Appendix A

Steel Deck Details & Calculations

Composite Steel Deck Load Calculations:

DL = 45 psf
LL = 100 psf
TL = 1.2(45)+1.6(100) = 214 psf

Total slab depth = 4" + 1.5" = 5.5"

Slab Reinforcing: 4" Slab w/ 6x6 – W1.4xW1.4 WWF

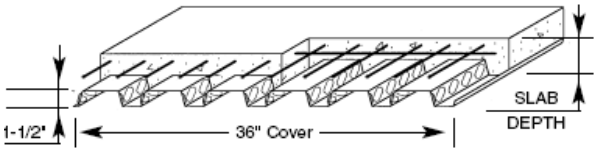
Deck Span = 7'-0

Deck Selected from Wheeling Deck Catalog:

1.5SB Normal Wt., 20 gage, Triple Span
$W_{ALLOWABLE}$ = 400 psf > W_{ACTUAL} = 214 psf; **Acceptable**

1.5 SB Normal Weight

Wheeling Composite Deck



Section Properties (per ft. of width)

Gage	t in	Wd psf	Sp in³	Sn in³	Ip in⁴	In in⁴	As in²	Fy ksi
22	0.0295	1.7	0.172	0.180	0.146	0.182	0.478	50
20	0.0358	2.0	0.218	0.229	0.190	0.221	0.581	50
18	0.0474	2.7	0.301	0.311	0.284	0.294	0.769	40
16	0.0600	3.4	0.388	0.394	0.374	0.373	0.973	40

145 pcf Normal Weight Concrete

Total Slab Depth D / Wt. Conc. / Area Conc.	Gage	Maximum Unshored Clear Spans: Single Span	Double Span	Triple Span	Composite Properties: Iavg in⁴/ft	Sc in³/ft	Superimposed Live Loads - psf: No Studds — Span - Feet and Inches: 6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	8'-6"	9'-0"	9'-6"	10'-0"	10'-6"	11'-0"	11'-6"
	22	5'-10"	7'-9"	7'-11"	3.573	0.887	400	34[illegible]	292	251	217	189	166	146	129	114	101	90
4"	20	6'-9"	9'-0"	9'-2"	3.854	1.052	400	40[illegible]	352	303	262	229	201	178	158	140	125	111
36.3 psf	18	7'-2"	9'-5"	9'-8"	4.333	1.345	400	40[illegible]	360	310	269	235	206	182	161	142	128	115
20.6 in²	16	8'-4"	10'-6"	10'-11"	4.782	1.638	400	40[illegible]	360	310	269	235	206	182	161	142	128	115
	22	5'-6"	7'-5"	7'-6"	5.107	1.087	400	40[illegible]	360	309	268	233	205	180	160	142	126	113
4-1/2"	20	6'-4"	8'-7"	8'-8"	5.496	1.291	400	40[illegible]	400	373	324	283	249	220	195	174	156	140
42.4 psf	18	6'-9"	8'-11"	9'-3"	6.160	1.653	400	40[illegible]	400	383	332	290	255	226	200	179	160	143
24.8 in²	16	7'-10"	10'-0"	10'-4"	6.789	2.018	400	40[illegible]	400	383	332	290	255	226	200	179	160	143
	22	5'-3"	7'-1"	7'-2"	7.022	1.293	400	40[illegible]	400	370	320	279	245	216	191	170	152	136
5"	20	6'-1"	8'-2"	8'-4"	7.544	1.538	400	40[illegible]	400	400	388	339	298	264	235	209	187	168
48.4 psf	18	6'-5"	8'-6"	8'-9"	8.431	1.972	400	40[illegible]	400	400	398	348	307	271	241	215	193	173
29.3 in²	16	7'-6"	9'-6"	9'-10"	9.280	2.415	400	40[illegible]	400	400	398	348	307	271	241	215	193	173
	22	5'-0"	6'-9"	6'-10"	9.360	1.503	400	40[illegible]	400	400	374	326	287	253	224	199	178	159
5-1/2"	20	5'-10"	7'-10"	7'-11"	10.036	1.791	400	40[illegible]	400	400	400	397	349	309	275	245	220	197
54.4 psf	[illegible]									400	400	400	360	318	283	253	227	204
34.1 in²	16	7'-2"	9'-2"	9'-5"	12.298	2.824	400	400	400	400	400	400	360	318	283	253	227	204
	22	4'-10"	6'-6"	6'-7"	12.157	1.717	400	400	400	400	400	374	329	290	258	229	205	183
6"	20	5'-7"	7'-6"	7'-8"	13.012	2.048	400	400	400	400	400	400	400	355	316	282	253	227
60.5 psf	18	5'-11"	7'-10"	8'-1"	14.468	2.636	400	400	400	400	400	400	400	366	326	291	261	235
39.4 in²	16	6'-10"	8'-9"	9'-1"	15.883	3.242	400	400	400	400	400	400	400	366	326	291	261	235

D, Wc, Ac	Gage	Single Span	Double Span	Triple Span	Stud Factors: 2' o.c.	3' o.c.	Superimposed Live Loads - psf: Studs @ 1'-0" O.C. — Span - Feet and Inches: 6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	8'-6"	9'-0"	9'-6"	10'-0"	10'-6"	11'-0"	11'-6"
	22	5'-10"	7'-9"	7'-11"	0.91	0.84	400	400	400	371	305	255	215	182	156	135	118	103
4"	20	6'-9"	9'-1"	9'-2"	0.88	0.82	400	400	400	400	329	275	231	197	169	146	127	111
36.3 psf	18	7'-2"	9'-5"	9'-5"	0.86	0.80	400	400	400	400	370	309	260	221	190	164	142	125
20.6 in²	16	8'-4"	10'-6"	10'-11"	0.83	0.78	400	400	400	400	400	341	287	244	209	181	157	138
	22	5'-6"	7'-5"	7'-6"	0.92	0.85	400	400	400	400	387	339	299	261	224	193	168	147
4-1/2"	20	6'-4"	8'-7"	8'-8"	0.89	0.83	400	400	400	400	400	392	330	281	241	208	181	158
42.4 psf	18	6'-9"	8'-11"	9'-3"	0.87	0.81	400	400	400	400	400	400	370	314	270	233	203	177
24.8 in²	16	7'-10"	10'-0"	10'-4"	0.84	0.79	400	400	400	400	400	400	400	347	297	257	223	195
	22	5'-3"	7'-1"	7'-2"	0.93	0.86	400	400	400	400	400	393	347	307	274	245	220	198
5"	20	6'-1"	8'-2"	8'-4"	0.89	0.84	400	400	400	400	400	400	400	371	330	285	248	217
48.4 psf	18	6'-5"	8'-6"	8'-9"	0.88	0.82	400	400	400	400	400	400	400	392	350	314	277	243
29.3 in²	16	7'-6"	9'-6"	9'-10"	0.85	0.81	400	400	400	400	400	400	400	400	400	351	305	267
	22	5'-0"	6'-9"	6'-10"	0.93	0.87	400	400	400	400	400	400	395	350	312	279	250	225
5-1/2"	20	5'-10"	7'-10"	7'-11"	0.90	0.85	400	400	400	400	400	400	400	400	378	339	305	276
54.4 psf	18	6'-2"	8'-2"	8'-5"	0.88	0.83	400	400	400	400	400	400	400	400	400	359	323	292
34.1 in²	16	7'-2"	9'-2"	9'-5"	0.85	0.82	400	400	400	400	400	400	400	400	400	400	400	354
	22	4'-10"	6'-6"	6'-7"	0.94	0.88	400	400	400	400	400	400	400	392	349	313	281	253
6"	20	5'-7"	7'-6"	7'-8"	0.91	0.86	400	400	400	400	400	400	400	400	400	381	343	310
60.5 psf	18	5'-11"	7'-10"	8'-1"	0.89	0.84	400	400	400	400	400	400	400	400	400	400	363	328
39.4 in²	16	6'-10"	8'-9"	9'-1"	0.86	0.83	400	400	400	400	400	400	400	400	400	400	400	400

1) Refer to the Design Notes, Note 7, for information on live load limits for fire-rated construction. See Page CD-3.
2) If stud spacing exceeds 1'-0" o.c., reduce live load by applicable stud factor listed above for actual stud spacing.
3) If welded wire fabric is not used, the live loads should be reduced by 10%.

Appendix B

RAM Output Designs & Values

RAM Takeoffs of Beams & Columns:

East Wing Beam Takeoff:

Gravity Beam Design Takeoff

RAM Steel v10.0 — Page 3/3
DataBase: east wing no roof — 03/22/06 10:22:40
Building Code: IBC — Steel Code: AISC LRFD

TOTAL STRUCTURE GRAVITY BEAM TAKEOFF

Steel Grade: 50

SIZE	#	LENGTH (ft)	WEIGHT (lbs)
W8X10	148	2196.85	22127
W10X12	262	5469.17	65881
W12X14	49	938.42	13284
W12X16	9	240.00	3846
W14X22	12	309.50	6835
W16X26	10	276.92	7237
W16X31	1	31.42	976
W18X35	3	94.25	3303
W18X40	4	125.67	5046
W21X44	36	1131.00	50031
	---		---
	534		**178566**

Total Number of Studs = **9199**

East Wing Column Takeoff:

Gravity Column Design TakeOff

RAM Steel v10.0
DataBase: east wing no roof — 04/02/06 16:38:00
Building Code: IBC — Steel Code: AISC LRFD

Steel Grade: 50

I section

Size	#	Length (ft)	Weight (lbs)
W10X33	106	1378.0	45530
W10X39	25	325.0	12718
W10X45	12	156.0	7060
W10X49	1	13.0	637
	____		_____
	144		65945

Link Beam Takeoff:

Gravity Beam Design Takeoff

RAM Steel v10.0
DataBase: link
Building Code: IBC

04/01/06 03:14:51
Steel Code: ASD 9th Ed.

STEEL BEAM DESIGN TAKEOFF:

TOTAL STRUCTURE GRAVITY BEAM TAKEOFF

Steel Grade: 50

SIZE	#	LENGTH (ft)	WEIGHT (lbs)
W8X10	122	1894.79	19085
W10X12	40	874.50	10534
W16X26	7	181.42	4741
W18X40	8	187.75	7539
W21X44	5	129.58	5732
	---		---
	182		**47631**

Total Number of Studs = **2322**

Link Column Takeoff:

Gravity Column Design TakeOff

RAM Steel v10.0
DataBase: link
Building Code: IBC

04/02/06 16:43:48
Steel Code: AISC LRFD

Steel Grade: 50

I section

Size	#	Length (ft)	Weight (lbs)
W10X33	65	845.0	27920
W12X53	1	13.0	690
	____		_____
	66		28610

West Wing Beam Takeoff:

Gravity Beam Design Takeoff

Steel Grade: 50

TOTAL STRUCTURE GRAVITY BEAM TAKEOFF

Steel Grade: 50

SIZE	#	LENGTH (ft)	WEIGHT (lbs)
W8X10	256	4037.48	40666
W8X13	1	26.67	348
W10X12	29	628.17	7567
W12X14	11	217.34	3077
W12X19	6	111.83	2120
W14X22	33	696.17	15374
W16X26	11	262.59	6862
W16X31	1	20.17	627
W18X35	7	220.50	7728
W18X40	14	418.33	16797
W21X50	2	63.00	3151
W24X55	2	63.00	3494
W24X62	2	63.00	3923
W24X76	3	84.25	6422
	---		---
	378		**118157**

Total Number of Studs = **5564**

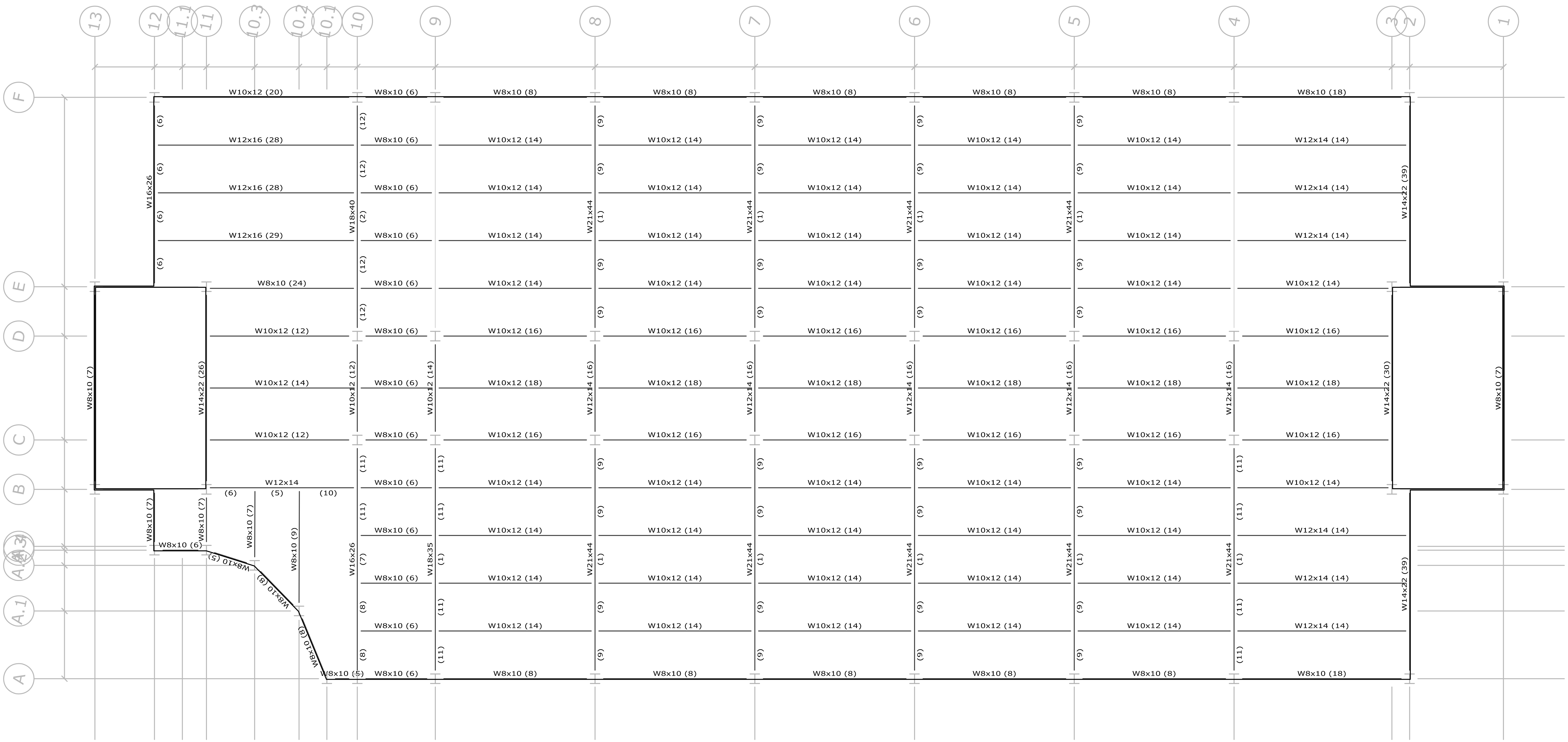
West Wing Beam Takeoff:

Gravity Column Design TakeOff

Steel Grade: 50

I section

Size	#	Length (ft)	Weight (lbs)
W10X33	88	1144.0	37799
W10X39	5	65.0	2544
W10X45	7	91.0	4118
	____		_____
	100		44461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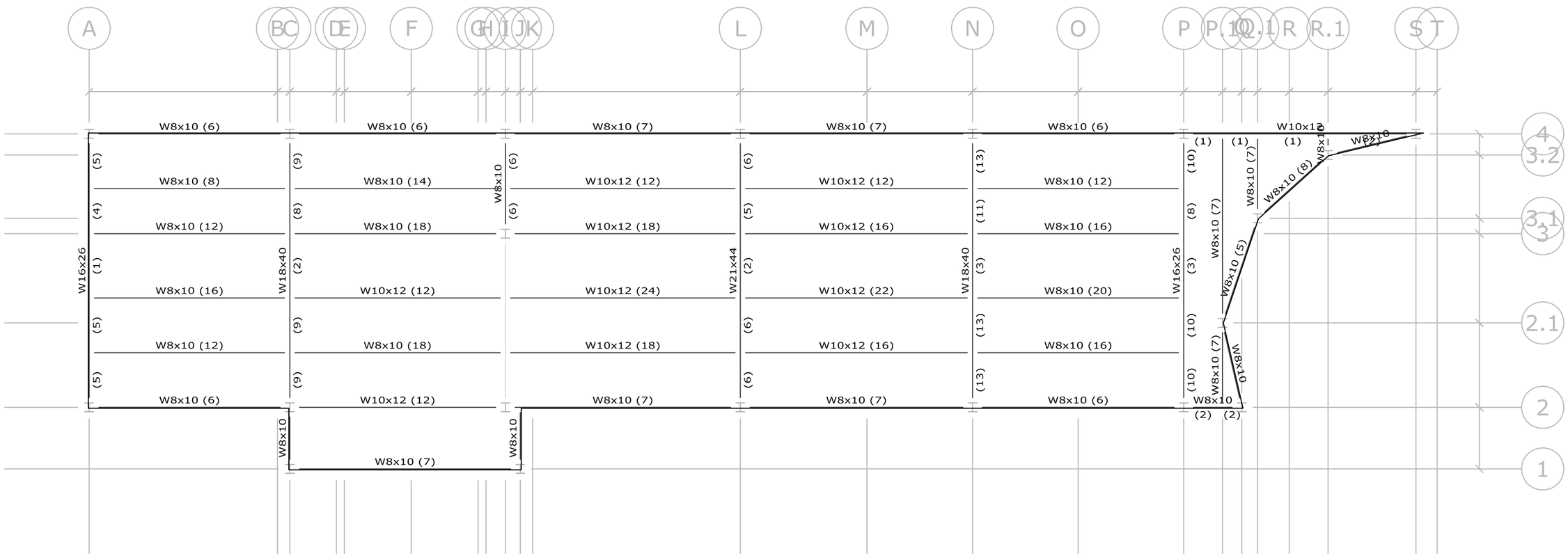
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Appendix C

Calculations of Lateral Loads

Wind Analysis

Simplified Method - ASCE 7 - 02 Sec. 6.4

Wind Load Factors			
mean building height (must be < 60'):	h (ft.) =	53.19	
Basic Wind Speed:	V (mph) =	90	From General Notes on Plans
Building Category:	Category	III	Table 1-1
Importance Factor:	I =	1.15	Table 6-1
Exposure Category:	Category	B	Sec. 6.5.6
Ht.& Exposure Adjustment Coeff.:	λ =	1.178	Fig. 6-2; by interpolation

Zone	p_{s30}	
A	12.8	Horizontal Pressures
B	-6.7	
C	8.5	
D	-4.0	
E	-15.4	Vertical Pressure
F	-8.8	
G	-10.7	
H	-6.8	

$p_s = \lambda * I * p_{s30}$
I = 1.15
p_{s30} = 12.8 - (-6.7)
λ: see below

height	λ	I	$p_{total} = \lambda * I * p_{s30}$ (psf)
15	1.00	1.15	21.42
20	1.00	1.15	21.42
25	1.00	1.15	21.42
30	1.00	1.15	21.42
35	1.05	1.15	22.16
40	1.09	1.15	22.74
45	1.12	1.15	23.19
50	1.16	1.15	23.78
55	1.19	1.15	24.22
60	1.22	1.15	24.66

Shears on West Wing & East Wing due to Wind Loads

		kips (n-s)		kips (e-w)	
Level	plf	West	East	West	East
Roof	170.0937	13.01	13.01	20.21	31.09
4th	311.0891	23.80	23.80	36.96	56.87
3rd	280.31	21.44	21.44	33.30	51.24
2nd	278.46	21.30	21.30	33.08	50.90
1st	0	0	0	0	0
Basement	------	------	------	------	------
Base Shear		79.56	79.56	123.55	190.10

Shears on Link due to Wind Loads

		kips (n-s)	kips (e-w)
Level	plf	Link	Link
Roof	146.36	18.69	5.15
3rd	280.31	35.80	9.87
2nd	278.46	35.56	9.80
1st	0	0.00	0.00
Basement	------	------	------
Base Shear		90.05	24.82

Building Information for Seismic Analysis:

Seismic Information	East & West Wings	Link
Building Location	Haverford, PA	Haverford, PA
# of stories	4	3
inner story ht.	13	13
Bldg. height	53	39
Seismic Use Group	II	II
Importance Factor	1.25	1.25
Site Classification	B	B
0.2s Acceleration	0.35	0.35
1.0s Acceleration	0.08	0.08
Site Class Factor:		
Fa	1.00	1.00
Fv	1.00	1.00
Adjusted Accelerations		
S_{ms}	0.35	0.35
S_{m1}	0.077	0.077
Spectral Response Accelerations		
S_{DS}	0.233	0.233
S_{D1}	0.051	0.051
Seismic Design Category	**B**	**B**

Seismic Analysis

East Wing

Vertical Distribution of Seismic Forces

$k_{N\text{-}S}$ = 1+ ($T_{N\text{-}S}$ - 0.5)/(2.5 - 0.5) = 0.946

Level, x	w_x	h_x	$w_x h_x^k$	C_{vx}	F_x	V_x	M_x
	(kips)	(ft)			(kips)	(kips)	(ft-kips)
			-	0.000	-		-
Roof	1297	53	55,579	0.263	73	-	3,860
4	2389	39	76,562	0.362	100	73	3,913
3	2389	26	52,162	0.247	68	173	1,777
2	2389	13	27,068	0.128	35	242	461
1						277	
	Σ = 8464		Σ = 211370	Σ = 1.000	Σ = 277		Σ = 10011

Link

Vertical Distribution of Seismic Forces

$k_{E\text{-}W}$ = 1+ ($T_{E\text{-}W}$ 0.5)/(2.5 - 0.5) = 0.906

Level, x	w_x	h_x	$w_x h_x^k$	C_{vx}	F_x	V_x	M_x
	(kips)	(ft)			(kips)	(kips)	(ft-kips)
			-	0.000	-		-
Roof	561	39	15,516	0.333	37	-	1,432
3	1057	26	20,227	0.435	48	37	1,245
2	1057	13	10,794	0.232	26	85	332
1						110	
	Σ = 2674		Σ = 46537	Σ = 1.000	Σ = 110		Σ = 3009

West Wing

Vertical Distribution of Seismic Forces

$k_{N\text{-}S}$ = 1+ ($T_{N\text{-}S}$ - 0.5)/(2.5 - 0.5) = 0.946

Level, x	w_x	h_x	$w_x h_x^k$	C_{vx}	F_x	V_x	M_x
	(kips)	(ft)			(kips)	(kips)	(ft-kips)
			-	0.000	-		-
Roof	892	53	38,203	0.262	50	-	2,655
4	1650	39	52,873	0.363	69	50	2,703
3	1650	26	36,023	0.247	47	119	1,228
2	1650	13	18,693	0.128	25	167	319
1						191	
	Σ = 5841		Σ = 145792	Σ = 1.000	Σ = 191		Σ = 6904

Lateral Forces on Steel Braced Frames Due to Torsion

East Wing

L	162.67
W	76.5
centroid,y	81.335
centroid,x	38.25
y_{cr}	73.25
x_{cr}	38.25
$e_{acc,y}$	8.1335
$e_{acc,x}$	3.825
$e_{total,y}$	16.2185
$e_{total,x}$	3.825

E-W frames

			Frame 1				Frame 2				Frame 3, 4, 5, 6				
Story	**Force**	**M**	**k**	**d_i**	**d_i^2**	**$F_{torsion}$**	**k**	**d_i**	**d_i^2**	**$F_{torsion}$**	**k**	**d_i**	**d_i^2**	**$F_{torsion}$**	**$\Sigma k_i*d_i^2$**
4	86.5	2805.801	1	-44.3665	1968.386	**-21.16575**	1	59.8835	3586.034	**28.56838**	0.46	13.33	177.6889	**2.925273**	5881.367
3	34	1102.858	1	-44.3665	1968.386	**-8.319485**	1	59.8835	3586.034	**11.22919**	0.46	13.33	177.6889	**1.149818**	5881.367
2	17.5	567.6475	1	-44.3665	1968.386	**-4.282088**	1	59.8835	3586.034	**5.779731**	0.46	13.33	177.6889	**0.591818**	5881.367
1	0	0	1	-44.3665	1968.386	**0**	1	59.8835	3586.034	**0**	0.46	13.33	177.6889	**0**	5881.367

N-S frames

			Frame 1				Frame 2				Frame 3, 4, 5, 6				
Story	**Force**	**M**	**k**	**d_i**	**d_i^2**	**$F_{torsion}$**	**k**	**d_i**	**d_i^2**	**$F_{torsion}$**	**k**	**d_i**	**d_i^2**	**$F_{torsion}$**	**$\Sigma k_i*d_i^2$**
4	43.25	661.725	1	-44.3665	1968.386	**-4.816077**	1	59.8835	3586.034	**6.50048**	0.46	17.155	294.294	**0.856617**	6095.921
3	17	260.1	1	-44.3665	1968.386	**-1.893024**	1	59.8835	3586.034	**2.555102**	0.46	17.155	294.294	**0.336705**	6095.921
2	8.75	133.875	1	-44.3665	1968.386	**-0.974351**	1	59.8835	3586.034	**1.315126**	0.46	17.155	294.294	**0.173304**	6095.921
1	0	0	1	-44.3665	1968.386	**0**	1	59.8835	3586.034	**0**	0.46	17.155	294.294	**0**	6095.921

Lateral Forces on Steel Braced Frames Due to Torsion

Link

L	104
W	26
centroid,x	52
centroid,y	13
y_{cr}	13
x_{cr}	38.83
$e_{acc,x}$	5.2
$e_{acc,y}$	1.3
$e_{total,x}$	18.37
$e_{total,y}$	1.3

E-W frames

			Frame 7				Frame 8				Frame 9				
Story	**Force**	**M**	**k**	**d_i**	**d_i^2**	**$F_{torsion}$**	**k**	**d_i**	**d_i^2**	**$F_{torsion}$**	**k**	**d_i**	**d_i^2**	**$F_{torsion}$**	**$\Sigma k_i*d_i^2$**
4	18.5	48.1	1	14.3	204.49	**0.205108**	1	14.3	204.49	**0.205108**	0.74	-31.54	994.7716	**-0.334765**	3353.504
3	24	62.4	1	14.3	204.49	**0.266086**	1	14.3	204.49	**0.266086**	0.74	-31.54	994.7716	**-0.434289**	3353.504
2	13	33.8	1	14.3	204.49	**0.14413**	1	14.3	204.49	**0.14413**	0.74	-31.54	994.7716	**-0.23524**	3353.504
1	0	0	1	14.3	204.49	**0**	1	14.3	204.49	**0**	0.74	-31.54	994.7716	**0**	3353.504

N-S frames

			Frame 7				Frame 8				Frame 9				
Story	**Force**	**M**	**k**	**d_i**	**d_i^2**	**$F_{torsion}$**	**k**	**d_i**	**d_i^2**	**$F_{torsion}$**	**k**	**d_i**	**d_i^2**	**$F_{torsion}$**	**$\Sigma k_i*d_i^2$**
4	37	679.69	1	14.3	204.49	**2.898332**	1	14.3	204.49	**2.898332**	0.74	-31.54	994.7716	**-4.730483**	3353.504
3	48	881.76	1	14.3	204.49	**3.759998**	1	14.3	204.49	**3.759998**	0.74	-31.54	994.7716	**-6.136843**	3353.504
2	26	477.62	1	14.3	204.49	**2.036666**	1	14.3	204.49	**2.036666**	0.74	-31.54	994.7716	**-3.324123**	3353.504
1	0	0	1	14.3	204.49	**0**	1	14.3	204.49	**0**	0.74	-31.54	994.7716	**0**	3353.504

Lateral Forces on Steel Braced Frames Due to Torsion

West Wing

L	111
W	76
centroid,y	55.5
centroid,x	38
y_{cr}	63.17
x_{cr}	39.9
$e_{acc,y}$	5.55
$e_{acc,x}$	3.8
$e_{total,y}$	13.22
$e_{total,x}$	5.7

E-W frames

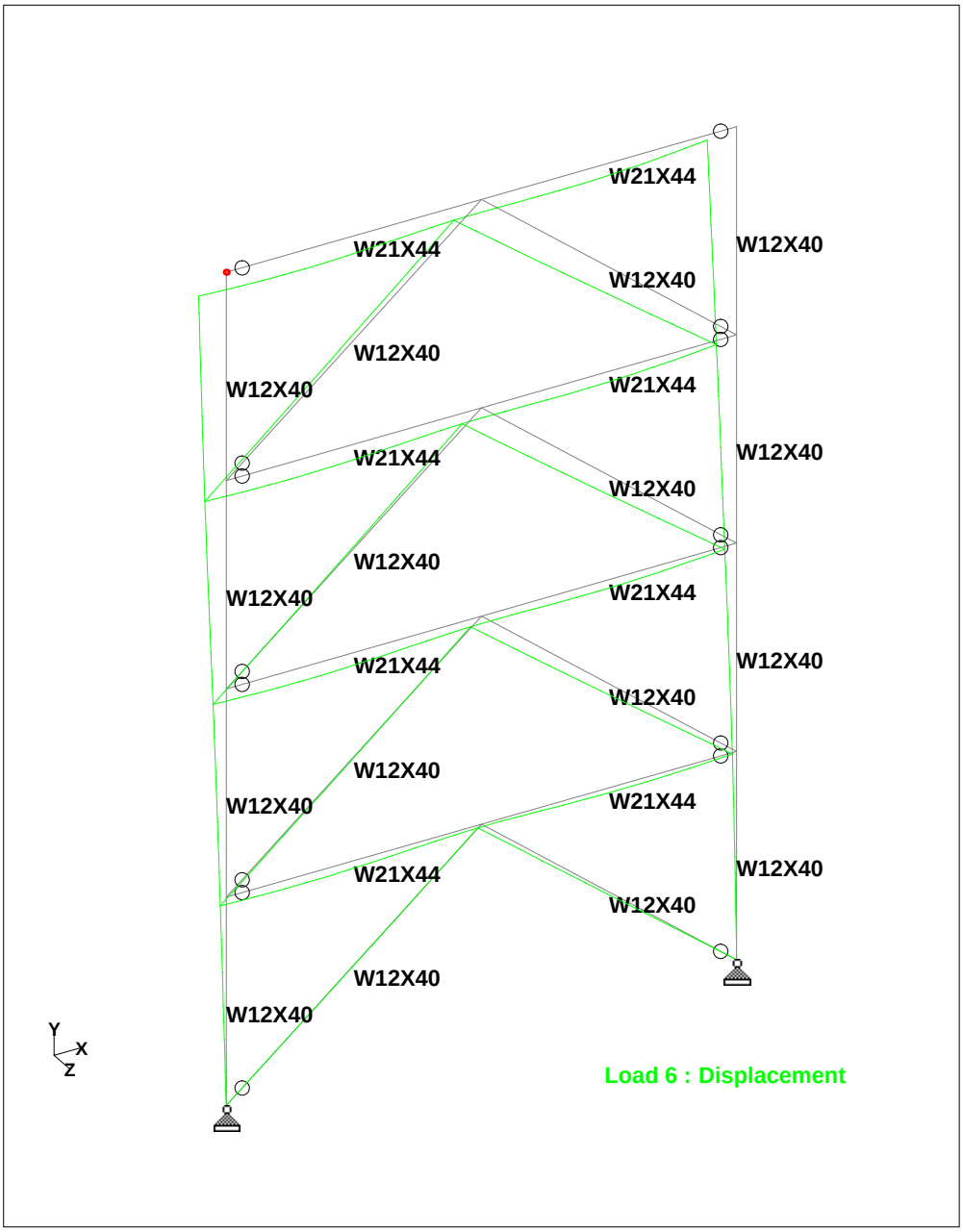
			Frame 10				Frame 11				Frame 12, 13, 14, 15				
Story	**Force**	**M**	**k**	**d_i**	**d_i^2**	**$F_{torsion}$**	**k**	**d_i**	**d_i^2**	**$F_{torsion}$**	**k**	**d_i**	**d_i^2**	**$F_{torsion}$**	**$\Sigma k_i*d_i^2$**
4	59.5	1573.18	0.85	-42.28	1787.598	**-9.390685**	1	68.72	4722.438	**15.26319**	0.48	20.93	438.0649	**2.231376**	7082.982
3	23.5	621.34	0.85	-42.28	1787.598	**-3.708926**	1	68.72	4722.438	**6.028321**	0.48	20.93	438.0649	**0.8813**	7082.982
2	12.5	330.5	0.85	-42.28	1787.598	**-1.972833**	1	68.72	4722.438	**3.206554**	0.48	20.93	438.0649	**0.468776**	7082.982
1	0	0	0.85	-42.28	1787.598	**0**	1	68.72	4722.438	**0**	0.48	20.93	438.0649	**0**	7082.982

N-S frames

			Frame 10				Frame 11				Frame 12, 13, 14, 15				
Story	**Force**	**M**	**k**	**d_i**	**d_i^2**	**$F_{torsion}$**	**k**	**d_i**	**d_i^2**	**$F_{torsion}$**	**k**	**d_i**	**d_i^2**	**$F_{torsion}$**	**$\Sigma k_i*d_i^2$**
4	29.75	678.3	0.85	-42.28	1787.598	**-4.048934**	1	68.72	4722.438	**6.580954**	0.48	20.93	438.0649	**0.962091**	7082.982
3	11.75	267.9	0.85	-42.28	1787.598	**-1.599159**	1	68.72	4722.438	**2.5992**	0.48	20.93	438.0649	**0.379986**	7082.982
2	6.25	142.5	0.85	-42.28	1787.598	**-0.850616**	1	68.72	4722.438	**1.382553**	0.48	20.93	438.0649	**0.20212**	7082.982
1	0	0	0.85	-42.28	1787.598	**0**	1	68.72	4722.438	**0**	0.48	20.93	438.0649	**0**	7082.982

Appendix D

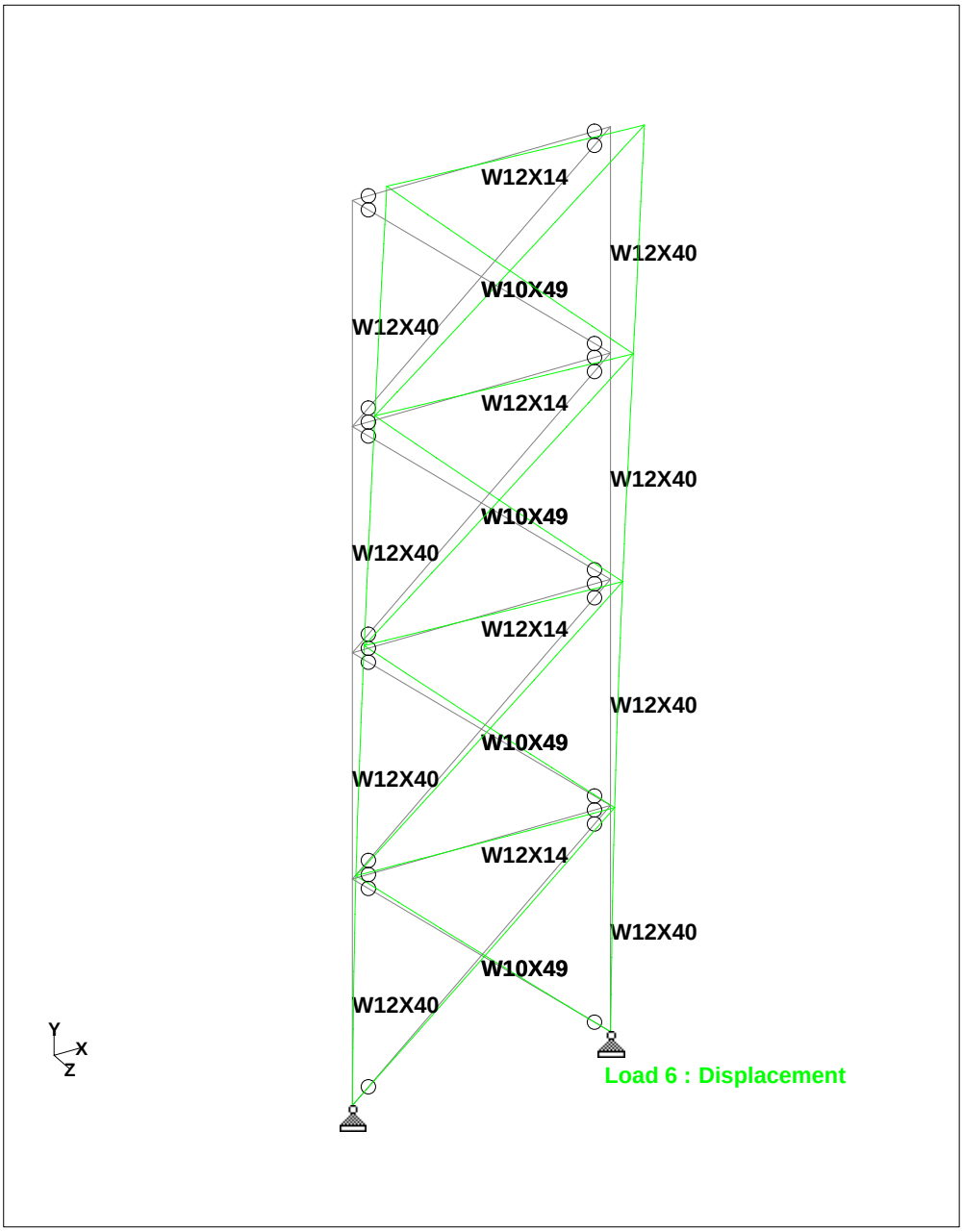
STAAD Deflections & Diagrams of Proposed Steel Braced Frames



Whole Structure Displacements 0.5in:1ft 6 COMBINATION LOAD CASE 6

Node Displacement Summary

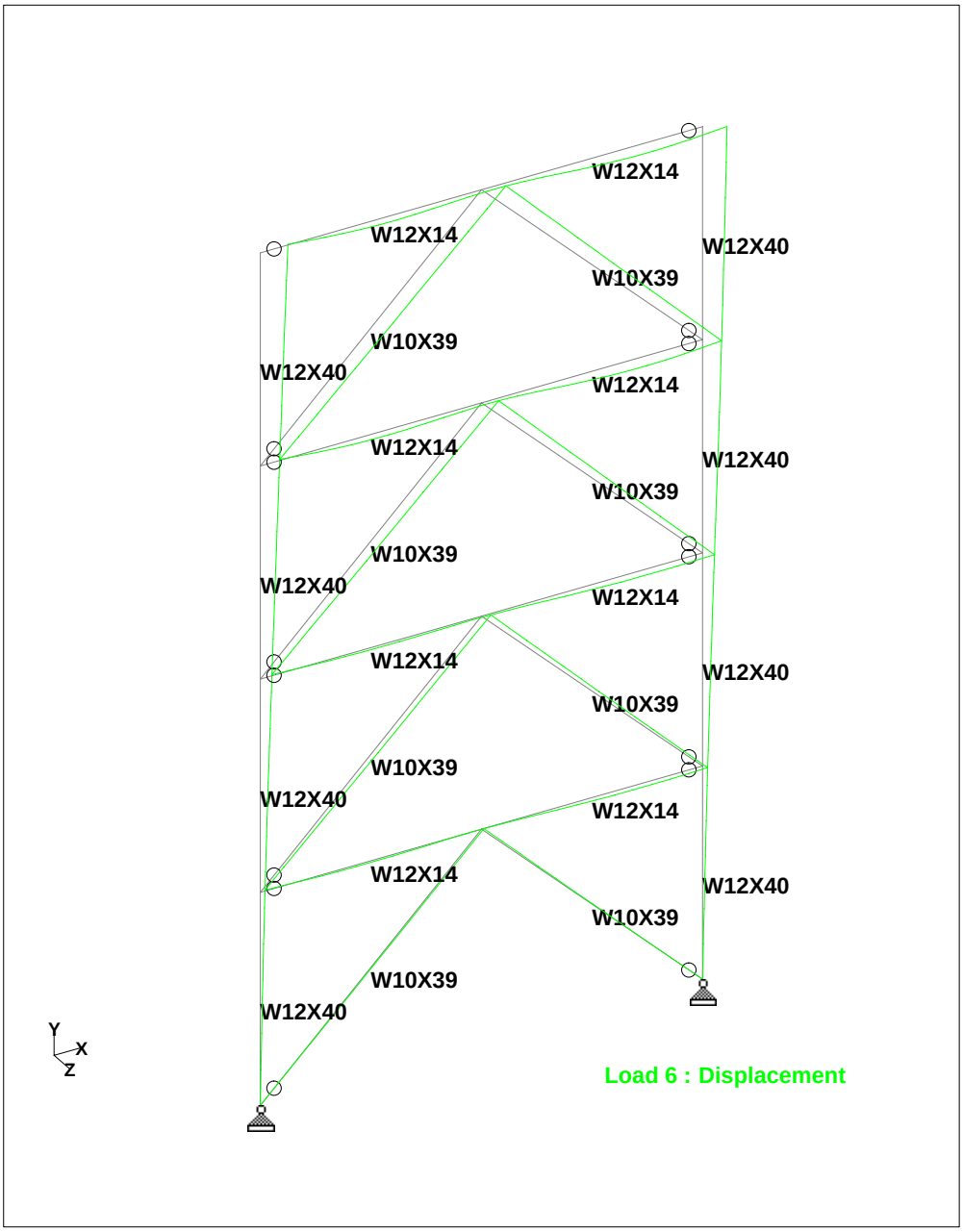
	Node	L/C	X (in)	Y (in)	Z (in)	Resultant (in)	rX (rad)	rY (rad)	rZ (rad)
Max X	4	4:COMBINATIC	**0.033**	-0.163	0.000	0.166	0.000	0.000	-0.000
Min X	10	6:COMBINATIC	**-0.908**	-0.157	0.000	0.921	0.000	0.000	0.002
Max Y	10	3:EQ	-0.894	**0.160**	0.000	0.908	0.000	0.000	0.002
Min Y	14	4:COMBINATIC	-0.017	**-0.532**	0.000	0.533	0.000	0.000	0.000
Max Z	1	1:DEAD	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000
Min Z	1	1:DEAD	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000
Max rX	1	1:DEAD	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000
Min rX	1	1:DEAD	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000
Max rY	1	1:DEAD	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000
Min rY	1	1:DEAD	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000
Max rZ	10	6:COMBINATIC	-0.908	-0.157	0.000	0.921	0.000	0.000	**0.002**
Min rZ	3	4:COMBINATIC	0.000	0.000	0.000	0.000	0.000	0.000	**-0.000**
Max Rst	9	6:COMBINATIC	-0.850	-0.500	0.000	**0.986**	0.000	0.000	0.001



Whole Structure Displacements 0.5in:1ft 6 1.2D+EQ+L

Node Displacement Summary

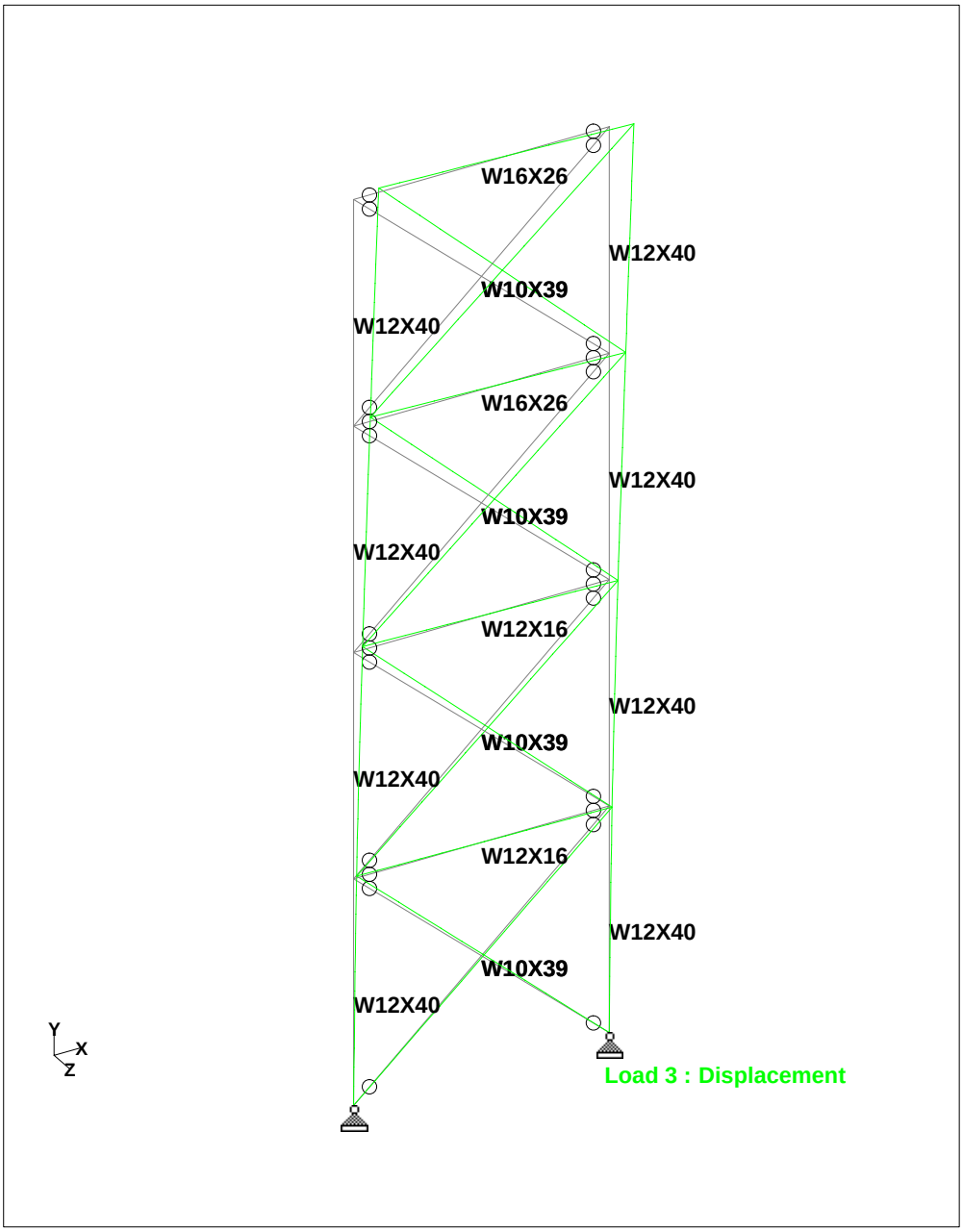
	Node	L/C	X (in)	Y (in)	Z (in)	Resultant (in)	rX (rad)	rY (rad)	rZ (rad)
Max X	9	3:EQ	**0.982**	0.181	0.000	0.999	0.000	0.000	-0.002
Min X	2	4:1.2D+1.6L	**-0.008**	-0.017	0.000	0.019	0.000	0.000	0.000
Max Y	9	3:EQ	0.982	**0.181**	0.000	0.999	0.000	0.000	-0.002
Min Y	10	6:1.2D+EQ+L	0.965	**-0.233**	0.000	0.992	0.000	0.000	-0.002
Max Z	1	1:DEAD	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000
Min Z	1	1:DEAD	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000
Max rX	1	1:DEAD	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000
Min rX	1	1:DEAD	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000
Max rY	1	1:DEAD	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000
Min rY	1	1:DEAD	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000
Max rZ	1	4:1.2D+1.6L	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
Min rZ	9	6:1.2D+EQ+L	0.979	0.122	0.000	0.987	0.000	0.000	**-0.002**
Max Rst	9	3:EQ	0.982	0.181	0.000	**0.999**	0.000	0.000	-0.002



Whole Structure Displacements 0.5in:1ft 6 1.2D+L+E

Node Displacement Summary

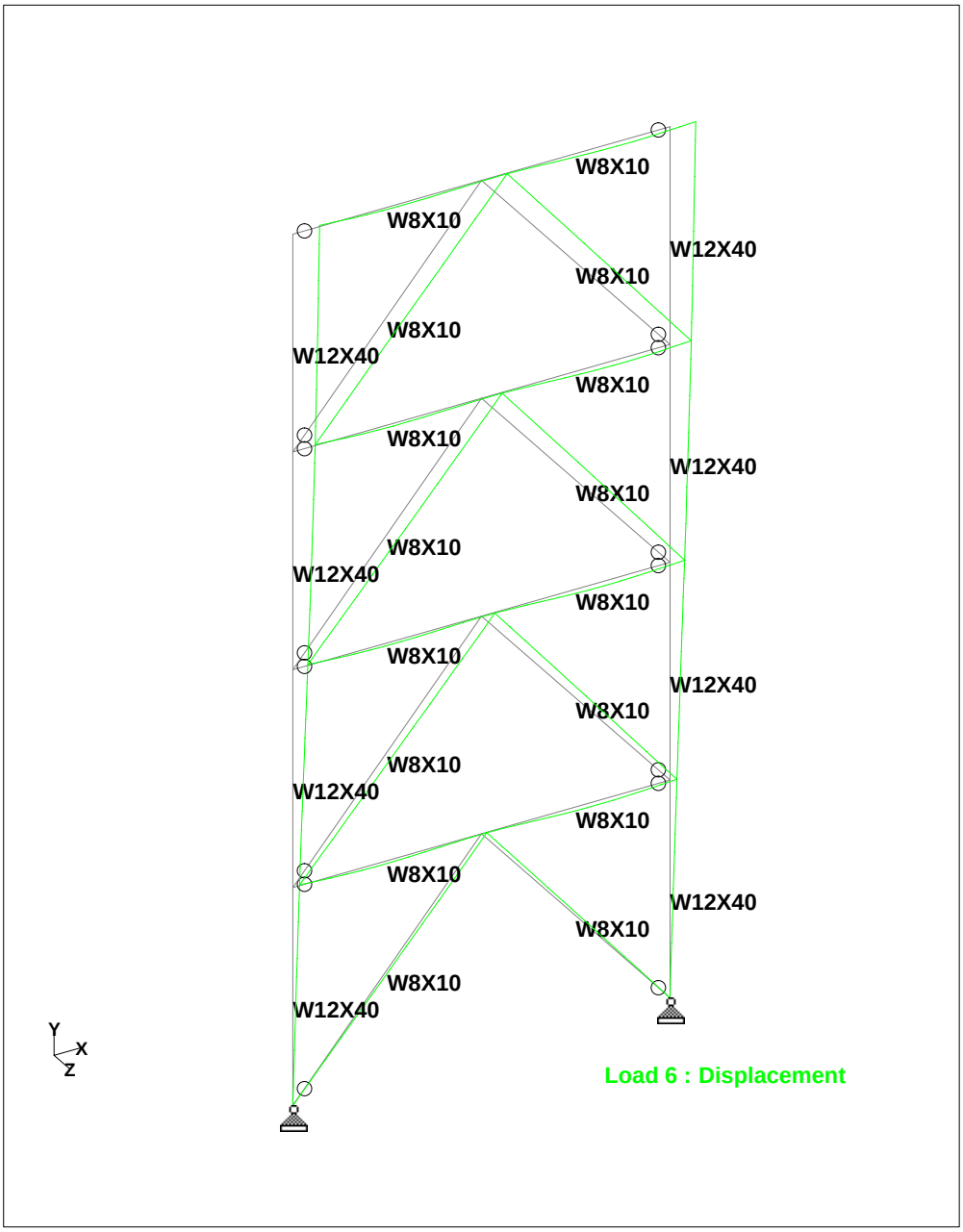
	Node	L/C	X (in)	Y (in)	Z (in)	Resultant (in)	rX (rad)	rY (rad)	rZ (rad)
Max X	9	3:EQ	**0.831**	0.115	0.000	0.839	0.000	0.000	-0.001
Min X	5	4:1.2D+1.6L	**-0.023**	-0.083	0.000	0.086	0.000	0.000	0.000
Max Y	9	3:EQ	0.831	**0.115**	0.000	0.839	0.000	0.000	-0.001
Min Y	10	6:1.2D+L+E	0.738	**-0.211**	0.000	0.768	0.000	0.000	-0.001
Max Z	1	1:DEAD	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000
Min Z	1	1:DEAD	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000
Max rX	1	1:DEAD	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000
Min rX	1	1:DEAD	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000
Max rY	1	1:DEAD	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000
Min rY	1	1:DEAD	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000
Max rZ	10	4:1.2D+1.6L	0.000	-0.128	0.000	0.128	0.000	0.000	**0.000**
Min rZ	9	6:1.2D+L+E	0.831	0.019	0.000	0.831	0.000	0.000	**-0.002**
Max Rst	9	3:EQ	0.831	0.115	0.000	**0.839**	0.000	0.000	-0.001



Whole Structure Displacements 0.5in:1ft 3 EQ

Node Displacement Summary

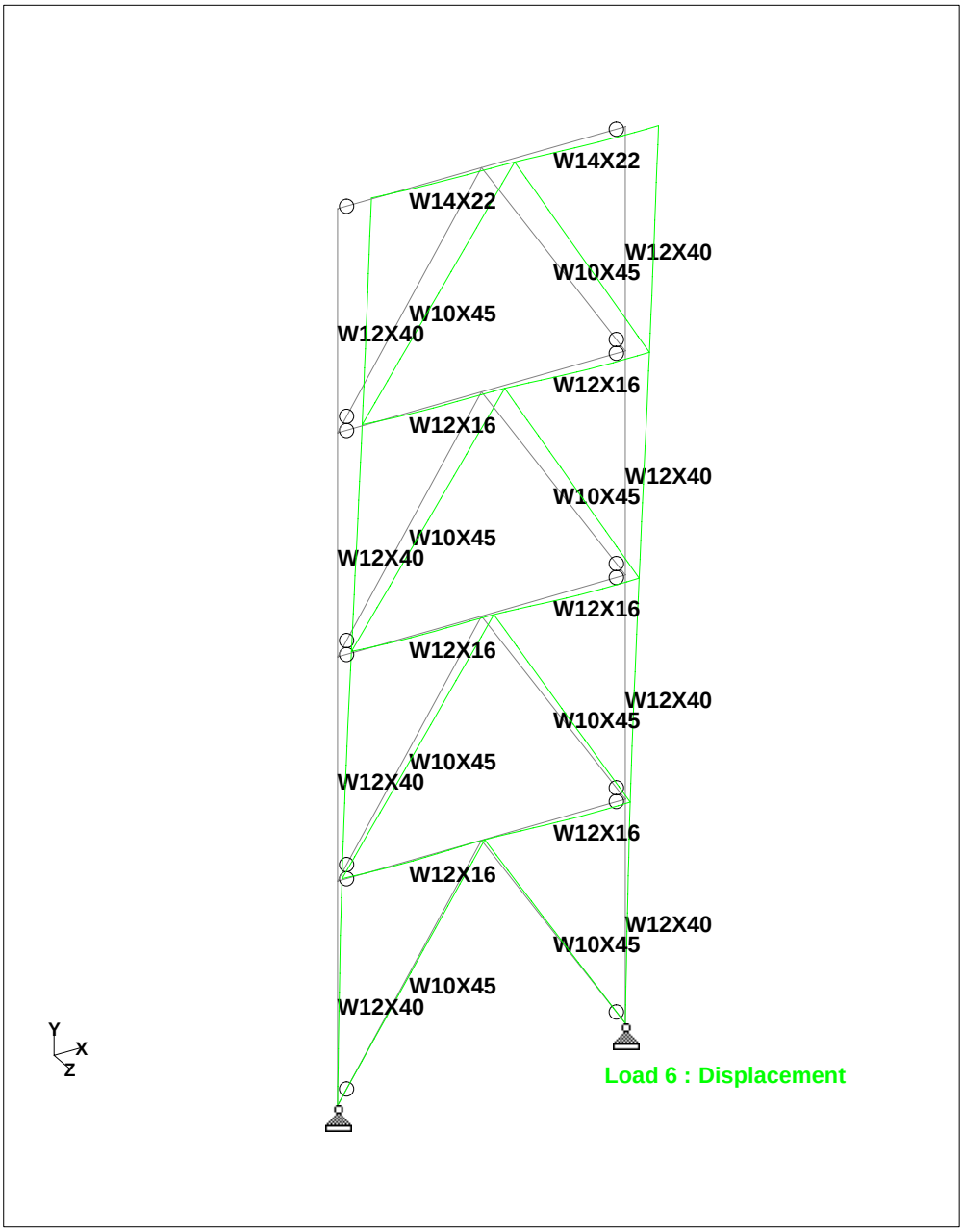
	Node	L/C	X (in)	Y (in)	Z (in)	Resultant (in)	rX (rad)	rY (rad)	rZ (rad)
Max X	9	3:EQ	**0.711**	0.126	0.000	0.722	0.000	0.000	-0.002
Min X	2	4:1.2D+1.6L	**-0.020**	-0.057	0.000	0.061	0.000	0.000	0.000
Max Y	9	3:EQ	0.711	**0.126**	0.000	0.722	0.000	0.000	-0.002
Min Y	10	6:1.2D+1.0L+1	0.702	**-0.225**	0.000	0.737	0.000	0.000	-0.001
Max Z	1	1:DEAD	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000
Min Z	1	1:DEAD	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000
Max rX	1	1:DEAD	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000
Min rX	1	1:DEAD	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000
Max rY	1	1:DEAD	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000
Min rY	1	1:DEAD	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000
Max rZ	1	4:1.2D+1.6L	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
Min rZ	9	6:1.2D+1.0L+1	0.710	0.022	0.000	0.710	0.000	0.000	**-0.002**
Max Rst	10	6:1.2D+1.0L+1	0.702	-0.225	0.000	**0.737**	0.000	0.000	-0.001



Whole Structure Displacements 0.5in:1ft 6 1.2D+E+L

Node Displacement Summary

	Node	L/C	X (in)	Y (in)	Z (in)	Resultant (in)	rX (rad)	rY (rad)	rZ (rad)
Max X	9	3:EQ	**0.787**	0.052	0.000	0.789	0.000	0.000	-0.001
Min X	5	4:1.2D+1.6L	**-0.007**	-0.020	0.000	0.021	0.000	0.000	-0.000
Max Y	9	3:EQ	0.787	**0.052**	0.000	0.789	0.000	0.000	-0.001
Min Y	10	6:1.2D+E+L	0.758	**-0.072**	0.000	0.762	0.000	0.000	-0.001
Max Z	1	1:DEAD	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000
Min Z	1	1:DEAD	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000
Max rX	1	1:DEAD	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000
Min rX	1	1:DEAD	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000
Max rY	1	1:DEAD	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000
Min rY	1	1:DEAD	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000
Max rZ	1	4:1.2D+1.6L	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
Min rZ	5	7:0.9D+E	0.444	0.042	0.000	0.446	0.000	0.000	**-0.002**
Max Rst	9	3:EQ	0.787	0.052	0.000	**0.789**	0.000	0.000	-0.001



Whole Structure Displacements 0.5in:1ft 6 1.2D+1.0L+1.0E

Node Displacement Summary

	Node	L/C	X (in)	Y (in)	Z (in)	Resultant (in)	rX (rad)	rY (rad)	rZ (rad)
Max X	9	3:EQ	**0.971**	0.141	0.000	0.981	0.000	0.000	-0.002
Min X	7	4:1.2D+1.6L	**-0.013**	-0.139	0.000	0.140	0.000	0.000	-0.000
Max Y	9	3:EQ	0.971	**0.141**	0.000	0.981	0.000	0.000	-0.002
Min Y	10	6:1.2D+1.0L+1	0.951	**-0.248**	0.000	0.983	0.000	0.000	-0.002
Max Z	1	1:DEAD	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000
Min Z	1	1:DEAD	0.000	0.000	**0.000**	0.000	0.000	0.000	0.000
Max rX	1	1:DEAD	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000
Min rX	1	1:DEAD	0.000	0.000	0.000	0.000	**0.000**	0.000	0.000
Max rY	1	1:DEAD	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000
Min rY	1	1:DEAD	0.000	0.000	0.000	0.000	0.000	**0.000**	0.000
Max rZ	10	4:1.2D+1.6L	0.000	-0.148	0.000	0.148	0.000	0.000	**0.000**
Min rZ	5	3:EQ	0.407	0.127	0.000	0.426	0.000	0.000	**-0.002**
Max Rst	10	6:1.2D+1.0L+1	0.951	-0.248	0.000	**0.983**	0.000	0.000	-0.002

Appendix E

Calculations of Typical Steel Connections

Typical Steel Connection Calculations:

Beam-To-Girder Bolted-Bolted Connection:

Beam used: W10x12 Girder used: W21x44

V_u = **20.73 kips** M_u = 20.73*2" = **41.46"k**

use A325N bolts w/ ¾" diameter: ΦR_n = 15.9 kips

$C_{MIN} = V_u / \Phi R_n$ = 1.303 bolts; therefore **use 2 bolts**

Try an L3.5"x3.5"x0.5" with a length of 6"

Limit State Checks:

Angle Shear Yield:

$\Phi R_n = 0.9(0.6F_YA_g) = 0.9*0.6*36*6*0.5$
$= 58.32$ kips $>$ 20.73 kips; ok

Angle Shear Rupture:

$\Phi R_n = 0.75(0.6F_UA_n) = 55.46$ kips $>$ 20.73 Kips; ok

Angle Block Shear:

Tension Rupture = 46.2 K
Shear Yield = 72.9 k
Shear Rupture = 83.2 k
Tension Yield = 40.5 k

$\Phi R_n = 0.5(83.2+40.5) = 61.85$ K $>$ 20.73 K; ok

Angle Flexural Yield:

$\Phi M_n = 0.9(F_YS_X) = 97.2$"k $>$ 41.46"k; ok

Angle Flexural Rupture:

$S_{net} = 2.34$
$\Phi M_n = \Phi F_u*S_{net} = 101.79$"k $>$ 41.46"k; ok

Beam Web Block Shear:

Tension Rupture = 51.8 K
Shear Yield = 101 k
Shear Rupture = 93.2 k
Tension Yield = 56.3 k

$\Phi R_n = 0.19(93.2+51.8) = 27.55$ k $>$20.73 k; ok

Coped Beam Flexure:

$\Phi F_{bc} = 58.04 < 0.9*50 = 45$; therefore use 45
$\Phi M_n = \Phi F_{bc}*S_{net} = 130.95$"k $>$ 41.46"k; ok

Bearing/T.O. & Bolt Shear:

Angle Bearing = $2.4F_u*t$ = 52.2 k

T.O.$_{edge}$ = $1.2F_u*t*l_e$ = 29.4 k

T.O.$_{other}$ = 76.1 k

Beam Bearing = 22.23 k

T.O.$_{edge}$ = 12.5 k

ΦR_n = 0.75(12.5)+15.9 = 25.3 k > 20.73 k; ok

Girder-To-Column Bolted-Bolted Connection:

girder used: W21x44 Column used: W10x33

V_u = **68.56 kips** M_u =68.56*1.5"=**102.86"k**

use A325N bolts w/ ¾" diameter: ΦR_n = 15.9 kips

C_{min} = V_u / ΦR_n = 4.3 bolts; therefore **use 6 bolts**

Try an L3"x3"x0.5" with a length of 18"

Limit State Checks:

Angle Shear Yield:

ΦR_n = 0.9(0.6$F_y A_g$) = 0.9*0.6*36*18*0.5
= 174.96 kips > 68.56 kips; ok

Angle Shear Rupture:

ΦR_n = 0.75(0.6$F_u A_n$) = 166.4 kips > 68.56 Kips; ok

Angle Block Shear:

Tension Rupture = 46.2 K

Shear Yield = 267 k

Shear Rupture = 305 k

Tension Yield = 40.5 k

ΦR_n = 0.5(305+40.5) = 172.8 K > 68.56 K; ok

Angle Flexural Yield:

ΦM_n = 0.9($F_y S_x$) = 874.8"k > 102.84"k; ok

Angle Flexural Rupture:

S_{net} = 19.3

ΦM_n = ΦF_u*S_{net} = 839.6"k > 102.84"k; ok

Bearing/T.O. & Bolt Shear:

Angle Bearing = $2.4F_u*t$ = 52.2 k

$T.O._{EDGE}$ = $1.2F_u*t*l_e$ = 29.4 k

$T.O._{OTHER}$ = 76.1 k

Beam Bearing = 40.95 k

$T.O._{EDGE}$ = 23.03 k

$T.O._{OTHER}$ = 53.27 k

ΦR_n = 15.9*6 = 95.4 k > 68.56 k; ok

Appendix F

C.M. Cost Comparisons & Construction Schedules

Cost Breakdown for Existing Precast Concrete System

COLUMNS

Size	Length (total) ft.	Cost / ft				Total Cost	
		Mat.	Labor	Equip.	Total		
18X26 16X16 20X20	3172	74.5	19.55	10.7	104.75	332267	

TOTAL = 332267.00

BEAMS

Size	Number #	Cost Info.				Total Cost	
		Mat.	Labor	Equip.	Total		
24x12	151	790.00	88.00	48.00	926.00	139826.00	
12x20	60	780.00	88.00	48.00	916.00	54960.00	
20x16	54	805.00	88.00	48.00	941.00	50814.00	

TOTAL = 245600.00

PRECAST PLANK

Size	Area (total) sq. ft.	Cost Info.				Total Cost	
		Mat.	Labor	Equip.	Total		
10" hollow	91697.81	6.10	0.78	0.43	7.31	670310.99	

TOTAL = 670311.00

CONCRETE TOPPING

Size	Area (total) sq. ft.	Cost / sq. ft.				Total Cost	
		Mat.	Labor	Equip.	Total		
2" topping	91697.81	1.04	0.67	0.27	1.98	181561.66	

TOTAL = 181561.66

CMU BEARING WALLS

Size	Area (total) sq. ft.	Cost / sq. ft.				Total Cost	
		Mat.	Labor	Equip.	Total		
8"	360	1.81	2.76		4.57		1645.2
10"	3406	2.27	2.84		5.11		17404.66
12"	1911	2.46	3.58		6.04		11542.44
14"	1144	2.67	3.58		6.25		7150
					TOTAL =		37742.30

PC SHEAR WALLS

Size	Area (total) sq. ft.	Cost / sq. ft.				Total Cost	
		Mat.	Labor	Equip.	Total		
8" thick	6300	10.88	4.15	4	19.03		119889
					TOTAL =		119889.00

Building Cost Summary for Existing Precast System

Building Cost Breakdown	
Structure component	**System Cost**
P.C. Columns	332267.00
P.C. Beams	245600.00
Precast Planks	670311.00
Concrete Topping	181561.66
CMU Bearing Walls	37742.30
P.C. Shear Walls	119889.00
Total Cost:	**1587370.96**

Cost Breakdown for Proposed Structural Steel System

BEAMS

Size	Length (total)	Cost Info.				Total Cost
	ft.	Mat.	Labor	Equip.	Total	
W8X10	8759.87	10.45	3.63	2.38	16.46	144187.46
W10X12	6341.09	12.55	3.63	2.38	18.56	117690.63
W12X14	1155.76	14.65	2.48	1.62	18.75	21670.50
W12X16	272.92	17.45	2.48	1.62	21.55	5881.43
W12X19	111.83	23.00	2.48	1.62	27.10	3030.59
W14X22	1135.25	23.00	2.20	1.44	26.64	30243.06
W16X26	591.34	27.00	2.18	1.43	30.61	18100.92
W16X31	284.84	32.50	2.42	1.59	36.51	10399.51
W18X35	321.08	36.50	3.28	1.58	41.36	13279.87
W18X40	569.92	42.00	3.28	1.58	46.86	26706.45
W21X44	1182.83	46.00	2.96	1.42	50.38	59590.98
W21X50	63	52.50	2.96	1.42	56.88	3583.44
W24X55	63	57.50	2.84	1.37	61.71	3887.73
W24X62	63	65.00	2.84	1.37	69.21	4360.23
W24X76	84.25	79.50	2.84	1.37	83.71	7052.57
					TOTAL =	469665.36

COLUMNS

Size	Length (total)	Cost Info.				Total Cost
	ft.	Mat.	Labor	Equip.	Total	
W10X33	2379	34.50	3.96	2.59	41.05	97657.95
W10X39	312	40.68	3.96	2.59	47.23	14735.76
W10X45	208	46.90	3.96	2.59	53.45	11117.60
W10X49	13	51.00	3.96	2.59	57.55	748.15
W12X40	806	42.00	2.69	1.76	46.45	37438.70
W12X45	13	46.90	2.90	1.90	51.70	672.10
					TOTAL =	162370.26

LATERAL BRACES

Size	Length (total) ft.	Cost Info. Mat.	Labor	Equip.	Total	Total Cost
W10X39	921.1	40.68	3.96	2.59	47.23	43503.55
W10X45	123.17	46.90	3.96	2.59	53.45	6583.44
W10X49	627.17	51.00	3.96	2.59	57.55	36093.63
W12X22	326.75	23.00	2.48	1.62	27.10	8854.93

TOTAL = 95035.548

METAL DECK

Size	Area (total) sq. ft.	Cost / sq. ft. Mat.	Labor	Equip.	Total	Total Cost
gage	91697.81	1.14	0.26	0.02	1.42	130210.89

TOTAL = 130210.89

WWF SLAB REINFORCING

Size	Area (total) sq. ft.	Cost / 100 sq. ft Mat.	Labor	Equip.	Total	Total Cost
WWF 6X6 W1.4XW1.4	91697.81	12	18.05	0	30.05	27555.19191

TOTAL = 27555.19

COMPOSITE CONCRETE SLAB

Size	Area (total) sq. ft.	Cost / 100 sq. ft Mat.	Labor	Equip.	Total	Total Cost
4"+1.5" deck	91697.81	1.18	0.66	0.27	2.11	193482.38

TOTAL = 193482.38

SHEAR STUDS

Size	Number #	Cost / 100 sq. ft Mat.	Labor	Equip.	Total	Total Cost
3/4" DIA., 4" LONG	16663	0.46	0.69	0.28	1.43	23828.09

TOTAL = 23828.09

FIREPROOFING

Component	Area (total) sq. ft.	Cost / 100 sq. ft Mat.	Labor	Equip.	Total	Total Cost
DECK	91697.81	0.62	0.54	0.09	1.25	114622.2625
BEAMS	73499.93	0.41	0.45	0.07	0.93	85278.9633
COLUMNS	14700.14	0.88	0.97	0.15	2	29400.28

TOTAL = 229301.51

CONNECTIONS

Size	Area (total) sq. ft.	Cost / 100 sq. ft Mat.	Labor	Equip.	Total	Total Cost
L3.5X3.5X0.5	576	8	3.45	2.21	13.66	7868.16
L3X3X0.5	1722	7.5	3.45	2.21	13.16	22661.52

TOTAL = 30529.68

Building Cost Summary for Existing Precast System

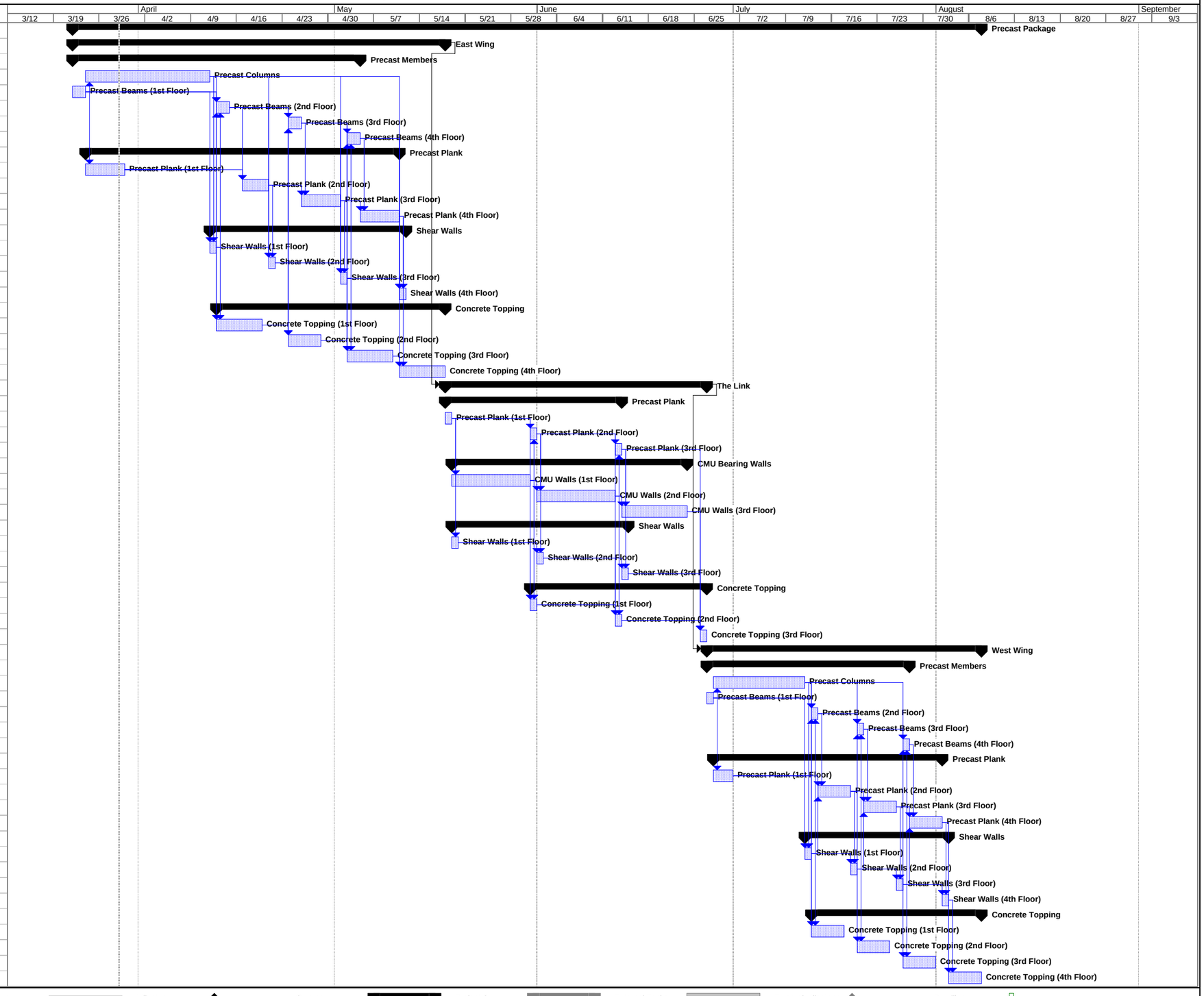
Building Cost Breakdown	
Structure component	**System Cost**
Structural Beams	469665.36
Structural Columns	162370.26
Lateral Braces	95035.548
Metal Deck	130210.89
WWF Slab Reinforcing	27555.19
Concrete Slab	193482.38
Fireproofing	229301.51
Connections	30529.68
Shear Studs	23828.09
Total Cost:	**1361978.902**

Building Cost Comparison of Both Structural System

Building Cost Breakdown		
Building System	**System Cost**	**Cost/sq. ft.**
Steel System	1361978.90	14.85
Precast System	1587370.96	17.31
Total Savings:	**225392.06**	
% Savings:	**14**	

Chris Shelow
Koshland Integrated Natural Science Center
Precast Package

ID	Task Name	Duration	Start	Finish	Predecessors
1	**Precast Package**	**99 days**	**Wed 3/22/06**	**Mon 8/7/06**	
2	**East Wing**	**41 days**	**Wed 3/22/06**	**Wed 5/17/06**	
3	**Precast Members**	**32 days**	**Wed 3/22/06**	**Thu 5/4/06**	
4	Precast Columns	13 days	Fri 3/24/06	Tue 4/11/06	5
5	Precast Beams (1st Floor)	2 days	Wed 3/22/06	Thu 3/23/06	
6	Precast Beams (2nd Floor)	2 days	Thu 4/13/06	Fri 4/14/06	5,4,10,15
7	Precast Beams (3rd Floor)	2 days	Mon 4/24/06	Tue 4/25/06	6,11,16
8	Precast Beams (4th Floor)	2 days	Wed 5/3/06	Thu 5/4/06	7,12,17
9	**Precast Plank**	**34 days**	**Fri 3/24/06**	**Wed 5/10/06**	
10	Precast Plank (1st Floor)	4 days	Fri 3/24/06	Wed 3/29/06	5
11	Precast Plank (2nd Floor)	4 days	Mon 4/17/06	Thu 4/20/06	10,6
12	Precast Plank (3rd Floor)	4 days	Wed 4/26/06	Mon 5/1/06	11,7
13	Precast Plank (4th Floor)	4 days	Fri 5/5/06	Wed 5/10/06	8,12
14	**Shear Walls**	**22 days**	**Wed 4/12/06**	**Thu 5/11/06**	
15	Shear Walls (1st Floor)	1 day	Wed 4/12/06	Wed 4/12/06	4,5,10
16	Shear Walls (2nd Floor)	1 day	Fri 4/21/06	Fri 4/21/06	4,6,11,15
17	Shear Walls (3rd Floor)	1 day	Tue 5/2/06	Tue 5/2/06	4,16,7,12
18	Shear Walls (4th Floor)	1 day	Thu 5/11/06	Thu 5/11/06	17,8,13,4
19	**Concrete Topping**	**25 days**	**Thu 4/13/06**	**Wed 5/17/06**	
20	Concrete Topping (1st Floor)	5 days	Thu 4/13/06	Wed 4/19/06	5,10,15
21	Concrete Topping (2nd Floor)	5 days	Mon 4/24/06	Fri 4/28/06	6,11,20,16
22	Concrete Topping (3rd Floor)	5 days	Wed 5/3/06	Tue 5/9/06	7,12,21,17
23	Concrete Topping (4th Floor)	5 days	Thu 5/11/06	Wed 5/17/06	8,13,22
24	**The Link**	**28 days**	**Thu 5/18/06**	**Mon 6/26/06**	**2**
25	**Precast Plank**	**19 days**	**Thu 5/18/06**	**Tue 6/13/06**	
26	Precast Plank (1st Floor)	1 day	Thu 5/18/06	Thu 5/18/06	
27	Precast Plank (2nd Floor)	1 day	Wed 5/31/06	Wed 5/31/06	26,30
28	Precast Plank (3rd Floor)	1 day	Tue 6/13/06	Tue 6/13/06	27,31
29	**CMU Bearing Walls**	**26 days**	**Fri 5/19/06**	**Fri 6/23/06**	
30	CMU Walls (1st Floor)	8 days	Fri 5/19/06	Tue 5/30/06	26
31	CMU Walls (2nd Floor)	8 days	Thu 6/1/06	Mon 6/12/06	27,30
32	CMU Walls (3rd Floor)	8 days	Wed 6/14/06	Fri 6/23/06	28,31
33	**Shear Walls**	**19 days**	**Fri 5/19/06**	**Wed 6/14/06**	
34	Shear Walls (1st Floor)	1 day	Fri 5/19/06	Fri 5/19/06	26
35	Shear Walls (2nd Floor)	1 day	Thu 6/1/06	Thu 6/1/06	27,34
36	Shear Walls (3rd Floor)	1 day	Wed 6/14/06	Wed 6/14/06	28,35
37	**Concrete Topping**	**19 days**	**Wed 5/31/06**	**Mon 6/26/06**	
38	Concrete Topping (1st Floor)	1 day	Wed 5/31/06	Wed 5/31/06	26,30,34
39	Concrete Topping (2nd Floor)	1 day	Tue 6/13/06	Tue 6/13/06	27,31,35,38
40	Concrete Topping (3rd Floor)	1 day	Mon 6/26/06	Mon 6/26/06	28,32,36,39
41	**West Wing**	**30 days**	**Tue 6/27/06**	**Mon 8/7/06**	**24**
42	**Precast Members**	**23 days**	**Tue 6/27/06**	**Thu 7/27/06**	
43	Precast Columns	10 days	Wed 6/28/06	Tue 7/11/06	44
44	Precast Beams (1st Floor)	1 day	Tue 6/27/06	Tue 6/27/06	
45	Precast Beams (2nd Floor)	1 day	Thu 7/13/06	Thu 7/13/06	43,44,49,54
46	Precast Beams (3rd Floor)	1 day	Thu 7/20/06	Thu 7/20/06	43,45,50,55
47	Precast Beams (4th Floor)	1 day	Thu 7/27/06	Thu 7/27/06	43,46,51,56
48	**Precast Plank**	**25 days**	**Wed 6/28/06**	**Tue 8/1/06**	
49	Precast Plank (1st Floor)	3 days	Wed 6/28/06	Fri 6/30/06	44
50	Precast Plank (2nd Floor)	3 days	Fri 7/14/06	Tue 7/18/06	45,54,49
51	Precast Plank (3rd Floor)	3 days	Fri 7/21/06	Tue 7/25/06	46,50,55
52	Precast Plank (4th Floor)	3 days	Fri 7/28/06	Tue 8/1/06	47,51,56
53	**Shear Walls**	**16 days**	**Wed 7/12/06**	**Wed 8/2/06**	
54	Shear Walls (1st Floor)	1 day	Wed 7/12/06	Wed 7/12/06	44,49,43
55	Shear Walls (2nd Floor)	1 day	Wed 7/19/06	Wed 7/19/06	50,54
56	Shear Walls (3rd Floor)	1 day	Wed 7/26/06	Wed 7/26/06	51,55
57	Shear Walls (4th Floor)	1 day	Wed 8/2/06	Wed 8/2/06	52,56
58	**Concrete Topping**	**18 days**	**Thu 7/13/06**	**Mon 8/7/06**	
59	Concrete Topping (1st Floor)	3 days	Thu 7/13/06	Mon 7/17/06	43,54,49
60	Concrete Topping (2nd Floor)	3 days	Thu 7/20/06	Mon 7/24/06	50,55
61	Concrete Topping (3rd Floor)	3 days	Thu 7/27/06	Mon 7/31/06	51,56
62	Concrete Topping (4th Floor)	3 days	Thu 8/3/06	Mon 8/7/06	52,57

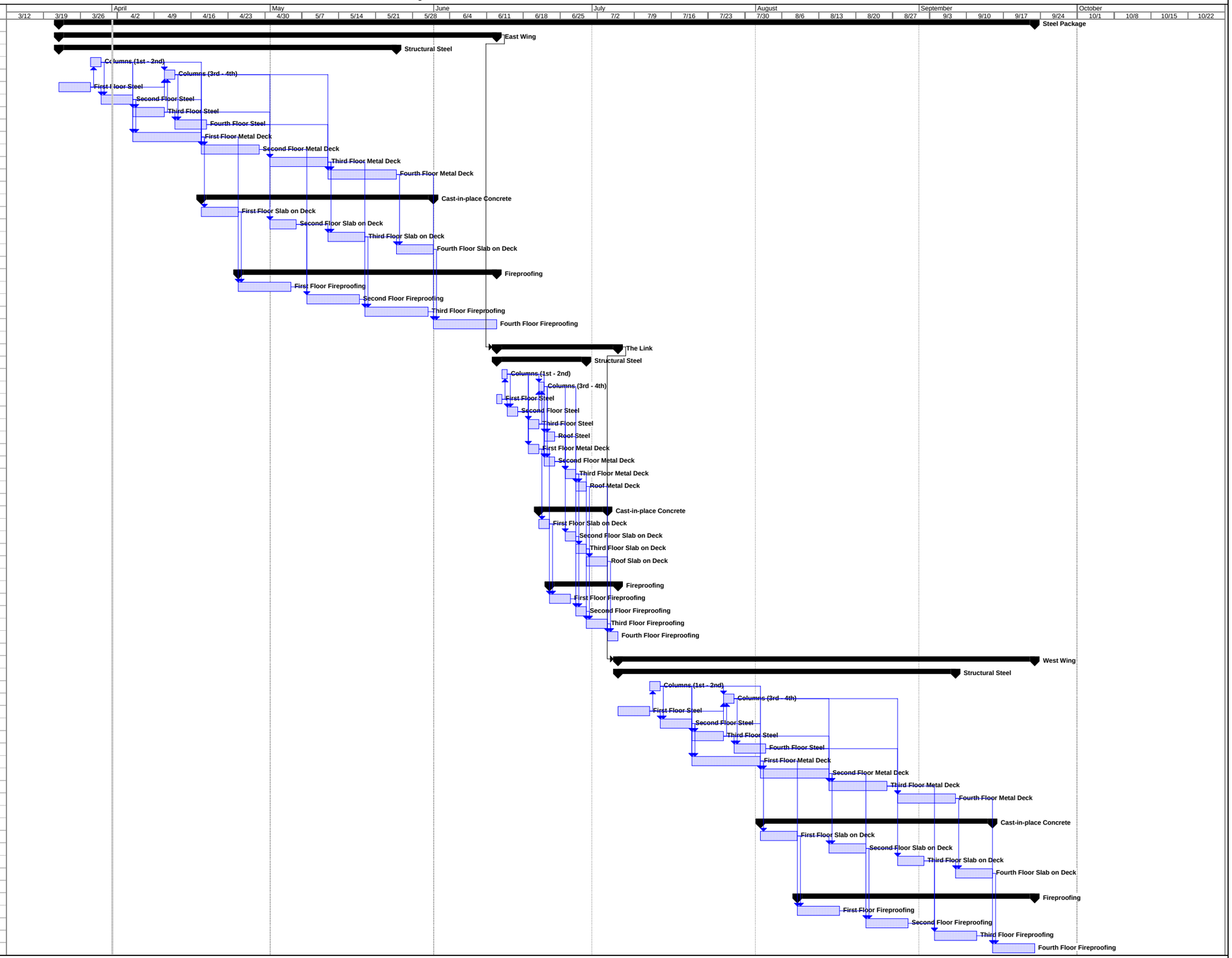


Project: Shelow Precast
Date: Wed 3/29/06

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

Chris Shelow
Koshland Integrated Natural Science Center
Steel Package Schedule

ID	Task Name	Duration	Start	Finish	Predecessors
1	**Steel Package**	**133 days**	**Wed 3/22/06**	**Fri 9/22/06**	
2	**East Wing**	**59 days**	**Wed 3/22/06**	**Mon 6/12/06**	
3	**Structural Steel**	**46 days**	**Wed 3/22/06**	**Wed 5/24/06**	
4	Columns (1st - 2nd)	2 days	Tue 3/28/06	Wed 3/29/06	6
5	Columns (3rd - 4th)	2 days	Tue 4/11/06	Wed 4/12/06	4,6,7,8
6	First Floor Steel	4 days	Wed 3/22/06	Mon 3/27/06	
7	Second Floor Steel	4 days	Thu 3/30/06	Tue 4/4/06	4,6
8	Third Floor Steel	4 days	Wed 4/5/06	Mon 4/10/06	7,4
9	Fourth Floor Steel	4 days	Thu 4/13/06	Tue 4/18/06	8,5
10	First Floor Metal Deck	9 days	Wed 4/5/06	Mon 4/17/06	4,6,7
11	Second Floor Metal Deck	9 days	Tue 4/18/06	Fri 4/28/06	4,5,7,8,10
12	Third Floor Metal Deck	9 days	Mon 5/1/06	Thu 5/11/06	5,8,9,11
13	Fourth Floor Metal Deck	9 days	Fri 5/12/06	Wed 5/24/06	9,12,5
14					
15	**Cast-in-place Concrete**	**32 days**	**Tue 4/18/06**	**Wed 5/31/06**	
16	First Floor Slab on Deck	5 days	Tue 4/18/06	Mon 4/24/06	10
17	Second Floor Slab on Deck	5 days	Mon 5/1/06	Fri 5/5/06	11,16
18	Third Floor Slab on Deck	5 days	Fri 5/12/06	Thu 5/18/06	12,17
19	Fourth Floor Slab on Deck	5 days	Thu 5/25/06	Wed 5/31/06	13,18
20					
21	**Fireproofing**	**35 days**	**Tue 4/25/06**	**Mon 6/12/06**	
22	First Floor Fireproofing	8 days	Tue 4/25/06	Thu 5/4/06	10,16
23	Second Floor Fireproofing	8 days	Mon 5/8/06	Wed 5/17/06	11,17,22
24	Third Floor Fireproofing	8 days	Fri 5/19/06	Tue 5/30/06	12,18,23
25	Fourth Floor Fireproofing	8 days	Thu 6/1/06	Mon 6/12/06	13,19,24
26					
27	**The Link**	**17 days**	**Tue 6/13/06**	**Wed 7/5/06**	**2**
28	**Structural Steel**	**13 days**	**Tue 6/13/06**	**Thu 6/29/06**	
29	Columns (1st - 2nd)	1 day	Wed 6/14/06	Wed 6/14/06	31
30	Columns (3rd - 4th)	1 day	Wed 6/21/06	Wed 6/21/06	29,31,32,33
31	First Floor Steel	1 day	Tue 6/13/06	Tue 6/13/06	
32	Second Floor Steel	2 days	Thu 6/15/06	Fri 6/16/06	29,31
33	Third Floor Steel	2 days	Mon 6/19/06	Tue 6/20/06	29,32
34	Roof Steel	2 days	Thu 6/22/06	Fri 6/23/06	30,33
35	First Floor Metal Deck	2 days	Mon 6/19/06	Tue 6/20/06	29,31,32
36	Second Floor Metal Deck	2 days	Thu 6/22/06	Fri 6/23/06	29,30,32,33,35
37	Third Floor Metal Deck	2 days	Mon 6/26/06	Tue 6/27/06	30,33,34,36
38	Roof Metal Deck	2 days	Wed 6/28/06	Thu 6/29/06	30,34,37
39					
40	**Cast-in-place Concrete**	**9 days**	**Wed 6/21/06**	**Mon 7/3/06**	
41	First Floor Slab on Deck	2 days	Wed 6/21/06	Thu 6/22/06	35
42	Second Floor Slab on Deck	2 days	Mon 6/26/06	Tue 6/27/06	41,36
43	Third Floor Slab on Deck	2 days	Wed 6/28/06	Thu 6/29/06	37,42
44	Roof Slab on Deck	2 days	Fri 6/30/06	Mon 7/3/06	38,43
45					
46	**Fireproofing**	**9 days**	**Fri 6/23/06**	**Wed 7/5/06**	
47	First Floor Fireproofing	2 days	Fri 6/23/06	Mon 6/26/06	35,41
48	Second Floor Fireproofing	2 days	Wed 6/28/06	Thu 6/29/06	36,42,47
49	Third Floor Fireproofing	2 days	Fri 6/30/06	Mon 7/3/06	37,43,48
50	Fourth Floor Fireproofing	2 days	Tue 7/4/06	Wed 7/5/06	38,44,49
57					
58	**West Wing**	**57 days**	**Thu 7/6/06**	**Fri 9/22/06**	**27**
59	**Structural Steel**	**46 days**	**Thu 7/6/06**	**Thu 9/7/06**	
60	Columns (1st - 2nd)	2 days	Wed 7/12/06	Thu 7/13/06	62
61	Columns (3rd - 4th)	2 days	Wed 7/26/06	Thu 7/27/06	60,62,63,64
62	First Floor Steel	4 days	Thu 7/6/06	Tue 7/11/06	
63	Second Floor Steel	4 days	Fri 7/14/06	Wed 7/19/06	60,62
64	Third Floor Steel	4 days	Thu 7/20/06	Tue 7/25/06	60,63
65	Fourth Floor Steel	4 days	Fri 7/28/06	Wed 8/2/06	61,64
66	First Floor Metal Deck	9 days	Thu 7/20/06	Tue 8/1/06	60,62,63
67	Second Floor Metal Deck	9 days	Wed 8/2/06	Mon 8/14/06	60,61,63,64,66
68	Third Floor Metal Deck	9 days	Tue 8/15/06	Fri 8/25/06	61,64,65,67
69	Fourth Floor Metal Deck	9 days	Mon 8/28/06	Thu 9/7/06	61,65,68
70					
71	**Cast-in-place Concrete**	**32 days**	**Wed 8/2/06**	**Thu 9/14/06**	
72	First Floor Slab on Deck	5 days	Wed 8/2/06	Tue 8/8/06	66
73	Second Floor Slab on Deck	5 days	Tue 8/15/06	Mon 8/21/06	67,72
74	Third Floor Slab on Deck	5 days	Mon 8/28/06	Fri 9/1/06	68,73
75	Fourth Floor Slab on Deck	5 days	Fri 9/8/06	Thu 9/14/06	69,74
76					
77	**Fireproofing**	**33 days**	**Wed 8/9/06**	**Fri 9/22/06**	
78	First Floor Fireproofing	6 days	Wed 8/9/06	Wed 8/16/06	66,72
79	Second Floor Fireproofing	6 days	Tue 8/22/06	Tue 8/29/06	67,73,78
80	Third Floor Fireproofing	6 days	Mon 9/4/06	Mon 9/11/06	68,74,79
81	Fourth Floor Fireproofing	6 days	Fri 9/15/06	Fri 9/22/06	69,75,80



Project: Shelow Steel shortened firepro
Date: Sat 4/1/06

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

Appendix G

ASHRAE Standard 90 Relevant Tables & Values

ASHRAE Standard 90 (2004) – Relevant Tables

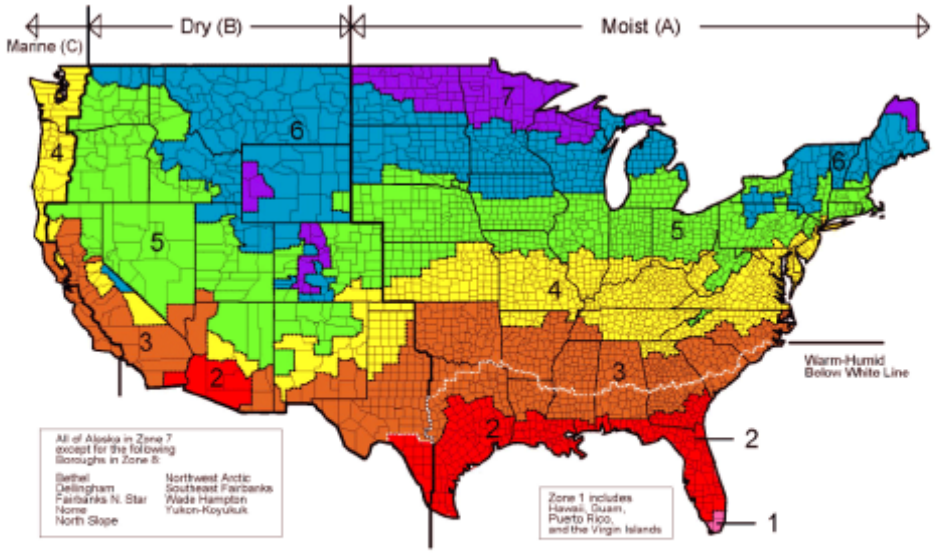


Figure B-1 Climate zones for United States locations.

TABLE B-1 U.S. Climate Zones

State County	Zone	State County	Zone	State County	Zone	State County	Zone
(North Dakota cont.)		Oregon (OR)		(South Dakota cont.)		(Texas cont.)	
Adams	6A	Zone 4C Except		Jackson	5A	Calhoun	2A
Billings	6A	Baker	5B	Mellette	5A	Cameron	2A
Bowman	6A	Crook	5B	Todd	5A	Chambers	2A
Burleigh	6A	Deschutes	5B	Tripp	5A	Cherokee	2A
Dickey	6A	Gilliam	5B	Union	5A	Colorado	2A
Dunn	6A	Grant	5B	Yankton	5A	Comal	2A
Emmons	6A	Harney	5B	Tennessee (TN)		Coryell	2A
Golden Valley	6A	Hood River	5B	Zone 4A Except		DeWitt	2A
Grant	6A	Jefferson	5B	Chester	3A	Dimmit	2B
Hettinger	6A	Klamath	5B	Crockett	3A	Duval	2A
LaMoure	6A	Lake	5B	Dyer	3A	Edwards	2B
Logan	6A	Malheur	5B	Fayette	3A	Falls	2A
McIntosh	6A	Morrow	5B	Hardeman	3A	Fayette	2A
McKenzie	6A	Sherman	5B	Hardin	3A	Fort Bend	2A
Mercer	6A	Umatilla	5B	Haywood	3A	Freestone	2A
Morton	6A	Union	5B	Henderson	3A	Frio	2B
Oliver	6A	Wallowa	5B	Lake	3A	Galveston	2A
Ransom	6A	Wasco	5B	Lauderdale	3A	Goliad	2A
Richland	6A	Wheeler	5B	Madison	3A	Gonzales	2A
Sargent	6A	Pennsylvania (PA)		McNairy	3A	Grimes	2A
Sioux	6A	Zone 5A Except		Shelby	3A	Guadalupe	2A
Slope	6A	Bucks	4A	Tipton	3A	Hardin	2A
Stark	6A	Chester	4A	Texas (TX)		Harris	2A
Ohio (OH)		Delaware	4A	Zone 3A Except		Hays	2A
Zone 5A Except		Montgomery	4A	Anderson	2A	Hidalgo	2A
Adams	4A	Philadelphia	4A	Angelina	2A	Hill	2A
Brown	4A	York	4A	Aransas	2A	Houston	2A

TABLE 5.5-4
Building Envelope Requirements For Climate Zone 4 (A,B,C)

		Nonresidential		Residential		Semiheated	
	Opaque Elements	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value
Roofs							
	Insulation Entirely above Deck	U-0.063	R-15.0 ci	U-0.063	R-15.0 ci	U-0.218	R-3.8 ci
	Metal Building	U-0.065	R-19.0	U-0.065	R-19.0	U-0.097	R-10.0
	Attic and Other	U-0.034	R-30.0	U-0.027	R-38.0	U-0.081	R-13.0
Walls, Above Grade							
	Mass	U-0.151[a]	R-5.7 ci[a]	U-0.104	R-9.5 ci	U-0.580	NR
	Metal Building	U-0.113	R-13.0	U-0.113	R-13.0	U-0.134	R-10.0
	Steel Framed	U-0.124	R-13.0	U-0.064	R-13.0 + R-7.5 ci	U-0.124	R-13.0
	Wood Framed and Other	U-0.089	R-13.0	U-0.089	R-13.0	U-0.089	R-13.0
Wall, Below Grade							
	Below Grade Wall	C-1.140	NR	C-1.140	NR	C-1.140	NR
Floors							
	Mass	U-0.107	R-6.3 ci	U-0.087	R-8.3 ci	U-0.322	NR
	Steel Joist	U-0.052	R-19.0	U-0.038	R-30.0	U-0.069	R-13.0
	Wood Framed and Other	U-0.051	R-19.0	U-0.033	R-30.0	U-0.066	R-13.0
Slab-On-Grade Floors							
	Unheated	F-0.730	NR	F-0.730	NR	F-0.730	NR
	Heated	F-0.950	R-7.5 for 24 in.	F-0.840	R-10 for 36 in.	F-1.020	R-7.5 for 12 in.
Opaque Doors							
	Swinging	U-0.700		U-0.700		U-0.700	
	Non-Swinging	U-1.450		U-0.500		U-1.450	
	Fenestration	Assembly Max. U (Fixed/ Operable)	Assembly Max. SHGC (All Orientations/ North-Oriented)	Assembly Max. U (Fixed/ Operable)	Assembly Max. SHGC (All Orientations/ North-Oriented)	Assembly Max. U (Fixed/ Operable)	Assembly Max. SHGC (All Orientations/ North-Oriented)
Vertical Glazing, % of Wall							
	0-10.0%	$U_{fixed}^{0.57}$	$SHGC_{all}^{0.39}$	$U_{fixed}^{0.57}$	$SHGC_{all}^{0.39}$	$U_{fixed}^{1.22}$	$SHGC_{all}^{NR}$
		$U_{oper}^{0.67}$	$SHGC_{north}^{0.49}$	$U_{oper}^{0.67}$	$SHGC_{north}^{0.49}$	$U_{oper}^{1.27}$	$SHGC_{north}^{NR}$
	10.1-20.0%	$U_{fixed}^{0.57}$	$SHGC_{all}^{0.39}$	$U_{fixed}^{0.57}$	$SHGC_{all}^{0.39}$	$U_{fixed}^{1.22}$	$SHGC_{all}^{NR}$
		$U_{oper}^{0.67}$	$SHGC_{north}^{0.49}$	$U_{oper}^{0.67}$	$SHGC_{north}^{0.49}$	$U_{oper}^{1.27}$	$SHGC_{north}^{NR}$
	20.1-30.0%	$U_{fixed}^{0.57}$	$SHGC_{all}^{0.39}$	$U_{fixed}^{0.57}$	$SHGC_{all}^{0.39}$	$U_{fixed}^{1.22}$	$SHGC_{all}^{NR}$
		$U_{oper}^{0.67}$	$SHGC_{north}^{0.49}$	$U_{oper}^{0.67}$	$SHGC_{north}^{0.49}$	$U_{oper}^{1.27}$	$SHGC_{north}^{NR}$
	30.1-40.0%	$U_{fixed}^{0.57}$	$SHGC_{all}^{0.39}$	$U_{fixed}^{0.57}$	$SHGC_{all}^{0.39}$	$U_{fixed}^{1.22}$	$SHGC_{all}^{NR}$
		$U_{oper}^{0.67}$	$SHGC_{north}^{0.49}$	$U_{oper}^{0.67}$	$SHGC_{north}^{0.49}$	$U_{oper}^{1.27}$	$SHGC_{north}^{NR}$
	40.1-50.0%	$U_{fixed}^{0.46}$	$SHGC_{all}^{0.25}$	$U_{fixed}^{0.46}$	$SHGC_{all}^{0.25}$	$U_{fixed}^{0.96}$	$SHGC_{all}^{NR}$
		$U_{oper}^{0.47}$	$SHGC_{north}^{0.36}$	$U_{oper}^{0.47}$	$SHGC_{north}^{0.36}$	$U_{oper}^{1.02}$	$SHGC_{north}^{NR}$
Skylight with Curb, Glass, % of Roof							
	0-2.0%	$U_{all}^{1.17}$	$SHGC_{all}^{0.49}$	$U_{all}^{0.98}$	$SHGC_{all}^{0.36}$	$U_{all}^{1.98}$	$SHGC_{all}^{NR}$
	2.1-5.0%	$U_{all}^{1.17}$	$SHGC_{all}^{0.39}$	$U_{all}^{0.98}$	$SHGC_{all}^{0.19}$	$U_{all}^{1.98}$	$SHGC_{all}^{NR}$
Skylight with Curb, Plastic, % of Roof							
	0-2.0%	$U_{all}^{1.30}$	$SHGC_{all}^{0.65}$	$U_{all}^{1.30}$	$SHGC_{all}^{0.62}$	$U_{all}^{1.93}$	$SHGC_{all}^{NR}$
	2.1-5.0%	$U_{all}^{1.30}$	$SHGC_{all}^{0.54}$	$U_{all}^{1.30}$	$SHGC_{all}^{0.27}$	$U_{all}^{1.93}$	$SHGC_{all}^{NR}$
Skylight without Curb, All, % of Roof							
	0-2.0%	$U_{all}^{0.69}$	$SHGC_{all}^{0.49}$	$U_{all}^{0.58}$	$SHGC_{all}^{0.36}$	$U_{all}^{1.36}$	$SHGC_{all}^{NR}$
	2.1-5.0%	$U_{all}^{0.69}$	$SHGC_{all}^{0.39}$	$U_{all}^{0.58}$	$SHGC_{all}^{0.19}$	$U_{all}^{1.36}$	$SHGC_{all}^{NR}$
b	Exception to A3.1.3.1 applies.						