

**NIRUPAMA** KOTCHARLAKOTA  
**NATHAN** HILL  
**ANNA** BURISCH  
**CAMILA** HERNANDEZ  
**CHRISTINE** BAUMER  
**WENJIN** SITU  
**LI** DENG

**team** **ISLAND**  
**2016**

WINTER CYBER PRESENTATION

3-11-2016

# TEAM & OWNERS

## A SE MEP CM LCFM

**MIKE**  
MILLER

**LUKE**  
LOMBARDI



**NATHAN**  
HILL  
*California State University, Chico*  
**CM**

**BIANCA**  
MORELL



**CAMILA**  
HERNANDEZ  
*UPR*  
**A**

**SARAH**  
SAXON



**ANNA**  
BURISCH  
*DTU*  
**MEP**

**CHRISTOPHER**  
GÖRSCH



**CHRISTINE**  
BAUMER  
*Bauhaus – University*

**LCFM**

**JURE**  
CESNIK



**NIRUPAMA**  
KOTCHARLAKOTA  
*Stanford University*  
**CM**



**WENJIN**  
SITU  
*Stanford University*  
**SE**



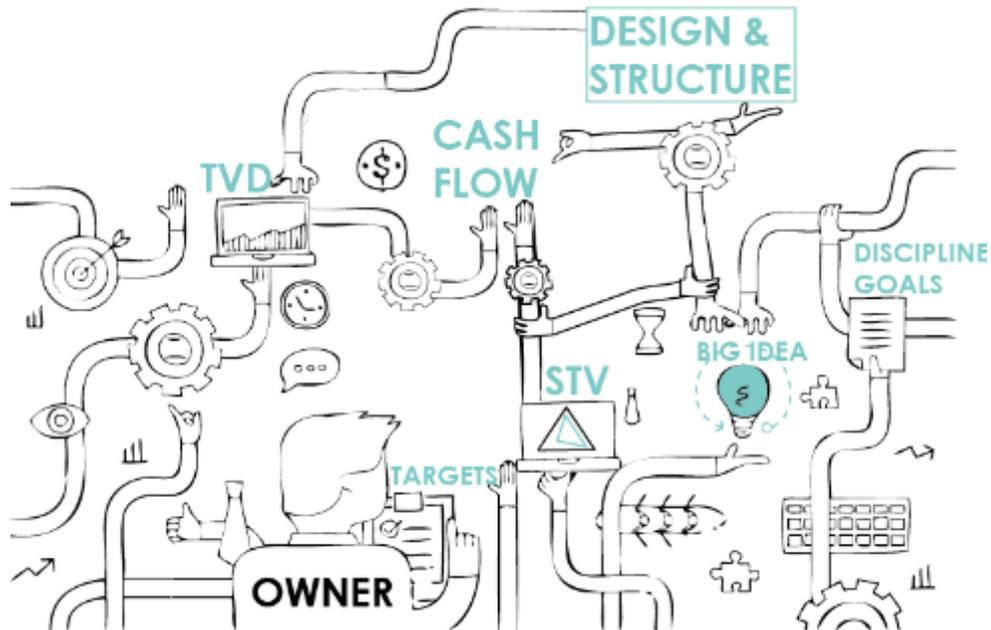
**LI**  
DENG  
*Stanford University*  
**SE**

# TEAM PROCESS

## A SE MEP CM LCFM

*Coming together is beginning  
Keeping together is progress  
Working together is success. (Henry Ford)*

**Integrated solutions!**

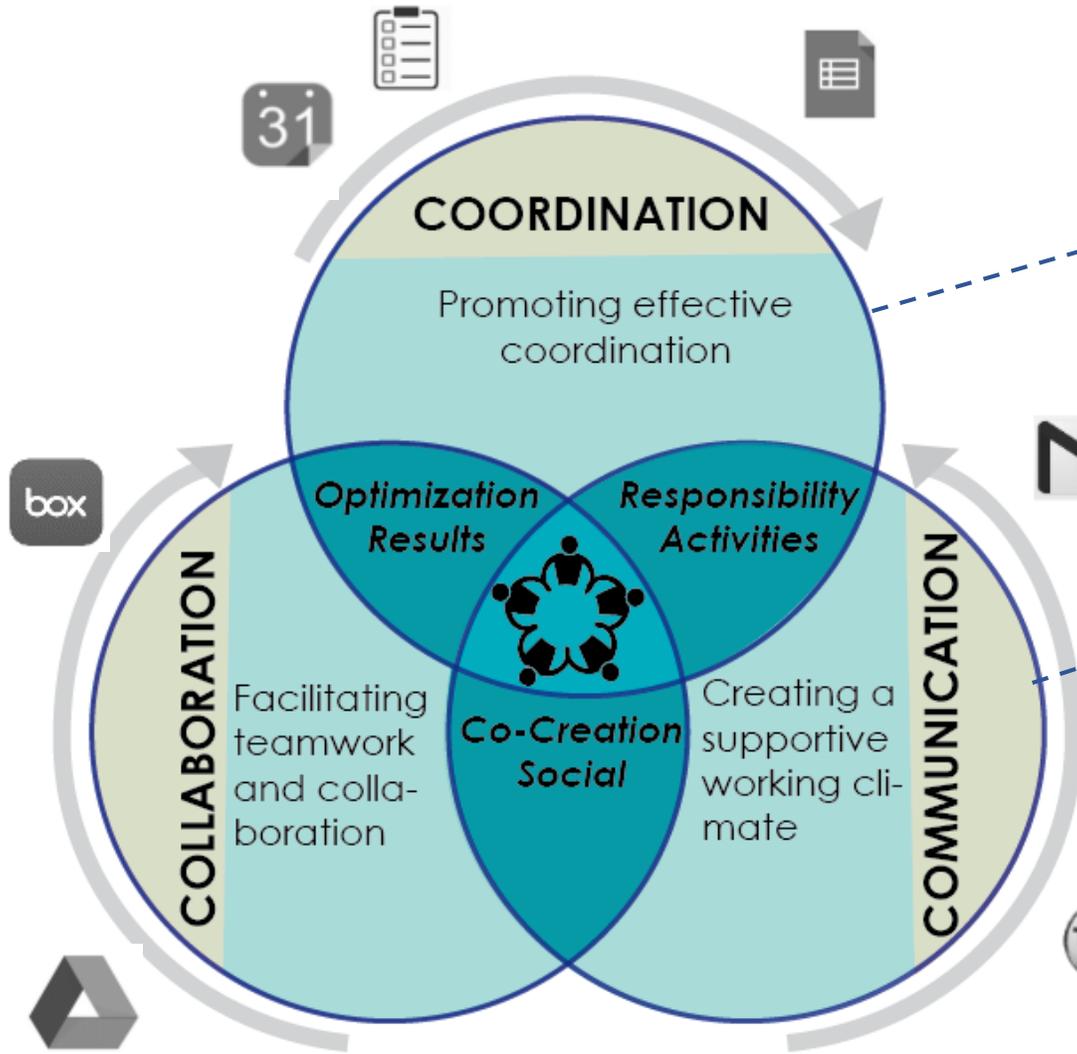


# RULES

1. Explain ideas/suggestions clearly – don't expect us to read your mind
2. Be on time and prepared – if you have problems let us know in advance
3. Set realistic goals in terms of finishing tasks – we respect if you are overworked
4. Give every idea a chance
5. Give feedback and be open to feedback
6. Trust your team-mates and help build trust
7. Invite other disciplines to input on your task

# TEAM PROCESS

## A SE MEP CM LCFM



	29-Jan	7-Feb	13/12-Feb	19-Feb	11-Mar
	M1: First ALL Concept Sketches/Models presented	M2: first concepts developed	M2a: Peer review of first concepts	M3: First concepts presented for industry meetings	M4: Website Cyber Project presentation
				for both footprints	
	Finished				
	In Progress				
	Future				
What we need to include		Floor Plans, Grid			4 different solutions 2 for each footprint
			For M2a check the guidelines here <a href="https://app.box.com/files/0/04417282/211/View-Review">https://app.box.com/files/0/04417282/211/View-Review</a>		

Project Management Tool



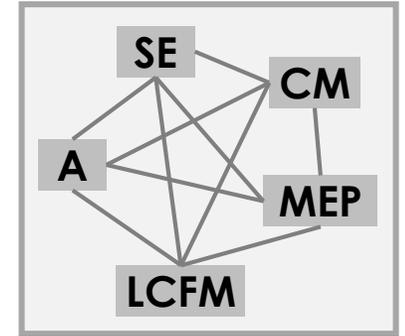
Weekly Team Meetings



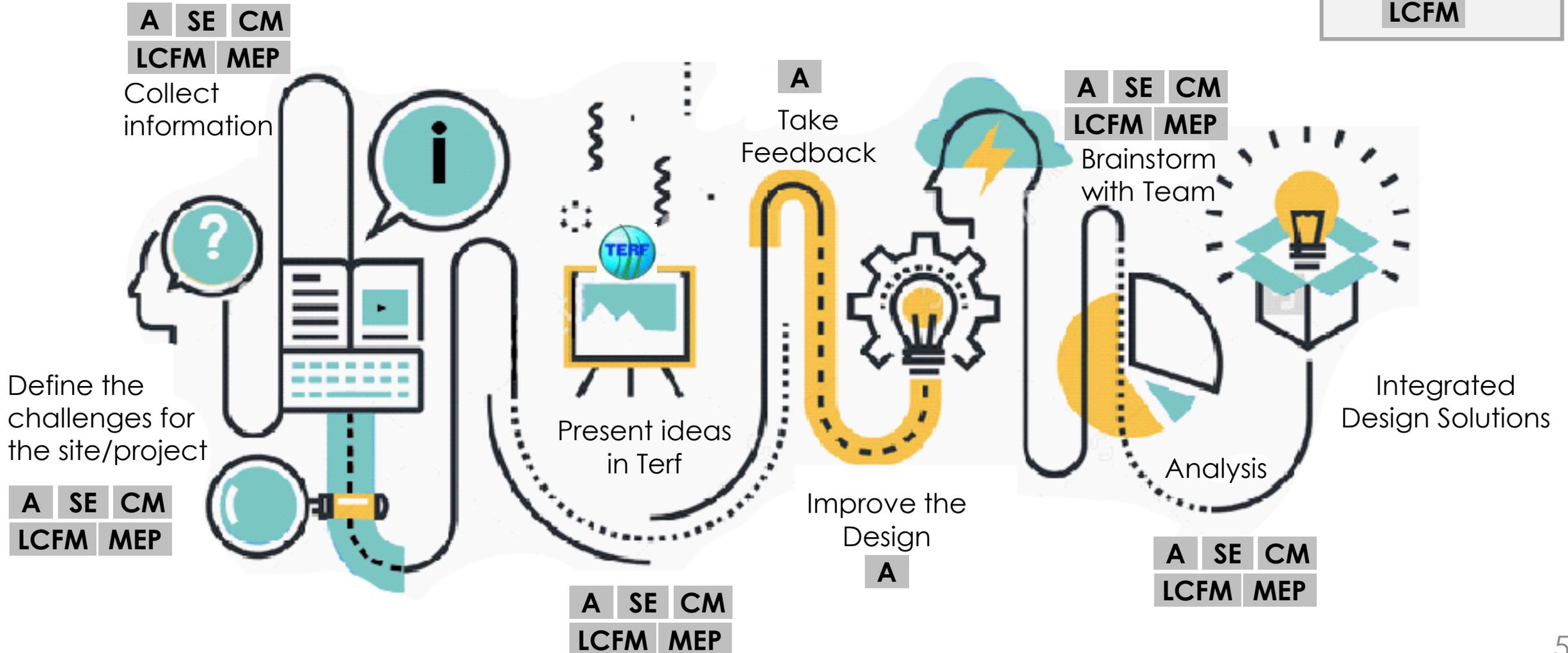
Organized TERF-Space

# TEAM PROCESS – AN EXAMPLE

A SE MEP CM LCFM



## DESIGN PROCESS



# SITE

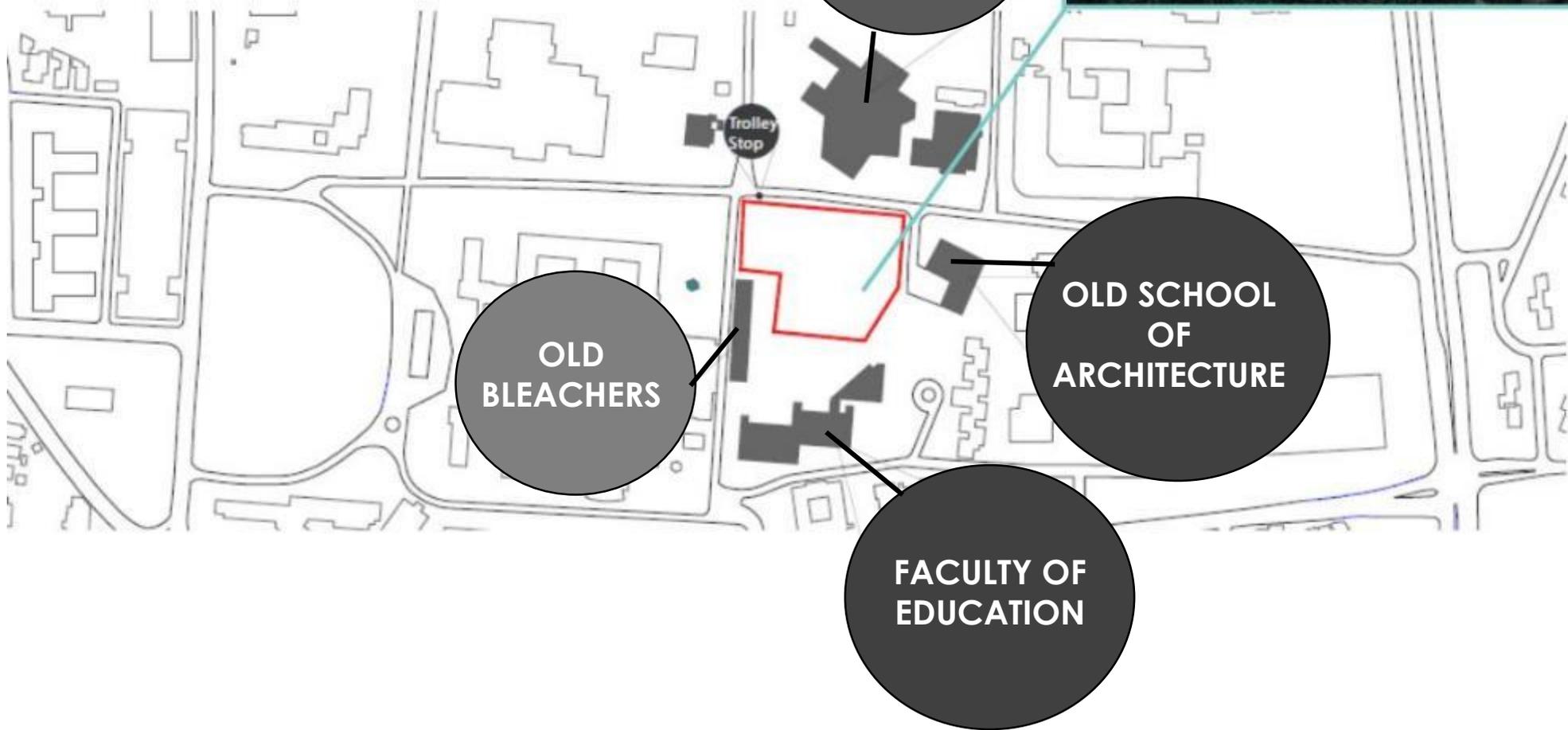
## A SE MEP CM LCFM



San Juan, Puerto Rico

# SITE

A SE MEP CM LCFM



# CLIMATE CONDITIONS

A SE MEP CM LCFM

Hot humid climate zone

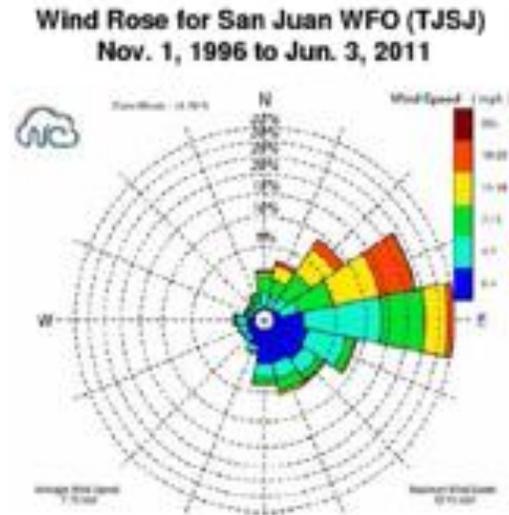
Warmest month: August

Coollest month: December

Average sunlight hours: 8 hrs

Average relative humidity:  
76 %

No cold season



Predominant wind  
direction are East &  
North East  
Average wind speed ~  
8 mph



Average annual  
temperature 79 °F  
Average rain ~ 64  
inches

# CHALLENGES

A SE MEP CM LCFM



## Hurricane Season

June - November, every year.



## Earthquakes

Everyday Puerto Rico moves, but is estimated that every 100 years there is a BIG earthquake. The last one was on 1918.



## Precipitations

May - September, are the most rainy months every year.



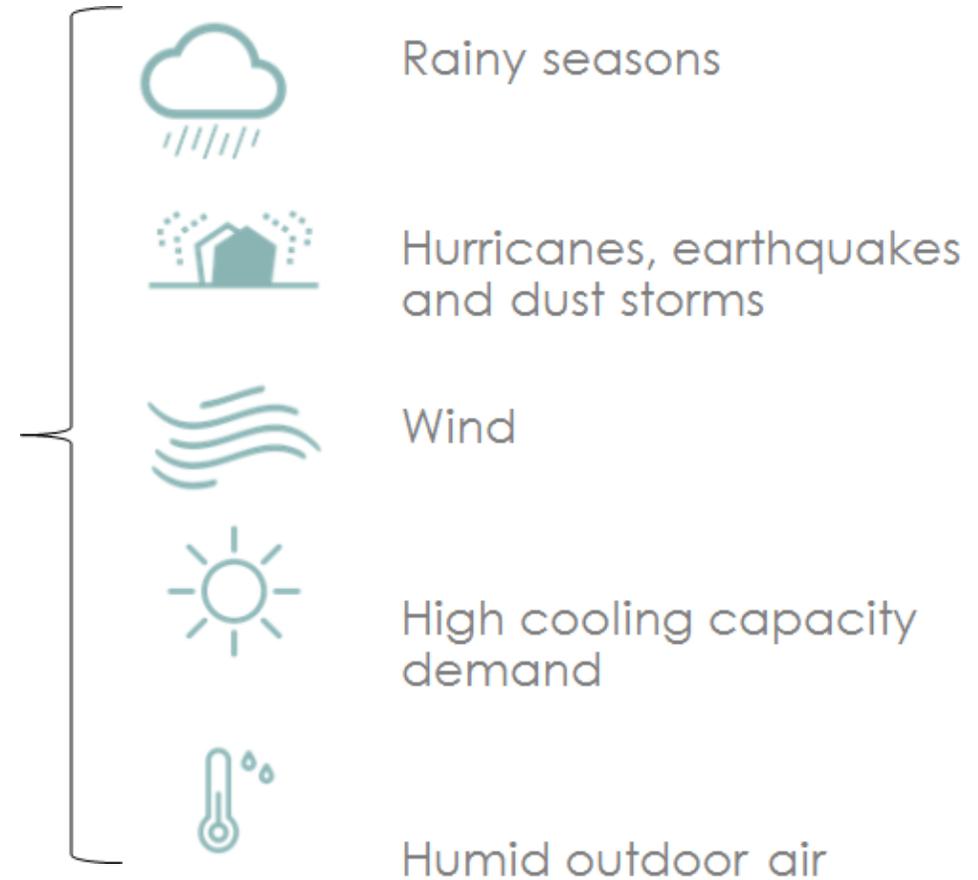
## Sahara's Dust

April - October, every year.

# TEAM STRATEGY

A SE MEP CM LCFM

We will work with the weather conditions instead of fighting them!

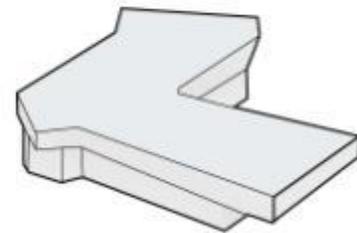
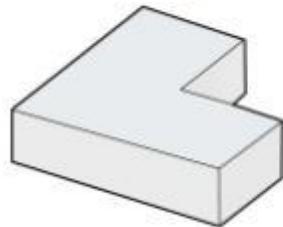
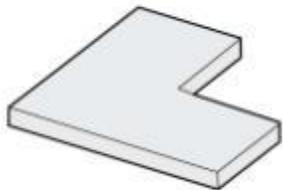
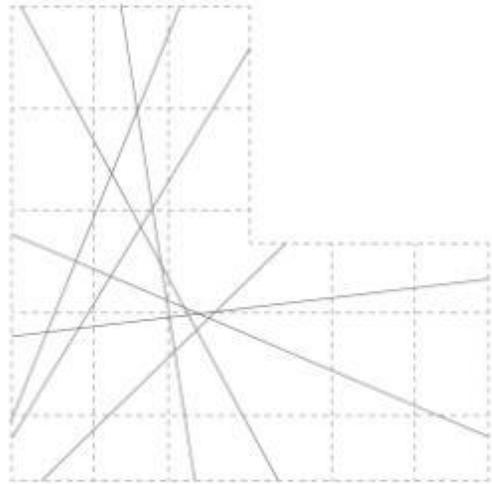


# BIG IDEA BIRD

A SE MEP CM LCFM

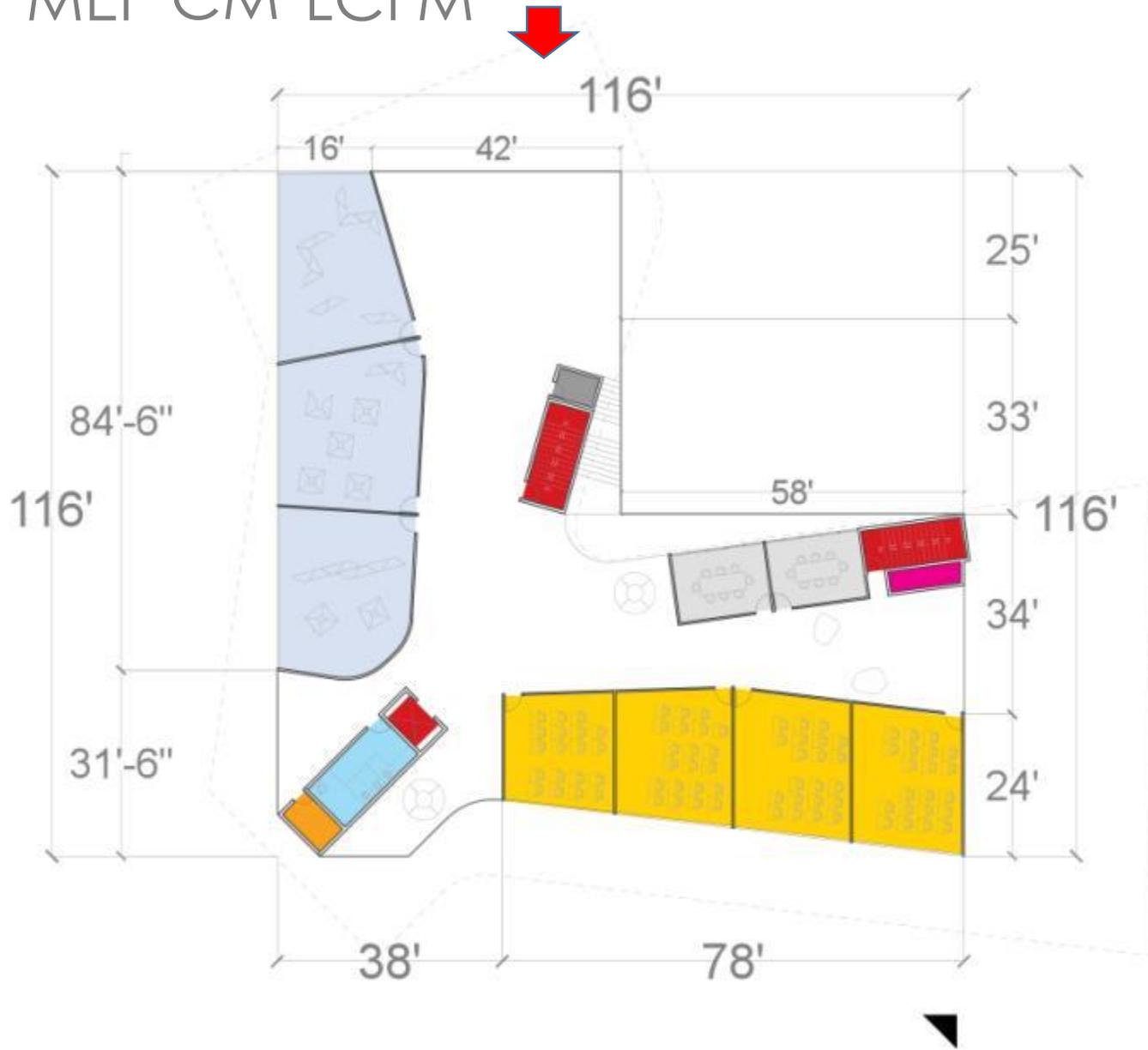


PUERTORRICAN PARROT



# BIRD FLOOR PLANS

A SE MEP CM LCFM

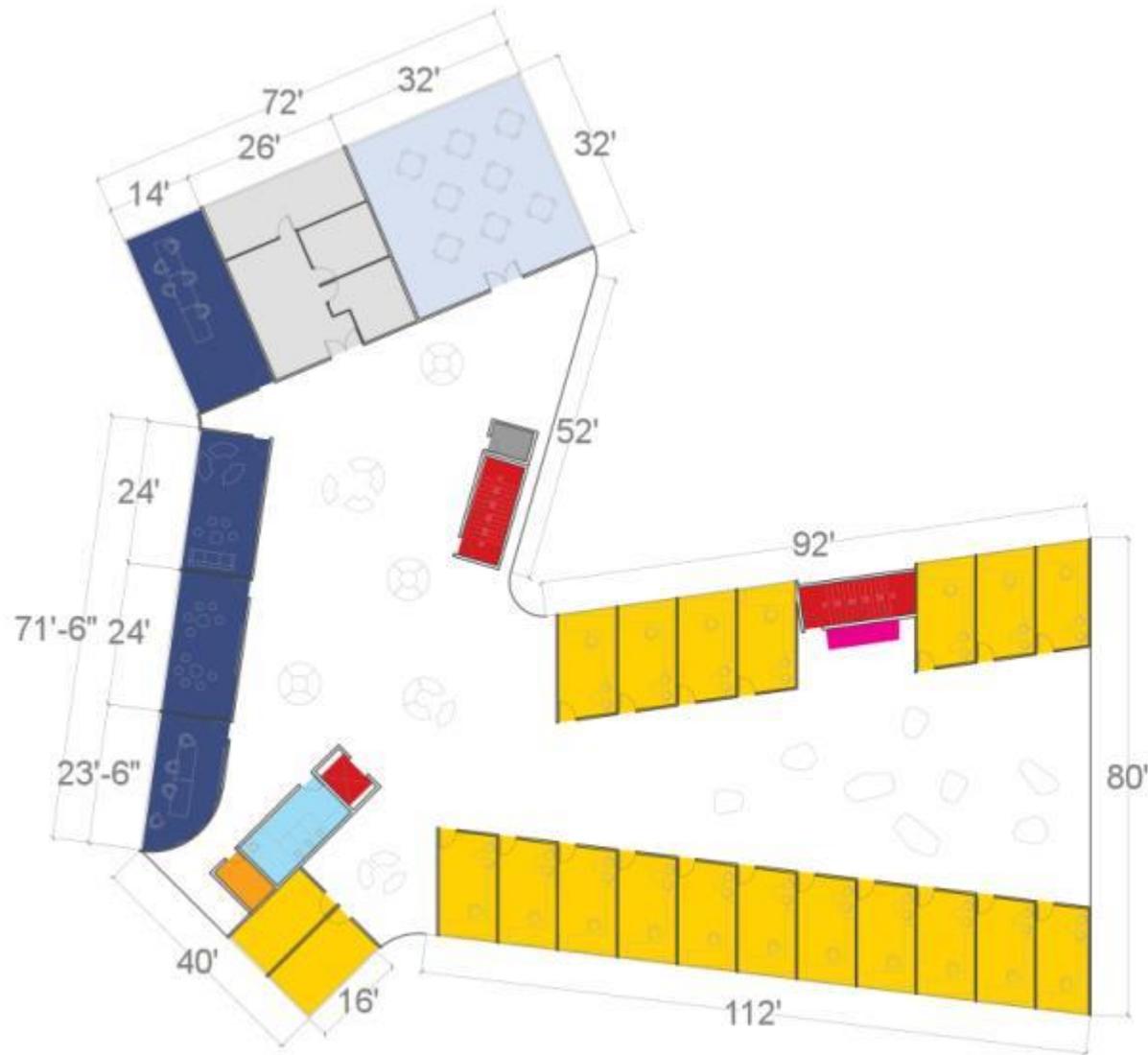


## Ground Floor

- Labs
- Small Classrooms
- Seminars
- Storage
- Bathrooms
- Mech Room
- Vertical Circulation
- Shaft

# BIRD FLOOR PLANS

A SE MEP CM LCFM

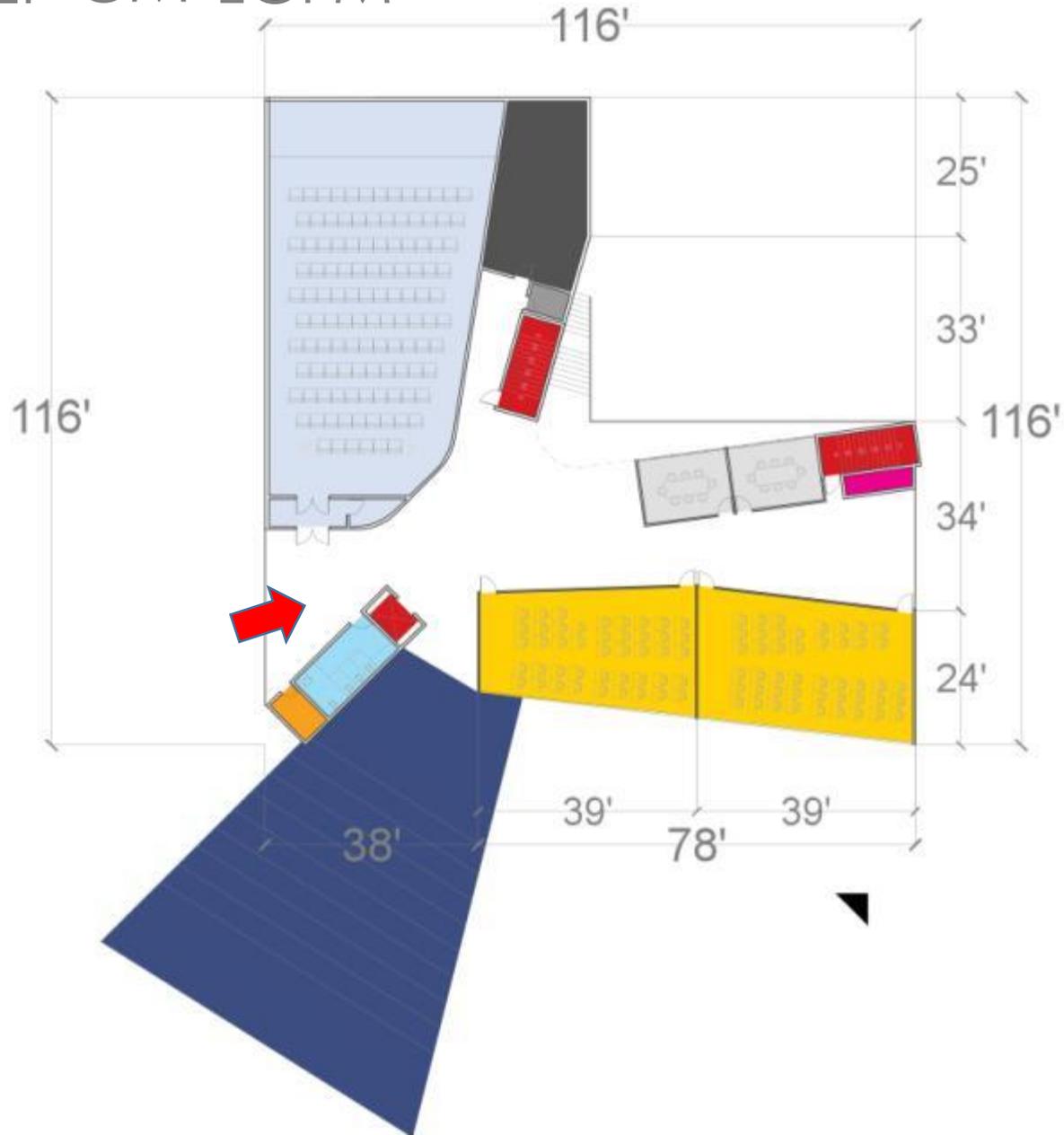


- Second Floor**
- Faculty Lounge
  - Faculty offices
  - Administration
  - Students Offices
  - Storage
  - Bathrooms
  - Mech Rooms
  - Vertical Circulation
  - Shaft



# BIRD FLOOR PLANS

A SE MEP CM LCFM

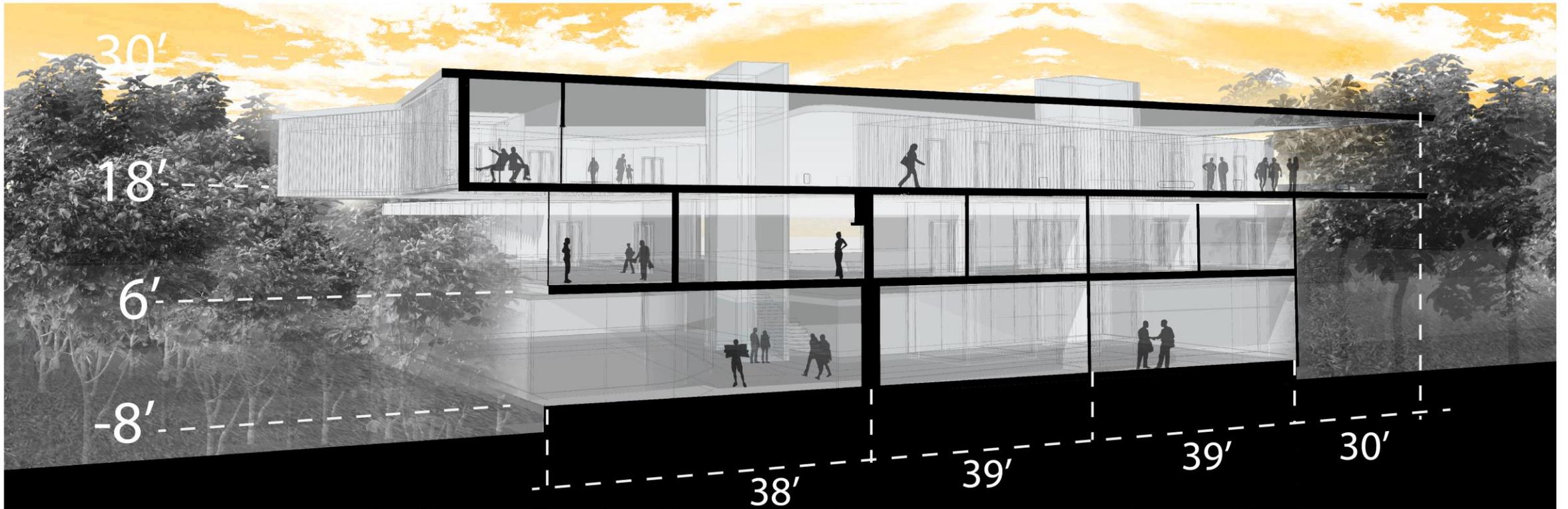


## Unground Floor

- Auditorium
- Large Classrooms
- Open Auditorium
- Seminars
- Storage
- Bathrooms
- Mech Room
- Vertical Circulation
- Storage
- Shaft

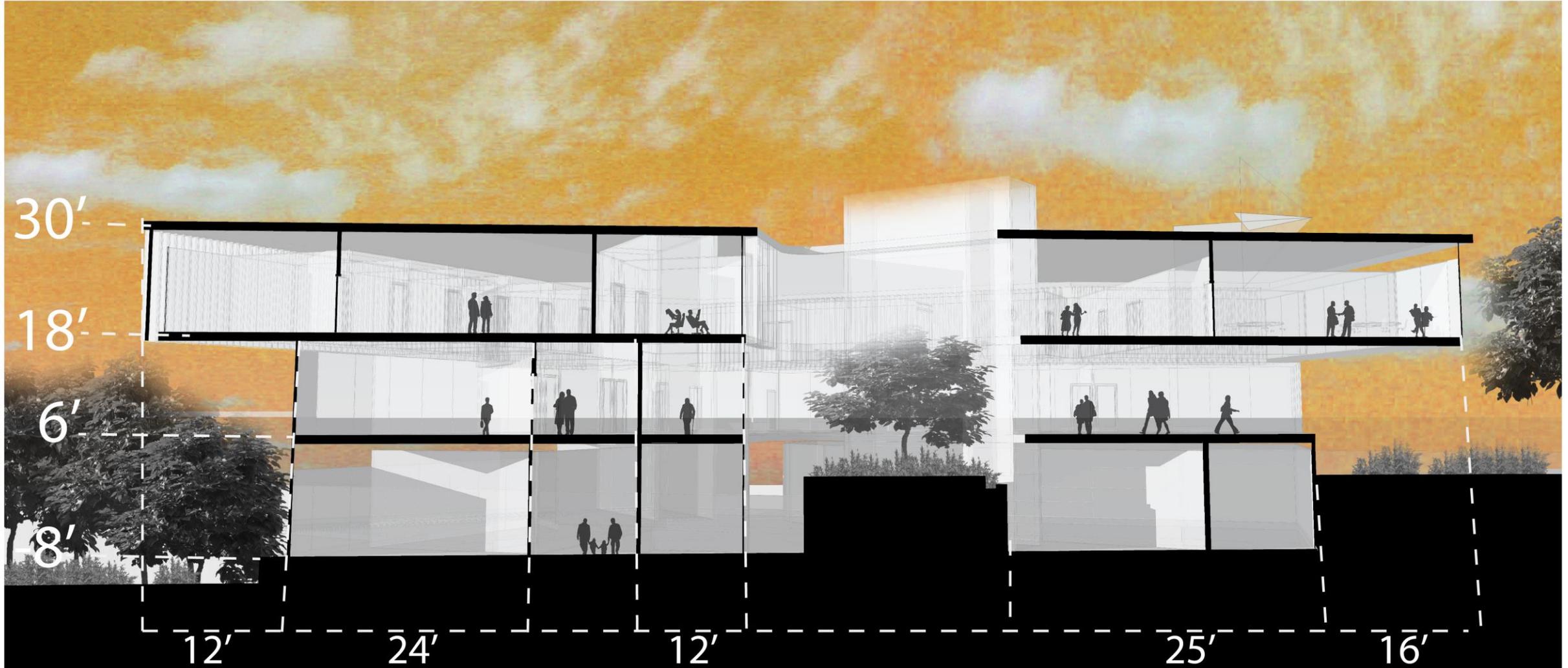
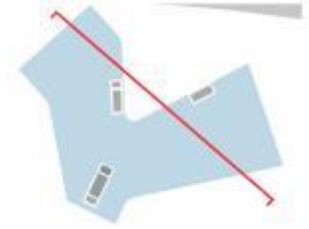
# BIRD SECTION A-A

A SE MEP CM LCFM



# BIRD SECTION BB

A SE MEP CM LCFM

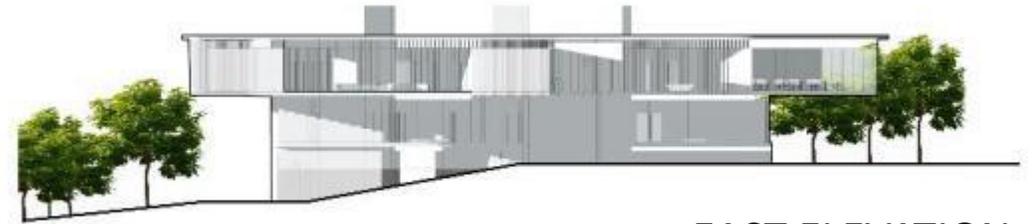


# BIRD ELEVATIONS

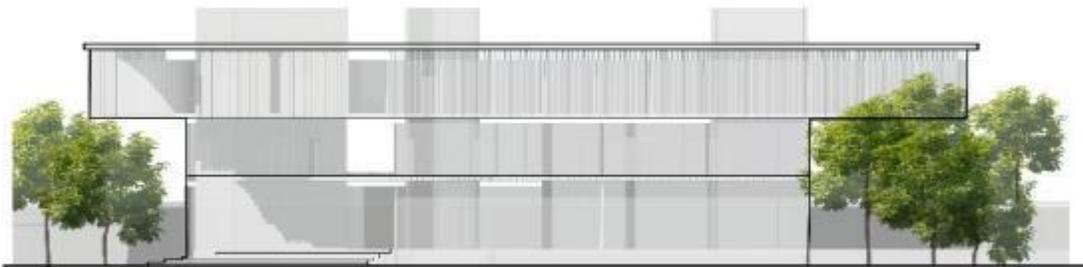
A SE MEP CM LCFM



NORTH ELEVATION



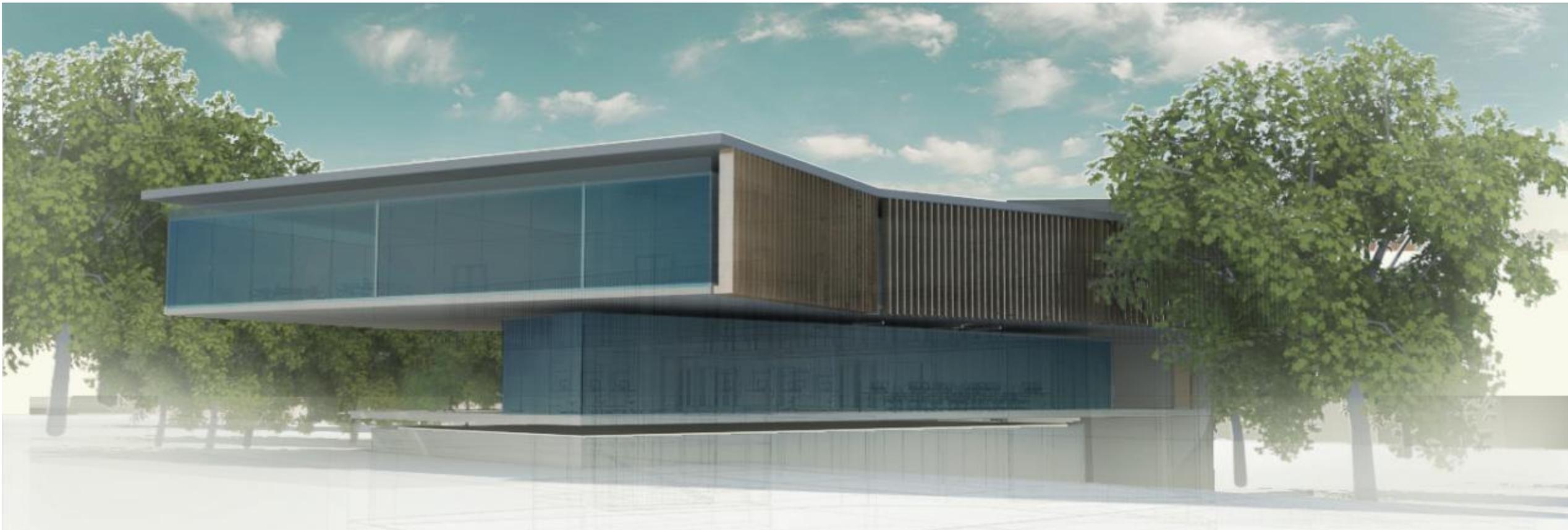
EAST ELEVATION



SOUTH ELEVATION

# BIRD VISUALIZATION

A SE MEP CM LCFM



Principal Entry – North Facade

# BIRD VISUALIZATION

A SE MEP CM LCFM



# BIRD VISUALIZATION

A SE MEP CM LCFM



# LOAD INFORMATION

A SE MEP CM LCFM

Based on ACSE 7-2010 Ed

## Earthquakes

0.2s SRA = 1.0 g

1.0s SRA = 0.4 g

Critical Damping 5%



## Wind

Hurricane season

V = 160-170 mph

Wind pressure = 39 psf

150(67) 160(72)  
170(76)

Puerto Rico



Bearing Capacity: 5000 psf

Soil conditions

# LOAD INFORMATION

A SE MEP CM LCFM



## ASCE General Design Load Table

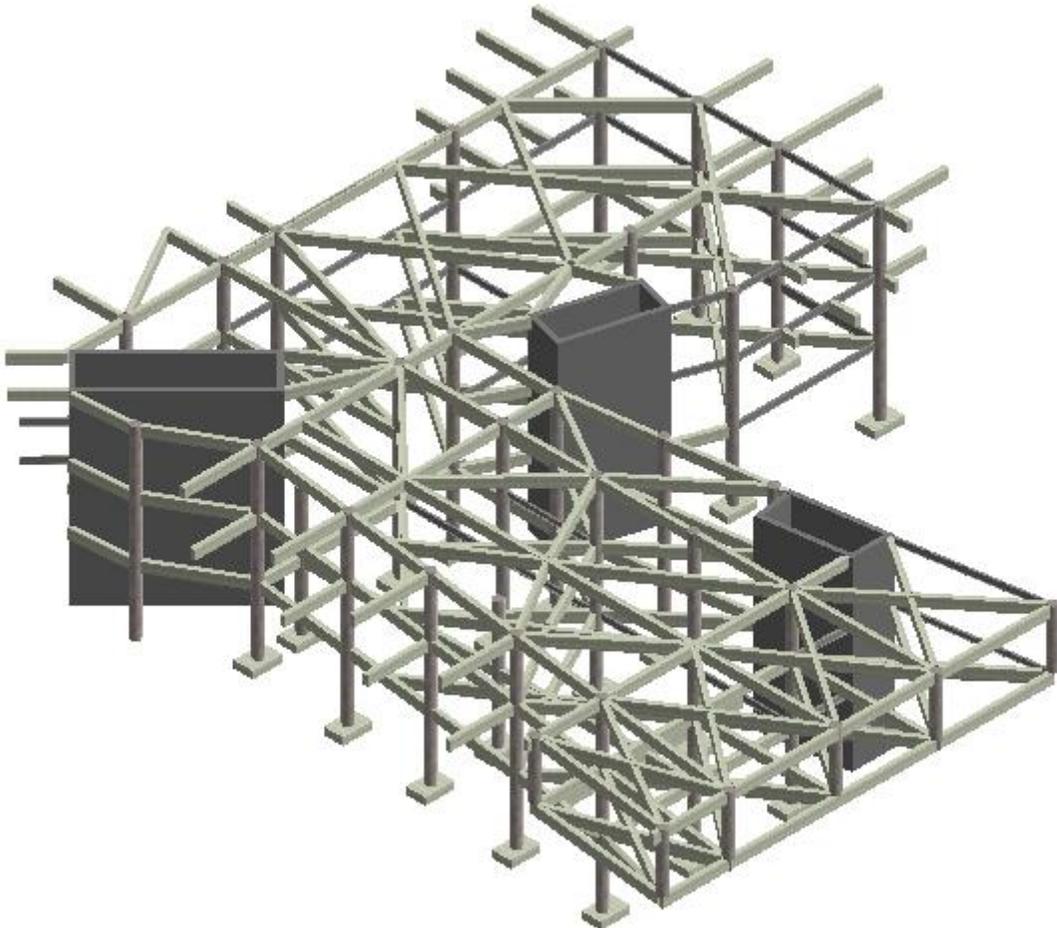
Type	Uniform Load / psf	Concentrated Load / k	Corresponding Island Building
Office	50	2	Faculty Offices; Department Chair's office; Administrative Assistants; Student offices
Lobbies	100		Faculty Lounge
Corridors	100	1	
Roof	40		
Classrooms	40	1	Large Classroom; Small Classroom; Seminar Rooms
Storage	250		Storage rooms
Stairs and exit ways	100	0.3	
Assembly areas and theaters	100		Auditorium
Lab	200	1	Instructional Labs
Other	50		Technical Support; Server Room

# STRUCTURAL SYSTEMS

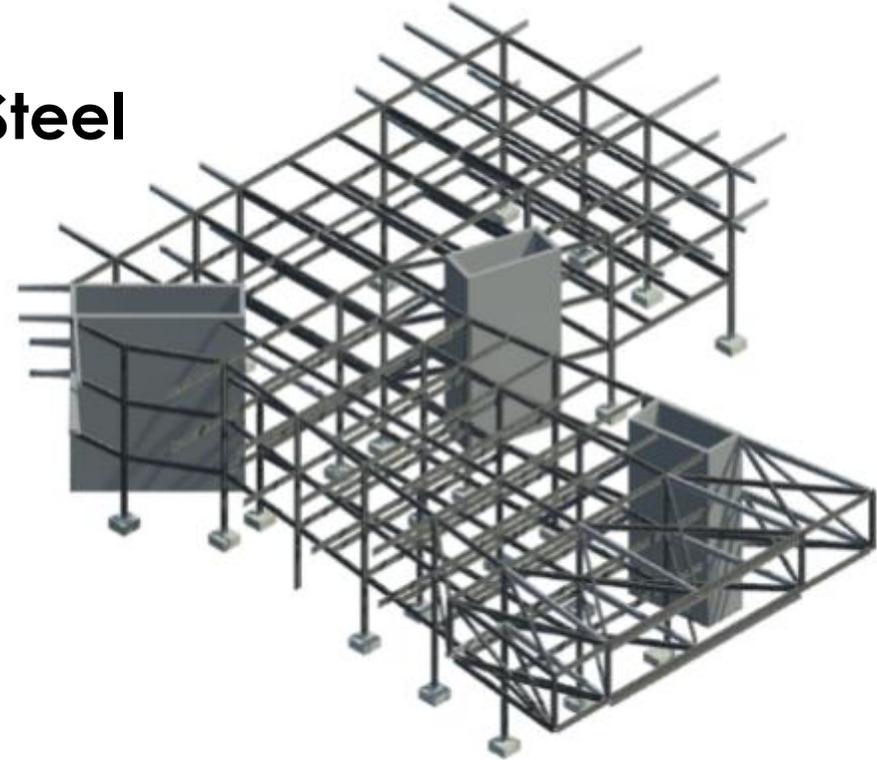
A **SE** MEP CM LCFM | Big Idea 1: Bird



## Concrete



## Steel

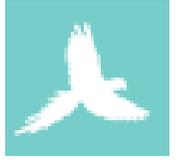


	STEEL	CONCRETE
Lateral System	Shear Wall Cores	Shear Wall Cores
Cantilever Solution	Tapped I-beam; Diagonal Bracing	Pre-stressed Composite Slab

# Structural Systems

A SE MEP CM LCFM

## Big Idea 1: Bird - Concrete



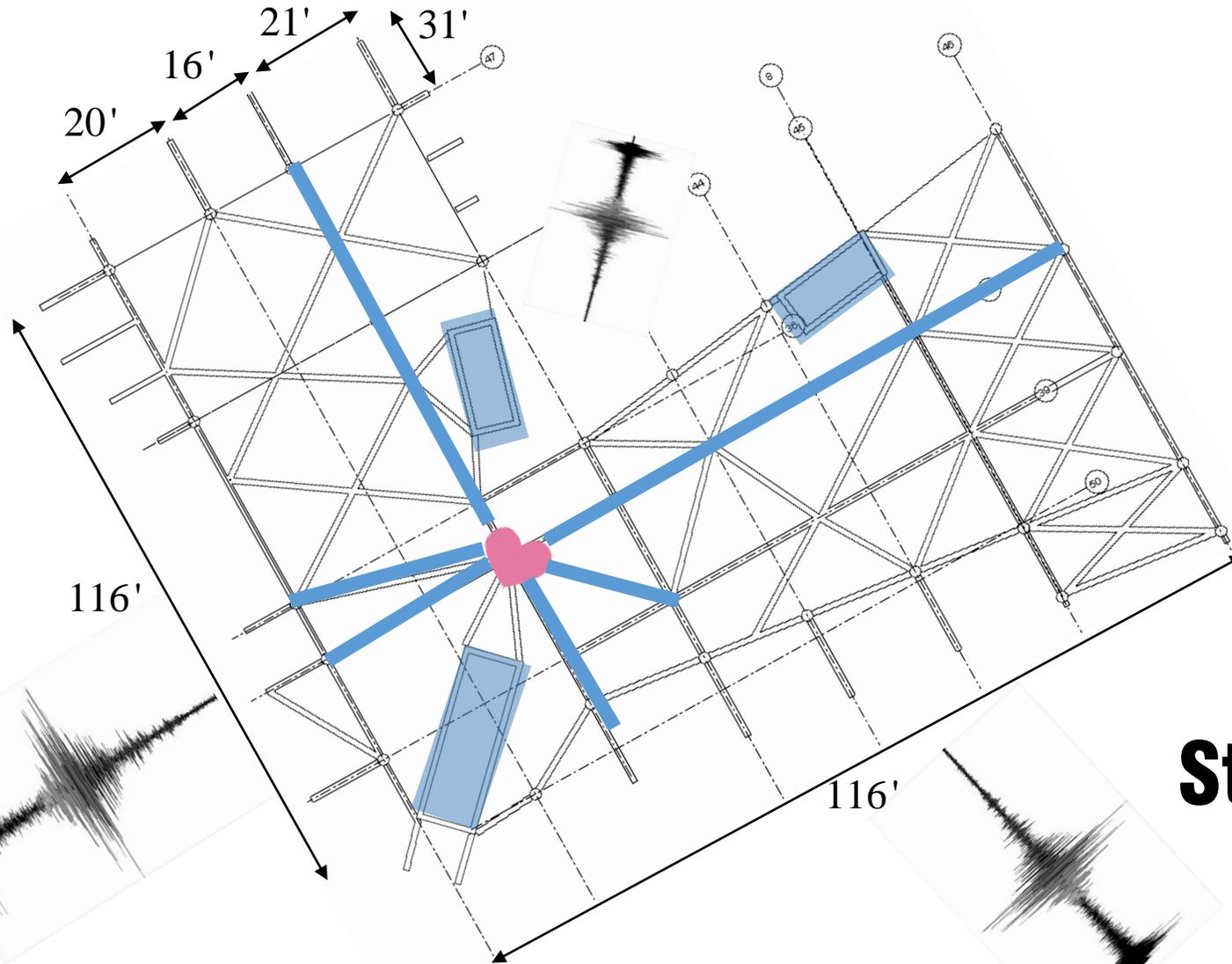
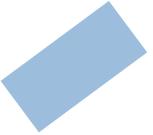
**Stiffness center: heart**



**Radial Frame: artery**



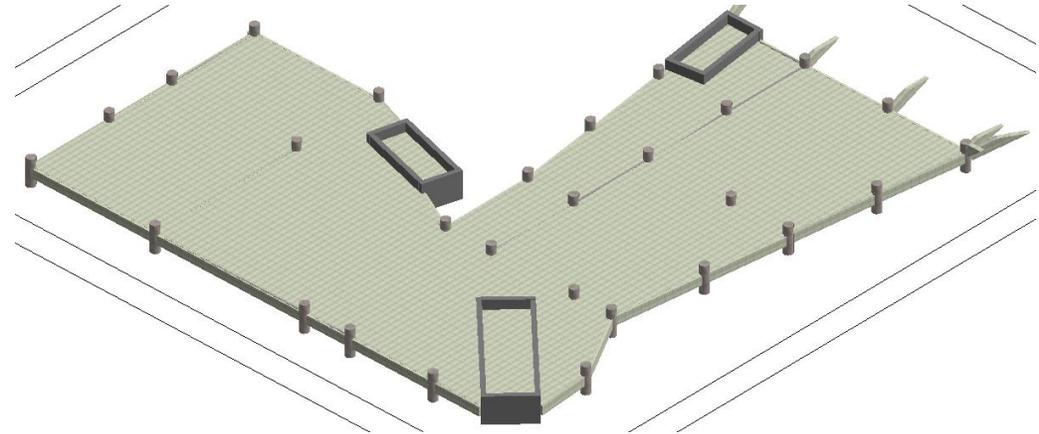
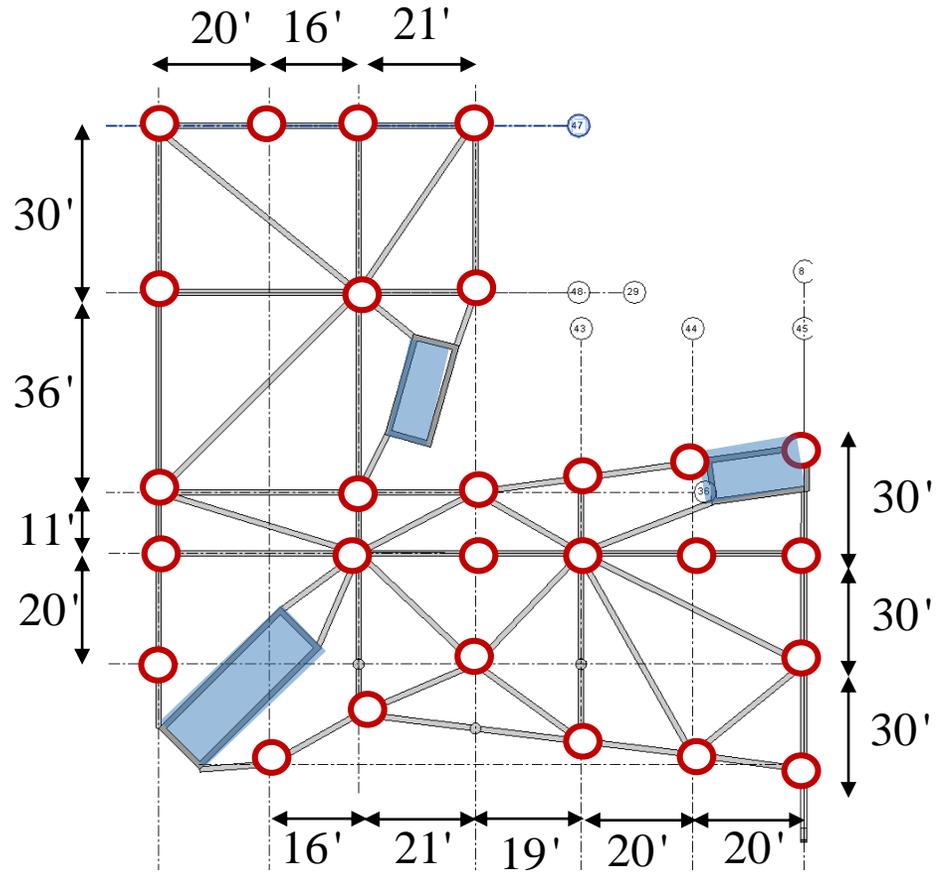
**Shear Wall: muscle**



**Strong bird in all directions**

# Concrete | Basement

A SE MEP CM LCFM



## Typ. Section Dimensions

Beam 10'' x 24''

Comp. Slab 8''

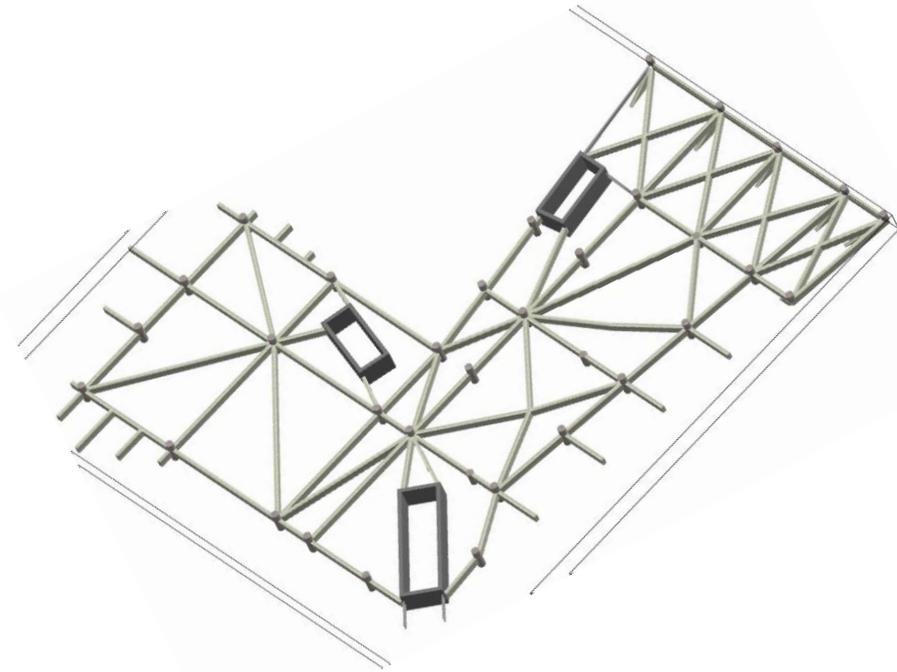
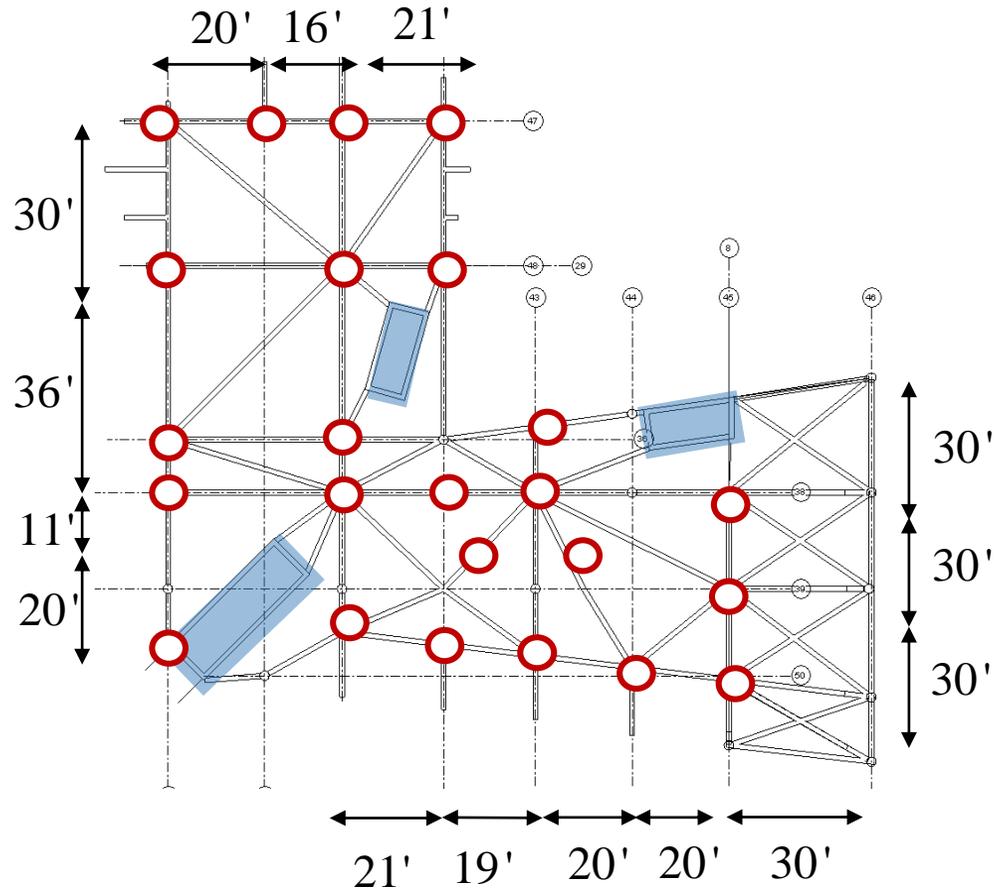
Shear Wall 12'' thick



Column  $\phi 2'$

# Concrete | Third Floor

A SE MEP CM LCFM



## Typ. Section Dimensions

Beam 10'' x 24''

Comp. Slab 8''

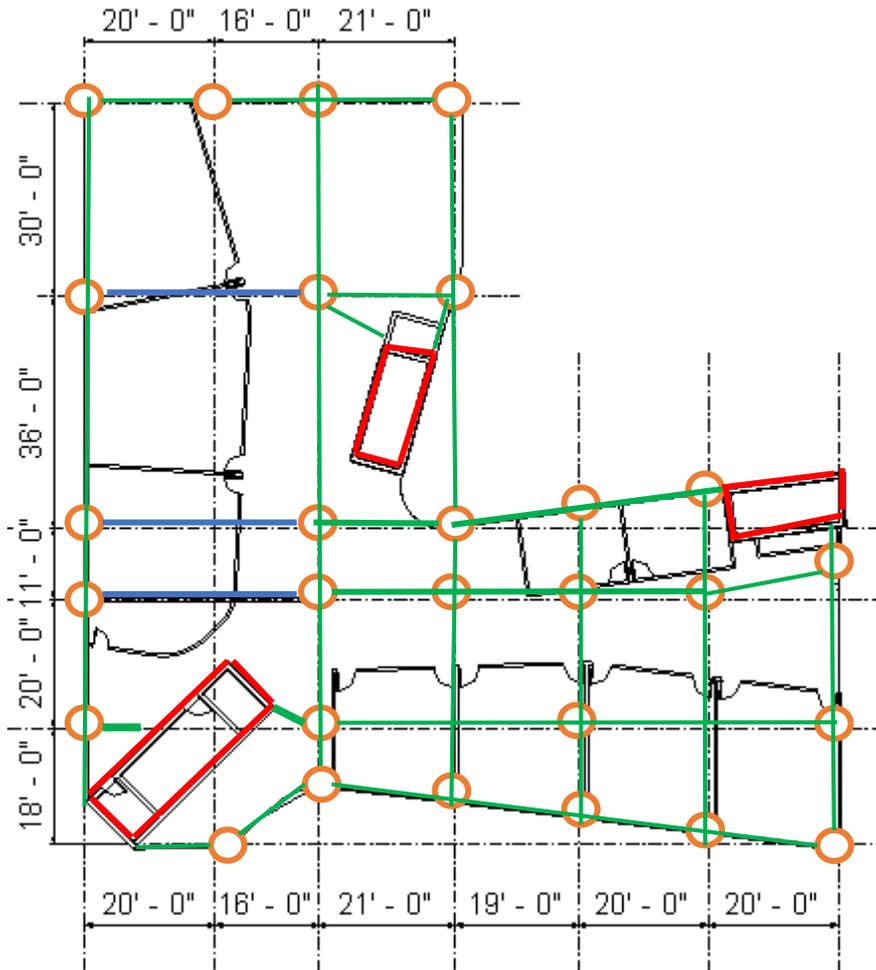
Shear Wall 12'' thick



Column  $\phi 2'$

# STEEL OPTION

A SE MEP CM LCFM | First Floor

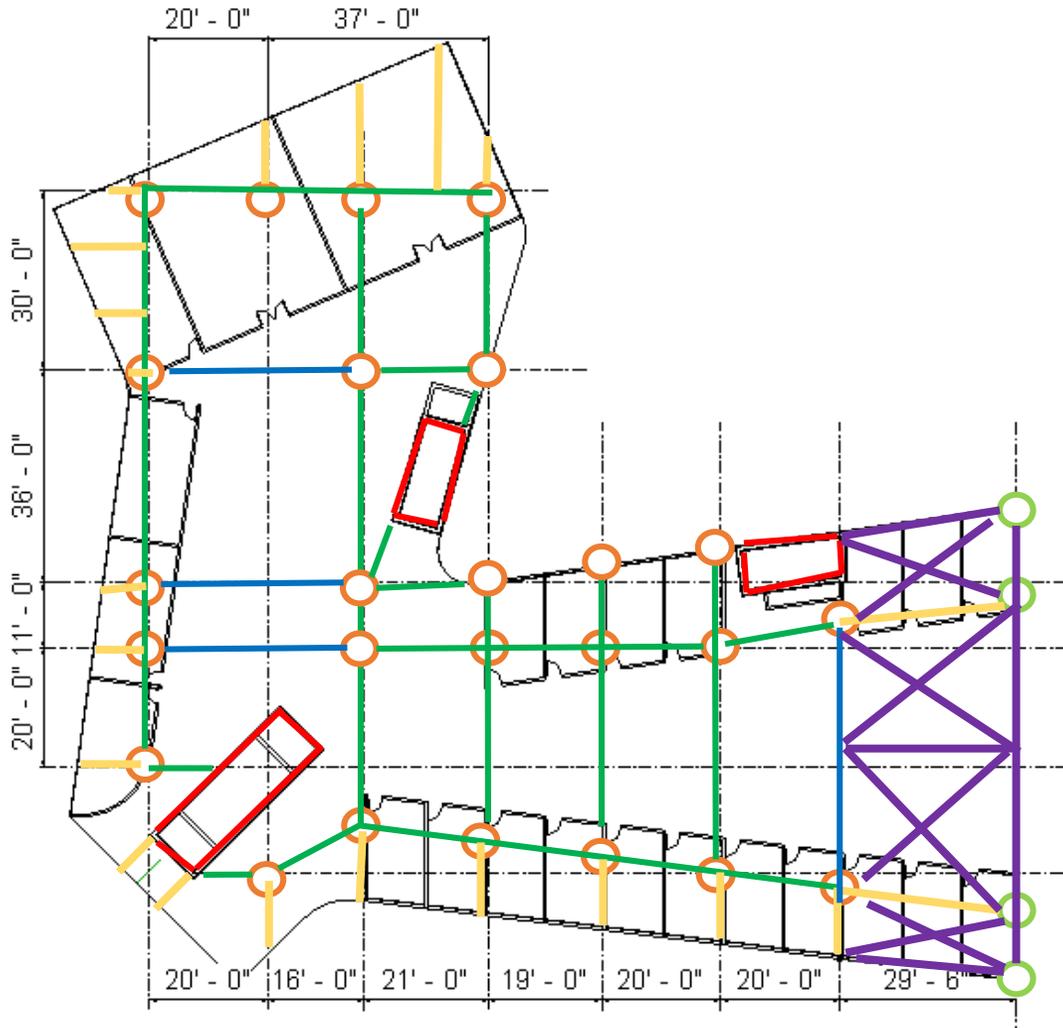


## Typ. Section Dimensions

	Beam	W 16 x 36
	Comp. Slab	6"
	Shear Wall	12"
	Column	W 14 x 96
	Auditorium Girder	W 32 x 50

# STEEL OPTION

A SE MEP CM LCFM | Second Floor



## Typ. Section Dimensions

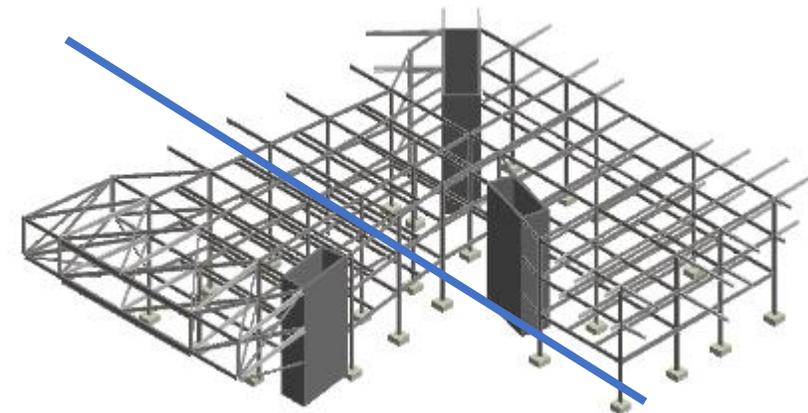
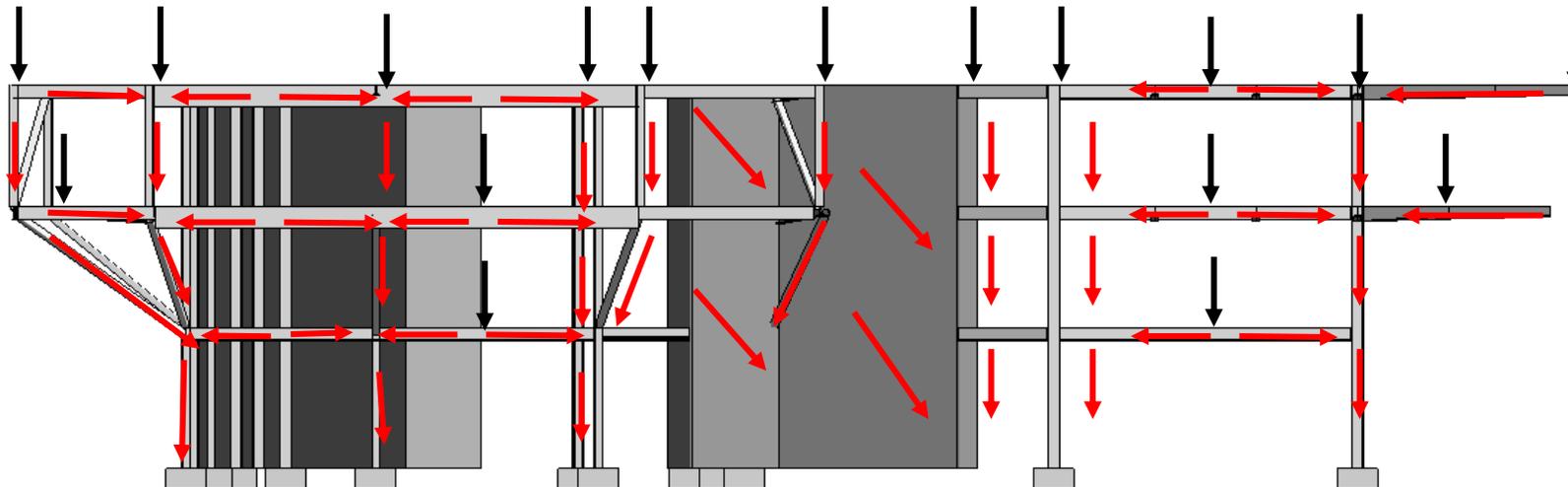
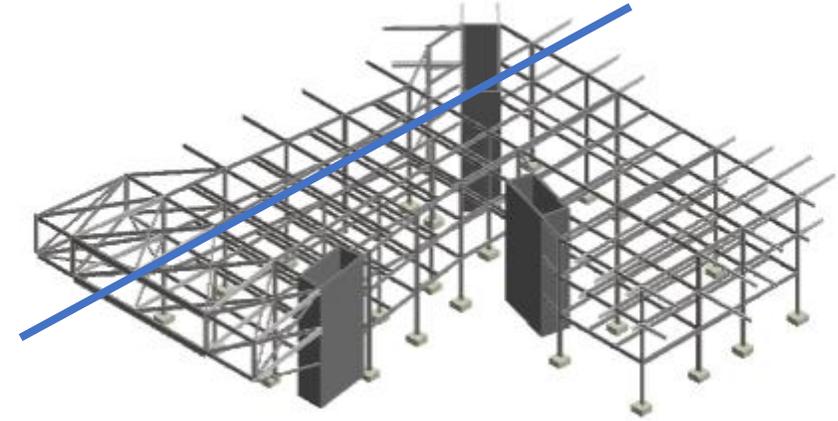
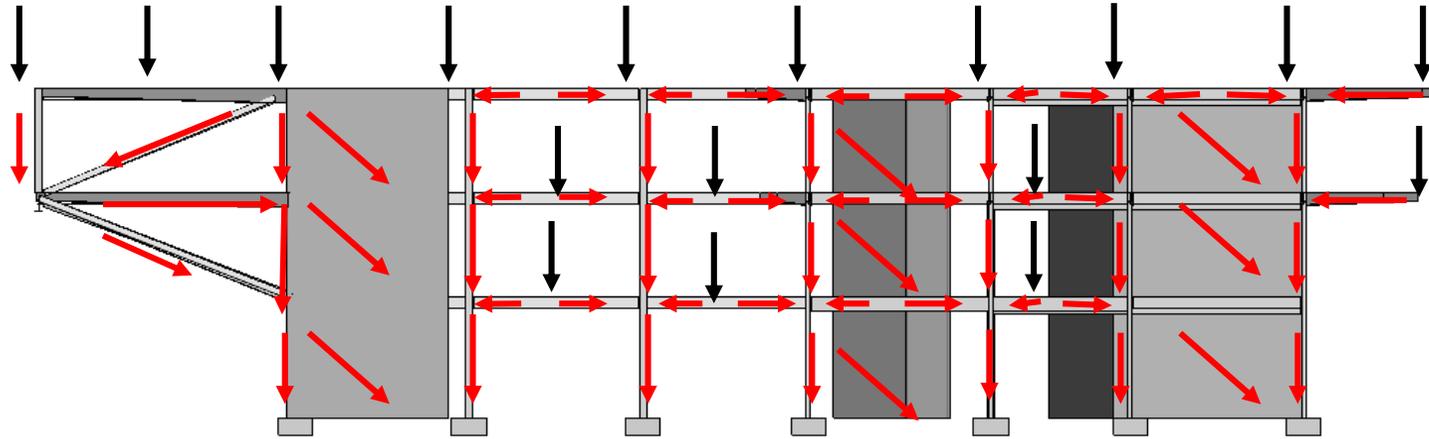
-  Vertical bracing column W 24 x 68
-  Cross Bracing W 16 x 36
-  Tapered Beam Depth varies from 18'' to 21''

# STEEL OPTION

A SE MEP CM LCFM | Vertical Load Path

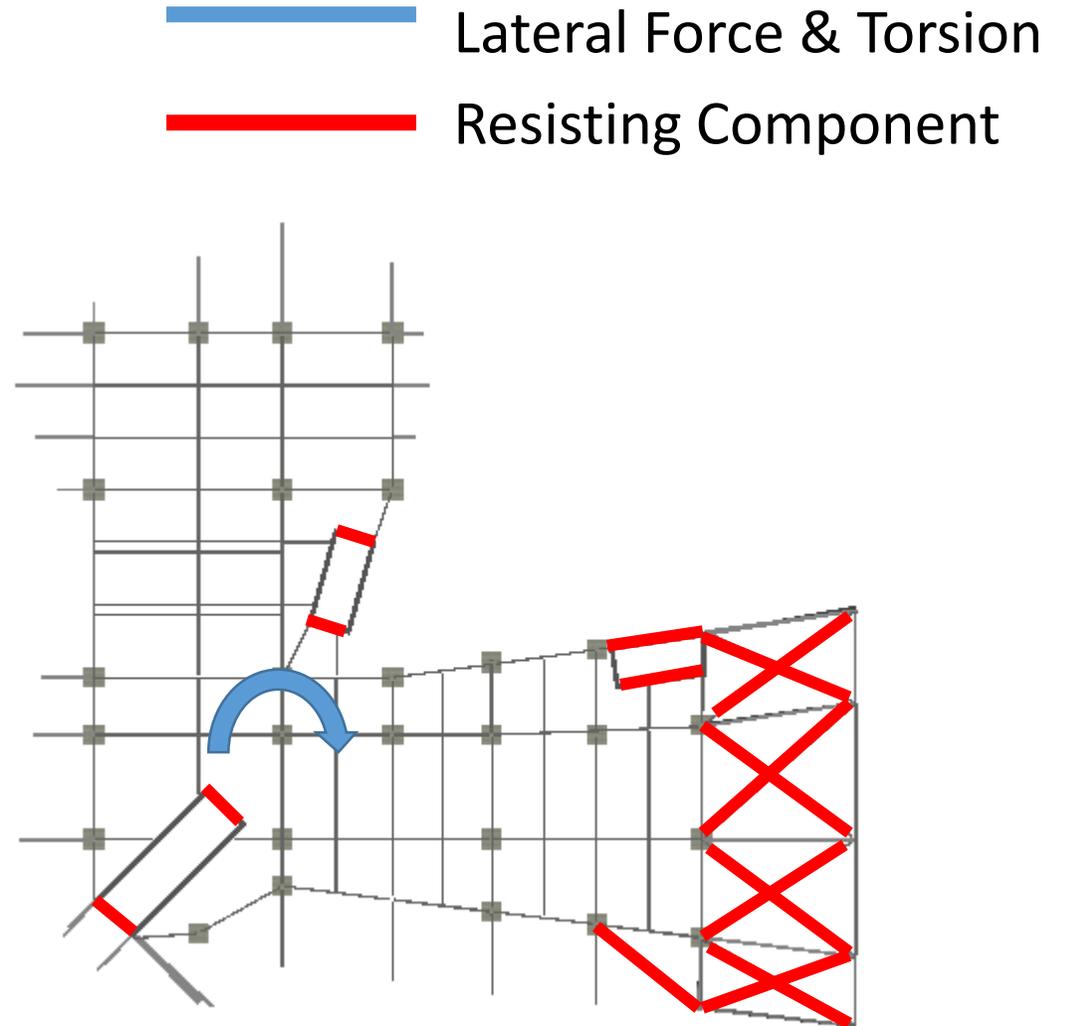
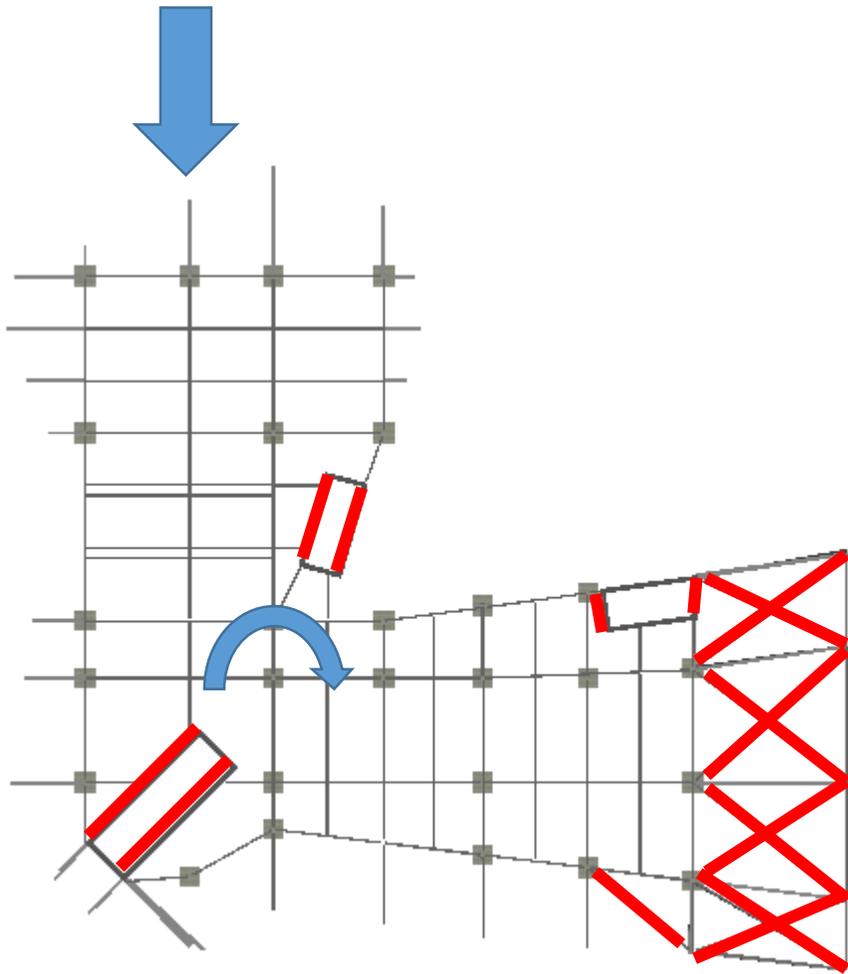
— Load

— Reactions



# STEEL OPTION

A SE MEP CM LCFM | Lateral Load Path

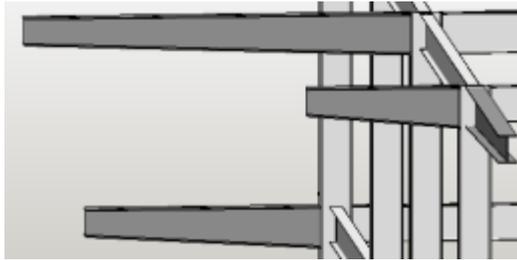


# STEEL CANTILEVER SOLUTION

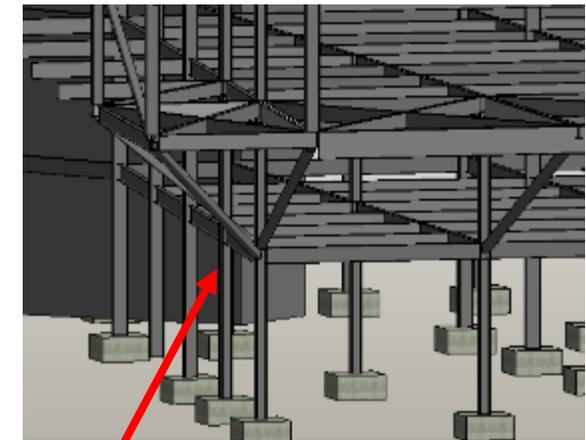
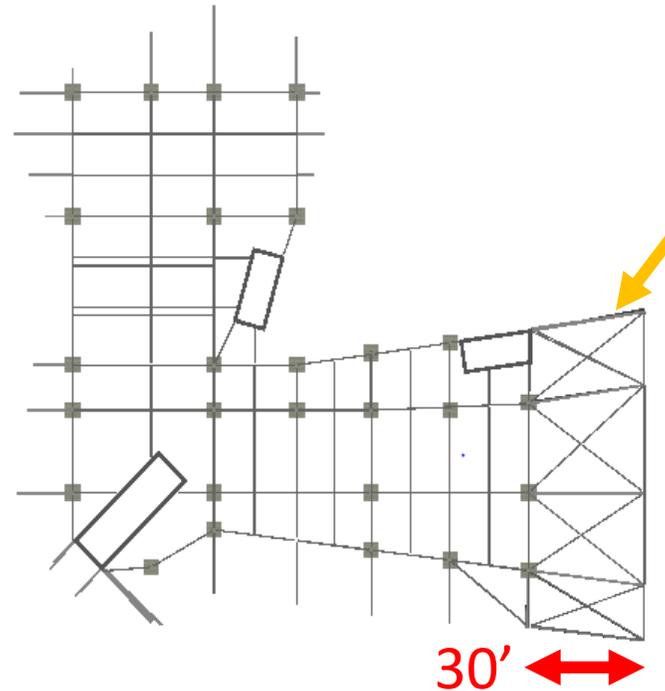
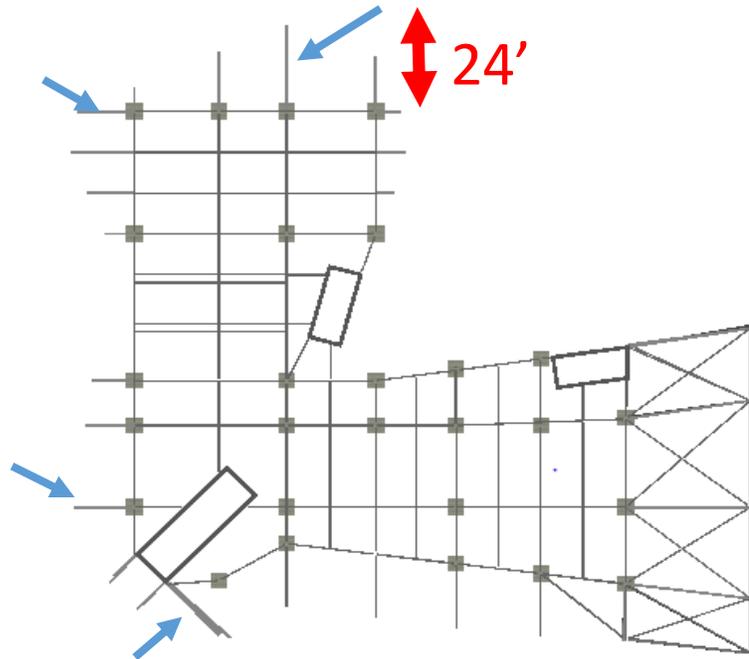
A SE MEP CM LCFM



Tapered I Beam



		
Start Depth	18''	21''
End Depth	12''	16''



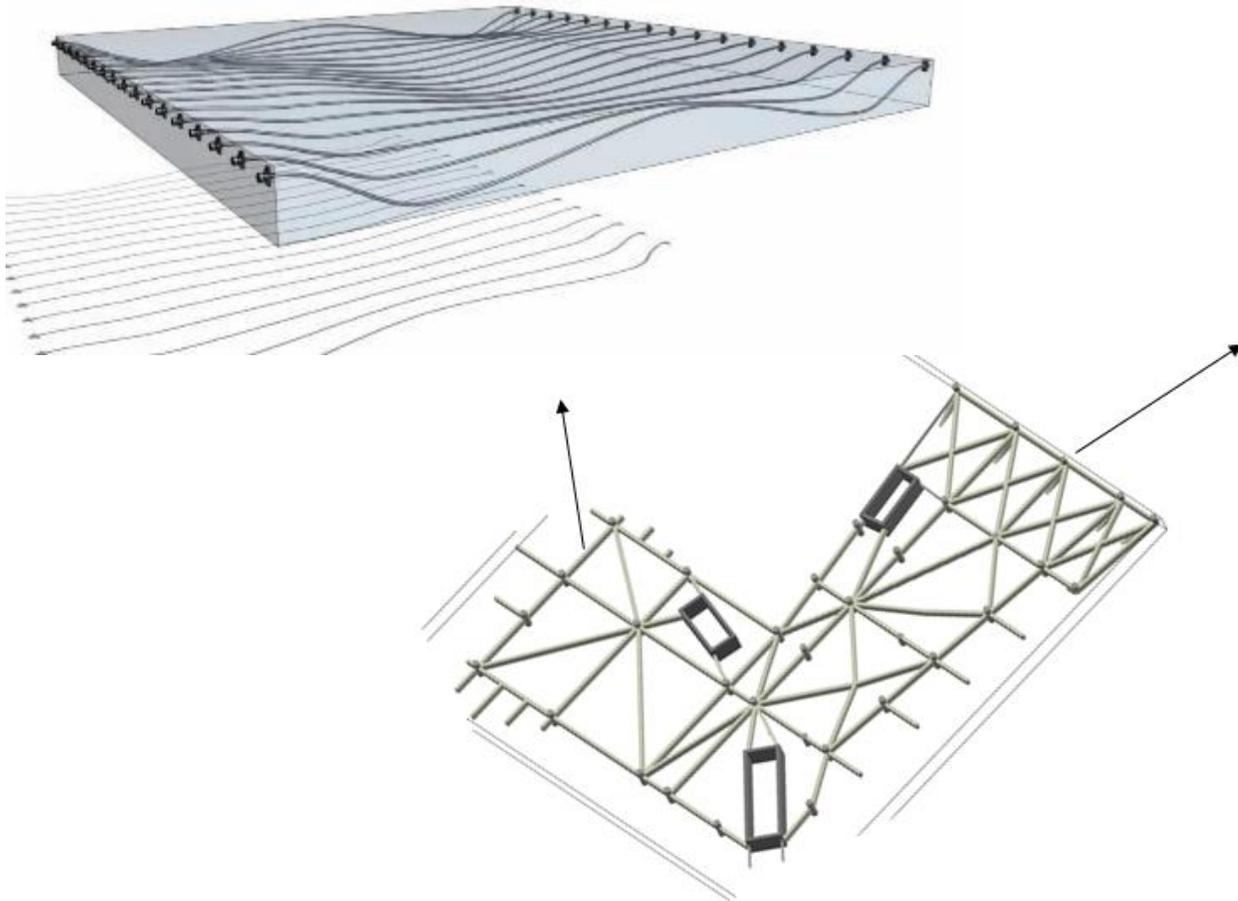
HSS 8 x 8 x 1/2 Diagonal Bracing

# CONCRETE CANTILEVER SOLUTION

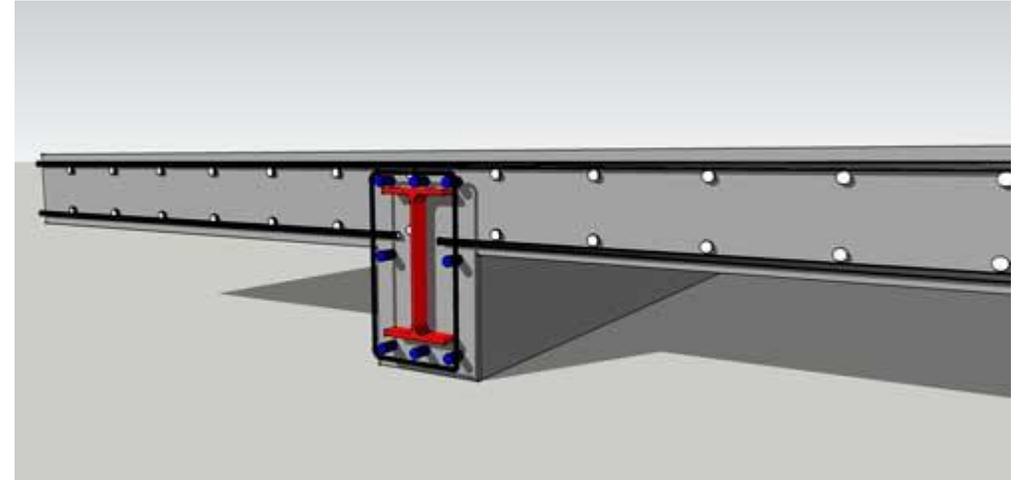
A SE MEP CM LCFM



Prestressed Slab



Composite Slab



# SHADE STUDY

A SE MEP CM LCFM



March 10 am – 8 pm



June 8 am – 10 pm



December 11 am – 7 pm



# SOLAR SHADING STRATEGIES

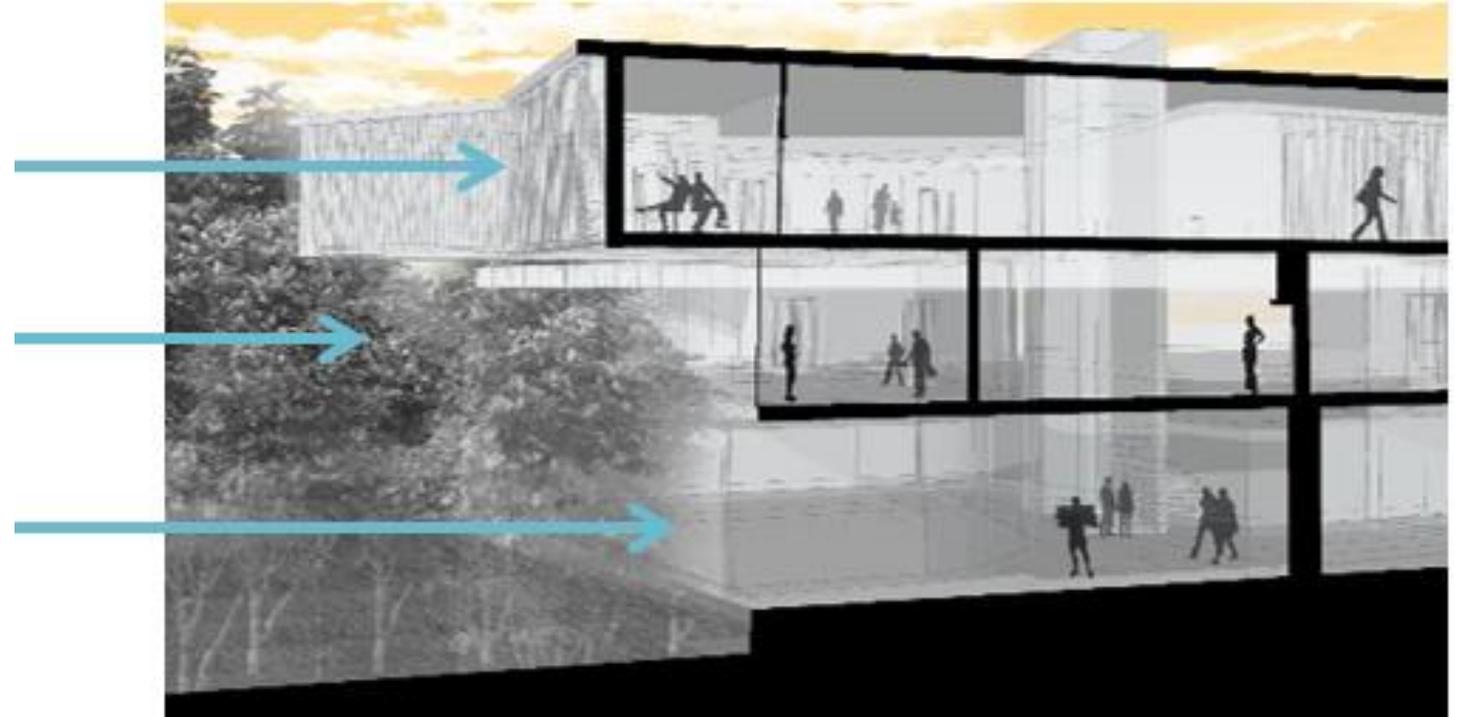
A SE **MEP** CM LCFM



External solar shading

Landscaped shading -  
surrounding trees

Electronically tintable glass  
for classroom/auditorium  
windows



SageGlass 

# OPTION # 1 – WATER BASED SYSTEM

A SE **MEP** CM LCFM



Radaint ceiling cooling panels



DOAS (dehumidification of outdoor air)

Underfloor air distribution



Displacement ventilation

PRO

Cooling evenly distributed

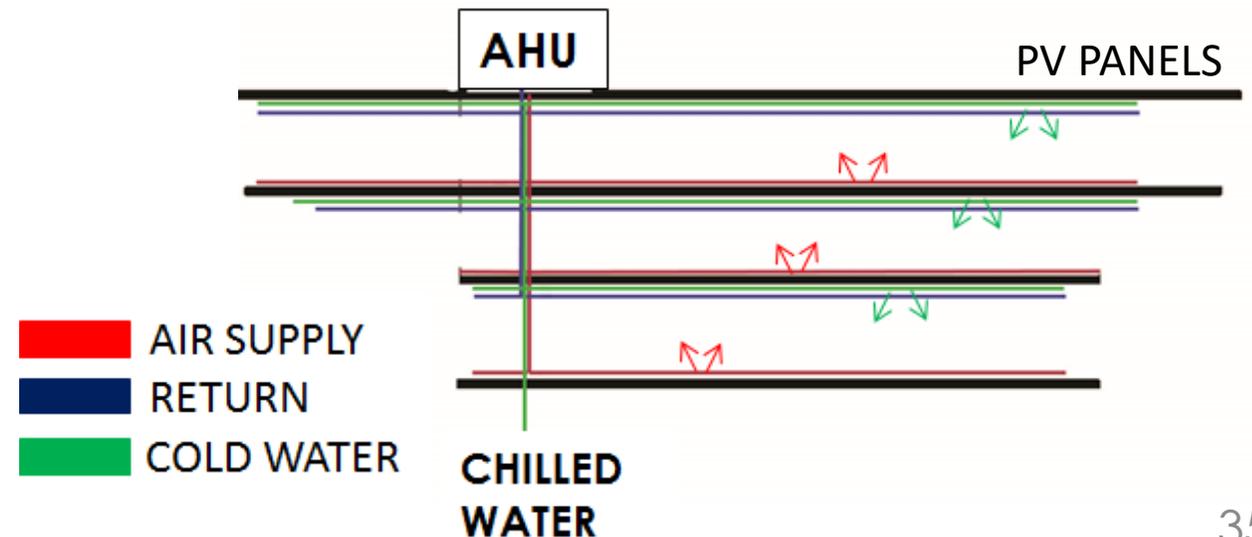
Installations are hidden

CONS

Condensation problems

High installation cost

Lower ceiling height



# OPTION # 2 – AIR BASED SYSTEM

A SE **MEP** CM LCFM



VAV system delivers air and cooling



DOAS system (Dehumidification of outdoor air)

VAV system overhead distribution



Displacement ventilation

PRO

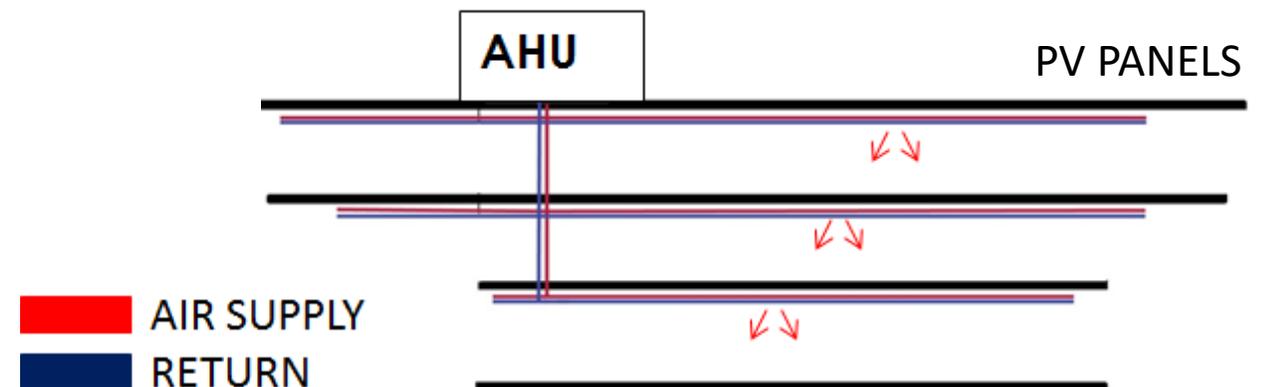
Humidity control

Simple solution

CONS

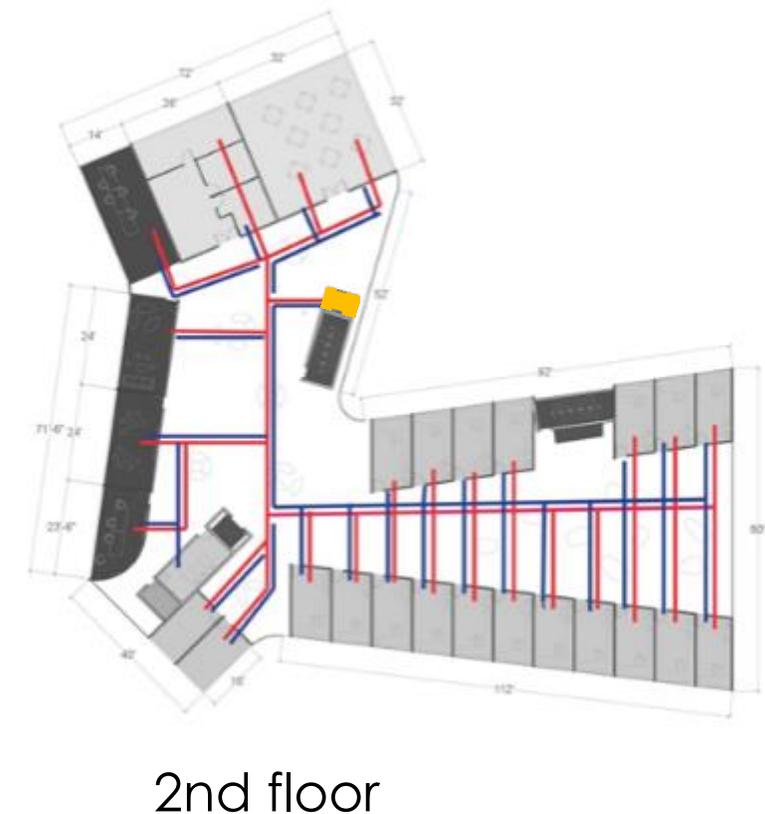
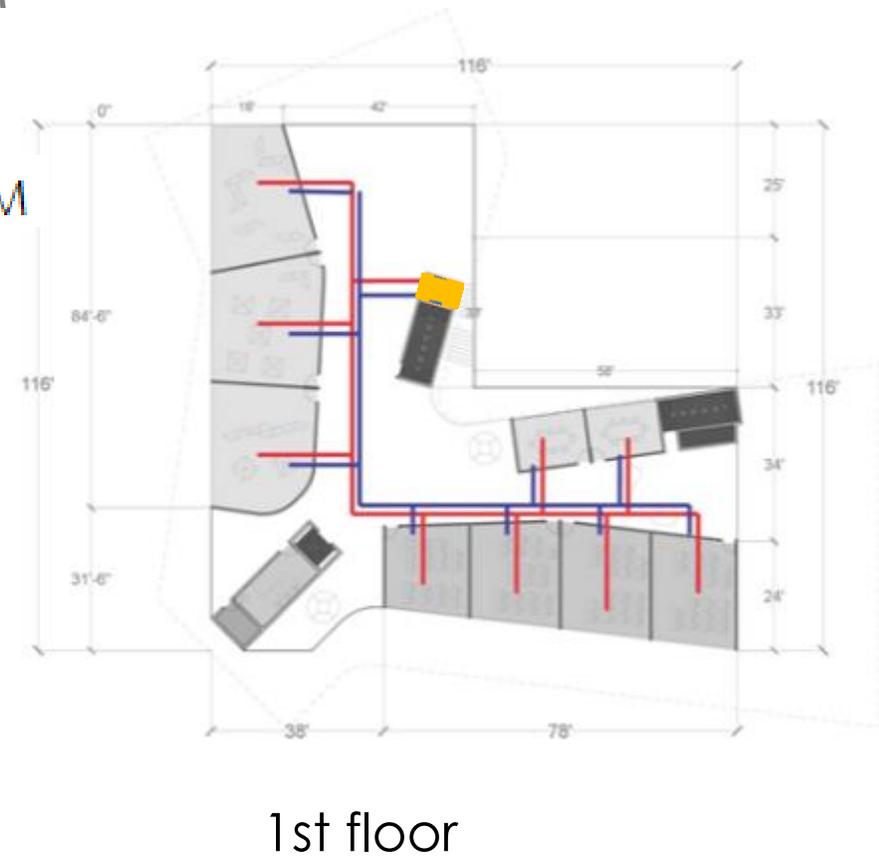
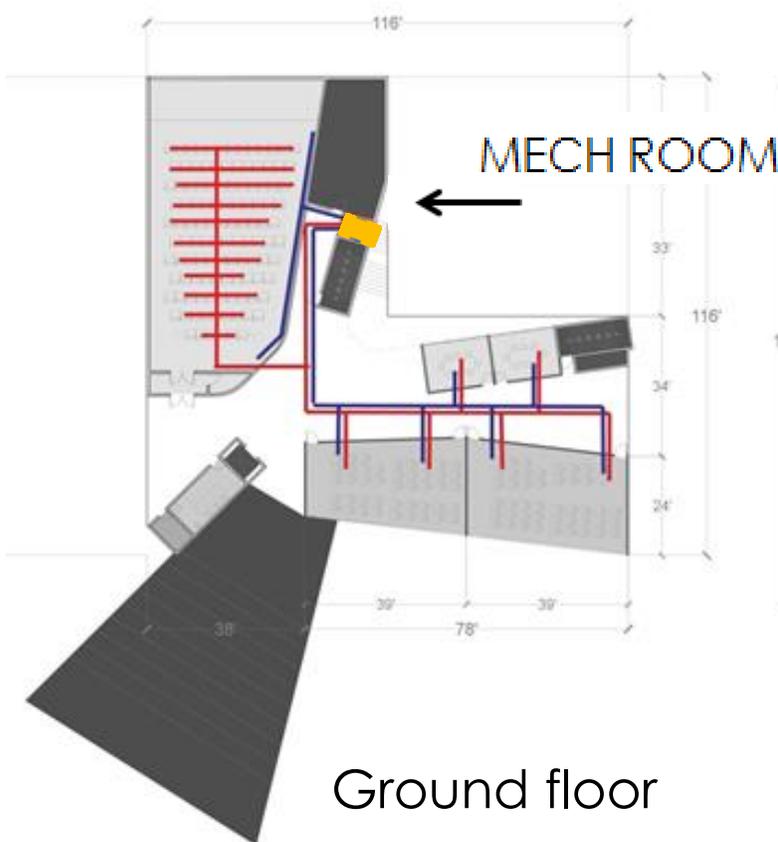
High electricity costs

More ductwork



# AIR DISTRIBUTION - DUCTING

A SE **MEP** CM LCFM



-  AIR SUPPLY
-  RETURN
-  SHAFT

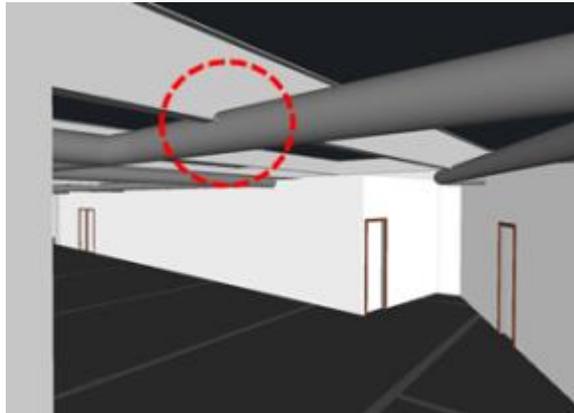


# INTEGRATION WITH STRUCTURAL SYSTEM

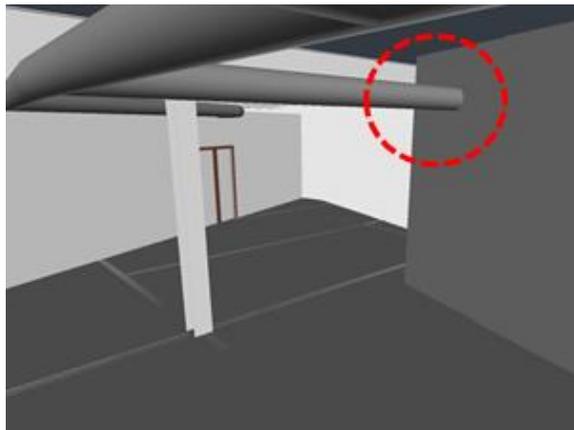
A SE MEP CM LCFM



## PROBLEMS



Penetration in W shape beams



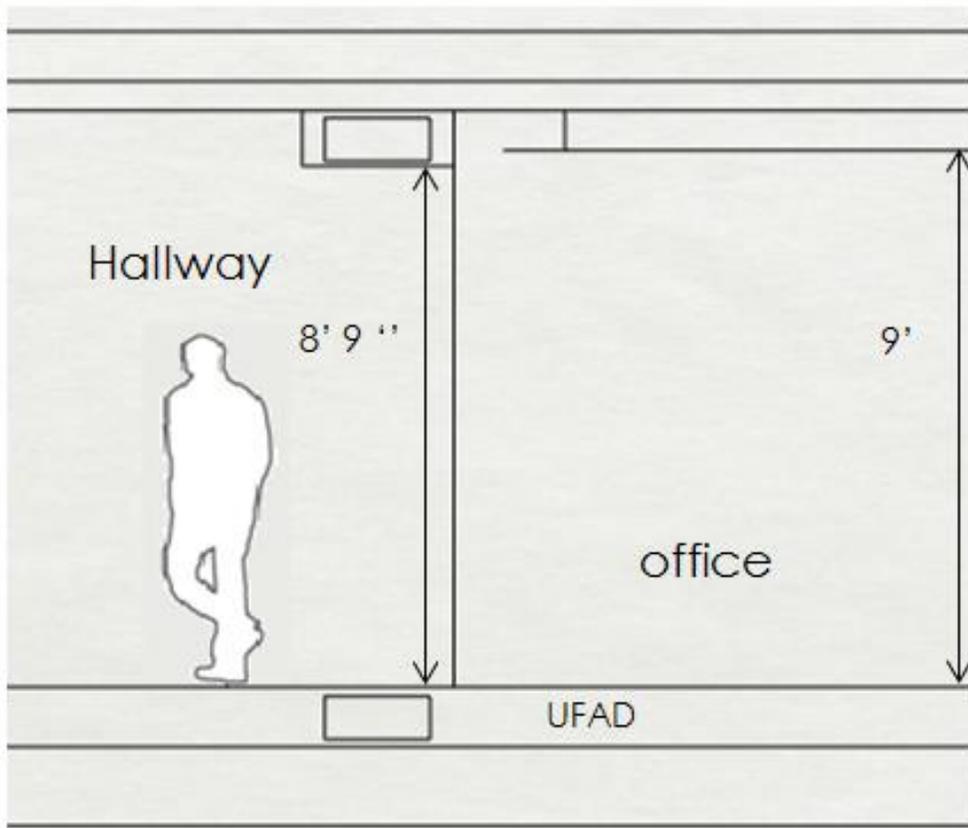
Opening in shear walls

# FLOOR SANDWICH

A SE MEP CM LCFM

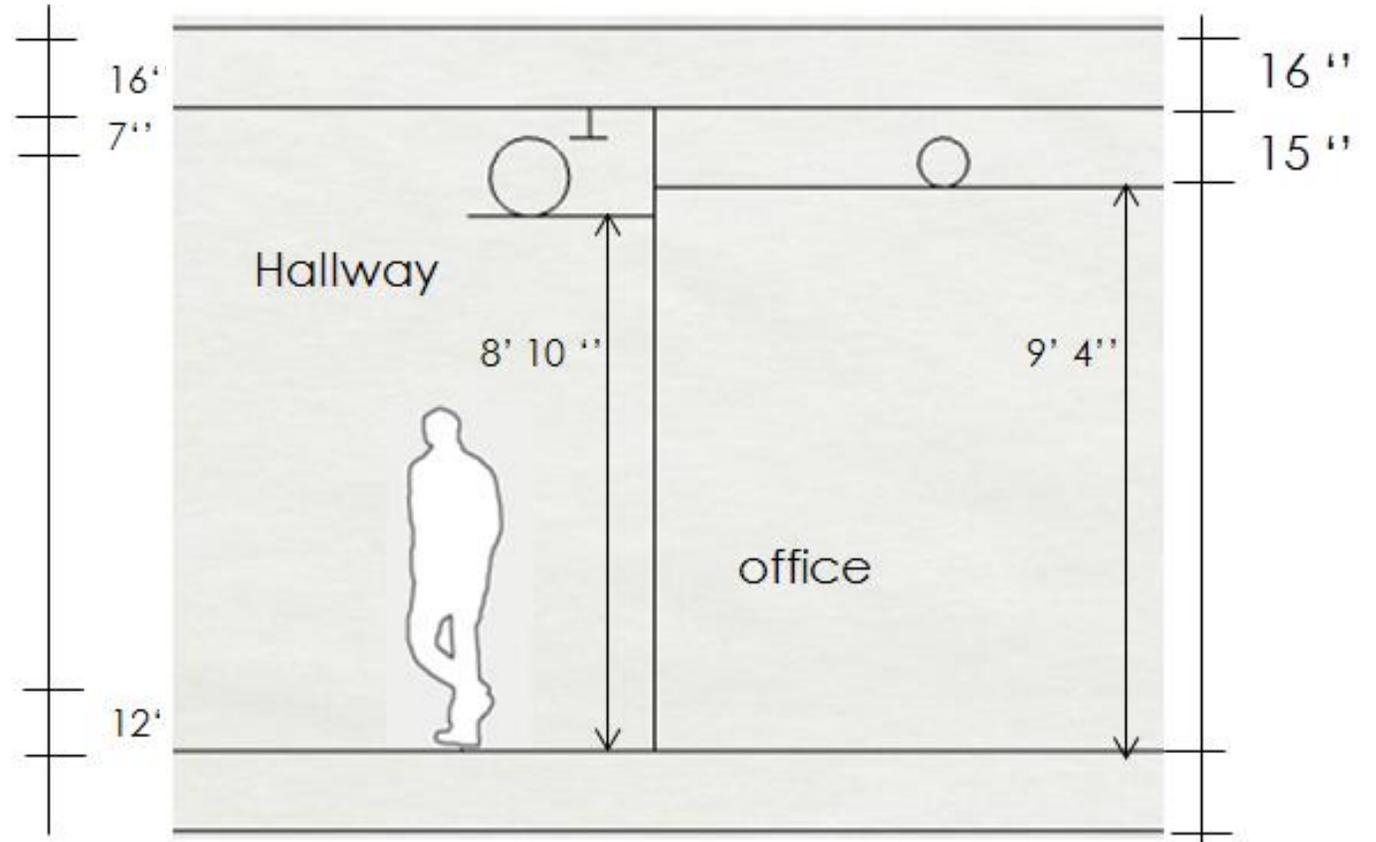


Concrete + Water based system



Slab to slab height: 12'

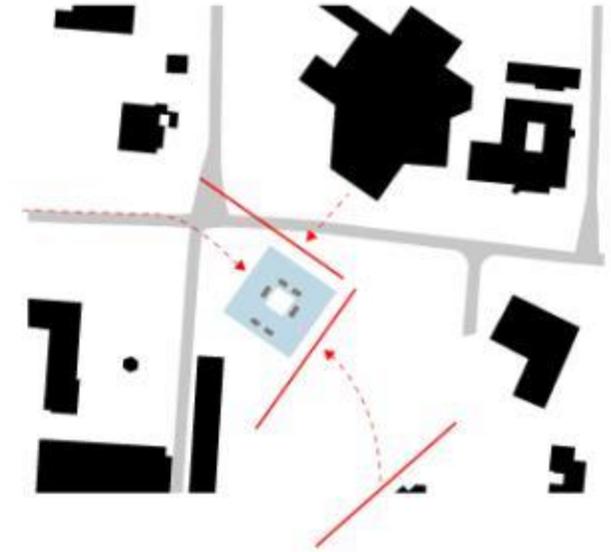
Steel/concrete + Air based system



Slab to slab height: 12'

# BIG IDEA – THE AIR CUBE

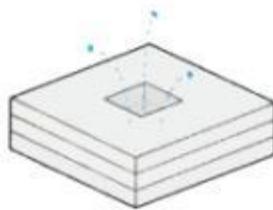
A SE MEP CM LCFM



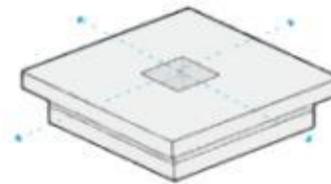
100' x 100'



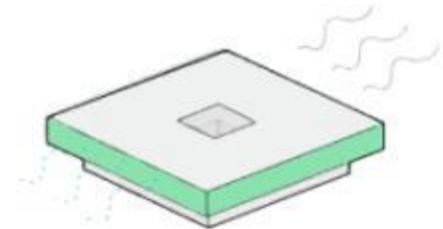
x 3



+ ATRIUM



+Cantilever



Green Facade  
Purification of the AIR

# AIR CUBE FLOOR PLANS

A SE MEP CM LCFM

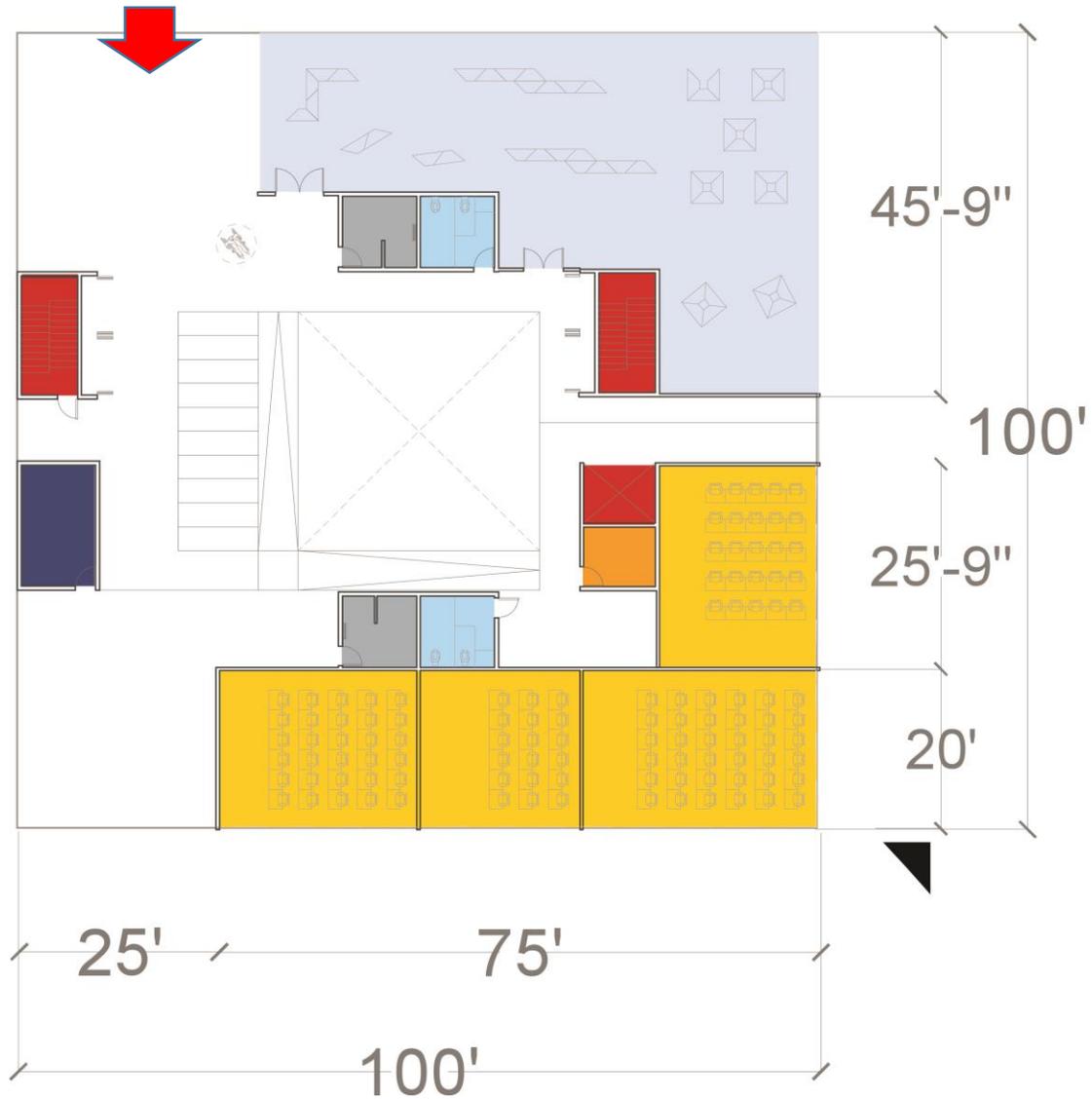
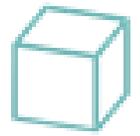


## Unground Floor

- Auditorium
- Seminars
- Storage
- Large Classrooms
- Bathrooms
- Mech Room
- Vertical Circulation
- Storage
- Shaft

# AIR CUBE FLOOR PLANS

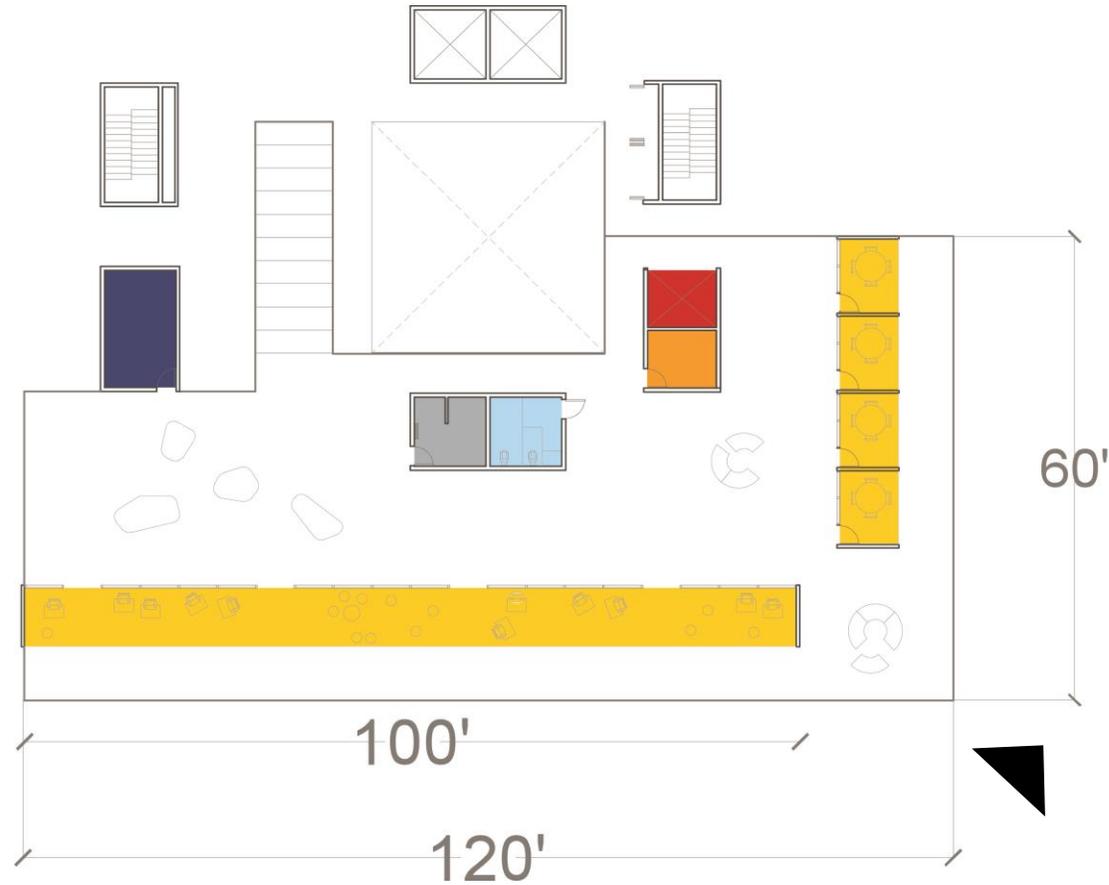
A SE MEP CM LCFM



- Ground Level**
- Labs
  - Small Classrooms
  - Bathrooms
  - Mech Room
  - Vertical Circulation
  - Shaft
  - Storage

# AIR CUBE FLOOR PLANS

A SE MEP CM LCFM



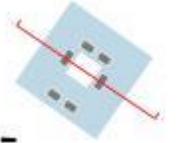
## Intermediate Level

- Students offices
- Bathrooms
- Mech Room
- Vertical Circulation
- Storage
- Shaft



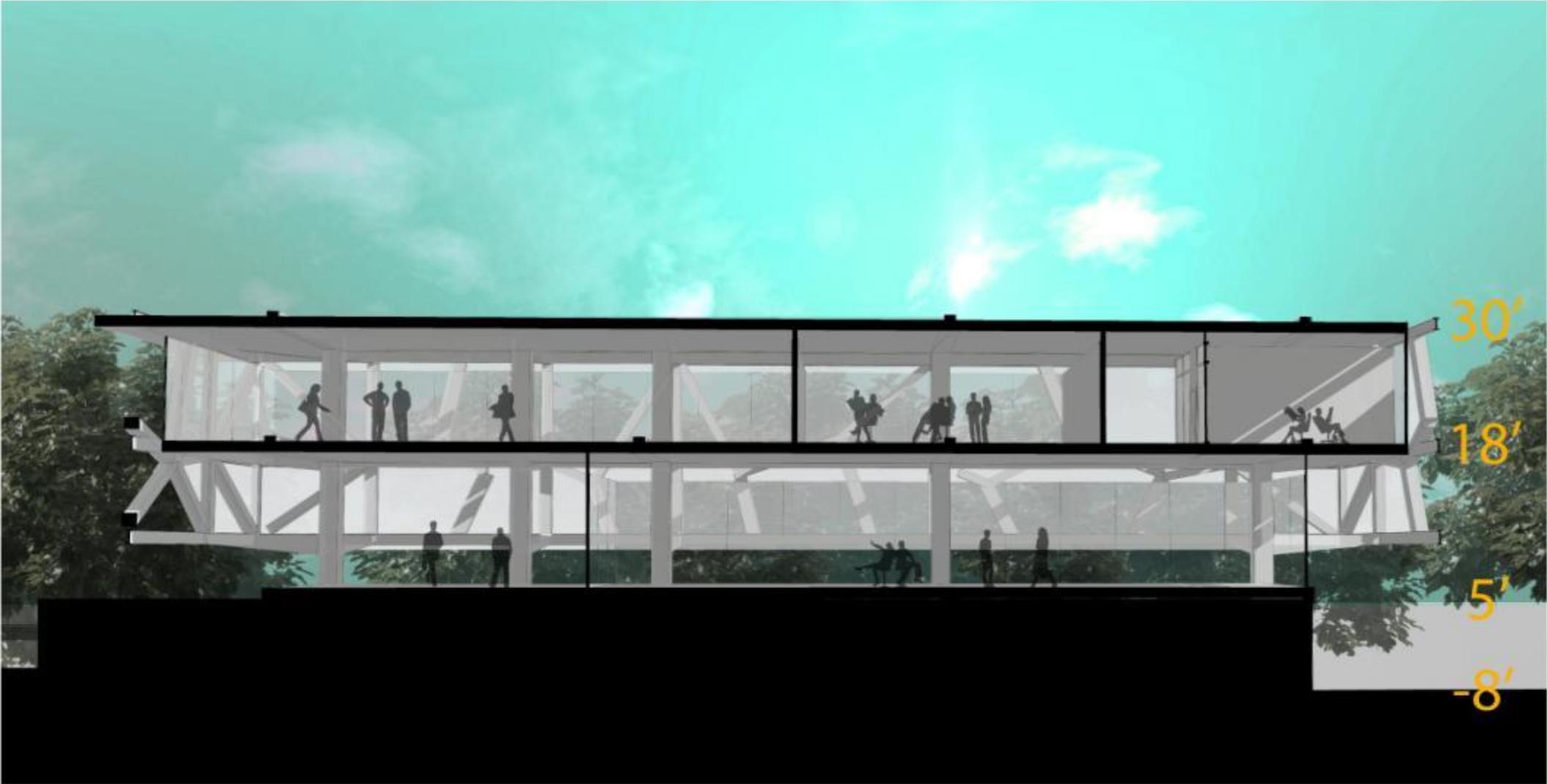
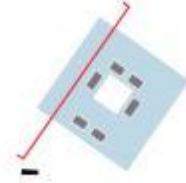
# AIR CUBE SECTION A-A

A SE MEP CM LCFM



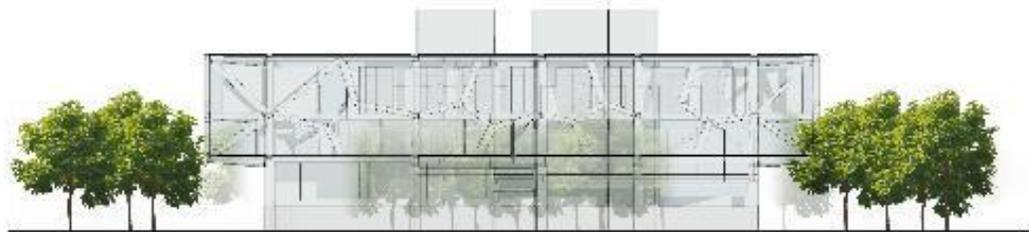
# AIR CUBE SECTION B-B

A SE MEP CM LCFM



# AIR CUBE ELEVATIONS

A SE MEP CM LCFM



SOUTH ELEVATION



WEST ELEVATION



EAST ELEVATION

# AIR CUBE VISUALIZATION

A SE MEP CM LCFM



# AIR CUBE VISUALIZATION

A SE MEP CM LCFM



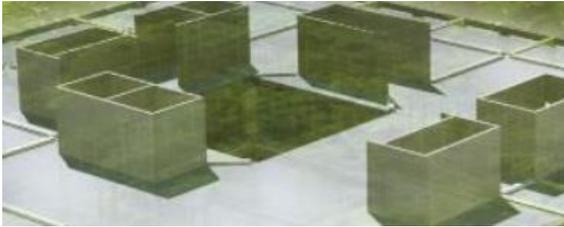
ATRIUM

# STRUCTURAL Challenges

A SE MEP CM LCFM



- **Big Atrium:** 30'x30' out of 100'x100' Rigid Floor Assumption Affected



- **Cantilever:** 10'



- **Hanging Facade:** Integration With Structural System

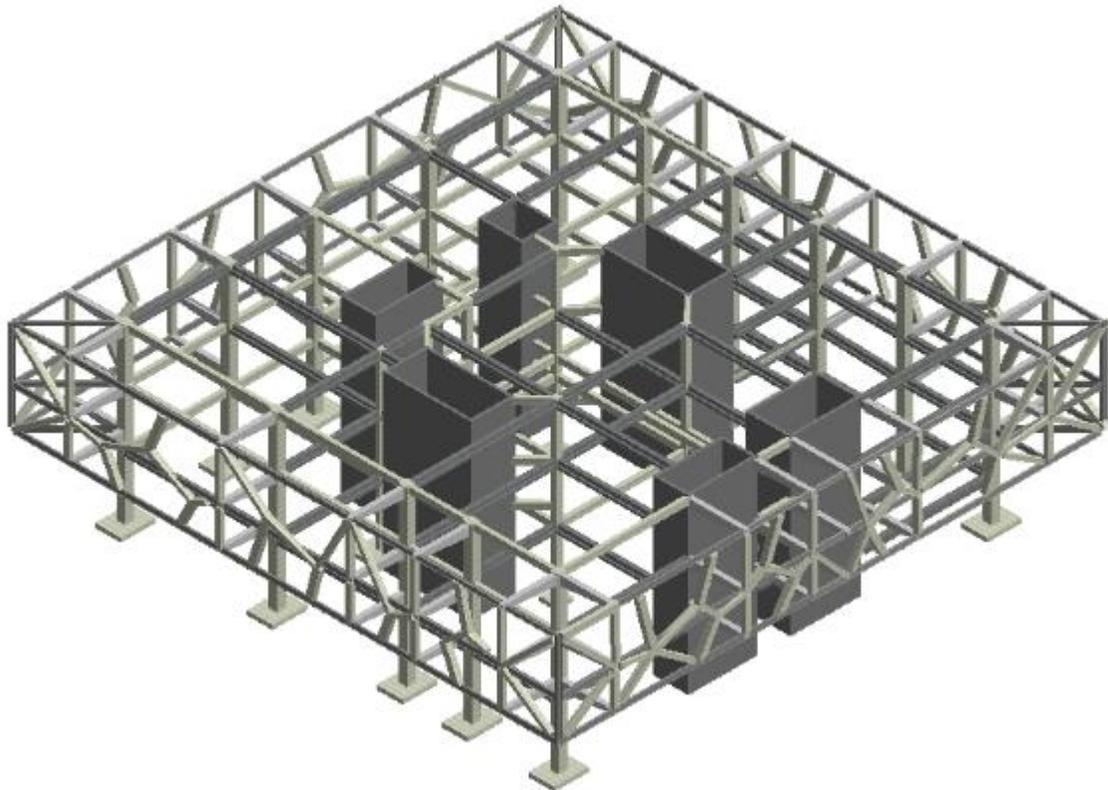


# STRUCTURAL SYSTEMS

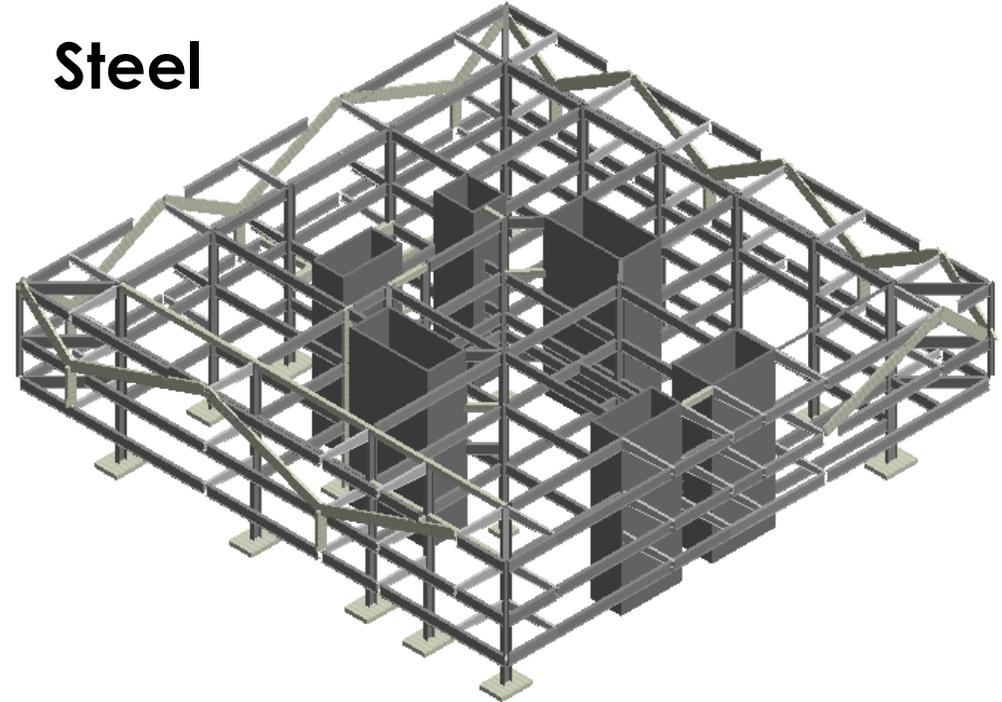
A SE MEP CM LCFM



## Concrete



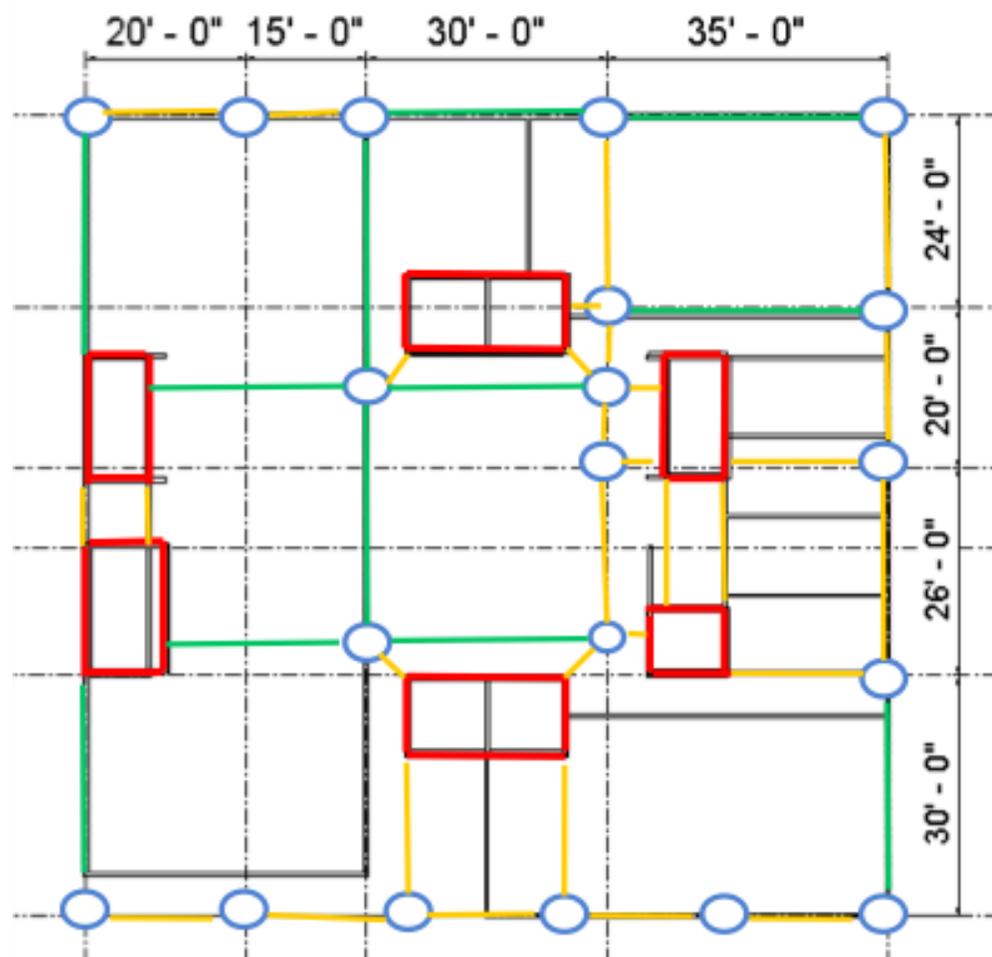
## Steel



	STEEL	CONCRETE
Lateral System	Shear Wall	Shear Wall
Cantilever Solution	Tapered I-beam; Diagonal Bracing	Pre-stress Composite Slab

# FIRST FLOOR

A SE MEP CM LCFM

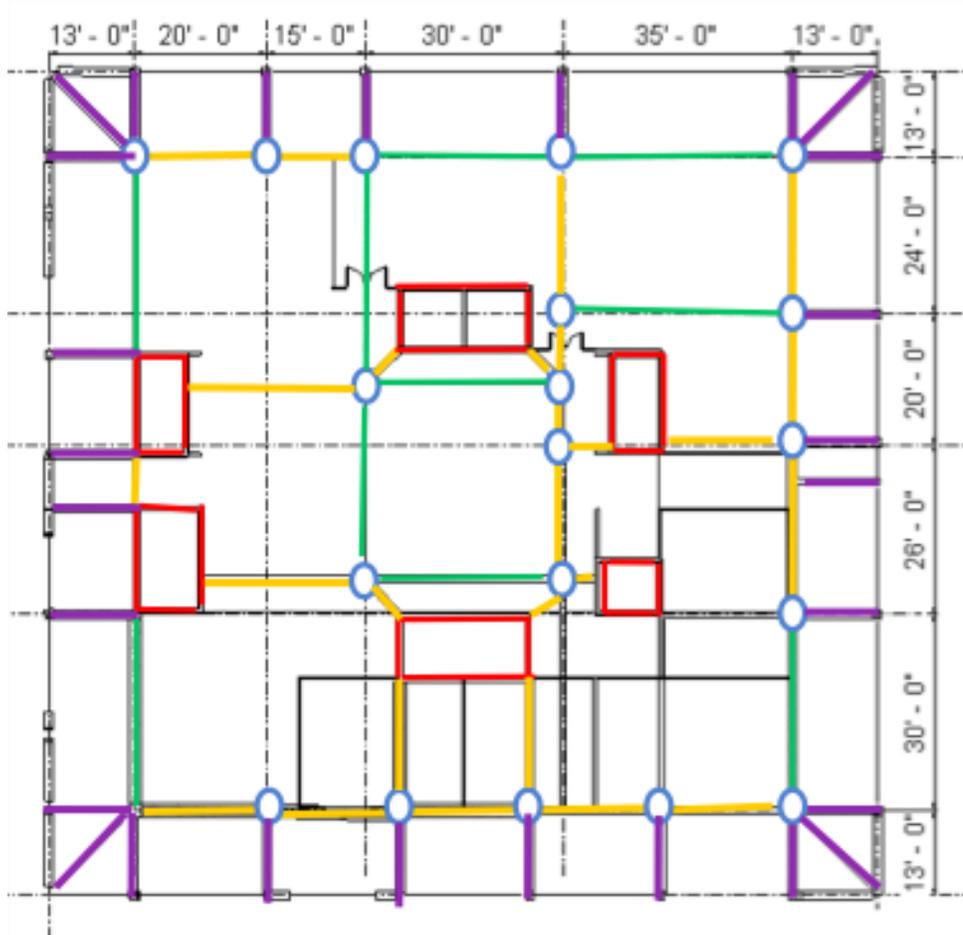


## Typ. Section Dimensions

- Normal inverted T Beam 18''
- P.T. Slab 9''
- Shear Wall 12''
- Long Span inverted T Beam 21''
- Square Column 24''

# SECOND FLOOR

A SE MEP CM LCFM



## Typ. Section Dimensions

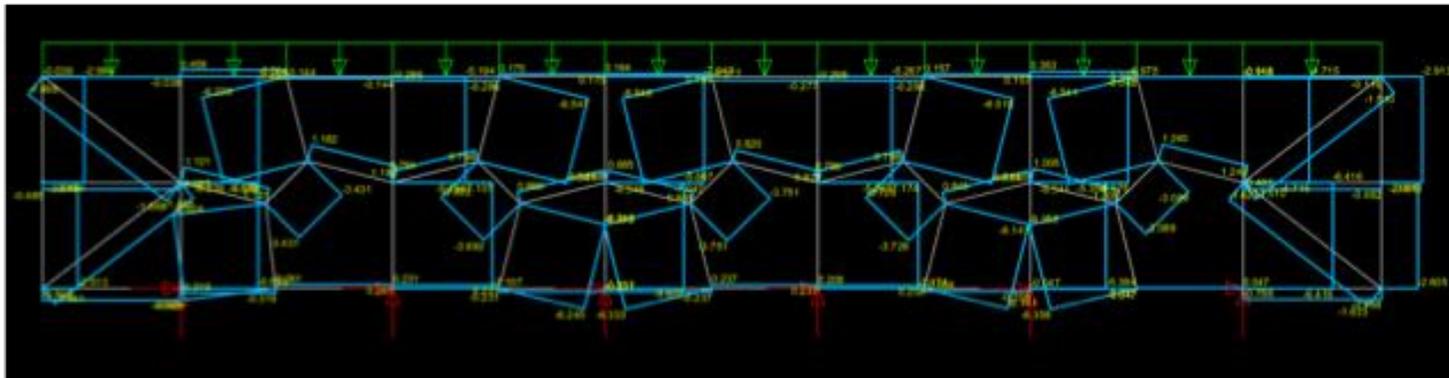
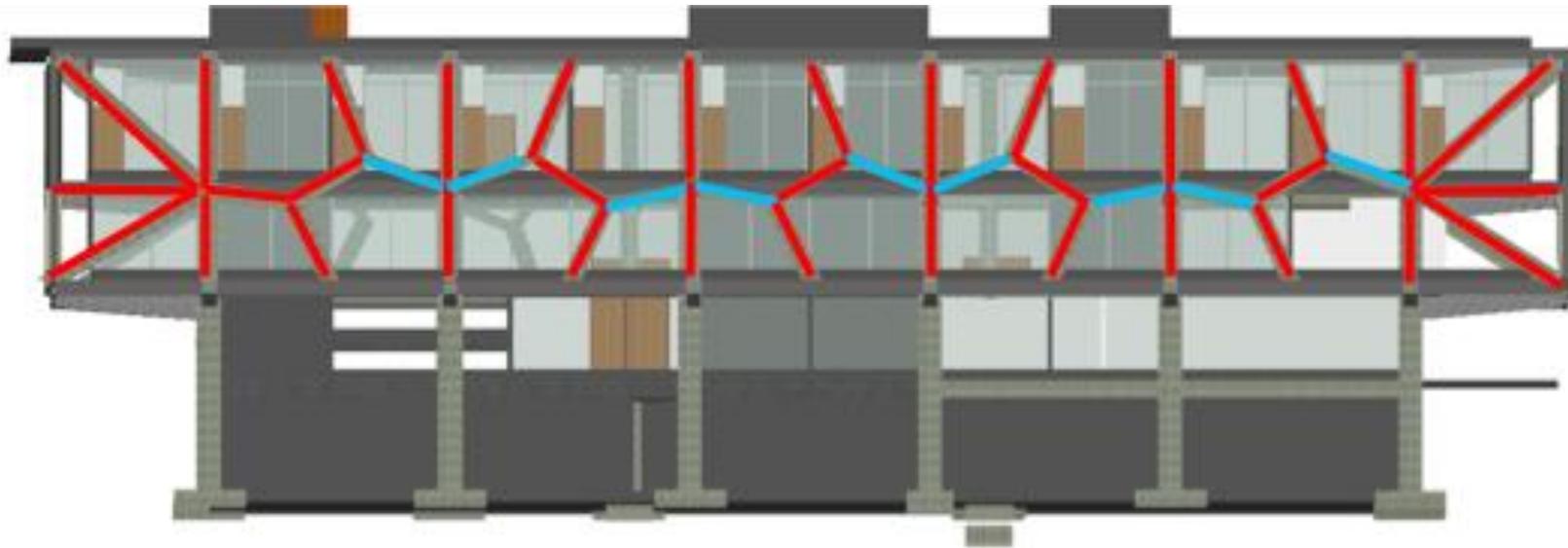
- Normal inverted T Beam 18''
- P.T. Slab 6''
- Shear Wall 12''
- Long Span inverted T Beam 21''
- Square Column 24''
- Tapered cantilever beam 21''

# GRAVITY LOAD PATH

A SE MEP CM LCFM | Concrete



— Compression  
— Tension



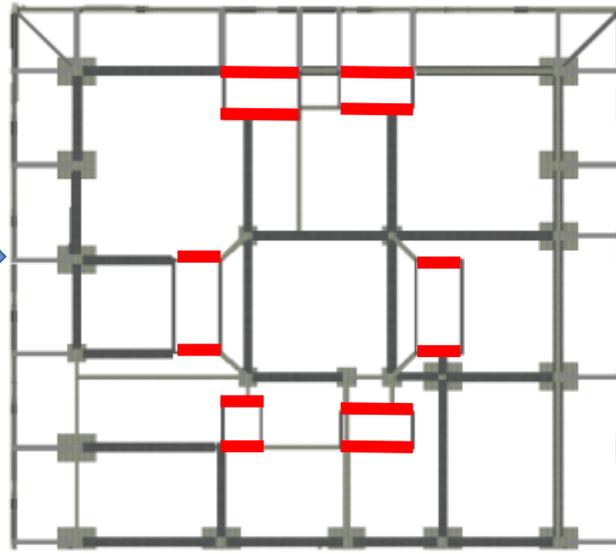
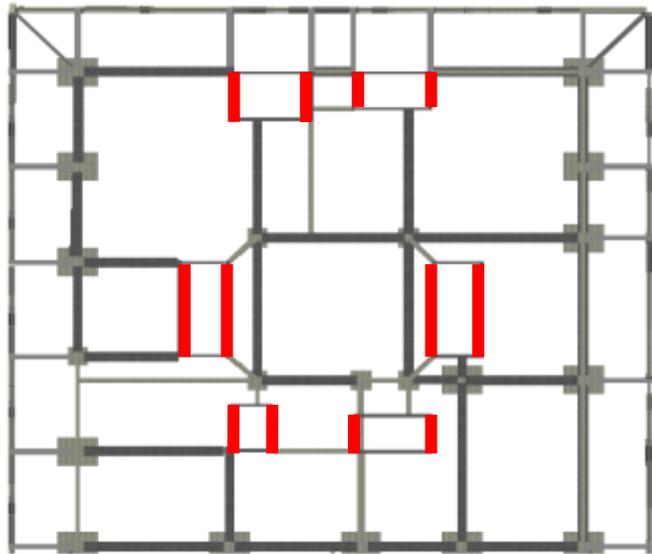
Mastan2 Structural Analysis

# LATERAL LOAD PATH

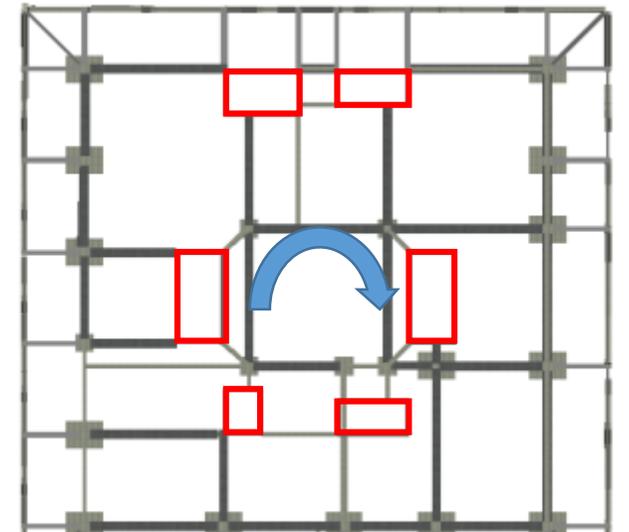
A SE MEP CM LCFM



-  Lateral Force & Torsion
-  Resisting Component



120'



# VERTICAL LOAD INFO & MEMBER SIZE

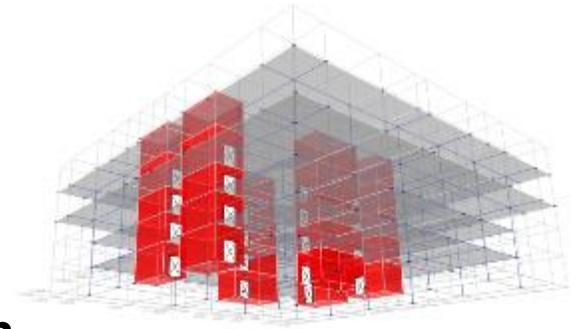
A **SE** MEP CM LCFM | Steel



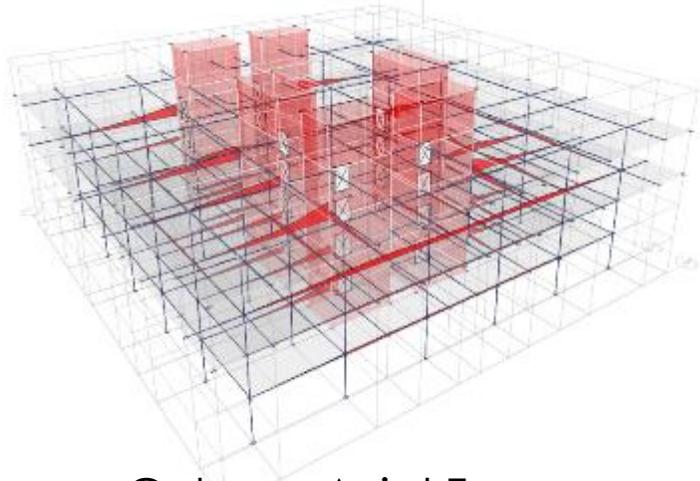
	Slab load	Roof load	Live load
	100 <i>psf</i>	40 <i>psf</i>	40 <i>psf</i>
<b>Corner Column</b>	$(100 \times 2 \times 1.2 + 40 \times 1.6) \times \frac{35}{2} \times \frac{20}{2} = 53.2k$	<b>Floor 1,2: W24X207</b>	<b>Floor 3: W24X162</b>
<b>Center Column</b>	$(100 \times 2 \times 1.2 + 40 \times 1.6) \times \frac{20}{2} \times \frac{20}{2} = 30.4k$	<b>Floor 1,2: W21X147</b>	<b>Floor 3: W21X101</b>
<b>Beam</b>	<b>W 21 X 68</b>		

# SYSTEM PERFORMANCE | STATIC

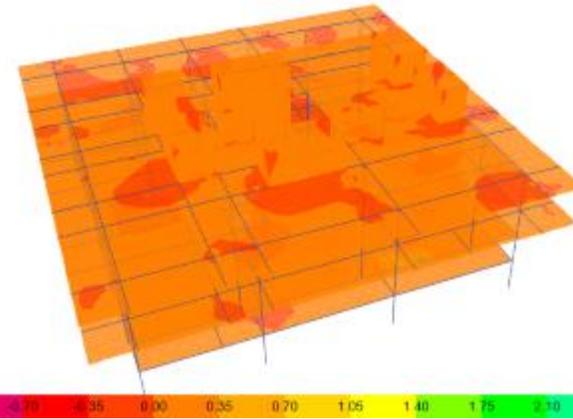
A SE MEP CM LCFM | Steel



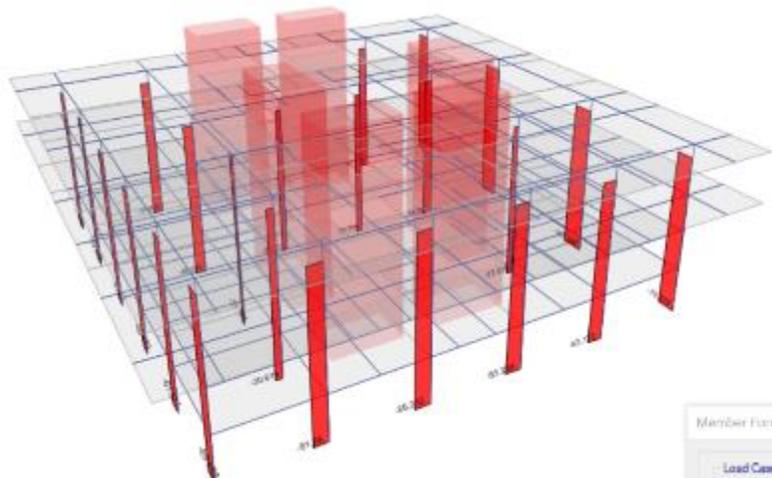
Frame Moment distribution



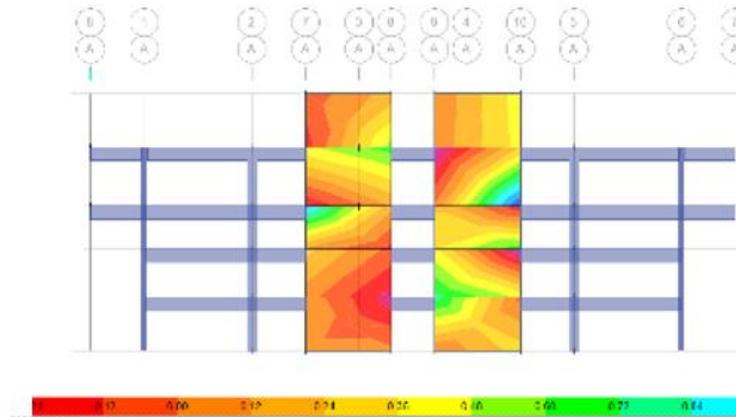
Slab Stress distribution



Column Axial Force

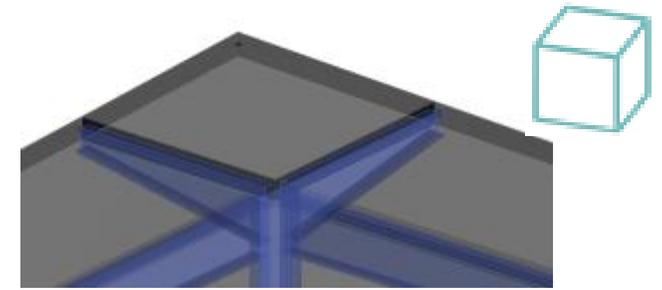


Wall Stress distribution



# SYSTEM PERFORMANCE | DYNAMIC

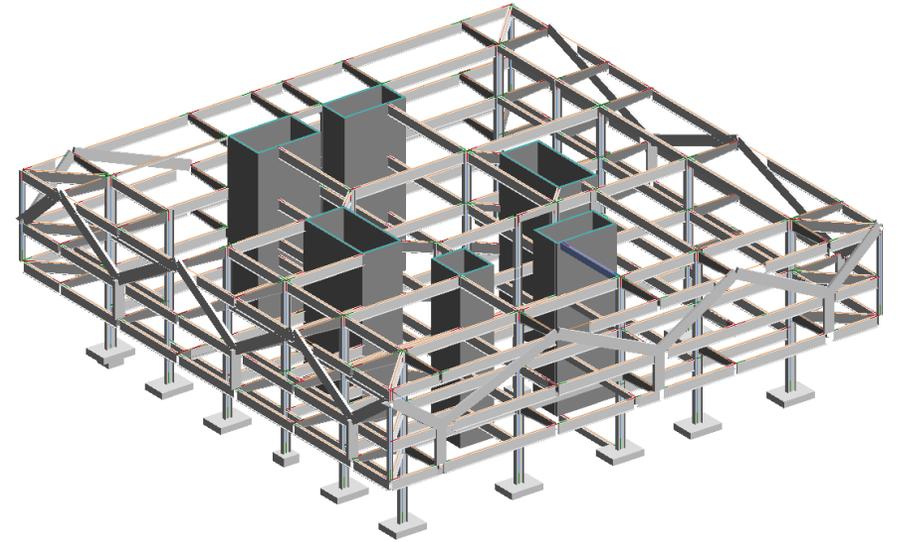
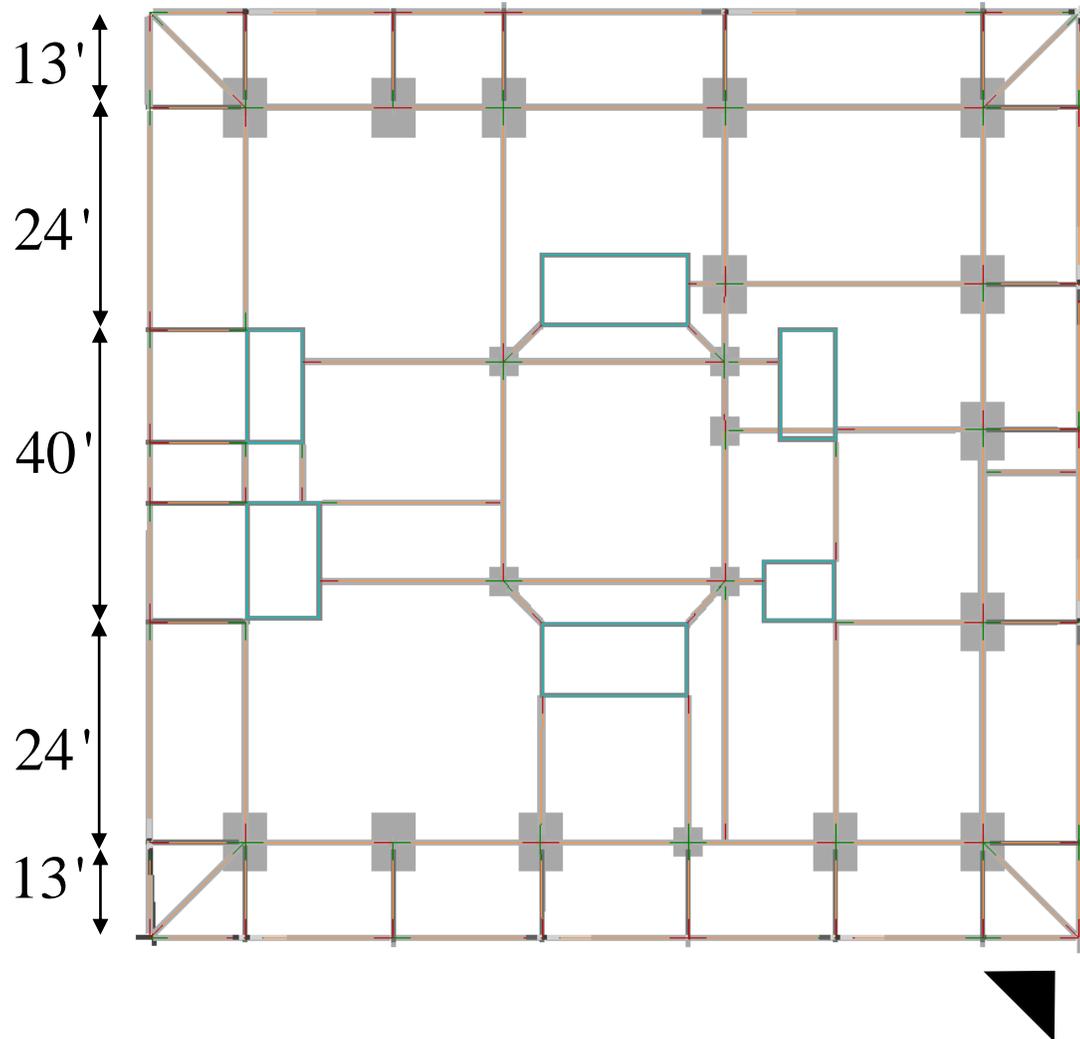
A SE MEP CM LCFM | Steel



	Without Taper Rib	With Taper Rib
Mode 1	A 2D grid diagram showing the first vibration mode shape for a structure without a taper rib. The structure is represented by a grid of blue lines. Two vertical red bars represent the columns. The horizontal lines (beams) show significant lateral displacement, particularly on the right side, indicating a global bending mode.	
Mode 2	A 2D grid diagram showing the second vibration mode shape for a structure without a taper rib. The structure is represented by a grid of blue lines. Two vertical red bars represent the columns. The horizontal lines (beams) show a complex deformation pattern, including lateral displacement and rotation, indicating a higher-order mode.	

# Steel Floor Plan

A SE MEP CM LCFM | Big Idea 2: Cube | Steel

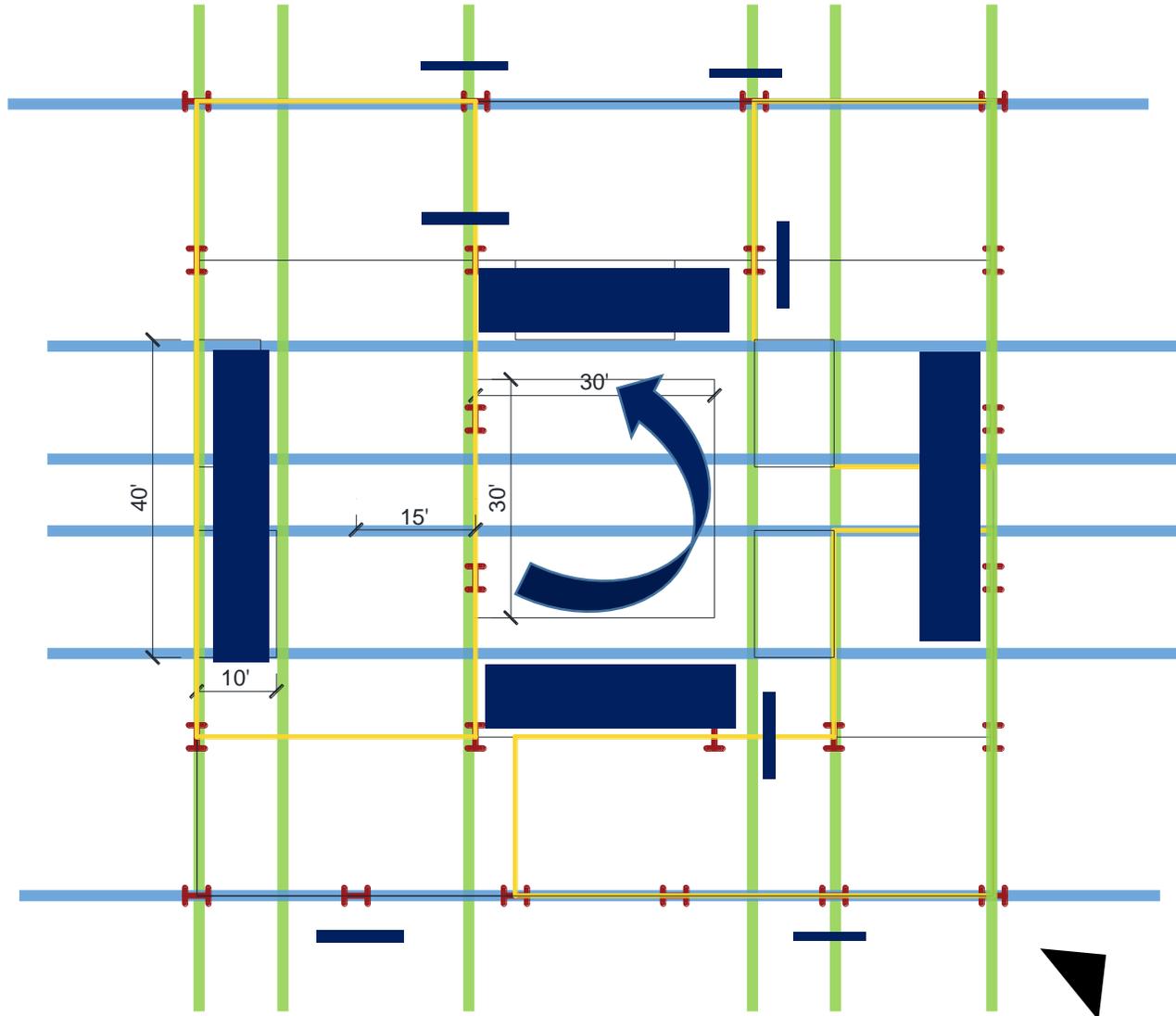
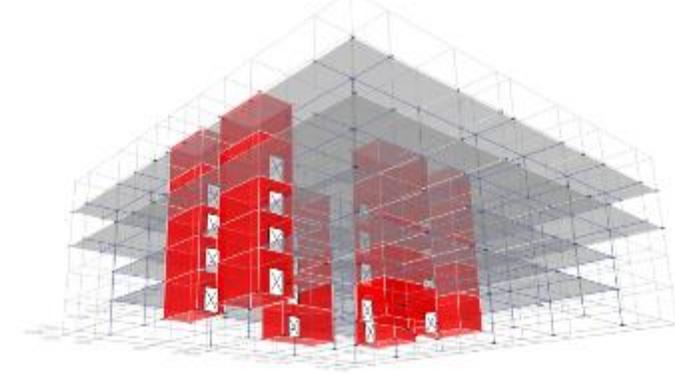


## Typ. Section Dimensions

Beam	W 21x 68
Comp. Slab	8''
Shear Wall	12''
Column	(Center) W24X 207->162 (Corner) W21X 147->101

# LATERAL & TORSIONAL RESISTANCE SYSTEM

A SE MEP CM LCFM | Steel



-  Resistance in y-direction
-  Resistance in x-direction
-  Torsion Resistance



# FOUNDATION

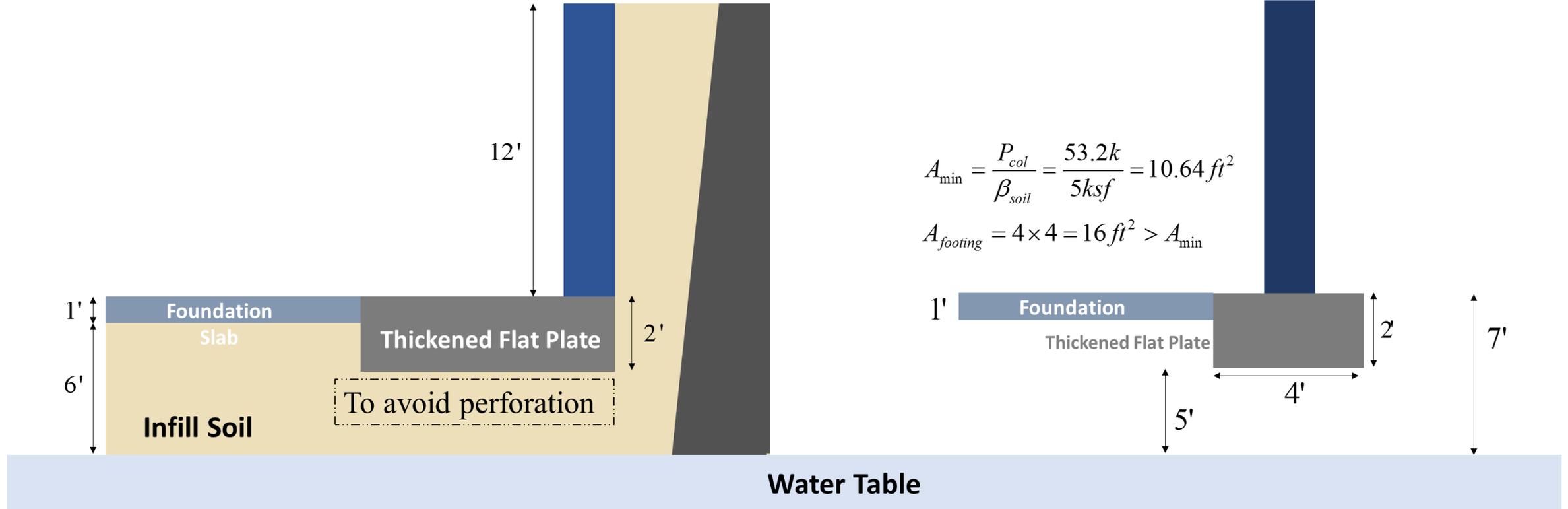
A SE MEP CM LCFM



To sustain soil pressure

Retaining Wall

Column



$$A_{\min} = \frac{P_{col}}{\beta_{soil}} = \frac{53.2k}{5ksf} = 10.64 ft^2$$

$$A_{footing} = 4 \times 4 = 16 ft^2 > A_{\min}$$



# FUTURE DEVELOPMENT

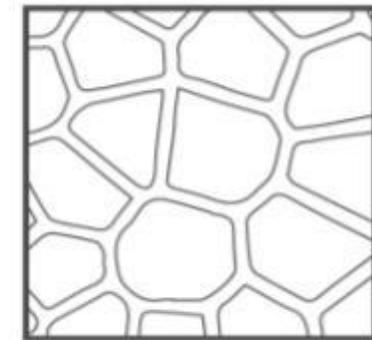
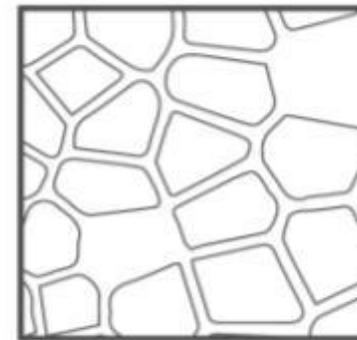
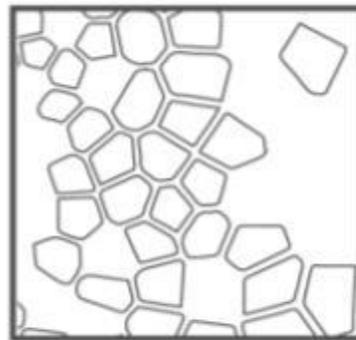
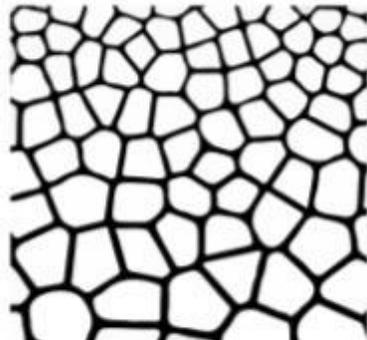
A SE MEP CM LCFM



Decouple Façade System as Non-structural  
- Light Structure Air cube  
- Patterned voronoi with various arrangement



CNC Prefabricated Voronoi Panels easy to replace



Solar Façade Panel Air Purifying Facade

# SMART BUILDING SYSTEMS

A SE **MEP** CM **LCFM**



# SHADE STUDY

A SE MEP CM LCFM



March 10 am – 8 pm ⌚



June 8 am – 10 pm ⌚



December 11 am – 7 pm ⌚



# OPTION # 1 – PASSIVE VENTILATION

A SE **MEP** CM LCFM



Passive ventilation with operable ceiling fans



Controlled ecosystem in facade to dehumidify the air



Displacement ventilation

## PRO

Use of passive strategy

Less ductwork

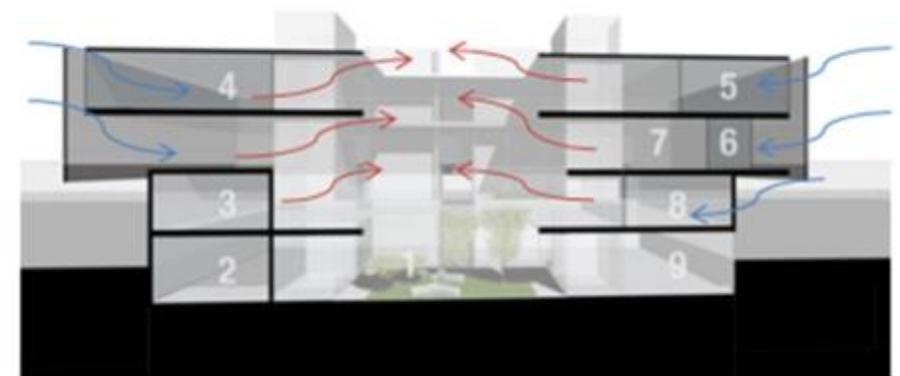
Lower electrical use

## CONS

Challenging to control



PV PANELS



# PLANTS AS BIOFILTER

A SE MEP CM LCFM



Improves aesthetical value

Improve microclimate and air quality

Local plants

Dehumidification of air

Students taking care of maintenance  
→ decrease vandalism risk

PLANTS



Ficus Rubber



Fern



Common Ivy



Sansiviera

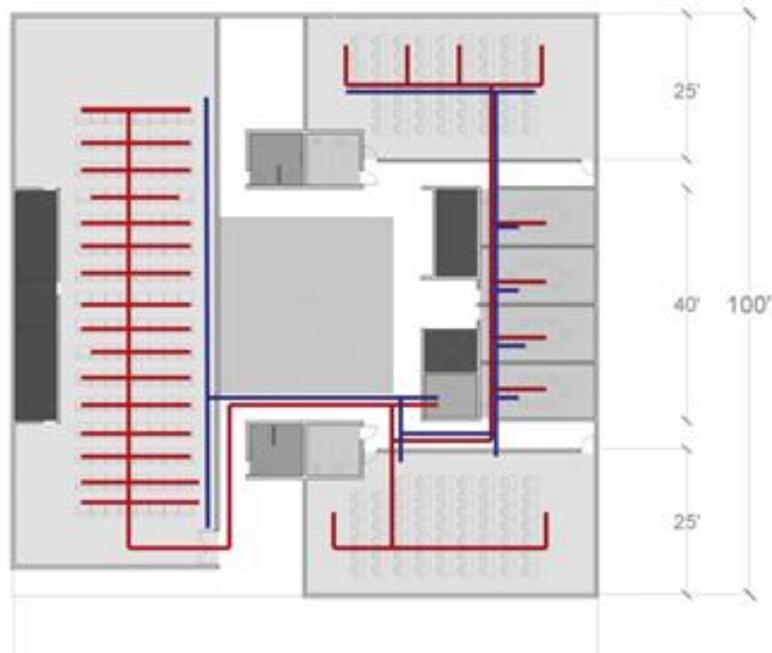


Spider Plant



# MECH. VENTILATED AREAS

A SE MEP CM LCFM



Underground level



Ground floor

 AIR SUPPLY  
 RETURN



# OPTION # 2 – AIR BASED SYSTEM

A SE **MEP** CM LCFM



VAV system delivers air and cooling



DOAS (Dehumidification of outdoor air)

VAV system overhead distribution



Displacement ventilation

PRO

Humidity control

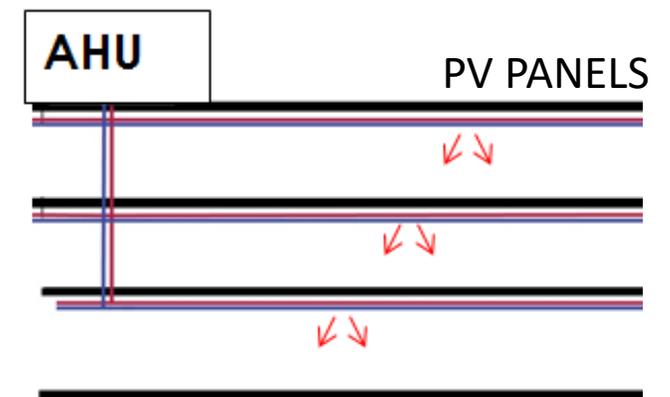
Simple solution

CONS

High electricity costs

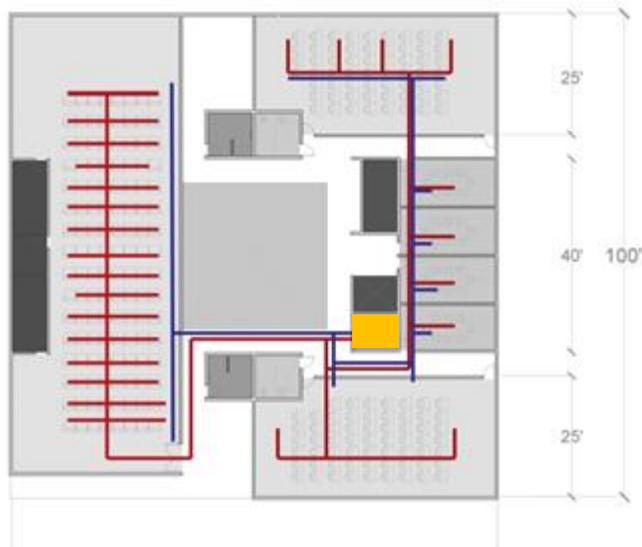
More ductwork

Lower ceiling height in offices

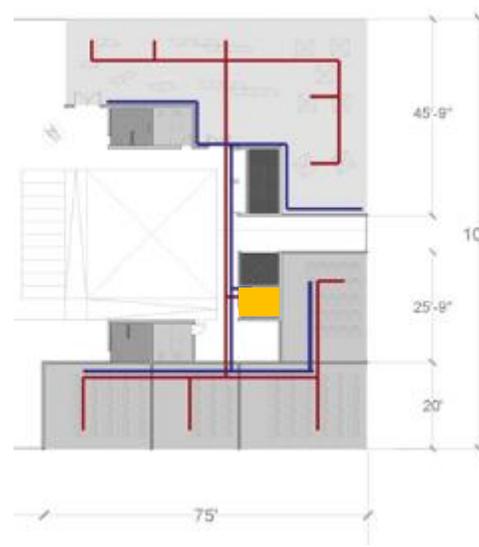


# AIR DISTRIBUTION - DUCTING

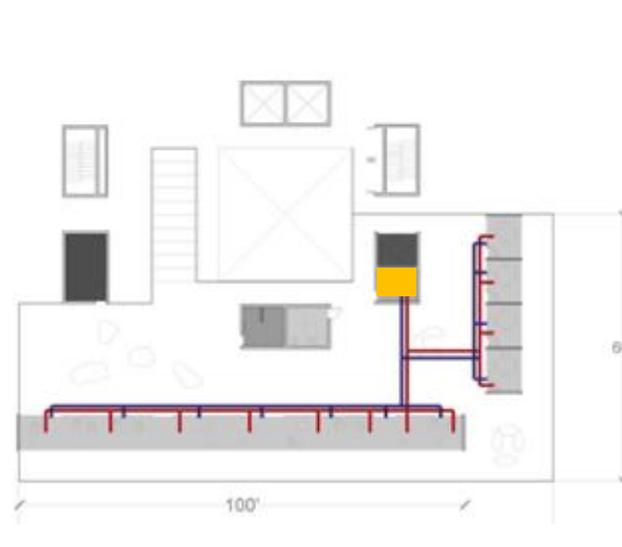
A SE MEP CM LCFM



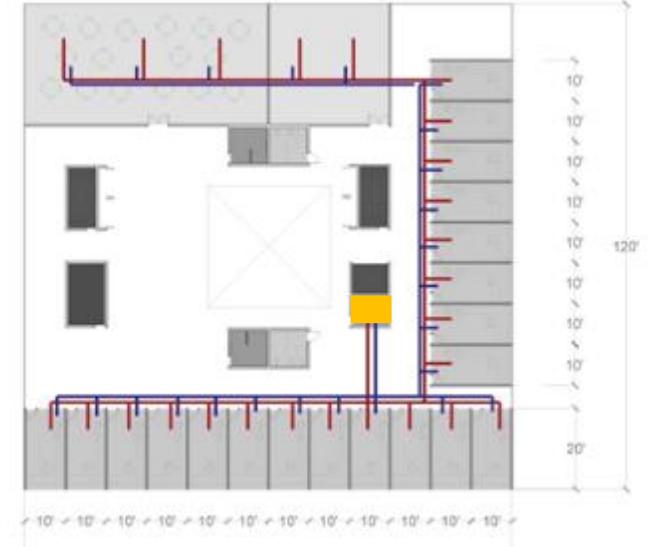
Ground floor



1st floor



Intermediate



2nd floor

-  AIR SUPPLY
-  RETURN
-  SHAFT

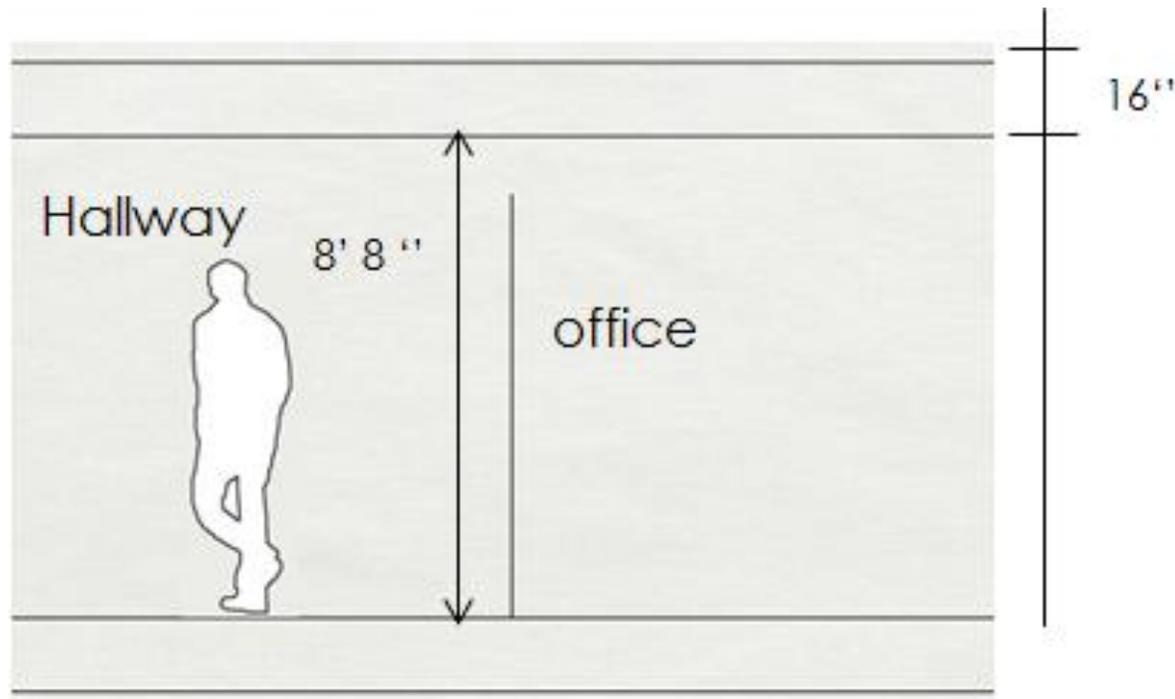


# FLOOR SANDWICH - OFFICE

A SE MEP CM LCFM

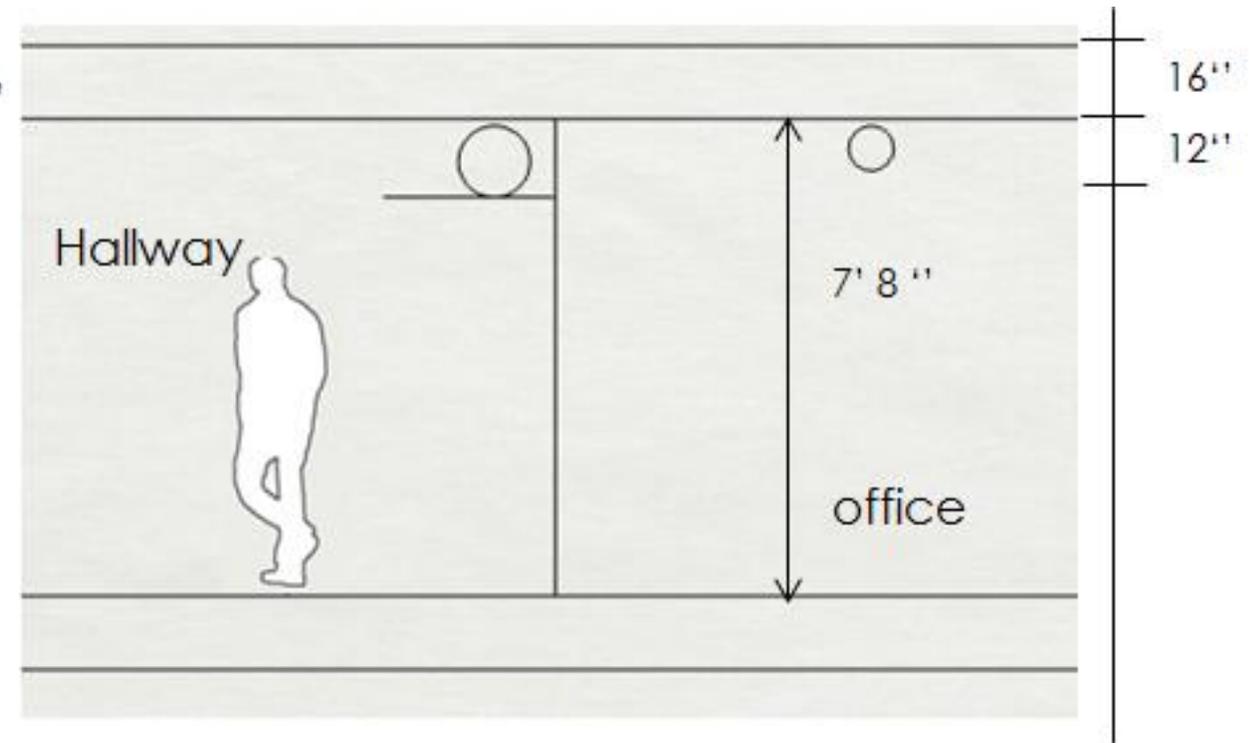


Concrete + Passive ventilation



Slab to slab height: 10'

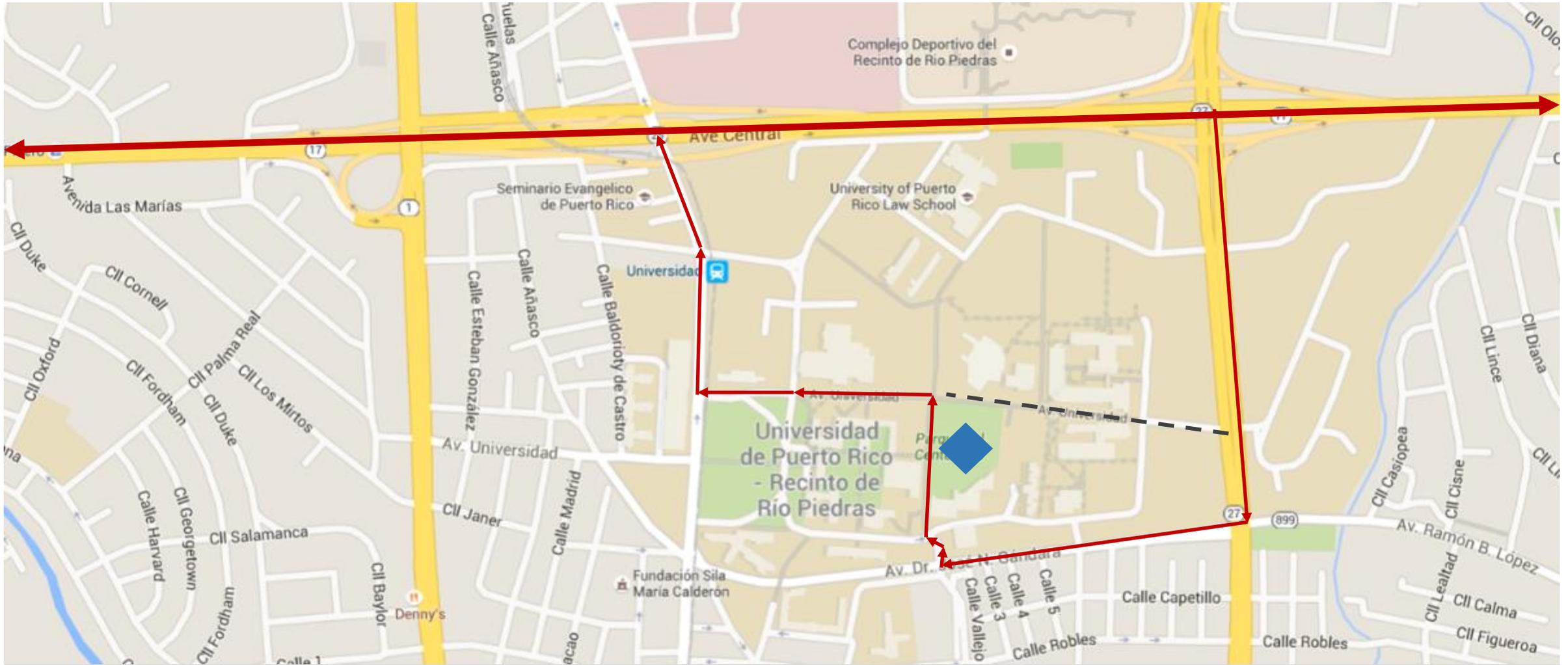
Steel/concrete + Air based system



Slab to slab height : 10'

# OFF SITE LOGISTICS

A SE MEP **CM** LCFM



◆ Site

# EQUIPMENT

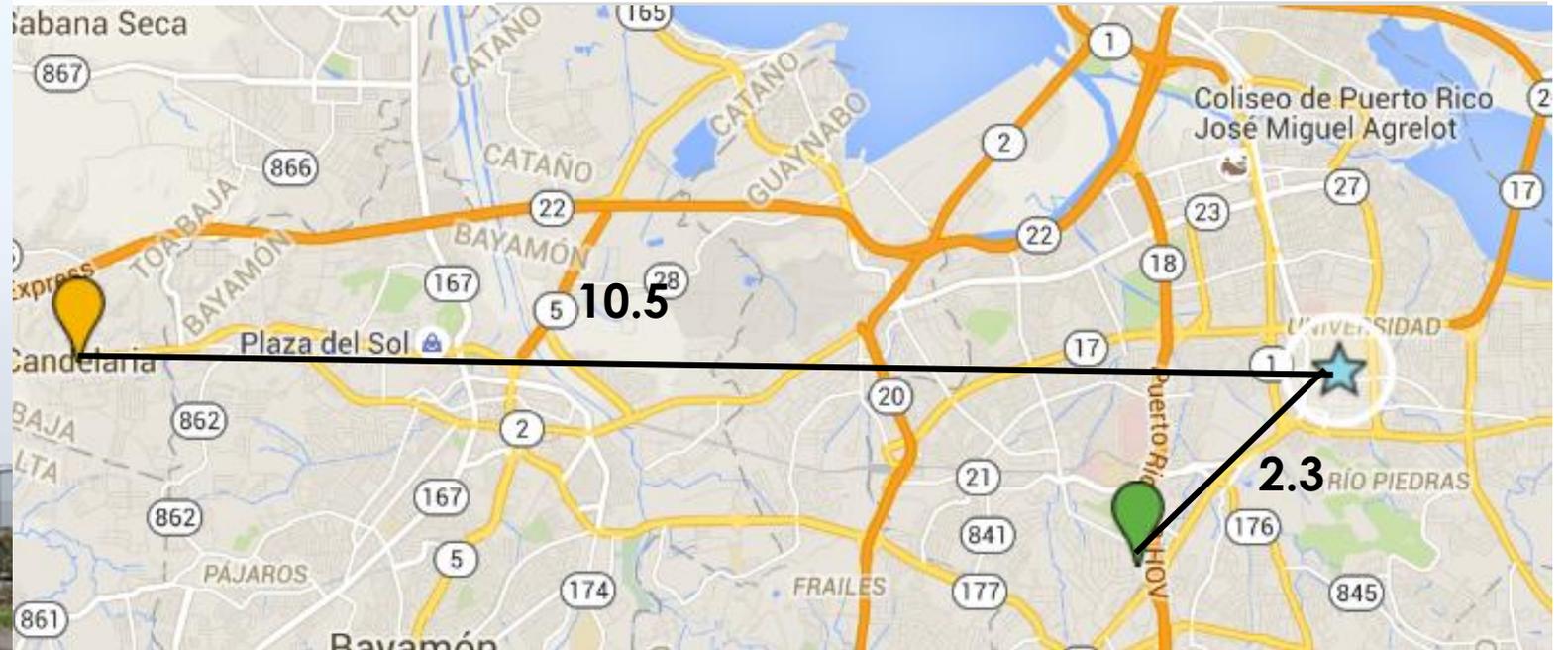
A SE MEP CM LCFM



★ Site

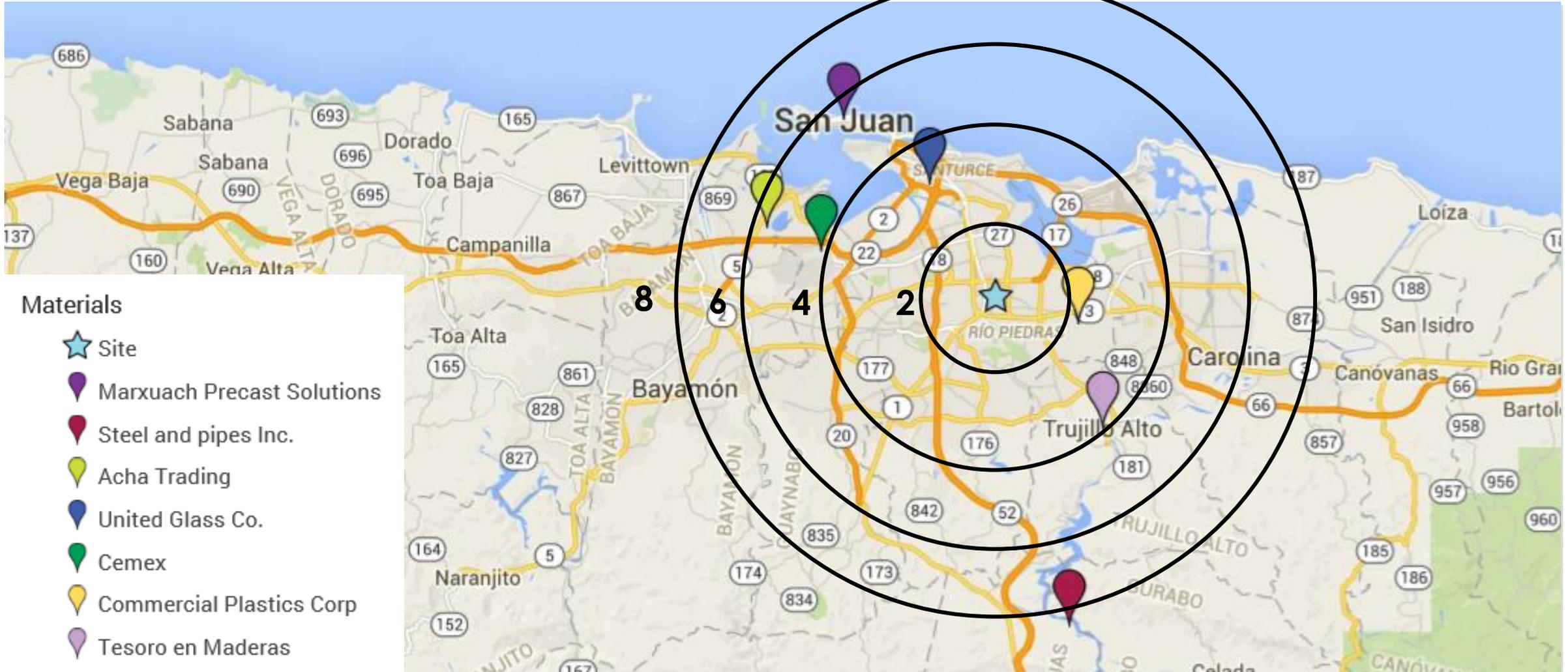
📍 Esmo Gruas Hidraulicas Cranes

📍 BlueLine Rental Excavators and Man lifts



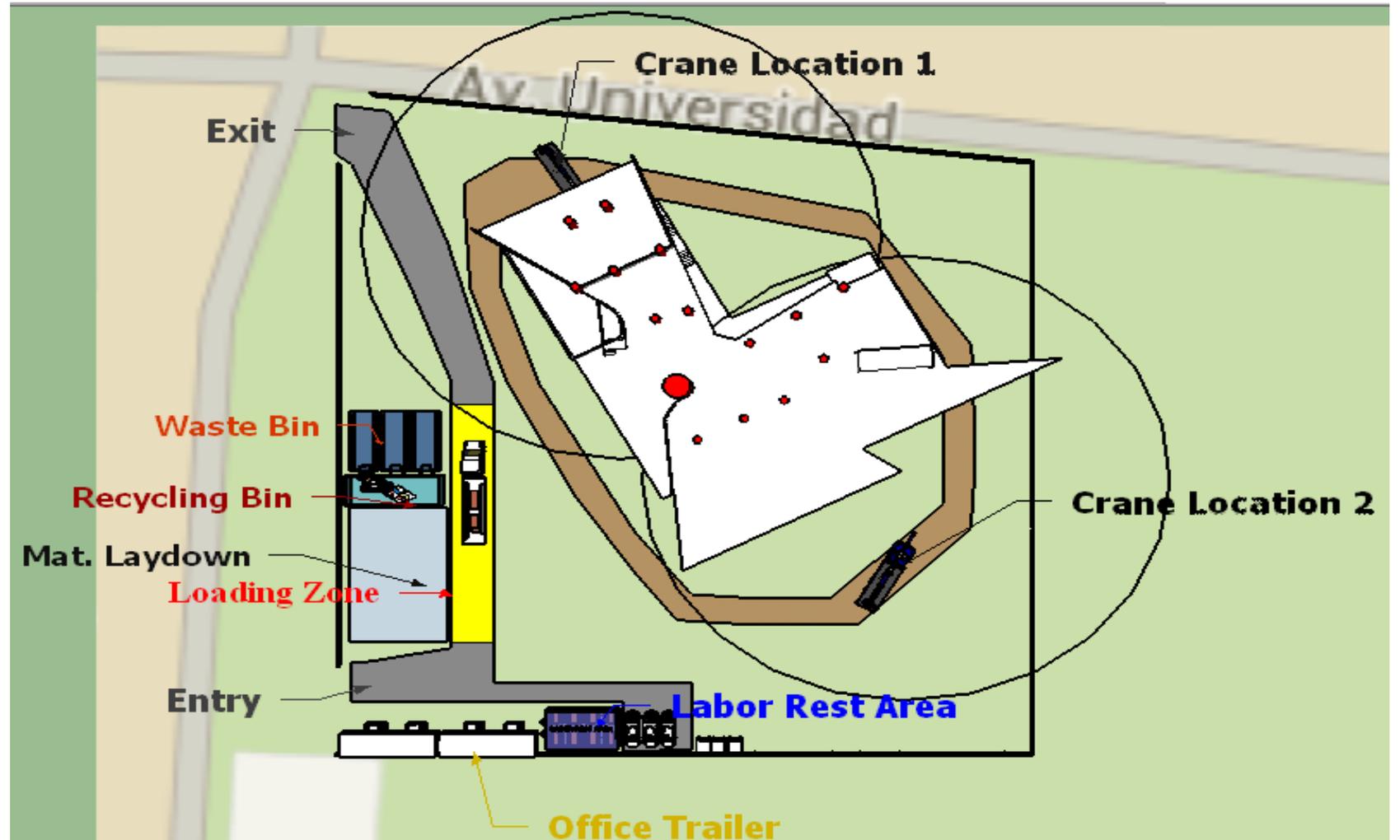
# MATERIAL PROCUREMENT

A SE MEP **CM** LCFM



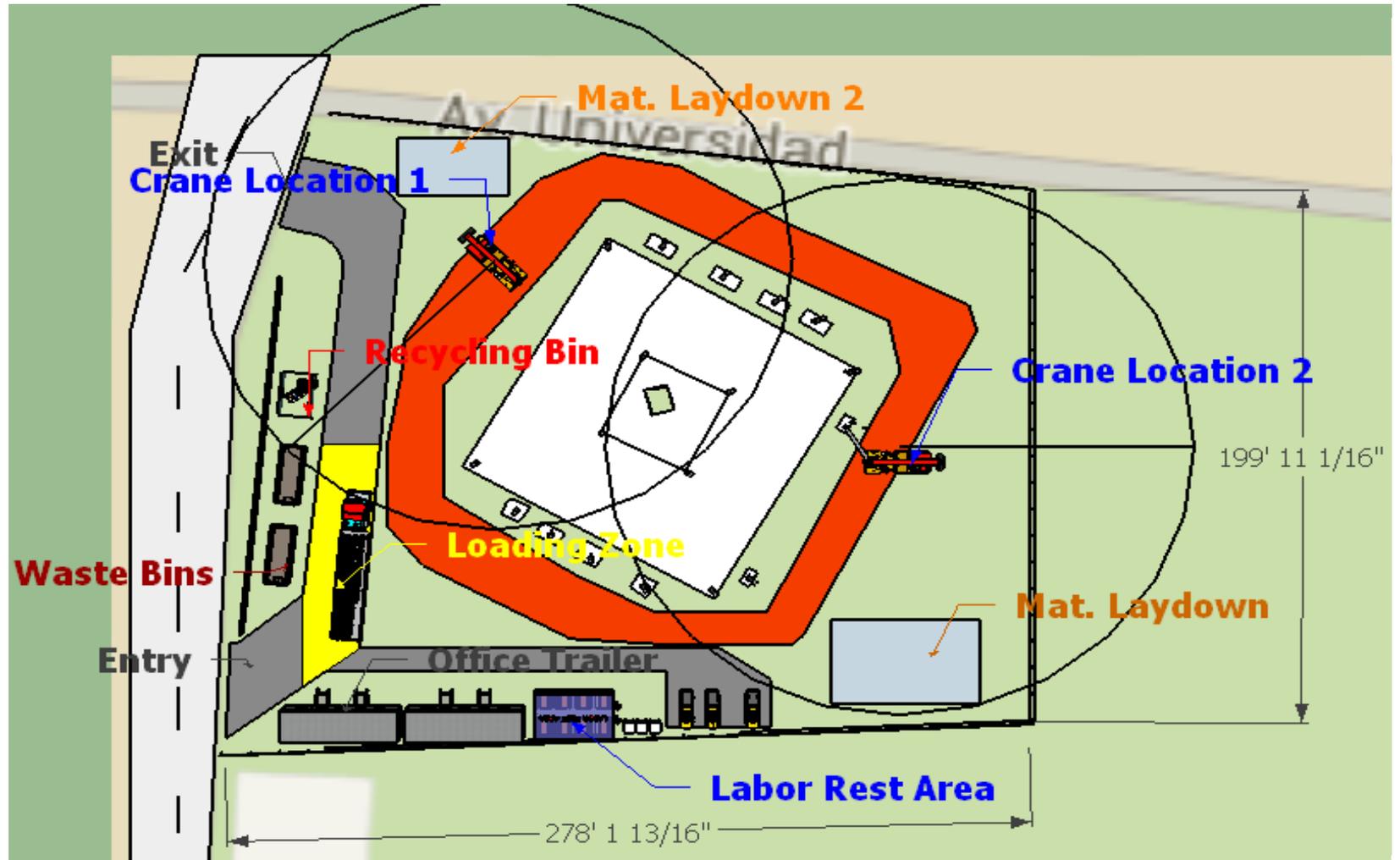
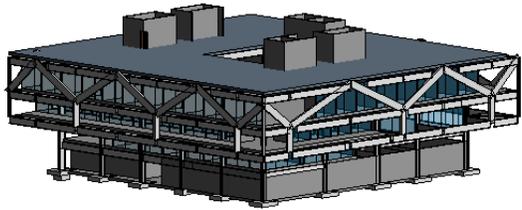
# SITE LOGISTICS PLAN

A SE MEP CM LCFM



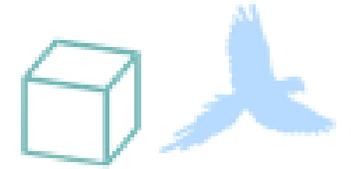
# SITE LOGISTICS PLAN

A SE MEP CM LCFM



# CONSTRUCTION QUALITY AND SITE SAFETY

A SE MEP **CM** LCFM



Training of workers.

Water provided to improve health.

Construction Activity  
Pollution prevention

Waste Diversion Plans

Traffic Management Plan

## SITE SAFETY

All Visitors and Contractors must report to Site Office to receive information and rules regarding this site.



Safety helmets must be worn



Safety footwear must be worn



High visibility jackets must be worn



No unauthorised persons allowed on this site



# CONSTRUCTION PHASING

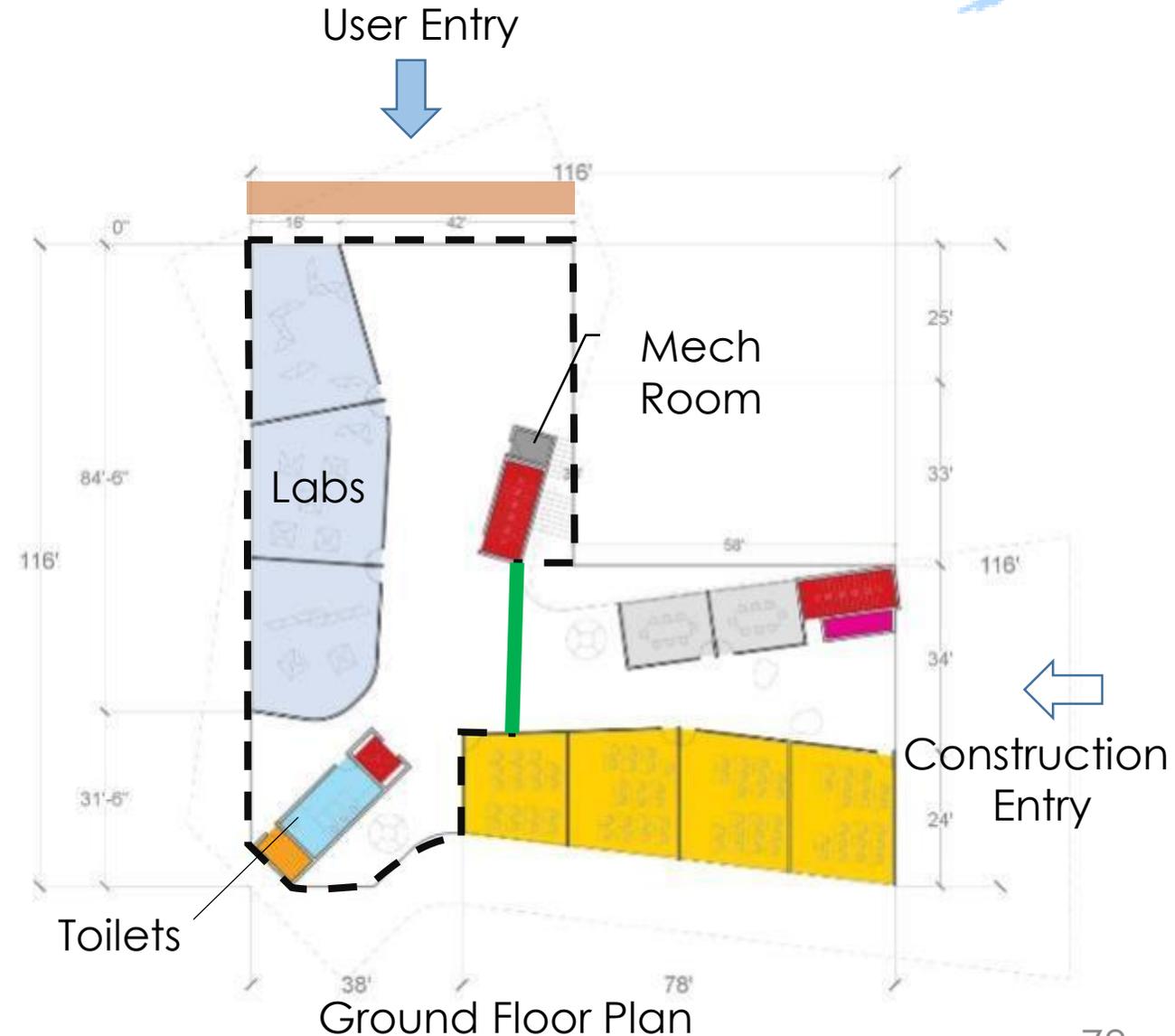
A SE MEP CM LCFM

Labs are located in the ground floor after coordination with A

Façade on the side of user entry completed

Temporary cooling provided for the labs

Lab Areas cordoned off



# CONSTRUCTION PHASING

A SE MEP CM LCFM

Labs located on the ground floor.

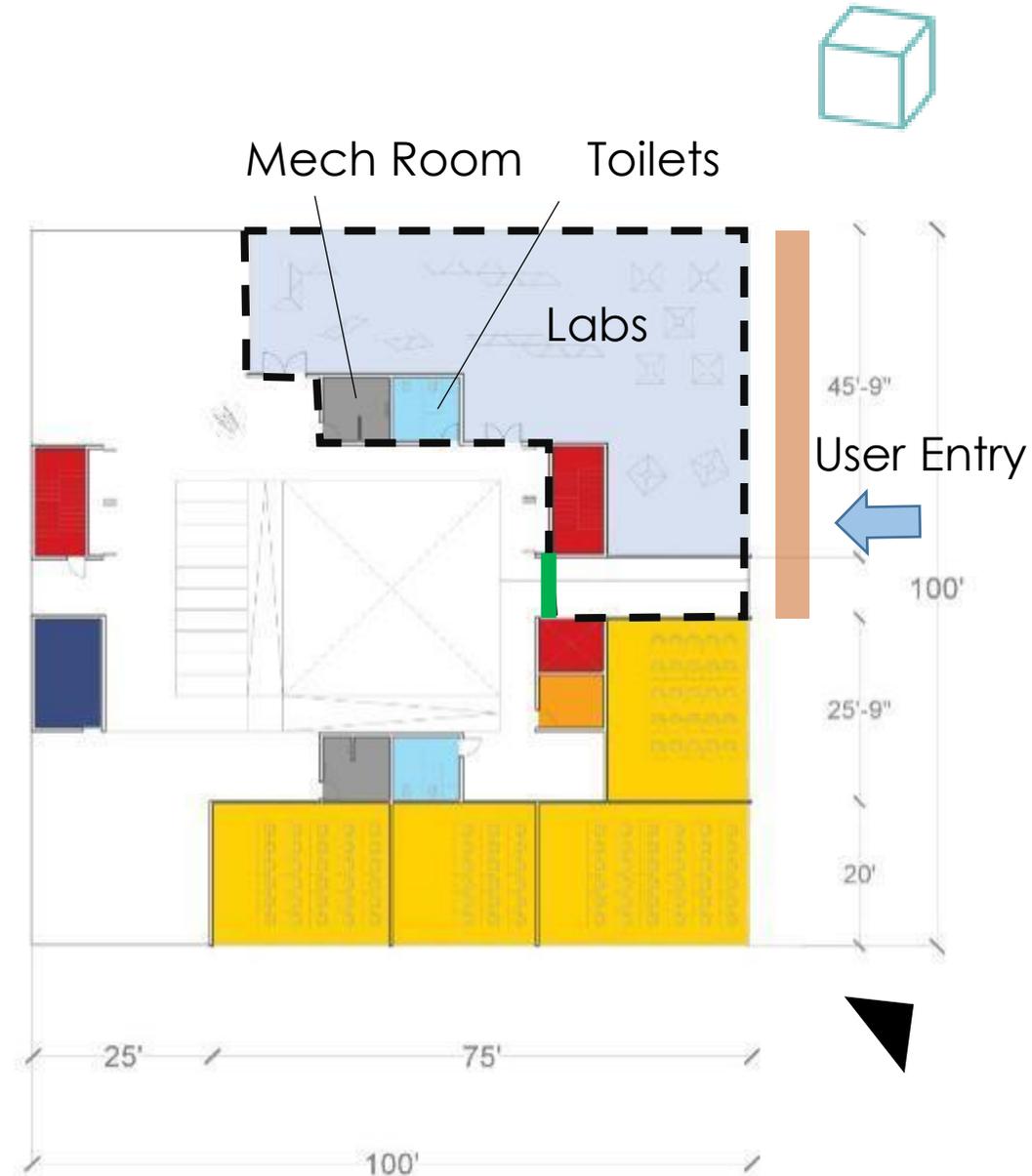
Façade on the side of user entry completed.

Labs occupied by May 5<sup>th</sup>.

Temporary cooling provided for the labs.

Lab Areas cordoned off.

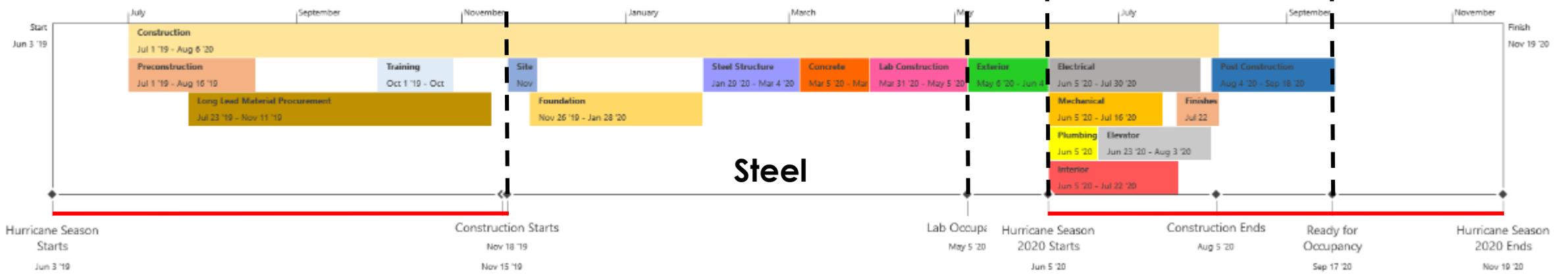
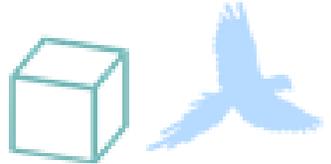
Construction Entry



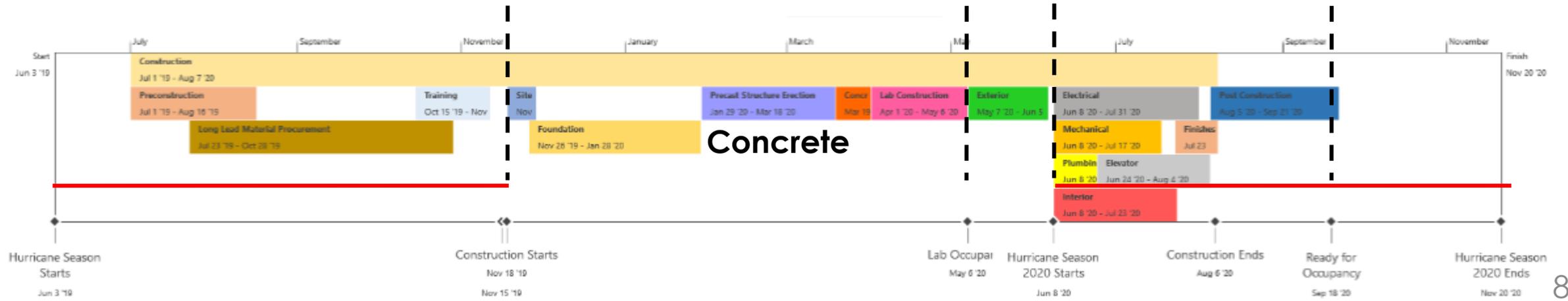
Ground Floor Plan

# CONSTRUCTION SCHEDULES

A SE MEP CM LCFM

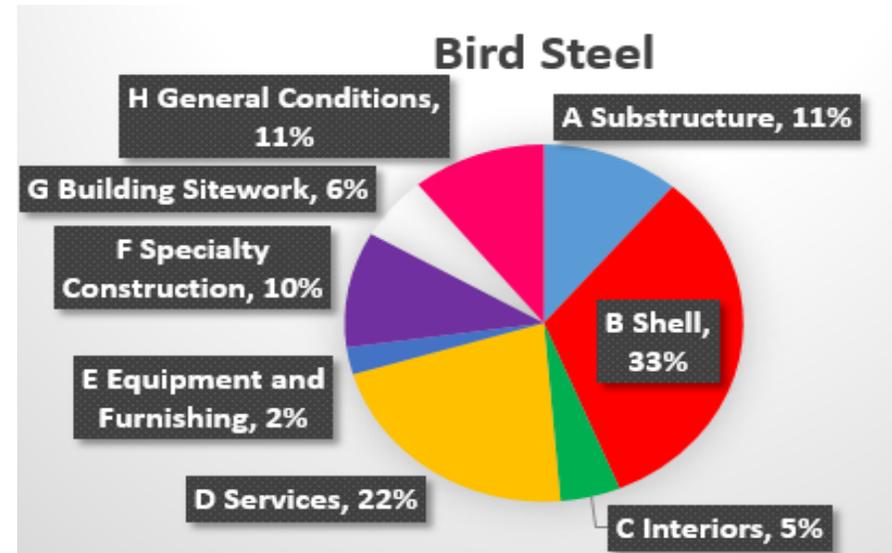
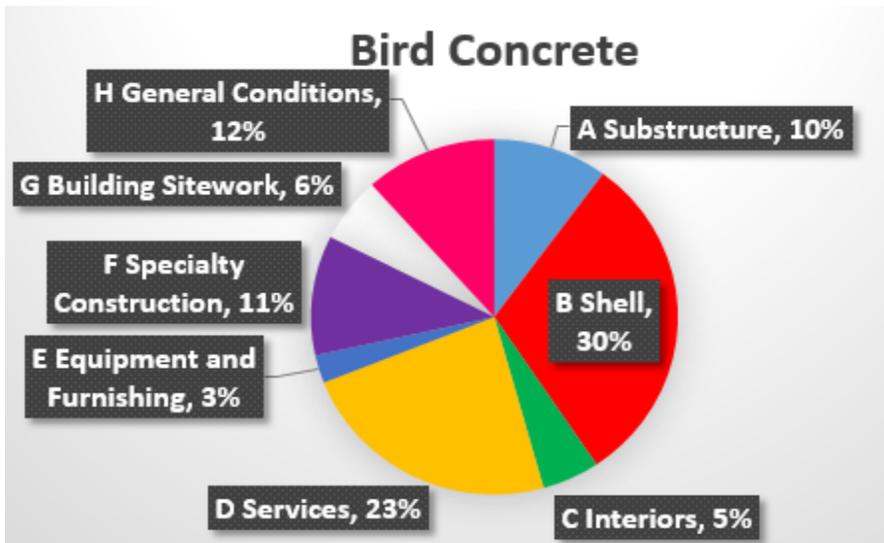
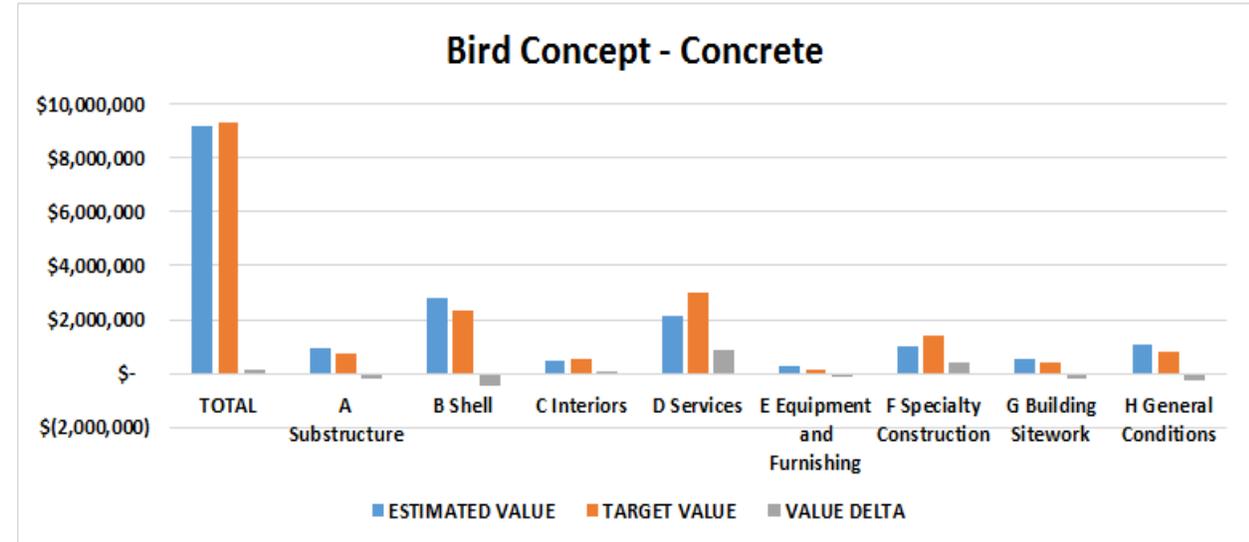
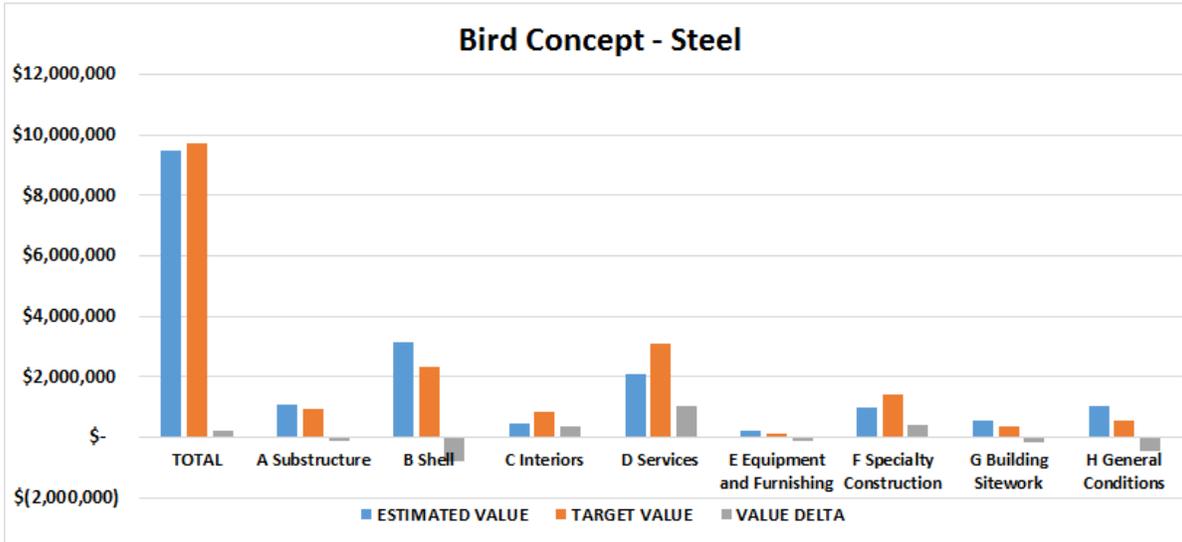


- Preconstruction
- Long Lead Material Procurement
- Site work and Mobilization
- Steel Structure Erection /Precast Concrete
- Lab Construction
- Electrical
- Plumbing
- Elevator
- Post construction
- Training
- Foundations
- Concrete
- Exterior
- Mechanical
- Interior
- Finishes



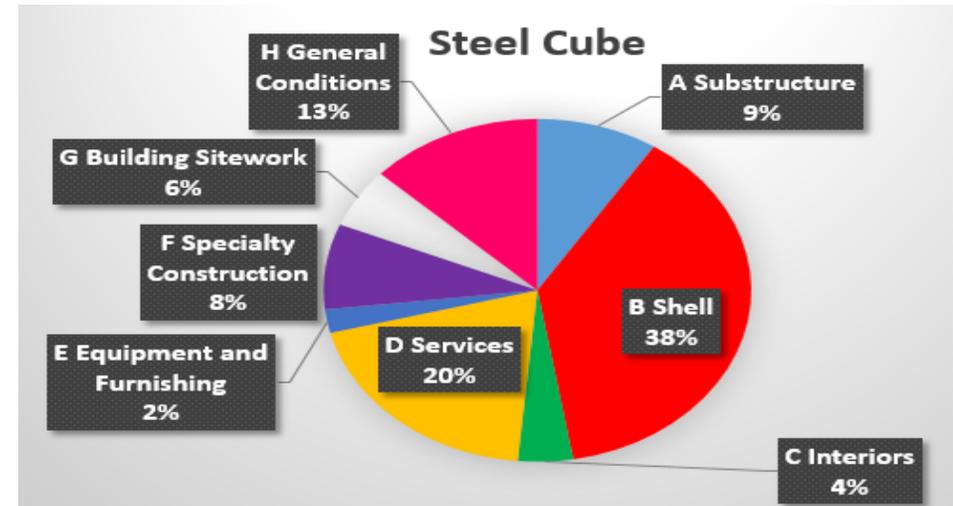
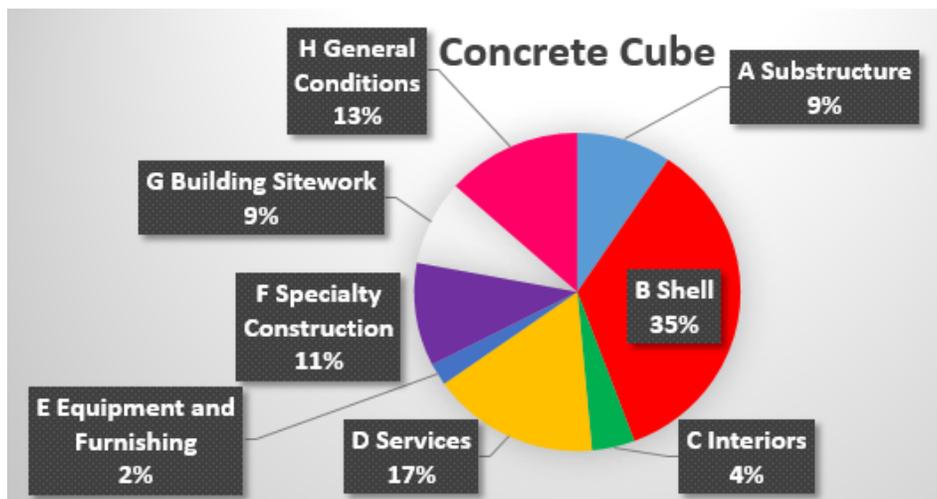
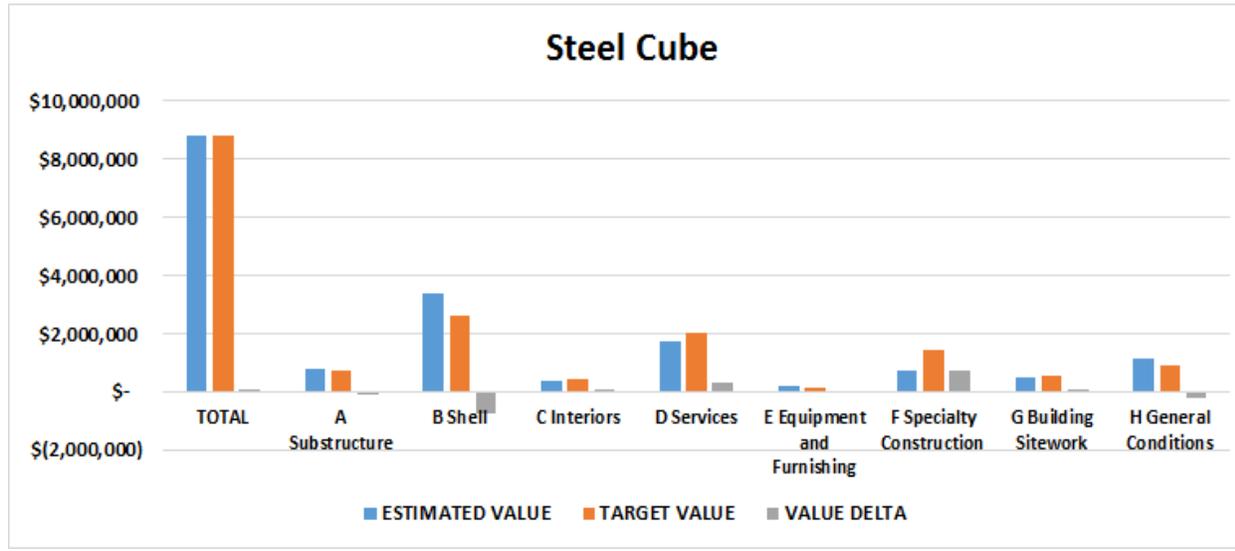
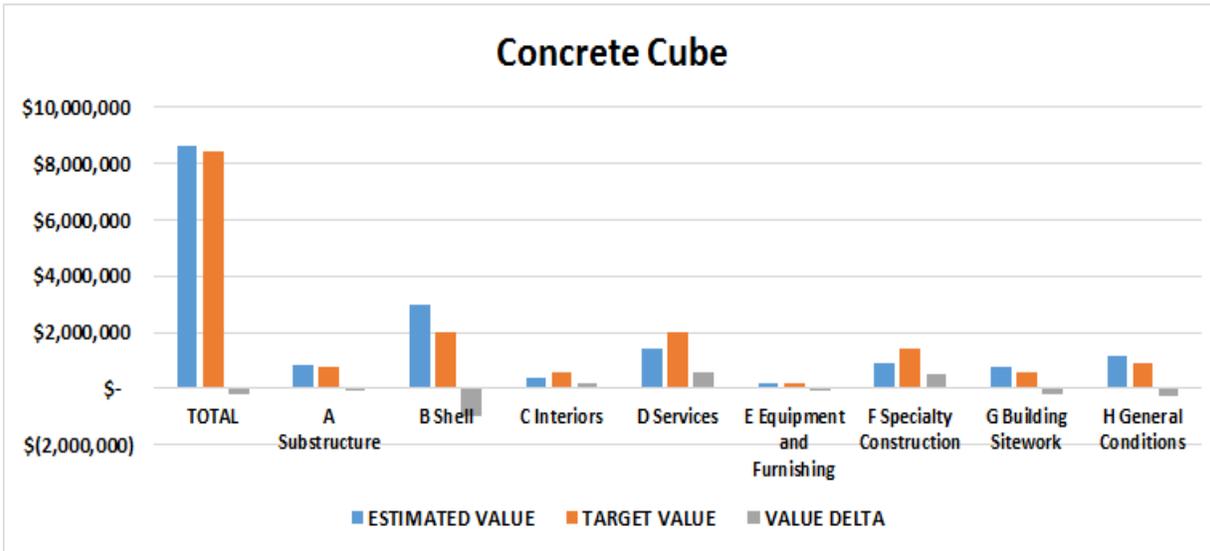
# TARGET VALUE DESIGN

## A SE MEP CM LCFM



# TARGET VALUE DESIGN

## A SE MEP CM LCFM

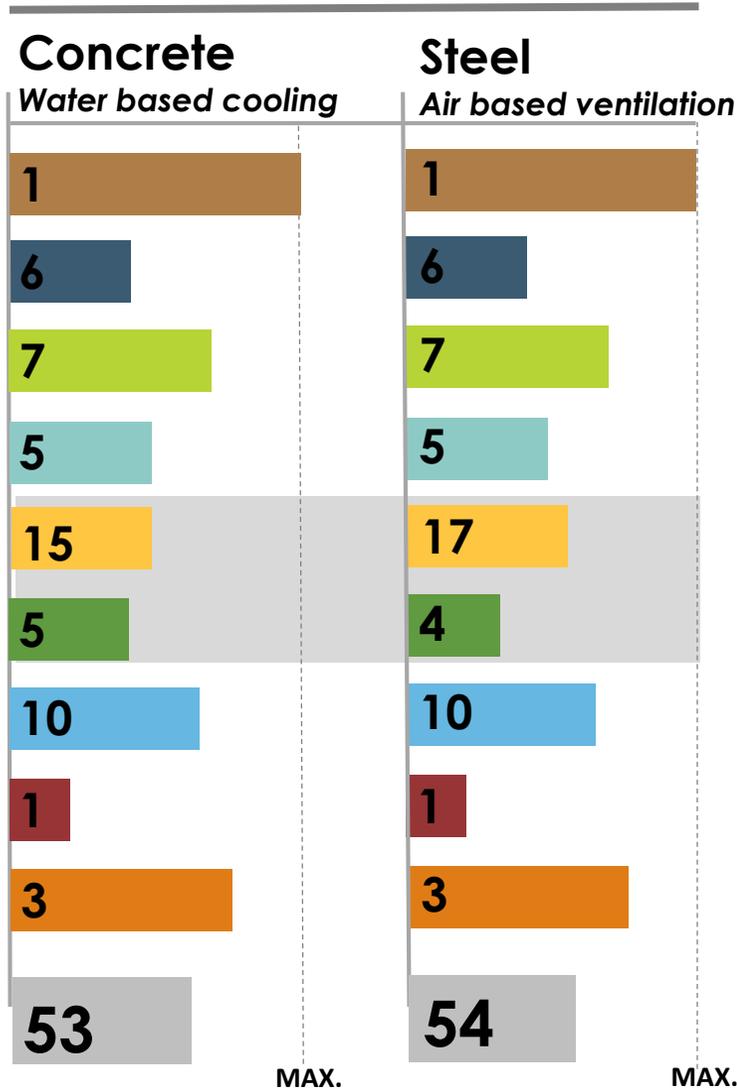


# LEED CERTIFICATION

A SE MEP CM LCFM



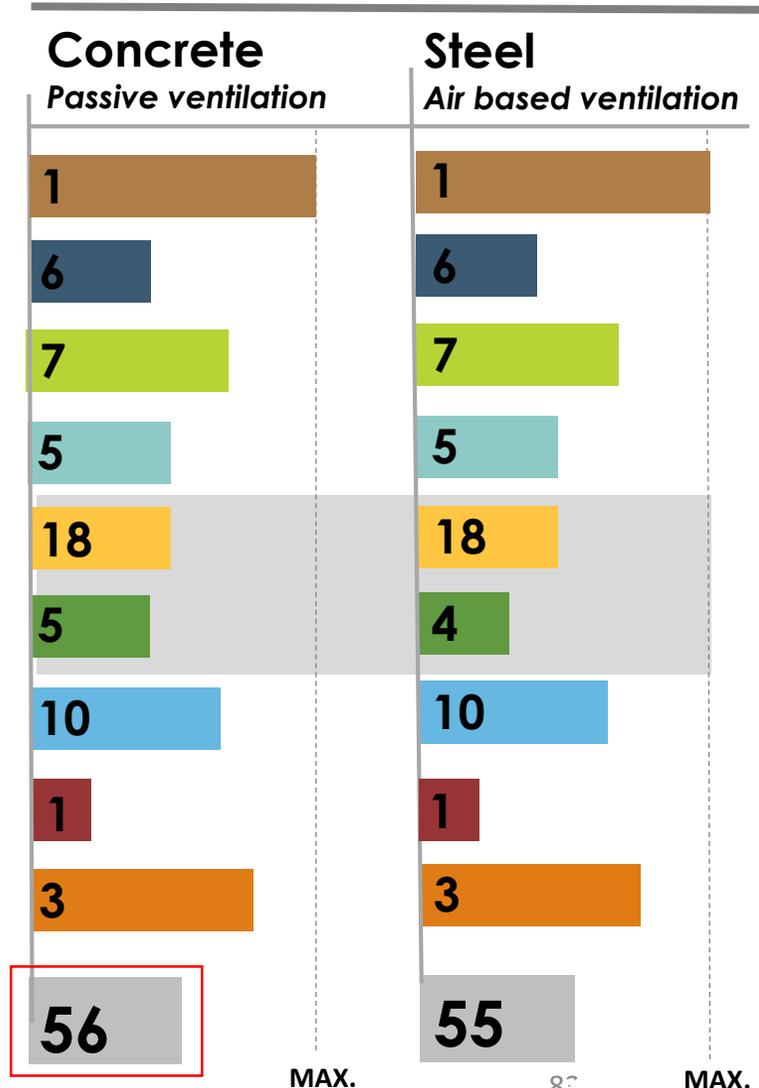
## BIRD



	<b>Integrative Process</b>	1
	<b>Location &amp; Transportation</b>	16
	<b>Sustainable Sites</b>	10
	<b>Water Efficiency</b>	11
	<b>Energy &amp; Atmosphere</b>	33
	<b>Material &amp; Resources</b>	13
	<b>Indoor environmental quality</b>	16
	<b>Innovation</b>	6
	<b>Regional priority</b>	4

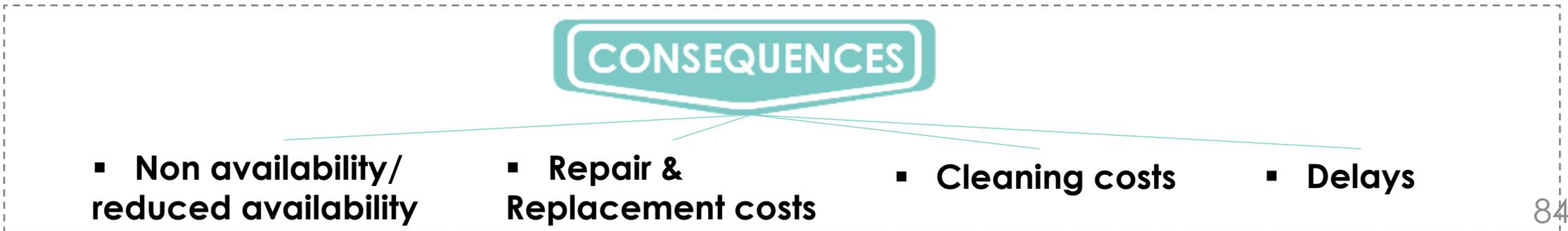
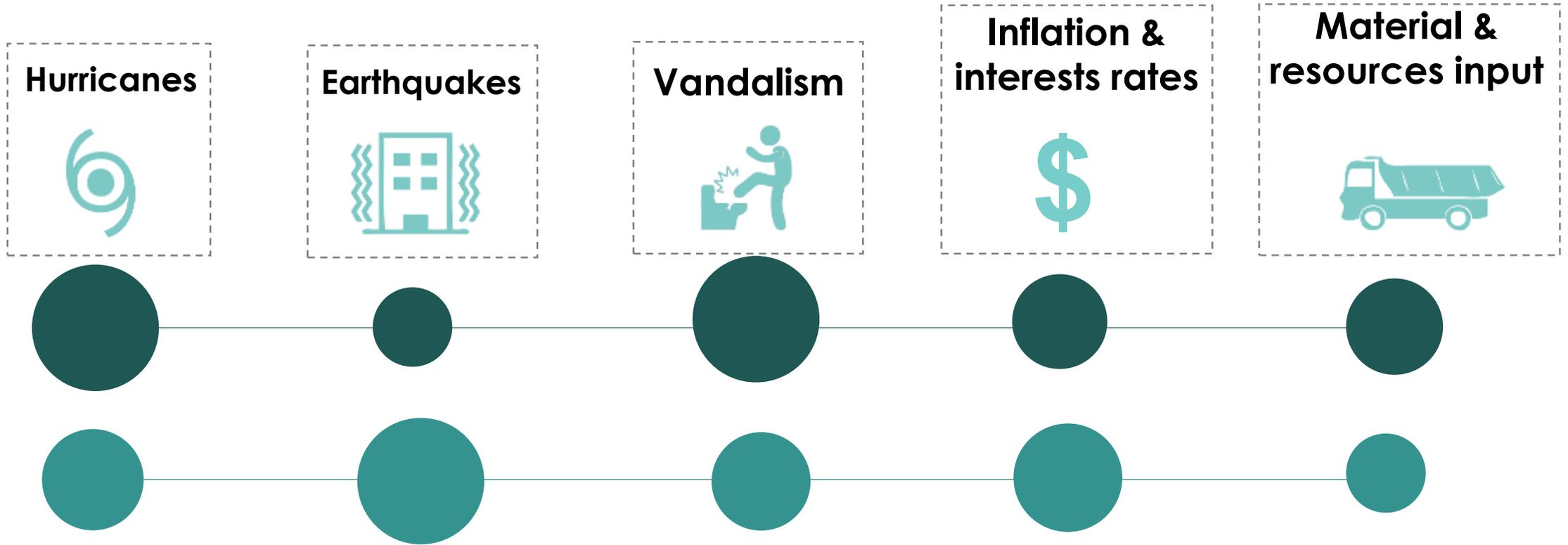
**Total** 110

## AIR CUBE



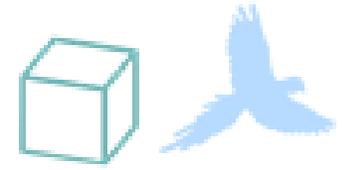
# RISK ANALYSIS

A SE MEP CM **LCFM**



# RISK MANAGEMENT

## A SE MEP CM LCFM



### TRADITIONAL RISK MANAGEMENT

- Looks at risks individually
- Silo-based processes



### ... NEW WAY OF THINKING

- Consider risk interaction
- Supported by a 'risk culture' in Team Island
- Neutralize risk – and even find profit in them
- Systematic, structured and timely RM



### BENEFITS

- Reduce Risk Costs
- Consistent Risk Management Decision
- Increased Transparency

# RISK MANAGEMENT

## A SE MEP CM LCFM



RISK



Earthquakes



Hurricanes

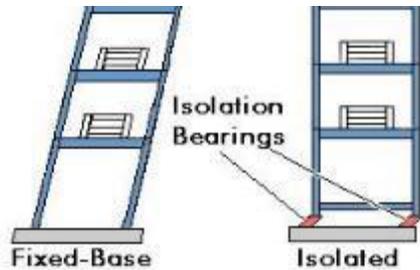


Vandalism

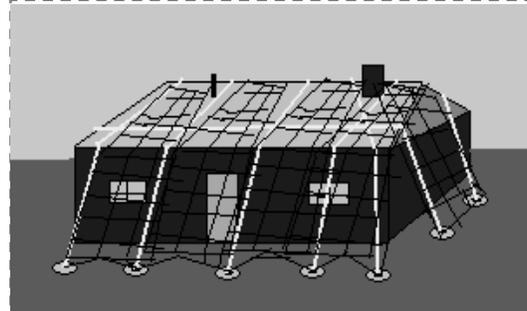


Material & resources input

STRATEGIES



Use of Base isolation & damping devices



Hurricane Netting System



Security and surveillance cameras



Use of local materials

CHANCES

REDUCE RISK OF INTERRUPTION OF OPERATIONS

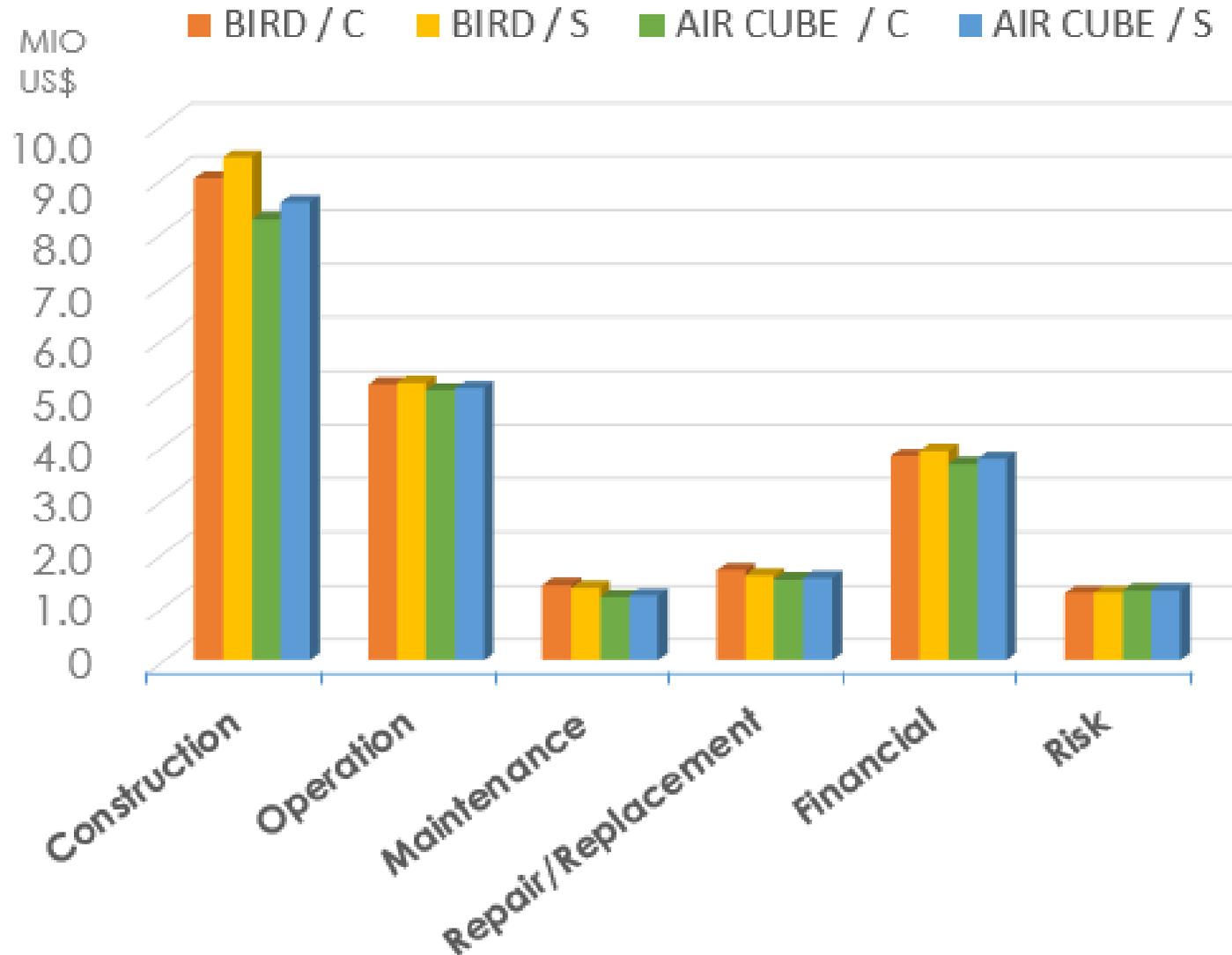
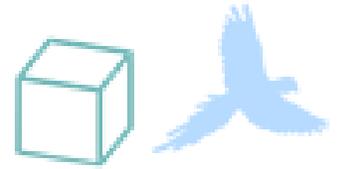
REDUCE REPAIR-/ REPLACEMENT COST

REDUCE CLEANING AND REPAIR COST

REDUCE DELAYS

# LIFE CYCLE COST

A SE MEP CM **LCFM**



	LCC over 25 years <i>Mio. US\$</i>	LCC per sf/year <i>US\$</i>
BIRD-Concrete	<b>22.23</b>	<b>605</b>
BIRD-Steel	<b>22.75</b>	<b>618</b>
AIR CUBE-Concrete	<b>20.86</b>	<b>526</b>
AIR CUBE-Steel	<b>21.36</b>	<b>539</b>

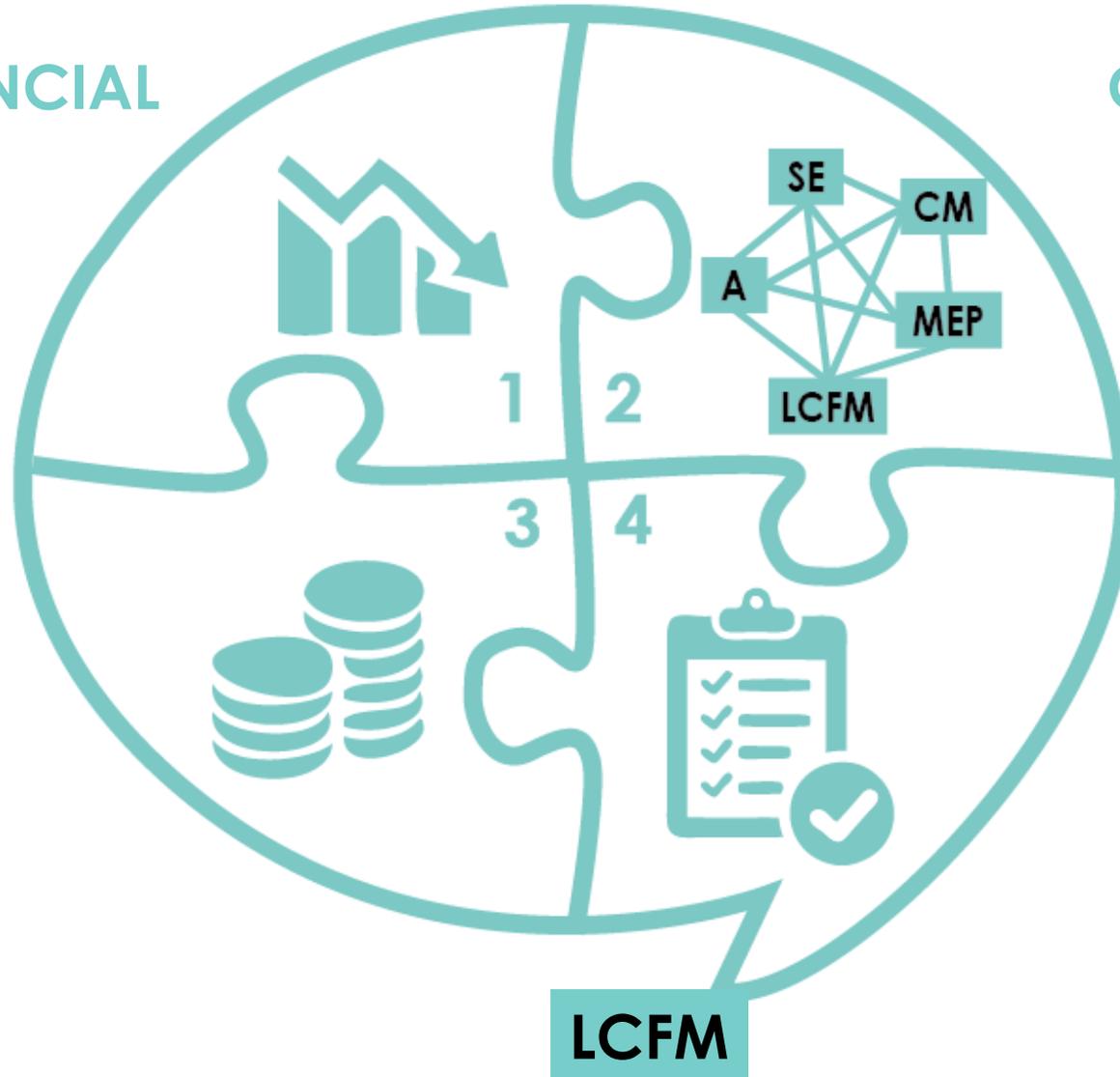
# STRATEGIES FOR OPTIMIZING LIFE CYCLE COST

A SE MEP CM **LCFM**



OPTIMIZE THE FINANCIAL  
STRUCTURE

COLLABORATION!!!



GENERATE  
ADDITIONAL  
INCOME

COMPARE ROOM  
SCHEDULE WITH  
REQUIREMENTS TO  
PROMOTE EFFICIENCY

# SUMMARY - TARGET VALUES

A SE **MEP CM LCFM**

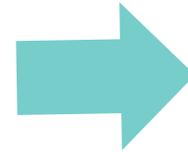
BIRD - Concrete



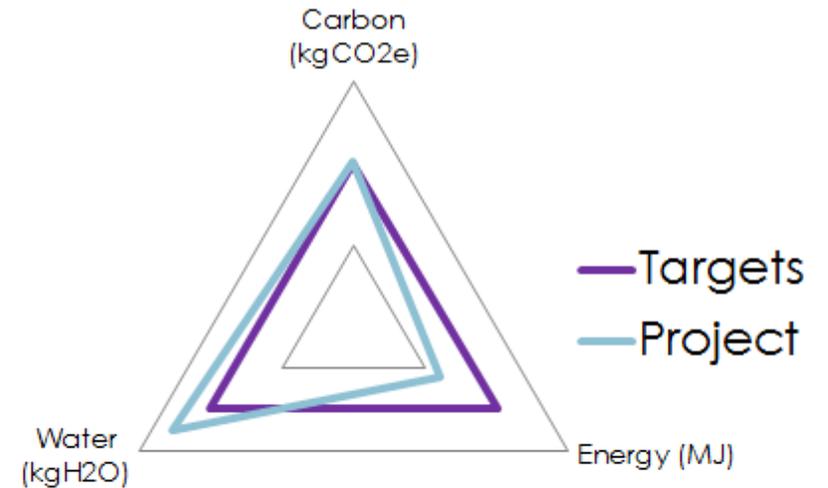
**TVD**

**CONSTRUCTION COST:**

\$ 9,203,000



**STV**



**LCC**

\$ 22,230,000



# SUMMARY - TARGET VALUES

A SE **MEP CM LCFM**

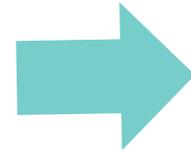
BIRD - Steel/concrete



**TVD**

**CONSTRUCTION COST:**

**\$ 9,564,000**

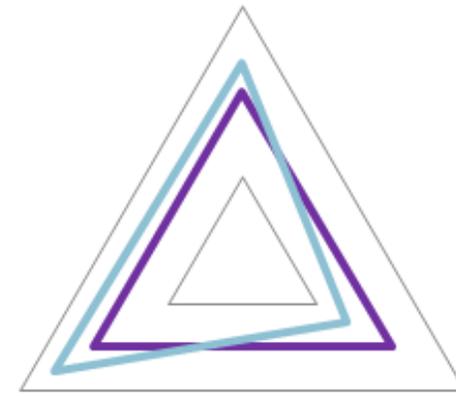


**STV**

Carbon  
(kgCO<sub>2</sub>e)

Water  
(kgH<sub>2</sub>O)

Energy (MJ)



— Targets  
— Project

**LCC**

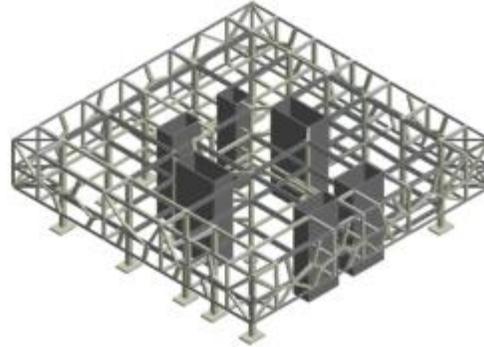
**\$ 22,750,000**



# SUMMARY - TARGET VALUES

A SE **MEP CM LCFM**

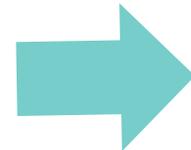
AIR CUBE - Concrete



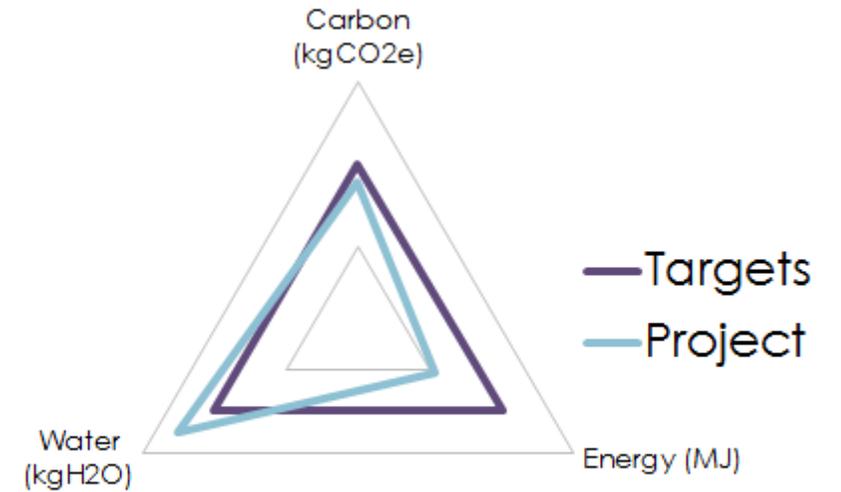
**TVD**

**CONSTRUCTION COST:**

\$ 8,615,000



**STV**



**LCC**

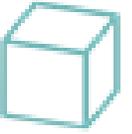
\$ 20,860,000



# SUMMARY - TARGET VALUES

A SE **MEP CM LCFM**

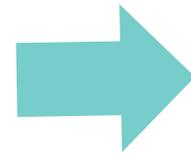
AIR CUBE - Steel/concrete



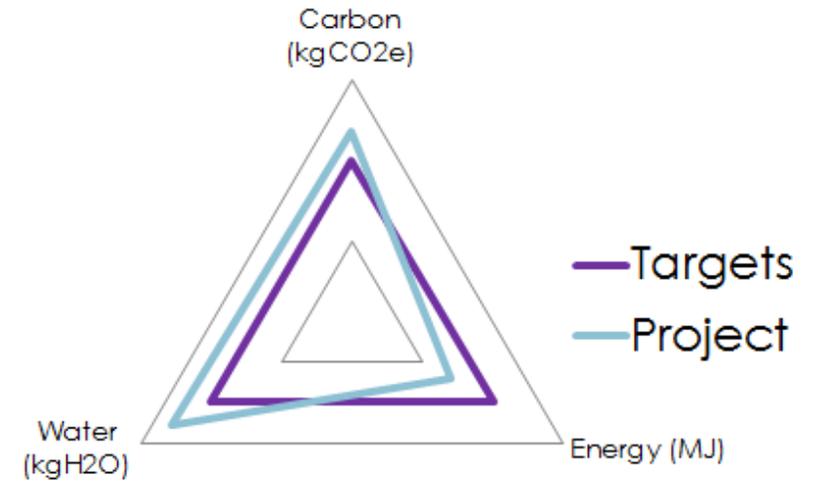
**TVD**

**CONSTRUCTION COST:**

\$ 8,813,000



**STV**



**LCC**

\$ 21,360,000



# STV PROGRESS

## A SE MEP CM LCFM



1. Choice of material

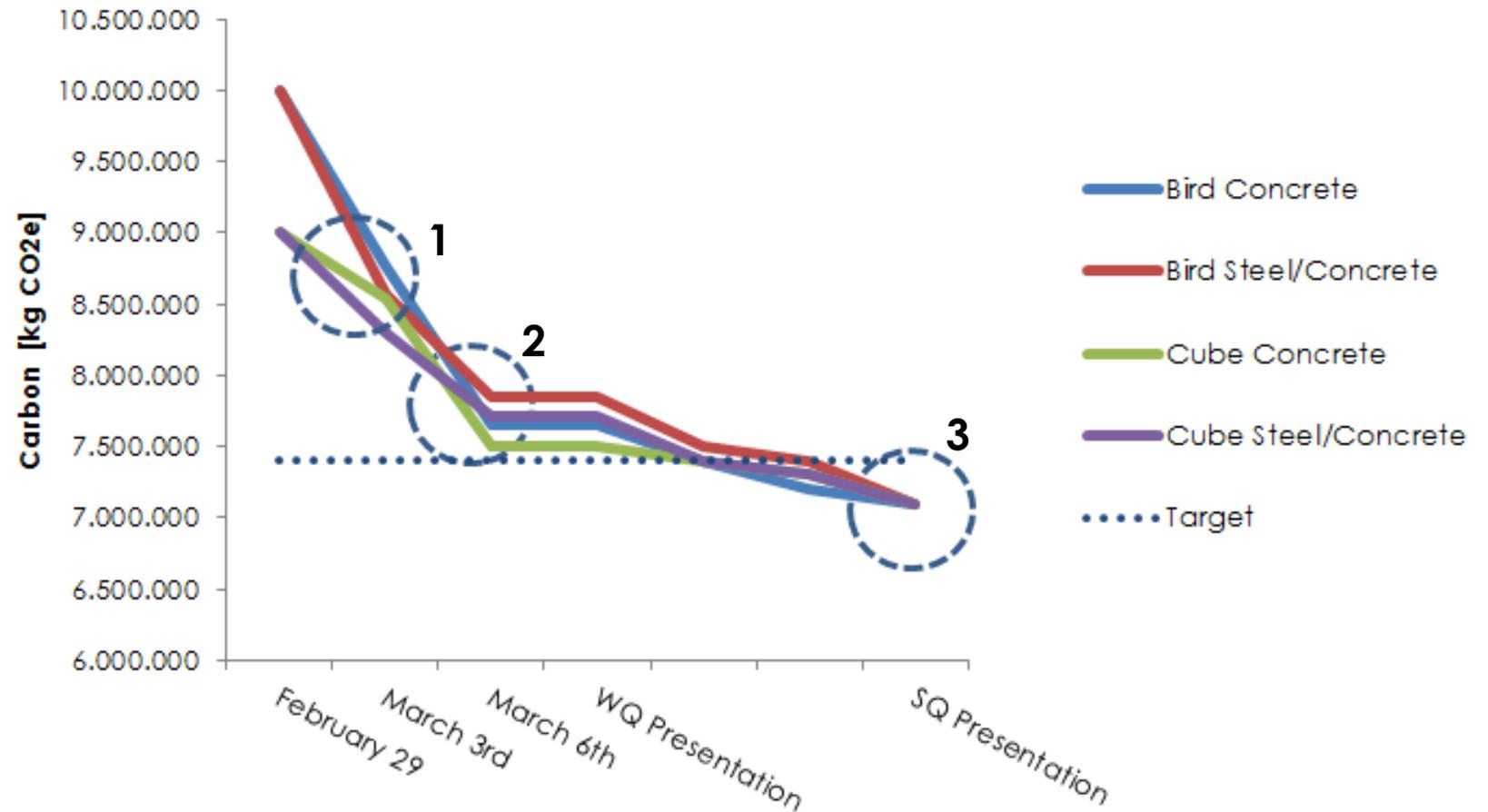


2. PV Panels on roof



3. Team Target

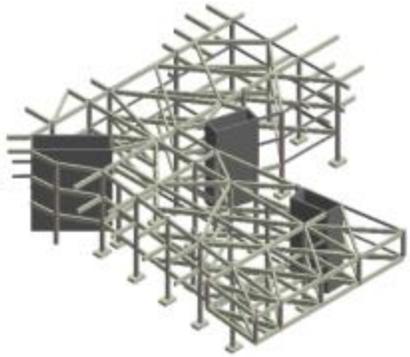
### STV evolution - CARBON (Kg CO2)



# DECISION MATRIX

## A SE MEP CM LCFM

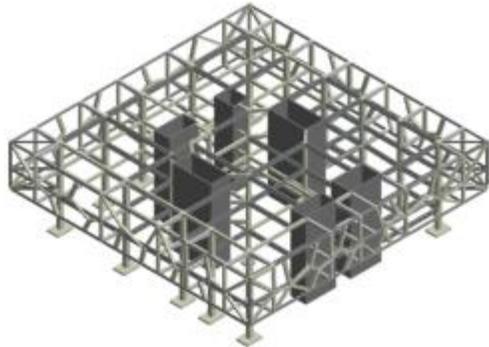
### OPTIONS



Bird Concrete



Bird Steel /C



Air Cube Concrete



Air Cube Steel /C

### DECISION

based on criteria which were defined & weighted in cooperation with the owners

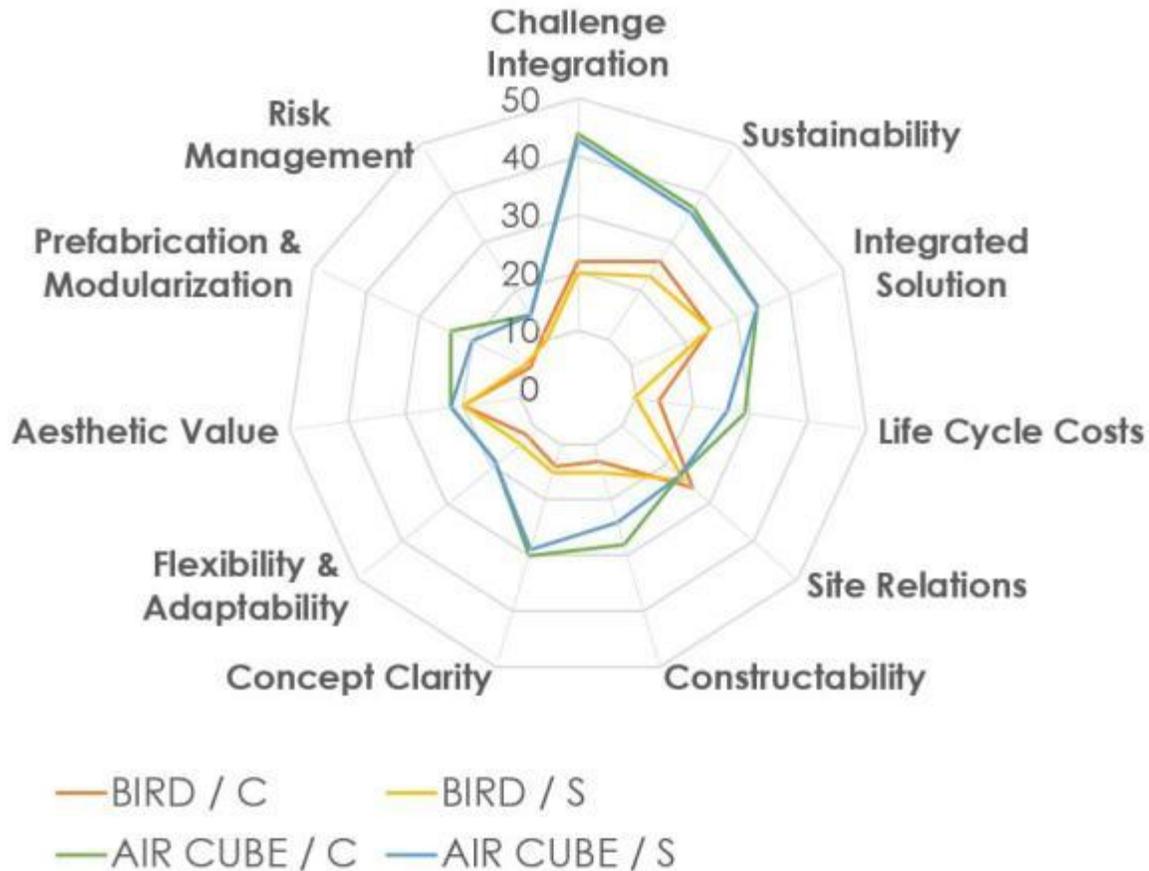
### CRITERIA

1. Challenge Integration
2. Sustainability
3. Integrated Solution
4. Life Cycle Costs
5. Site Relations
6. Constructability
7. Concept Clarity
8. Flexibility & Adaptability
9. Aesthetic Value
10. Risk Management
11. Prefabrication & Modularization

# DECISION MATRIX

## A SE MEP CM LCFM

### RATING BY OWNERS AND TEAM



	Reached Points <i>Points</i>	Ratio to max. points <i>%</i>	Annual Rent <i>US\$</i>	Value for Cost* <i>Points</i>
<b>BIRD-Concrete</b>	192	48	880,000	58
<b>BIRD-Steel / C</b>	187	47	910,000	41
<b>AIR CUBE-Concrete</b>	293	73	830,000	124
<b>AIR CUBE-Steel/C</b>	291	72	850,000	109

\* = Ratio to max. x (1Mio. \$ - Annual rent) / 100,000

# FINAL CONCEPT - A SE MEP CM LCFM



WHY IS THIS OPTION THE BEST?

- Compact structure
- Rent: 830,000 US\$/year
- TVD: 8,215,000 US\$
- Integrated Design (Façade system)
- Air quality challenge

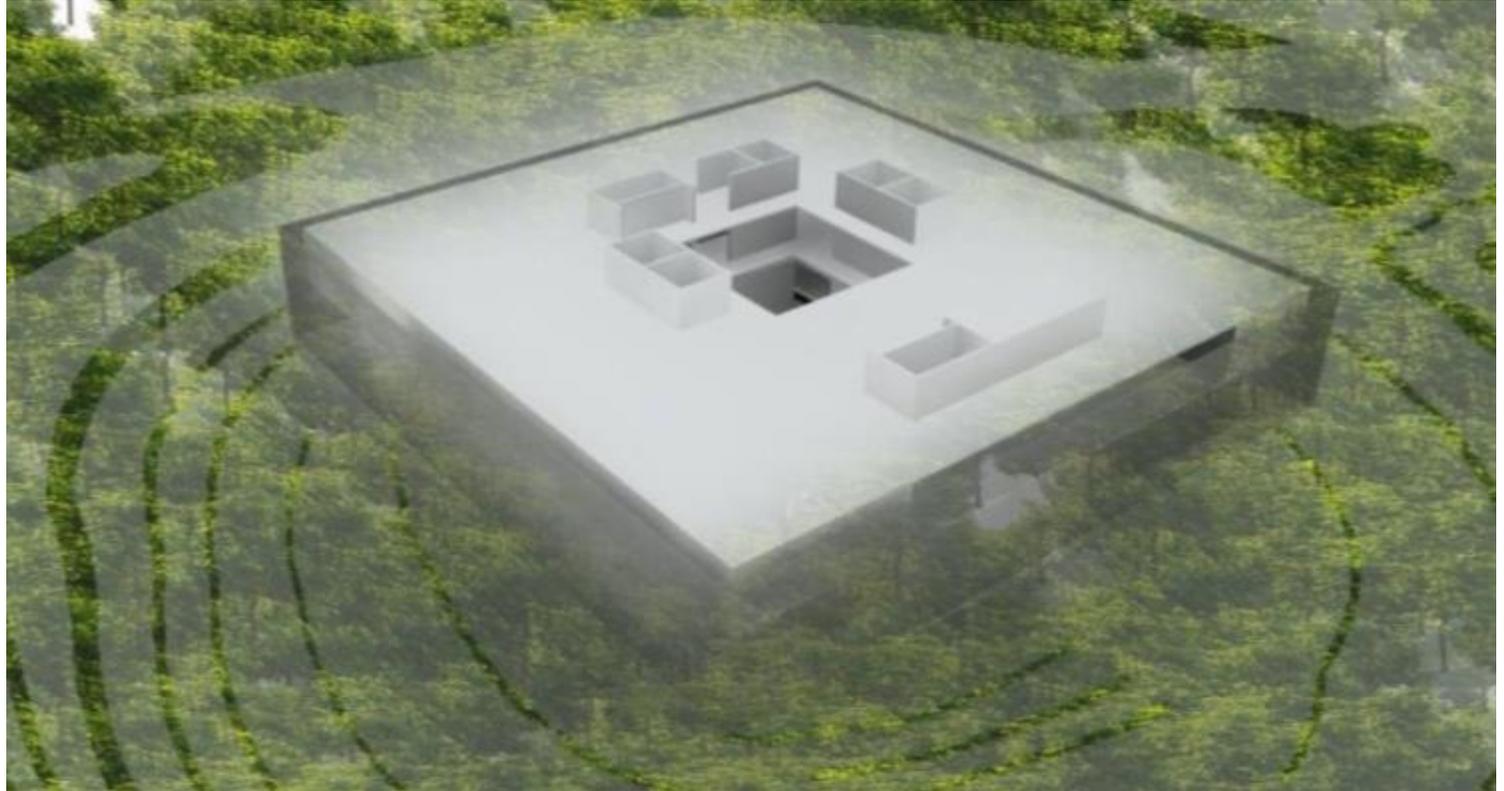
# AIR QUALITY CHALLENGE

## A SE MEP CM LCFM

Clean construction

Indoor environment

Air cleaning façade material



# Thank you!

Renate, Owner, Mentors and many others...



team **ISLAND**  
2016

WINTER CYBER PRESENTATION

**NIRUPAMA** KOTCHARLAKOTA

**NATHAN** HILL

**ANNA** BURISCH

**CAMILA** HERNANDEZ

**CHRISTINE** BAUMER

**WENJIN** SITU

**LI** DENG

3-11-2016