APPENDIX B

CONCRETE FRAMING

Seismic Loading Calculations:
(using ASCE 7-02 Equivalent Lateral Force System)

For Pittsburgh, PA

$S_s = 0.127g$
$S_1 = 0.054g$

Occupancy II
Seismic Use Group I
$I_E = 1.0$

Site Class: D — *(without sufficient detail to determine a Site Class, class D shall be used. As found in the geotechnical report prepared by L. Robert Kimball & Associates, the samples have a plasticity index (PI) ranging from 8-20. Site Class E is not used since the PI indicates that it is not a soft clay (PI>20)*

Based on site class, S_s, and S_1,

$F_a = 1.6$ $F_v = 2.4$

$S_{DS} = {}^2/_3 S_{MS} = {}^2/_3 F_a Ss = {}^2/_3(1.6)(0.127) = 0.135$
$S_{D1} = {}^2/_3 S_{M1} = {}^2/_3 F_v S_1 = {}^2/_3(2.4)(0.054) = 0.086$

S_{DS}, S_{D1}, and Seismic Use Group I, yields:

Seismic Design Category B

Based on this Seismic Design Category, the Equivalent Lateral Force System is permissible.

Base Shear Calculation:

$V_{BASE} = C_S W$

$C_S = S_{DS}/(R/I_E) \geq 0.044 S_{DS} I_E$

R = 3.0 (for ordinary reinforced concrete moment frames)

$C_S = 0.135/(3.0/1.0) \geq 0.044(0.135)(1.0)$
$= 0.045 \geq 0.006$ *(OK)*

W (Total weight is calculated from the typical floor plan for the tower, adjusted for the heights and floor plans of the main and ground levels)

Weight of Typ. Floor

Columns							
	L	W	H	lb/ft3	#/floor		Wt.
	22"	32"	10'	150 pcf	44/floor	=	**322.7k**
Col. Strip							
	61'	72"	8"	150 pcf	11/floor	=	**402.6k**
Slab							
	t	SF		lb/ft^3			
	8"	16302.5 sf		150 pcf	.75	=	**1222.7k**
					TOTAL	**=**	**1948k**

Weight ofMain Floor

Columns							
	L	W	H	lb/ft3	#/floor		Wt.
	22"	32"	20'	150 pcf	44/floor	=	**645.3k**
Col. Strip							
	61'	72"	8"	150 pcf	11/floor	=	**402.6k**
Slab							
	t	SF		lb/ft^3			
	8"	16302.5 sf		150 pcf	.75	=	**1222.7k**
					TOTAL	**=**	**2270.6k**

Weight of Ground Floor

Columns							
	L	*W*	*H*	*lb/ft3*	*#/floor*		*Wt.*
	22"	32"	14'	150 pcf	18/floor	=	**184.8k**
Col. Strip							
	61'	72"	8"	150 pcf	11/floor	=	**402.6k**
Slab							
	t	*SF*		*lb/ft^3*			
	8"	4739.8 sf		150 pcf	.75	=	**355.5k**
					TOTAL	**=**	**942.9k**

$W_{TOT} = 10(1948) + 2270.6 + 942.9 = 22694k$
$V_{BASE} = 0.045(22694k) = 1021\ k$

Distribution to Floors:

The building does not exceed 12 stories, the lateral resisting system is entirely concrete, and the story height is at least 10ft, therefore the following assumption is valid:

$T_a = 0.1N = 0.1(12) = 1.2$ sec

$k = 1.3$ *(linear interpolation between 1 and 2 for a value of T_a = 1.2 sec)*

$F_x = C_{vx}V$ *(force at story x)*

$C_{vx} = w_x h_x^k / (\Sigma w_i h_i^k)$

Story Forces

Story	w_x	h_x	$w_x h_x^k$	C_{vx}	Story Force
1	942.9	14	29136	0.004	4.2
2	2270.6	34	222363	0.031	32.0
3	1948	44	266733	0.038	38.4
4	1948	54	348097	0.049	50.1
5	1948	64	434133	0.061	62.4
6	1948	74	524312	0.074	75.4
7	1948	84	618233	0.087	88.9
8	1948	94	715575	0.101	102.9
9	1948	104	816079	0.115	117.4
10	1948	114	919529	0.130	132.3
11	1948	124	1025740	0.144	147.5
Roof	1948	138	1178777	0.166	169.5
		Σ	7098709	1	1021.0

STEEL FRAMING

Seismic Loading Calculations:
(using ASCE 7-02 Equivalent Lateral Force System)

For Pittsburgh, PA

$S_s = 0.127g$
$S_1 = 0.054g$

Occupancy II
Seismic Use Group I
$I_E = 1.0$

Site Class: D — *(without sufficient detail to determine a Site Class, class D shall be used. As found in the geotechnical report prepared by L. Robert Kimball & Associates, the samples have a plasticity index (PI) ranging from 8-20. Site Class E is not used since the PI indicates that it is not a soft clay (PI>20)*

Based on site class, S_s, and S_1,

$F_a = 1.6$ $F_v = 2.4$

$S_{DS} = {}^2/_3 S_{MS} = {}^2/_3 F_a Ss = {}^2/_3(1.6)(0.127) = 0.135$
$S_{D1} = {}^2/_3 S_{M1} = {}^2/_3 F_v S_1 = {}^2/_3(2.4)(0.054) = 0.086$

S_{DS}, S_{D1}, and Seismic Use Group I, yields:

Seismic Design Category B

Based on this Seismic Design Category, the Equivalent Lateral Force System is permissible.

Base Shear Calculation:

$V_{BASE} = C_S W$

$C_S = S_{DS}/(R/I_E) \geq 0.044 S_{DS} I_E$

R = 5.0 (for ordinary steel concentrically braced frames)

$C_S = 0.135/(5.0/1.0) \geq 0.044(0.135)(1.0)$
$= 0.027 \geq 0.006$ *(OK)*

W = (Weights taken from members designed in RAM Model.)

Story	Framing Weight
Roof	168.7
10	669.1
9	667.0
8	671.9
7	676.7
6	676.7
5	683.7
4	690.6
3	690.6
2	702.4
Main	755.0
Ground	233.2

$\sum W = 7350$

$V_{BASE} = 0.027(7350k) = 198$ k

Distribution to Floors:

$T_a = C_t h_n^{\ x} = 0.03(146)^{0.75} = 1.26$

k = 1.6 *(linear interpolation between 1 and 2 for a value of T_a = 1.26 sec)*

$F_x = C_{vx} V$ *(force at story x)*

$C_{vx} = w_x h_x^{\ k} / (\Sigma w_i h_i^{\ k})$

Story Forces

Story	w_x	h_x	$w_x h_x^{\ k}$	C_{vx}	Story Force
1	233.2	14	15905	0.002	0.35
2	755.0	34	212967	0.023	4.63
3	702.4	45	310259	0.034	6.74
4	690.6	56	432840	0.047	9.40
5	690.6	67	576695	0.063	12.53
6	683.7	78	728143	0.080	15.82
7	676.7	89	890062	0.098	19.34
8	676.7	100	1072497	0.118	23.30
9	671.9	111	1258408	0.138	27.34
10	667.0	122	1453120	0.159	31.57
11	669.1	133	1673608	0.184	36.36
Roof	168.7	146	489869	0.054	10.64
		∑	9114374	1.000	198.00