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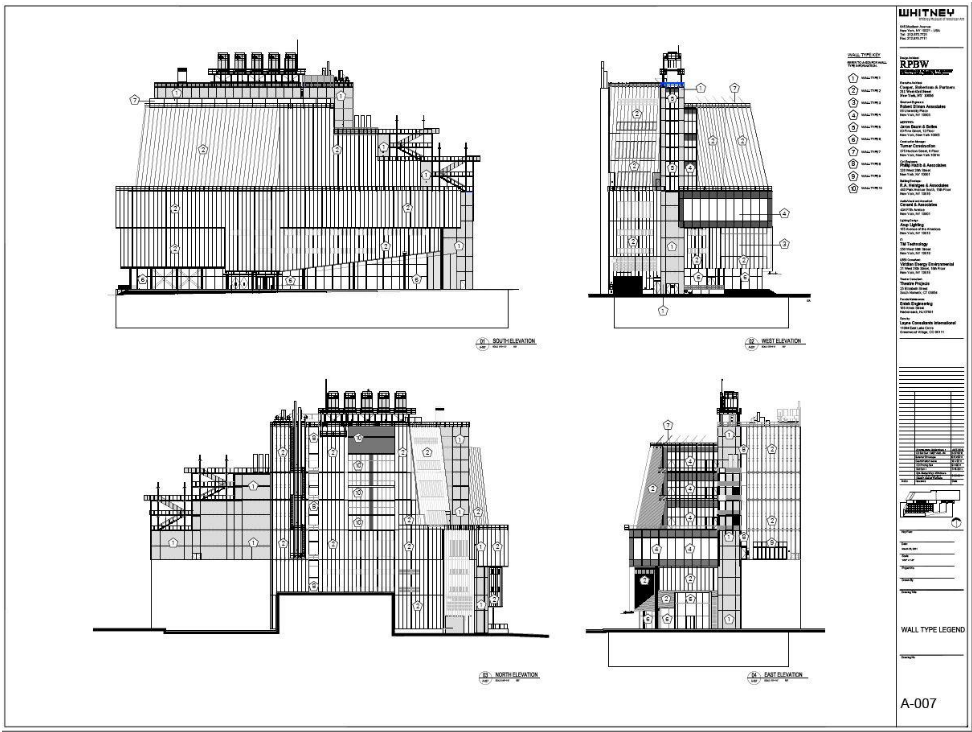
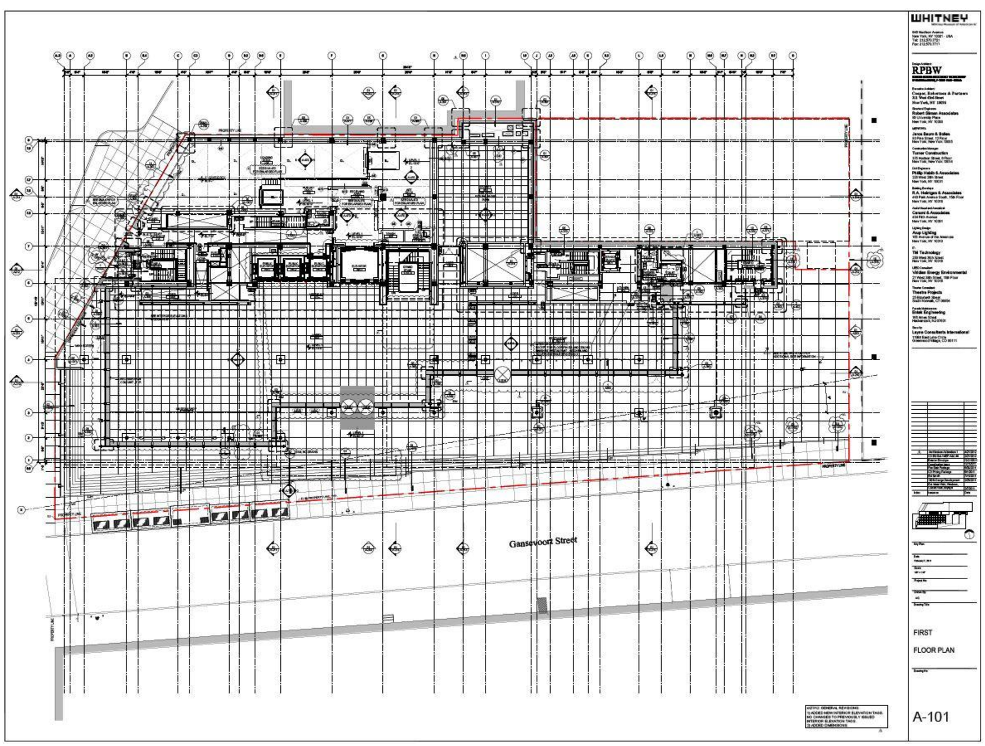
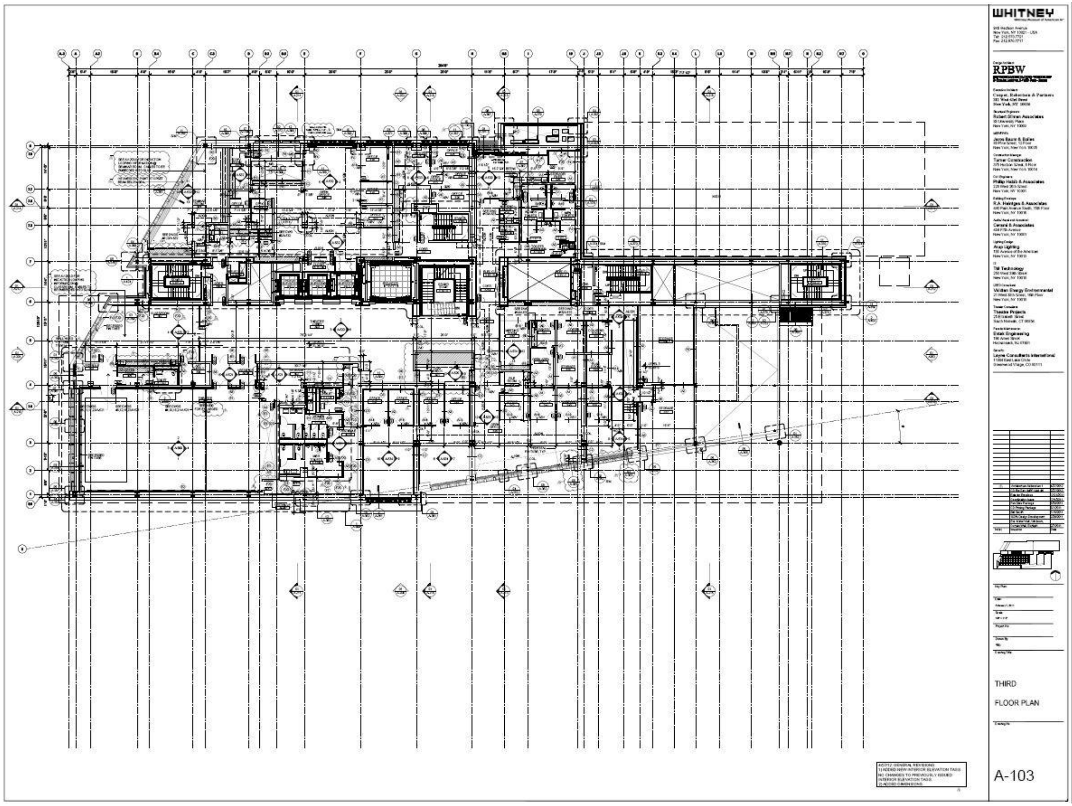
APPENDIX A: TECHNICAL DRAWINGS

ARCHITECTURAL DRAWINGS



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THIRD
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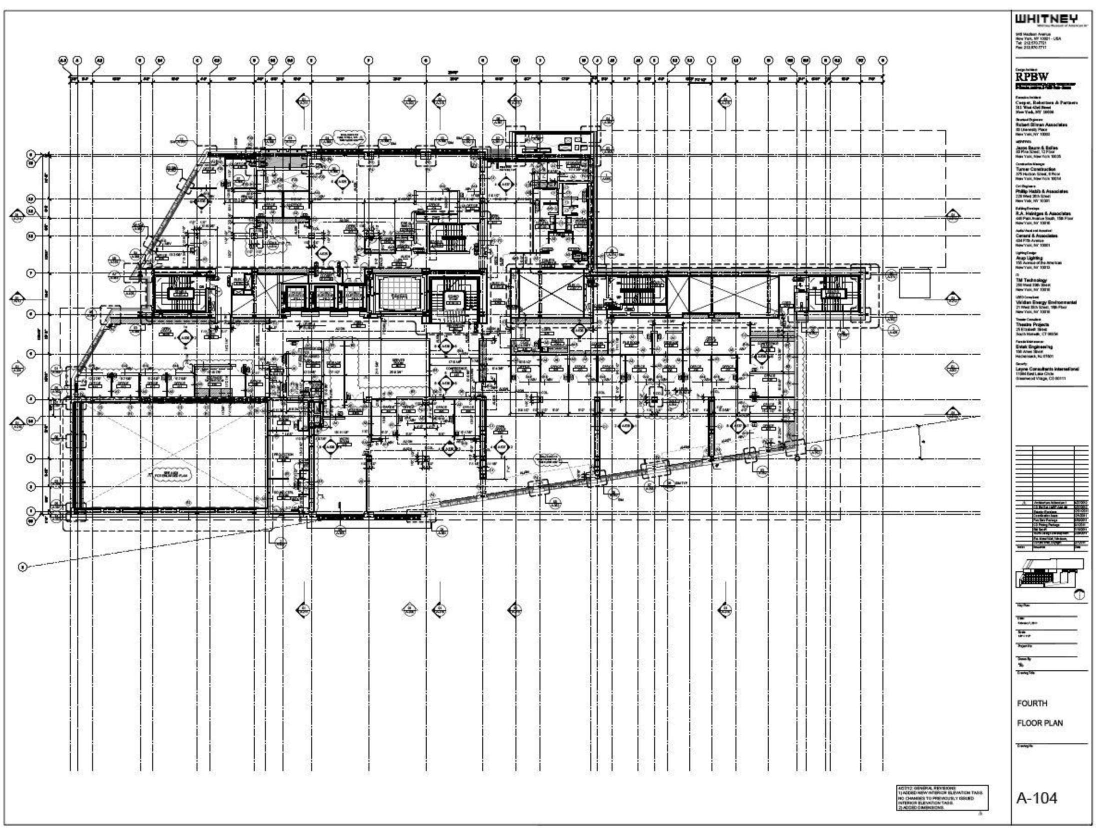
A-103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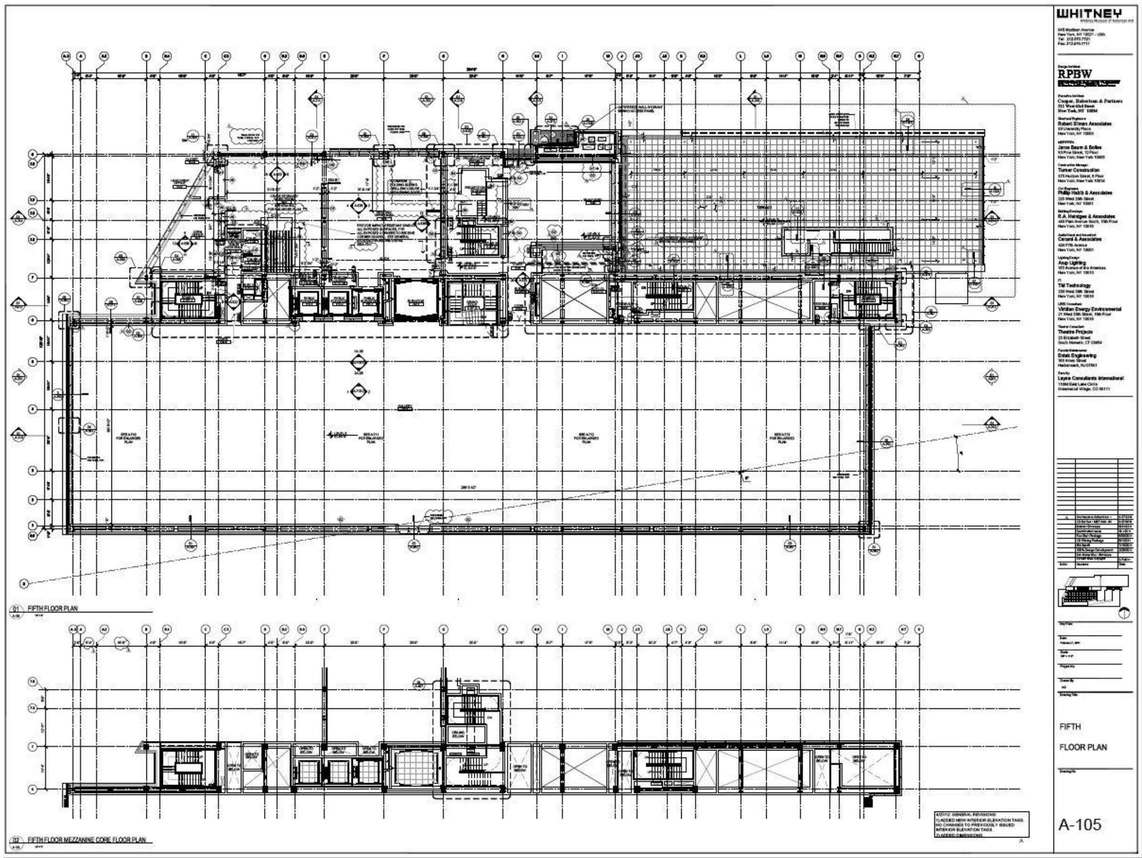
FOURTH
FLOOR PLAN
A-104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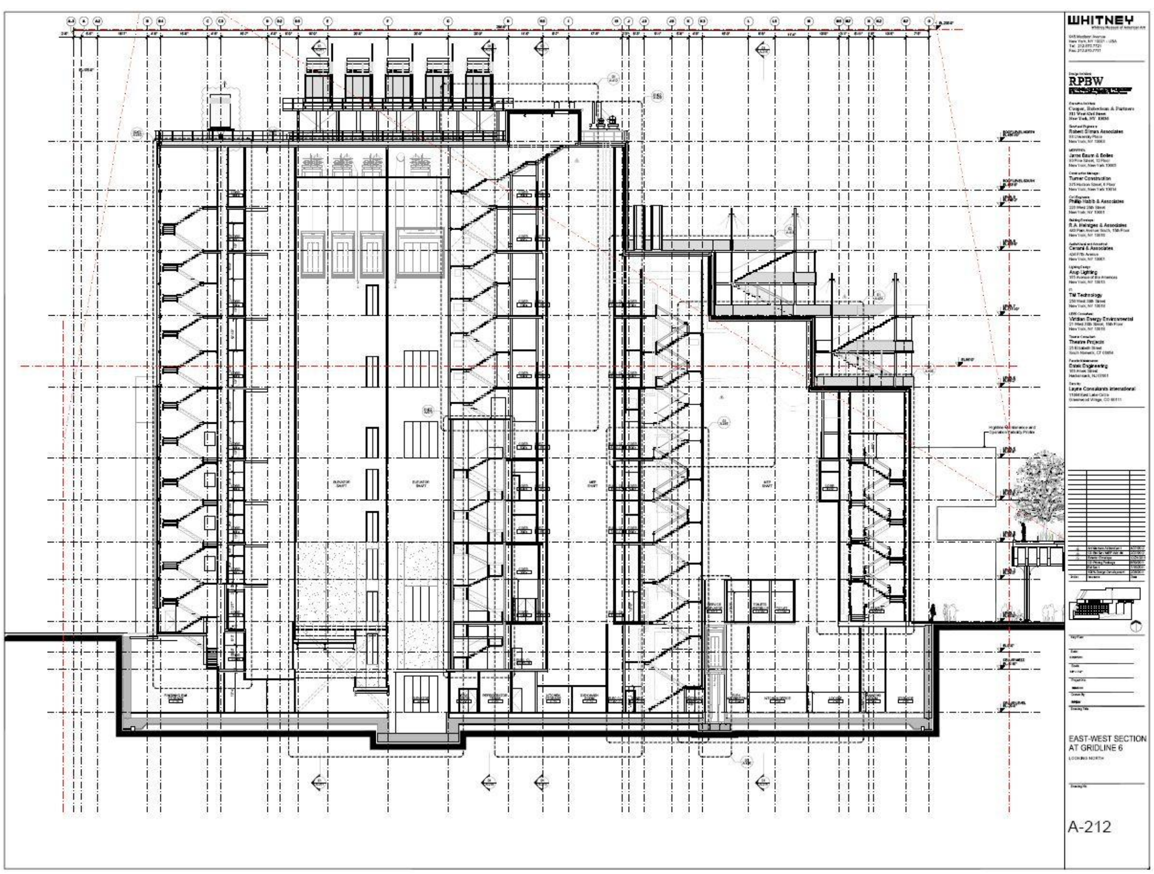
RPBW
FIFTH
FLOOR PLAN
A-105
FIFTH FLOOR PLAN
FIFTH FLOOR MEZZANINE CORE FLOOR PLAN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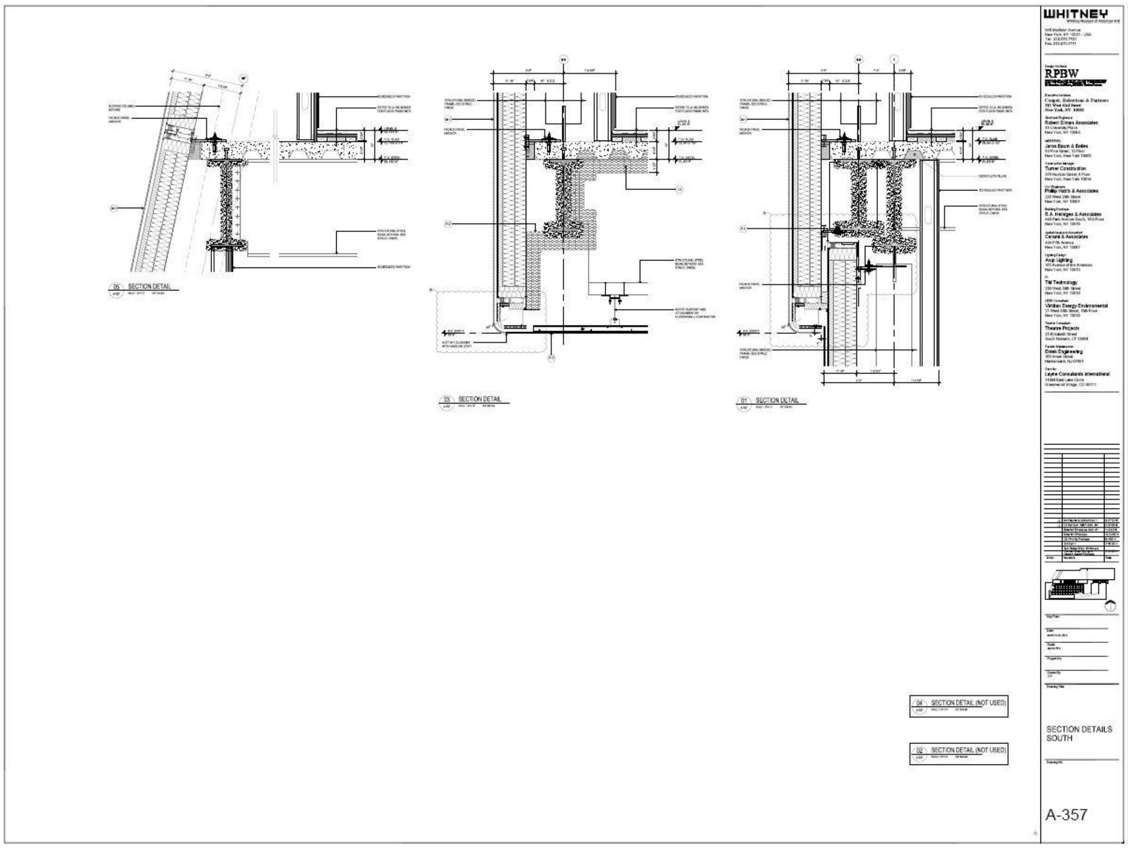
RPBW
EAST-WEST SECTION
AT GRIDLINE 6
A-212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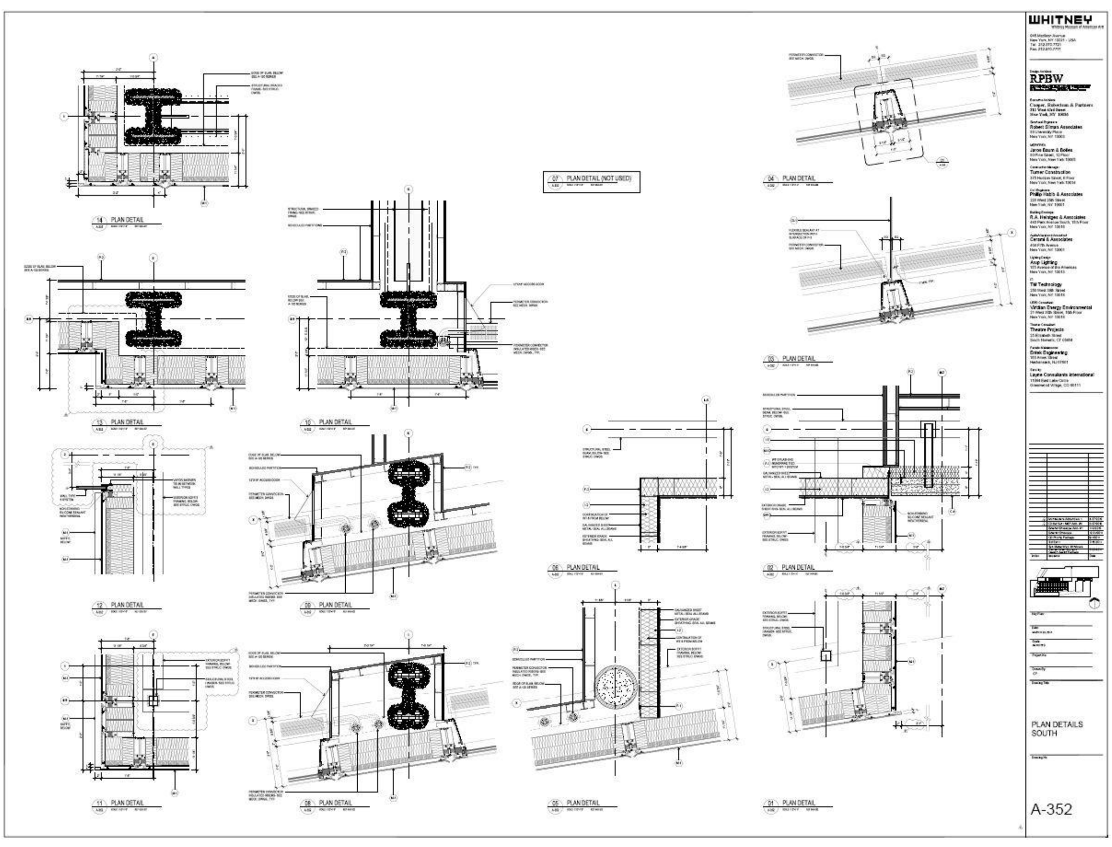
RPBW
SECTION DETAIL
SECTION DETAIL
SECTION DETAIL
SECTION DETAIL (NOT USED)
SECTION DETAIL (NOT USED)
SECTION DETAILS
SOUTH
A-357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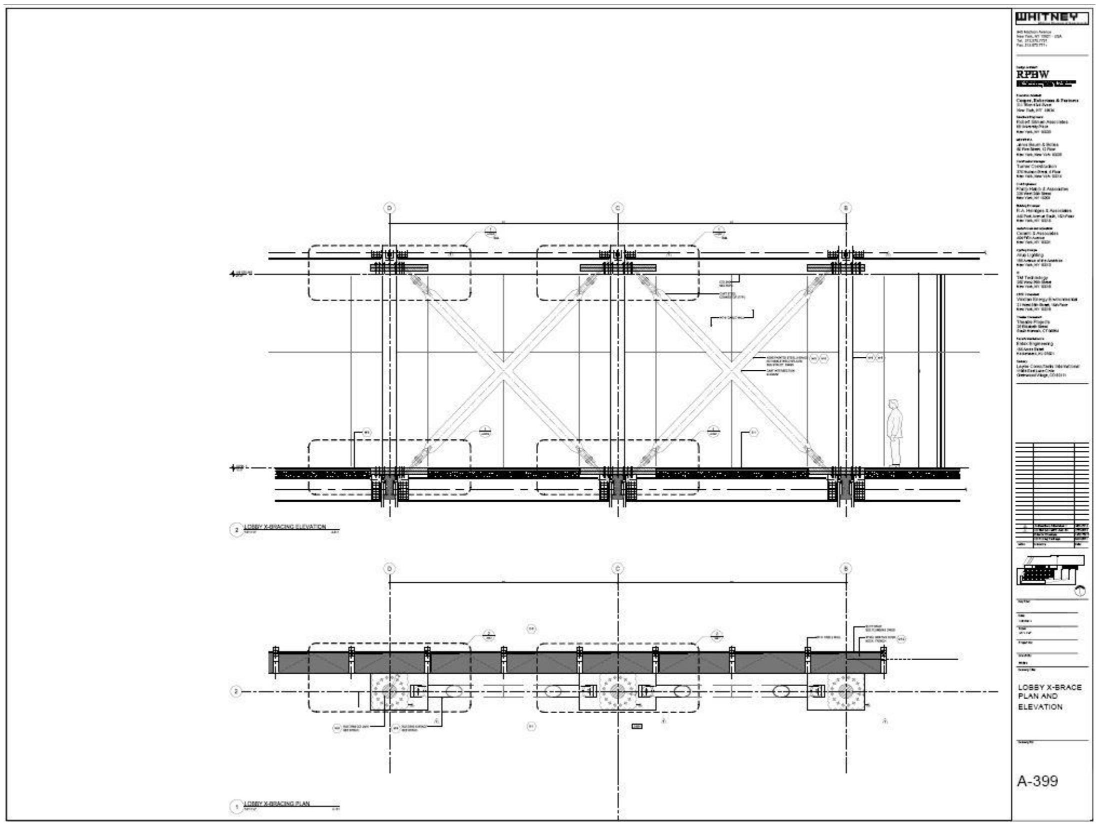
PLAN DETAILS
SOUTH
A-352



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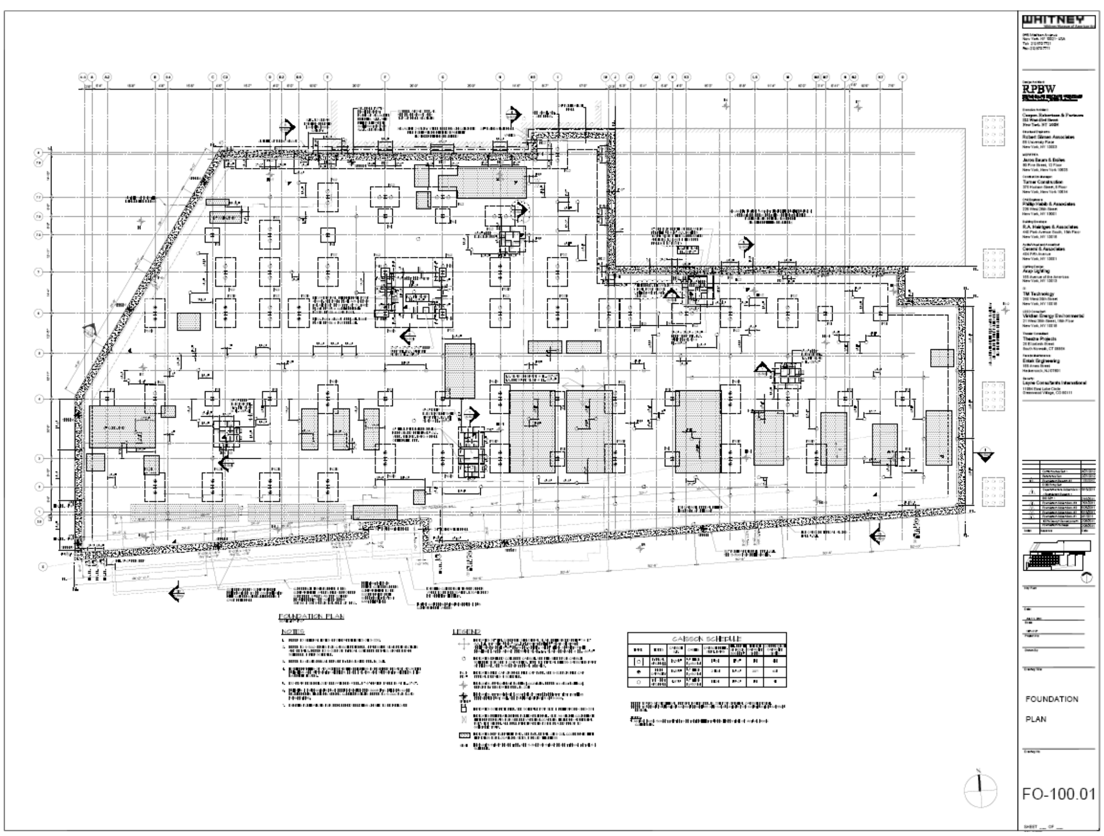
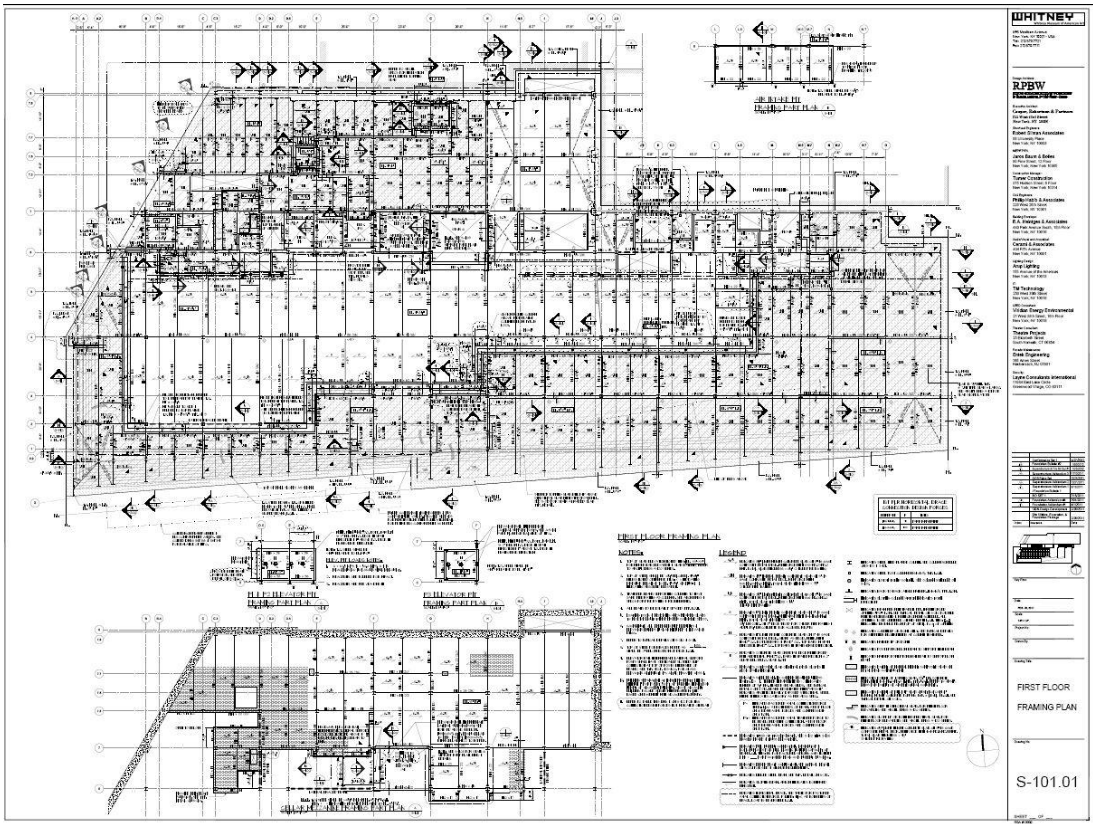
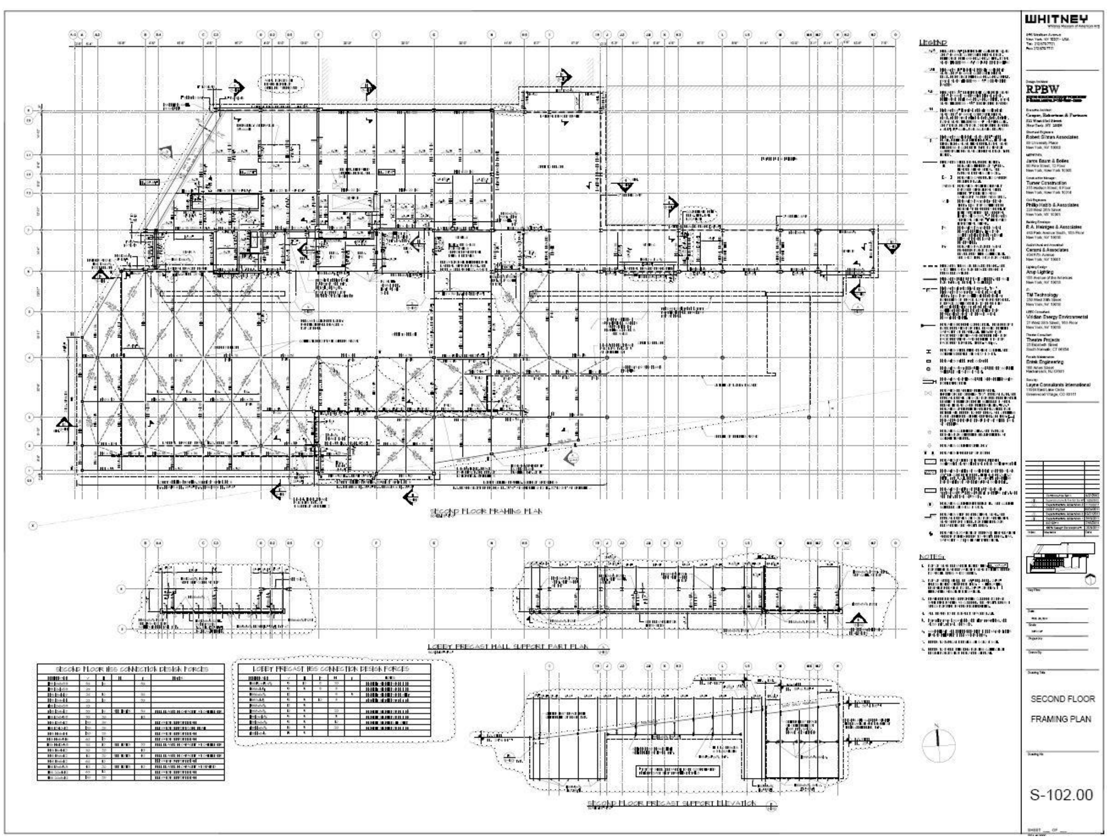
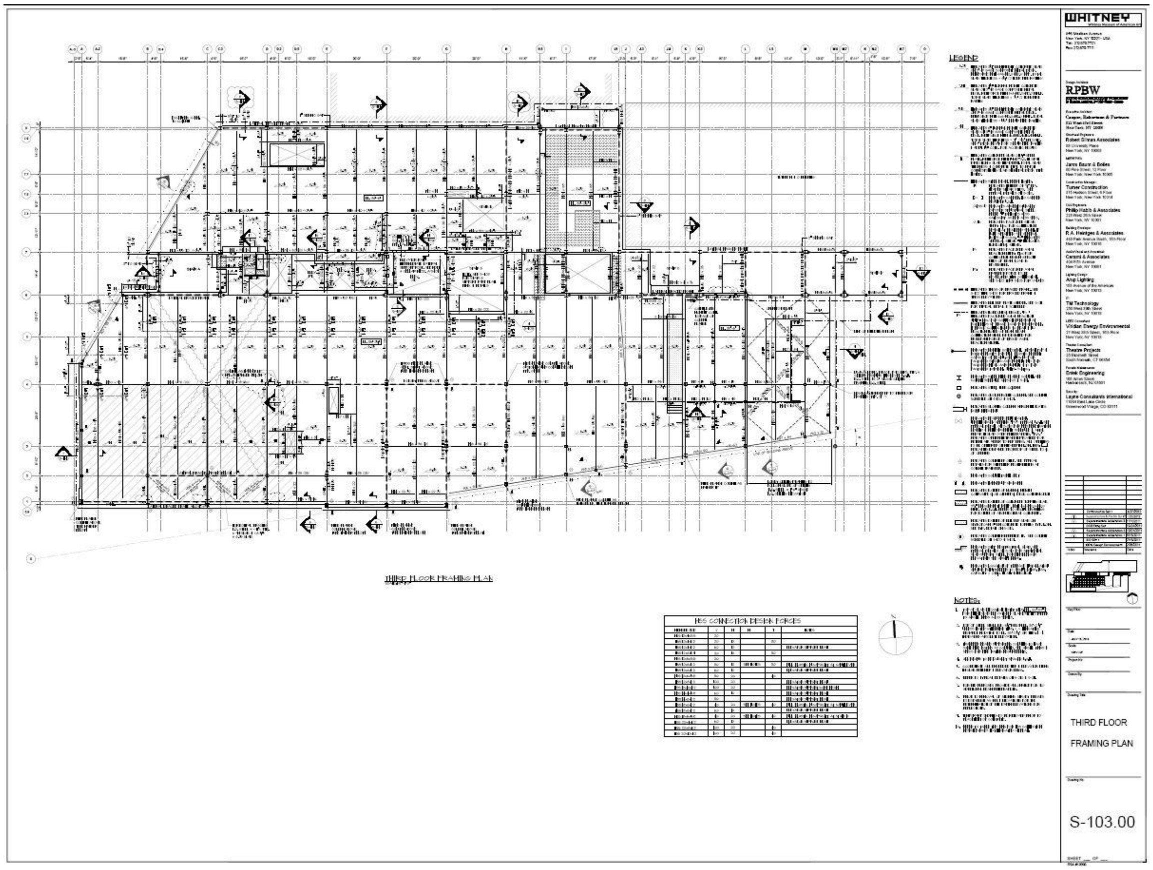


STRUCTURAL DRAWINGS



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RPBW
LEGEND
NOTES:
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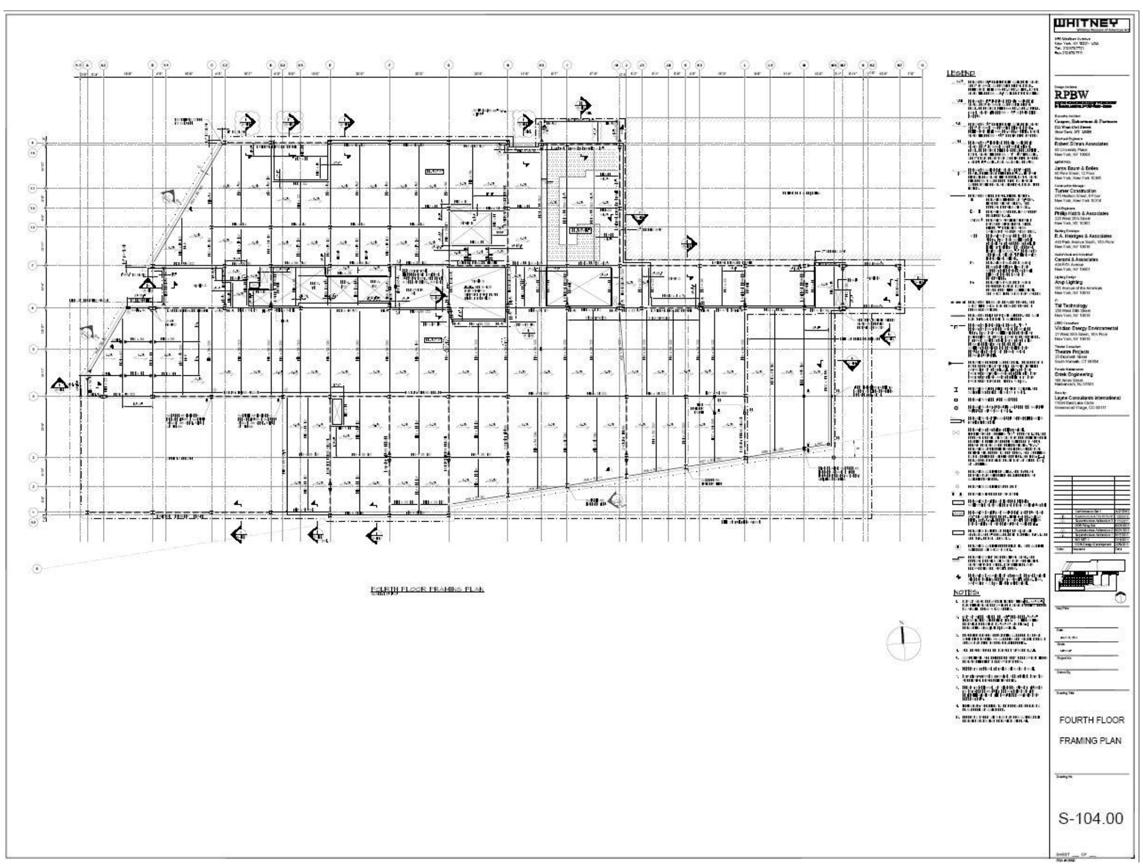
FRAMING PLAN
S-103.00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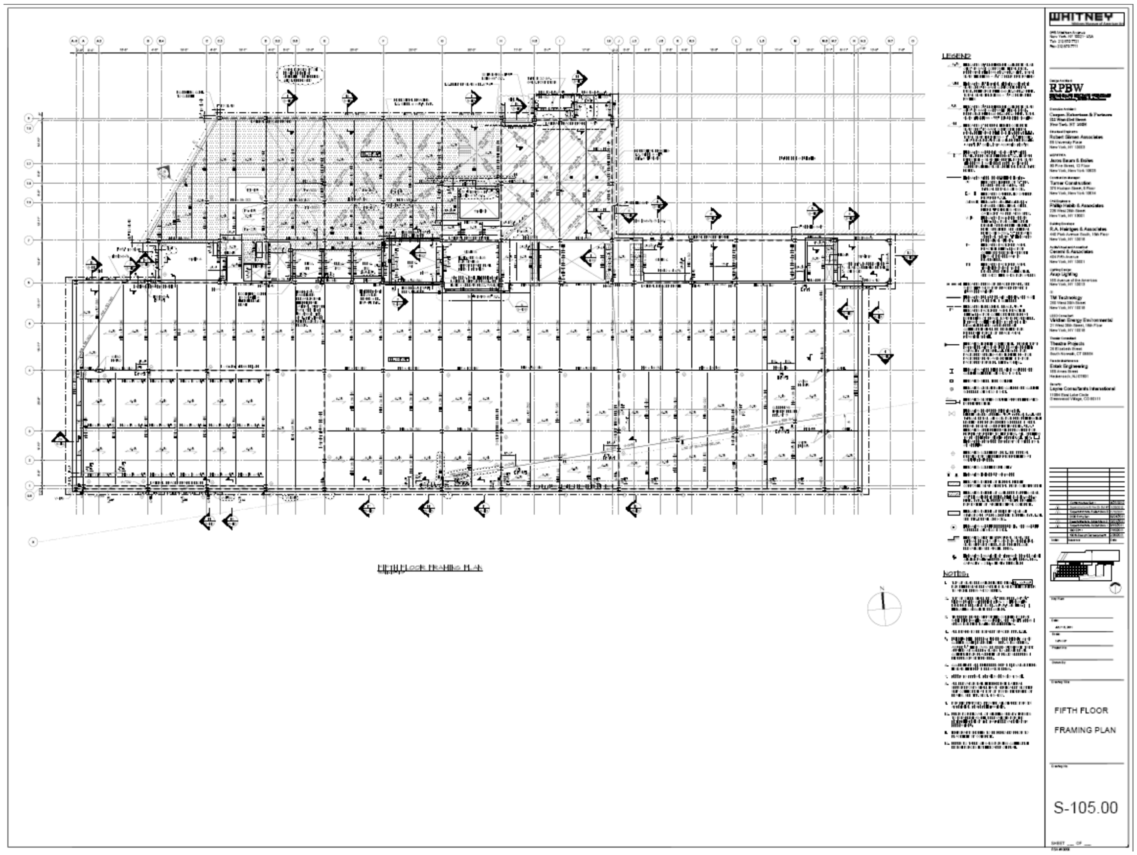
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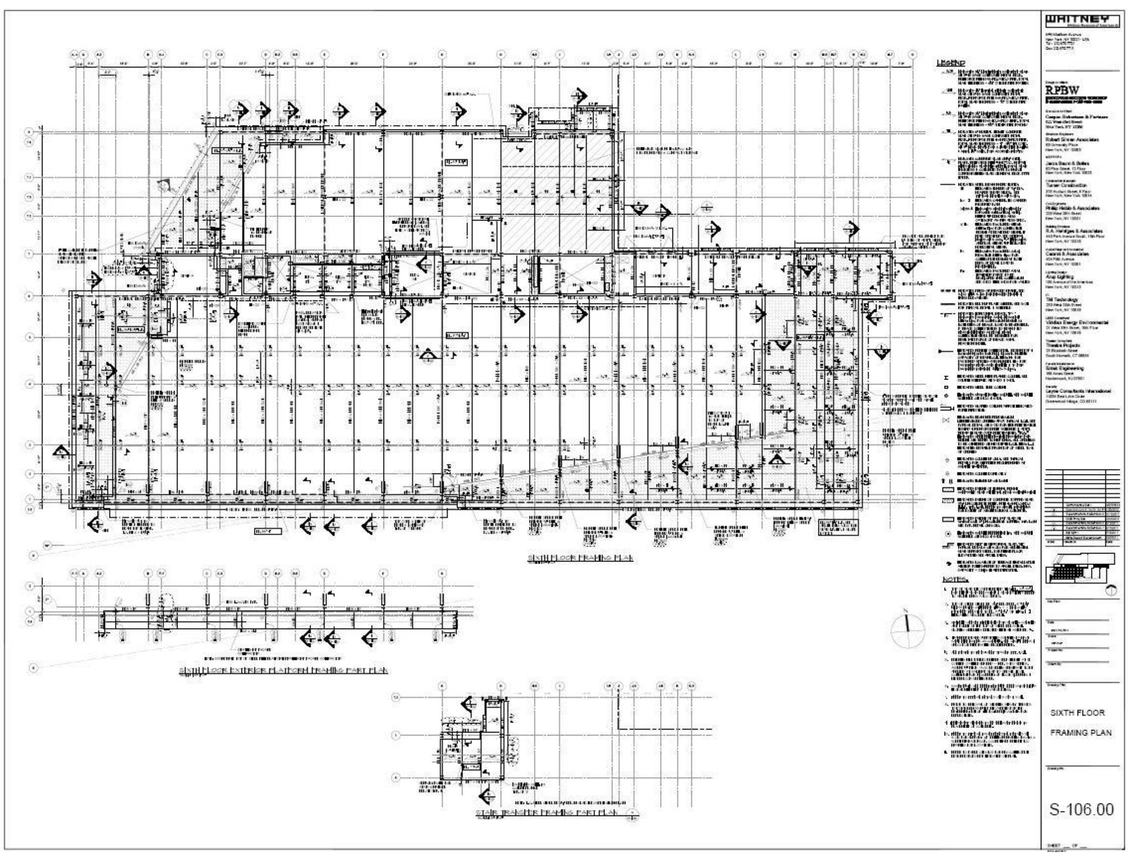
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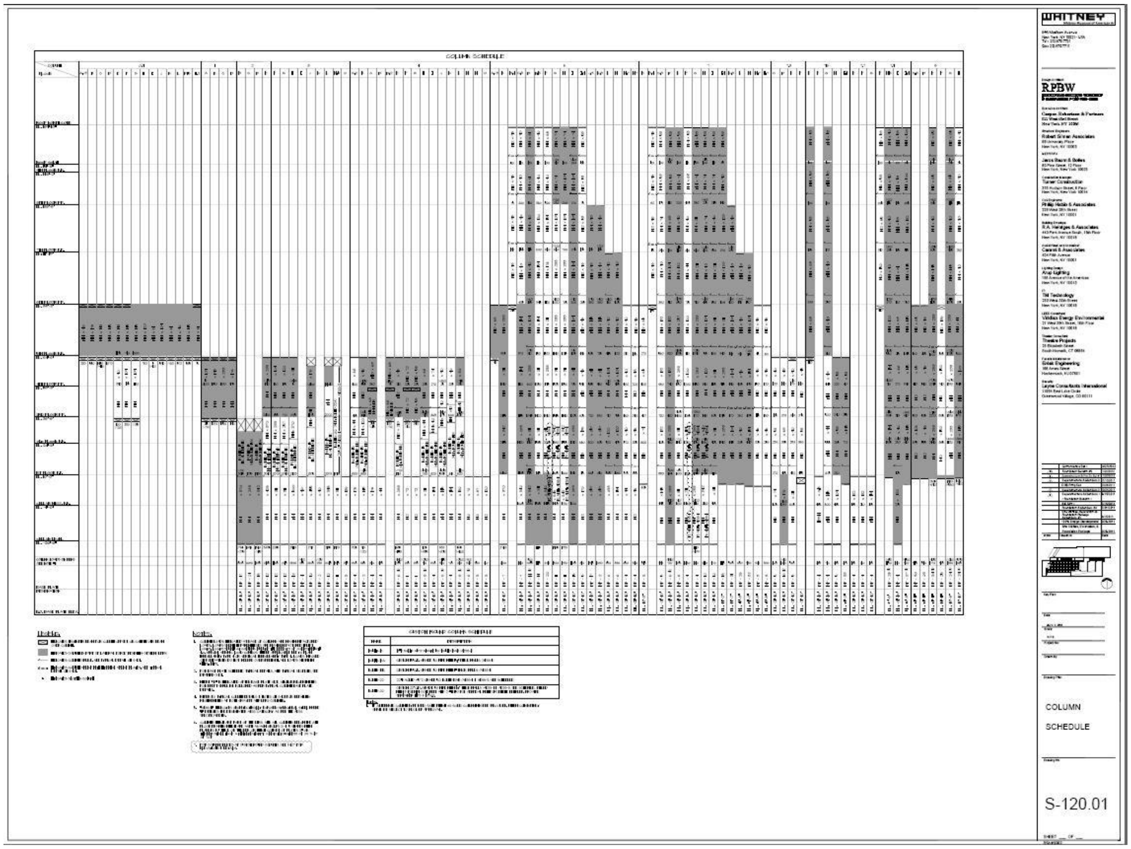
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SCHEDULE
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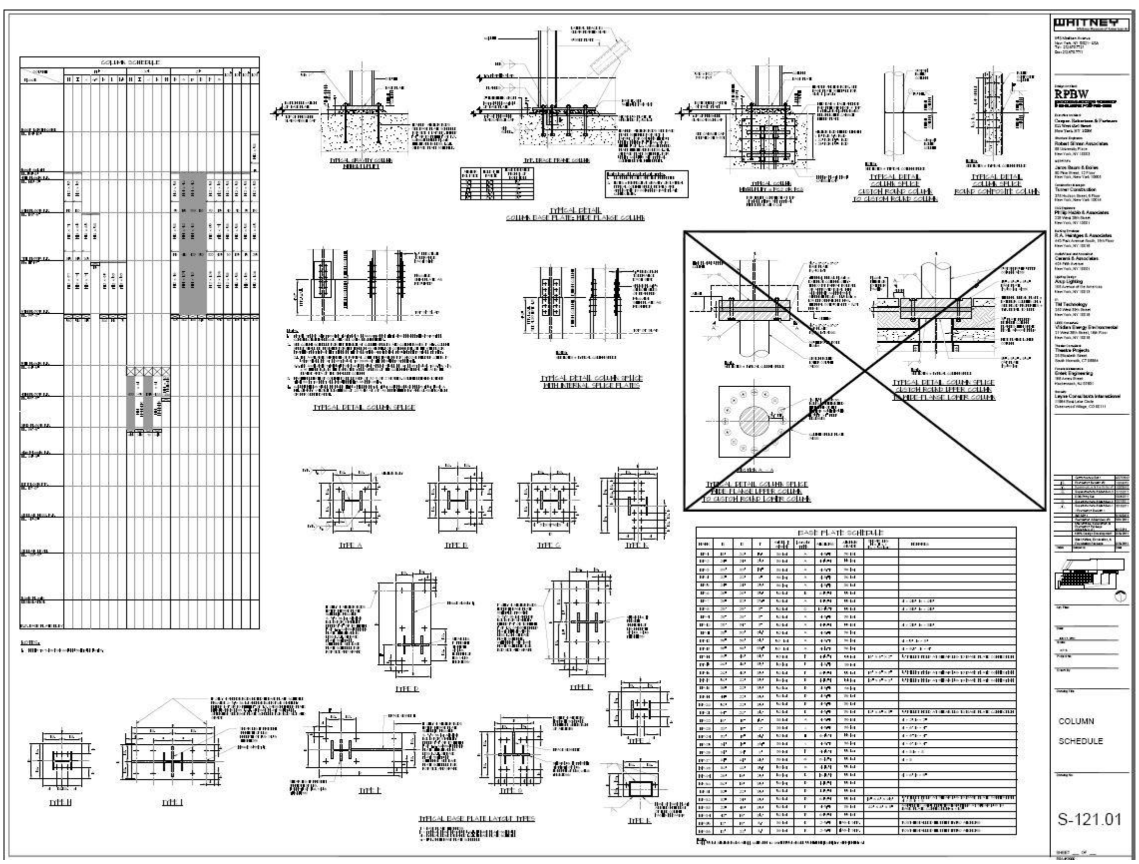
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SCHEDULE
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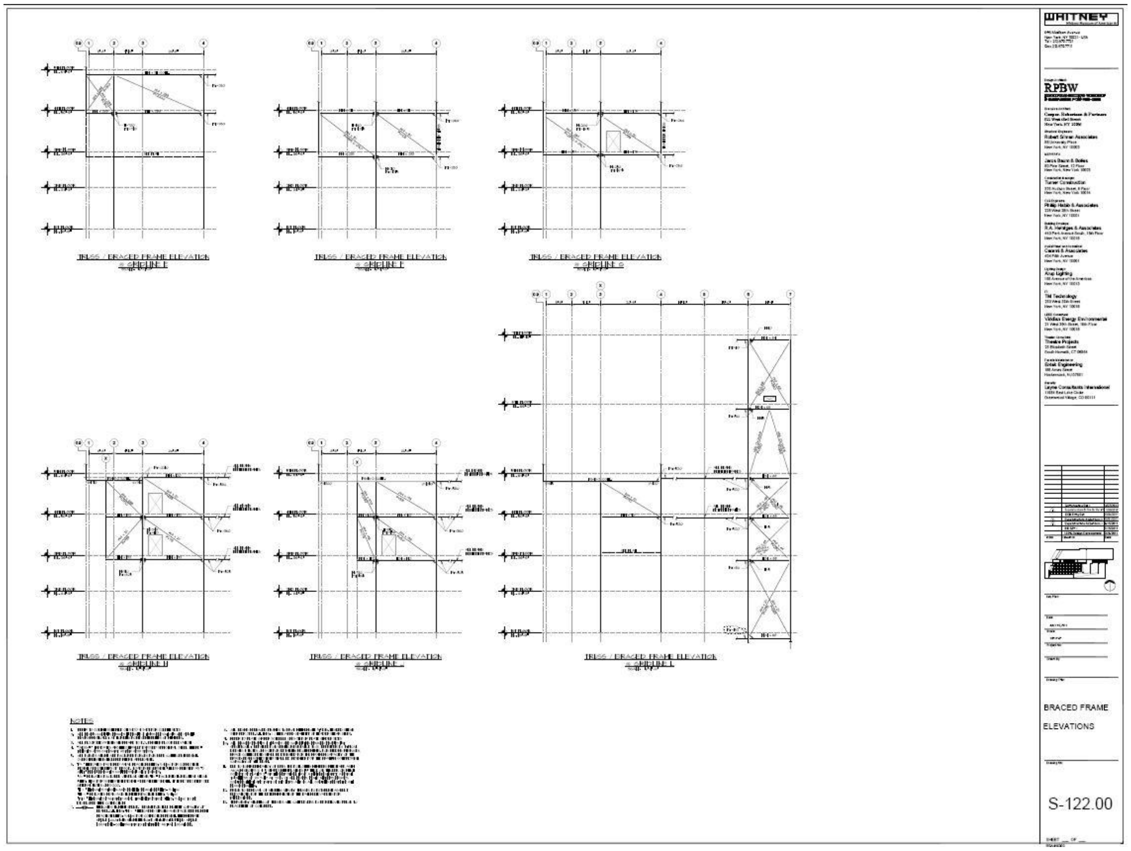
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BRACED FRAME
ELEVATIONS
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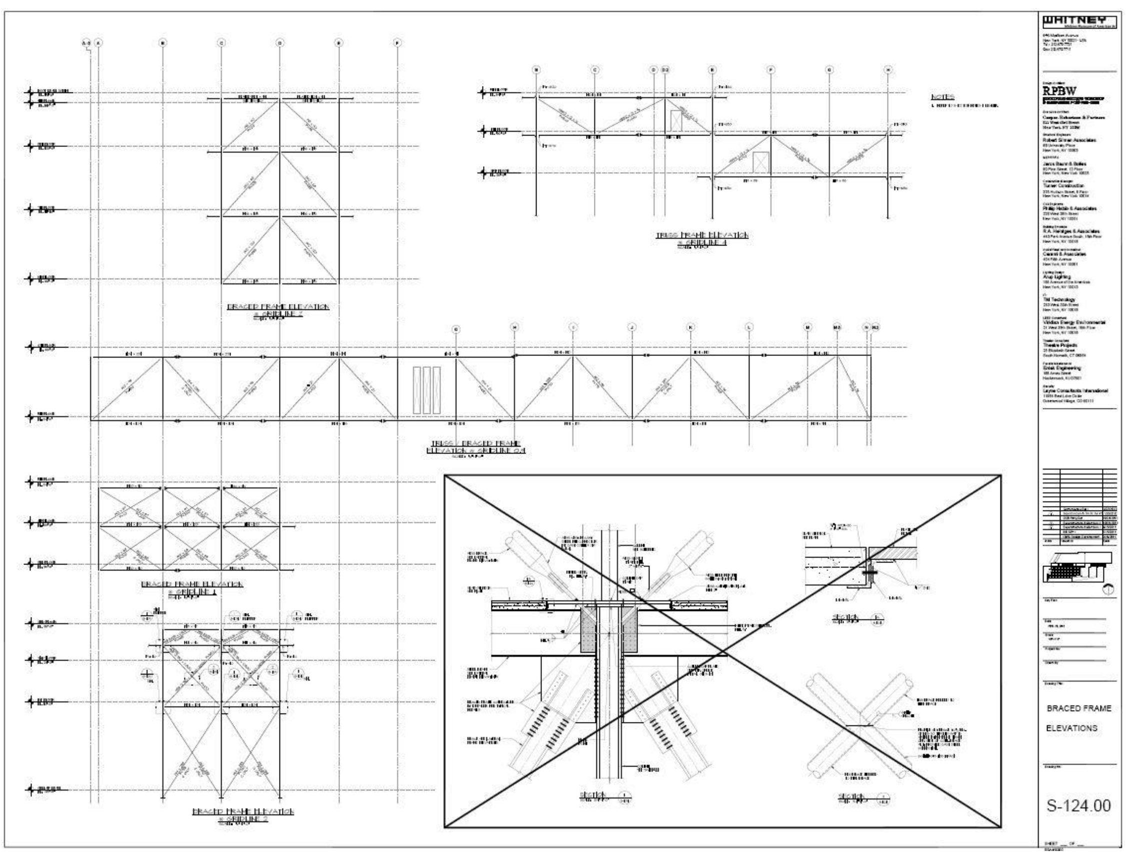
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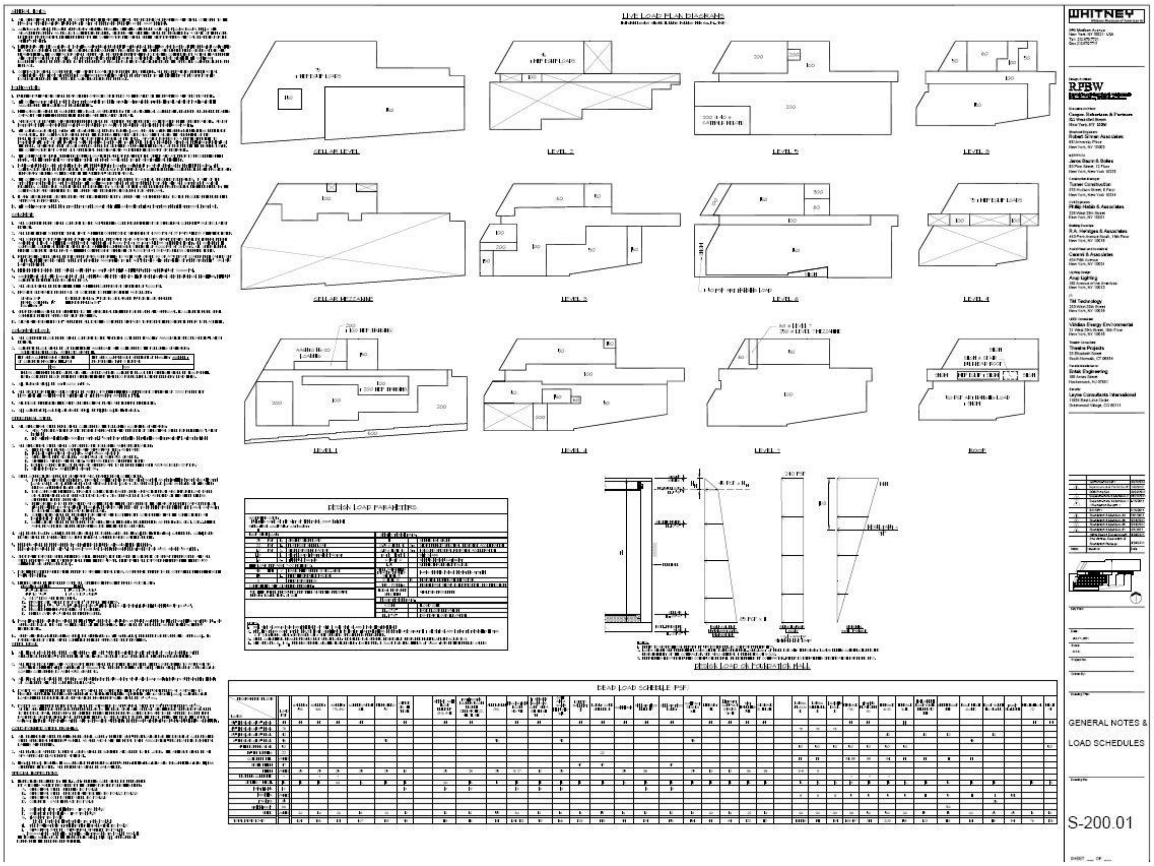
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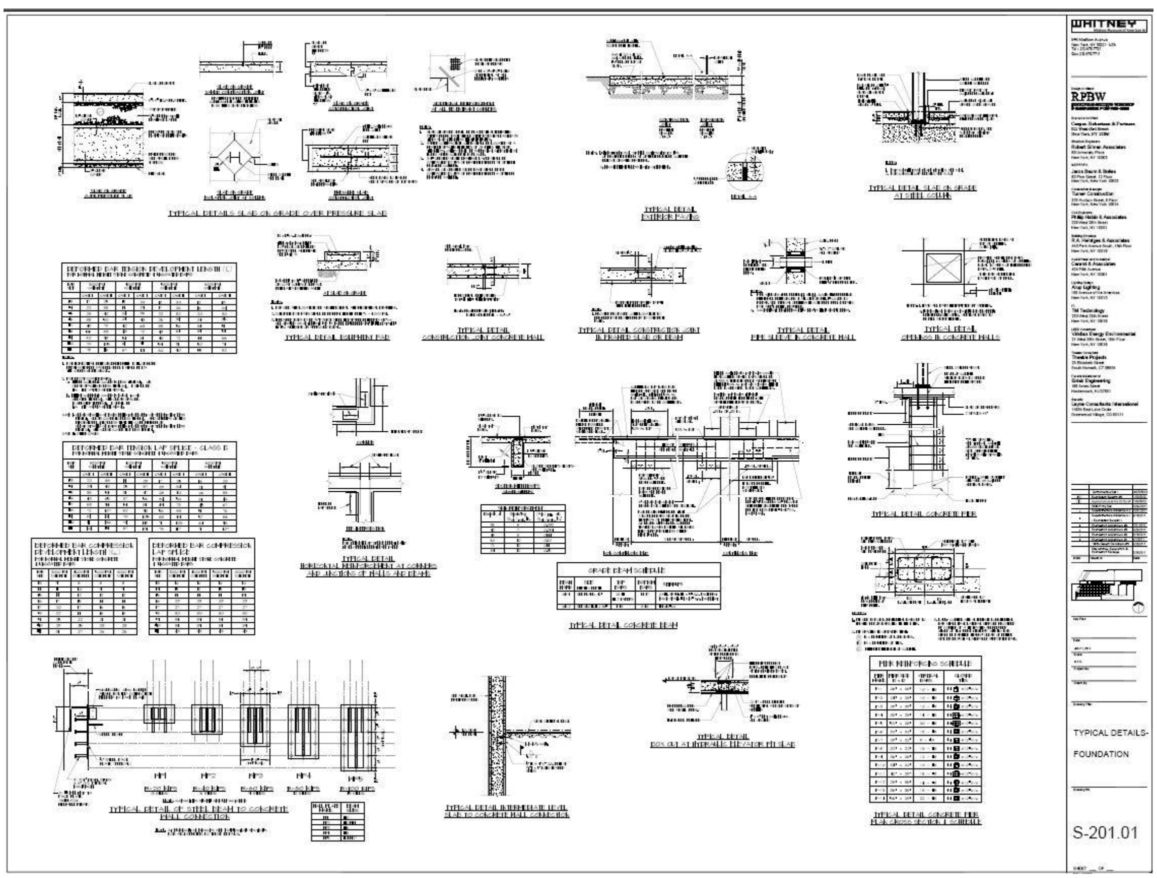
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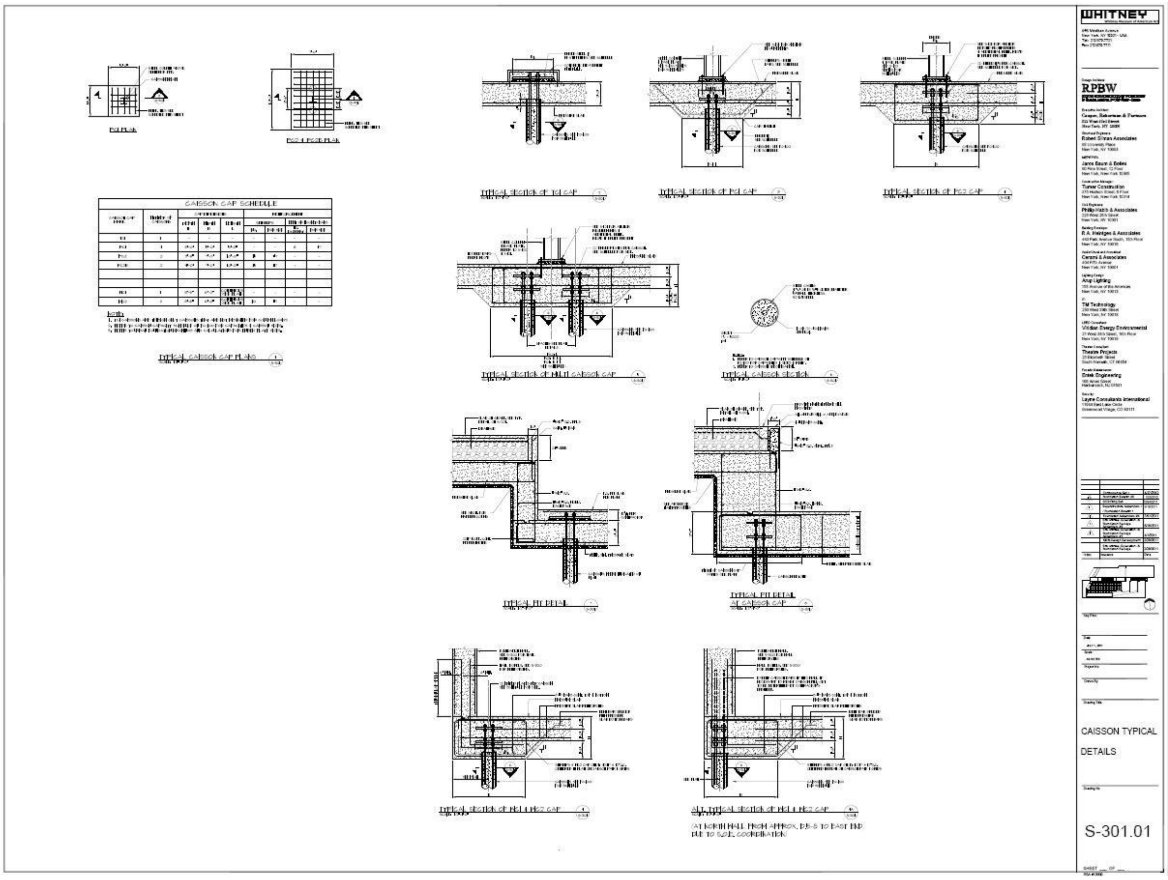
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DETAILS
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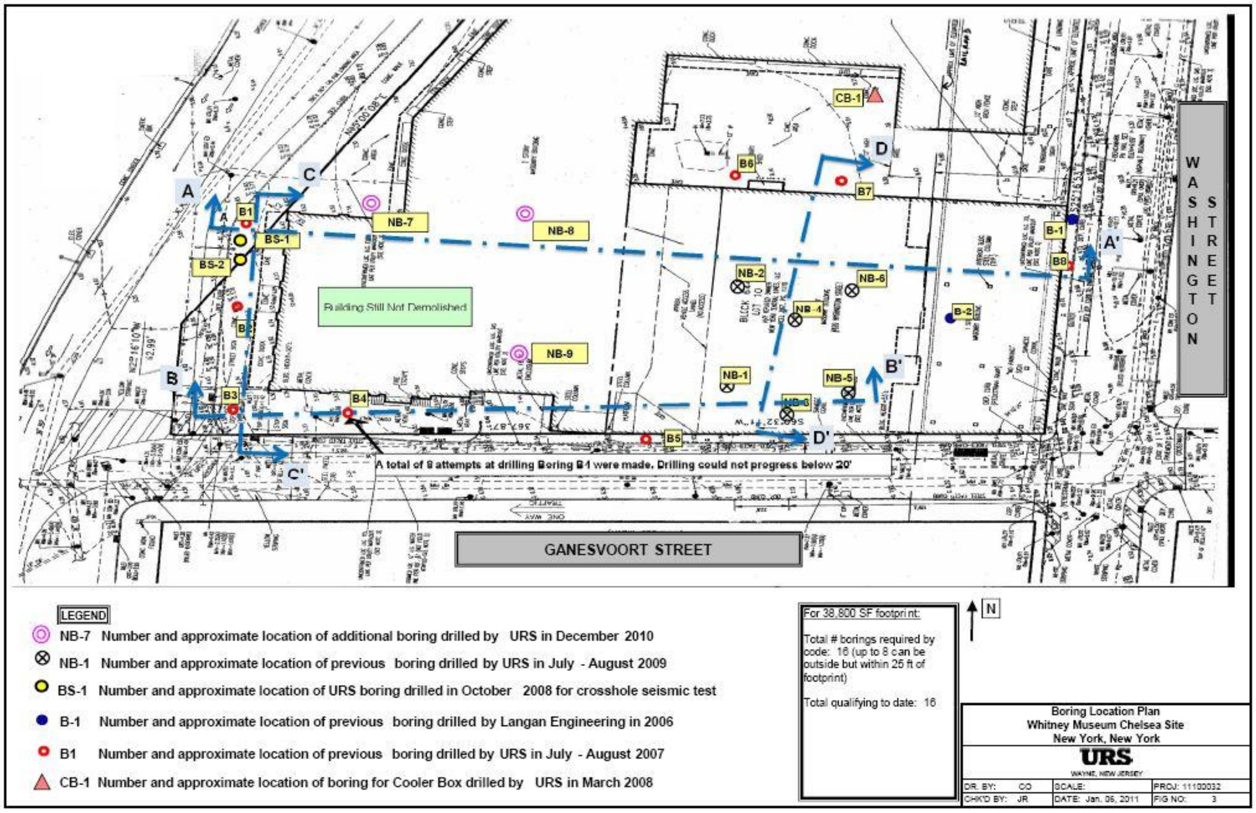
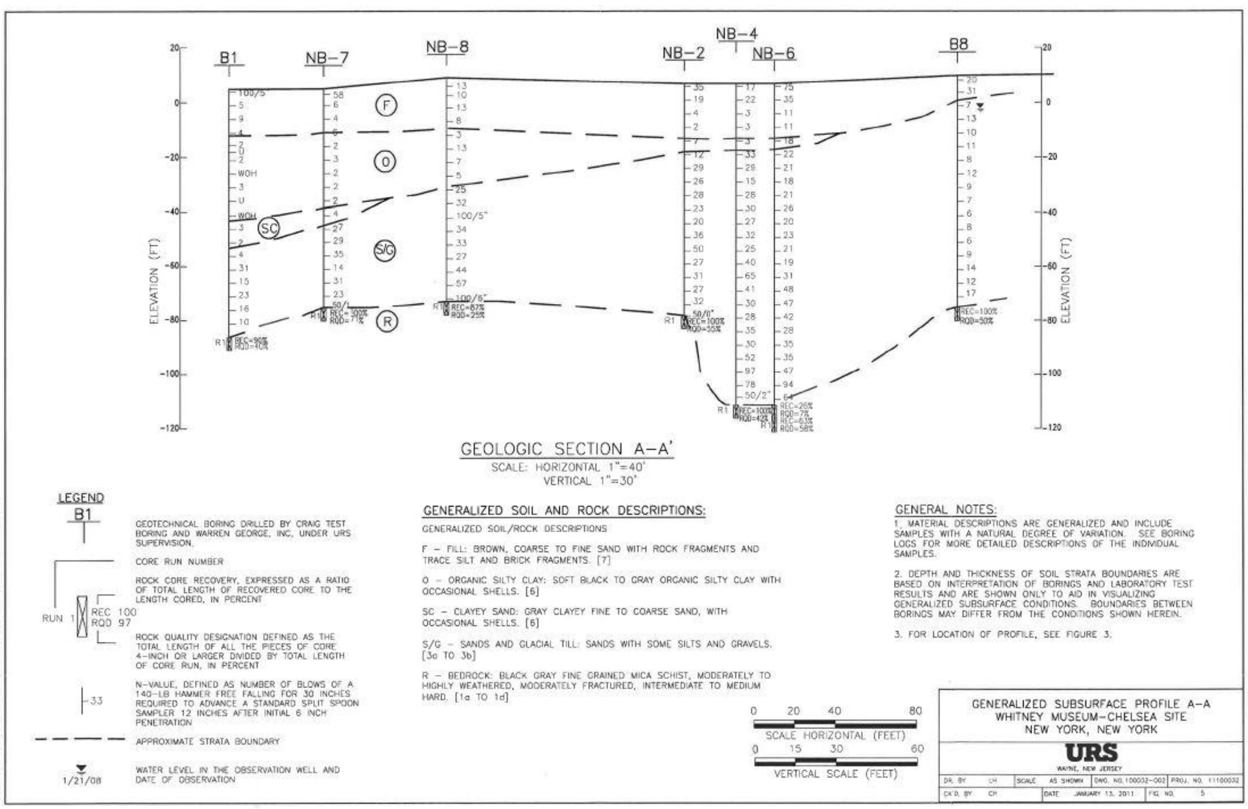
GEOTECHNICAL DOCUMENTS





APPENDIX B: INTRODUCTION CALCULATIONS

BUILDING DEAD LOAD CALCULATIONS

Total Dead Load Calculations							
Level		Type		SQ in	SQ ft	Wt/SFt	Wt/flr (k)
Roof N		31		431080	2994	102	305.35
483		32		220480	1531	116	177.61
Roof S		33		154530	1073	161	172.77
628		34		128723	894	118	105.48
		35		598722	4158	84	349.25
Level 9		16		96701	672	99	66.48
500		37		495578	3442	126	433.63
Level 8		3		877728	6095	121	737.54
2002		6		119746	832	98	81.49
		7		225656	1567	118	184.91
		8		271800	1888	116	218.95
		16		415454	2885	99	285.62
		23		75238	522	112	58.52
		27		334730	2325	187	434.68
Level 7		3		1498650	10407	121	1259.28
2342		6		535436	3718	98	364.39
		8		69584	483	116	56.05
		12		123266	856	98	83.89
		16		40078	278	99	27.55
		20		83450	580	94	54.47
		21		103600	719	84	60.43
		27		335340	2329	187	435.48
Level 6		2		1897600	13178	136	1792.18
4188		4		460080	3195	107	341.87
		12		49612	345	98	33.76
		13		79600	553	166	91.76
		16		40078	278	99	27.55
		19		103640	720	154	110.84
		28		156520	1087	214	232.61
		29		988974	6868	203	1394.18
		30		149084	1035	158	163.58

Total Dead Load Calculations							
Level		Type		SQ in	SQ ft	Wt/SFt	Wt/flr (k)
Level 5		1		2830400	19656	109	2142.46
2915		5		172000	1194	158	188.72
		11		84200	585	133	77.77
		16		40078	278	99	27.55
		22		564400	3919	122	478.17
Level 4		6		2801124	19452	98	1906.32
2589		8		90400	628	116	72.82
		10		93800	651	109	71.00
		12		98340	683	98	66.93
		16		591510	4108	99	406.66
		23		84280	585	112	65.55
Level 3		6		949600	6594	98	646.26
2155		7		93200	647	118	76.37
		8		205328	1426	116	165.40
		9		458320	3183	181	576.08
		12		26000	181	98	17.69
		16		704038	4889	99	484.03
		23		243288	1690	112	189.22
Level 2		16		265600	1844	99	182.60
419		36		448300	3113	76	236.60
Level 1		14		1434000	9958	126	1254.75
4863		15		371600	2581	148	381.92
		16		222000	1542	99	152.63
		24		1222800	8492	186	1579.45
		25		384200	2668	191	509.60
		26		839400	5829	169	985.13
					Totals		
					Sq. ft		Weight (k)
					183882		23084

DL Schedule Summary (S-200.01)			
Floor Type	DL PSF	Floor Type	DL PSF
1	109	21	84
2	136	22	122
3	121	23	112
4	107	24	186
5	158	25	191
6	98	26	169
7	118	27	187
8	116	28	214
9	181	29	203
10	109	30	158
11	133	31	102
12	98	32	116
13	166	33	161
14	126	34	118
15	148	35	84
16	99	36	76
17	124	37	126
18	135		
19	154		
20	94		

SNOW LOAD CALCULATIONS

ASCE 7-05
SNOW LOADS 1/1

GROUND SNOW LOAD 7.2

p_g = 25 PSF (FIGURE 7-1) – verified by structural notes, city BC

FLAT ROOF SNOW LOADS 7.3

$p_f = 0.7\, C_e C_t I p_g$, $p_{f\,min} = \begin{cases} I\, p_g & (p_g \le 20\text{PSF}) \\ 20 I & (p_g > 20\text{ PSF}) \end{cases}$

EQN 7-1

EXPOSURE FACTOR 7.3.1

TERRAIN CATEGORY "C" (WIND CALCS p1, ASCE 7-05 6.5.6)
PARTIALLY EXPOSED ROOF

$C_e = 1.0$ (TABLE 7-2) – verified by structural notes

THERMAL FACTOR 7.3.2

$C_t = 1.0$ (TABLE 7-3) – verified by structural notes

IMPORTANCE FACTOR 7.3.3
OCCUPANCY III
$I = 1.15$ – verified by structural notes

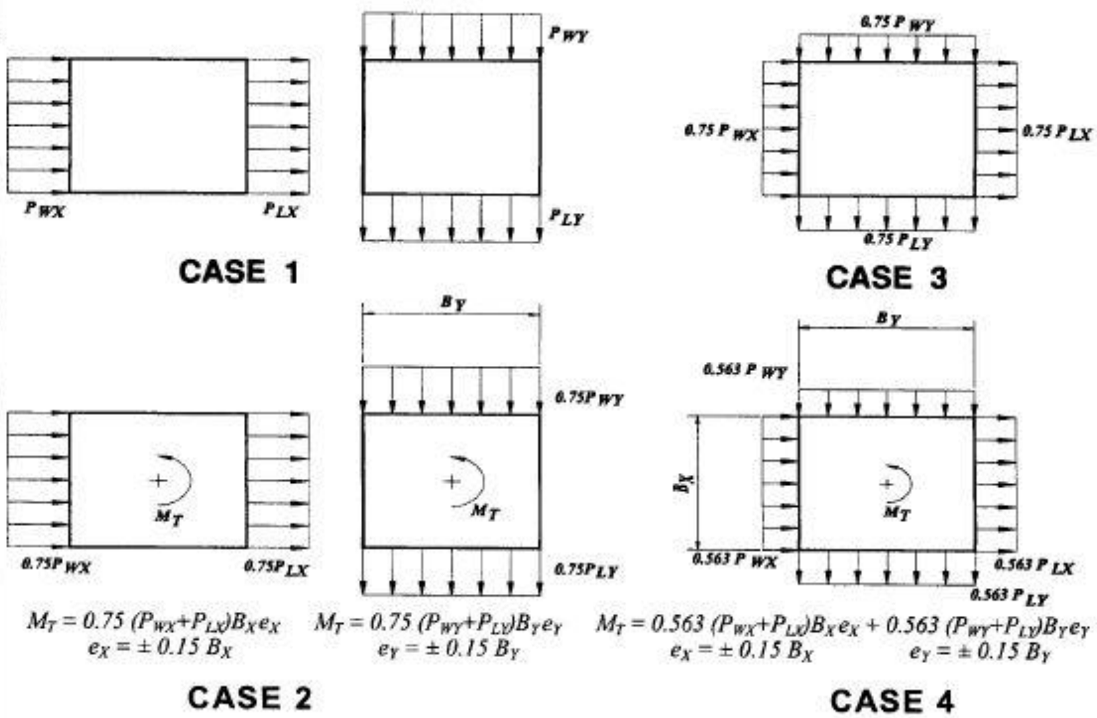
$p_f = 0.7 \cdot 1.0 \cdot 1.0 \cdot 1.15 \cdot 25 = 21$ PSF

$p_{f,min} = 20 I = 20 \cdot 1.15 = 23$ PSF * CONTROLS

* DRAWINGS DENOTE 22 PSF FOR p_f. LIKELY ASSUME LL WILL CONTROL

WIND LOAD CALCULATIONS

Main Wind Force Resisting System – Method 2		All Heights
Figure 6-9	Design Wind Load Cases	



Case 1. Full design wind pressure acting on the projected area perpendicular to each principal axis of the structure, considered separately along each principal axis.

Case 2. Three quarters of the design wind pressure acting on the projected area perpendicular to each principal axis of the structure in conjunction with a torsional moment as shown, considered separately for each principal axis.

Case 3. Wind loading as defined in Case 1, but considered to act simultaneously at 75% of the specified value.

Case 4. Wind loading as defined in Case 2, but considered to act simultaneously at 75% of the specified value.

Notes:

1. Design wind pressures for windward and leeward faces shall be determined in accordance with the provisions of 6.5.12.2.1 and 6.5.12.2.3 as applicable for building of all heights.
2. Diagrams show plan views of building.
3. Notation:
   - P_{WX}, P_{WY}: Windward face design pressure acting in the x, y principal axis, respectively.
   - P_{LX}, P_{LY}: Leeward face design pressure acting in the x, y principal axis, respectively.
   - e (e_X, e_Y) : Eccentricity for the x, y principal axis of the structure, respectively.
   - M_T: Torsional moment per unit height acting about a vertical axis of the building.

Wall Pressures								
E-W				qGfCp	qiGCpi	WW	LW	Pressure
Level	ht	Kz	qz	Cp	-0.55	0.8	-0.3	PSF
RN	160	1.39	33.41	23.793	-18.37	42.17	-7.72	49.89
RS	142	1.36	32.68	23.279	-17.98	41.26	-7.72	48.98
9	140	1.36	32.68	23.279	-17.98	41.26	-7.72	48.98
8	124	1.32	31.72	22.595	-17.45	40.04	-7.72	47.76
7	102	1.26	30.28	21.568	-16.65	38.22	-7.72	45.94
6	78	1.21	29.08	20.712	-15.99	36.71	-7.72	44.43

Equivalent Point Loads					
E-W	Pressure	hi	Dist Ld	Bx	Px
Level	PSF	ft	plf	ft	k
RN	49.89	10	498.9	55.8	27.9
RS	48.98	9	1348.3	53.8	72.5
9	48.98	18	1789.1	55.8	99.9
8	47.76	19	1964.3	113.7	223.3
7	45.94	23	1589.9	118.3	188.1
Vb =	611.6 k		Mover =	27902.3	kft

Wall Pressures								
N-S				qGfCp	qiGCpi	WW	LW	Pressure
Level	ht	Kz	qz	Cp	-0.55	0.8	-0.5	PSF
RN	160	1.39	33.41	22.631	-18.37	41.00	-13.38	54.38
RS	142	1.36	32.68	22.143	-17.98	40.12	-13.38	53.50
9	140	1.36	32.68	22.143	-17.98	40.12	-13.38	53.50
8	124	1.32	31.72	21.491	-17.45	38.94	-13.38	52.32
7	102	1.26	30.28	20.515	-16.65	37.17	-13.38	50.55
6	78	1.21	29.08	19.700	-15.99	35.69	-13.38	49.07

Equivalent Point Loads					
N-S	Pressure	ht	Dist Ld	By	Py
Level	PSF	ft	plf	ft	k
RN	54.38	10	543.8	150.3	81.7
RS	53.50	9	1527.9	143.8	219.8
9	53.50	18	2009.4	150.3	301.9
8	52.32	20	2209.0	191.2	422.3
7	50.55	23	1162.6	229.2	266.4
Vb =	1292.1 k		Mover =	65303.3	kft

Wind Factors		
	E - W	N - S
G_f =	0.89	0.85
GC pi =	0.55	-
Cp =	-0.3	-0.5
Kd =	0.85	-
Kzt =	1.0	-
I =	1.15	-

Inherent Moments						
	Bx	ex	Mtx	By	ey +	Mt +
Level	ft	ft	k-in	ft	ft	k-in
RN	55.8	8.4	2799	150.3	22.5	22099
RS	53.8	8.1	7014	143.8	21.6	56896
9	55.8	8.4	10039	150.3	22.5	81651
8	113.7	17.1	45681	191.2	28.7	145310
7	118.3	17.8	40072	229.2	34.4	109905

SEISMIC LOAD CALCULATIONS

Seismic Loads								E-W Direction					N-S Direction				
	Ht (ft)	hi	W (k)	wh^k	Cvx	fi	Vi	Bx	5%Bx	Ax	RS	Mz (ft-k)	By	5%By	Ay	RS	Mzy (ft-k)
RN	160	20	841	21539881	0.2278	192	192	150	7.5	22.7		32649	56	2.8	7.1		3809
RS	142	18	649	13092727	0.1385	90	282	144	7.2	70.2	13.2	8558	54	2.7	278.9	1.0	242
9	140	16	678	13281336	0.1405	95	377	150	7.5	11.6		8326	56	2.8	11.4		3040
8	124	22	1674	25746066	0.2723	456	833	191	9.6	2.3		9942	114	5.7	2.8		7333
7	102	24	2007	20876383	0.2208	443	1276	229	11.5	1.0		5077	118	5.9	1.0		2622
k	2	Σ	5849	94536394		Vb =	1276										
T	1.53	s				Mov =	158514										

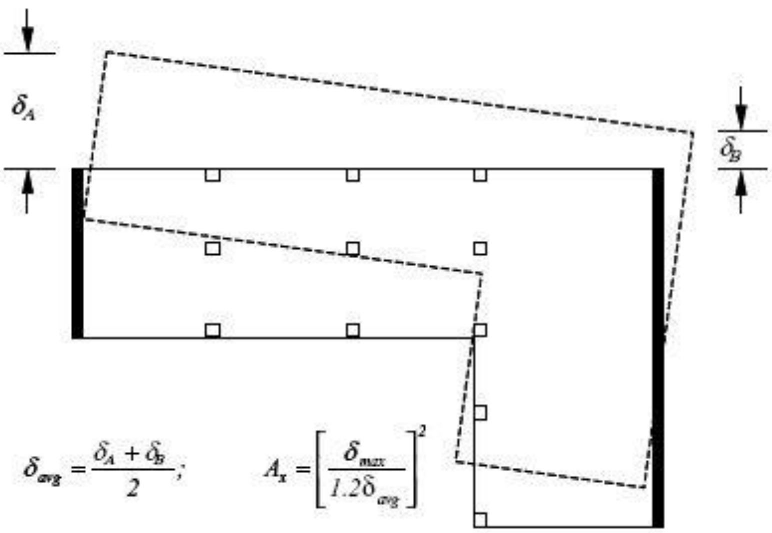


FIGURE 12.8-1 TORSIONAL AMPLIFICATION FACTOR, A_x

Amplification Factor Analysis								RS Alternative					
E-W	$(\delta_{xe})_1$	Δ_{x1}	$(\delta_{xe})_2$	Δ_{x2}	Δ_{avg}	$\Delta_{max}/\Delta_{avg}$		$(\delta_{xe})_1$	Δ_{x1}	$(\delta_{xe})_2$	Δ_{x2}	Δ_{avg}	$\Delta_{max}/\Delta_{avg}$
RN	1.057	0.236	1.054	0.134	0.1850	1.28	*						
RS	0.821	0.041	0.920	0.142	0.0915	1.55	*	0.556	0.128	0.705	0.195	0.1615	1.21
9	0.780	0.191	0.778	0.19	0.1905	1.00							
8	0.589	0.32	0.588	0.33	0.3250	1.02		0.428		0.510			
7	0.269	0.269	0.258	0.258	0.2635	1.02							
	$(\delta_{ye})_1$	Δ_{y1}	$(\delta_{ye})_2$	Δ_{y2}	Δ_{avg}	$\Delta_{max}/\Delta_{avg}$		$(\delta_{ye})_1$	Δ_{y1}	$(\delta_{ye})_2$	Δ_{y2}	Δ_{avg}	$\Delta_{max}/\Delta_{avg}$
RN	0.183	0.053	-0.238	-0.102	-0.0245	4.16	*						
RS	0.130	0.01	-0.136	-0.016	-0.0030	5.33	*	0.308	0.135	0.274	0.100	0.1175	1.15
9	0.120	0.041	-0.120	-0.061	-0.0100	6.10	*						
8	0.079	0.042	-0.059	-0.043	-0.0005	86.00	*	0.173		0.174			
7	0.037	0.037	-0.016	-0.016	0.0105	3.52	*						
N-S	$(\delta_{xe})_1$	Δ_{x1}	$(\delta_{xe})_2$	Δ_{x2}	Δ_{avg}	$\Delta_{max}/\Delta_{avg}$		$(\delta_{xe})_1$	Δ_{x1}	$(\delta_{xe})_2$	Δ_{x2}	Δ_{avg}	$\Delta_{max}/\Delta_{avg}$
RN	0.185	0.032	0.183	0.032	0.0320	1.00							
RS	0.153	0.007	0.151	0.006	0.0065	1.08		0.062	0.023	-0.045	-0.004	0.0095	2.42
9	0.146	0.03	0.145	0.03	0.0300	1.00							
8	0.116	0.038	0.115	0.037	0.0375	1.01		0.039		-0.041			
7	0.078	0.078	0.078	0.078	0.0780	1.00							
	$(\delta_{ye})_1$	Δ_{y1}	$(\delta_{ye})_2$	Δ_{y2}	Δ_{avg}	$\Delta_{max}/\Delta_{avg}$		$(\delta_{ye})_1$	Δ_{y1}	$(\delta_{ye})_2$	Δ_{y2}	Δ_{avg}	$\Delta_{max}/\Delta_{avg}$
RN	0.123	-0.829	0.978	0.218	-0.3055	2.71	*						
RS	0.952	0.053	0.760	0.042	0.0475	1.12		1.039	0.284	1.087	0.341	0.3125	1.09
9	0.899	0.245	0.718	0.198	0.2215	1.11							
8	0.654	0.342	0.520	0.306	0.3240	1.06		0.755		0.746			
7	0.312	0.312	0.214	0.214	0.2630	1.19							

Seismic Design Criteria			
S-200.01		ASCE 7-05	
Sds	0.65	Ta (s)	0.9
Sd1	0.13	Cu	1.7
I	1.25	T (s)	1.53
R	3	TL (s)	6
W (k)	5849		
Cs	0.0602		

	Amp Factor Maximums			RS Alternative		
	δ_{EW}	Δ_{avg}	$\Delta_{max}/\Delta_{avg}$	δ_{EW}	Δ_{avg}	$\Delta_{max}/\Delta_{avg}$
RN	1.057	0.185	5.71			
RS	0.920	0.092	10.05	0.705	0.1615	1.21
9	0.780	0.191	4.09			
8	0.589	0.325	1.81			
7	0.269	0.264	1.02			
	δ_{NS}	Δ_{avg}	$\Delta_{max}/\Delta_{avg}$	δ_{NS}	Δ_{avg}	$\Delta_{max}/\Delta_{avg}$
RN	0.978	-0.31	3.20			
RS	0.952	0.05	20.04	1.087	0.3125	1.09
9	0.899	0.22	4.06			
8	0.654	0.32	2.02			
7	0.312	0.26	1.19			

APPENDIX C: CUSTOM MEMBER STRENGTHS

MEMBERS SPECIFIED IN CURRENT DESIGN

PLATE GIRDERS

Plate Element Dimensions (in)						
Shape	B	tf	nf	D	tw	h
32.5	18	4	1	32.5	2	24.5
33-1	18	4	1	33	2	25
44-1	18	4	1	44	2	36
46-1	18	2	1	46	1	42
46-2	20	4	2	46	2	30
46-3	18	4	1	46	2	38
72-1	16	3	1	72	2	66
L	20	ft				
Weld size	0.5	in				

Material Propoerties		
ϕ	0.9	
E	29000	ksi
Fy	50	ksi
G	11200	ksi
K	1.0	

Note: Dimensions taken from drawing S-211

Section Properties																
	Individual Flange								Web		Total					
	A	x	Ax	Ax2	y	Ay2	Iox	Ioy	A	Ax	A	Ixx	Iyy	rx	ry	WT (plf)
32.5	72	14.25	1026	14620.5	5	1458.0	96.0	1944.0	49	600	193	29433	6804	12	6	656
33-1	72	14.5	1044	15138.0	5	1458.0	96.0	1944.0	50	625	194	30468	6804	13	6	659
44-1	72	20	1440	28800.0	5	1458.0	96.0	1944.0	72	1296	216	57792	6804	16	6	734
46-1	36	22	792	17424.0	5	729.0	12.0	972.0	42	882	114	34872	3402	17	5	388
46-2	160	19	3040	57760.0	5	4000.0	853.3	5333.3	60	900	380	117227	18667	18	7	1291
46-3	72	21	1512	31752.0	5	1458.0	96.0	1944.0	76	1444	220	63696	6804	17	6	748
72-1	48	34.5	1656	57132.0	4	768.0	36.0	1024.0	132	4356	228	114336	3584	22	4	775

Tensile Strength	
	ϕTn (k)
32.5	8685
33-1	8730
44-1	9720
46-1	5130
46-2	17100
46-3	9900
72-1	10260

Flexural Strength												
	Flange Compactness				Web Compactness				Yielding		Max Unbr Length (Lp)	
	bf/2tf	λp	λr		h/tw	λp	λr		Z	ϕMn (ft-k)	in	ft
32.5	2.25	9.2	24.1	C	12.3	90.6	137.3	C	3252.5	12197	214	18
33-1	2.25	9.2	24.1	C	12.5	90.6	137.3	C	3338	12518	214	18
44-1	2.25	9.2	24.1	C	18.0	90.6	137.3	C	5472	20520	202	17
46-1	4.50	9.2	24.1	C	42.0	90.6	137.3	C	3348	12555	197	16
46-2	2.50	9.2	24.1	C	15.0	90.6	137.3	C	7880	29550	253	21
46-3	2.25	9.2	24.1	C	19.0	90.6	137.3	C	5912	22170	201	17
72-1	2.67	9.2	24.1	C	33.0	90.6	137.3	C	12024	45090	143	12

Compressive Strenth																						
	Flange Slenderness					Web Slenderness				Flexural Buckling				Torsional Buckling					Compressive Strength			
	b/2tf	Kc'	Kc	λr		h/tw	λr			KL/r	KL/r Limit	Fe flex	Fcr flex	ho	Cw	J	Fe tors	Fcr tors	Fcr	Pn	ϕPn	
32.5	2.25	1.14	0.76	13.44	NS	12.25	35.88	NS	NS	19.4	113	758	48.6	29	1381637	460	332	46.9	46.9	9060	8154	k
33-1	2.25	1.13	0.76	13.44	NS	12.50	35.88	NS	NS	19.2	113	780	48.7	29	1430541	461	329	46.9	46.9	9103	8193	k
44-1	2.25	0.94	0.76	13.44	NS	18.00	35.88	NS	NS	14.7	113	1330	49.2	40	2721600	491	294	46.6	46.6	10059	9053	k
46-1	4.50	0.62	0.62	12.11	NS	42.00	35.88	S	SLENDER	-	-	-	-	-	-	-	-	-	-	-	-	
46-2	1.25	1.03	0.76	13.44	NS	15.00	35.88	NS	NS	13.7	113	1533	49.3	38	6738667	3515	536	48.1	48.1	18273	16445	k
46-3	2.25	0.92	0.76	13.44	NS	19.00	35.88	NS	NS	14.1	113	1439	49.3	42	3000564	496	290	46.5	46.5	10235	9211	k
72-1	2.67	0.70	0.70	12.86	NS	33.00	35.88	NS	NS	10.7	113	2492	49.6	69	4265856	328	211	45.3	45.3	10323	9291	k

HSS Round Sections

22R

Section Properties

Concrete			Reinforcement			Pipe					
wt	145	pcf	fy	150	ksi	fy	46	ksi	Do	22	in
f'c	8000	psi	Esr	29000	ksi	Es	29000	ksi	t	1.25	in
						wt	490	pcf			
			Callout	11					td	1.16	
Ag	299	in2	Ai	1.56	in2	Isx	64638.9	in4	Di	19.5	in
Ec	5098	ksi	n	2		Zx	496.8	in3	Dd	21.8	
Ig	7098	in4	Asr	3.12	in2	ρ	0.202	OK	Ast	75.5	in2

Slenderness Checks

AISC XIV Chapter I

Pipe Slenderness			λp	λr	Max		
D/t	18.92	<	95	120	195	C	Compression
			57	195	195	C	Flexure

ACI 318-11 Chapter 10

Composite Shape Slenderness					
EcIg	36184968	rcomp	27.5		
EcAg	1522576	K	1.0		
EsIsx	1874528059	L	45		
EsAsx	2188385	KL/r	19.7	22	KL/r Limit
		SLENDERNESS NOT CONSIDERED			

AISC Chapter I

Compression Capacity		
NO SLENDER ELEMENTS		
FyAs	3471	
C2	0.95	
AsrEs/Ec	17.75	
Pno	5852	
ϕPn	4389	k
Tensile Capacity		
Asfy	3471	k
AsrFysr	468	k
Tno	3939	
ϕTn	3545	k
Flexural Capacity		
SLENDERNESS NOT CONSIDERED		
Yielding		
Mp=FyZ	22855	in-k
ϕMn	1714	ft-k

15A

Section Properties

Concrete			Reinforcement			Pipe					
wt	145	pcf	fy	150	ksi	fy	46	ksi	Do	15	in
f'c	8000	psi	Esr	29000	ksi	Es	29000	ksi	t	1.25	in
						wt	490	pcf			
Ag	123	in2	Callout	11					td	1.16	
Ac	123	in2	Ai	1.56	in2	Isx	18763	in4	Di	12.5	in
Ec	5098	ksi	n	0		Zx	217.5	in3	Dd	14.83	
Ig	1198	in4	Asr	0	in2	ρ	0.289	OK	Ast	49.9	in2

Slenderness Checks

AISC XIV Chapter I

Pipe Slenderness			λp	λr	Max		
D/t	12.90	<	95	120	195	C	Compression
			57	195	195	C	Flexure

ACI 318-11 Chapter 10

Composite Shape Slenderness					
EcIg	6109839	rcomp	18.6		
EcAg	625648	K	1.0		
EsIsx	544119416	L	25		
EsAsx	1447008	KL/r	16.1	22	KL/r Limit
		SLENDERNESS NOT CONSIDERED			

AISC Chapter I

Compression Capacity		
NO SLENDER ELEMENTS		
FyAs	2295	
C2	0.95	
AsrEs/Ec	0.00	
Pno	3228	
ϕPn	2421	k
Tensile Capacity		
Asfy	2295	k
AsrFysr	0	k
Tno	2295	
ϕTn	2066	k
Flexural Capacity		
SLENDERNESS NOT CONSIDERED		
Yielding		
Mp=FyZ	10006	in-k
ϕMn	750	ft-k

15B

Section Properties

Concrete			Reinforcement			Pipe					
wt	145	pcf	fy	150	ksi	fy	46	ksi	Do	15	in
f'c	8000	psi	Esr	29000	ksi	Es	29000	ksi	t	1	in
						wt	490	pcf			
Ag	133	in2	Callout	11					td	0.93	
Ac	133	in2	Ai	1.56	in2	Isx	15865	in4	Di	13	in
Ec	5098	ksi	n	0		Zx	180.7	in3	Dd	14.86	
Ig	1402	in4	Asr	0	in2	ρ	0.235	OK	Ast	40.7	in2

Slenderness Checks

AISC XIV Chapter I

Pipe Slenderness		λp	λr	Max		
D/t	16.13 <	95	120	195	C	Compression
		57	195	195	C	Flexure

ACI 318-11 Chapter 10

Composite Shape Slenderness					
EcIg	7147648	rcomp	18.7		
EcAg	676700	K	1.0		
EsIsx	460092980	L	25		
EsAsx	1180272	KL/r	16.0	22	KL/r Limit
		SLENDERNESS NOT CONSIDERED			

AISC Chapter I

Compression Capacity		
NO SLENDER ELEMENTS		
FyAs	1872	
C2	0.95	
AsrEs/Ec	0.00	
Pno	2881	
ϕPn	2161	k

Tensile Capacity		
Asfy	1872	k
AsrFysr	0	k
Tno	1872	
ϕTn	1685	k

Flexural Capacity		
SLENDERNESS NOT CONSIDERED		
Yielding		
Mp=FyZ	8314	in-k
ϕMn	624	ft-k

PROPOSED ADDITIONAL MEMBERS

PG56-1

Material Properties

fy	50	ksi
E	29000	ksi
G	11200	ksi
dens	490	PCF
	0.284	pci

Plate Properties

Lb	20	ft
D	56	in
B	24	in
tf	10	in
tw	2.25	in
hw	36	in
ho	46	in

Section Properties

Single Flange		Web			Total		
A	240	A	81		A	561	in2
x	23	x	0.563		Ixx	128960	in4
Ax	5520	Ax	45.56		rx	15.2	in
Ax2	126960				Zx	11085.6	in3
Ixo	2000						
y	6				Iyy	20160	in4
Ay	1440				ry	6.0	in
Ay2	8640						
Iyo	11520				J	16136.7	
					Weight	1909	PLF

Compression Design

Flange Slenderness				
B/2tf	K'c	Kc	λr	
1.20	1.000	0.76	13.4	NS
Web compactness				
hw/tw	λr			
16	35.9	NS		
SLENDERNESS NOT CONSIDERED				
Limit State 1		Flexural Buckling		
	K	1.0		
	L	240		
	KL/r	15.8	113.4	KL/r Limit
	Fe	1142	ksi	E3-2
	Fcr	49.1	ksi	
Limit State 2		Torsional Buckling		
	Cw	1E+07	in6	
	Fe	1567	ksi	
	Fcr	49.3	ksi	
ϕPn	27541	k		

Flexure Design

Flange Compactness			
B/2tf	λp	λr	
1.20	9.2	24.1	C
Web Compactness			
hw/tw	λp	λr	
16	90.6	137.3	C
SLENDERNESS NOT CONSIDERED			
Limit State 1		Yielding	
	Mp	554278.1	in-k
Limit State 2		LTB	
	Lb	240	in
	Lp	254.1	in
LTB DOES NOT APPLY			
ϕMn	41570.86	ft-k	

Tension Design

Yielding		
ϕTn	25245	k
RUPTURE MUST BE CONSIDERED		

Shear Design

Traverse Stiffeners			
hw/tw	hw/tw Limit		
16	59.2		
NO STIFFENERS REQUIRED			
kv	5		
Cv = 1.0			
	hw/tw Limit		59.2
	Cv		1.0
Vn	3780		
ϕVn	3402	k	

PG56-1 Equivalent Cross Section

Material Properties

fy	50	ksi
E	29000	ksi
G	11200	ksi
dens	490	PCF
	0.284	pci

Plate Properties

Lb	15	ft
D	76	in
B	20	in
tf	8	in
tw	2	in
hw	60	in
ho	68	in

Section Properties

Single Flange		Web		Total		
A	160	A	120	A	440	in2
x	34	x	0.5	Ixx	185813	in4
Ax	5440	Ax	60	rx	20.6	in
Ax2	184960			Zx	10940	in3
Ixo	853.33					
y	5			Iyy	9333.33	in4
Ay	800			ry	4.6	in
Ay2	4000					
Iyo	5333.3			J	6986.67	
				Weight	1497	PLF

Flexure Design

Flange Compactness				
B/2tf		λp	λr	
1.25		9.2	24.1	C
Web Compactness				
hw/tw		λp	λr	
30		90.6	137.3	C
SLENDERNESS NOT CONSIDERED				
Limit State 1		Yielding		
	Mp		547000	in-k
Limit State 2		LTB		
	Lb		180	in
	Lp		195.2	in
LTB DOES NOT APPLY				
ϕMn	41025	ft-k		

Compression Design

Flange Slenderness				
B/2tf	K'c	Kc	λr	
1.25	0.730	0.7303	13.2	NS
Web compactness				
hw/tw	λr			
30	35.9	NS		
SLENDERNESS NOT CONSIDERED				
Limit State 1		Flexural Buckling		
	K	1.0		
	L	180		
	KL/r	8.8	113.4	KL/r Limit
	Fe	3731	ksi	E3-2
	Fcr	49.7	ksi	
Limit State 2		Torsional Buckling		
	Cw	1E+07	in6	
	Fe	889	ksi	
	Fcr	48.8	ksi	
ϕPn	21488	k		

Tension Design

Yielding		
ϕTn	19800	k
RUPTURE MUST BE CONSIDERED		

Shear Design

Traverse Stiffeners			
hw/tw	hw/tw Limit		
30	59.2		
NO STIFFENERS REQUIRED			
kv	5		
Cv = 1.0			
	hw/tw Limit		59.2
	Cv		1.0
Vn	4560		
ϕVn	4104	k	

24R-1

Section Properties

Concrete			Reinforcement			Pipe					
wt	145	pcf	fy	150	ksi	fy	46	ksi	Do	24	in
f'c	15000	psi	Esr	29000	ksi	Es	29000	ksi	t	1.75	in
						wt	490	pcf			
			Callout	11					td	1.63	
Ag	330	in2	Ai	1.56	in2	Isx	111388.7	in4	Di	20.5	in
Ec	6981	ksi	n	16		Zx	798.3	in3	Dd	23.755	
Ig	8669	in4	Asr	24.96	in2	ρ	0.255	OK	Ast	113.1	in2

Slenderness Checks

AISC XIV Chapter I

Pipe Slenderness			λp	λr	Max		
D/t	13.71	<	95	120	195	C	Compression
			57	195	195	C	Flexure

ACI 318-11 Chapter 10

Composite Shape Slenderness					
EcIg	60520963	rcomp	29.4		
EcAg	2304189	K	1.0		
EsIsx	3230271344	L	25		
EsAsx	3280962	KL/r	10.2	22	KL/r Limit
		SLENDERNESS NOT CONSIDERED			

AISC Chapter I

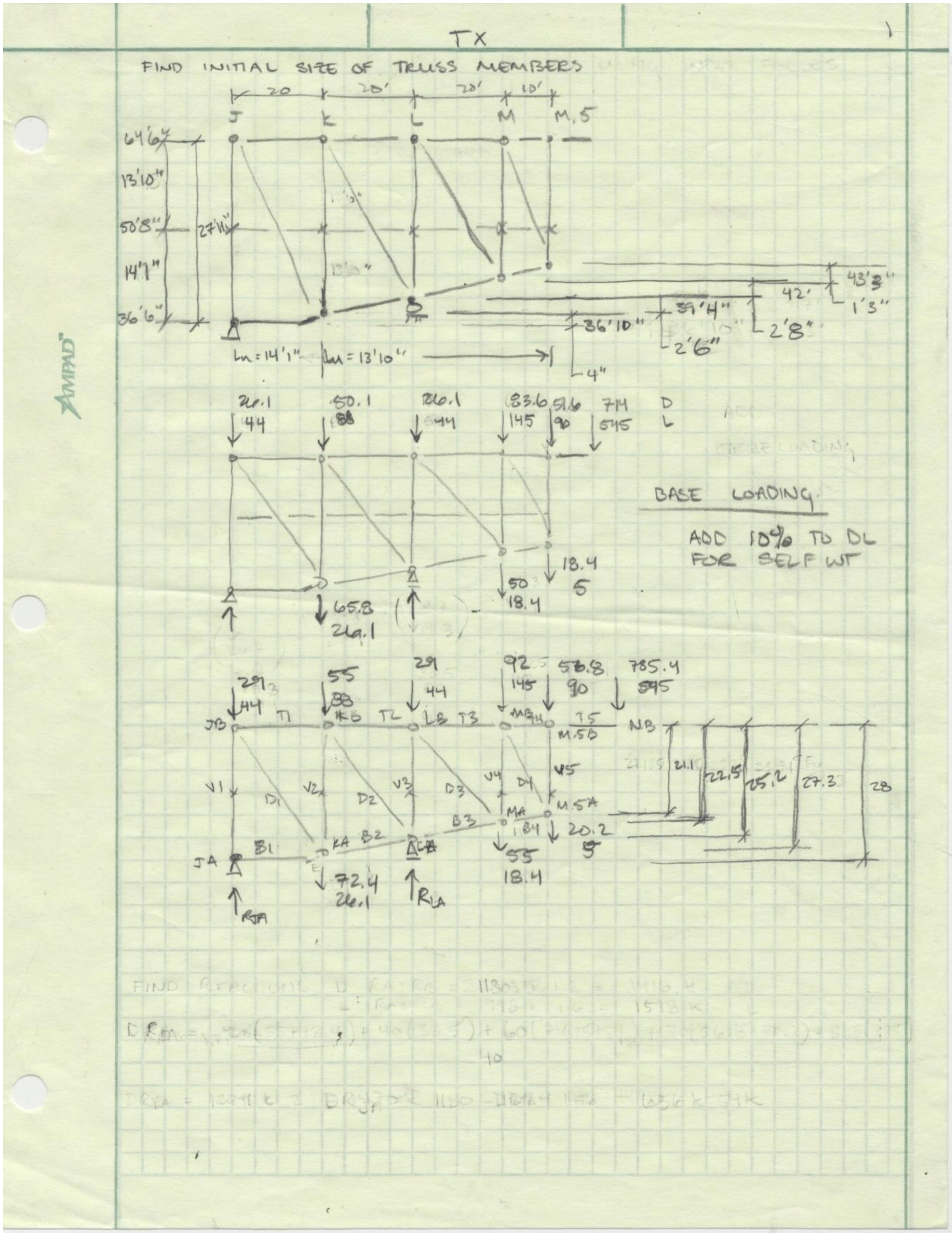
Compression Capacity		
NO SLENDER ELEMENTS		
FyAs	5204	
C2	0.95	
AsrEs/Ec	103.69	
Pno	11030	
ϕPn	8272	k

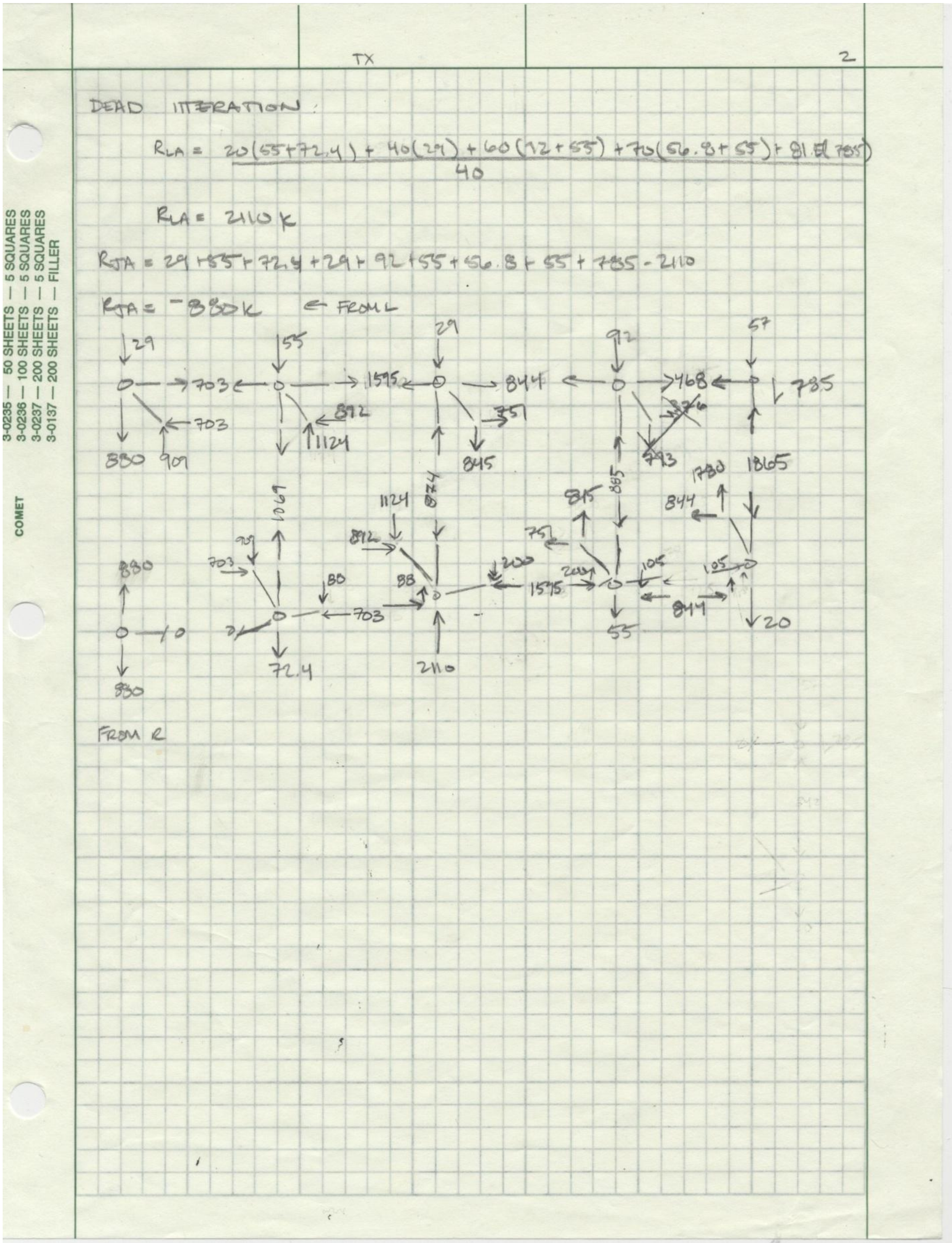
Tensile Capacity		
Asfy	5204	k
AsrFysr	3744	k
Tno	8948	
ϕTn	8053	k

Flexural Capacity		
SLENDERNESS NOT CONSIDERED		
Yielding		
Mp=FyZ	36722	in-k
ϕMn	2754	ft-k

APPENDIX D: ETABS VERIFICATION

HAND CALCULATIONS





TX 2

DEAD ITTERATION:

$$R_{LA} = \frac{20(55+72.4) + 40(29) + 60(92+55) + 70(56.8+55) + 81.5(785)}{40}$$

$R_{LA} = 2110$ k

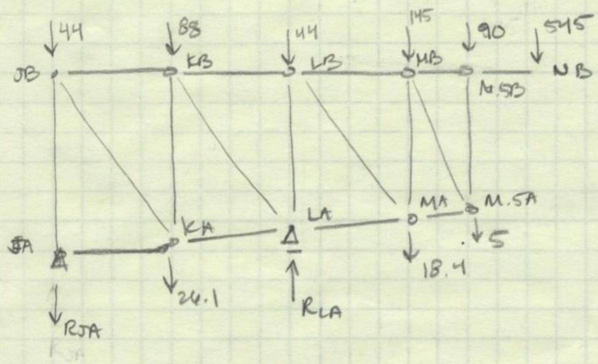
$R_{JA} = 29 + 55 + 72.4 + 29 + 92 + 55 + 56.8 + 55 + 785 - 2110$

$R_{JA} = -880$ k ← FROM L

FROM R

TX 3

LIVE ITERATION



IGNORE PATTERN LOADING FOR TRIAL SIZES.

$\Sigma F_y = 0$

$R_{JA} + 26.1 + 18.4 + 5 + 44 + 88 + 44 + 145 + 90 + 545 = R_{LA}$

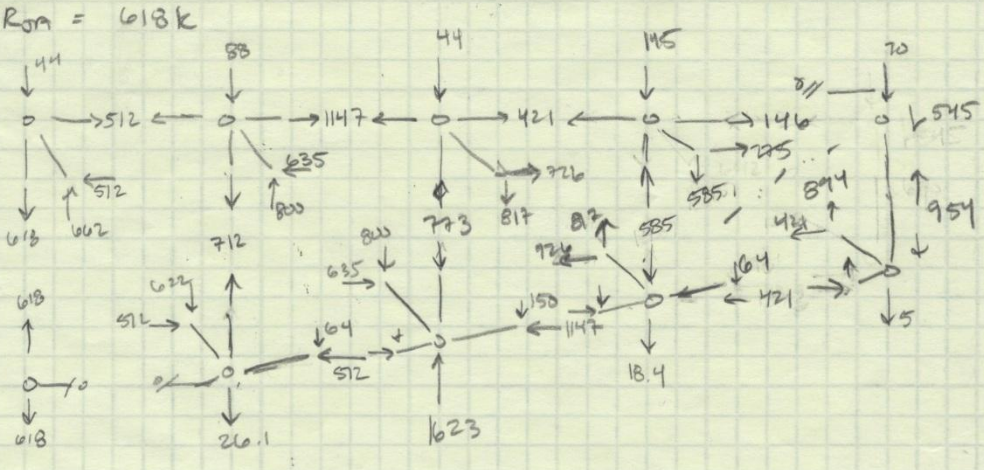
$R_{JA} + 1005 = R_{LA}$

$\Sigma M_{JA} = 0$

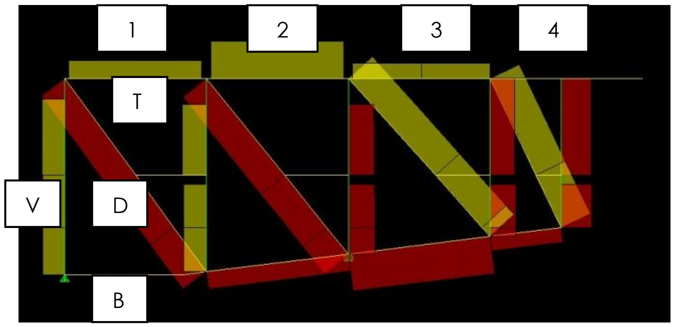
$$R_{LA} = \frac{20(88+26.1) + 40(44) + 60(145+18.4) + 70(95) + 81.5(545)}{40}$$

$R_{LA} = 1623\text{k}$

$R_{JA} = 618\text{k}$



Member Selection Table



		Truss Loads											Trial Member Selection					
		L	Pdx	Pdy	Plx	Ply	Pd	PL	1.2Pd	1.6Pl	Pu	T/C	p max	L	p	Trial Size		φPn
D	1	33.8	703	909	512	662	1149	837	1379	1339	2718	C	0.368	18	0.325	W14x	283	3077
	2	32.2	892	1124	635	800	1435	1021	1722	1634	3356	C	0.298	18	0.266	W14x	342	3759
	3	29.7	751	845	726	817	1130	1093	1357	1749	3105	T	0.322	0	0.271	W14x	342	3690
	4	23.3	844	1780	421	894	1970	988	2364	1581	3945	T	0.253	0	0.204	W14x	455	4902
T	1	20	703		512		703	512	843.6	819.2	1663	T	0.601	0	0.521	W27x	178	1919
	2	20	1595		1147		1595	1147	1914	1835	3749	T	0.267	0	0.172	W27x	539	5814
	3	20	844		421		844	421	1013	673.6	1686	T	0.593	0	0.575	W27x	161	1739
	4	10	468		146		468	146	561.6	233.6	795.2	T	1.258	0	0.575	W27x	161	1739
B	1	20.05	0		0		0	0	0	0	0	C	0.597	22	0.552	W27x	217	1812
	2	20.16	703	88	512	64	708	516	850.2	825.6	1676	C	0.597	22	0.552	W27x	217	1812
	3	20.16	1595	200	1147	150	1607	1157	1929	1851	3780	C	0.265	22	0.205	W27x	539	4878
	4	10.08	844	105	421	64	851	426	1021	681.3	1702	C	0.588	12	0.54	W27x	161	1852
V	1	28	880		618		880	618	1056	988.8	2045	T	0.489	0	0.482	W14x	193	2075
	2	27.3	1069		712		1069	712	1283	1139	2422	T	0.413	0	0.399	W14x	233	2506
	3	25.2	874		773		874	773	1049	1237	2286	C	0.438	14	0.406	W14x	211	2463
	4	22	885		585		885	585	1062	936	1998	C	0.501	14	0.487	W14x	176	2053
	5	21.1	1865		954		1865	954	2238	1526	3764	C	0.266	14	0.247	W14x	342	4049

APPENDIX E: TRUSS DESIGN CALCULATIONS

EXTERIOR WALL ALLOCATION

TRUSS 0.9

Truss 0.9																	
Wt	15	PSF	G		H		I		J		K		L		L.5		
L	Elev.	Ht	W	Wt	W	Wt	W	Wt	W	Wt	W	Wt	W	Wt	W	Wt	
9	151.67	9.1	20	2.73	20	2.73	11.5	1.57									
8	133.5	19.9	20	5.98	20	5.98	20	5.98	17.1	5.11	8.67	2.59					
7	111.83	22.7	20	6.80	20	6.80	20	6.80	20	6.80	20	6.80	14.33	4.87	5	1.70	
6	88.17	23.7	20	7.10	20	7.10	20	7.10	20	7.10	20	7.10	14.33	5.09	5	1.78	
			Loads Applied	22.6	k	22.6	k	21.4	k	19.0	k	16.5	k	10.0	k	3.5	k
L	Elev.	Ht.	KLF														
5	64.5	11.8	0.18														

TRUSS X

Truss X								
AREA		H	I	J	K	L	M	M.5
L	Elev.	20	40	60	80	100	120	130
5	64.5	138.3	138.3	138.3	138.3	138.3	172.9	34.6
4	50.67	283.4	283.4	283.4	283.4	283.4	283.4	283.4
3	36.5	245.0	245.0	219.6	165.2	110.8	56.4	29.2
2	24.25	83.4	29.0					
	Bottom	20.08	22.8	25.52	28.24	30.96	33.68	35.04
LOAD		Wt =	15	PSF				
L	Elev.	H	I	J	K	L	M	M.5
5	24.25	2.1	2.1	2.1	2.1	2.1	2.6	0.5
4	50.67	4.3	4.3	4.3	4.3	4.3	4.3	4.3
3	36.5	3.7	3.7	3.3	2.5	1.7	0.8	0.4
2	24.25	1.3	0.4					

TRUSS 0.9

LEVEL 6 LOADS

Z*-G									
Level	Area	DL	DW	DC	LL	SL	D	L	S
9	520	84	2.73	2	50	22	48.4	26.0	11.4
8	590	121	5.98	2	150	0	79.4	88.5	0.0
7	660	121	6.80	2	100	0	88.7	66.0	0.0
6	390	148	7.10	2	130	4.4	66.8	50.7	1.7
						Total =	283	231	13

G.5									
Level	Area	DL	DW	DC	LL	SL	D	L	S
6	390	152.1	0	0	130	4.4	59.3	50.7	1.7

W*-H									
Level	Area	DL	DW	DC	LL	SL	D	L	S
9	470	84	2.73	2	50	22	44.2	23.5	10.3
8	530	121	5.98	2			72.1	0.0	0.0
7	580	121	6.80	2	100		79.0	58.0	0.0
6	390	156	7.10	2	130	4.4	70.0	50.7	1.7
						Total =	265	132	12

H.5									
Level	Area	DL	DW	DC	LL	SL	D	L	S
6	390	157.8	0	0	140	2.2	61.5	54.6	0.9

W*-I									
Level	Area	DL	DW	DC	LL	SL	D	L	S
9	280	84	1.57	2	50	22	27.1	14.0	6.2
8	500	154	5.98	2	125	0	85.0	62.5	0.0
7	550	121	6.80	2	100	0	75.3	55.0	0.0
6	390	159	7.10	2	150	0	71.3	58.5	0.0
						Total =	259	190	6

I.5									
Level	Area	DL	DW	DC	LL	SL	D	L	S
6	390	162.8	0	0	150	0	63.5	58.5	0.0

W*-J									
Level	Area	DL	DW	DC	LL	SL	D	L	S
8	365	187	5.11	2	100	0	75.4	36.5	0.0
7	530	121	6.80	2	100	0	72.9	53.0	0.0
6	390	166	7.10	2	150	0	73.9	58.5	0.0
						Total =	222	148	0

J.5									
Level	Area	DL	DW	DC	LL	SL	D	L	S
6	390	168	0	0	150	0	65.5	58.5	0.0

W*-K									
Level	Area	DL	DW	DC	LL	SL	D	L	S
8	245	187	2.59	2	100	0	50.4	24.5	0.0
7	520	146	6.80	2	100	0	84.8	52.0	0.0
6	390	170	7.10	2	150	0	75.2	58.5	0.0
						Total =	210	135	0

K.5									
Level	Area	DL	DW	DC	LL	SL	D	L	S
6	390	173	0	0	150	0	67.4	58.5	0.0

W*-L									
Level	Area	DL	DW	DC	LL	SL	D	L	S
7	370	183	4.87	2	100	0	74.6	37.0	0.0
6	364	176	5.09	2	150	0	71.2	54.6	0.0
						Total =	146	92	0

W*-L.5									
Level	Area	DL	DW	DC	LL	SL	D	L	S
7	150	183	1.70	2	100	0	31.1	15.0	0.0
6	372	183	1.78	2	150	0	71.9	55.9	0.0
						Total =	103	71	0

W*-M									
Level	Area	DL	DW	DC	LL	SL	D	L	S
6	411	203	0.00	2	150	0	85.5	61.7	0.0

M.5									
Level	Area	DL	DW	DC	LL	SL	D	L	S
6	390	203	33.00	2	150	0	114.2	58.5	0.0

LEVEL 5 LOADS

Load Information		
Wall Load	0.18	KLF
Dead Load	109	PSF
Live Load	200	PSF
Grid Angle	9	deg
	0.157	rad
Trib Angle	0.079	rad

		X Trib			Y Trib				Load Components					Loads	
Grid	X	Start	End	Dx	Base	Start	End	Dy	At	AD	PW	PC	AL	PD	PL
F	0	0	5	5	0.31	0.31	0.70	0.39	2.5	0.3	3.6	2	0.5	5.8	0.5
F.5	10	5	15	10	1.09	0.70	1.49	0.79	10.9	1.2			2.2	1.2	2.2
G	20	15	25	10	1.88	1.49	2.27	0.79	18.8	2.0	3.6	2	3.8	7.6	3.8
G.5	30	25	35	10	2.67	2.27	3.06	0.79	26.7	2.9			5.3	2.9	5.3
H	40	35	45	10	3.45	3.06	3.85	0.79	34.5	3.8	3.6	2	6.9	9.3	6.9
H.5	50	45	55	10	4.24	3.85	4.63	0.79	42.4	4.6			8.5	4.6	8.5
I	60	55	65	10	5.03	4.63	5.42	0.79	50.3	5.5	3.6	2	10.1	11.0	10.1
I.5	70	65	75	10	5.81	5.42	6.21	0.79	58.1	6.3			11.6	6.3	11.6
J	80	75	85	10	6.60	6.21	7.00	0.79	66.0	7.2	3.6	2	13.2	12.7	13.2
J.5	90	85	95	10	7.39	7.00	7.78	0.79	73.9	8.1			14.8	8.1	14.8
K	100	95	105	10	8.18	7.78	8.57	0.79	81.8	8.9	3.6	2	16.4	14.5	16.4
K.5	110	105	115	10	8.96	8.57	9.36	0.79	89.6	9.8			17.9	9.8	17.9
L	120	115	125	10	9.75	9.36	10.14	0.79	97.5	10.6	3.6	2	19.5	16.2	19.5
L.5	130	125	135	10	10.54	10.14	10.93	0.79	105.4	11.5			21.1	11.5	21.1
M	140	135	145	10	11.32	10.93	11.72	0.79	113.2	12.3	3.8	2	22.6	18.2	22.6
M.5	150	145	155.75	10.8	12.11	11.72	12.56	0.85	130.5	14.2			26.1	14.2	26.1
N.2	162	155.8	161.5	5.75	13.02	12.56	13.02	0.45	73.5	8.0	2.0	2	14.7	12.1	14.7

REACTIONS

Reactions (k)		
Level 6	H	N.2
D	0	340
L	0	244
S	0	0.5
Level 5		
D	1112	404
L	747	295
S	18	0.5

TRUSS N.2

Load Properties			
	Level 6	Level 5	
Trib W	6.5	6.5	ft
DL	203	109	PSF
LL	150	200	PSF
Distributed Loads			
wD	1.3	0.7	klf
wL	1.0	1.3	klf
Point Loads			
Pd	340	404	k
Pl	244	295	k

Reactions		
	N.2	6
D	1340	-350
L	945	-252
S	2	-1

TRUSS X

LOAD SUMMARY

Level		J	J.5	K	K.5	L	L.5	M	M.5	N.2
5	D	2.1	24.0	26.1	24.0	2.1	32.7	50.9	51.6	1340.0
	L		44.0	44.0	44.0		60.0	85.0	90.0	945.0
	S									2.0
4	D	17.5		31.7		22.6		45.9	16.9	
	L	6.8		14.0		10.3		18.4	5.0	
3	D	19.2		34.1		9.1		3.6	1.5	
	L	6.8		12.1		9.0		0.0	0.0	

Load	Reaction (k)	
	J	L
D	-1072	3392
L	-787	2419
S	-2	4
Pu	-2547	7943

AREA TAKEOFF

X-H							
Level	Area	DL	DW	DC	LL	D	L
2	170	20	1.3	0.5	0	5.2	0.0

X-H.5							
Level	Area	DL	DW	DC	LL	D	L
5	220	109	0	0	200	24.0	44.0
4	170	98	0	0	50	16.7	8.5
3	200	118	0	0	50	23.6	10.0
2	80	20	0.0	0.5	0	2.1	0.0

X-I							
Level	Area	DL	DW	DC	LL	D	L
5	220	109	2.1	0	200	26.1	44.0
4	160	98	4.3	2	50	21.9	8.0
3	215	118	3.7	2	50	33.3	10.8
3(2)	160	20	0	0	0	3.2	0.0
2	66	20	0.4	0.5	0	2.3	0.0

X-I.5							
Level	Area	DL	DW	DC	LL	D	L
5	220	109	0	0	200	24.0	44.0
4	150	98	0	0	50	14.7	7.5
3	145	118	0	0	50	17.1	7.3
2	50	20	0	0.5	0	1.5	0.0

X-J.5							
Level	Area	DL	DW	DC	LL	D	L
5	220	109	0	0	200	24.0	44.0
4	120	98	0	0	50	11.8	6.0
3	125	118	0	0	50	14.8	6.3

X-K							
Level	Area	DL	DW	DC	LL	D	L
5	220	109	2.1	0	200	26.1	44.0
4	130	98	4.3	2	50	19.0	6.5
3	135	115	2.5	2	100	20.0	13.5

X-K.5							
Level	Area	DL	DW	DC	LL	D	L
5	220	109	0	0	200	24.0	44.0
4	115	98	0	0	50	13.7	8.9
4(3)	85	112	0	0	150	9.5	12.8
3	120	112	0	0	150	13.4	18.0

X-L.5							
Level	Area	DL	DW	DC	LL	D	L
5	300	109	0	0	200	32.7	60.0
4	235	98	0	0	50	23.0	11.8
3	95	15	0	0	0	1.4	0.0

X-M							
Level	Area	DL	DW	DC	LL	D	L
5	425	109	2.6	2	200	50.9	85.0
4	250	98	4.3	2	50	34.4	12.5
4(3)	350	15	0.0	0	0	5.3	0.0
3	100	15	0.8	0.5	0	2.8	0.0

X-M.5							
Level	Area	DL	DW	DC	LL	D	L
5	450	109	0.5	2	200	51.6	90.0
4	100	98	4.3	2	50	16.9	5.0
4(3)	85	15	0	0	0	1.3	0.0
3	40	15	0.4	0.5	0	1.5	0.0

TRUSS J

Area Takeoff							
Dead Loads				4			0.9
	w	D	wD (klf)	A	PD	PC	PD
5	10	109	1.1	445	48.5	0.0	1072
4	10	98	1.0	445	43.6	2.0	
3	10	118	1.2	445	52.5	2.0	
Live Loads				4			0.9
	w	D	wD (klf)	A	PL	PC	PL
5	10	200	2.0	445	89.0		787
4	10	50	0.5	445	22.3		
3	10	50	0.5	445	22.3		
Level 5					Reactions (k)		
	w	0.9	X	4		3	4
D	1.1	1072	-18.7	48.5	D	-973	429
L	2.0	787	-6.8	89.0	L	-22	179
S			-4		S	-6	2
Level 4							
D	1.0		-361.7	45.6			
L	0.5		283.6	22.3			
Level 3							
D	1.2		-419.7	54.5			
L	0.5		-333.9	22.3			

TRUSS H

Level 5				
	0.9	X	4	w
D	1112	-19	35	2.2
L	747	-7	64	4
S	18			
Level 4				
	0.9	X	4	w
D		780	31	2.0
L		568	19	1
Level 3				
	0.9	X	4	w
D		-640	38	2.36
L		-464	32	1

	Reactions (k)	
Load	3	4
D	2479	-906
L	1661	-572
S	34	-16
Pu	5646	-2008.8
Colun	24R-1	15A

APPENDIX F: FOUNDATION IMPACT

4-H								
Loads In			Exterior			Point Loads		
Pd	-898	k	Area	56	sft	Pd1	70	k
Pl	-572	k	DL	198	PSF	Pl1	58	k
Ps	-16	k	LL	200	PSF	Ps1	0	k
Self	8	k	Interior			Design Loads		
			Area	470	sft	Pd2	-820	k
			DL	126	PSF	Pl2	-514	k
Pu =	-1814	k	LL	100	PSF	Ps2	-16	k

4-J								
Loads In			Exterior			Point Loads		
Pd	429	k	Area	112	sft	Pd1	74	k
Pl	179	k	DL	198	PSF	Pl1	64	k
Ps	2	k	LL	200	PSF	Ps1	0	k
Self	8	k	Interior			Design Loads		
			Area	414	sft	Pd2	511	k
			DL	126	PSF	Pl2	243	k
Pu =	1003	k	LL	100	PSF	Ps2	2	k

6-N.2								
Loads In			Exterior			Point Loads		
Pd	-350	k	Area	250	sft	Pd1	50	k
Pl	-252	k	DL	198	PSF	Pl1	50	k
Ps	-1	k	LL	200	PSF	Ps1	0	k
Self	8	k	Interior			Design Loads		
			Area	0	sft	Pd2	-293	k
			DL	126	PSF	Pl2	-202	k
Pu =	-675	k	LL	100	PSF	Ps2	-1	k

3-H								
Loads In			Exterior			Point Loads		
Pd	2479	k	Area	470	sft	Pd1	100	k
Pl	1661	k	DL	198	PSF	Pl1	100	k
Ps	34	k	LL	200	PSF	Ps1	0	k
Self	8	k	Interior			Design Loads		
			Area	56	sft	Pd2	2587	k
			DL	126	PSF	Pl2	1761	k
Pu =	5938	k	LL	100	PSF	Ps2	34	k

3-J								
Loads In			Exterior			Point Loads		
Pd	-973	k	Area	526	sft	Pd1	104	k
Pl	-179	k	DL	198	PSF	Pl1	105	k
Ps	-6	k	LL	200	PSF	Ps1	0	k
Self	8	k	Interior			Design Loads		
			Area	0	sft	Pd2	-861	k
			DL	126	PSF	Pl2	-74	k
Pu =	-1154	k	LL	100	PSF	Ps2	-6	k

3-L								
Loads In			Exterior			Point Loads		
Pd	3392	k	Area	526	sft	Pd1	104	k
Pl	2419	k	DL	198	PSF	Pl1	105	k
Ps	4	k	LL	200	PSF	Ps1	0	k
Self	20	k	Interior			Design Loads		
			Area	0	sft	Pd2	3516	k
			DL	126	PSF	Pl2	2524	k
Pu =	8260	k	LL	100	PSF	Ps2	4	k

Appendix G: Deflection Calculations

Truss Information								Itemized Deflections (in)			Live Load Deflection				Total Load Deflection			
		Lsimple		Ls	Lcant		Lc				Support		Mid/		Support		Mid/	
I.D.	Condition	ft	in	in	ft	in	in	D	L	T	1	2	End	Max	1	2	End	Max
J	Cantilever	0	0	0	6	4	76	-0.46	-0.03	-0.49	0.00	0.00	0.03	0.03	0	0	0.49	0.49
X	Cantilever	40	6	486	42	1	505	2.12	1.50	3.62	0.03	0.00	1.50	1.53	0.49	0	3.62	4.13
N.2	Cantilever	43	11	527	26	1	313	0.58	0.41	0.99	0.00	1.53	0.41	2.85	0	4.129	0.99	7.57
H	Cantilever	0	0	0	19	6	234	1.13	0.76	1.89	0.00	0.00	0.76	0.76	0	0	1.89	1.89
0.9	Simple	121	6	1458	0	0	0	1.21	0.875	2.09	0.76	2.85	0.88	2.68	1.89	7.572	2.085	6.82
X:0.9	Simple	13	0	156	0	0	0	1.05	0.75	1.80	0.03	1.80	-	1.83	0.49	6.82	-	7.31

Allowable Deflection at Cantilever							
	X	Y	dX	dY	L	L/180	L/120
3-L	2664	222	498	-234	550.2	3.06	4.59
0.9-N.2	3162	-12					

Allowable Deflection for X:0.9							
	X	Y	dX	dY	L	L/360	L/240
3-J	2184	222	0	-234	234	0.65	0.98
0.9-J	2184	-12					

APPENDIX H: COST AND SCHEDULE INFORMATION

RS MEANS CITY DATA

	[illegible]	71.7	
on mountain	97.2	86.4	9
aint Paul	100.4	119.9	10
inneapolis	101.4	122.0	11
uluth	99.7	110.3	10
ochester	100.1	106.1	10
ankato	97.3	103.2	9
ndom	96.0	92.8	9
llmar	95.6	103.9	9
. Cloud	97.2	119.4	10
ainerd	97.1	103.7	10
troit Lakes	99.1	97.9	9
midji	98.4	99.8	9
ef River Falls	98.0	94.5	9
rksdale	96.1	54.9	77
enville	99.9	64.3	84
elo	97.7	57.3	79
enwood	97.3	54.4	78
kson	97.4	63.6	82
idian	96.5	65.3	82
rel	97.5	58.1	80
xi	98.1	59.5	81
comb	96.1	54.0	77
mbus	97.4	56.2	79
Louis	99.9	106.3	102.
ling Green	98.2	94.5	96.
ibal	97.1	91.8	94.
ville	100.3	89.4	95.
River	99.1	95.2	97.
Girardeau	99.5	89.5	95.
ston	97.5	89.9	94.
r Bluff	97.0	89.7	93.
as City	100.7	108.2	104.
oseph	99.9	94.3	97.
cothe	96.6	95.2	96.
sonville	96.2	102.9	99.
	98.6	81.7	91.
son City	96.6	91.7	94.4
bia	97.7	93.2	95.7
ia	96.7	92.4	94.8
	95.1	95.7	95.3
field	98.6	82.8	91.7
s	103.3	77.5	91.9
oint	102.5	75.4	90.6
City	100.3	75.1	89.2
Falls	104.5	76.8	92.3
	101.4	75.0	89.7
	102.7	75.0	90.5
la	103.1	77.5	91.8
ll	100.6	77.0	90.2
	99.3	76.3	89.1
	100.4	79.5	91.2
	98.6	73.0	87.3
us	96.8	70.6	85.3
	98.6	74.0	87.8
sland	98.7	77.8	89.5
s	97.8	78.1	89.1
	97.6	69.6	85.3
latte	98.1	78.3	89.4
e	100.0	66.6	85.3
	100.0	64.8	84.5
as	100.2	109.0	104.1
	98.7	99.3	99.0
	99.0	92.0	95.9
City	98.9	91.8	95.8
	97.6	84.5	91.0

	98.4	92.8	95.9
	96.4	74.6	86.8
	96.0	77.7	88.0
	95.8	70.6	84.7
	94.9	70.7	84.2
	97.3	94.5	96.1
	102.7	124.8	112.4
	100.1	124.8	111.0
	99.0	124.7	110.3
	100.9	124.9	111.5
	98.9	124.9	110.4
	98.4	122.3	108.9
	99.2	124.9	110.5
	99.2	124.8	110.5
	97.1	123.4	108.7
	99.0	122.8	109.5
	97.6	123.3	108.9
	99.5	122.5	109.6
	98.9	121.6	108.9
	99.4	123.9	110.2
	99.1	73.5	87.9
	99.0	73.5	87.8
	99.7	73.5	88.2
	100.4	73.5	88.5
	97.6	73.5	87.0
	97.1	73.5	86.7
es	97.1	70.2	85.2
	96.2	69.4	84.4
	97.7	73.4	87.0
	99.6	73.5	88.1
	99.7	73.5	88.2
	98.4	73.4	87.4
	104.2	167.0	131.9
	100.0	164.8	128.6
	98.3	164.8	127.6
	98.0	133.0	113.4
	98.3	133.0	113.6
	102.9	133.1	116.2
	98.3	133.0	113.6
	98.1	121.5	108.4
	101.1	164.8	129.1
	102.5	164.8	130.0
	103.0	164.8	130.2
	102.4	164.8	129.9
	100.7	164.8	129.0
	101.0	145.4	120.5
	102.6	164.8	130.0
	101.7	145.1	120.9
	97.0	99.8	98.2
	97.6	99.0	98.2
	100.4	118.5	108.4
	99.6	128.6	112.4
	99.0	117.6	107.2
	92.2	94.9	93.4
	96.8	88.6	93.2
	98.7	96.2	97.6
	96.7	93.3	95.2
	98.2	93.1	95.9
	98.2	100.1	99.0
	100.0	104.1	101.8
	97.5	105.5	101.0
	100.1	96.0	98.3
	96.5	87.9	92.7
	96.3	92.7	94.8
	99.0	56.2	80.2
	98.8	57.5	80.6
	99.0	55.1	79.7
	100.3	53.9	79.9
	96.1	53.9	77.5
	97.0	[illegible]	[illegible]

SUPERSTRUCTURE

Truss 0.9

Member Size		Diagonal Li	Diagonal n	Vertical Li	Vertical n	Horizontal Li	Horizontal n	Lin ft	Weight (k)	Weight (t)
W14x	43	31	1	24	5			151	6.5	3.2
	48	31	2					62	3.0	1.5
	53	31	2					62	3.3	1.6
	68	31	1					31	2.1	1.1
	82	31	1					31	2.5	1.3
	90	32	1					32	2.9	1.4
	109	31	2					62	6.8	3.4
	176	32	1					32	5.6	2.8
	193	31	1					31	6.0	3.0
	211			24	1			24	5.1	2.5
W27x	102					41.5	1	41.5	4.2	2.1
	178					41.5	1	41.5	7.4	3.7
	307					20	4	80	24.6	12.3
	336					20	4	80	26.9	13.4
										53.4 tons

Truss 0.9

Member Size		Diagonal Li	Diagonal n	Vertical Li	Vertical n	Horizontal Li	Horizontal n	Lin ft	Weight (k)	Weight (t)
W12x	96	127	1					126.5	12.1	6.1
W14x	61			24	3			72	4.4	2.2
	90			24	1			24	2.2	1.1
	109			24	1			24	2.6	1.3
	120			24	1			24	2.9	1.4
	145			24	1			24	3.5	1.7
	257	31	1					31	8.0	4.0
	233	31	1					31	7.2	3.6
W24x	94					41.5	1	41.5	3.9	2.0
	131					20	2	40	5.2	2.6
	176					20	2	40	7.0	3.5
	192					121.5	1	121.5	23.3	11.7
										41.2 tons

Truss H

Member Size		Diagonal Li	Diagonal n	Vertical Li	Vertical n	Horizontal Li	Horizontal n	Lin ft	Weight (k)	Weight (t)
W14x	132	25	1					25	3.3	1.7
	193	25	1	28	1			53	10.2	5.1
	176	19.5	1					19.5	3.4	1.7
	283			28	1			28	7.9	4.0
	311	37.77	1			33.33	1	71.1	22.1	11.1
	665			28	1			28	18.6	9.3
W18x	311					33.33	1	33.33	10.4	5.2
PG46-2	1291					40.16	1	40.16	51.8	25.9
										63.9 tons

Truss H

Member Size		Diagonal Li	Diagonal n	Vertical Li	Vertical n	Horizontal Li	Horizontal n	Lin ft	Weight (k)	Weight (t)
W14x	68			28	1			28	1.9	1.0
	81			28	1			28	2.3	1.1
	120					21	1	21	2.5	1.3
	132					33.33	2	66.66	8.8	4.4
	145			28	1			28	4.1	2.0
	211	69	1					69	14.6	7.3
	655	18.8	1					18.8	12.3	6.2
PG46-2	1291					19.5	1	19.5	25.2	12.6
										35.8 tons

Truss J

Member Size		Diagonal Li	Diagonal n	Vertical Li	Vertical n	Horizontal Li	Horizontal n	Lin ft	Weight (k)	Weight (t)
W14x	48			28	1			28	1.3	0.7
	68	65	1	28	1	27	3	174	11.8	5.9
	90	15.5	1					15.5	1.4	0.7
	145			28	1			28	4.1	2.0
										9.3 tons

Truss J

Member Size		Diagonal Li	Diagonal n	Vertical Li	Vertical n	Horizontal Li	Horizontal n	Lin ft	Weight (k)	Weight (t)
W14x	90			28	1			28	2.5	1.3
	120			28	1			28	3.4	1.7
	132					27	1	27	3.6	1.8
	176			28	1			28	4.9	2.5
	193	65	1					65	12.5	6.3
	370	15.5	1					15.5	5.7	2.9
W24x	192					27	1	27	5.2	2.6
PG46-2	1291					40.5	1	40.5	52.3	26.1
										45.1 tons

Truss L

Member Size		Diagonal Li	Diagonal n	Vertical Li	Vertical n	Horizontal Li	Horizontal n	Lin ft	Weight (k)	Weight (t)
W14x	257			25	1			25	6.4	3.2
										3.2 tons

Truss L

Member Size		Diagonal Li	Diagonal n	Vertical Li	Vertical n	Horizontal Li	Horizontal n	Lin ft	Weight (k)	Weight (t)
W14x	82			14	1			14	1.1	0.6
	90					21	1	21	1.9	0.9
	211	25	1					25	5.3	2.7
	233			14	1			14	3.3	1.6
PG46-2	1291					40.5	1	40.5	52.3	26.1
										32.0 tons

Truss N.2										
		Diagonal		Vertical		Horizontal				
Member	Size	Li	n	Li	n	Li	n	Lin ft	Weight (k)	Weight (t)
W14x	48			24	2			48	2.3	1.2
	120			24	1			24	2.9	1.4
	159	36	1					36	5.7	2.9
	211	29	1					29	6.1	3.1
	233			24	1			24	5.6	2.8
	257	34	1					34	8.7	4.4
W18x	211					70	1	70	14.8	7.4
W24x	370					70	1	70	25.9	13.0
										36.0 tons

Truss X										
		Diagonal		Vertical		Horizontal				
Member	Size	Li	n	Li	n	Li	n	Lin ft	Weight (k)	Weight (t)
W14x	68			25	2			50	3.4	1.7
	159	33.82	1					33.82	5.4	2.7
	211	34.5	1					34.5	7.3	3.6
	233	34.5	1					34.5	8.0	4.0
	311	32.2	1					32.2	10.0	5.0
	342	54	1					54	18.5	9.2
	398	57	1					57	22.7	11.3
	455	21.25	1					21.25	9.7	4.8
W27x	129					10.2	1	10.2	1.3	0.7
	146					17	1	17	2.5	1.2
	539					20.25	2	40.5	21.8	10.9
PG46-3	748					44.18	1	44.18	33.0	16.5
PG56-1	2369					42	1	42	99.5	49.7
										121.6 tons

Truss N.2										
		Diagonal		Vertical		Horizontal				
Member	Size	Li	n	Li	n	Li	n	Lin ft	Weight (k)	Weight (t)
W38x	201					70	1	70	14.1	7.0
PG46-3	748					70	1	70	52.4	26.2
										26.2 tons

Truss X										
		Diagonal		Vertical		Horizontal				
Member	Size	Li	n	Li	n	Li	n	Lin ft	Weight (k)	Weight (t)
W10x	15					20.25	0.5	10.13	0.2	0.1
W14x	61			28	1			28	1.7	0.9
	90			28	1			28	2.5	1.3
W16x	31					20.25	1	20.25	0.6	0.3
	84					20.25	1	20.25	1.7	0.9
W18x	60					20.25	2	40.5	2.4	1.2
W27x	84					20.25	1	20.25	1.7	0.9
W36x	135					20.25	1.5	30.38	4.1	2.1
W44x	335					20.25	3.5	70.88	23.7	11.9
										19.3 tons

FOUNDATIONS

REINFORCEMENT

DYWIDAG Prestressing Steel Threadbar System

DYWIDAG Prestressing Steel Threadbar is a high tensile alloy steel bar which features a coarse right-hand thread over its full length. The system is proven worldwide and offers versatility in a range of applications.

Manufactured in accordance with the German Certificate of Approval (Deutsches Institut für Bautechnik), the system also offers general conformance with BS 4486 : High Tensile Steel Bars for Prestressing of Concrete. During the steel making process, the threadbars are hot rolled, quenched and tempered, followed by cold working and further tempering, to achieve the necessary performance.

DYWIDAG Prestressing Steel Threadbars, 15mm - 75mmØ are suitable for all static loading applications. Additionally, for post-tensioning and dynamic applications, DYWIDAG Prestressing Steel Threadbars 26.5mm - 40mmØ, see note (c) below, offer a fatigue resistance in excess of 2 million load cycles over a tensile range of 630 - 682N/mm² as specified in the European Technical Approval No. ETA - 05/0123 and ETAG 013. Stress relaxation when loaded to 70% *f*pu is less than 3.5% over a 1000 hour period in accordance with BS4486.

Key features of the system are:
- Fully threaded bar – can be cut and coupled at any point.
- Coarse pitch threadform (d/2), right-hand, with two faces ensuring the thread is self cleaning. Ideal for construction site use.
- Low relaxation steel – minimum relaxation during service life.
- Prestressing grade steel – high strength offers weight savings and reduced working diameters.

Technical Data for Prestressing Steel Threadbar

Nominal Diameter	Steel Grade	Ultimate Strength *f*pu	0.1% (a) Proof Strength	70% (b) Ultimate Strength	50% Ultimate Strength	Cross Sectional Area	Diameter Over Threads	Thread Pitch	Bar Weight
mm	N/mm²	kN	kN	kN	kN	mm²	mm	mm	kg/m
15	900/1100	195	159	136	98	177	17	10	1.44
20	900/1100	345	283	241	173	314	23	10	2.56
26.5	950/1050	579	523	405	290	551	30	13	4.48
32	950/1050	844	764	591	422	804	36	16	6.53
36	950/1050	1069	967	748	535	1018	40	18	8.27
40	950/1050	1320	1194	924	660	1257	45	20	10.21
47	950/1050	1822	1648	1275	911	1735	52	21	14.10
57	835/1035	2671	2155	1870	1335	2581	64	21	20.95
65	835/1035	3447	2771	2413	1724	3318	71	23	27.10
75	835/1035	4572	3645	3200	2286	4418	82	24	35.90

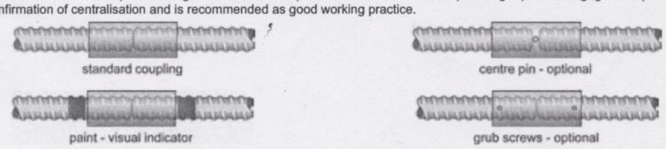
(a) 0.1% Proof Stress also referred to, in general terms, as Yield Strength - *fy*. (b) For geotechnical applications 75% *f*pu may be used for proof testing.
(c) Approval Standards: Ø 26.5 - 47mm (grade 950/1050N/mm²) ETA 05/0123 and ETAG 013. Øs 15 & 20mm (grade 900/1100N/mm²) formtie approvals. Øs 57 - 75mm (grade 855/1035 N/mm²) system approval.

Modulus of Elasticity: E = 205,000 N/mm² +/- 5%.
Stock Lengths: 15mm - 20mmØ bars, 6.0m; 26.5mm - 75mmØ bars, 12.0m. Tolerances +/- 50mm.
All bar diameters can be cut to length to suit customer requirements.

Couplers for Threadbars

Couplers enable prestressing steel threadbars to be coupled or extended, reliably and efficiently. Coupler strength (for bar Øs 26.5 - 47mm) = 1.27 x Yield Strength, which equates to 1.15 x Ultimate Strength, in accordance with German Approval Certificates. Coupler strengths for other prestressing steel bar grades (bar Øs 15 & 20mm, and 57 - 75mm) exceed the published Ultimate Bar Strengths and are covered by separate approvals (see note C, Technical Data).

Precautions should be taken to ensure that the coupler remains centrally located. This can be achieved through the use of grub screws and/or a centre pin. Marking the two bars with paint or similar at half a coupler length prior to engagement provides visual confirmation of centralisation and is recommended as good working practice.



DSI Prestressing Steel Threadbar

DRIVEN PILES

			Type	Do (in)	t (in)	Di	Astl	plf	Embd.(ft)	L	
Depth	68	ft									
fy	80	ksi	1	13.375	0.5	12.375	20.2	68.8	11	79	ft
f'c	5000	psi	2	13.375	0.5	12.375	20.2	68.8	16	84	ft
dstl	490	PCF									
	0.284	pci									

Diameter		Area	
75	mm	4418	mm2
2.95	in	6.848	in2

RS Means p 290					
Dia	Mat'l	Sales	Labor	Equip	O&P
12	32.00	5%	6.80	4.41	15%
13.375	33.72	5%	7.59	4.92	15%
14	34.5	5%	7.95	5.15	15%
Thick Wall Addition					
+	0.93	5%	0	0	15%
Reinforcement					
+	0.83	5%	0.34	0	15%
Final Cost Figures					
Dia	Mat'l	Sales	Labor	Equip	O&P
13.38	154.84	5%	30.99	4.92	15%
Loc	1.042		1.670	1.319	
Time					1.01
			Total	$	238.75

Current	Type	n	Cost
	1	2	37722.01
	2	10	200547.39
	Total	$	238269.40
Proposed	Type	n	Cost
	1	5	94305.02
	2	12	240656.87
	Total	$	334961.90
Difference		$	96692.49