Structural Notebook
Submission A

AC Hotel Philadelphia
Philadelphia, Pennsylvania

Jesse C Bordeau

Heather Sustersic, Advisor

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Executive Summary

AC Hotel Philadelphia is a 15-story residential transient hotel (including penthouse) located in the heart of downtown Philadelphia. This new hotel, owned by Baywood Hotels, will be built on top of the previous NFL Films and Warner Bros distribution center, a historic two-story building located at the corner of Florist and North 13th Street in Philadelphia.

The original two-story, 31'-0" tall building is a load bearing masonry structure. In order to properly satisfy the proposed addition, a mat foundation of varying thickness will be installed and the building will be gutted and restructured. The new construction will consist of composite steel at the bottom two levels, supporting a 12-story steel-frame structure atop, capped with a penthouse. The typical floor to floor height measures 10'6". Multiple 14" shear walls make up the lateral system until floor 3 where braced frames are utilized for architectural/spatial purposes including door and window openings.

AC Hotel Philadelphia was designed using the 2009 edition of the International Building Code and ASCE 7-05 was used to determine lateral loads on the building. The City of Philadelphia Building Code (with current amendments) and the 2014 version of "AC Hotels by Marriott Design Standards" were also used as references. The Philadelphia Historical Commission also influenced the project boundaries.

The purpose of this report is to identify the structural loads used in the design of AC Hotel Philadelphia. Gravity, wind and seismic loads are established in the following report.used A code analysis was completed in order to have an accurate understanding of the design loads used for 230 North 13th Street. Codes were used in accordance to the actual design codes applied when designing the building.

AC Hotel Philadelphia

Baywood Hotels | 230 North 13th Street, Philadelphia, Pa

Project Information

- Occupancy: Residential transient hotel
- Stories: parking garage + 14 levels above grade + Mech. Penthouse & Rooftop Terrace
  - 192ft. Above sidewalk grade
- Overall project cost: $35,000,000
- Size: 107,680 sq.ft.
- Construction Dates: Fall 2015 – Summer 2017

Project Team

Owner: Kurt Blorstad
General Contractor: Clemens Construction
Architect: Spg3
Structural Engineer: Holbert Apple Associates
MEP: McHugh Engineering

Features:

- 150 luxury units
- Underground, valet parking via car elevator
- Exclusive restaurant for guests
- Fitness center & indoor pool
- Green Roofs
  - Extensive (2nd & 3rd Levels)
  - Intensive (Rooftop Terrace)

Structure:

- Foundation
  - Mat-slab
  - Underpinning of adjacent structures during construction
- Framing
  - Structural steel framing
  - Composite deck (normal-weight concrete)
  - Precast hollow-core plank girder slab system
- Lateral System
  - Concrete shear walls (lower levels)
  - Concentric brace frames (upper levels)

MEP:

- Mechanical
  - (4) three-ton air handling units
  - Water-source heat pump
  - Energy recovery wheel on the roof used to mix outside air with return air
  - Plethora of fans used to exhaust class 3&4 air
- Electrical
  - 600KW Emergency generator on roof
  - 2500A Main Circuit Breaker

JESSE BORDEAU ~ Structural Option
http://jbordeau18.wix.com/thesis

Site Location

230 North 13th St. is located in Philadelphia, Pennsylvania in proximity to the Liberty Bell, The Franklin Institute and the Eastern State Penitentiary. The site lies northwest of center city, offering dwellers a beautiful view of the Philadelphia skyline. Figures 1 and 2 clarify the exact location below.

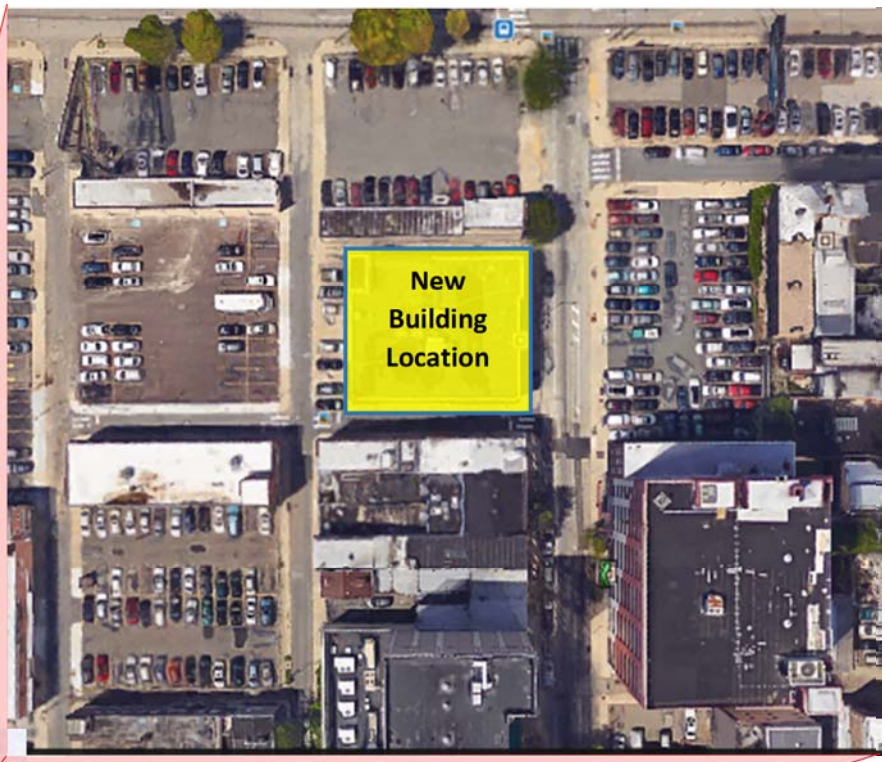


Figure 1: Overhead view of 230 North 13th St in Philadelphia, Pa (Courtesy of Google Maps)

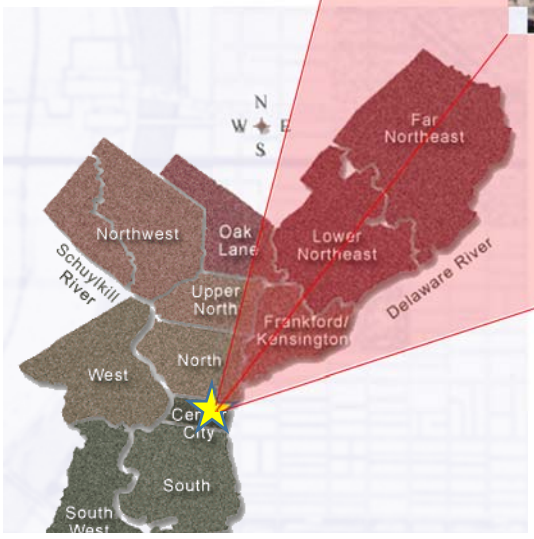


Figure 2: Map of Philadelphia (Courtesy Google Maps)

Documents used in preparation for this report

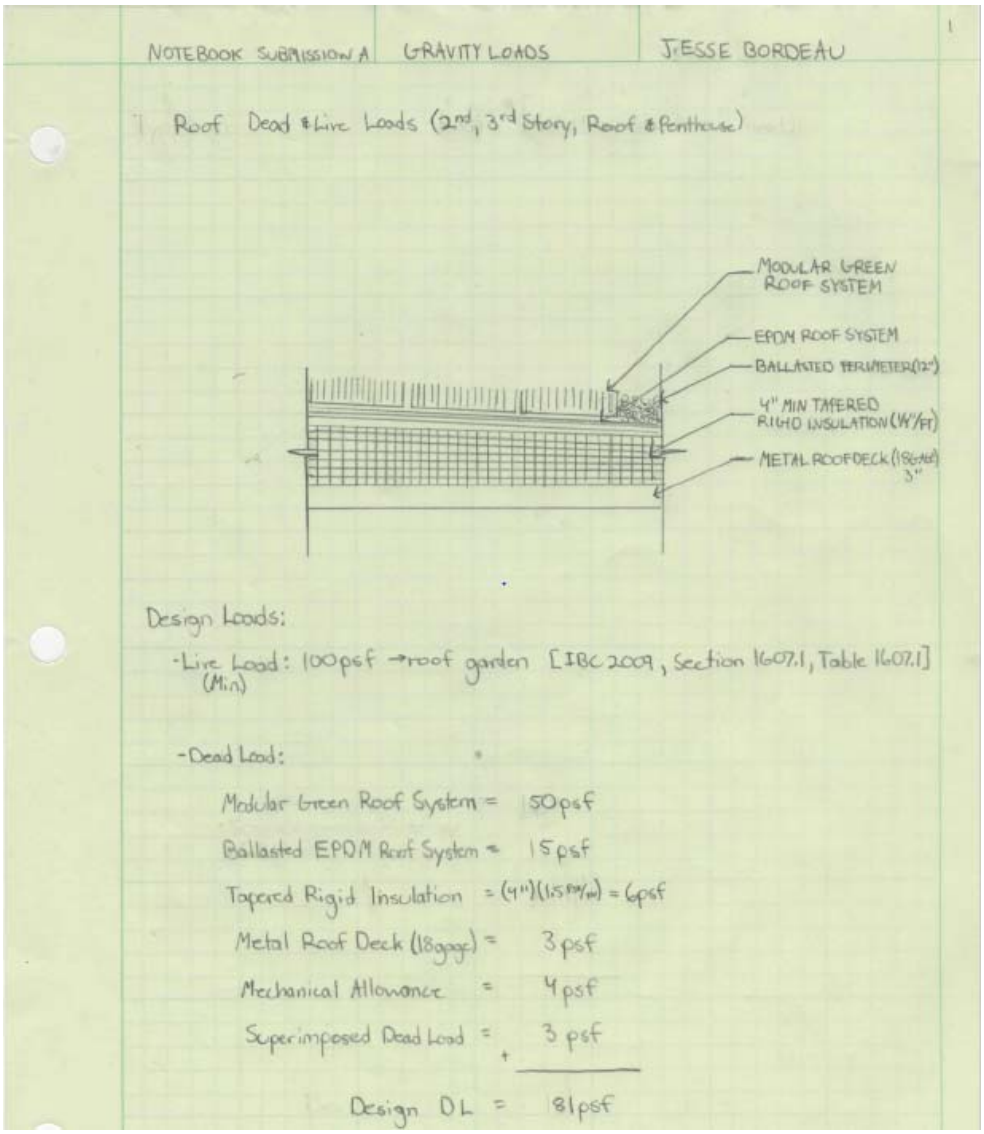
Listed below are the codes which were used to determine loads for the AC Hotel Philadelphia.

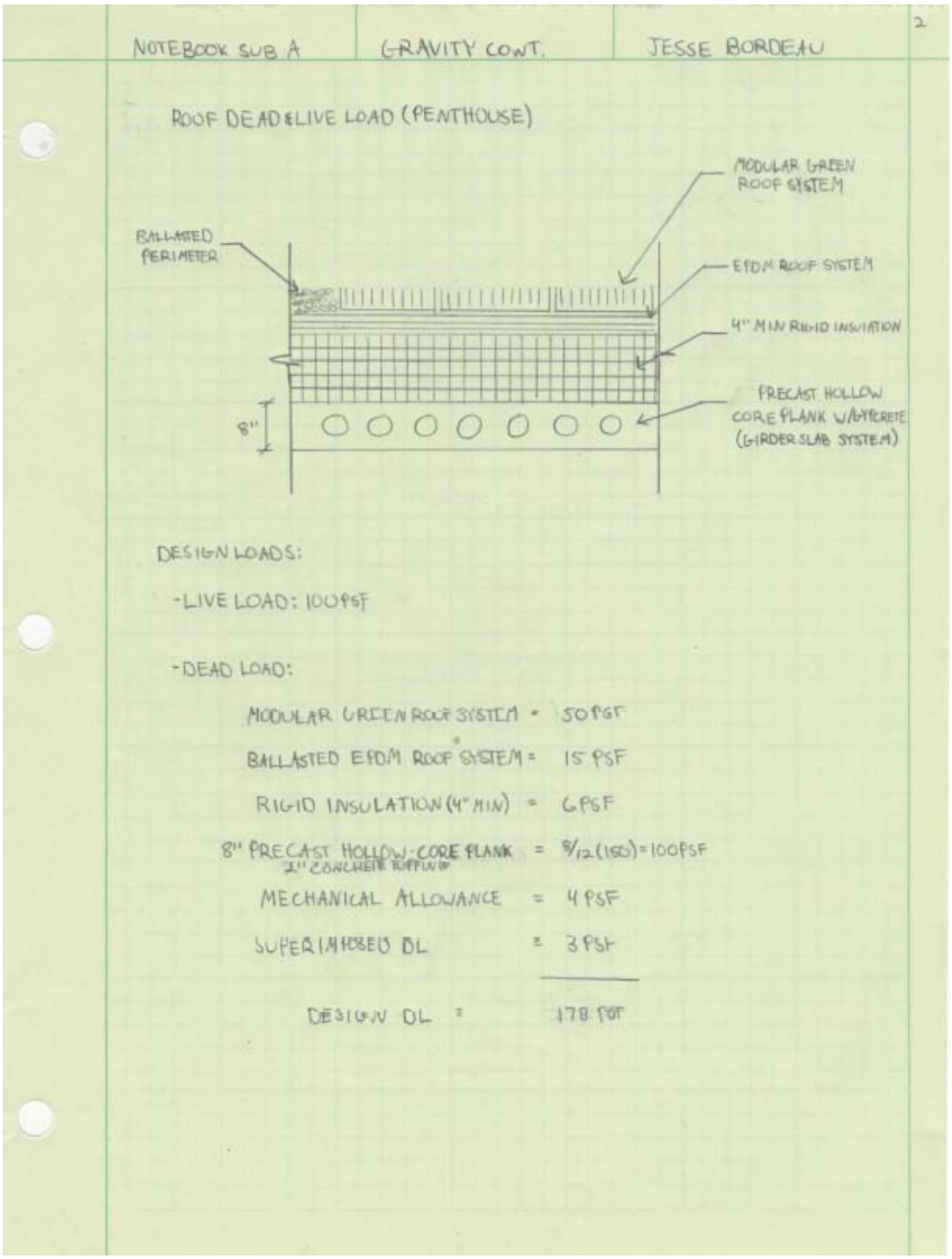
- American Society of Civil Engineers
  - ASCE 7-05
- International Code Council
  - International Building Code 2009
- Construction drawings
  - Courtesy Holbert Apple Associates
- Course notes from previous semesters

Gravity Load Determination (Dead, Live & Snow)

Roof Loads

The roof load calculated below is for the intensive green roof used in several locations around the building. Loads are compared to code minimum (IBC ch 16, Table 1607.1) within each section. Original loads, determined by professionals are located at the end of the gravity load portion of this report.




NOTEBOOK SUB A | GRAVITY CONT. | JESSE BORDEAU | 2

ROOF DEAD & LIVE LOAD (PENTHOUSE)

DESIGN LOADS:

-LIVE LOAD: 100PSF

-DEAD LOAD:

MODULAR GREEN ROOF SYSTEM	=	50PSF
BALLASTED EPDM ROOF SYSTEM	=	15 PSF
RIGID INSULATION (4" MIN)	=	6PSF
8" PRECAST HOLLOW-CORE PLANK (2" CONCRETE TOPPING)	=	8/12(150) = 100PSF
MECHANICAL ALLOWANCE	=	4 PSF
SUPERIMPOSED DL	=	3 PSF
DESIGN DL	=	178 PSF

Note: Intensive green roofs require higher design criteria because of the possibility of human traffic over it. Modular Green Roof Systems vary in weight, therefore an average load was applied.

NOTEBOOK SUB A | SNOW LOADS | JESSE B. | 5

SNOW LOAD:

USING ASCE 7-05 [FIGURE 7-1] → $p_g = 30$ PSF

$p_f = 0.7 C_e C_t I p_g$

C_e - EXPOSURE FACTOR [TABLE 7-2]

C_t - THERMAL FACTOR

I - IMPORTANCE FACTOR

DETERMINE C_e:

[TABLE 7-2] TERRAIN CAT. B [SECTION 6.5.6] → FULLY EXPOSED → $C_e = 0.9$

DETERMINE C_t:

[TABLE 7-3] $C_t = 1.0$

DETERMINE I:

[TABLE 1-1] OCCUPANCY CATEGORY → II

[TABLE 7-4] $I = 1.0$

DETERMINE p_f:

$p_f = (0.7)(1.0)(1.0)(30) = \underline{21 \text{ PSF}}$

NOTEBOOK SUB A | SNOW DRIFT CALCS | JESSE B | 6

$\gamma = \begin{cases} 0.13 p_g + 14 = 0.13(20) + 14 = 16.7 \\ 30 \text{ PCF} \end{cases}_{min}$

$h_b = \frac{p_s(\text{balanced})}{\gamma} = \frac{21}{16.7} = 1.26 \rightarrow h_c = 191 - 181 = 10' \rightarrow \frac{h_c}{h_b} = \frac{10}{1.26} = 7.94 > 0.2$ ∴ REQ'D

LEEWARD $l_u = 29' > 25'$ ∴

$h_d = 0.43 \sqrt[3]{l_u} \sqrt[4]{p_g + 10} - 1.5$

$= 0.43 \sqrt[3]{29} \sqrt[4]{20 + 10} - 1.5$

$= 1.50 < h_c = 5.25$

WINDWARD $l_u = 13 \leq 20$ ∴ $h_d = 0.75 [(0.43 \sqrt[3]{26.7} \sqrt[4]{26.7} - 1.5$

$= 1.42$

LW CONTROLS

$h_d < h_c$ ∴ $p_d = h_d \gamma = (1.5)(16.7) = 25.1$ PSF

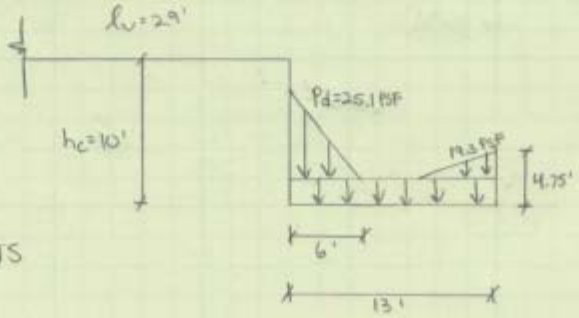
$w = 4 h_d = 4(1.5) = 6'$

PARAPET $l_u = 13 < 20$ ∴ $h_d = 0.75 [0.43 \sqrt[3]{20}^{1.167} \sqrt[4]{26.7} - 1.5$

$= 1.153 < h_c$ ∴ $p_d = 1.153(16.7) = 19.3$

$w = 4(1.153) = 4.6'$

NORTH ELEVATION
ROOFTOP PARAPET



NTS

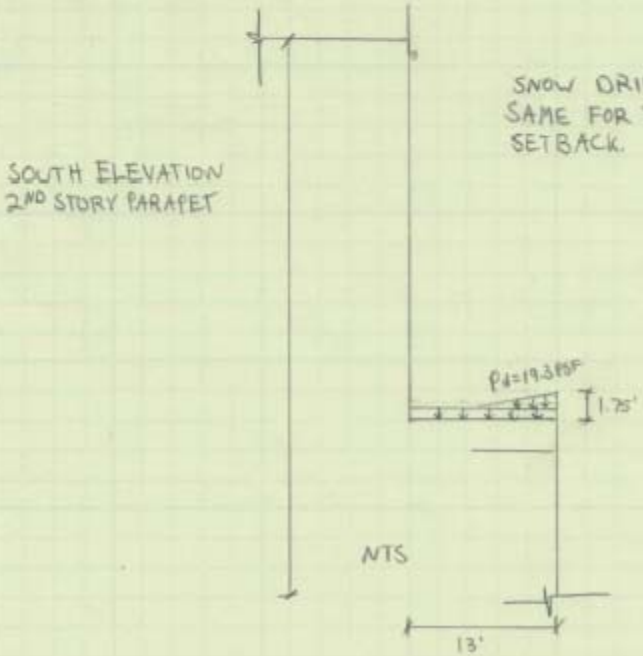
NOTEBOOK SUB A. | SNOW DRIFT CONT. | JESSE B. 7

$\gamma = 16.7$

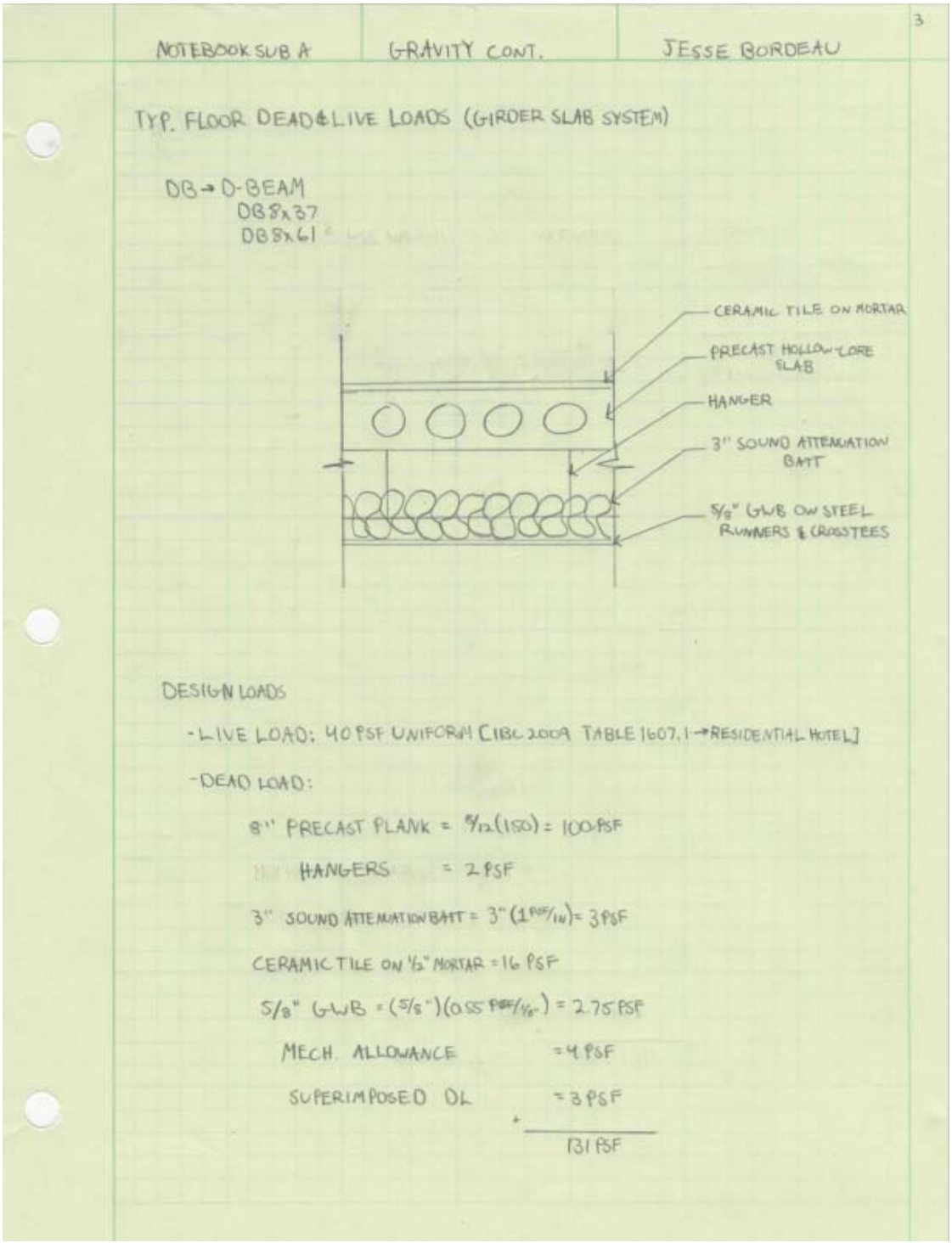
$h_b = 1.26 \rightarrow h_{c2} = 181 - 30 = 151' \rightarrow \frac{h_c}{h_b} = \frac{151}{126} > 0.2 \therefore$ REQ'D

SNOW WILL NOT OVERCOME UPPER PARAPET ∴ DESIGN FOR SNOW DRIFT FROM LOWER PARAPET

$l_u = 13 < 25 \therefore h_d = 1.153 \rightarrow p_d = 19.3, w = 4.6'$



Floor Loads



NOTEBOOK SUB A | GRAVITY CONT. | JESSE BORDEAU 3

TYP. FLOOR DEAD & LIVE LOADS (GIRDER SLAB SYSTEM)

DB → D-BEAM
DB8x37
DB8x61

DESIGN LOADS

- LIVE LOAD: 40 PSF UNIFORM [IBC 2009 TABLE 1607.1 → RESIDENTIAL HOTEL]
- DEAD LOAD:

8" PRECAST PLANK = 8/12(150) = 100 PSF
HANGERS = 2 PSF
3" SOUND ATTENUATION BATT = 3"(1 PSF/IN) = 3 PSF
CERAMIC TILE ON ½" MORTAR = 16 PSF
5/8" GWB = (5/8")(0.55 PSF/½") = 2.75 PSF
MECH. ALLOWANCE = 4 PSF
SUPERIMPOSED DL = 3 PSF
+ 131 PSF

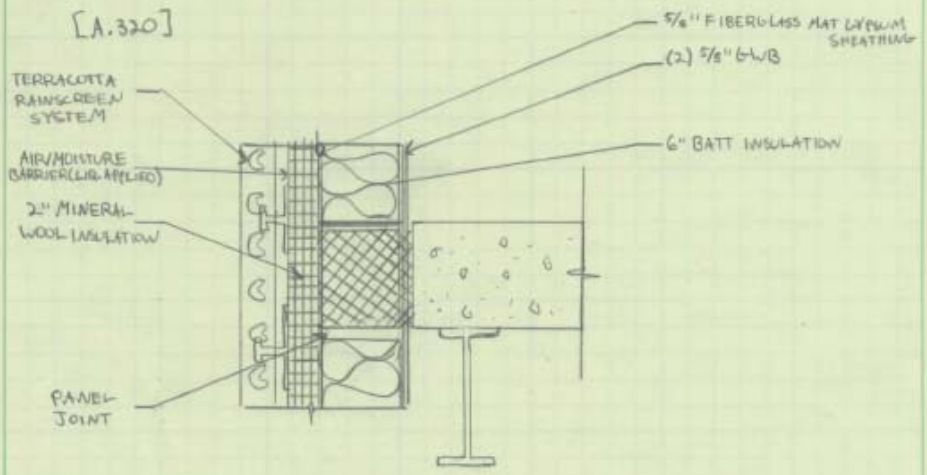
The girder-slab system is utilized to benefit construction efficiency and to reduce floor-to-floor height

Exterior Wall Loads

NOTEBOOK SUB A | GRAVITY CONT | JESSE BORDEAU | 4

TYP. WALL SECTION DEAD & LIVE LOADS

[A.320]



DESIGN LOADS:

- DEAD LOAD

TERRACOTTA RAIN SCREEN SYSTEM	= 10 PSF
MINERAL WOOL INSULATION (2")	= (2")(1 PSF/IN) = 2 PSF
BATT INSULATION (6")	= (6")(4 PSF/IN) = 24 PSF
GYPSUM WALL BOARD (2) 5/8"	= (2)(5)(0.55 PSF/5/8") = 5.5 PSF
AIR/MOISTURE BARRIER LIQUID APPLIED	= 1 PSF
+	
DESIGN DL	= 43 PSF

LOAD PATH: TYP EXTERIOR WALLS DO NOT BEAR ANY LOADS. THE LOAD IS TRANSFERRED FROM THE PANELS THROUGH THE CLIPS AND INTO THE GIRDER SLAB SYSTEM. FROM HERE, THE LOAD IS ABLE TO TRANSFER INTO THE BRACE FRAMES AND DOWN INTO THE FOUNDATION.

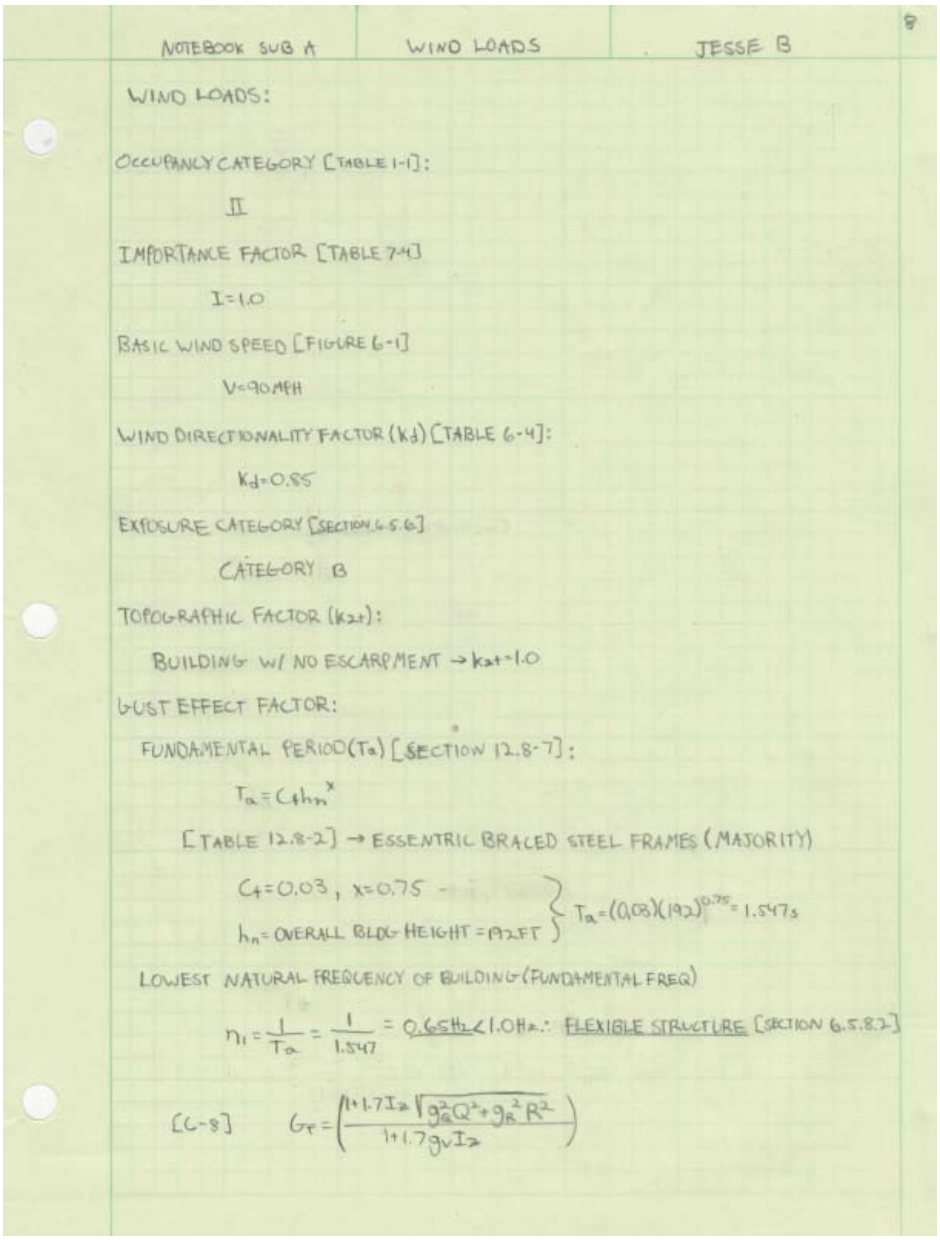
Listed below are the dead load values used by the engineers who originally determined the loads for AC Marriott Philadelphia.

Table 1: Superimposed dead loads

Superimposed Dead Loads (in addition to structure self-weight)	
Area	Loading [psf]
Typical Roof	30
Floors	10
Intensive Green Roof	200
Extensive Green Roof	60

Wind Load Determination

The following section is the wind calculations for 230 North 13th Street using ASCE 7-05 chapter 6. Most of the calculations were determined using Microsoft Excel, therefore spreadsheets are provided. These spreadsheets can be found at the end of this section which also include base shear, along with diagrams which visually display the forces & pressures vs. building height.



NOTEBOOK SUB A | WIND LOADS | JESSE B

WIND LOADS:

OCCUPANCY CATEGORY [TABLE 1-1]:

II

IMPORTANCE FACTOR [TABLE 7-4]

I=1.0

BASIC WIND SPEED [FIGURE 6-1]

V=90MPH

WIND DIRECTIONALITY FACTOR (K_d) [TABLE 6-4]:

K_d=0.85

EXPOSURE CATEGORY [SECTION 6.5.6]

CATEGORY B

TOPOGRAPHIC FACTOR (K_{zt}):

BUILDING W/ NO ESCARPMENT → K_{zt}=1.0

GUST EFFECT FACTOR:

FUNDAMENTAL PERIOD(T_a) [SECTION 12.8-7]:

$T_a = C_t h_n^x$

[TABLE 12.8-2] → ESSENTRIC BRACED STEEL FRAMES (MAJORITY)

C_t=0.03, x=0.75

h_n= OVERALL BLDG HEIGHT = 192FT

$T_a = (0.03)(192)^{0.75} = 1.547s$

LOWEST NATURAL FREQUENCY OF BUILDING (FUNDAMENTAL FREQ)

$n_1 = \frac{1}{T_a} = \frac{1}{1.547} = 0.65Hz < 1.0Hz$ ∴ FLEXIBLE STRUCTURE [SECTION 6.5.8.2]

[C-8] $G_f = \left(\frac{1+1.7I_z\sqrt{g_Q^2Q^2+g_R^2R^2}}{1+1.7g_vI_z}\right)$

NOTEBOOK SUB A | WIND LOADS (N-S) | JESSE B | 9

NORTH-SOUTH DIRECTION

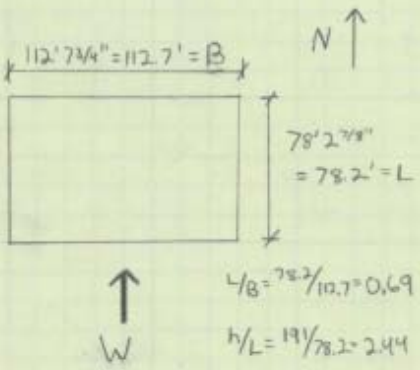
$\bar{z} = 0.6h = 0.6(192) = 115.2'$

$g_Q = g_v = 3.4$

$\bar{z} = \max\left(\begin{matrix} 0.6h = 115.2' \\ z_{min} = 30' \end{matrix}\right)$

[TABLE 6-2] → EXPOSURE B:

$\alpha = 7.0$
$z_g = 1200ft$
$\hat{a} = 1/7$
$\hat{b} = 0.84$
$\bar{\alpha} = 1/4.0$
$\bar{b} = 0.45$
$c = 0.30$
$l = 320$
$\bar{\varepsilon} = 1/3.0$
$z_{min} = 30ft$
$h = 191'$



[6-5] $I_{\bar{z}} = 0.3\left(\frac{33}{\bar{z}}\right)^{1/6} = 0.3\left(\frac{33}{115.2}\right)^{1/6} = 0.244$

[6-7] $L_{\bar{z}} = l\left(\frac{\bar{z}}{30}\right)^{\bar{\varepsilon}} = 320\left(\frac{115.2}{33}\right)^{1/3} = 483.4$

$\bar{V}_{\bar{z}} = \bar{b}\left(\frac{\bar{z}}{33}\right)^{\bar{\alpha}} \cdot V\left(\frac{33}{30}\right) = (0.45)\left(\frac{115.2}{33}\right)^{0.25} \cdot 90\left(\frac{33}{30}\right)$

$= (0.6151) \cdot (132) = 81.2$

[6-6] $Q = \sqrt{\frac{1}{1+0.63\left(\frac{B+h}{L_{\bar{z}}}\right)^{0.63}}} = \sqrt{\frac{1}{1+0.63\left(\frac{112.7+191}{483.4}\right)^{0.63}}} = 0.825$

[6-9] $g_r = \sqrt{2\ln(3600 n_1)} + \frac{0.577}{\sqrt{2\ln(3600 n_1)}} = \sqrt{2\ln(3600(0.65))} + \frac{0.577}{\sqrt{2\ln(3600(0.65))}}$

$= 3.94 + \frac{0.577}{3.94} = 4.09$

[6-12] $N_1 = \frac{n_1 L_{\bar{z}}}{\bar{V}_{\bar{z}}} = \frac{(0.65)(483.4)}{81.2} = 3.87$

NOTE BOOK SUB A | WIND LOADS CONT (N-S) | JESSE B | 10

[6.11] $R_h = \frac{7.47N_1}{(1+10.3N_1)^{5/6}} = \frac{7.47(3.87)}{(1+10.3(3.87))^{5/6}} = 0.0596$

[6.12] $\eta(R_h) = \frac{4.6\,n_1\,h}{V_z} = \frac{4.6(0.65)(191)}{81.2} = 7.03$

$\eta(R_B) = \frac{4.6\,n_1\,B}{V_z} = \frac{4.6(0.65)(112.7)}{81.2} = 4.15$

$\eta(R_L) = \frac{15.4\,n_1\,L}{V_z} = \frac{15.4(0.65)(79.2)}{81.2} = 9.20$

[6.13a] $R_h = \frac{1}{\eta} - \frac{1}{2\eta^2}\left(1-e^{-2\eta}\right) = \frac{1}{7.03} - \frac{1}{2(7.03)^2}\left(1-e^{-2(7.03)}\right) = 0.142-(0.0102)(1.000) = 0.132$

$R_B = \frac{1}{4.15} - \frac{1}{2(4.15^2)}\left(1-e^{-2(4.15)}\right) = 0.241-0.029(0.9998) = 0.212$

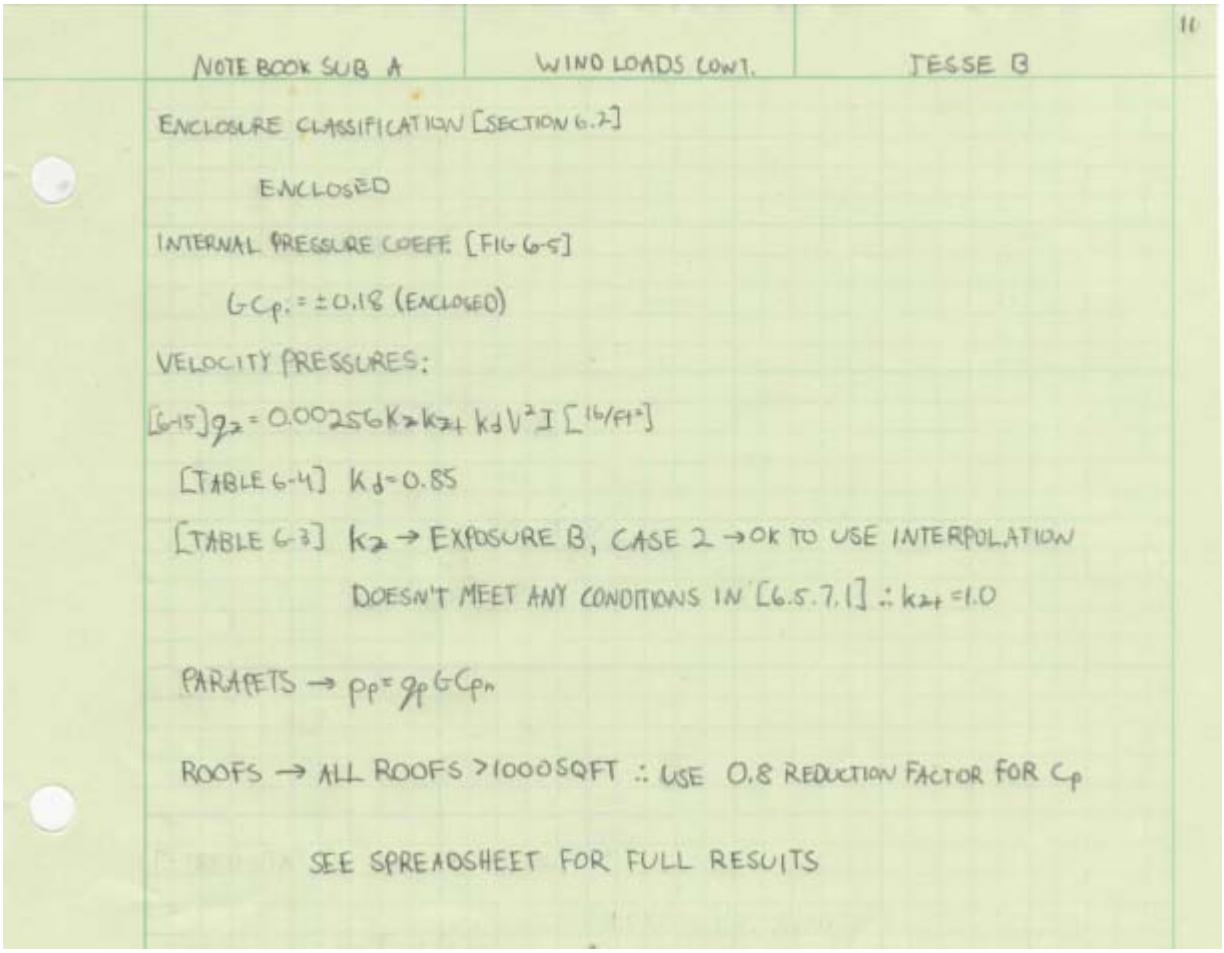
$R_L = \frac{1}{9.2} - \frac{1}{2(9.2^2)}\left(1-e^{-2(9.2)}\right) = 0.109-(0.006)(0.999) = 0.103$

$B = 0.02$

[6.10] $R = \sqrt{\frac{1}{B} R_n R_h R_B (0.53+0.47R_L)} = \sqrt{\frac{1}{0.02}(0.0596)(0.132)(0.212)(0.53+0.47(0.103))}$

$= \sqrt{0.0834(0.5784)} = 0.22$

$G_f = \left(\frac{1+1.7(0.244)\sqrt{(3.4^2)(0.825^2)+(4.09^2)(0.22^2)}}{1+1.7(3.4)(0.244)}\right) = \frac{2.22}{2.41} = 0.922$



NOTE BOOK SUB A | WIND LOADS CONT. | JESSE B

ENCLOSURE CLASSIFICATION [SECTION 6.2]

ENCLOSED

INTERNAL PRESSURE COEFF. [FIG 6-5]

$GC_{pi} = \pm 0.18$ (ENCLOSED)

VELOCITY PRESSURES:

[6-15] $q_z = 0.00256 K_z K_{zt} K_d V^2 I$ [$^{lb}/_{ft^2}$]

[TABLE 6-4] $K_d = 0.85$

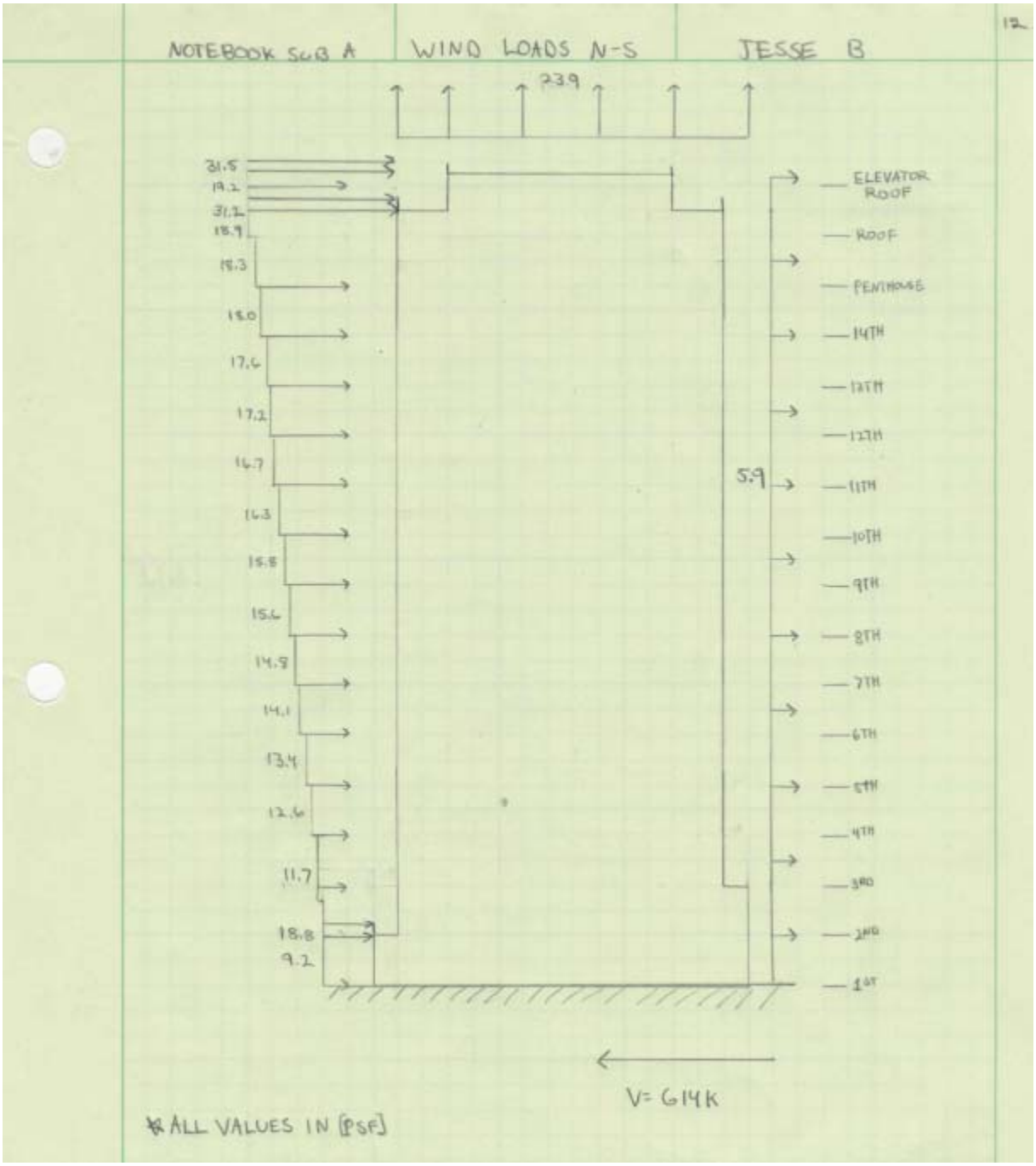
[TABLE 6-3] $K_z \rightarrow$ EXPOSURE B, CASE 2 $\rightarrow$ OK TO USE INTERPOLATION

DOESN'T MEET ANY CONDITIONS IN [6.5.7.1] $\therefore K_{zt} = 1.0$

PARAPETS $\rightarrow p_p = q_p GC_{pn}$

ROOFS $\rightarrow$ ALL ROOFS >1000SQFT $\therefore$ USE 0.8 REDUCTION FACTOR FOR C_p

SEE SPREADSHEET FOR FULL RESULTS


NOTEBOOK SUB A
WIND LOADS N-S
JESSE B
12
239
31.5
19.2
31.2
18.9
18.3
18.0
17.6
17.2
16.7
16.3
15.8
15.6
14.9
14.1
13.4
12.6
11.7
18.8
9.2
5.9
ELEVATOR ROOF
ROOF
PENTHOUSE
14TH
13TH
12TH
11TH
10TH
9TH
8TH
7TH
6TH
5TH
4TH
3RD
2ND
1ST
V= 614K
* ALL VALUES IN (PSF)

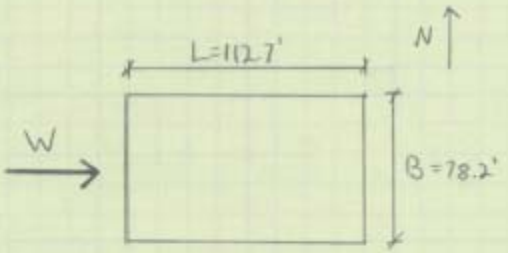
Wind Pressure Determination (N-S)									Net Pressures [psf]	
Location	Story	z [ft]	kz	qz [psf]	Cp	qzGCp [psf]	Gcpi	qhGCpi [psf]	qzGCp-qh(+Gcpi)	qzGCp-qh(-Gcpi)
Windward	1	0	0.57	10.05	0.8	7.41	0.18	1.81	5.60	9.2
	2	15.66	0.57	10.05	0.8	7.41	0.18	1.81	5.60	9.2
	3	33.75	0.72	12.74	0.8	9.40	0.18	2.29	7.11	11.7
	4	44.25	0.78	13.75	0.8	10.14	0.18	2.47	7.67	12.6
	5	54.75	0.83	14.63	0.8	10.79	0.18	2.63	8.16	13.4
	6	65.25	0.87	15.33	0.8	11.31	0.18	2.76	8.55	14.1
	7	75.75	0.91	16.09	0.8	11.87	0.18	2.90	8.97	14.8
	8	86.25	0.96	16.99	0.8	12.53	0.18	3.06	9.47	15.6
	9	96.75	0.98	17.27	0.8	12.74	0.18	3.11	9.63	15.8
	10	107.25	1.01	17.80	0.8	13.13	0.18	3.20	9.93	16.3
	11	117.75	1.03	18.21	0.8	13.43	0.18	3.28	10.15	16.7
	12	128.25	1.06	18.70	0.8	13.79	0.18	3.37	10.43	17.2
	13	138.75	1.09	19.21	0.8	14.17	0.18	3.46	10.71	17.6
	14	149.25	1.11	19.56	0.8	14.43	0.18	3.52	10.91	18.0
	Penthouse Deck	163.00	1.13	19.92	0.8	14.69	0.18	3.59	11.11	18.3
	Penthouse	163.25	1.13	19.92	0.8	14.69	0.18	3.59	11.11	18.3
	Roof	181.00	1.17	20.62	0.8	15.21	0.18	3.71	11.50	18.9
	Elevator Roof	191.02	1.19	20.97	0.8	15.47	0.18	3.78	11.70	19.2
Leeward	All	All	1.19	20.97	-0.5	-9.67	0.18	3.78	-13.44	-5.89
Side	All	All	1.19	20.92	-0.7	-13.50	0.18	3.77	-17.27	-9.74
Parapet (WW)	2nd Story	31.50	0.71	12.51			1.50	18.77		18.77
	Penthouse	167.75	1.15	20.27			1.50	30.40		30.40
	Roof	185.75	1.18	20.80			1.50	31.20		31.20
	Elevator Roof	192.00	1.19	20.97			1.50	31.46		31.46
Parapet (LW)	2nd Story	31.50	0.71	12.51			-1.00	-12.51		-12.51
	Penthouse	167.75	1.15	20.27			-1.00	-20.27		-20.27
	Roof	185.75	1.18	20.80			-1.00	-20.80		-20.80
	Elevator Roof	192.00	1.19	20.97			-1.00	-20.97		-20.97
Roof	(0-95.5ft)	191.02	1.19	20.97	-1.04	-20.11	0.18	3.78	-23.89	-16.34
	(>95.5ft)	191.02	1.19	20.97	-0.7	-10.13	0.18	3.78	-13.91	-6.36

V^2	8100
I	1
kd	0.85
kzt	1
G	0.922
L/B	0.69

Forces	B	pw+pl	H	Total Force
F1	113	22.66	7.83	19999.1
F2	113	22.66	16.88	43101.5
F3	113	25.14	14.3	40498.3
F4	113	26.06	10.5	30837.8
F5	113	26.87	10.5	31794.8
F6	113	27.52	10.5	32560.3
F7	113	28.21	10.5	33383.3
F8	113	29.04	10.5	34359.3
F9	113	29.29	10.5	34665.5
F10	113	29.78	10.5	35239.7
F11	113	30.15	10.5	35679.9
F12	113	30.60	10.5	36215.8
F13	113	31.07	10.5	36770.8
F14	113	31.40	12.13	42903.5
FPD	113	31.72	7	25024.2
FPD	113	31.72	9	32174.0
FR	113	32.37	13.89	50649.7
FER	113	32.69	5.01	18458.1
			[lb]	614315.7
			[kip]	**614.3**

NOTEBOOK SUB A | WIND LOADS (E-W) | JESSE B | 13

EAST-WEST DIRECTION



$L/B = 112.7/78.2 = 1.44$

$h/L = 191/112.7 = 1.70$

$$Q = \sqrt{\frac{1}{1+0.63\left(\frac{78.2+191}{483.4}\right)^{.63}}} = 0.835$$

$n(R_h) = 7.03$

$$n(R_B) = \frac{4.6(0.65)(78.2)}{81.2} = 2.88$$

$$n(R_L) = \frac{15.4(0.65)(112.7)}{81.2} = 13.89$$

$R_h = 0.132$

$$R_B = \frac{1}{2.88} - \frac{1}{2(2.88^2)}\left(1-e^{-2(2.88)}\right) = 0.3472 - (.0602)(0.997) = 0.287$$

$$R_L = \frac{1}{13.89} - \frac{1}{2(13.89^2)}\left(1-e^{-2(13.89)}\right) = 0.072 - (0.00259)(0.999) = 0.069$$

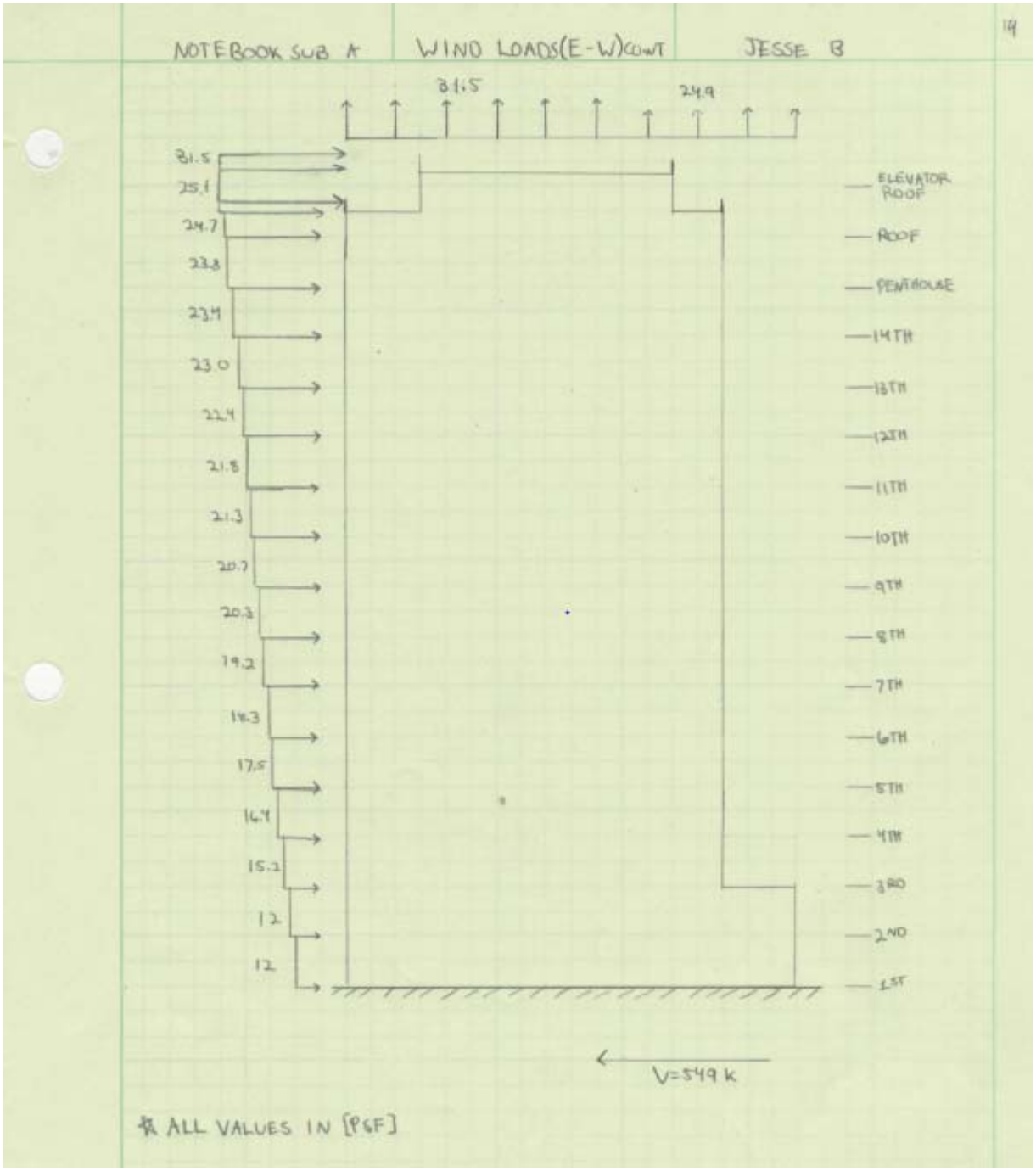
$$R = \sqrt{\frac{1}{0.02}(0.0596)(0.132)(0.287)(0.53+0.47(0.069))} = 0.252$$

$$G_f = \left(\frac{1+1.7(0.244)\sqrt{(3.4^2)(0.835^2)+(4.08^2)(0.252^2)}}{1+1.7(3.4)(0.244)}\right) = \frac{3.07}{2.41} = 1.27$$

(8.06)

$G_{f\,N-S} = 0.922$

$G_{f\,E-W} = 1.27$


NOTEBOOK SUB A
WIND LOADS(E-W)CONT
JESSE B
14
31.5
24.9
31.5
25.1
24.7
23.8
23.4
23.0
22.4
21.8
21.3
20.7
20.3
19.2
18.3
17.5
16.9
15.1
12
12
ELEVATOR ROOF
ROOF
PENTHOUSE
14TH
13TH
12TH
11TH
10TH
9TH
8TH
7TH
6TH
5TH
4TH
3RD
2ND
1ST
V=549 k
* ALL VALUES IN [PSF]

Wind Pressure Determination (E-W)									Net Pressures [psf]	
Location	Story	z [ft]	kz	qz [psf]	Cp	qzGCp [psf]	Gcpi	qhGCpi [psf]	qzGCp-qh(+Gcpi)	qzGCp-qh(-Gcpi)
Windward	1	0	0.57	10.05	0.8	10.21	0.18	1.81	8.40	12.0
	2	15.66	0.57	10.05	0.8	10.21	0.18	1.81	8.40	12.0
	3	33.75	0.72	12.74	0.8	12.95	0.18	2.29	10.65	15.2
	4	44.25	0.78	13.75	0.8	13.97	0.18	2.47	11.49	16.4
	5	54.75	0.83	14.63	0.8	14.86	0.18	2.63	12.23	17.5
	6	65.25	0.87	15.33	0.8	15.58	0.18	2.76	12.82	18.3
	7	75.75	0.91	16.09	0.8	16.35	0.18	2.90	13.45	19.2
	8	86.25	0.96	16.99	0.8	17.26	0.18	3.06	14.20	20.3
	9	96.75	0.98	17.27	0.8	17.55	0.18	3.11	14.44	20.7
	10	107.25	1.01	17.80	0.8	18.09	0.18	3.20	14.88	21.3
	11	117.75	1.03	18.21	0.8	18.50	0.18	3.28	15.22	21.8
	12	128.25	1.06	18.70	0.8	19.00	0.18	3.37	15.63	22.4
	13	138.75	1.09	19.21	0.8	19.52	0.18	3.46	16.06	23.0
	14	149.25	1.11	19.56	0.8	19.88	0.18	3.52	16.36	23.4
	Penthouse Deck	163.00	1.13	19.92	0.8	20.24	0.18	3.59	16.65	23.8
	Penthouse	163.25	1.13	19.92	0.8	20.24	0.18	3.59	16.65	23.8
	Roof	181.00	1.17	20.62	0.8	20.95	0.18	3.71	17.24	24.7
	Elevator Roof	191.02	1.19	20.97	0.8	21.31	0.18	3.78	17.53	25.1
Leeward	All	All	1.19	20.92	-0.5	-13.29	0.18	3.77	-17.05	-9.52
Side	All	All	1.19	20.92	-0.7	-18.60	0.18	3.77	-22.37	-14.83
Parapet (WW)	2nd Story	31.50	0.71	12.51			1.50	18.77		18.77
	Penthouse	167.75	1.15	20.27			1.50	30.40		30.40
	Roof	185.75	1.18	20.80			1.50	31.20		31.20
	Elevator Roof	192.00	1.19	20.97			1.50	31.46		31.46
Parapet (LW)	2nd Story	31.50	0.71	12.51			-1.00	-12.51		-12.51
	Penthouse	167.75	1.15	20.27			-1.00	-20.27		-20.27
	Roof	185.75	1.18	20.80			-1.00	-20.80		-20.80
	Elevator Roof	192.00	1.19	20.97			-1.00	-20.97		-20.97
Roof	(0-95.5ft)	191.02	1.19	20.97	-1.04	-27.70	0.18	3.78	-31.48	-23.93
	(>95.5ft)	191.02	1.19	20.97	-0.7	-21.14	0.18	3.78	-24.92	-17.37

V^2	8100
I	1
kd	0.85
kzt	1
G	1.27
L/B	1.44

Forces	B [ft]	pw+pl	H [ft]	Total Force
S1	78.2	29.07	7.83	17797.8
F2	78.2	29.07	16.875	38357.3
F3	78.2	32.29	14.295	36098.3
F4	78.2	33.49	10.5	27501.6
F5	78.2	34.55	10.5	28367.1
F6	78.2	35.39	10.5	29059.5
F7	78.2	36.30	10.5	29803.7
F8	78.2	37.37	10.5	30686.5
F9	78.2	37.71	10.5	30963.4
F10	78.2	38.34	10.5	31482.7
F11	78.2	38.83	10.5	31880.8
F12	78.2	39.42	10.5	32365.5
F13	78.2	40.03	10.5	32867.4
F14	78.2	40.45	12.125	38353.8
FPD	78.2	40.87	7	22373.2
FPD	78.2	40.87	9	28765.5
FR	78.2	41.71	13.885	45294.4
FER	78.2	42.14	5.01	16508.3
			[lb]	548527.0
			[kip]	**548.5**

Seismic Load Determination

Seismic loads are calculated in the following section using ASCE 7-05, chapters 11 &12.

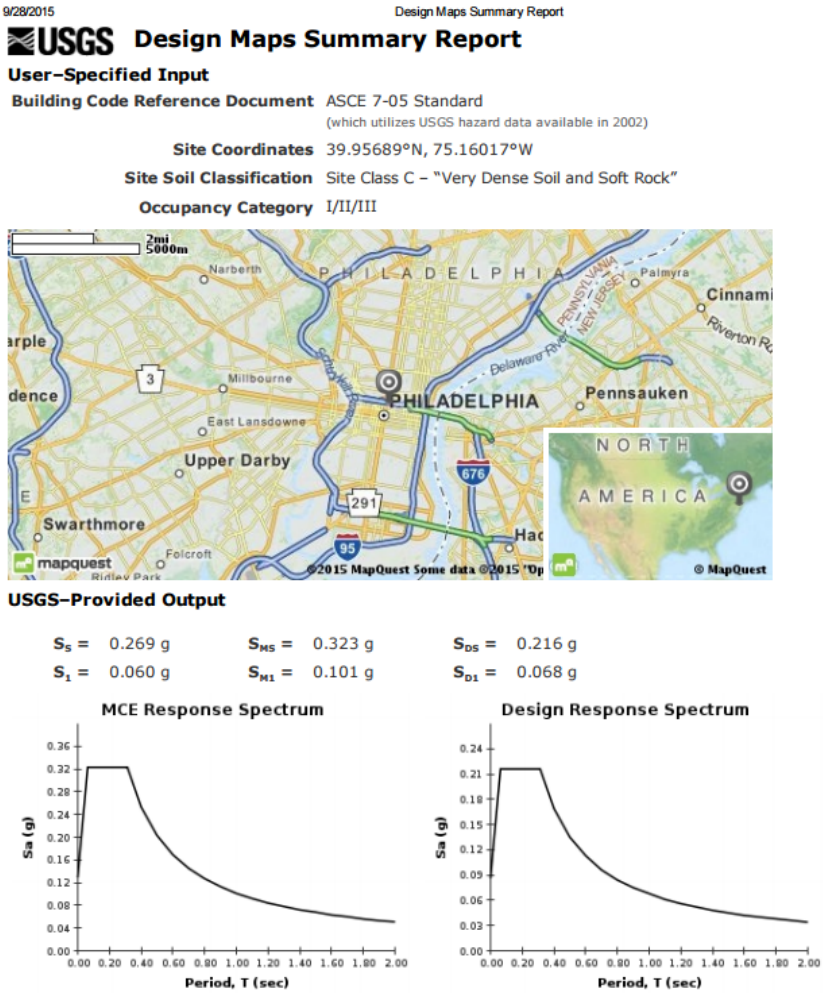


Figure 1: Seismic design criteria based on exact site location (Courtesy http://ehp2-earthquake.wr.usgs.gov)

NOTEBOOK SUB A | SEISMIC LOADS | JESSE B | 15

SEISMIC LOADS

[SECTION 11.1.2] STRUCTURE NOT EXEMPT

[FROM DRAWINGS] SITE CLASS C

[SECTION 11.4.3] $S_s = 0.269g$ $S_{MS} = 0.323g$ $S_{DS} = 0.216g$
$S_1 = 0.060g$ $S_{M1} = 0.101g$ $S_{D1} = 0.068g$

[TABLE 12.6-1] SITE CLASS C, OCC. CAT II → ELF IS PERMITTED

[TABLE 12.2-1] ASSUME ESSENTRIC BRACE FRAMES TAKE MAJORITY OF LOAD ∴

ORDINARY STEEL CONCENTRICALLY BRACED FRAMES

$R = 3.25$
$\Omega = 2$
$C_d = 3.25$

[TABLE 11.5-1] $I_e = 1.0$

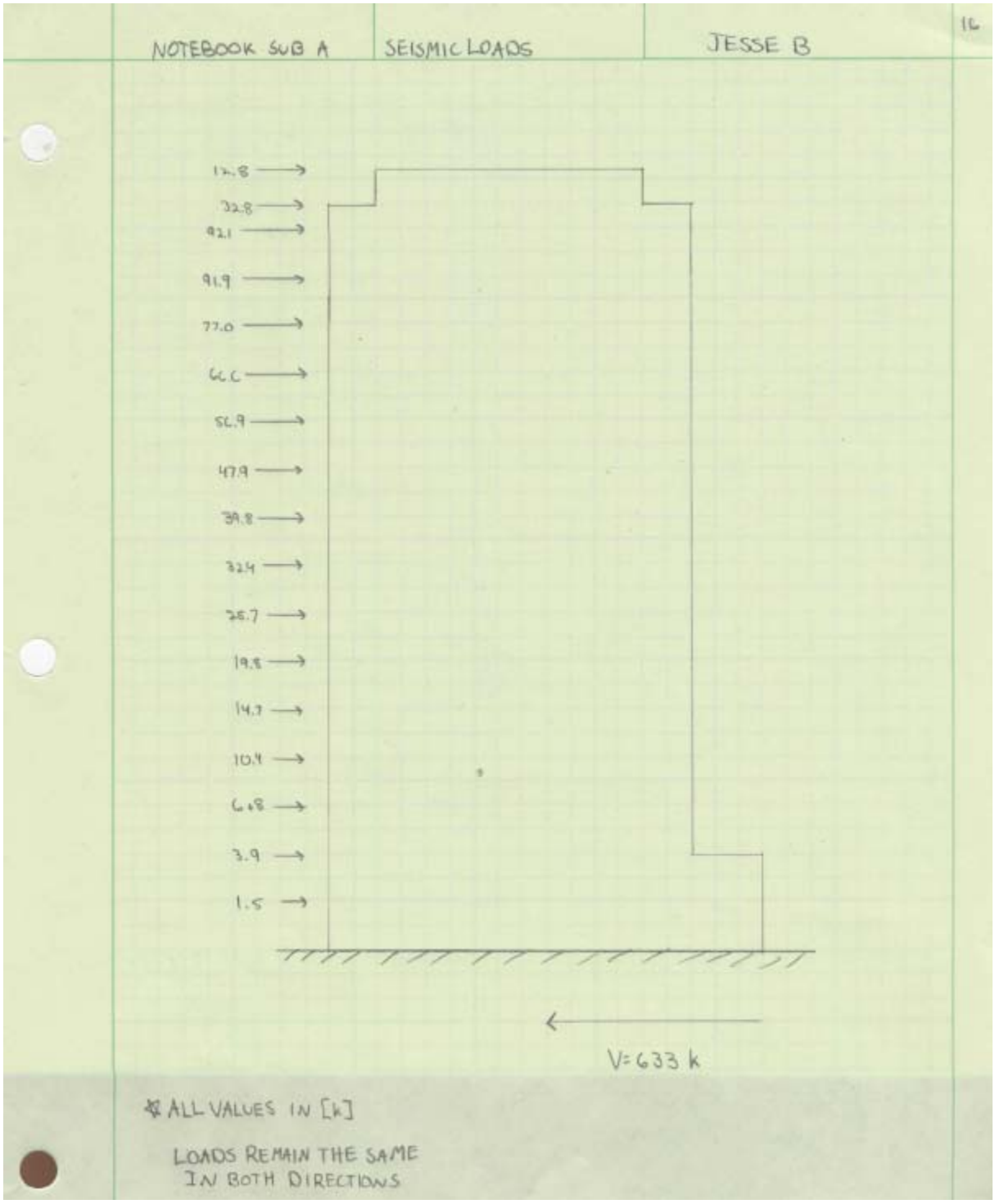
[EQN 12.8-7] $T_a = C_t h_n^x$ where: $C_t = 0.03$
$x = 0.75$
$h_n = 191'$

$T_a = (0.03)(191^{0.75}) = 1.54_s$

[FIGURE 22-15] $T_L = 6_s$ → $T_a < T_L$ ∴ $C_s = \frac{S_{D1}}{\left(\frac{R}{I_e}\right)} = \frac{0.216}{1.54\left(\frac{3.25}{1}\right)} = 0.043 > 0.01$ √
[12.8-3]

[EQN 12.8-1] $V = C_s W = (0.043)(14728) = 633.0k$

BUILDING LOADS → SEE SPREADSHEET


NOTEBOOK SUB A
SEISMIC LOADS
JESSE B
16
14.8
32.8
92.1
91.9
77.0
66.6
56.9
47.9
39.8
32.4
26.7
19.8
14.7
10.9
6.8
3.9
1.5
V=633 k
* ALL VALUES IN [k]
LOADS REMAIN THE SAME
IN BOTH DIRECTIONS

Story	Floor Area [sq.ft.]	Floor Load [psf]	Snow Load (20%) [psf]	Trib. Wall Height	Building Perimeter	Wall Load [psf]	Weight	Parapet	Mech/Misc	Total Floor Weight
1	8050	141		7.83	381.8	43	1263598			1263598
2	9770	141		16.88	381.8	43	1378296	1020	56160	1435476
3	5925	141		14.3	381.8	43	836039.9	1909		837949
4	5925	141		10.5	381.8	43	835876.5			835877
5	5925	141		10.5	381.8	43	835876.5			835877
6	5925	141		10.5	381.8	43	835876.5			835877
7	5925	141		10.5	381.8	43	835876.5			835877
8	5925	141		10.5	381.8	43	835876.5			835877
9	5925	141		10.5	381.8	43	835876.5			835877
10	5925	141		10.5	381.8	43	835876.5			835877
11	5925	141		10.5	381.8	43	835876.5			835877
12	5925	141		10.5	381.8	43	835876.5			835877
13	5925	141		10.5	381.8	43	835876.5			835877
14	5925	141		12.125	381.8	43	835946.4			835946
Penthouse Deck	5925	141		7	381.8	43	835726			835726
Penthouse	5925	141		9	381.8	43	835812			835812
Roof	1250	178	4.2	13.89	328	43	228347.3	11480	2000	241827
Elevator Roof	400	81	4.2	5.01	68	43	34295.43	680	50000	84975
*included 10 psf for weight of steel and extra allowances for pool, mech equip & fitness							Total Building Weight [kips]			14730

Story	hx [ft]	wx [kip]	wxhx^k	Cvx	Fx	Vx
Elevator Roof	191.0	85.0	3101534.4	0.02	12.8	12.8
Roof	181.0	241.8	7922494.3	0.05	32.8	45.6
Penthouse	163.3	835.8	22274859.9	0.15	92.1	137.8
Penthouse Deck	163.0	835.7	22204404.1	0.15	91.9	229.6
14	149.3	835.9	18621167.4	0.12	77.0	306.6
13	138.8	835.9	16091938.3	0.11	66.6	373.2
12	128.3	835.9	13748557.1	0.09	56.9	430.1
11	117.8	835.9	11589486.8	0.08	47.9	478.0
10	107.3	835.9	9614727.4	0.06	39.8	517.8
9	96.8	835.9	7824278.9	0.05	32.4	550.2
8	86.3	835.9	6218141.2	0.04	25.7	575.9
7	75.8	835.9	4796314.5	0.03	19.8	595.7
6	65.3	835.9	3558798.6	0.02	14.7	610.5
5	54.8	835.9	2505593.5	0.02	10.4	620.8
4	44.3	835.9	1636699.4	0.01	6.8	627.6
3	33.8	835.9	952116.1	0.01	3.9	631.5
2	15.7	1435.5	352029.8	0.00	1.5	633.0
1	0.0	1263.6	0.0	0.00	0.0	633.0
	Σ	14728.0	153013142.0	1.0		
*k=2 b/c period is >0.5s						
V=	633.0					