EPT OF BLDGS121186028 Job Number



Leslie E. Robertson Associates, R.L.L.P. Consulting Structural Engineers



40 Wall Street, 23<sup>rd</sup> Floor New York, NY 10005

Tel: (212) 750-9000 Fax: (212) 750-9002 http://www.lera.com

William J. Faschan william.faschan@lera.com

25 April 2016 File: P903

### Mr. Kenneth G. Cartelli

50 Lex Development LLC c/o Ceruzzi Properties 1720 Post Road Fairfield, CT 06824 Via e-mail: kcartelli@ceruzziproperties.com

138 East 50<sup>th</sup> Street, New York, NY Structural Engineering Peer Review

Dear Mr. Cartelli:

At the request of Lex Development LLC, Leslie E. Robertson Associates International, PLLC has conducted a Structural Peer Review of the design of 138 East 50<sup>th</sup> Street as required by New York City Building Code Section 1617. This report summarizes the extent and findings of our review.

We have reviewed the plans listed in Appendix A, as well as the available wind tunnel and geotechnical reports, copies of which are attached to this report as Appendix B.

We have reviewed the Structural Design Criteria prepared by WSP Group, dated 30 March 2016 and a copy is attached as Appendix C.

Through our review, we have confirmed the following aspects of the structural design, as required by Section 1617.5.1:

- The design loads conform to the Building Code.
- The other structural design criteria and design assumptions conform to the code and are in accordance with generally accepted engineering practice.
- The design properly incorporates the results and recommendations of the wind tunnel and geotechnical investigations.
- We have reviewed the structural frame and the load supporting parts of floors, roofs, walls and foundations and based on our independent calculations for a representative fraction of systems, members and details, we find that the structure has adequate strength.
- The structure has a complete load path.
- The design engineer of record complied with the structural integrity provisions of the code.

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- The structural plans are in general conformance with the architectural plans regarding loads and other conditions that may affect the structural design.
- Major mechanical items are accommodated in the structural plans.
- The structural plans are generally complete.

Accordingly, we find the design of the structure to be in general conformance with the structural design provisions of the Building Code.

The opinions expressed in this letter represent our professional view, based on the information made available to us. In developing these opinions, we have exercised a degree of care and skill commensurate with that exercised by professional engineers licensed in the State of New York for similar types of projects. No other warranty, expressed or implied, is made as to the professional advice included in this letter.

Very truly yours,

LESLIE E. ROBERTSON ASSOCIATES, R.L.L.P.

William J. Faschan Member

Enclosure

Cc: Mr. Hezi Mena, WSP, via e-mail: Hezi.Mena@WSPGroup.com

#### STRUCTURAL PEER REVIEW STATEMENT

This structural peer review and report, dated April 25, 2016, is complete for the superstructure.

Structural	Peer	Reviewer	Name:	William J. Faschan Leslie E. Robertson Associates
Structural	Peer	Reviewer	Address:	40 Wall Street, FL 23 New York, NY 10005

**Project Address:** 138 East 50<sup>th</sup> Street, Block #1304, Lot 45.

Department Application Number for Structural Work: # 121186028

#### Structural Peer Reviewer Statement:

I, <u>William J. Faschan</u>, am a qualified and independent NYS licensed and registered engineer in accordance with BC Section 1627.4, and I have reviewed the structural plans, specifications, and supplemental reports for <u>138 50<sup>th</sup> Street</u>, <u>New York</u>, <u>NY</u>, <u>Block # 1304</u>, <u>Lot # 45</u>, <u>Application # 121186028</u> and found that the structural design shown on the plans and specifications generally conforms to the foundation and structural requirements of Title 28 of the Administrative Code and the 2008 NYC Construction Codes. The Structural Peer Review Report is attached.

#### New York State Registered Design Professional

(for Structural Peer Review only)



CC: Project Owner: 50 Lex Development LLC, c/o Ceruzzi Properties Project Registered Design Professional: Sylvian Marcus



## APPENDIX A

## 138 EAST $50^{\text{TH}}$ STREET

#### STRUCTURAL DRAWING LIST

DRAWING NUMBER	DRAWING TITLE	DATE	SUBMISSION
FO-001 to FO-310	FOUNDATION DRAWINGS	03-22-2016	DOB SUBMISSION
S-001 to S-990	SUPERSTRUCTURE DRAWINGS	03-22-2016	DOB SUBMISSION

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P903 25 April 2016

APPENDIX B

138 EAST 50<sup>TH</sup> STREET GEOTECHNICAL REPORT WIND TUNNEL REPORT SUBSOIL INVESTIGATIONS



### SOIL MECHANICS DRILLING CORP. 3770 MERRICK ROAD • SEAFORD, L. I., NEW YORK 11783 (516) 221-2333 • FAX (516) 221-0254

August 9, 2013

50 Lex Development LLC c/o Ceruzzi Properties 1720 Post Road Fairfield, CT 06824 Att: Kenneth Cartelli, Sr. Vice President

Re: 238 E. 50<sup>th</sup> St. & 151 E. 49<sup>th</sup> St. New York, NY Our Job #13-294

Gentlemen:

Forwarded herewith are copies of the boring logs for drilling work completed at the above referenced site.

The purpose of the subsurface investigation was to determine the nature and extent of the underlying soil deposits and determine the structural engineering characteristics of the soil at the site. A 2" diameter, 2'0" long split spoon sampler was advanced into the subsurface by the use of an automatic 140 lb. hammer with a 30" drop. From the drops of the hammer, blow counts required to advance the split spoon sampler over each 6" interval were recorded and is shown on the boring logs.

Our investigation revealed that the areas drilled are blanketed by from 2 ft. to 4 ft. of loose to moderately dense soil and rubble fill, underlain, generally, by a moderately dense to dense silty sand with traces of gravel and rock fragments extending to decomposed rock or rock. Decomposed rock was encountered between 3-1/2 ft. to 15 ft. below the existing basement floor.

Water was encountered in three or the five borings at depths ranging from  $4^{-5^{\circ}}$  to  $6^{-4^{\circ}}$  at the time the work was done and is not considered reliable due to the impervious nature of the soils encountered.

The natural sand below the fill is capable of supporting foundation loads of 2 to 4 tons per square foot. The decomposed rock is capable of supporting 8 tons per square foot and the hard rock (1C) is capable of supporting 20 tons per square foot.

With respect to liquefaction, the site is classified as Category "C", liquefaction unlikely.

TEST BORINGS - GROUND WATER DETERMINATIONS - FOUNDATION RECOMMENDATIONS - HOLLOW STEM AUGER BORINGS LABORATORY ANALYSES - CONTROLLED LANDFILL - DIAMOND CORE DRILLING - SAND & GRAVEL PROSPECTING BEARING VALUES - WELL POINT INSTALLATIONS - ENGINEERING SUPERVISION - PERCOLATION TESTS SANITADY INVESTIGATIONS - UNDISTURBED SAMPLING - TEST PITS - TOP SOIL ANALYSES Soil Mechanics Drilling Corp.

3770 MERRICK ROAD + SEAFORD, L. L. NEW YORK 11783 (516) 221-2333 + FAX (516) 221-0254

50 Lex Development LLC c/o Ceruzzi Properties Att: Kenneth Cartelli, Sr. Vice President

August 9, 2013 Page 2

With respect to seismic, the site is classified as Site Class "C" per the New York City Code.

Frost penetration in this area is 4 feet. All exterior foundations must have a minimum of 4 foot of cover.

It would appear, due to the high loads and the configuration of the building, you may need to install rock sockets into the lower hard rock. We recommend taking some additional borings and test pits to better define the rock profile and condition.

Soil samples recovered during drilling operations will be stored in our lab for a period of 30 days after which they will be destroyed. During this period we will deliver these samples to any prescribed location upon request.

If after you examine the enclosed you have any further questions, please feel free to call and discuss them with us.

Billing is enclosed.

Very truly yours, SOIL N CHANICS DRILLING CORP. Vernick, P.E

President

CV:mlf Encls.



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The wind loads provided in this report include the effects of directionality in the local wind climate. These loads do not contain safety or load factors and are to be applied to the building's structural system in the same manner as would wind loads calculated by code analytical methods.

Table 2a: Summary of Predicted Peak Overall Structural Wind Loads



- Notes: The above loads are the cumulative summation of the wind-induced loads at the Structural level "GROUND" (i.e. grade) centered about the reference axis shown in Figure 4, exclusive of combination factors. (1)
  - (2) A total damping ratio of 2.0% of critical was used for structural load calculations.
  - The above loads are based on the structural properties as provided on December 3, 2015. The natural building periods were as follows: (3)
    - 8.30 sec (primarily X coupled with Y & Torsion) 7.85 sec (primarily Y coupled with X & torsion) 3.45 sec (primarily torsion ). Mode 1:
    - Mode 2:
    - Mode 3:
  - (4) The above loads correspond to a 50-year return period basic wind speed (3-second gust) of 98 mph.

#### Table 3a: Effective Static Floor-by-Floor Wind Loads

11-1-1-4 (6

Floor Level	Above	Fx (lb)	Fy (lb)	Mz (lb-ft)
	"GROUND"			
GROUND	0.00	10000	12600	150000
2	40.00	12700	15200	168000
4 MECH	91.00	9000	11500	137000
5	103.58	9200	9000	105000
6	114.25	6100	5800	68000
7	124.92	6400	5900	71000
8	135.58	6600	5900	72000
9	146.25	6900	6000	74000
10	156.92	6100	6100	68000
11	167.58	6400	6100	69000
12	178.25	6700	6100	6/000
13	100.92	7100	6200	85000
15	210.25	8000	7200	98000
16	222.08	8600	7900	103000
17	232.92	7400	6500	62000
18	244.25	7900	6900	64000
19	255.08	8500	7500	70000
20	265.92	9100	8200	78000
21	276.75	9800	9000	86000
22	287.58	10400	9800	93000
23	290.42	11800	11400	101000
25	320.08	12500	12300	117000
26-MECH	331.25	16400	16400	160000
27	345.08	22100	22700	193000
28	356.08	15100	15700	134000
29	367.08	15900	16700	141000
30	378.08	16500	17600	149000
31	389.08	17700	19000	161000
32	401.08	18300	19700	164000
34	412.00	18800	20000	171000
35	434.08	19600	221000	179000
36	445.08	20400	23100	187000
37	456.08	21200	24100	195000
38	467.08	21900	25200	204000
39	478.08	22700	26200	212000
40	489.08	23500	27200	220000
41	500.08	24300	28300	228000
42	511.08	25500	29900	241000
43	523.06	25200	30800	243000
45	545.08	26500	31700	246000
46	556.08	27300	32800	253000
47-MECH	567.25	37400	45800	359000
48	581.08	39900	49400	370000
49	592.58	32800	40800	286000
50	604.08	33400	41900	291000
51	627.09	34200	43000	297000
53	638.58	35800	44200	309000
54	650.08	36600	46400	315000
55	661.58	37300	47500	321000
56	673.08	38100	48600	327000
57	684.58	39600	50500	340000
58	697.08	39900	51100	337000
59	708.58	39100	50700	330000
60	720.58	40900	52700	348000
62-MECH	734.08	42200	54/00	362000
63-DAMP	740.75	68500	90200	584000
64-ROOF	788.75	81700	109200	621000
65-TOB	803.00	15200	19500	167000
SI	IMS	1.45E+06	1 72E+06	1 31E+07

#### Table 4a: Recommended Wind Load Combination Factors

Factor for Simultaneous Application of Loads in Table 3a					
Load Case	X Forces (Fx)	Y Forces (Fy)	Torsion (Mz)		
1	+100%	+45%	+35%		
2	+100%	+45%	-50%		
3	+100%	-45%	+35%		
4	+100%	-45%	-50%		
5	-90%	+35%	+60%		
6	-90%	+35%	-30%		
7	-90%	-65%	+60%		
8	-90%	-65%	-30%		
9	+60%	+95%	+35%		
10	+60%	+95%	-40%		
11	+50%	-100%	+30%		
12	+55%	-100%	-45%		
13	-30%	+95%	+35%		
14	-30%	+95%	-40%		
15	-50%	-100%	+30%		
16	-50%	-100%	-40%		
17	+30%	+30%	+100%		
18	+55%	+35%	-100%		
19	+30%	-30%	+100%		
20	+55%	-40%	-100%		
21	-55%	+30%	+100%		
22	-30%	+35%	-100%		
23	-55%	-30%	+100%		
24	-30%	-40%	-100%		

#### Note:

(1) Load combination factors have been produced through consideration of the structure's response to various wind directions, modal coupling, correlation of wind gusts and the directionality of strong winds in the local wind climate.

#### Notes

(1) The loads given in this table should be used with the load combination factors given in Table 4a.

(2) The loads given in this table are centered about the reference axis shown in Figure 4

(3) The above loads correspond to a 50-year return period basic wind speed (3-second gust) of 98 mph.

#### Preliminary Results - Wind-Induced Structural Responses 138 East 50th Street - New York City, New York, RWDI Project #1302084 December 7, 2015

The wind loads provided in this report include the effects of directionality in the local wind climate. These loads do not contain safety or load factors and are to be applied to the building's structural system in the same manner as would wind loads calculated by code analytical methods.

Table 2b: Summary of Predicted Peak Overall Structural Wind Loads

Cases	Damping	My (lb-ft)	Mx (lb-ft)	Mz (lb-ft)	Fx (lb)	Fy (lb)
1	2%	6.48E+08	8.50E+08	1.06E+07	1.21E+06	1.53E+06
2	3%	5.56E+08	7.61E+08	9.49E+06	1.04E+06	1.38E+06

Notes:

(1)	Above damning ratios	were used along with the following periods:
··/	/ word dumping ratio	nore accounting man are reacting periode.

Mode 1:	8.30 sec	(primarily X coupled with Y & Torsion)
Mode 2:	7.85 sec	(primarily Y coupled with X & torsion)
Mode 3:	3.45 sec	(primarily torsion ).

- (2) The above loads are the cumulative summation of the wind-induced loads at the Structural level 'GROUND' (i.e. grade) contend about the reference axis shown in Figure 4, exclusive of combination factors.
- (3) The above loads are based on the structural properties as provided on December 3, 2015.
- (4) The above loads correspond to a 50-year return period basic wind speed (3-second gust) of 90 mph.

#### Table 3b: Effective Static Floor-by-Floor Wind Loads

Table 4b: Recommended Wind Load Combination Factors

GROUND         0.00         10000         9200         119000           2         40.00         12200         13300         143000           3-AMEN         53.00         8500         10100         98000           4-MECH         81.00         11400         12600         124000           5         103.58         8500         5700         62000           6         114.25         5800         5700         62000           7         124.92         5800         5700         64000           9         146.25         6200         5700         64000           10         155.25         6000         5800         69000           11         167.58         5800         5800         69000           13         188.92         6100         5800         73000           16         220.08         7300         7400         87000           17         223.22         6200         6400         54000           20         265.92         7500         7600         65000           21         276.75         8100         13000         71000         59000           22         287.88	Floor Level	Height (ft) Above "GROUND"	Fx (lb)	Fy (lb)	Mz (lb-ft)
GROUND         0.00         10000         9200         119000           2         40.00         12200         13300         143000           3-AMEN         53.00         8500         10100         98000           4-MECH         81.00         11400         12600         124000           5         103.58         8500         8700         93000           6         114.25         5600         5600         60000           7         124.92         5800         5700         63000           9         146.25         6200         5700         64000           11         167.88         5800         5800         5800         68000           12         178.25         6600         6800         83000         16           22.08         7300         7400         87000         7400         87000           16         22.08         7300         7600         65000         6400         54000           20         265.92         7500         7600         65000         21         27.75         8100         8300         71000         23         28.42         9100         9700         83000         220					
2         40.00         12200         13300         143000           3-AMEN         53.00         8500         10100         98000           4-MECH         81.00         11400         12600         124000           5         103.58         8500         5700         62000           6         114.25         5600         5600         60000           7         124.92         5800         5700         64000           9         146.25         6200         5700         64000           10         156.92         5600         5800         60000           11         167.58         5800         5600         66000           13         188.92         6100         5900         66000           14         199.58         6100         5900         7300           15         210.25         6800         6400         54000           18         244.25         6800         6400         54000           20         265.92         7500         7600         65000           21         276.75         8100         9300         71000           22         287.58         8700         1	GROUND	0.00	10000	9200	119000
3-AMEN         53.00         8500         10100         98000           4-MECH         81.00         11400         12600         124000           5         103.58         8500         8700         93000           6         114.25         5600         5600         60000           7         124.92         5600         5700         63000           9         146.25         6200         5700         64000           10         156.92         5800         5800         64000           12         178.25         6000         5800         66000           13         188.92         6100         5900         73000           16         222.08         7300         7400         87000           17         232.92         6200         6400         54000           18         244.25         6600         6400         54000           20         285.92         7500         7600         65000           21         276.75         8100         8300         71000           23         298.42         9100         9700         83000           24         309.25         9700         1	2	40.00	12200	13300	143000
4-MECH         81.00         11400         12600         124000           5         103.58         8500         8700         93000           6         114.25         5600         5700         62000           7         124.92         5800         5700         62000           9         146.25         6200         5700         64000           10         156.92         5800         5800         5800         5900           11         167.58         5800         5800         5900         66000           13         188.92         6100         5900         66000         63000           16         222.08         7300         7400         87000         7600         65000           16         222.08         7300         7600         65000         54000         93000         20         22         287.85         8600         9000         71000         23         22         287.85         8600         9000         71000         23         284.42         9100         9700         33000         1200         98000         24         309.25         320.81         13500         14700         130000         122         287.84	3-AMEN	53.00	8500	10100	98000
5         103.58         8500         8700         93000           6         114.25         5600         5600         60000           7         124.92         5800         5700         63000           8         105.58         6000         5700         64000           10         156.52         5600         5800         5800         60000           11         167.58         5800         5800         60000         114         193.58         6100         5800         66000           14         199.58         6100         5800         6800         83000           15         210.25         6800         6400         54000           16         222.08         7300         7400         87000           17         232.92         6200         6200         54000           20         265.92         7500         7600         65000           21         276.75         8100         9700         83000         71000           22         287.58         8800         9000         77000         23         298.42         9100         9700         83000         24         302.5         9700         1	4-MECH	81.00	11400	12600	124000
6         114.25         5600         5600         60000           7         124.92         5800         5700         62000           8         136.58         6000         5700         62000           9         146.25         6200         5700         64000           10         156.52         6600         5800         5900           11         167.58         5800         5800         66000           14         199.58         6100         5900         7300           15         210.25         6800         6800         83000           16         222.08         7300         7400         87000           17         223.92         6200         6200         54000           20         265.92         7500         7600         65000           21         276.75         8100         8300         71000           22         287.58         8600         9000         77000           23         298.42         9100         9700         83000           24         309.25         13000         11200         98000           27         345.08         18600         19900	5	103.58	8500	8700	93000
7         124.92         5800         5700         62000           9         146.25         6200         5700         64000           10         156.92         5600         5800         59000           11         167.88         5800         5800         69000           12         178.25         6000         5800         69000           13         188.92         6100         5900         73000           15         210.25         6800         6800         83000           16         222.08         7300         7400         87000           17         232.92         6200         6200         54000           19         255.08         7000         7000         59000           20         265.92         7500         7600         65000           21         27.75         8100         8300         71000           23         28.42         9100         9700         83000           24         309.25         9700         10400         89000           27         345.08         18600         19900         155000           28         36.08         12400         14200 </td <td>6</td> <td>114.25</td> <td>5600</td> <td>5600</td> <td>60000</td>	6	114.25	5600	5600	60000
8         135.88         6000         5700         63000           9         146.25         6200         5700         64000           10         156.92         5800         5800         69000           11         167.88         5800         5800         66000           12         178.25         6000         5800         66000           13         188.92         6100         5900         7300           15         210.25         6800         6800         83000           16         222.08         7300         7400         87000           18         244.25         6600         6400         54000           19         255.08         7000         7000         65000           20         285.92         7500         7600         65000           21         27.75         8100         9300         77000           23         298.42         9103         9700         83000           24         309.25         9700         10400         89000           27         346.08         18600         19900         155000           28         356.08         12400         14200<	7	124.92	5800	5700	62000
9         146.25         5200         5700         64000           10         165.82         5600         5800         59000           11         167.58         5800         5800         6000           12         178.25         6000         5800         66000           14         199.58         6100         5900         73000           15         210.25         6800         6800         83000           16         222.08         7300         7400         87000           17         223.22         6200         6200         54000           20         265.92         7500         7600         65000           21         276.75         8100         8300         71000           23         298.42         9100         9700         83000           24         309.25         9700         10400         89000           25         320.08         13300         14700         130000           28         36.08         12400         14200         14000           29         367.08         13600         15800         15000           31         389.08         14500         1	8	135.58	6000	5700	63000
10         10         108.52         3600         3600         3600         3600           11         167.58         5600         5600         60000           12         178.25         6000         5800         60000           14         199.58         6100         5900         66000           15         210.25         6800         6800         83000           16         222.08         7300         7400         87000           17         232.92         6200         6200         54000           18         244.25         6600         6400         54000           20         265.92         7500         7600         66000           21         276.75         8100         8300         71000           23         284.42         9100         9700         83000           24         309.25         9700         10400         89000           25         320.08         13000         14200         19000           26         36.08         12400         14200         19000           27         345.08         18600         19000         15000           30         378.08	9	146.25	6200	5700	64000
11         107.35         5800         380.0         00000           12         178.25         6000         5800         68000           13         188.92         6100         5900         68000           14         199.58         6100         5900         73000           15         210.25         6800         6800         83000           16         222.08         7300         7400         87000           17         232.22         6200         6400         54000           18         244.25         6600         6400         54000           20         225.59         7500         7600         65000           21         276.75         8100         8300         71000           23         298.42         9100         9700         83000           24         309.25         9700         10400         89000           25         320.08         13300         11200         96000           27         346.08         18600         19900         15500           28         366.08         12400         14200         19900           30         378.08         13600 <t< td=""><td>10</td><td>156.92</td><td>5000</td><td>5800</td><td>59000</td></t<>	10	156.92	5000	5800	59000
12         17.02.3         0.000         3.000         3.000         3.000           13         188.92         6100         5900         66000           14         199.58         6100         5900         73000           15         210.25         6800         6800         83000           16         222.08         7300         7400         87000           17         232.92         6200         6200         54000           18         244.25         6600         6400         54000           20         265.92         7500         7600         65000           21         276.75         8100         8300         71000           23         298.42         9100         9700         83000           24         392.25         9700         10400         89000           25         320.08         10300         14200         130000           26         36.08         12400         14200         13000           27         346.08         18600         19900         155000           31         389.08         14500         17000         131000           32         401.08	12	107.00	6000	5000	50000
13         103.22         303.03         303.03           14         199.58         6100         530.0         730.00           15         210.25         660.0         680.0         830.00           16         222.08         730.0         740.0         8700.0           17         232.92         620.0         640.0         540.00           18         244.25         660.0         640.0         540.00           20         265.92         750.0         760.0         650.00           21         276.75         810.0         930.0         770.00           23         284.42         910.0         970.0         830.00           24         309.25         970.0         104.00         890.00           25         320.08         1030.0         112.00         960.00           26         27.1         345.08         1860.0         1990.0         1550.00           28         356.08         1240.0         1420.0         1150.00         1150.00           30         378.08         1360.0         1580.0         1210.00         33.00         31.00         131.000         132.000         32.00         140.00         1	12	188.02	6100	5900	66000
17         100.25         6800         6800         6800           16         222.08         7300         7400         87000           17         222.02         6200         6400         54000           18         244.25         6600         6400         54000           19         256.08         7000         7000         59000           20         265.92         7800         7600         65000           21         276.75         8100         8300         71000           23         298.42         9100         9700         83000           24         309.25         9700         10400         89000           25         320.08         10300         11200         96000           24         309.25         9700         10400         89000           25         320.08         13600         14500         109000           28         356.08         12400         14200         109000           30         378.08         13800         13200         132000           31         389.08         14500         17000         131000           32         401.08         14800	14	100.52	6100	5900	73000
16         222.08         7300         7400         87000           17         232.92         6200         6200         54000           18         244.25         6600         6400         54000           19         255.08         7000         7000         59000           20         225.92         7500         7600         65000           21         276.75         8100         8300         71000           23         298.42         9100         9700         83000           24         309.25         9700         10400         89000           25         320.08         10300         11200         96000           28         356.08         12400         14200         130000           28         356.08         12400         14200         14200         14000           30         378.08         13600         15000         131000         131000           31         389.08         144500         17000         13000         32000         334         423.08         16100         19700         144000         36         446.08         16800         2600         15000         167000         34         <	15	210.25	6800	6800	83000
17         232.92         6200         6200         54000           18         244.25         6600         6400         54000           19         255.08         7000         7000         59000           20         265.92         7500         7600         65000           21         276.75         8100         8300         71000           22         287.88         8800         9000         77000           23         298.42         9100         9700         83000           24         302.25         9700         10400         89000           25         320.08         10300         11200         96000           28         356.08         12400         144200         109000           29         367.08         13000         15000         15000           30         378.08         14500         17000         133000           32         401.08         14490         17700         133000           34         423.08         15500         18800         132000           35         434.08         16100         19700         144000           36         445.08         16800 <td>16</td> <td>222.08</td> <td>7300</td> <td>7400</td> <td>87000</td>	16	222.08	7300	7400	87000
18         244.25         6600         6400         54000           19         255.08         7000         7000         59000           20         265.92         7500         7600         65000           21         276.75         8100         8300         71000           22         287.88         8600         9000         77000           23         298.42         9100         9700         83000           24         309.25         320.08         10300         11200         96000           25         320.08         10300         14700         130000         155000           28         356.08         12400         14200         109000         15500           29         367.08         13800         15800         121000         31000           31         389.08         14500         17000         131000         32000         333         412.08         15500         18000         127000         33000         32000         336         445.08         16800         20600         150000         36         445.08         16800         22400         15000         157000         336         445.08         16800	17	232.92	6200	6200	54000
19         255.08         7000         7000         59000           20         286.92         7500         7600         65000           21         276.75         8100         8300         71000           22         287.58         8600         9000         77000           23         298.42         9100         9700         83000           24         309.25         9700         10400         89000           25         320.08         10300         11200         96000           28         356.08         12400         14200         19900         155000           28         356.08         12400         14200         19900         155000           30         378.08         13600         15800         121000           31         380.08         144500         17000         13000           32         401.08         14500         17000         13000           33         412.08         16500         18800         137000           34         423.08         16100         19700         144001           35         434.08         16100         19700         14000           36	18	244.25	6600	6400	54000
20         265.92         7500         7600         66000           21         276.75         8100         8300         71000           22         287.58         8600         9000         77000           23         298.42         9100         9700         83000           24         309.25         9700         10400         89000           25         320.08         10300         11200         96000           28.MECH         311.25         13500         14700         130000           29         367.08         13000         15000         12100           30         378.08         13600         15000         121000           31         380.06         14500         17000         133000           32         401.08         14900         17700         133000           33         412.08         15500         18001         137000           34         423.08         16500         18000         132000           35         434.08         16100         19700         144000           36         445.08         18700         23300         17000           37         456.08	19	255.08	7000	7000	59000
21         276.75         8100         8300         71000           22         287.88         8800         9000         77000           23         298.42         9100         9700         83000           24         309.25         9700         10400         89000           25         320.08         10300         11200         96000           26.MECH         331.25         13500         14700         130000           27         345.08         12400         14200         109000           28         36.08         12400         14200         115000           30         378.08         13800         15800         121000           31         389.08         14500         17000         131000           32         401.08         14900         17700         133001           33         412.08         15500         18800         137000           34         423.08         16500         18000         12400           35         446.08         18800         20800         15000           36         445.08         17400         21500         176000           37         456.08	20	265.92	7500	7600	65000
22         287.58         8600         9000         77000           23         286.42         9100         9700         83000           24         309.25         9700         10400         89000           25         320.08         10300         11200         96000           26.MECH         331.25         13500         14700         130000           27         345.08         18600         19900         155000           28         366.08         12400         14200         19000           30         378.08         13600         15600         115000           31         389.08         144500         17000         131000           32         401.08         144900         17700         133000           33         412.08         15500         18800         137000           34         423.08         15500         18000         127000           35         434.08         16100         19700         140000           36         445.08         17400         21500         157000           37         456.08         19300         24200         176000           41         50.08	21	276.75	8100	8300	71000
23         298.42         9100         9700         83000           24         309.25         9700         10400         89000           25         320.08         10300         11200         96000           28-MECH         331.25         13500         14700         130000           27         345.08         18600         19900         155000           28         356.08         12400         14200         109000           30         378.08         13900         15500         131000           31         389.08         14500         17700         131000           32         401.08         14490         17700         13000           33         412.08         15500         18800         132000           34         423.08         15500         18800         132000           35         434.08         16100         19700         144000           36         445.08         16800         22300         176000           37         456.08         17400         21500         157000           38         467.08         18700         23300         176000           41         50.08	22	287.58	8600	9000	77000
24         309.25         9700         10400         89000           25         320.08         10300         11200         96000           26.MECH         331.25         13500         14700         130000           27         346.08         18600         19900         155000           28         356.08         12400         14200         10900           29         367.08         13000         15000         115000           30         378.08         13600         15800         121000           31         389.08         14500         17700         133000           32         401.08         15500         18000         132000           34         423.08         15500         18000         132000           35         434.08         16100         19700         14000           36         445.08         16800         20800         15000           37         456.08         17400         21500         17600           38         467.08         18700         23300         176000           41         500.08         21800         25100         182000           42         511.08 <td>23</td> <td>298.42</td> <td>9100</td> <td>9700</td> <td>83000</td>	23	298.42	9100	9700	83000
25         320.08         10300         11200         96000           28-MECH         331.25         13500         14700         130000           27         345.08         18600         19900         155000           28         356.08         12400         14200         109000           29         367.08         13000         15000         115000           30         378.08         13600         15000         121000           31         389.08         144500         17000         133000           32         401.08         144500         17000         132000           34         423.08         15500         18800         132000           35         434.08         16100         19700         144000           36         445.08         16800         22600         157000           37         456.08         17400         21500         157000           39         478.08         18700         23300         170000           40         489.08         19300         24200         18000           41         50.08         21800         27400         194000           42         511.	24	309.25	9700	10400	89000
28-MECH         331.25         13500         14/00         130000           27         345.08         13800         19900         155000           28         356.08         12400         14200         199000           29         367.08         13000         15600         115000           30         378.08         13600         15600         121000           31         389.08         14500         17700         131000           32         401.08         144900         17700         133000           33         412.08         15500         18800         137000           34         423.08         16100         19700         14400           35         434.08         16100         19700         14400           36         445.08         16800         20600         150000           37         456.08         17400         21500         157000           38         467.08         18700         23300         176000           41         500.08         19300         24200         163000           42         511.08         20900         26500         193000           43         523.	25	320.08	10300	11200	96000
27         345.08         18600         19900         155000           28         356.08         12400         14200         119000           29         367.08         13000         15000         115000           30         378.08         13600         15000         121000           31         389.08         144500         17700         13000           32         401.08         14500         17700         13000           33         412.08         15500         18800         132000           34         423.08         16100         19700         144000           36         4445.08         16800         20600         150000           37         456.08         17400         21500         177000           38         467.08         18700         23300         170000           40         480.08         19300         24200         176000           41         500.08         19800         25100         176000           42         511.08         20900         25100         176000           43         523.08         21200         27200         191000           44         534.08 </td <td>26-MECH</td> <td>331.25</td> <td>13500</td> <td>14700</td> <td>130000</td>	26-MECH	331.25	13500	14700	130000
28         330.08         12400         14200         192000           29         387.08         13600         15500         115000           30         378.08         13800         15500         115000           31         389.08         14500         17000         131000           32         401.08         144900         17700         133000           33         412.08         15500         18800         132000           34         423.08         15500         18800         132000           35         434.08         16100         19700         144000           36         445.08         16800         20600         159000           37         456.08         17400         21500         157000           38         467.08         18700         23300         170000           40         489.08         19300         24200         176000           41         50.08         19300         24500         194000           44         534.08         21200         27200         194000           44         534.08         21200         27200         194000           445         545.08<	27	345.08	18600	19900	155000
2.9         307.86         13600         19000         119000           30         378.66         13600         15800         121000           31         389.08         14500         17000         131000           32         401.08         144900         17700         133000           33         412.08         15000         18000         132000           34         423.08         16500         18800         137000           35         434.08         16100         19700         144000           36         445.08         16800         20600         150000           37         456.08         17400         21500         157000           38         467.08         18700         23300         176000           41         500.08         19300         24200         163000           41         500.08         19300         24200         176000           43         523.08         21500         192000         182000           44         534.08         21200         27100         196000           45         545.08         21400         29100         196000           44         534.0	20	300.00	12400	14200	115000
30         370.03         1360.03         1360.03         121000           31         389.08         144500         17700         133000           32         401.08         144900         17700         133000           33         412.08         15500         18000         132000           34         423.08         15500         18800         137000           35         434.08         16100         19700         144000           36         445.08         16800         20600         15000           37         456.08         17400         21500         157000           38         467.08         18300         22400         163000           40         489.08         19300         24200         176000           41         50.08         21800         23300         170000           42         511.08         20900         26500         193000           43         523.08         21200         27400         194000           44         534.08         21200         27400         194000           45         545.08         21800         28100         196000           46         56.0	29	307.00	13600	15000	121000
32         401.08         14900         17700         133000           33         412.08         15000         18000         132000           34         423.08         15500         18800         132000           35         434.08         16500         18800         132000           35         434.08         16100         19700         144000           36         445.08         16800         22600         150000           37         456.08         17400         21500         157000           38         467.08         18700         23300         170000           40         489.08         19300         24200         176000           41         50.08         19700         23300         170000           42         511.08         20900         26500         193000           43         523.08         21200         27200         194000           44         534.08         21200         27200         194000           45         545.08         21800         28100         29000         202000           46         550.68         22400         29000         228000         284000         3	31	389.08	14500	17000	131000
33         412.08         15000         18000         132000           34         423.08         15500         18000         137000           35         434.08         16500         18000         137000           36         445.08         16500         20600         150000           37         456.08         17400         21500         157000           38         467.08         18000         22400         163000           40         489.08         19300         24200         176000           41         500.08         19900         25100         182000           42         511.08         20900         26500         193000           43         523.08         21500         27400         194000           44         534.08         21800         28100         196000           46         566.08         22400         29000         222000           47-MECH         667.25         31200         38700         248000           50         664.08         27700         36700         236000           51         615.58         28400         37700         236000           52         627	32	401.08	14900	17700	133000
34         423.08         15500         18800         137000           35         434.08         16100         19700         144000           36         445.08         16800         20600         15000           37         456.08         17400         21500         157000           38         467.08         18800         22400         163000           39         478.08         18700         23300         170000           40         489.08         19300         24200         176000           41         50.08         19300         24200         176000           42         511.08         20900         25100         182000           43         523.08         21500         27400         194000           44         534.08         21200         27000         191000           45         546.08         21400         28000         28000           46         556.08         22400         28000         28000           49         592.58         27100         36700         231000           50         604.08         27700         36700         24000           51<615.58	33	412.08	15000	18000	132000
35         434.08         16100         19700         144000           36         445.08         16800         20600         150000           37         456.08         17400         21500         157000           38         467.08         18000         22400         163000           39         478.08         18700         23300         170000           40         489.08         19300         24201         176000           41         500.08         19900         25100         182000           42         511.08         20900         26500         193000           43         523.08         21200         27200         191000           44         534.08         21200         27200         194000           45         545.08         21400         28100         19600           46         556.08         22400         29000         225000           47.MECH         567.25         31200         39800         28500         294000           50         604.08         27700         36700         228000         51         615.58         29400         37700         236000         52         627.08	34	423.08	15500	18800	137000
36         445.08         16800         20600         150000           37         456.08         17400         21500         157000           38         467.08         18000         22400         163000           39         478.08         18700         23300         170000           40         489.08         19300         24200         176000           41         500.08         19300         24200         182000           42         511.08         20900         26500         193000           43         523.08         21500         27400         194000           44         534.08         21200         28100         196000           46         566.08         22400         29000         202000           47.MECH         667.25         31200         38800         285000           48         581.08         33300         42800         294000           50         664.08         27400         39700         246000           51         615.58         28400         37700         236000           52         627.08         30300         442600         245000           54         65	35	434.08	16100	19700	144000
37         456.08         17400         21500         157000           38         447.08         18000         22400         163000           39         478.08         18700         2330         177000           40         489.08         19300         24200         176000           41         500.08         19300         24200         176000           42         511.08         20900         26500         193000           43         523.08         21500         17400         194000           44         534.08         21200         27200         191000           45         545.08         21800         28100         18000           46         556.08         22400         29000         20200           47.MECH         567.25         31200         39800         285000           49         592.58         27100         35700         228000           50         604.08         27700         36700         241000           51         615.58         28400         37700         246000           52         627.08         29000         38700         246000           54         650.08	36	445.08	16800	20600	150000
38         467.08         18000         22400         163000           39         478.08         18700         23300         170000           40         489.08         19300         24200         176000           41         500.08         19900         25100         182000           42         511.08         20900         26500         193000           43         523.08         21500         27400         194000           44         534.08         21200         27200         191000           45         545.08         21800         28100         196000           46         556.08         22400         29000         226000           47-MECH         567.25         31200         39800         285000           50         604.08         27700         36700         28000           50         604.08         27700         36700         24000           51         615.58         28400         37700         246000           53         638.68         29600         38700         241000           54         650.08         30300         41500         255000           56         673.0	37	456.08	17400	21500	157000
39         478.08         18700         23300         170000           40         489.08         19300         24200         176000           41         500.08         19900         25100         182000           42         511.08         20900         26500         193000           43         523.08         21500         27400         194000           44         534.08         21200         27200         191000           45         545.08         21800         28100         196000           46         556.08         22400         29000         202000           47.MECH         567.25         31200         38900         285000           48         581.08         33300         42800         294000           50         604.08         27700         36700         23000           51         615.88         29400         37700         236000           52         627.08         29000         38700         246000           54         650.08         30300         44260         251000           55         661.58         30900         41500         256000           57         684.	38	467.08	18000	22400	163000
40         489.08         19300         24200         176000           41         500.08         19300         25100         182000           42         511.08         20900         26500         193000           43         523.08         21500         176000         194000           44         534.08         21200         27400         194000           44         534.08         21200         27200         191000           45         545.08         22400         29000         202000           46         556.08         22400         29000         22000           47.MECH         567.25         31200         39800         285000           49         592.58         27100         36700         228000           50         604.08         27700         36700         231000           51         615.58         28400         37700         246000           52         627.08         30300         44600         251000           54         650.08         30300         44500         25000           57         684.58         32700         44300         250000           58         670.	39	478.08	18700	23300	170000
41         500.08         19900         25100         182000           42         511.08         20900         26500         193000           43         523.08         21500         27400         194000           44         534.08         21200         27200         191000           45         545.08         21800         28100         196000           46         556.08         22400         29000         202000           47-MECH         567.25         31200         39800         285000           48         581.08         33300         42800         294000           49         592.58         27100         35700         228000           50         604.08         27700         36700         224000           51         615.58         28400         37700         236000           52         627.08         29600         38700         241000           53         638.68         29600         38700         246000           54         650.08         30300         41500         255000           56         673.08         31600         42500         260000           58         697	40	489.08	19300	24200	176000
42         511.08         20900         26500         193000           43         523.08         21500         27400         194000           44         534.08         21200         27200         191000           45         546.08         21800         28100         196000           46         556.08         22400         28000         28000           47.MECH         567.25         31200         39800         285000           48         581.08         33300         42800         294000           49         592.58         27100         36700         236000           50         604.08         27700         36700         236000           51         615.58         28400         37700         236000           52         627.08         29000         38700         246000           53         661.58         30900         41500         255000           55         661.58         30900         44300         28000           57         684.58         32700         44300         28000           58         708.58         32400         44400         282000           60         720.58	41	500.08	19900	25100	182000
43         523.08         21500         27400         194000           44         534.08         21200         27200         191000           45         545.08         21800         28100         196000           46         556.08         22400         29000         202000           47-MECH         567.25         31200         39800         28500           48         581.08         33300         42800         224000           49         592.58         27100         35700         228000           50         604.08         27700         36700         231000           51         615.58         28400         37700         286000           52         627.08         29000         38700         241000           53         638.58         28600         39700         246000           54         650.08         30300         40600         251000           56         673.08         31600         42500         260000           57         684.58         32700         44300         270000           58         697.08         32400         44400         282000           60         708.	42	511.08	20900	26500	193000
44         334.08         21200         191000           44         334.08         21200         191000           45         545.08         21800         196000           46         556.08         22400         29000         222000           47-MECH         567.25         31200         39800         228000           48         581.08         33300         42800         294000           49         592.58         27100         35700         228000           50         604.08         27700         36700         228000           51         615.58         28400         37700         236000           52         627.08         29600         38700         241000           53         638.68         29600         38700         246000           54         650.08         30300         40600         251000           55         661.58         32900         44800         268000           57         684.58         32700         44300         268000           58         697.08         32400         44400         268000           60         705.88         33400         44800         26	43	523.08	21500	27400	194000
+3         24.00         21.00         20.00         130.00           46         56.08         22.400         22000         22000           47.MECH         567.25         31200         39800         228000           48         581.08         33300         42800         229000           49         592.58         27100         35700         228000           50         604.08         27700         36700         231000           51         615.58         28400         37700         226000           52         627.08         29000         38700         241000           53         638.58         29600         38700         246000           54         650.08         30300         40500         251000           55         661.58         30900         41500         255000           56         673.08         31600         42500         260000           57         684.58         32700         44300         280000           59         708.58         32400         44400         282000           60         720.58         33600         46600         277000           61-RES         7	44	545.09	21200	27200	191000
47-MECH         567.25         31200         39800         228000           48         581.08         33300         42800         224000           49         592.58         27100         36700         228000           50         604.08         27700         36700         228000           51         615.58         27400         36700         228000           52         627.08         29900         38700         241000           53         638.58         228000         39700         246000           54         650.08         30300         40600         251000           55         661.58         30300         44600         255000           56         673.08         31600         42500         26000           57         644.58         32700         44300         270000           58         697.08         32400         44400         262000           59         708.58         32400         44400         262000           60         720.58         33800         46600         277000           61-RES         734.08         34700         48300         288000           62-MECH	45	556.08	21000	20100	202000
AB         Strike         Strike         Strike         Strike           48         S81.08         33300         42800         294000           49         592.58         27100         35700         228000           50         604.08         27700         36700         228000           51         615.58         29400         37700         231000           52         627.08         29600         38700         241000           53         638.58         29600         38700         246000           54         650.08         30300         40600         251000           55         661.58         30990         41500         25500           56         673.08         31600         42500         260000           57         684.58         32700         44300         228000           58         697.08         32300         44400         228000           59         708.58         32400         44400         228000           60         720.58         33600         46600         277000           61-RES         734.08         34700         48300         288000           641-RES <t< td=""><td>47-MECH</td><td>567.25</td><td>31200</td><td>39800</td><td>285000</td></t<>	47-MECH	567.25	31200	39800	285000
49         592.58         27100         35700         228000           50         604.08         27700         36700         231000           51         615.58         28400         37700         236000           52         627.08         29000         38700         241000           53         638.58         29600         38700         246000           54         650.08         30300         40600         251000           55         661.58         30800         41500         256000           57         684.58         32700         44300         260000           57         684.58         32700         44300         260000           58         9708.58         32400         44300         260000           60         720.58         33600         46600         277000           61-RES         734.08         344700         48300         280000           63-14RECH         746.75         49800         67800         386000           63-DAMP         761.25         56300         79800         464000         246000           64-ROOF         788.75         68100         95200         493000	48	581.08	33300	42800	294000
50         604.08         27700         36700         231000           51         615.58         28400         37700         236000           52         627.08         29000         38700         241000           53         638.58         29600         39700         240000           54         650.08         30300         40600         251000           55         661.58         30300         40500         255000           56         673.08         31600         42500         260000           57         684.58         32700         44300         270000           58         697.08         32200         44400         262000           60         703.58         33400         44600         268000           60         705.83         32400         44400         282000           61-RES         734.08         34700         48300         288000           62-HECH         746.75         49800         67800         366000           63-DAMP         761.25         56300         79800         44400         249000           64-ROOF         788.75         68100         95200         493000         68-FO	49	592.58	27100	35700	228000
51         615.88         224000         37700         226000           52         627.08         29600         38700         241000           53         638.68         29600         38700         246000           54         650.08         30300         40600         251000           55         661.58         30990         41500         255000           56         673.08         31600         42500         280000           57         684.58         32700         44300         260000           58         697.08         32200         44400         262000           59         708.58         32400         44400         262000           60         720.58         33600         46600         277000           61-RES         734.08         344700         48300         288000           62-MECH         746.75         49800         67800         386000           63-DAMP         761.25         56300         79800         44400         249000           64-ROOF         788.75         68100         95200         493000         66-708         39300         64-700         134000         134000         134000	50	604.08	27700	36700	231000
52         627.08         29000         38700         241000           53         638.58         29600         39700         246000           54         650.08         30300         40600         251000           55         661.58         30900         41500         256000           56         673.08         31600         42500         280000           57         684.58         32700         44300         270000           58         697.08         32400         44400         262000           60         720.58         32400         44400         262000           60         720.58         33600         46600         277000           61-RES         734.08         34700         48300         288000           63-DAMP         761.25         56300         79800         366000           63-DAMP         761.25         56300         79800         44400         346000           64-ROOF         788.75         68100         95200         493000         64-ROOF         708.75         68100         95200         493000           64-ROOF         788.75         68100         95200         493000         134000	51	615.58	28400	37700	236000
53         638.68         29600         39700         246000           54         650.08         30300         40600         251000           55         661.58         30300         41500         25500           56         673.08         31600         41500         226000           57         684.58         32700         44300         226000           58         697.08         32900         44800         268000           59         708.58         32400         44400         262000           60         720.58         33600         46600         277000           61.FES         734.08         34700         48300         288000           62-MECH         746.75         49800         67800         366000           63-DAMP         761.25         56300         79800         464000           64-ROOF         788.75         68100         95200         493000           64-ROOF         788.75         68100         95200         493000           65-TOB         803.00         11700         18400         134000	52	627.08	29000	38700	241000
54         650.08         30300         40600         251000           55         661.58         303900         41500         255000           56         673.08         31600         42500         260000           57         684.58         32700         44300         270000           58         697.08         32290         44400         268000           59         708.58         32400         44400         262000           60         720.58         33600         46600         277000           61-RES         734.08         34700         48300         288000           62-MECH         746.75         49800         67800         366000           63-DAMP         761.25         56300         79800         44400         242000           64-ROOF         778.75         68100         95200         493000         66-T08         03.00         11700         18400         134000           64-ROOF         803.00         11700         18400         134000         134000	53	638.58	29600	39700	246000
55         661.58         30900         41500         255000           56         673.08         31600         42500         260000           57         684.58         32700         44300         270000           58         697.08         32200         44300         268000           59         708.58         32400         44400         268000           60         720.58         33600         46600         277000           61.RES         734.08         34700         48300         288000           62-MECH         746.75         49800         67800         366000           63-DAMP         761.25         56300         79800         464000           64-ROOF         788.75         68100         95200         493000           65-TOB         803.00         11700         18400         134000           SUMS         1.21E+06         1.05E+07         1.05E+07	54	650.08	30300	40600	251000
56         673.08         31600         42500         280000           57         684.58         32700         44300         27000           58         697.08         32900         44800         268000           59         708.58         32400         44400         262000           60         720.58         33800         46600         277000           61-RES         734.08         34700         48300         288000           62-MECH         746.75         49800         67800         366000           63-DAMP         761.25         56300         79800         464000           64-ROOF         788.75         68100         95200         493000           65-TOB         803.00         11700         18400         134000           SUMS         1.21E+06         1.05E+07         1.05E+07	55	661.58	30900	41500	255000
57         684.58         32700         44300         270000           58         697.08         32290         44400         268000           59         708.58         32400         44400         268000           60         720.58         33600         46600         277000           61-RES         734.08         34700         48300         288000           62-MECH         746.75         49800         67800         386000           63-DAMP         761.25         56300         79800         464000           64-ROOF         788.75         68100         95200         493000           64-ROOF         788.75         68100         95200         493000           65-TOB         803.00         11700         18400         134000	56	673.08	31600	42500	260000
DB         US         32290         44800         288000           59         708.58         32400         44400         282000           60         720.58         33600         46600         277000           61.RES         734.08         34700         48300         288000           62.MECH         746.75         49800         67800         386000           63-DAMP         761.25         56300         79800         464000           64-ROOF         788.75         68100         95200         493000           65-TOB         803.00         11700         18400         134000           SUMS         1.21E+06         1.05E+07         1.06E+07	57	684.58	32700	44300	270000
by         708:58         32:400         44:400         22:2000           60         720:58         33:600         46600         277000           61.RES         734.08         34700         48300         288000           62-MECH         746.75         49800         67800         366000           63-DAMP         761.25         56300         79800         464000           64-ROOF         788.75         68100         95200         493000           65-TOB         803.00         11700         18400         134000           SUMS         1.21E+06         1.05E+07         1.05E+07	58	697.08	32900	44800	268000
UO         120.30         33000         40000         27/1000           61-RES         734.08         34700         48300         288000           62-MECH         746.75         49800         67800         366000           63-DAMP         761.25         56300         79800         464000           64-ROOF         788.75         68100         95200         493000           64-ROOF         788.75         68100         95200         493000           65-TOB         803.00         11700         18400         134000           SUMS         1.21E+06         1.53E+06         1.06E+07	59	708.58	32400	44400	262000
017LS         734.00         344.00         465.00         2880.00           02-MECH         746.75         4980.0         6780.0         3660.00           63-DAMP         761.25         5630.0         7980.0         46400.0           64-ROOF         788.75         6810.0         9520.0         49300.0           65-TOB         803.00         1170.0         1840.0         13400.0           SUMS         1.21E+06         1.53E+06         1.06E+07	61 DES	720.00	34700	40000	277000
Company         Total         Total <thtotal< th="">         Total         Total         <t< td=""><td>62-MECH</td><td>746 75</td><td>49800</td><td>67800</td><td>366000</td></t<></thtotal<>	62-MECH	746 75	49800	67800	366000
64-ROOF         788.75         68100         95200         433000           65-TOB         803.00         11700         18400         134000           SUMS         1.21E+06         1.53E+06         1.06E+07	63-DAMP	761.25	56300	79800	464000
65-TOB         803.00         11700         18400         134000           SUMS         1.21E+06         1.53E+06         1.06E+07	64-ROOF	788.75	68100	95200	493000
SUMS 1.21E+06 1.53E+06 1.06E+07	65-TOB	803.00	11700	18400	134000
	SL	JMS	1.21E+06	1.53E+06	1.06E+07

#### Factor for Simultaneous Application of Loads in Table 3b

Pactor for Simultaneous Application of Loads in Table 30					
Load Case	X Forces (Fx)	Y Forces (Fy)	Torsion (Mz)		
1	+100%	+45%	+35%		
2	+100%	+45%	-45%		
3	+100%	-45%	+35%		
4	+100%	-45%	-45%		
5	-100%	+35%	+60%		
6	-100%	+35%	-30%		
7	-100%	-65%	+60%		
8	-100%	-65%	-30%		
9	+60%	+90%	+35%		
10	+60%	+90%	-45%		
11	+60%	-100%	+30%		
12	+60%	-100%	-45%		
13	-35%	+90%	+35%		
14	-35%	+90%	-45%		
15	-55%	-100%	+30%		
16	-55%	-100%	-45%		
17	+30%	+30%	+100%		
18	+55%	+35%	-95%		
19	+30%	-30%	+100%		
20	+55%	-40%	-95%		
21	-60%	+30%	+100%		
22	-30%	+35%	-95%		
23	-60%	-30%	+100%		
24	-30%	-40%	-95%		

Note:

(1) Load combination factors have been produced through consideration of the structure's response to various wind directions, modal coupling, correlation of wind gusts and the directionality of strong winds in the local wind climate.

Notes

The loads given in this table should be used with the load combination factors given in Table 4b.

(2) The loads given in this table are centered about the reference axis shown in Figure 4.

(3) The above loads correspond to a 50-year return period basic wind speed (3-second gust) of 90 mph.

# LERA

P903 25 April 2016

APPENDIX C

138 EAST  $50^{\text{TH}}$  STREET

STRUCTURAL DESIGN CRITERIA



**138 East 50<sup>th</sup> Street** Ceruzzi Properties, LLC SLCE Architects March 30, 2016



QM

Issue/revision	Issue 1	Revision 1	Revision 2	Revision 3
Remarks				
Date	03-30-2016			
Prepared by	НМ			
Signature				
Checked by	НМ			
Signature				
Authorized by	SM			
Signature				
Project number	B1590-031			
File reference				

WSP USA 228 E45th St. New York, NY 10017

http://www.wsp-usa.com

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<ol> <li>2.1</li> <li>2.2</li> <li>2.3</li> <li>2.4</li> <li>2.5</li> <li>3</li> <li>3.1</li> </ol>	Other Design CriteriaDeflection, generallyHorizontal SwayVibration LimitsDurability of the StructureFire Resistance PeriodsDesign StandardsStatutory Codes of Practice	3 3 3 3 3 3 3 5 5
<ol> <li>2.1</li> <li>2.2</li> <li>2.3</li> <li>2.4</li> <li>2.5</li> <li>3</li> <li>3.1</li> <li>4</li> </ol>	Other Design Criteria Deflection, generally Horizontal Sway Vibration Limits Durability of the Structure Fire Resistance Periods Design Standards Statutory Codes of Practice	3 3 3 3 3 3 3 5 5 6
<ol> <li>2.1</li> <li>2.2</li> <li>2.3</li> <li>2.4</li> <li>2.5</li> <li>3</li> <li>3.1</li> <li>4</li> <li>4.1</li> </ol>	Other Design Criteria Deflection, generally Horizontal Sway Vibration Limits Durability of the Structure Fire Resistance Periods Design Standards Statutory Codes of Practice Design References Computer Programs	3 3 3 3 3 3 5 5 5 6 6

#### STRUCTURAL DESIGN CRITERIA

1 Design Criteria

#### **DESIGN LOADS**

#### 1.1 DESIGN DEAD LOADS

Dead loads are calculated from the known self-weight of the materials used for the construction of the frame.

#### 1.2 DESIGN SUPERIMPOSED DEAD LOADS

Additional allowance is made for fixed finishes and services as follows:

Residential Floors (ceiling, partitions, finishes)	
Balconies	30 psf
Lobby/public spaces (ceiling, dense finishes)	30 psf
Retail (ceiling, dense finishes)	30 psf
Mechanical room (ceiling, suspended services, partitions)	30 psf
Elevator/stair lobbies within core (Ceiling, suspended services and dense finishes)	30 psf
Roof (Finishes, insulation, tapered slab, ceiling)	30 psf

#### 1.3 DESIGN LIVE LOADS

The following loads have been adopted in the design:

Residential	40 psf
Balconies	100 psf
Staircases	100 psf
Main roof (access for maintenance only)	40 psf
Mechanical areas	150 psf
Public areas (lobby)	100 psf

The building structure will be checked for the loadings applied from the proposed temporary cranes and hoists by the Contractor, with the capacity of the structure being adjusted where necessary.

#### 1.4 WIND LOADS

Wind loads acting on the main building frame and the various elements of cladding were determined by wind tunnel testing as described in RWDI's wind tunnel testing report.

#### 1.5 EARTHQUAKE LOADS

Static Analysis using New York City Building Code - 2014 Edition

 $\begin{array}{l} S_s = 0.365 \ g \\ S_1 = 0.071 \ g \\ \text{Seismic Importance Factor} = 1.0 \\ \text{Site Class} = B \end{array}$ 

Ordinary Reinforced Concrete Shearwalls

R = 5

#### 1.6 CLADDING LOADS

Unitised window wall

25 psf

#### 1.7 TEMPORARY HOIST AND CRANE LOADS

The permanent structure will be designed to support the design loads provided by the Contractor from the temporary cranes and hoists.

#### 1.8 ELEVATOR LOADS

All elevator shaft walls and elevator machine room slabs will be designed for elevator loadings provided by the elevator consultant.

#### 1.9 FAÇADE ACCESS EQUIPMENT LOADS

The structures will be designed to support the window cleaning equipment loads to be provided by the façade access consultant.

#### 1.10 MECHANICAL EQUIPMENT REPLACEMENT LOADS

All equipment replacement in and around the building is to be undertaken in such a manner as not to exceed the imposed loadings indicated on the WSP PB loading plans.

#### 1.11 CONSTRUCTION LOADS

To be determined by the Contractor.

## 2 Other Design Criteria

#### 2.1 DEFLECTION, GENERALLY

Vertical floor deflections for concrete floor construction:

Calculation of deflections includes long-term effects after installation of partitions/façade: Spandrel beam/slab edge live load + super-imposed dead load deflection: ½" Super-imposed + live load deflection: span / 480 (beam supported at each end) span / 240 (cantilever beam)

#### 2.2 HORIZONTAL SWAY

#### Wind

Sway deflection of any one story (to be accommodated by the perimeter cladding and interior partitions) for a 1 in 50 year design wind speed:  $\frac{1}{2}$ "

#### Earthquake

Sway deflection of any one story: 1/2"

#### 2.3 VIBRATION LIMITS ON STEEL FRAMED FLOORS

The floor structures will be designed in accordance with the American Institute of Steel Construction's Design Guide 11 – Floor Vibrations Due To Human Activity.

Floor designs will meet the criteria specified for walking excitation and rhythmic excitation. Acceptance levels of acceleration vary based on occupancy use and type of structural element.

Vibratory isolation of equipment at mechanical levels will be designed by others.

#### 2.4 DURABILITY OF THE STRUCTURE

The structure is to have a design life of 50 years. Some structural elements, such as those with concrete wearing surfaces and corrosion protection will require periodic inspection and maintenance.

#### 2.5 FIRE RESISTANCE PERIODS

The following fire resistance periods are adopted in the design of the building:

Beams and slabs:	2 hours
Columns:	3 hours

## **Material Properties**

Concrete				
Shearwalls:	f'c = 14,000psi to 10,000psi	E = 7,080ksi to 6,270ksi		
Columns:	f'c = 14,000psi to 10,000psi	E = 7,080ksi to 6,270ksi		
Link Beams:	f'c = 14,000psi to 10,000psi	E = 7,080ksi to 6,270ksi		
Floor Slabs:	f'c = 6,000psi to 10,000psi	E = 4,415ksi to 5,700ksi		
Bearing Foundations:	f'c = 10,000psi	E = 5,700ksi		
Foundation Walls:	f'c = 14,000psi to 10,000psi	E = 7,080ksi to 5,700ksi		

#### Grout:

Grout around anchor bolts and under base plates is to be a non-metallic non-shrink or expansive grout.

Reinforcement:		
Deformed reinforcing bars		

Deformed reinforcing bars	ASTM A615 Gr.60
Structural Steelwork:	
Hot rolled steel sections	ASTM A992 Gr.50
HSS sections	ASTM A500 Gr.B
Plate and misc. steel	ASTM A572 Gr.50
Channels and angles	ASTM A36

# 3 Design Standards

### 3.1 STATUTORY CODES OF PRACTICE

New York City Building Code - 2014

ACI-318 Building Code Requirements for Structural Concrete and Commentary

ACI-530-08: Building Code Requirements and Specifications for Masonry Structures and Related Commentaries

AISC-13thed.: LRFD Manual of Steel Construction

# 4 Design References

Other publications used include: IBC-2009: International Building Code ASCE7-05 Minimum Design Loads for Buildings and Other Structures AISC Design Guide 11 – Floor Vibrations Due To Human Activity

#### 4.1 COMPUTER PROGRAMS

RAM Structural System Version 14.02.01

SAFE Version 12.0

ETABS non-linear Version 9.7.4

#### 4.2 UNITS

The structural calculations will be completed using the following units.

feet and inches
Kip / g
Kip
K/in <sup>2</sup>
Kip-ft
Miles/hour
ft/s <sup>2</sup> and milli-g