1-2
7	1	M7	W8X21	.122	1.625	.021	0	y	28.756	30	37.5	33	1.084	.6	.85	H1-2
8	1	M8	W8X21	.129	1.648	.010	0	y	28.652	30	37.5	33	1	.6	.85	H1-2
9	1	M9	W8X21	.130	.4	.013	2.305	y	28.089	30	37.5	33	1	.6	.85	H1-2
10	1	M10	W8X21	.121	0	.020	2.305	y	28.089	30	37.5	33	1.126	.6	.85	H1-2
11	1	M11	W8X21	.097	0	.024	2.358	y	28.033	30	37.5	33	1.243	.6	.85	H1-2
12	1	M12	W8X21	.065	0	.020	2.167	y	28.231	30	37.5	33	1.376	.6	.85	H1-2
13	1	M13	W8X21	.039	0	.015	2.587	y	27.788	30	37.5	33	2.047	.6	.85	H1-2
14	1	M14	W8X21	.039	2.522	.004	2.522	y	27.859	30	37.5	33	1	.6	.85	H1-1
15	1	M15	W8X21	.040	0	.005	0	y	27.321	30	37.5	33	1	.6	.85	H1-1

Joint Reactions (By Combination)

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	2	N1	.625	2.53	0	0	0	0
2	2	N2	.331	2.43	0	0	0	0
3	2	Totals:	.956	4.96	0			
4	2	COG (ft):	X: 10.059	Y: 11.179	Z: 0			

Member Section Forces

	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Moment[k-...	z-z Moment[k-...
1	2	M1	1	2.53	-.625	0	0	0	0
2			2	2.336	-.447	0	0	0	4.424
3			3	2.142	-.269	0	0	0	7.377
4	2	M2	1	1.045	1.889	0	0	0	7.377
5			2	.991	1.792	0	0	0	6.139
6			3	.936	1.694	0	0	0	4.965
7	2	M3	1	.57	1.85	0	0	0	4.965
8			2	.534	1.736	0	0	0	3.675
9			3	.498	1.622	0	0	0	2.467
10	2	M4	1	.209	1.684	0	0	0	2.467
11			2	.193	1.567	0	0	0	1.316
12			3	.178	1.451	0	0	0	.248
13	2	M5	1	.05	1.461	0	0	0	.248
14			2	.045	1.343	0	0	0	-.75
15			3	.04	1.225	0	0	0	-1.663
16	2	M6	1	-.152	1.216	0	0	0	-1.663
17			2	-.137	1.089	0	0	0	-2.554
18			3	-.123	.961	0	0	0	-3.346
19	2	M7	1	-.265	.932	0	0	0	-3.346
20			2	-.23	.802	0	0	0	-4.051
21			3	-.194	.672	0	0	0	-4.649
22	2	M8	1	-.282	.64	0	0	0	-4.649
23			2	-.226	.507	0	0	0	-5.147
24			3	-.17	.374	0	0	0	-5.53
25	2	M9	1	-.235	.338	0	0	0	-5.53
26			2	-.13	.177	0	0	0	-5.827
27			3	-.026	.017	0	0	0	-5.939
28	2	M10	1	-.028	.013	0	0	0	-5.939
29			2	.1	-.129	0	0	0	-5.871
30			3	.228	-.272	0	0	0	-5.64
31	2	M11	1	.266	-.235	0	0	0	-5.64
32			2	.417	-.359	0	0	0	-5.29
33			3	.568	-.484	0	0	0	-4.793
34	2	M12	1	.639	-.384	0	0	0	-4.793
35			2	.795	-.475	0	0	0	-4.328
36			3	.95	-.565	0	0	0	-3.765
37	2	M13	1	1.017	-.433	0	0	0	-3.765
38			2	1.216	-.515	0	0	0	-3.152
39			3	1.414	-.597	0	0	0	-2.434
40	2	M14	1	1.479	-.411	0	0	0	-2.434
41			2	1.681	-.465	0	0	0	-1.881
42			3	1.883	-.519	0	0	0	-1.261
43	2	M15	1	1.918	-.373	0	0	0	-1.261
44			2	2.163	-.42	0	0	0	-.665
45			3	2.408	-.466	0	0	0	0

Member AISC ASD Steel Code Checks (By Combination)

	LC	Member	Shape	UC Max	Loc[ft]	Shear U...	Loc[ft]	Dir	Fa[ksi]	Ft[ksi]	Fby[ksi]	Fbz[ksi]	Cb	Cmy	Cmz	Eqn
1	2	M1	W8X21	.238	16.5	.015	0	y	6.041	30	37.5	27.002	1.75	.6	.85	H1-3
2	2	M2	W8X21	.153	0	.046	0	y	29.006	30	37.5	33	1.179	.6	.85	H1-2
3	2	M3	W8X21	.102	0	.045	0	y	28.924	30	37.5	33	1.302	.6	.85	H1-2
4	2	M4	W8X21	.050	0	.041	0	y	28.945	30	37.5	33	1.648	.6	.85	H1-2
5	2	M5	W8X21	.033	1.423	.035	0	y	28.939	30	37.5	33	1.913	.6	.85	H1-2
6	2	M6	W8X21	.068	1.546	.029	0	y	28.828	30	37.5	33	1.302	.6	.85	H2-1
7	2	M7	W8X21	.094	1.625	.023	0	y	28.756	30	37.5	33	1.15	.6	.85	H2-1
8	2	M8	W8X21	.111	1.737	.015	0	y	28.652	30	37.5	33	1.079	.6	.85	H2-1
9	2	M9	W8X21	.119	2.258	.008	0	y	28.089	30	37.5	33	1.032	.6	.85	H2-1
10	2	M10	W8X21	.119	0	.007	2.305	y	28.089	30	37.5	33	1	.6	.85	H2-1
11	2	M11	W8X21	.114	0	.012	2.358	y	28.033	30	37.5	33	1.074	.6	.85	H1-2
12	2	M12	W8X21	.099	0	.014	2.167	y	28.231	30	37.5	33	1.11	.6	.85	H1-2
13	2	M13	W8X21	.081	0	.014	2.587	y	27.788	30	37.5	33	1.197	.6	.85	H1-2
14	2	M14	W8X21	.057	0	.013	2.522	y	27.859	30	37.5	33	1.287	.6	.85	H1-2
15	2	M15	W8X21	.036	0	.011	3.005	y	27.321	30	37.5	33	1.75	.6	.85	H1-2

Joint Deflections (By Combination)

	LC	Joint Label	X [in]	Y [in]	Z [in]	X Rotation [rad]	Y Rotation [rad]	Z Rotation [rad]
1	3	N1	0	0	0	0	0	4.633e-3
2	3	N2	0	0	0	0	0	4.849e-3
3	3	N3	-.565	-.002	0	0	0	-3.981e-4
4	3	N4	-.56	-.014	0	0	0	-9.901e-4
5	3	N5	-.557	-.036	0	0	0	-1.39e-3
6	3	N6	-.557	-.063	0	0	0	-1.56e-3
7	3	N7	-.559	-.091	0	0	0	-1.528e-3
8	3	N8	-.566	-.118	0	0	0	-1.295e-3
9	3	N9	-.574	-.138	0	0	0	-8.681e-4
10	3	N10	-.581	-.149	0	0	0	-2.595e-4
11	3	N11	-.577	-.145	0	0	0	6.943e-4
12	3	N12	-.552	-.123	0	0	0	1.703e-3
13	3	N13	-.499	-.09	0	0	0	2.685e-3
14	3	N14	-.424	-.059	0	0	0	3.47e-3
15	3	N15	-.308	-.028	0	0	0	4.197e-3
16	3	N16	-.173	-.01	0	0	0	4.652e-3

Member AISC ASD Steel Code Checks (By Combination)

	LC	Member	Shape	UC Max	Loc[ft]	Shear U...	Loc[ft]	Dir	Fa[ksi]	Ft[ksi]	Fby[ksi]	Fbz[ksi]	Cb	Cmy	Cmz	Eqn
1	3	M1	W8X21	.248	16.5	.018	0	y	6.041	30	37.5	27.002	1.75	.6	.85	H1-3
2	3	M2	W8X21	.163	0	.045	0	y	29.006	30	37.5	33	1.163	.6	.85	H1-2
3	3	M3	W8X21	.113	0	.044	0	y	28.924	30	37.5	33	1.269	.6	.85	H1-2
4	3	M4	W8X21	.060	0	.041	0	y	28.945	30	37.5	33	1.521	.6	.85	H1-2
5	3	M5	W8X21	.027	1.423	.037	0	y	28.939	30	37.5	33	2.3	.6	.85	H2-1
6	3	M6	W8X21	.065	1.546	.032	0	y	28.828	30	37.5	33	1.364	.6	.85	H2-1
7	3	M7	W8X21	.096	1.625	.025	0	y	28.756	30	37.5	33	1.177	.6	.85	H2-1
8	3	M8	W8X21	.119	1.737	.019	0	y	28.652	30	37.5	33	1.099	.6	.85	H2-1
9	3	M9	W8X21	.134	2.305	.011	0	y	28.089	30	37.5	33	1.054	.6	.85	H2-1
10	3	M10	W8X21	.135	.941	.003	2.305	y	28.089	30	37.5	33	1	.6	.85	H2-1
11	3	M11	W8X21	.133	0	.009	2.358	y	28.033	30	37.5	33	1.046	.6	.85	H2-1
12	3	M12	W8X21	.120	0	.013	2.167	y	28.231	30	37.5	33	1.083	.6	.85	H1-2
13	3	M13	W8X21	.102	0	.016	2.587	y	27.788	30	37.5	33	1.161	.6	.85	H1-2
14	3	M14	W8X21	.074	0	.016	2.522	y	27.859	30	37.5	33	1.26	.6	.85	H1-2
15	3	M15	W8X21	.045	0	.017	3.005	y	27.321	30	37.5	33	1.75	.6	.85	H1-2

Joint Reactions (By Combination)

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	4	N1	1.377	3.717	0	0	0	0
2	4	N2	1.492	1.243	0	0	0	0
3	4	Totals:	2.869	4.96	0			
4	4	COG (ft):	X: 10.059	Y: 11.179	Z: 0			

Member Section Forces

	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Moment[k-...	z-z Moment[k-...
1	4	M1	1	3.717	-1.377	0	0	0	0
2			2	3.524	-.843	0	0	0	9.158
3			3	3.33	-.308	0	0	0	13.905
4	4	M2	1	1.523	2.977	0	0	0	13.905
5			2	1.441	2.891	0	0	0	11.93
6			3	1.359	2.804	0	0	0	10.013
7	4	M3	1	.758	3.023	0	0	0	10.013
8			2	.691	2.914	0	0	0	7.878
9			3	.625	2.806	0	0	0	5.82
10	4	M4	1	.128	2.872	0	0	0	5.82
11			2	.082	2.755	0	0	0	3.828
12			3	.036	2.638	0	0	0	1.919
13	4	M5	1	-.196	2.631	0	0	0	1.919
14			2	-.232	2.511	0	0	0	.09
15			3	-.267	2.39	0	0	0	-1.653
16	4	M6	1	-.638	2.319	0	0	0	-1.653
17			2	-.655	2.183	0	0	0	-3.393
18			3	-.673	2.048	0	0	0	-5.028
19	4	M7	1	-.971	1.924	0	0	0	-5.028
20			2	-.968	1.781	0	0	0	-6.533
21			3	-.966	1.637	0	0	0	-7.922
22	4	M8	1	-1.175	1.494	0	0	0	-7.922
23			2	-1.151	1.342	0	0	0	-9.153
24			3	-1.128	1.19	0	0	0	-10.253
25	4	M9	1	-1.323	.969	0	0	0	-10.253
26			2	-1.256	.776	0	0	0	-11.258
27			3	-1.19	.583	0	0	0	-12.041
28	4	M10	1	-1.265	.395	0	0	0	-12.041
29			2	-1.17	.214	0	0	0	-12.392
30			3	-1.074	.034	0	0	0	-12.535
31	4	M11	1	-1.067	-.127	0	0	0	-12.535
32			2	-.943	-.294	0	0	0	-12.287
33			3	-.819	-.462	0	0	0	-11.841
34	4	M12	1	-.733	-.59	0	0	0	-11.841
35			2	-.595	-.723	0	0	0	-11.13
36			3	-.457	-.856	0	0	0	-10.275
37	4	M13	1	-.339	-.91	0	0	0	-10.275
38			2	-.155	-1.046	0	0	0	-9.01
39			3	.029	-1.181	0	0	0	-7.569
40	4	M14	1	.18	-1.168	0	0	0	-7.569
41			2	.375	-1.276	0	0	0	-6.028
42			3	.57	-1.385	0	0	0	-4.35
43	4	M15	1	.675	-1.337	0	0	0	-4.35
44			2	.916	-1.448	0	0	0	-2.258
45			3	1.158	-1.559	0	0	0	0

Joint Reactions (By Combination)

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	5	N1	1.59	4.254	0	0	0	0
2	5	N2	3.709	-1.682	0	0	0	0
3	5	Totals:	5.299	2.572	0			
4	5	COG (ft):	X: 12.379	Y: 11.854	Z: 0			

Member Section Forces

	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Moment[k-...	z-z Moment[k-...
1	5	M1	1	4.254	-1.59	0	0	0	0
2			2	4.427	-1.441	0	0	0	12.503
3			3	4.6	-1.292	0	0	0	23.774
4	5	M2	1	2.908	3.792	0	0	0	23.774
5			2	2.769	3.771	0	0	0	21.229
6			3	2.63	3.75	0	0	0	18.697
7	5	M3	1	1.808	4.209	0	0	0	18.697
8			2	1.668	4.157	0	0	0	15.688
9			3	1.527	4.105	0	0	0	12.716
10	5	M4	1	.79	4.308	0	0	0	12.716
11			2	.663	4.233	0	0	0	9.692
12			3	.536	4.159	0	0	0	6.721
13	5	M5	1	.168	4.19	0	0	0	6.721
14			2	.047	4.104	0	0	0	3.772
15			3	-.074	4.019	0	0	0	.883
16	5	M6	1	-.701	3.958	0	0	0	.883
17			2	-.817	3.845	0	0	0	-2.133
18			3	-.932	3.733	0	0	0	-5.062
19	5	M7	1	-1.479	3.552	0	0	0	-5.062
20			2	-1.581	3.417	0	0	0	-7.893
21			3	-1.683	3.282	0	0	0	-10.614
22	5	M8	1	-2.104	3.029	0	0	0	-10.614
23			2	-2.193	2.871	0	0	0	-13.176
24			3	-2.282	2.714	0	0	0	-15.601
25	5	M9	1	-2.732	2.26	0	0	0	-15.601
26			2	-2.811	2.033	0	0	0	-18.074
27			3	-2.89	1.806	0	0	0	-20.287
28	5	M10	1	-3.132	1.343	0	0	0	-20.287
29			2	-3.175	1.107	0	0	0	-21.698
30			3	-3.218	.87	0	0	0	-22.837
31	5	M11	1	-3.312	.38	0	0	0	-22.837
32			2	-3.32	.134	0	0	0	-23.14
33			3	-3.327	-.112	0	0	0	-23.153
34	5	M12	1	-3.264	-.653	0	0	0	-23.153
35			2	-3.234	-.877	0	0	0	-22.324
36			3	-3.204	-1.101	0	0	0	-21.253
37	5	M13	1	-3.028	-1.519	0	0	0	-21.253
38			2	-2.957	-1.779	0	0	0	-19.12
39			3	-2.886	-2.039	0	0	0	-16.65
40	5	M14	1	-2.601	-2.391	0	0	0	-16.65
41			2	-2.5	-2.634	0	0	0	-13.482
42			3	-2.399	-2.876	0	0	0	-10.007
43	5	M15	1	-2.171	-3.052	0	0	0	-10.007
44			2	-2.028	-3.331	0	0	0	-5.213
45			3	-1.886	-3.609	0	0	0	0

Joint Deflections (By Combination)

	LC	Joint Label	X [in]	Y [in]	Z [in]	X Rotation [rad]	Y Rotation [rad]	Z Rotation [rad]
1	5	N1	0	0	0	0	0	1.36e-2
2	5	N2	0	0	0	0	0	1.746e-2
3	5	N3	-1.808	-.005	0	0	0	2.178e-4
4	5	N4	-1.803	-.019	0	0	0	-1.667e-3
5	5	N5	-1.795	-.064	0	0	0	-3.156e-3
6	5	N6	-1.795	-.13	0	0	0	-4.062e-3
7	5	N7	-1.802	-.206	0	0	0	-4.417e-3
8	5	N8	-1.822	-.288	0	0	0	-4.201e-3
9	5	N9	-1.852	-.36	0	0	0	-3.357e-3
10	5	N10	-1.881	-.41	0	0	0	-1.851e-3
11	5	N11	-1.892	-.424	0	0	0	8.898e-4
12	5	N12	-1.84	-.38	0	0	0	4.181e-3
13	5	N13	-1.697	-.291	0	0	0	7.772e-3
14	5	N14	-1.47	-.197	0	0	0	1.096e-2
15	5	N15	-1.088	-.096	0	0	0	1.421e-2
16	5	N16	-.622	-.034	0	0	0	1.644e-2

Member Section Deflections

	LC	Member Label	Sec	x [in]	y [in]	z [in]	x Rotate[rad]	(n) L/y Ratio	(n) L/z Ratio
1	5	M1	1	0	0	0	0	NC	NC
2			2	-.002	1.238	0	0	592.935	NC
3			3	-.005	1.808	0	0	NC	NC
4	5	M2	1	-1.681	.667	0	0	NC	NC
5			2	-1.681	.663	0	0	4244.609	NC
6			3	-1.681	.652	0	0	NC	NC
7	5	M3	1	-1.779	.294	0	0	NC	NC
8			2	-1.779	.275	0	0	5373.341	NC
9			3	-1.779	.248	0	0	NC	NC
10	5	M4	1	-1.795	-.064	0	0	NC	NC
11			2	-1.795	-.095	0	0	550.572	NC
12			3	-1.795	-.13	0	0	259.138	NC
13	5	M5	1	-1.777	-.287	0	0	NC	NC
14			2	-1.777	-.325	0	0	455.22	NC
15			3	-1.777	-.364	0	0	223.112	NC
16	5	M6	1	-1.698	-.637	0	0	NC	NC
17			2	-1.698	-.68	0	0	NC	NC
18			3	-1.698	-.721	0	0	NC	NC
19	5	M7	1	-1.571	-.967	0	0	NC	NC
20			2	-1.571	-1.008	0	0	9469.371	NC
21			3	-1.571	-1.045	0	0	NC	NC
22	5	M8	1	-1.418	-1.244	0	0	NC	NC
23			2	-1.418	-1.277	0	0	5306.733	NC
24			3	-1.418	-1.302	0	0	NC	NC
25	5	M9	1	-1.161	-1.536	0	0	NC	NC
26			2	-1.161	-1.554	0	0	2915.624	NC
27			3	-1.161	-1.553	0	0	NC	NC
28	5	M10	1	-.91	-1.713	0	0	NC	NC
29			2	-.909	-1.69	0	0	2428.315	NC
30			3	-.909	-1.645	0	0	NC	NC
31	5	M11	1	-.653	-1.762	0	0	NC	NC
32			2	-.653	-1.69	0	0	2225.241	NC
33			3	-.652	-1.593	0	0	NC	NC
34	5	M12	1	-.384	-1.678	0	0	NC	NC
35			2	-.383	-1.566	0	0	2510.58	NC
36			3	-.383	-1.433	0	0	NC	NC

Member Section Deflections (Continued)

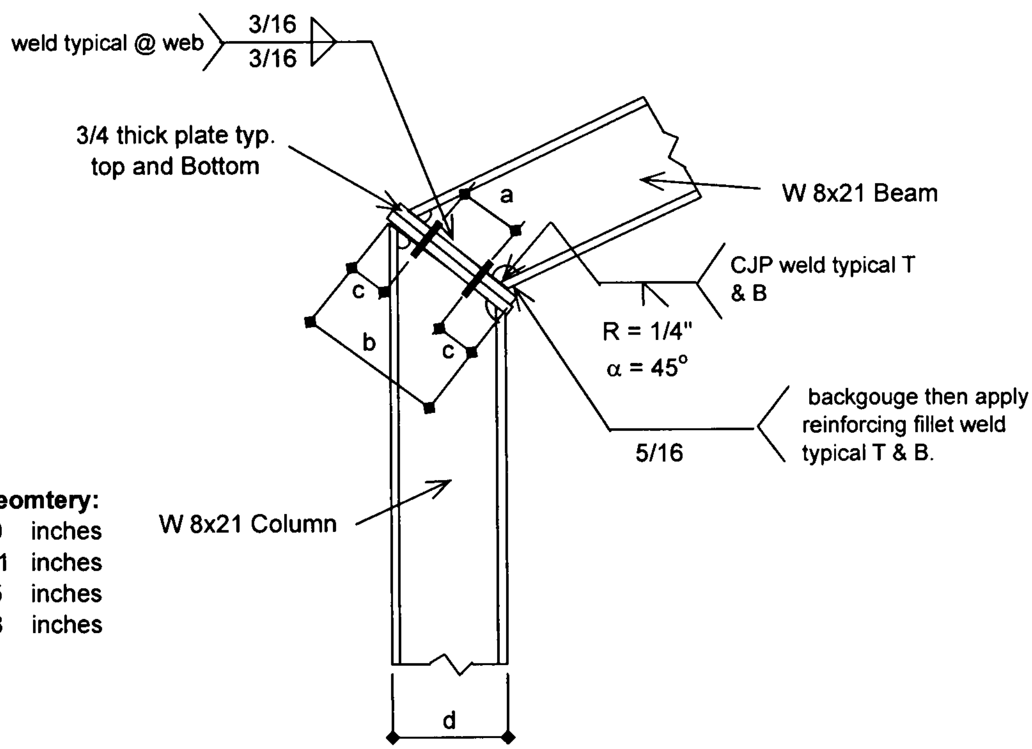
	LC	Member Label	Sec	x [in]	y [in]	z [in]	x Rotate[rad]	(n) L/y Ratio	(n) L/z Ratio
37	5	M13	1	-.188	-1.472	0	0	NC	NC
38			2	-.188	-1.287	0	0	2455.867	NC
39			3	-.188	-1.076	0	0	NC	NC
40	5	M14	1	-.049	-1.091	0	0	NC	NC
41			2	-.048	-.865	0	0	3574.679	NC
42			3	-.048	-.621	0	0	NC	NC
43	5	M15	1	0	-.623	0	0	NC	NC
44			2	0	-.316	0	0	7797.309	NC
45			3	0	0	0	0	NC	NC

Member AISC ASD Steel Code Checks (By Combination)

	LC	Member	Shape	UC Max	Loc[ft]	Shear U...	Loc[ft]	Dir	Fa[ksi]	Ft[ksi]	Fby[ksi]	Fbz[ksi]	Cb	Cmy	Cmz	Eqn
1	5	M1	W8X21	.705	16.5	.038	0	y	6.041	30	37.5	27.002	1.75	.6	.85	H1-3
2	5	M2	W8X21	.491	0	.092	0	y	29.006	30	37.5	33	1.11	.6	.85	H1-2
3	5	M3	W8X21	.384	0	.102	0	y	28.924	30	37.5	33	1.175	.6	.85	H1-2
4	5	M4	W8X21	.259	0	.104	0	y	28.945	30	37.5	33	1.279	.6	.85	H1-2
5	5	M5	W8X21	.135	0	.101	0	y	28.939	30	37.5	33	1.617	.6	.85	H1-2
6	5	M6	W8X21	.106	1.546	.096	0	y	28.828	30	37.5	33	1.942	.6	.85	H2-1
7	5	M7	W8X21	.221	1.625	.086	0	y	28.756	30	37.5	33	1.317	.6	.85	H2-1
8	5	M8	W8X21	.324	1.737	.073	0	y	28.652	30	37.5	33	1.174	.6	.85	H2-1
9	5	M9	W8X21	.421	2.305	.055	0	y	28.089	30	37.5	33	1.12	.6	.85	H2-1
10	5	M10	W8X21	.474	2.305	.032	0	y	28.089	30	37.5	33	1.054	.6	.85	H2-1
11	5	M11	W8X21	.481	1.829	.009	0	y	28.033	30	37.5	33	1	.6	.85	H2-1
12	5	M12	W8X21	.481	0	.027	2.167	y	28.231	30	37.5	33	1.039	.6	.85	H2-1
13	5	M13	W8X21	.441	0	.049	2.587	y	27.788	30	37.5	33	1.112	.6	.85	H2-1
14	5	M14	W8X21	.347	0	.069	2.522	y	27.859	30	37.5	33	1.227	.6	.85	H2-1
15	5	M15	W8X21	.212	0	.087	3.005	y	27.321	30	37.5	33	1.75	.6	.85	H2-1

OMRF1 - MOMENT RESISTING FRAME CONNECTION 1

Beam RB1 to Column C1 (Moment Connection)



Geomtery:

a =	6.00	inches
b =	11.71	inches
c =	2.85	inches
d =	8.28	inches

Beam to Column Connection Due to Seismic with Overstrength Factor Ω_o applied

Load Combination for Beam to Column Connection: $(1.0+0.14S_{DS})DL+\Omega_o Eh$

Where: $M_S =$ 13.91 k-ft From RISA LC-3)

$V_S =$ 3.344 k From RISA LC-3)

$\Omega_o =$ 3.00

Beam End Moment Connection Due to Wind Load)

Load Combination for Beam to Column Connection: $DL+w_{WIND}$

Where: $M_W =$ 23.8 k-ft From RISA LC-4)

$V_W =$ 4.643 k From RISA LC-4)

(Wind Force Controls)

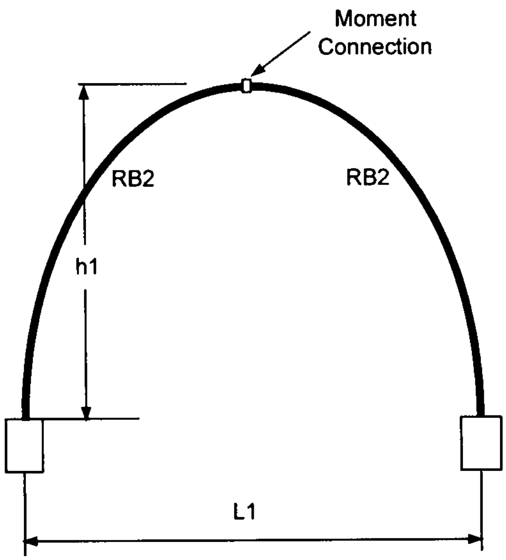
Bolts Required: (Try 7/8" diam. A325 Bolts, Allowable Tension load = 26.5 kips)

Bolts @ T & B Plate to Beam Flanges = M / a / 26.5 kips = 1.794 ea.

(Use 2 - 7/8 " A325 Bolts @ 6" o.c.)

	MADISON LOS ANGELES, PHOENIX, TULSA, ATLANTA	JOB NO.	W17283-10
		SHT	36 OF 72
		DATE	11/22/2010
	FOR TUSTIN FIELD GAS AND FOOD	DES. BY	ML
	DESCRIPTION 17'-0" x 76'-8" Car Wash + Equipment Rm. Bldg.	CHKD. BY	

OMRF2 - Moment Resisting Frame (Lateral Load Resisting system Transverse Direction)



TRIBUTARY LOADING STRIP:
Vertical Load = 5.11 ft
Horizontal load = 5.11 ft

GRAVITY LOADS:
Roof Dead Load = 10 psf
w_{DL} = 63.8 plf
Roof Live Load = 20 psf
w_{LL} = 97.5 plf

LATERAL WIND LOAD:
(Windward) P_{LAT} = 16.19 psf
(Leeward) P_{LAT} = 1.65 psf

C1

Windward on RB2 = 78.9 plf
Leeward on RB2 = 8.02 plf

Load Combination for maximum Stress
DL+w_{WIND} (Allowable Stress Level)

LATERAL SEISMIC LOAD:
Seismic Load, Eh = 0.198 w_{DL}
Seismic Load, Eh = 11.0 plf
Where: ρ = 1.0
S_{DS} = 0.97
Ω_o = 3
C_d = 3

GEOMETRY:
h1 = 17.25 ft
L1 = 25.0 ft

Member Sizes:

RB2 = W 8x10

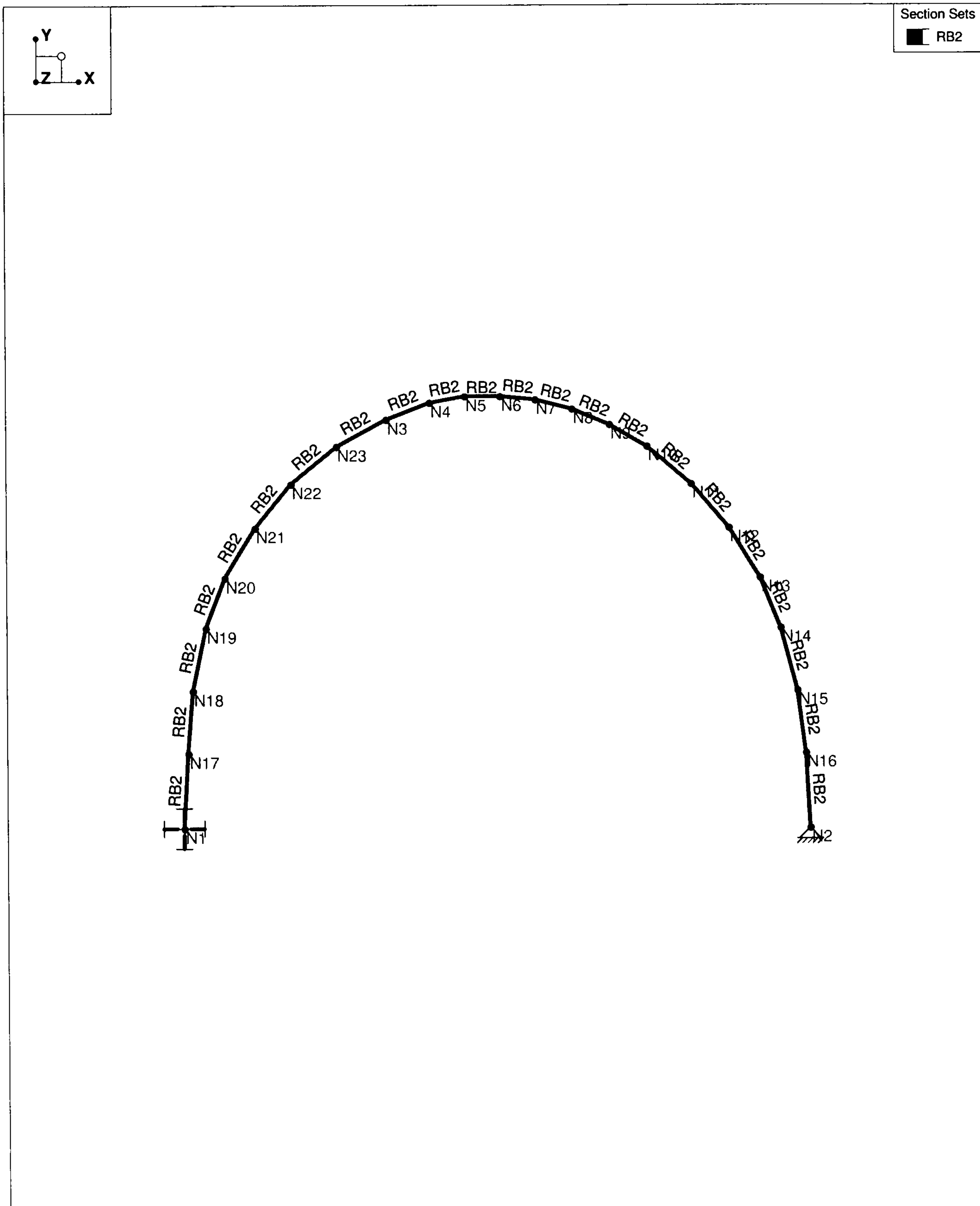
Load Combination for maximum Stress
$(1.0+0.14S_{DS})DL+Eh$ (Allowable Stress Level)

Load Combination for Maximum Force @ Connection.
$0.9D+\Omega_o\rho Eh$ (Allowable Stress Level)

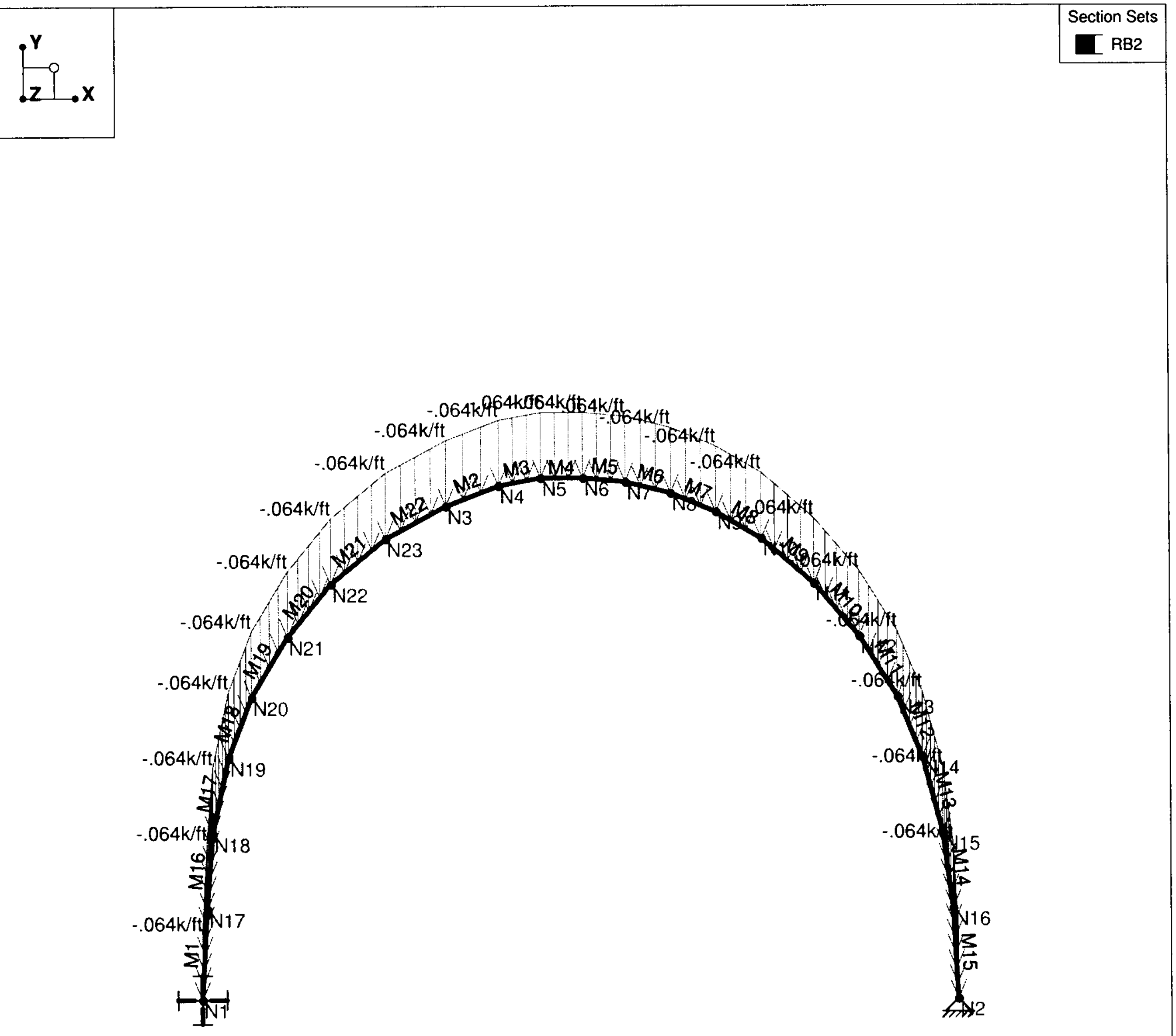
Load Combination for maximum Story Drift Δ_s
$0.9D+1.4\rho Eh(C_d)$ (Strength Level)

Max. elastic displacement, δ_e = 0.524 inches **(from RISA result sht. 38)**
Max. calculated Story Drift, $\Delta s = (C_d)(\delta_e)$ = 1.57 inches < 5.18 inches ok
Max. Allowable Story Drift, Δs = (h1)(0.025) = 5.18 inches

(See Pages Following for result of RISA Analysis)

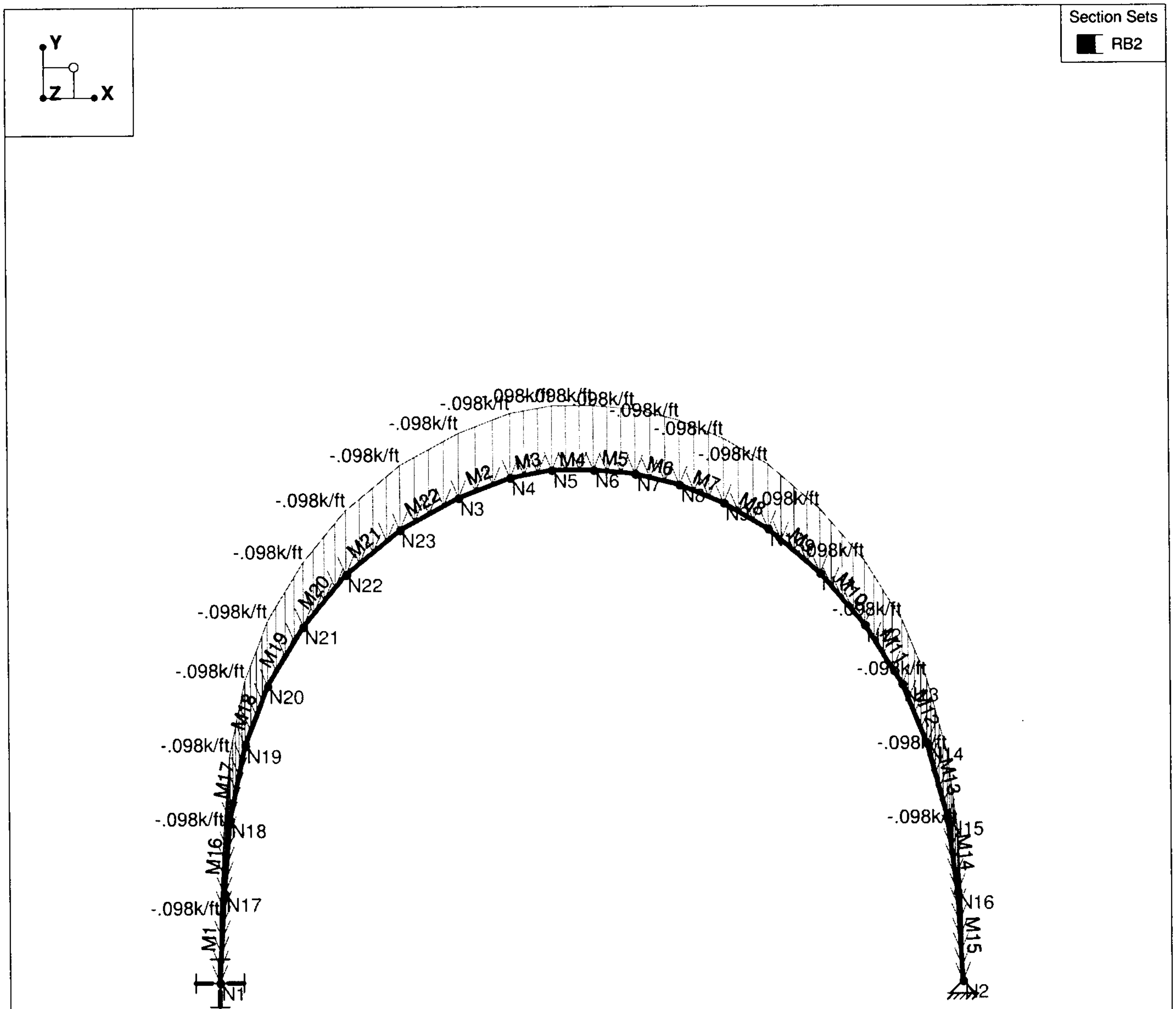


Madison Industries	OMRF2 Moment Frame At Lines 2 &10	
ML		July 14, 2010 at 8:18 PM
W17283-10 sht. 37		TUSTIN CW OMRF2.r3d



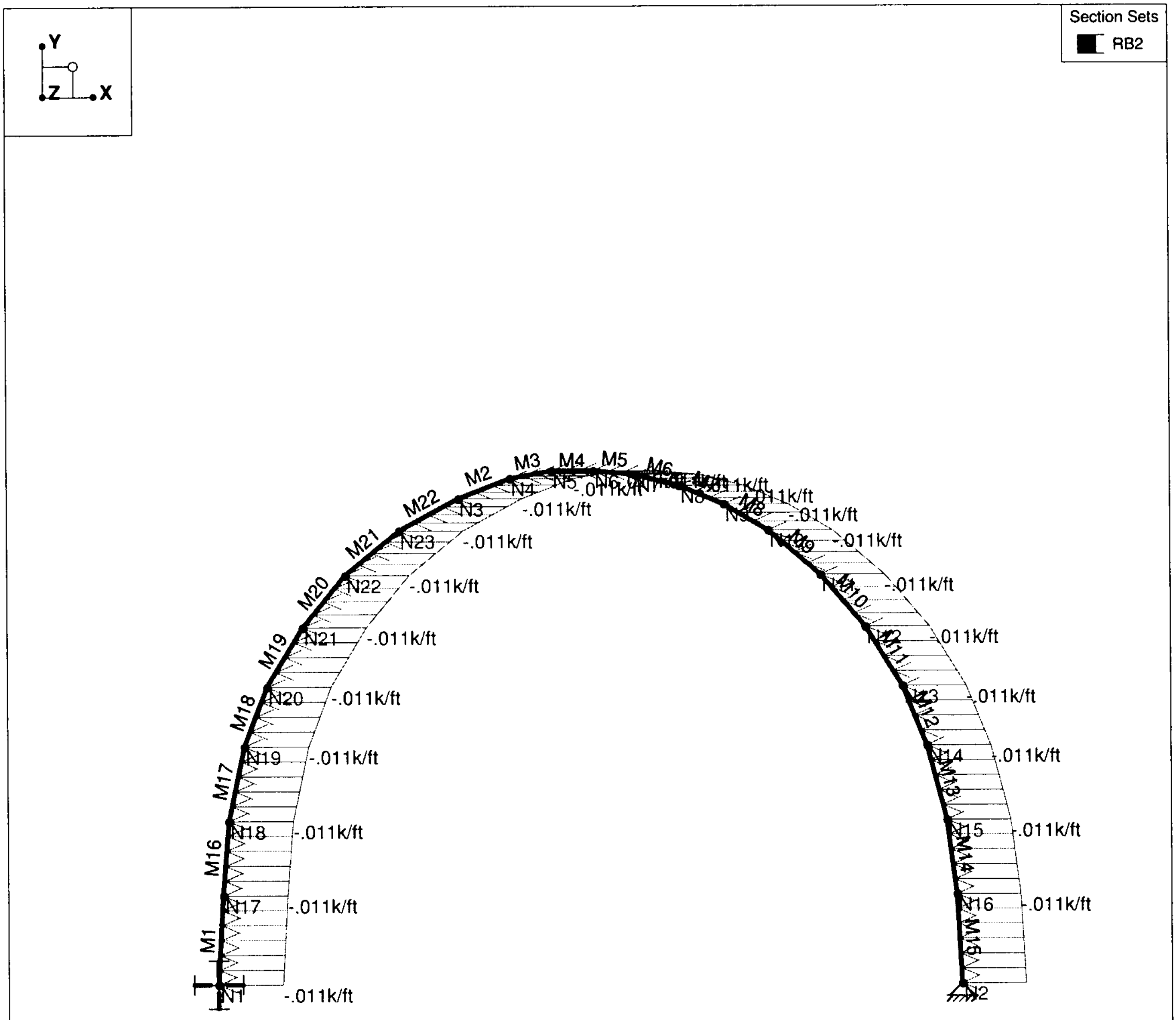
Loads: BLC 1, Dead Load

Madison Industries	OMRF2 Moment Frame At Lines 2 &10	
ML		July 14, 2010 at 8:18 PM
W17283-10 sht. 38		TUSTIN CW OMRF2.r3d



Loads: BLC 2, Live Load

Madison Industries	OMRF2 Moment Frame At Lines 2 &10	
ML		July 14, 2010 at 8:19 PM
W17283-10 sht. 39		TUSTIN CW OMRF2.r3d

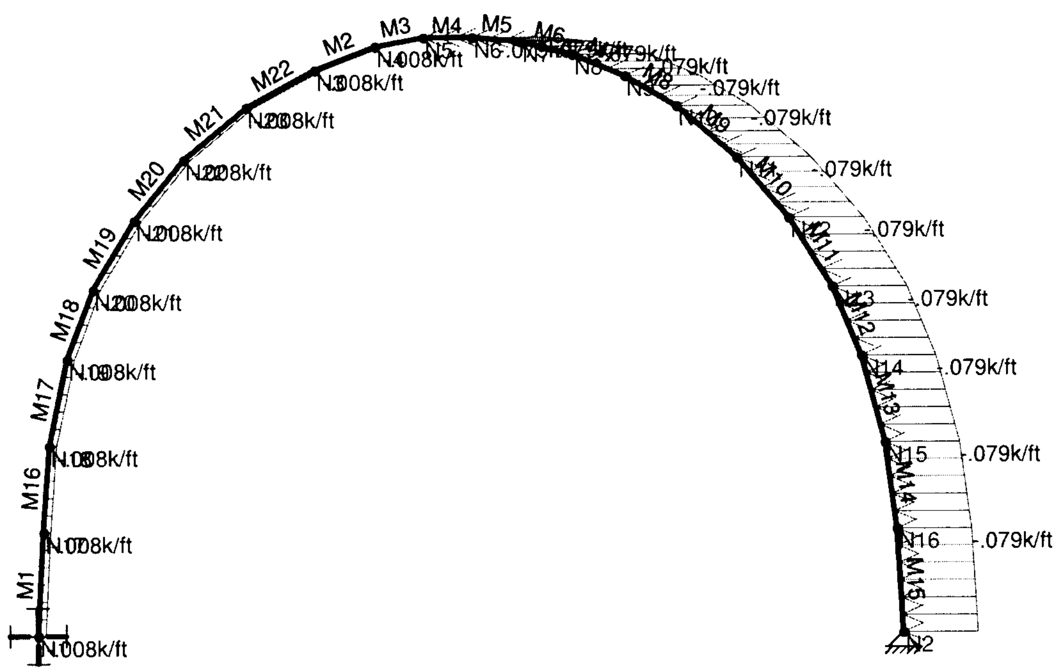


Loads: BLC 3, Earthquake Load

Madison Industries	OMRF2 Moment Frame At Lines 2 &10	
ML		July 14, 2010 at 8:19 PM
W17283-10 sht. 40		TUSTIN CW OMRF2.r3d

Section Sets

RB2



Loads: BLC 4, Wind Load

Madison Industries	OMRF2 Moment Frame At Lines 2 &10	
ML		July 14, 2010 at 8:20 PM
W17283-10 sht. 41		TUSTIN CW OMRF2.r3d

Global

Display Sections for Member Calcs	3
Max Internal Sections for Member Calcs	99
Include Shear Deformation	Yes
Include Warping	Yes
Area Load Mesh (in^2)	144
Merge Tolerance (in)	.12
P-Delta Analysis Tolerance	0.50%
Vertical Axis	Y

Hot Rolled Steel Code	AISC: ASD 9th
Cold Formed Steel Code	AISI 99: ASD
Wood Code	NDS 91/97: ASD
Wood Temperature	< 100F
Concrete Code	ACI 1999

Number of Shear Regions	4
Region Spacing Increment (in)	4
Biaxial Column Method	PCA Load Contour
Parme Beta Factor (PCA)	.65
Concrete Stress Block	Rectangular
Use Cracked Sections	Yes
Bad Framing Warnings	No
Unused Force Warnings	Yes

Hot Rolled Steel Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (\1E5 F)	Density[k/ft^3]	Yield[ksi]
1	A36	29000	11154	.3	.65	.49	36
2	A572Grade50	29000	11154	.3	.65	.49	50
3	A992	29000	11154	.3	.65	.49	50
4	A500_42	29000	11154	.3	.65	.49	42
5	A500_46	29000	11154	.3	.65	.49	46

Hot Rolled Steel Section Sets

	Label	Shape	Type	Design List	Material	Design Rules	A [in2]	Iyy [in4]	Izz [in4]	J [in4]
1	RB2	W8X10	Beam	Wide Flange	A992	Typical	2.96	2.09	30.8	.04

Hot Rolled Steel Design Parameters

	Label	Shape	Length...	Lbyy[ft]	Lbzz[ft]	Lcomp to...	Lcomp bo...	Kyy	Kzz	Cm-yy	Cm-zz	Cb	y sway	z sway	Function
1	M1	RB2	3.005												Lateral
2	M2	RB2	1.874			2									Lateral
3	M3	RB2	1.439			2									Lateral
4	M4	RB2	1.416			2									Lateral
5	M5	RB2	1.423			2									Lateral
6	M6	RB2	1.546			2									Lateral
7	M7	RB2	1.625			2									Lateral
8	M8	RB2	1.737			2									Lateral
9	M9	RB2	2.305			2									Lateral
10	M10	RB2	2.305			2									Lateral
11	M11	RB2	2.358			2									Lateral
12	M12	RB2	2.167			2									Lateral
13	M13	RB2	2.587			2									Lateral
14	M14	RB2	2.522			2									Lateral
15	M15	RB2	3.005			2									Lateral
16	M16	RB2	2.508			2									Lateral

Hot Rolled Steel Design Parameters (Continued)

	Label	Shape	Length...	Lbyy[ft]	Lbzz[ft]	Lcomp to...	Lcomp bo...	Kyy	Kzz	Cm-yy	Cm-zz	Cb	y sway	z sway	Function
17	M17	RB2	2.556			2									Lateral
18	M18	RB2	2.142			2									Lateral
19	M19	RB2	2.341			2									Lateral
20	M20	RB2	2.273			2									Lateral
21	M21	RB2	2.369			2									Lateral
22	M22	RB2	2.273			2									Lateral

Member Primary Data

	Label	I Joint	J Joint	K Joint	Rotate(deg)	Section/Shape	Type	Design List	Material	Design Rules
1	M1	N1	N17			RB2	Beam	Wide Flange	A992	Typical
2	M2	N3	N4			RB2	Beam	Wide Flange	A992	Typical
3	M3	N4	N5			RB2	Beam	Wide Flange	A992	Typical
4	M4	N5	N6			RB2	Beam	Wide Flange	A992	Typical
5	M5	N6	N7			RB2	Beam	Wide Flange	A992	Typical
6	M6	N7	N8			RB2	Beam	Wide Flange	A992	Typical
7	M7	N8	N9			RB2	Beam	Wide Flange	A992	Typical
8	M8	N9	N10			RB2	Beam	Wide Flange	A992	Typical
9	M9	N10	N11			RB2	Beam	Wide Flange	A992	Typical
10	M10	N11	N12			RB2	Beam	Wide Flange	A992	Typical
11	M11	N12	N13			RB2	Beam	Wide Flange	A992	Typical
12	M12	N13	N14			RB2	Beam	Wide Flange	A992	Typical
13	M13	N14	N15			RB2	Beam	Wide Flange	A992	Typical
14	M14	N15	N16			RB2	Beam	Wide Flange	A992	Typical
15	M15	N16	N2			RB2	Beam	Wide Flange	A992	Typical
16	M16	N17	N18			RB2	Beam	Wide Flange	A992	Typical
17	M17	N18	N19			RB2	Beam	Wide Flange	A992	Typical
18	M18	N19	N20			RB2	Beam	Wide Flange	A992	Typical
19	M19	N20	N21			RB2	Beam	Wide Flange	A992	Typical
20	M20	N21	N22			RB2	Beam	Wide Flange	A992	Typical
21	M21	N22	N23			RB2	Beam	Wide Flange	A992	Typical
22	M22	N23	N3			RB2	Beam	Wide Flange	A992	Typical

Load Combinations

	Description	Sol...	PD...	S...	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	DL+LL	Yes			Y	1	1	1	2	1										
2	(1.0+0.14Sds)DL+Eh	Yes			Y	-1.12	1	1.12	3	1										
3	(0.90)DL+1.4Eh	Yes			Y	-.9	1	.9	3	1.4										
4	(1.0+0.14Sds)DL+Omega...	Yes			Y	-1.12	1	1.12	3	3										
5	DL+Lateral WL	Yes			Y	1	1	1	4	1										

Joint Reactions (By Combination)

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	1	N1	.709	3.661	0	0	0	0
2	1	N2	-.709	3.597	0	0	0	0
3	1	Totals:	0	7.258	0			
4	1	COG (ft):	X: 12.473	Y: 10.53	Z: 0			

Member Section Forces

	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Moment[k-...	z-z Moment[k-...
1	1	M1	1	3.695	-.504	0	0	0	0
2			2	3.467	-.517	0	0	0	.767
3			3	3.239	-.53	0	0	0	1.553
4	1	M2	1	.913	.404	0	0	0	-1.395
5			2	.863	.271	0	0	0	-1.711
6			3	.812	.138	0	0	0	-1.902
7	1	M3	1	.771	.289	0	0	0	-1.902
8			2	.752	.182	0	0	0	-2.072
9			3	.733	.074	0	0	0	-2.164
10	1	M4	1	.709	.2	0	0	0	-2.164
11			2	.709	.093	0	0	0	-2.267
12			3	.709	-.015	0	0	0	-2.295
13	1	M5	1	.707	.047	0	0	0	-2.295
14			2	.717	-.06	0	0	0	-2.29
15			3	.726	-.168	0	0	0	-2.209
16	1	M6	1	.744	-.052	0	0	0	-2.209
17			2	.772	-.166	0	0	0	-2.125
18			3	.801	-.28	0	0	0	-1.953
19	1	M7	1	.833	-.157	0	0	0	-1.953
20			2	.881	-.271	0	0	0	-1.778
21			3	.928	-.385	0	0	0	-1.512
22	1	M8	1	.971	-.259	0	0	0	-1.512
23			2	1.038	-.372	0	0	0	-1.238
24			3	1.104	-.486	0	0	0	-.865
25	1	M9	1	1.174	-.28	0	0	0	-.865
26			2	1.288	-.413	0	0	0	-.465
27			3	1.402	-.546	0	0	0	.088
28	1	M10	1	1.469	-.325	0	0	0	.088
29			2	1.602	-.439	0	0	0	.528
30			3	1.734	-.553	0	0	0	1.1
31	1	M11	1	1.798	-.288	0	0	0	1.1
32			2	1.95	-.383	0	0	0	1.495
33			3	2.102	-.478	0	0	0	2.003
34	1	M12	1	2.151	-.128	0	0	0	2.003
35			2	2.303	-.192	0	0	0	2.176
36			3	2.455	-.255	0	0	0	2.417
37	1	M13	1	2.467	.075	0	0	0	2.417
38			2	2.657	.025	0	0	0	2.353
39			3	2.847	-.026	0	0	0	2.354
40	1	M14	1	2.827	.338	0	0	0	2.354
41			2	3.017	.313	0	0	0	1.943
42			3	3.207	.288	0	0	0	1.564
43	1	M15	1	3.175	.533	0	0	0	1.564
44			2	3.403	.52	0	0	0	.772
45			3	3.631	.508	0	0	0	0
46	1	M16	1	3.251	-.451	0	0	0	1.553
47			2	3.061	-.466	0	0	0	2.128
48			3	2.871	-.481	0	0	0	2.722

Member Section Forces (Continued)

	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Moment[k-...	z-z Moment[k-...
49	1	M17	1	2.909	-.104	0	0	0	2.722
50			2	2.719	-.145	0	0	0	2.882
51			3	2.529	-.185	0	0	0	3.093
52	1	M18	1	2.528	.21	0	0	0	3.093
53			2	2.376	.152	0	0	0	2.899
54			3	2.224	.094	0	0	0	2.767
55	1	M19	1	2.171	.49	0	0	0	2.767
56			2	2.019	.398	0	0	0	2.247
57			3	1.867	.306	0	0	0	1.836
58	1	M20	1	1.803	.573	0	0	0	1.836
59			2	1.67	.463	0	0	0	1.247
60			3	1.537	.353	0	0	0	.783
61	1	M21	1	1.441	.642	0	0	0	.783
62			2	1.327	.503	0	0	0	.105
63			3	1.213	.363	0	0	0	-.408
64	1	M22	1	1.122	.586	0	0	0	-.408
65			2	1.04	.434	0	0	0	-.988
66			3	.958	.282	0	0	0	-1.395

Member AISC ASD Steel Code Checks

	LC	Member	Shape	UC Max	Loc[ft]	Shear U...	Loc[ft]	Dir	Fa[ksi]	Ft[ksi]	Fby[ksi]	Fbz[ksi]	Cb	Cmy	Cmz	Eqn
1	1	M1	W8X10	.109	3.005	.020	3.005	y	25.417	30	36.762	32.705	1.75	.6	.85	H1-2
2	1	M2	W8X10	.099	1.874	.015	0	y	27.544	30	36.762	32.705	1.141	.6	.85	H1-2
3	1	M3	W8X10	.110	1.439	.011	0	y	28.241	30	36.762	32.705	1.059	.6	.85	H1-2
4	1	M4	W8X10	.116	1.315	.007	0	y	28.276	30	36.762	32.705	1	.6	.85	H1-2
5	1	M5	W8X10	.116	.334	.006	1.423	y	28.266	30	36.762	32.705	1	.6	.85	H1-2
6	1	M6	W8X10	.112	0	.010	1.546	y	28.076	30	36.762	32.705	1.056	.6	.85	H1-2
7	1	M7	W8X10	.101	0	.014	1.625	y	27.952	30	36.762	32.705	1.117	.6	.85	H1-2
8	1	M8	W8X10	.082	0	.018	1.737	y	27.772	30	36.762	32.705	1.247	.6	.85	H1-2
9	1	M9	W8X10	.054	0	.020	2.305	y	26.785	30	36.762	32.705	1.859	.6	.85	H1-2
10	1	M10	W8X10	.071	2.305	.021	2.305	y	26.785	30	36.762	32.705	1.668	.6	.85	H1-2
11	1	M11	W8X10	.118	2.358	.018	2.358	y	26.686	30	36.762	32.705	1.264	.6	.85	H1-2
12	1	M12	W8X10	.141	2.167	.009	2.167	y	27.036	30	36.762	32.705	1.086	.6	.85	H1-2
13	1	M13	W8X10	.143	2.587	.003	0	y	26.252	30	36.762	32.705	1.012	.6	.85	H1-2
14	1	M14	W8X10	.142	0	.013	0	y	26.378	30	36.762	32.705	1.185	.6	.85	H1-2
15	1	M15	W8X10	.109	0	.020	0	y	25.417	30	36.762	32.705	1.75	.6	.85	H1-2
16	1	M16	W8X10	.160	2.508	.018	2.508	y	26.405	30	36.762	32.705	1.249	.6	.85	H1-2
17	1	M17	W8X10	.174	2.556	.007	2.556	y	26.313	30	36.762	32.705	1.058	.6	.85	H1-2
18	1	M18	W8X10	.174	0	.008	0	y	27.08	30	36.762	32.705	1.051	.6	.85	H1-2
19	1	M19	W8X10	.154	0	.018	0	y	26.719	30	36.762	32.705	1.186	.6	.85	H1-2
20	1	M20	W8X10	.107	0	.021	0	y	26.844	30	36.762	32.705	1.357	.6	.85	H1-2
21	1	M21	W8X10	.053	0	.024	0	y	26.666	30	36.762	32.705	2.3	.6	.85	H1-2
22	1	M22	W8X10	.076	2.273	.022	0	y	26.843	30	36.762	32.705	1.469	.6	.85	H1-2

Joint Reactions (By Combination)

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	2	N1	.647	2.219	0	0	0	0
2	2	N2	-.122	1.744	0	0	0	0
3	2	Totals:	.526	3.963	0			
4	2	COG (ft):	X: 12.473	Y: 10.53	Z: 0			

Member Section Forces

	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Moment[k-...	z-z Moment[k-...
1	2	M1	1	2.252	-.523	0	0	0	0
2			2	2.126	-.513	0	0	0	.778
3			3	2.001	-.504	0	0	0	1.542
4	2	M2	1	.62	.409	0	0	0	.138
5			2	.583	.34	0	0	0	-.213
6			3	.545	.272	0	0	0	-.5
7	2	M3	1	.484	.37	0	0	0	-.5
8			2	.466	.313	0	0	0	-.746
9			3	.448	.255	0	0	0	-.95
10	2	M4	1	.396	.329	0	0	0	-.95
11			2	.389	.271	0	0	0	-1.162
12			3	.381	.212	0	0	0	-1.333
13	2	M5	1	.361	.244	0	0	0	-1.333
14			2	.358	.185	0	0	0	-1.486
15			3	.356	.125	0	0	0	-1.596
16	2	M6	1	.332	.18	0	0	0	-1.596
17			2	.339	.115	0	0	0	-1.71
18			3	.346	.051	0	0	0	-1.774
19	2	M7	1	.335	.102	0	0	0	-1.774
20			2	.352	.036	0	0	0	-1.831
21			3	.37	-.029	0	0	0	-1.834
22	2	M8	1	.371	.02	0	0	0	-1.834
23			2	.399	-.047	0	0	0	-1.822
24			3	.427	-.114	0	0	0	-1.752
25	2	M9	1	.44	-.035	0	0	0	-1.752
26			2	.493	-.116	0	0	0	-1.665
27			3	.545	-.197	0	0	0	-1.484
28	2	M10	1	.569	-.111	0	0	0	-1.484
29			2	.634	-.183	0	0	0	-1.315
30			3	.698	-.255	0	0	0	-1.062
31	2	M11	1	.728	-.148	0	0	0	-1.062
32			2	.804	-.211	0	0	0	-.851
33			3	.88	-.274	0	0	0	-.565
34	2	M12	1	.913	-.126	0	0	0	-.565
35			2	.992	-.172	0	0	0	-.404
36			3	1.07	-.217	0	0	0	-.193
37	2	M13	1	1.089	-.072	0	0	0	-.193
38			2	1.189	-.114	0	0	0	-.073
39			3	1.289	-.155	0	0	0	.102
40	2	M14	1	1.299	.011	0	0	0	.102
41			2	1.401	-.017	0	0	0	.105
42			3	1.502	-.044	0	0	0	.144
43	2	M15	1	1.501	.071	0	0	0	.144
44			2	1.625	.048	0	0	0	.054
45			3	1.748	.024	0	0	0	0
46	2	M16	1	2.012	-.455	0	0	0	1.542
47			2	1.908	-.449	0	0	0	2.109
48			3	1.803	-.444	0	0	0	2.669

Member Section Forces (Continued)

	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Moment[k-...	z-z Moment[k-...
49	2	M17	1	1.845	-.206	0	0	0	2.669
50			2	1.739	-.215	0	0	0	2.938
51			3	1.632	-.223	0	0	0	3.217
52	2	M18	1	1.647	.034	0	0	0	3.217
53			2	1.56	.013	0	0	0	3.193
54			3	1.472	-.008	0	0	0	3.19
55	2	M19	1	1.45	.256	0	0	0	3.19
56			2	1.36	.216	0	0	0	2.914
57			3	1.271	.177	0	0	0	2.683
58	2	M20	1	1.232	.36	0	0	0	2.683
59			2	1.151	.309	0	0	0	2.304
60			3	1.07	.258	0	0	0	1.981
61	2	M21	1	1.001	.459	0	0	0	1.981
62			2	.929	.391	0	0	0	1.477
63			3	.856	.324	0	0	0	1.054
64	2	M22	1	.78	.48	0	0	0	1.054
65			2	.724	.403	0	0	0	.552
66			3	.668	.326	0	0	0	.138

Member AISC ASD Steel Code Checks

	LC	Member	Shape	UC Max	Loc[ft]	Shear U...	Loc[ft]	Dir	Fa[ksi]	Ft[ksi]	Fby[ksi]	Fbz[ksi]	Cb	Cmy	Cmz	Eqn
1	2	M1	W8X10	.095	3.005	.019	0	y	25.417	30	36.762	32.705	1.75	.6	.85	H1-2
2	2	M2	W8X10	.030	1.874	.015	0	y	27.544	30	36.762	32.705	2.063	.6	.85	H1-2
3	2	M3	W8X10	.050	1.439	.014	0	y	28.241	30	36.762	32.705	1.28	.6	.85	H1-2
4	2	M4	W8X10	.067	1.416	.012	0	y	28.276	30	36.762	32.705	1.154	.6	.85	H1-2
5	2	M5	W8X10	.079	1.423	.009	0	y	28.266	30	36.762	32.705	1.082	.6	.85	H1-2
6	2	M6	W8X10	.087	1.546	.007	0	y	28.076	30	36.762	32.705	1.048	.6	.85	H1-2
7	2	M7	W8X10	.091	1.327	.004	0	y	27.952	30	36.762	32.705	1	.6	.85	H1-2
8	2	M8	W8X10	.091	.354	.004	1.737	y	27.772	30	36.762	32.705	1	.6	.85	H1-2
9	2	M9	W8X10	.087	0	.007	2.305	y	26.785	30	36.762	32.705	1.076	.6	.85	H1-2
10	2	M10	W8X10	.076	0	.010	2.305	y	26.785	30	36.762	32.705	1.152	.6	.85	H1-2
11	2	M11	W8X10	.058	0	.010	2.358	y	26.686	30	36.762	32.705	1.276	.6	.85	H1-2
12	2	M12	W8X10	.037	0	.008	2.167	y	27.036	30	36.762	32.705	1.426	.6	.85	H1-2
13	2	M13	W8X10	.022	0	.006	2.587	y	26.252	30	36.762	32.705	1	.6	.85	H1-1
14	2	M14	W8X10	.025	2.522	.002	2.522	y	26.378	30	36.762	32.705	1	.6	.85	H1-1
15	2	M15	W8X10	.026	0	.003	0	y	25.417	30	36.762	32.705	1	.6	.85	H1-1
16	2	M16	W8X10	.146	2.508	.017	0	y	26.405	30	36.762	32.705	1.244	.6	.85	H1-2
17	2	M17	W8X10	.170	2.556	.008	2.556	y	26.313	30	36.762	32.705	1.085	.6	.85	H1-2
18	2	M18	W8X10	.170	0	.001	0	y	27.08	30	36.762	32.705	1.004	.6	.85	H1-2
19	2	M19	W8X10	.166	0	.010	0	y	26.719	30	36.762	32.705	1.079	.6	.85	H1-2
20	2	M20	W8X10	.140	0	.013	0	y	26.844	30	36.762	32.705	1.138	.6	.85	H1-2
21	2	M21	W8X10	.104	0	.017	0	y	26.666	30	36.762	32.705	1.276	.6	.85	H1-2
22	2	M22	W8X10	.058	0	.018	0	y	26.843	30	36.762	32.705	1.618	.6	.85	H1-2

Joint Deflections

	LC	Joint Label	X [in]	Y [in]	Z [in]	X Rotation [rad]	Y Rotation [rad]	Z Rotation [rad]
1	3	N1	0	0	0	0	0	5.529e-3
2	3	N2	0	0	0	0	0	3.508e-3
3	3	N3	-.483	.013	0	0	0	-1.8e-3
4	3	N4	-.468	-.027	0	0	0	-1.881e-3
5	3	N5	-.463	-.059	0	0	0	-1.796e-3
6	3	N6	-.463	-.088	0	0	0	-1.595e-3
7	3	N7	-.465	-.113	0	0	0	-1.29e-3
8	3	N8	-.47	-.133	0	0	0	-8.675e-4
9	3	N9	-.475	-.144	0	0	0	-3.497e-4
10	3	N10	-.476	-.145	0	0	0	2.492e-4
11	3	N11	-.464	-.131	0	0	0	1.054e-3
12	3	N12	-.434	-.105	0	0	0	1.797e-3
13	3	N13	-.382	-.073	0	0	0	2.431e-3
14	3	N14	-.318	-.046	0	0	0	2.873e-3
15	3	N15	-.226	-.021	0	0	0	3.232e-3
16	3	N16	-.125	-.007	0	0	0	3.426e-3
17	3	N17	-.196	.01	0	0	0	5.125e-3
18	3	N18	-.338	.021	0	0	0	4.212e-3
19	3	N19	-.446	.043	0	0	0	2.904e-3
20	3	N20	-.501	.064	0	0	0	1.686e-3
21	3	N21	-.526	.079	0	0	0	4.211e-4
22	3	N22	-.524	.076	0	0	0	-6.142e-4
23	3	N23	-.505	.053	0	0	0	-1.395e-3

Member AISC ASD Steel Code Checks

	LC	Member	Shape	UC Max	Loc[ft]	Shear U...	Loc[ft]	Dir	Fa[ksi]	Ft[ksi]	Fby[ksi]	Fbz[ksi]	Cb	Cmy	Cmz	Eqn
1	3	M1	W8X10	.097	3.005	.021	0	y	25.417	30	36.762	32.705	1.75	.6	.85	H1-2
2	3	M2	W8X10	.037	0	.016	0	y	27.544	30	36.762	32.705	1.885	.6	.85	H1-2
3	3	M3	W8X10	.034	1.439	.016	0	y	28.241	30	36.762	32.705	1.62	.6	.85	H1-2
4	3	M4	W8X10	.056	1.416	.015	0	y	28.276	30	36.762	32.705	1.257	.6	.85	H1-2
5	3	M5	W8X10	.074	1.423	.012	0	y	28.266	30	36.762	32.705	1.138	.6	.85	H1-2
6	3	M6	W8X10	.089	1.546	.010	0	y	28.076	30	36.762	32.705	1.091	.6	.85	H1-2
7	3	M7	W8X10	.100	1.625	.007	0	y	27.952	30	36.762	32.705	1.053	.6	.85	H1-2
8	3	M8	W8X10	.105	1.737	.004	0	y	27.772	30	36.762	32.705	1	.6	.85	H1-2
9	3	M9	W8X10	.106	.823	.004	2.305	y	26.785	30	36.762	32.705	1	.6	.85	H1-2
10	3	M10	W8X10	.103	0	.007	2.305	y	26.785	30	36.762	32.705	1.06	.6	.85	H1-2
11	3	M11	W8X10	.092	0	.008	2.358	y	26.686	30	36.762	32.705	1.112	.6	.85	H1-2
12	3	M12	W8X10	.074	0	.008	2.167	y	27.036	30	36.762	32.705	1.142	.6	.85	H1-2
13	3	M13	W8X10	.058	0	.008	2.587	y	26.252	30	36.762	32.705	1.235	.6	.85	H1-2
14	3	M14	W8X10	.039	0	.006	2.522	y	26.378	30	36.762	32.705	1.305	.6	.85	H1-2
15	3	M15	W8X10	.027	0	.005	3.005	y	25.417	30	36.762	32.705	1.75	.6	.85	H1-2
16	3	M16	W8X10	.152	2.508	.018	0	y	26.405	30	36.762	32.705	1.242	.6	.85	H1-2
17	3	M17	W8X10	.181	2.556	.009	0	y	26.313	30	36.762	32.705	1.094	.6	.85	H1-2
18	3	M18	W8X10	.183	2.142	.002	2.142	y	27.08	30	36.762	32.705	1.009	.6	.85	H1-2
19	3	M19	W8X10	.182	0	.007	0	y	26.719	30	36.762	32.705	1.055	.6	.85	H1-2
20	3	M20	W8X10	.161	0	.012	0	y	26.844	30	36.762	32.705	1.104	.6	.85	H1-2
21	3	M21	W8X10	.129	0	.016	0	y	26.666	30	36.762	32.705	1.202	.6	.85	H1-2
22	3	M22	W8X10	.084	0	.018	0	y	26.843	30	36.762	32.705	1.376	.6	.85	H1-2

Joint Reactions (By Combination)

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	4	N1	1.167	2.659	0	0	0	0
2	4	N2	.41	1.305	0	0	0	0
3	4	Totals:	1.577	3.963	0			
4	4	COG (ft):	X: 12.473	Y: 10.53	Z: 0			

Member Section Forces

	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Moment[k-...	z-z Moment[k-...
1	4	M1	1	2.72	-1.017	0	0	0	0
2			2	2.592	-.975	0	0	0	1.497
3			3	2.465	-.932	0	0	0	2.929
4	4	M2	1	.863	.787	0	0	0	1.937
5			2	.807	.726	0	0	0	1.229
6			3	.75	.664	0	0	0	.577
7	4	M3	1	.61	.794	0	0	0	.577
8			2	.576	.74	0	0	0	.026
9			3	.543	.685	0	0	0	-.487
10	4	M4	1	.415	.769	0	0	0	-.487
11			2	.392	.71	0	0	0	-1.011
12			3	.369	.652	0	0	0	-1.493
13	4	M5	1	.31	.681	0	0	0	-1.493
14			2	.292	.621	0	0	0	-1.956
15			3	.274	.56	0	0	0	-2.376
16	4	M6	1	.183	.596	0	0	0	-2.376
17			2	.173	.527	0	0	0	-2.81
18			3	.164	.459	0	0	0	-3.191
19	4	M7	1	.094	.478	0	0	0	-3.191
20			2	.095	.406	0	0	0	-3.55
21			3	.096	.333	0	0	0	-3.85
22	4	M8	1	.051	.343	0	0	0	-3.85
23			2	.063	.266	0	0	0	-4.114
24			3	.074	.19	0	0	0	-4.312
25	4	M9	1	.039	.2	0	0	0	-4.312
26			2	.072	.103	0	0	0	-4.486
27			3	.106	.005	0	0	0	-4.548
28	4	M10	1	.104	.021	0	0	0	-4.548
29			2	.151	-.07	0	0	0	-4.521
30			3	.199	-.161	0	0	0	-4.388
31	4	M11	1	.221	-.129	0	0	0	-4.388
32			2	.283	-.214	0	0	0	-4.185
33			3	.346	-.299	0	0	0	-3.883
34	4	M12	1	.39	-.239	0	0	0	-3.883
35			2	.459	-.306	0	0	0	-3.588
36			3	.528	-.374	0	0	0	-3.219
37	4	M13	1	.574	-.3	0	0	0	-3.219
38			2	.666	-.369	0	0	0	-2.787
39			3	.759	-.438	0	0	0	-2.265
40	4	M14	1	.809	-.337	0	0	0	-2.265
41			2	.907	-.392	0	0	0	-1.806
42			3	1.005	-.447	0	0	0	-1.277
43	4	M15	1	1.036	-.369	0	0	0	-1.277
44			2	1.158	-.425	0	0	0	-.681
45			3	1.28	-.481	0	0	0	0
46	4	M16	1	2.487	-.872	0	0	0	2.929
47			2	2.38	-.839	0	0	0	4.002
48			3	2.273	-.806	0	0	0	5.034

Member Section Forces (Continued)

	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Moment[k-...	z-z Moment[k-...
49	4	M17	1	2.358	-.504	0	0	0	5.034
50			2	2.246	-.485	0	0	0	5.667
51			3	2.133	-.466	0	0	0	6.275
52	4	M18	1	2.18	-.129	0	0	0	6.275
53			2	2.084	-.127	0	0	0	6.412
54			3	1.989	-.126	0	0	0	6.548
55	4	M19	1	1.979	.232	0	0	0	6.548
56			2	1.876	.214	0	0	0	6.287
57			3	1.773	.197	0	0	0	6.046
58	4	M20	1	1.726	.452	0	0	0	6.046
59			2	1.629	.421	0	0	0	5.55
60			3	1.533	.39	0	0	0	5.089
61	4	M21	1	1.429	.677	0	0	0	5.089
62			2	1.337	.626	0	0	0	4.317
63			3	1.244	.574	0	0	0	3.607
64	4	M22	1	1.113	.799	0	0	0	3.607
65			2	1.035	.734	0	0	0	2.735
66			3	.958	.669	0	0	0	1.937

Joint Reactions (By Combination)

	LC	Joint Label	X [k]	Y [k]	Z [k]	MX [k-ft]	MY [k-ft]	MZ [k-ft]
1	5	N1	1.049	2.222	0	0	0	0
2	5	N2	1.108	.355	0	0	0	0
3	5	Totals:	2.157	2.576	0			
4	5	COG (ft):	X: 12.473	Y: 10.53	Z: 0			

Member Section Forces

	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Moment[k-...	z-z Moment[k-...
1	5	M1	1	2.277	-.924	0	0	0	0
2			2	2.195	-.916	0	0	0	1.382
3			3	2.114	-.909	0	0	0	2.752
4	5	M2	1	1.253	.775	0	0	0	3.861
5			2	1.228	.731	0	0	0	3.155
6			3	1.203	.686	0	0	0	2.491
7	5	M3	1	1.051	.902	0	0	0	2.491
8			2	1.038	.865	0	0	0	1.856
9			3	1.026	.828	0	0	0	1.247
10	5	M4	1	.866	.993	0	0	0	1.247
11			2	.81	.955	0	0	0	.557
12			3	.755	.917	0	0	0	-.106
13	5	M5	1	.671	.98	0	0	0	-.106
14			2	.618	.937	0	0	0	-.787
15			3	.566	.894	0	0	0	-1.438
16	5	M6	1	.419	.971	0	0	0	-1.438
17			2	.37	.916	0	0	0	-2.168
18			3	.321	.86	0	0	0	-2.854
19	5	M7	1	.189	.899	0	0	0	-2.854
20			2	.146	.834	0	0	0	-3.558
21			3	.104	.768	0	0	0	-4.209
22	5	M8	1	.001	.775	0	0	0	-4.209
23			2	-.035	.7	0	0	0	-4.85
24			3	-.07	.625	0	0	0	-5.425
25	5	M9	1	-.181	.603	0	0	0	-5.425
26			2	-.21	.496	0	0	0	-6.058
27			3	-.239	.39	0	0	0	-6.569
28	5	M10	1	-.296	.349	0	0	0	-6.569
29			2	-.308	.239	0	0	0	-6.908
30			3	-.32	.13	0	0	0	-7.12
31	5	M11	1	-.336	.08	0	0	0	-7.12
32			2	-.331	-.032	0	0	0	-7.148
33			3	-.326	-.145	0	0	0	-7.044
34	5	M12	1	-.298	-.196	0	0	0	-7.044
35			2	-.277	-.298	0	0	0	-6.776
36			3	-.256	-.399	0	0	0	-6.398
37	5	M13	1	-.201	-.43	0	0	0	-6.398
38			2	-.16	-.547	0	0	0	-5.767
39			3	-.119	-.663	0	0	0	-4.984
40	5	M14	1	-.033	-.673	0	0	0	-4.984
41			2	.022	-.781	0	0	0	-4.067
42			3	.076	-.889	0	0	0	-3.014
43	5	M15	1	.144	-.88	0	0	0	-3.014
44			2	.218	-1.003	0	0	0	-1.6
45			3	.292	-1.126	0	0	0	0
46	5	M16	1	2.135	-.857	0	0	0	2.752
47			2	2.067	-.852	0	0	0	3.824
48			3	1.999	-.848	0	0	0	4.89

Member Section Forces (Continued)

	LC	Member Label	Sec	Axial[k]	y Shear[k]	z Shear[k]	Torque[k-ft]	y-y Moment[k-...	z-z Moment[k-...
49	5	M17	1	2.092	-.581	0	0	0	4.89
50			2	2.022	-.586	0	0	0	5.636
51			3	1.953	-.59	0	0	0	6.387
52	5	M18	1	2.021	-.279	0	0	0	6.387
53			2	1.964	-.292	0	0	0	6.693
54			3	1.907	-.304	0	0	0	7.012
55	5	M19	1	1.93	.042	0	0	0	7.012
56			2	1.872	.017	0	0	0	6.977
57			3	1.813	-.008	0	0	0	6.972
58	5	M20	1	1.795	.256	0	0	0	6.972
59			2	1.742	.223	0	0	0	6.7
60			3	1.689	.191	0	0	0	6.464
61	5	M21	1	1.62	.512	0	0	0	6.464
62			2	1.573	.469	0	0	0	5.883
63			3	1.525	.425	0	0	0	5.353
64	5	M22	1	1.417	.706	0	0	0	5.353
65			2	1.38	.657	0	0	0	4.579
66			3	1.343	.607	0	0	0	3.861

Joint Deflections

	LC	Joint Label	X [in]	Y [in]	Z [in]	X Rotation [rad]	Y Rotation [rad]	Z Rotation [rad]
1	5	N1	0	0	0	0	0	1.267e-2
2	5	N2	0	0	0	0	0	1.296e-2
3	5	N3	-1.351	.203	0	0	0	-3.203e-3
4	5	N4	-1.321	.123	0	0	0	-4.159e-3
5	5	N5	-1.308	.047	0	0	0	-4.59e-3
6	5	N6	-1.308	-.033	0	0	0	-4.718e-3
7	5	N7	-1.316	-.113	0	0	0	-4.539e-3
8	5	N8	-1.335	-.192	0	0	0	-4.e-3
9	5	N9	-1.362	-.257	0	0	0	-3.07e-3
10	5	N10	-1.388	-.302	0	0	0	-1.716e-3
11	5	N11	-1.4	-.316	0	0	0	5.278e-4
12	5	N12	-1.363	-.284	0	0	0	3.087e-3
13	5	N13	-1.256	-.217	0	0	0	5.796e-3
14	5	N14	-1.088	-.147	0	0	0	8.157e-3
15	5	N15	-.805	-.072	0	0	0	1.055e-2
16	5	N16	-.46	-.026	0	0	0	1.22e-2
17	5	N17	-.45	.024	0	0	0	1.2e-2
18	5	N18	-.791	.051	0	0	0	1.046e-2
19	5	N19	-1.073	.11	0	0	0	8.132e-3
20	5	N20	-1.242	.174	0	0	0	5.82e-3
21	5	N21	-1.35	.239	0	0	0	3.185e-3
22	5	N22	-1.391	.272	0	0	0	7.284e-4
23	5	N23	-1.383	.262	0	0	0	-1.522e-3

Member Section Deflections

	LC	Member Label	Sec	x [in]	y [in]	z [in]	x Rotate[rad]	(n) L/y Ratio	(n) L/z Ratio
1	5	M1	1	0	0	0	0	NC	NC
2			2	0	.229	0	0	NC	NC
3			3	0	.451	0	0	NC	NC
4	5	M2	1	-1.19	.672	0	0	NC	NC
5			2	-1.19	.633	0	0	8383.613	NC
6			3	-1.19	.588	0	0	NC	NC
7	5	M3	1	-1.28	.351	0	0	NC	NC
8			2	-1.28	.313	0	0	NC	NC

Member Section Deflections (Continued)

	LC	Member Label	Sec	x [in]	y [in]	z [in]	x Rotate[rad]	(n) L/y Ratio	(n) L/z Ratio
9			3	-1.28	.274	0	0	NC	NC
10	5	M4	1	-1.308	.047	0	0	NC	NC
11			2	-1.308	.007	0	0	NC	NC
12			3	-1.308	-.033	0	0	NC	NC
13	5	M5	1	-1.3	-.148	0	0	NC	NC
14			2	-1.3	-.189	0	0	NC	NC
15			3	-1.3	-.229	0	0	NC	NC
16	5	M6	1	-1.249	-.429	0	0	NC	NC
17			2	-1.249	-.471	0	0	NC	NC
18			3	-1.249	-.51	0	0	NC	NC
19	5	M7	1	-1.159	-.691	0	0	NC	NC
20			2	-1.159	-.728	0	0	8593.395	NC
21			3	-1.159	-.761	0	0	NC	NC
22	5	M8	1	-1.047	-.909	0	0	NC	NC
23			2	-1.047	-.938	0	0	5898.931	NC
24			3	-1.047	-.96	0	0	NC	NC
25	5	M9	1	-.858	-1.133	0	0	NC	NC
26			2	-.858	-1.15	0	0	3559.6	NC
27			3	-.858	-1.151	0	0	NC	NC
28	5	M10	1	-.672	-1.269	0	0	NC	NC
29			2	-.672	-1.253	0	0	3121.442	NC
30			3	-.672	-1.22	0	0	NC	NC
31	5	M11	1	-.482	-1.306	0	0	NC	NC
32			2	-.482	-1.253	0	0	2947.849	NC
33			3	-.482	-1.18	0	0	NC	NC
34	5	M12	1	-.283	-1.243	0	0	NC	NC
35			2	-.282	-1.16	0	0	3384.715	NC
36			3	-.282	-1.061	0	0	NC	NC
37	5	M13	1	-.138	-1.089	0	0	NC	NC
38			2	-.138	-.952	0	0	3332.996	NC
39			3	-.138	-.796	0	0	NC	NC
40	5	M14	1	-.035	-.807	0	0	NC	NC
41			2	-.035	-.639	0	0	4851.331	NC
42			3	-.035	-.459	0	0	NC	NC
43	5	M15	1	0	-.46	0	0	NC	NC
44			2	0	-.234	0	0	NC	NC
45			3	0	0	0	0	NC	NC
46	5	M16	1	-.012	.451	0	0	NC	NC
47			2	-.012	.628	0	0	5174.39	NC
48			3	-.013	.793	0	0	NC	NC
49	5	M17	1	-.115	.784	0	0	NC	NC
50			2	-.116	.937	0	0	3444.144	NC
51			3	-.116	1.072	0	0	NC	NC
52	5	M18	1	-.282	1.041	0	0	NC	NC
53			2	-.282	1.139	0	0	3460.749	NC
54			3	-.282	1.222	0	0	NC	NC
55	5	M19	1	-.496	1.151	0	0	NC	NC
56			2	-.497	1.224	0	0	3037.337	NC
57			3	-.497	1.278	0	0	NC	NC
58	5	M20	1	-.677	1.192	0	0	NC	NC
59			2	-.677	1.227	0	0	3257.551	NC
60			3	-.678	1.245	0	0	NC	NC
61	5	M21	1	-.904	1.091	0	0	NC	NC
62			2	-.904	1.093	0	0	3557.533	NC
63			3	-.905	1.078	0	0	NC	NC
64	5	M22	1	-1.092	.887	0	0	NC	NC
65			2	-1.093	.86	0	0	4762.996	NC

Member Section Deflections (Continued)

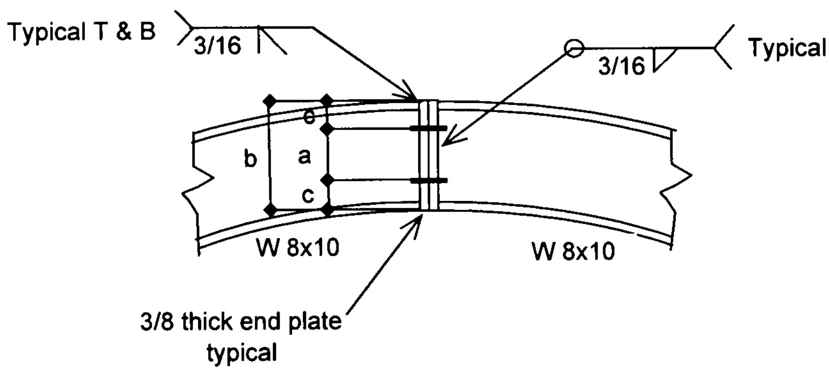
	LC	Member Label	Sec	x [in]	y [in]	z [in]	x Rotate[rad]	(n) L/y Ratio	(n) L/z Ratio
66			3	-1.093	.82	0	0	NC	NC

Member AISC ASD Steel Code Checks

	LC	Member	Shape	UC Max	Loc[ft]	Shear U...	Loc[ft]	Dir	Fa[ksi]	Ft[ksi]	Fby[ksi]	Fbz[ksi]	Cb	Cmy	Cmz	Eqn
1	5	M1	W8X10	.153	3.005	.034	0	y	25.417	30	36.762	32.705	1.75	.6	.85	H1-2
2	5	M2	W8X10	.196	0	.029	0	y	27.544	30	36.762	32.705	1.197	.6	.85	H1-2
3	5	M3	W8X10	.129	0	.034	0	y	28.241	30	36.762	32.705	1.3	.6	.85	H1-2
4	5	M4	W8X10	.068	0	.037	0	y	28.276	30	36.762	32.705	1.841	.6	.85	H1-2
5	5	M5	W8X10	.074	1.423	.037	0	y	28.266	30	36.762	32.705	1.674	.6	.85	H1-2
6	5	M6	W8X10	.138	1.546	.036	0	y	28.076	30	36.762	32.705	1.297	.6	.85	H1-2
7	5	M7	W8X10	.199	1.625	.034	0	y	27.952	30	36.762	32.705	1.176	.6	.85	H1-2
8	5	M8	W8X10	.256	1.737	.029	0	y	27.772	30	36.762	32.705	1.116	.6	.85	H2-1
9	5	M9	W8X10	.311	2.305	.022	0	y	26.785	30	36.762	32.705	1.087	.6	.85	H2-1
10	5	M10	W8X10	.338	2.305	.013	0	y	26.785	30	36.762	32.705	1.037	.6	.85	H2-1
11	5	M11	W8X10	.340	.842	.005	2.358	y	26.686	30	36.762	32.705	1	.6	.85	H2-1
12	5	M12	W8X10	.334	0	.015	2.167	y	27.036	30	36.762	32.705	1.044	.6	.85	H2-1
13	5	M13	W8X10	.303	0	.025	2.587	y	26.252	30	36.762	32.705	1.114	.6	.85	H2-1
14	5	M14	W8X10	.235	0	.033	2.522	y	26.378	30	36.762	32.705	1.225	.6	.85	H2-1
15	5	M15	W8X10	.143	0	.042	3.005	y	25.417	30	36.762	32.705	1.75	.6	.85	H1-2
16	5	M16	W8X10	.252	2.508	.032	0	y	26.405	30	36.762	32.705	1.254	.6	.85	H1-2
17	5	M17	W8X10	.322	2.556	.022	2.556	y	26.313	30	36.762	32.705	1.122	.6	.85	H1-2
18	5	M18	W8X10	.351	2.142	.011	2.142	y	27.08	30	36.762	32.705	1.042	.6	.85	H1-2
19	5	M19	W8X10	.351	0	.002	0	y	26.719	30	36.762	32.705	1.003	.6	.85	H1-2
20	5	M20	W8X10	.348	0	.010	0	y	26.844	30	36.762	32.705	1.034	.6	.85	H1-2
21	5	M21	W8X10	.322	0	.019	0	y	26.666	30	36.762	32.705	1.086	.6	.85	H1-2
22	5	M22	W8X10	.268	0	.026	0	y	26.843	30	36.762	32.705	1.149	.6	.85	H1-2

OMRF2 - MOMENT RESISTING FRAME CONNECTION 1

Beam RB2 (Moment Connection)



Geomtery:

a =	4.00	inches
b =	7.89	inches
c =	1.95	inches

Beam to Column Connection Due to Seismic with Overstrength Factor Ω_o applied

Load Combination for Beam to Column Connection: $(1.0+0.14S_{DS})DL+\Omega_o Eh$

Where: $M_S =$ 6.55 k-ft From RISA LC-3)

$V_S =$ 1.994 k From RISA LC-3)

$\Omega_o =$ 3.00

Beam End Moment Connection Due to Wind Load)

Load Combination for Beam to Column Connection: $DL+w_{WIND}$

Where: $M_W =$ 7.15 k-ft From RISA LC-4)

$V_W =$ 0.333 k From RISA LC-4)

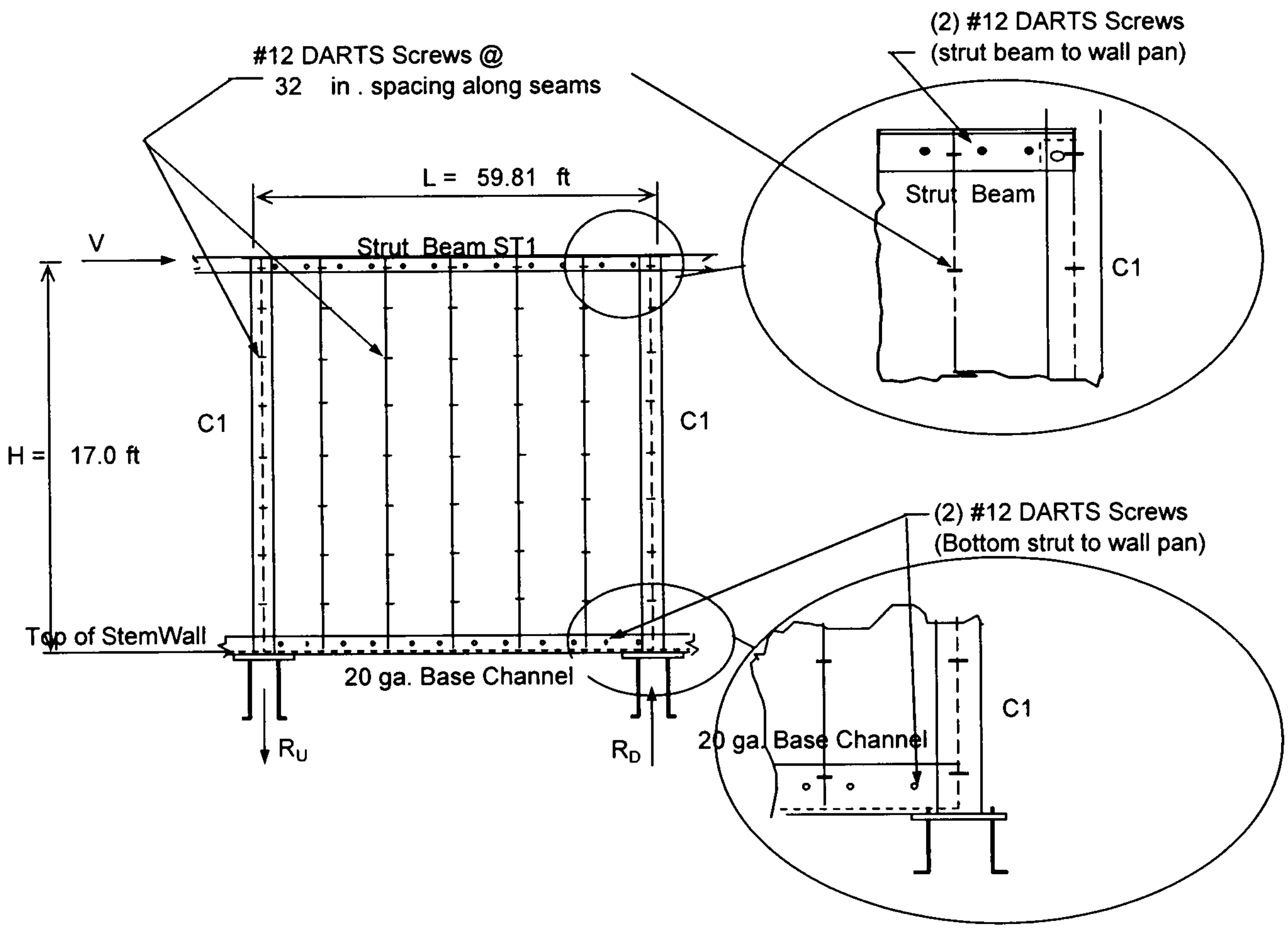
(Seismic Force Controls)

Bolts Required: (Try 3/4" diam. A325 Bolts, Allowable Tension load = 26.5 kips)

Bolts @ T & B Plate to Beam Flanges = M / a /26.5 kips = 0.809 ea.

(Use 2 - 3/4 " A325 Bolts @ 4" o.c.)

Vertical Shear Wall SW1 - Sketch & Loads 1



Loads

Maximum V = $Vy_{(CW)}$ = 2052 lbs N-S Seismic Controls:

$R_{U(SEISMIC)} = R_{D(SEISMIC)}$ = (V)(H)/L = 583 lbs (use to check bldg. uplift/overturning)

$R_{D(DL)}$ = 48 lbs (= reaction @ RB3)

Max R_D = 631 lbs (use to check column & footing soil bearing)

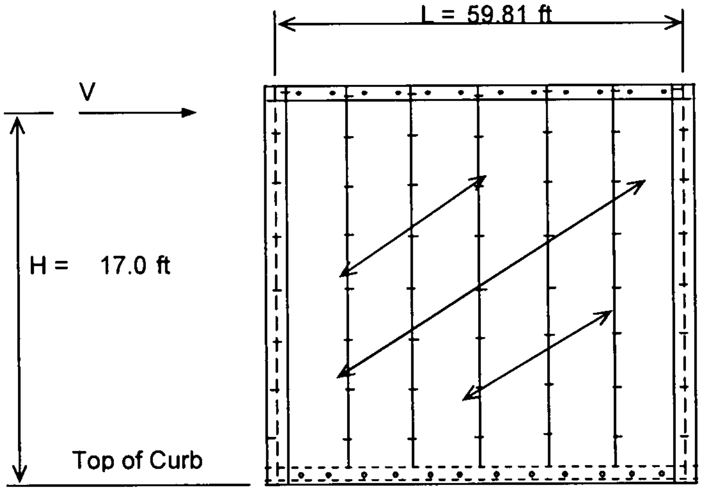
Max shear per foot (υ) = V/L = 34.31 plf

Shear Wall Design

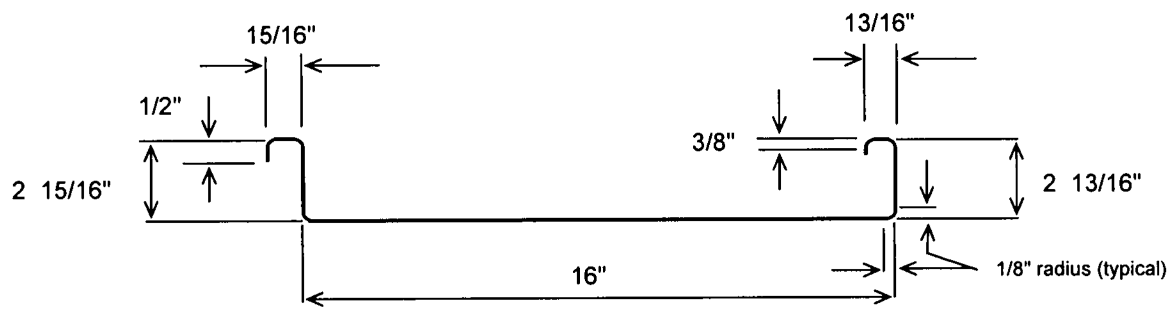
The gauge metal panels and top and bottom struts are designed to transfer the lateral load to the columns at either end of the panel section as down load, uplift, & shear.

The vertical component of the shear is transferred by the mechanical fasteners (#12 DARTS screws) at an appropriate spacing. Test values are available for these screws & 1/4 of this value is used for design (see sheet SMS-1 in this package).

The horizontal component of the shear is transferred by the flat surface of the wall panels to the top and bottom struts, which in turn transfer it to the TS columns.



V = 2052 lbs
No. panels required = n = L/1.33' = 44.8



Typ #20 Gauge Galvanized Wall Panel Section

Material = ASTM A446 Gr. D

Fy = 40000 psi

Fb = 24000 psi

t = 0.036 in

Shear Wall Design, cont.

Design Code: 2001 Edition AISI Specification for the Design of Cold-Formed Steel Structural Members

Allowable shear per AISI Cold-Formed Spec. Section C3.2:

h/t = 444.4

$A = 1.38[(E)(k_v)/F_y]^{1/2} =$ 85.87

Where: $k_v =$ 5.34

Since h/t > A, allowable shear on panel $(V_a) = 1.33(0.53Ek_vt^3/h) =$ 239 lbs

(1/3 increase included for wind/earthquake forces)

Max. allowable shear per foot of panel = $Q_a = [(V_a)(12\text{ in/ft})]/(16\text{"/panel}) =$ **179 plf**

Max. actual shear per foot of panel = Q = V/L = **34.3 plf**

Since Q < Qa, Use #20 ga. Shear Wall Panels

#12 DARTS Screw Spacing Along Panel Seams and Panel Seams to End Columns

Allowable shear value, $v_{sms} =$ 232 lbs/screw

Min. req'd spacing = (s)(12in/ft)/Q = 81.1 in

Actual spacing (use max of 24") = 32 in

#12 DARTS Screws @ Top & Bottom of Shear Wall Panels

Actual shear @ top & bottom of each panel (x) = (Q)(16") = 46 lbs

Allowable shear value, $v_{sms} =$ 232 lbs/screw

Shear strength of two #12 DARTS screws (y) = 464 lbs

Since y > x, Use (2) #12 DARTS Screws @ Top & Bottom Ea. Panel

Anchor Bolts for OMRF1 and OMRF2

1 Use "Strength Design" per CBC Section 1912A *(with Reference to Appendix D of ACI 318)*

Trial Input Data

Bolt Diameter, d_o =	0.75	in dia.
Bolt Head or Nut Diameter, d_h =	1.125	in dia.
Cross-sectional area of bolt (A_{se}) =	0.334	in^2
Edge of Continuous Grade Beam footing =	1.25	ft
Edge of square alternate spread footing =	0.0	ft
Spacing between Anchor Bolts (s_1) =	0.833	ft
No. tens. bolts per Base Plate (n) =	2	
f'c of concrete =	3000	psi
Seismic Factor for Strength =	0.277	
Seismic Uplift (UPs) =	0.583	k
Horz seismic force (Hs) =	1.492	k
Wind Uplift (UPw) =	1.7	k
Horz wind force (Hw) =	3.709	k
Vertical DL (P) =	1.9	k

Where:
LL = M2/(s*n)
DL' = P/N
W = Mw/(s*n)
DL = M1/(s*n)

WIND CONDITIONS GOVERN

Required Embedment Depth

Min. req'd embedment depth of A.B., h_{ef} = 7.5 inches (to develop truncated pyramid failure surface)

Is anchor bolt embedment depth > h_{ef} = 7.5 in ? (y/n) y

For Headed or Threaded and Nutted Anchor:

Required Tensile Strength per Bolt (Nu) Nu = max of:

Case 1: Nua = [(1.2DL+LL+1.6W-1.2DL')] = **1.61 k**

Case 2: Nua = (1.6W - 1.2DL') = 1.61 k

Design Strength in Tension

ϕN_n = min of ϕN_{sa} or ϕN_{cb} or ϕN_{pn} or ϕN_{sb} = **11.273 k**

1) **Design Steel Strength of Anchor in Tension**

$0.75\phi N_{sa} = 0.75\phi A_{se} f_{uta}$ = 11.27 k

Where: f_{uta} = 60 ksi

A_{se} = 0.334

2) **Design Concrete Breakout Strength of Anchor in Tension**

$0.75\phi N_{cb} = 0.75\phi(A_{Nc}/A_{Nco})\psi_{ed}\psi_{cp}\psi_c N_b$ = 15.356 k

$A_{Nc} = (1.5h_{ef}+s_1+1.5h_{ef})(2)(c_{a1})$ = 487 in^2

$A_{Nco} = 9h_{ef}^2$ = 506.25 in^2

$N_b = k_c(f'_c)^{0.5}(h_{ef})^{1.5}$ = 27.00 k

Where:

$\phi_{(ductile\ stl)}$ = 0.75 (Tension Loads)

$\phi_{(concrete)}$ = 0.70 (Tension Loads)

k_c = 24.0

h_{ef} = 7.5 in

f'_c = 3000 psi

$\psi_{ed} = 0.7+0.3(c_{min}/1.5h_{ef})$ = 0.90

c_{min} = 7.5 in

ψ_{cp} = 1.00

ψ_c = 1.25

$c_{a1} = c_{a2}$ = 7.5 in

s_1 = 10.00 in

Anchor Bolts for OMRF1 and OMRF2 ,cont

3) Design Pullout Strength of Anchor in Tension

$0.75N_{pn} = \psi_{c,p}N_p =$ 11.777

Where: $N_p = 8A_{brg}f'_c =$ 15.703 kips

$A_{brg.} = A_h - \pi d_o^2/4 =$ 0.65 in.

$d_o =$ 0.75 in.

$A_h =$ 1.096 in^2

$\psi_{c,p} =$ 1.0

4) Design Concrete Side-Face Blowout Strength of Anchor in Tension

$0.75\phi N_{sb} = 0.75\ \phi 160c_{a1}\ (A_{brg})^{0.5}(f'c)^{0.5} =$ 33.892 kips

Where: $c_{a1} = c_{a2} =$ 7.5 in

$A_{brg.} = A_h - \pi d_o^2/4 =$ 0.65 in.

$\phi_{\text{(concrete)}} =$ 0.85 (Tension Loads)

$f'_c =$ 3000 psi

Required Shear Strength per Bolt (V_{ua})

Horizontal load on column = 3.7 k

Vua = (1.3W)/n = **2.41 k**

Design Strength in Shear

ϕV_n = min of ϕV_{sa} or ϕV_{cb} = **3.85 k**

1) Design Steel Strength of Anchor in Shear

$0.75\phi V_{sa} = 0.75\phi(0.6A_{se}f_{uta}) =$ 5.47 k

2) Design Concrete Breakout Strength of Anchor in Shear

$0.75\phi V_{cb} = 0.75\phi(A_{vc}/A_{vco})\psi_{ed,V}\psi_{c,v}V_b =$ 3.85 k

3) Design Concrete Pryout Strength of Anchor in Shear

$0.75\phi V_{cp} = 0.75\phi K_{cp}N_{cb} =$ 30.712 k

Where:

$\phi_{\text{(ductile stl)}} =$ 0.65 (Shear Loads)

$\phi_{\text{(concrete)}} =$ 0.70 (Shear Loads)

$A_{se} =$ 0.33

$f_{uta} =$ 60 ksi

$A_{vc} =$ 159 in^2

$A_{vco} = 4.5c_{a1}^2 =$ 253.1 in^2

$c_{a1} = c_{a2} =$ 7.5 in

$\ell_e =$ 7.5 in

$d_o =$ 0.75 in

$f'_c =$ 3000 psi

$\psi_{ed,v} = 0.7+0.3(c_{a2}/1.5c_{a1}) =$ 0.90

$\psi_{c,v} =$ 1.20

$V_b = 7[\ell_e/d_o]^{0.2}(d_o)^{0.5}(f'_c)^{0.5}\ c_{a1}^{1.5} =$ 10.8

$0.75\phi N_{cb} =$ 15.36

$K_{cp} =$ 2.0

Interaction of Tensile and Shear Forces

Combined Tension and Shear Checks:

$(N_{ua}/\phi N_n)+(V_{ua}/\phi V_n) =$ 0.769 **< 1.2 OK**

THEREFORE USE 2 ANCHOR BOLTS, dia = 0.75 inches x 18 inches long
(9.0 inches min. embedment to concrete)
(Special Inspection Required)

OMRF1 and OMRF2 Base Plate 1

Base Plate

Loads @ base of column:

P_{DOWN} = WIND CONDITIONS GOVERN 4254 lbs

P_{UP} = Gross uplift minus roof & wall DL = 1682 lbs

V = 3709 lbs

Base plate dimensions & yield strength:

b = 4.25 in
c = 8.5 in
d = 12 in
F_y = 36 ksi

Uniform pressure on base plate:

$p = P_{DOWN}/(dc) =$ 42 psi

Required base plate thk = max of:

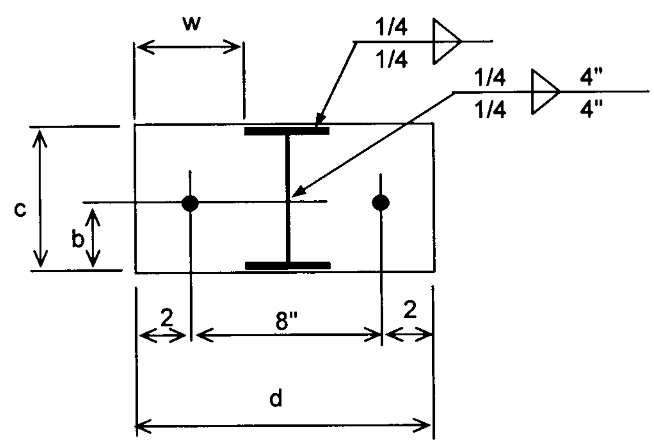
$t_{DOWNLOAD} = w[p/(0.25F_y)]^{1/2} =$ 0.27 in

Where: w = free edge length of base plate = 4 in

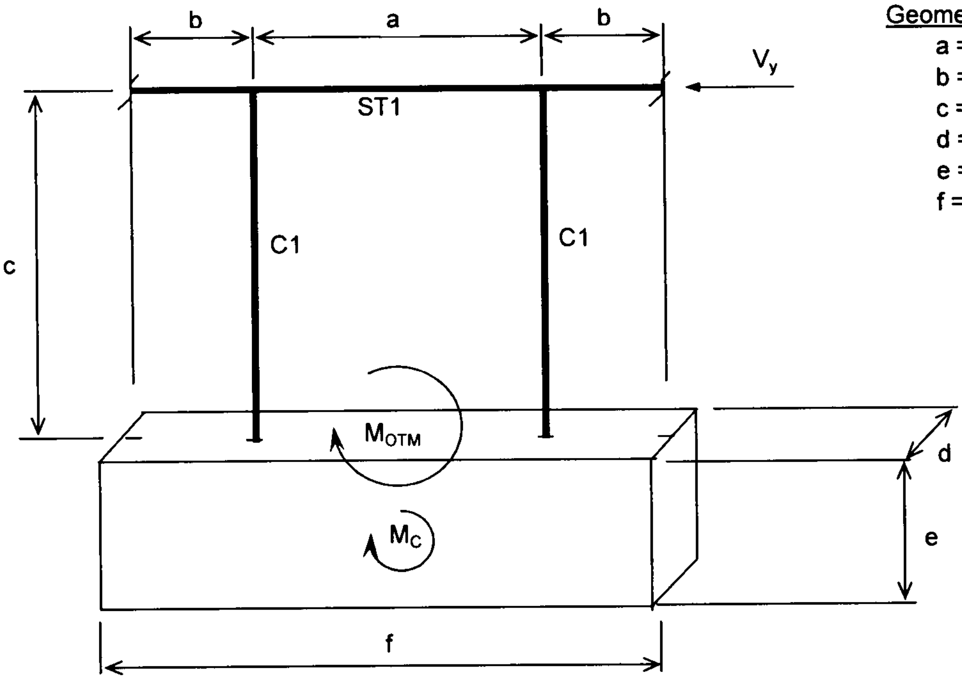
$t_{UPLIFT} = [6P_{UP}x/(0.75F_yb)/2]^{1/2} =$ 0.21 in

Where: x = dist. from A.B. to weld line of column to plate = 2 in

Therefore use base plate 12.0 in x 8.5 in x 0.500 in thk (min)



Footing - GBF1 for OMRF and SHEAR WALLS 1



Geometry

a = 11.49 ft
b = 1.00 ft
c = 17.50 ft
d = 1.25 ft
e = 1.50 ft
f = 14.0 ft

Loads

Vy =	412 lbs	
Max. Uplift Reaction @ base of Col. C1 (R) =	565 lbs	(from RISA results)
M_c =	3245.8 ft-lbs	(Use to check steel/concrete)
$M_{OTM} = (V_x)(c)$ =	7204.6 ft-lbs	(Use to check soil bearing/uplift)

Check Soil Bearing

Allowable bearing (Sa) =	1500 psf	(per 2007 CBC)
Actual bearing (sa) $=M_{OTM}/S_{ftg}$ =	177 psf	
Where: S_{ftg} =	41 ft^3 $[=(d)(f)^2/6]$	

Since sa < Sa, Footing is OK for Soil Bearing

Check Uplift

Overturning moment = M_{OTM} = 7204.6 ft-lbs

Resisting Moment (M_R):

Wt. footing = (d)(e)(f)(150 pcf) =	3935 lbs	Where: w_r =	10 psf
Wt. roof = $(a+2b)(g)(w_r)$ =	135 lbs	w_w =	8 psf
Wt. walls = $(w_w)(a+2b)(h)$ =	1889 lbs	h = wall height =	17.5 ft
Wt. slab = (slab thk)(f)(d)(150 pcf) =	1312 lbs	slab thk =	6 in
Total Wt. =	7270 lbs		

M_R = (Total Wt.)(0.5f)(1.33)/(1.5 F.S.) = 25424 ft-lbs

Since $M_R > M_{OTM}$, Footing is OK to Resist Uplift

Therefore Use Footing 18 inches Deep by 15 inches Wide

Footing - GBF1 for OMRF and SHEAR WALLS , cont.

Check Steel Tension

Try 2 No. 5 Bars Top & Bottom (Grade 50 or 60)

Actual tensile stress: $f_s = (M/A_s jd)/1.33 =$ 3769.1 psi

Where: $M =$ 2440.5 ft-lbs (reduced 1/3 for wind/seimic loads)

Actual rebar area = 0.62 in^2 $A_s =$ 0.413 in^2

$j = 1 - k/3 =$ 0.942

$d =$ 15 in

$k = [2np-(np)^2]^{1/2} - np =$ 0.173

$n =$ 10.1 for concrete with fc' = 3000 psi

$p = A_s/bd =$ 0.0018

$b =$ 15 in

Allowable tensile stress: $F_s =$ 20000 psi

Since fs < Fs, steel rebar is OK

Check Concrete Compression

Actual compressive stress:

$f_c = [2M/(kjbd^2)]/1.33 =$ 80 psi

Allowable compressive stress: $F_c =$ 1350 psi for concrete with fc' = 2500 psi

Since fc < Fc, concrete is OK

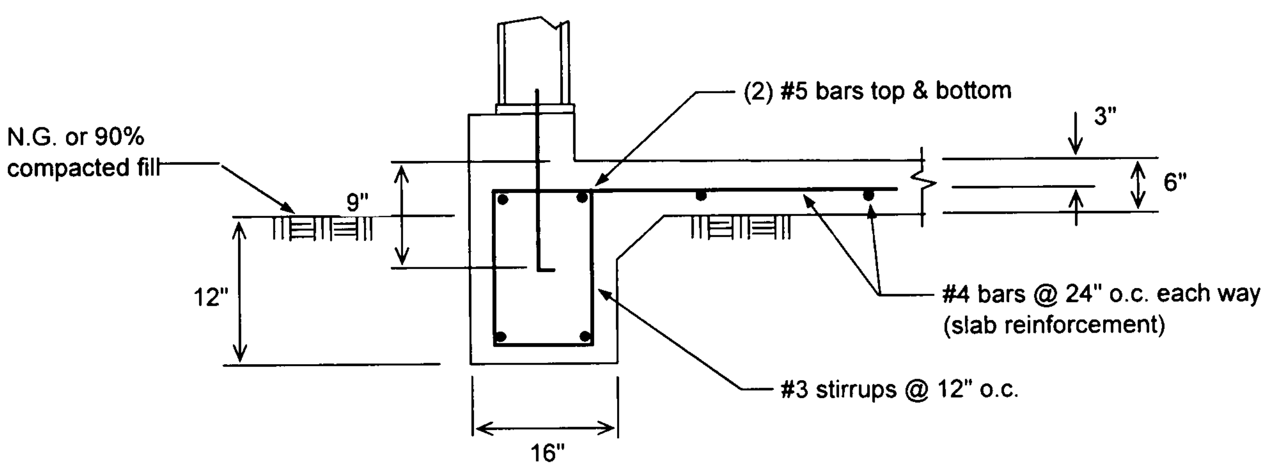
Stirrups

Actual shear: $\upsilon = [M/(b'bd)]/1.33 =$ 3 psi

Where: $b' =$ 2.34 ft

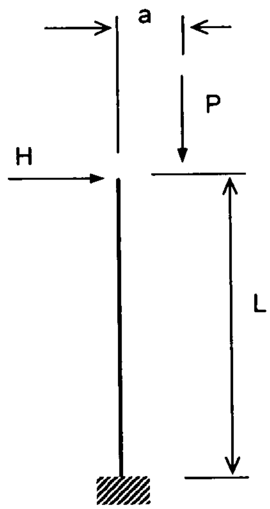
Allowable shear: $\upsilon_c = 1.1(fc')^{1/2} =$ 55 psi

Use #3 stirrups at 12 in. on center (Grade 40)



Sign Facade Column C2

Design Code: AISC Steel Construction Manual (ASD), 9th Edition



Material

A500 Gr. B

$F_y =$ 46 ksi

E = 29000 ksi

Geometry

L = 15.00 ft

Deflection shown below (to account for PΔ effects) = a = 0.17 ft

Loads

$P_{DL+LL} =$ 2.74 k

$P_{DL} =$ 0.74 k

Mom. added to wind/seis/unbal due to ecc. P_{DL} (M1) = 0.13 ft-k

Moment due to ecc. P_{LL} (M2) = 0.34 ft-k

H_{wind} = (3.0 ft)(wind pressure)(trib. length) /(2cols*1000) = 0.711 k

H_{seis} = (0.000) (0.7 k) = 0.000 k

$M_{wind} =$ 10.7 ft-k

$M_{seis} =$ 0.00 ft-k

$M_{unbalanced\ LL} =$ 0 ft-k

Fixed base; axial compression & bending

K = 2.1

Downspout Penetrates Column wall, (y/n)? n

WIND CONDITIONS GOVERN

Try: **TS6x6x1/4**

(Section is Compact)

$I_{nom} =$ 30.3 in^4

$S_{nom} =$ 10.1 in^3

$A_e =$ 5.59 in^2

$I_{eff} =$ 30.3 in^4

$S_{eff} =$ 10.10 in^3

r = 2.33 in

Wt = 19.02 plf

Actual axial stress (f_a): f_a = [P+(Wt)(L)]/A = **0.18 ksi**

Allowable axial stress (F_a): KL/r = 162.2

$C_c = [(2)(\pi)^2(E)/F_y]^{1/2} =$ 111.6

$F_a =$ **5.7 ksi**

Check 15 % rule for cantilever column **$15\%F_a =$ 0.851 ksi** **> 0.18 ksi (OK)**

Actual bending stress (f_b): Mt = Mwind + M1 + M2 = 10.79 ft-k

$f_b = Mt/S_{eff} =$ **12.8 ksi**

Allowable bending stress (F_b): Fb = (0.66)(Fy) = **30.36 ksi**

(see unity checks next page)

Sign Facade Column C2 , cont

Unity Check: F'_e = 6
C_{mx} = 1.0

Eq H1-1: $f_a/F_a + C_{mx}f_b/[(1-fa/F'_e)(F_b)]$ = 0.47 $\leq$ 1.00

Eq H1-2: $f_a/[(0.6)(F_y)] + f_b/F_b$ = 0.43 $\leq$ 1.00

COLUMN IS OK FOR STRESS

Check Drift: Include drift check for this column? (y/n) y

0.668
Allowable Drift = (0.025)(L) = 4.50 in

Max. Actual Drift, Δ_M = HL^3/3EI = 2.069 in **(Due to Wind)**
Where Lateral Force for deflection calculation, HD = 0.01 kips

COLUMNS OK FOR DRIFT

Anchor Bolts for Column C2

Use "Strength Design" per CBC Section 1912A *(with Reference to Appendix D of ACI 318)*

Trial Input Data

Bolt Diameter, d_o =	0.750 in dia.	
Cross-sectional area of bolt (A_{se}) =	0.334 in^2	
Dia. of round alternate footing Pedestal =	2.5 ft	
Edge of square alternate footing pedestal =	2.5 ft	
Spacing between outside A.B.'s (s) =	0.83 ft	
No. tens. bolts per edge of B.P. (n) =	2.0	
Total no. of bolts (n) =	4.0	
f'c of concrete =	3000 psi	
Seismic Factor for Strength =	0.300	
Seismic moment (Ms) =	3.327 ft-k	
Horz seismic force (Hs) =	0.22 k	
Wind moment (Mw) =	10.7 ft-k	
Horz wind force (Hw) =	0.71 k	
Unbalanced LL moment (Mu) =	0.00 ft-k	
Additional eccentric DL moment (M1) =	0.13 ft-k	(added to all cases)
Additional eccentric LL moment (M2) =	0.34 ft-k	(added to wind/seis cases)
Vertical DL (P) =	0.74 k	

Where:
LL = M2/(s*n)
DL' = P/N
W = Mw/(s*n)
DL = M1/(s*n)

WIND CONDITIONS GOVERN

Required Embedment Depth

Min. req'd embedment depth of A.B., h_{ef} = 11.5 inches (to develop truncated pyramid failure surface)

Anchor bolt is assumed to effectively transfer forces to reinforcing steel of foundation with depth sufficient to provide basic development length of rebar to tie the potential concrete failure surface, ϕ = 0.75.

Size of foundation vertical rebar = # 5 A_{bar} = 0.31 in^2 $f_{y(min)}$ rebar = 50 ksi

Basic development length required = $0.04(A_b)(f_y)/(f'_c)$ + 3" = 14.3 inches (added to h_{ef})

Therefore, minimum required depth of anchor bolt to use, ϕ = 0.75, $h_{total} = h_{ef} + l_d$ = 25.82 in

Is anchor bolt embedment depth > h_{total} = 25.8 in ? (y/n) y

For Hooked Anchor:

Required Tensile Strength per Bolt (Nua) Nua = max of:

Case 1: Nua = [(1.2DL+LL+1.6W-1.2DL')] = **10.11 k**

Case 2: Nua = (1.6W - 1.2DL') = 10.02 k

Design Strength in Tension

ϕN_n = min of ϕN_{sa} or ϕN_{cb} = **11.27 k**

1) **Design Steel Strength of Anchor in Tension**

$0.75\phi N_{sa} = 0.75\phi A_{se} f_{uta}$ = 11.27 k

Where: f_{uta} = 60 ksi

A_{se} = 0.334

Where:

$\phi_{(ductile\ stl)}$ = 0.75 (Tension Loads)

Anchor Bolts for Column C2 ,cont

2) Design Concrete Breakout Strength of Anchor in Tension

$0.75\phi N_{cb} = 0.75\phi(A_{Nc}/A_{Nco})\psi_{ed}\psi_{cp}\psi_c N_b =$ 16.97 k

$A_{Nc} = (c_{a1}+s_1+c_{a1})(c_{a2}+s_2+c_{a2}) =$ 669 in^2

$A_{Nco} = 9h_{ef}^2 =$ 1190.7 in^2

$N_b = k_c(f'_c)^{0.5}(h_{ef})^{1.5} =$ 51.28 k

Where: $\phi_{(concrete)} =$ 0.75 (Tension Loads)

$k_c =$ 24.0

$h_{ef} =$ 11.5 in

$f'_c =$ 3000 psi

$\psi_{ed} = 0.7+0.3(c_{min}/1.5h_{ef}) =$ 0.8

$c_{min} =$ 7.9328 in

$c_{a1} = c_{a2} =$ 7.9328 in

$s_1 = s_2 =$ 10.00 in

$\psi_{cp} =$ 1.00

$\psi_c =$ 1.25

Required Shear Strength per Bolt (Vua)

Horizontal load on column = 0.7109 k

Vua = (1.3W)/n = **0.23 k**

Design Strength in Shear

ϕV_n = min of ϕV_{sa} or ϕV_{cb} = **5.47 k**

1) Design Steel Strength of Anchor in Shear

$0.75\phi V_{sa} = 0.75\phi(0.6A_{se}f_{uta}) =$ 5.47 k

2) Design Concrete Breakout Strength of Anchor in Shear

$0.75\phi V_{cb} = 0.75\phi(A_{vc}/A_{vco})\psi_{ed,V}\psi_{c,v}V_b =$ 7.09 k

3) Design Concrete Pryout Strength of Anchor in Shear

$0.75\phi V_{cp} = 0.75\phi K_{cp}N_{cb} =$ 33.941 k

Where:

$\phi_{(ductile\ stl)} =$ 0.65 (Shear Loads)

$\phi_{(concrete)} =$ 0.75 (Shear Loads)

$A_{se} =$ 0.33

$f_{uta} =$ 60 ksi

$A_{vc} =$ 258 in^2

$A_{vco} = 4.5c_{a1}^2 =$ 283.2 in^2

$c_{a1} = c_{a2} =$ 7.93 in

$\ell_e =$ 11.5 in

$d_o =$ 0.75 in

$f'_c =$ 3000 psi

$\psi_{ed,v} = 0.7+0.3(c_{a2}/1.5c_{a1}) =$ 0.90

$\psi_{c,v} =$ 1.20

$V_b = 7[\ell_e/d_o]^{0.2}(d_o)^{0.5}(f'_c)^{0.5}c_{a1}^{1.5} =$ 12.8

$0.75\phi N_{cb} =$ 16.97

$K_{cp} =$ 2.0

Interaction of Tensile and Shear Forces

Combined Tension and Shear Checks:

$(N_{ua}/\phi N_n)+(V_{ua}/\phi V_n) =$ 0.939 **< 1.2 OK**

THEREFORE USE 4 ANCHOR BOLTS, dia = 0.75 inches x 32 inches long

(26 inches min. embedment to concrete)

(Special Inspection Required)

Base Plate for Column C2

Material = A36
Ft = 21.6 ksi
Fy = 36.0 ksi

Length of square edge of base plate, w = 14 in (Use min of **12.2** in)
Base Plate Area, A = 196 in^2

Column used = TS6x6x1/4

Base plate thickness (tp1) per compression of concrete:

Pressure due to Axial Load P, f_{p1} = P/A = 5 psi
Pressure Due to Moment M, f_{p2} = (2M/jd)/wkd)/1.33 = 583 psi
Where: P = 1.02 k
M = 10.79 ft-k
Where: kd = 2.87 in
jd = 11.04 in
d = 12 in

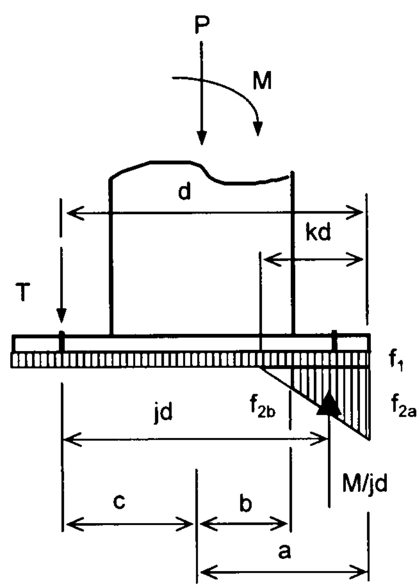
tp1 = (2)(a-0.95b)sqrt(fp1/Fy)+(a-0.95b)sqrt(fp2/2Fy) = **0.473 in** (min)
Where: a = 7 in
b = 3 in

[F_p = Bearing on less than full area of conc.
= 0.70f'c = 2799 psi **OK]**
Where: f'_c = 3000 psi
R = $(A_2/A)^{1/2}$ = 2.424
A_2 = 1152
$f_{s(AB)}$ = 20000 psi
n = 10
k = 0.239
j = 0.920

Base plate thickness (tp2) per tension on anchor bolt:

Tension on A.B.'s, one side of B.P. = T = (M-Pc)/(2c) = 2.2 k
tp2 = sqrt{6M'/[(1.33)(0.75)(Fy)(w)]} = **0.40 in** (min)
Where: c = 7.0 in
P = 14.1 k
M' = (T)(c-0.8b) = 10.03 in-k

Therefore use Base Plate 0.500 in thk x 14 in x 14 in



MADISON LOS ANGELES, PHOENIX, TULSA, ATLANTA	JOB NO.	W17283-10
	SHT 69 OF 69	
	DATE	11/22/2010
FOR TUSTIN FIELD GAS AND FOOD	DES. BY	ML
DESCRIPTION 17'-0" x 76'-8" Car Wash + Equipment Rm. Bldg.	CHKD. BY	

Weld of B.P. to Column C2

Max load case:

P = 1.0 k

M = 11 ft-k

Allowable stress in weld:

Fillet weld: Fw = (0.3)(70ksi)(1.33)/1.5 = 18.6 ksi

Full Pen. weld: Fw = 1.33Ft(Base Plate) = 19.2 ksi (same as base metal)

Actual stress in weld:

Square fillet weld: Weld size = 0.31 in

$f_w = P/A_w + M/S_w =$ 12.4 ksi

Where:

$A_w =$ 5.3 in^2

$S_w =$ 10.6 in^3

Since fw < Fw, fillet weld is sufficient

Simple square full penetration weld:

$f_w = P/A_w + M/S_w =$ 11 ksi

Where:

$A_w =$ 6 in^2

$S_w =$ 12 in^3

Since fw < Fw, full pen. weld is sufficient & no gussets are req'd

Properties of weld used:

$A_w =$ 5.3 in^2

$S_w =$ 10.6 in^3

Therefore:

$f_w = P/A_w + M/S_w =$ 12.4 ksi

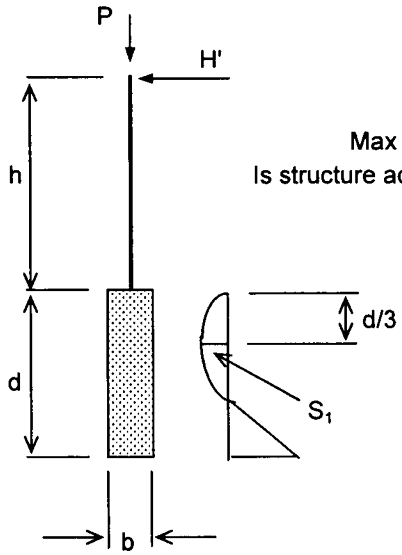
Use Fillet Weld All Around

MADISON		JOB NO.	W17283-10
LOS ANGELES, PHOENIX, TULSA, ATLANTA		SHT	70 OF 72
		DATE	11/22/2010
FOR	TUSTIN FIELD GAS AND FOOD	DES. BY	ML
DESCRIPTION	17'-0" x 76'-8" Car Wash + Equipment Rm. Bldg.	CHKD. BY	

Foundation for Column C2

Soils Report Received? (y/n) n

Use non-constrained design employing lateral bearing per IBC Section 1805.7.2.1:



WIND CONDITIONS GOVERN

Equivalent applied lateral force (H') = 719.42 lbs

Max Lateral Passive Earth Pressure allowed = 100 psf/ ft depth per CBC

Is structure adversely affected by 1/2 inch ground motion?(y/n) n LP_p = 200 psf/ ft depth

(ref. IBC 2006 Table 1804.2, Sect. 1804.3.1)

$P = P_{DL+LL} =$ 2.74 k

Where: H' = [Hwind + (M1+M2)/L]

Required Footing Depth (d) = $A/2[1 + (1 + 4.36h/A)^{1/2}]$

Where: $A = 2.34H'/S_1b$

Alternate No. 1: Drilled Pier Footing

Column height (h) = 15.00 ft

Diameter of round footing (b_1) = 2.5 ft

Required depth for this diameter (d_1) = 6.5 ft

Actual bearing on soil at bottom of footing = $(P)/(A_{footing})$ = 558.07 psf

Allowable bearing to check soil at bottom of footing = 1500 psf per IBC

[Max IBC 2006 allowable bearing for unknown soil types (ref. IBC Table 1804.2) = 1500 psf]

Footing Size is OK for Soil Bearing

Therefore use 2.5 ft diameter x 6.5 ft minimum deep footing

Cross-sectional Area of Reinforcing Steel Required:

Ax per quad = 1.33M/[(fs)(j)(d)] = 0.34 in^2 per quadrant

Where: M = 12.3 ft-k [@ unconstrained reaction pt. (1/3 of ftg depth)]

f_s = 24 ksi

j = 0.893 (conservative)

d = 2.25 ft

Area of Footing, A_{ftg} = 572.6 in^2

Area steel, Ax total reqd. = 1.13 in^2 or Ax total reqd = 0.0018Aftg = 1.0306 in^2 **OK**

Suggested rebar pattern:

Use 8 No. 5 vertical rebars per footing (A_x = 2.48 in^2)

Foundation for Column C2 ,cont

Alternate No. 2: Square Pier Footing

Length of side of square footing (b_2) = 2.5 ft

Required depth for this size (d_2) = 5.5 ft

Actual bearing on soil at bottom of footing = (P)/($A_{footing}$) = 438.3 psf

Allowable bearing to check soil at bottom of footing = 1500 psf per IBC

[Max IBC 2006 allowable bearing for unknown soil types (ref. IBC Table 1804.2) = 1500 psf]

Footing Size is OK for Soil Bearing

Therefore use 2.5 ft square x 5.5 ft deep footing

Cross-sectional Area of Reinforcing Steel Required:

Ax per face = 1.33M/[(fs)(j)(d)] = 0.33 in^2 per side

Where: M = 12.1 ft-k [@ unconstrained reaction pt. (1/3 of ftg depth)]

d = 2.25 ft

Area of Footing, A_{ftg} = 729 in^2 Ax total reqd = 0.0018Aftg = 1.3122 in^2

Suggested rebar pattern:

Use 3 No. 5 vertical rebars per face (A_x = 0.93 in^2)

Ax total Provided = 2.48 in^2 **OK**

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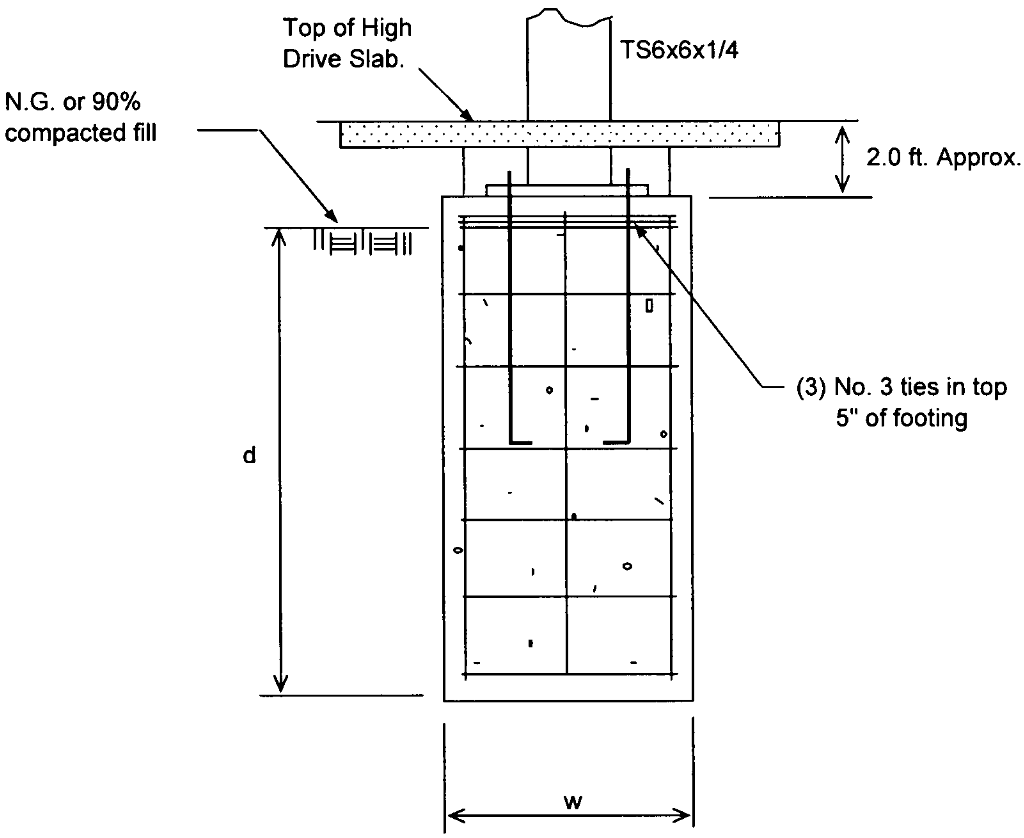
	DESCRIPTION 17'-0" x 76'-8" Car Wash + Equipment Rm. Bldg.	CHKD. BY

Column C2

Foundation Summary Sheet



For round foundation, w = **2.5** ft diameter x d = **6.5** ft deep minimum per Soils Report
with **8** no. **5** vertical rebars per ftg & no. 3 horz ties @ 12" o.c.

For square foundation, w = **2.5** ft square x d = **5.5** ft deep minimum per Soils Report
with **3** no. **5** vertical rebars per face of sq. ftg w/ # 3 horz ties @ 12" o.c.

Anchor Bolts = **4** -- **0.75** inch dia. x 2.67 ft long (Material = A307)
(**26** inches min. embedment to concrete)
Base Plate = **14** inch square x **0.50** in thick (Material = A36)
(c/c spacing of bolt holes = **10.0** inches)
Weld - column to base plate = **5/16** **inch fillet weld all around**