Appendix A – Wind & Seismic

Wind Loading Calculations

	Hershey 5	Assumptions and Information
(K_{zt}) Topographic Factor	1	Code 6.5.7.2, Figure 6-4, $K_{zt} = (1+(k_1)*(k_2)*(k_3))^2$
(K_d) Directional Wind Factor	0.85	Code 6.5.5.4, Table 6-4
(V) Basic Wind Speed	70	Given by Structural Notes
(I) Importance Factor	1	Code 6.5.5, Table 6-1
(C_t) Peroid Parameter	0.02	Code 9.5.3.2, Table 9.5.5.3.2
(h) Building Height in Feet	69	Height to the 5th Story
(f) Frequency in Hz	2.08849378	Code 9.5.3.2, Table 9.5.5.3.2, f = 1/((C_t)*((h)^0.75))
Exposure Category C	α	Given by Structural Notes
(α)	9.5	Code 6.5, Table 6-2
(zg (ft))	900	Code 6.5, Table 6-2
(^a)	2/19	Code 6.5, Table 6-2
(^b)	1	Code 6.5, Table 6-2
(α bar)	1/6	Code 6.5, Table 6-2
(b bar)	0.65	Code 6.5, Table 6-2
(c) alsdrj	0.2	Code 6.5, Table 6-2
(L (ft))	500	Code 6.5, Table 6-2
(Є bar)	1/5	Code 6.5, Table 6-2
(z min)	15	Code 6.5, Table 6-2
Rigid Structures N-S		
*Exposure C, Table 6-2		
(g_q) Gust Coefficient	3.4	Code 6.5.8.2, Equation 6-8
(g_v) Gust Coefficient	3.4	Code 6.5.8.2, Equation 6-8
(z bar) Wind Coefficient	41.4	Code 6.5.8.2, Table 6-2, z bar = 0.6(h)
(L_z) Turbulence Scale Factor	523.199457	L_z = L*((z bar)/33)^(Є bar)
(I_z) Turbulence Intensity	0.19258196	Code 6.5.8.1, Equation 6-5, Iz = (c)*(33/(z bar))^(1/6)
(B) Perpendicular to Wind	268.33	Code 6.3, Given in Plan
(L) Parallel to Wind	102.67	Code 6.3, Given in Plan
(Q) Background Response	0.82260391	Code 6.5.8.1, Equation 6-6, Q = SQRT(1/(1+(0.63*((B+h)/L_z)^0.63)))
(G) Gust Factor	0.83856209	Code 6.5.8.2, Equation 6-8, G = 0.925*((1+(1.7*(g_q)*(I_z)*(Q)))/(1+(1.7*(g_v)*(I_z))))
Rigid Structures E-W		
(B)	102.67	
(Q)	0.8729702	
(G)	0.86310353	
Flexible Structures N-S		
*Exposure B, Table 6-2		
(g_q)	3.4	

(g_v)	3.4	
(z bar)	41.4	
(L_z)	523.199457	
(I_z)	0.19258196	
(B) Perpendicular to Wind	268.33	
(L) Parallel to Wind	102.67	
(Q)	0.82260391	
(β) Damping Ratio	0.05	Code 6.3, Section 9
(n_1) Natural Frequency	2.08849378	Code 6.5.8.2
(V_z) Mean Hourly Wind Speed	69.3038272	Code 6.5.8.2, Equation 6-14, V_z = ((b bar)*(B40/33)^(α bar)*(V)*(88/60)
(η_h) R_l Coefficient	9.5649541	Code 6.5.8.2, Equation 6-13, η_h = 4.6*(n_1)*(h)/(V_z)
(η_B) R_l Coefficient	37.1965816	Code 6.5.8.2, Equation 6-13, η_B = 4.6*(n_1)*(B)/(V_z)
(η_L) R_l Coefficient	47.6475145	Code 6.5.8.2, Equation 6-13, η_L = 4.6*(n_1)*(L)/(V_z)
(R_h) R_l Coefficient	0.09908316	Code 6.5.8.2, Equation 6-13, R_h = (1/η_h)-(1/(2*(η_h^2)))*(1-(2.718281828^(-2*η_h)))
(R_B) R_l Coefficient	0.02652281	Code 6.5.8.2, Equation 6-13, R_h = (1/η_B)-(1/(2*(η_B^2)))*(1-(2.718281828^(-2*η_B)))
(R_L) R_l Coefficient	0.02076722	Code 6.5.8.2, Equation 6-13, R_h = (1/η_L)-(1/(2*(η_L^2)))*(1-(2.718281828^(-2*η_L)))
(N_1) Reduced Frequency	15.7667889	Code 6.5.8.2, Equation 6-12, N_1 = (n_1*L_z)/V_z
(R_n) Resonance Coefficient	0.0241168	Code 6.5.8.2, Equation 6-11, R_n = (7.47*N_1)/((1+(10.3*N_1))^(5/3))
(R) Resonance Response Factor	0.02615683	Code 6.8.5.2, Equation 6-10, R = (1/β)*R_n*R_h*R_B*(0.53+(0.47*R_L)))
(g_R) Gust Coefficient	4.36152676	Equation 6-9, g_R = (SQRT((2*(LN(3600*n_1))))+(0.577/(SQRT((2*LN(3600*n_1))))))
(G_f) Gust Factor	0.8388954	Equation 6-8, G_f = 0.925*((1+(1.7*I_z*(SQRT(((g_q)^2)*((Q)^2)+((g_R)^2)*((R)^2)))))/(1+(1.7*g_v*I_z
Flexible Structures E-W		
*Exposure B, Table 6-2		
(B) Perpendicular to Wind	102.67	
(L) Parallel to Wind	268.33	
(Q)	0.8729702	
(η_B)	14.2323744	
(η_L)	124.527686	
(R_B)	0.06779395	
(R_L)	0.0079981	
(R)	0.04158559	
(G_f)	0.863897	
(Cp) Windward	0.8	Code 6.5.11.2, Figure 6-6
(Cp) Leeward N-S	-0.5	Code 6.5.11.2, Figure 6-6, L/B
(Cp) Leeward E-W	-0.3	Code 6.5.11.2, Figure 6-6, L/B
(q_z)*K_z Velocity Pressure	10.6624	Code 6.5.10, Equation 6-15, (qz)*Kz = 0.00256*K_{zt}*K_d*(V^2)*I
(q_h) Velocity Pressure at z	12.4323584	Code 6.5.12.2, Table 6-3, q_h = ((h-C131)/(C132-C131))*(A132-A131)*((qz)*Kz)+(((qz)*Kz)*A
(P_{wz})*q_z N-S	0.69048283	(Pwz)*qz = (Cp Windward)*G
(P_{wz})*q_z E-W	0.67111632	(Pwz)*qz = (Cp Windward)*G_f
Leeward Wind Pressure		

(P_{lh}) N-S	-5.2126522	$P_{lh} = q_h$*(Cp Leeward N-S)*G
(P_{lh}) E-W	-3.21912374	$P_{lh} = q_h$*(Cp Leeward E-W)*G_f

Windward Pressure N-S

(P_{wz}) 0-15	6.07993738
(P_{wz}) 20	6.43758076
(P_{wz}) 25	6.72369546
(P_{wz}) 30	7.00981016
(P_{wz}) 40	7.43898221
(P_{wz}) 50	7.79662559
(P_{wz}) 60	8.08274029
(P_{wz}) 70	8.36885499

Windward Pressure E-W

(P_{wz}) 0-15	6.25787348
(P_{wz}) 20	6.62598369
(P_{wz}) 25	6.92047185
(P_{wz}) 30	7.21496002
(P_{wz}) 40	7.65669226
(P_{wz}) 50	8.02480247
(P_{wz}) 60	8.31929063
(P_{wz}) 70	8.6137788

K_z	q_z	z (ft)
0.85	9.06304	0-15
0.9	9.59616	20
0.94	10.022656	25
0.98	10.449152	30
1.04	11.088896	40
1.09	11.622016	50
1.13	12.048512	60
1.17	12.475008	70

Total Pressure N-S — $P = P_{wz} + P_{lh}$

(P_{tot}) 0-15	11.2925896
(P_{tot}) 20	11.650233
(P_{tot}) 25	11.9363477
(P_{tot}) 30	12.2224624
(P_{tot}) 40	12.6516344
(P_{tot}) 50	13.0092778
(P_{tot}) 60	13.2953925
(P_{tot}) 70	13.5815072

$P = P_{wz} + P_{lh}$

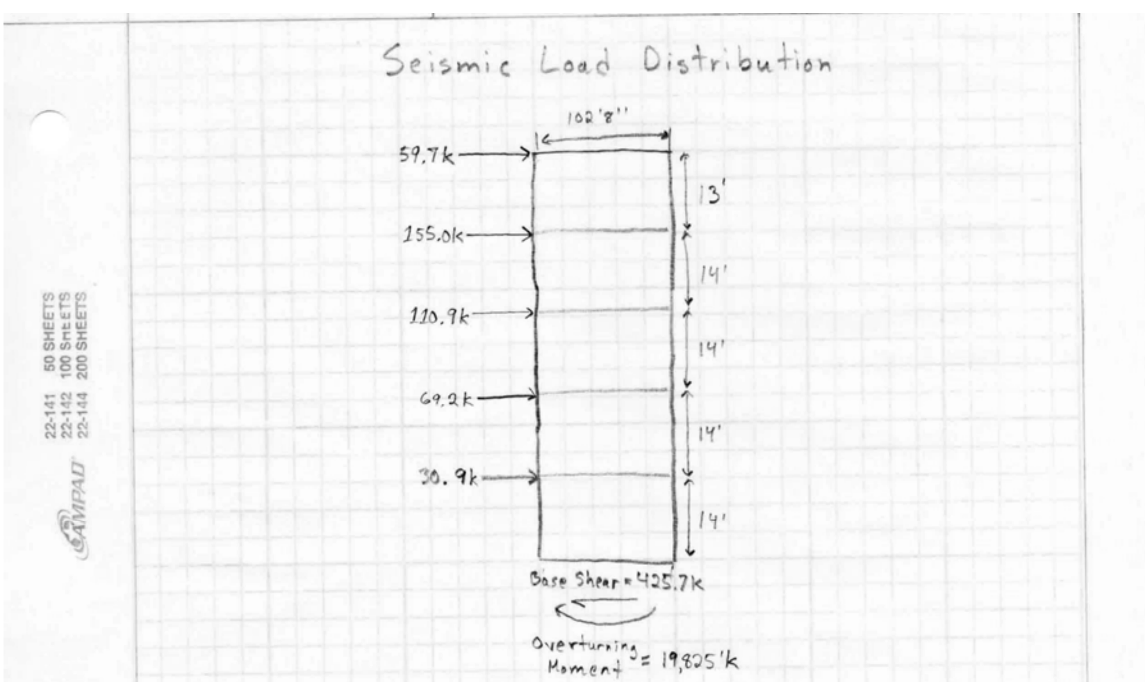
Total Pressure E-W	
(P_{tot}) 0-15	9.47699723
(P_{tot}) 20	9.84510743
(P_{tot}) 25	10.1395956
(P_{tot}) 30	10.4340838
(P_{tot}) 40	10.875816
(P_{tot}) 50	11.2439262
(P_{tot}) 60	11.5384144
(P_{tot}) 70	11.8329025
Leeward Shear N-S	
(B) Perpendicular to Wind	268.33
Shear @ Ground	-9790.97675
Shear @ Floors	-19581.9535
Shear @ Roof	-9091.62127
Leeward Shear E-W	
(B) Perpendicular to Wind	102.67
Shear @ Ground	-2313.55204
Shear @ Floors	-4627.10408
Shear @ Roof	-2148.29833
Winward Shear N-S	
(B) Perpendicular to Wind	268.33
Shear @ 0	11420.0072
Shear @ 1	23492.5862
Shear @ 2	26601.8991
Shear @ 3	28809.1274
Shear @ 4	30517.3301
Shear @ 5	15719.304
Windward Shear E-W	
(B)Perpendicular to Wind	102.67
Shear @ 0	4497.47109
Shear @ 1	9251.94054
Shear @ 2	10476.4621
Shear @ 3	11345.7212
Shear @ 4	12018.4522
Shear @ 5	6190.63668

Seismic Loads

Hershey 5 Vertical Distribution N-S					
Level	w_x	h_x	$w_x h_x^k$	C_{vx}	F_x
1	2195.5809	14	47409.8578	0.072521	30.8688
2	2195.5809	28	106249.519	0.162527	69.1796
3	2195.5809	42	170346.004	0.260573	110.9131
4	2195.5809	56	238114.2	0.364236	155.0374
5	662.50927	69	91616.8137	0.140143	59.65217
Value Sum			653736.394	1	425.6511
Base Shear					425.6511
Overturning Moment					19825.64

Hershey 5 Vertical Distribution E-W					
Level	w_x	h_x	$w_x h_x^k$	C_{vx}	F_x
1	2195.5809	14	47409.8578	0.072521	30.8688
2	2195.5809	28	106249.519	0.162527	69.1796
3	2195.5809	42	170346.004	0.260573	110.9131
4	2195.5809	56	238114.2	0.364236	155.0374
5	662.50927	69	91616.8137	0.140143	59.65217
Value Sum			653736.394	1	425.6511
Base Shear					425.6511
Overturning Moment					19825.64

The charts shown above summarize the results found from my seismic calculation analysis. Shown below is the seismic loading for a typical building as depicted by story forces. Specific calculations of seismic forces are located in the Appendix.



Appendix B – Existing Conditions

AE Senior Thesis | Spot Check | Technical Assignment 1

First solve the loading for a typical Office Floor:

Dead Load = 70 psf (See Loading for specifics)

Live Load = 100 psf (Main Floor)

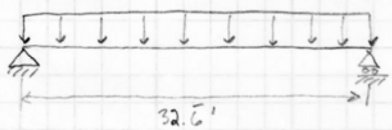
Use Live Load Reduction → $L = L_0\left(0.25 + \frac{15}{\sqrt{A_I}}\right)$ where

$A_{TOT} = (9.\bar{3}')(32.\bar{6}') = 304.\bar{8}\ ft^2$, $A_I = 2A_T = 2(304.\bar{8}) = 609.\bar{7}\ ft^2$

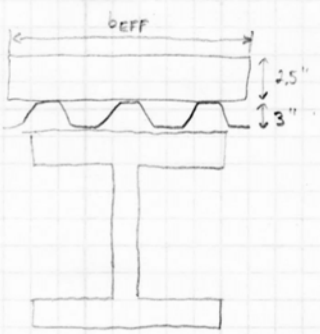
$L = (100)\left(0.25 + \frac{15}{\sqrt{609.\bar{7}}}\right) = 85.74\ psf$

Using Load Factors: $1.2DL + 1.6LL = 1.2(70) + 1.6(85.74) = 221.84\ psf$

$P_u = 221.84\ psf$, $\omega_u = (9.\bar{3}')(221.84) = 2.06\ klf$



Typical Beam Calculation



Given: $f'_c = 4ksi$ (Lightweight (115pcf)) & $f_y = 50ksi$

From Above, $\omega_u = 2.06\ klf$

$M_u = \frac{\omega_u l^2}{8} = \frac{(2.06)(32.\bar{6}')^2}{8} = 274.78\ 'k$

Assume $a = 1''$, $b_{EFF} = \begin{cases} l_n = 112'' \\ \frac{(32.\bar{6})}{4}(12) = \boxed{98''} \end{cases}$

$Y_2 = 5.5'' - \frac{a}{2} = 5''$

Use LRFD Table 5-14, Try W18×40 where $\phi_b M_p = 294\ 'k$

PNA @ 7 for $Y_2 = 5''$ → 400 so $\phi_b M_p = 400\ 'k$ & $\Sigma Q_n = 148\ k$

$\Sigma Q_n = 0.85 f'_c b a \rightarrow a = \frac{\Sigma Q_n}{0.85 f'_c b} = \frac{148}{0.85(4)(98)} = 0.444$

$Y_2 = 5.5'' - \frac{0.444}{2} = 5.28'' \rightarrow \phi_b M_N = 403'k$ by interpolation

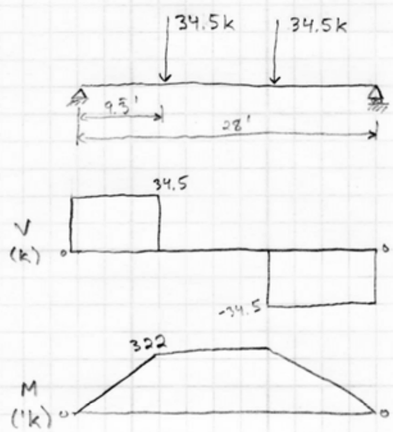
From the Structural notes, Minimum stud capacity is 9.7k

$\frac{\Sigma Q_n}{\text{Stud capacity}} = \frac{148}{9.7} = 15.26 \rightarrow$ Use 32 shear studs

Overall Design W18×40 with 32 shear studs

The beam specified in the drawings is W16×31. I believe my beam is larger because an older code was used for factoring and there is a perscribed camber of $c = \frac{3}{4}''$ for the given design.

Typical Girder Calculation



$P = \frac{\omega_u l}{2} = \frac{(2.06)(32.\bar{6})}{2} = 33.6k$

$M_u = (33.6)(9.\bar{3}) = 313.6'k$

Assume $a = 1''$, $b_{EFF} = \begin{cases} l_n = 112'' \\ \frac{(28)}{4}(12) = \boxed{84''} \end{cases}$

$Y_2 = 5.5'' - \frac{a}{2} = 5''$, LRFD Table 5-14

Try W21×44 where $\phi_b M_p = 358'k$

$A_s = 13.0\,in^2$, $\Sigma Q_n = A_s f_y = (50)(13) = 650k$

Find $a = \frac{\Sigma Q_n}{0.85 f'_c b} = \frac{650}{0.85(4)(84)} = 2.28$, $Y_2 = 5.5'' - \frac{2.28}{2} = 4.36''$

For PNA @ 7 & $Y_2 = 4.36''$ → $\phi_b M_p = 481'k$ by interpolation

For shear studs: $\Sigma Q_n = 163k$ & capacity is given as 33k

$\frac{\Sigma Q_n}{\text{stud capacity}} = \frac{163}{33} = 4.9$ → Use 10 shear studs

Overall Design W21x44 with 10 studs

The girder specified in the drawings is given as W21x50. The design I proposed is close in size and the slight variance can be attributed from the beam load being slightly different.

Typical Column Design

Dead Load = 70psf + 5psf (self weight) = 75 psf (Office Design)

Live Load = 100psf (Main Floor)

Use Live Load Reduction → $L = L_o\left(0.25 + \frac{15}{\sqrt{A_I}}\right)$ where

Column Tributary Area = $(28')(32.\bar{6}') = 914.\bar{6}\ ft^2$

$A_T = (4\ \text{floors})(914.\bar{6}) = 3658.\bar{6}\ ft^2$, $A_I = 4A_T = 4(3658.\bar{6}) = 14,634.\bar{6}\ ft^2$

Reduction Factor = $\left(0.25 + \frac{15}{\sqrt{14,634.\bar{6}}}\right) = 0.374 \not> 0.4$ for multiple story buildings, $L = (100)(0.4) = 40\ psf$, Factor the loading

$1.2DL + 1.6LL = 1.2(75) + 1.6(40) = 154\ psf$, $P_u = 154\ psf$,

$P_{Floor} = (154)(3658.\bar{6}) = 563.43K$, $\omega_u = 2.06 + (0.05)(1.2) = 2.12\ klf$ (self weight)

$M_u = \frac{\omega l^2}{12} = \frac{(2.12)(28)^2}{12} = 138.51'k$, Calculate for the wall

Appendix C – Lateral Calculations

Total Stiffness per Floor

Moment Frames	Floor 5	Floor 4	Floor 3	Floor 2	Floor 1	Total Stiffness
East N-S #7	7.199424046	8.849557522	11.14827202	15.03759	22.98851	65.22335332
East N-S #8	8.183306056	10.55966209	13.96648045	20.04008	32.05128	84.8008108
East N-S #9	6.752194463	9.00090009	11.9760479	16.33987	25.5102	69.57921582
East N-S #10	6.285355123	8.680555556	11.31221719	15.74803	24.39024	66.41640327
East N-S #11	6.422607579	8.960573477	11.69590643	16.33987	25.5102	68.92916085
East N-S #12	5.93824228	7.930214116	10.18329939	14.12429	21.05263	59.22868115
East E-W #A	11.09877913	16.55629139	21.59827214	30.39514	51.54639	131.1948712
East E-W #B	14.81481481	22.83105023	29.58579882	41.49378	69.44444	178.1698842
East E-W #D	18.24817518	30.03003003	39.37007874	54.64481	89.28571	231.578807
East E-W #F	8.34028357	12.61034048	16.61129568	23.20186	39.0625	99.82627588
West N-S #2	5.93824228	7.936507937	10.18329939	14.12429	21.05263	59.23497497
West N-S #3	6.422607579	8.960573477	11.69590643	16.33987	25.5102	68.92916085
West N-S #4	6.285355123	8.680555556	11.31221719	15.74803	24.39024	66.41640327
West N-S #5	6.711409396	9.033423668	11.77856302	16.44737	25.70694	69.67770537
West N-S #6	11.72332943	15.12859304	18.97533207	25.64103	38.02281	109.4910939
West E-W #AA	11.24859393	15.38461538	20.40816327	30.03003	51.81347	128.8848741
West E-W #BB	16.97792869	23.58490566	30.48780488	42.37288	70.92199	184.3455064
West E-W #DD	16.36661211	22.88329519	29.3255132	40.48583	67.56757	176.628818
West E-W #FF	10.03009027	13.24503311	1.689189189	23.36449	39.84064	88.169436
Center E-W #A	37.03703704	0	0	0	0	37.03703704
Center E-W #B	6.426735219	9.813542689	12.93661061	18.05054	30.30303	77.53046033
Center E-W #D	3.579098067	4.995004995	6.618133686	9.451796	16.89189	41.53592448
Center E-W #E	3.785011355	5.224660397	6.108735492	7.385524	11.7096	34.21353349
Center E-W #F	23.4741784	0	0	0	0	23.4741784
Total Stiffness Per Floor	259.2894111	280.8798861	348.9671372	506.807	824.5731	2220.51657

Direct Shear

Direct Shear	Stiffness	Relative Stiffness	Max Story Shear	Direct Shear
East N-S #7	65.22335	0.029373054	425.65	12.5026405
East N-S #8	84.80081	0.038189677	425.65	16.2554361
East N-S #9	69.57922	0.031334698	425.65	13.3376141
East N-S #10	66.4164	0.029910339	425.65	12.7313358
East N-S #11	68.92916	0.031041948	425.65	13.2130053
East N-S #12	59.22868	0.026673379	425.65	11.353524
East E-W #A	131.1949	0.059083041	425.65	25.1486963
East E-W #B	178.1699	0.080238034	425.65	34.1533192
East E-W #D	231.5788	0.104290511	425.65	44.3912559
East E-W #F	99.82628	0.04495633	425.65	19.1356619
West N-S #2	59.23497	0.026676214	425.65	11.3547304
West N-S #3	68.92916	0.031041948	425.65	13.2130053
West N-S #4	66.4164	0.029910339	425.65	12.7313358
West N-S #5	69.67771	0.031379052	425.65	13.3564936
West N-S #6	109.4911	0.049308839	425.65	20.9883073
West E-W #AA	128.8849	0.058042744	425.65	24.7058938
West E-W #BB	184.3455	0.083019199	425.65	35.3371219
West E-W #DD	176.6288	0.079544022	425.65	33.8579128
West E-W #FF	88.16944	0.039706723	425.65	16.9011666
Center E-W #A	37.03704	0.016679469	425.65	7.09961593
Center E-W #B	77.53046	0.034915506	425.65	14.8617853
Center E-W #D	41.53592	0.018705523	425.65	7.962006
Center E-W #E	34.21353	0.015407916	425.65	6.55837958
Center E-W #F	23.47418	0.010571494	425.65	4.49975658

Torsional Shear

Torsion	k	x (ft)	kx^2	$kx/\Sigma kx^2$
East N-S #7	65.22335332	20.41	27169.97	9.36421E-05
East N-S #8	84.8008108	28.31	67964.13	0.000168875
East N-S #9	69.57921582	54.24	204700.5	0.000265475
East N-S #10	66.41640327	81.55	441695.8	0.000381
East N-S #11	68.92916085	109.22	822256.5	0.000529578
East N-S #12	59.22868115	142.65	1205246	0.000594332
East E-W #A	131.1948712	92.55	1123750	0.000854119
East E-W #B	178.1698842	73.11	952330.9	0.000916297
East E-W #D	231.578807	66.25	1016414	0.00107922
East E-W #F	99.82627588	87.67	767267.6	0.000615632
West N-S #2	59.23497497	142.65	1205374	0.000594395
West N-S #3	68.92916085	109.22	822256.5	0.000529578
West N-S #4	66.41640327	81.55	441695.8	0.000381
West N-S #5	69.67770537	54.24	204990.2	0.000265851
West N-S #6	109.4910939	28.31	87752.31	0.000218044
West E-W #AA	128.8848741	103.04	1368402	0.000934185
West E-W #BB	184.3455064	86	1363419	0.001115209
West E-W #DD	176.628818	80.24	1137217	0.00099696
West E-W #FF	88.169436	86.67	662301.4	0.000537542
Center E-W #A	37.03703704	63.41	148919.6	0.000165203
Center E-W #B	77.53046033	31.87	78747.45	0.000173812
Center E-W #D	41.53592448	14.21	8387.104	4.15186E-05
Center E-W #E	34.21353349	25.31	21917.06	6.09137E-05
Center E-W #F	23.4741784	39.02	35740.85	6.44322E-05

MC- 1		**MC- 2**	
General Properties		General Properties	
Elastic Modulus(E) ksi	29000	Elastic Modulus(E) ksi	29000
Yield Stress (Fv) ksi	36	Yield Stress (Fv) ksi	36
Bolt Properties	3/4"ø A325N	Bolt Properties	3/4"ø A325N
Bolt Diameter(d_b) in	0.750	Bolt Diameter(d_b) in	0.750
Nut Width(w) in	1.125	Nut Width(w) in	1.125
Connection Type	MC-1	Connection Type	MC-2
Top Angle	L6 X 4 X 7/8 X 0'-7"	Top Angle	L6 X 4 X 7/8 X 0'-6"
Leg Thickness(t) in	0.875	Leg Thickness(t) in	0.875
Leg Length(l) in	7.000	Leg Length(l) in	6.000
Beam Properties	W21X44	Beam Properties	W18X40
Beam Length (L) ft	28.00	Beam Length (L) ft	32.67
Beam Depth (d_t) in	20.70	Beam Depth (d_t) in	17.90
Moment of Inertia(I) in^4	843.00	Moment of Inertia(I) in^4	612.00
Connection Properties		Connection Properties	
Length Factor (α_i)	11.63	Length Factor (α_i)	10.16
Initial Connection Stiffness(R_{ki})	101,549	Initial Conn. Stiffness(R_{ki})	97,589

MC- 3		**MC- 4**	
General Properties		General Properties	
Elastic Modulus(E) ksi	29000	Elastic Modulus(E) ksi	29000
Yield Stress (Fv) ksi	36	Yield Stress (Fv) ksi	36
Bolt Properties	3/4"ø A325N	Bolt Properties	3/4"ø A325N
Bolt Diameter(d_b) in	0.750	Bolt Diameter(d_b) in	0.750
Nut Width(w) in	1.125	Nut Width(w) in	1.125
Connection Type	MC-3	Connection Type	MC-4
Top Angle	L3-1/2 X 3-1/2 X 5/8 X 0'-6 1/2"	Top Angle	L6 X 4 X 3/4 X 0'-7"
Leg Thickness(t) in	0.625	Leg Thickness(t) in	0.750
Leg Length(l) in	7.000	Leg Length(l) in	7.000
Beam Properties	W18X35	Beam Properties	W21X50
Beam Length (L) ft	28.00	Beam Length (L) ft	28.00
Beam Depth (d_t) in	17.70	Beam Depth (d_t) in	20.80
Moment of Inertia(I) in^4	510.00	Moment of Inertia(I) in^4	984.00
Connection Properties		Connection Properties	
Length Factor (α_i)	10.55	Length Factor (α_i)	15.67
Initial Connection Stiffness(R_{ki})	79,203	Initial Conn. Stiffness(R_{ki})	87,551

MC- 5		MC- 6	
General Properties		General Properties	
Elastic Modulus(E) ksi	29000	Elastic Modulus(E) ksi	29000
Yield Stress (Fv) ksi	36	Yield Stress (Fv) ksi	36
Bolt Properties	3/4"ø A325N	Bolt Properties	3/4"ø A325N
Bolt Diameter(db) in	0.750	Bolt Diameter(db) in	0.750
Nut Width(w) in	1.125	Nut Width(w) in	1.125
Connection Type	MC-5	Connection Type	MC-6
Top Angle	L6 X 4 X 3/4 X 0'-8"	Top Angle	L4 X 4 X 5/8 X 0'-10"
Leg Thickness(t) in	0.750	Leg Thickness(t) in	0.625
Leg Length(l) in	8.000	Leg Length(l) in	10.000
Beam Properties	W24X55	Beam Properties	W27X84
Beam Length (L) ft	33.67	Beam Length (L) ft	40.90
Beam Depth (dt) in	23.60	Beam Depth (dt) in	24.10
Moment of Inertia(I) in4	1350.00	Moment of Inertia(I) in4	2370.00
Connection Properties		Connection Properties	
Length Factor (αi)	18.77	Length Factor (αi)	35.91
Initial Connection Stiffness(Rki)	88,380	Initial Connection Stiffness(Rki)	79,417
MC- 7		MC- 8	
General Properties		General Properties	
Elastic Modulus(E) ksi	29000	Elastic Modulus(E) ksi	29000
Yield Stress (Fv) ksi	36	Yield Stress (Fv) ksi	36
Bolt Properties	3/4"ø A325N	Bolt Properties	3/4"ø A325N
Bolt Diameter(db) in	0.750	Bolt Diameter(db) in	0.750
Nut Width(w) in	1.125	Nut Width(w) in	1.125
Connection Type	MC-7	Connection Type	MC-8
Top Angle	L6 X 4 X 3/4 X 0'-9"	Top Angle	L3-1/2 X 3-1/2 X 1/2 X 0'-6 1/2"
Leg Thickness(t) in	0.750	Leg Thickness(t) in	0.500
Leg Length(l) in	9.000	Leg Length(l) in	6.500
Beam Properties	W24X76	Beam Properties	W21X50

Beam Length (L) ft	31.28	Beam Length (L) ft	28.14
Beam Depth (dt) in	23.90	Beam Depth (dt) in	20.80
Moment of Inertia(I) in4	2100.00	Moment of Inertia(I) in4	984.00
Connection Properties		Connection Properties	
Length Factor (αi)	27.60	Length Factor (αi)	20.00
Initial Connection Stiffness(Rki)	92,323	Initial Connection Stiffness(Rki)	68,596

General Properties			General Properties		
Elastic Modulus(E) ksi		29000	Elastic Modulus(E) ksi		29000
Yield Stress (Fv) ksi		36	Yield Stress (Fv) ksi		36
Bolt Properties	3/4"ø A325N		Bolt Properties	3/4"ø A325N	
Bolt Diameter(d_b) in		0.750	Bolt Diameter(d_b) in		0.750
Nut Width(w) in		1.125	Nut Width(w) in		1.125
Connection Type	MC-9		Connection Type	MC-10	
Top Angle	L3-1/2 X 3-1/2 X 9/16 X 0'-5"		Top Angle	L3-1/2 X 3-1/2 X 1/2 X 0'-10"	
Leg Thickness(t) in		0.563	Leg Thickness(t) in		0.500
Leg Length(l) in		5.000	Leg Length(l) in		10.000
Beam Properties	W14X22		Beam Properties	W33X118	
Beam Length (L) ft		12.76	Beam Length (L) ft		33.67
Beam Depth (d_t) in		13.70	Beam Depth (d_t) in		32.90
Moment of Inertia(I) in^4		199.00	Moment of Inertia(I) in^4		5900.00
Connection Properties			Connection Properties		
Length Factor (α_i)		6.12	Length Factor (α_i)		71.24
Initial Connection Stiffness(R_{ki})		68,830	Initial Connection Stiffness(R_{ki})		73,001

Appendix D - Miscellaneous

*SAP, RAM, & Excel Calculations
available upon request*