



# ISLAND team

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A



E



MEP



C



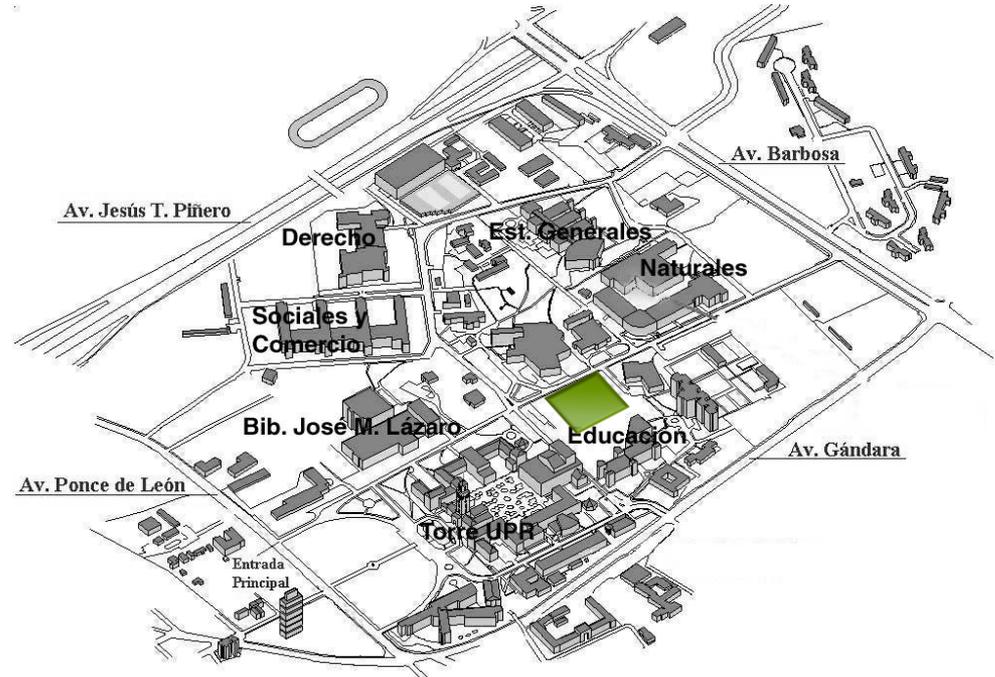
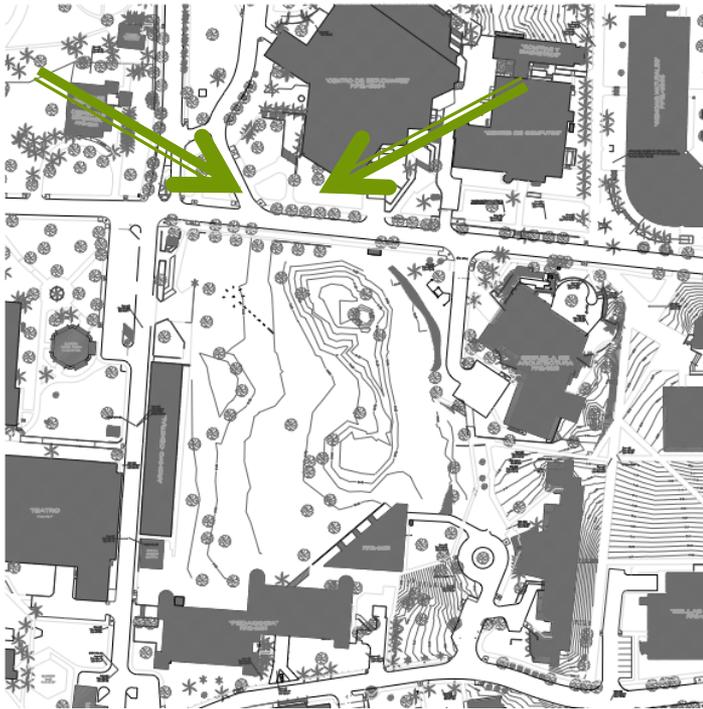
LC



# Project Site



# Project Site



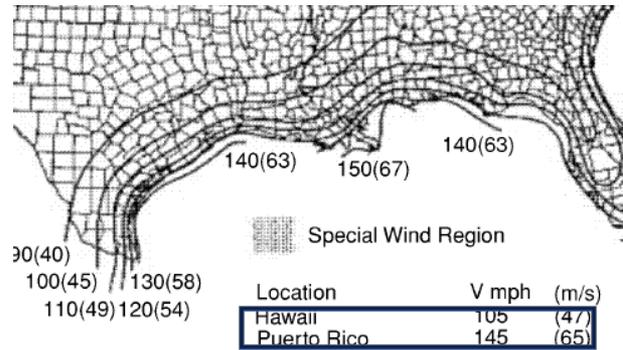
- Existing slope: 1:12 (aprox.)
- High traffic pedestrian corner
- Lush vegetation
- Vast green lawn



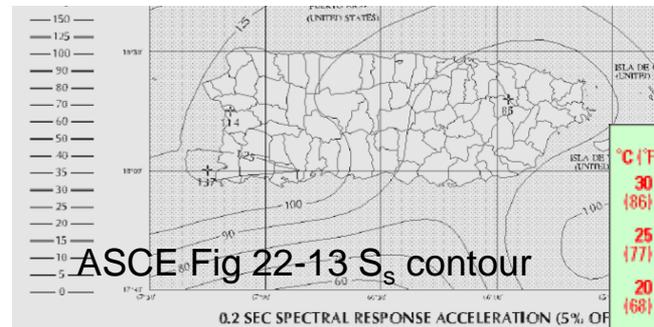
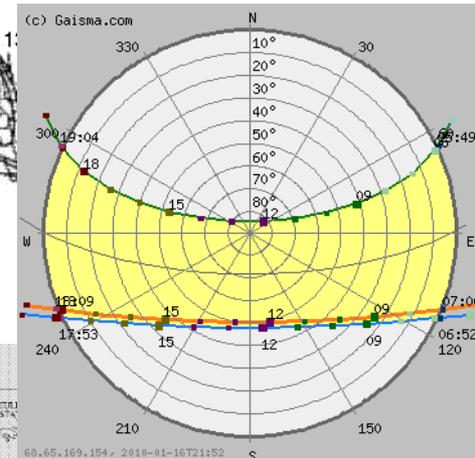
# Site Conditions



- 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

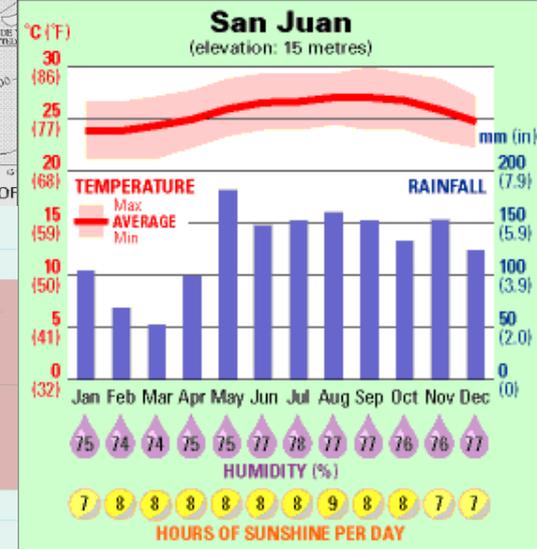


ASCE Fig 6.1 Basic Wind Speed



ASCE Fig 22-13 S<sub>s</sub> contour

Tropical Climate Zone



# Five Goals



## sustainability/ building performance

- strenght of concept
- use of natural ressources
- 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



## Structual performance

- Clear load path
- Seismic performance
- Hurricane performance

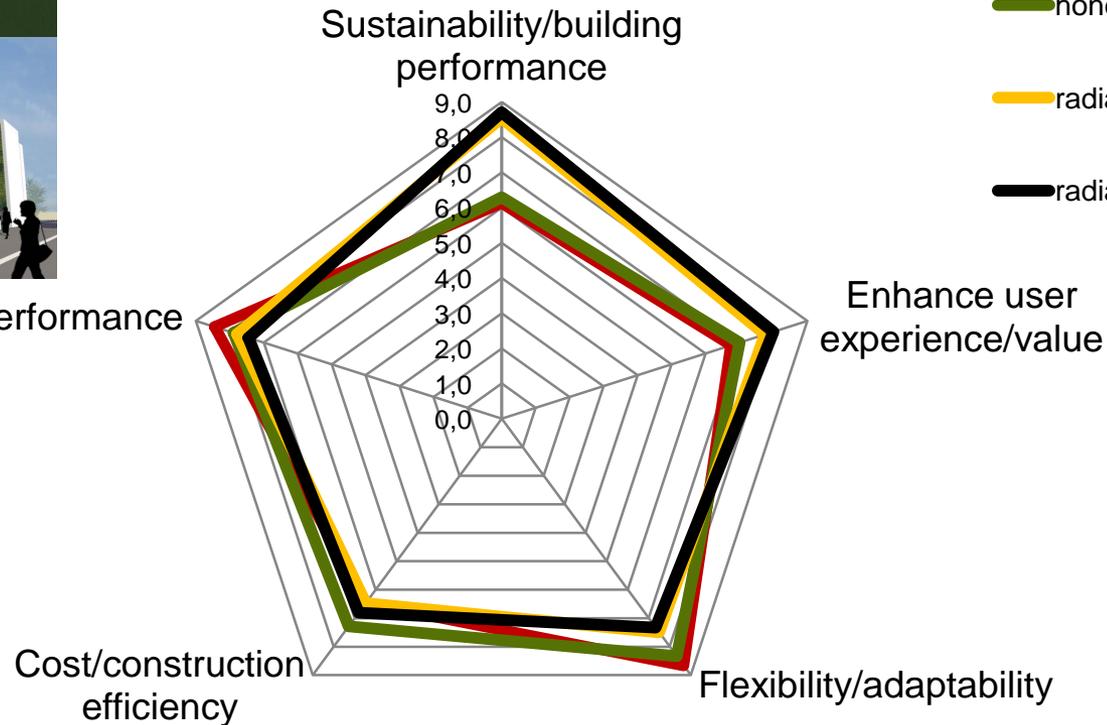
| honeycomb |          | radiator |          |
|-----------|----------|----------|----------|
| steel     | concrete | steel    | concrete |
| 6.1       | 6.3      | 8.5      | 8.7      |
| 6.8       | 7.0      | 7.8      | 8.0      |
| 8.7       | 8.3      | 7.5      | 7.3      |
| 6.5       | 7.3 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

# Decision Matrix



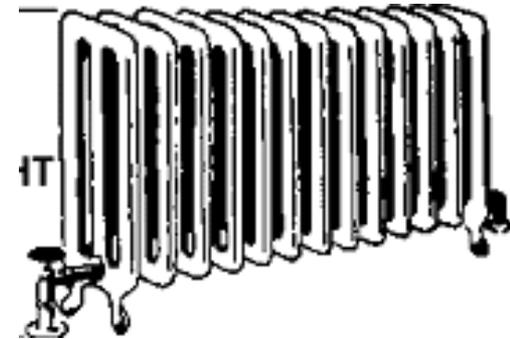
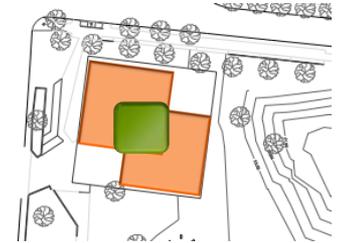
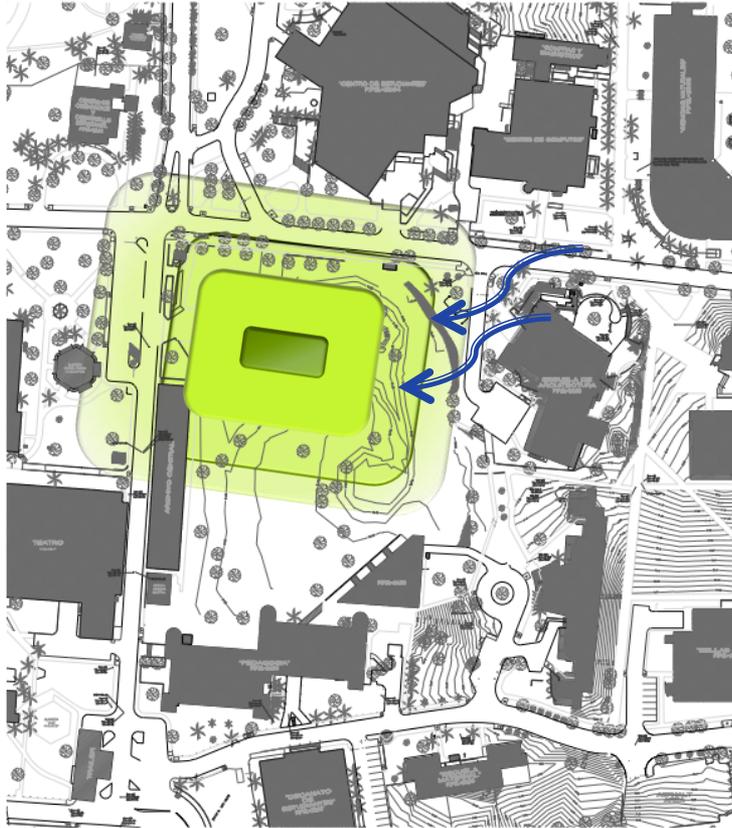
Structural performance

- honeycomb steel
- honeycomb concrete
- radiator steel
- radiator concrete



**CHOICE: RADIATOR**  
**CONCRETE STRUCTURE**

# Radiator Concept



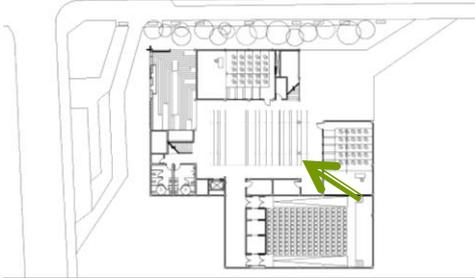
Create an interaction hub in campus and within itself



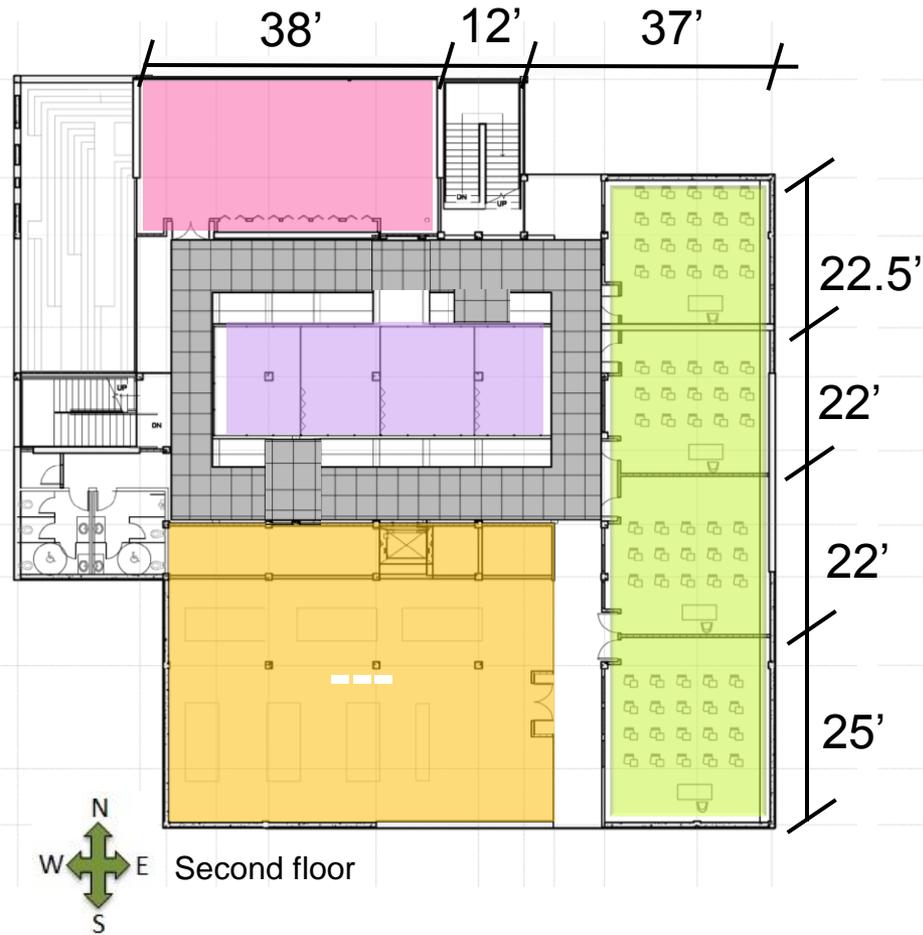
# Floor Plans



# Engineering Plaza

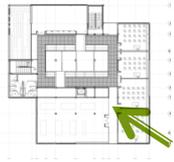


# Floor plans

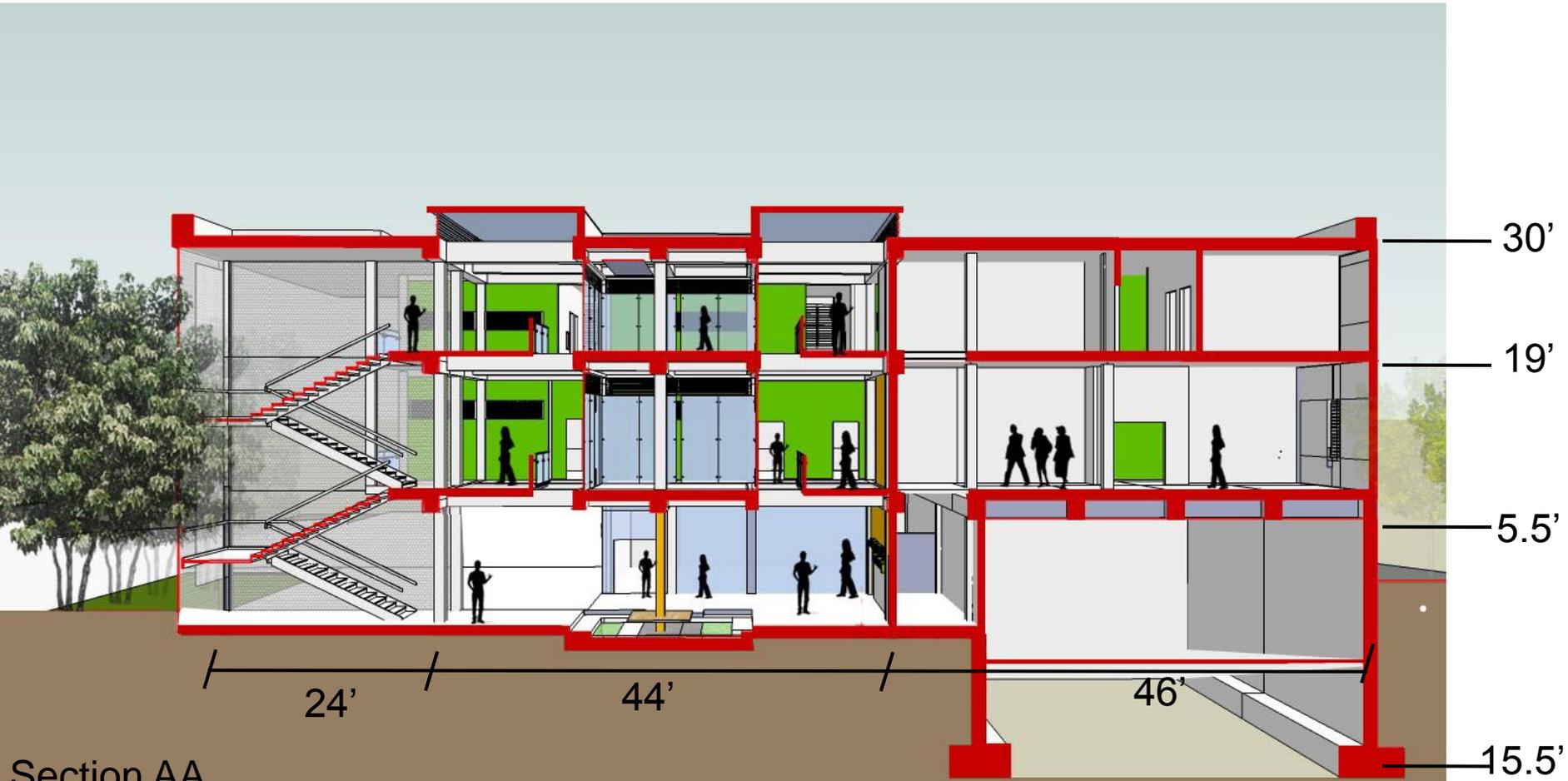
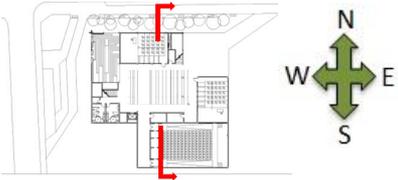


- |  |             |   |                |   |                         |
|--|-------------|---|----------------|---|-------------------------|
|  | Entrance    |  | Seminars       |  | Faculty offices         |
|  | Large Class |  | Laboratories   |    | Server rm.              |
|  | Auditorium  |  |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

# Education Island



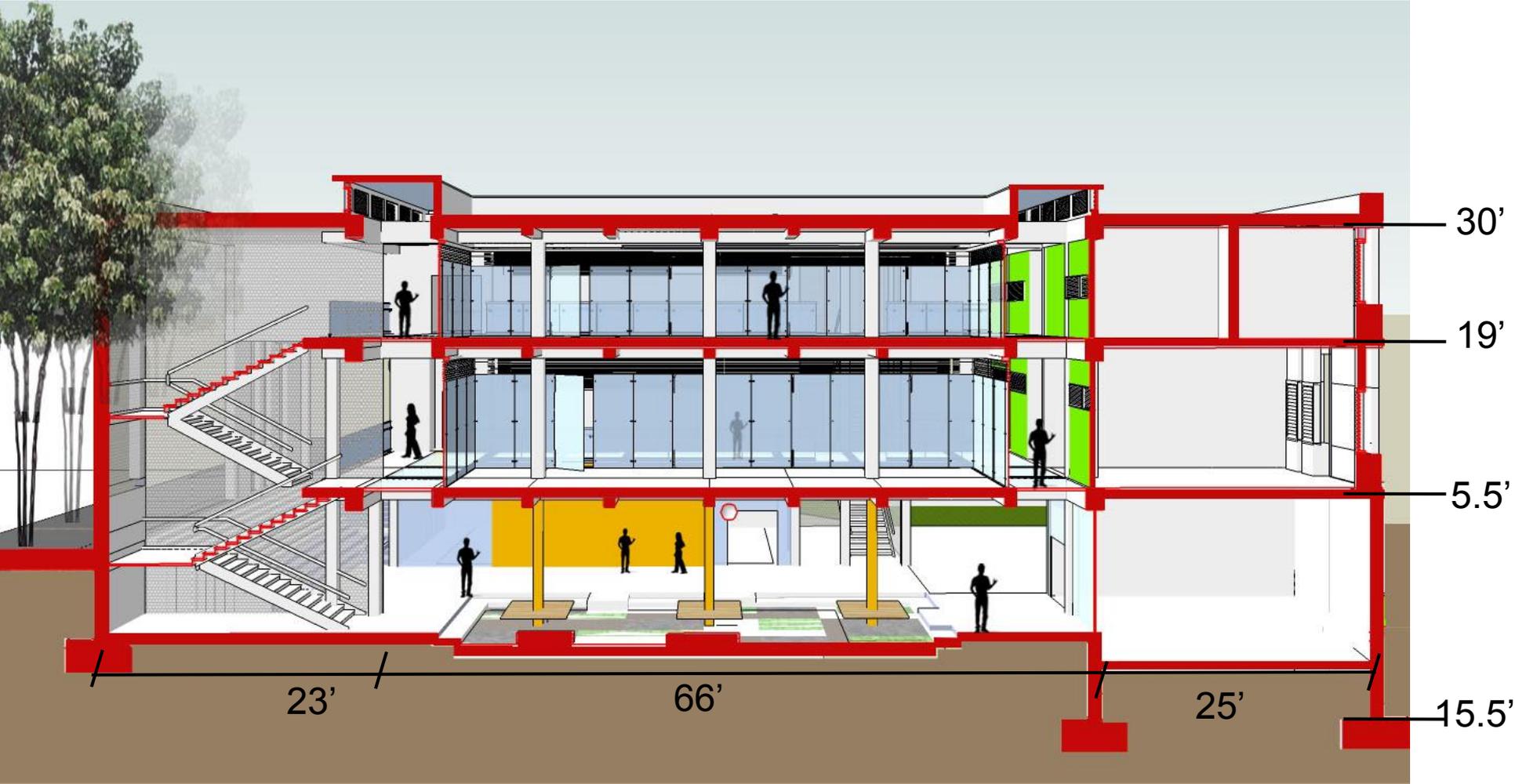
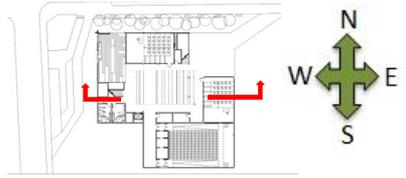
# Volumetric Development



# Small Classroom View



# East-West Section



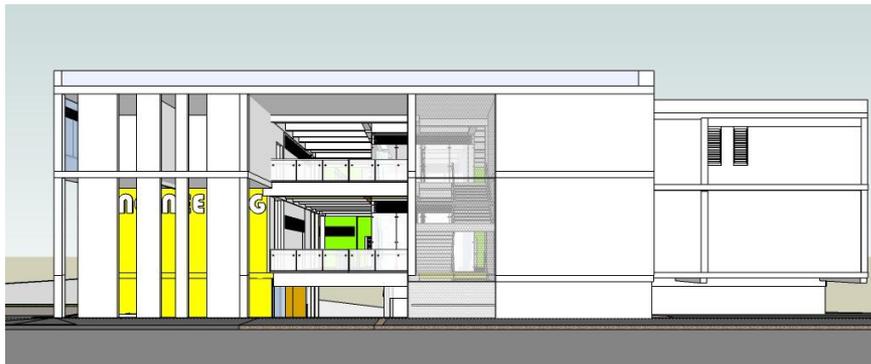
# Facade



South Facade



East Facade



West Facade



North Facade

# Volumetric Development East Entrance



# Volumetric Development North West Entrance

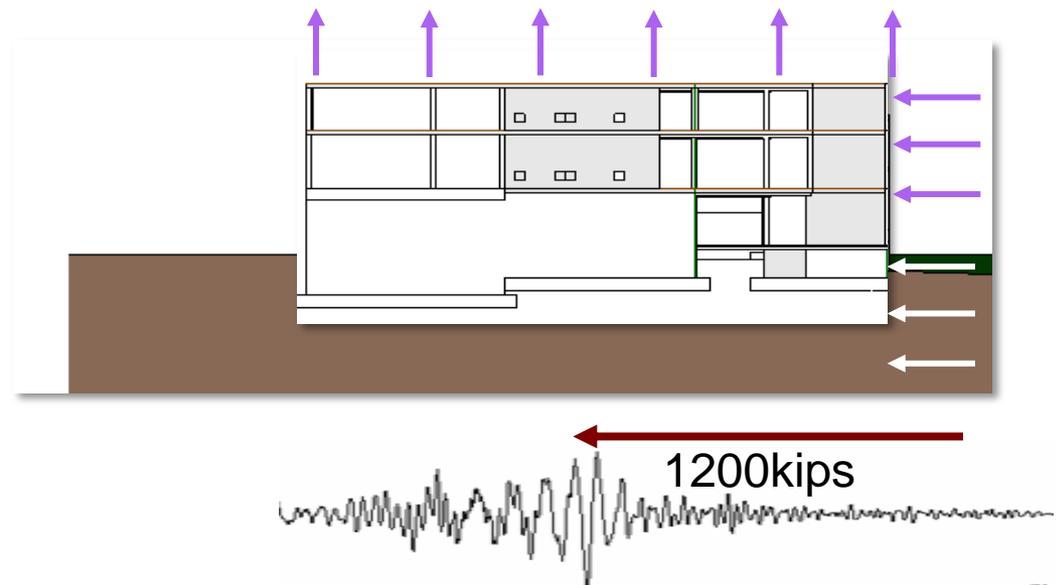


# Loadings and Combinations



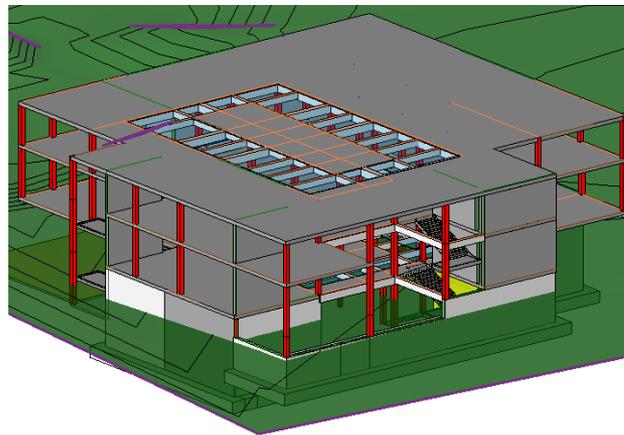
| Dead load       |               |                  |
|-----------------|---------------|------------------|
|                 | Ceiling       | 6 psf            |
|                 | Self weight   | 88 psf           |
|                 | MEP           | 4 psf            |
| Live load       |               |                  |
|                 | Partitions    | 20 psf           |
|                 | Auditorium    | 60psf            |
|                 | Classroom     | 40-80psf         |
| Wind Load       |               |                  |
|                 | Roof Edge     | 40 psf           |
|                 | Roof interior | 23 psf           |
|                 | Windward      | 22 psf           |
|                 | Leeward       | 14 psf           |
| Lateral Earth   |               |                  |
|                 | Surcharge     | 100psf           |
|                 | Sandy clad    | $\gamma=120$ pcf |
| Earthquake Load |               |                  |
|                 | Sds (g)       | 0.676            |
|                 | Sd1 (g)       | 0.365            |

- Wind Exposure B
- Hurricane seismic prone region
- Design wind speed 145mph
- Fundamental structural period 0.2sec
- Reduction factor 4 for Reinforced Shear Wall
- Load Combinations
  - $1.2D + 1.6L$
  - $1.2D + 0.5L + 1.6W$
  - $(1.2 + 0.2 SDS)D + 0.5L + 1.0E$
  - $0.9D + 1.0E$



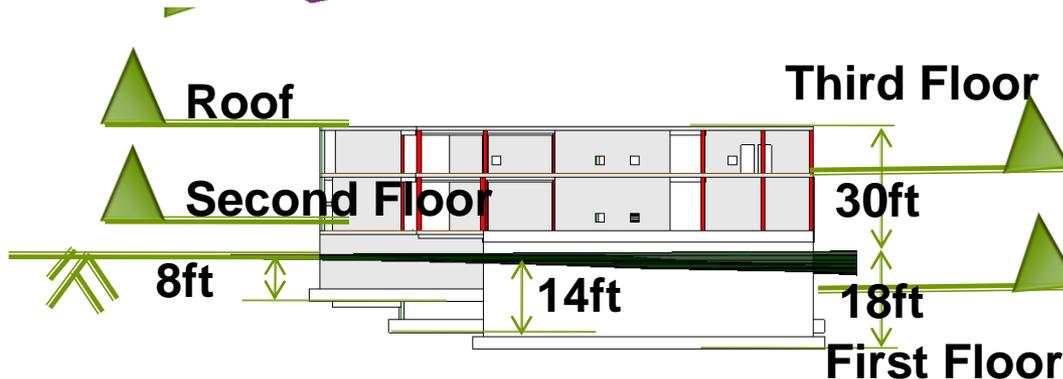
# Concrete Structure Overview

- Height above surface 30ft
- Deepest excavation 18ft
- Light weight concrete,  $w=110\text{pcf}$
- Reinforced Concrete Building (Shear wall)
  - Strong lateral system
  - Little displacement



Third Floor

First Floor



Roof

Second Floor

Third Floor

30ft

18ft

First Floor

8ft

14ft



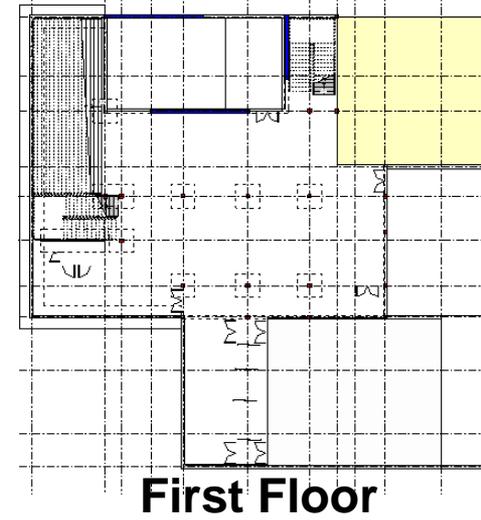
114ft

114ft

15ft

22.5ft

Third Floor



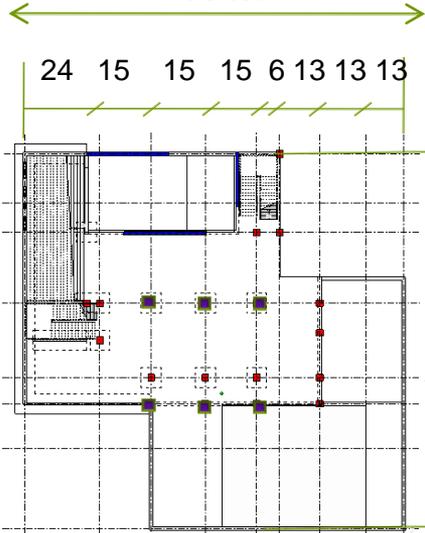
First Floor

# Floor Plans

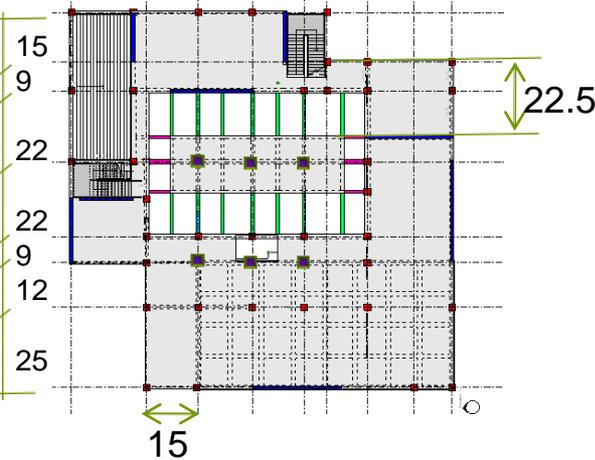


**First Floor**

114ft

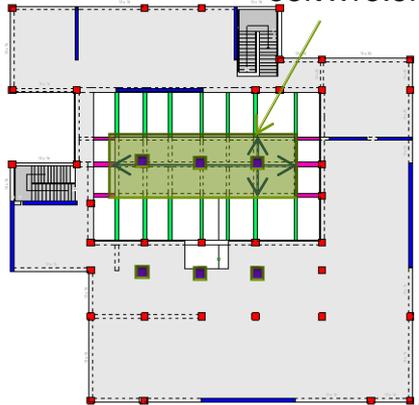


**Second Floor**

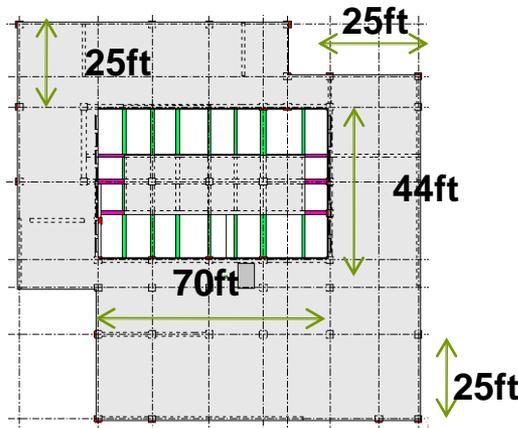


**Third Floor**

55ft x 15.5ft



**Roof**



■ Slab

■ Post tension flat slab

- 8-wirePT tendon @ 30 in c/c
- #4 @ 12 in c/c rebar T&B

■ Flat slab 10"

■ Typical "Island" Beam Size

- 12 x 20
- 18 x 24

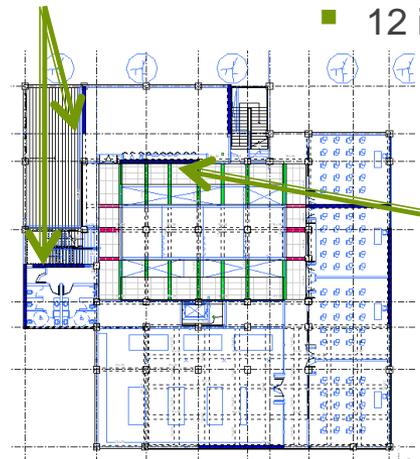
■ Typical Column Size

- 12 x 12
- 14 x 14

■ Shear Wall thickness

- 12 in

Most shear wall at the periphery



Two interior shear walls align with hard constraints

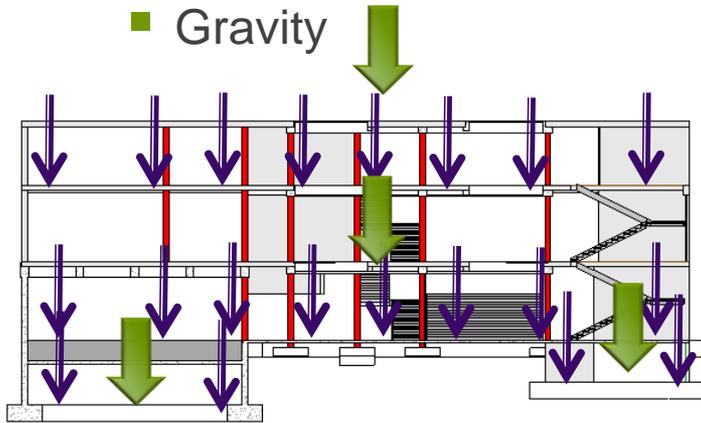


# Gravity and Soil Load Path

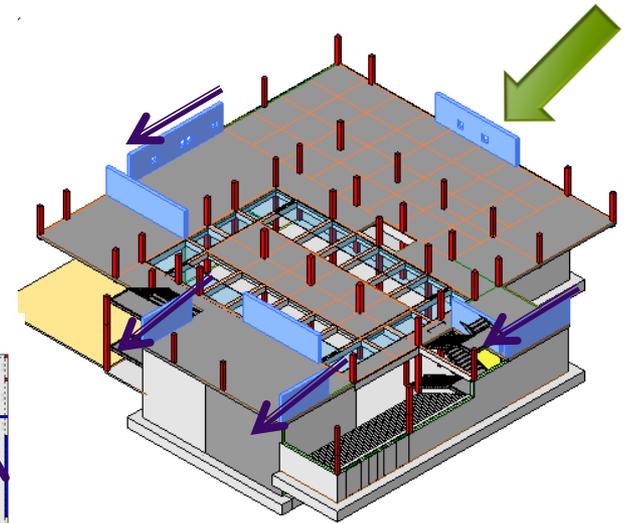


Load Direction    Load Path

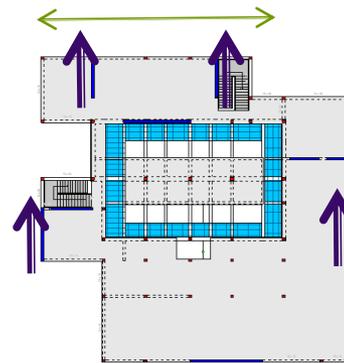
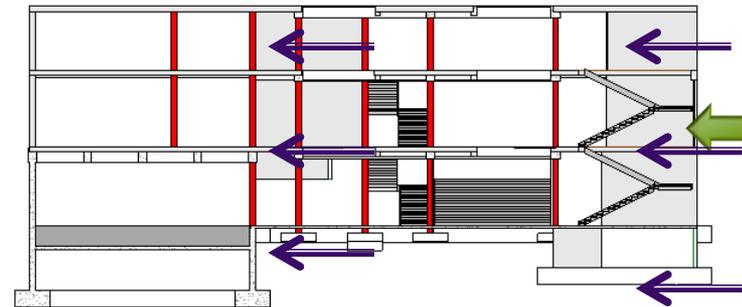
■ Gravity



■ Lateral (Wind Load)



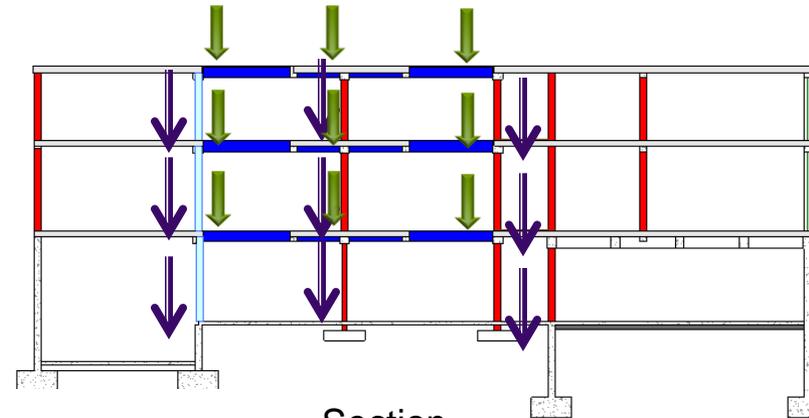
■ Lateral (Soil Load)



# Seismic/ Wind Load Path on the 'Island'



- Regular beam-column grid
  - Gravity
    - Regular support at 6 ft interval for glass walkway
    - 3 central columns – direct gravity load path
  - Lateral
    - Direct load path - tension /compression of the beams

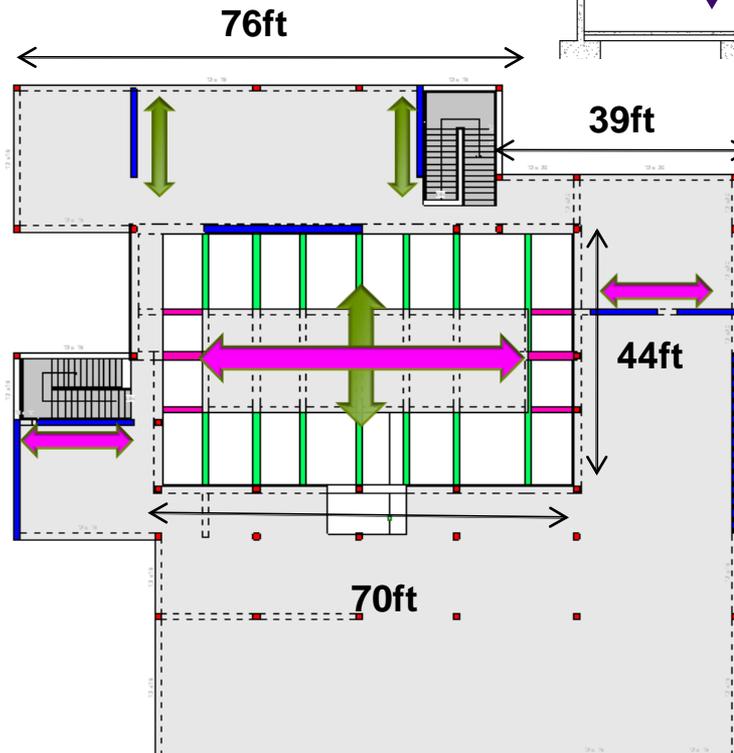
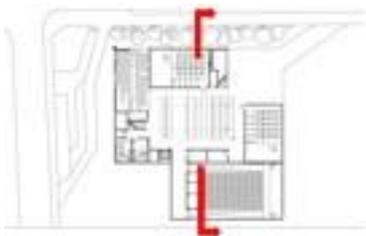


Section Gravity Load Path

Load Direction



Load Path



Total weight ~7000kips  
 Total base shear 1200kips  
 (R=4)

Roof 580kips

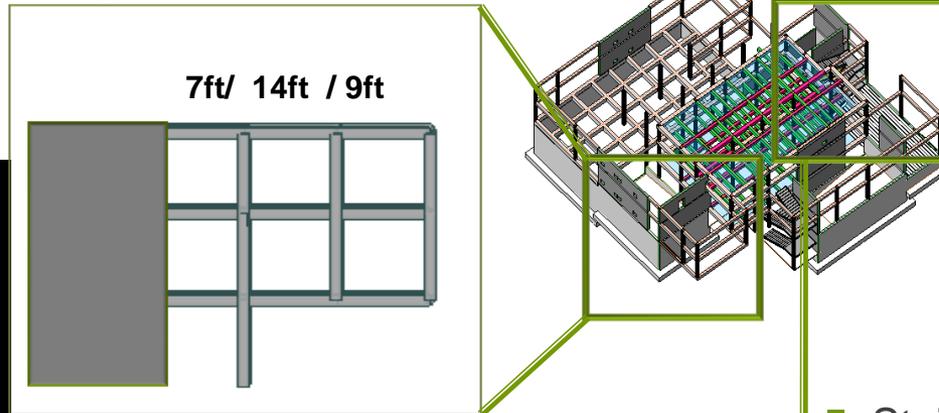
Third floor 410kips

Second floor 220kips

# Engineering Details



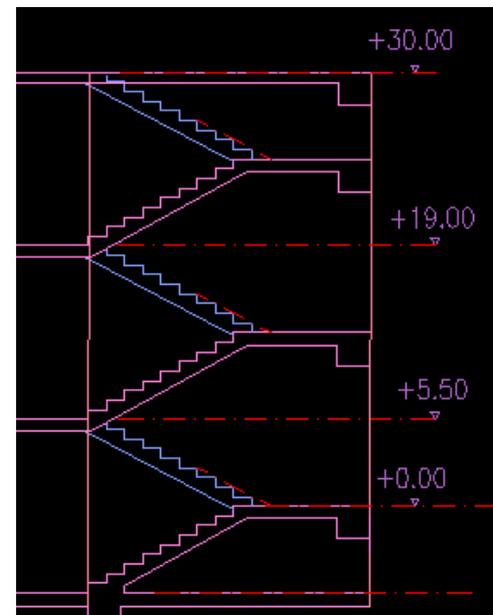
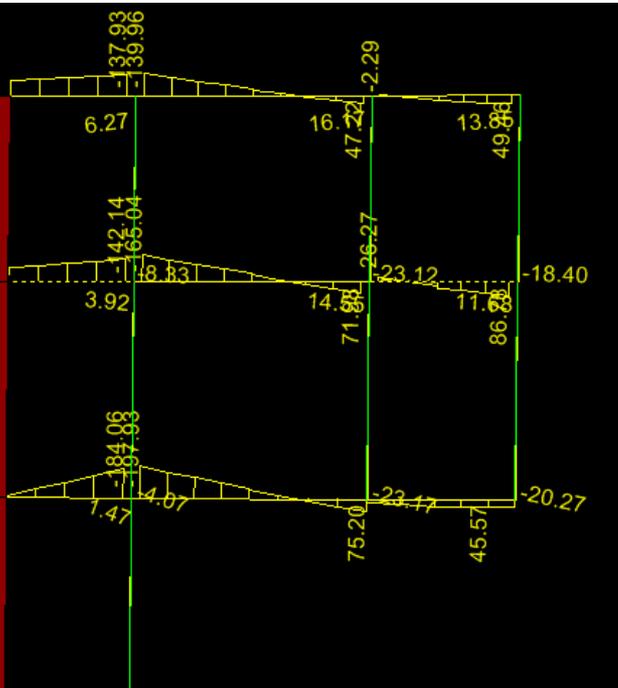
- Vierendeel Truss for Cantilever
  - 12 x 24 Beam (4 no.s #9)
  - 14 x 14 Column (8 no.s #8)



CAD drawings of the Stairs

## ■ Staircases

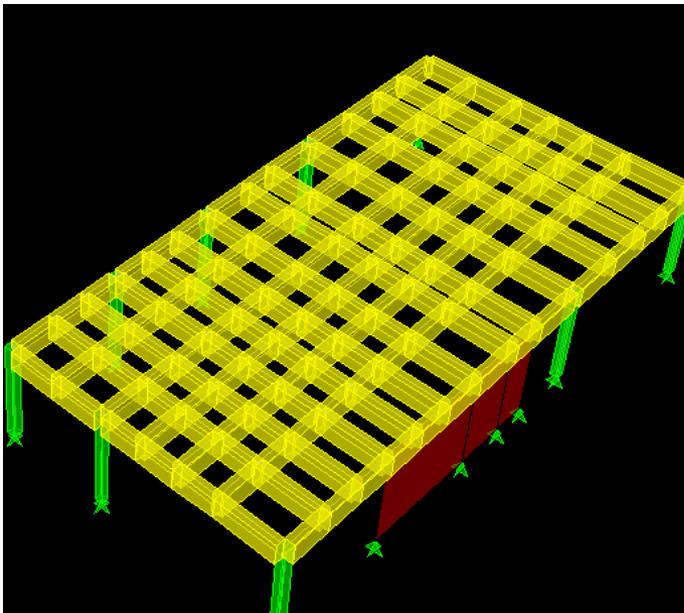
- Slider joint
- Supported by half landings and floors
- #4- 8" longitudinal rebar T&B



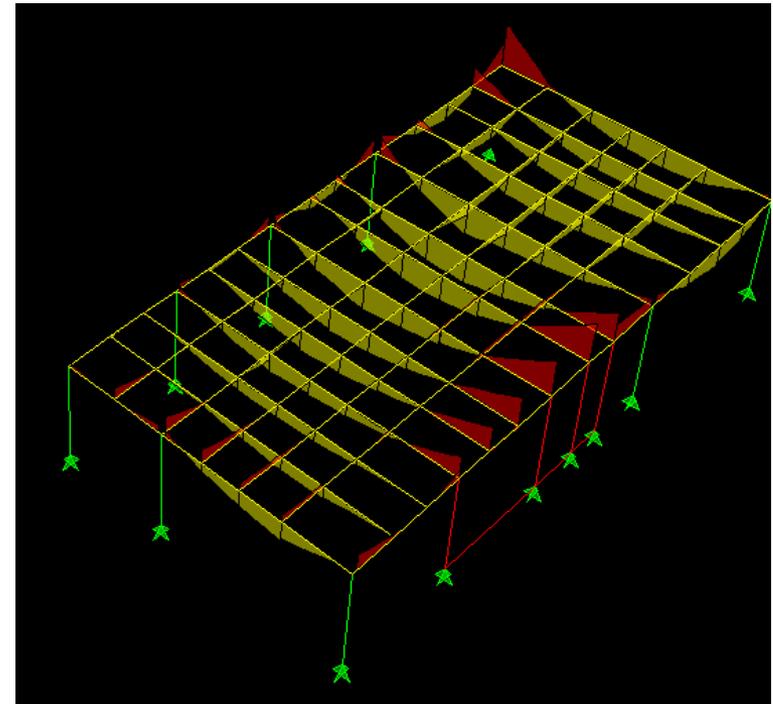
# Engineering Details



- Waffle Slab
  - 16 x 28 Beam
  - 4 no.s #9



Modeling of slab in Etabs

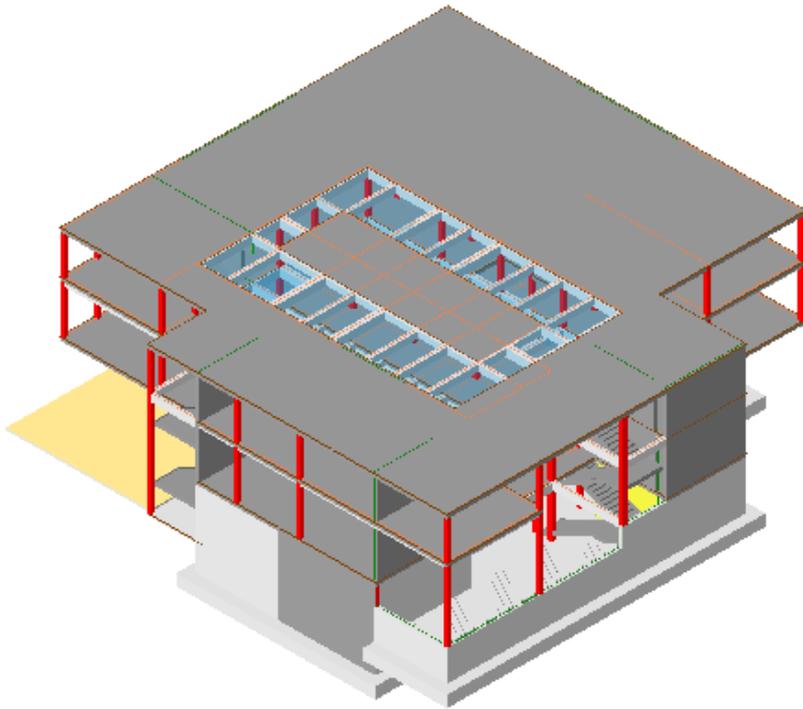


Moment diagram of the long span beams

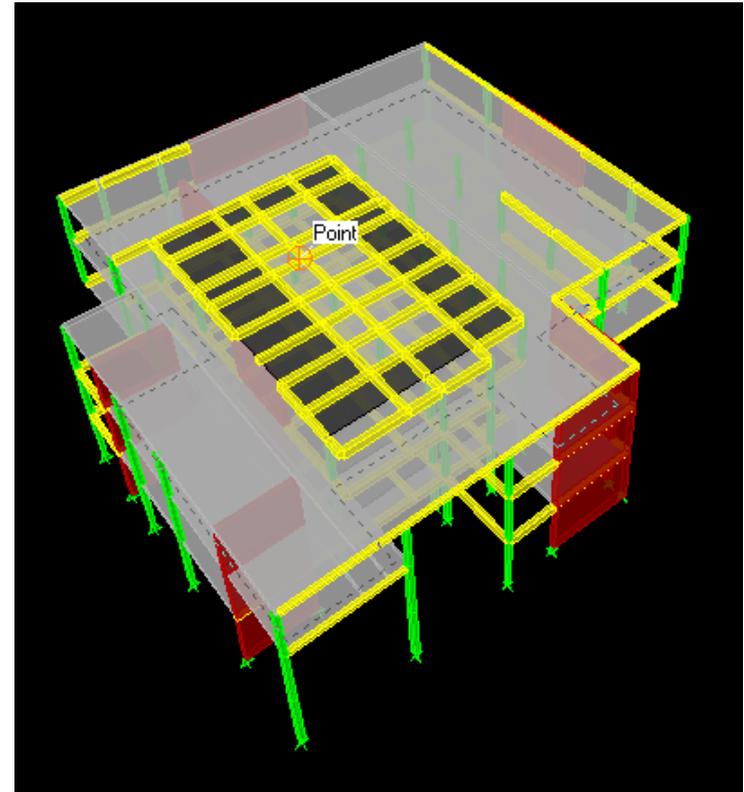
# Structural Model



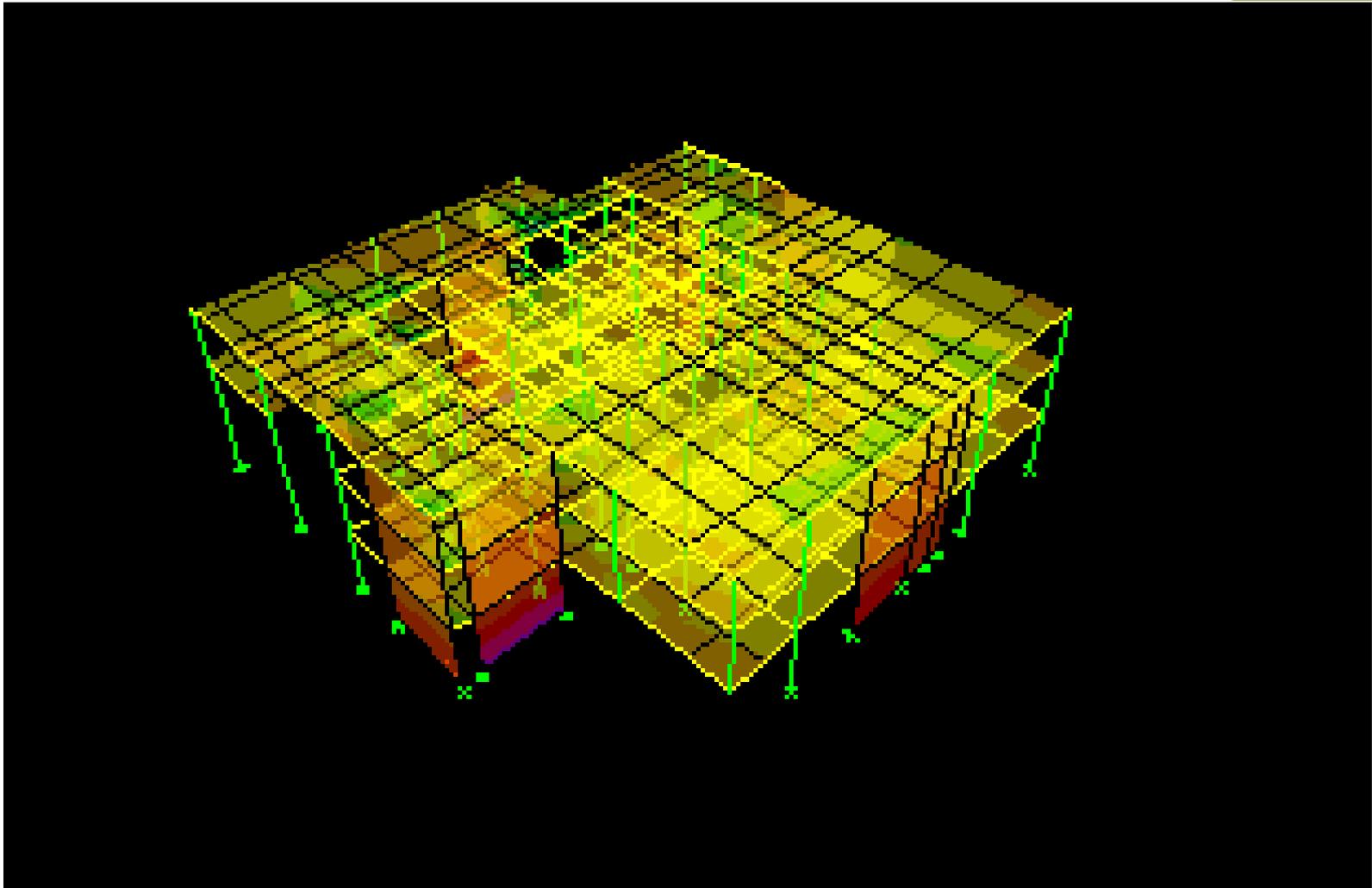
- BIM- Revit



- Structural Analysis- Etabs



# Structure subject to earthquake loads

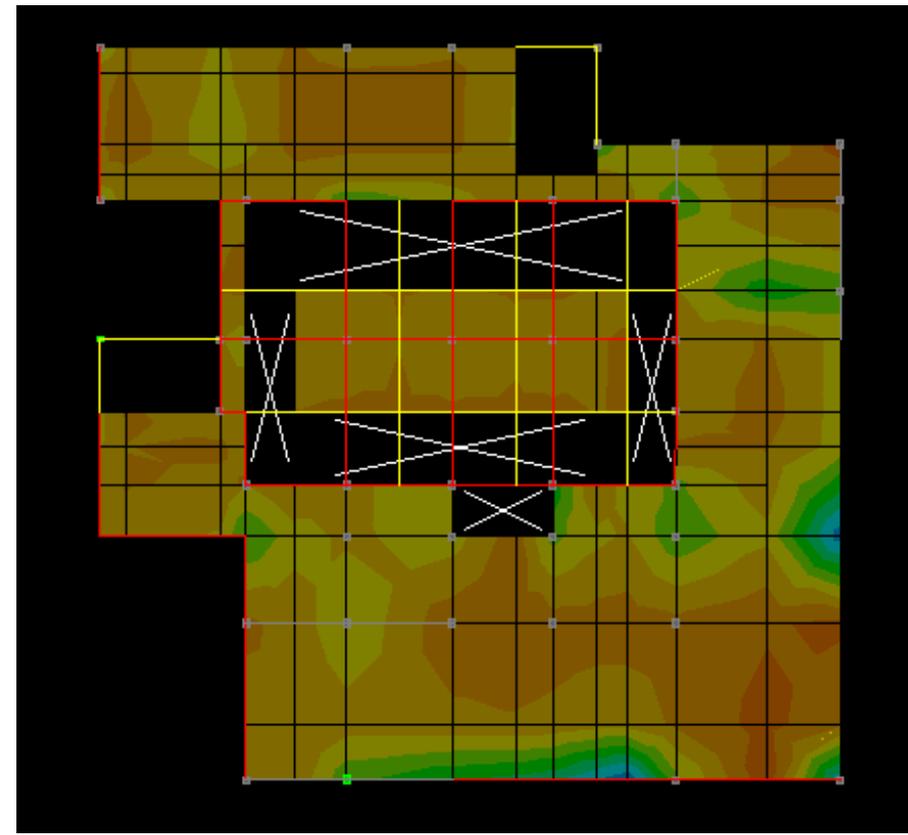
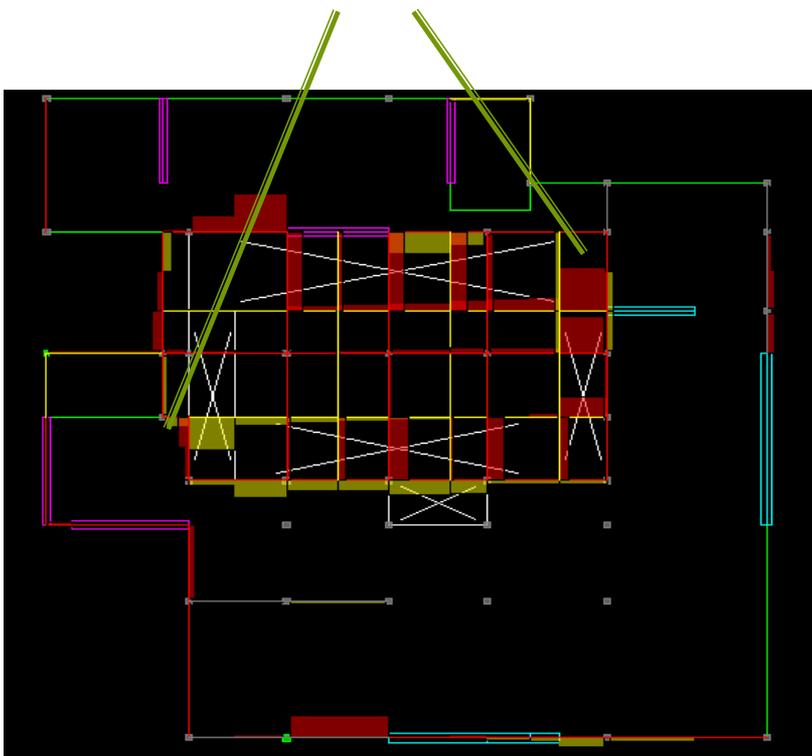


# Analysis Result



- Strength
  - Force (Axial Force Shear Moment)
  - Stress (Floor diaphragm and wall)

Axial force in beams under Earthquake Load  
Tension (20kips) Compression  
(18kips)



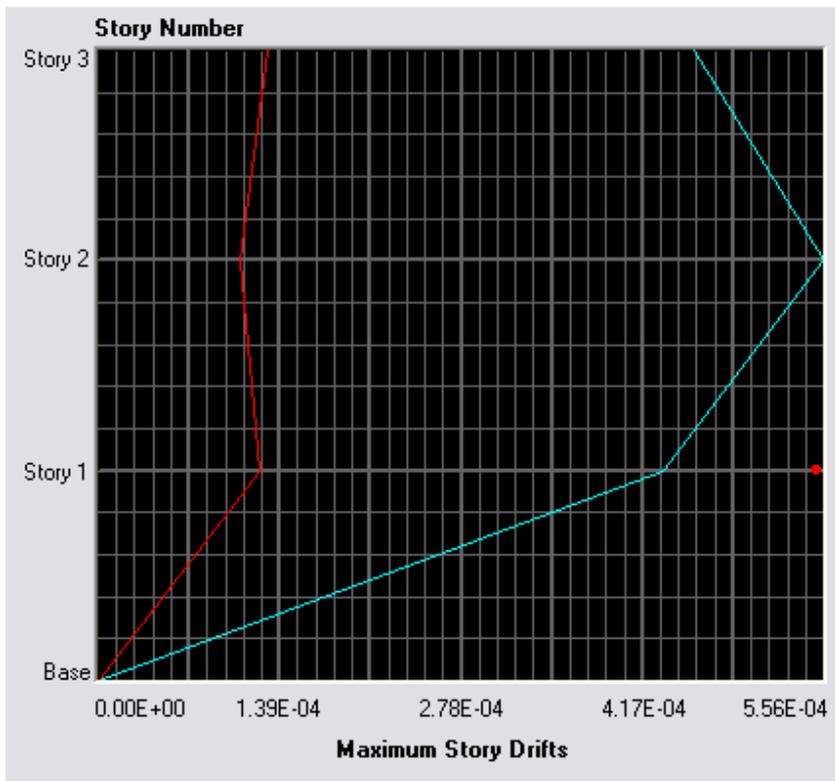
Slab diaphragm stress under semi rigid diaphragm under earthquake load  
Max shear stress 0.3 ksi

# Analysis Result

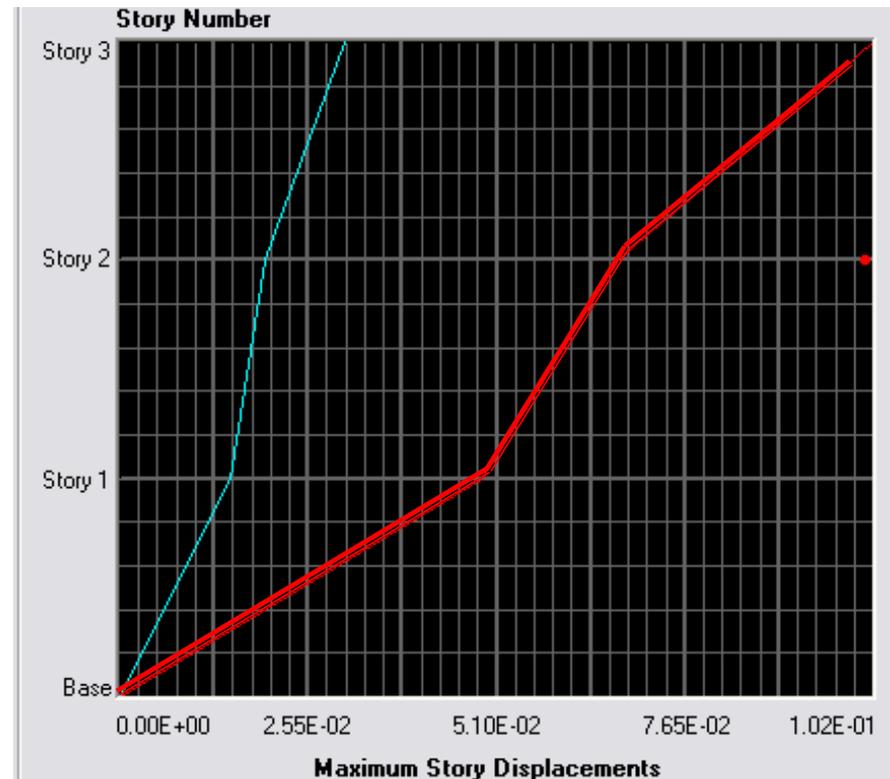


- Stiffness ( $C_d = 4$ )
  - Inter-story Drift ( $2.5 \times 10^{-3}$ )
  - Max Roof Displacement (0.7 in)

Drift Ratios in X&Y direction



Displacement in X & Y direction

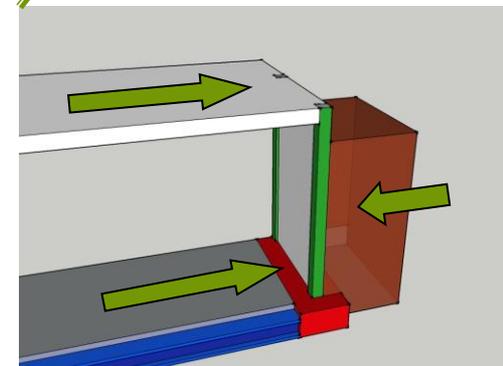
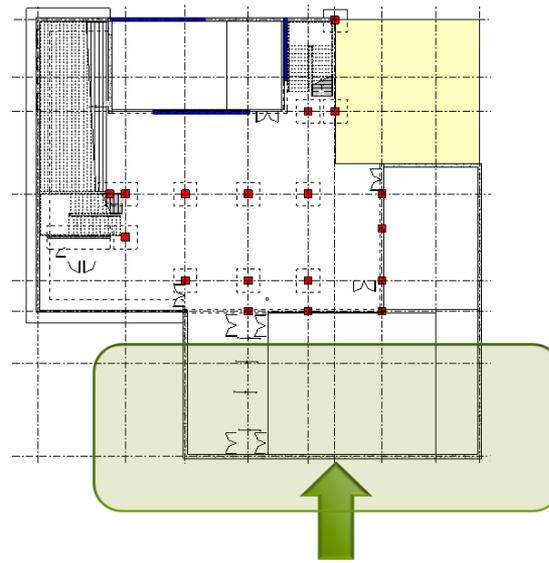
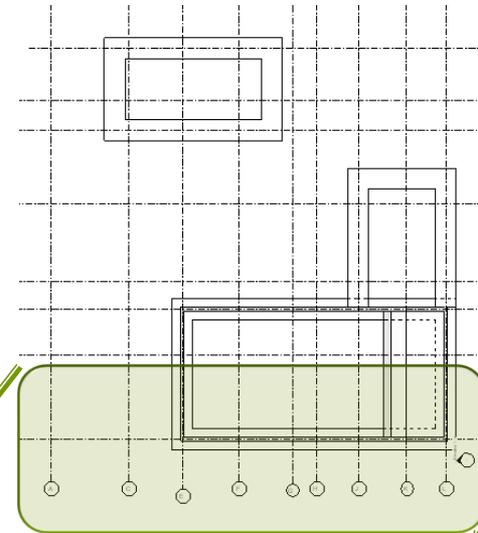


# Foundation

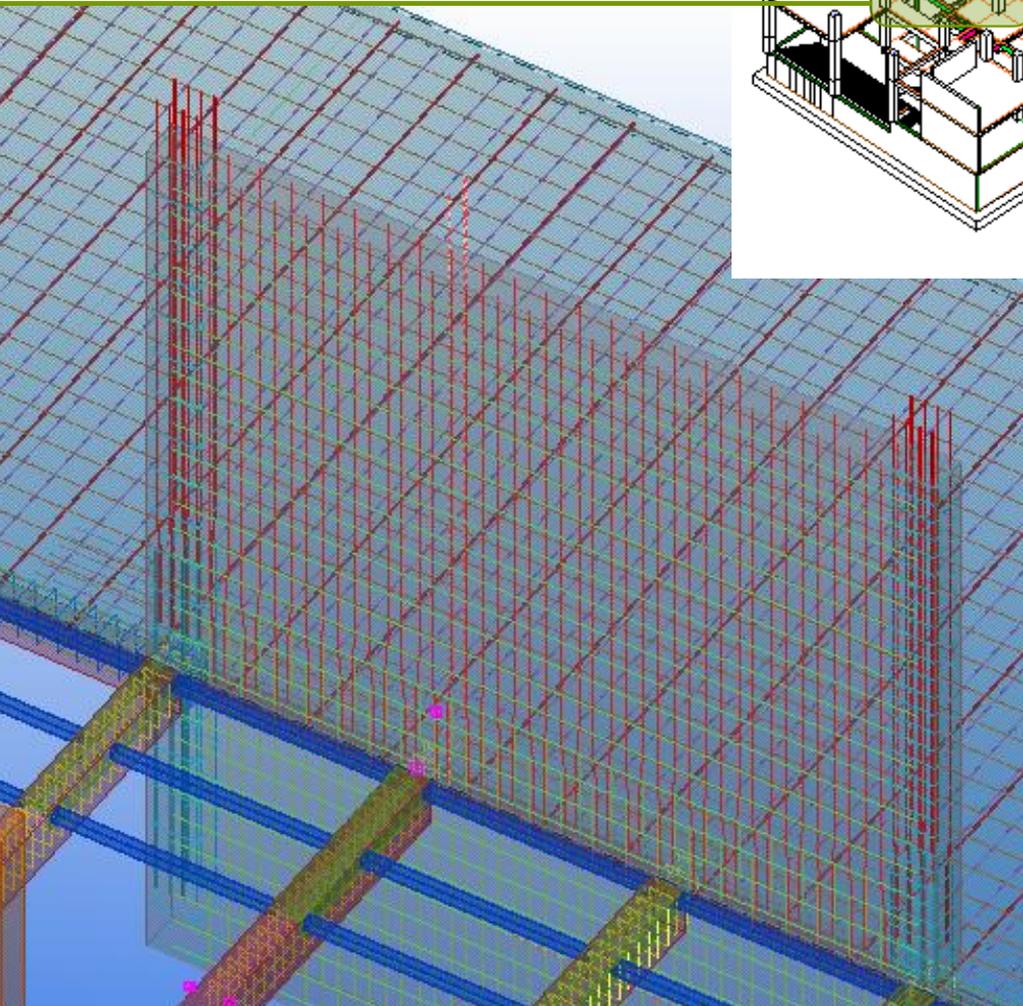
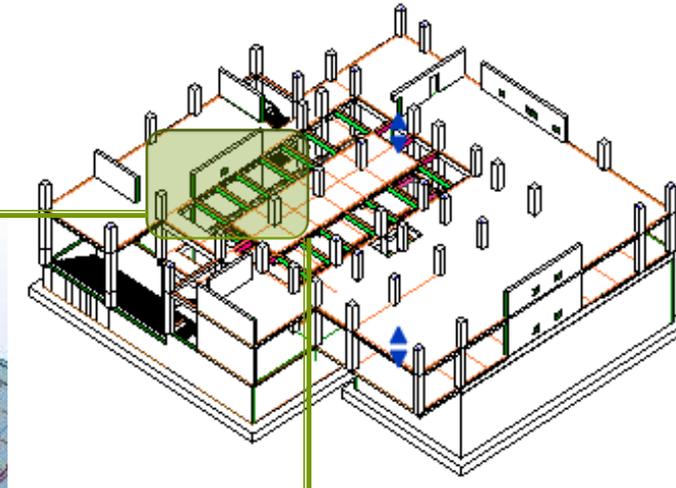


| Type        | Qty | Length (ft) | Width (ft) | Depth (ft) |
|-------------|-----|-------------|------------|------------|
| Square      | 11  | 6           | 6          | 1.5        |
| Aud Strip   | 2/2 | 76/38       | 6          | 4          |
| Class Strip | 4/3 | 30 /25      | 6          | 3          |

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



# Typical Details

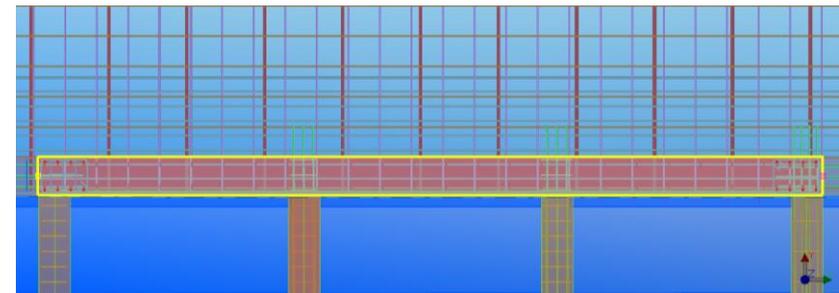


## Beam Detail (18 x 24)

- Flexure rebar 3 no.s #4
- 135 ° Links #4 @ 6" at 1' from the end of beam

## Wall Reinforcement (12 in)

- # 5 @12"
- 8 no.s # 9 @ Boundary Zone

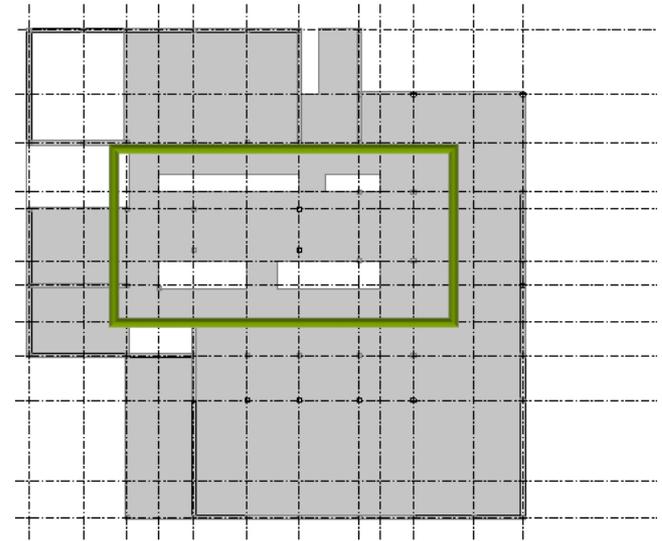
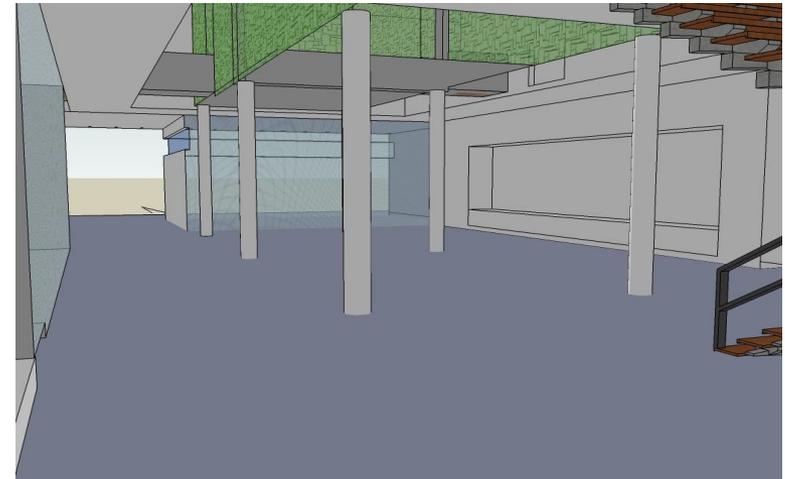


# ISLAND story

A design & development story....

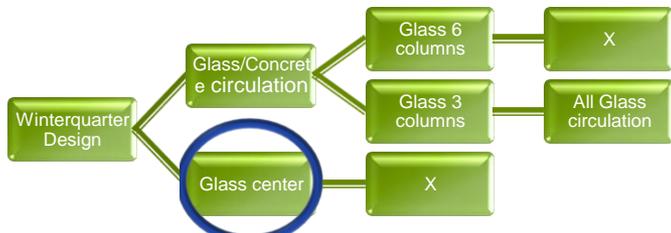
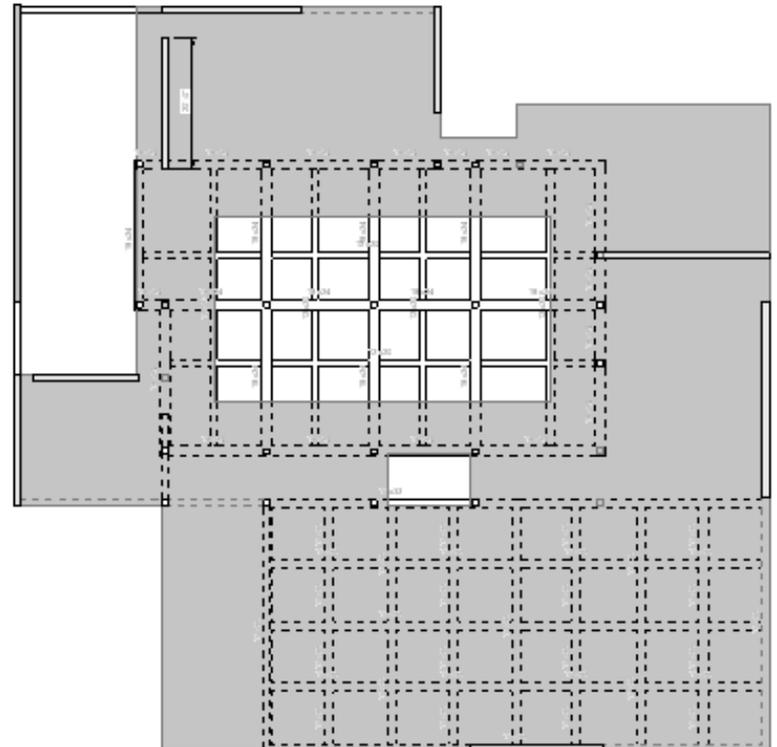


Winter Quarter: success & challenges



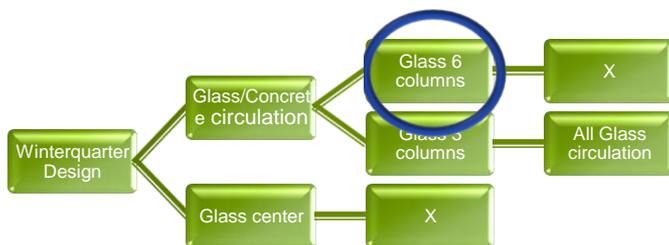
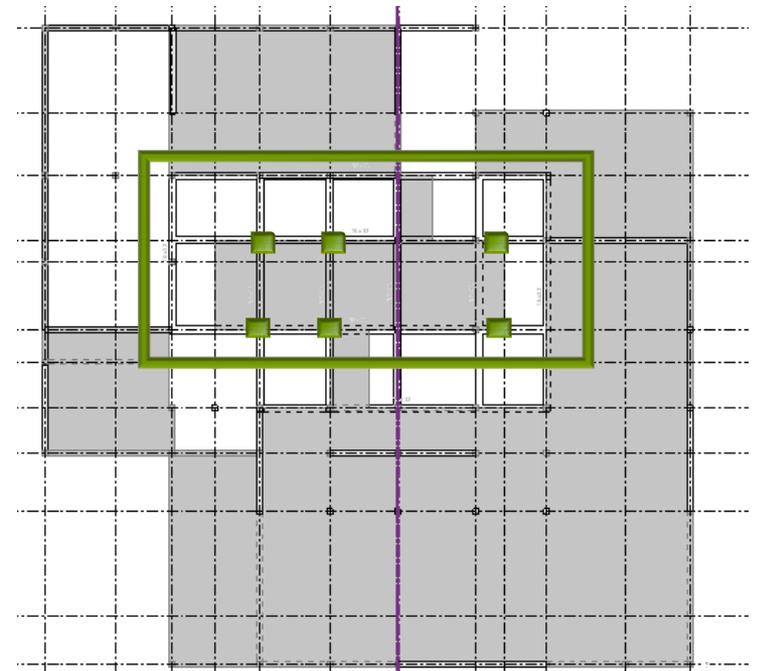
# ISLAND story

## Central Glass Area



# ISLAND story

## Glass/Concrete Walkway (6-Column)



# ISLAND story

## Life Cycle Insight



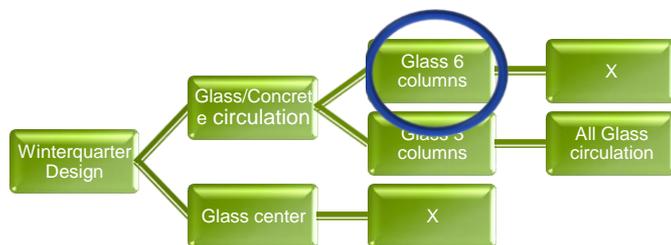
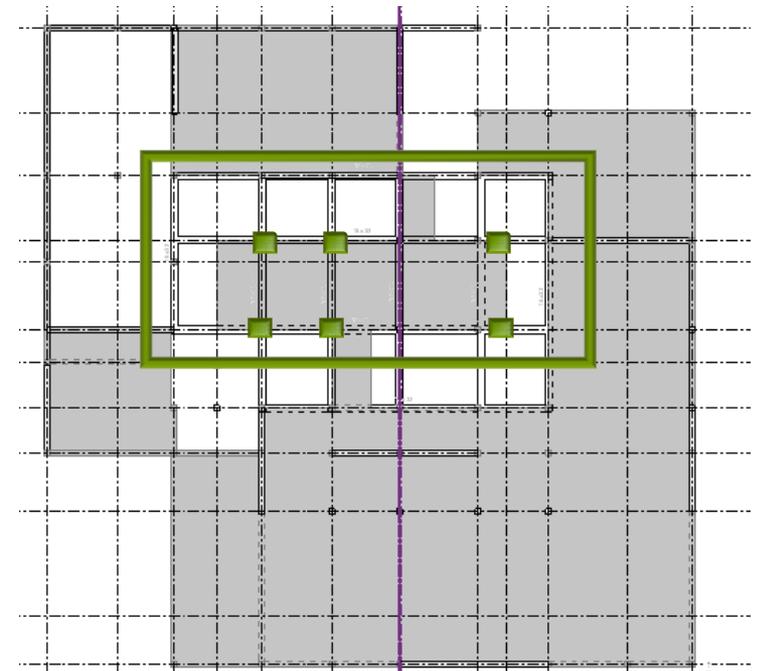
**lighting cost**



**cleaning  
cost**

# ISLAND story

## Glass/Concrete Walkway (6-Column)



# Island story

## Life Cycle Insight



**cooling  
cost**



**lighting  
cost**

# Island story

## Life Cycle Insight



**cleaning  
cost**



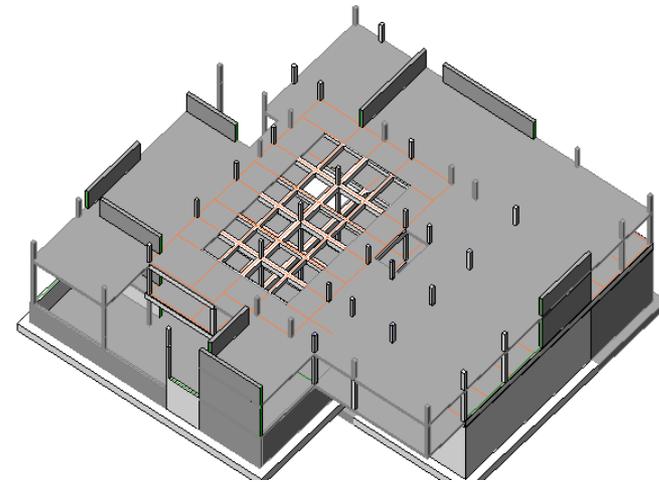
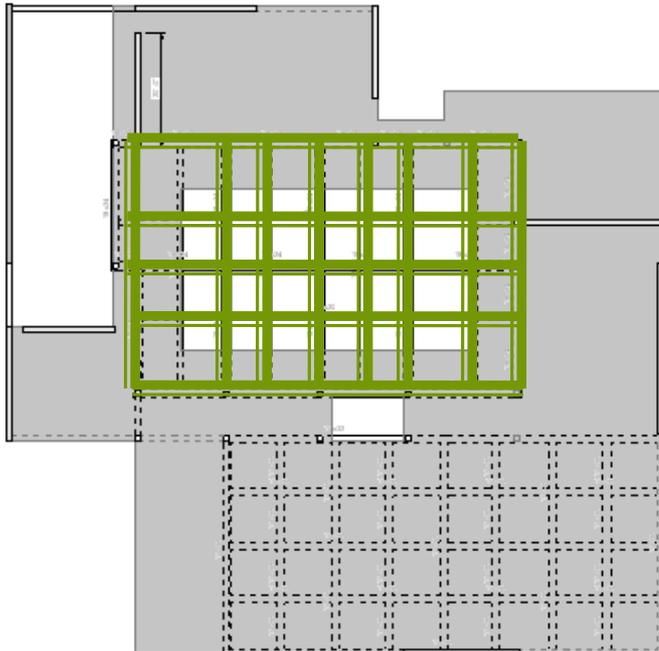
**lighting cost  
cooling cost**

# ISLAND Story

## Structural Insight



- A→E
  - Loss of structural rigidity of the building
    - Regular beam column framing
    - Change of design assumptions and modeling assumptions
      - Increased forces in beams members → potential congestion rebar → CM

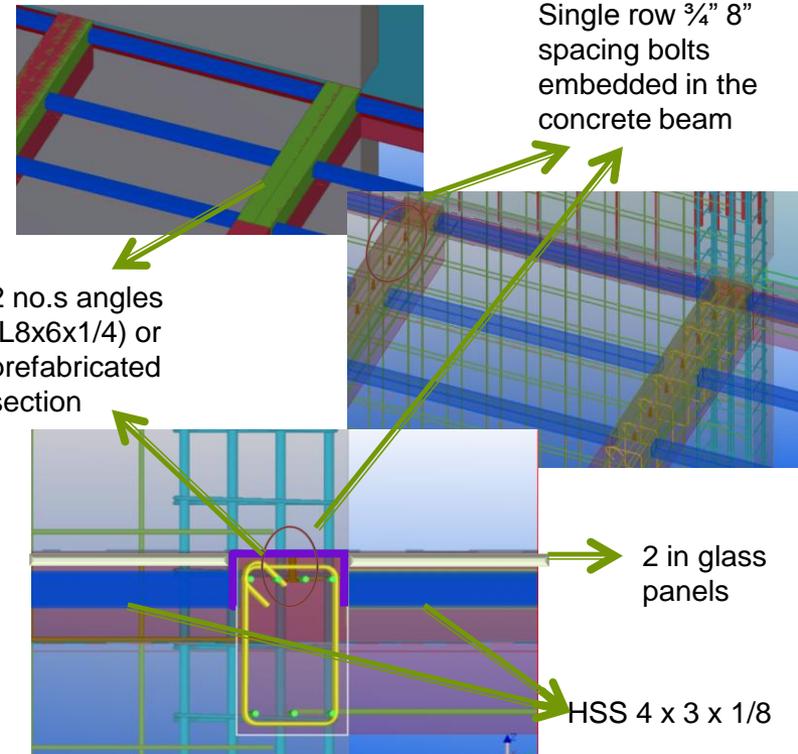


# ISLAND Story

## Structural Insight

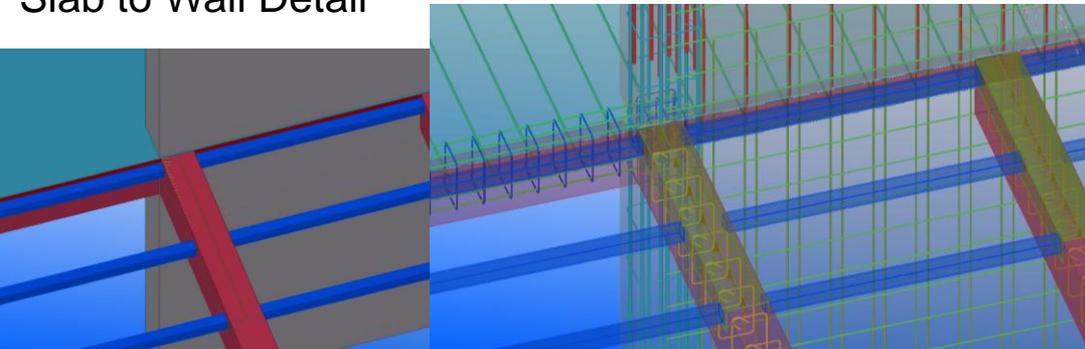


- Loss of structural rigidity of the building
  - More thorough considerations in beam/wall/slab reinforcement detail (feasible?)
- Details of glass panel supporting system
  - Seamless – same level
  - Invisible – no bolts and nuts visible to users



Glass Panel supporting system and details

Slab to Wall Detail



# ISLAND Story

## Structural Insight

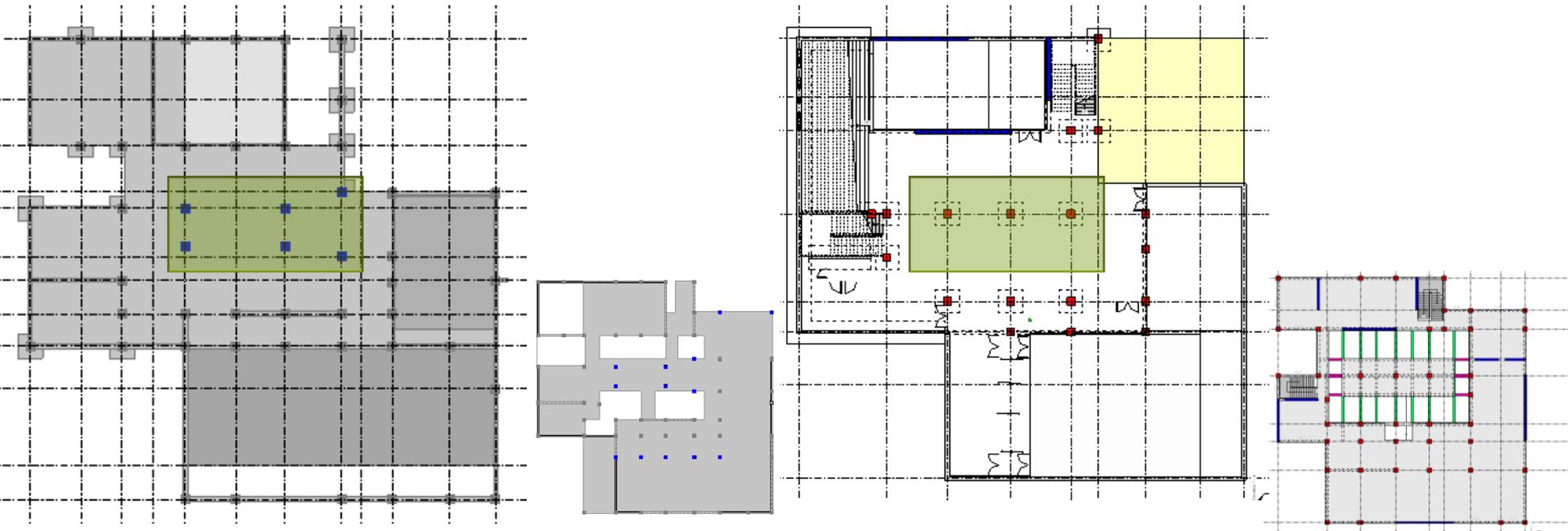


- Rework the central area vertical system to reduce columns from 6 to 3 columns
- Column align with proposed seminar rooms partition
- Larger columns 14 x 14 to be used

10 ft  $\longleftrightarrow$

10 ft  $\rightarrow$  17 ft from column to the  
classroom partition

$\longleftrightarrow$  17 ft

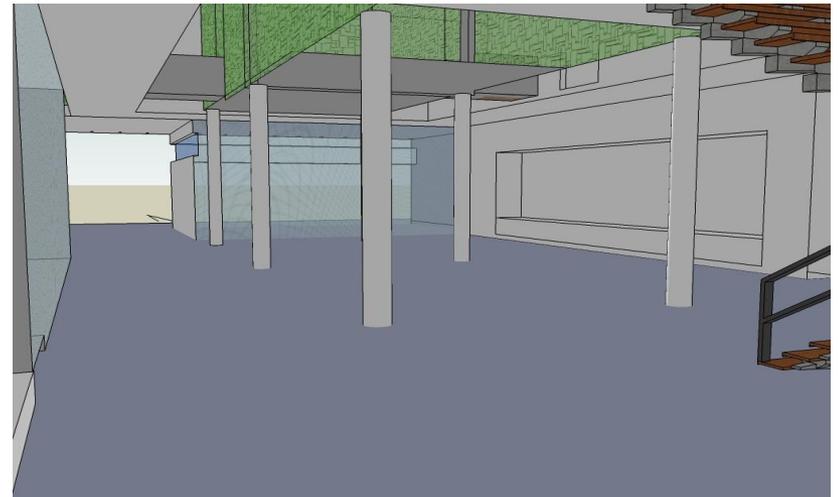
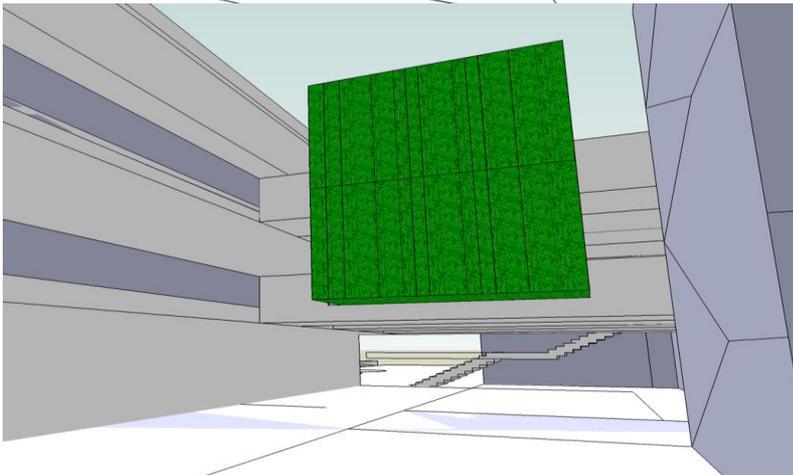
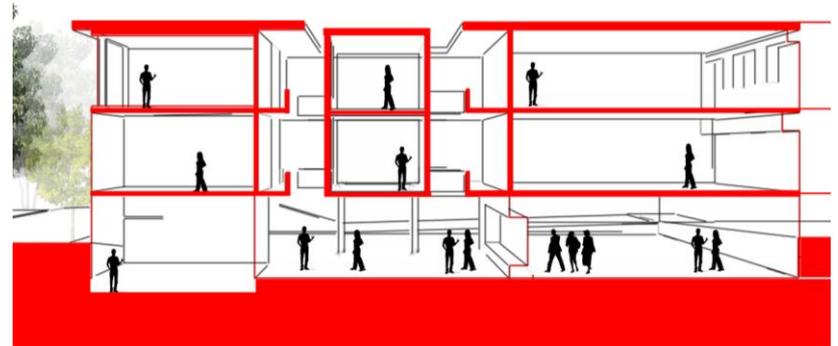
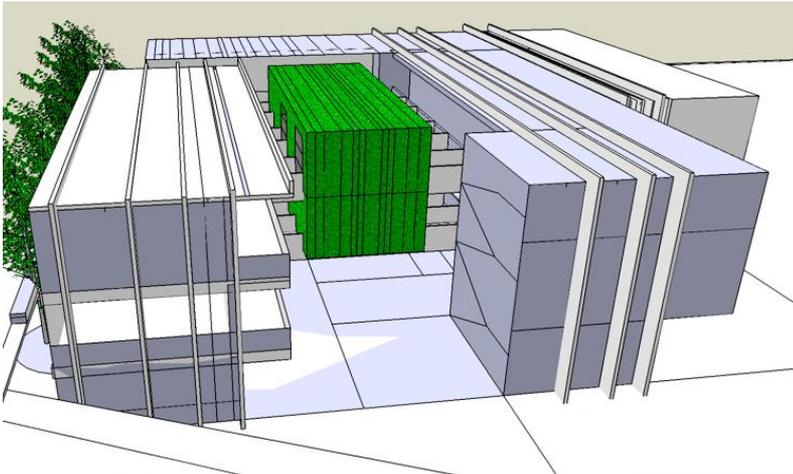


# Winter Quarter Design

## Architect Insight



- Loss of concept and spatial qualities...



# ISLAND story

## MEP Insight



- More Natural Lighting



# ISLAND story

## MEP Insight



- Good Lighting

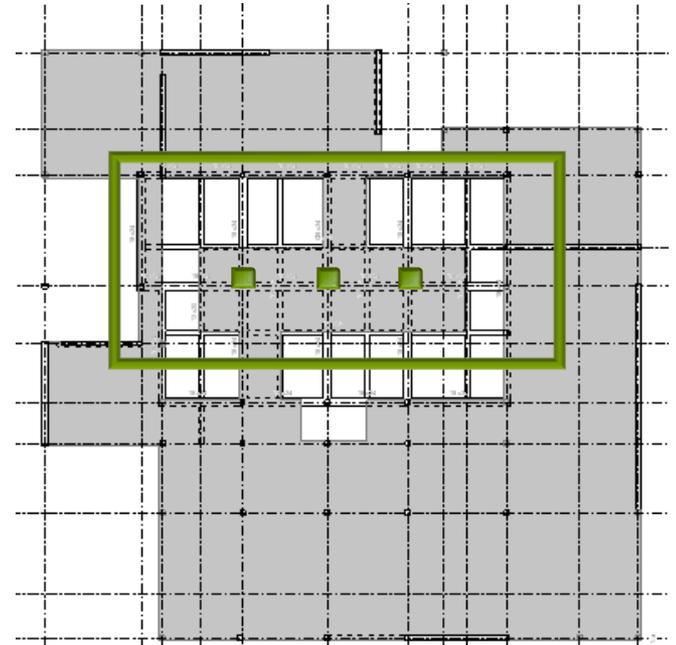


- High Solar Heat Gain



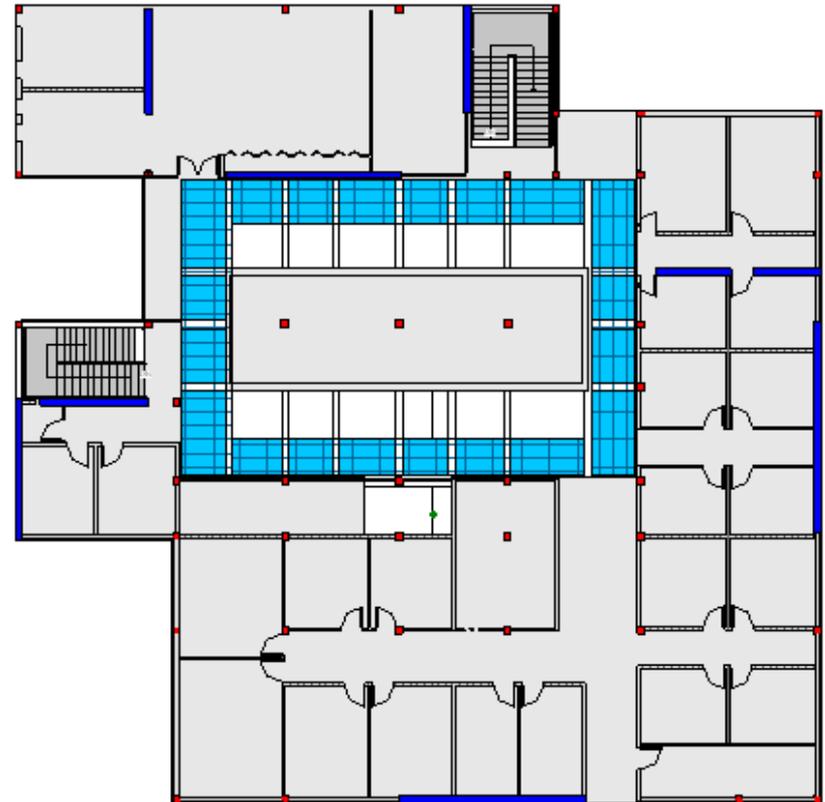
# ISLAND story

## 3-Column Glass Walkway



# ISLAND story

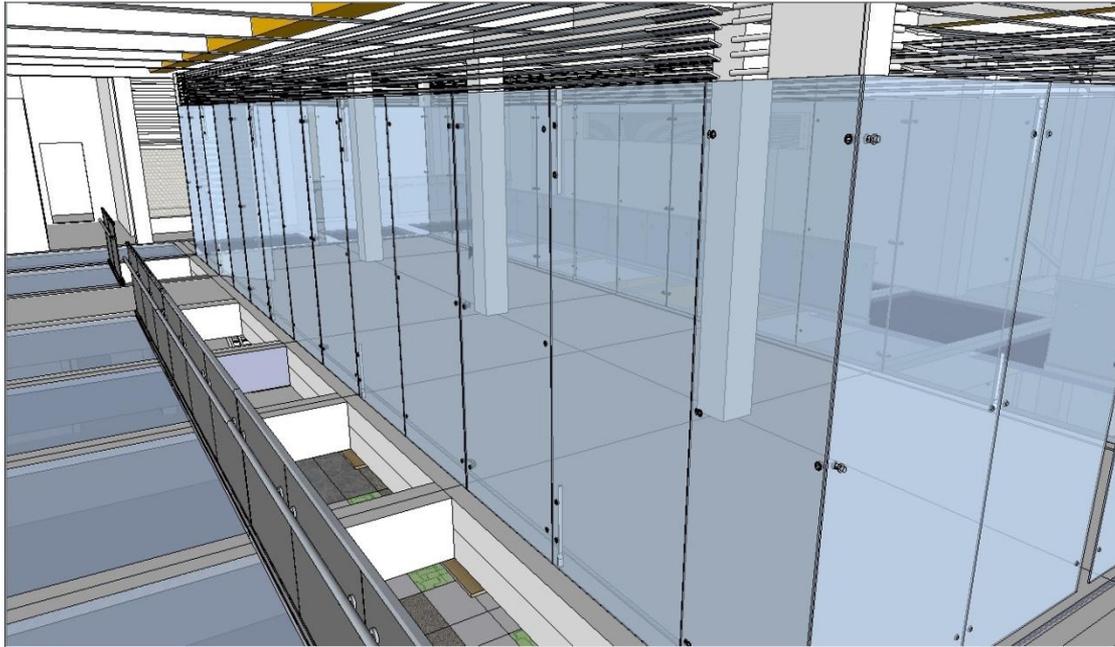
## Final Design



# Construction Manger Goals and Challenges



- CM Challenges of the “Island,” as defined by the Island Story
  - Keeping on Schedule and Under budget
- Goals of CM
  - Based on design development, meeting the needs of the owner, architect, structural engineer, and integrating with life cycle financial manager



# Jobsite Traffic Route

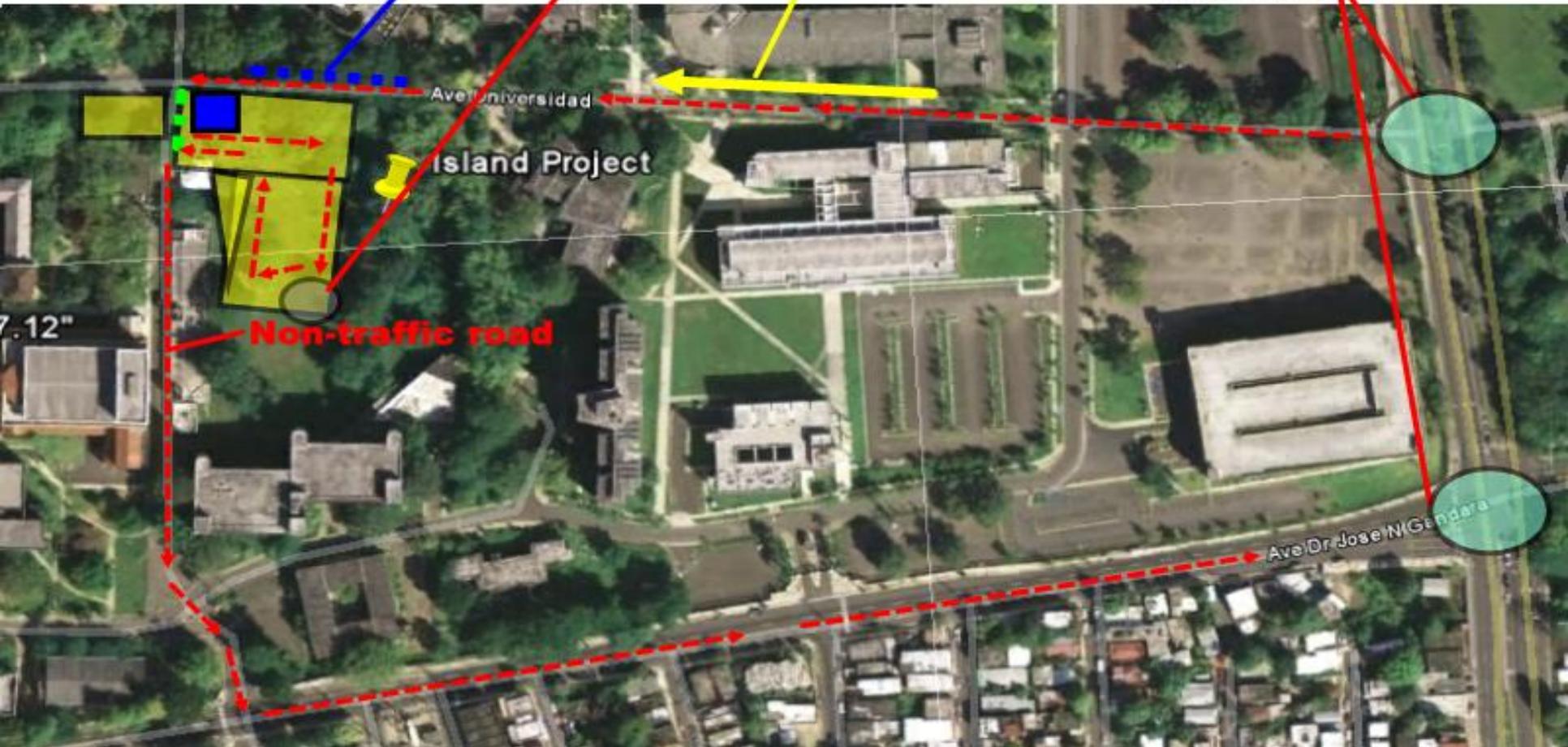
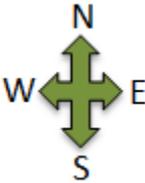


Concrete Truck  
Waiting Area

Concrete  
Washout Area

One-way Traffic  
Direction

Fast Transit  
Access Points  
Hwy Pr-27

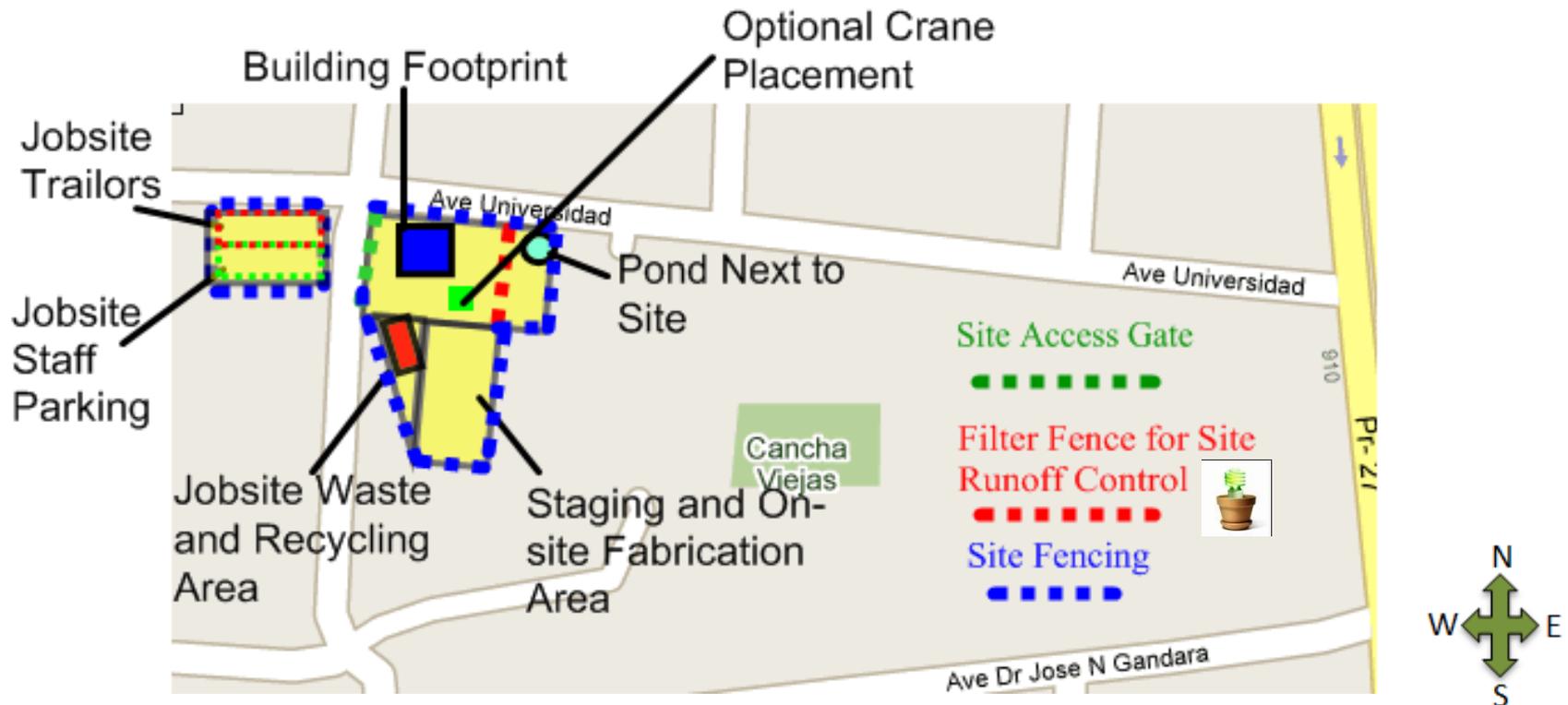


# Jobsite Logistics/Placement



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



# Estimate Breakdown

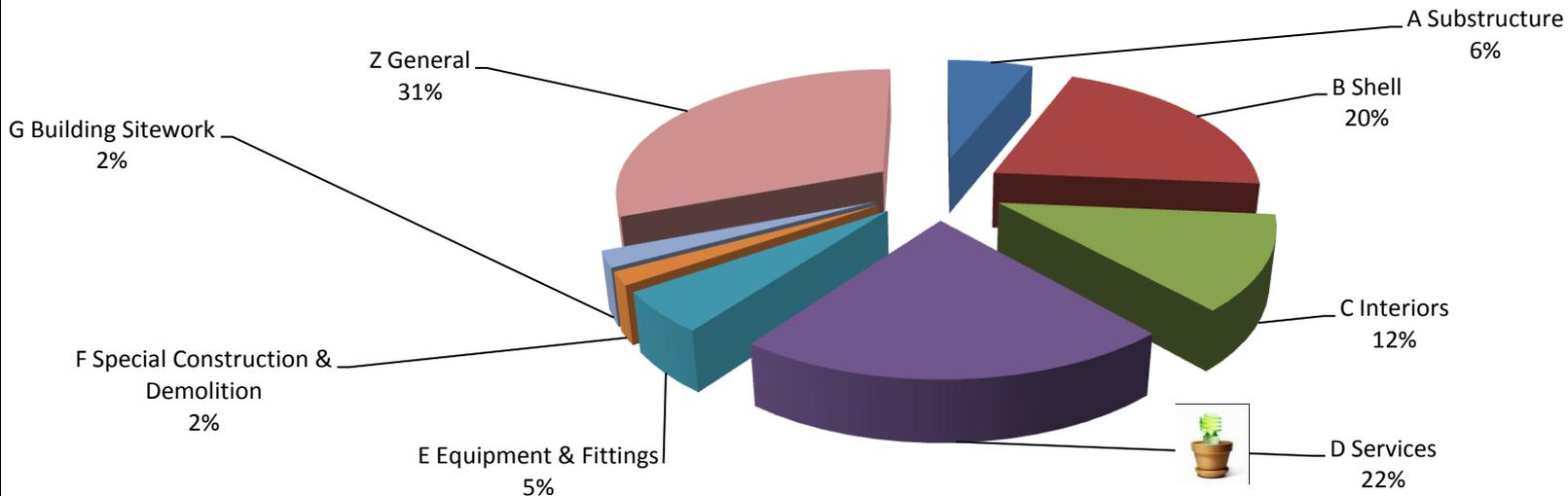


| UNIFORMAT                           |              |
|-------------------------------------|--------------|
| A Substructure                      | \$ 432,600   |
| B Shell                             | \$ 1,652,900 |
| C Interiors                         | \$ 855,000   |
| D Services                          | \$ 1,550,100 |
| E Equipment & Fittings              | \$ 373,300   |
| F Special Construction & Demolition | \$ 120,300   |
| G Building Sitework                 | \$ 148,600   |
| Z General                           | \$ 2,403,800 |
| TOTAL 2009                          | \$ 7,136,600 |
| TOTAL 2015                          | \$ 8,037,000 |

## Z General

- Architectural Fees - 10%
- Contingencies - 10%
- Over Head and Profit - 15%
- Builders Risk Insurance - 0.5%
- Commissioning - 0.5%
- Bond s- 2%
- Permits - 2%
- Equipment - 5%
- Site Tools - 2% of bare labor costs
- Construction Field Testing - \$3,800
- Site Temporary Power - \$2,200

## Uniformat Breakdown



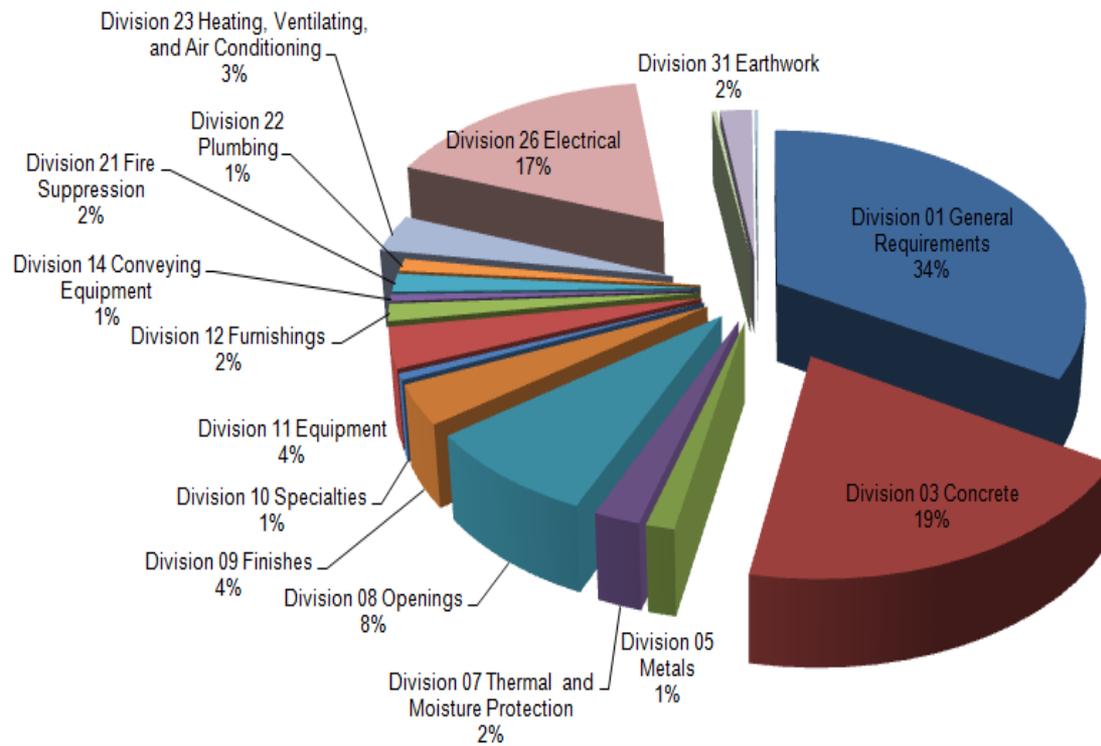
# Estimate Breakdown

## Financial Adjustments

- 2009 RS Means Data
- Inflation = 2%
- Investment Rate = 3%
- 2015 Budget @ 3%= \$8,700,000



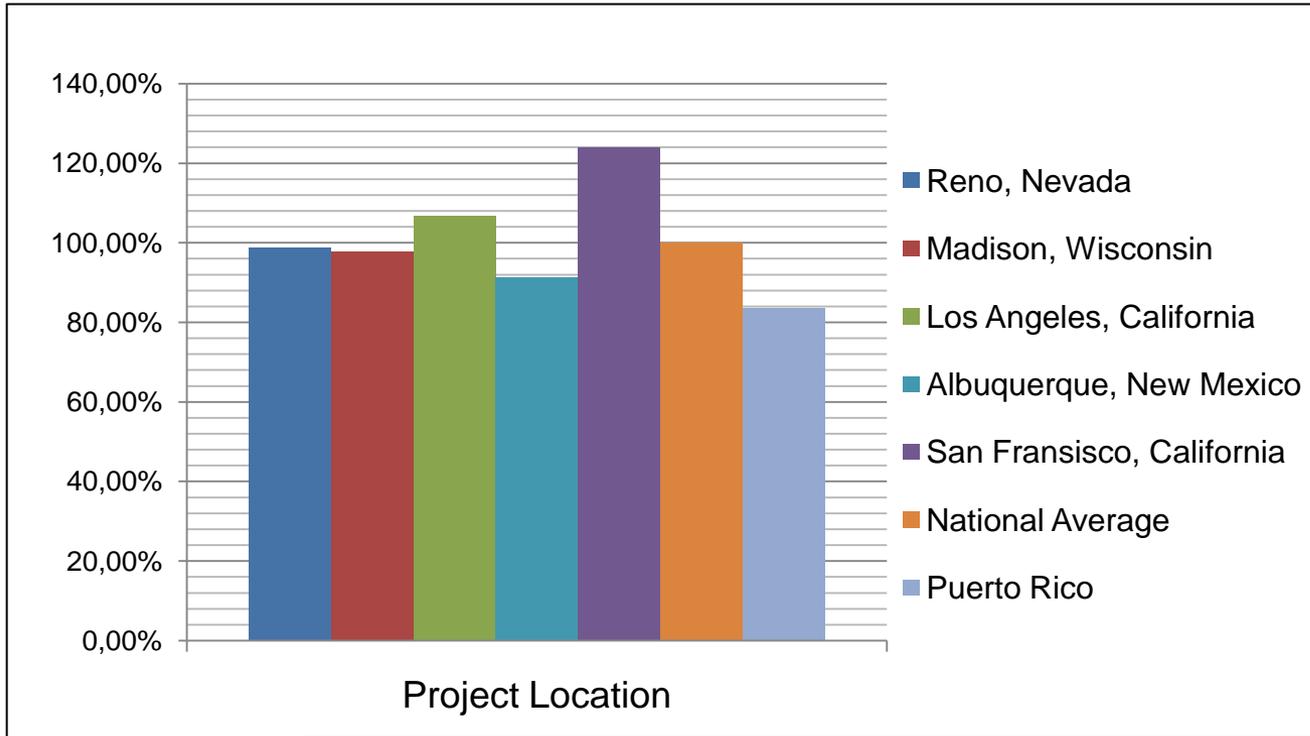
**Masterformat**



**MASTER FORMAT**

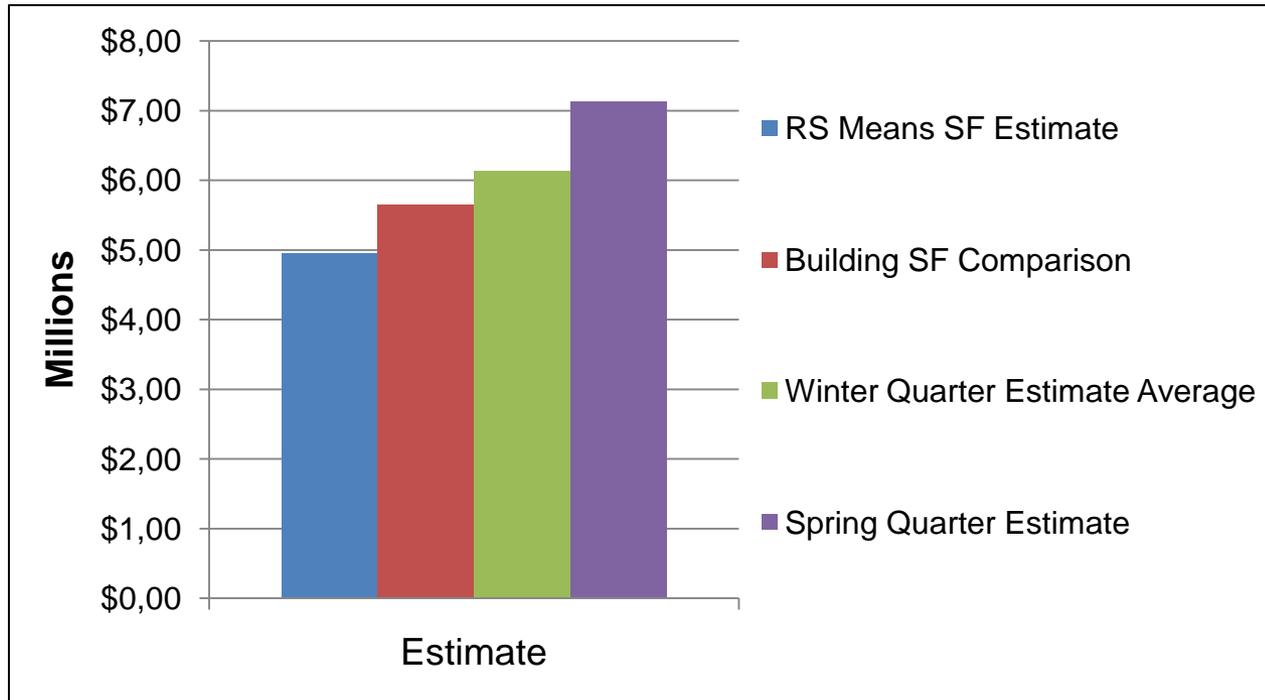
|  |                     |
|--|---------------------|
| Division 01 General Requirements                       | \$ 2,403,800        |
| Division 03 Concrete                                   | \$ 1,379,700        |
| Division 05 Metals                                     | \$ 92,900           |
| Division 07 Thermal and Moisture Protection            | \$ 150,200          |
| Division 08 Openings                                   | \$ 584,600          |
| Division 09 Finishes                                   | \$ 257,600          |
| Division 10 Specialties                                | \$ 41,200           |
| Division 11 Equipment                                  | \$ 261,500          |
| Division 12 Furnishings                                | \$ 111,800          |
| Division 14 Conveying Equipment                        | \$ 45,900           |
| Division 21 Fire Suppression                           | \$ 119,000          |
| Division 22 Plumbing                                   | \$ 81,400           |
| Division 23 Heating, Ventilating, and Air Conditioning | \$ 245,300          |
| Division 26 Electrical                                 | \$ 1,193,500        |
| Division 27 Communications                             | \$ 19,400           |
| Division 31 Earthwork                                  | \$ 136,600          |
| Division 32 Exterior Improvements                      | \$ 12,000           |
| <b>TOTAL 2009</b>                                      | <b>\$ 7,136,600</b> |
| <b>TOTAL 2015</b>                                      | <b>\$ 8,037,000</b> |

# Project Cost - City Comparisons



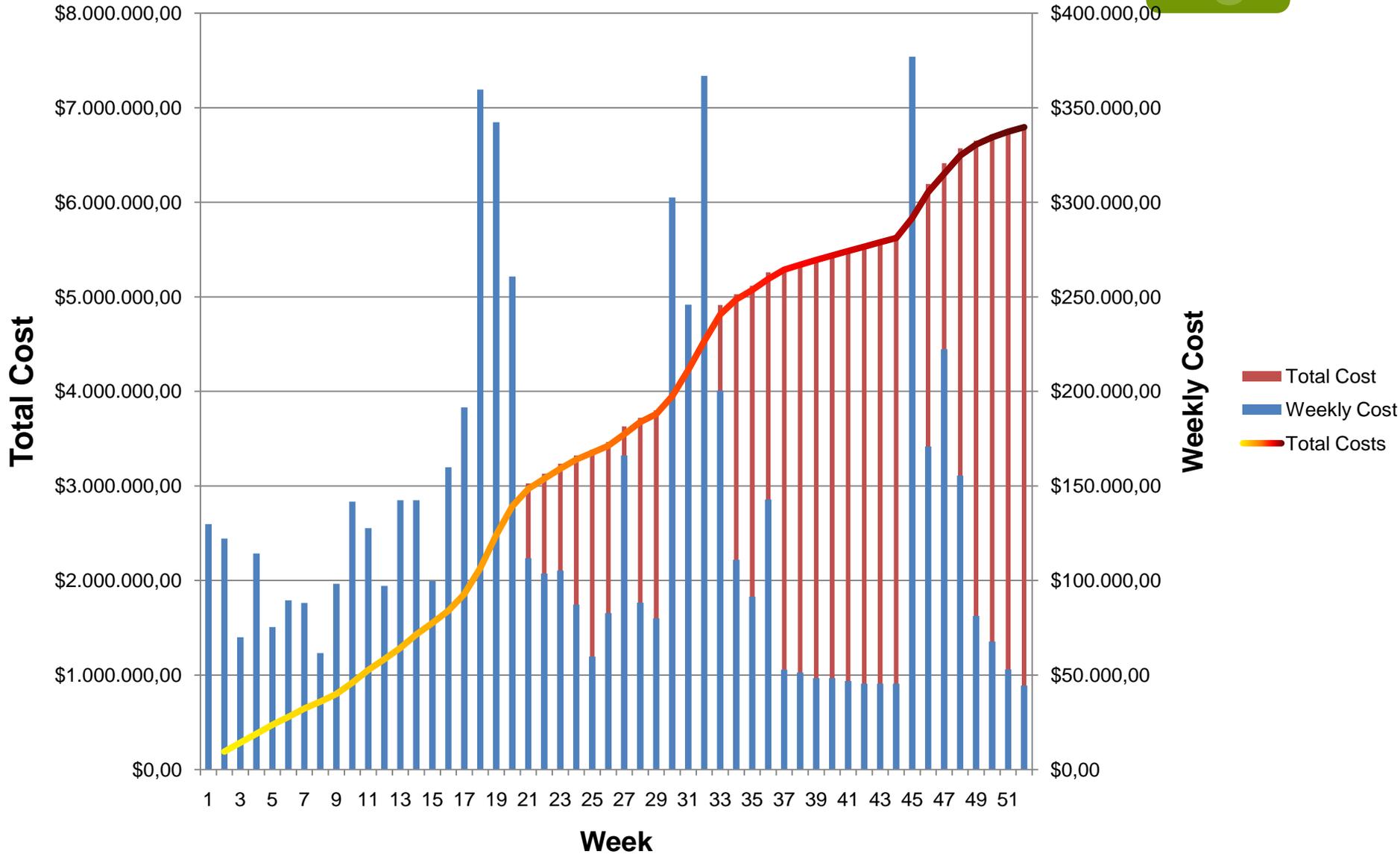
|                           |               |
|---------------------------|---------------|
| Reno, Nevada              | 98.83%        |
| Madison, Wisconsin        | 97.85%        |
| Los Angeles, California   | 106.80%       |
| Albuquerque, New Mexico   | 91.31%        |
| San Francisco, California | 124.00%       |
| National Average          | 100.00%       |
| <b>Puerto Rico</b>        | <b>83.63%</b> |

# Estimate Progression and Lessons Learned



| Method                  | Date   | Cost (million) | \$/SF | Lessons  |
|-------------------------|--------|----------------|-------|--|
| RS Means SF Estimator   | 30-Jan | \$4.95         | \$138 | Poor Quality   |
| Project SF Comparisons  | 19-Feb | \$5.65         | \$160 | High Variability   |
| Winter Quarter Estimate | 12-Mar | \$6.13         | \$173 | Concrete more economically Viable in PR                      |
| Spring Quarter Estimate | 5-May  | \$7.13         | \$237 | Construction Costs in Puerto Rico less than national average |

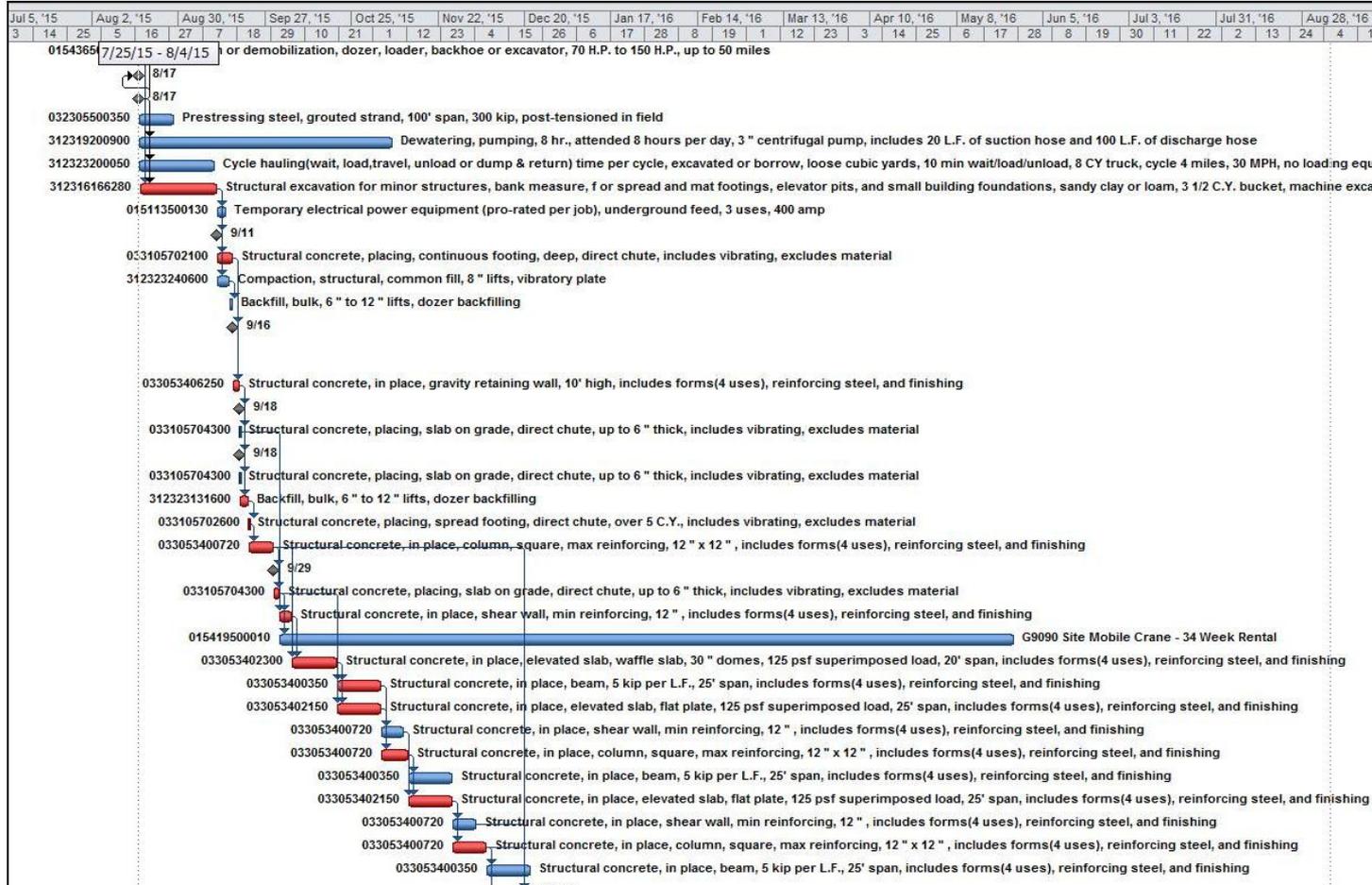
# Construction Cash Flow Diagram



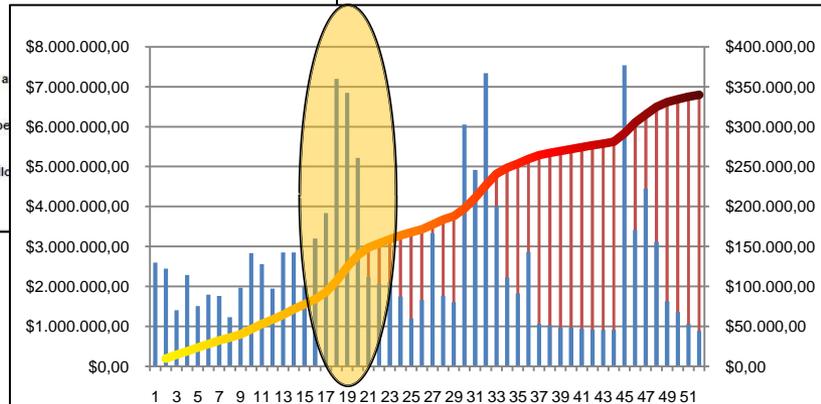
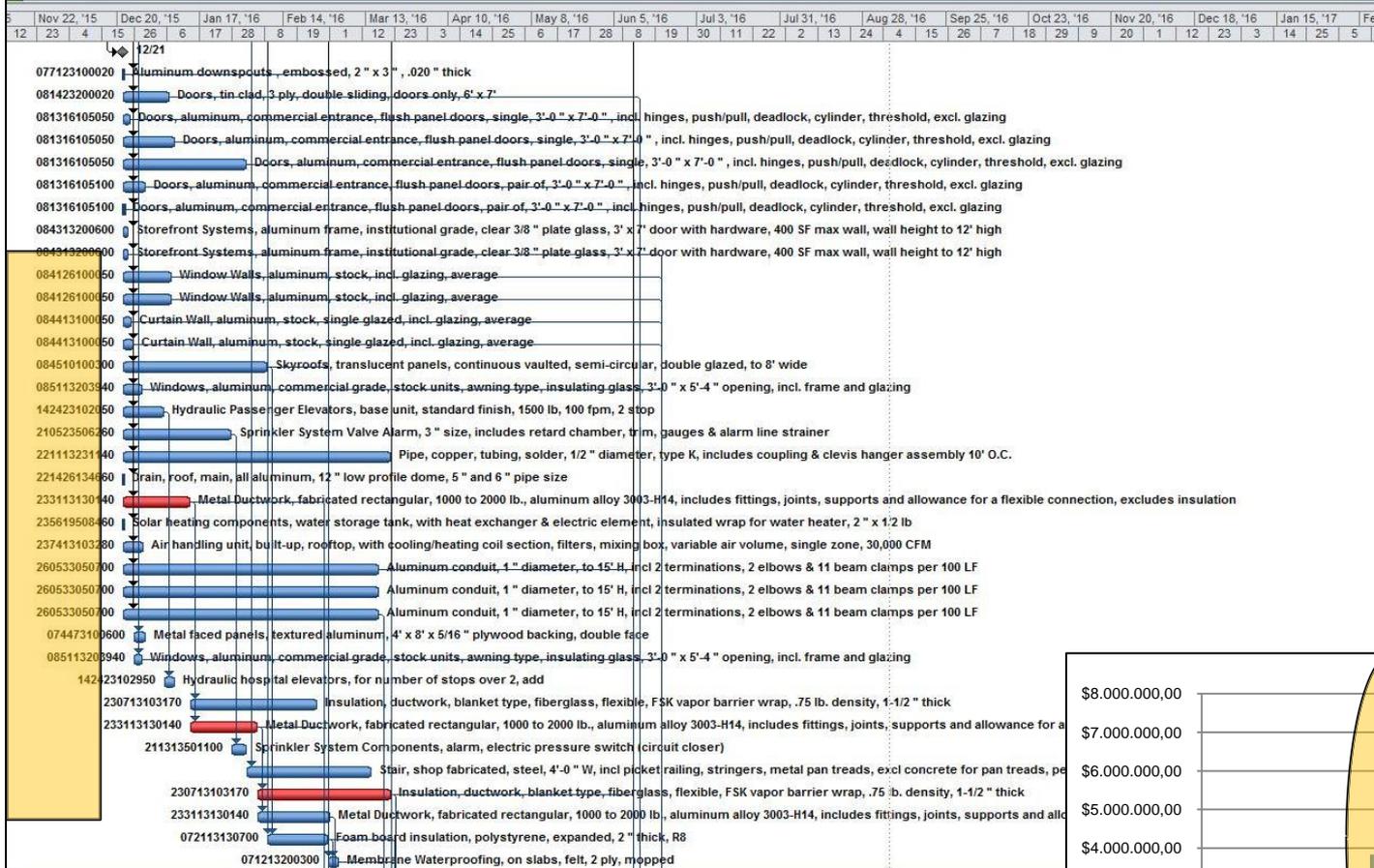
# Project Schedule – Phase I



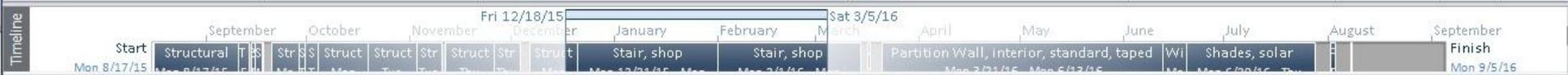
- **Start Date: August 17, 2015**
- **Crane On Site: October 1, 2015**
- **Critical Stage: Superstructure Completion**
- **Milestone I (topping off): December 25, 2015**



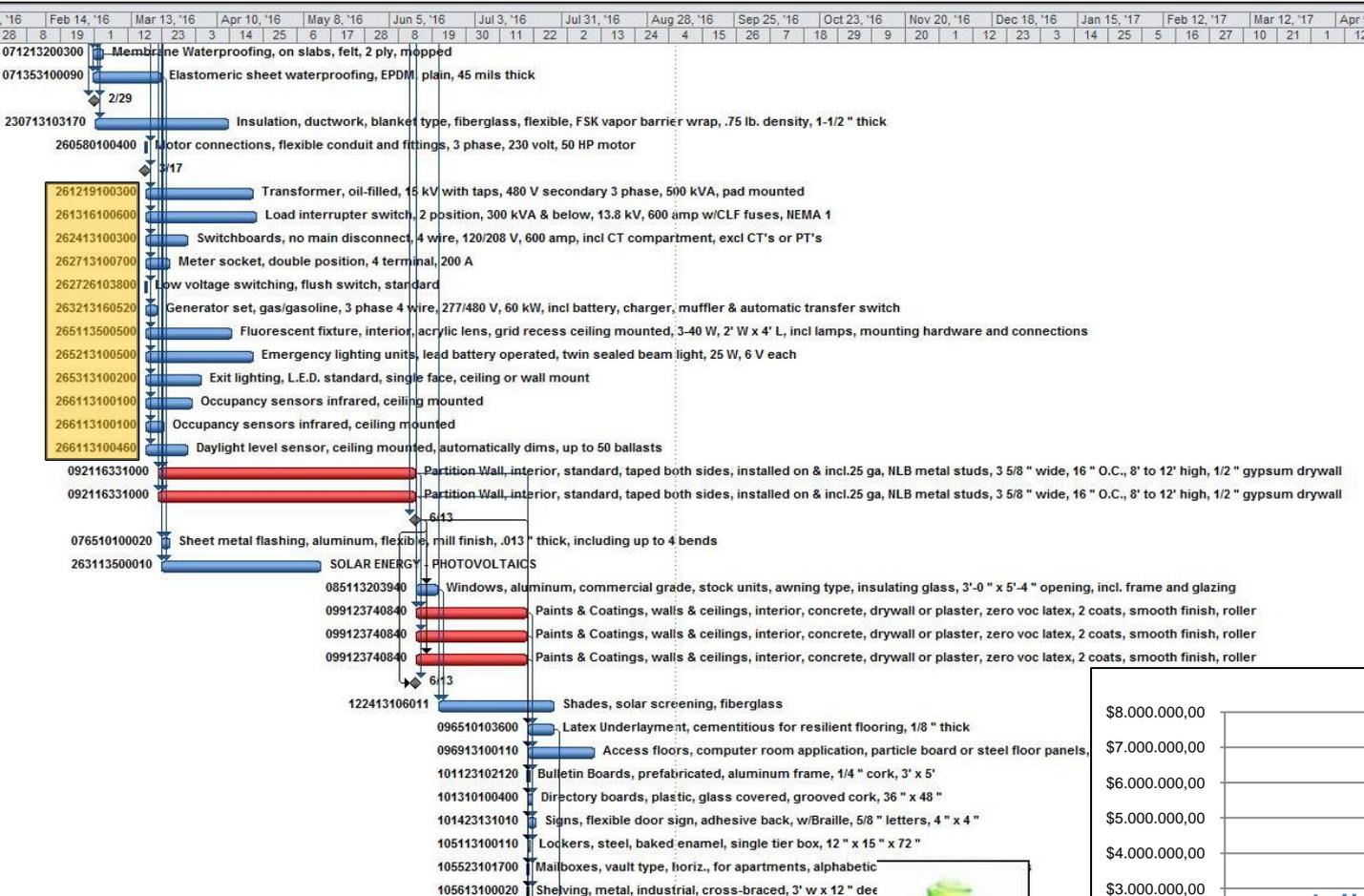
# Project Schedule – Phase II



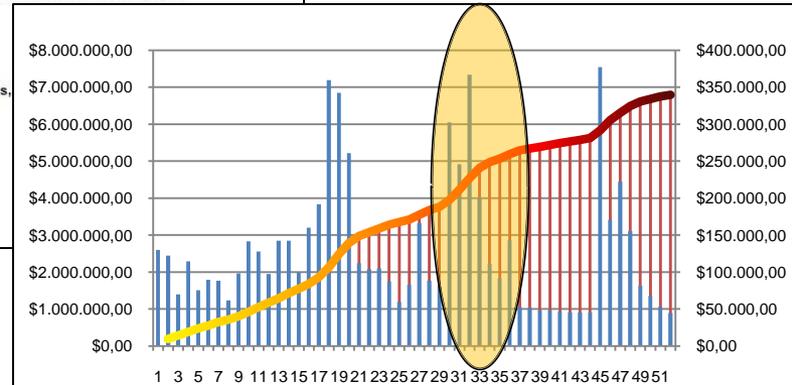
- Critical Stage I: Interiors Startup After Building Top-off
- Critical Path: Mechanical Systems



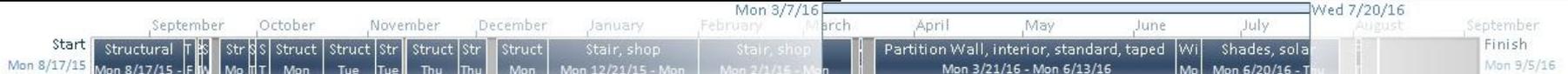
# Project Schedule – Phase III



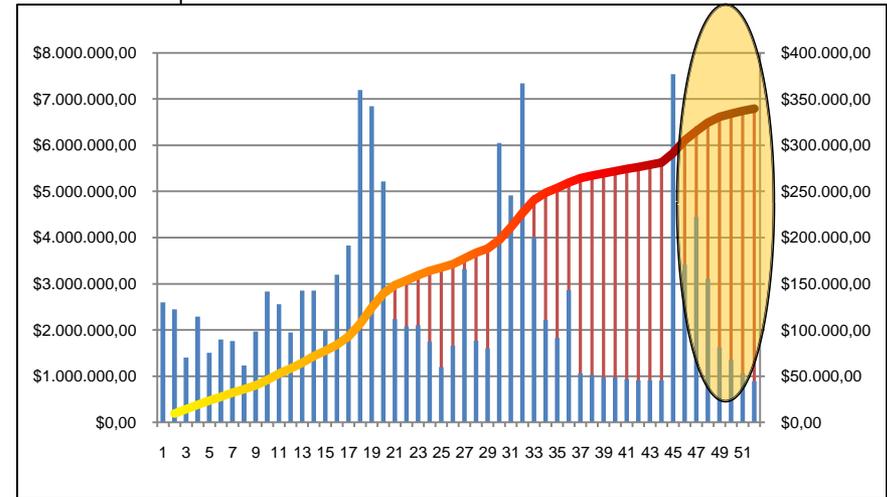
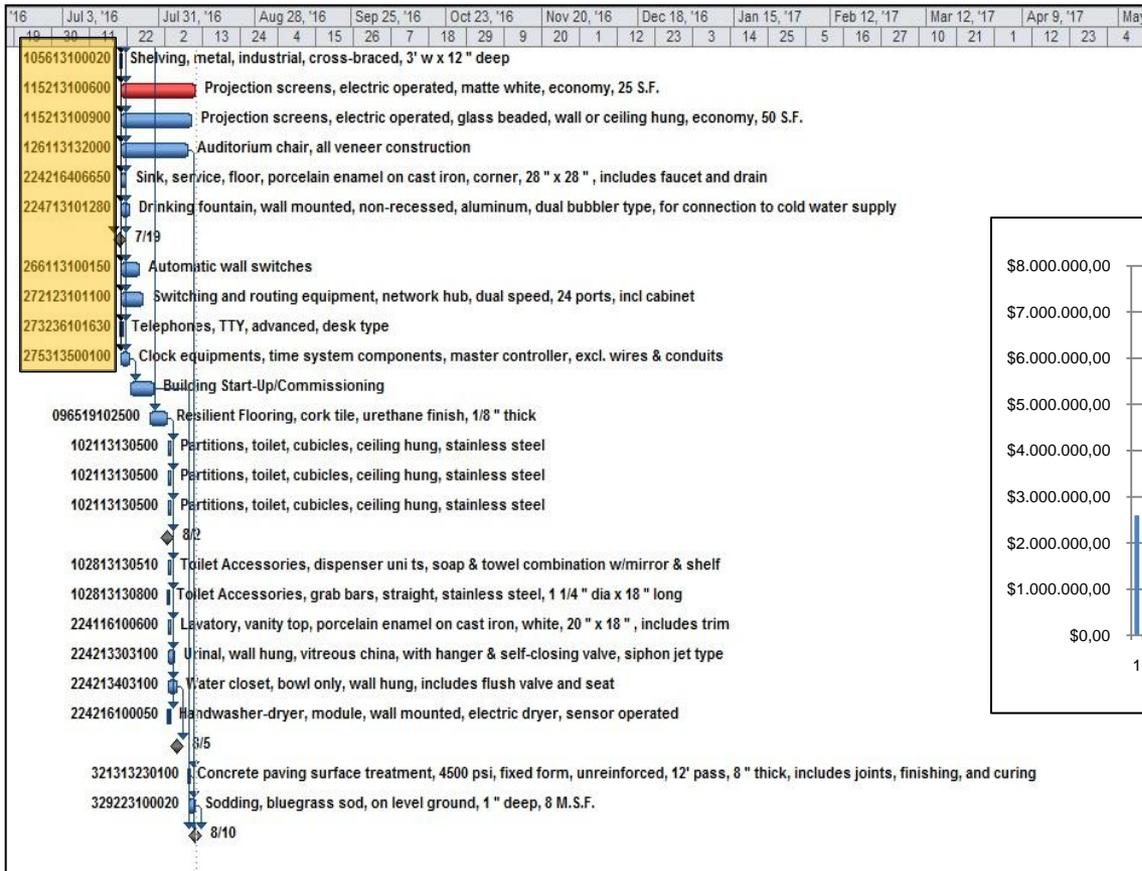
- Critical Stage II: Electrical Fixture Installation
- Critical Path: Partition Walls and Painting
- Milestone II: (crane off site): May 26, 2016



Timeline



# Project Schedule – Phase VI



- **Critical Stage III: Interior Shades, solar Installation**
- **Building Start-Up/Commissioning: July 22, 016**
- **Milestone III (Substantial Completion): August 5, 2016**
- **Building Closeout and Turnover: August 10, 2016**



# Clash Detection – CM/MEP



Clash Detective

Batch Rules Select Results Report

Results

| Name     | Status | Distance | Descri |
|----------|--------|----------|--------|
| Clash291 | New    | -0.10m   | Hard   |
| Clash292 | New    | -0.10m   | Hard   |
| Clash293 | New    | -0.10m   | Hard   |
| Clash294 | New    | -0.10m   | Hard   |
| Clash295 | New    | -0.10m   | Hard   |
| Clash296 | New    | -0.10m   | Hard   |
| Clash297 | New    | -0.10m   | Hard   |
| Clash298 | New    | -0.10m   | Hard   |
| Clash299 | New    | -0.10m   | Hard   |
| Clash300 | New    | -0.10m   | Hard   |
| Clash301 | New    | -0.10m   | Hard   |
| Clash302 | New    | -0.09m   | Hard   |
| Clash303 | New    | -0.09m   | Hard   |
| Clash304 | New    | -0.09m   | Hard   |
| Clash305 | New    | -0.09m   | Hard   |
| Clash306 | New    | -0.09m   | Hard   |
| Clash307 | New    | -0.09m   | Hard   |
| Clash308 | New    | -0.09m   | Hard   |
| Clash309 | New    | -0.09m   | Hard   |
| Clash310 | New    | -0.09m   | Hard   |
| Clash311 | New    | -0.09m   | Hard   |
| Clash312 | New    | -0.09m   | Hard   |
| Clash313 | New    | -0.09m   | Hard   |
| Clash314 | New    | -0.09m   | Hard   |
| Clash315 | New    | -0.09m   | Hard   |

Display

- Select Filter
- Auto Reveal
- Auto Zoom
- Save Viewpoint
- Animate Transitions
- Highlight All
- Dim Other
- Transparent Dimming
- Hide Other
- Simulation

View in Context

View All

Item 1

Item Name: Body  
Item Type:

05-02-10-fianl-Radiator

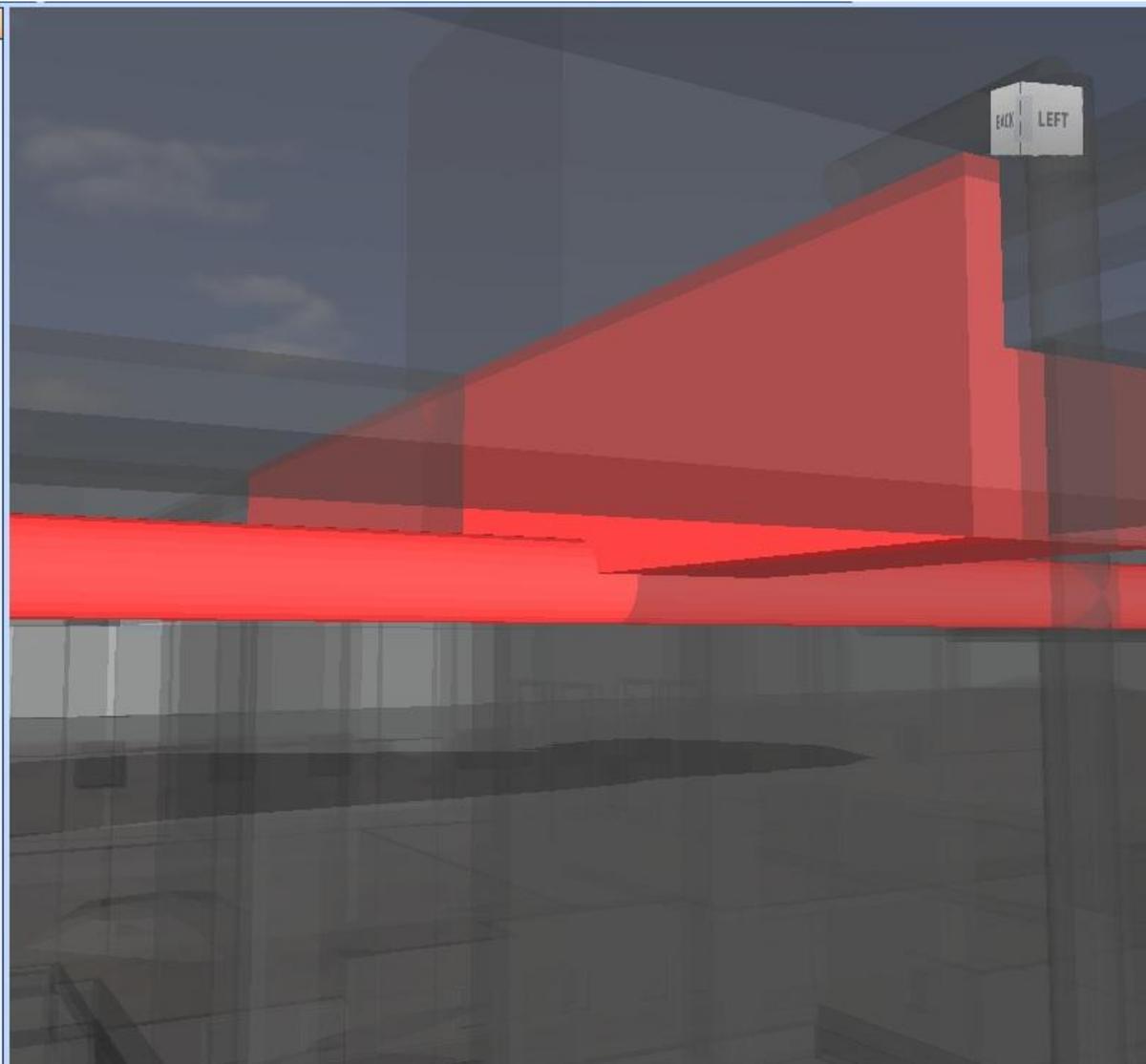
Highlight Select SwitchBack

Item 2

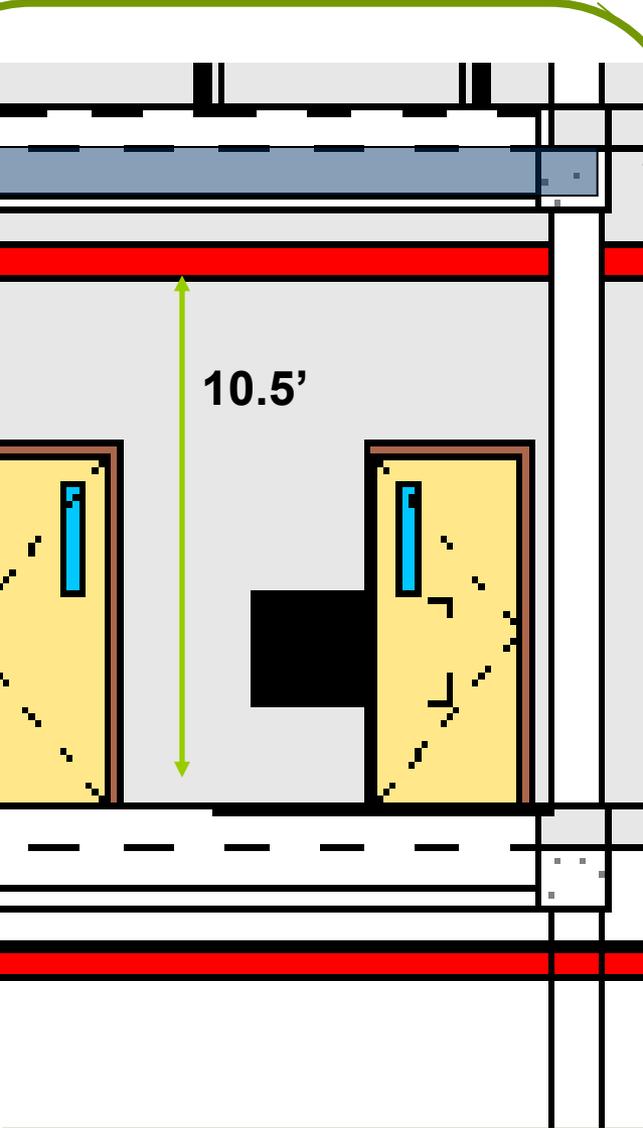
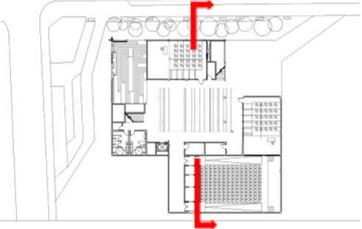
Item Name: Body  
Item Type:

05-02-10-fianl-Radiator

Highlight Select SwitchBack



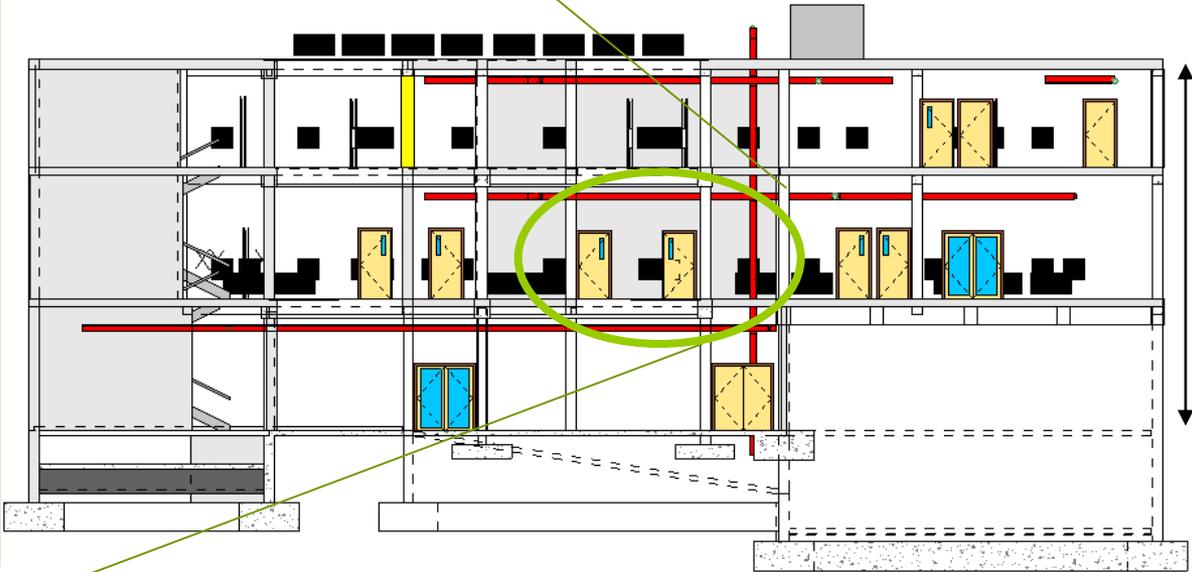
# MEP Section



1' Structure

1.5' MEP

10.5'



30'

MEP

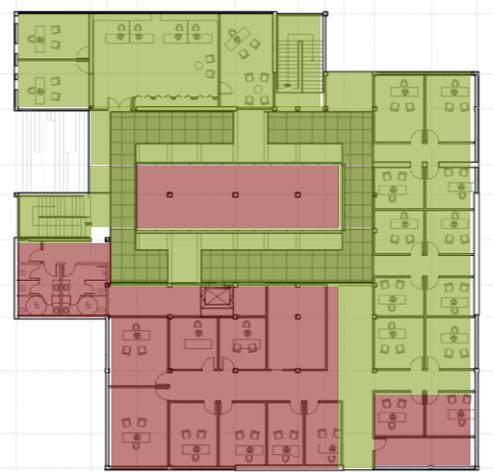
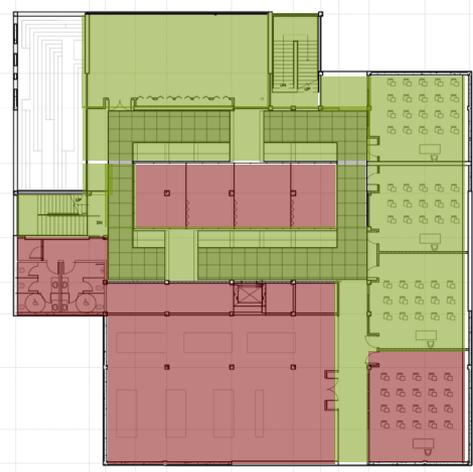
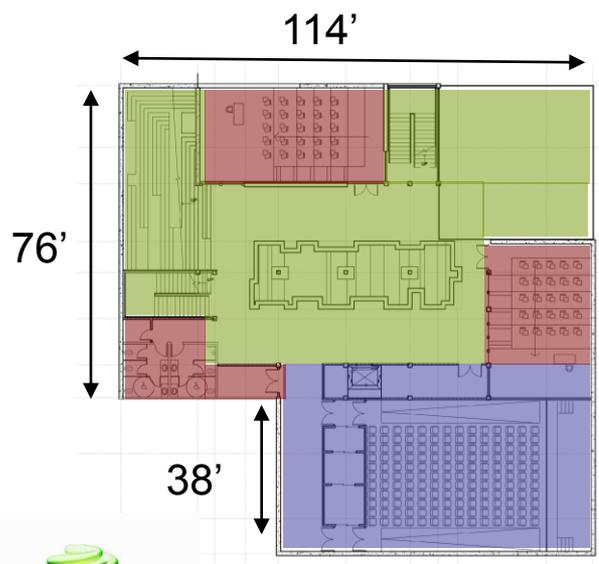
# MEP Design



- Chilled Beams
- Large Classrooms
- Computer Lab
- South facing façade
- ”Island”

- Raised Flooring
- Auditorium

- Natural Ventilation
- Corridors
- Lobby
- North and East Facades



# Sustainable Systems



## Daylight Controls

- Dim lights on the perimeter and in the center area



## Multi Service Chilled Beams

- Are prefabricated and generate less labor
- Help decrease clashes between systems

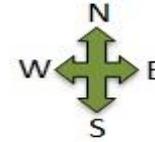


## Raised Flooring

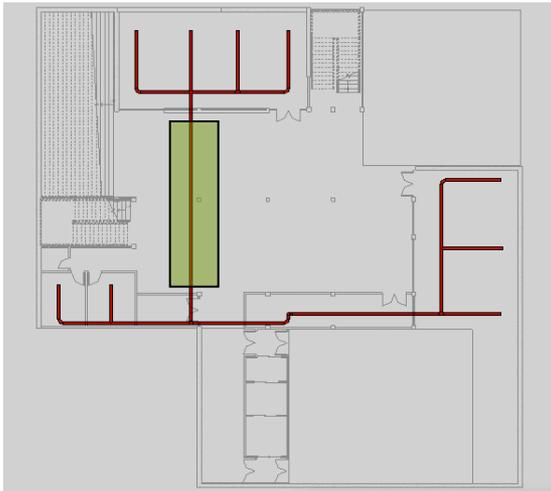
- Reduced Maintenance Cost



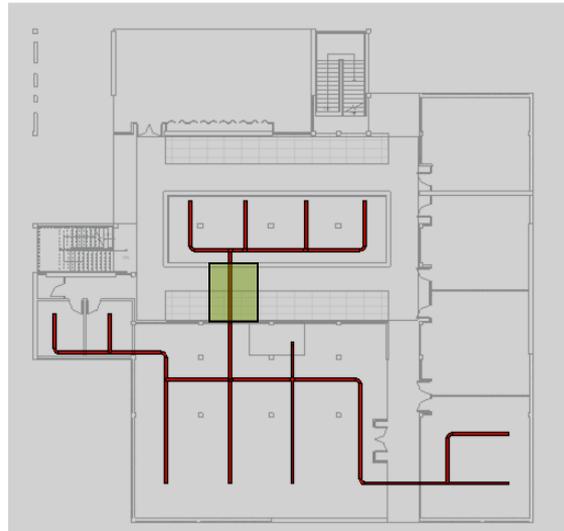
# MEP Distribution



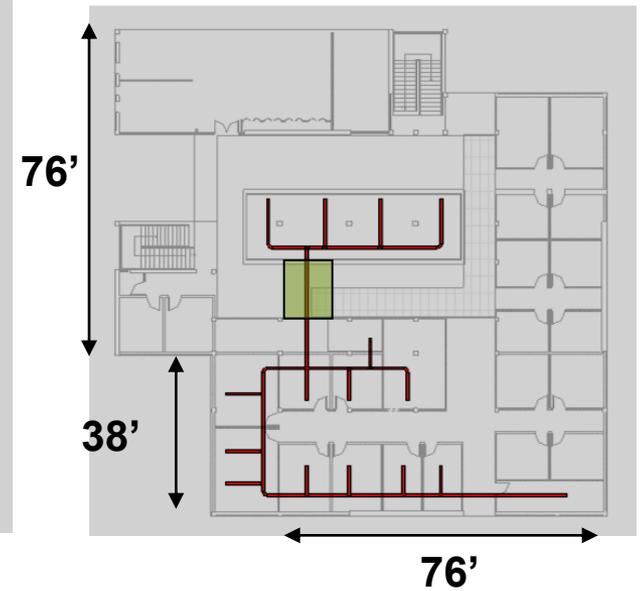
First Floor



Second Floor



Third Floor





## Natural Ventilation CA Title 24 Requirements

- All spaces are within 20 ft of operable window
- Openings are at least 5% of floor area

## Mechanical Ventilation CA Title 24 Requirements

Larger of

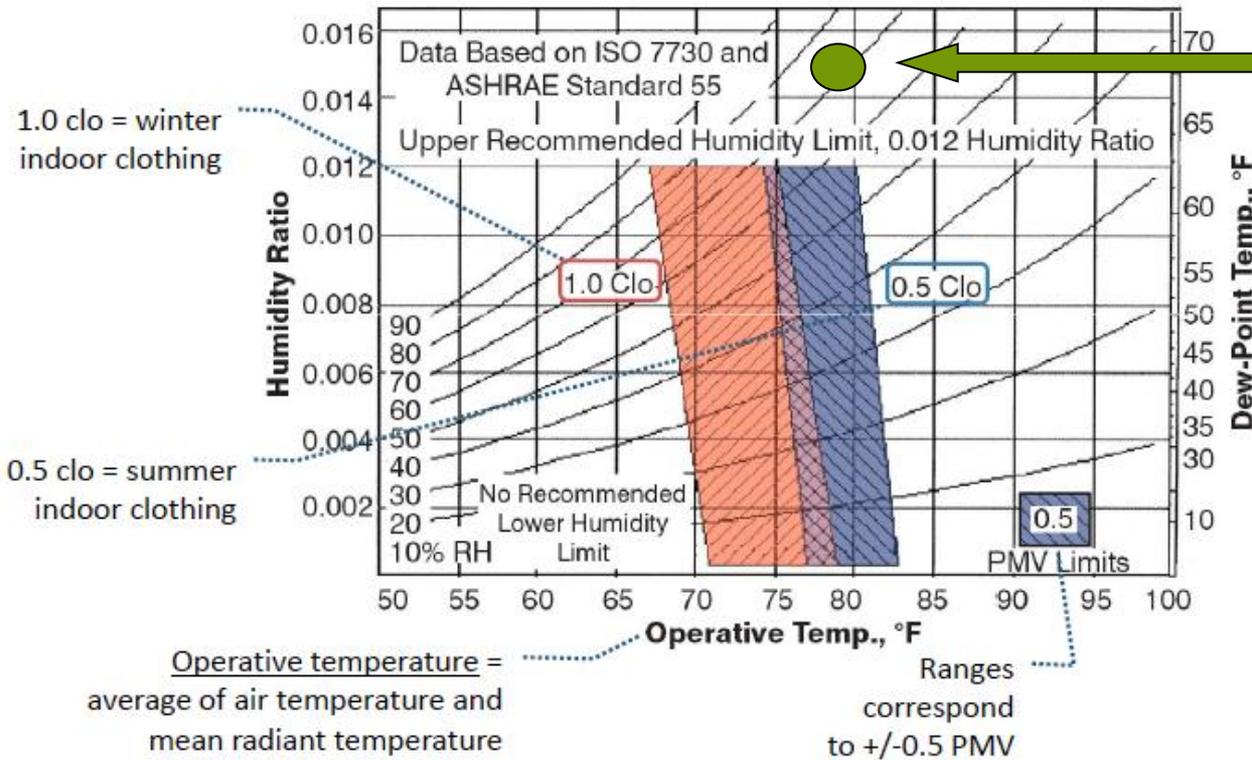
1. 15cfm/person
2. Minimum rate (cfm/sqft) based on building type. Typically = .15cfm/sqft



# Thermal Comfort Humidity



## Standard 55-2004 Comfort Range



~.5 Clo

**Knee Length Skirt  
+ short sleeve shirt**

**Or Shorts + short  
sleeve shirt**



# Thermal Comfort

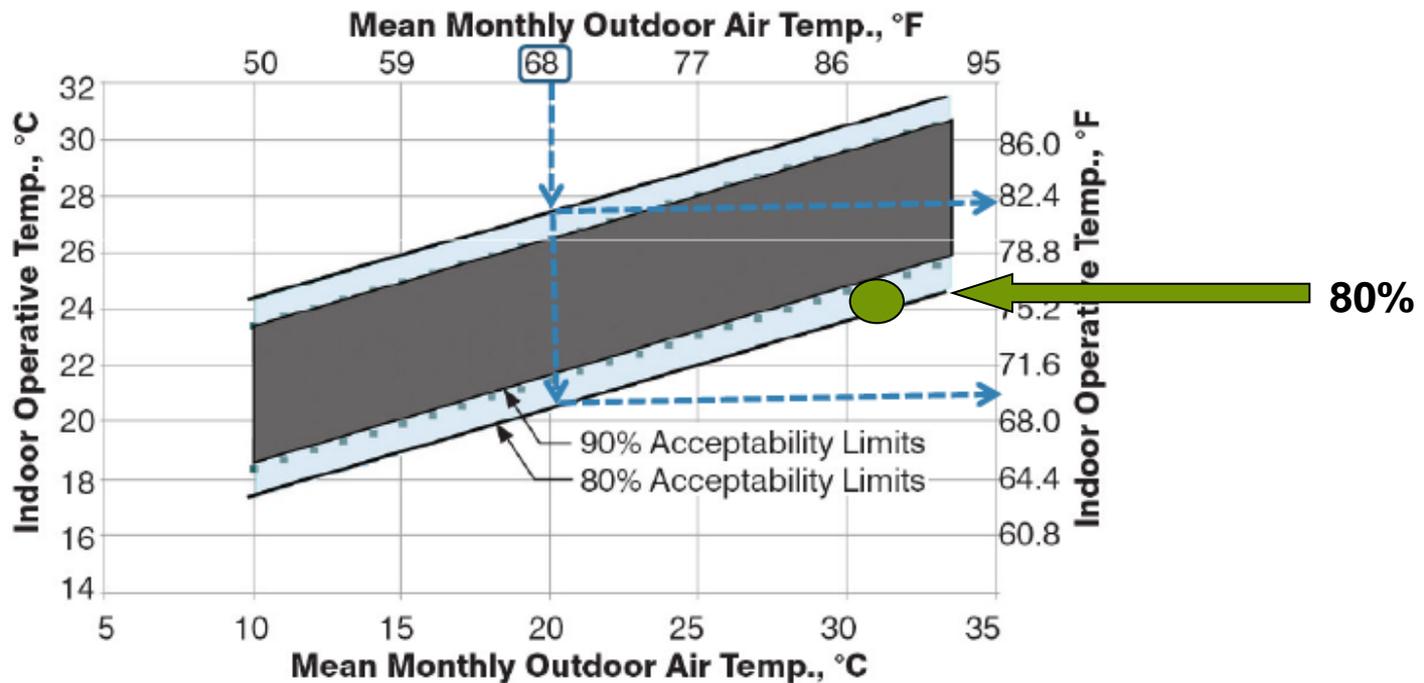
## Natural Ventilation Areas



### ASHRAE Standard 55-2004

### Adaptive Comfort Model for Nat Vent Spaces

(Applies when occupants have access to operable windows)



# Lighting Design



From the IESNA Ninth Edition Handbook (2000)

| Category | Activity                  | Illuminance Target (footcandles) |
|----------|---------------------------|----------------------------------|
| A        | Circulation Orientation   | 2                                |
| B        | Public Areas              | 5                                |
| C        | Simple Tasks              | 10                               |
| D        | Large Tasks Good Contrast | 30                               |
| E        | Small Tasks Good Contrast | 50                               |
| F        | Small Tasks Poor Contrast | 100                              |

+/- 33% variation acceptable

**Use 3800 lumen lamps in the Multi Service Chilled Beams with 58W per lamp**

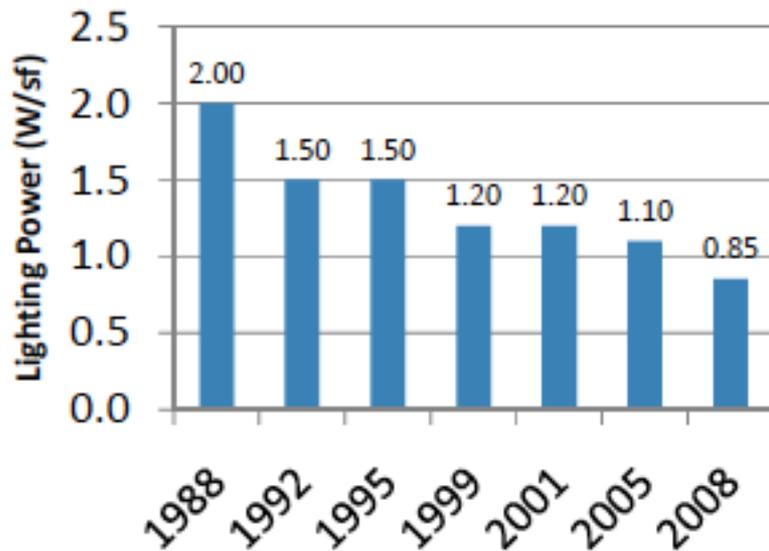
| Area            | Number of Lamps |
|-----------------|-----------------|
| Auditorium      | 51              |
| Large Classroom | 20              |
| Lab             | 38              |
| Small Classroom | 10              |
| “Island”        | 17              |
| Office          | 4               |
| Corridor        | 5               |
| Lobby           | 17              |

# Lighting Power Benchmark

## CA Title 24 Area Category Method



**CA Title 24**



| Room             | Allowable(W) | Actual(W) |
|------------------|--------------|-----------|
| Auditorium       | 4275         | 2863      |
| Large Classrooms | 1296         | 1085      |
| Small Classrooms | 717          | 600       |
| Lab              | 2530         | 2119      |
| “Island”         | 1320         | 947       |
| Offices          | 224          | 204       |
| Corridors        | 807          | 225       |
| Lobby            | 2574         | 957       |



# Ventilation Needed Per Room



CA Title 24  
Higher of the Two

|  | Sqft | People/SF | People | cfm/person | cfm | cfm | ASHRAE cfm |
|--|------|-----------|--------|------------|-----|-----|------------|
|--|------|-----------|--------|------------|-----|-----|------------|

## First Floor

|             |      |       |        |    |         |        |         |
|-------------|------|-------|--------|----|---------|--------|---------|
| Auditorium  | 2850 | 0.143 | 407.55 | 15 | 6113.25 | 3049.5 | 2208.75 |
| Office      | 5000 | 0.01  | 50     | 15 | 750     | 750    | 550     |
| Restroom    | 286  | 0.01  | 2.86   | 15 | 42.9    | 42.9   | 31.46   |
| Classroom E | 950  | 0.05  | 47.5   | 15 | 712.5   | 361    | 294.5   |
| Classroom N | 943  | 0.05  | 47.15  | 15 | 707.25  | 358.34 | 292.33  |

## Second Floor

|           |      |      |       |    |         |       |        |
|-----------|------|------|-------|----|---------|-------|--------|
| Lab       | 2346 | 0.01 | 23.46 | 15 | 351.9   | 351.9 | 258.06 |
| Restroom  | 286  | 0.01 | 2.86  | 15 | 42.9    | 42.9  | 31.46  |
| Classroom | 1350 | 0.67 | 904.5 | 15 | 13567.5 | 202.5 | 4603.5 |

## Third Floor

|          |      |      |       |    |        |        |        |
|----------|------|------|-------|----|--------|--------|--------|
| Office   | 2183 | 0.01 | 21.83 | 15 | 327.45 | 327.45 | 240.13 |
| Office   | 925  | 0.01 | 9.25  | 15 | 138.75 | 138.75 | 101.75 |
| Restroom | 286  | 0.01 | 2.86  | 15 | 42.9   | 42.9   | 31.46  |

## Total

22797.3    5668.14    8643.4

LEED                    29636.49    7368.582

11236.42

# Internal Heat Gains



- Office Equipment

Laptops - 40W

Desktops - 80W

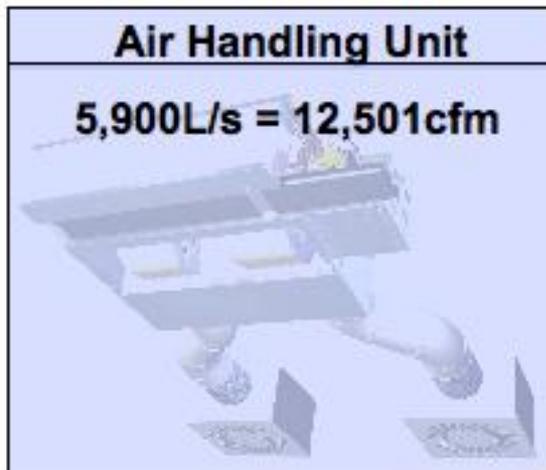
Projectors - 100W

- Occupants

Light office work - 225Btu/hr

- Lighting

58W per Lamp



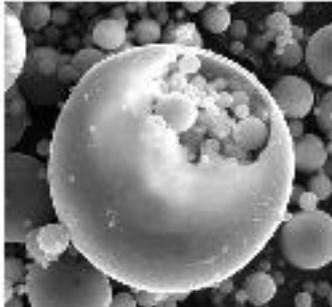
|             | Feet of Beams |
|-------------|---------------|
| Auditorium  | 300           |
| Large Class | 78            |
| Small Class | 70            |
| Lab         | 80            |
| Seminar     | 10            |
| Office      | 4             |

# Sustainable Materials



- EcoRock Drywall
- 80% less energy to produce
- 80% recycled materials
- Can be fully reutilized
- Most mold-resistant

- 



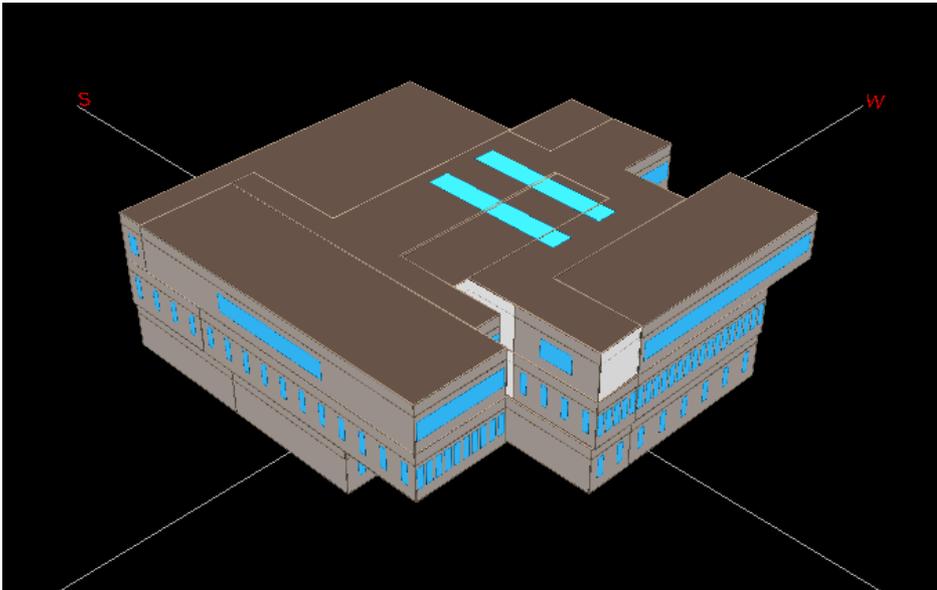
- Fly Ash
- 1 ton reduces 1 ton of CO2 emissions
- Stronger and more durable
- Increases Workability
- Decreases heat of hydration

- 



- Bamboo Flooring
- 1 ton reduces 1 ton of CO2 emissions
- Stronger and more durable
- Easier to pour

# eQuest Model



## Goals

- Most accurate representation of the actual building envelope.
- Accurate load inputs
- Multiple HVAC systems

## Customized Features

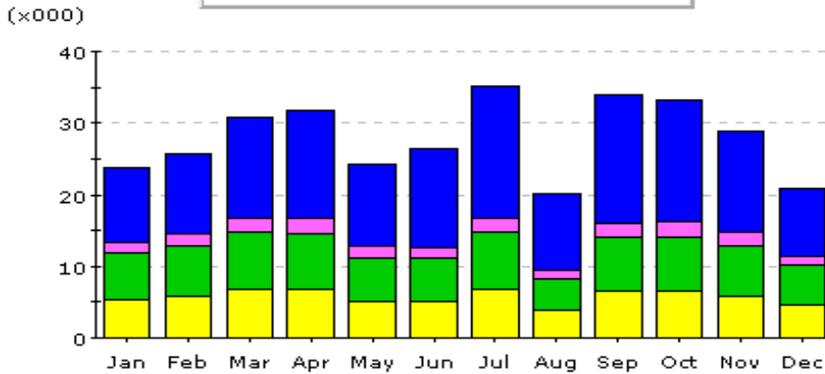
- Glazed roof openings
- Daylight controls
- Natural Ventilation



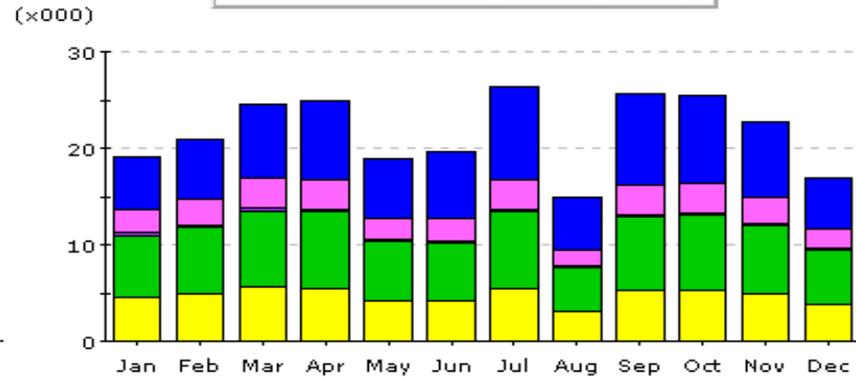
# Baseline vs Radiator



Electric Consumption (kWh)



Electric Consumption (kWh)



- Area Lighting
- Exterior Usage
- Task Lighting
- Pumps & Aux.
- Misc. Equipment
- Ventilation Fans

- Water Heating
- Refrigeration
- Ht Pump Supp.
- Heat Rejection
- Space Heating
- Space Cooling

**334,000kwh/yr**

**259,000kwh/yr**



# Energy Benchmarks



## Target Energy Performance Results (estimated)

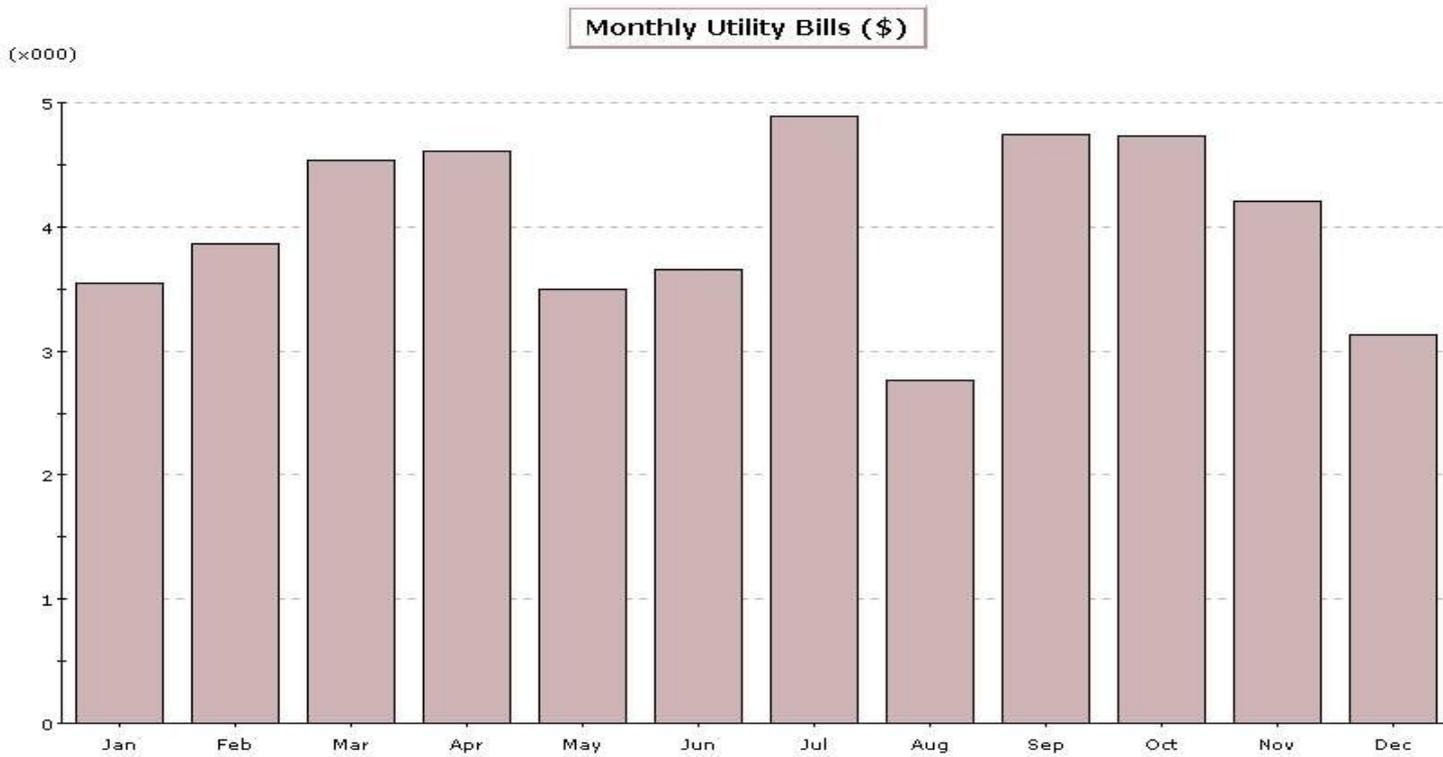
| Energy  | Design    | Target    |
|---|-----------|-----------|
| <a href="#">Energy Performance Rating (1-100)</a>             | 100       | 75        |
| <a href="#">Energy Reduction (%)</a>                          | 76        | 26        |
| <a href="#">Source Energy Use Intensity (kBtu/Sq. Ft./yr)</a> | 99        | 311       |
| <a href="#">Site Energy Use Intensity (kBtu/Sq. Ft./yr)</a>   | 30        | 93        |
| <a href="#">Total Annual Source Energy (kBtu)</a>             | 3,054,149 | 9,567,869 |
| <a href="#">Total Annual Site Energy (kBtu)</a>               | 914,416   | 2,864,631 |
| <a href="#">Total Annual Energy Cost (\$)</a>                 | \$49,580  | \$155,321 |



## kWh/year Comparison to Building in SoCal

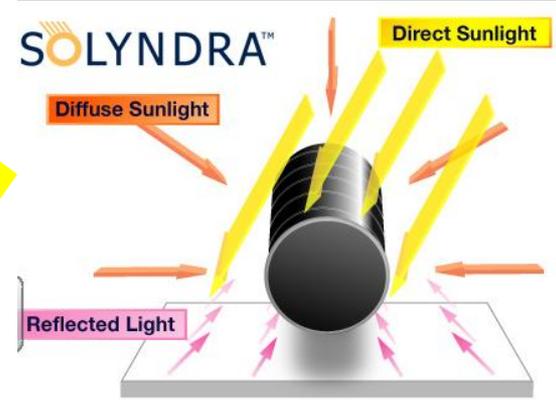
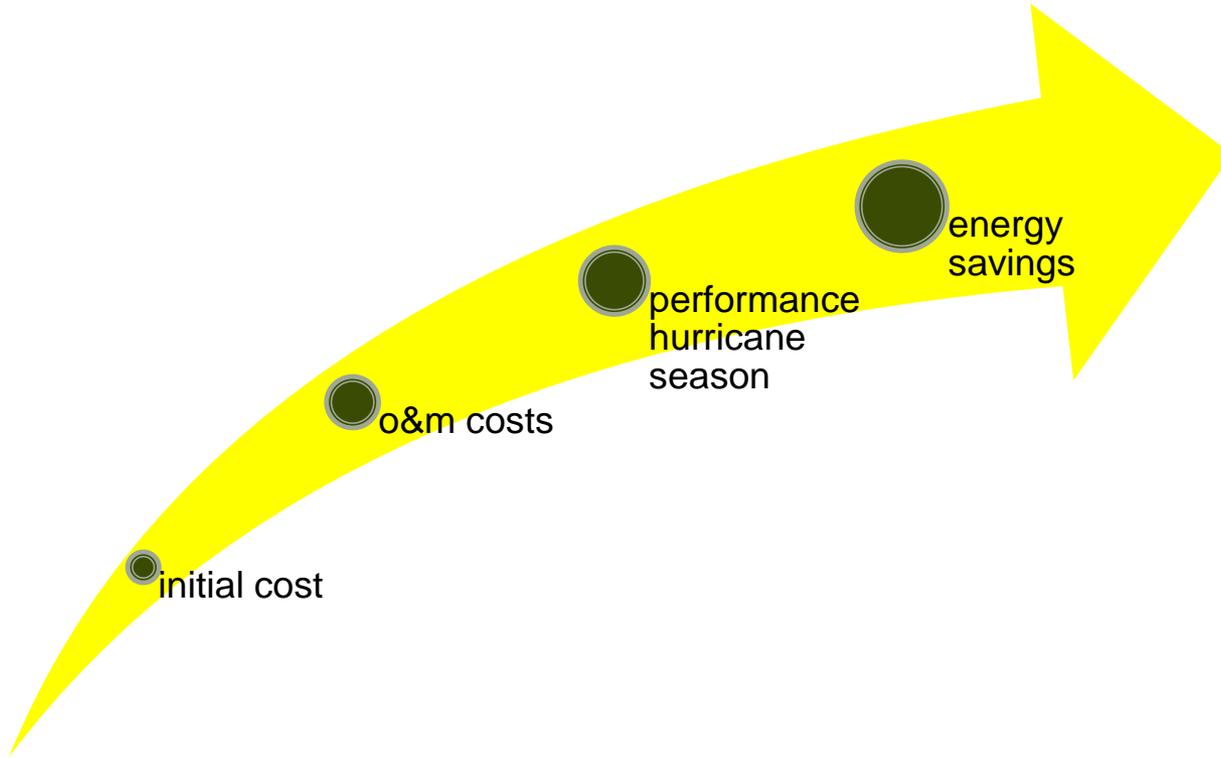
| End Use              | kWh/year       | kWh/year       |
|----------------------|----------------|----------------|
| Cooling              | 83750          | 87340          |
| Ventilation          | 60500          | 31070          |
| Interior Lighting    | 134750         | 56840          |
| Office Equipment     | 24750          | 81650          |
| <a href="#">Misc</a> | 10750          |                |
| <b>Total</b>         | <b>314,500</b> | <b>256,900</b> |

# Monthly Utility Bill

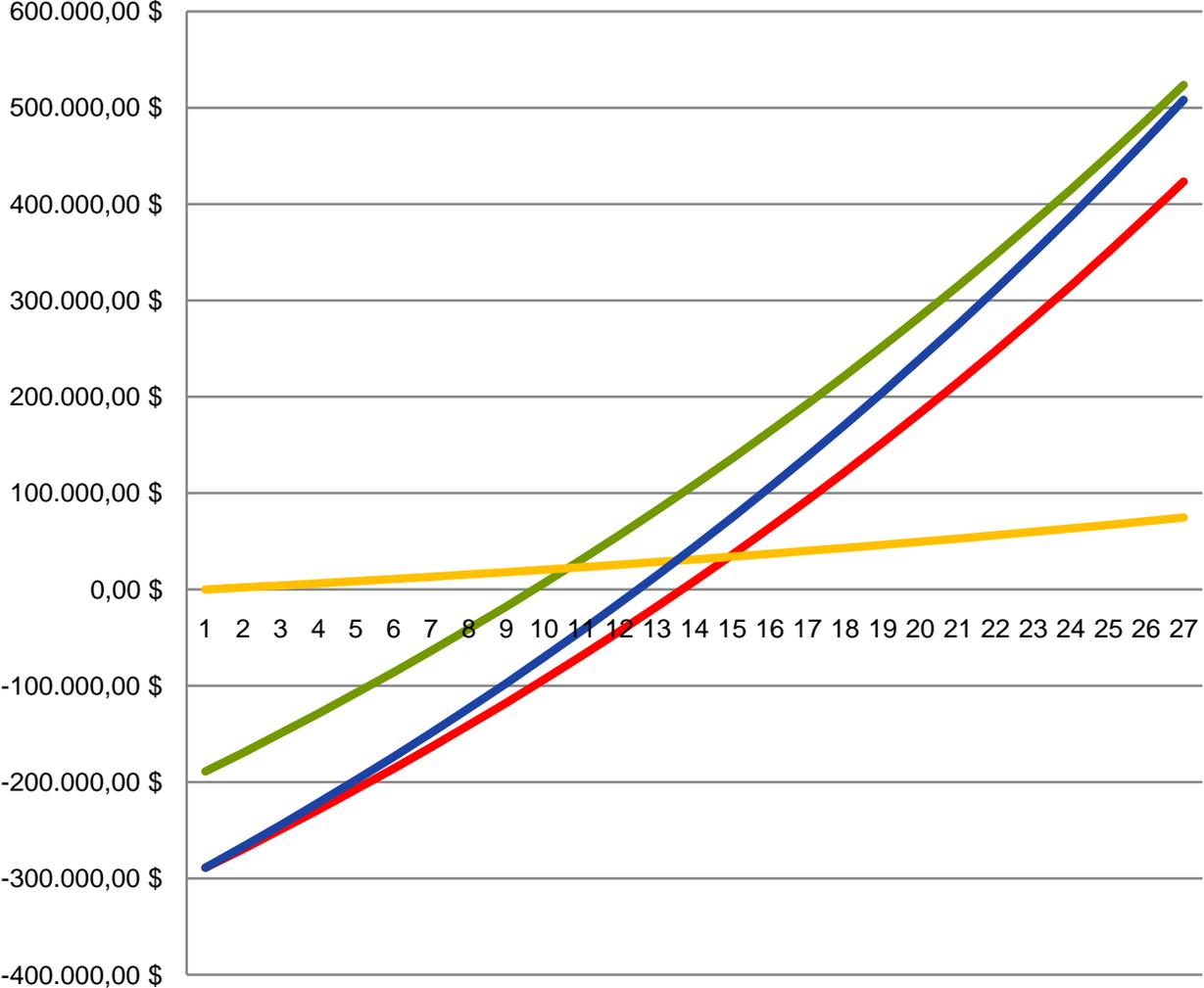


Annual Bill: \$48,163

# Decision PV-Systems



# Trade-Off Analysis PV-Panels



- State Rebate
- Without State Rebate
- rent of roof
- buyback



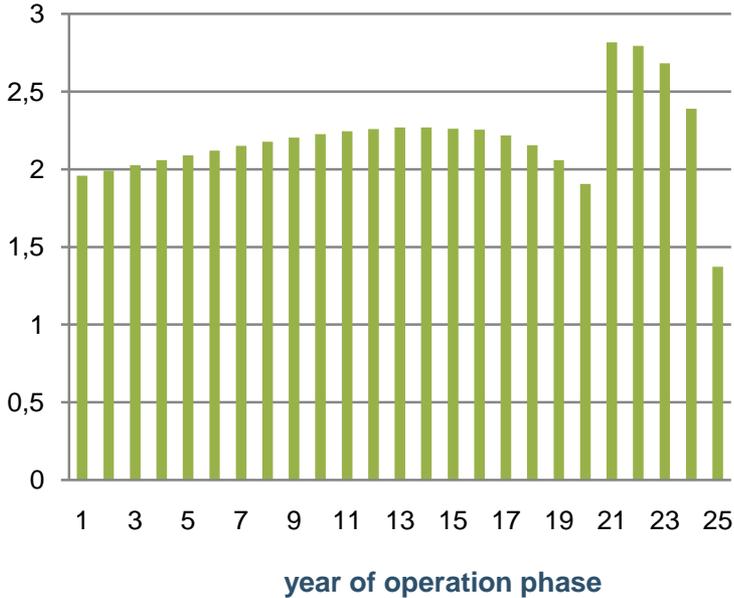
# Project Cash-Flow



# Debt Service Coverage Ratio/ Loan Life Coverage Ratio



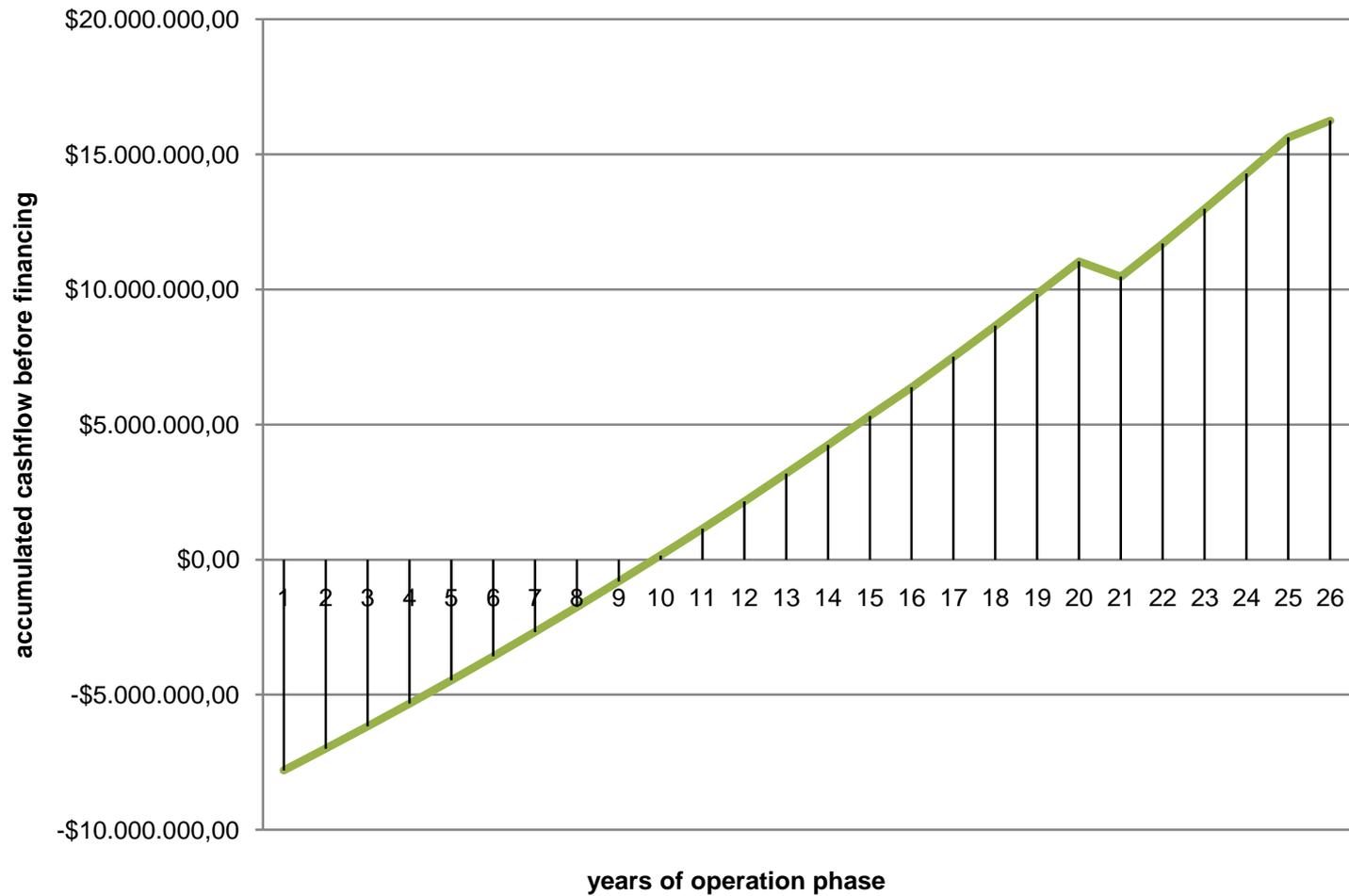
DSCR



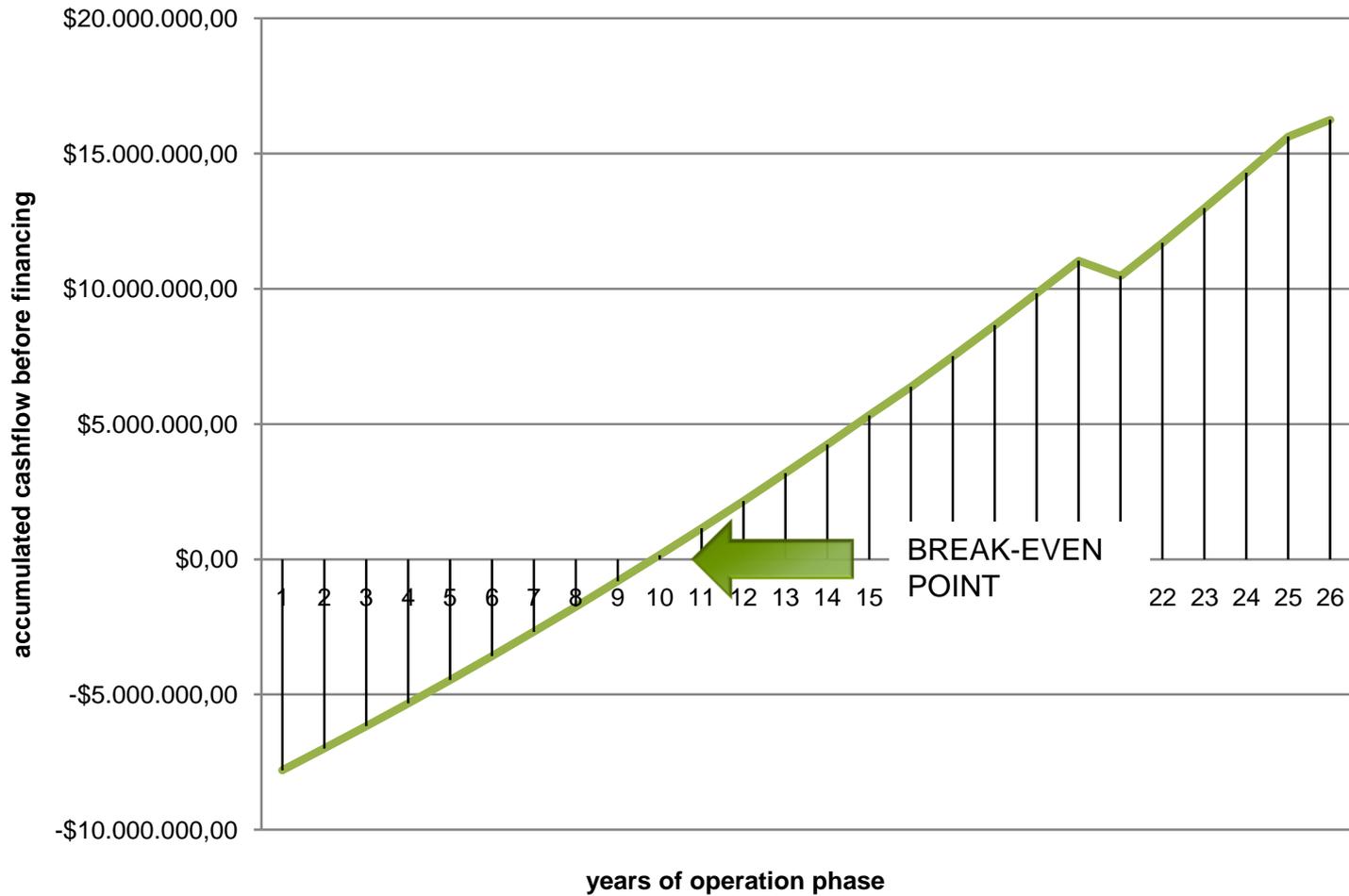
LLCR



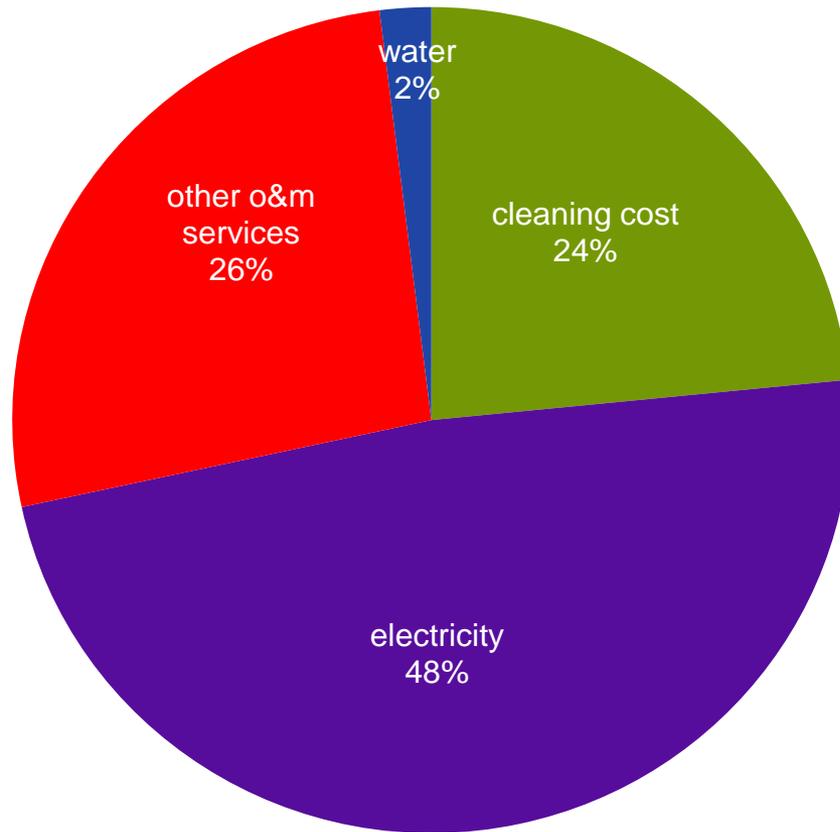
# Point of Break-Even



# Point of Break-Even



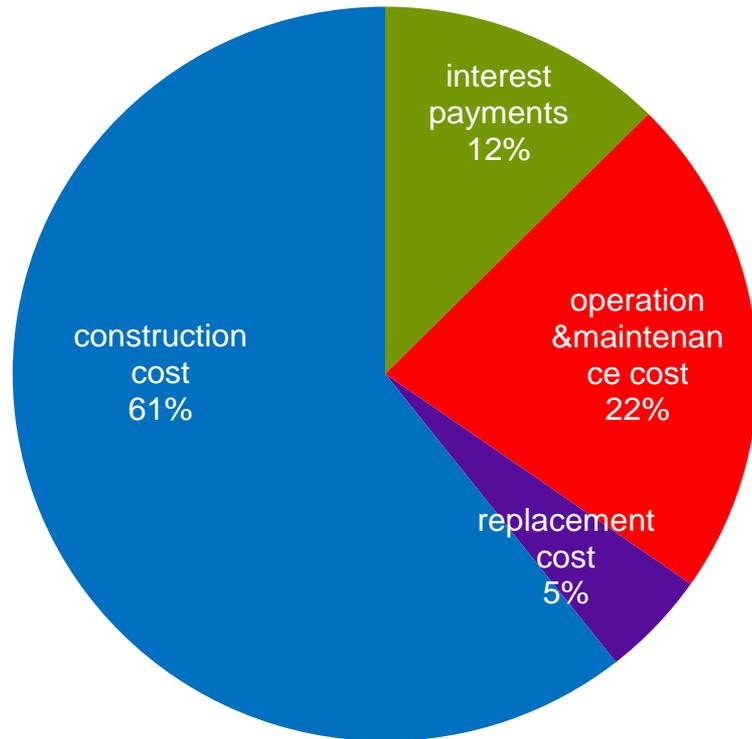
# O&M Cost



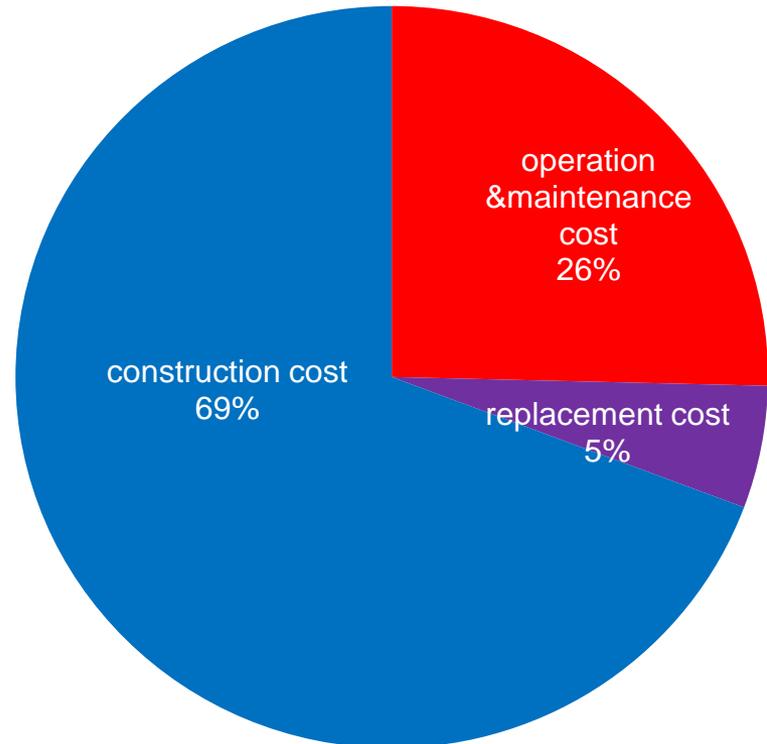
# Life-Cycle Cost Present Value



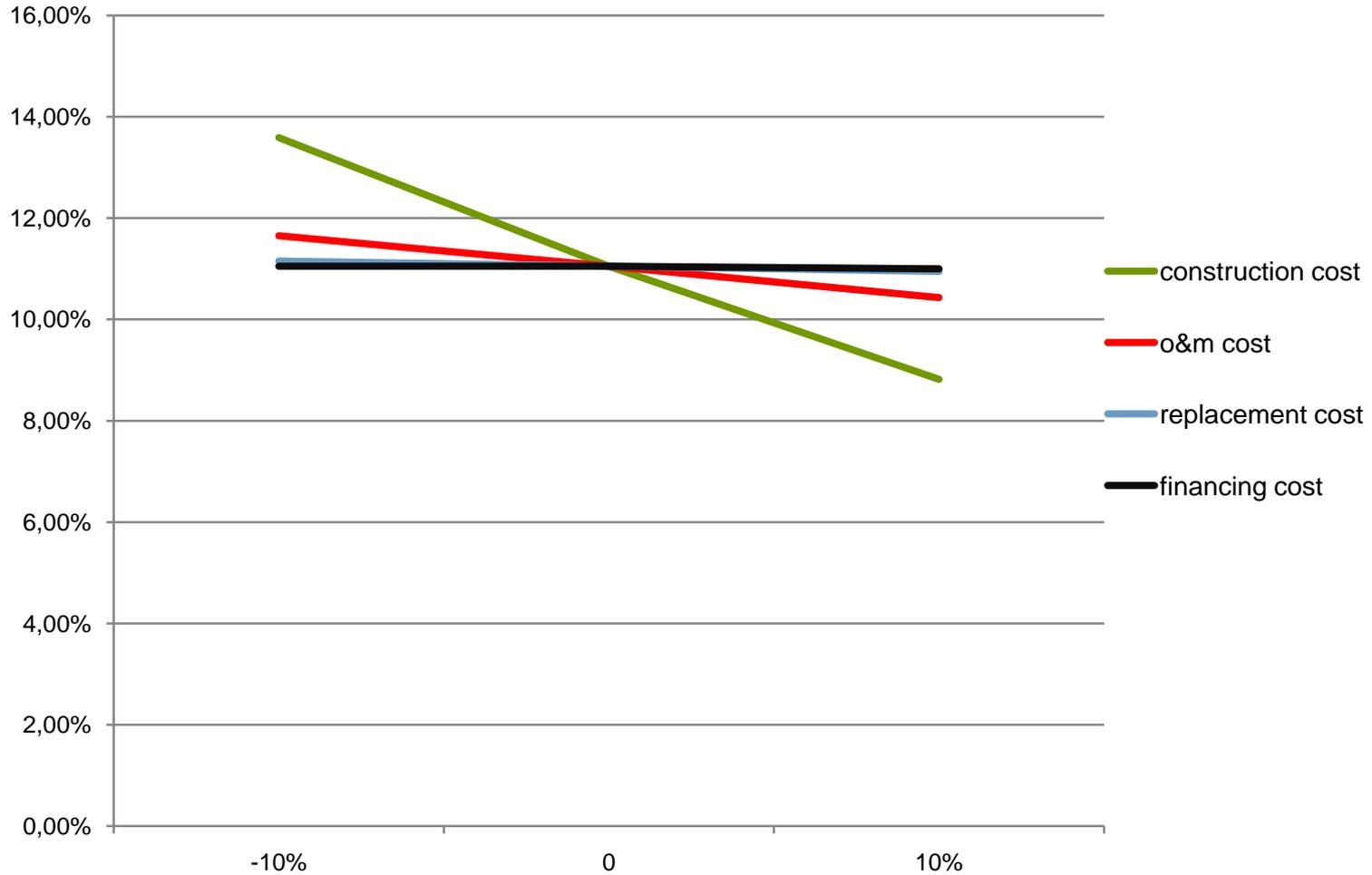
**with financing cost**



**without financing cost**



# Sensitivity Analysis



# LEED Certification



|                              |           |
|------------------------------|-----------|
| Sustainable Site             | 15        |
| Water Efficiency             | 6         |
| Energy and Atmosphere        | 15        |
| Material and Resources       | 4         |
| Indoor Environmental Quality | 12        |
| Innovation in Design         | 3         |
| <b>TOTAL</b>                 | <b>55</b> |



**LEED SILVER  
CERTIFICATION**



# Sustainable Performance



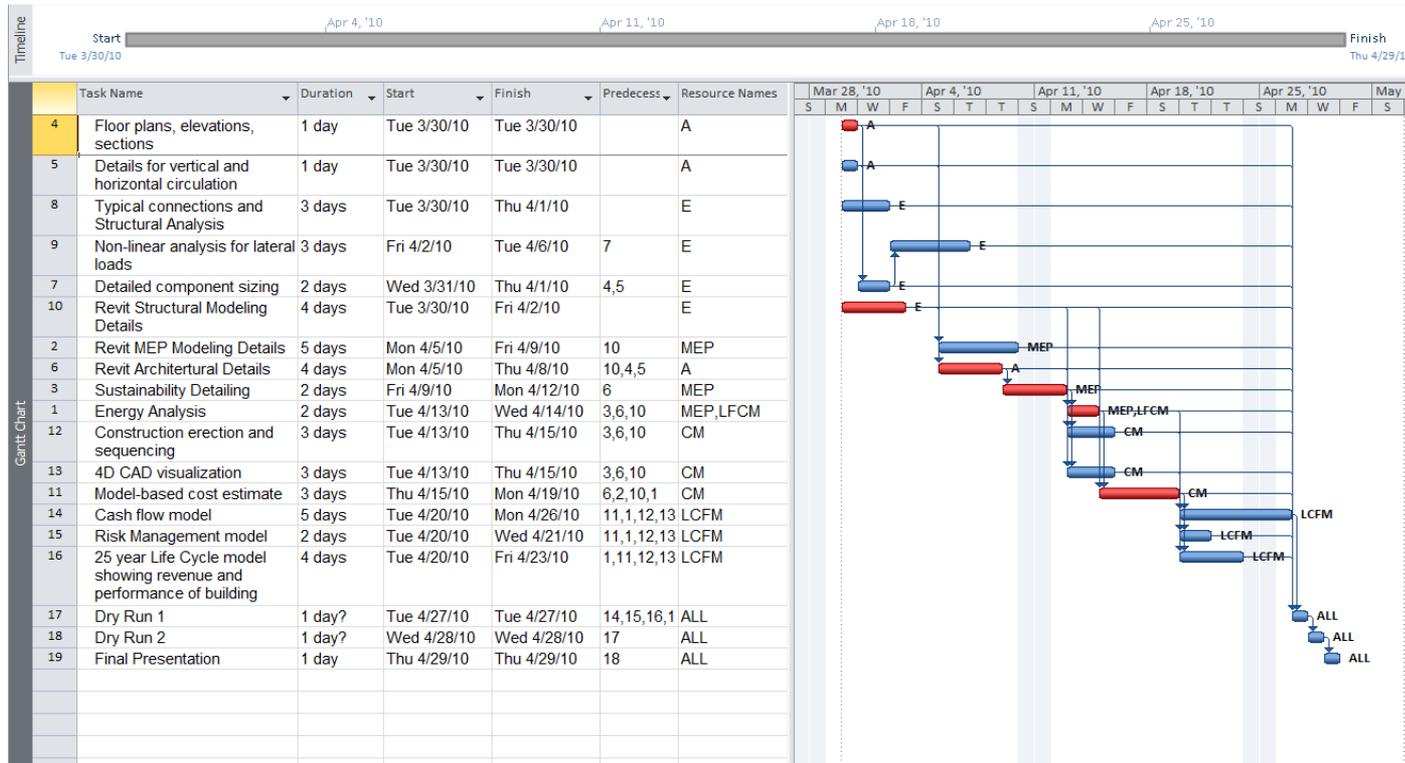
- use of natural ventilation
- sensing & monitoring of lighting
- use of solar energy
- use of local materials/ by-products
  - Fly Ash , EcoRock
- open spaces → permability/ connectivity
- ability of adaption of changed specification



# Team Process



- Winter Quarter Presentation March 5<sup>th</sup>
- Meeting After Winter Presentation to define goals for Spring Quarter
- Early April Schedule Pushed back by “Island” Development
- Revit “check out” and “check in” model
- Façade development between architect and construction manager



# Model Coordination



---

 **Me:** Using model, start at: 6:25pm PST Apr 22 ▾  
● End at: 9:55pm PST

---

 **Sandra:** hey everybody! i will be available from 2Pst onwards till i don't know maybe 4-5 PST. i will be online at skype Apr 23 ▾

---

 **Marielis\*:** using model: 9am -11:30am PST. friday apr 23. Apr 23 ▾  
opened file : CM-4.22.2010\_Radiator\_Model\_(floor attachment)v5  
new file saved as: A-4.23.2010\_Radiator\_Model\_v6

---

 **Marielis\*:** using model: 12:30pm -2:30PST PST. friday apr 23. Apr 23 ▾  
opened file : A-4.23.2010\_Radiator\_Model\_v6  
new file saved as: A-4.23.2010\_Radiator\_Model\_v6

---

 **Zan:** Hi Marielis, so I took the 4.17.2010 for the change in wall ...I have Apr 23 ▾  
● not uploaded yet but seems you have another model..I will change your updatest model then ..I have made small change so i dont think it it take a lot of time. So I will use A-4.23.2010\_Radiator\_model\_v6

Can I confirm A-4.23.2010\_Radiator\_Model\_v6 is the most update one and I will finish using model: 7:20pm -9:00PST PST. friday apr 23.

---

 **Zan:** Hi guys...you want to add anything specific on Sunday agenda? you Apr 23 ▾  
● add edit it on googledoc...For now, I just have two items but I will add one more about the presenation soon...free feel to add yours

---

 **Zan:** opened file : A-4.23.2010\_Radiator\_Model\_v6 Apr 23 ▾  
● new file saved as:4.23.2010\_Radiator\_Model\_v7

---

 **Marielis\*:** using model: 8pm -9PST PST. sat.apr.24 Apr 24 ▾  
opened file : 4.23.2010\_Radiator\_Model\_v7  
new file saved as:4.24.2010\_Radiator\_Model\_v8

# Communication



RECALL



A

E

MEP

C

LC

Axel Seifert

Afann Naqvi

Kristen and Tim and GPLA

Prof. Renate Fruchter

Erik Kneer

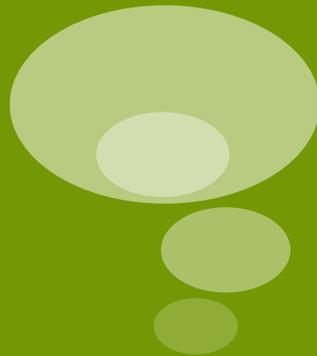
Prof. Helmut Krawinkler,

David Bendet

Greg Luth

Prof. Humberto Cavallin

Thank You!



Andrea Jungbecker

Cole Roberts

Prof. Cristina Algaze

Prof. Ronnie Borja

Willem Kymmel

Henry Tooryani

Glenn Katz

Matthias Ehrlich

