Tech Report #3
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Structural
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Upper Campus Housing Project

Executive Summary

The University of Pittsburgh is currently constructing a dormitory facility on its upper campus. The Upper Campus Housing Project is a 161,600ft^2, 9-story building. This building will hold approximately 500 students. Located in the city of Pittsburgh, this 102ft structure will be located near the Peterson Events Center. The building construction began in May of this year and is expected to be completed in July of 2006. The floor system is composed of 8" precast hollow-core concrete planks with a 2 ½" topping. The lateral system consists of concrete masonry bearing and shear walls of varying thicknesses.

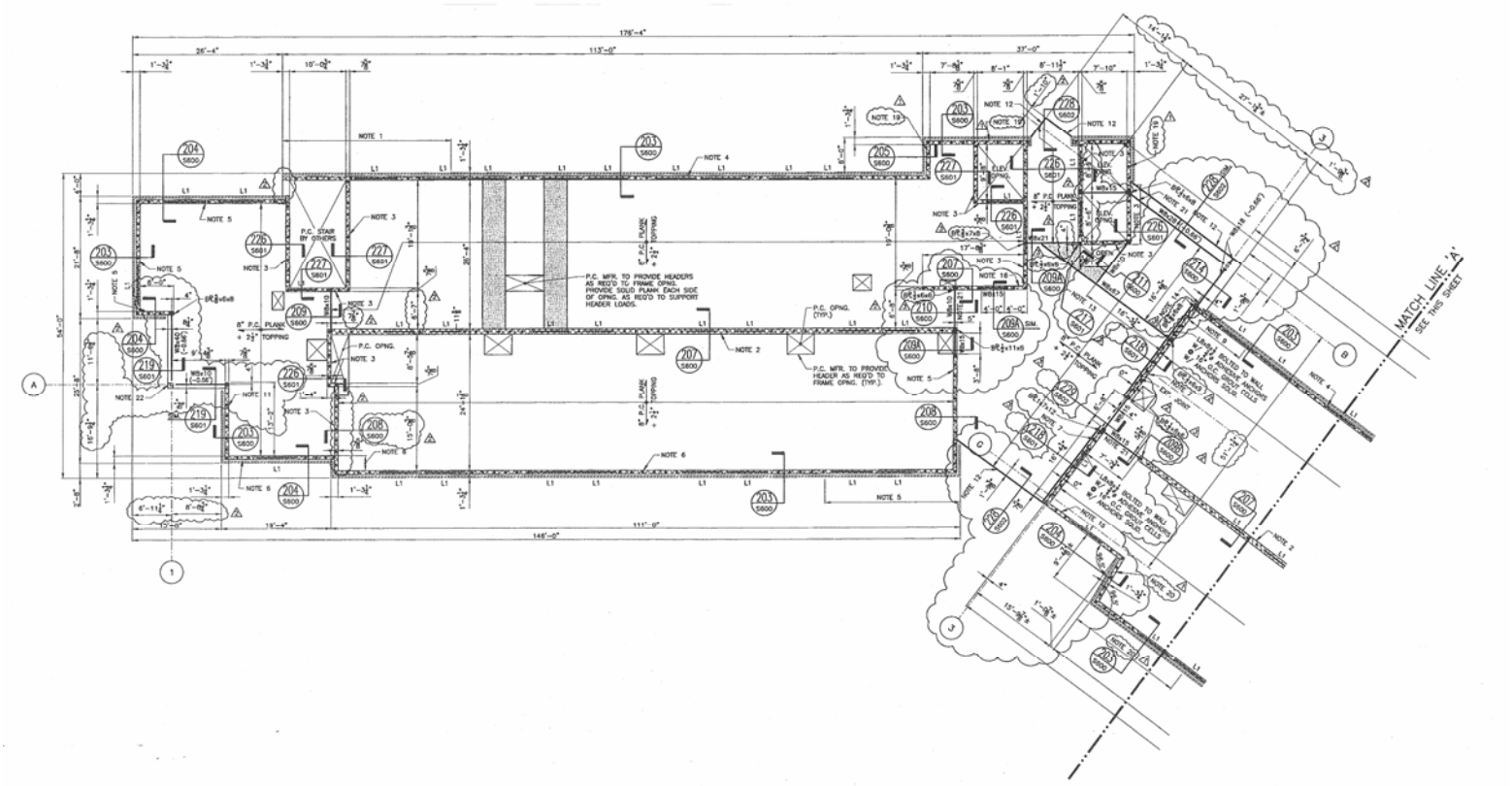
The following report examines the lateral system for the Upper Campus Housing Project. By examination of the load cases, it is clear the seismic loading will control the design of the shear walls. The load case 1.2D+1.0E+0.5L+0.2S was used. A full distribution of lateral loads was completed based on stiffness. Due to the location of an expansion joint (along line 3) the building can be broken into two halves and analyzed separately. After analysis of the shear on each wall a spot check was performed to compare the design provided by the structural engineer (Atlantic Engineering Services). Drift and overturning were also considered and analyzed. The drift the right side of the building was computed to be less than 0.36", which is the allowable value of drift (H/400). Overturning proved not to be an issue because the weight of the building causes a resisting moment that is larger than that caused by overturning.

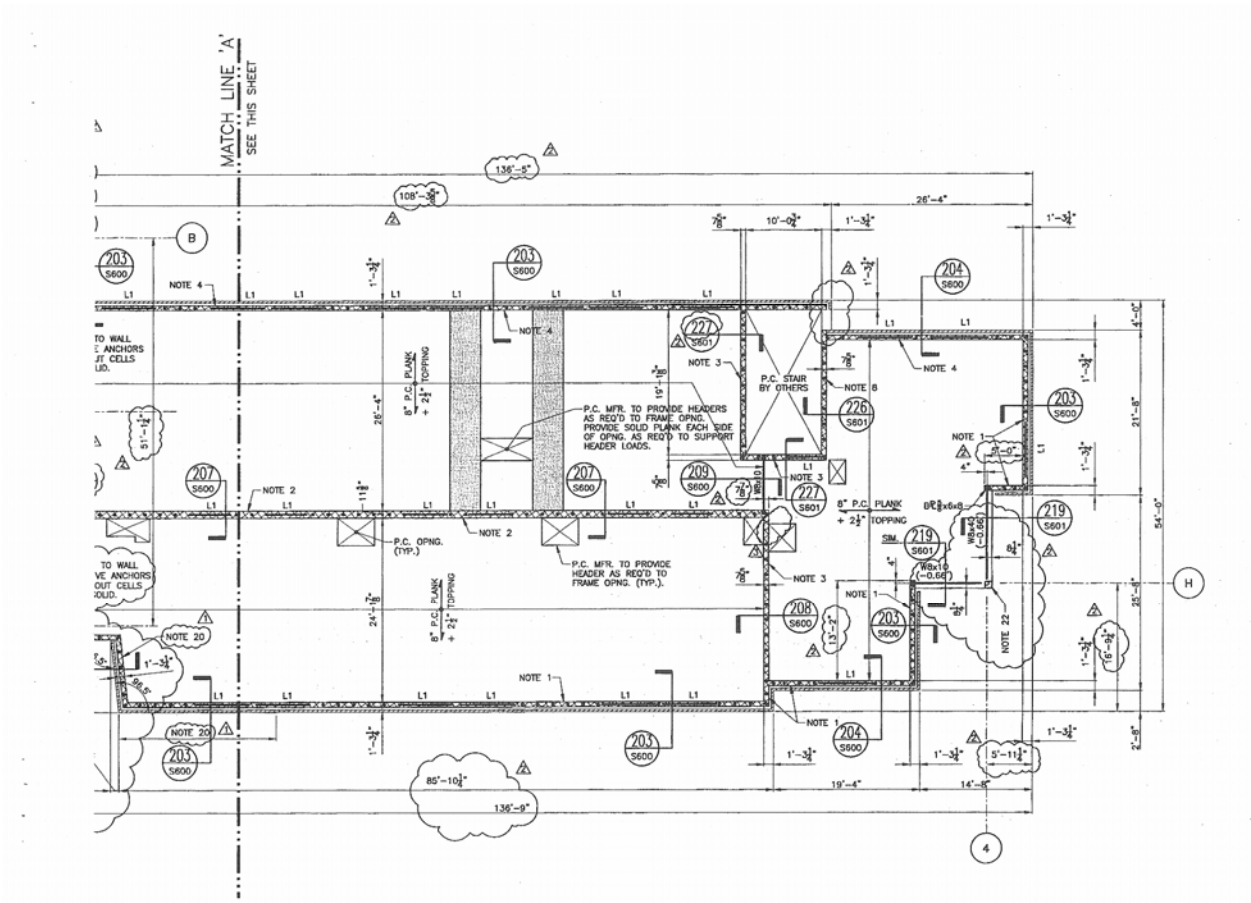
Introduction

The Upper Campus Housing Project is currently under construction on the University of Pittsburgh campus. This building is a nine-story dormitory with an approximate total height of 102ft. The dormitory will be approximately 161,600ft^2 and will house approximately 500 students. The Upper Campus Housing Project is located on Stadium Drive in Pittsburgh, PA. Construction for this project began in May of 2005 and is expected to be completed by July of 2006.

The Upper Campus Housing Project can be broken into two separate buildings along the expansion joint along Line 3 shown in the framing plan on the next page. The floor system consists of 8" precast hollow-core concrete plank floors with a 2 ½" topping. The lateral system for this building is reinforced masonry bearing and shear walls of varying thicknesses. A typical framing layout for the building is shown on the next page.

This report will examine the lateral system of the Upper Campus Housing Project. An Excel spreadsheet was used to manually calculate wall stiffnesses and distribute lateral loads to all walls appropriately based on stiffness. This procedure is described in the PCI Design Handbook in Chapter 3. Also located in the spreadsheet is the torsional distribution of loads. From the spreadsheet each wall can be checked and compared to the design given by Atlantic Engineering Services. These checks will be done by hand and also with another excel sheet.


MATCH LINE 'A'
SEE THIS SHEET
P.C. MFR. TO PROVIDE HEADERS AS REQ'D TO FRAME OPNG. PROVIDE SOLID PLANK EACH SIDE OF OPNG. AS REQ'D TO SUPPORT HEADER LOADS.
P.C. MFR. TO PROVIDE HEADER AS REQ'D TO FRAME OPNG. (TYP.).
P.C. OPNG. (TYP.)
P.C. STAIR BY OTHERS
8" P.C. PLANK + 2½" TOPPING
NOTE 1
NOTE 2
NOTE 3
NOTE 4
NOTE 5
NOTE 6
NOTE 20
NOTE 22


MATCH LINE 'A'
SEE THIS SHEET
P.C. MFR. TO PROVIDE HEADERS AS REQ'D TO FRAME OPNG. PROVIDE SOLID PLANK EACH SIDE OF OPNG. AS REQ'D TO SUPPORT HEADER LOADS.
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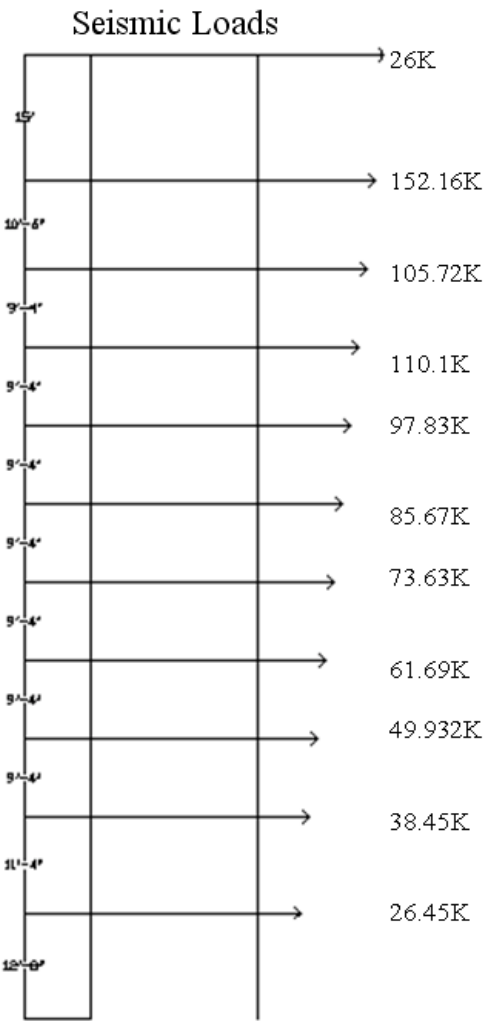
P.C. STAIR BY OTHERS
8" P.C. PLANK + 2½" TOPPING
NOTE 1
NOTE 2
NOTE 3
NOTE 4
NOTE 20
NOTE 22

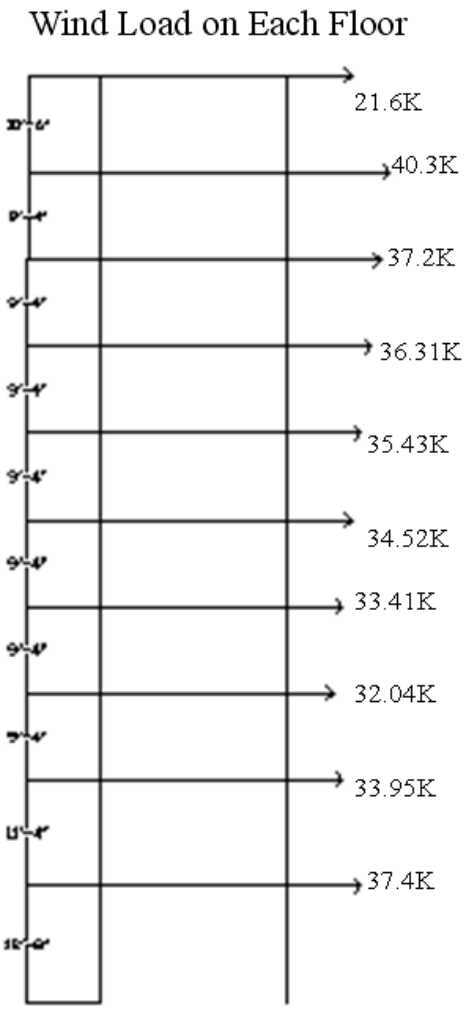
Load Cases

- 1.4D
- 1.2D+1.6L+0.5(Lr or S or R)
- 1.2D+1.6(Lr or S or R)+(0.5L or 0.8W)
- 1.2D+1.6W+0.5L+0.5(Lr or S or R)
- 1.2D+1.0E+0.5L+0.2S
- 0.9D+(1.6W+1.0E)

From examination of load cases, 1.2D+1.0E+0.5L+0.2S will control due to the large seismic loads and dead loads. From examination of this load case, it is concluded that it is highly unlikely for the building to experience full live loading while under seismic stresses. Therefore, the seismic loads will be used with a 1.0 factor in the calculation of loads on the lateral elements.

Lateral Loads





A complete analysis of wind and seismic loads is located in Appendix A.1-A.2. These calculations were also done in Technical Report #1.

Distribution of Loads to Lateral Resisting Elements

An excel spreadsheet was developed in accordance with the procedure described in the PCI Design Handbook (Ch.3) to distribute loads to lateral elements based on stiffness. The total shear in each wall is calculated as direct shear plus torsional shear. In some cases the direct and torsional shears will be additive, in other cases they will not. Below are some of the formulas used to calculate the forces on each wall:

- $F_{I_{direct}} = (k_I/\Sigma k_I)P$
- $F_{I_{eccentric}} = ((k_I * d_I)/\Sigma(k_I * d_I)^2)M$
- $M = Pe$
- $K = Et/(4(h/L)^3 + 3(h/L))$

Because concrete is a rigid diaphragm this procedure can be used to analyze this building. Another important thing to note is that the openings in shear walls was considered. Each wall was broken into sections without openings and stiffness was calculated. Then, for each wall a sum of each part was taken to be the stiffness of the total wall. Below is an example of some of the first floor output. The complete spreadsheet is located in Appendix B. There is also a link on my webpage to view the file.

East/West Stiffness (Left)

Wall	First
A	1675.40
B	30226.74
C	30021.78
D	948.68
E	671.13
F	1519.66
G	9344.48
H	33916.16
I	4518.13
J	39895.44
Sum	152737.61

North/South Stiffness (Left)

Wall	First
K	5909.12
L	5004.95
M	10602.88
N	10602.88
O	4875.46
P	19264.00
Q	6683.00
R	276.17
S	8182.65
Sum	71401.11

Direct Shear East/West (Left)

Wall	First
A	6.39
B	147.71
C	183.66
D	3.67
E	2.57
F	6.32
G	60.06
H	175.40
I	17.93
J	197.47

Direct Shear North/South (Left)

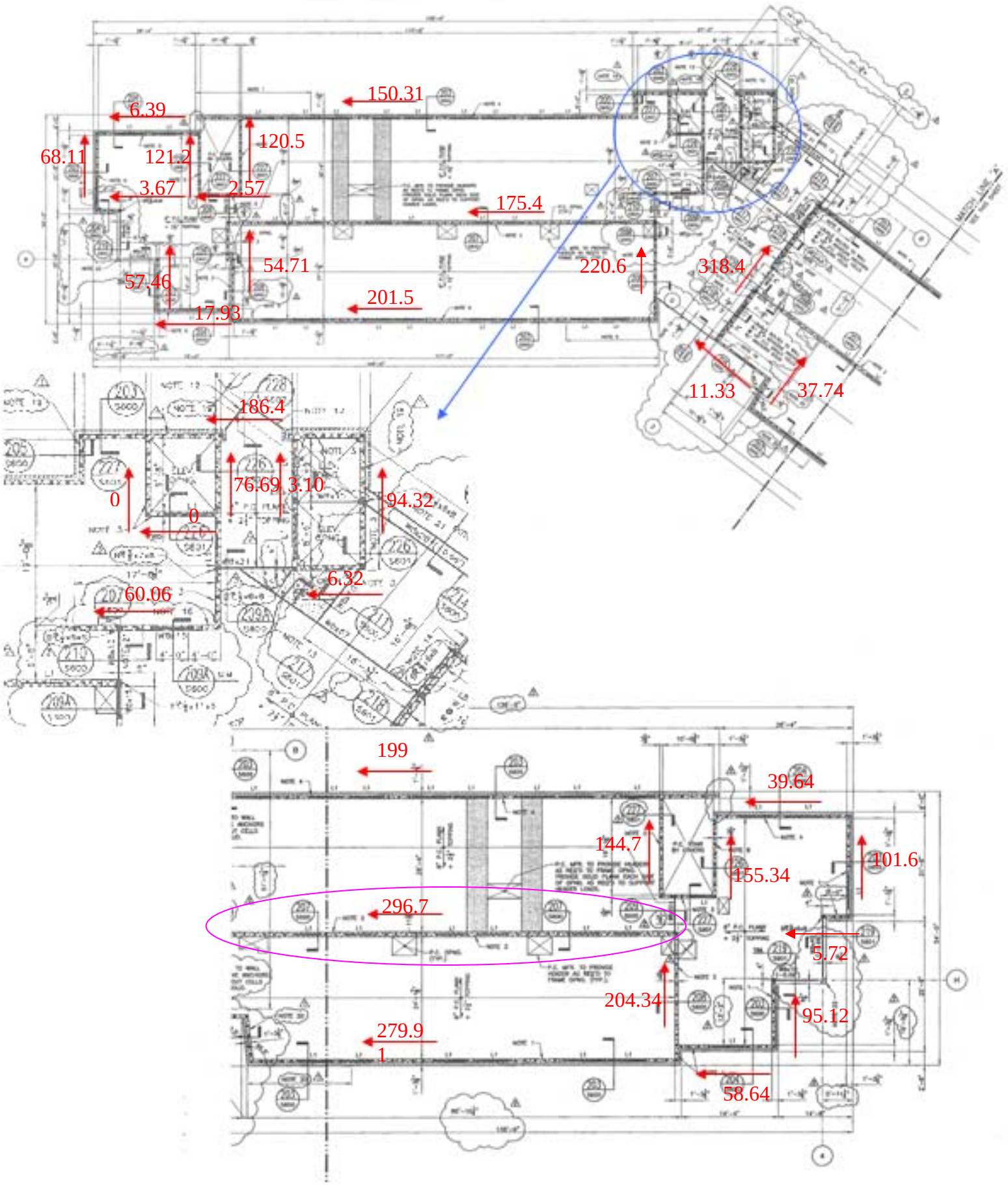
Wall	First
K	66.31
L	56.16
M	118.97
N	118.97
O	54.71
P	216.16
Q	74.99
R	3.10
S	91.82

Torsional Shear First Floor (Left)

Floor	Wall	k	x	kx^2	$kx/\Sigma kx^2$	Torsional Shear
First	A	1675.40	20.77	722429.48	0.000088	0.118865
	B	30226.74	24.93	18789527.49	0.001908	2.574835
	C	30021.78	26.27	20710997.61	0.001996	2.694105
	D	948.68	0.90	776.49	0.000002	0.002932
	E	671.13	2.10	2946.45	0.000004	0.004805
	F	1519.66	9.23	129596.07	0.000036	0.047947
	G	9344.48	1.90	33900.85	0.000045	0.060811
	H	33916.16	4.13	579823.58	0.000355	0.479123
	I	4518.13	26.57	3189091.93	0.000304	0.410118
	J	39895.44	29.23	34097352.42	0.002952	3.984903
	K	5909.12	86.48	44193289.38	0.001293	1.745965
	L	5004.95	70.81	25097361.80	0.000897	1.210904
	M	10602.88	60.31	38569904.69	0.001619	2.184903
	N	10602.88	47.31	23734955.11	0.001270	1.713965
	O	4875.46	51.48	12922484.86	0.000635	0.857584
	P	19264.00	59.52	68244795.53	0.002902	3.917453
	Q	6683.00	73.52	36122678.09	0.001244	1.678693
	R	276.17	82.52	1880595.04	0.000058	0.077863
	S	8182.65	89.85	66058450.87	0.001861	2.511927

The values for torsional shear for this side of the building are very low because the center of rigidity is only 1 ft away from the center of mass in each direction.

The following page displays a typical floor plan with the shear in each wall calculated at the first floor level.


150.31
6.39
120.5
68.11
121.2
3.67
2.57
175.4
54.71
57.46
17.93
201.5
220.6
318.4
11.33
37.74
186.4
76.69
3.10
0
0
94.32
6.32
60.06
199
39.64
144.7
155.34
101.6
296.7
5.72
204.34
95.12
279.9
1
58.64

Overturning

Mo=26K(114.84') + 152.2K(109.17') + 105.72K(98.67') + 110.1K(89.34')
+ 97.826K(80') + 85.67K(70.67') + 73.63K(61.34') + 61.69K(52')
+ 49.93K(42.67') + 38.45K(33.34') + 26.45K(24') +
7.58K(12.67') = 65622.5 ft-K

Calculation of total dead load of structure:

Masonry wall = 120plf(1250ft) = 150K
8" plank = 56psf + 31psf + 10psf (misc) = 97psf
12" plank = 1ft(150pcf) + 10psf = 160psf
Ground Floor = [16322sf(4"/12)(150pcf)]/1000 + 150K = 966.1K
First = [15986sf(97plf)]/1000 + 150K = 1701K
Second → Eighth = [16340sf(97plf)/1000] + 150K = 1735K
Ninth = [13892sf(97plf)/1000] + 150K = 1498K
Roof = [6946sf(97plf) + 6946sf(160plf)]/1000 + 150K = 1935K
Penthouse = [1020sf(160plf)]/1000 = 313.2K

Total Building Weight = 18558.3K

Resisting Moment of Dead Load = 18558.3K(102ft) = 1892946.6ft-K

Dead Load (1892946.6ft-K) >> Overturning Moment (65622.5ft-K) therefore, overturning is not an issue.

Drift

$\Delta = (Ph^3/3EI)+(2.78Ph/AE) = (h^3/3I) + (3h/A) = V/\Sigma k$

$E = 33(150pcf)^{1.5}(5000psi)^{1/2}=4286.8ksi$

Story Drift Check:

$$\Delta_{North/South} = \frac{(296000lb(12ft)^3)}{3(4286800psi)(1571in^4)} + \frac{(2.78(296000lb)(12ft)}{12in(705.6in)(4286800psi)} = 0.078"$$

$$\Delta_{North/South} = \frac{(144")^3}{3(1571in^4)} + \frac{3(144")}{12"(705.6")} = 0.14"$$

$\Delta_{North/South} = V/\Sigma k = 801.2K/64966.9 = 0.12"$

$\Delta_{allowable} = H/400 = (12ft*12in/ft)/400 = 0.36"$ OK

Shear Wall Check

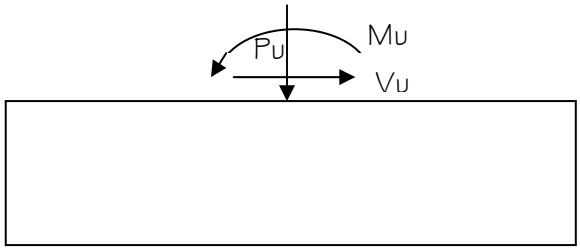
Wall shown on page 7 in pink circle

Loads on Wall:

P_u = (1.2[(10.5"/12)(150pcf)(27')(58.8')+120psf(12')(58.8')]+
1.6[27'(67psf+40psf)(58.8')])9 = 5611K

M_u = 3560.4ft-K

V_u = 296.7K



$S = (1/6)(12")(705.6")^2 = 995742.72in^3$

$A = 12"(705.6") = 8467.2in^2$

$F_t = (M/S)-(P/A) = [(3560.4ft-K*12in/ft)/995742.72in^3]-[5611K/8467.2in^2]$

$= -619.8psi$

***Therefore, wall is in compression and wall is OK

Note: The following page displays the design for reinforcement of this wall.

Input

Wall Data:

Wall Height=	12	ft
Wall Thickness(8, 8, 10, 12, 16)=	12	ft

Masonry Data:

f'm =	1500	psi
Em Multiplier (X=750, 900, 1000):	900	
Em = X*f'm=	1.4E+06	psi
n=	21.43	
Allowable F. ten=	25	psi
Masonry Density (L,M,N)=	n	
Weight of Wall	126.6	psf
Auto Calc. Total Wall DL? (Y/N)	y	

Grouting/Reinforcing Data:

Grout and Bar spacing=		
(8, 16, 24, 32, 48, or 0)	0	in c/c
Grout Solid? (Y/N)	y	
Bar Size (#4,5,6,7,8, 9, or 0)=	5	
Steel Grade (80, 60, 40)=	60	Gr
Bar @ Center (C), edge (E)? :	c	
d:	5.5125	in

Loads:

Concentric Dead Load=	1622	plf
Concentric Live Load=	27	plf
Auto Calc. Of Total Wall DL=	1519.2	plf
Eccentric Dead Load=	20	plf
Eccentric Live Load=	150	plf
Input eccentricity=	1	< .1"!!!
Additional Moment=	0	in-lb/ft
& Type (D, L, or W):	d	
Lateral Pressure=	25	psf
Lat from Live or Wind? (L/W)	w	

Wall Properties

Effective area, An=	139	sq-in
Radius of gyration, r=	3.34	in
Moment of Inertia, I=	157.1	in^4
Actual Wall Thickness=	11.625	in

Output

Unreinforced Design

	Load Cases				
	D	D+L	D+W	D+L+W	
Des. Mom=	20.00	170.00	5625.00	5701.00	in-lb
h/r=	43.11	43.11	43.11	43.11	
max fa=	22.74	24.02	22.74	24.02	psi
fa @ fb max=	11.01	13.09	17.25	18.55	
max fb=	0.07	0.63	20.02	21.09	psi
Fa=	339.44	339.44	451.45	451.45	psi
Fb=	500.00	500.00	665.00	665.00	psi
f net=	-11.74	-12.46	3.54	2.54	psi
Interaction	0.07	0.07	0.07	0.07	
Check:	<1.0 OK	<1.0 OK	<1.0 OK	<1.0 OK	
CMU Tension	no tension	no tension	f ten>f net	f ten>f net	
Check:	OK!	OK!	OK!	OK!	
Overall Result:	PASS				

Reinforced Design

Initial Kd> Face Shell	Load Cases				
	D	D+L	D+W	D+L+W	
Des. Mom=	20	170	5625	5701	in-lb
As, prov.=	0.4650	0.4650	0.4650	0.4650	sq-in/ft
pn=	0.1432	0.1432	0.1432	0.1432	
h/r=	43	43	43	43	
Fs,all=	24000	24000	31920	31920	psi
fs=	8.81	74.88	2477.99	2511.02	psi
k=	0.4726	0.4726	0.4726	0.4726	
j=	0.8400	0.8400	0.8400	0.8400	
2/jk=	5.0379	5.0379	5.0379	5.0379	
fa,max=	22.7	24.0	22.7	24.0	psi
fb,max=	0.2	2.1	65.9	69.5	psi
Fa=	339.4	339.4	451.5	451.5	psi
Fb=	500.0	500.0	665.0	665.0	psi
Checks: fa<Fa:	OK!	OK!	OK!	OK!	
fa+fb<Fb:	OK!	OK!	OK!	OK!	
fs Check:	Fs>fs	Fs>fs	Fs>fs	Fs>fs	
	OK!	OK!	OK!	OK!	
Overall Result:	PASS				

Unreinforced Summary:

12 in. block OK with Grouting @ Full

Wall Reinforcing

5 Reinf. @ 8 in o/c Grouting Full

Conclusion

The Upper Campus Housing Project lateral system is composed of concrete masonry bearing and shear walls of varying thicknesses. Seismic lateral loads control the design of the lateral system for this structure. The load case 1.2D+1.0E+0.5L+0.2S controls. Lateral loads were distributed throughout the building to all shear walls based on stiffness. As noted earlier, an excel spreadsheet was used to complete these calculations and can be viewed in the appendix of this report and in full on my webpage. One skewed wall was encountered and the stiffness was calculated as follows: $k_x = k\cos^2\theta$, $k_y = k\sin^2\theta$. Because this building is composed of concrete masonry shear walls it is considered a rigid structure and this approach is valid.

Overturning was checked and it was determined that the weight of the structure causes a resisting moment greater than that caused by overturning. Drift is also a factor that can control a lateral design. Story drift was checked at the first floor where the loads are the greatest and was determined to be less than 0.36". From this it was determined that the drift for the entire building will not be an issue because as the floors go up, the loads get smaller and therefore, the first floor is the worst case. A lateral check on a shear wall was also completed. This check proved that the current design of the wall and reinforcement are sufficient to carry lateral loads.

Another issue not mentioned thus far is the foundations. Lateral loads cause foundation systems to experience tension on one side and compression on the other. Overturning is a factor here. As mentioned above, because the resisting moment is much larger than the overturning moment this is not a concern. However, when designing the foundations all loads from walls (gravity and lateral) must be considered and used.

Appendix

Main Wind Force Resisting System per ASCE7-02
Assumptions:
***FOR ALL "h"

***Calculating Wind in Direction:	**N/S**	Left Half of Building

Building Name	Upper Campus Housing Project			
Building Location	Pittsburgh, PA			
Location Data	**Variable**	**Reference**	**Chart/Fig.**	**Value**
Occupancy Type	-	1.5.1	T1-1	III
Importance Factor	I	6.5.5	T6-1	1.15
Surface Roughness	-	6.5.6.2	-	-
Exposure Factor	-	6.5.6.3	-	B
Enclosure Classification**	-	-		Open
				Partially
			X	Enclosed
Internal Pressure Coefficient	GC_{pi}	-	-	0.18
Topographic	K_{zt}	6.5.7.2	F6-4*	1.00
*$K_{zt}=(1+k_1k_2k_3)^2$				
**Place an "X" in the box indicating Enclosure Classification				

Building Dimensions (ft)	**Variable**	**Reference**	**Source**	**Value**
Height Above Base	h_n	9.5.5.3	Spec	102.15
Height Above Ground	z	6.300	Spec	102.15
Horiz. Length II to Wind Dir.	L	6.300	Spec	54.33
Horiz. Length Perp. to Wind	B	6.300	Spec	184.33
Horizontal Dimension Ratio	L/B	F6-6	Spec	0.29
Mean Roof Height	h	6.200	*	100.99
*Average of roof eave height and height of highest point of roof				

Wind Velocity (mph)	**Variable**	**Reference**	**Chart/Fig.**	**Value**
Basic Wind Speed	V	6.5.4	F6.1	90
Wind Directionality	k_d	6.5.4.4	T6-4	0.85
3-sec Gust Power Law	α	6.300	T6-2	7.0
Mean Wind Speed Factor: α hat	a	6.5.8.2	T6-2	0.25
Wind Coefficient: b hat	b	6.5.8.2	T6-2	0.45
Min Height	z_{min}	6.5.8.2	T6-2	30
Equivalent Height: z hat	z	6.5.8.2	T6-2	60.594
Mean Hourly Wind Speed	V_z	6.5.8.2	Eq 6-14	69.15
Height atm Boundary	z_g	6.300	T6-2	1200
Velocity Pressure Exp.*	k_z	6.5.6.6	T6-3**	1.04

Velocity Pressure Exp.*	k_h	6.5.6.6	T6-3**	1.04
*Calculated for ($15' \le z \le z_g$), or use Table 6-3				
**k_z and k_h: Use "Kz" Sheet to find value coordinating to largest "z"				

Integral Length Scale	Variable	Reference	Chart/Fig.	Value
Integral Length Scale Factor	l	6.5.8.1	T6-2	320
Integral Length Scale Exp	ε	6.5.8.1	T6-2	0.33
Integral Length Scale, Turb.	L_z	6.5.8.1	Eq 6-7	391.06
Turbulence Intensity Factor	c	6.300	T6-2	0.30
Intensity of Turbulence	I_z	6.5.8.1	Eq 6-5	0.27

Fundamental Period	Variable	Reference	Chart/Fig.	Value
Period Coefficient	C_t	9.5.3.2	T9.5.5.3.2	0.02
Period Exponent	x	9.5.3.2	T9.5.5.3.2	0.75
Approx. Fund. Period	T_a	9.5.3.2	$T_a=C_t(h_n^x)$	0.64
Natural Frequency	n_1	6.5.8.2	$n_1=1/T_a$	1.56
Rigid or Flexible	-	6.5.8.2	$n_1>1$?	Rigid

Resonance	Variable	Reference	Chart/Fig.	Value	η
R_1 Coefficient	R_h	6.5.8.2	Eq 6-13	0.091	10.455
R_1 Coefficient	R_b	6.5.8.2	Eq 6-13	0.051	19.082
R_1 Coefficient	R_l	6.5.8.2	Eq 6-13	0.052	18.829
Reduced Frequency	N_1	6.5.8.2	Eq 6-13	8.801	
Resonance Coefficient	R_n	6.5.8.2	Eq 6-13	0.035	
Damping Ratio	β	6.300	Section 9	0.050	
Resonant Response Factor	R	6.5.8.2	Eq 6-10	0.043	

Gust Effect Factor	Variable	Reference	Chart/Fig.	Value
Gust Coefficient	g_q	6.5.8.2	Eq 6-8	3.4
Gust Coefficient	g_v	6.5.8.2	Eq 6-8	3.4
Gust Coefficient	g_r	6.5.8.2	Eq 6-9	4.29
Background Response	Q	6.5.8.1	Eq 6-6	0.81
Gust Factor	G_f	6.5.8.2	Eq 6-8	0.85

Wind Pressure	Variable	Reference	Chart/Fig.	Value
Velocity Pressure	qz	6.5.10	Eq 6-15	21.080
Velocity Pressure @ h	qh	6.5.12.2	T6-3*	21.080
*$q_h=0.00256k_hk_zk_d(V^2)I$				

Ext. Pressure Coefficient	Variable	Reference	Chart/Fig.	Value
Windward Side	C_p	6.5.11.2	F6-6*	0.8
Leeward Side	C_p	6.5.11.2	F6-6*	-0.5
Sidewall	C_p	6.5.11.2	F6-6*	-0.7
*Formulas must be checked with any new code changes				

Leeward Pressure (psf)	P_1	6.5.12.2	$P_1=q_hG_fC_p$	-8.959

Final Pressure (psf)	$P=q_z G f C_p - q_h G f C_p$

z(ft)	**k_z(T6-3)	q_z	$P_{sidewall}$(psf)	$P_{leeward}$(psf)	$P_{windward}$(psf)	P_{total}(psf)
0-15	0.57	11.554	-6.874	-8.959	7.856	16.816
20	0.62	12.567	-7.477	-8.959	8.546	17.505
25	0.66	13.378	-7.960	-8.959	9.097	18.056
30	0.70	14.189	-8.442	-8.959	9.648	18.607
40	0.76	15.405	-9.166	-8.959	10.475	19.434
50	0.81	16.418	-9.769	-8.959	11.164	20.124
60	0.85	17.229	-10.251	-8.959	11.716	20.675
70	0.89	18.040	-10.734	-8.959	12.267	21.226
80	0.93	18.851	-11.216	-8.959	12.818	21.777
90	0.96	19.459	-11.578	-8.959	13.232	22.191
100	0.99	20.067	-11.940	-8.959	13.645	22.604
120	1.04	21.080	-12.543	-8.959	14.335	23.294
140	-	-	-	-	-	-
160	-	-	-	-	-	-
180	-	-	-	-	-	-
200	-	-	-	-	-	-
225	-	-	-	-	-	-
300	-	-	-	-	-	-
350	-	-	-	-	-	-
400	-	-	-	-	-	-
450	-	-	-	-	-	-
500	-	-	-	-	-	-

**k_z and k_h: Use "Kz" Sheet to copy and paste values

Seismic Calcs

per ASCE7-02

Seismic Use Group I — Table 9.1.3
Site classification D — 9.4.1.2.1
$S_S = 0.127$ — Fig. 9.4.1.1a
$S_1 = 0.054$ — Fig 9.4.1.1b
$F_a = 1.6$ — Tbl 9.4.1.2a
$F_v = 2.4$ — Tbl 9.4.1.2b

$S_{MS} = F_a S_S = 1.6(0.127) = 0.203$
$S_{M1} = F_v S_1 = 2.4(0.054) = 0.129$

$S_{DS} = (2/3) S_{MS} = (2/3)0.203 = 0.135$
$S_{D1} = (2/3) S_{D1} = (2/3)0.129 = 0.086$

Seismic Design Category → A

W_{roof} = Penthouse + Low Roof = 313.2K + 1935K = 2248.2K

W_{Floor} = Ground + First + 7(Typ Floor) + Ninth

= 966.1K + 1701K + 7(1735K) + 1498K = 16310.1K

$W = 2248.2 + 16310.1 = 18558.3K$

$R = 3$ — Tbl 9.5.2.2
$I = 1.0$ — Tbl 9.1.4

$T = C_t h_n^x = 0.02(100ft)^{0.75} = 0.632$ — Tbl 9.5.5.3.2

$C_S = \frac{S_{DS}}{R/I} = \frac{0.135}{3/1} = 0.045$

$C_{smax} = \frac{S_{D1}}{T(R/I)} = \frac{0.086}{0.632(3/1)} = 0.045$

$C_{smin} = 0.044 I S_{DS} = 0.044(1.0)(0.135) = 0.006$

$V = C_S W = 0.045(18558K) = \boxed{835.1K}$

$K = 1 + \frac{0.632 - 0.5}{2} = 1.07$

Appendix B.1 (Left)

Floor	Height	Story Forces
Roof	99.14	26
Ninth	88.64	178.16
Eighth	79.31	283.88
Seventh	69.98	393.98
Sixth	60.65	491.81
Fifth	51.32	577.48
Fourth	41.99	651.11
Third	32.66	712.8
Second	23.33	762.73
First	12	801.18

Direct Shear

Wall	First	Second	Third	Fourth	Fifth
A	6.39	6.08	5.21	4.56	3.96
B	147.71	140.62	128.21	115.64	101.83
C	183.66	174.84	171.63	160.62	144.38
D	3.67	3.49	3.00	2.63	2.28
E	2.57	2.45	2.10	1.84	1.60
F	6.32	6.02	5.25	4.64	4.04
G	60.06	57.18	56.74	53.34	48.05
H	175.40	166.98	154.47	140.25	123.94
I	17.93	17.07	14.73	12.96	11.26
J	197.47	187.99	171.47	154.63	136.15

Sixth	Seventh	Eighth	Ninth	Roof
3.33	2.64	1.89	1.18	0.17
86.35	68.97	49.60	31.09	4.53
123.96	99.82	72.18	45.41	6.64
1.92	1.53	1.09	0.68	0.10
1.34	1.07	0.76	0.48	0.07
3.40	2.71	1.94	1.21	0.18
41.30	33.29	24.08	15.16	2.22
105.31	84.24	60.63	38.02	5.55
9.47	7.53	5.39	3.37	0.49
115.43	92.20	66.30	41.55	6.06

Wall	First	Second	Third	Fourth	Fifth
K	66.31	49.89	42.45	36.88	31.76
L	56.16	43.48	37.29	32.50	28.05
M	118.97	118.24	110.80	101.02	89.41
N	118.97	118.24	110.80	101.02	89.41
O	54.71	42.05	35.99	31.34	27.03
P	216.16	249.70	251.05	238.34	216.12
Q	74.99	56.56	48.31	42.04	36.26
R	3.10	1.64	1.29	1.08	0.91
S	91.82	82.92	74.83	66.89	58.54

Sixth	Seventh	Eighth	Ninth	Roof
26.56	21.03	15.03	9.37	1.36
23.48	18.60	13.30	8.30	1.21
76.02	60.82	43.78	27.46	4.00
76.02	60.82	43.78	27.46	4.00
22.62	17.92	12.81	7.99	1.16
186.59	150.82	109.34	68.93	10.09
30.35	24.03	17.18	10.72	1.56
0.75	0.59	0.42	0.26	0.04
49.42	39.36	28.25	17.67	2.57

Torsional Shear

Floor	Wall	k	x	kx^2	$kx/\Sigma kx^2$	Torsional Shear
First	A	1675.40	20.77	722429.48	0.000088	0.118865
	B	30226.74	24.93	18789527.49	0.001908	2.574835
	C	30021.78	26.27	20710997.61	0.001996	2.694105
	D	948.68	0.90	776.49	0.000002	0.002932
	E	671.13	2.10	2946.45	0.000004	0.004805
	F	1519.66	9.23	129596.07	0.000036	0.047947
	G	9344.48	1.90	33900.85	0.000045	0.060811
	H	33916.16	4.13	579823.58	0.000355	0.479123
	I	4518.13	26.57	3189091.93	0.000304	0.410118
	J	39895.44	29.23	34097352.42	0.002952	3.984903
	K	5909.12	86.48	44193289.38	0.001293	1.745965
	L	5004.95	70.81	25097361.80	0.000897	1.210904
	M	10602.88	60.31	38569904.69	0.001619	2.184903
	N	10602.88	47.31	23734955.11	0.001270	1.713965
	O	4875.46	51.48	12922484.86	0.000635	0.857584
	P	19264.00	59.52	68244795.53	0.002902	3.917453
	Q	6683.00	73.52	36122678.09	0.001244	1.678693
	R	276.17	82.52	1880595.04	0.000058	0.077863
	S	8182.65	89.85	66058450.87	0.001861	2.511927

Second	A	254.22	20.77	109617.35	0.000056	0.071547614
	B	5878.56	24.93	3654224.40	0.001546	1.986492451
	C	7309.15	26.27	5042329.25	0.002025	2.601973567
	D	146.06	0.90	119.55	0.000001	0.001790974
	E	102.33	2.10	449.24	0.000002	0.002905953
	F	251.61	9.23	21457.22	0.000025	0.031492304
	G	2390.24	1.90	8671.56	0.000048	0.061705402
	H	6980.48	4.13	119336.79	0.000304	0.391186369
	I	713.47	26.57	503599.95	0.000200	0.256912706
	J	7858.76	29.23	6716629.45	0.002423	3.113914033
	K	1200.26	86.48	8976543.31	0.001095	1.406845696
	L	1046.14	70.81	5245892.09	0.000781	1.004058849
	M	2844.99	60.31	10349174.71	0.001810	2.325666289
	N	2844.99	47.31	6368623.39	0.001420	1.824388484
	O	1011.82	51.48	2681842.74	0.000549	0.706027864
	P	6007.83	59.52	21283370.66	0.003771	4.84655115
	Q	1360.97	73.52	7356277.40	0.001055	1.35614977
	R	39.47	82.52	268769.91	0.000034	0.044144475
	S	1995.08	89.85	16106247.77	0.001891	2.429579696

Third	A	94.61	20.77	40795.50	0.000048	0.058123625
	B	2329.60	24.93	1448126.77	0.001431	1.718394551
	C	3118.57	26.27	2151393.91	0.002018	2.423350403
	D	54.50	0.90	44.61	0.000001	0.001458746
	E	38.11	2.10	167.30	0.000002	0.002362227
	F	95.35	9.23	8131.56	0.000022	0.026051305
	G	1031.03	1.90	3740.47	0.000048	0.058100148
	H	2806.69	4.13	47982.58	0.000286	0.343334616
	I	267.62	26.57	188900.50	0.000175	0.210357316
	J	3115.64	29.23	2662835.32	0.002244	2.6947851
	K	479.43	86.48	3585587.91	0.001021	1.226654652
	L	421.08	70.81	2111511.87	0.000735	0.882181494
	M	1251.21	60.31	4551493.93	0.001859	2.232647944
	N	1251.21	47.31	2800875.58	0.001458	1.751419461
	O	406.40	51.48	1077169.91	0.000515	0.619009546
	P	2835.04	59.52	10043444.42	0.004157	4.992288469
	Q	545.54	73.52	2948726.12	0.000988	1.18661161
	R	14.52	82.52	98846.52	0.000030	0.035439018
	S	845.07	89.85	6822272.97	0.001871	2.246417459

Fourth	A	44.91	20.77	19364.77	0.000045	0.049531919
	B	1137.69	24.93	707212.06	0.001373	1.50660137
	C	1580.24	26.27	1090152.85	0.002010	2.204530258
	D	25.90	0.90	21.20	0.000001	0.001244455
	E	18.09	2.10	79.43	0.000002	0.002013524
	F	45.61	9.23	3889.90	0.000020	0.022373106
	G	524.77	1.90	1903.81	0.000048	0.053089349
	H	1379.81	4.13	23588.97	0.000276	0.303022779
	I	127.46	26.57	89965.19	0.000164	0.179858682
	J	1521.32	29.23	1300222.87	0.002153	2.362272637
	K	234.88	86.48	1756647.34	0.000983	1.078894328
	L	207.03	70.81	1038139.69	0.000710	0.778668493
	M	643.47	60.31	2340742.34	0.001879	2.061352581
	N	643.47	47.31	1440434.32	0.001474	1.617045372
	O	199.61	51.48	529064.62	0.000498	0.545826035
	P	1518.14	59.52	5378188.75	0.004375	4.799383151
	Q	267.81	73.52	1447539.44	0.000953	1.045771867
	R	6.86	82.52	46685.67	0.000027	0.030049437
	S	426.08	89.85	3439732.14	0.001854	2.033379259

Fifth	A	24.71	20.77	10654.28	0.000043	0.042262614
	B	635.43	24.93	394994.06	0.001341	1.304964275
	C	900.91	26.27	621508.49	0.002003	1.949104362
	D	14.26	0.90	11.67	0.000001	0.001062397
	E	9.96	2.10	43.71	0.000002	0.001718214
	F	25.20	9.23	2148.74	0.000020	0.019165941
	G	299.83	1.90	1087.76	0.000048	0.047041097
	H	773.38	4.13	13221.62	0.000271	0.263396738
	I	70.25	26.57	49582.03	0.000158	0.153723597
	J	849.55	29.23	726079.85	0.002103	2.045766012
	K	131.40	86.48	982679.98	0.000962	0.935978329
	L	116.03	70.81	581843.73	0.000696	0.676803383
	M	369.86	60.31	1345416.63	0.001889	1.837446991
	N	369.86	47.31	827935.76	0.001481	1.441400749
	O	111.81	51.48	296362.02	0.000487	0.474162737
	P	894.01	59.52	3167131.59	0.004505	4.383034075
	Q	149.99	73.52	810710.93	0.000934	0.908305473
	R	3.76	82.52	25620.04	0.000026	0.025573601
	S	242.14	89.85	1954831.98	0.001842	1.792101308

Sixth	A	15.01	20.77	6471.56	0.000042	0.035155369
	B	389.40	24.93	242059.16	0.001322	1.095165962
	C	559.01	26.27	385643.91	0.001999	1.656246086
	D	8.66	0.90	7.09	0.000001	0.000884012
	E	6.05	2.10	26.55	0.000002	0.001429355
	F	15.34	9.23	1308.20	0.000019	0.015979796
	G	186.27	1.90	675.79	0.000048	0.040022262
	H	474.94	4.13	8119.39	0.000267	0.221513137
	I	42.71	26.57	30146.45	0.000154	0.1279979
	J	520.55	29.23	444897.03	0.002072	1.716648784
	K	80.59	86.48	602744.60	0.000949	0.786207842
	L	71.25	70.81	357285.64	0.000687	0.569143908
	M	230.63	60.31	838944.73	0.001894	1.569067916
	N	230.63	47.31	516265.62	0.001485	1.230868526
	O	68.64	51.48	181924.25	0.000481	0.398607837
	P	566.10	59.52	2005455.05	0.004587	3.800773898
	Q	92.06	73.52	497624.70	0.000921	0.763516096
	R	2.28	82.52	15538.85	0.000026	0.021241316
	S	149.94	89.85	1210482.37	0.001834	1.519714314

Seventh	A	9.79	20.77	4219.71	0.000042	0.027734757
	B	255.34	24.93	158724.19	0.001309	0.868881756
	C	369.53	26.27	254925.39	0.001996	1.324678972
	D	5.65	0.90	4.62	0.000001	0.000697551
	E	3.94	2.10	17.31	0.000002	0.00112769
	F	10.02	9.23	854.24	0.000019	0.012625205
	G	123.23	1.90	447.06	0.000048	0.032034421
	H	311.84	4.13	5331.19	0.000265	0.175978467
	I	27.87	26.57	19668.84	0.000152	0.10104258
	J	341.31	29.23	291703.03	0.002052	1.361827283
	K	52.88	86.48	395455.71	0.000940	0.624109862
	L	46.78	70.81	234580.52	0.000681	0.452124072
	M	152.94	60.31	556340.34	0.001897	1.258948865
	N	152.94	47.31	342357.93	0.001488	0.987593028
	O	45.06	51.48	119419.83	0.000477	0.316585383
	P	379.26	59.52	1343583.15	0.004641	3.080936896
	Q	60.43	73.52	326642.53	0.000914	0.606384591
	R	1.49	82.52	10122.45	0.000025	0.016742003
	S	98.98	89.85	799071.28	0.001829	1.213802866

Eighth	A	6.73	20.77	2901.96	0.000041	0.019776064
	B	176.27	24.93	109572.89	0.001300	0.621910089
	C	256.51	26.27	176956.21	0.001993	0.953389294
	D	3.89	0.90	3.18	0.000001	0.000497449
	E	2.71	2.10	11.91	0.000002	0.000804112
	F	6.90	9.23	588.05	0.000019	0.009011136
	G	85.58	1.90	310.48	0.000048	0.023067145
	H	215.47	4.13	3683.63	0.000264	0.126071791
	I	19.17	26.57	13532.17	0.000151	0.072077554
	J	235.60	29.23	201359.36	0.002038	0.974675019
	K	36.52	86.48	273098.50	0.000934	0.446878486
	L	32.32	70.81	162078.11	0.000677	0.323889576
	M	106.39	60.31	387020.32	0.001899	0.908046804
	N	106.39	47.31	238162.63	0.001489	0.712324954
	O	31.13	51.48	82498.78	0.000474	0.226761253
	P	265.72	59.52	941344.42	0.004679	2.238070347
	Q	41.75	73.52	225650.35	0.000908	0.434328529
	R	1.02	82.52	6957.00	0.000025	0.011930274
	S	68.64	89.85	554139.13	0.001825	0.872747041

Ninth	A	4.82	20.77	2080.25	0.000041	0.012319018
	B	126.70	24.93	78757.78	0.001294	0.388444711
	C	185.09	26.27	127690.51	0.001992	0.597825352
	D	2.79	0.90	2.28	0.000001	0.000309902
	E	1.94	2.10	8.54	0.000002	0.000500911
	F	4.95	9.23	421.83	0.000019	0.005617135
	G	61.78	1.90	224.12	0.000048	0.014469343
	H	154.97	4.13	2649.37	0.000263	0.078794539
	I	13.75	26.57	9703.29	0.000150	0.044912037
	J	169.33	29.23	144724.03	0.002028	0.608751319
	K	26.25	86.48	196346.19	0.000930	0.279192563
	L	23.25	70.81	116567.28	0.000674	0.202423298
	M	76.89	60.31	279701.53	0.001900	0.570270041
	N	76.89	47.31	172121.33	0.001490	0.447353131
	O	22.38	51.48	59327.54	0.000472	0.141706228
	P	193.03	59.52	683813.22	0.004707	1.41277798
	Q	30.02	73.52	162270.85	0.000904	0.271415161
	R	0.73	82.52	4984.89	0.000025	0.0074284
	S	49.50	89.85	399584.15	0.001822	0.546876254

Appendix B.2 (Right)

Direct Shear

Wall	First	Second	Third	Fourth	Fifth
A	158.15	150.56	135.15	121.10	106.28
B	32.14	30.60	27.16	24.22	21.21
C	14.86	14.15	12.73	11.42	10.03
D	5.72	5.44	4.81	4.28	3.74
E	292.88	278.83	266.87	246.29	219.58
F	9.69	9.22	8.21	7.33	6.42
G	47.64	45.35	40.53	36.25	31.78
H	231.91	220.78	208.17	190.69	169.32
I	8.19	7.80	9.16	9.52	9.13

Sixth	Seventh	Eighth	Ninth	Roof
89.94	71.75	51.56	32.29	4.70
17.92	14.28	10.26	6.42	0.94
8.49	6.77	4.87	3.05	0.44
3.16	2.52	1.81	1.13	0.16
187.56	150.53	108.59	68.21	9.96
5.43	4.33	3.11	1.95	0.28
26.88	21.44	15.40	9.64	1.40
144.27	115.60	83.31	52.29	7.63
8.16	6.76	4.98	3.18	0.47

Wall	First	Second	Third	Fourth	Fifth
I	318.39	343.70	340.75	322.29	291.99
J	28.24	16.69	12.93	10.64	8.88
K	98.43	87.72	77.54	68.14	58.91
L	98.43	87.72	77.54	68.14	58.91
M	143.07	148.20	140.55	128.62	113.92
N	58.08	40.32	32.62	27.41	23.10
O	56.54	38.38	30.87	25.87	21.78

Sixth	Seventh	Eighth	Ninth	Roof
252.10	203.82	147.81	93.20	13.65
7.27	5.68	4.02	2.49	0.36
49.31	39.04	27.89	17.39	2.53
49.31	39.04	27.89	17.39	2.53
96.83	77.44	55.72	34.93	5.09
19.04	14.93	10.59	6.57	0.95
17.94	14.05	9.97	6.18	0.89

Floor	Wall	k	x	kx^2	$kx/\Sigma kx^2$	Torsional Shear
First	A	14747.41	27.47	11128791.60	0.002529	40.793123
	B	3158.89	23.47	1740114.25	0.000463	7.465536
	C	1365.55	7.72	81394.83	0.000066	1.061593
	D	576.84	1.47	1247.29	0.000005	0.085411
	E	21523.89	1.76	66636.55	0.000236	3.813482
	F	938.70	17.36	282880.35	0.000102	1.640854
	G	4522.39	24.19	2646855.07	0.000683	11.016763
	H	17755.22	26.86	12809219.71	0.002977	48.020802
	I	378.00	0.31	35.27	0.000001	0.011627
	J	3041.86	31.03	2929366.65	0.000589	9.505207
	K	10602.88	43.30	19879668.18	0.002866	46.229763
	L	10602.88	53.30	30122152.83	0.003528	56.906268
	M	15411.20	39.47	24005361.85	0.003797	61.245956
	N	6256.19	58.80	21628530.28	0.002296	37.040215
	O	6090.77	73.47	32874720.36	0.002793	128.900000

Second	A	2372.05	27.47	1790010.05	0.001728	26.53035023
	B	482.06	23.47	265546.74	0.000300	4.606518104
	C	222.87	7.72	13284.57	0.000046	0.700579181
	D	85.76	1.47	185.45	0.000003	0.051346697
	E	4392.84	1.76	13599.93	0.000205	3.14698358
	F	145.27	17.36	43778.70	0.000067	1.026782958
	G	714.48	24.19	418169.52	0.000458	7.037603485
	H	3478.37	26.86	2509417.56	0.002477	38.0389247
	I	122.85	0.31	11.46	0.000001	0.015279546
	J	541.21	31.03	521195.65	0.000445	6.838127213
	K	2844.99	43.30	5334163.02	0.003266	50.15651835
	L	2844.99	53.30	8082452.49	0.004020	61.73988558
	M	4806.26	39.47	7486505.16	0.005029	77.23192427
	N	1307.68	58.80	4520831.18	0.002039	31.30497381
	O	1244.78	73.47	6718659.17	0.002425	37.23413018

Third	A	893.70	27.47	674407.05	0.001526	21.89370582
	B	179.62	23.47	98945.06	0.000262	3.759547533
	C	84.20	7.72	5018.58	0.000040	0.579695395
	D	31.78	1.47	68.72	0.000003	0.041673413
	E	1764.71	1.76	5463.43	0.000193	2.769063847
	F	54.27	17.36	16355.57	0.000059	0.840216353
	G	268.03	24.19	156872.68	0.000403	5.782683096
	H	1376.52	26.86	993068.34	0.002297	32.97190941
	I	60.60	0.31	5.65	0.000001	0.016508653
	J	208.57	31.03	200854.66	0.000402	5.772022028
	K	1251.21	43.30	2345927.21	0.003367	48.31536817
	L	1251.21	53.30	3554605.51	0.004144	59.47353206
	M	2268.03	39.47	3532819.11	0.005562	79.82681273
	N	526.35	58.80	1819669.29	0.001923	27.59924374
	O	498.16	73.47	2688795.57	0.002274	32.63818866

Fourth	A	426.46	27.47	321818.92	0.001433	18.78135682
	B	85.30	23.47	46991.25	0.000245	3.209790404
	C	40.22	7.72	2397.46	0.000038	0.497839936
	D	15.06	1.47	32.56	0.000003	0.035494566
	E	867.34	1.76	2685.24	0.000187	2.446629167
	F	25.80	17.36	7776.22	0.000055	0.718144624
	G	127.66	24.19	74715.30	0.000378	4.951193095
	H	671.55	26.86	484477.55	0.002206	28.91723975
	I	33.54	0.31	3.13	0.000001	0.016425974
	J	100.51	31.03	96794.82	0.000381	5.000534168
	K	643.47	43.30	1206463.47	0.003407	44.66868366
	L	643.47	53.30	1828062.56	0.004194	54.98466618
	M	1214.52	39.47	1891797.99	0.005862	76.84584073
	N	258.78	58.80	894653.23	0.001861	24.39369942
	O	244.28	73.47	1318483.49	0.002195	28.77141213

Fifth	A	235.27	27.47	177543.39	0.001383	16.079468
	B	46.95	23.47	25860.90	0.000236	2.741290791
	C	22.20	7.72	1323.39	0.000037	0.426460545
	D	8.28	1.47	17.89	0.000003	0.030276419
	E	486.10	1.76	1504.93	0.000183	2.12791249
	F	14.21	17.36	4281.93	0.000053	0.613669612
	G	70.36	24.19	41178.47	0.000364	4.234696407
	H	374.83	26.86	270417.09	0.002154	25.04777129
	I	20.20	0.31	1.89	0.000001	0.015355345
	J	55.74	31.03	53674.73	0.000370	4.30314409
	K	369.86	43.30	693453.52	0.003427	39.84355722
	L	369.86	53.30	1050737.50	0.004218	49.04520379
	M	715.21	39.47	1114050.37	0.006040	70.22669077
	N	145.04	58.80	501424.21	0.001825	21.21680571
	O	136.72	73.47	737929.69	0.002149	24.98925088

Sixth	A	143.13	27.47	108012.92	0.001353	13.40174185
	B	28.52	23.47	15710.69	0.000230	2.281524301
	C	13.51	7.72	805.38	0.000036	0.355556872
	D	5.02	1.47	10.86	0.000003	0.025180431
	E	298.50	1.76	924.13	0.000181	1.790156749
	F	8.63	17.36	2602.15	0.000052	0.510911343
	G	42.78	24.19	25037.36	0.000356	3.527434467
	H	229.61	26.86	165647.95	0.002123	21.02032347
	I	12.99	0.31	1.21	0.000001	0.013529254
	J	34.01	31.03	32752.08	0.000363	3.597272089
	K	230.63	43.30	432408.20	0.003437	34.03713882
	L	230.63	53.30	655195.33	0.004231	41.89782555
	M	452.88	39.47	705426.31	0.006152	60.92105411
	N	89.06	58.80	307903.41	0.001803	17.848741
	O	83.88	73.47	452754.91	0.002121	21.00486027

Seventh	A	93.42	27.47	70498.92	0.001335	10.58602447
	B	18.60	23.47	10244.97	0.000227	1.800551822
	C	8.82	7.72	525.77	0.000035	0.280911156
	D	3.27	1.47	7.08	0.000003	0.019863106
	E	195.99	1.76	606.77	0.000179	1.422479779
	F	5.63	17.36	1697.21	0.000051	0.403287406
	G	27.91	24.19	16335.59	0.000351	2.785289298
	H	150.52	26.86	108589.64	0.002102	16.67656577
	I	8.80	0.31	0.82	0.000001	0.011089596
	J	22.24	31.03	21417.40	0.000359	2.846860196
	K	152.94	43.30	286748.47	0.003444	27.31650592
	L	152.94	53.30	434488.20	0.004239	33.6251001
	M	303.41	39.47	472610.39	0.006227	49.39510703
	N	58.48	58.80	202157.98	0.001788	14.18237223
	O	55.05	73.47	297104.43	0.002103	16.68132987

Eighth	A	64.29	27.47	48515.63	0.001322	7.55457434
	B	12.79	23.47	7046.08	0.000225	1.284163444
	C	6.07	7.72	361.87	0.000035	0.200495713
	D	2.25	1.47	4.87	0.000002	0.014162175
	E	135.42	1.76	419.25	0.000178	1.01922252
	F	3.87	17.36	1167.43	0.000050	0.287666052
	G	19.20	24.19	11238.97	0.000348	1.987190895
	H	103.89	26.86	74948.96	0.002088	11.93608002
	I	6.21	0.31	0.58	0.000001	0.008120346
	J	15.32	31.03	14757.67	0.000356	2.034206746
	K	106.39	43.30	199477.69	0.003448	19.70589908
	L	106.39	53.30	302253.41	0.004244	24.25686619
	M	212.58	39.47	331121.42	0.006279	35.88771637
	N	40.40	58.80	139676.49	0.001778	10.16153185
	O	38.02	73.47	205204.00	0.002090	11.94772607

Ninth	A	46.11	27.47	34794.53	0.001313	4.708694454
	B	9.17	23.47	5051.18	0.000223	0.800066905
	C	4.35	7.72	259.55	0.000035	0.124978979
	D	1.61	1.47	3.49	0.000002	0.008821517
	E	97.40	1.76	301.53	0.000178	0.637078573
	F	2.78	17.36	836.99	0.000050	0.179240528
	G	13.77	24.19	8058.97	0.000345	1.238380642
	H	74.66	26.86	53863.73	0.002078	7.455104457
	I	4.54	0.31	0.42	0.000001	0.005156211
	J	11.00	31.03	10593.41	0.000354	1.269036161
	K	76.89	43.30	144163.53	0.003450	12.37708933
	L	76.89	53.30	218440.06	0.004247	15.23550884
	M	154.42	39.47	240533.85	0.006316	22.65666359
	N	29.06	58.80	100455.93	0.001771	6.351446697
	O	27.34	73.47	147546.22	0.002081	7.466012402