Chapel Hill, NC

# Appendix A: Composite Deck Design

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Chapel Hill, NC

VULCRAFT

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## FLOOR-CEILING ASSEMBLIES WITH COMPOSITE DECK

Restrained Assemblv	Type of	Concrete Thickness &	U.L. Design	Classified D	eck Type	Unrest Bea
Rating	Protection	Type (1)	No. (2,3,4)	Fluted Deck	Cellular Deck (5)	Rat
	Linguisticated Deals	0.1/2" []]M	D914 #	1.5VL,1.5VLI,2VLI,3VLI	1.5VLP, 2VLP, 3VLP	
3/4 Hr.	Unprotected Deck	2 72 LVV	D916 #	1.5VL,1.5VLI,2VLI,3VLI	1.5VLP, 2VLP, 3VLP	1,1.5
	Exposed Grid	2 1/2" NW	D216 +	1.5VL,1.5VLI,2VLI,3VLI	2VLP, 3VLP	
		2" NW&LW	D743 *	2VLI,3VLI	2VLP, 3VLP	1,1.5
			D703 *	1.5VLI,2VLI,3VLI	1.5VLP, 2VLP, 3VLP	
	Cementitious	2 1/0" NIM/8J M/	D712 *	3VLI	3VLP	
		2 72 INVOLVV	D722 *	2VLI,3VLI	2VLP, 3VLP	1,1
			D739 *	1.5VLI,2VLI,3VLI	1.5VLP, 2VLP, 3VLP	1,1.5,2
		AN 1 11/01/11/	D759	1.5VL,1.5VLI,2VLI,3VLI	1.5VLP, 2VLP, 3VLP	1,1.5
	·	2" NW&LW	D859 *	2VLI,3VLI		1,1.5
	Spraved Fiber		D832 *	1.5VLI,2VLI,3VLI	1.5VLP, 2VLP, 3VLP 2V/I P	1,1.0
4 1.4%	oprayour isor	2 1/2" NW&LW	D847	2/1,3/1	2\/I D 3\/I D	114
T Hr.			D050	2/13/11	2VLP 3VLP	111
			D902 #	15VL15VL12VL13VL1	1 5VLP 2VLP 3VLP	
			D914 #	15VL 15VL 2VL 3VL	1.5VLP. 2VLP. 3VLP	
		2 1/2" LW	D916 #	1.5VL.1.5VLI.2VLI.3VLI	1.5VLP. 2VLP. 3VLP	1,1.5
			D918 #	1.5VL,1.5VLI,2VLI,3VLI	1.5VLP, 2VLP, 3VLP	
	Unprotected Deck		D919 #	1.5VL,1.5VLI,2VLI,3VLI	1.5VLP, 2VLP, 3VLP	
			D902 #	1.5VL,1.5VLI,2VLI,3VLI	1.5VLP, 2VLP, 3VLP	-
		0	D916 #	1.5VL,1.5VLI,2VLI,3VLI	1.5VLP, 2VLP, 3VLP	1,1.
		3 1/2" INW	D918 #	1.5VL,1.5VLI,2VLI,3VLI	1.5VLP, 2VLP, 3VLP	
			D919 #	1.5VL,1.5VLI,2VLI,3VLI	1.5VLP, 2VLP, 3VLP	
	Gypsum Board	2 1/2" NW	D502 *	1.5VL,1.5VLI,2VLI,3VLI	2VLP, 3VLP	
		2" NW&LW	D743 *	2VLI,3VLI	2VLP, 3VLP	1,1.
			D703 *	1.5VLI,2VLI,3VLI	1.5VLP, 2VLP, 3VLP	
	Cementitious		D712*	3VLI	<u>3VLP</u>	
		2 1/2" NW&LW	D722 *	2VLI,3VLI	2VLP, 3VLP	1.15
			D739 *	1.5VLI,2VLI,3VLI	1.5VLP, 2VLP, 3VLP	1,1.5,
			D/59	1.5VL, 1.5VLI, 2VLI, 3VLI	1.5VLF, 2VLF, 3VLF	1,1,
	Sprayed Fiber	2 INVV&LVV	0859	1 5//1 2//1 3//1	3VI P	11
11/2 Hr			D847 *	2/1.3/11	3VLP	1
172111.		2 1/2" NW&LW	D858 *	2/13/11	2VI P 3VI P	1.1.
			D871 *	2VLI.3VLI	2VLP. 3VLP	1.1.
			D902 #	1.5VL,1.5VLI,2VLI,3VLI	1.5VLP, 2VLP, 3VLP	
		3" LW	D916 #	1.5VL,1.5VLI,2VLI,3VLI	1.5VLP, 2VLP, 3VLP	1,1.
	Unnyatastad Dask		D919 #	1.5VL,1.5VLI,2VLI,3VLI	1.5VLP, 2VLP, 3VLP	
	Unprotected Deck		D902 #	1.5VL,1.5VLI,2VLI,3VLI	1.5VLP, 2VLP, 3VLP	
		4" NIM	D916 #	1,5VL,1.5VLI,2VLI,3VLI	1.5VLP, 2VLP, 3VLP	1,1.
		4 1AAA	D918 #	1.5VL,1.5VLI,2VLI,3VLI	1.5VLP, 2VLP, 3VLP	
			D919 #	1.5VL,1.5VLI,2VLI,3VLI	1.5VLP, 2VLP, 3VLP	
	Exposed Grid	2 1/2" NW	D216 +	1.5VL,1.5VLI,2VLI,3VLI	2VLP, 3VLP	
	Gypsum Board	2 72 NW	D502 +	1.5VL,1.5VLI,2VLI,3VLI	2VLP, 3VLP	
		2" NW&LW	D743 *	2VLI,3VLI	2VLP, 3VLP	1.1.
		2 1/2" LW	D750 *	1 5//11 0//11 0//11	1 5\/I P 2\/I P 2\/I P	1.
			D702 *	1.5/1.2/1.3/1	1 5VI P 2VI P 3VI P	·····
			D712 *	3\/11	3VI P	
			D716 *	1.5VI 2VI 3VI	2VLP. 3VLP	
0.11-			D722 *	2VI1.3VI1	2VLP. 3VLP	1.
2 mr.	Cementitious	2 1/2" NW&LW	D739 *	1.5VLL2VLL3VLL	1.5VLP. 2VLP. 3VLP	1,1.5
			D745 *	2VLI.3VL		1.1
			D750 *	1.5VLI.2VLI.3VLI		
			D755	1.5VLI,2VLI,3VLI	1.5VLP, 2VLP, 3VLP	1,1.
			D759	1.5VL,1.5VLI,2VLI,3VLI	1.5VLP, 2VLP, 3VLP	1,1.
			D760 *	2VLI,3VLI		1,1.5,
		0.//- 1.1.4/	D730 *	2VLI,3VLI	2VLP, 3VLP	
		2 1/2" NW	D742 *	1.5//1.2//1.3//11		
	<u> </u>		0/42	1.0 4		

Chapel Hill, NC

Final Report

VULCRAFT



#### **SLAB INFORMATION**

Total Slab	Theo, Conc	rete Volume	Recommended
Depth, in.	Yd <sup>3</sup> / 100 ft <sup>2</sup>	ft <sup>3</sup> / ft <sup>2</sup>	Welded Wire Fabric
4	0.93	0.250	6x6 - W1.4xW1.4
4 1/2	1.08	0.292	6x6 - W1.4xW1.4
5	1.23	0.333	6x6 - W1.4xW1.4
5 1/4	1.31	0.354	6x6 - W1.4xW1.4
5 1/2	1.39	0.375	6x6 - W2.1xW2.1
6	1.54	0.417	6x6 - W2.1xW2.1
6 1/4	1.62	0.438	6x6 - W2.1xW2.1
6 1/2	1.70	0.458	6x6 - W2.1xW2.1

#### (N=14.15) LIGHTWEIGHT CONCRETE (110 PCF)

TOTAL		SDI	Max. Unsho	ored	Superimposed Live Load, PSF														
DEPTH	TYPE	1 SPAN	2 SPAN	3 SPAN	6'-0	6'-6	7'-0	7'-6	8'-0	8'-6	9'-0	9'-6	<u>(In.)</u> 10'-0	10'-6	11'-0	11'-6	12'-0	12'-6	13'-0
	2VLI22	8'-1	10'-3	10'-7	238	209	186	167	152	120	108	98	90	82	75	69	64	59	55
4.00	2VL120	9'-6	11'-8	12'-1	268	235	209	187	169	153	140	129	101	92	84	78	72	66	61
(t=2.00)	2VLI19	10'-10	13'-0	13'-2	297	260	230	206	185	168	153	141	130	121	93	86	79	73	68
30 PSF	2VLI18	11'-7	13'-7	13'-7	324	285	253	227	205	187	171	158	146	136	127	119	92	86	80
	2VLI16	12'-3	14'-3	14'-4	377	330	292	261	235	214	195	179	165	153	143	133	118	98	91
	2VL122	7'-8	9'-10	10'-2	276	243	216	194	155	139	126	114	104	96	88	81	75	69	64
4.50	2VLI20	9'-0	11'-3	11'-7	312	273	243	217	196	178	163	128	117	107	.98	90		77	72
(t=2.50)	2VLI19	10'-3	12'-5	12'-9	346	302	268	239	215	195	178	164	151	118	108	100	92	85	79
35 PSF	2VLI18	11'-2	13'-1	13'-1	376	331	294	264	238	217	199	183	170	158	147	116	107	100	93
	2VLI16	11'-7	13'-8	13'-10	400	384	340	303	273	248	227	208	192	178	166	155	123	114	106
	2VLI22	7'-4	9'-5	9'-9	315	277	247	197	176	159	143	130	119	109	100	92	85	79	73
5.00	2VLI20	8'-7	10'-9	11'-2	355	312	276	248	224	203	161	146	133	122	112	103	95	88	82
(t=3.00)	2VLI19	9'-9	11'-11	12'-4	394	345	305	272	245	223	203	187	147	135	124	114	105	97	90
39 PSF	2VLI18	10'-9	12'-9	12'-9	400	377	335	300	272	247	227	209	193	180	143	132	122	114	106
	2VLI16	11'-0	13'-1	13'-5	400	400	387	346	311	283	258	237	219	203	189	151	140	130	121
	2VLI22	7'-2	9'-3	9'-7	334	294	262	209	187	168	152	138	126	116	106	98	90	84	78
5.25	2VL120	8'-5	10'-7	10'-11	377	331	293	263	237	190	171	155	142	130	119	110	101	94	87
(t=3.25)	2VLI19	9'-6	11'-8	12'-1	400	366	324	289	260	236	216	198	156	143	131	121	111	103	95
42 PSF	2VLI18	10'-6	12'-7	12'-7	400	400	355	319	288	263	241	222	205	191	151	140	130	121	113
	2VLI16	10'-9	12'-10	13'-3	400	400	400	367	330	300	274	252	232	215	173	160	148	138	128
	2VL122	7'-0	9'-1	9'-5	353	311	277	222	198	178	161	147	134	122	113	104	96	89	82
5.50	2VL120	8'-3	10'-4	10'-9	399	350	310	278	251	201	181	165	150	137	126	116	107	99	92
(t=3.50)	2VLI19	9'-4	11'-6	11'-10	400	387	342	306	275	250	228	182	165	151	139	128	118	109	101
44 PSF	2VLI18	10'-3	12'-5	12'-5	400	400	376	337	305	278	254	234	217	174	160	148	138	128	119
	2VLI16	10'-6	12'-7	13'-0	400	400	400	388	350	317	290	266	246	228	184	170	157	146	136
	2VL122	6'-8	8'-7	8'-11	400	362	291	258	231	208	188	171	156	143	131	121	112	103	96
6.25	21/1120	7' 0	9,10	10'-2	400	400	361	323	260	234	211	192	175	160	147	135	125	115	107
(t=4.25)	2VLI19	8'-9	10'-11	11'-3	400	400	398	356	320	291	233	212	193	176	162	149	137	127	118
51 PSF	2VLI18	9'-8	11'-10	11'-11	400	400	400	392	355	323	296	273	220	202	187	173	160	149	139
	2VLI16	9'-11	12'-0	12'-5	400	400	400	400	400	369	337	310	253	232	214	198	183	170	158

COMPOSITE

 Minimum exterior bearing length required is 2.00 inches. Minimum interior bearing length required is 4.00 inches. If these minimum lengths are not provided, web crippling must be checked. Notes:

2. Always contact Vulcraft when using loads in excess of 200 psf. Such loads often result from concentrated, dynamic,

or long term load cases for which reductions due to bond breakage, concrete creep, etc. should be evaluated. 3. All fire rated assemblies are subject to an upper live load limit of 250 psf.

TILL CALLER

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# **Appendix B: Wind Calculations**

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Table 2a - Wind	Variab	les	ASCE 7-05 References
Basic Wind Speed	V	95 mph	(Fig. 6-1)
Directionality Factor	k <sub>d</sub>	0.85	(Table 6-4)
Importance Factor	Ι	1.15	(Table 6-1)
Exposure Category		В	(Sec. 6.5.6.3)
Topographic Factor	K <sub>zt</sub>	1	(Sec. 6.5.7.1)
Velocity Pressure Exposure Coefficient evaluated at Height z	Kz	Varies	(Table 6-3)
Velocity Pressure at Height z	qz	Varies	(Eq. 6-15)
Velocity Pressure at Mean Roof Height (North/South)	$q_{\rm h}$	25.29 psf	(Eq. 6-15)
Velocity Pressure at Mean Roof Height (East/West)	q <sub>h</sub>	24.62 psf	(Eq. 6-15)
Equivalent Height of Struture	>	94.6'	(Table 6-2)
Intensity of Turbulence	I,	0.252	(Eq. 6-5)
Integral Length Scale of Turbulence	L,	454.6'	(Eq. 6-7)
Background Response Factor (East/West)	Q	0.794	(Eq. 6-6)
Background Response Factor (North/South)	Q	0.786	(Eq. 6-6)
Gust Effect Factor (East/West)	G	0.878	(Eq. 6-4)
Gust Effect Factor (North/South)	G	0.873	(Eq. 6-4)
External Pressure Coefficient	C	0.8	(Fig. 6-6)
(Windward)	Ср	0.0	(1 15. 0 0)
External Pressure Coefficient (E/W	Cp	-0.47	(Fig. 6-6)
External Pressure Coefficient (N/S Leeward)	Cp	-0.5	(Fig. 6-6)

			Tal	ble 2c-	Wind Lo	ads (Ea	ıst/Wes	t) B=247	'-3'' L=2	282'-4''			
Floor	Height Above Ground- z (ft)	Story Height (ft)	Kz	qz	Wind Press Windward	sure (psf) Leeward	Total Pressure (psf)	Force (k) of Windward only	Force (k) of Total Pressure	Story Shear Windward (k)	Story Shear Total (k)	Factored Story Force (k)	Factored Story Shear (k)
Roof	144	13.33	1.10	24.84	21.90	-14.59	36.49	46.52	77.50	46.52	77.50	124.01	124.01
Mech													
Mez.	130.66	18.66	1.06	23.94	21.27	-14.59	35.86	63.37	106.84	109.89	184.34	170.94	294.95
8	112	16	1.02	23.04	20.64	-14.59	35.23	81.65	139.37	191.54	323.71	222.99	517.94
7	96	16	0.98	22.13	20.01	-14.59	34.60	79.16	136.87	270.70	460.59	219.00	736.94
6	80	16	0.93	21.00	19.22	-14.59	33.81	76.04	133.76	346.74	594.34	214.01	950.95
5	64	16	0.87	19.65	18.27	-14.59	32.86	72.29	130.01	419.03	724.36	208.02	1158.97
4	48	16	0.80	18.07	17.17	-14.59	31.76	67.93	125.64	486.95	850.00	201.03	1360.00
3	32	16	0.71	16.03	15.75	-14.59	30.34	62.31	120.03	549.26	970.03	192.04	1552.04
2	16	16	0.58	13.10	13.70	-14.59	28.29	54.20	111.92	603.46	1081.94	179.07	1731.11
1	0	0	0.00	0.00	0.00	0	0.00	0.00	0.00	603.46	1081.94	0.00	1731.11
∑Story (Windy	v Shear ward) =	603.46	k		∑Story (Tota	Shear al) =	1081.94	k		Factored Force	l Story e =	1731.11	

	Table 2b-Wind Loads (North/South) B=282'-4'' L-247'-3''												
Floor	Height Above Ground-	Story Height	Kz	qz	Wind Pres	sure (psf)	Total Pressure	Force (k) of Windward	Force (k) of Total	Story Shear Windward	Story Shear Total	Factored Story	Factored Story
	z (ft)	(11)			Windward	Leeward	(psi)	only	Tiessuie	(k)	(k)		
Roof	162	14.33	1.13	25.52	22.38	-15.59	37.97	73.00	123.86	73.00	123.86	198.17	198.17
Mech													
Mez.	148.66	18.66	1.11	25.07	22.06	-15.59	37.65	98.11	167.44	171.10	291.30	267.90	466.07
8	130	16	1.07	24.17	21.43	-15.59	37.02	96.80	167.22	267.90	458.52	267.56	733.63
7	114	16	1.03	23.26	20.80	-15.59	36.39	93.95	164.37	361.85	622.90	263.00	996.63
6	98	16	0.98	22.13	20.01	-15.59	35.60	90.39	160.81	452.24	783.71	257.30	1253.93
5	82	16	0.94	21.23	19.38	-15.59	34.97	87.54	157.96	539.78	941.67	252.74	1506.67
4	66	16	0.87	19.65	18.27	-15.59	33.86	82.55	152.97	622.33	1094.65	244.76	1751.43
3	50	16	0.81	18.29	17.33	-15.59	32.92	78.28	148.70	700.60	1243.35	237.92	1989.35
2	34	16	0.72	16.26	15.91	-15.59	31.50	71.86	142.29	772.47	1385.63	227.66	2217.01
1	18	18	0.6	13.55	14.02	-15.59	29.61	71.23	150.45	843.69	1536.09	240.73	2457.73
B1	0	0	0	0.00	0.00	0	0.00	0.00	0.00	843.69	1536.09	0.00	2457.73
∑Story	Shear				∑Story	Shear				Factored	Story		
(Windy	ward) =	843.69	k		(Tota	l) =	1536.09	k		Force	e =	2259.56	

## UNC- IRB





#### Chapel Hill, NC

UNC- IRB







Wind Certevlentions Cont Pressure Coefficient Cp (Fig. 6-6) NIS: Windword: Cp= 0.8 heard - 4/B = 247.25/282.33 = 0.876 Cp = +0.5 Elw: Windward: Cp= 0.8 Leenard - 4/B: 282.33/247.25 + 1.14 Cp = -0.47 Pressure Pz = 2z Gr Cp - qh (GCpi) (Lundword) Pn = qh Gr Cp - qh (GCpi) (Leeward) W/ GCpi = + 0.18, - 0.18 For enclosed bildges (Fig 6-5) N/S! hunduard Pz= (qz) (0.873) (6.8) - 25.29 (-0.18) Pz = (qz)(0.6987) + 4.552 Leeverd Ph= (25.29) (0.873) (-0.5) - 4.552 = -15.59 psf Elwi Windwerd PZ= (92)(0.878)(0.8)-24.62(-0.18) Pz = (qz)(0.7024) + 4.43 ( Leeword Ph = (24.62) (0.878) (-0.47) - 743 - -14.59 PSF ME-02





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# **Appendix C: Seismic Calculations**

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Table 2. Gairmin D	7 1 - 1	ASCE 7-05	
Table 3a - Seismic De	esign v	ariables	References
Site Class		С	(Table 20.3-1)
Occupancy		III	(Table 1-1)
Importance Factor		1.25	(Table 11.5-1)
Structural System		Building Frame Sytem: Ordinary Reinforced Concrete Shear Wall	(Table 12.2-1)
Spectral Response Acceleration, short	Ss	0.209 g	(USGS)
Spectral Response Acceleration, 1 s	$\mathbf{S}_1$	0.081g	(USGS)
Site Coefficient	Fa	1.2	(Table 11.4-1)
Site Coefficient	$F_{v}$	1.7	(Table 11.4-2)
MCE Spectral Response Acceleration, short	$S_{MS}$	0.251	(Eq. 11.4-1)
MCE Spectral Response Acceleration, 1 s	$S_{M1}$	0.092	(Eq.11.4-2)
Design Spectral Acceleration, short	$S_{DS}$	0.167	(Eq. 11.4-3)
Design Spectral Acceleration, 1s	S <sub>D1</sub>	0.092	(Eq. 11.4-4
Seismic Design Category	SDC	В	(Eq. 11.6-2)
Response Modification Coefficient	R	5	(Table 12.2-1)
Approximate Period Parameter	Ct	0.02	(Table 12.8-2)
Building Height (above grade)	h <sub>n</sub>	162	
Approximate Period Parameter	х	0.75	(Table 12.8-2)
Calculated Period Upper Limit Coefficient	Cu	1.7	(Table 12.8-1)
Approximate Fundamental Period	T <sub>a</sub>	0.92 s	(Eq. 12.8-7)
Fundamental Period Max	T <sub>max</sub>	1.56	(Sec. 12.8.2)
Long Period Transition Period	$T_L$	8 g	(Fig. 22-15)
Seismic Response Coefficient	Cs	0.025	(Eq. 12.8-2)
Structural Period Exponent	k	1.21	(Sec. 12.8.3)

	Table	3b - Total R	edesign Buildi	ng Weight	for Seismic	
Floor	Area (sf)	Composite Deck (3 psf)	NonComposite Deck (5psf)	Slab LWC (115 pcf)	Superimposed DL (Partion's,finishes, MEP) (25psf)	Total Weight (k)
Penthouse Roof	13473.70	0.00	67.37	336.84	336.84	741.05
Lower Penthouse	22224.10	0.00	111.12	2555.77	555.60	3222.49
PH/Roof	34824.70	104.47	0.00	4004.84	870.62	4979.93
7.00	34824.70	104.47	0.00	4004.84	870.62	4979.93
6.00	34824.70	104.47	0.00	4004.84	870.62	4979.93
5.00	34824.70	104.47	0.00	4004.84	870.62	4979.93
4.00	34824.70	104.47	0.00	4004.84	870.62	4979.93
3.00	34824.70	104.47	0.00	4004.84	870.62	4979.93
2.00	34824.70	104.47	0.00	4004.84	870.62	4979.93
1.00	33226.20	99.68	0.00	3821.01	830.66	4751.35
					Total (Non-Structural Steel)=	43574.42
					Structural Steel =	3242.43
					Exterior Walls =	2884.49
					Total Weight =	49701.33

	Table 3c- Seismic Loads								
	Story					Lateral	Story		
	Weight W <sub>x</sub>	Height h <sub>x</sub>				Force F <sub>x</sub>	Shear V <sub>x</sub>		
Level	(k)	(ft)	$h_x^k$	$w_x h_x^{\ k}$	$C_{vx}$	(k)	(k)		
Roof	876.45	162	471.53	413276.12	0.04	42.99	0.00		
Mech									
Mez.	3452.93	148.66	424.97	1467380.25	0.15	152.65	42.99		
8.00	5341.01	130	361.30	1929722.44	0.19	200.75	195.64		
7.00	5341.01	114	308.22	1646183.56	0.17	171.25	396.39		
6.00	5341.01	98	256.67	1370903.68	0.14	142.61	567.65		
5.00	5341.01	82	206.88	1104938.62	0.11	114.95	710.26		
4.00	5341.01	66	159.09	849711.61	0.09	88.40	825.21		
3.00	5341.01	50	113.70	607263.39	0.06	63.17	913.60		
2.00	5341.01	34	71.30	380813.98	0.04	39.62	976.78		
1.00	5095.87	18	33.03	168305.41	0.02	17.51	1016.39		

e.	
· · ·	Seismic Culculations (Steel Redesign)
	Sc= 0.209 y S,= 0.081 y (USGS. gov)
	Fa: 1.2 Fv: 1.7 Site Class C
	Sms = Fass = 1.2 (0.209) = 0.251 Is = 1.25
	Sm, = Fv S, = 1.7 (0.081) = 0.138 Occ (at III
(IPAD)	SDS = 2/3 Sms = 2/3 (0.251) = 0.1676
(Star)	SDI= 2/3 Smi= 2/3 (0.138) = 0.0920
	Seismic Design Category (SDC) = B
	-> Determine Structure Fundamental Period, T
	To: SDI/SN = 0.92/0.167 = 0.551
	$T_L = 8q$
$\tilde{c} \rightarrow$	Ta = (+h," = 0.02 (162)"73 = 0.92 S
	La SCBFIS
	T = Ta = 0.92 K Trax = Cu Ta = 1.7 (0.92) = 1.56 s
	T= 0.92 < 3.5 Ts = 3.5 (0.551)= 1.13
	From Tech 1 - Type 2 Horizontal Irregularities
	ASCE 7-05 Requires modal Response Spectrum Analysis or Seismic response history procedure
	(se min [ SDS/(R/3) = 0.167/(6/125) = 0.0348
	R=6 SDi/T(R/s) = 0.092/0.92 (4.25) = 0.0208 > 0.01
	$\frac{S_{0,1}T_{1}}{T^{2}(R_{1})} = \frac{S_{1}S_{1}}{S_{1}} \frac{S_{1}S_{2}}{S_{1}} \frac{S_{1}S_{1}}{S_{1}} \frac{S_{1}S_{2}}{S_{1}} \frac{S_{1}S_{1}}{S_{1}} \frac{S_{1}S_{2}}{S_{1}} \frac{S_{1}S_{1}}{S_{1}} \frac{S_{1}S_{2}}{S_{1}} \frac{S_{1}S_{2}}{S_{$
	V = CoW = 0.0208 (49,705.68) = 1033.9"



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# **Appendix D: Gravity Beams & Girders Calculations**

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- C 7	
ige A	$Deflection: \Delta \mu \leq \frac{21.33(12)}{360}, 0.71'' = \frac{(5)(0.722)(21.22)^{1}}{384}(29,000)(100)}{384}(29,000)(100)$ $\implies I(eq = 159.97 m^{4})$
AMPAD	$\Delta_{T} \leq \frac{21.33(12)}{240} = 1.07'' = \frac{(5)(1.29)(21.22)^{4}1728}{387(29,000)(Irea)}$ => Irea = 189.27 in <sup>4</sup> < controls
ع) ا	$\Delta_{PC} \leq \frac{21.33(12)}{360} = 0.71'' = \frac{(5)(0.385)(21.22)^{7}}{387(21,000)(31.02)}$ $\Rightarrow \text{ Iread : 85.27.17''}$
	Size Composite For $Y_2 = 6 - \frac{G}{2} = 5.5$ Qn: 17.2 (2"deut accome a:1
	$\frac{Mem}{Min} = \frac{J \times (2m)}{2} = \frac{2(2m)}{2} = \frac{1}{2}$ $W 14x 22  199  (189)  81.2  (5) \iff Jx > Jrea$ $W 12x 26  204  208  95.6  (6)$
	W14x26 245 227 96.1 (6) W14x22 w/ 10 studs * Member Selection is Consistent w/ RAM

e i	
. <del>9</del>	Girder Design
· ( ·	Tr.b Area : (21.33)(21.66) = 462 SF
	Influence Area = ZAT = 924 SF
đ	4: Lo ( 6.15 + 15 ) = Lo (0.74) =74: 74 por
aMPAD	P. P. J
(er	$\Delta$ 3eq opens = 7.22'
	PU = Dend = (53.3 + 25) (21.33)(7.22) - 12.14
	Live = (74)(21.33)(7.22) = 11.4 K
	Arenyth 1.2 D + 1.6 L = 32.76 " = PU
C ·	MU= (32,76)(7.22) = 236.5 "
2	Declection
	$14 \frac{2}{360} = 0.722"$
	$\Delta_{max} = \frac{\beta \ell^3}{788J} \implies 0.722 = 11.4 (21.66)^3 (1728) \\ = \frac{11.4}{78} (29.000) (Jrea)$
	Iread => 341.6 mm
	$\Delta_{T} \leq (21.66)(12) = 1.08"$
	Amux = Pl <sup>3</sup> = 1.03 = 23.5 (21.66) <sup>2</sup> (1728) 28 EI = 28 (29,000) (Irea)
C ,	Iread => 470. 6" & Controls

Pie Compusite IL = (53.3 pst) (7.22) (21.33) = 8.24=P Ape 4 (21.6)(12): 0.722" Amm = 0.722 : (8.2)(21.66)<sup>3</sup>(1728) 28(29,000)(Jrea) = Iread - 245.6 in" (EAMPAD Member Selection Compusite Assume a = 1" Yz = 5.5" Qn = 17.1 Limit Dejoth 18" Øm. Zan # Men Ix WIRXYO GIL 428 9 147 367 129 8 5 Ix > Iread W13.35 510 W16 × 40 518 147 9 396 W18 ×35 w/ (18) studs Member Selection Consistent up RAM

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# **Appendix E: Gravity Column Calculations**

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	Sout Check
Самрар	$\frac{\text{Upple al Interior Column Design}}{\frac{1}{4} = 100 \text{ psf}}$ $\frac{1}{4} = 100 \text{ psf}$
	From KANI Dead -> 155.75 K Live -> 126.89 K
	Strength 1.2D+1.6L+0.5RF PU= 389.55 Moment Negligible For Juterior Column Try WIOX49 ØPn: 428k > Pu .: Ok Member Selection Consident W/ RAM

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## **Appendix F: Lateral Calculations and Frame Elevations**

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enteral Braces Spot Check HSS 10 × 10 × 12" = 80.7" (From RAM) Skinderness > 1 × 300 P= 80.7 " 22 s = 22.39(12) = 69.61 3-86 Yielding CAMPAD ok Pn: Fyltg: 36 (17.2) = 619.2 \* Pu Le Pn : ok Gr 50 PL - 14" Ryphre Fam Tube D3.1 ... U= )- X/I: 1-3.75=0.99  $\overline{X} = \frac{|3^2 \perp 2BH}{4/B+H}$ Pr= Fude Ae = Anu  $\bar{X} = \frac{10^2 + 2(10)(10)}{24(10+10)} = 3.75$ For slutted Has welded to a Gusset FL ... An = Ag - [(1.25)(0.465)(2)] = 17.2 - 1.1625 = (C.04 Ac = 15.88 in2 Pn= (58)(15.28) = 920.9 K Pu < Pn : ok!



Frame Elevation 1







Frame Elevation 4









Frame Elevation 7 & 8









18X76

### Final Report

**W18X76** 



Frame Elevation 11

Σ















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# Appendix G: Steel Redesign Floor Plans

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						M/2/1	W12x19	W12x19	W1422	W1422	W1022	W1022	W1422	W1422	W11/22	W1622		
	·						1	exa niu			26×8	100.	16461	29	axahiv A		i×81/1	
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Floors 5-7

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		י י י		X14	kx19	×19	kx19 	g j	ğ§	M/16x		W16x	- <b>5</b>	618
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				·	97	xarviv	- 1-1	98	×8170	-1-	- <mark>- s - s</mark> 19×31	AN T	97	(91 <b>/</b> )/
				2x14	2×19	2x19	2x19	<b>ទ្</b>	4×22	2x19	2419 01-20	2×19	2419	6 6
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				2x14	2x19	2x19	2x19	4x22	4x22	2x19	2x19 2x19	2x19	219	12x19
				1M	101	W1	- I		100	1W1	1001	μ.	Ň	M
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				12x14	12×19	12x19	12×19		11/22	12×19	12x19	12×19	12:19	112119
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**Roof/Penthouse** 

### Chapel Hill, NC

Final Report

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Lower Penthouse Roof

Final Report

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21×01/M	W1240 (V10×12	21×01W													
÷;-{;(	W10X12							10000							
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	W10×12														
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**Upper Penthouse Roof** 

UNC- IRB

Chapel Hill, NC

# **Appendix H: Construction Management Breadth**

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#### Chapel Hill, NC



### **Frame Takeoff**

Page 9/9 04/04/10 15:27:15

RAM Frame v14.00.03.00 DataBase: IRB Thesis Building Code: IBC

#### Level: LOADING DOCK

Floor Area (ft\*\*2): 0.0

#### TOTAL STRUCTURE FRAME TAKEOFF

Floor Area (ft\*\*2): 359712.0

Columns:

# 164 1 25 16 2 6	Length ft 2640.0 16.0 400.0 256.0 32.0 96.0	Weight lbs 200325 1552 42330 33276 5041 16758	UnitWt psf
# 164 1 25 16 2 6	Length ft 2640.0 16.0 400.0 256.0 32.0 96.0	Weight lbs 200325 1552 42330 33276 5041 16758	UnitWt psf
164 1 25 16 2 6	ft 2640.0 16.0 400.0 256.0 32.0 96.0	<b>Ibs</b> 200325 1552 42330 33276 5041 16758	psf
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16 2 6	256.0 32.0 96.0	33276 5041 16758	
2 6 	32.0 96.0	5041 16758	
6	96.0	16758	
214		299281	0.83
#	Length	Weight	UnitWt
	ft	lbs \	. psf
219	4510.7	302366	
219		302366	0.84
#	Length	Weight	UnitWt
	ft	lbs	psf
1	16.9	1205	-
415	8059.9	471722	
20	440.3	31314	
436		504242	1.40
	# 219 219 219 # 1 415 20 436	#       Length ft         219       4510.7         219       4510.7         219       410.3         #       Length ft         1       16.9         415       8059.9         20       440.3         436       436	#       Length ft       Weight lbs         219 $4510.7$ $302366$ 219 $302366$ $302366$ 219 $302366$ $302366$ #       Length ft       Weight lbs         1 $16.9$ $1205$ 415 $8059.9$ $471722$ $20$ $440.3$ 436 $504242$

Note: Length and Weight based on Centerline dimensions.

Chapel Hill, NC

RAM Steel v14.00.03.00 DataBase: IRB Thesis Building Code: IBC			04. Steel Code: AIS	Page 5/: /04/10 15:20:01 C360-05 LRFI
SIZE	#	LENGTH (ft)	WEIGHT (lbs)	
W40X183	1	31.67	5743	
	273		163741	
So tal Number of Studs = 36	17			
AL STRUCTURE GRAVITY	Y BEAM T	AKEOFF		
Steel Grade: 50				
	ц			
	370	$\frac{1}{5} \frac{1}{4} \frac{1}{9} \frac{1}{4}$	<b>WEIGHT</b> (108) 54540	
78¥13	579 7	42.67	558	
/8X15	1	21.67	327	
/10X12	106	2573 21	30996	
V12X14	294	5950.40	84231	
V12X16	62	1288.46	20650	
V12X19	596	12557.09	238001	
V12X40	133	1855.61	73877	
V14X22	737	15626.38	345093	
V16X26	82	1780.83	46539	
V16X31	188	3830.02	118989	
/16X50	2	20.04	1002	
V18X35	52	1133.84	39739	•
V18X40	1	31.33	1258	
W18X55	1	30.67	1691	
/18X60	11	341.33	20442	
V18X76	2	66.00	5008	
W18X65	4	124.00	8059	
V18X86	10	341.00	29357	
W18X71	15	460.00	32558	
V18X97	93	3173.95	307807	
W21X101	2	69.33	7031	
W40X183	1	31.67	5743	
	2774		1473496	

Total Number of Studs = 29125

Page 83|90

#### Chapel Hill, NC



## **Gravity Column Design TakeOff**

RAM Steel v14.00.03.00 DataBase: IRB Thesis Building Code: IBC

04/04/10 15:20:03 Steel Code: AISC360-05 LRFD

#### Steel Grade: 50

I section

Size	#	Length (ft)	Weight (lbs)
W10X33	205	3344.0	110489
W10X39	35	560.0	21914
W12X40	88	1408.0	56056
W14X43	33	536.0	22981
W12X45	6	96.0	4279
W10X45	32	512.0	23172
W14X48	4	64.0	3071
W10X49	47	752.0	36848
W12X50	16	256.0	12718
W12X53	15	240.0	12740
W14X53	12	192.0	10192
W10X54	5	80.0	4301
W12X58	8	128.0	7404
W10X60	10	160.0	9582
W14X61	40	640.0	38982
W12X65	15	240.0	15598
W10X68	11	176.0	11978
W14X68	11	176.0	11978
W12X72	9	144.0	10339
W14X74	13	208.0	15430
W10X77	9	144.0	11074
W12X79	31	496.0	39156
W14X82	9	144.0	11760
W12X87	6	104.1	9070
W10X88	2	32.0	2820
W14X90	38	608.0	54826
W12X96	1	16.0	1535
W14X99	3	48.0	4753
W10X100	2	32.0	3201
W12X106	1	16.0	1699
W14X109	2	32.0	3484
W10X112	12	192.0	21495
W14X145	10	160.0	23248
W14X159	2	32.0	5085
W14X176	3	48.0	8461
W12X190	6	96.0	18228
W14X193	1	16.0	3092
	753		663040

Structural Concrete Estimate									
Beams and Girders									
		Unit Mat'l		Unit Labor		Unit Equip.		Total Item	
Item	Total CY	Cost	Mat'l Cost	Cost	Labor Cost	Cost	Equip. Cost	Cost	
Normal Weight Concrete, 5000 PSI	5024.92	\$109.00	\$547,716.28					\$547,716.28	
		11.11.00.11						<b>T</b>	
14 mm	Tatal CV	Unit Mat'i	Martill Cast	Unit Labor	Labor Cost	Unit Equip.	Faulta Coat	Total Item	
Reading beams alovated numbed	5024 02	Cost	iviat i Cost	\$29.00	\$145 722 69	¢12.20	Equip. Cost	¢212 554 12	
Flacing beams, elevated, pumped	3024.32			\$29.00	\$143,722.08	\$13.30	300,831.44	\$212,334.12	
		Unit Mat'l		Unit Labor		Unit Fauin.		Total Item	
Item	SFCA	Cost	Mat'l Cost	Cost	Labor Cost	Cost	Equip. Cost	Cost	
Forms in Place, Beams and Girders, 3 use	282568	\$1.11	\$313,650.48	\$4.56	\$1,288,510.08		4. 6	\$1,602,160.56	
		Unit Mat'l		Unit Labor		Unit Equip.		Total Item	
ltem	Ton	Cost	Mat'l Cost	Cost	Labor Cost	Cost	Equip. Cost	Cost	
Reinforcing in Place, Beams and Girders, #3 to #7	218.47	\$800.00	\$174,776.00	\$700.00	\$152,929.00			\$327,705.00	
Columns									
		Unit Mat'l		Unit Labor		Unit Equip.		Total Item	
Item	Total CY	Cost	Mat'l Cost	Cost	Labor Cost	Cost	Equip. Cost	Cost	
Normal Weight Concrete, 7000 PSI	436.63	\$103.50	\$71,389.01					\$71,389.01	
Normal Weight Concrete, 5000 PSI	121.1	\$109.00	\$79,519.50					\$79,519.50	
		Unit Mat'l		Unit Labor		Unit Fauin.		Total Item	
Item	Total CY	Cost	Mat'l Cost	Cost	Labor Cost	Cost	Equip. Cost	Cost	
Placing columns, 24" thick, pumped	1164.3			\$19.05	\$22,179.92	\$8.70	\$10,129.41	\$32,309.33	
		Unit Mat'l		Unit Labor		Unit Equip.		Total Item	
Item	SFCA	Cost	Mat'l Cost	Cost	Labor Cost	Cost	Equip. Cost	Cost	
Forms in Place, 24" x 24" Columns, 3 use	68744.54	\$0.91	\$62,557.53	\$3.99	\$274,290.71			\$336,848.25	
		Unit Mat'l		Unit Labor		Unit Equip.		Total Item	
ltem	Ton	Cost	Mat'l Cost	Cost	Labor Cost	Cost	Equip. Cost	Cost	
Reinforcing in Place, Columns, #8 to #18	75.78	\$800.00	\$60,624.00	\$490.00	\$37,132.20			\$97,756.20	
Cheer Wells									
Shear wans		Lipit Mat'l		Unit I shor		Lipit Equip		Total Itom	
Item	Total CV	Cost	Mat'l Cost	Cost	Labor Cost	Cost	Fauin Cost	Cost	
Normal Weight Concrete 7000 PSI	2345 99	\$163.50	\$383 569 37	COSt	Lubor Cost	6051	Equip. Cost	\$383 569 37	
Normal Weight Concrete, 5000 PSI	1407.6	\$109.00	\$153,428.40					\$153,428.40	
			. ,					. ,	
		Unit Mat'l		Unit Labor		Unit Equip.		Total Item	
ltem	Total CY	Cost	Mat'l Cost	Cost	Labor Cost	Cost	Equip. Cost	Cost	
Placing Walls, 12" thick, direct chute	3753.59			\$12.85	\$48,233.63	\$0.61	\$2,289.69	\$50,523.32	
		Unit Mat'l		Unit Labor		Unit Equip.		Total Item	
Item	SFCA	Cost	Mat'l Cost	Cost	Labor Cost	Cost	Equip. Cost	Cost	
Forms in Place, 8' to 16' Walls, 3 use	183444.4	\$0.72	\$132,079.97	\$3.71	\$680,578.72			\$812,658.69	
		I with Adaptil		theit taken		Unit Caulo		Tatal Itans	
ltom	Tom	Unit Wat I	Matil Cost	Unit Labor	Labor Cost	Unit Equip.	Fauin Cost	Total item	
Reinforcing in Place Walls #3 to #7	54.23	\$760.00	\$41 214 80	\$375.00	\$20,336,25	COST	Equip. Cost	\$61 551 05	
Reinforcing in Place, Walls, #8 to #18	55.32	\$760.00	\$42.043.20	\$281.00	\$15,544,92			\$57.588.12	
			+ ·=,• ·•·=•	7-000	<i>,,.</i>			<i></i>	
Subtotals			\$2,062,368.33		\$2,685,458.12		\$79,250.54	\$4,827,076.98	
Adjusted for Location (0.91)								\$4,392,640.05	
Design Contingency (1.5%)								\$65,889.60	
Escalation Contingency (3.5%)								\$153,742.40	
Insurance (3%)								\$131,779.20	
Bonds (2%)								\$87,852.80	
Overhead & Profit (10%)								\$439,264.01	
					Tot	al Structural	Concrete Cost:	\$5,271,168.06	

Structural Steel Estimate										
Member Size	Unit	Quantity	length (LE)	Unit Mat'l Cost	Mat'l Cost	Unit Labor Cost	Labor	Unit Equipment Cost	Equipment	Total Item
Beams and Girders	Unit	Quantity	Length (LF)	COST	What I Cost	COST	cost	COST	COSI	COSt
Wide Flange Shapes										
W8X10	LF	379	5414.94000	\$12.10	\$65,521	\$2.83	\$15,324	\$2.68	\$14,512	\$95,357
W8X13		2	42.67000	\$18.15 \$18.15	\$774	\$2.83	\$121 \$61	\$2.68	\$114 \$58	\$1,010 \$512
W10X12	LF	106	2573.21000	\$18.15	\$37,312	\$2.83	\$7,282	\$2.68	\$6,896	\$51,490
W12X14	LF	294	5950.40000	\$19.35	\$115,140	\$1.93	\$11,484	\$1.83	\$10,889	\$137,514
W12X16	LF	62	1288.46000	\$19.35	\$24,932	\$1.93	\$2,487	\$1.83	\$2,358	\$29,776
W12X19	LF	596	12557.09000	\$19.35	\$242,980	\$1.93	\$24,235	\$1.83	\$22,979	\$290,194
W12X40 W14X22		737	15626 38000	\$42.50	\$78,863 \$492 231	\$2.10 \$1.71	\$3,897	\$1.98 \$1.62	\$3,674 \$25,315	\$86,434 \$544 267
W14X22	LF	82	1780.83000	\$31.50	\$56,096	\$1.71	\$3,045	\$1.62	\$2,885	\$62,026
W16X31	LF	188	3830.02000	\$37.50	\$143,626	\$1.89	\$7,239	\$1.79	\$6,856	\$157,720
W16X50	LF	2	20.01000	\$60.50	\$1,211	\$2.12	\$42	\$2.01	\$40	\$1,293
W18X35		52	1133.84000	\$42.50	\$48,188 \$1,520	\$2.65	\$3,005	\$1.83 ¢1.92	\$2,075	\$53,268
W18X55		1	30.67000	\$66.50	\$1,520	\$2.03	305 \$86	\$1.05	\$59	\$1,000
W18X60	LF	11	341.33000	\$66.50	\$22,698	\$2.79	\$952	\$1.92	\$655	\$24,306
W18X65	LF	4	124.00000	\$78.50	\$9,734	\$2.82	\$350	\$1.95	\$242	\$10,325
W18X71	LF	15	460.00000	\$78.50	\$36,110	\$2.82	\$1,297	\$1.95	\$897	\$38,304
W18X76 W18X86		2 10	341,00000	\$92.00 \$104.00	\$6,072	\$2.82 \$2.82	\$186	\$1.95 \$1.95	\$129	\$6,387 \$37.091
W18X97		93	3173.95000	\$104.00	\$330.091	\$2.82	\$8.951	\$1.95	\$6.189	\$345.231
W21X101	LF	2	69.33000	\$122.00	\$8,458	\$2.54	\$176	\$1.75	\$121	\$8,756
W40X183	LF	1	31.67000	\$235.00	\$7,442	\$2.26	\$72	\$1.56	\$49	\$7,563
Columns Wide Flange Shapes	[	1								
Wide Hange Shapes W10X33	LF	205	3344.00000	\$54.50	\$182,248	\$1.64	\$5,484	\$1.56	\$5,217	\$192,949
W10X39	LF	35	560.00000	\$54.50	\$30,520	\$1.64	\$918	\$1.56	\$874	\$32,312
W10X45	LF	32	512.00000	\$54.50	\$27,904	\$1.64	\$840	\$1.56	\$799	\$29,542
W10X49	LF	47	752.00000	\$54.50	\$40,984	\$1.64	\$1,233	\$1.56	\$1,173	\$43,390
W10X54 W10X60		5 10	80.00000	\$54.50 \$54.50	\$4,360	\$1.64 \$1.64	\$131	\$1.56	\$125	\$4,616 \$9,232
W10X68	LF	10	176.00000	\$82.50	\$14,520	\$1.72	\$303	\$1.63	\$287	\$15,110
W10X77	LF	9	144.00000	\$82.50	\$11,880	\$1.72	\$248	\$1.63	\$235	\$12,362
W10X88	LF	2	32.00000	\$82.50	\$2,640	\$1.72	\$55	\$1.63	\$52	\$2,747
W10X100	LF	2	32.00000	\$82.50	\$2,640	\$1.72	\$55	\$1.63	\$52	\$2,747
W10X112 W12X40		88	1408 00000	\$136.00	\$20,112	\$1.77 \$1.64	\$340 \$2 309	\$1.07	\$321 \$2,196	\$20,772
W12X45	LF	6	96.00000	\$60.50	\$5,808	\$1.64	\$157	\$1.56	\$150	\$6,115
W12X50	LF	16	256.00000	\$60.50	\$15,488	\$1.64	\$420	\$1.56	\$399	\$16,307
W12X53	LF	15	240.00000	\$60.50	\$14,520	\$1.64	\$394	\$1.56	\$374	\$15,288
W12X58	LF	8	128.00000	\$60.50	\$7,744	\$1.64	\$210	\$1.56	\$200	\$8,154
W12X65	LF	15	240.00000	\$60.50	\$14,520	\$1.64	\$394	\$1.56	\$374	\$15,288
W12X/2 W12Y7Q	LF I F	31	496 00000	500.50 \$60 50	58,712 \$30.008	\$1.64 \$1.64	\$236 \$812	\$1.56 \$1.56	\$225 \$774	\$9,1/3 \$31 595
W12X73	LF	6	104.00000	\$105.00	\$10,920	\$1.72	\$179	\$1.63	\$170	\$11,268
W12X96	LF	1	16.00000	\$105.00	\$1,680	\$1.72	\$28	\$1.63	\$26	\$1,734
W12X106	LF	1	16.00000	\$105.00	\$1,680	\$1.72	\$28	\$1.63	\$26	\$1,734
W12X190	LF	6	96.00000	\$230.00	\$22,080	\$1.86	\$179	\$1.76	\$169	\$22,428
W14X43	LF	33	536.00000	\$89.50	\$47,972	\$1.72	\$922	\$1.63	\$874	\$49,768
W14X48 W14X52		4	64.00000	\$89.50	\$5,728	\$1.72	\$110	\$1.63	\$104 \$212	\$5,942
W14X53	LF	40	640.00000	\$89.50	\$17,184	\$1.72	\$1,101	\$1.63	\$1.043	\$59.424
W14X68	LF	11	176.00000	\$89.50	\$15,752	\$1.72	\$303	\$1.63	\$287	\$16,342
W14X74	LF	13	208.00000	\$89.50	\$18,616	\$1.72	\$358	\$1.63	\$339	\$19,313
W14X82	LF	9	144.00000	\$89.50	\$12,888	\$1.72	\$248	\$1.63	\$235	\$13,370
W14X90	LF	38	608.00000	\$89.50	\$54,416	\$1.72	\$1,046	\$1.63	\$991	\$56,453
W14X99	LF	3	48.00000	\$89.50	\$4,296	\$1.72	\$83	\$1.63	\$78	\$4,457
W14X109		2 10	32.00000 160.00000	\$89.50 \$145.00	\$2,864 \$23,200	\$1.72 \$1.77	\$55 ¢782	\$1.63 \$1.67	\$52 \$767	\$2,9/1 \$73 750
W14X143	LF	2	32.00000	\$145.00	\$4.640	\$1.77	\$205 \$57	\$1.67	\$53	\$4,750
W14X176	LF	3	48.00000	\$213.00	\$10,224	\$1.86	\$89	\$1.76	\$84	\$10,398
W14X193	LF	1	16.00000	\$213.00	\$3,408	\$1.86	\$30	\$1.76	\$28	\$3,466

		i								
Duase of Evenues										
Wide Elange Shapes				1						
W18276	LE	164	2640.00000	\$92.00	\$2/12 880	\$2.82	\$7 1/15	¢1 95	\$5 1/18	\$255 //73
W18X70	IF	104	16,00000	\$104.00	\$1 66/	\$2.02	\$45	\$1.95	\$3,140	\$255,475
W18X106	IF	25	400.00000	\$128.00	\$51,004	\$2.02	\$1 128	\$1.95	\$780	\$1,740
W10X100	IF	16	256.00000	\$1/18.00	\$37,888	\$2.02	\$650	\$1.55	\$1/18	\$38,986
W10X150	IF	2	32,00000	\$1/18.00	\$1,000 \$1,736	\$2.54	\$050 \$81	\$1.75	\$56	\$30,500 \$4 873
W10X130	IF	6	96,00000	\$1/18.00	\$1/ 208	\$2.54	\$2///	\$1.75	\$50 \$168	\$14 620
Beams	-	0	50.00000	J140.00	J1 <del>4</del> ,200	Υ <u></u> 2.34	γz++	Ş1.75	Ş100	Ş1 <del>4</del> ,020
W16X67	LE	219	4510 70000	\$77.50	\$349 579	\$2.36	\$10 645	\$1.69	\$7 623	\$367 848
Braces	E1	215	4510.70000	<i>Ş11.50</i>	<i>43</i> ,373	Ş2.30	<i>910,043</i>	<i></i>	<i>\$1,025</i>	\$307,040
HSS10X10X5/8	LF	1	16,90000	\$1,200.00	\$75	\$29.50	\$31	\$27.50	\$29	\$135
HSS10X10X1/2	LE.	/15	8059 90000	\$1,200,00	\$31 125	\$29.50	\$14,860	\$27.50	\$13,853	\$59,838
HSS10X10X1/2	16	20	440 20000	\$1,200.00	\$1,125 \$1,500	\$20.50	¢917	\$27.50	\$15,055	\$3,060
115512/112/11/2	-	20	440.30000	Ş1,200.00	Ş1,500	Ş25.50	ÇÜIZ	Ş21.30	Ş737	\$3,005
Subtotal Costs					\$3.351.091		\$174.228		\$155.825	\$3.681.143.53
Adjusted for Location (0.91)					., ,		. ,		. ,	\$3,349,840.61
Design Contingency (1.5%)										\$50,247.61
Escalation Contingency (3.5%)										\$117,244.42
Insurance (3%)										\$100,495.22
Bonds (2%)										\$66,996.81
Overhead & Profit (10%)										\$334,984.06
							Total Structural Steel Cost:			\$4,019,808.73

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# Appendix I: Enclosure Breadth: Blast Design

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Fig. 3. Chart that relates standoff distance and charge size to equivalent 3-s duration equivalent design loading from ASTM F 2248-03. (Reprinted with permission from ASTM F 2248-03, copyright ASTM International, 100 Barr Harbor Dr., West Conshohocken, PA 19428.)





#### Chapel Hill, NC

∰ E 1300 – 04<sup>€1</sup>



FIG. A1.29 (upper chart) Nonfactored Load Chart for 8.0 mm (5/16 in.) Laminated Glass with Four Sides Simply Supported (lower chart) Deflection Chart for 8.0 mm (5/16 in.) Laminated Glass with Four Sides Simply Supported