Rebecca Bires | Scott Brown | Scott Eckert | Jordan Huey | Helen Leenhouts | Andrew Levy | Jeffrey Loeb | Patrick Vogel

APOLLO

350 Mission

Energy

Structure

Performance

Defining Net Zero

Net Off-Site Energy Use (Buy From Renewable Sources)

- 100% of the energy purchased comes from renewable energy sources, even if the energy is generated off the site

Zero Net Site Energy Use (Onsite Renewable)

- Amount of energy provided by on-site renewable energy sources is equal to the amount of energy used by the building

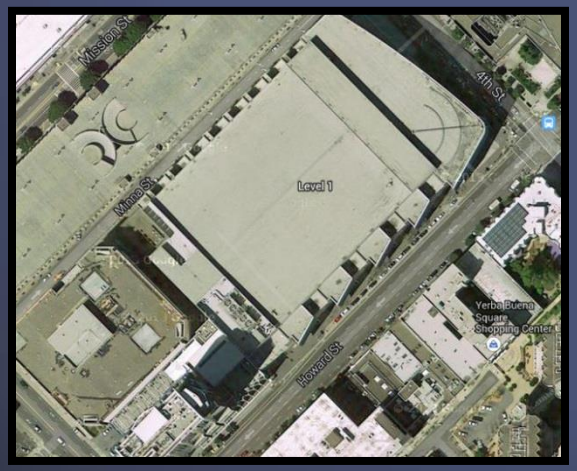
Zero Net Source Energy Use (Co-generation)

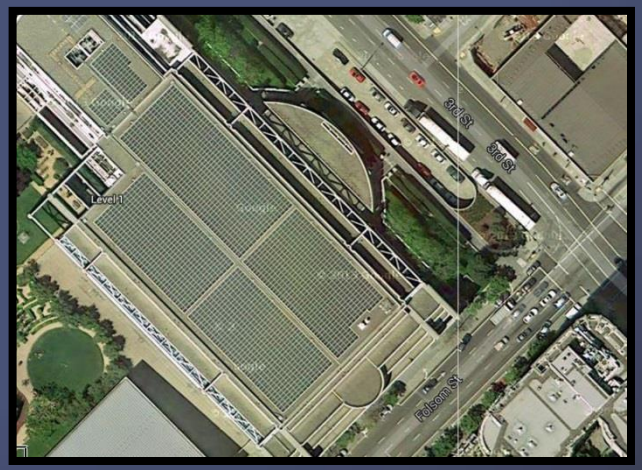
- The building generates the same amount of energy that it uses

Solar energy

Photovoltaic (PV) and Ecodistricts

- Onsite PV
  - PV roof area: 8,000 SF (half of roof)
  - PV Efficiency: 21%
  - Energy Produced: 210,704 KWh
  - EUI Reduction: 1 kBTU/SF
- Ecodistrict PV
  - Estimated area: 75,000 SF (w/o incentive)





Reducing Energy Use

Lighting Power Density

- Whole Building Method: 0.9 W/SF
- Space By Space Method: 0.89 W/SF

- Energy Used for 1 year…… 786 kW-h
  - Designed to 75% of code……590 kW-h
  - Dimming and Solar Harvesting…442 kW-h

- Reduction of 344 kW-h, or 44% of load

Co-generation

Combined Heat and Power (CHP)

- Used in combination with Boiler and DHW system loads

Heating Load Density:	13 kBTU/SF
Electrical Efficiency:	29%
Power Production:	500 kW
Energy Production:	1,000,000 kWh
EUI Reduction:	7 kBTU/SF

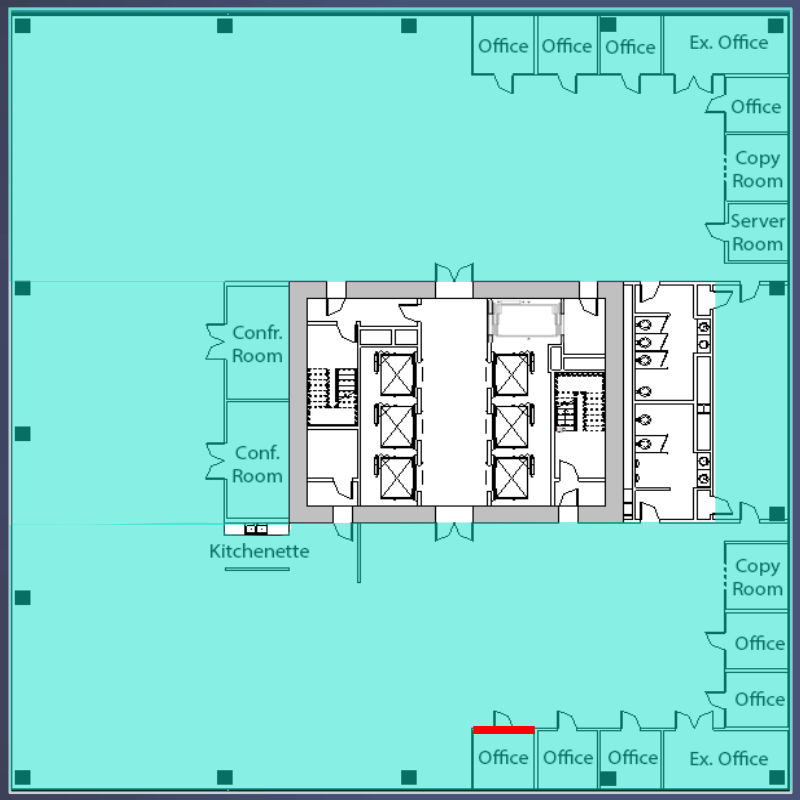
Raised Floor System

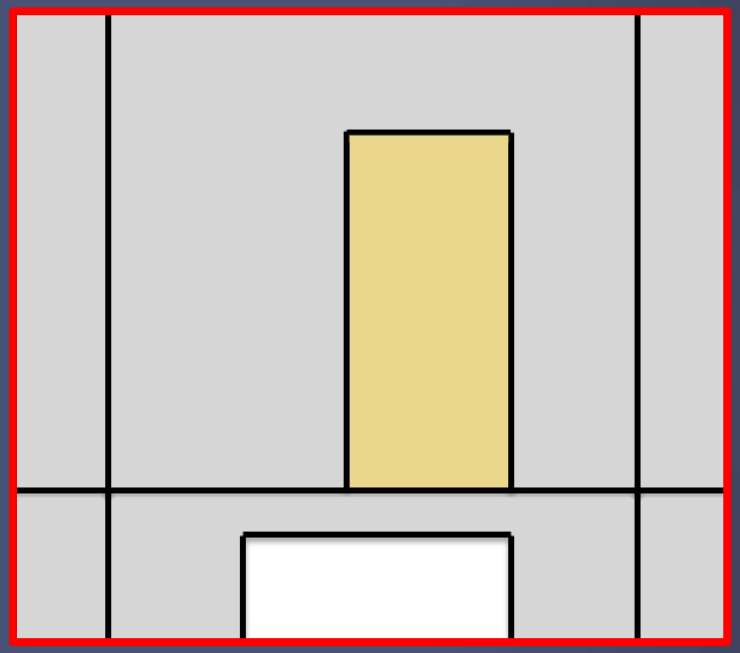
Benefits

- Supply air at 63°F instead of 55 °F
- Better air quality

Room Number	Room Description	Az Floor Area of Zone (SF)	Pz Zone Pop.	Table 6.1 Space Type	Occupant Density	Rp Table 6.1 cfm/ person	Ra OA rate cfm/sf	Pz*Rp People OA CFM	Az*Ra Area OA CFM	Ez Zone Air Distr. Effec.	Voz OA Flow to Zone
Office	Open Floor Plan UFAD	13000	84	Office Space	5	5	0.06	420	780	1.2	1000
Office	Open Floor Plan VAV	13000	84	Office Space	5	5	0.06	420	780	0.8	1500

Raised Floor System





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Raised Floor System

Seismic Considerations

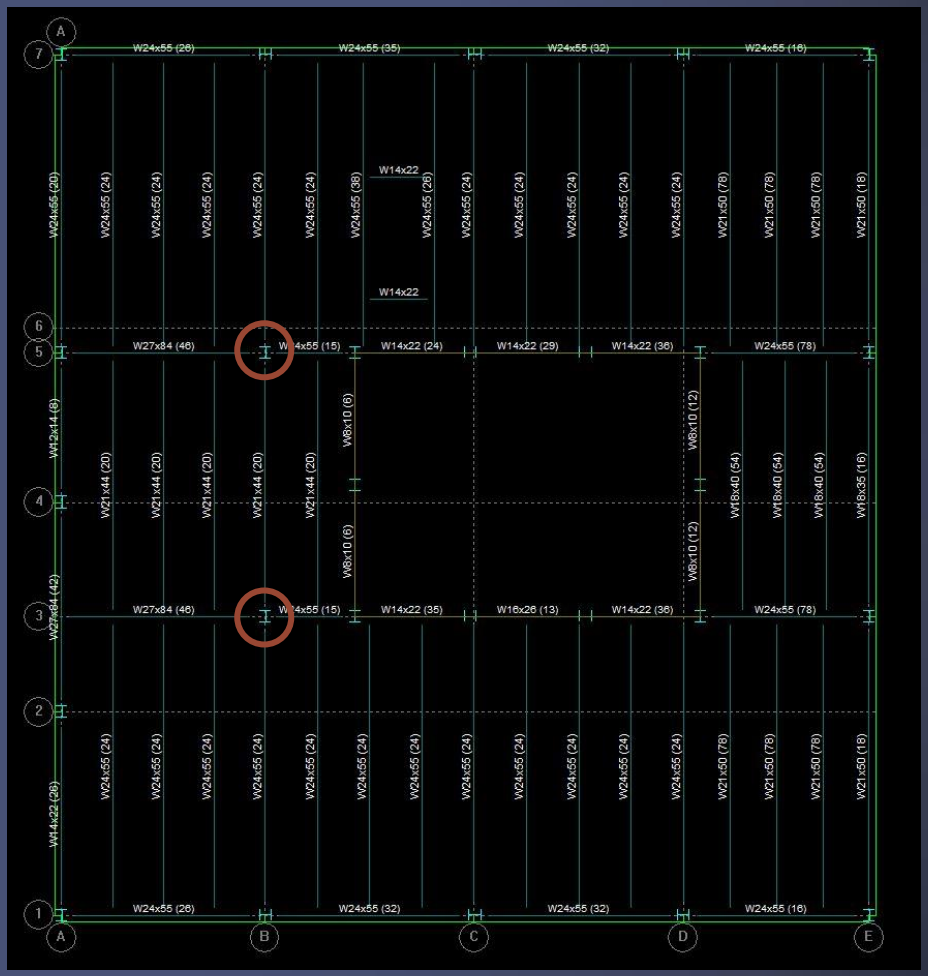
Pods

- Weight: 128 lbs/ft^2
- Place into raised floor system

Gravity Floor Plan

Includes Tentative Worst Case Loads

- Excessive beam depths in several cases
- Further research into the best way to alleviate this problem
- Possible adding interior columns to critical sections



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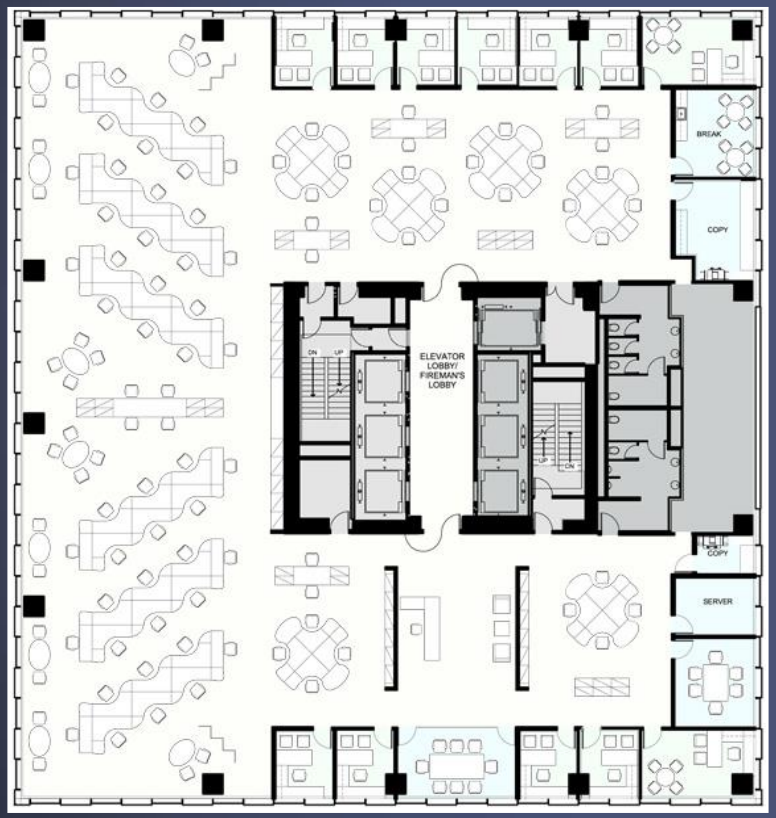
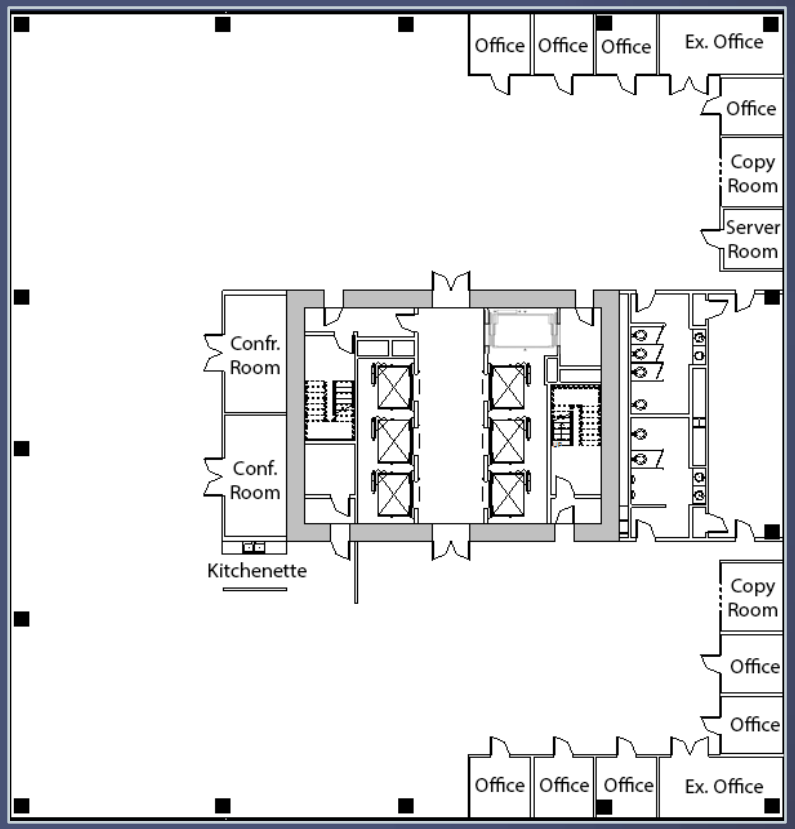
Floor Layout

350 Mission Plan

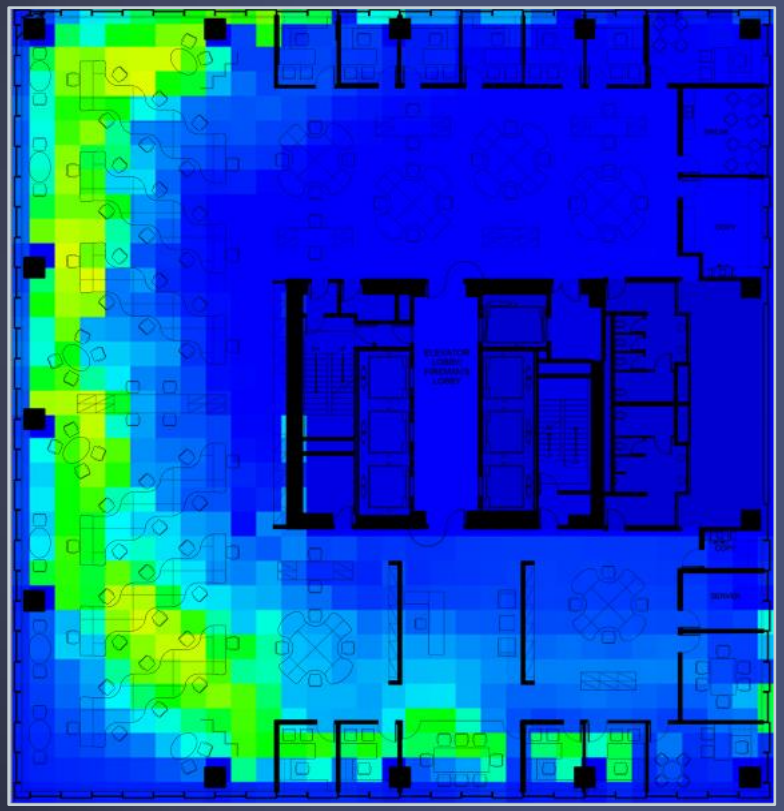


Our Floor Plan

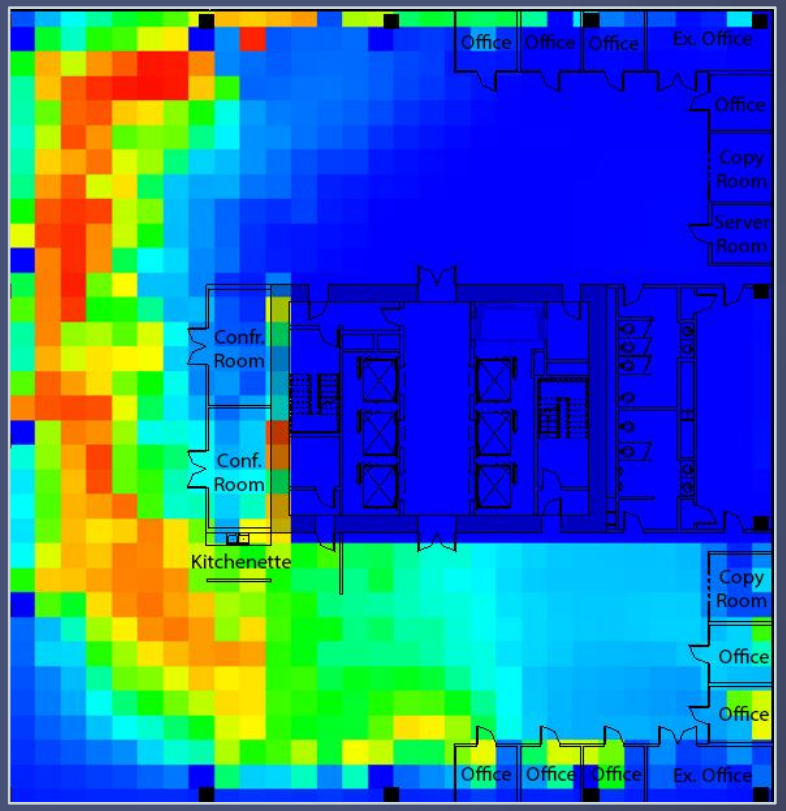


Daylighting Study

350 Mission Plan



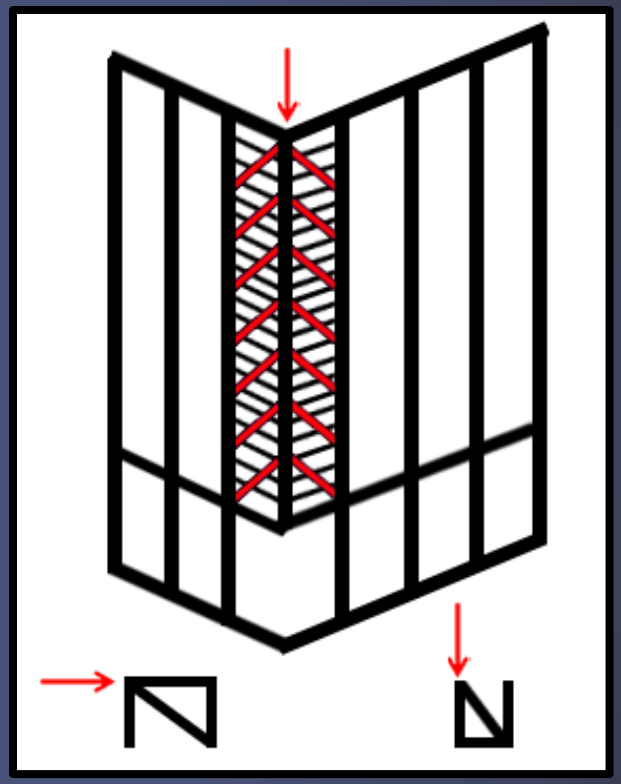
Our Floor Plan



Corner Column Addition

A Column has Been Added to the Remaining Corner in Conjunction With the Rest of the Design

- This creates several logistical and architectural concerns that must be addressed.
- We do intend to retain the open air atrium for the first four stories of the building.



Double Façade System

Located on the Southeast and Southwest walls

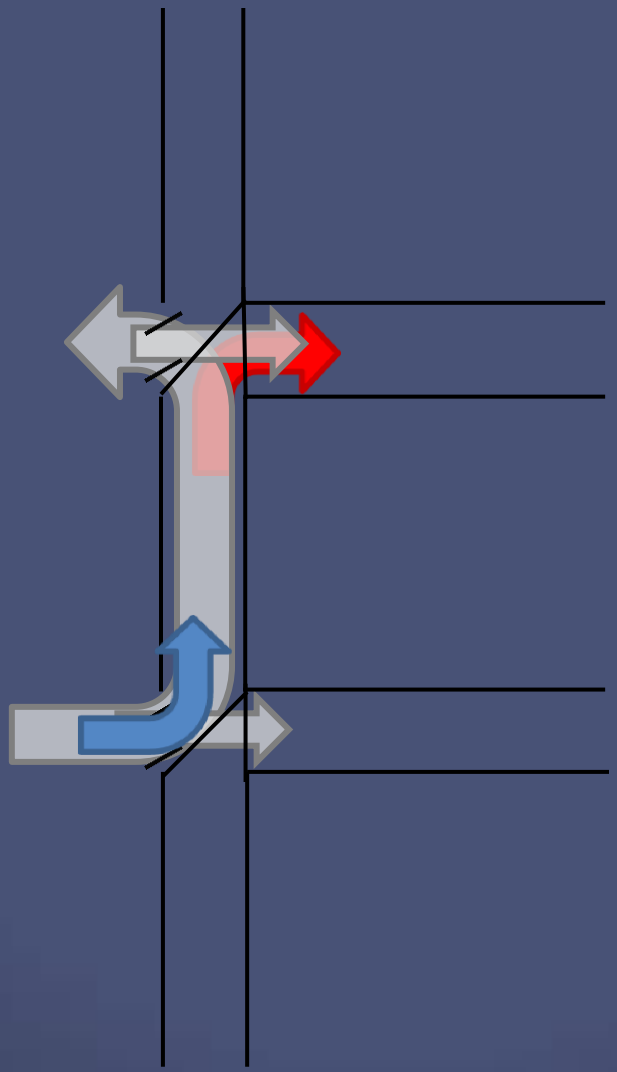
- Construction

  Baseline:
  - Low-E double pane glazing SC=0.5
  - Net U-Value .37

  DFS:
  - Low-E double pane glazing SC=0.5
  - 6" air gap
  - Venetian blinds
  - Single pane clear float glass
  - Net U-value .33

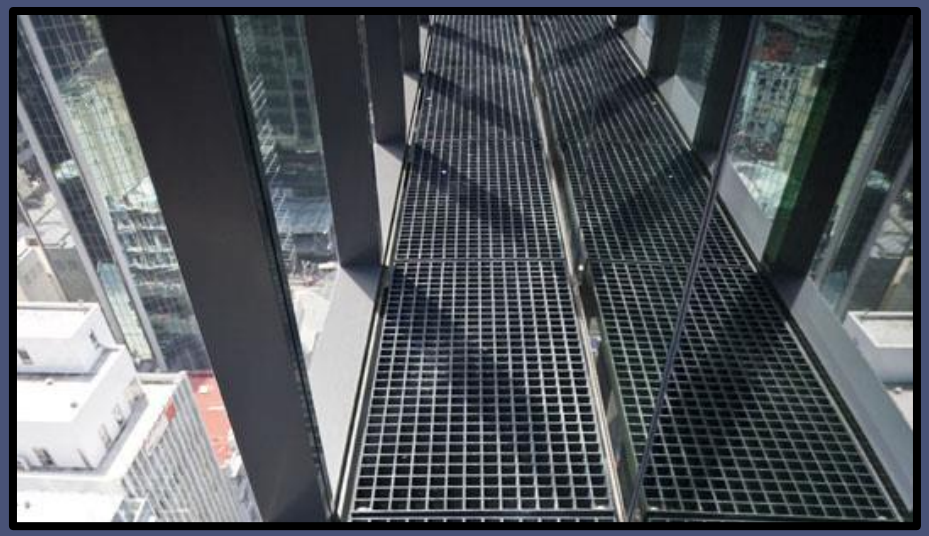
- EUI Reduction: 7 kBTU/SF

Double Façade System



Cleaning Double Façade System

- Open Floor Grates



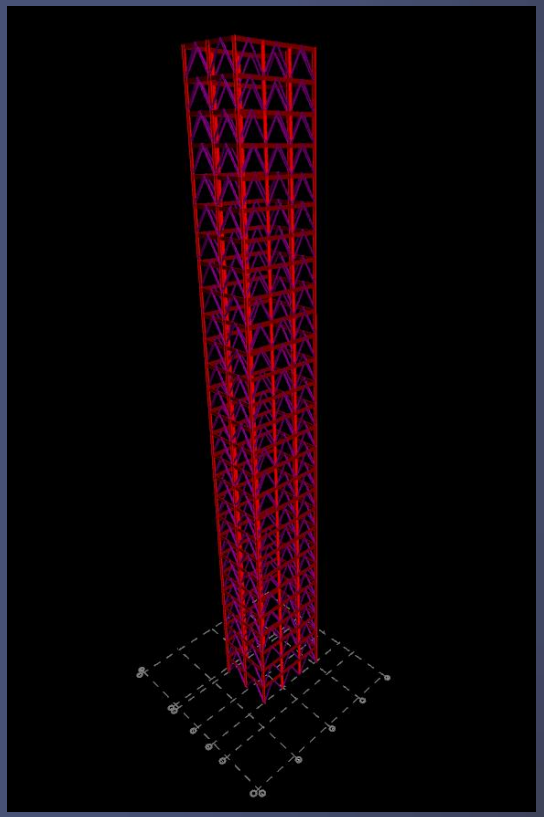
- Interior window panels open fully for access
- 2x as much cleaning time

Lateral Elements

ELF procedure in Excel

LEVEL	W	h	h^k	w*h^k	C	Fx	M	
Roof	1595	384.167	29595.09	47204172	0.090216	221.60	85130.23	
26	1595	370.008	27733.53	44234988	0.084541	207.66	76835.23	
25	1595	356.841	26048.42	41547223	0.079404	195.04	69598.54	
24	1595	343.674	24408.09	38930900	0.074404	182.76	62809.38	
23	1595	330.507	22813.01	36386747	0.069542	170.82	56455.63	
22	1595	317.34	21263.66	33915531	0.064819	159.21	50525.06	
21	1595	304.173	19760.54	31518057	0.060237	147.96	45005.28	
20	1595	291.006	18304.18	29195173	0.055797	137.05	39883.79	
19	1595	277.839	16895.16	26947776	0.051502	126.50	35147.91	
18	1595	264.672	15534.06	24776818	0.047353	116.31	30784.84	
17	1595	251.505	14221.51	22683306	0.043352	106.49	26781.59	
16	1595	238.338	12958.19	20668315	0.039501	97.03	23125.00	
15	1595	225.171	11744.82	18732996	0.035802	87.94	19801.73	
14	1595	212.004	10582.18	16878580	0.032258	79.24	16798.22	
13	1595	198.837	9471.09	15106395	0.028871	70.92	14100.72	
12	1595	185.67	8412.46	13417880	0.025644	62.99	11695.24	
11	1595	172.503	7407.27	11814597	0.02258	55.46	9567.51	
10	1595	159.336	6456.59	10298258	0.019682	48.34	7703.02	
9	1595	146.169	5561.60	8870749	0.016954	41.64	6086.94	
8	1595	133.002	4723.62	7534168	0.014399	35.37	4704.10	
7	1595	119.835	3944.12	6290866	0.012023	29.53	3538.98	
6	1595	106.668	3224.77	5143512	0.00983	24.15	2575.59	
5	1595	93.501	2567.51	4095178	0.007827	19.22	1797.51	
4	1595	80.334	1974.59	3149464	0.006019	14.78	1187.73	
3	1595	67.167	1448.70	2310684	0.004416	10.85	728.58	
2	1595	54	993.21	1584170	0.003028	7.44	401.59	
Lobby	3190	0	0.00	0	0	0.00	0	
	44660			5.23E+08	1	2456.3	**702769.9**	**OTM**

Core modeled in RAM



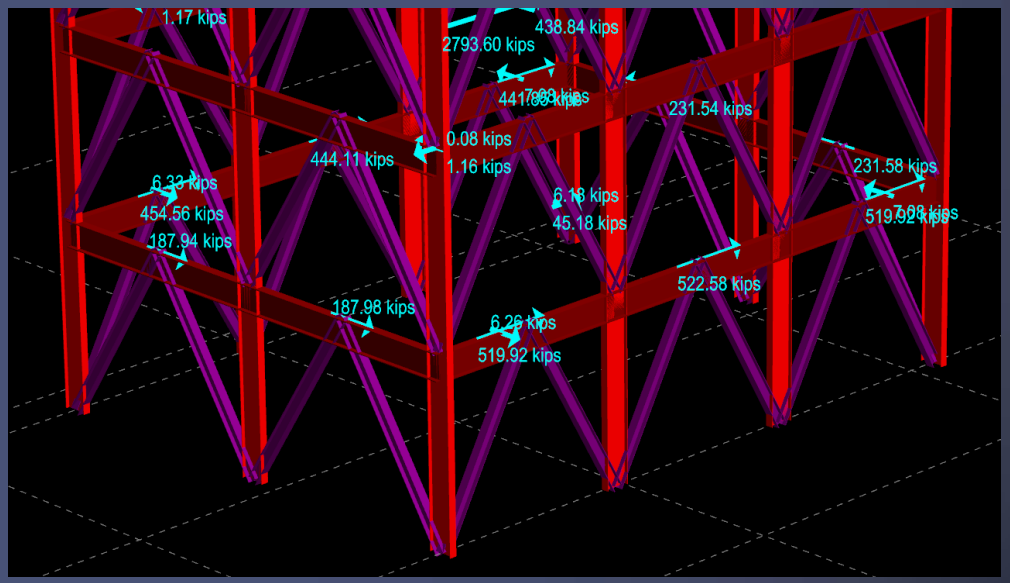
Lateral Elements

Displacement at roof level calculated by RAM

Level: roof, Diaph: 1
Center of Mass (ft): (62.04, 66.88)

LdC	Disp X in	Disp Y in	Theta Z rad
E8	152.80090	73.94435	-0.00646
E9	152.78716	-72.20437	-0.00271
E10	-152.78715	72.20439	0.00271
E11	-152.80090	-73.94437	0.00646
E12	45.86111	243.84219	-0.00762
E13	45.81530	-243.32020	0.00487

Frame shear forces calculated in RAM



Potential Members

- Built up columns
  - Save money through diminishing column size
  - Potential problems with scheduling
- Concentrically braced frames
- Steel Plate Shear Walls or Composite SPSW
- Viscous Dampers

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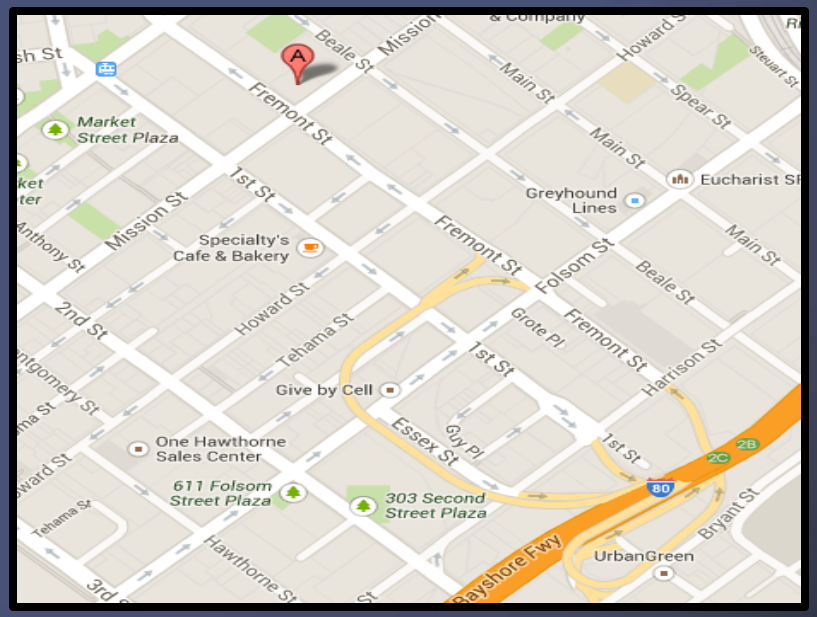

Questions?