



ISLAND team

Winter Quarter Presentation– March 12, 2010

Marielis Suarez
U. Puerto Rico

Mei Ling (Zan) Chu
Stanford

Gino Mazzotti
Stanford

Andrew Keene
U. Wisconsin

Sandra Kittler
Bauhaus U.



A

E

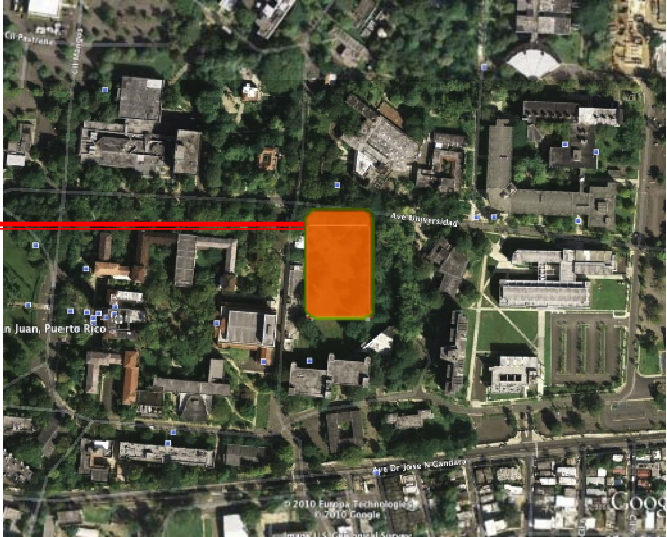
E

C

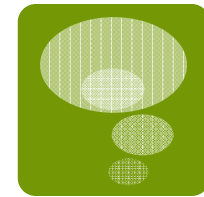
LC

Erik Kneer
Owner

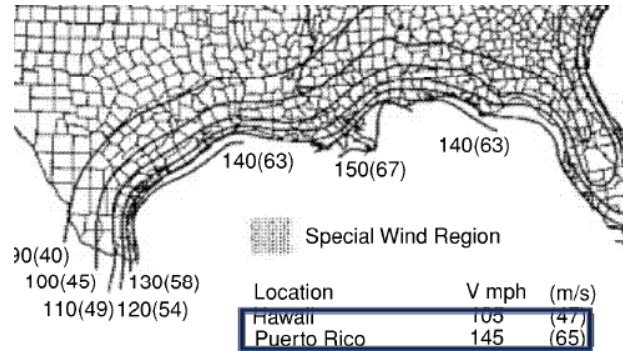
Project Site



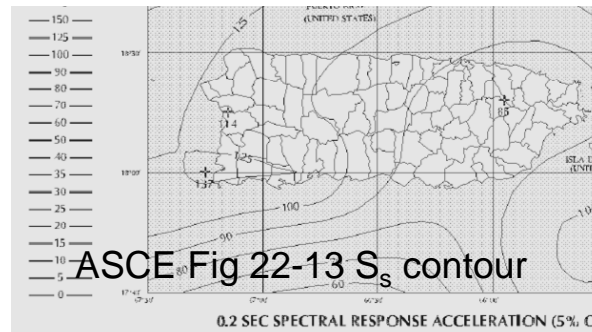
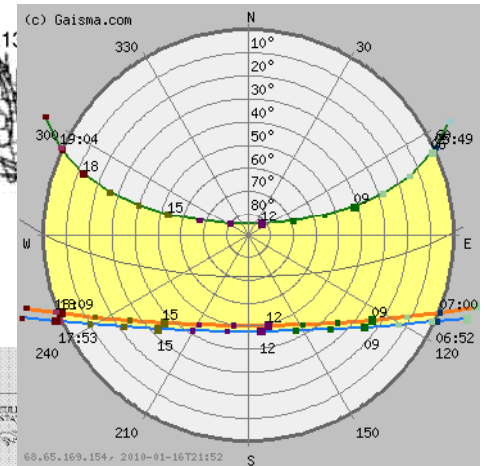
Site Conditions



- Latitude : 18°30' N
- Prevailing Winds: North-East Trade Winds
- Basic design wind speed: 145 mph
- Seismic: Site Classification D
- Average Temp: 86°F -Max
66.9°F -Min
- Average Sunlight: 8hrs per day
1,466 BTU/sq.ft/per day
- Precipitation : 60-90" annual

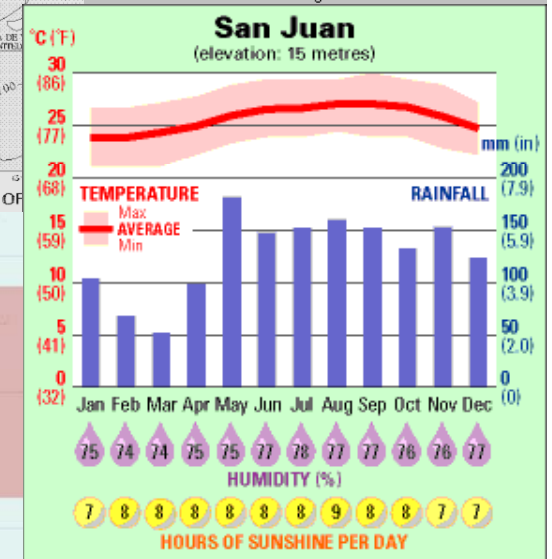


ASCE Fig 6.1 Basic Wind Speed

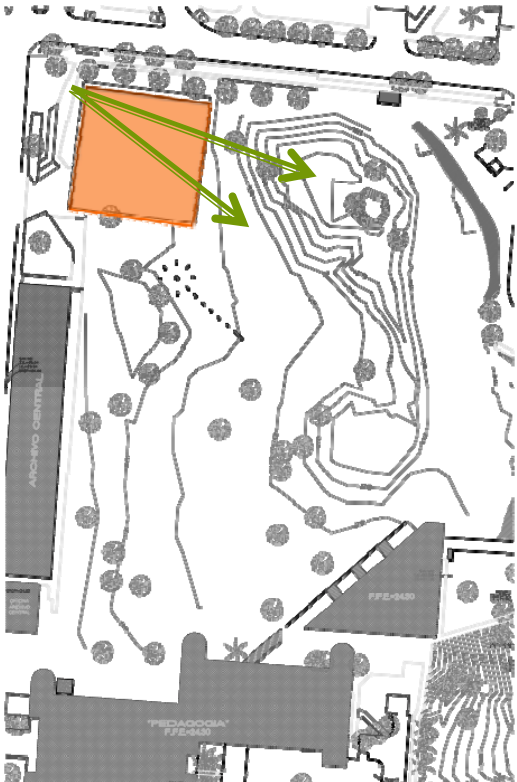


ASCE Fig 22-13 S_s contour

Tropical Climate Zone

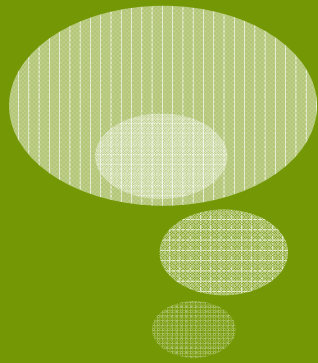


Project Site



- Existing slope:
1:12 (aprox.)
- High traffic pedestrian corner
- Lush vegetation
- Vast green lawn

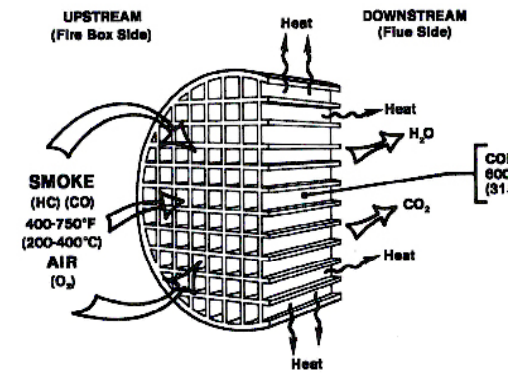
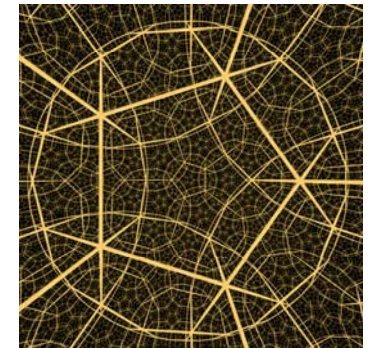
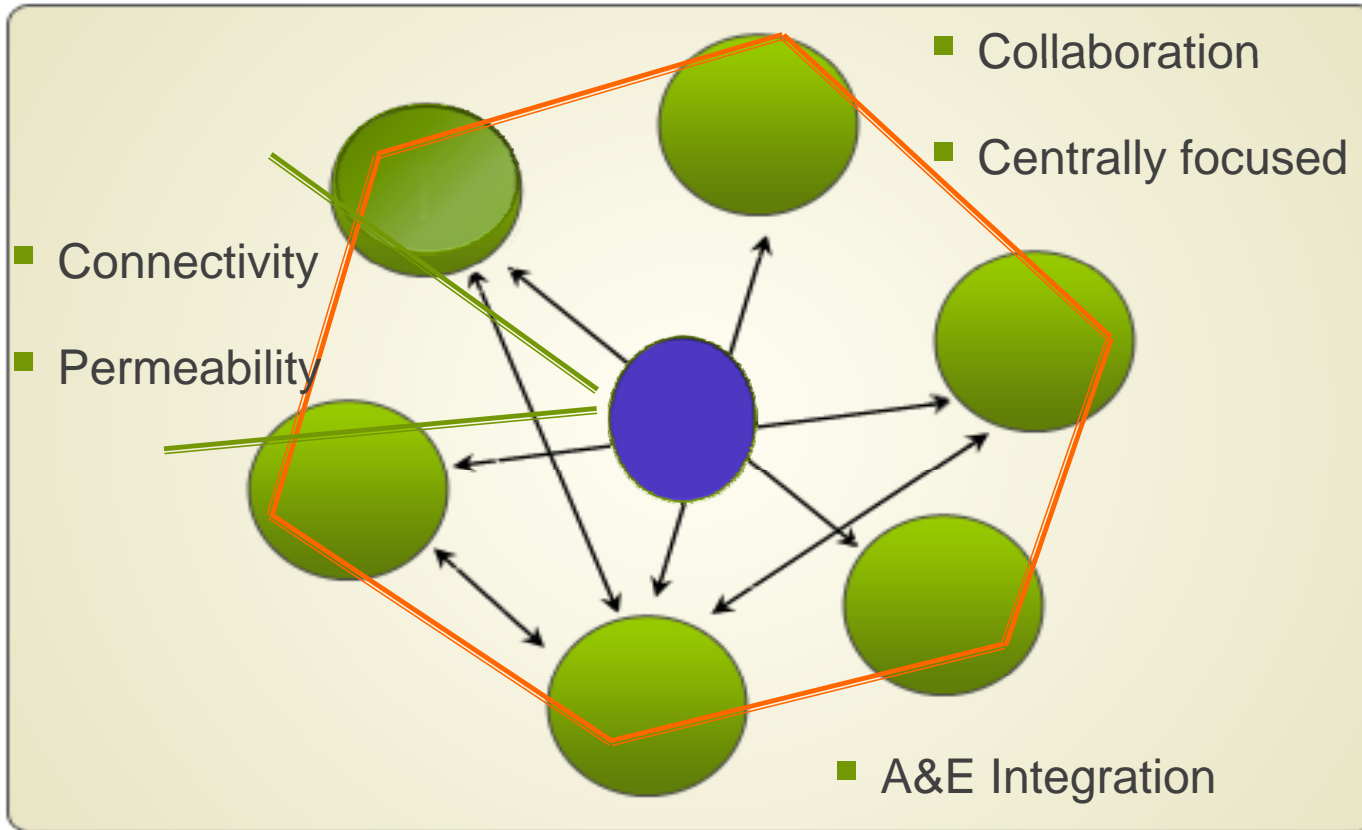
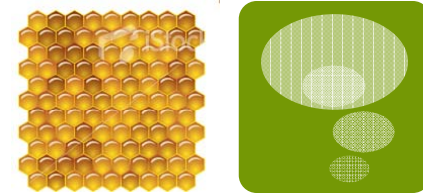




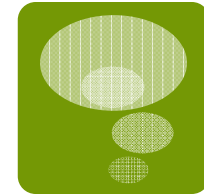
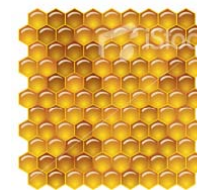
Concept A



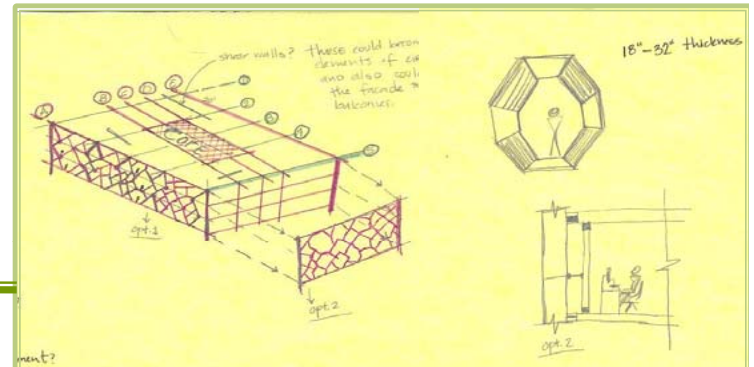
Concept A - the Beehive



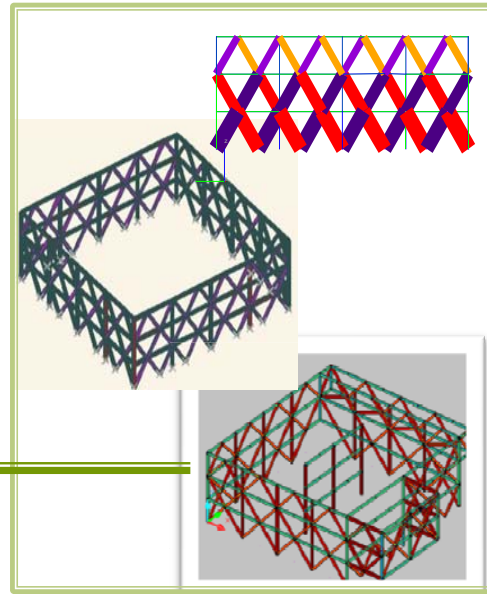
Design Iterations - Process



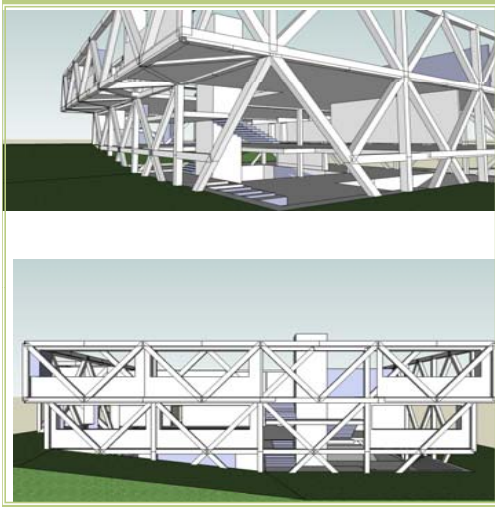
A Concept



E Development

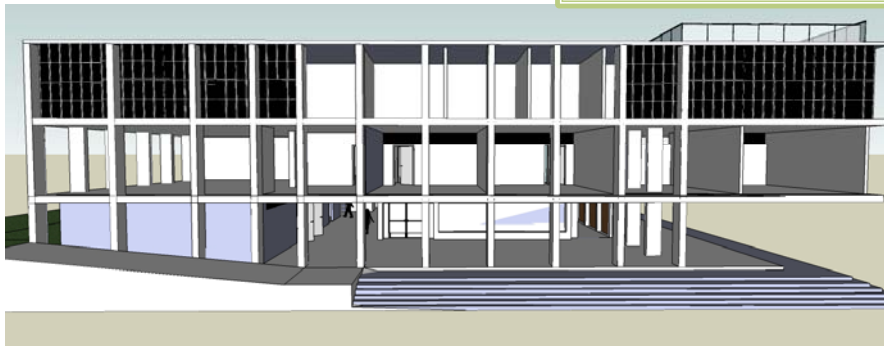


A Visualization

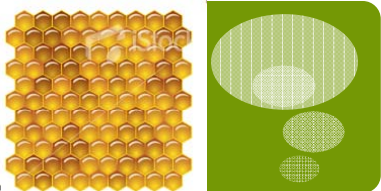


C Input

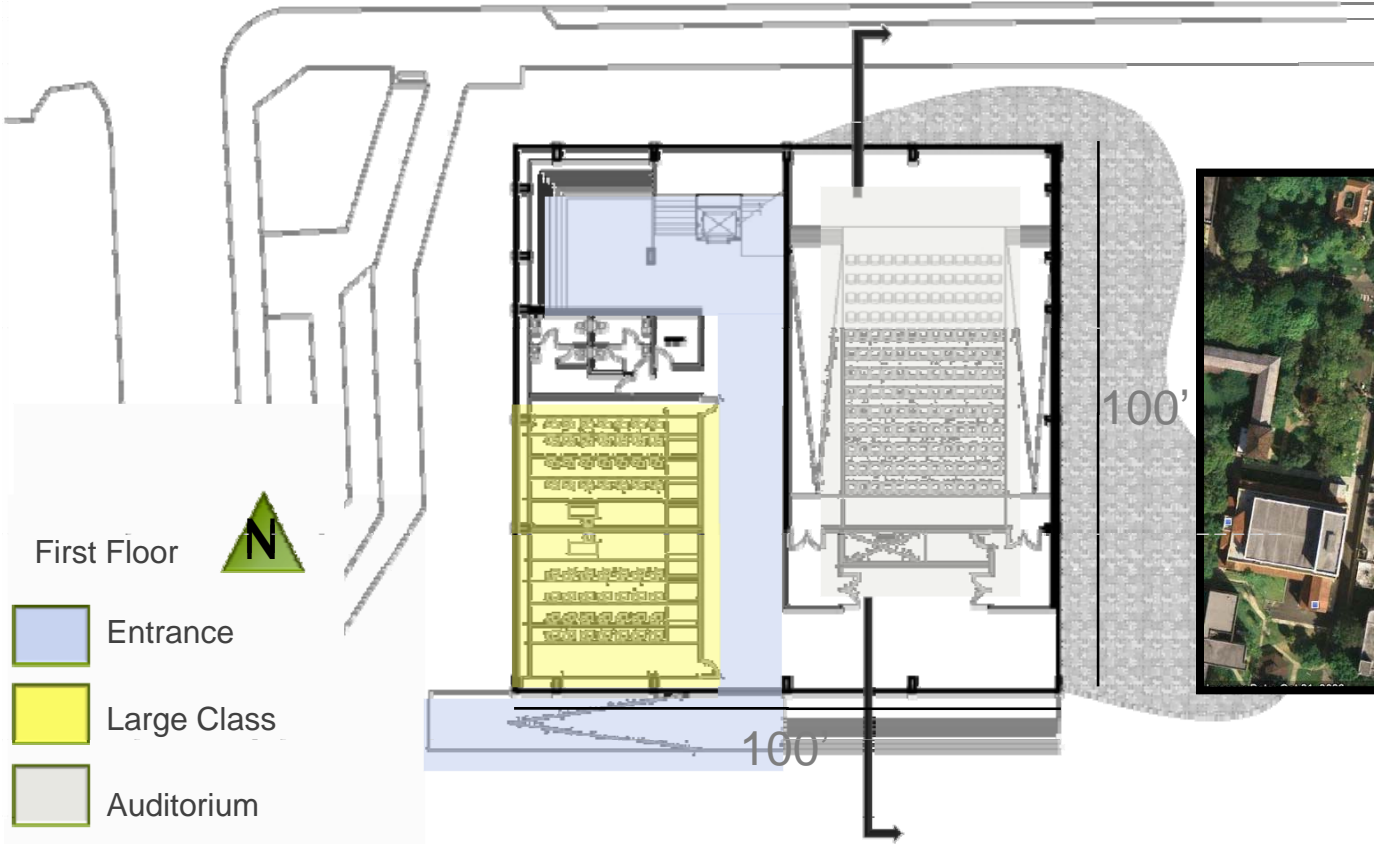
\$ 800 more per ton of steel



Plans



Section AA

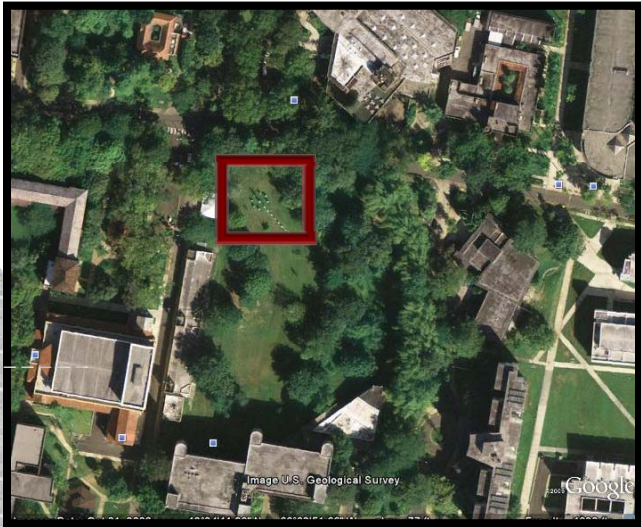


First Floor

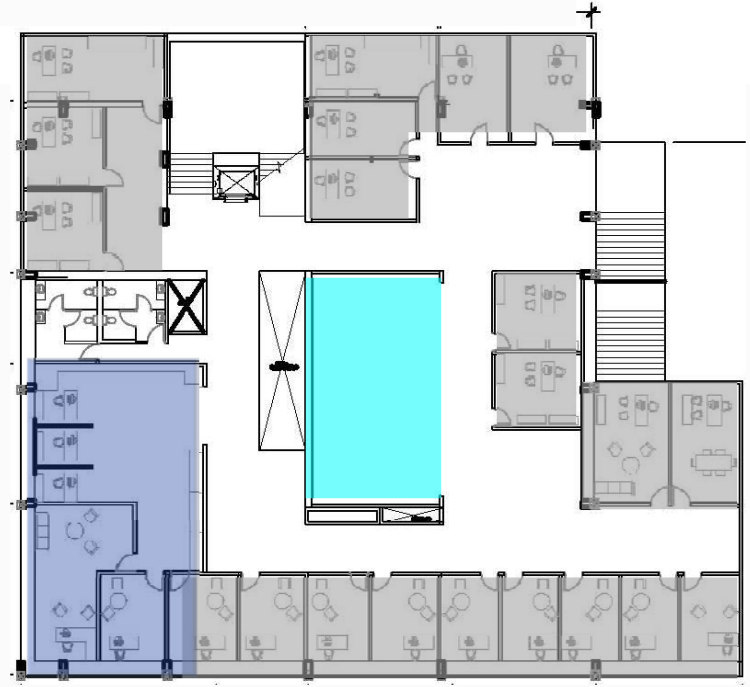
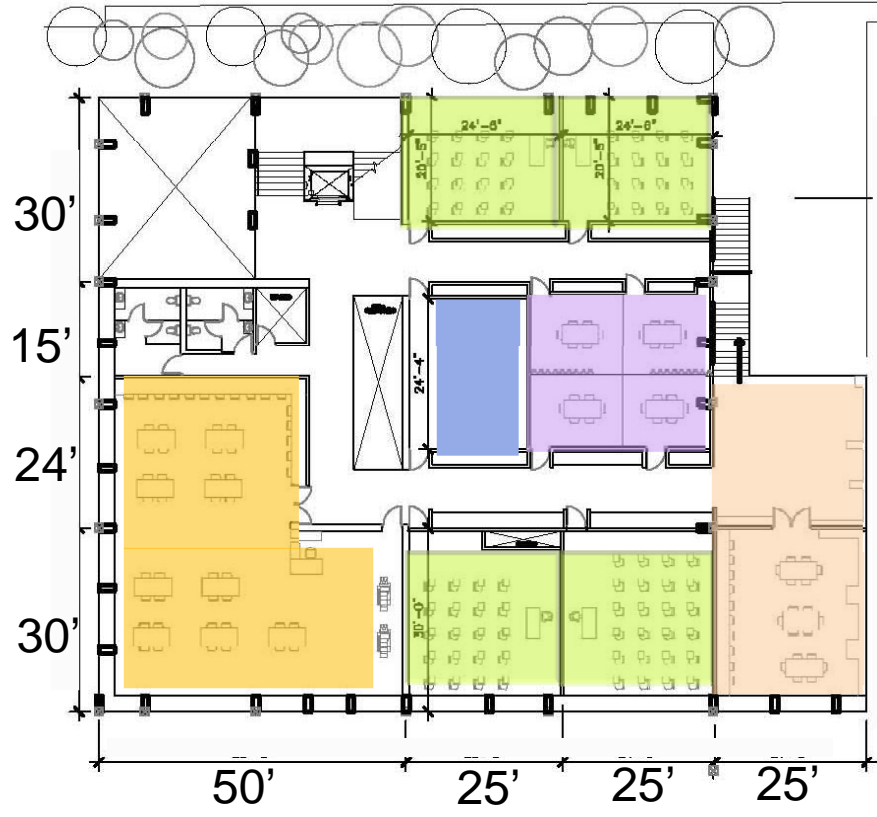
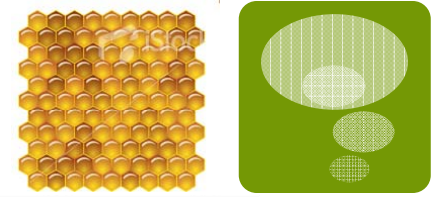
Entrance

Large Class

Auditorium



Plans



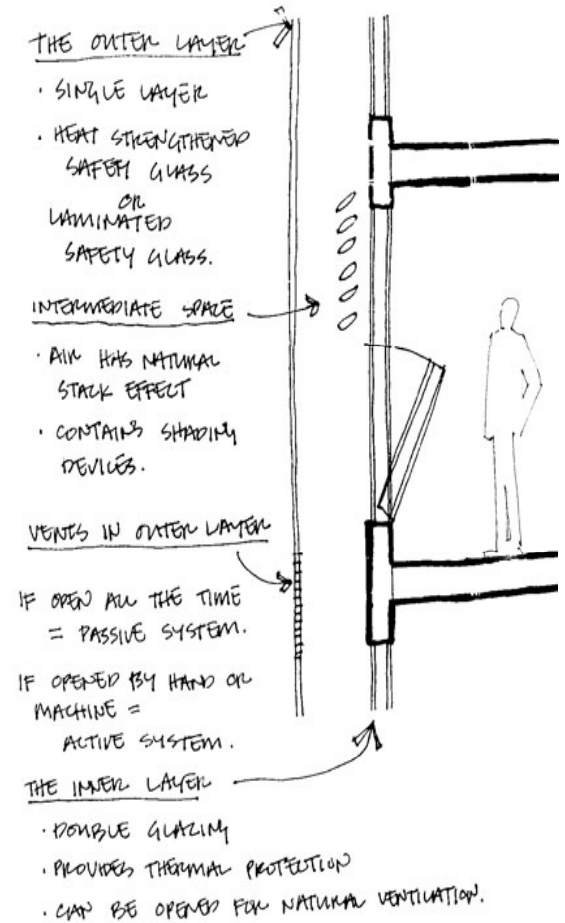
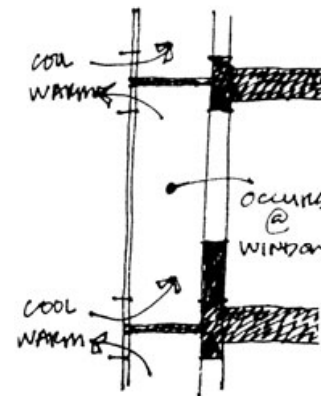
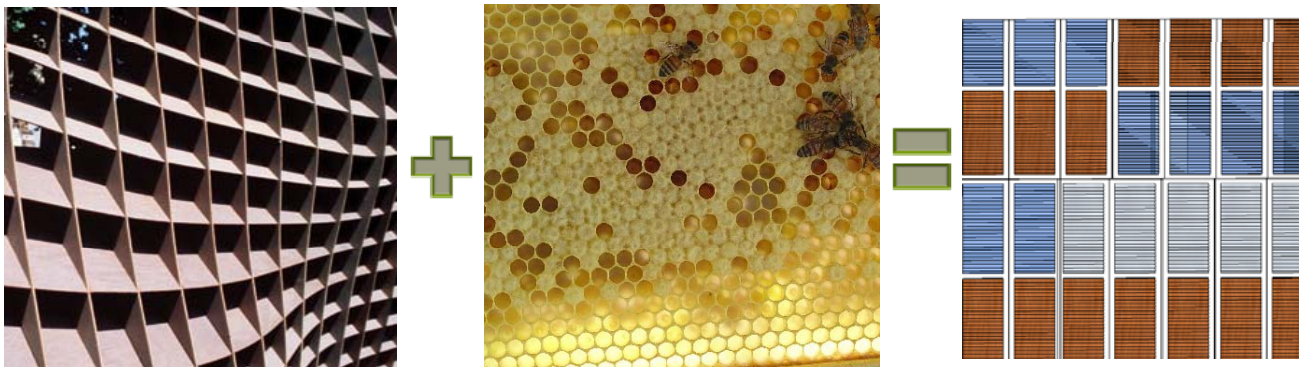
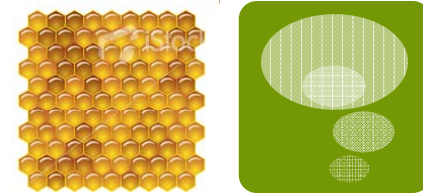
Third floor



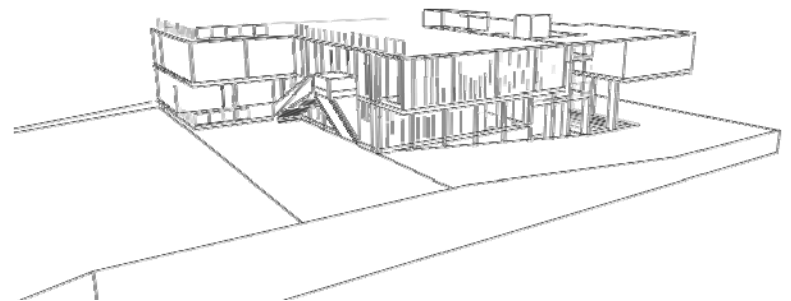
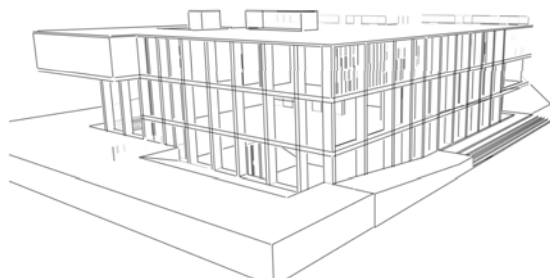
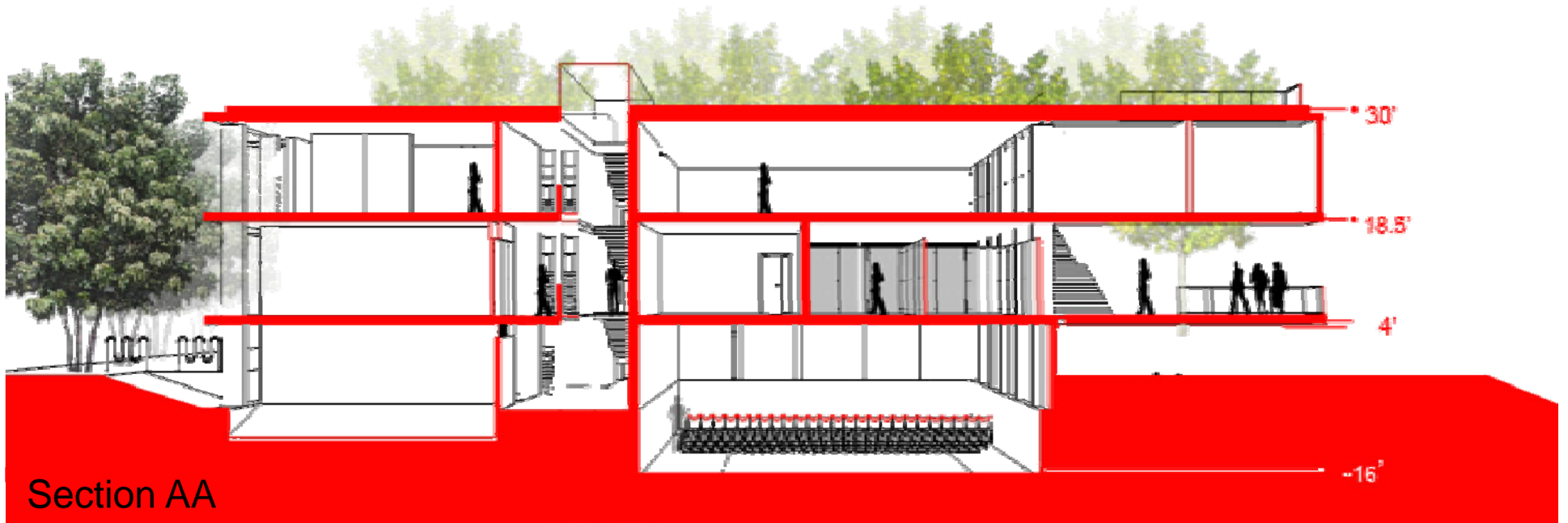
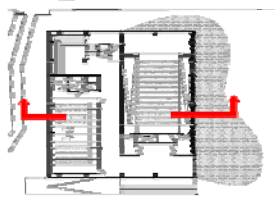
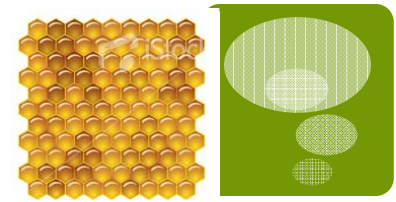
- | | | | |
|-------------|--------------|----------------|-------------------------|
| Entrance | Laboratories | Seminars | Faculty offices |
| Large Class | Small Class | Server rm. | Student Offices/terrace |
| Auditorium | | Faculty lounge | Administration |

Façade Development

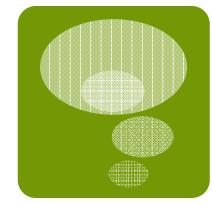
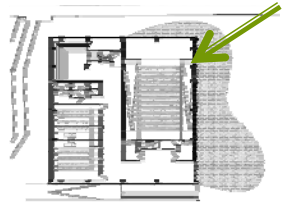
- Structure = brisoleils
- Curtain Wall = transparency, opacity, translucency
- Structure + curtain wall = tectonic



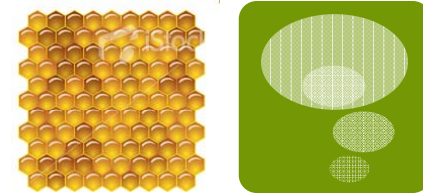
Volumetric Development



Volumetric Development



Loading Assumption



- Dead load
 - Self weight
 - MEP/ ceiling/ flooring/ cladding
 - - chillers 250 psf - air exchange unit 100 psf
- Live load (According to ASCE 7.2)
 - Corridor : 80-100psf ; Classroom: 40-80psf; Auditorium: 60psf;
 - Library/ file room: 150psf

Wind Load (ASCE)

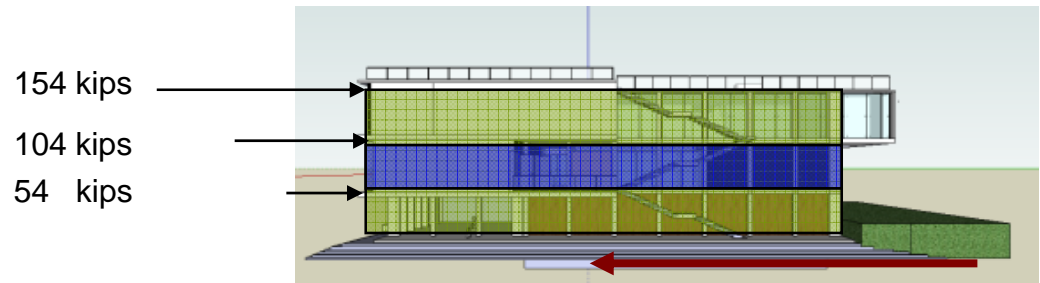
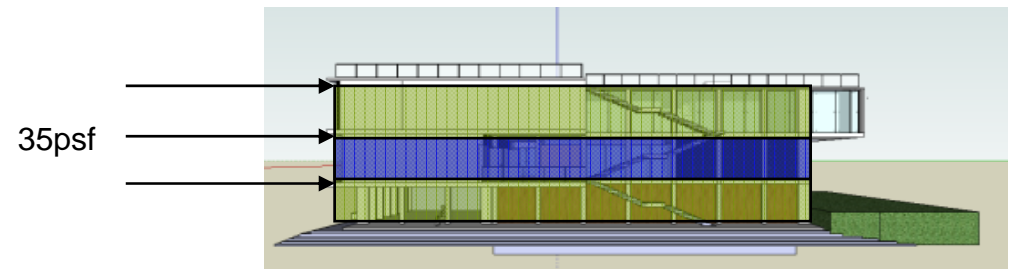
Windward	22	psf
Leeward	14	psf
total	35	psf

Earthquake Load (USGS)

Ss (g)	1
S1 (g)	0.4

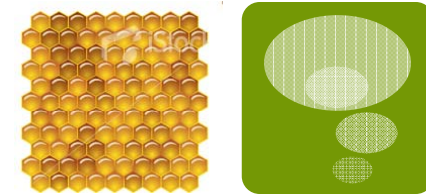
Based on Square footage

(*Assume Reduction factor 8
R=8 for Moment frame)



312.5kips

Concrete Structure



- Gravity Column (20ft – 25ft spacing)

- 12" x 12" or 14" X 14" (p=1.5%)

- Post-tension Slab and Flat Slab

- First Floor

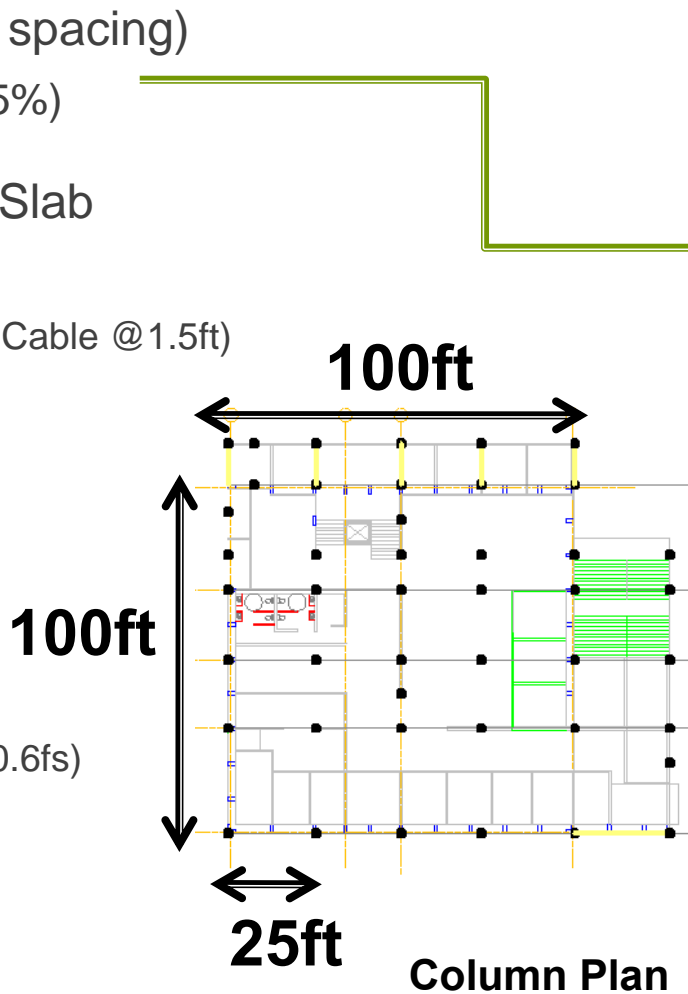
- PT Slab at Auditorium (12 in, Cable @1.5ft)
 - Flat Slab (10 in)

- Second Floor/Roof

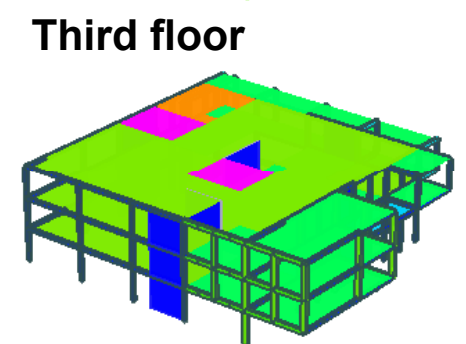
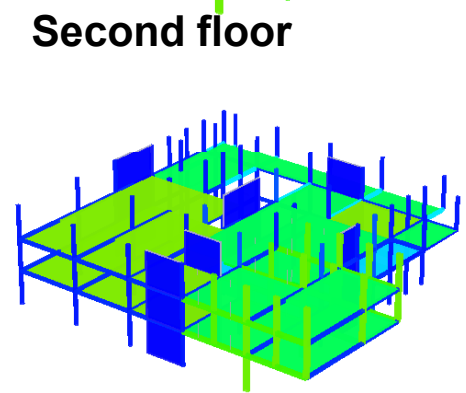
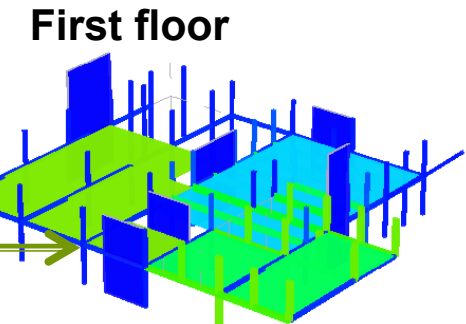
- Flat Slab (10in)

- Material specification

- LW concrete ($f'c=5\text{ksi}$)
 - Steel tendon 7-wire strands ($f_s=270\text{ksi}$, effective stress= $0.6f_s$)



Column Plan



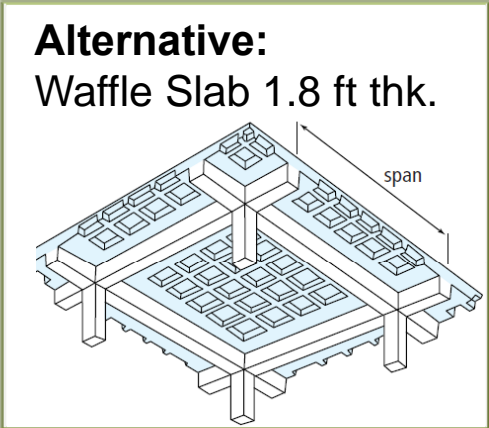
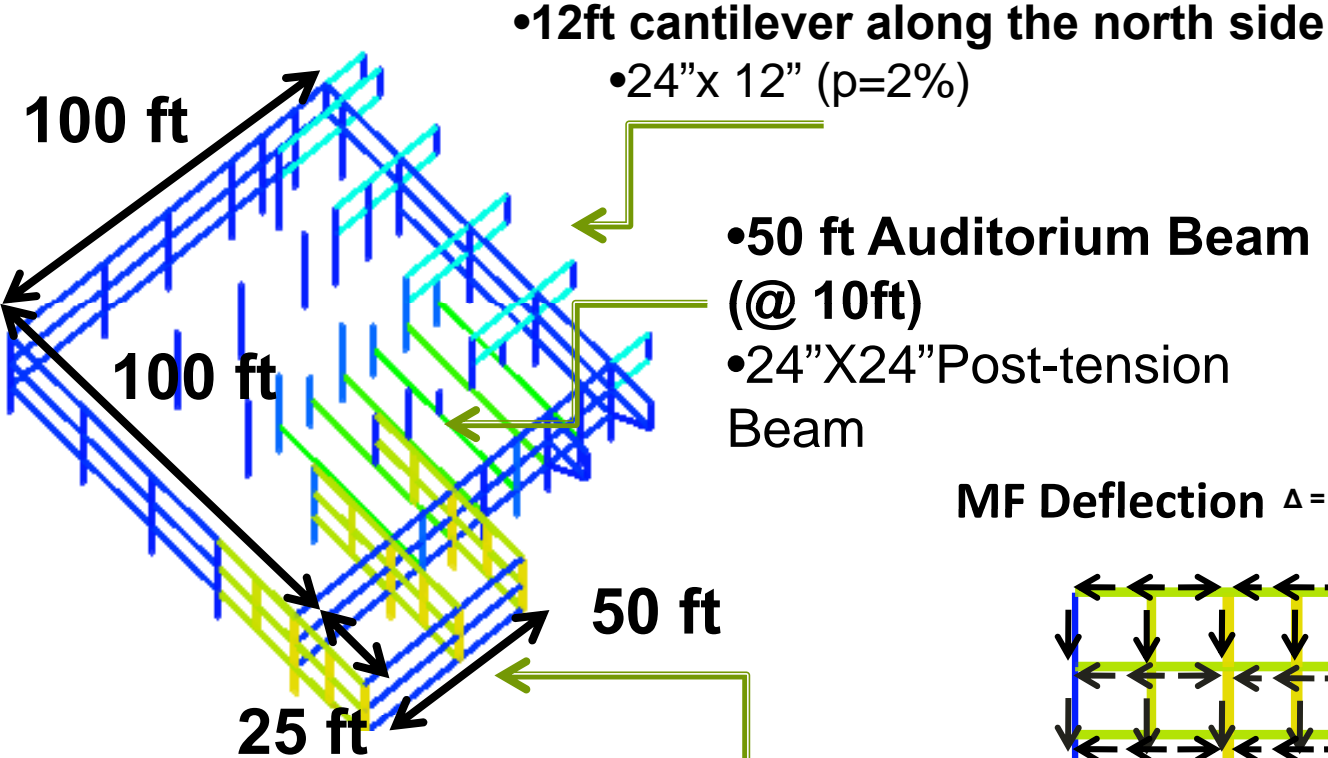
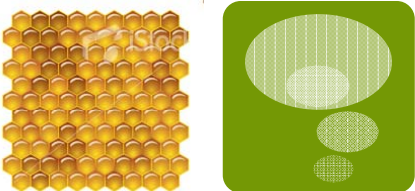
First floor

Second floor

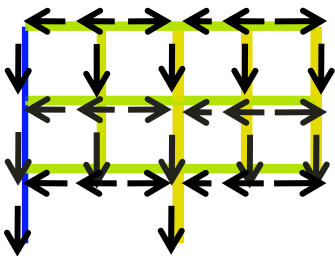
Third floor

Concrete Structure

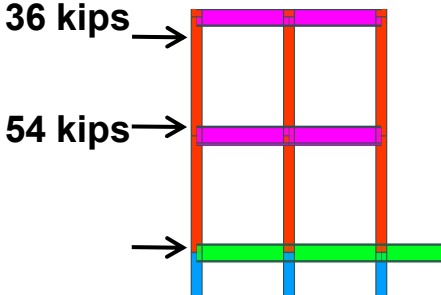
- Challenges



MF Deflection $\Delta = \Sigma V_{col} * (h/2)^2 / \Sigma K_{beam} + \Sigma V_{col} * (h/2)^3 / 3EI_{col}$



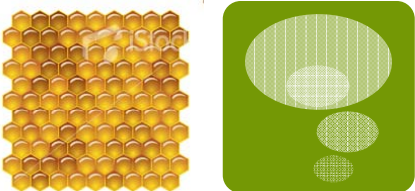
Preliminary sizing:
according to 1.2 DL + 0.2S(DL) + 1.6 LL
Cantilever column: **28X14 (p=2%)**
Interior column: **24X14 (p=2%)**



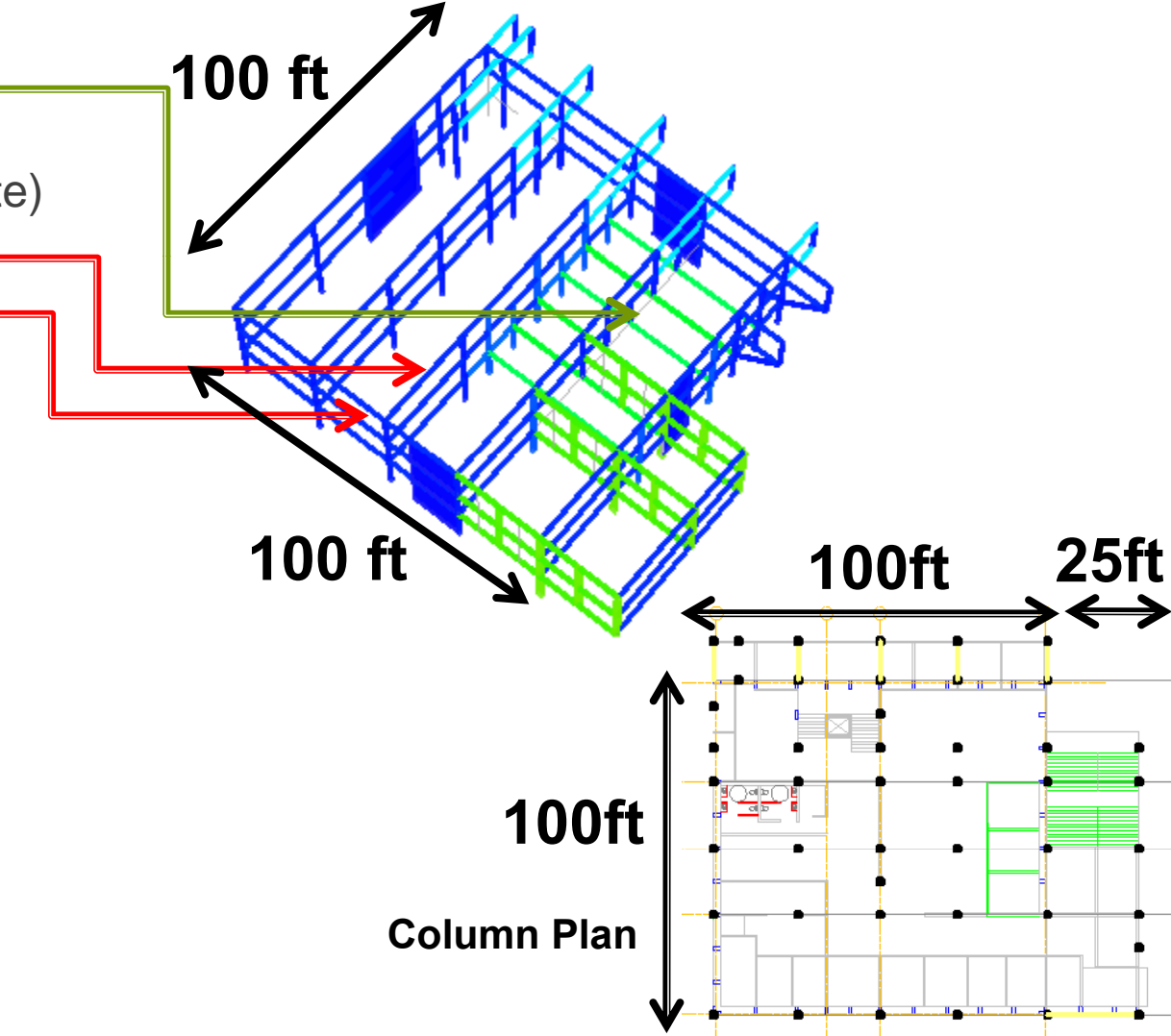
Estimated deflection under live load:
0.512 in (L/510)

Continuous Girder: **28x14 (p=2.2%)**

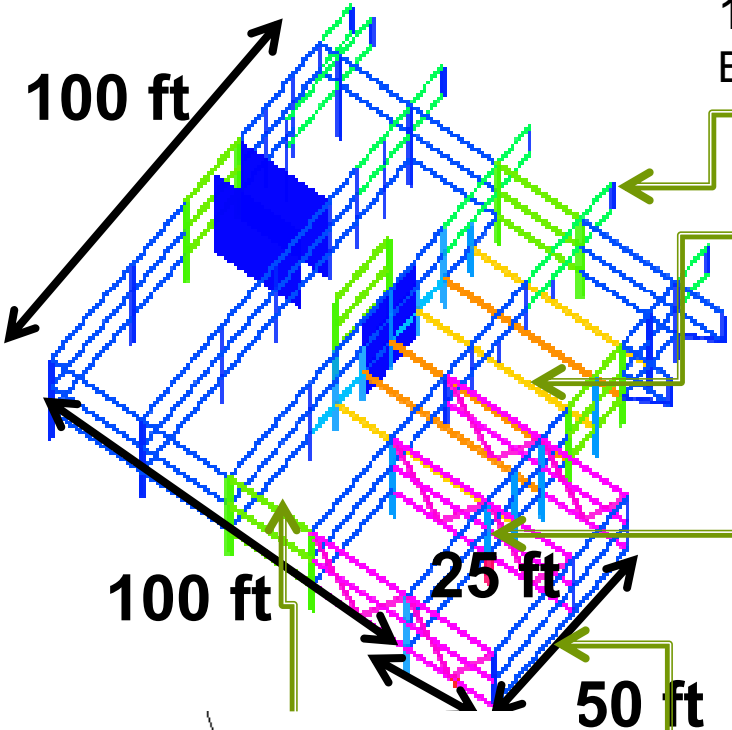
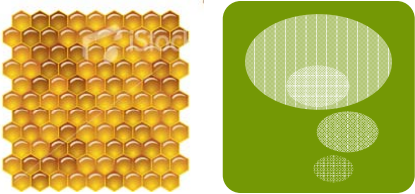
Steel Structure



- Gravity Column
 - W14 X 48 W12 X 50
- Gravity Beam (full composite)
 - Interior girder (W18x 55)
 - Exterior girder (W16X31)
 - Filler beam (W12X26)
- Composite floor system
 - 2 hr fire rating
 - 4 inches LW concrete
 - 2VLI17 ($I_p/I_n = 0.633in^4$) or equivalent



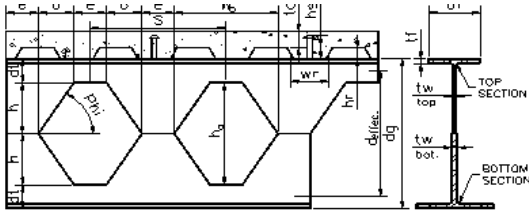
Steel Structure Challenges



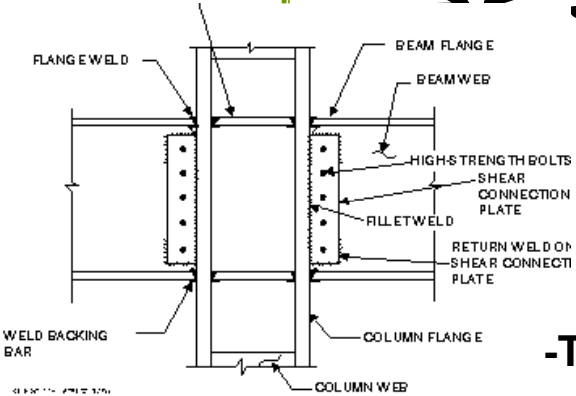
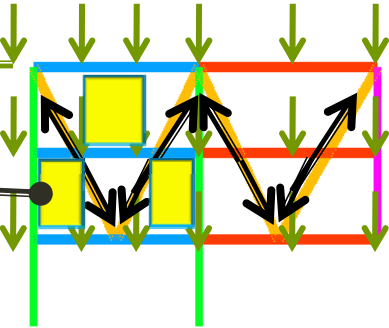
12ft cantilever along the north side
Back span cantilever beam W21X48

50 ft Auditorium Beam (@ 10ft)
CB 36X104 (root beam W24X104)
18 in openings

30 in



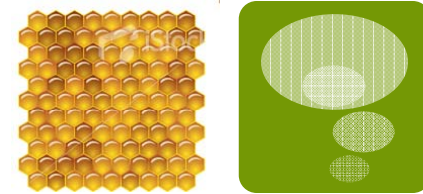
Allow openings



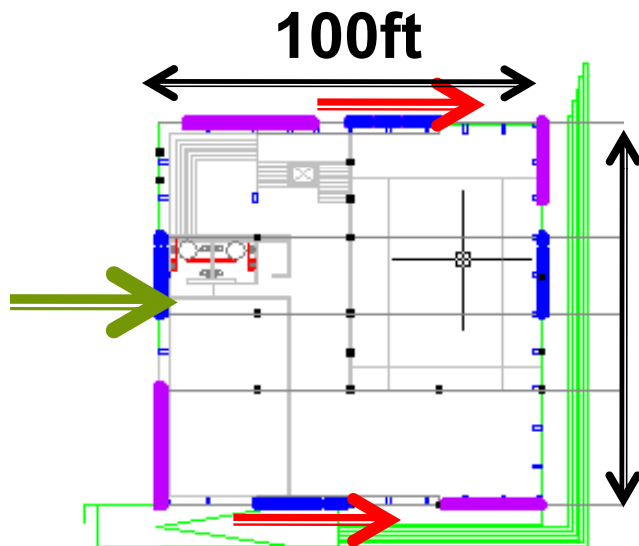
-Typical connection details

Preliminary sizing:
according to $1.2 DL + 0.2S(DL) + 1.6 LL$
Girder: W14x82
Brace: W14x74

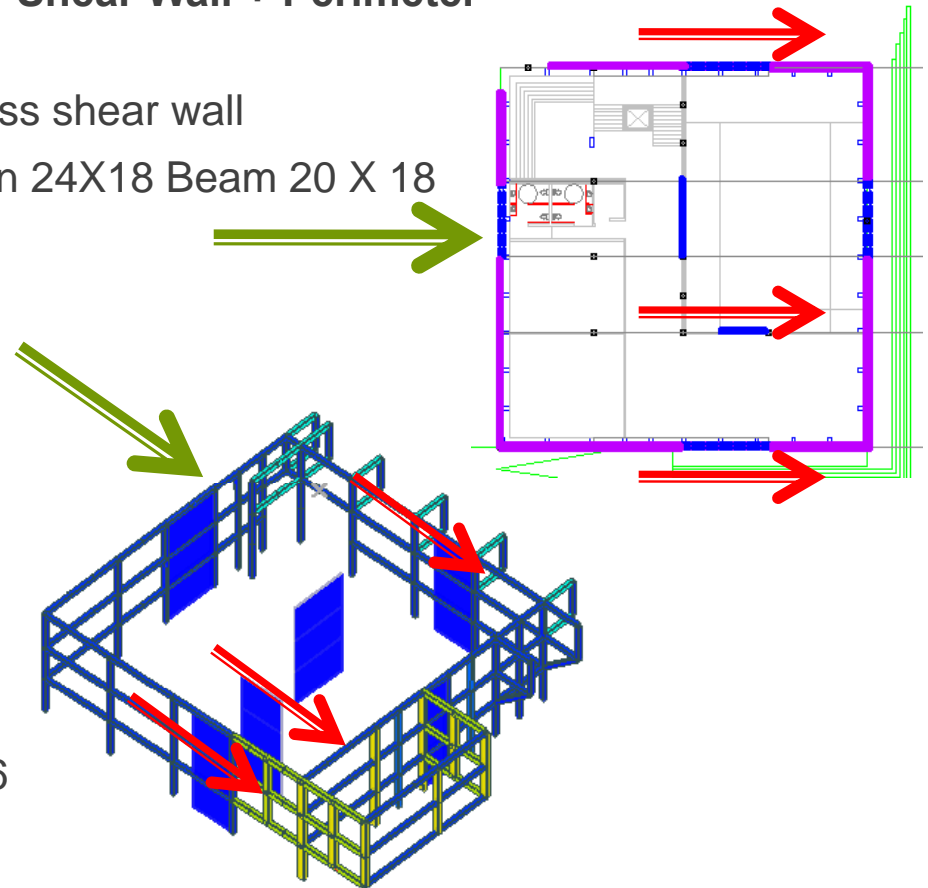
Lateral resisting system



- Shear wall at peripheral/ one side of mechanical shafts/ auditorium wall
- SMF peripheral

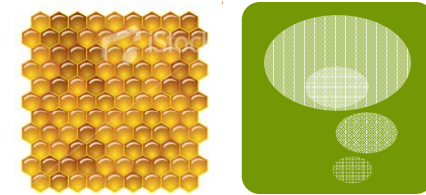


- Concrete system
- Dual System - Shear Wall + Perimeter RC SMF
 - 10in thickness shear wall
 - SMF Column 24X18 Beam 20 X 18



- Steel system
- Dual System - Shear Wall + Steel SMF
 - 12in thickness Shear Wall
 - SMF Column W14 x 145 Beam W18 x 106
 - Reduce Steel RC connection

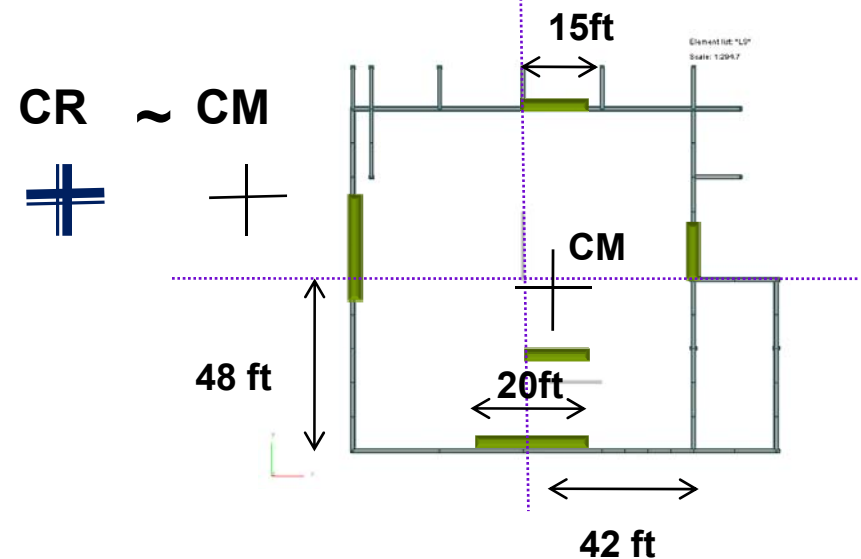
Lateral resisting system



- Decision of choosing Dual system

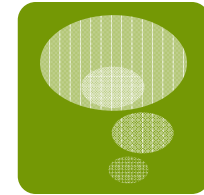
	Shear Wall + Peripheral SMF	Shear wall + Ordinary MF	Shear wall + SMF
Cost /complexity	√√	√√√	√
Lateral Load Resistance	√√	√	√√√
Internal gravity system	√√√	√	√
Overall performance	√√√	√	√√

- Tuning of length and rigidity (CR) of the shear wall.



- The use of flat slab/ PT slab in combination to peripheral SMF

Foundation

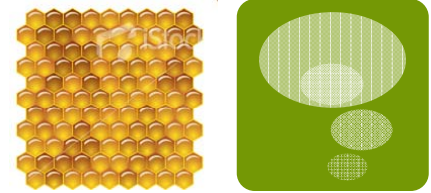
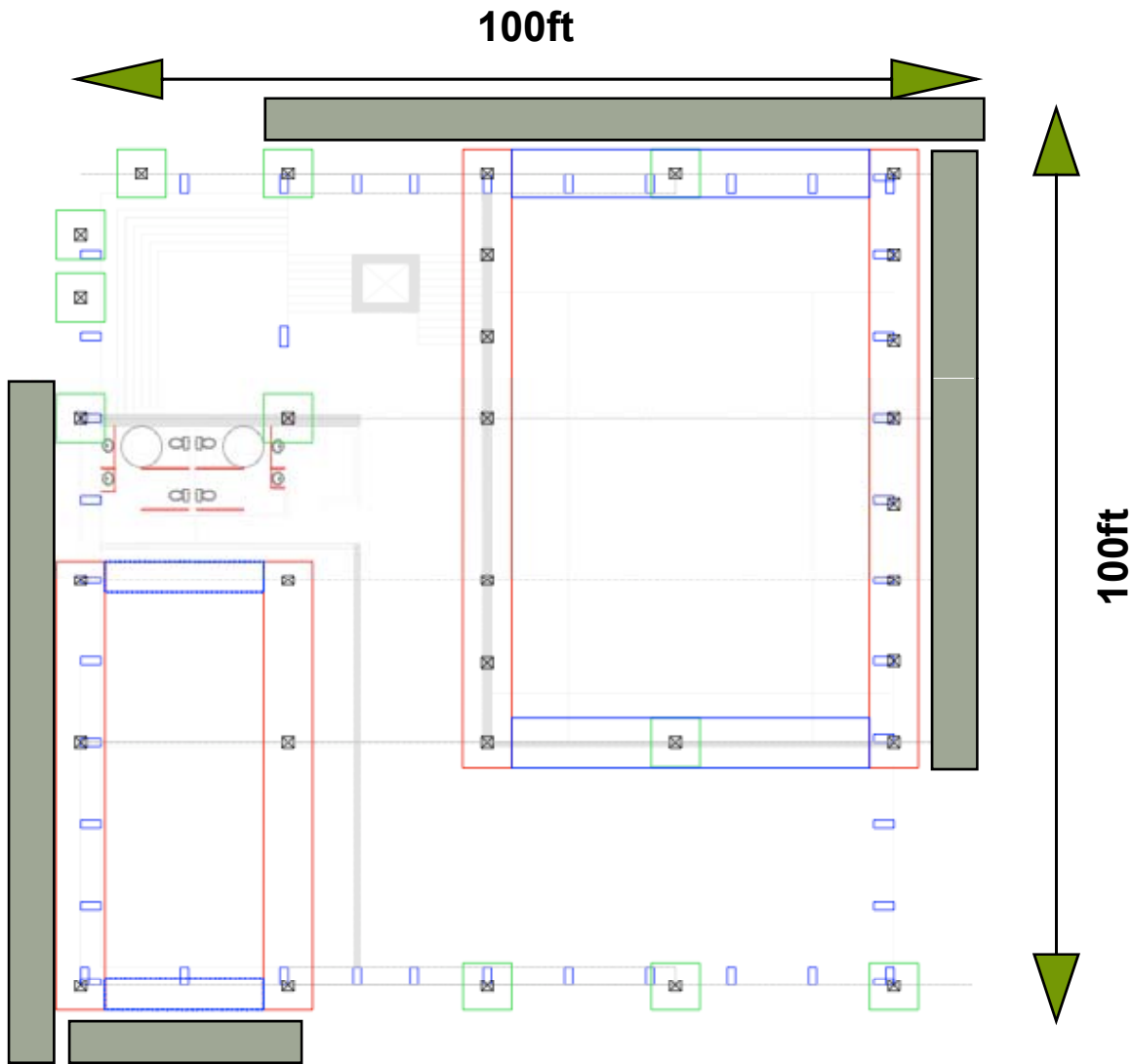


Type	Qty	Length (ft)	Width (ft)	Depth (ft)
Square	11	6	6	1.5
Aud Strip	2	70	6	3.5
Class Strip	2	50	6	2.5
Aud Beam	2	50	1	1
Class Beam	2	26	1	1



Slab on Grade	Area (ft ²)	Thickness (in)
Auditorium	50x70	8
Classroom	35x53	6

Foundation Plan

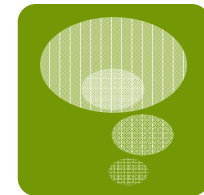


Strip

Square

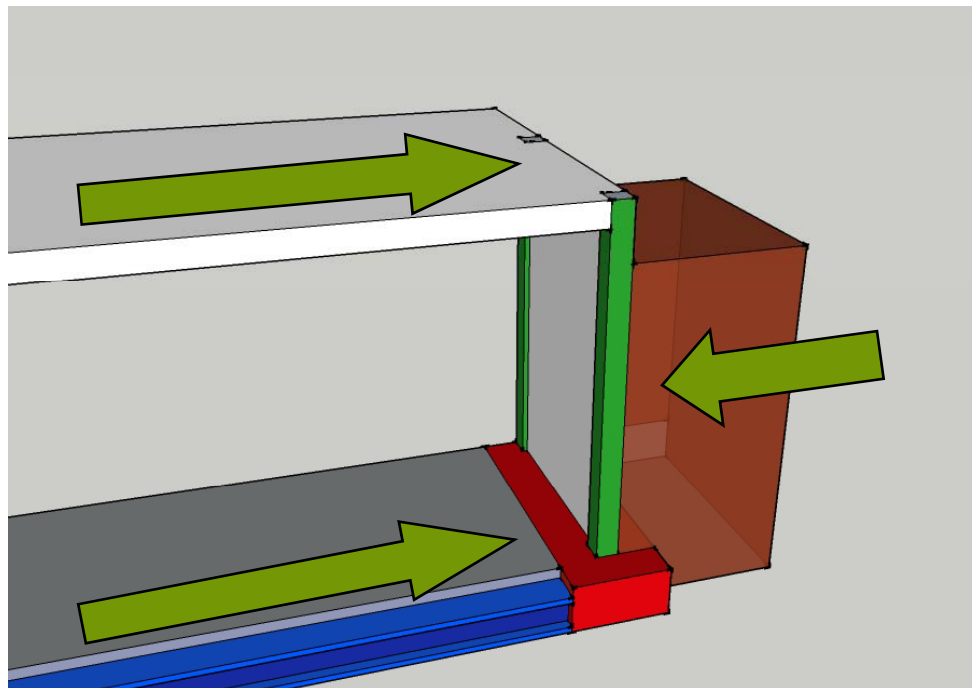
Beam on
Grade

Sunken Box Structure

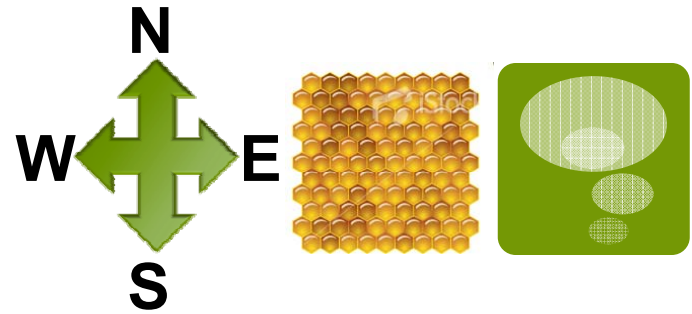


Kips per unit width	Length	Height	Width
43	67ft	12ft	8in
77	120ft	16ft	10in

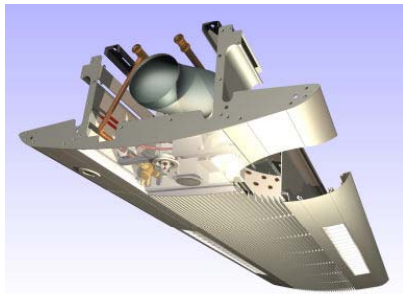
Volume of Concrete
2140 ft³



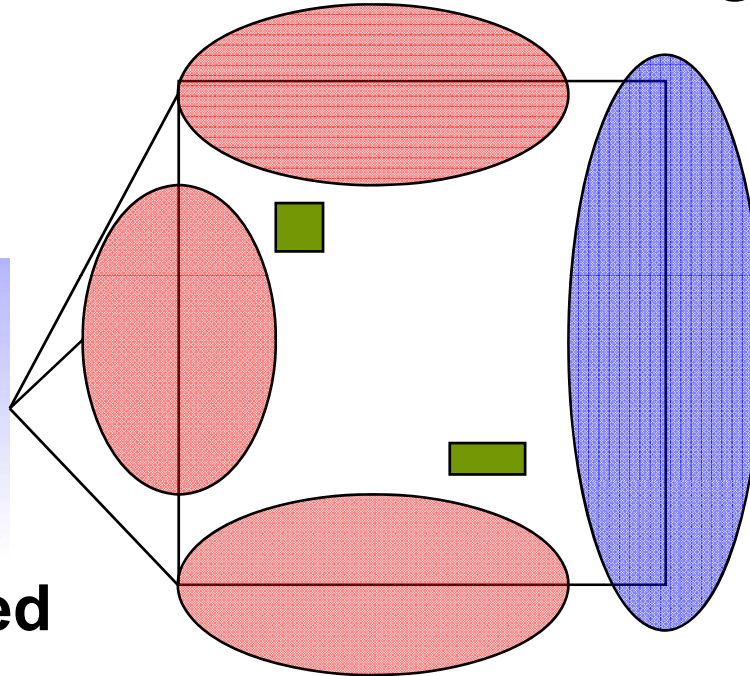
MEP Rationale



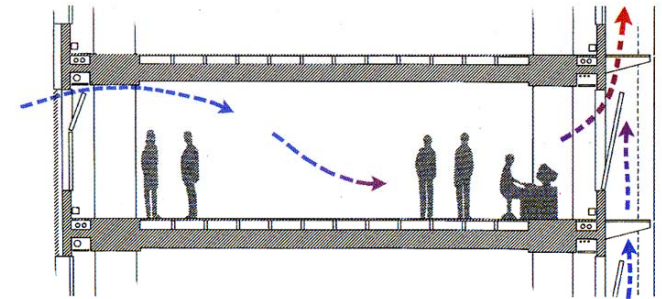
Forced Air Ventilation



Active Chilled Beams

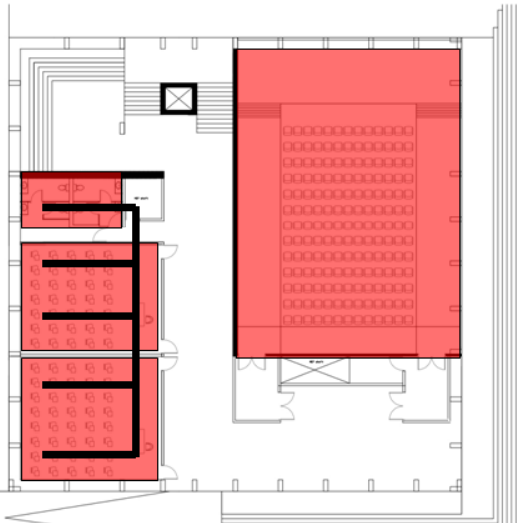
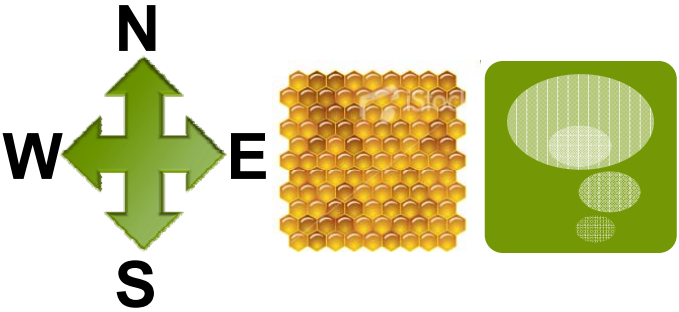


Natural Ventilation

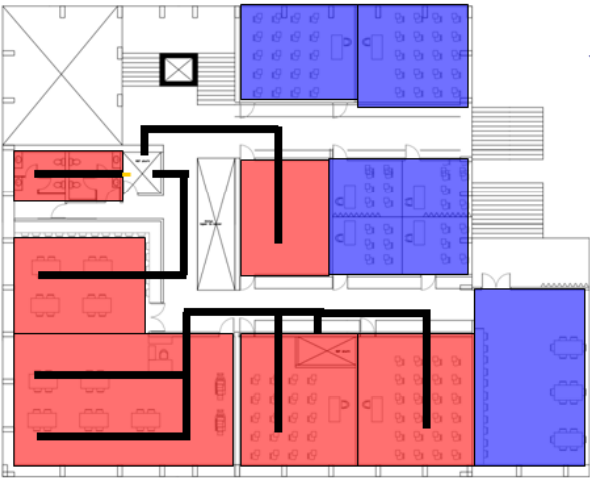


Raised Flooring for Third Floor

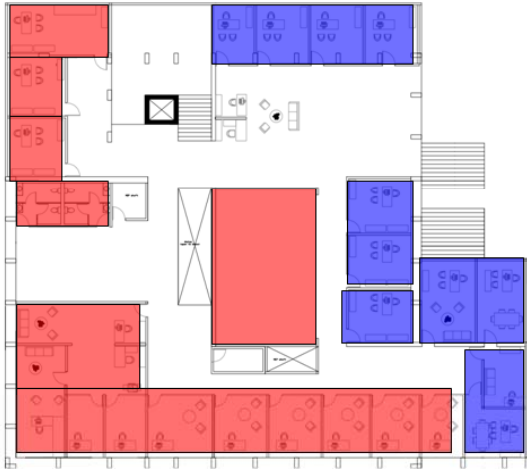
MEP Distribution



1st Floor



2nd Floor

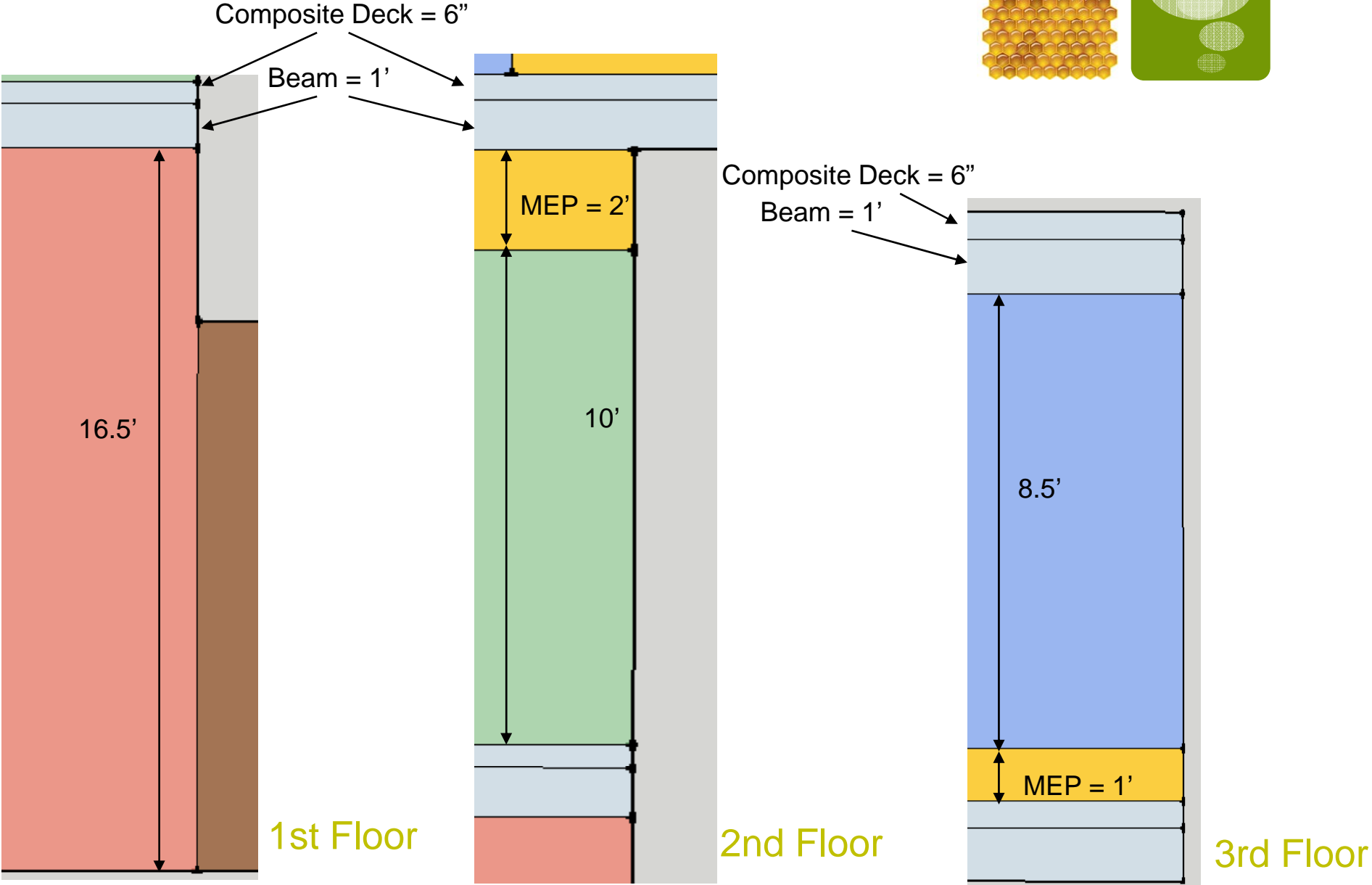
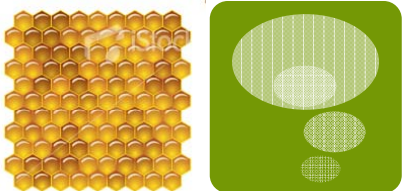


3rd Floor

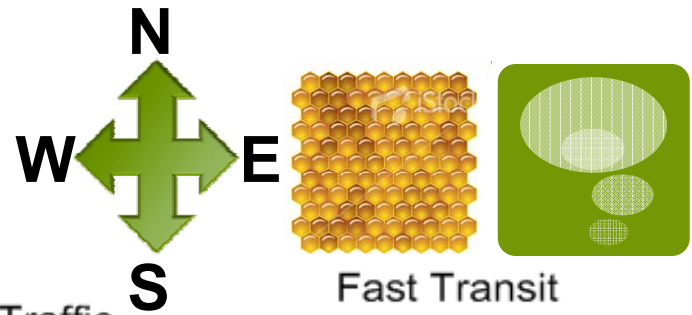
Ventilation
and Cooling
Vents



Floor Level Section



Jobsite Traffic Route

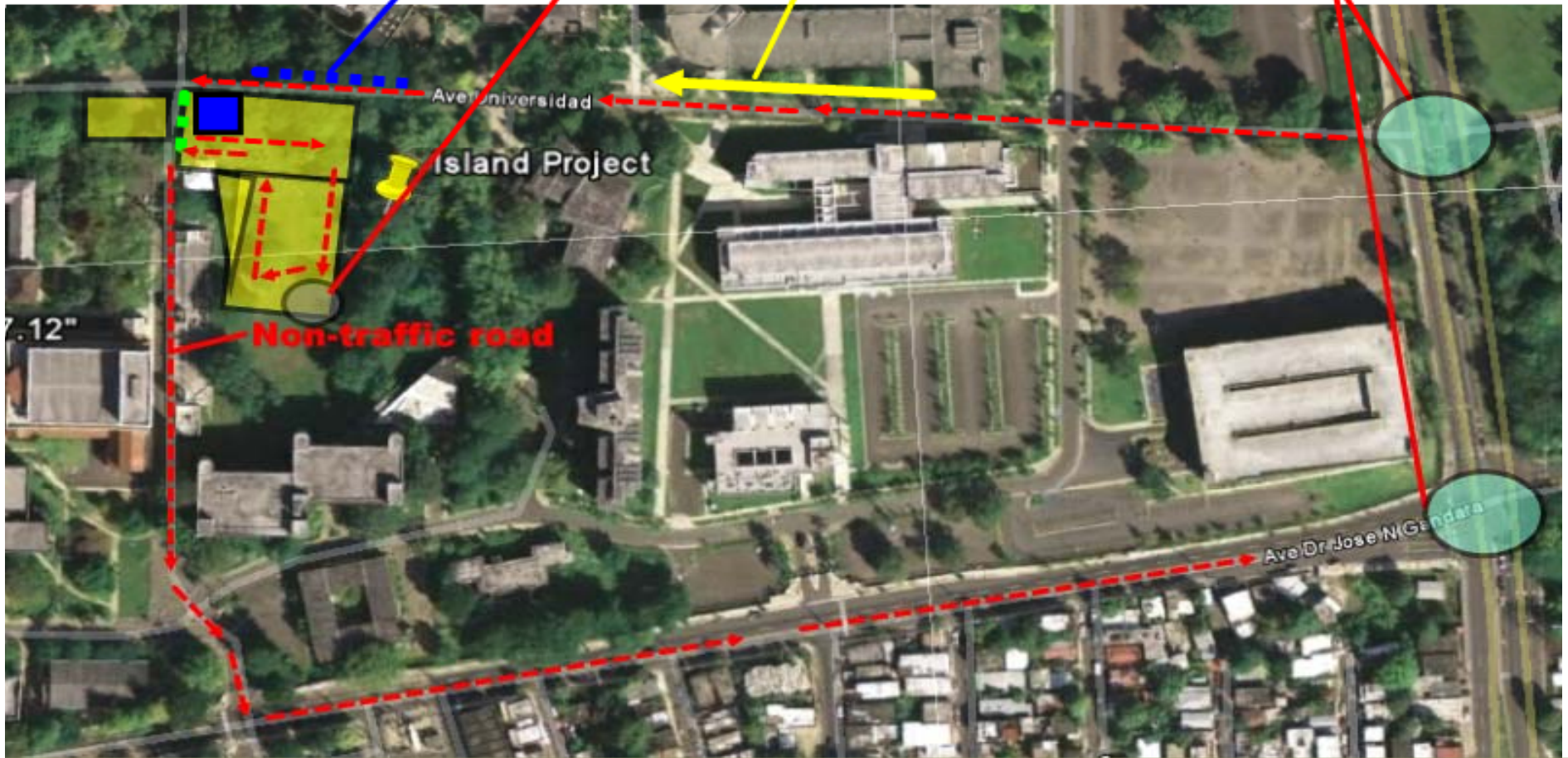


Concrete Truck
Waiting Area

Concrete
Washout Area

One-way Traffic
Direction

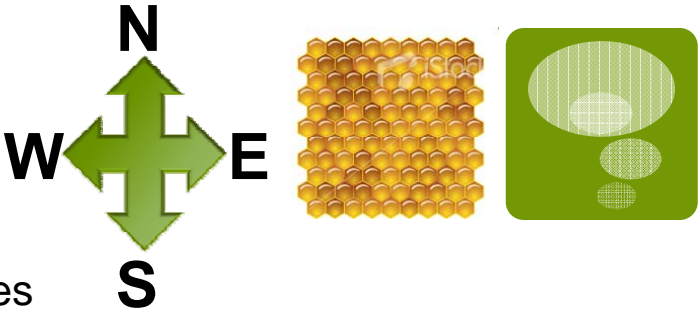
Fast Transit
Access Points
Hwy Pr-27



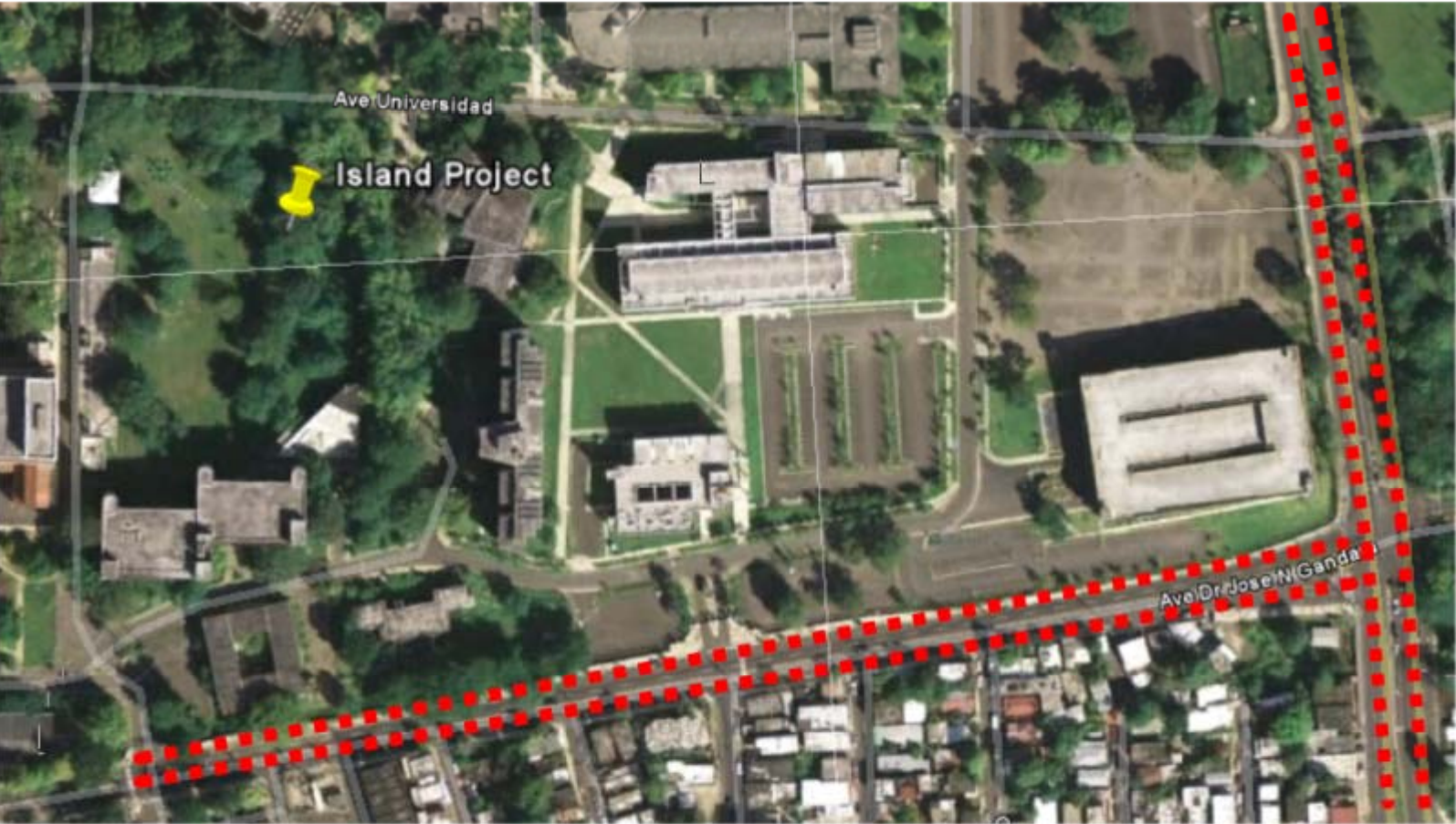
Construction Manager

Delivery Times

- Besides Hwy Pr-27, route has low traffic conflict
- Schedule delivery times outside of rush-hour times



Heavy Traffic Routes



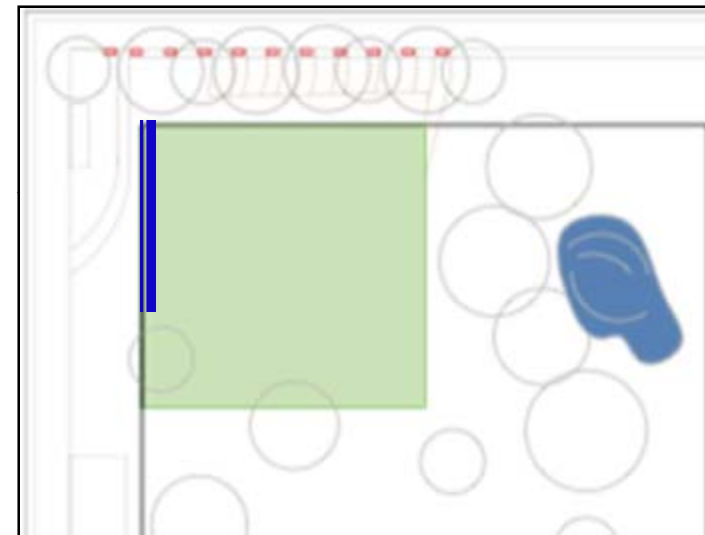
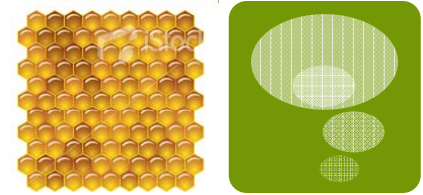
Critical Site Areas

Site Access

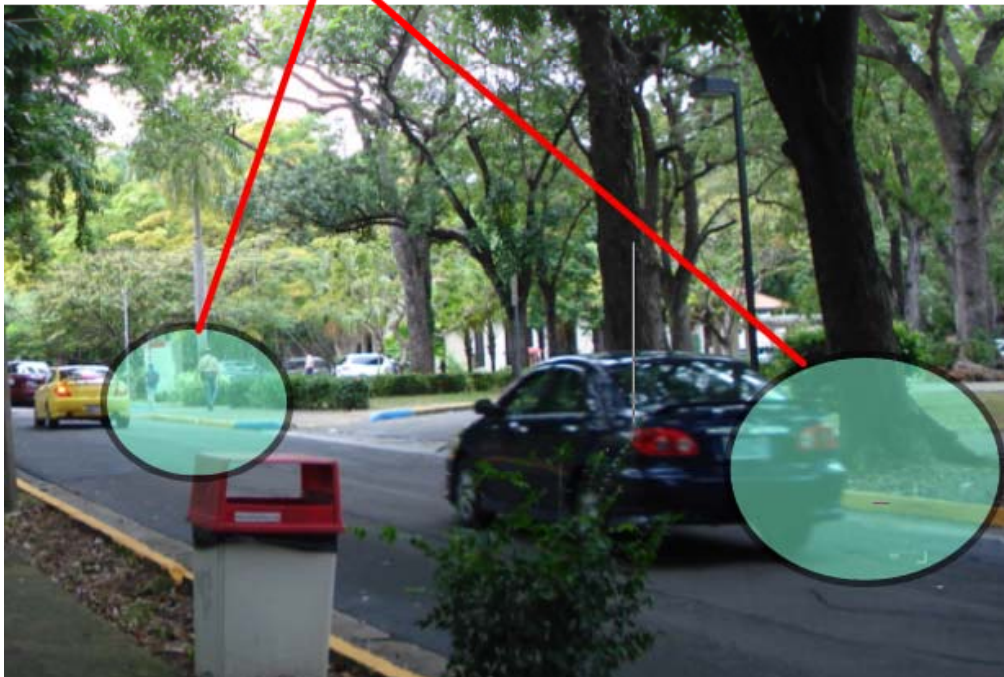
- Road west of site is a non-traffic road
- Minimal construction of site access road
- Local vegetation would go unharmed

Concrete Truck Waiting Area

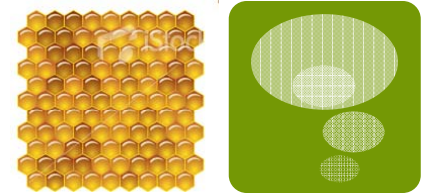
- Waiting area would not obstruct traffic
- Existing Areas already used as loading zones



Concrete Truck
Waiting Areas

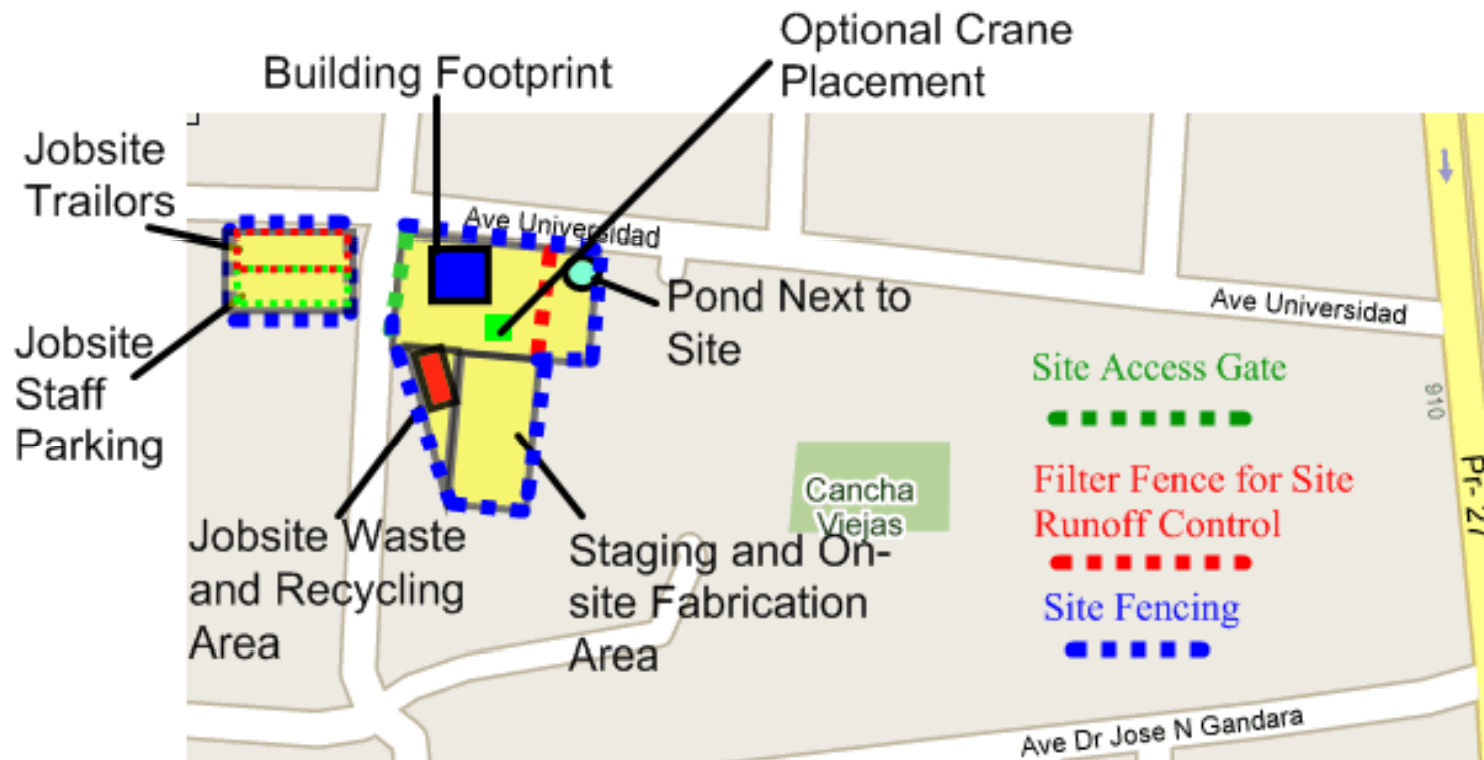
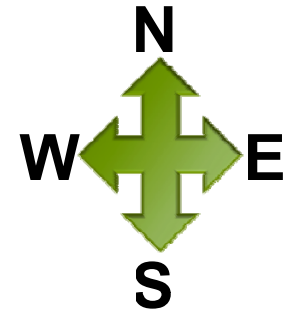


Jobsite Logistics/Placement

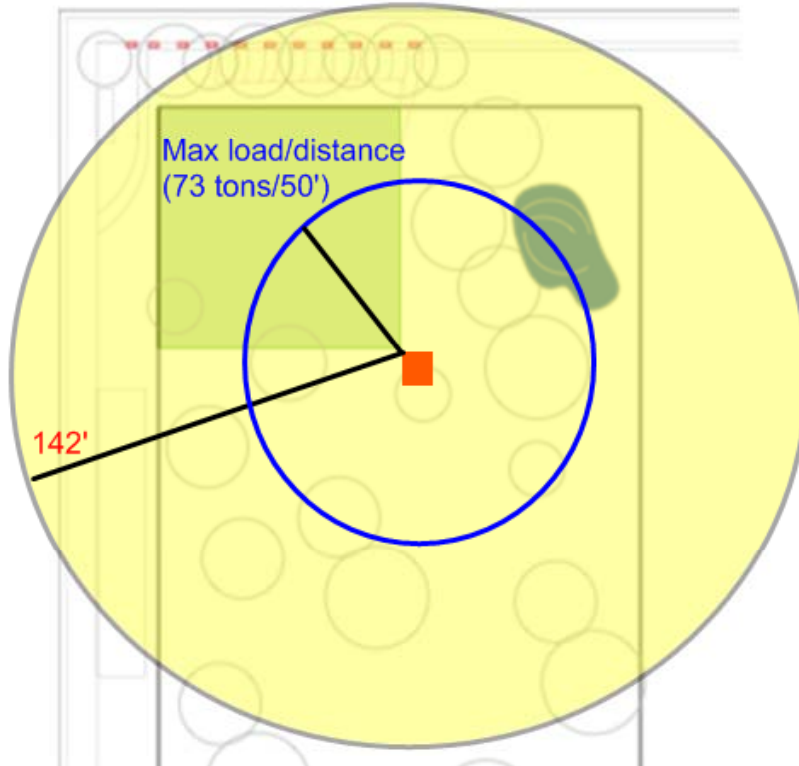
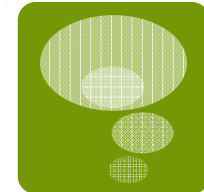
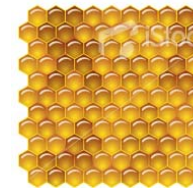


Staging and on-site fabrication:

- Reachable by crane
- Used for building components that require on-site fabrication
- Formwork assembly and storage
- Rebar assembly
- Storage of components too heavy for forklift operations

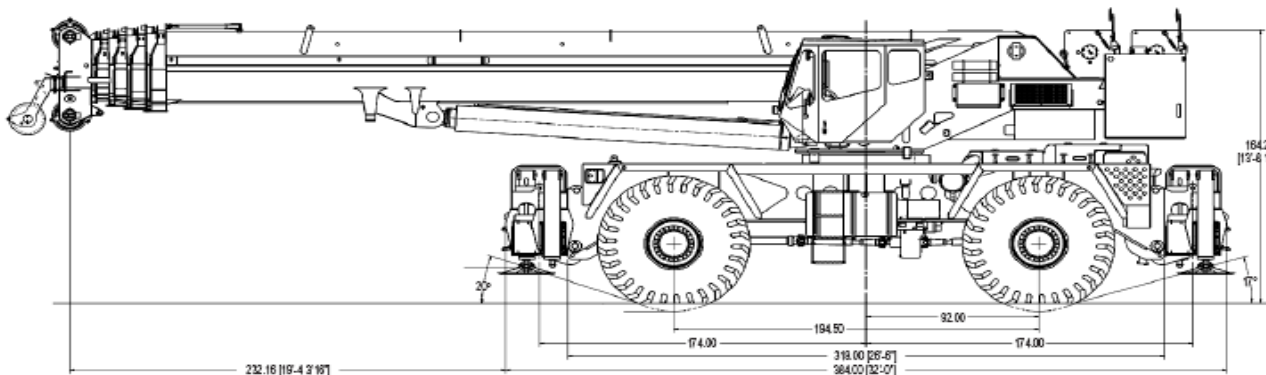


Jobsite Crane



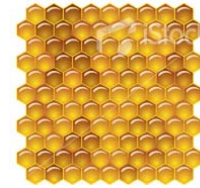
30	76,900 (34)	75,250 (53.5)	75,050 (62.5)	68,500 (68.5)	56,800 (72)	44,600 (75.5)	43,150 (75)		
35		60,950 (46.5)	60,750 (58)	60,100 (64.5)	50,050 (66)	44,600 (73)	42,200 (76)	32,550 (78)	
40		50,300 (38.5)	50,150 (52.5)	50,550 (60.5)	44,050 (66)	41,400 (70)	38,000 (73.5)	32,550 (76)	25,100 (78)
45		42,050 (28)	41,950 (47)	42,350 (56.5)	38,950 (62.5)	37,450 (67.5)	34,150 (71)	32,550 (74)	24,800 (76.5)
50			35,400 (41)	35,850 (52.5)	34,650 (59)	33,450 (64.5)	31,350 (68.5)	29,550 (71.5)	24,000 (74.5)
55			30,050 (34)	30,550 (47.5)	30,050 (55.5)	30,000 (61.5)	29,200 (66)	28,850 (69.5)	24,000 (72.5)
60			25,600 (24.5)	26,100 (42.5)	25,850 (52)	26,950 (58.5)	26,350 (63.5)	24,700 (67.5)	23,200 (70.5)
65				22,400 (37)	22,150 (48)	23,800 (55.5)	23,850 (61)	22,950 (65)	21,100 (68.5)
70				19,200 (30.5)	18,950 (44)	20,800 (52.5)	21,600 (58.5)	20,850 (62.5)	19,200 (66.5)
75				16,400 (22)	16,200 (39)	18,100 (49)	19,250 (55.5)	19,000 (60.5)	17,500 (64.5)
80					13,800 (34)	15,700 (45.5)	16,900 (52.5)	17,100 (58)	15,750 (62.5)
85					11,650 (28)	13,550 (41.5)	15,000 (49.5)	15,000 (55.5)	14,300 (60)
90					9,770 (19.5)	11,700 (37)	13,100 (46.5)	13,900 (53)	13,100 (58)
95						10,000 (32)	11,450 (43)	12,250 (50)	12,150 (55.5)
100						8,490 (26.5)	9,940 (39.5)	11,000 (47)	11,400 (53)
105						5,690 (18.5)	8,630 (35.5)	9,730 (44)	10,200 (50.5)
110							7,320 (30.5)	8,480 (41)	9,020 (48)
115							6,220 (25)	7,370 (37.5)	8,100 (45.5)
120							5,120 (17.5)	6,280 (33.5)	7,190 (42.5)
125								5,350 (29.5)	6,270 (39.5)
130								4,430 (24)	5,350 (36)
135								2,560 (16.5)	4,900 (32.5)
140									3,770 (28)

imum boom angle (deg.) for indicated length (no load)

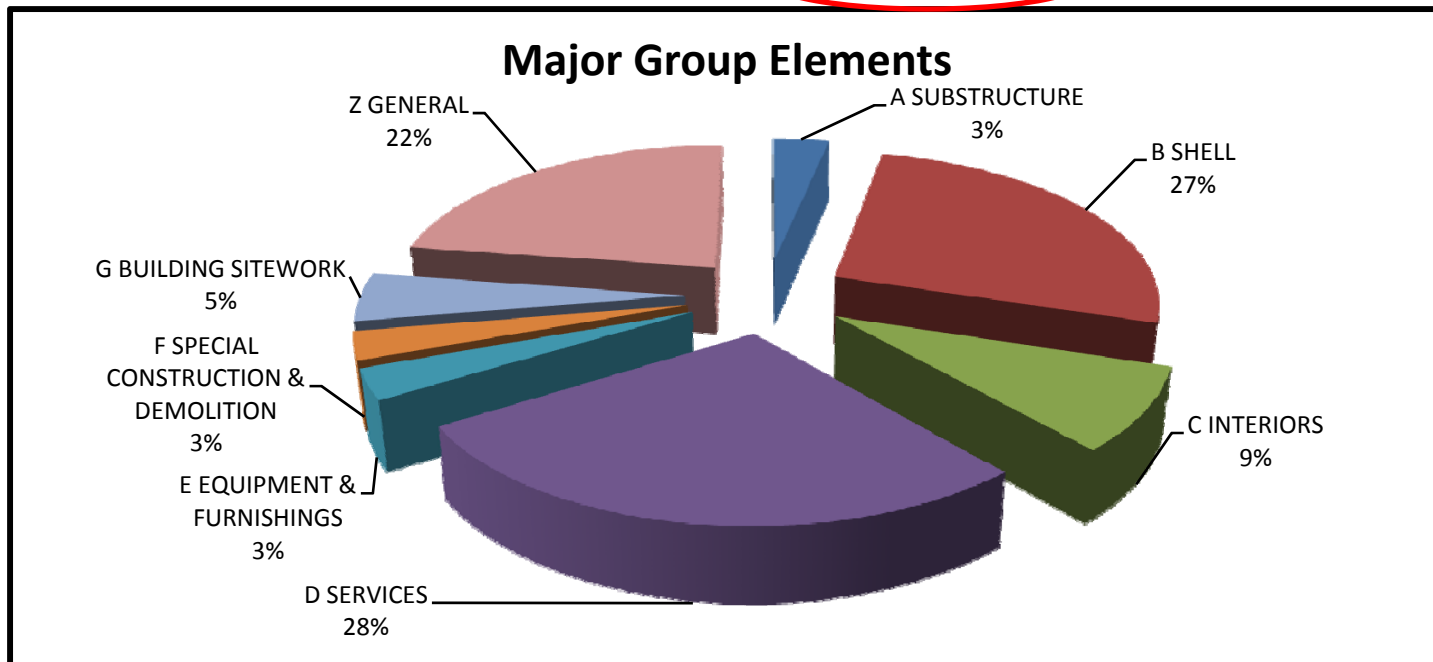


- Grove RT9130E
- Max load of 73 tons from AHU
- Crane on site for 34 weeks
- \$4500/week
- Proximity of max load and crane reach-ability reduces risk due to wind loads

Concrete Structure Estimate

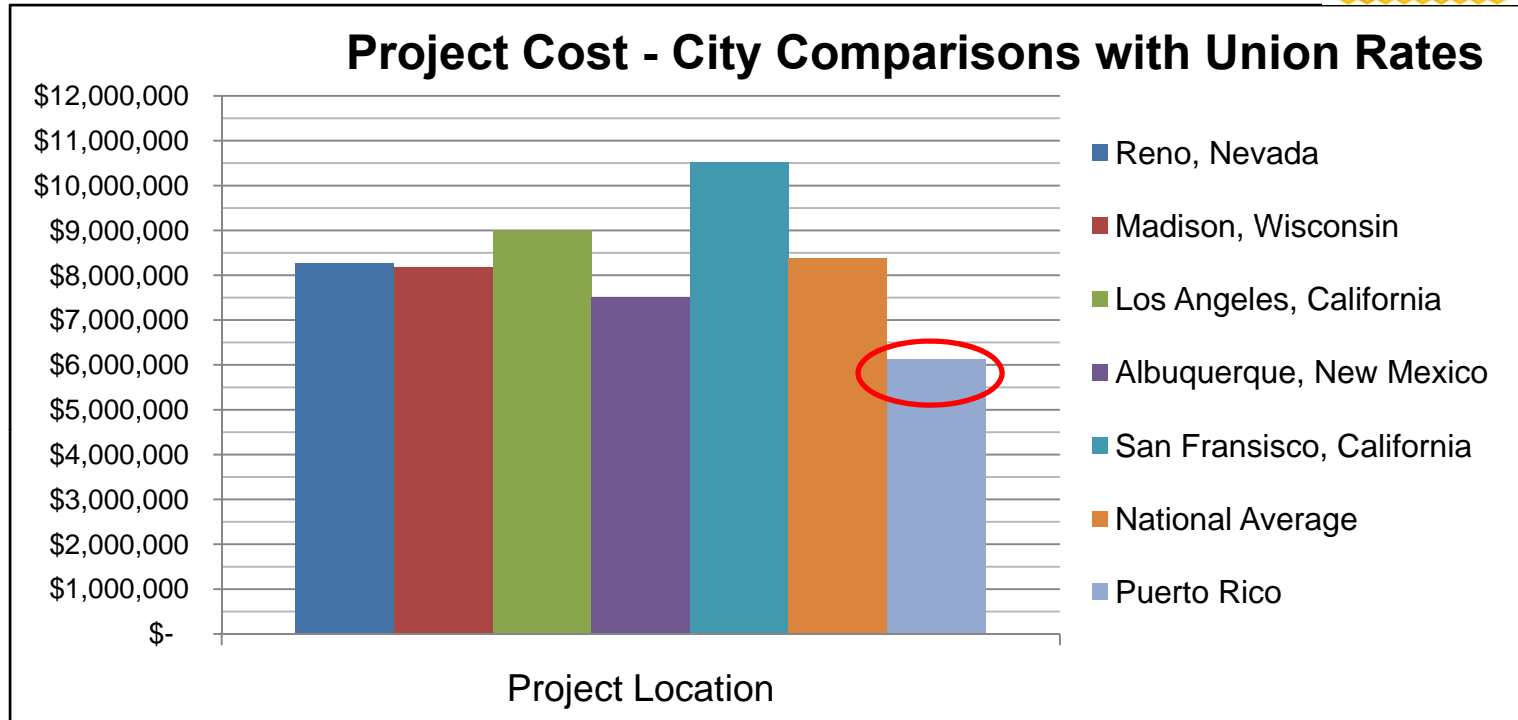
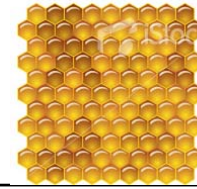


Major Group Element	Cost	Cost per SF	Percent of Total
A SUBSTRUCTURE	\$ 196,370	\$ 6	3%
B SHELL	\$ 1,605,833	\$ 45	27%
C INTERIORS	\$ 518,784	\$ 15	9%
D SERVICES	\$ 1,663,606	\$ 47	28%
E EQUIPMENT & FURNISHINGS	\$ 191,018	\$ 5	3%
F SPECIAL CONSTRUCTION & DEMOLITION	\$ 177,120	\$ 5	3%
G BUILDING SITEWORK	\$ 304,234	\$ 9	5%
JOB SUBTOTAL	\$ 4,656,965	\$ 132	77%
Z1010 Administration (Overhead and Profit, 15%)	\$ 698,545	\$ 20	12%
Z1050 Permit, insurance and bonds (2%)	\$ 195,584	\$ 6	3%
Z2010 Design Contingencies (5%)	\$ 232,848	\$ 7	4%
Z2030 Construction Contingencies (5%)	\$ 232,848	\$ 7	4%
Total Project Cost	\$ 6,016,791	\$ 70	100%



Our Project in Other Cities

Concept 1 Concrete Structure

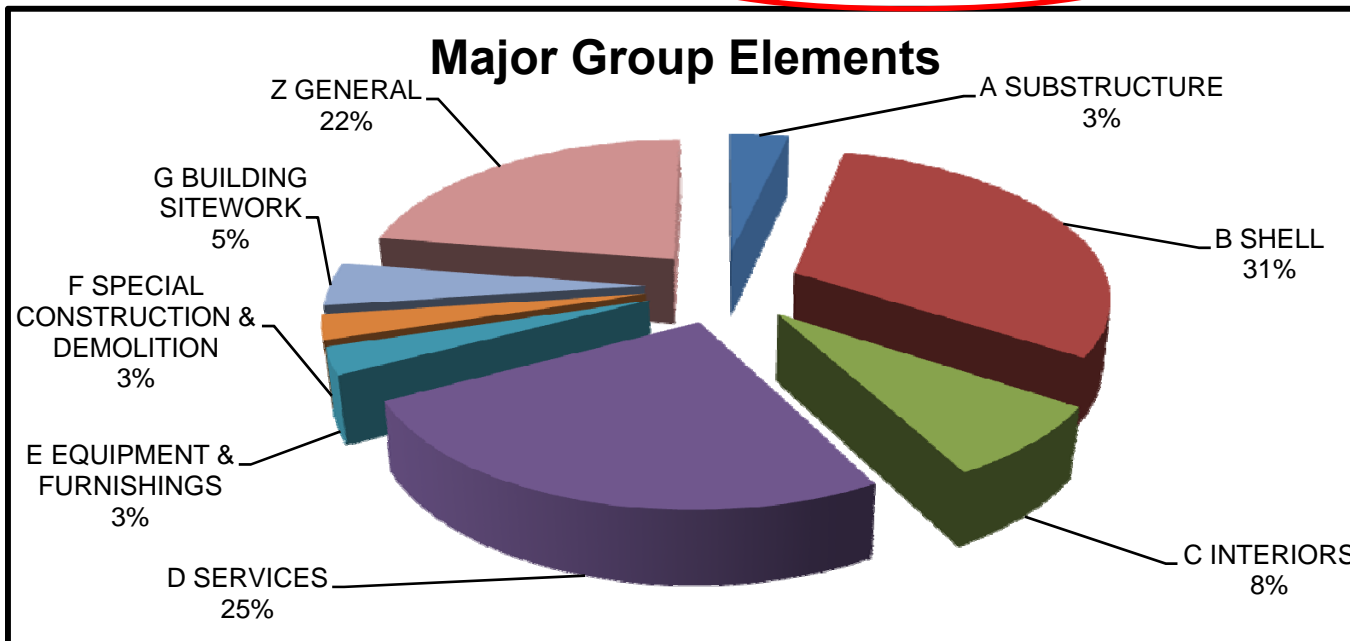


	Base	Overhead and Profit (15%)	Contingency (10%)	Permits, Bond, and Insurance (2%)	Total	Cost per SF	Labor
Reno, Nevada	\$ 6,013,473	\$ 902,021	\$ 601,347	\$ 229,497	\$ 7,746,338	\$ 258	Open Shop
	\$ 6,428,217	\$ 964,233	\$ 642,822	\$ 239,865	\$ 8,275,136	\$ 276	Standard Union
Madison, Wisconsin	\$ 5,934,816	\$ 890,222	\$ 593,482	\$ 227,530	\$ 7,646,051	\$ 255	Open Shop
	\$ 6,349,482	\$ 952,422	\$ 634,948	\$ 237,897	\$ 8,174,750	\$ 272	Standard Union
Los Angeles, California	\$ 6,496,727	\$ 974,509	\$ 649,673	\$ 241,578	\$ 8,362,487	\$ 279	Open Shop
	\$ 7,008,622	\$ 1,051,293	\$ 700,862	\$ 254,376	\$ 9,015,153	\$ 301	Standard Union
Albuquerque, New Mexico	\$ 5,500,633	\$ 825,095	\$ 550,063	\$ 216,676	\$ 7,092,467	\$ 236	Open Shop
	\$ 5,830,597	\$ 874,590	\$ 583,060	\$ 224,925	\$ 7,513,171	\$ 250	Standard Union
San Francisco, California	\$ 7,555,801	\$ 1,133,370	\$ 755,580	\$ 268,055	\$ 9,712,806	\$ 324	Open Shop
	\$ 8,185,175	\$ 1,227,776	\$ 818,517	\$ 283,789	\$ 10,515,258	\$ 351	Standard Union
National Average	\$ 6,075,700	\$ 911,355	\$ 607,570	\$ 231,052	\$ 7,825,677	\$ 261	Open Shop
	\$ 6,515,002	\$ 977,250	\$ 651,500	\$ 242,035	\$ 8,385,788	\$ 280	Standard Union
Puerto Rico	\$ 4,656,965	\$ 698,545	\$ 465,697	\$ 195,584	\$ 6,016,791	\$ 201	Open Shop
	\$ 4,745,586	\$ 711,838	\$ 474,559	\$ 197,800	\$ 6,129,782	\$ 204	Standard Union

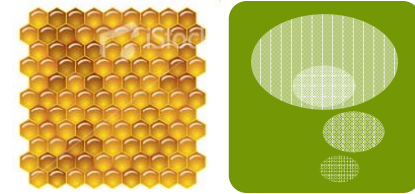
Steel Structure Estimate



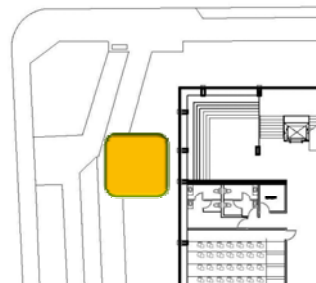
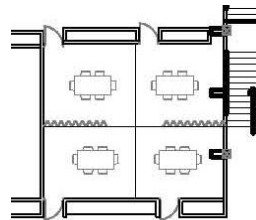
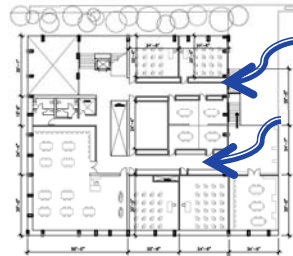
Major Group Element	Cost	Cost per SF	Percent of Total
A SUBSTRUCTURE	\$ 233,139	\$ 7	4%
B SHELL	\$ 2,033,162	\$ 57	31%
C INTERIORS	\$ 518,784	\$ 15	8%
D SERVICES	\$ 1,663,606	\$ 47	25%
E EQUIPMENT & FURNISHINGS	\$ 191,018	\$ 5	3%
F SPECIAL CONSTRUCTION & DEMOLITION	\$ 177,120	\$ 5	3%
G BUILDING SITEWORK	\$ 304,234	\$ 9	5%
JOB SUBTOTAL	\$ 5,121,063	\$ 145	77%
Z1010 Administration (Overhead and Profit, 15%)	\$ 768,159	\$ 22	12%
Z1050 Permit, insurance and bonds (2%)	\$ 207,187	\$ 6	3%
Z2010 Design Contingencies (5%)	\$ 256,053	\$ 7	4%
Z2030 Construction Contingencies (5%)	\$ 256,053	\$ 7	4%
Total Project Cost	\$ 6,608,516	\$ 187	100%



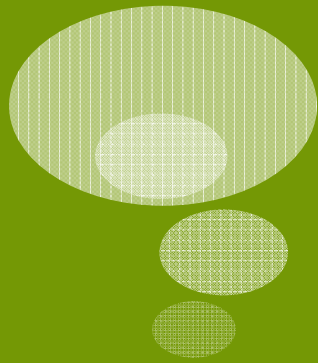
Sustainable Performance



- Passive Design Strategies (orientation, brisoleis, etc.)
- Natural Ventilation (corridors open to east / atrium is escape route)
- Energy Harvesting System on roof (sunpower pv panels à use of “State Sun Energy Program”)
- Flexible interior space
- Bicycle pkg.
- High efficiency windows and curtain wall



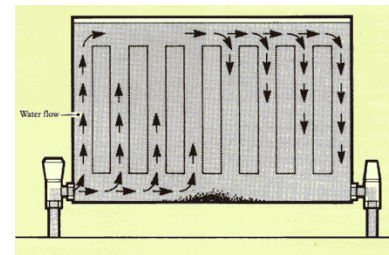
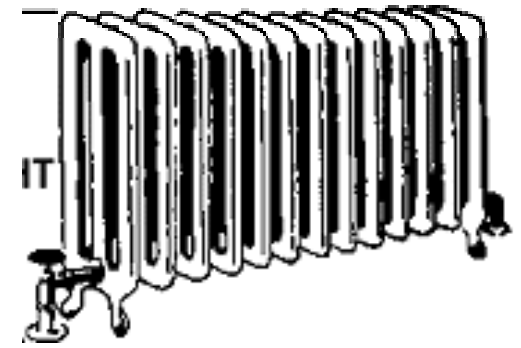
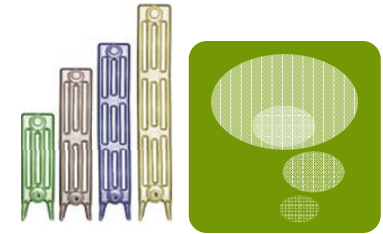
<u>Circulation area</u> net foot area		0.287
<u>Building volume</u> gross floor area	3.0	3.7
<u>Surface area</u> building volume	<0.25	0.10
<u>Net floor area</u> gross floor area	>0.60	0.85



Concept B



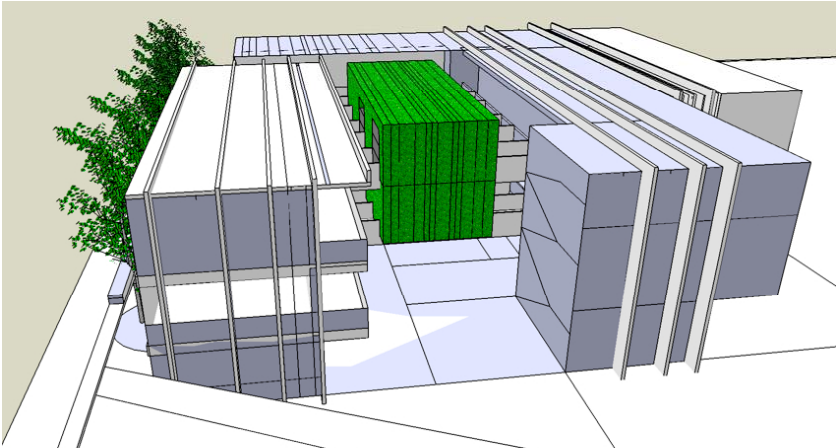
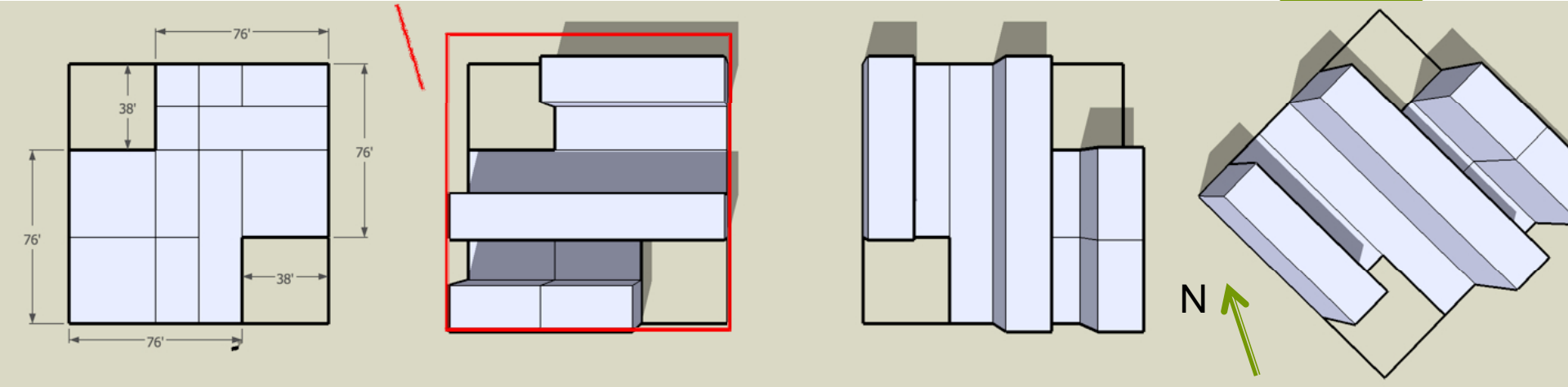
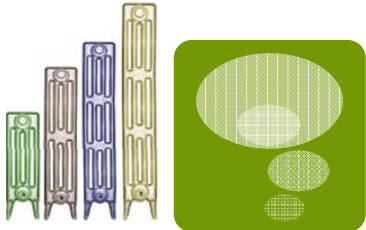
Radiator



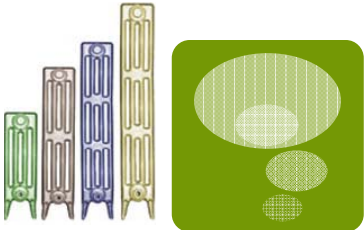
Site- What influences my site experience?



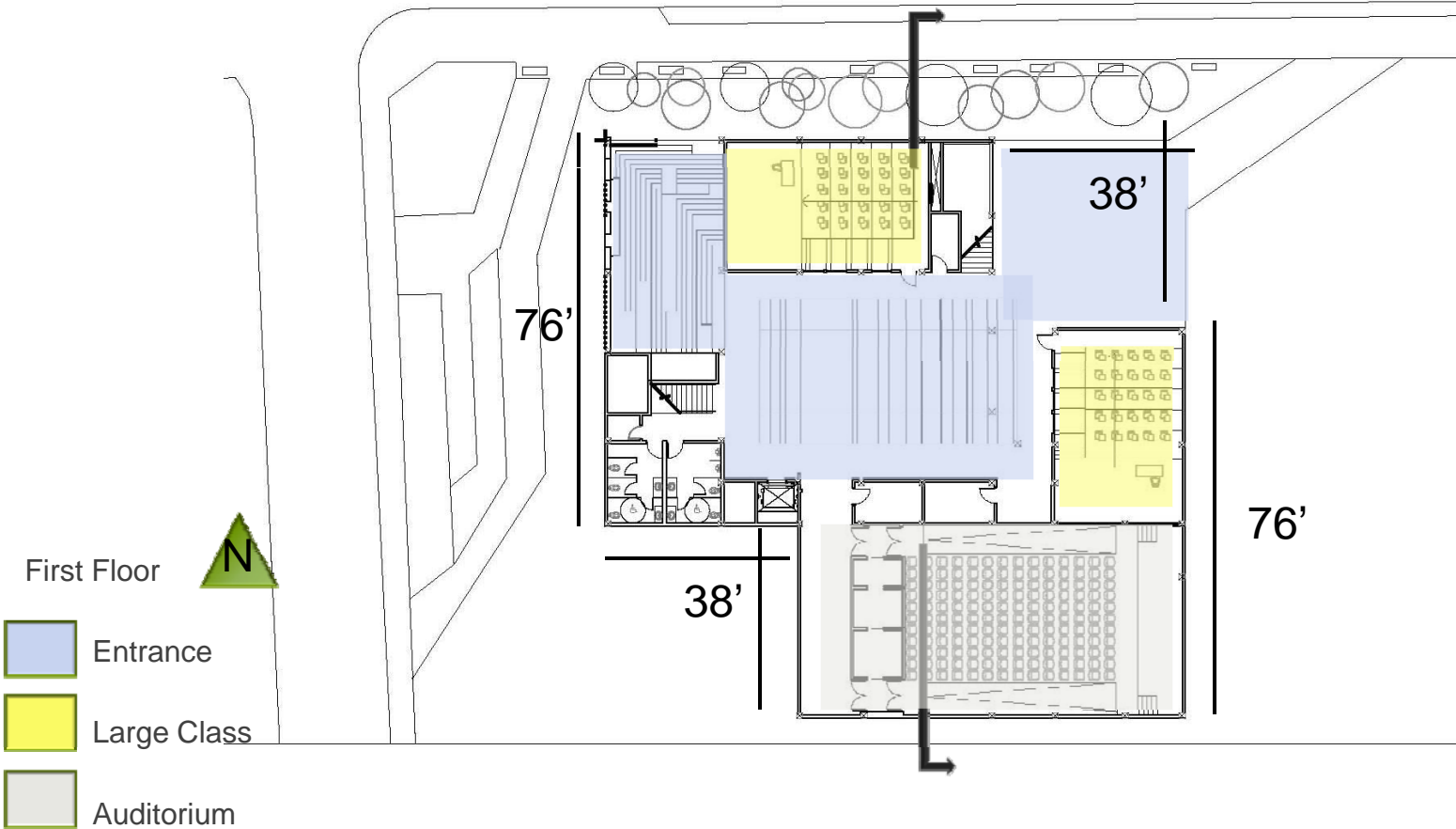
Initial ideas: volumetry/orientation sun path study



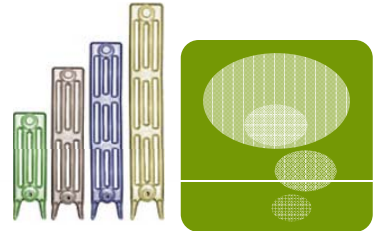
Floor Plans



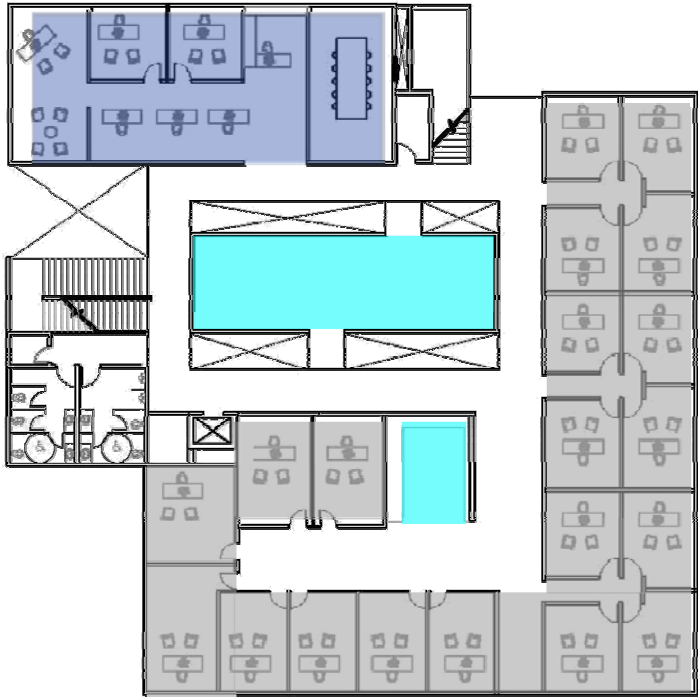
Section AA



Floor plans














Second floor

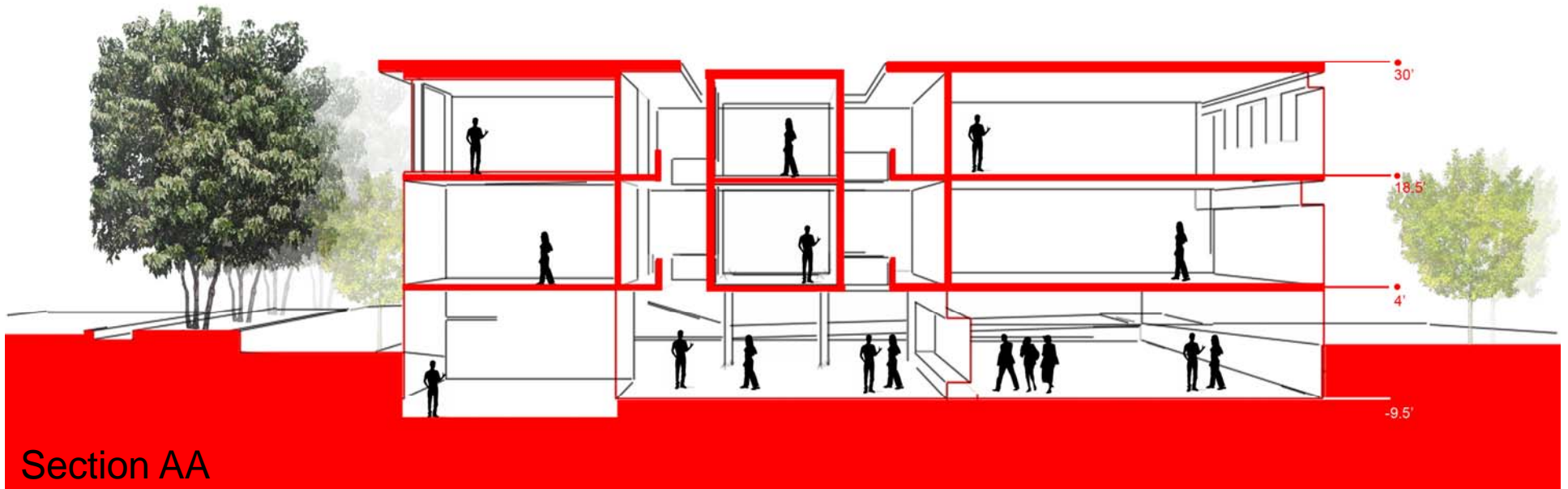
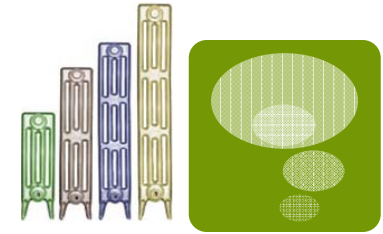
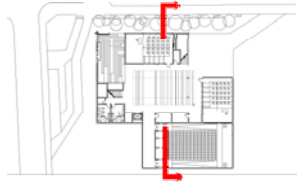


Third floor

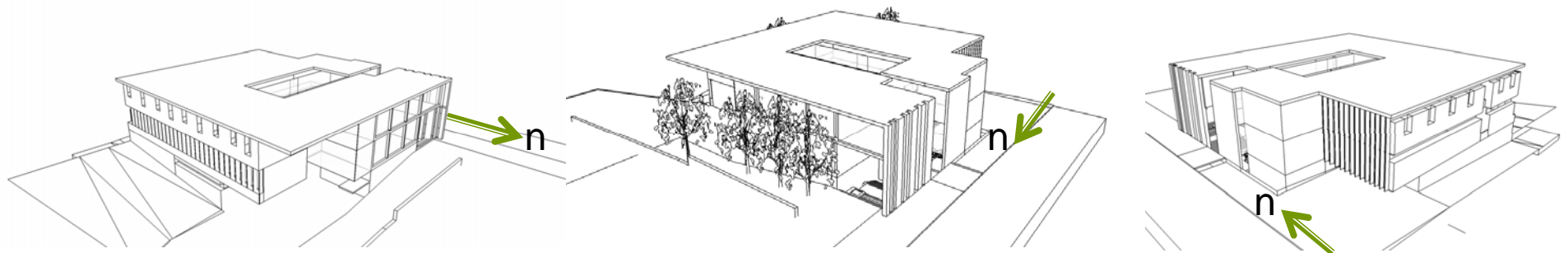


- | | | | |
|---|--|--|---|
|  Entrance |  Laboratories |  Seminars |  Faculty offices |
|  Large Class |  Small Class |  Server rm. |  Student Offices/terrace |
|  Auditorium | |  Faculty lounge |  Administration |

Volumetric Development

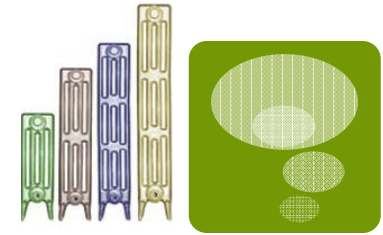


Section AA

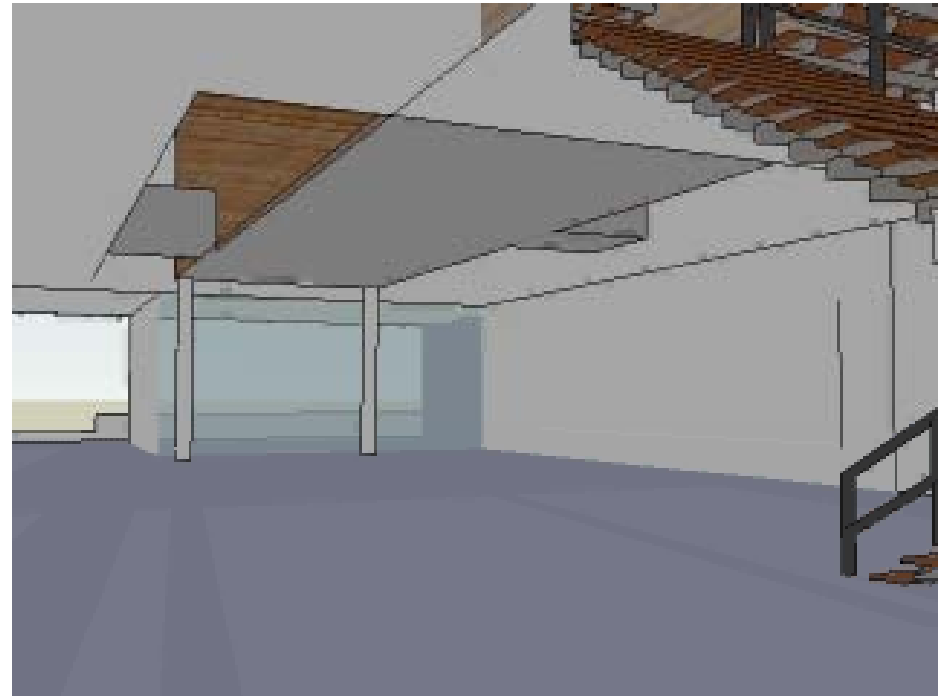


Axonometrics

Sun Studies

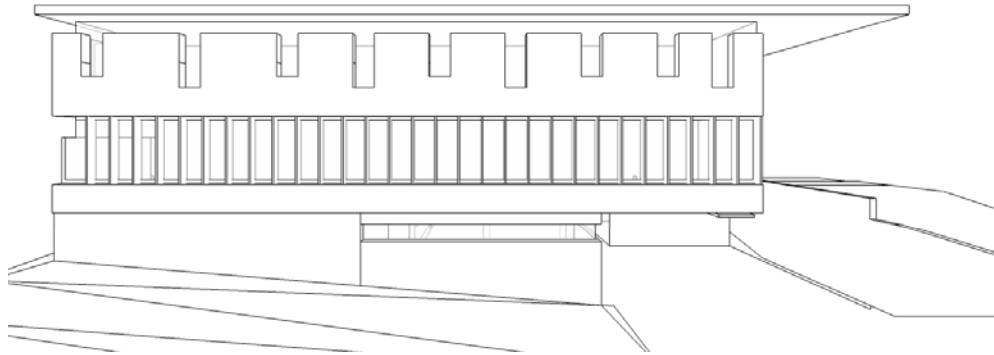
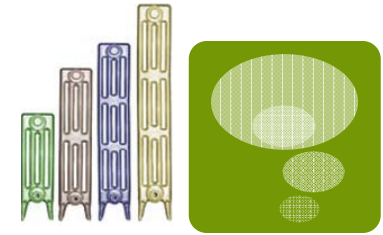


April 21, 2015

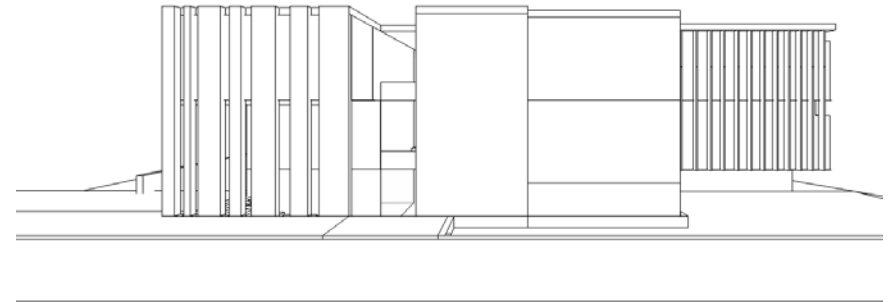


October 21, 2015

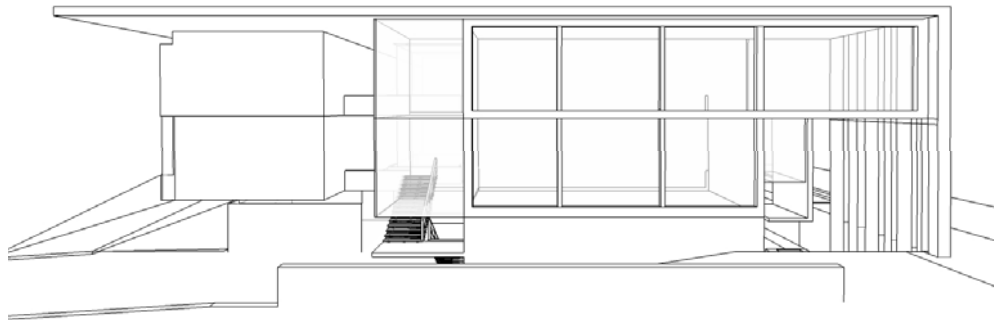
Facades



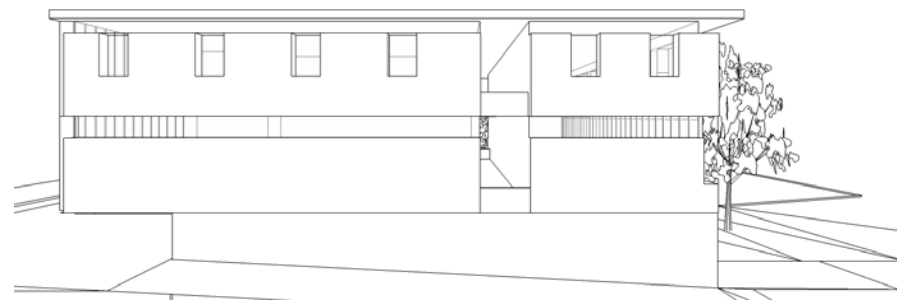
East Facade



West Facade

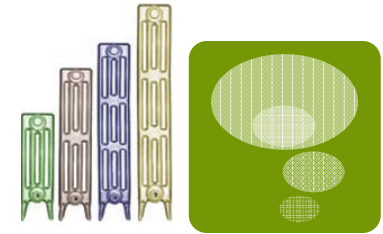


North Facade

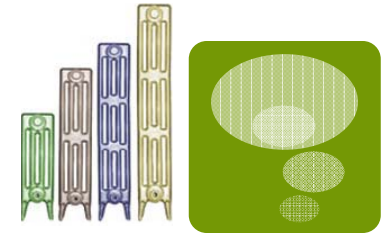


South Facade

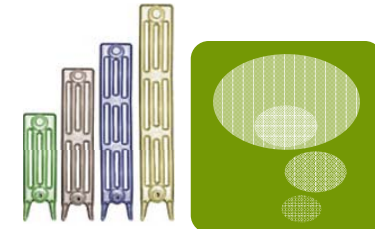
Volumetric Development North West



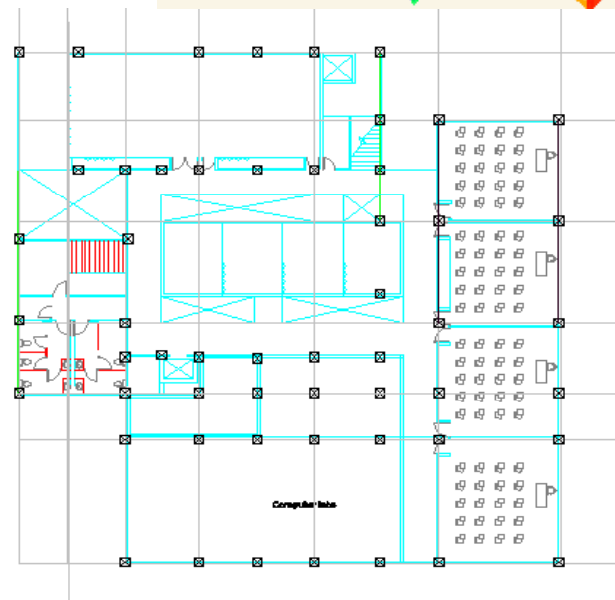
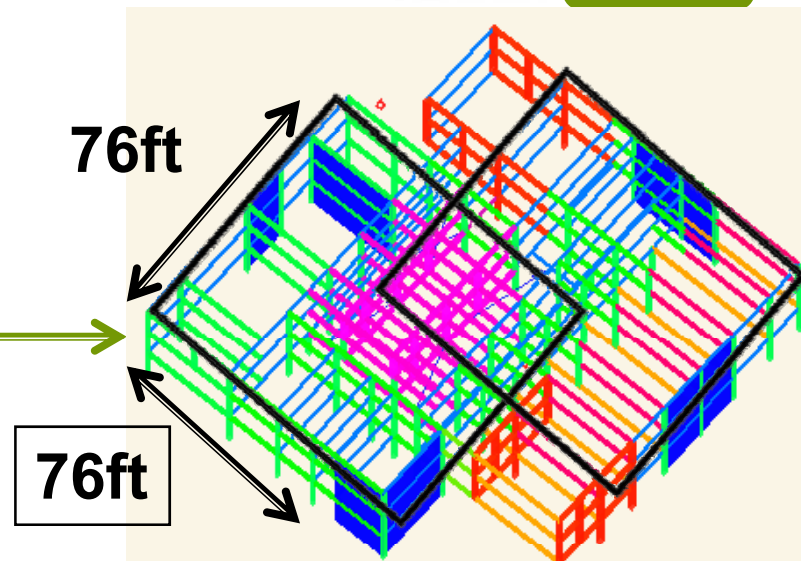
Volumetric Development



Concrete Structure

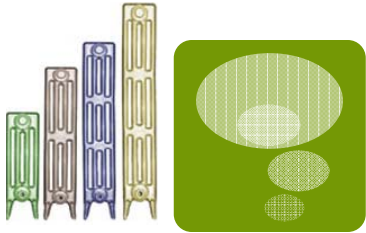


- Gravity Column
 - 12" x 12" or 14" X 14" ($p=1.5\%$)
- Post-tension Slab and Flat Slab
 - First Floor
 - PT Slab at Auditorium (9 in, Cable @ 1.5ft)
 - Flat Slab (8 in)
 - Second Floor/Roof
 - Flat Slab (8in)
 - Material specification
 - LW concrete ($f'c=5\text{ksi}$)
 - Steel tendon 7-wire strands ($f_s=270\text{ksi}$, effective stress= 0.6 f_s)
- Central box structure
 - Beam 18" X 12"
 - Column 12" X12"



Column plan

Concrete Structure -Challenges

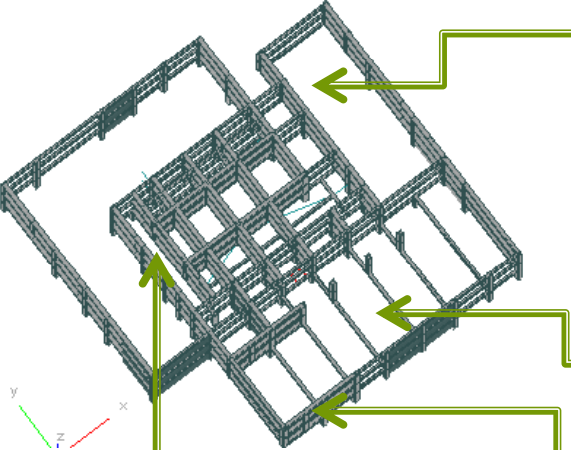
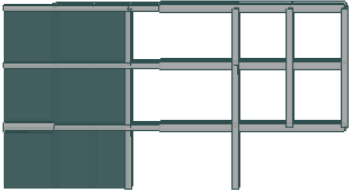


• **25ft cantilever at the east side**

Vierendeel Truss

Cantilever column: **28X14 (p=2%)**

Cantilever Girder: **28x18 (10 PT Tendons)**



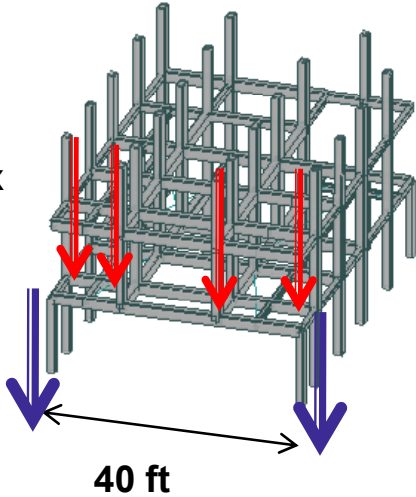
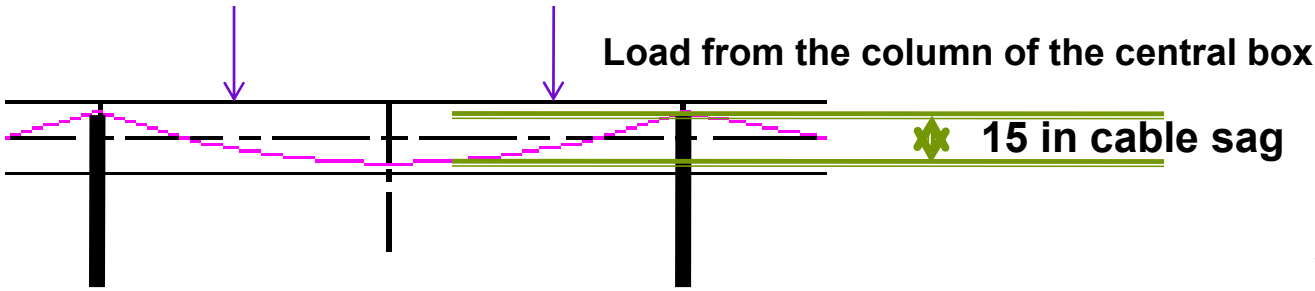
• **40 ft Auditorium Beam (@10ft)**

• **24"X24" Post-tension Beam (9 PT)**

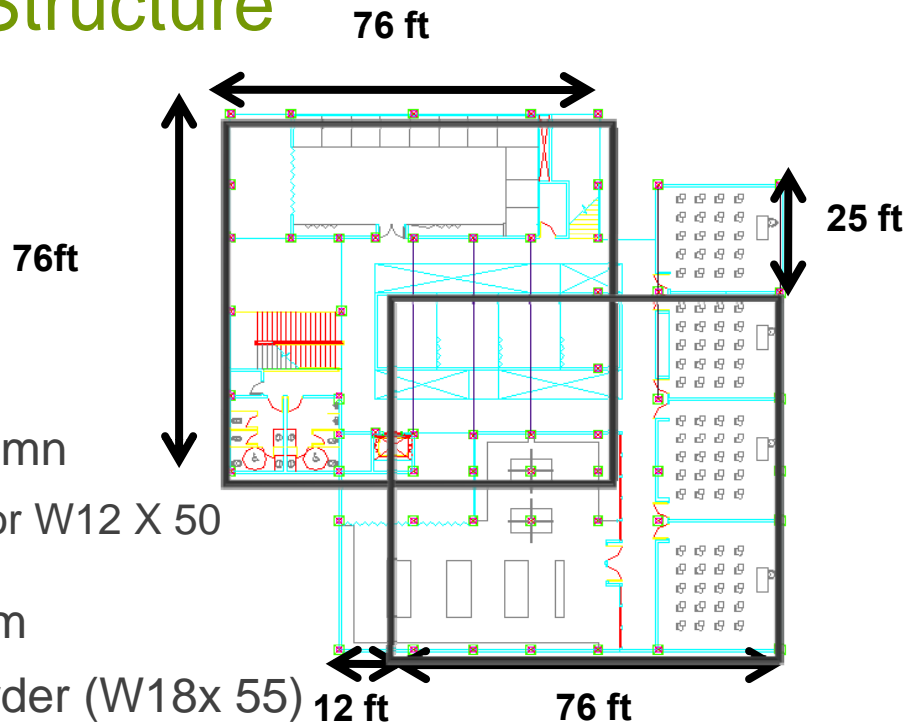
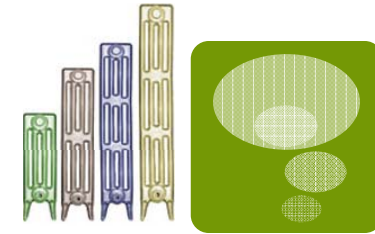
• **Moment connection detail of the Truss**

Post-tension Girder for Central Long Span Beam

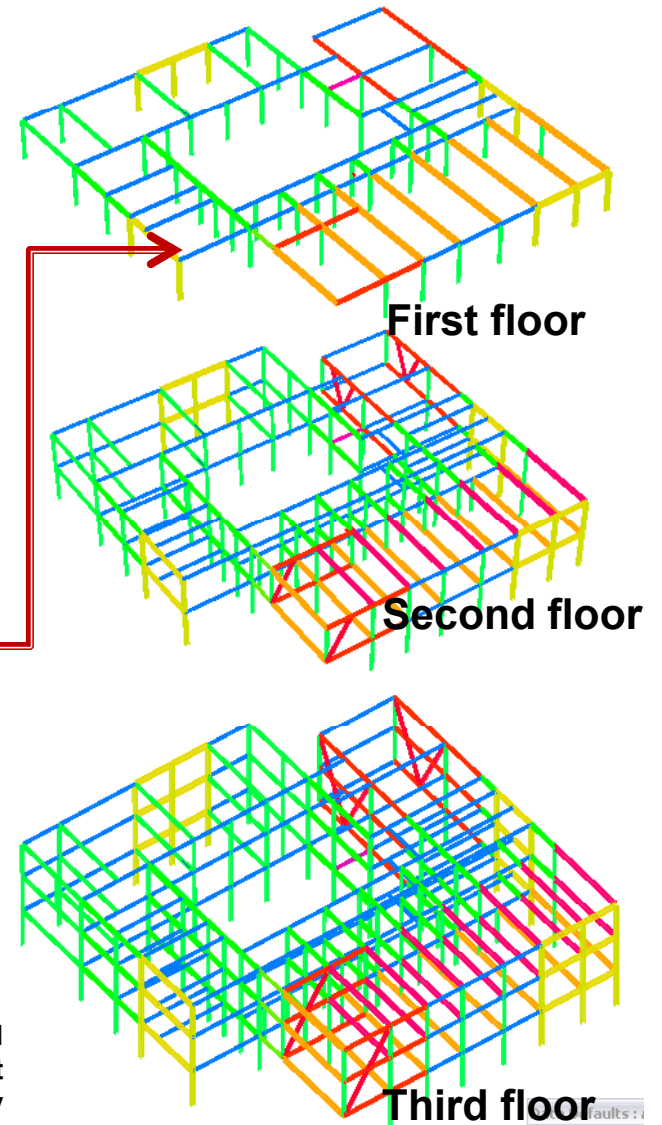
28x18 (10 PT Tendons)



Steel Structure

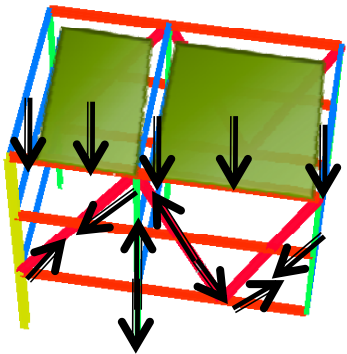
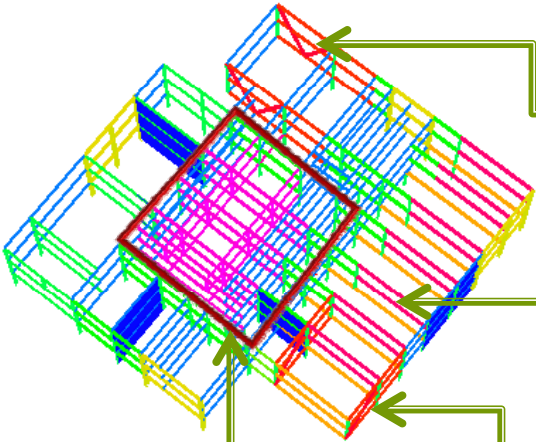
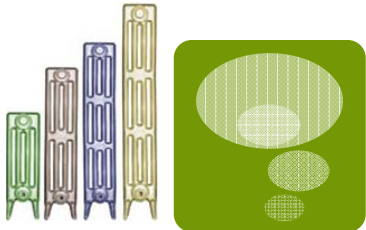


- Gravity Column
 - W14 X 48 or W12 X 50
- Gravity Beam
 - Interior girder (W18x 55)
 - Exterior girder (W16X31)
 - Filler beam (W12X26)
- Composite floor system
 - 2 hr fire rating
 - 4 inches LW concrete
 - 2VLI17 ($I_p/I_n = 0.633in^4$) or equivalent



*Central Structure not shown for clarity

Steel Structure Challenges



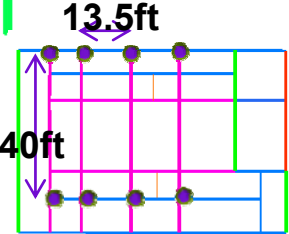
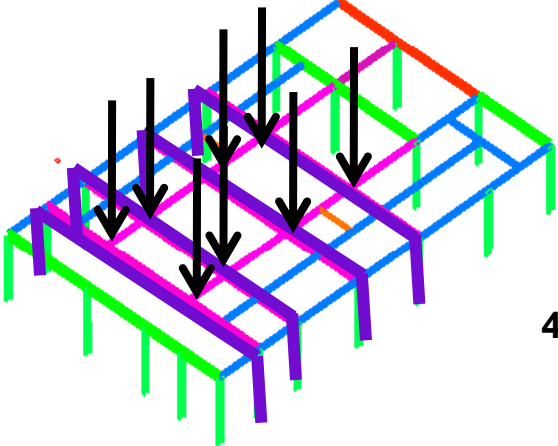
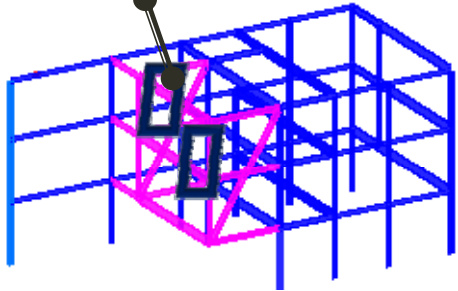
- 25ft cantilever at the east side
- Girder: W14x82
- Brace:W14x74

- 40 ft Auditorium Beam (@10ft)
- CB 36X84 root beam W24X84

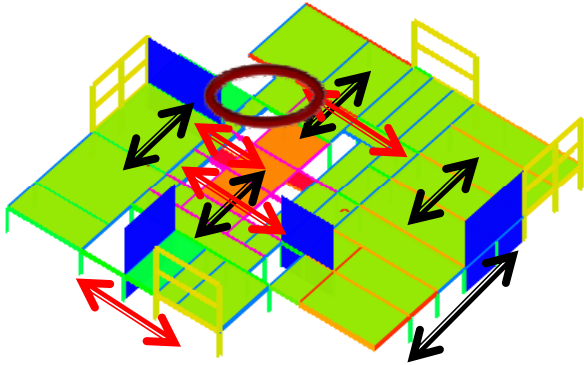
- 12ft cantilever at the south side
- Brace:W14x74

- 40 ft Central Long Span Beam (@13ft)
- W30X90

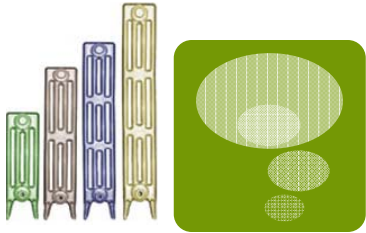
Allow openings



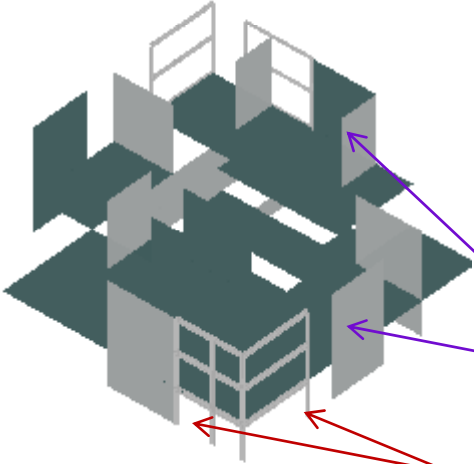
•Critical section on floor system



Lateral resisting system



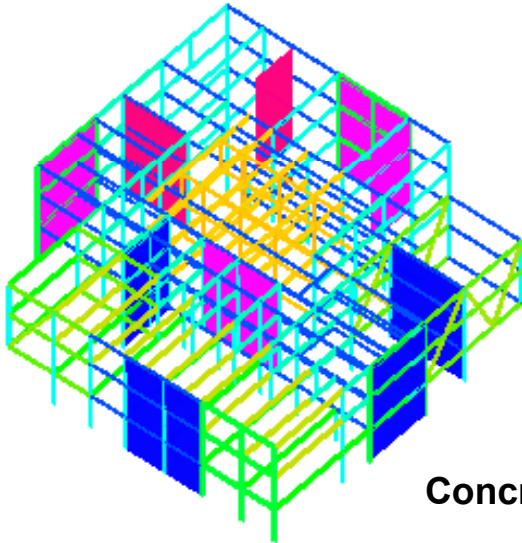
Steel Dual System



- **Steel system**
- **Dual System - Shear Wall + Steel SMF**
 - 10in thickness Shear Wall
 - Typical wall length 10ft, 15ft or 25 ft
 - Special Moment Frame
 - Column W14 x 159 Beam W18 x 119

Shear Wall

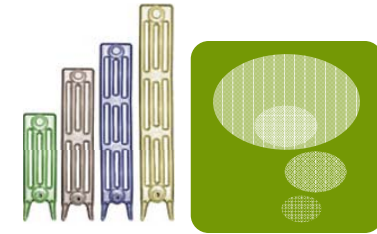
Special Moment Frame



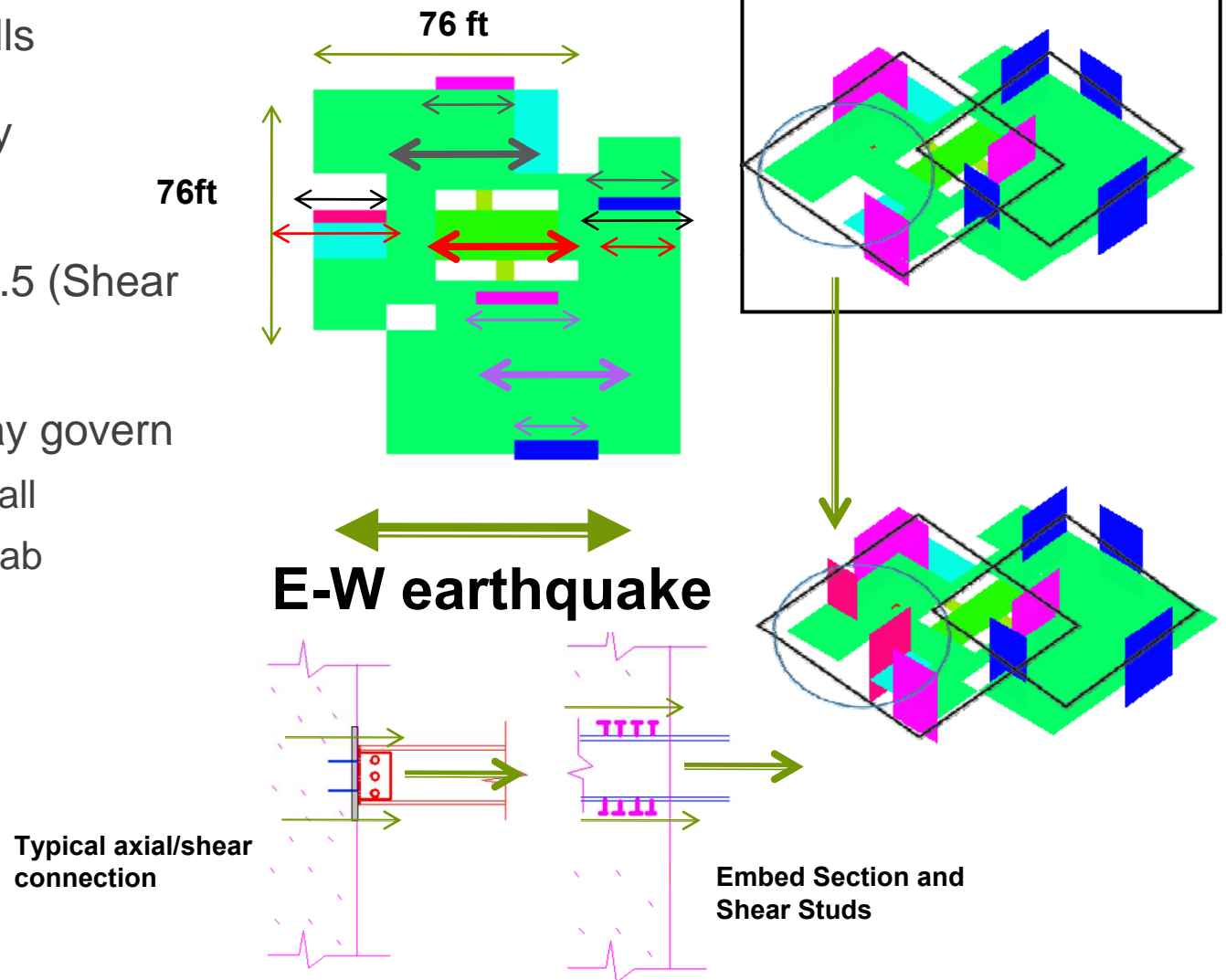
- **Concrete system**
- 8 no.s of Shear Wall
 - 12in thk

Concrete Shear Wall System

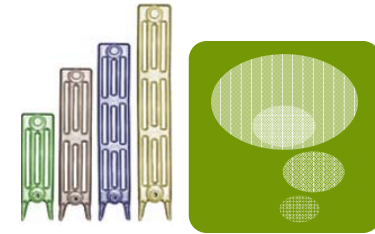
Lateral resisting system – critical design details



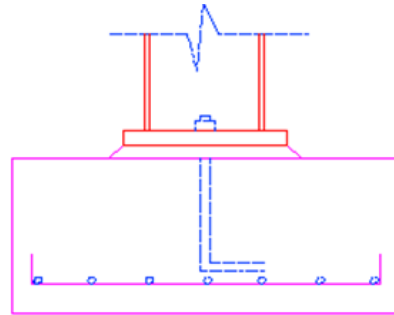
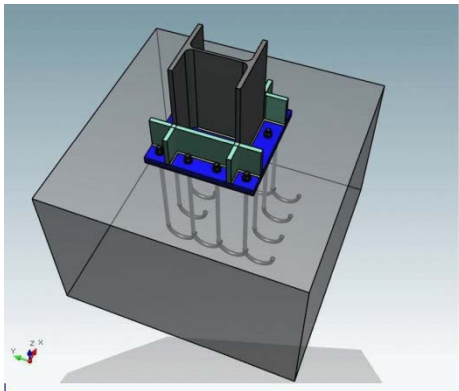
- 8-10 no.s of shear walls
- Reduce shear walls by connector element
- Over-strength factor 2.5 (Shear wall system)
- Connection details may govern
 - connectors to shear wall
 - Check beam size or slab thickness



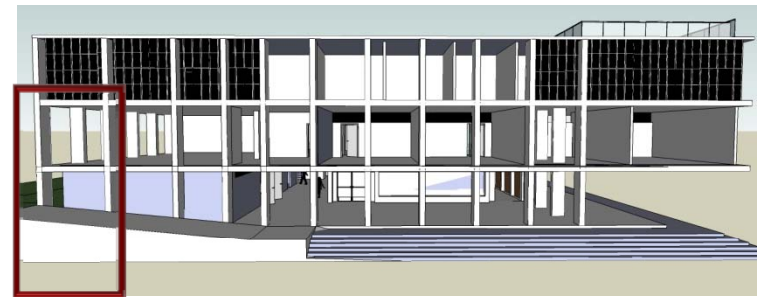
Foundation Structure interaction



- Steel Column to Square Foundation/ Strip footing

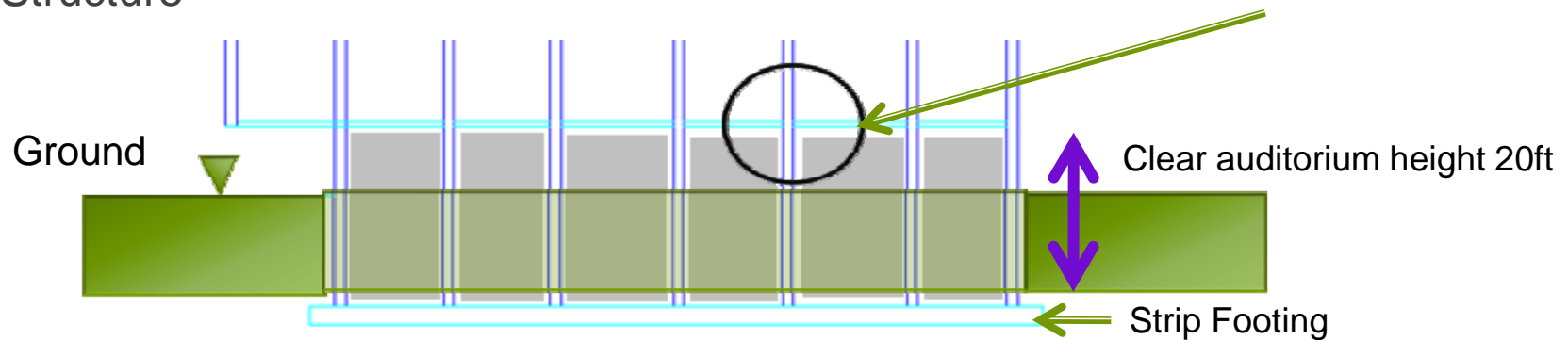


Part of the auditorium is sunk down by 18ft

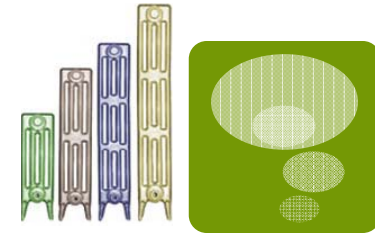


- Column and Foundation Box Structure

Starter bar extending from substructure box to column

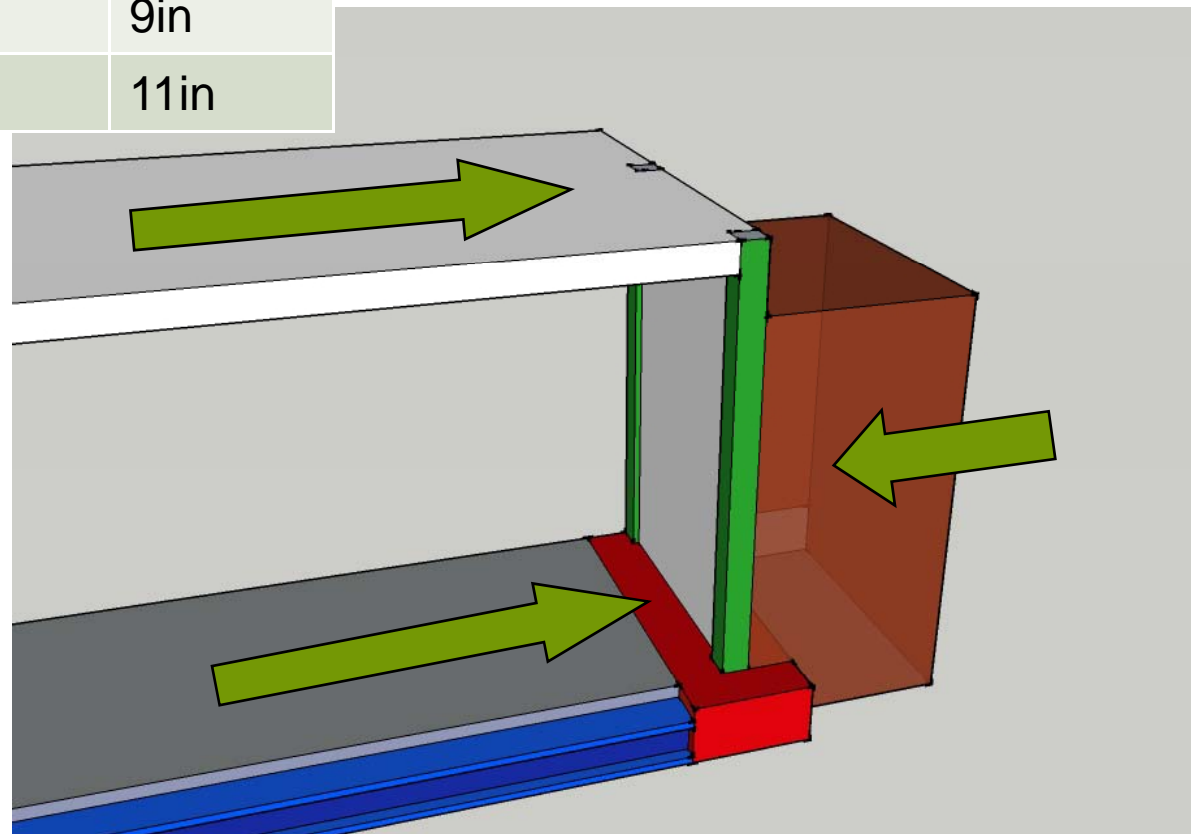


Sunken Box Structure

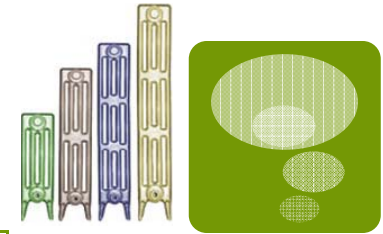


Kips per unit width	Length	Height	Width
24ft	60ft	9ft	5in
67ft	40ft	15ft	9in
97ft	114ft	18ft	11in

Volume of Concrete
2556 ft³



Foundation

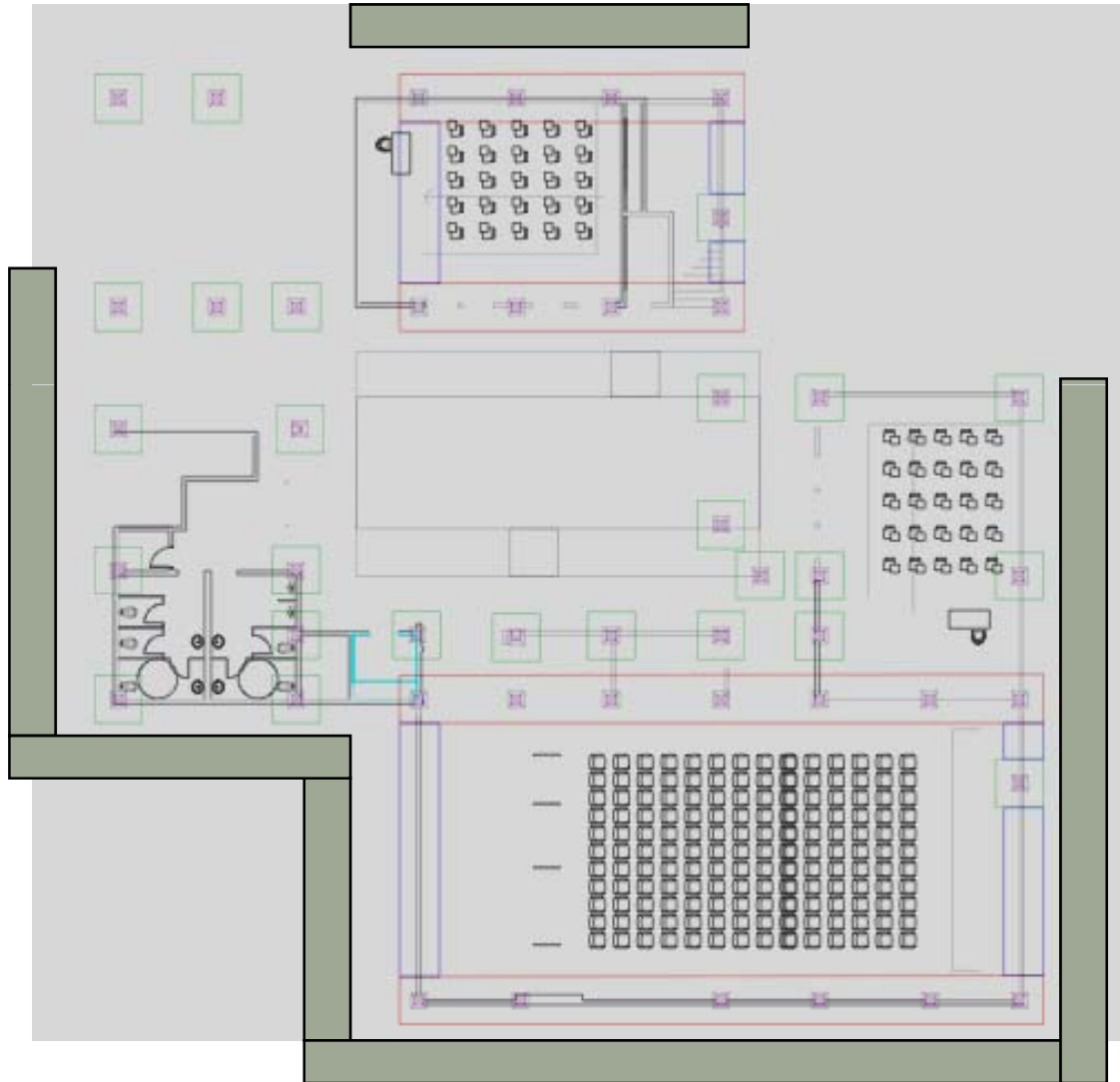
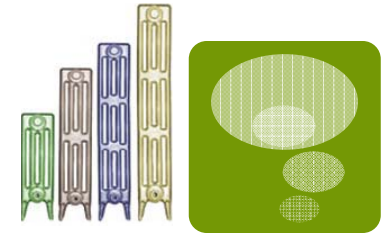


Type	Qty	Length (ft)	Width (ft)	Depth (ft)
Square	26	6	6	1.5
Aud Strip	2	76	6	4
Class Strip	2	30	6	3
Aud Beam	2	38	1	1
Class Beam	2	25	1	1

Slab on Grade	Area (ft ²)	Thickness(in)
Auditorium	76x38	8
Classroom	30x25	6



Foundation Plans

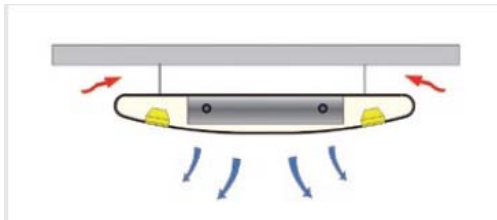
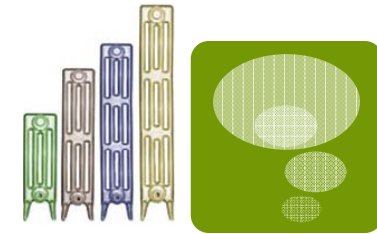
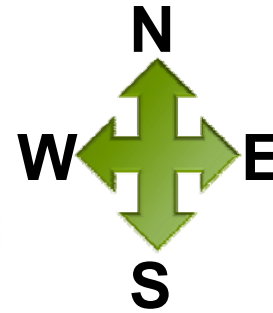


Strip

Square

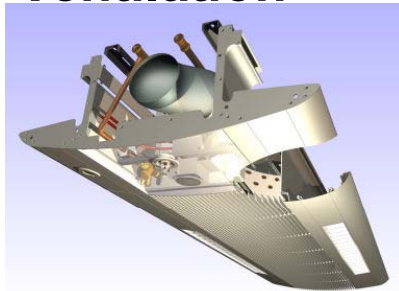
Beam on
Grade

MEP Rationale



Passive Chilled Beam

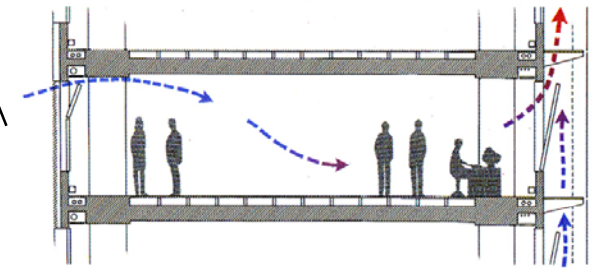
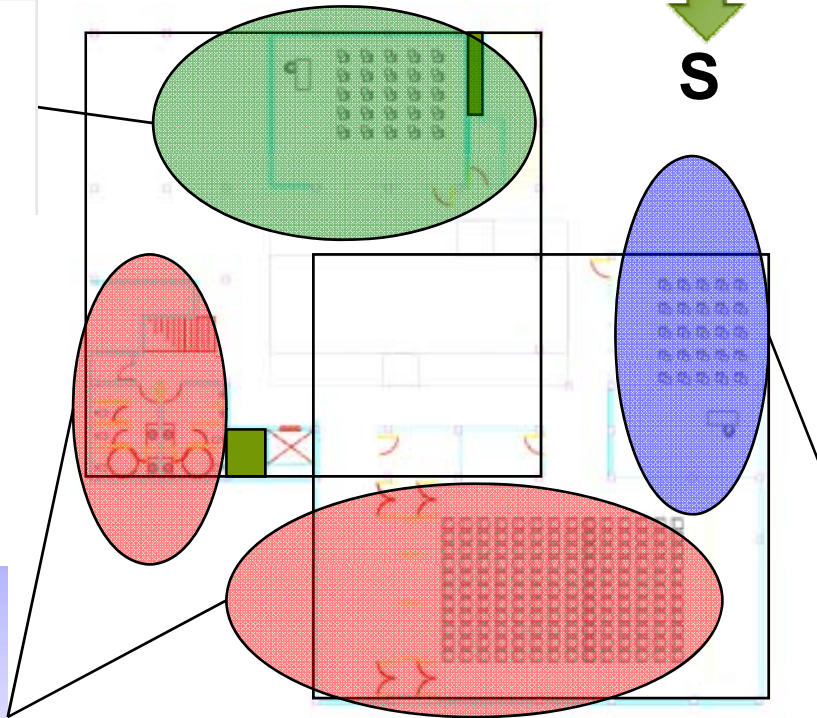
Forced Air Ventilation



Active Chilled Beams

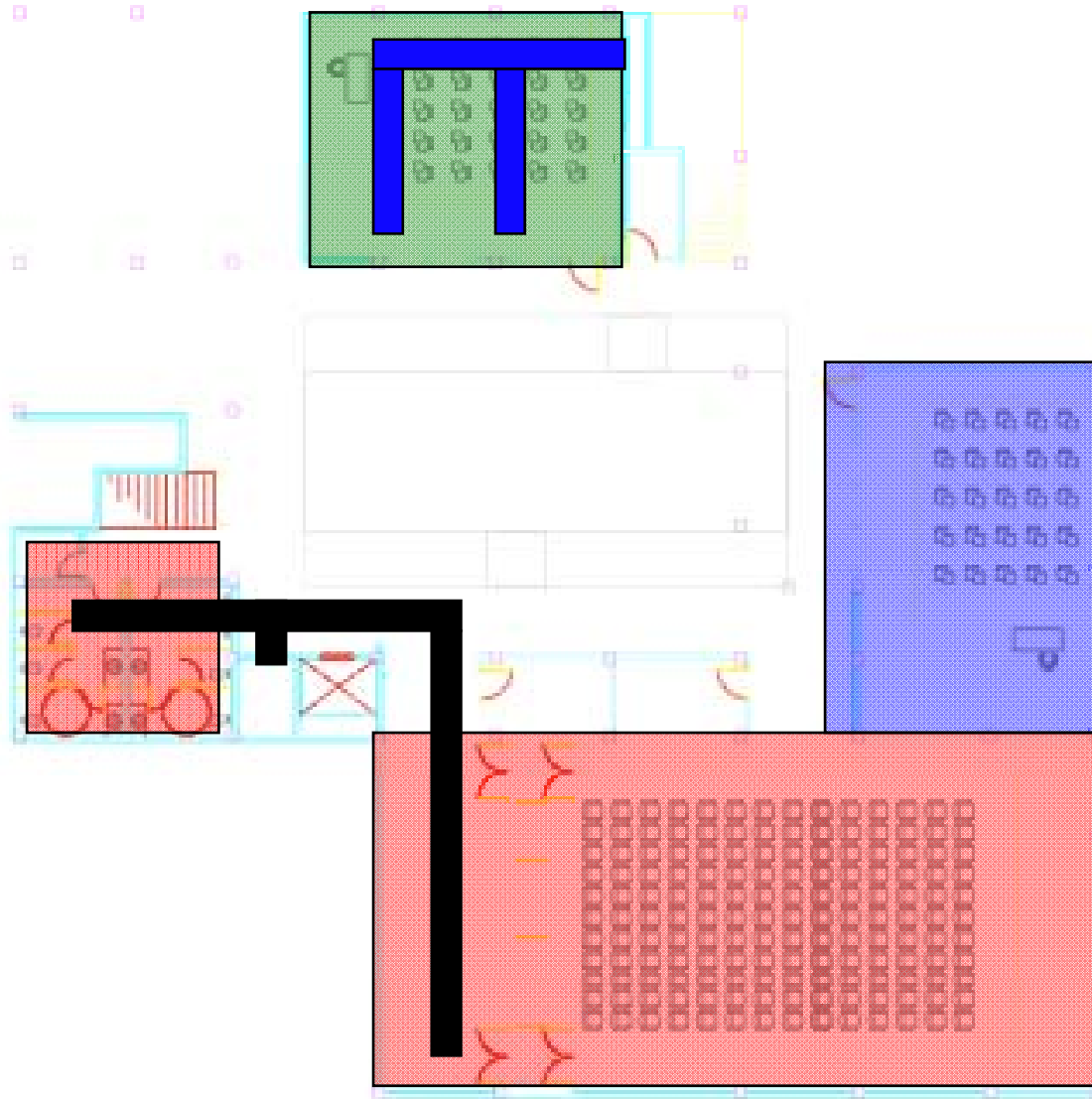
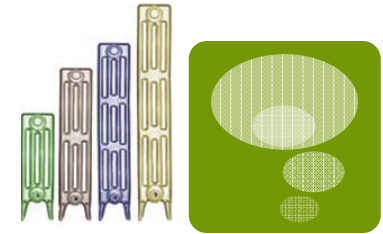


Raised Flooring for Third Floor



Natural Ventilation

First Floor



Forced Air

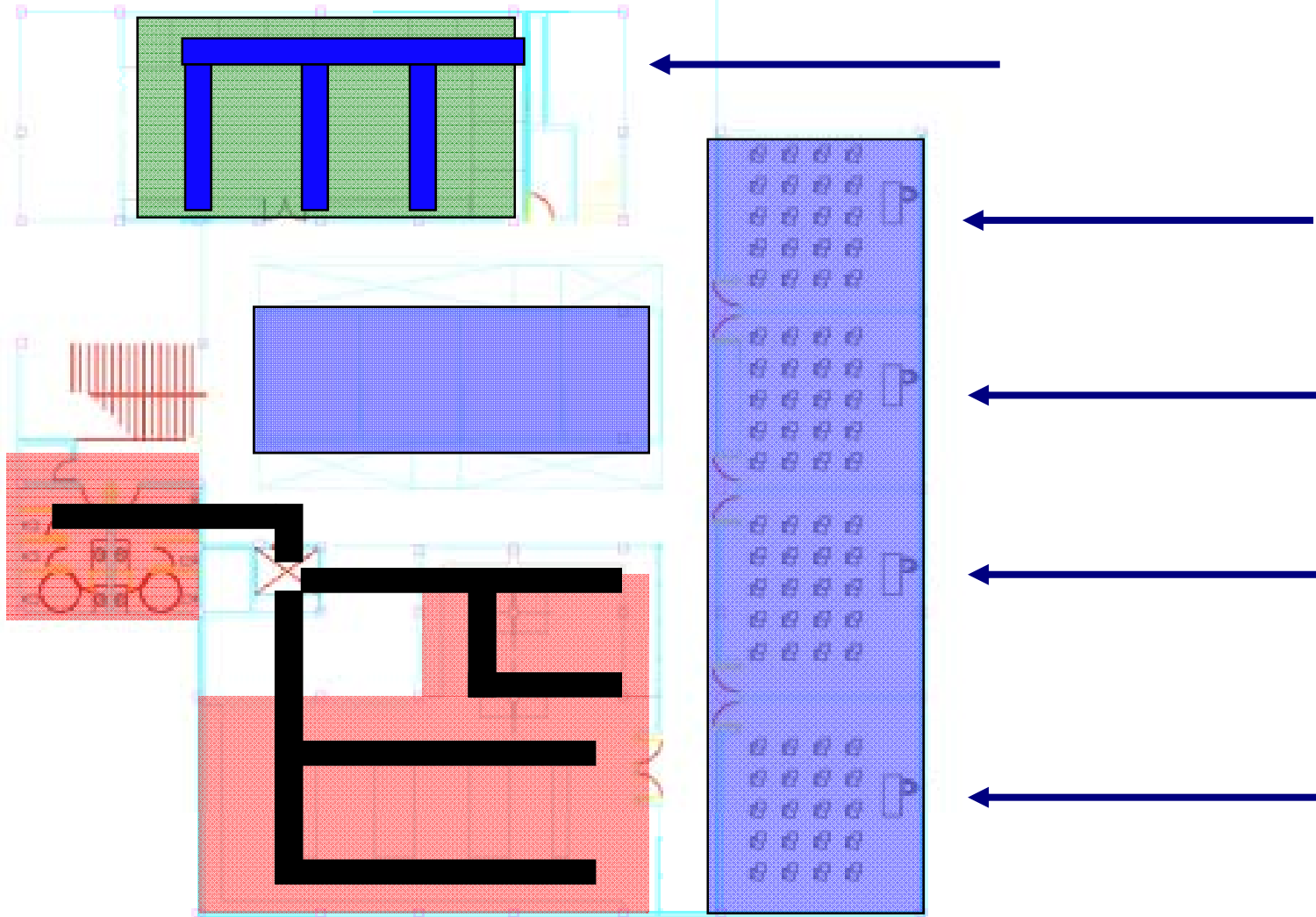
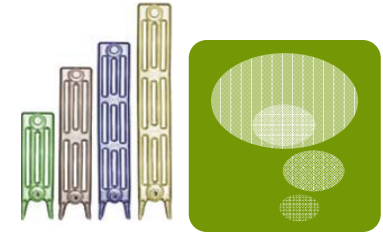
Passive

Natural

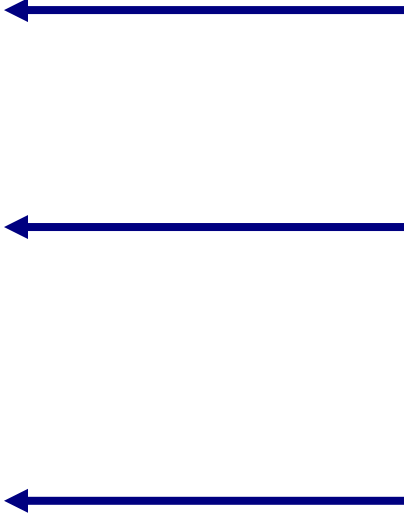
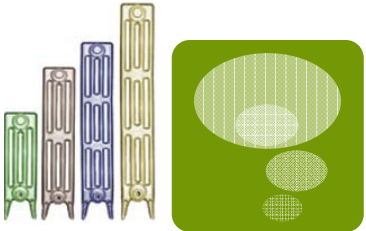
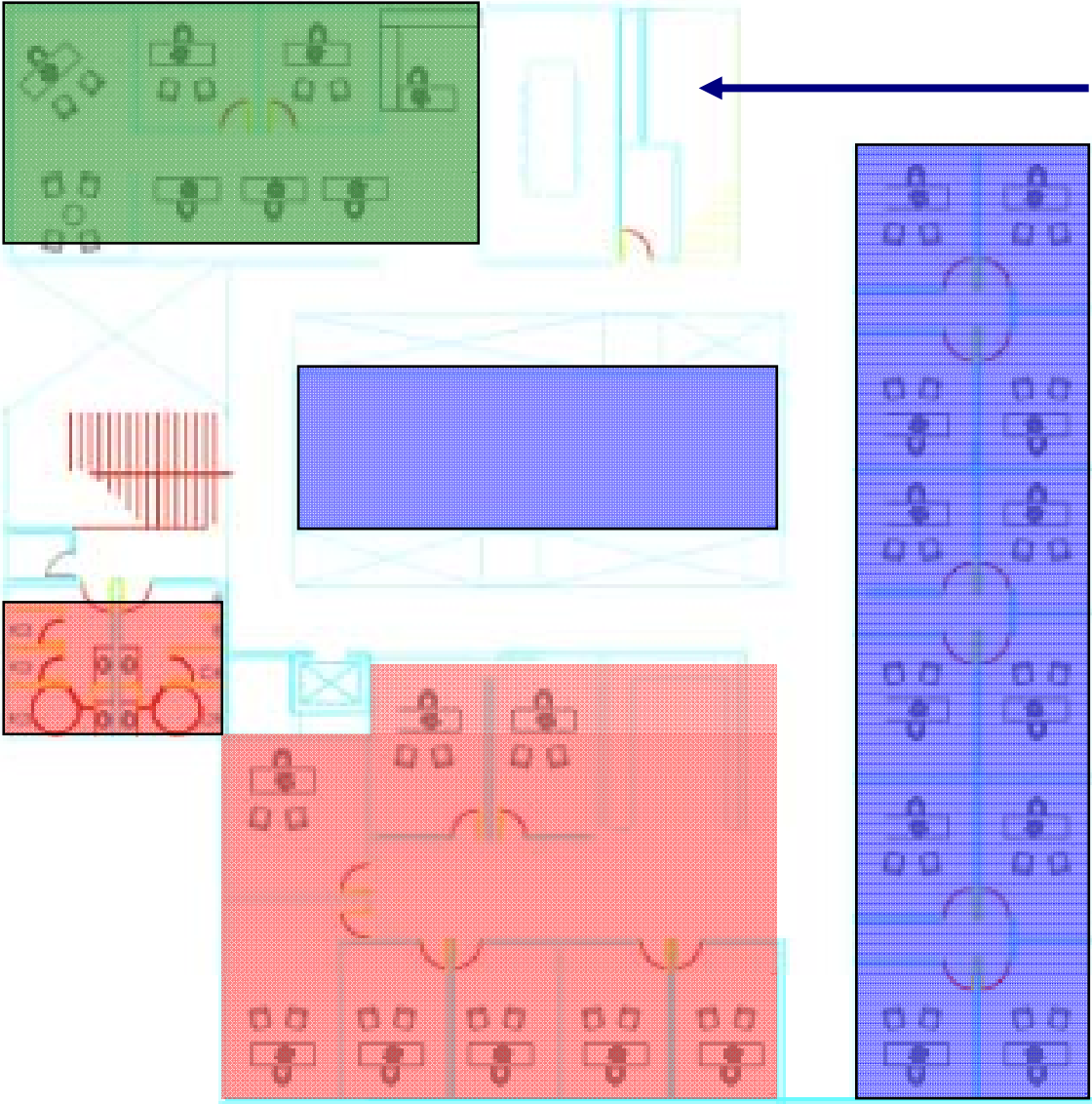
Forced Air
and Cooling

Cooling Coils

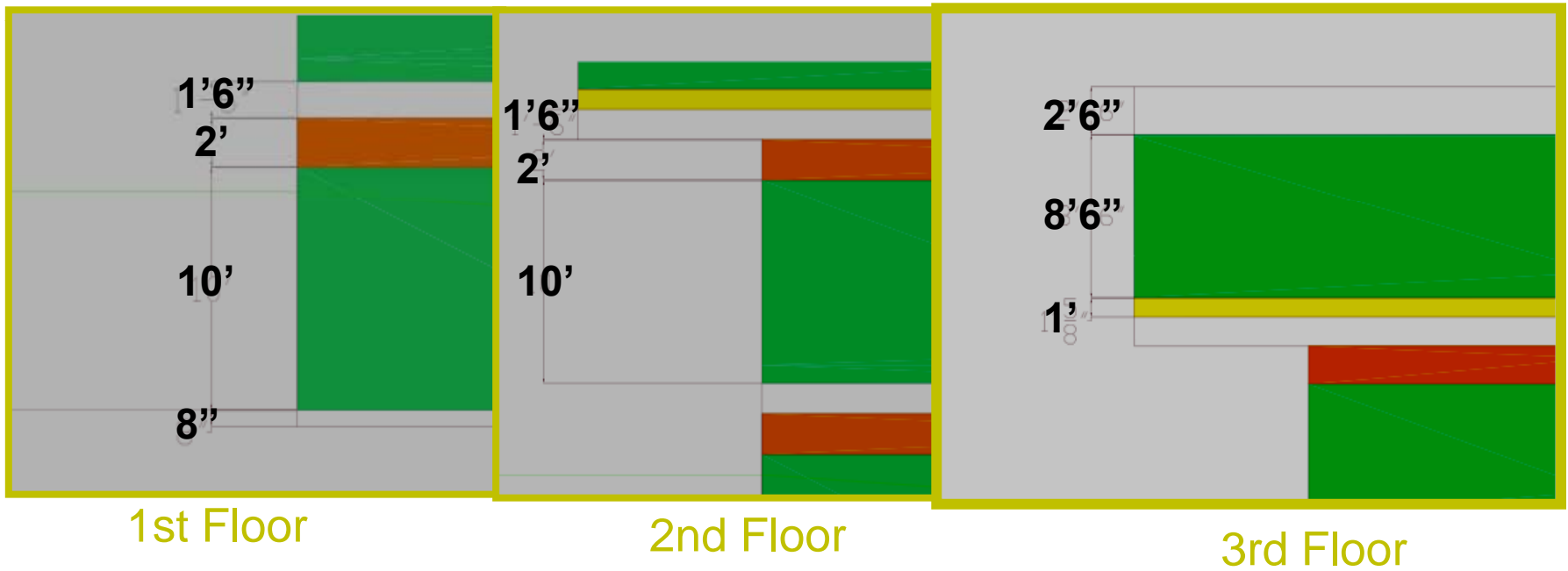
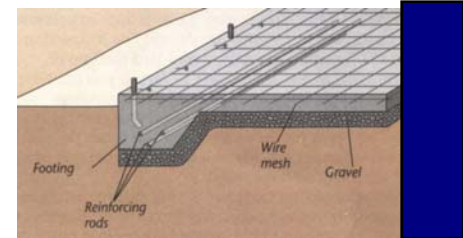
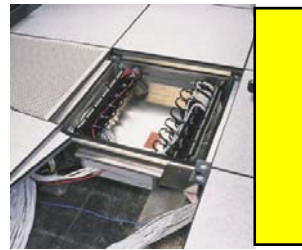
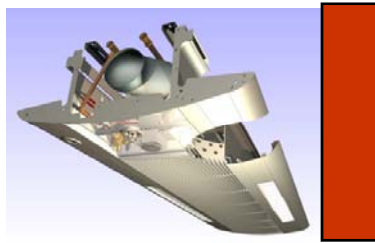
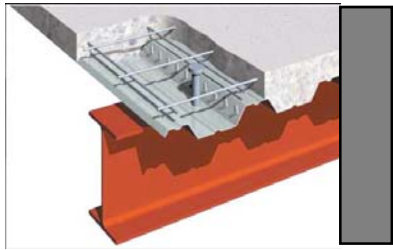
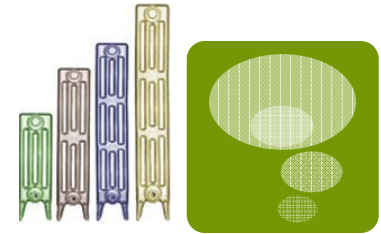
Second Floor



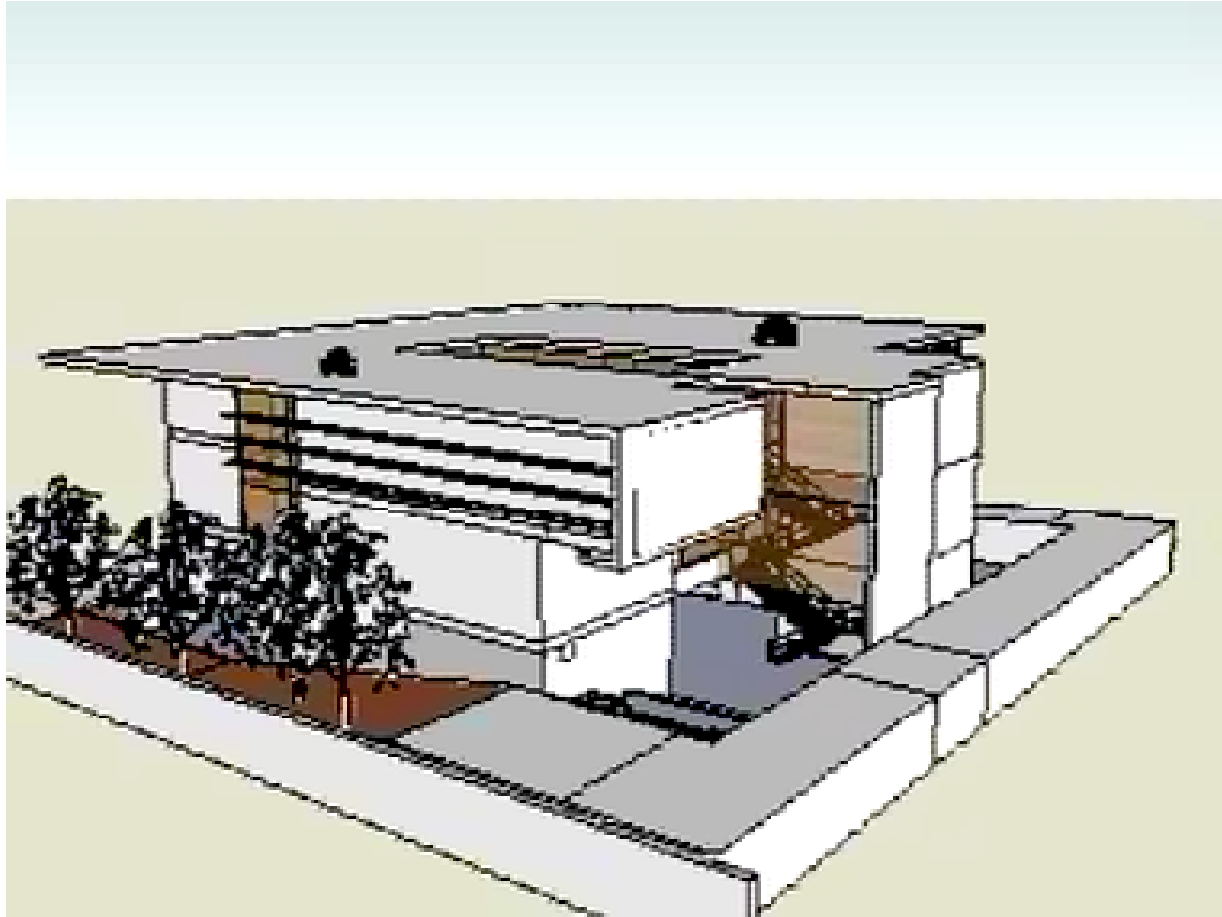
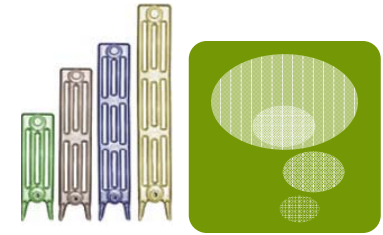
Third Floor



MEP/Structural Section



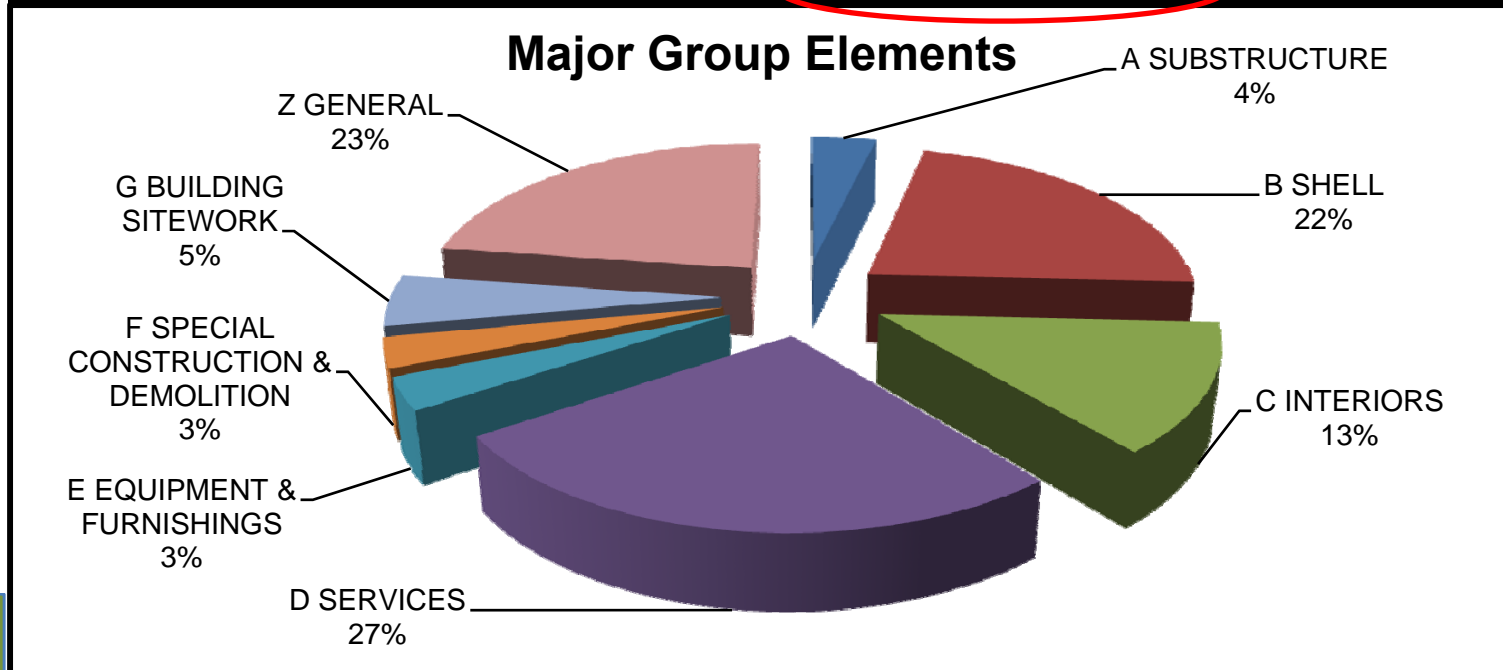
MEP 3D Model



Concrete Structure Estimate



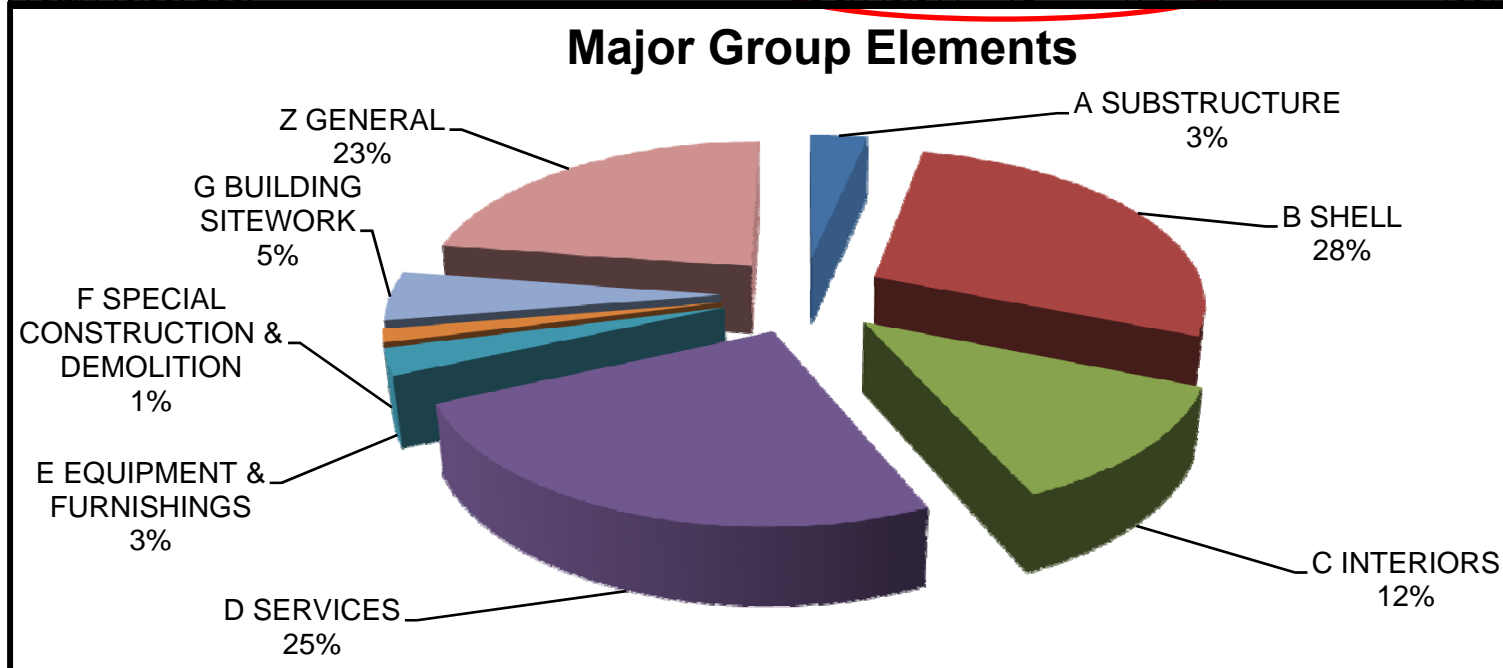
Major Group Element	Cost	Cost per SF	Percent of Total
A SUBSTRUCTURE	\$ 212,389	\$ 6	4%
B SHELL	\$ 1,269,547	\$ 36	22%
C INTERIORS	\$ 752,721	\$ 21	13%
D SERVICES	\$ 1,531,754	\$ 43	27%
E EQUIPMENT & FURNISHINGS	\$ 191,018	\$ 5	3%
F SPECIAL CONSTRUCTION & DEMOLITION	\$ 177,120	\$ 5	3%
G BUILDING SITEWORK	\$ 304,234	\$ 9	5%
JOB SUBTOTAL	\$ 4,438,783	\$ 125	77%
Z1010 Administration (Overhead and Profit, 15%)	\$ 665,817	\$ 19	12%
Z1050 Permit, insurance and bonds (2%)	\$ 190,130	\$ 5	3%
Z2010 Design Contingencies (5%)	\$ 221,939	\$ 6	4%
Z2030 Construction Contingencies (5%)	\$ 221,939	\$ 6	4%
Total Project Cost	\$ 5,738,609	\$ 162	100%



Steel Structure Estimate

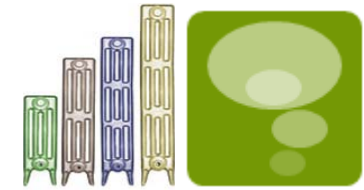


Major Group Element	Cost	Cost per SF	Percent of Total
A SUBSTRUCTURE	\$ 201,753	\$ 6	3%
B SHELL	\$ 1,715,713	\$ 48	28%
C INTERIORS	\$ 752,721	\$ 21	12%
D SERVICES	\$ 1,524,796	\$ 43	25%
E EQUIPMENT & FURNISHINGS	\$ 166,409	\$ 5	3%
F SPECIAL CONSTRUCTION & DEMOLITION	\$ 85,228	\$ 2	1%
G BUILDING SITEWORK	\$ 310,049	\$ 9	5%
JOB SUBTOTAL	\$ 4,756,669	\$ 134	77%
Z1010 Administration (Overhead and Profit, 15%)	\$ 713,500	\$ 20	12%
Z1050 Permit, insurance and bonds (2%)	\$ 198,077	\$ 6	3%
Z2010 Design Contingencies (5%)	\$ 237,833	\$ 7	4%
Z2030 Construction Contingencies (5%)	\$ 237,833	\$ 7	4%
Total Project Cost	\$ 6,143,914	\$ 174	100%



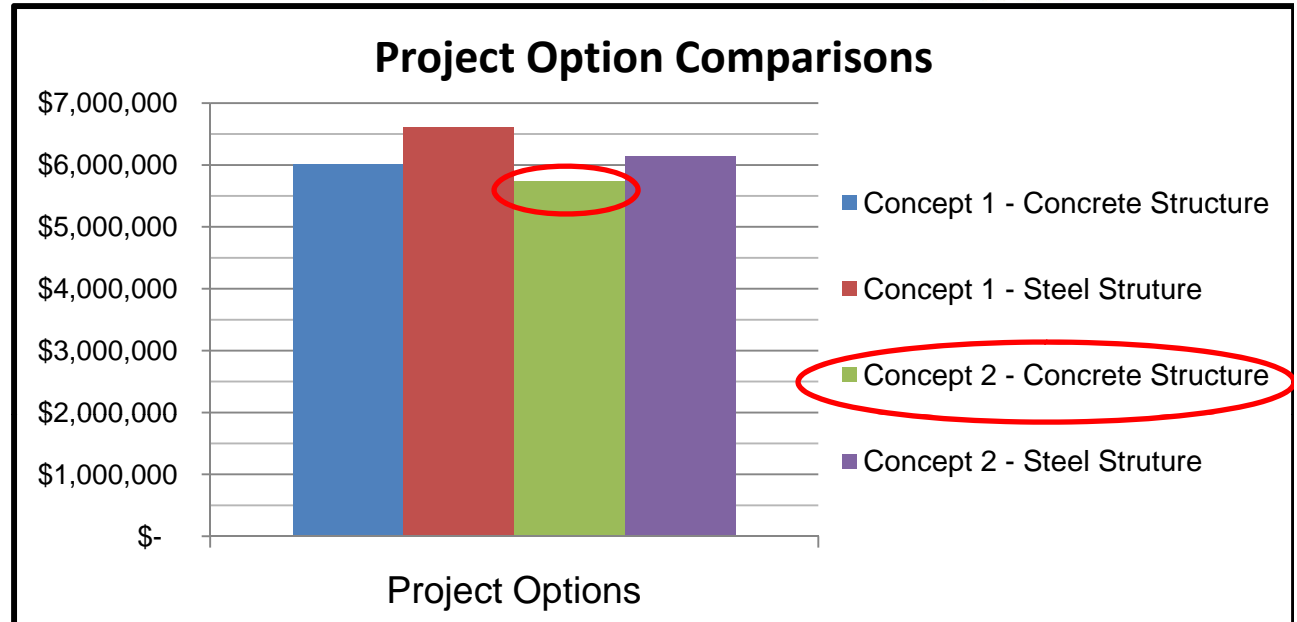
CM Estimate

- Project Option Comparisons



Project Cost Criteria:

- Steel building 16% below national average
- Concrete building 19% below national average
- Concept 2 cheaper than Concept 1



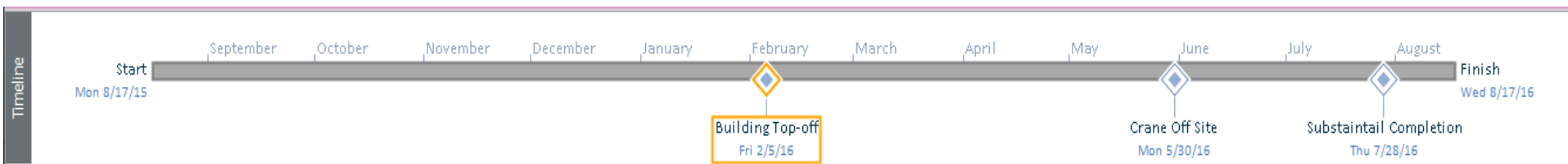
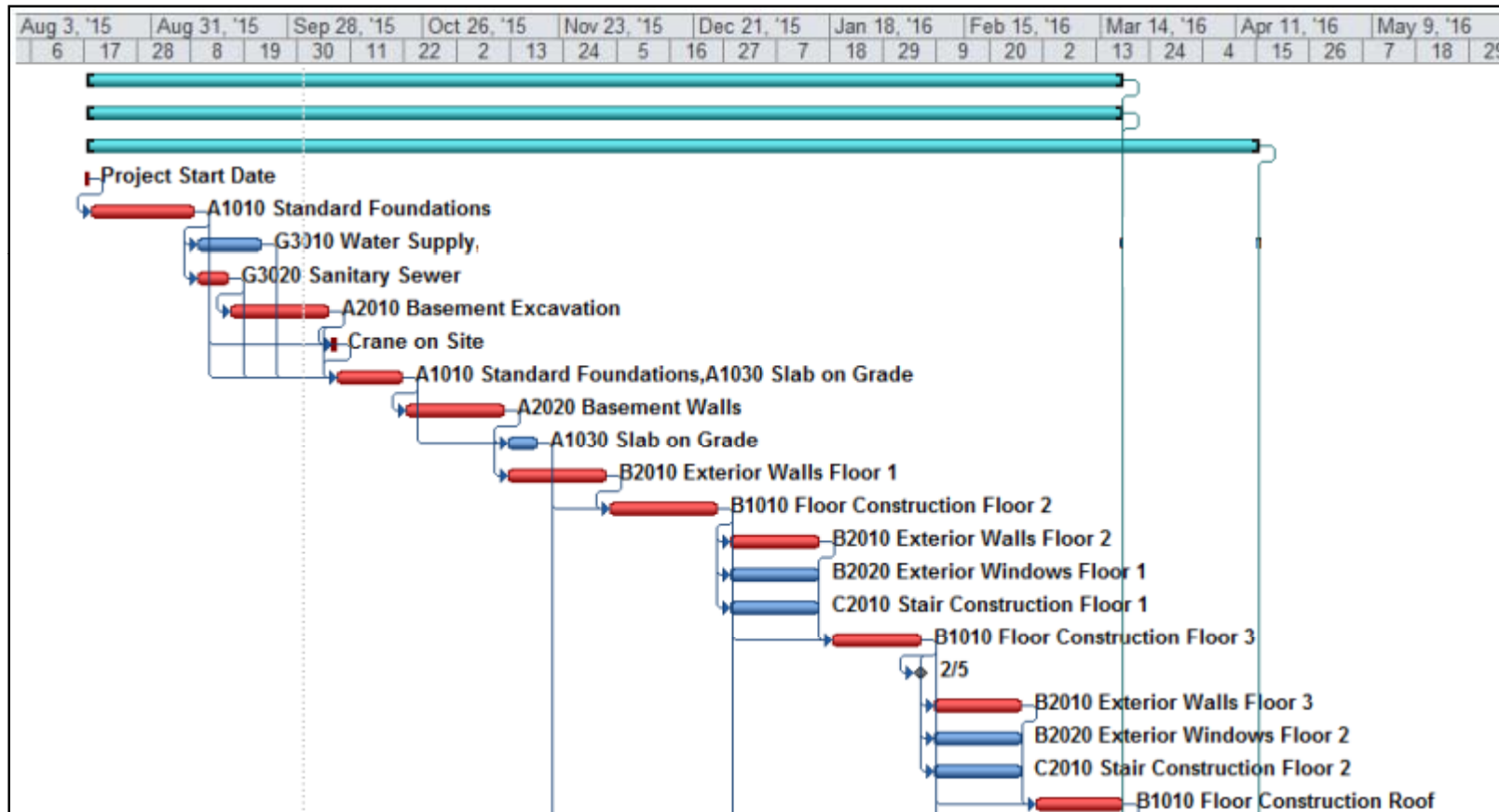
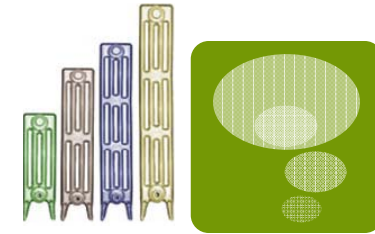
CM Estimate Progression:

- RS Means SF Estimator
 - \$4.95 million - \$138/SF
- Building SF Comparison
 - \$5.65 million - \$160/SF
- Assembly Estimates Average
 - \$6.13 million - \$173/SF

	Concept 1		Concept 2	
	Concrete	Steel	Concrete	Steel
A SUBSTRUCTURE	\$ 196,370	\$ 233,139	\$ 212,389	\$ 201,753
B SHELL	\$ 1,605,833	\$ 2,033,162	\$ 1,269,547	\$ 1,715,713
C INTERIORS	\$ 518,784	\$ 518,784	\$ 752,721	\$ 752,721
D SERVICES	\$ 1,663,606	\$ 1,663,606	\$ 1,531,754	\$ 1,524,796
E EQUIPMENT & FURNISHINGS	\$ 191,018	\$ 191,018	\$ 191,018	\$ 166,409
F SPECIAL CONSTRUCTION & DEMOLITION	\$ 177,120	\$ 177,120	\$ 177,120	\$ 85,228
G BUILDING SITEWORK	\$ 304,234	\$ 304,234	\$ 304,234	\$ 310,049
JOB SUBTOTAL	\$ 4,656,965	\$ 5,121,063	\$ 4,438,783	\$ 4,756,669
Z1010 Administration (Overhead and Profit, 15%)	\$ 698,545	\$ 768,159	\$ 665,817	\$ 713,500
Z1050 Permit, insurance and bonds (2%)	\$ 195,584	\$ 207,187	\$ 190,130	\$ 198,077
Z2010 Design Contingencies (5%)	\$ 232,848	\$ 256,053	\$ 221,939	\$ 237,833
Z2030 Construction Contingencies (5%)	\$ 232,848	\$ 256,053	\$ 221,939	\$ 237,833
Total Project Cost	\$ 6,016,791	\$ 6,608,516	\$ 5,738,609	\$ 6,143,914
Cost Per Square Foot	\$ 169.97	\$ 186.68	\$ 162.11	\$ 173.56

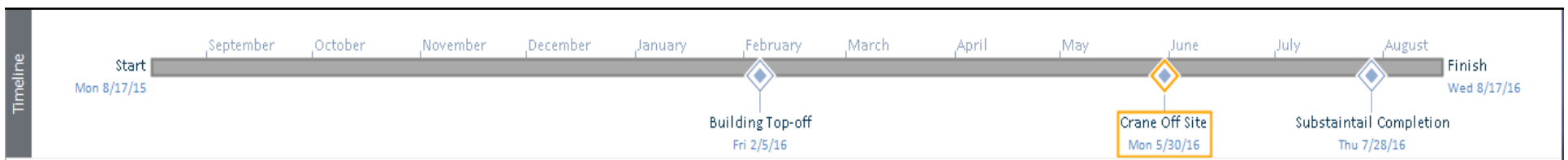
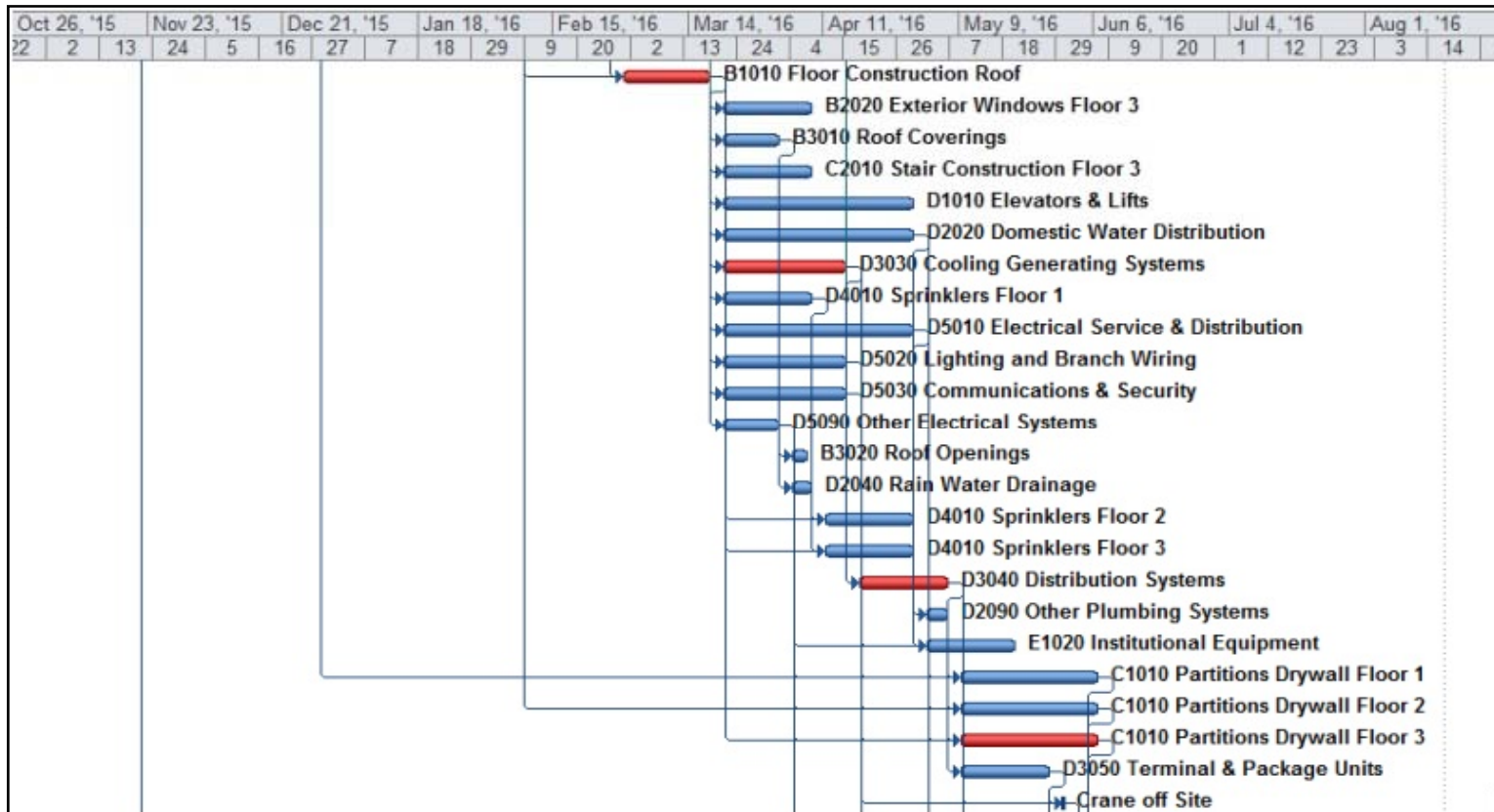
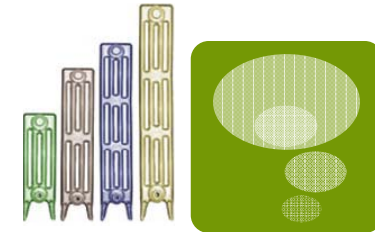
Project Schedule – Milestone 1

- **Start Date: August 17, 2015**
- **Crane On Site: October 7, 2015**
- **Milestone I (topping off): February 5, 2016**



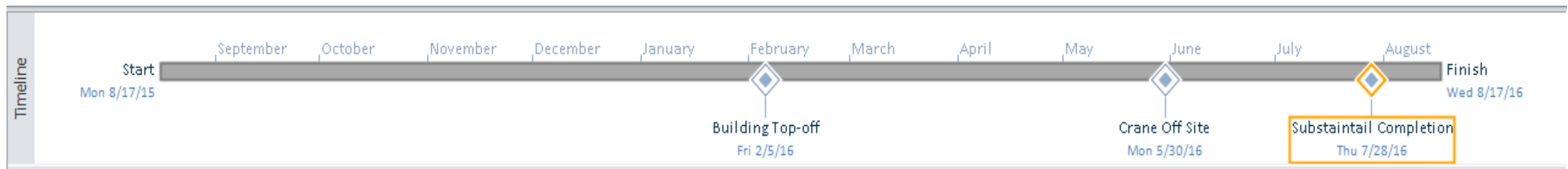
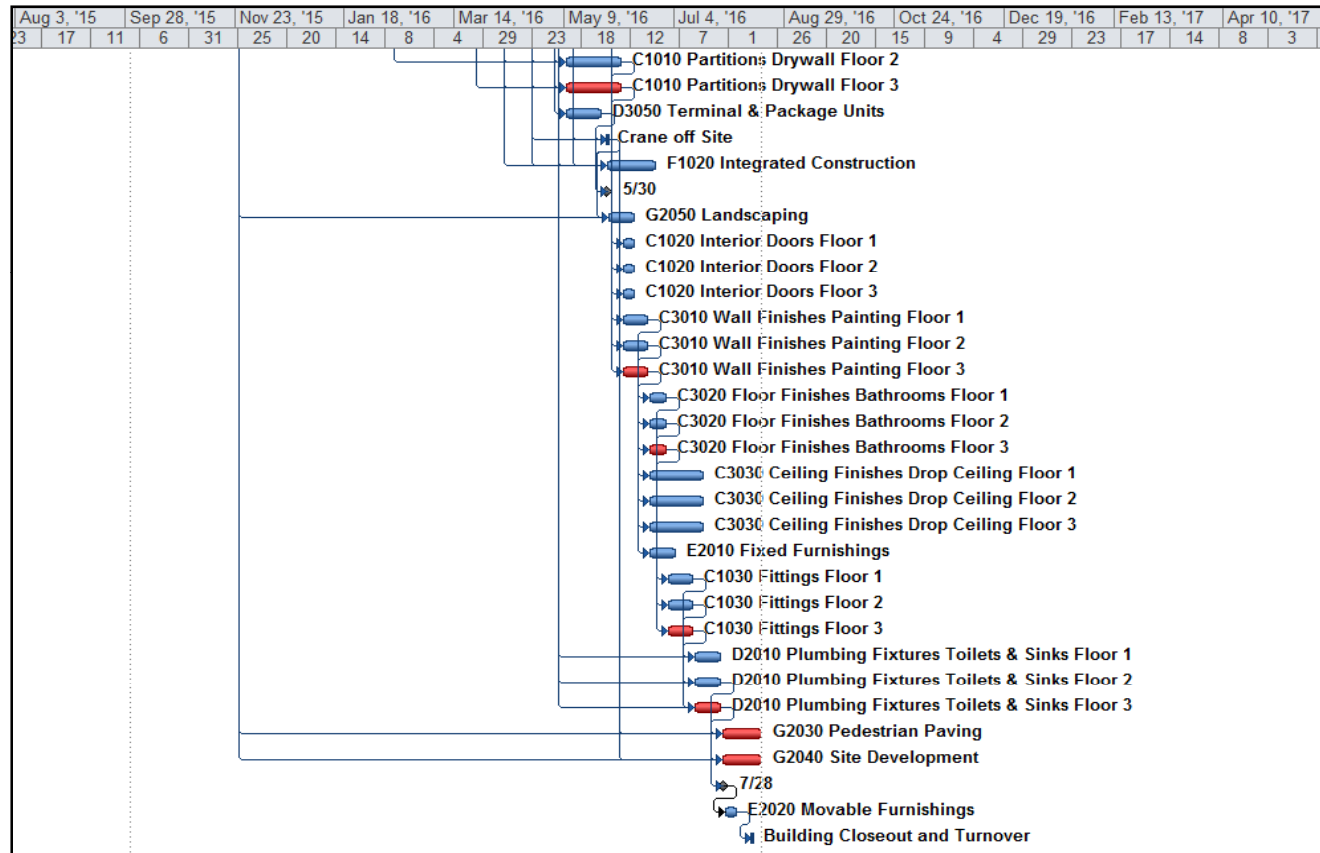
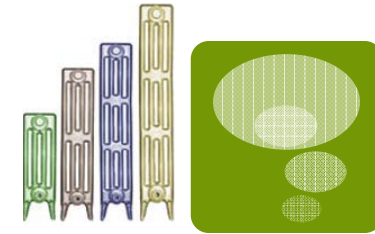
Project Schedule – Milestone 2

- Electrical Systems Finish: April 29, 2016
- Plumbing and Fire System Piping Finish: May 6, 2016
- Final Heavy Equipment Placement: May 27, 2016
- Milestone II (crane off site): May 30, 2016

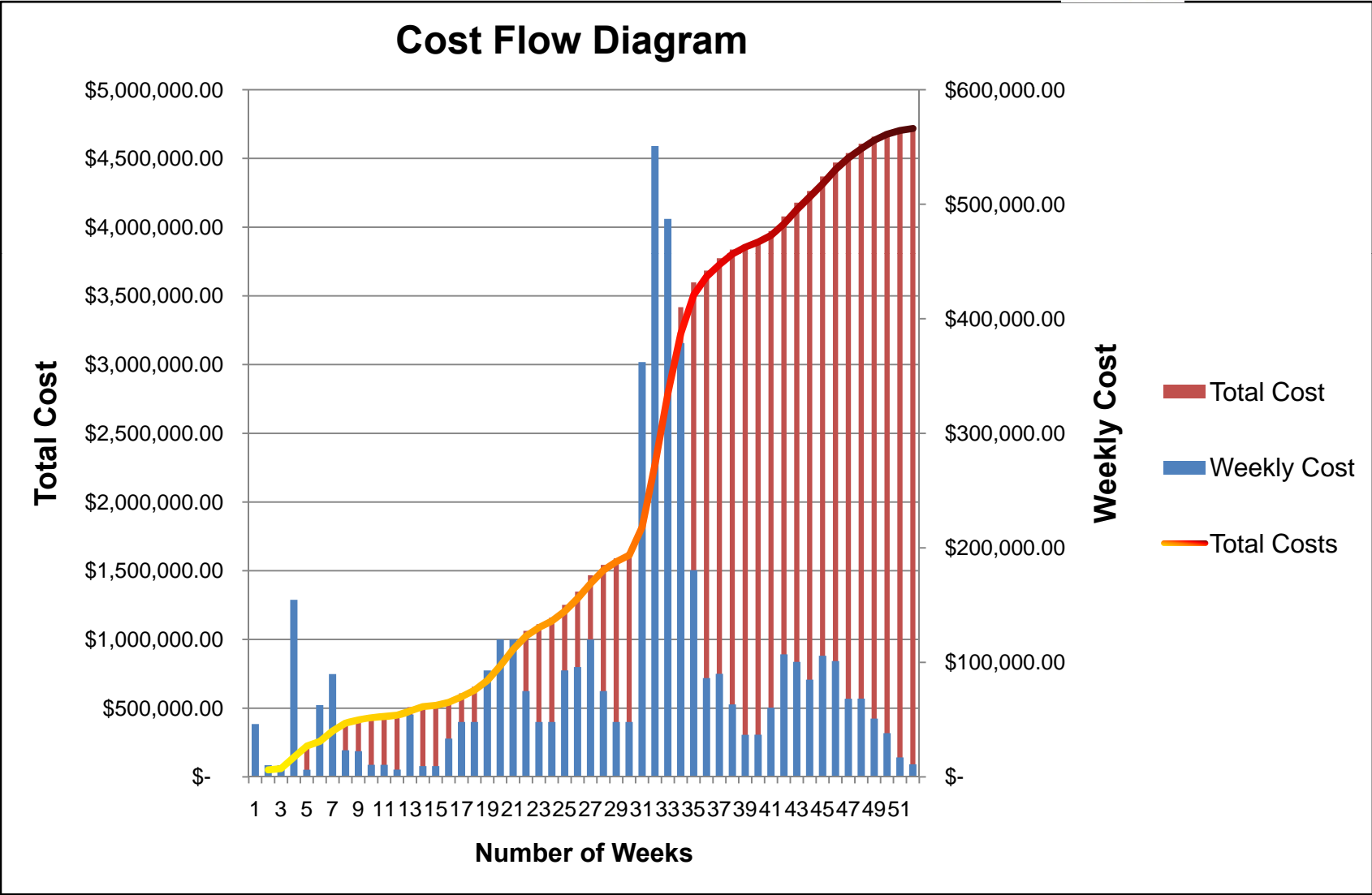
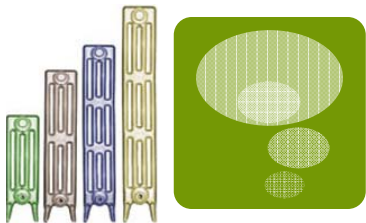


Project Schedule – Milestone 3

- Interior Finishes Completion: July 14, 2016
- Milestone III (Substantial Completion): July 28, 2016
- Side Development Completion: August 3, 2016
- Building Closeout and Turnover: August 12, 2016

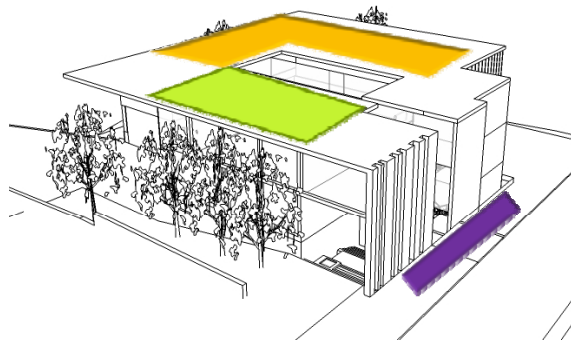
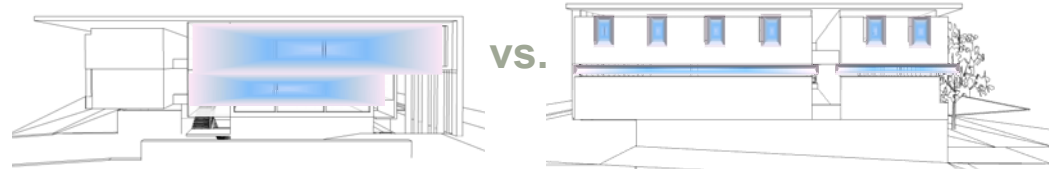
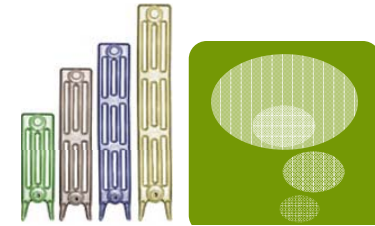


Cost Flow



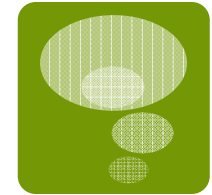
Sustainable Performance

- Passive Design Strategies (orientation study, climate responsive façade design)
- Natural Ventilation
- Green Roof
- Energy Harvesting System on roof (sunpower pv panels → use of “State Sun Energy Program”)
- Open interaction Courtyard
- Bicycle pkg.
- High efficiency windows and glass



<u>Circulation area</u> net foot area		0.256
<u>Building volume</u> gross floor area	3.0	3.7
<u>Surface area</u> building volume	<0.25	0.16
<u>Net floor area</u> gross floor area	>0.60	0.92

Sustainable Performance LEED Certification

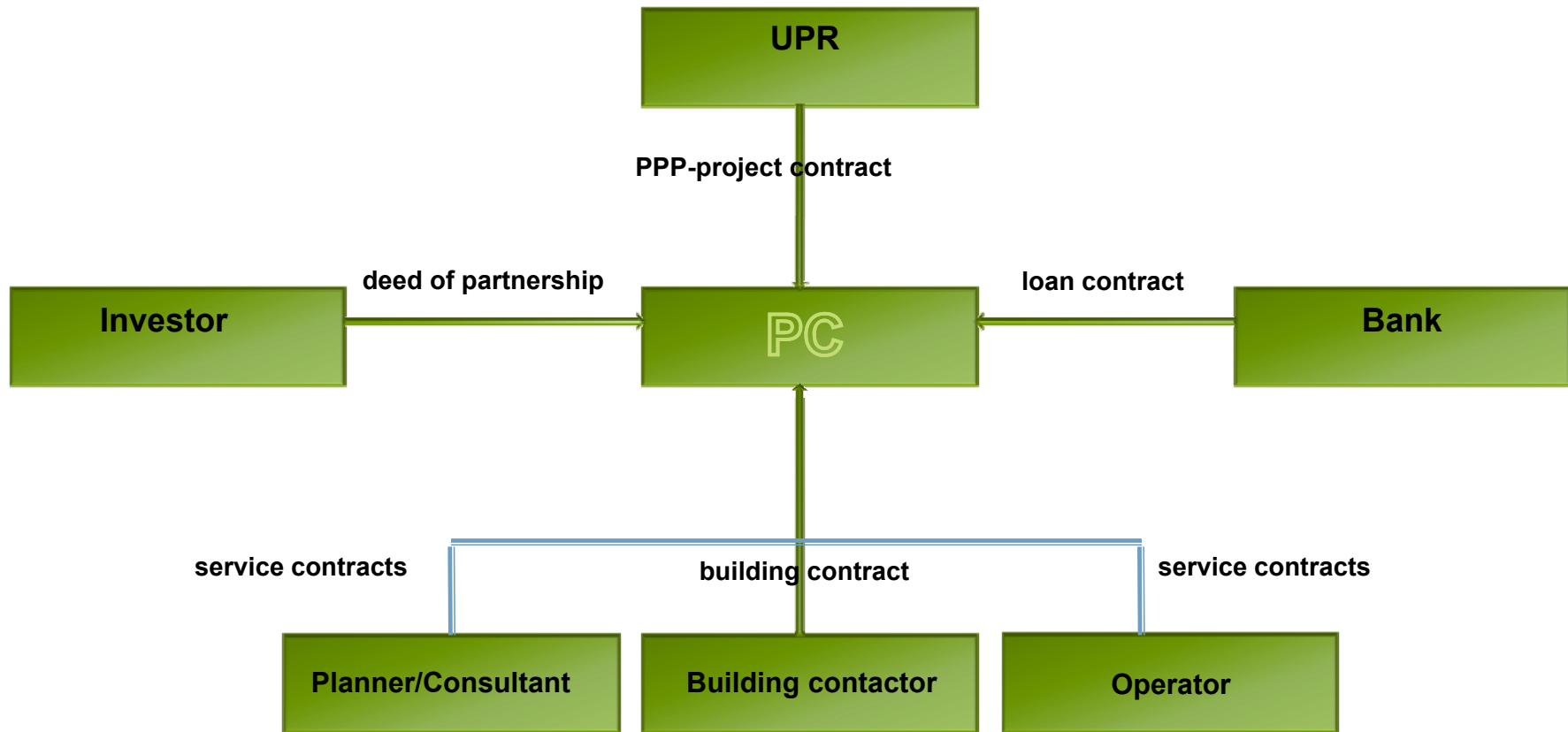
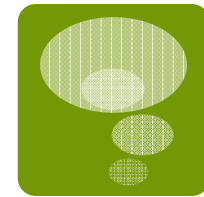


MINIMUM SILVER LEED CERTIFICATION (50 points or above)

1.Sustainable Sites	→	12
2.Water Efficiency	→	4
3.Energy and Atmosphere	→	23
4.Materials and Resources	→	5
5.Indoor Enviromental Quality	→	10
6.Innovation in Design	→	3
7.Regional Priority	→	3

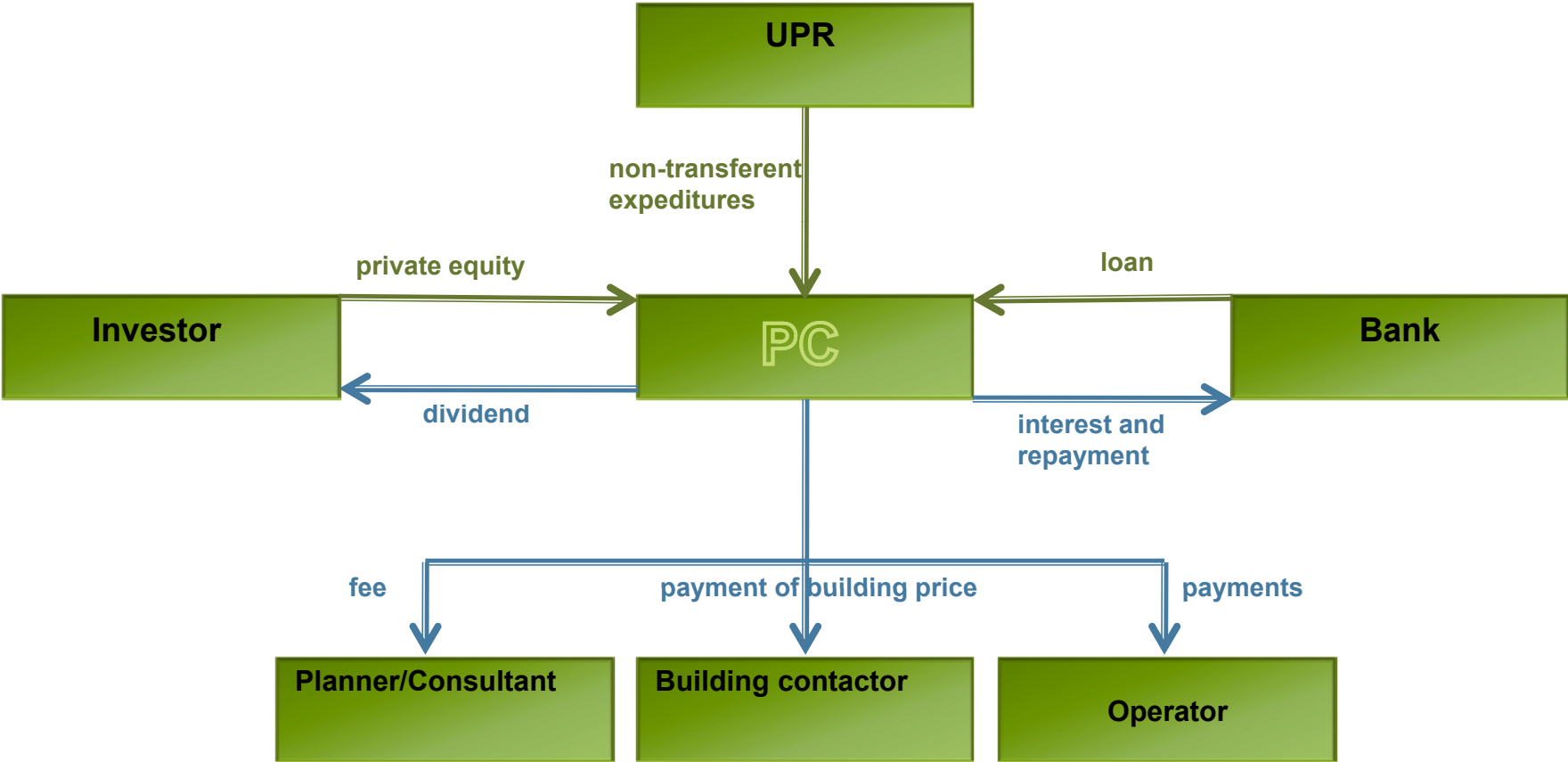


Finance Model - PPP (contractual relationships)



LifeCycle

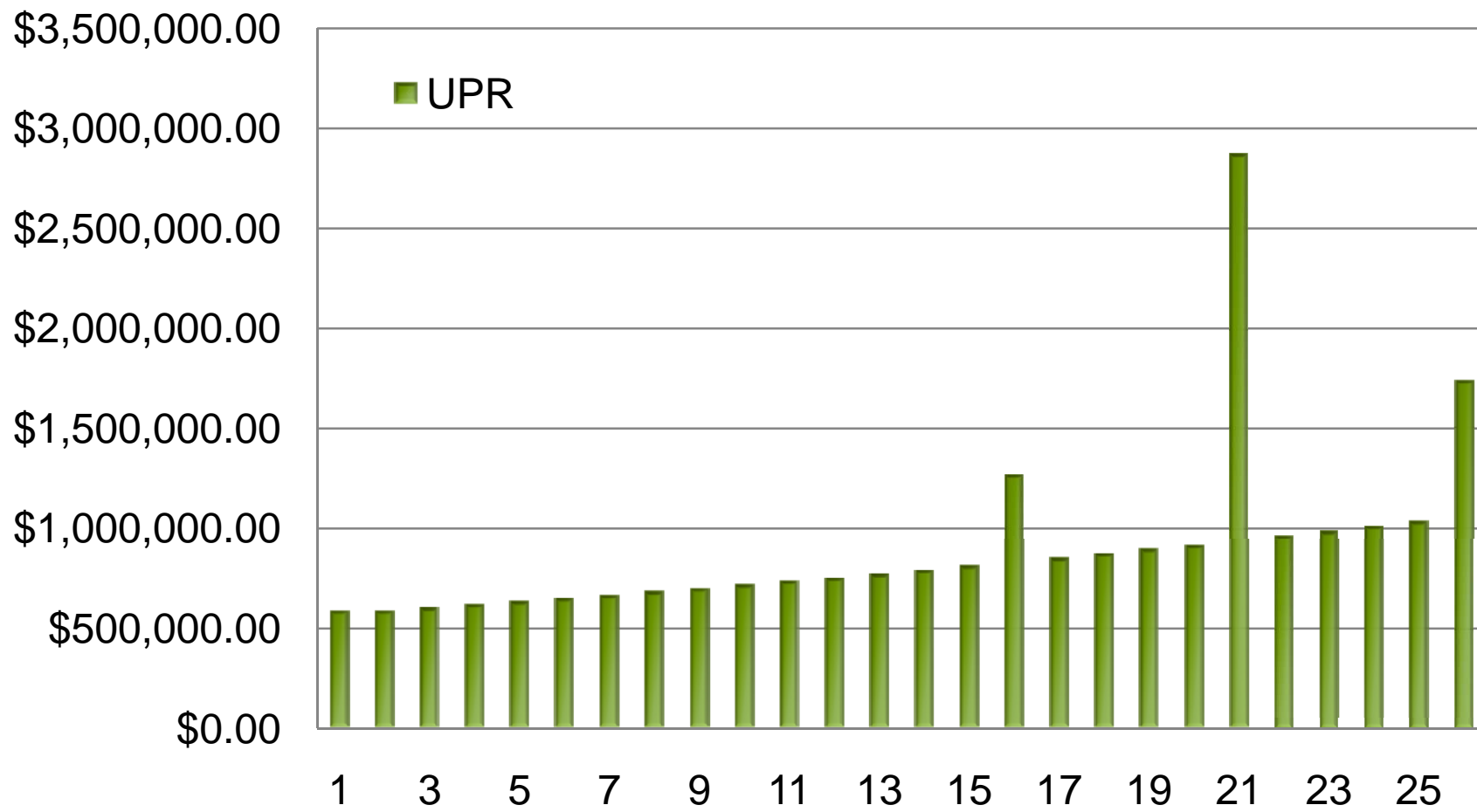
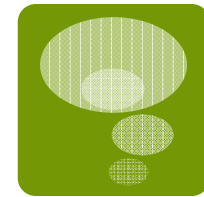
Finance Model - PPP (payments flow)



Risk



O&M Cost Estimate



Five Goals



sustainability/ building performance

- strength of concept
- use of natural resources
- interior/exterior connection
- energy efficiency
- efficient use of space on site



enhance user experience/value

- user experience
- circulation
- program relationships
- surrounding context



flexibility/adaptability

- flexibility
- modularity



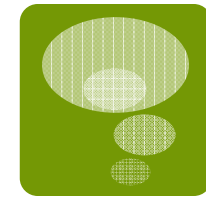
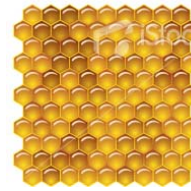
cost/construction efficiency

- initial cost
- short schedule
- local building method
- maintenance & operation cost
- floor space efficiency
- constructability
- space requirements



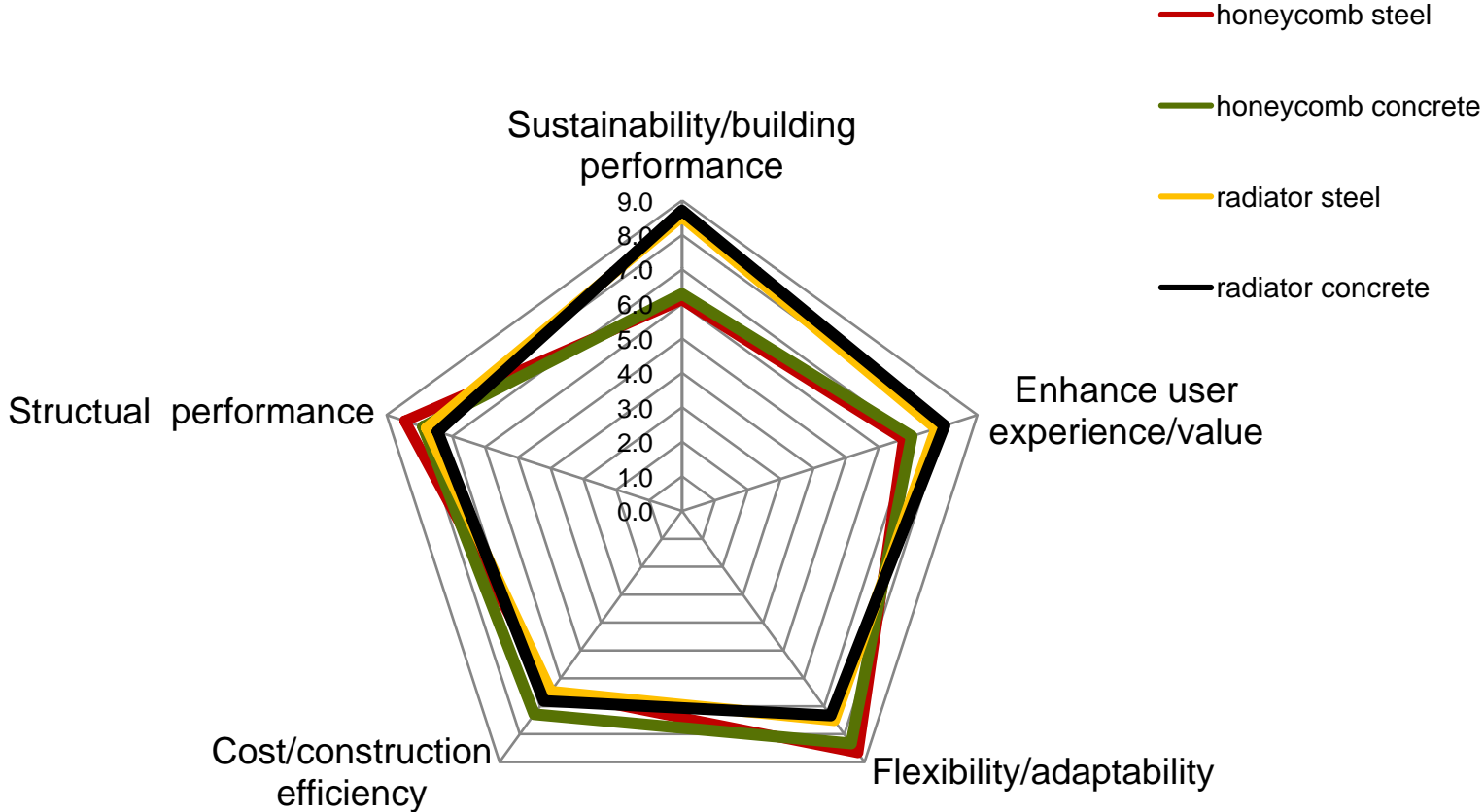
Structural performance

- Clear load path
- Seismic performance
- Hurricane performance



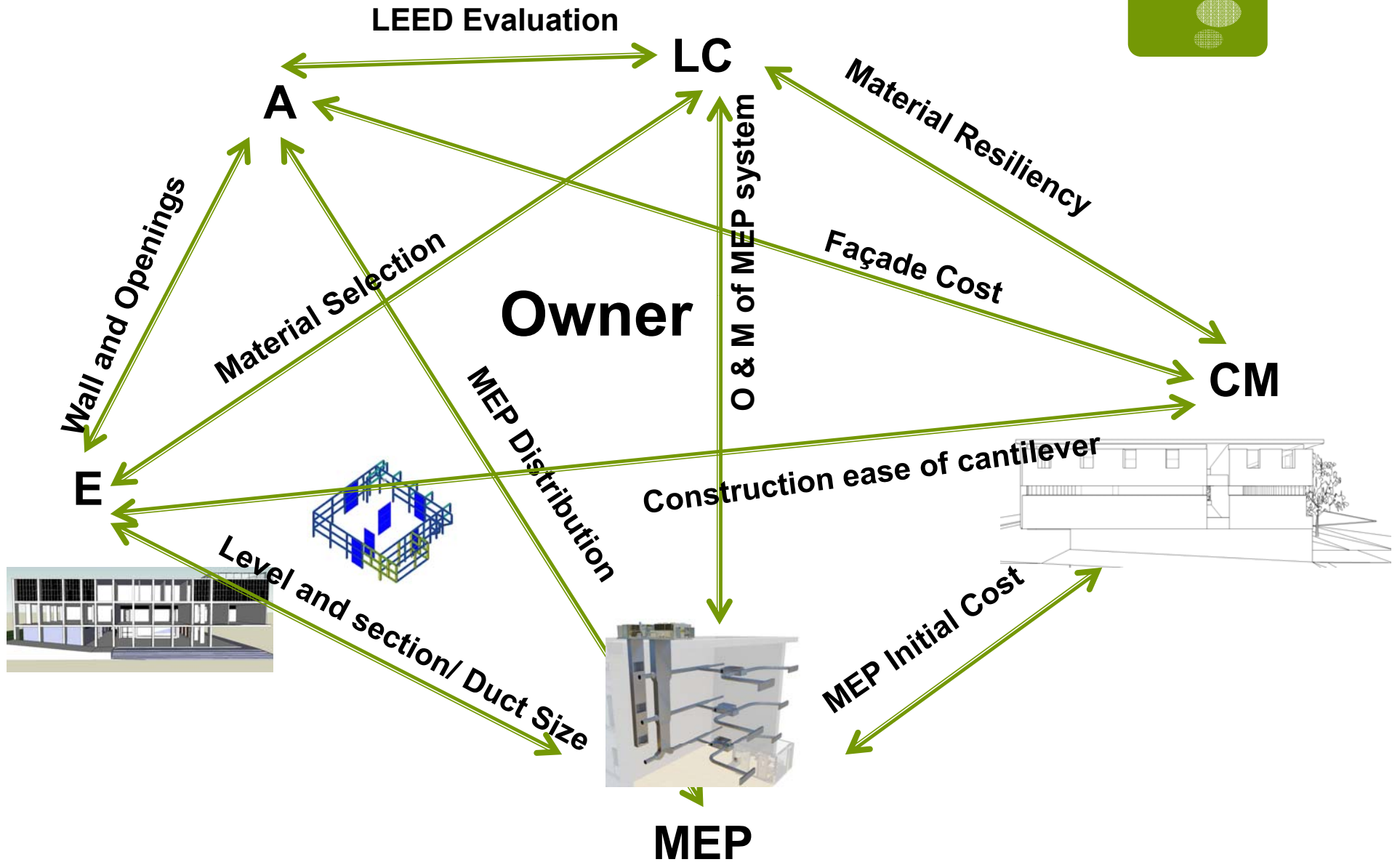
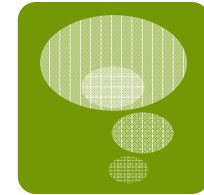
	steel	concrete	steel	concrete
	6.1	6.3	8.5	8.7
	6.8	7.0	7.8	8.0
	8.7	8.3	7.5	7.3
	6.5	7.3	6.5	6.8
	8.4	7.9	7.8	7.4

Decision Matrix

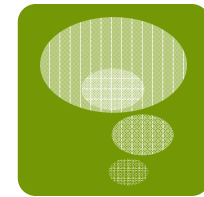


CHOICE: RADIATOR
CONCRETE STRUCTURE

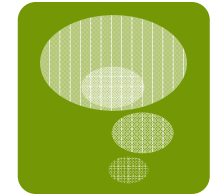
Integrated Project Delivery



Communication



A E MEP C LC



What Works

- Notification Wave to alert when and where new uploads are located
- Good communication and accessibility
- High responsiveness
- Addressing the concerns of other disciplines
- Talk about things other than work!!!

How to Improve

- More Documentation of our process and our actions to address the IPD Challenge
- Keep track of deadlines so there is workflow back up

A

E

MEP

C

LC

Thank You!

