



2015

Meng | Catrin | Marveliz

Martin | Marios | Robert | Ben









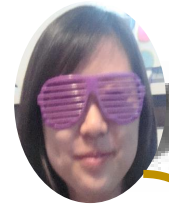


A scenic view of a city at sunset. In the foreground, a city skyline is visible with various buildings, including a prominent orange-brown skyscraper on the left. The city is nestled in a valley. In the background, a large, rugged mountain with patches of snow or light-colored rock rises against a sky filled with soft, orange and yellow clouds from the setting sun. The overall atmosphere is warm and serene.

Our Team



MEET THE TEAM



Meng **SE**



Catrin **CM**



Marveliz **Ap**



Mike, Maria, Enrique, Ana



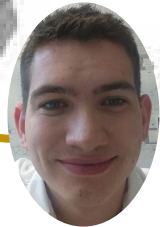
Owners



Martin **A**



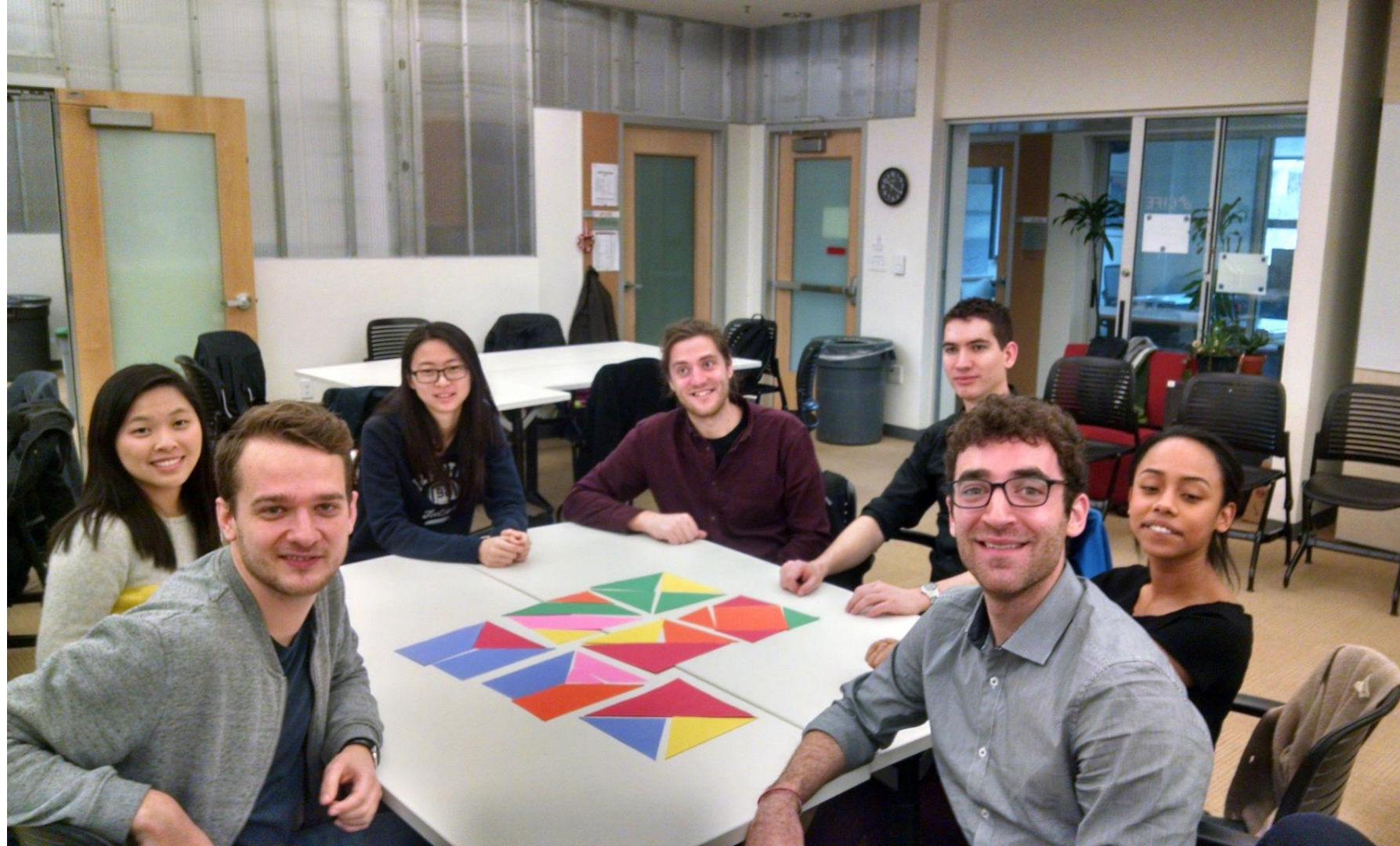
Marios **MEP**



Robert **SE**

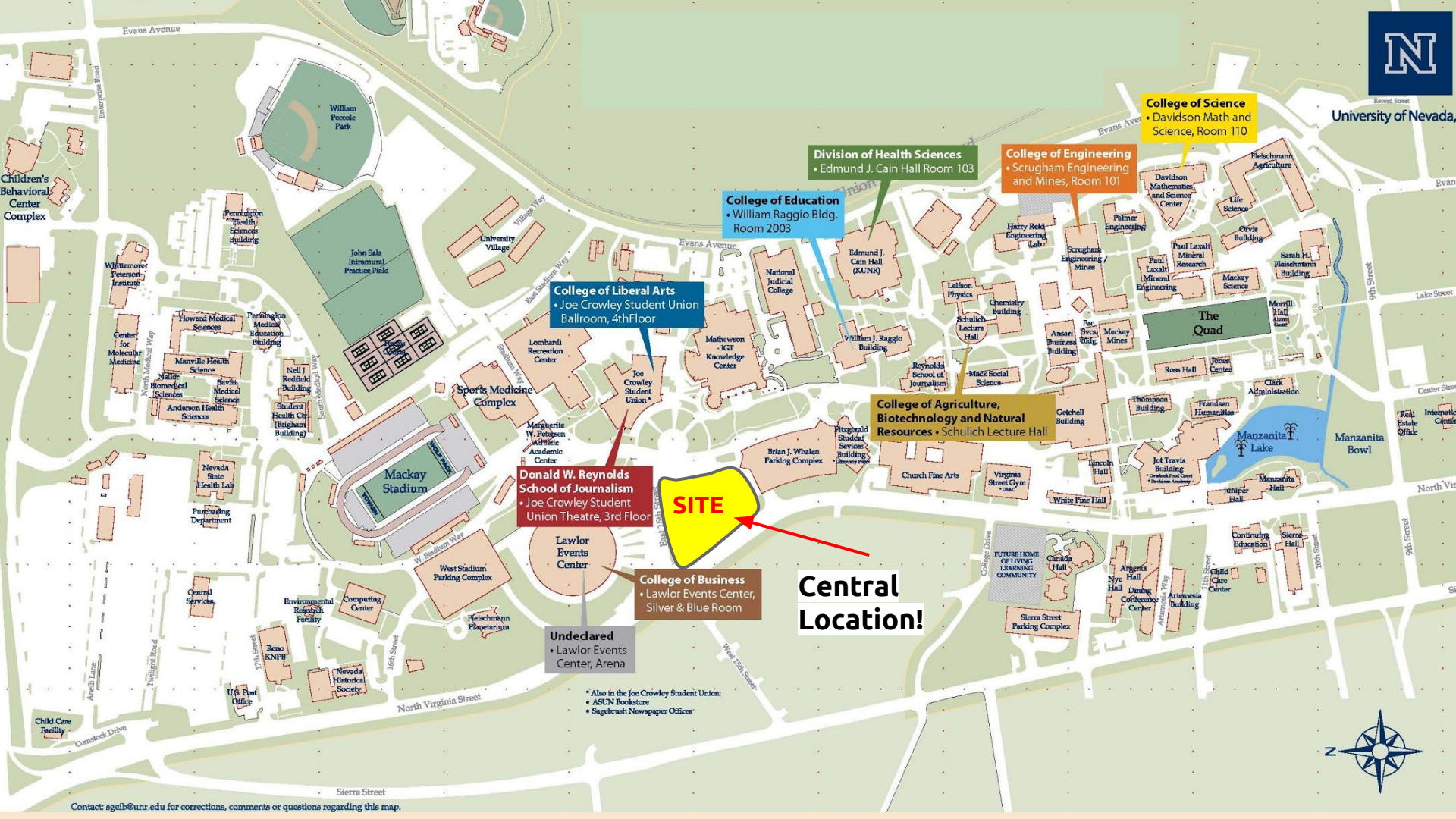


Ben **CM**



Overview

A scenic view of a city at sunset. In the foreground, a city skyline is visible with various buildings, including a prominent orange-brown skyscraper on the left. The city lights are beginning to glow. In the background, a large, rugged mountain with patches of snow or light-colored rock rises against a sky filled with soft, orange and yellow clouds from the setting sun. The word "Overview" is superimposed in large, bold, black letters across the center of the image.



University of Nevada,

College of Science
• Davidson Math and Science, Room 110

College of Engineering
• Scrugham Engineering and Mines, Room 101

Division of Health Sciences
• Edmund J. Cain Hall Room 103

College of Education
• William Raggio Bldg, Room 2003

College of Liberal Arts
• Joe Crowley Student Union Ballroom, 4th Floor

College of Agriculture, Biotechnology and Natural Resources
• Schulich Lecture Hall

Donald W. Reynolds School of Journalism
• Joe Crowley Student Union Theatre, 3rd Floor

SITE

Central Location!

College of Business
• Lawlor Events Center, Silver & Blue Room

Undeclared
• Lawlor Events Center, Arena

• Also in the Joe Crowley Student Union:
• ASUN Bookstore
• Sagebrush Newspaper Offices





Residential Area

Residential Area

- Campus Boundary
- Pedestrian Flow



**Student
Union**

IGT Knowledge Center

Nearby amenities,
green space, and
public transit
promote **Active
Transportation!**

**Bus
Stop**

Events Center

SITE

Client Requirements

- \$10.5 Million Budget
- 30,000 GSF, max 30'
- 1-year Max Construction
 - Start Date 5/2/19
 - End Date 8/15/20
- Early Completion of Lab
- Carbon Cap - 5.63×10^6 CO₂e
- Energy - 1.31×10^8 MJ
- Water - 1.10×10^8 kg



New building reflecting UNR's School of Engineering's Commitment to Local Impact
UNR's Initiative new buildings min LEED 2.2 Silver & 30% reduction ASHRAE 90.1 Energy Standard

Important Site Conditions

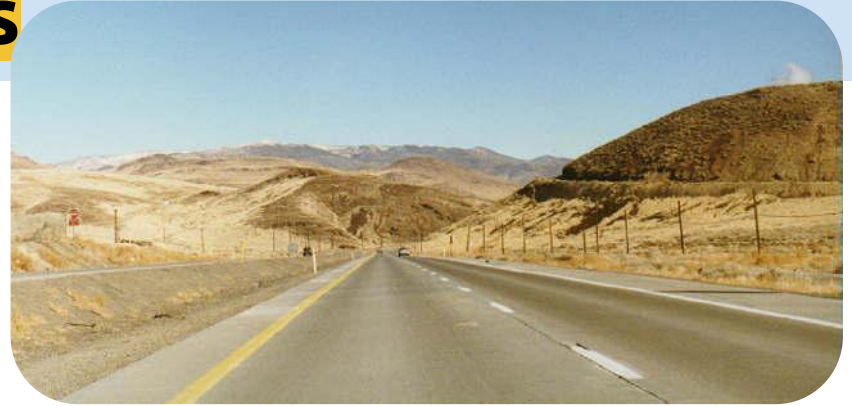
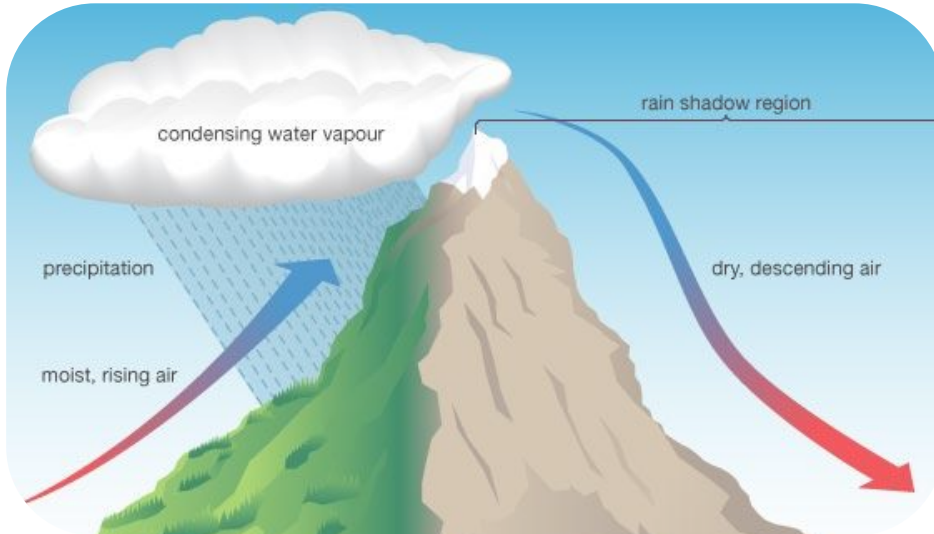
Highly Seismic Area

Shallow Water Table

Large Fluctuation in Temps. (daily and seasonally)

High desert winds - 60 mph avg

Rain Shadow: 7 in. of rain, 23 in. of snow



Climate Conditions

99% heating design Temperature = 14.9F

1% cooling design Temperature = 92.5F

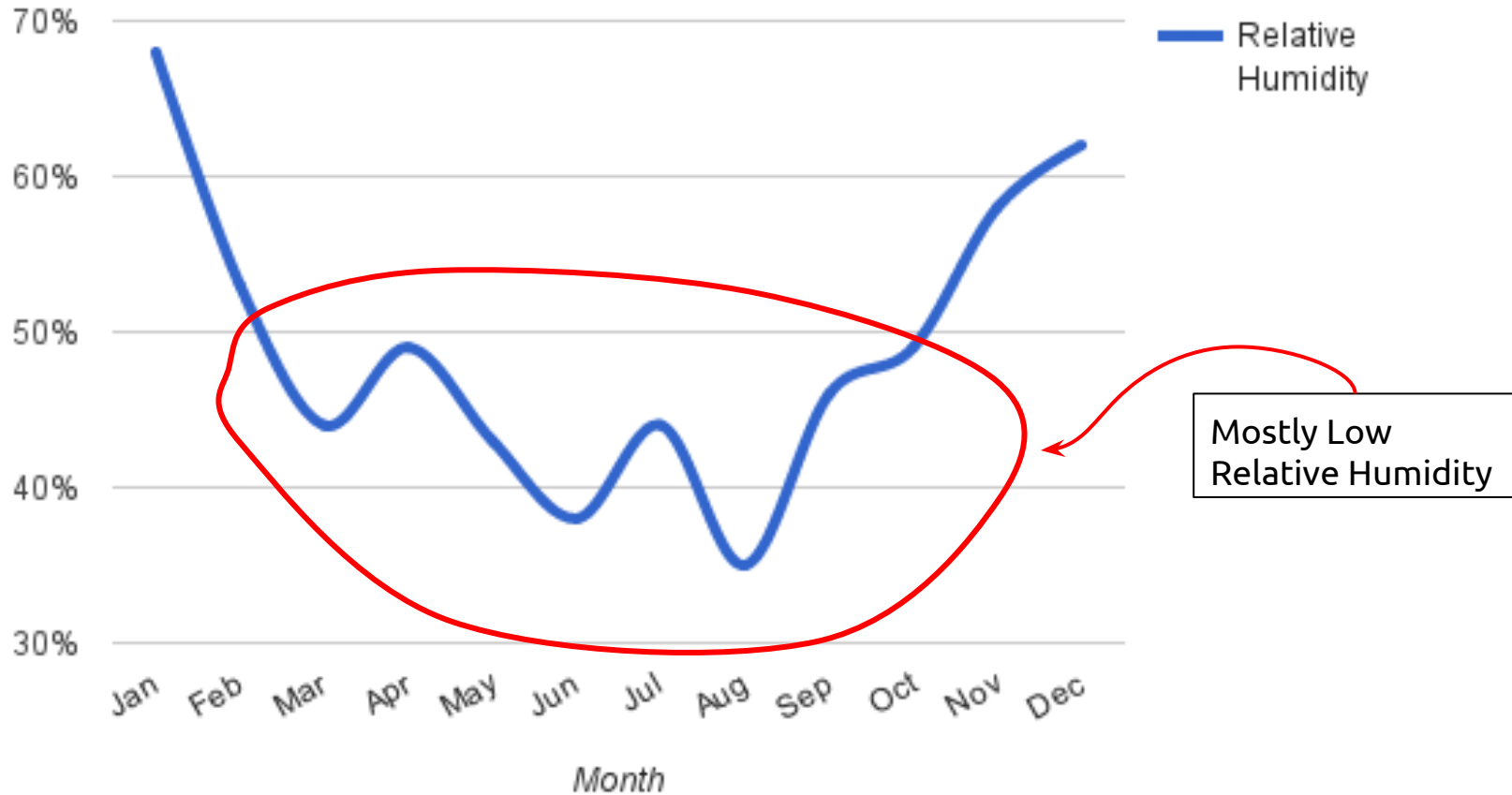
Average humidity: 60%

Indoor Design Conditions

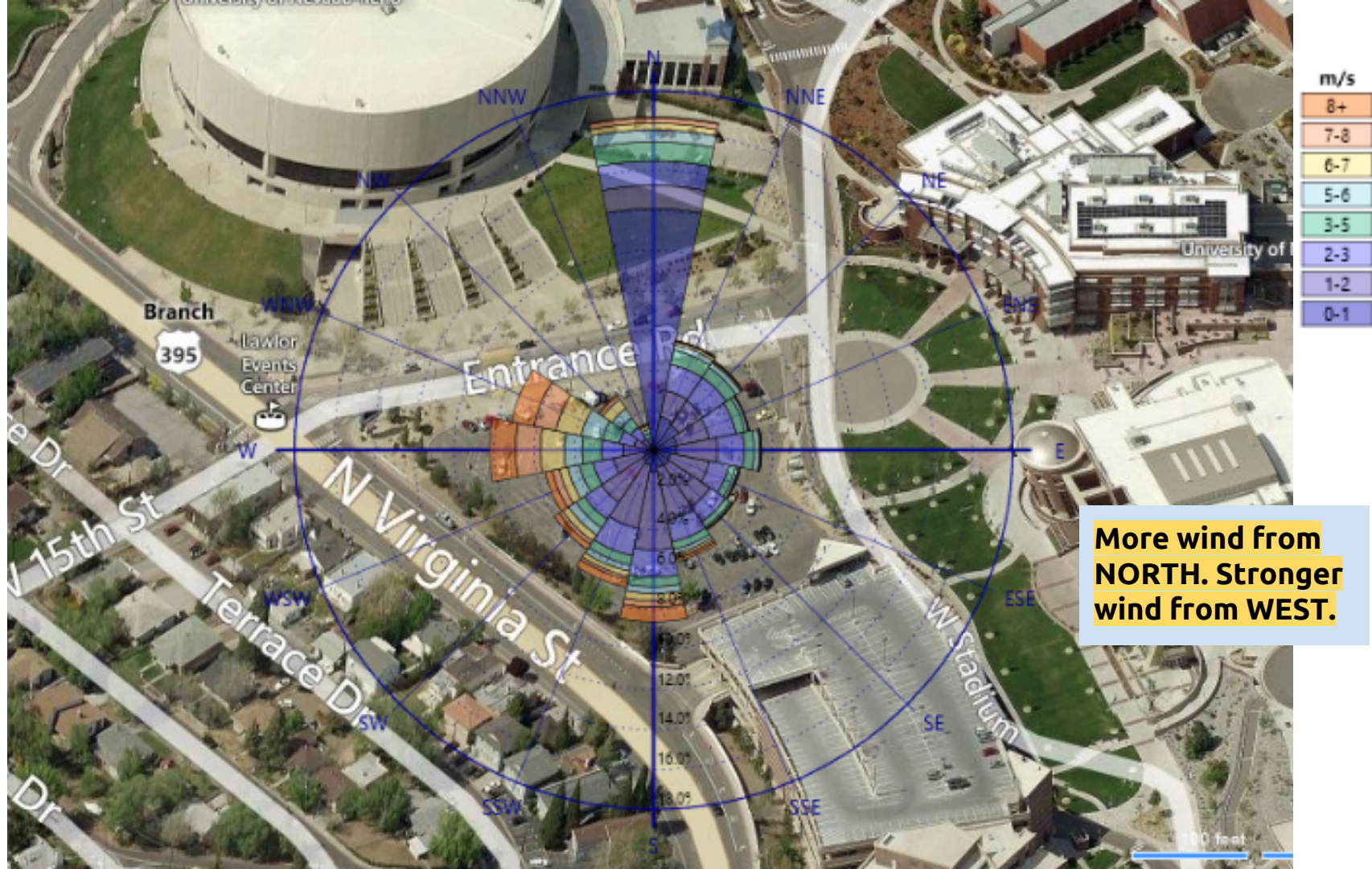
51 days above 90F, HDD68=5674

166 days below freezing, CDD74=508

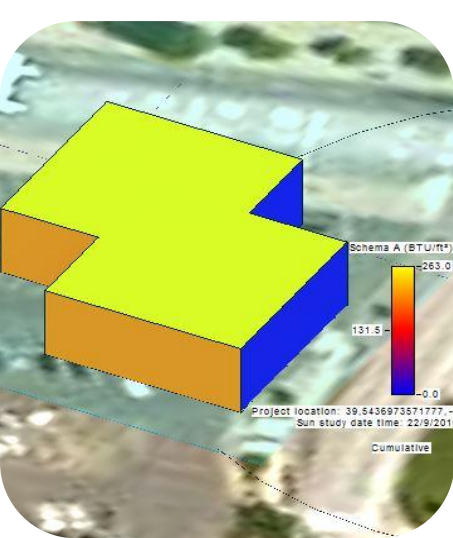
Monthly Average Relative Humidity



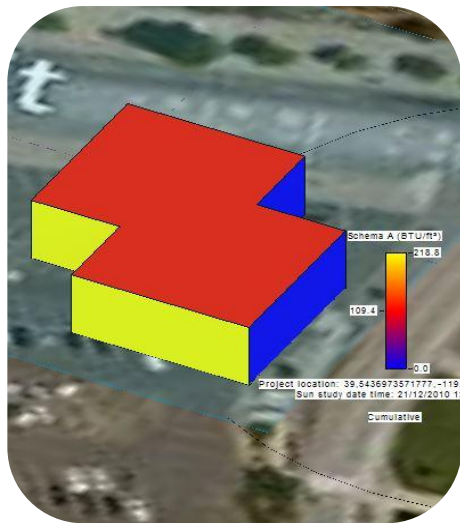
Orientation : Wind Rose



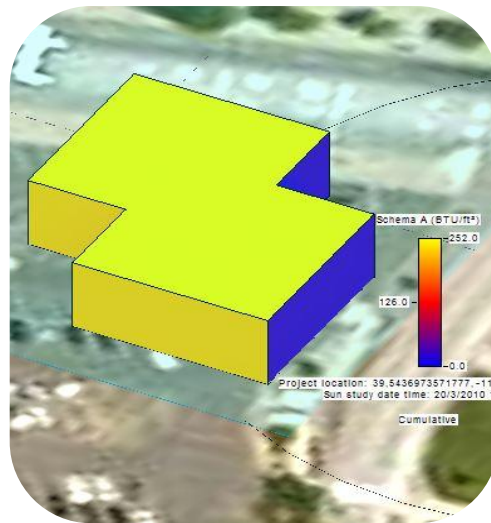
Solar Resources



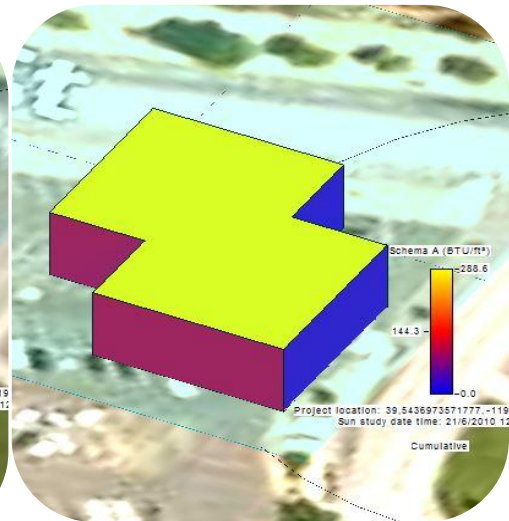
Fall



Winter



Spring

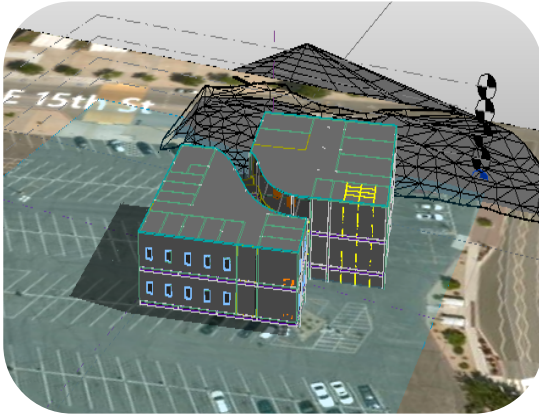


Summer

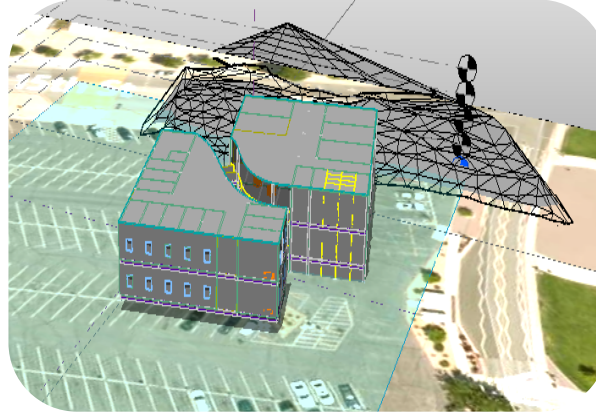
Roof Radiation ~ 6 KWh/m²/day, 252 Sunny Days per year

Sun Path Visualization

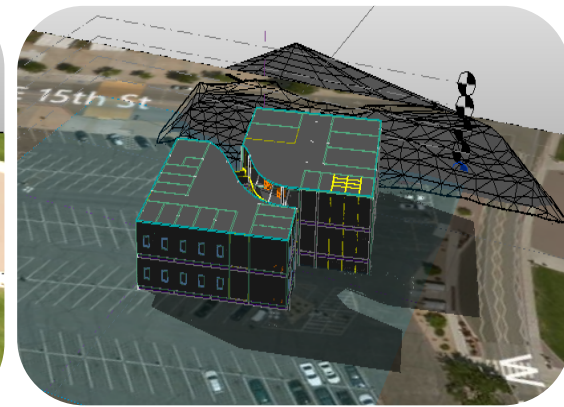
Summer Solstice



8am

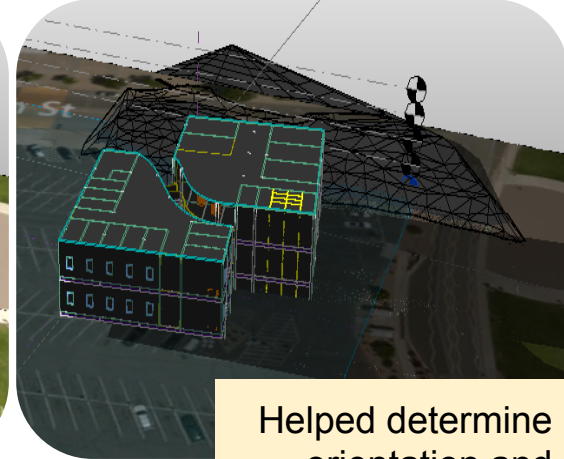
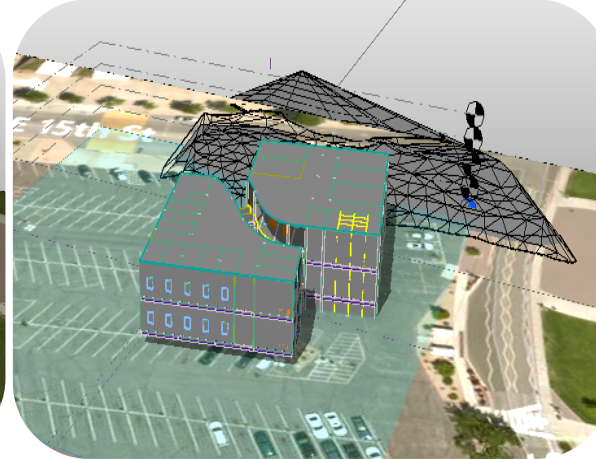
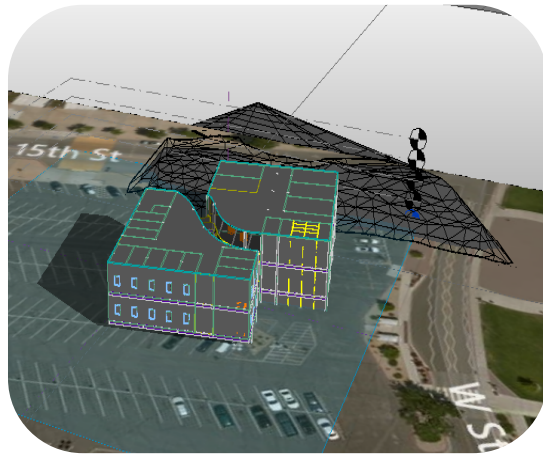


12pm



5pm

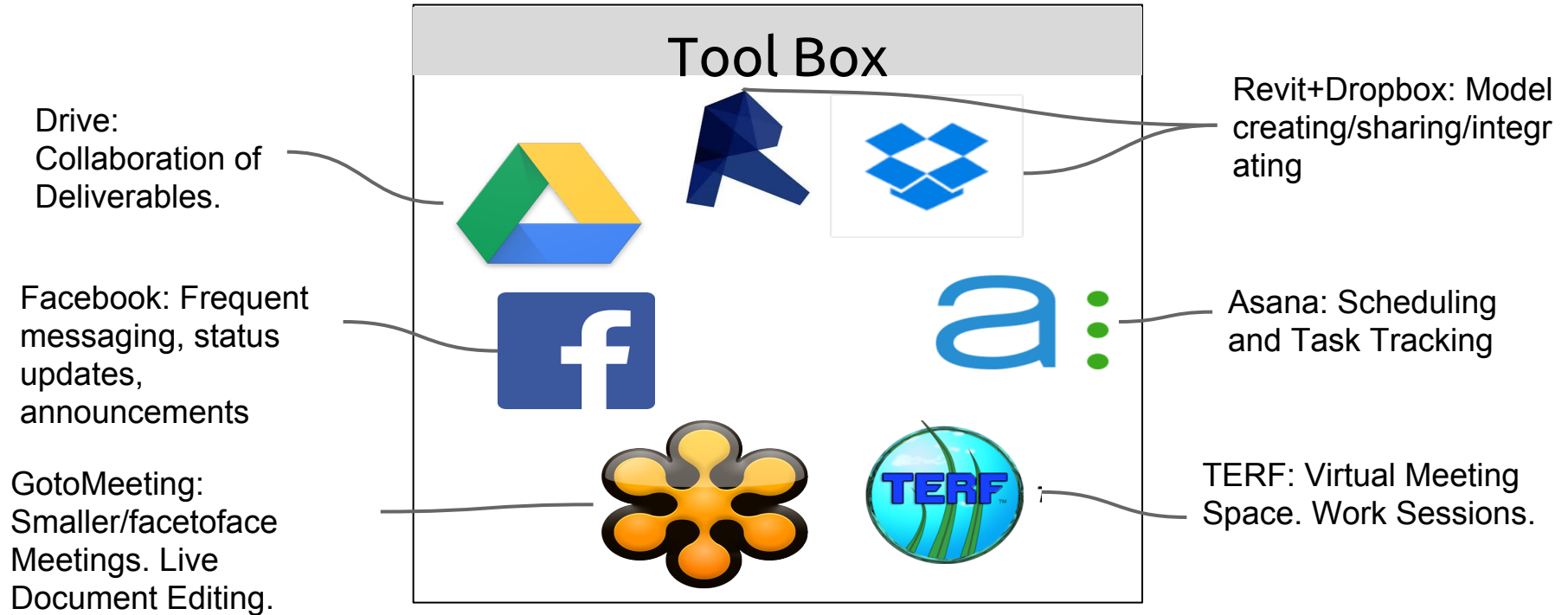
Fall Equinox



Helped determine
orientation and
location of spaces

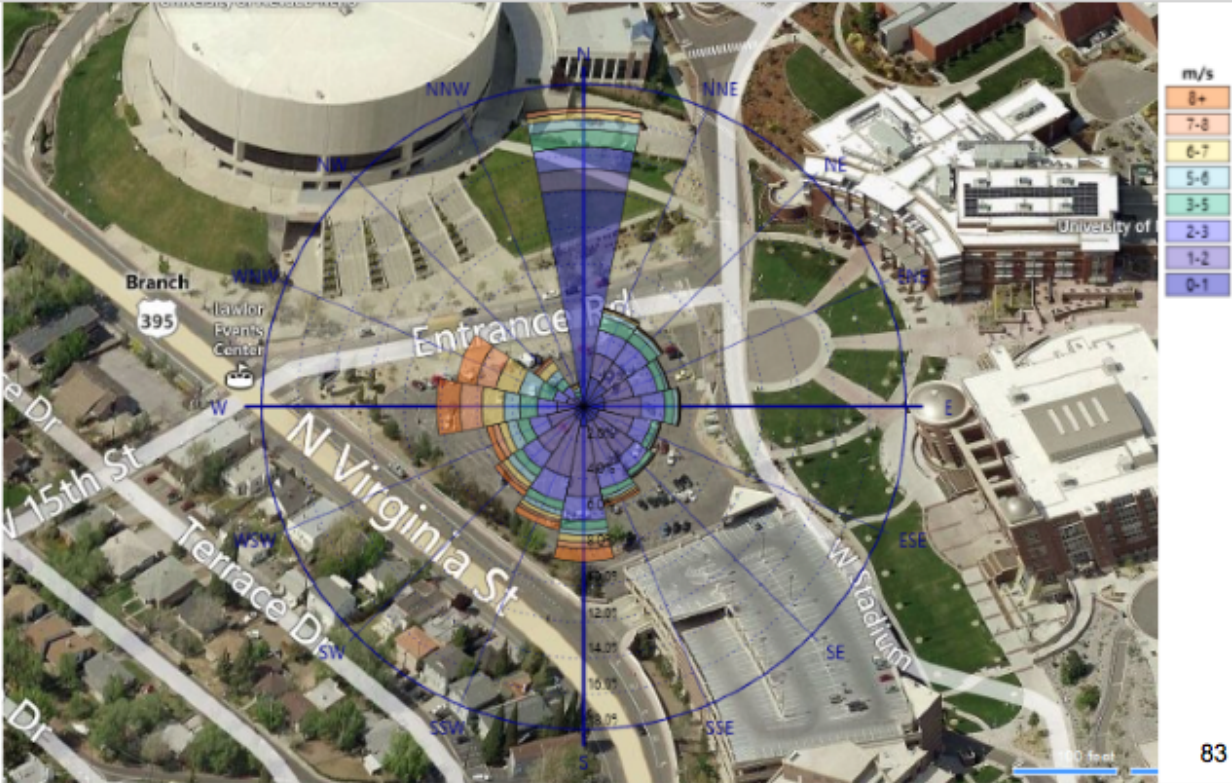
Our Team Process

After experimenting with many technologies, we chose to consolidate our tool box into the essential and most effective tools for our particular needs.



Our Team Process

Orientation : Wind Rose



83



Marios Tsikos

10:57 AM Yesterday

Resolve



+msantos1@stanford.edu Can you undertake this?



Marios Tsikos

12:25 PM Yesterday

Maybe also add a legend for the different colours.



Marveliz Santos

1:54 AM Today

what do you think about this?



Marios Tsikos

9:24 AM Today

Great!

Example of live feedback, communication, iteration via Google Drive.

A

E

MEP

C

Water

Latency

Spring Quarter GAMEPLAN!!!!



File Edit View Insert Format Data Tools Add-ons Help All changes saved in Dr

\$ % .0 .00 123 v Courier New v 10 v B I S A v

We moved from Asana to Google Drive as new method of requesting tasks/information and measuring interdependencies of disciplines.

fx | Marios

	A	B	C	D	E
1	Task	Required From	Affected Task	Assigned Date	Due Date
7	Quantities of structural elements	Robert	STV update	5/6/2015	4/28/2015
8	Quantities of structural elements	Meng	STV update	5/6/2015	4/28/2015
9	Dewatering for foundation	Catrin	Foundation design	4/28/2015	5/3/2015
10	Excavation for foundation	Ben	Foundation design	4/28/2015	5/3/2015
11	Atrium work (special mechanics because of water wall and plants?)	Marios	 Martin Legaard H... 10:59 AM Apr 27 +tsikosmarios@gmail.com	4/28/2015	4/28/2015
12	Atrium work (roof construction, Column placement)	Meng			4/28/2015
13	Atrium work (roof construction, Column placement)	Robert			
14	Completed Models	Meng		4/19/2015	4/24/2015
15	Completed Models	Robert		4/19/2015	4/24/2015
16	Completed Models	Marios		4/19/2015	4/24/2015
17	Completed Models	Martin		4/19/2015	4/24/2015
18	Add materiality to model	Martin	Cost Estimation	4/28/2015	4/29/2015

+email, member receives notification of request & link to sheet

A

E

MEP

C

Water

Latency

Spring Quarter GAMEPLAN!!!!

File Edit View Insert Format Data Tools Add-ons Help All changes saved in Drive

msantos1@st

Comments

date info is
receivedpredicted
transferrate (tr)

measured (tr)

difference bet. measured
and predicted (tr)

Team Members' Latency Points

	E	F	G	H	I	J	K	L	M	N	O	P
	Due Date	True Date	Predicted	Actual	Delay	Ben	Catrin	Marios	Martin	Marveliz	Meng	Robert
2												
3	4/14/2015	4/16/2015	-22	-20	2	0		2	0	0	0	0
4	4/23/2015	4/22/2015	1	0	-1	0		0	0	-1	0	0
5	4/23/2015	4/23/2015	1	1	0	0		0	0	0	0	0
6	4/23/2015	4/23/2015	2	2	0	0		0	0	0	0	0
7	4/28/2015	4/28/2015	-8	-8	0	0		0	0	0	0	0
8	4/28/2015	4/28/2015	-8	-8	0	0		0	0	0	0	0
9	4/28/2015	4/28/2015	-8	-8	0	0		0	0	0	0	0
10	5/3/2015	5/3/2015	5	5	0	0						
11	5/3/2015	5/3/2015	5	5	0	0						
12	4/28/2015	4/28/2015	0	0	0	0						
13	4/28/2015	4/28/2015	0	0	0	0						
14												
15												
16												
17	4/24/2015	4/25/2015	5	6	1	0						

Led to further consolidation of tools. We
were ALL already there! (Email+Drive)

		Delay
Ben	benycohen90@gmail.com	-1
Catrin	catrinm@stanford.edu	2
Marios	tsikosmarios@gmail.com	0
Martin	martinlegaard88@gmail.com	-2
Marveliz	Msantos1@stanford.edu	0
Meng	Mwang15@stanford.edu	1
Robert	Robert.Hartung@uni-weimar.de	1
	Total	1

A

E

MEP

C

Water

Latency

Week	Dates	Architecture	Construction	Structural Engineering	MEP	Integration
1	1/19 - 1/25	Martin	Ben	Meng	Marios	Marveliz
2	1/26 - 2/1	Martin	Ben	Meng	Marios	Marveliz
3	2/2 - 2/8	Martin	Catrin	Trebor	Marios	Marveliz
4	2/9 - 2/15	Martin	Ben	Trebor	Marios	Marios
5	2/16 - 2/22	Marveliz	Ben	Meng	Marios	Marveliz
6	2/23 - 3/1	Martin	Catrin	Trebor	Marios	Marveliz
7	3/2 - 3/8	Martin	Catrin	Meng	Marios	Marios
8	3/9 - 3/15	Martin	Ben	Meng	Marios	Marveliz
9	3/16 - 3/22	BREAK	BREAK	BREAK	Break	Break
10	3/23 - 3/29					
11	3/30 - 4/5	Marveliz	Ben	Trebor	Marveliz	Marveliz
12	4/6 - 4/12	Martin	Catrin	Meng	Marios	Marios
13	4/13 - 4/19					

PT

CET

Take into account availability to assign Weekly Discipline Leaders.

Use Time Difference for Round-the-Clock work.

Ensure that each discipline + whole project is moving forward.

Canyon Idea



Target Value Design Wall

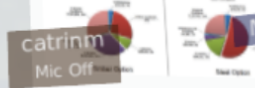
Canyon Steel = \$5.2 M

Canyon Concrete = \$4.3 M

Mountain Timber = \$6.3 M

Mountain Steel = \$5.2M

Mountain Idea



Members
Evaluating
Dynamic TVD
Wall on TERF



1. What is the baseline cost? / Ave
2. Quantities when you have
3. How much more expensive

People

Online

- B Cohen-14 (Me)
- × catrinm (Here)
- Marios (Here)
- Martin (Here)
- × msantos1 (Here)
- ROBERT (Here)

Landmarks

- cdn.archinect.net - URL
- google.com - URL
- mlh_archlocal_doublediamond_pbl.stanford.edu - URL
- s3.amazonaws.com - URL
- static.dezeen.com - URL
- www.drive.google.com - URL
- www.google.com - URL
- www.inhabitat.com - URL

1. What is the baseline cost? /
2. Quantities when you have th

Exchange

Set

Decision Matrix

The background image is a scenic view of a city at sunset. In the foreground, a city skyline is visible with various buildings, including a prominent orange-brown skyscraper on the left. The city lights are beginning to glow. In the background, a large, rugged mountain with patches of snow or light-colored rock rises against a sky filled with soft, orange and yellow clouds from the setting sun.

Weighting Process

1. Expression of Big Idea

2. Site Connection

3. User Comfort

4. Water Challenge

5. Sustainability

6. Floor to Ceiling Height

7. Structural Strength (Seismic Performance)

8. Cost

9. Constructability

10. Duration of Build

11. Innovation

12. Interdisciplinary Integration

Owner Percentages

	1	2	3	4	5	6	7	8	9	10	11	12
Total	17	11	15	9	18	8	14	4	2	0	22	11
Percentage	13%	8%	11%	7%	14%	6%	11%	3%	2%	0%	17%	8%

Team Percentages

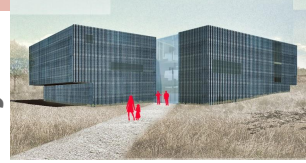
	1	2	3	4	5	6	7	8	9	10	11	12
Total	62	33	40	35	47	25	38	24	27	11	56	58
Percentage	14%	7%	9%	8%	10%	5%	8%	5%	6%	2%	12%	13%

Comined Outcome

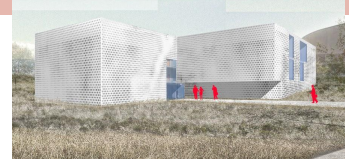
1. Expression of Big Idea	14%
2. Site Connection	7%
3. User Comfort	9%
4. Water Challenge	8%
5. Sustainability	10%
6. Floor to Ceiling Height	5%
7. Structural Strength (Seismic Performance)	8%
8. Cost	5%
9. Constructability	6%
10. Duration of Build	2%
11. Innovation	12%
12. Interdisciplinary Integration	13%

Decision Diagram Results

Canyon

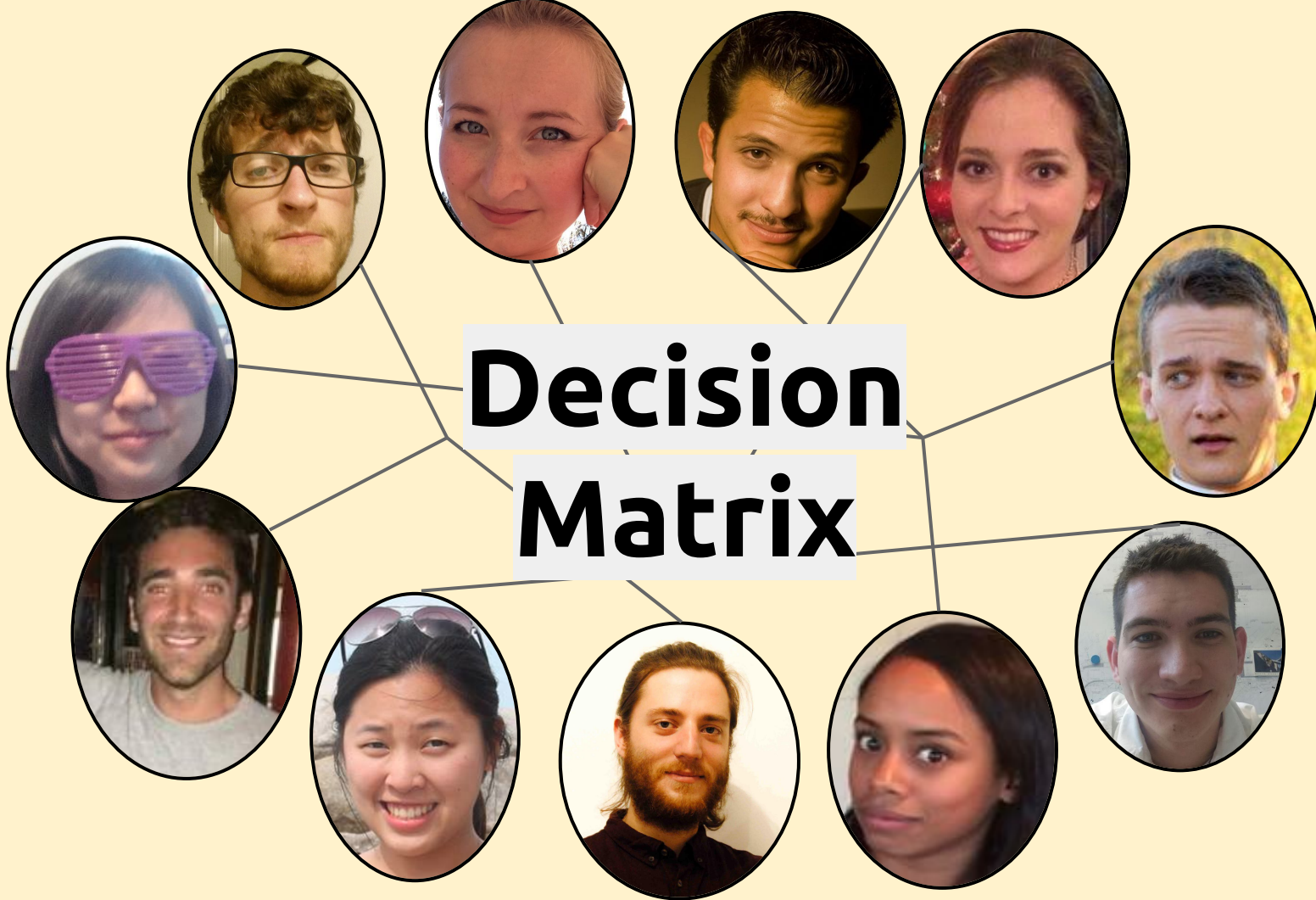


Oasis



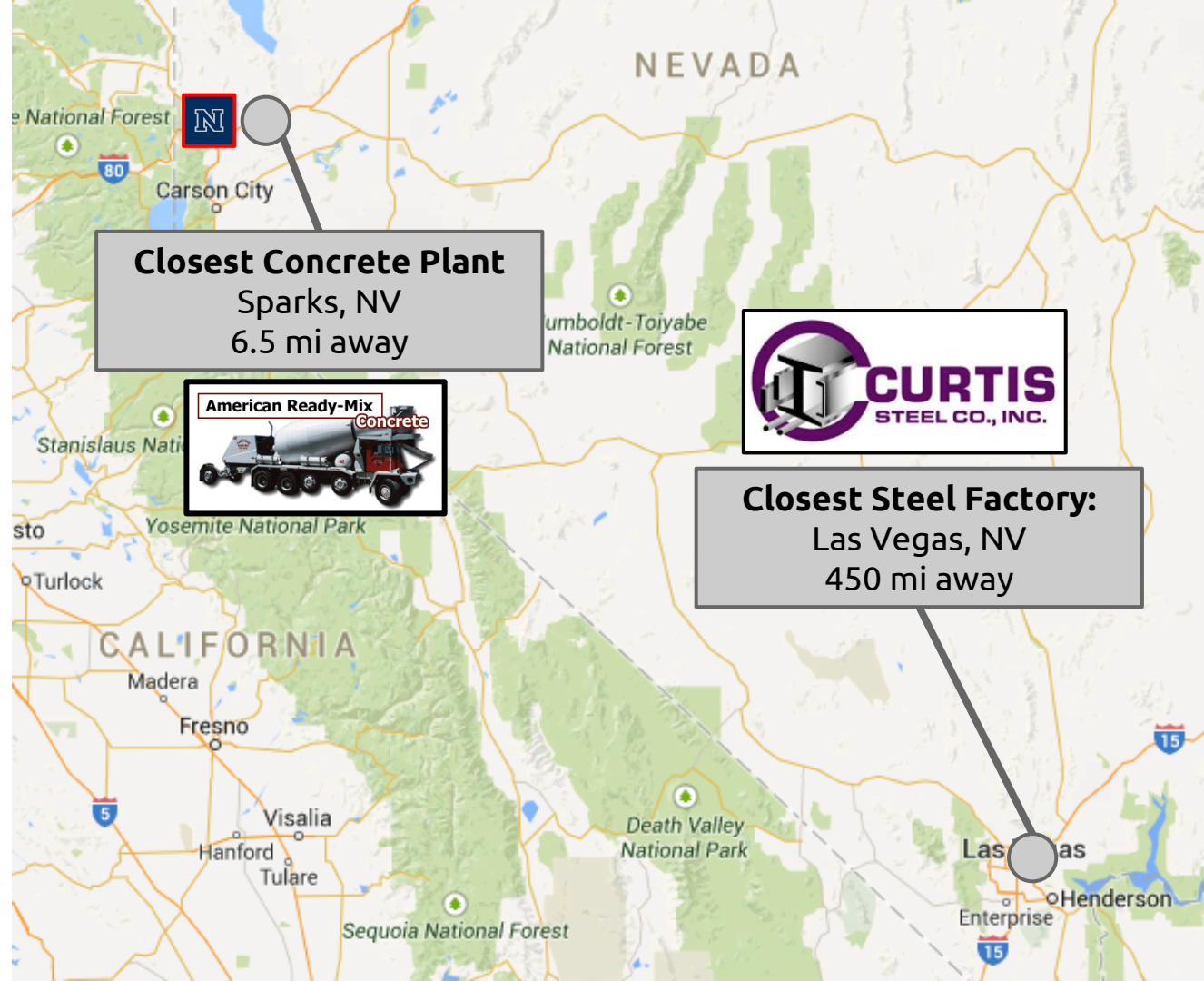
	Average Weighting	Canyon Steel	Canyon Concrete	Oasis Steel	Oasis Timber
1. Expression of Big Idea	14%	3.26	3.54	2.18	2.31
2 .Site Connection	7%	1.74	1.88	1.23	1.23
3. User Comfort	9%	2.19	2.19	2.02	2.11
4. Water Challenge	8%	1.30	1.30	1.30	1.30
5. Sustainability	10%	2.47	1.65	2.58	2.27
6. Floor to Ceiling Height	5%	1.21	1.21	1.21	0.88
7. Structural Strength (Seismic Performance)	8%	1.83	2.25	1.83	1.67
8. Cost	5%	1.05	0.84	1.11	1.42
9. Constructability	6%	1.48	1.07	1.48	1.60
10. Duration of Build	2%	0.55	0.39	0.55	0.63
11. Innovation	12%	2.33	2.95	2.33	2.33
12. Interdisciplinary Integration	13%	2.93	3.05	2.54	1.91
	100%	22.36	22.31	20.36	19.65

Decision Matrix



Final Choice:
Concrete

Keeping
it
Local!



A

E

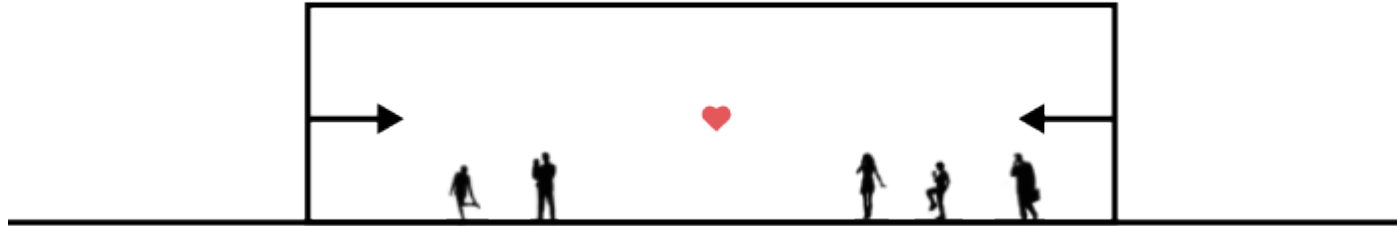
MEP

C

Water

Latency





A

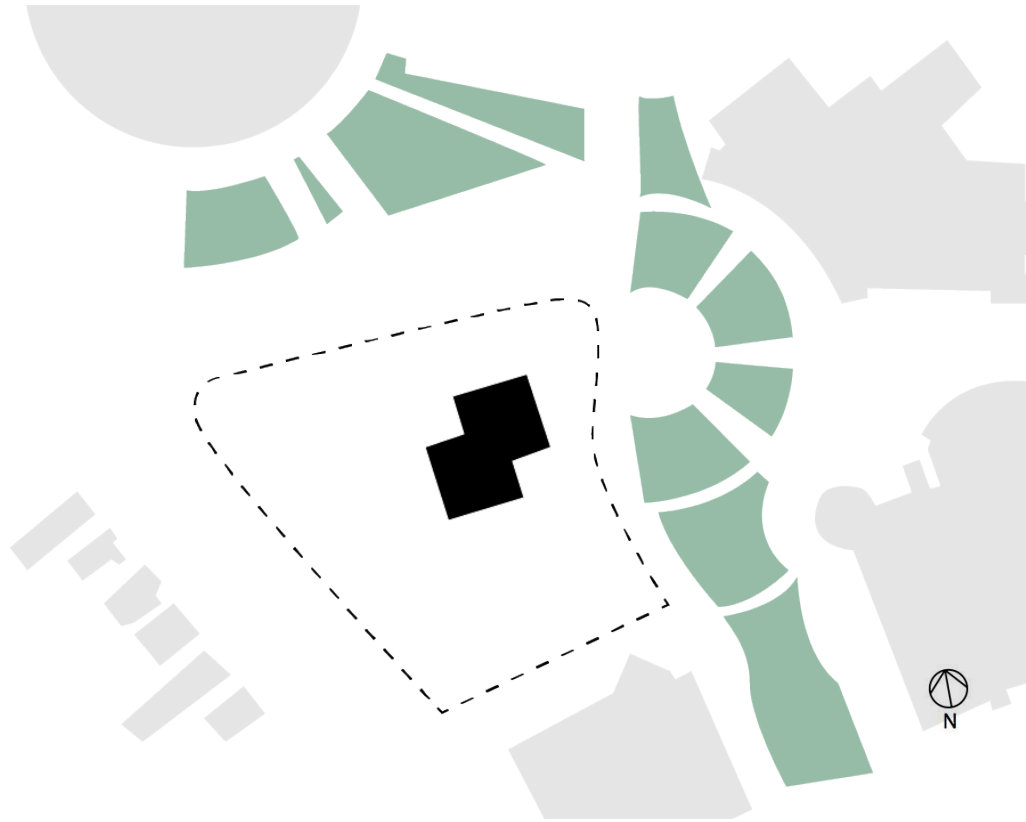
E

MEP

C

Water

Latency



A

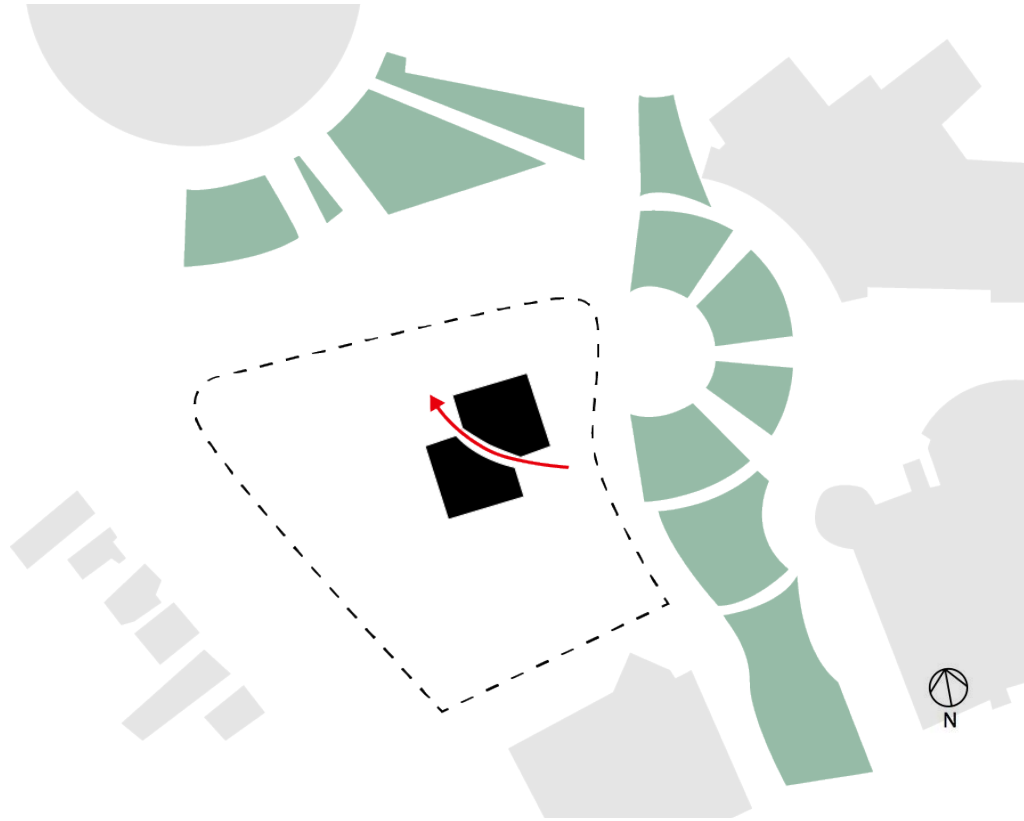
E

MEP

C

Water

Latency





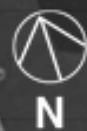
Path 1

N Virginia St

East 15th Street

Path 1

University-Nv
School-Med



Click to add text



SOUTH FACADE

A

E

MEP

C

Water

Latency

MEP

Student

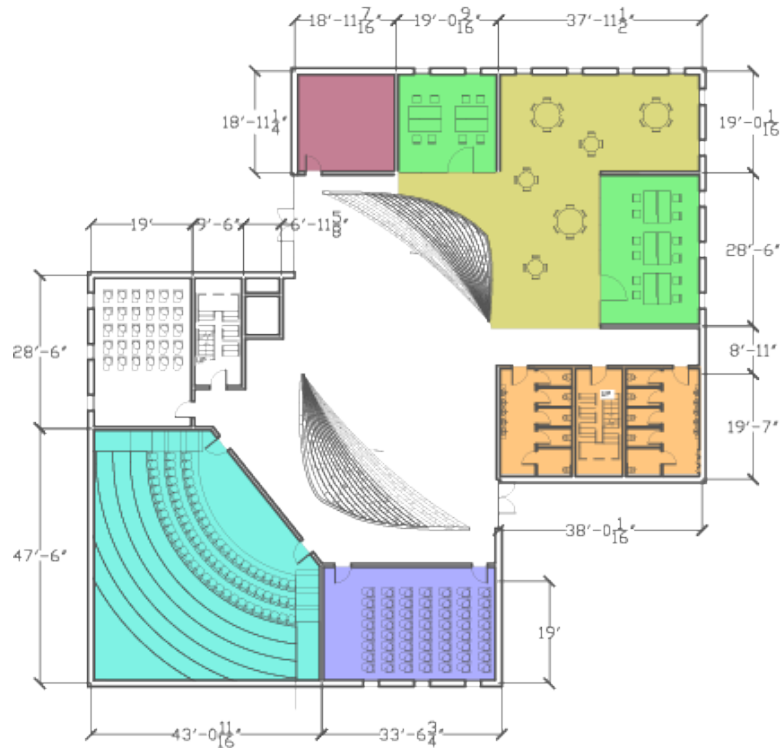
Seminar

Auditorium

Large Class

Small Class

Toilet



LEVEL 1



A

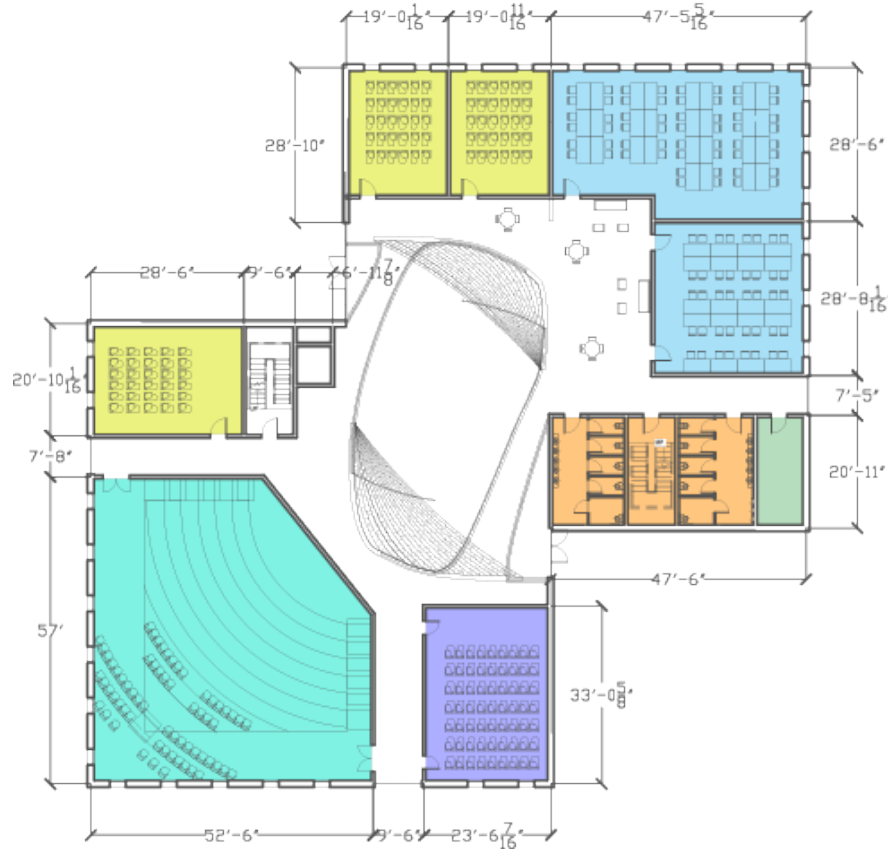
E

MEP

C

Water

Latency



LEVEL 2

LAB

Storage

Auditorium

Large Class

Small Class

Toilet



A

E

MEP

C

Water

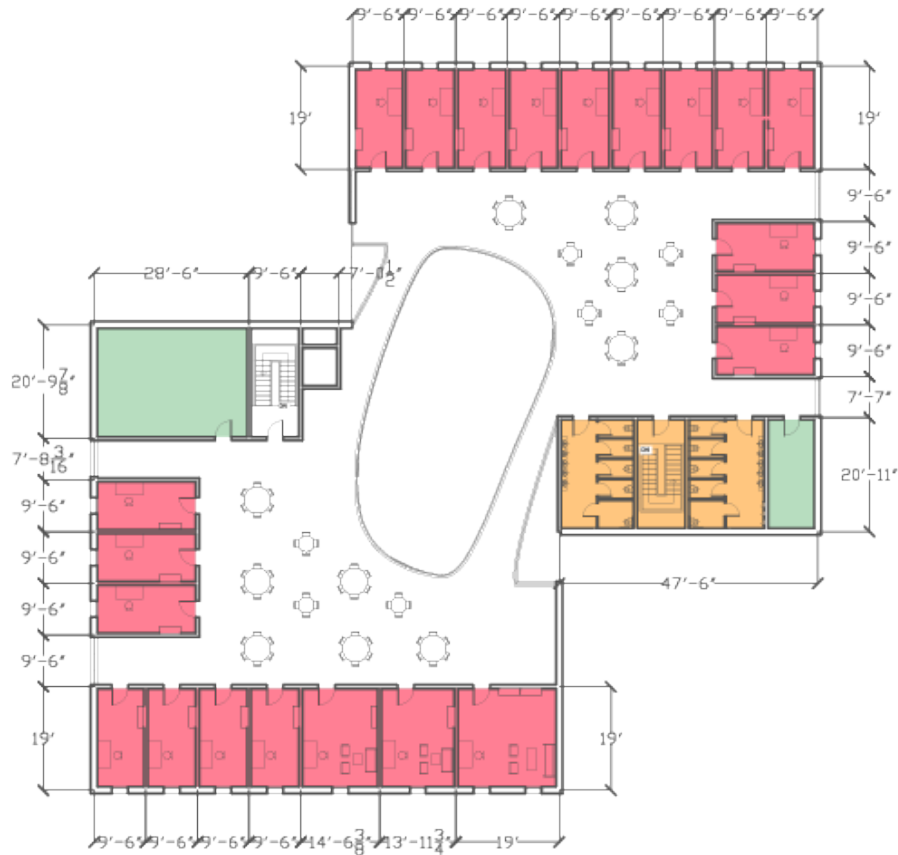
Latency

Faculty

Storage

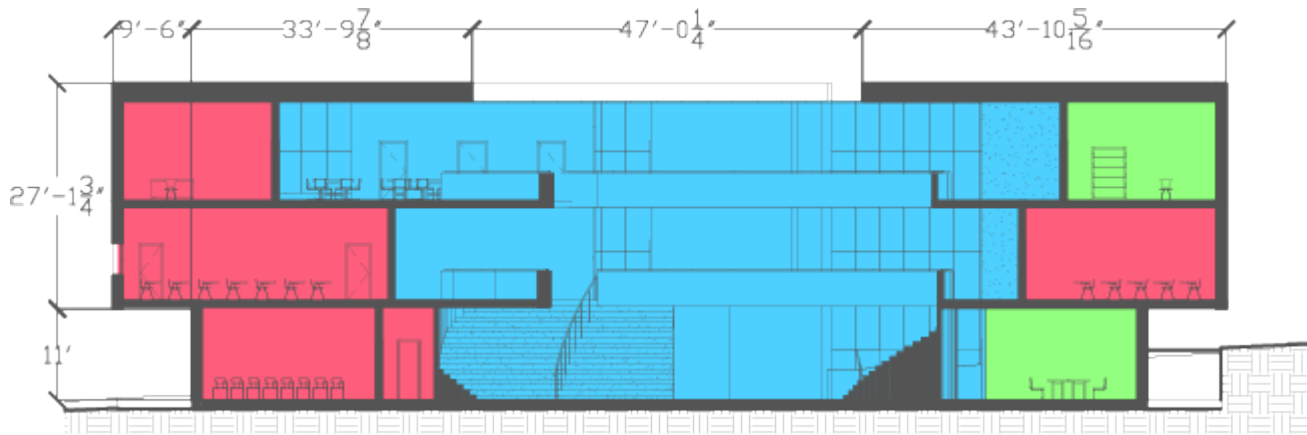
Toilet

Small Class



LEVEL 3





OFFICE AREA

CLASS ROOM

OPEN SPACE

A

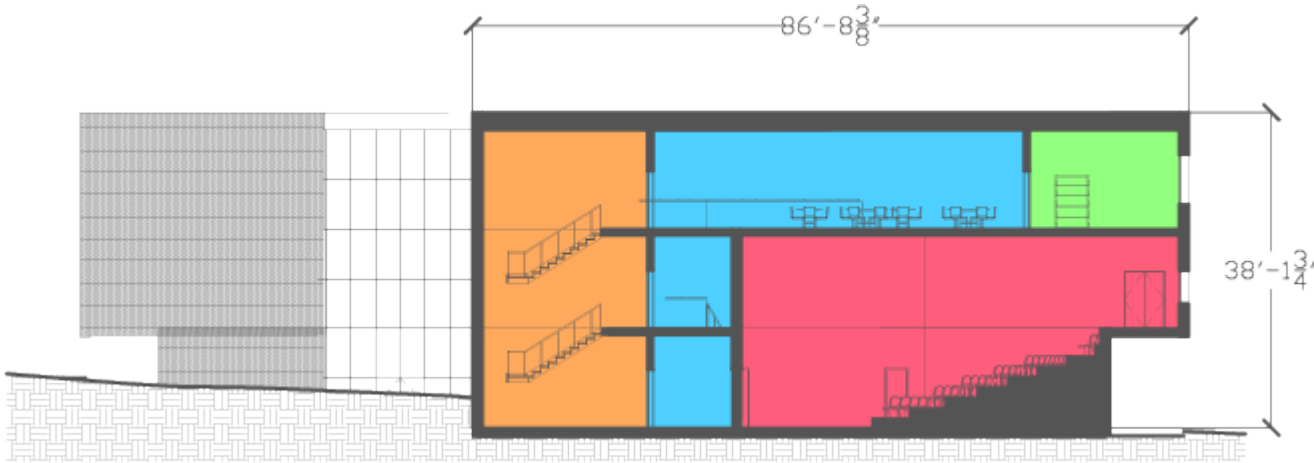
E

MEP

C

Water

Latency



OFFICE AREA

CLASS ROOM

OPEN SPACE

STAIRS

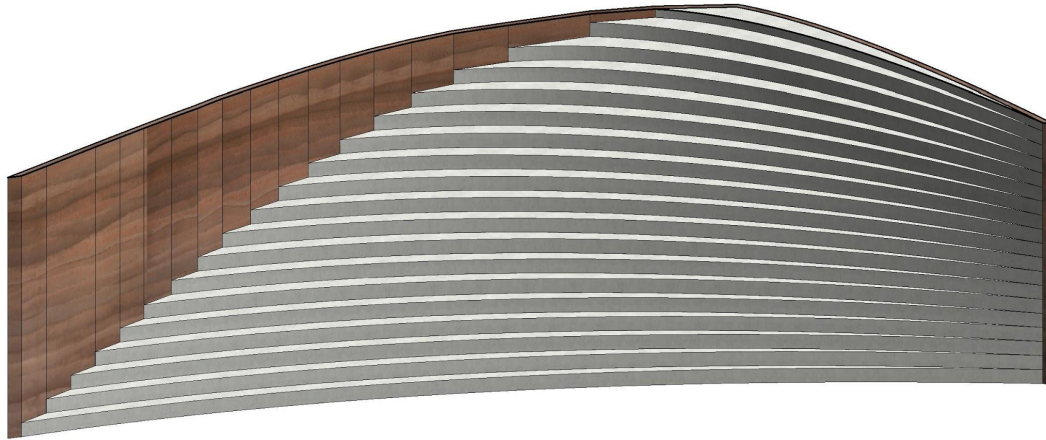


STUDENT AREA





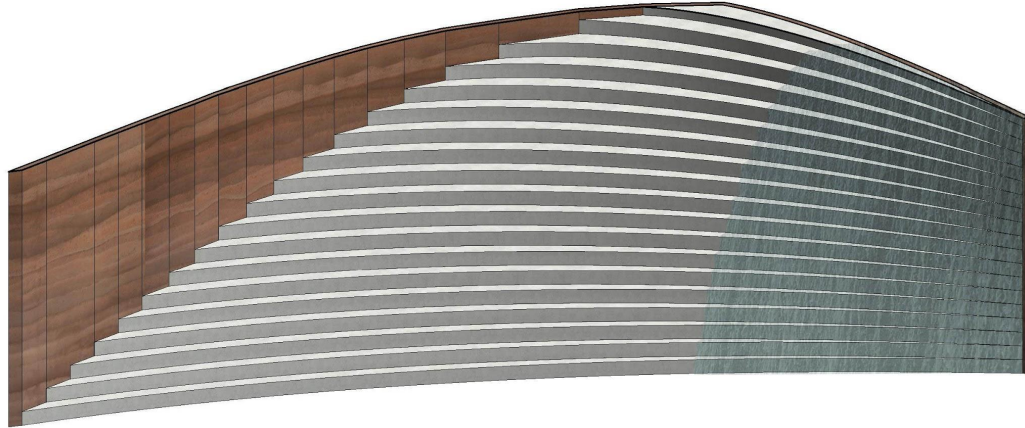
ATRIUM



Stairs



Water wall



Water wall implemented in stairs

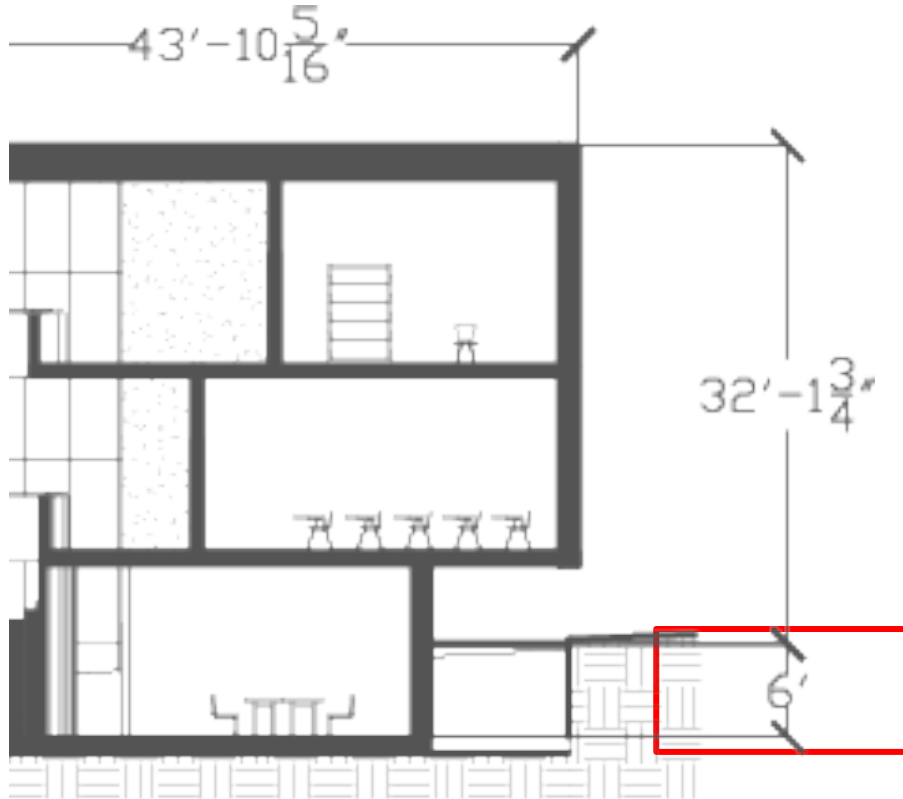


AUDITORIUM





Building Elevation



6 ft below grade



increase floor-ceiling height



increase user comfort

Soil Profile

(Grade at 4580 ft Elevation) 0 ft

1.58 ft

Water Table (4 ft)

2.42 ft

4.67 ft

Excavation (7.5 ft)

7 ft

Depth of Excavation	Soil Type	Thickness	Bearing Capacity
	Stony Sandy Loam and Heavy Loam	19"	1500 psf
	Sandy Clay Loam	10"	1500 psf
	Clay and Clay Loam	27"	1500 psf
	Very Gravelly Sandy Loam and Very Gravelly Loam	28"	5000 psf
	Volcanic Rock	Unknown	8000 psf

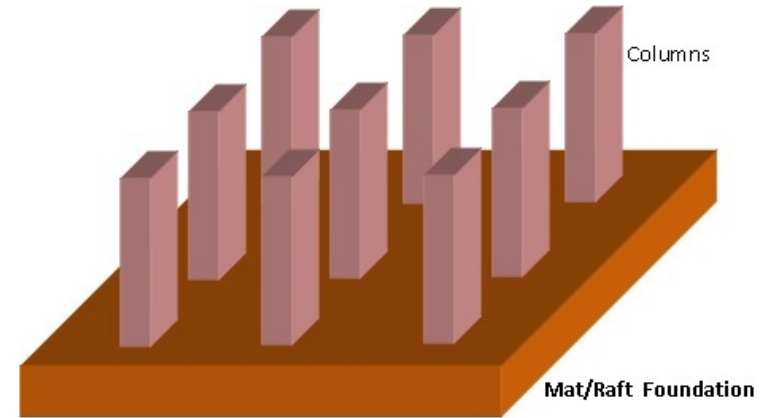
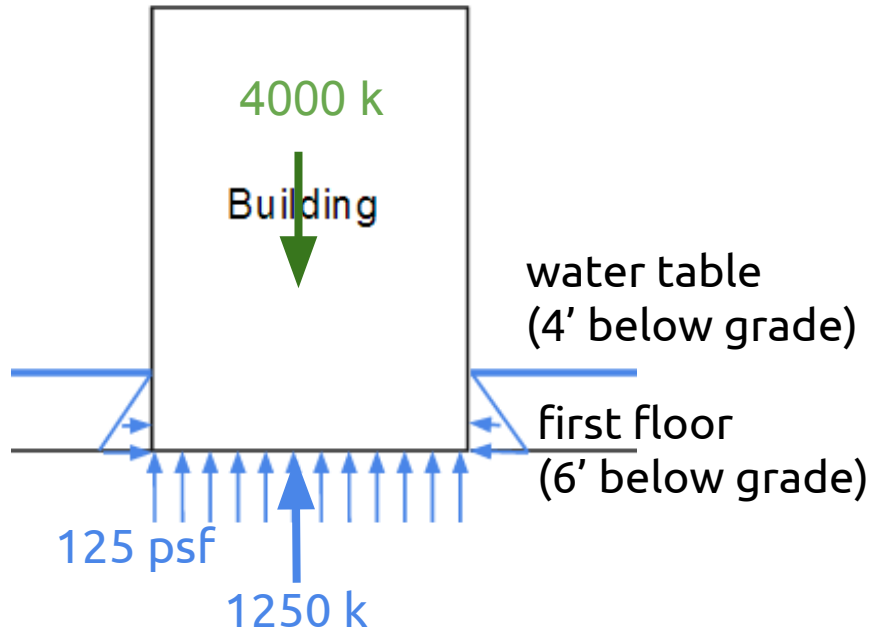
Foundation

Hydrostatic Forces

need thicker base slab



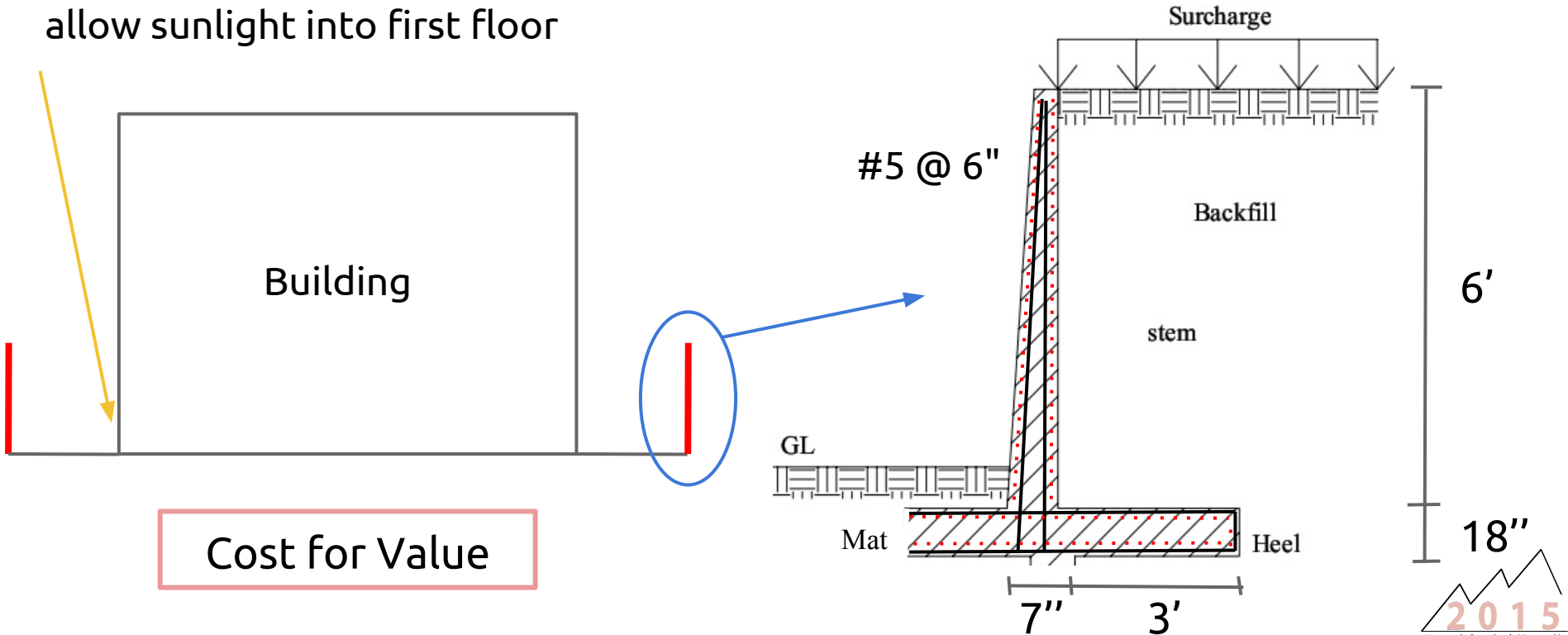
Mat Foundation



5000 psi concrete - 18" thick
placed 6' below grade

Waterproofed Retaining Wall

allow sunlight into first floor

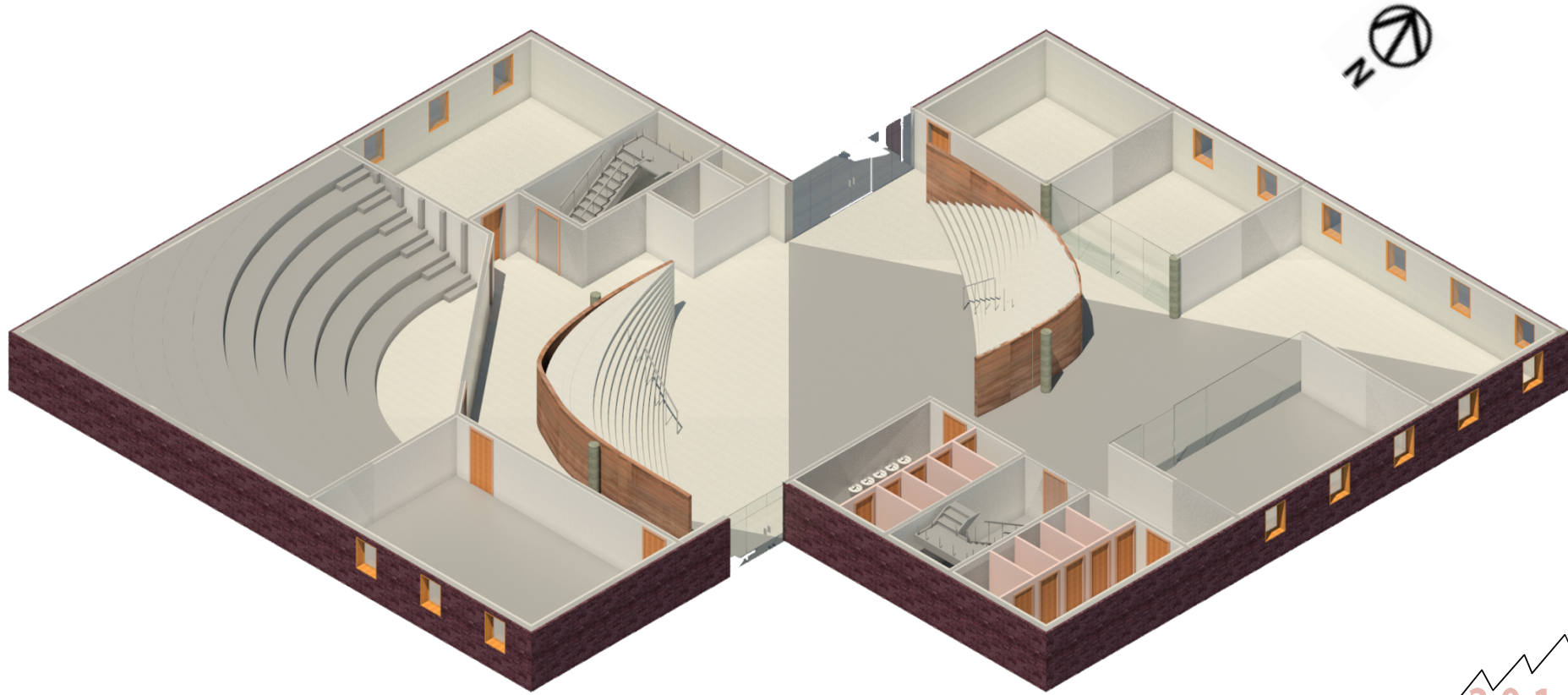


Retaining Wall Location

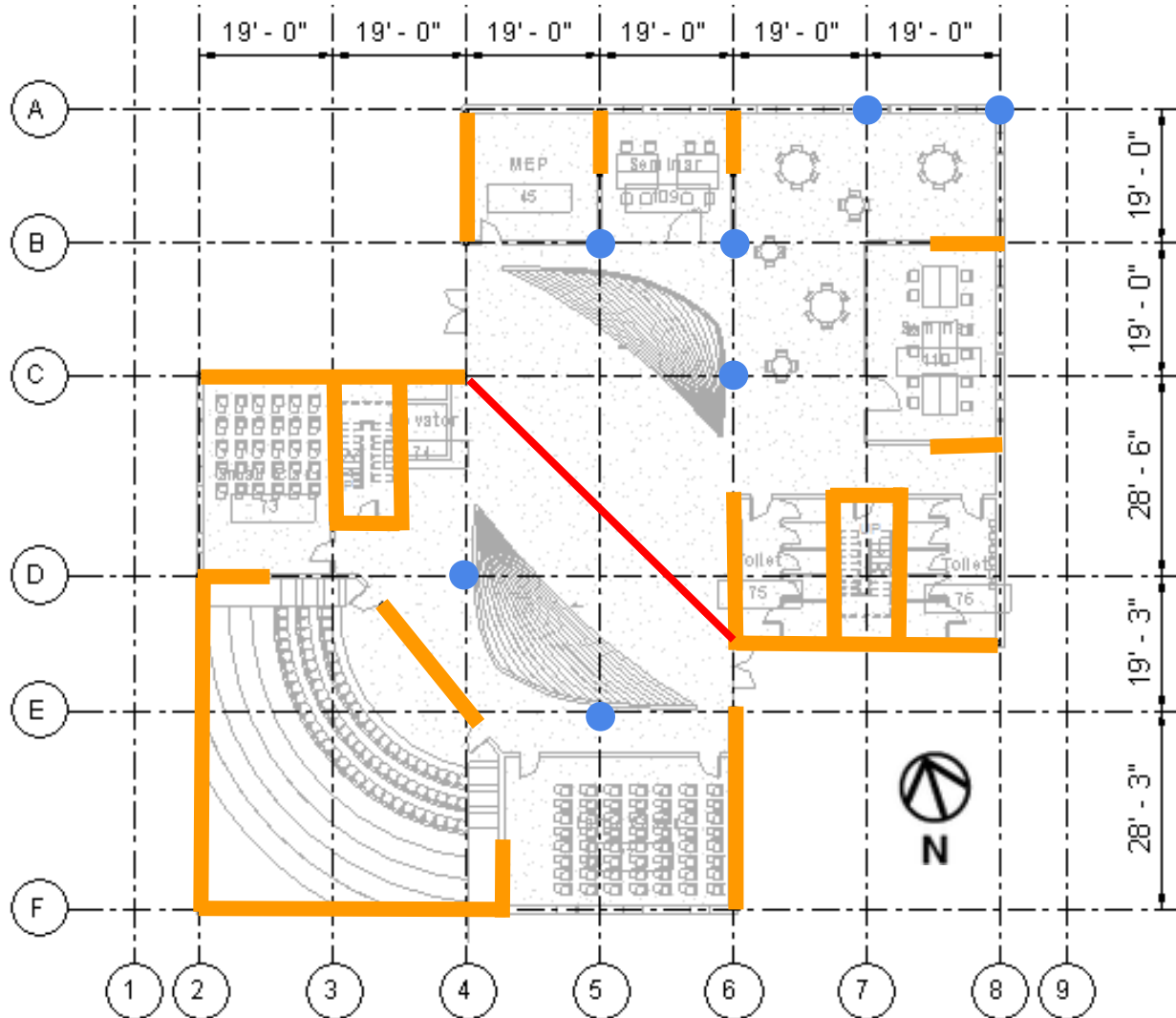
- - - Retaining Wall
- - - Site Boundary

10 ft from the building

3D View Level 1



Level 1



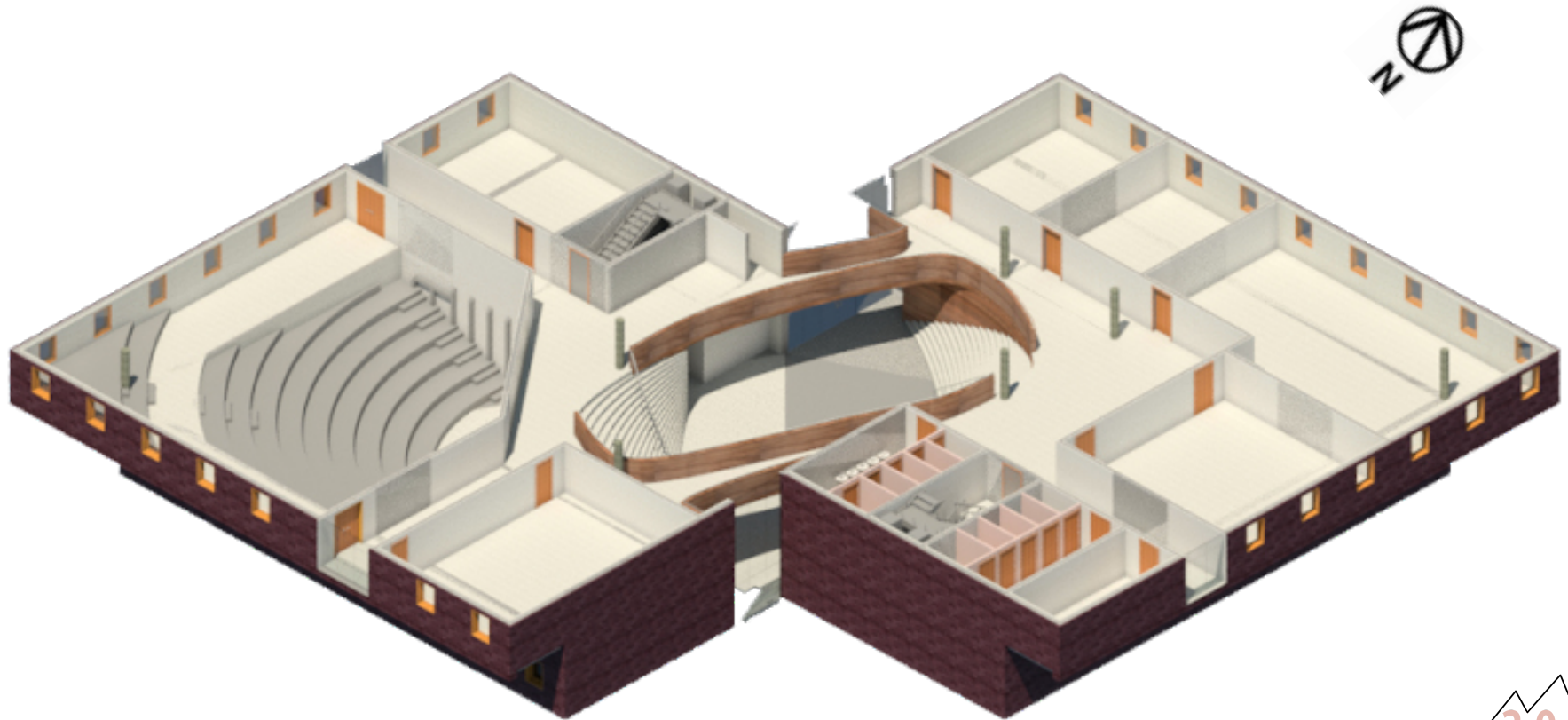
9" PT Flat Slab

8" RC Shear Wall

14" RC Column

Seismic Separation

3D View Level 2



Level 2

9" PT Flat Slab

8" RC Shear Wall

14" RC Column

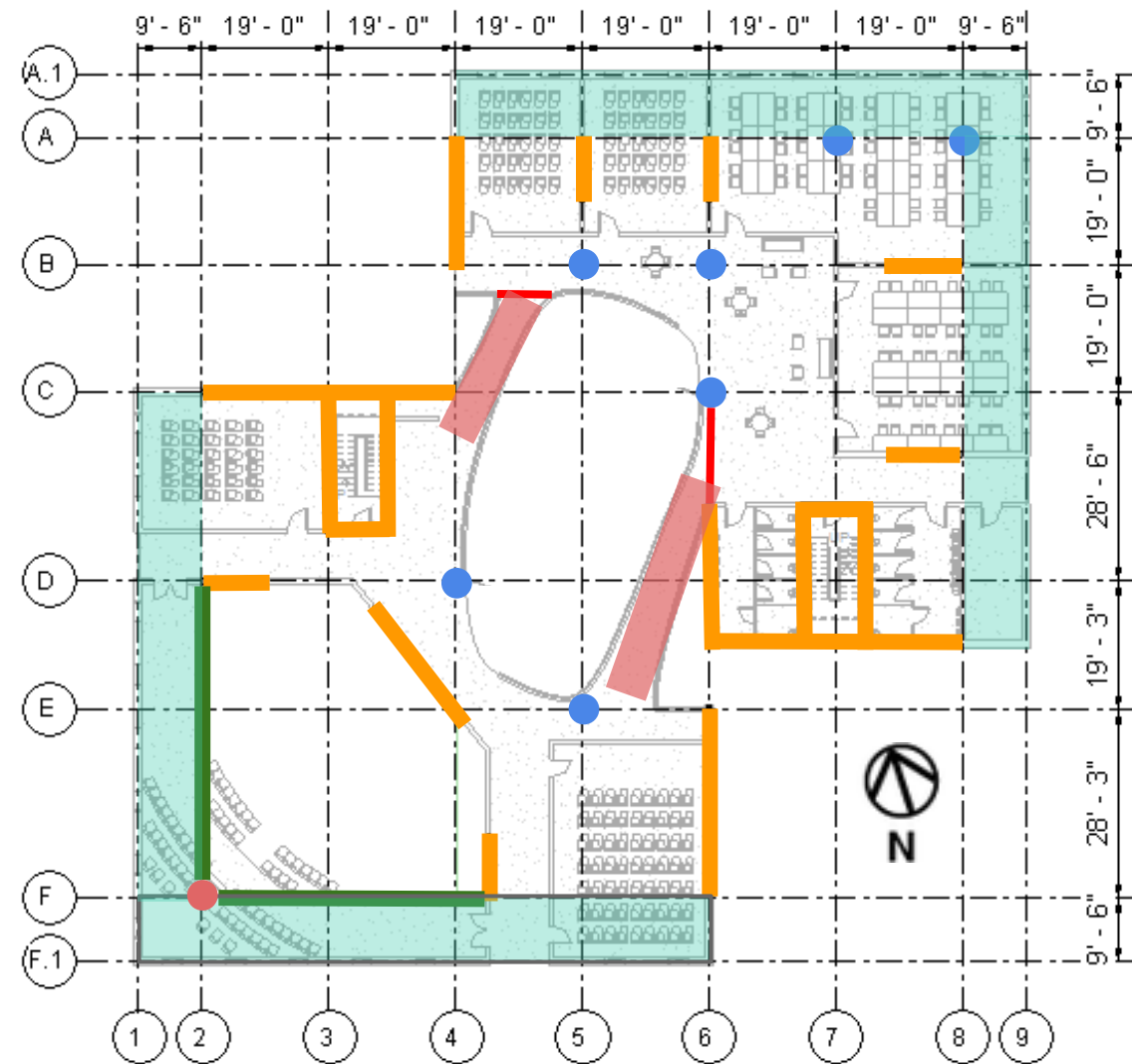
20" RC Column

18 x 36 RC Beam

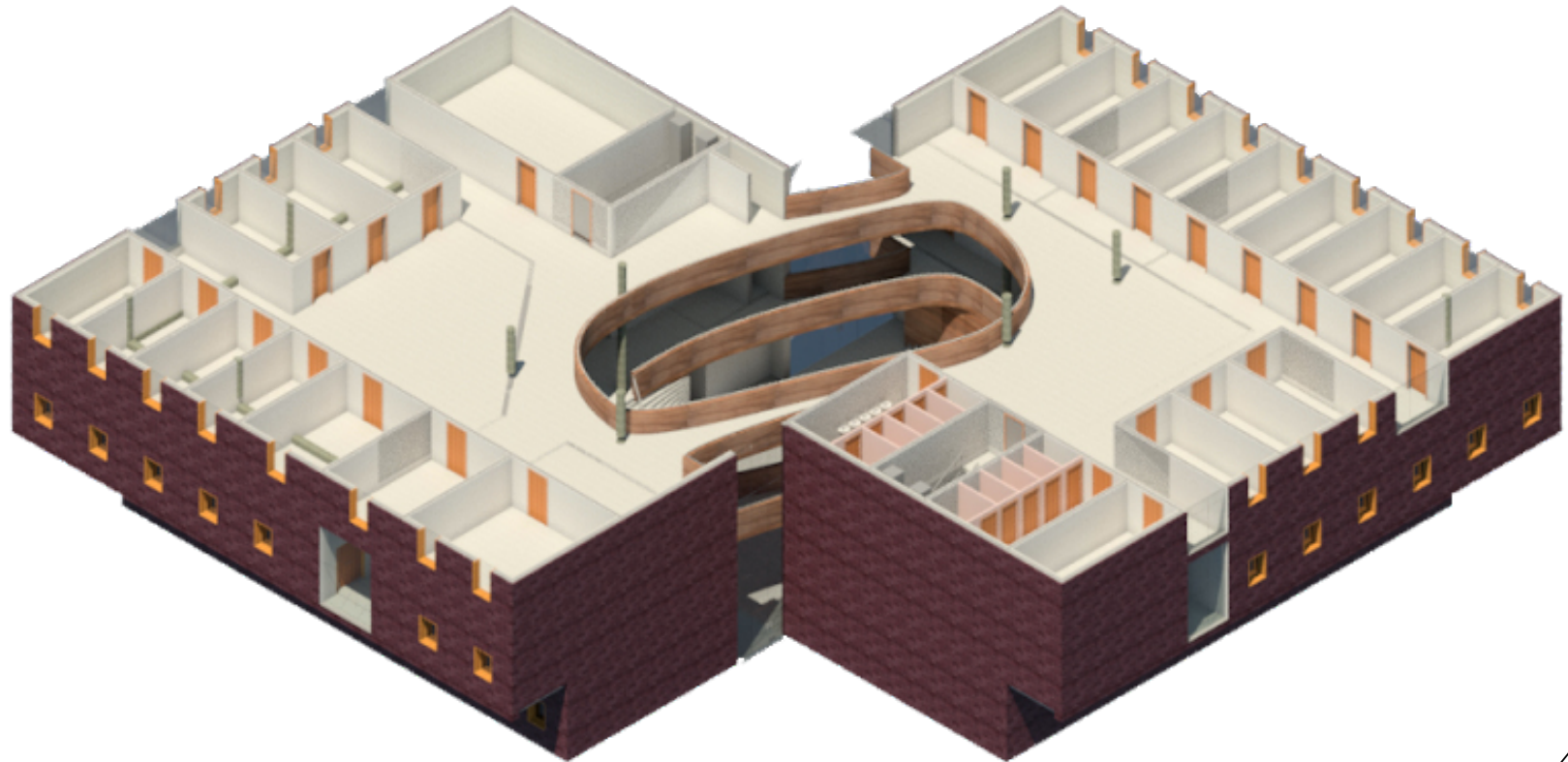
Seismic Separation

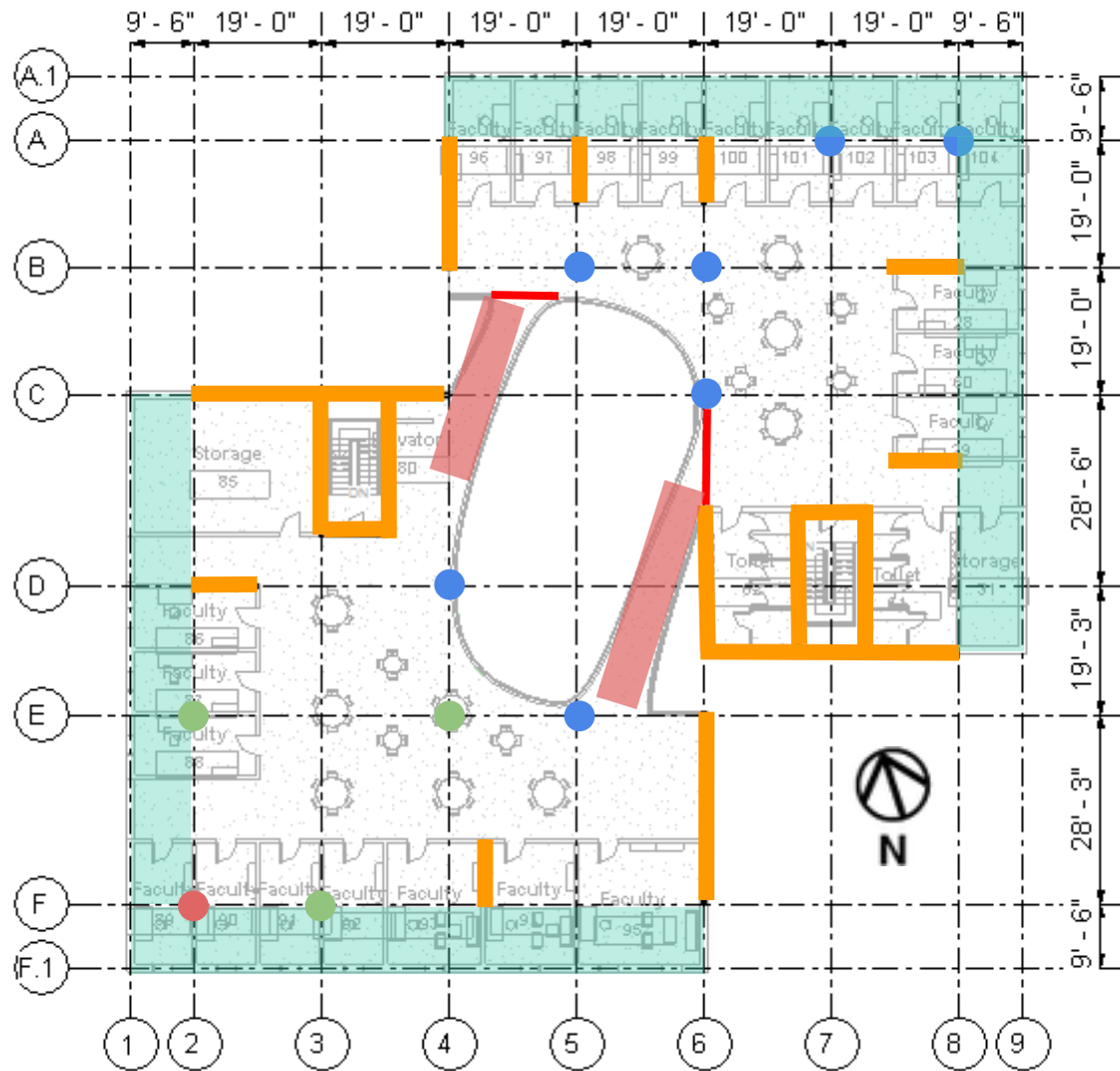
9.5' Cantilever

Bridges (steel)



3D View Level 3





Level 3

9" PT Flat Slab

8" RC Shear Wall

14" RC Column

20" RC Column

16" RC Column

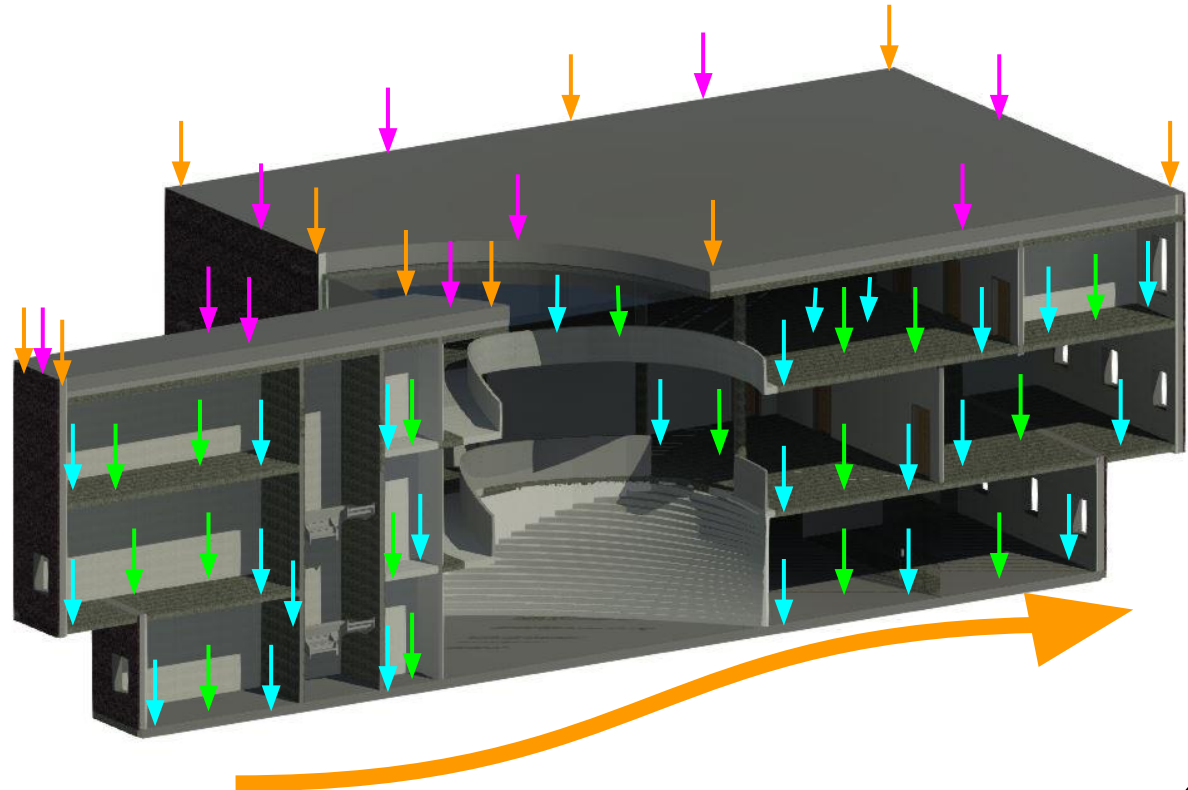
Seismic Separation

9.5' Cantilever

Bridges (steel)

Design Loads

Roof	
Dead	110 psf
PV Panels	5 psf
Live	20 psf
Snow	10 psf
Other Floors	
Dead	110 psf
SDL	10 psf
Live	65 psf



Earthquake Base Shear 320 kips per Wing

Typical Dimensions

5000 psi Concrete

9" PT Flat Slab

14" Dia. RC Column

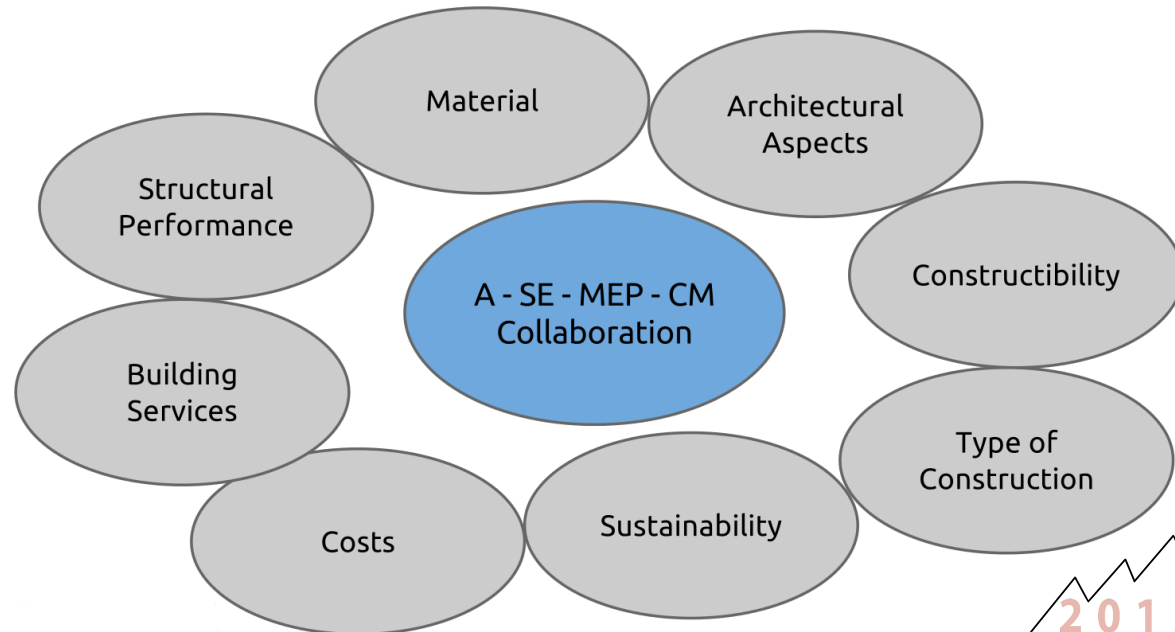
8" RC Shear Wall

9'6" Cantilever

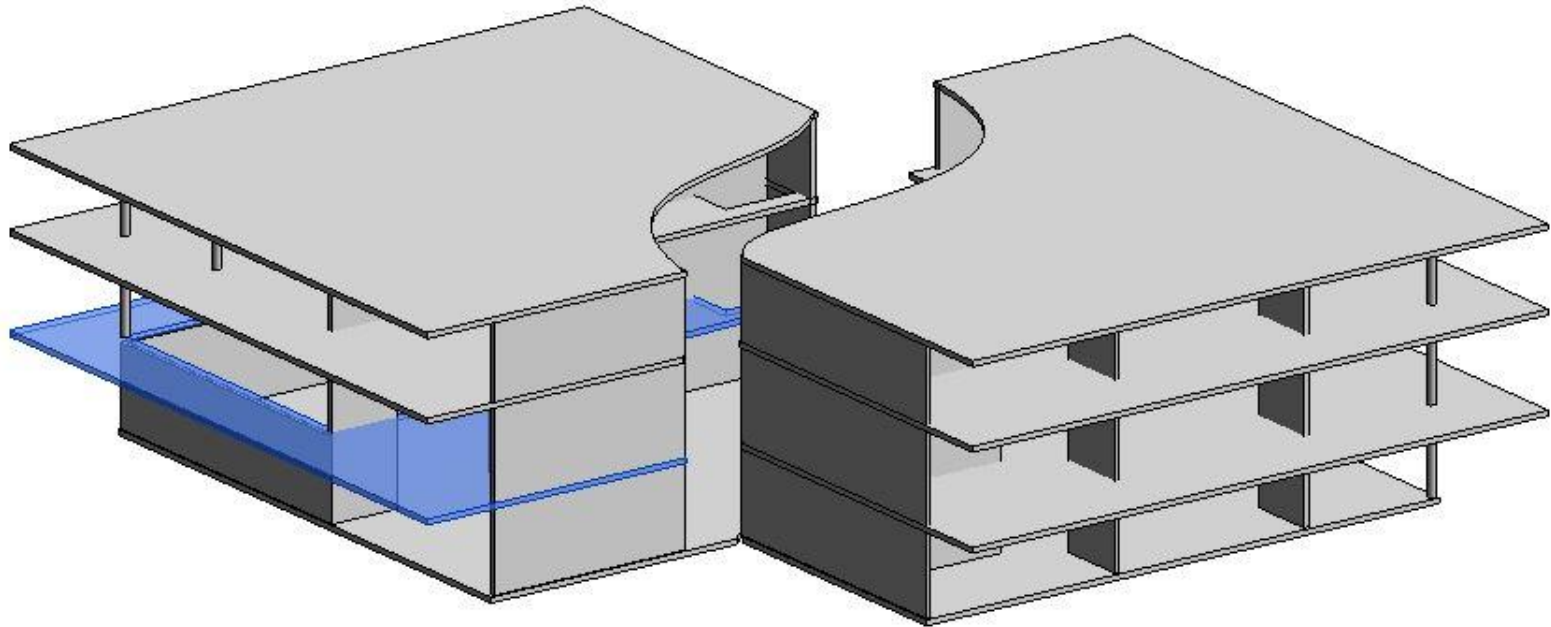
Seismic Separation

Adding fly ash:

reduce water demand of concrete
10% of fly ash → 3% water reduction



Auditorium PT Slab Analysis

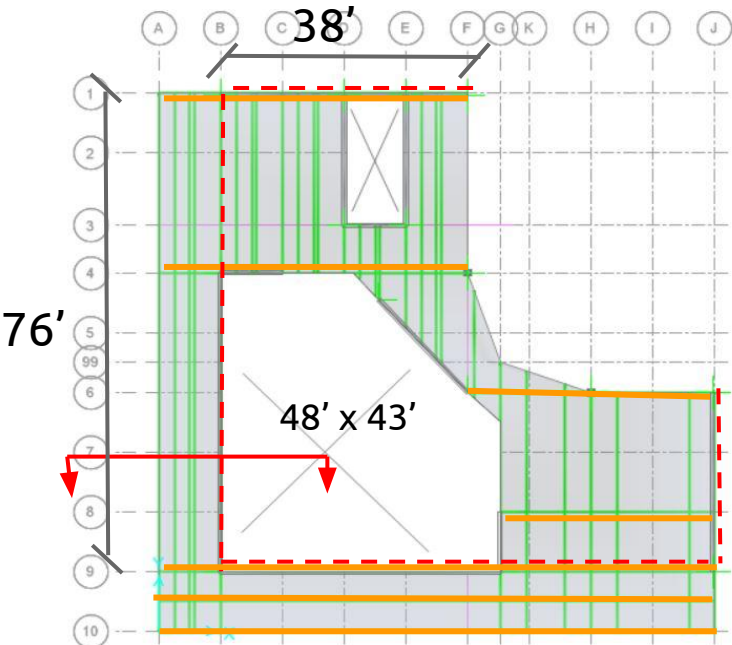


Stress Check - Auditorium

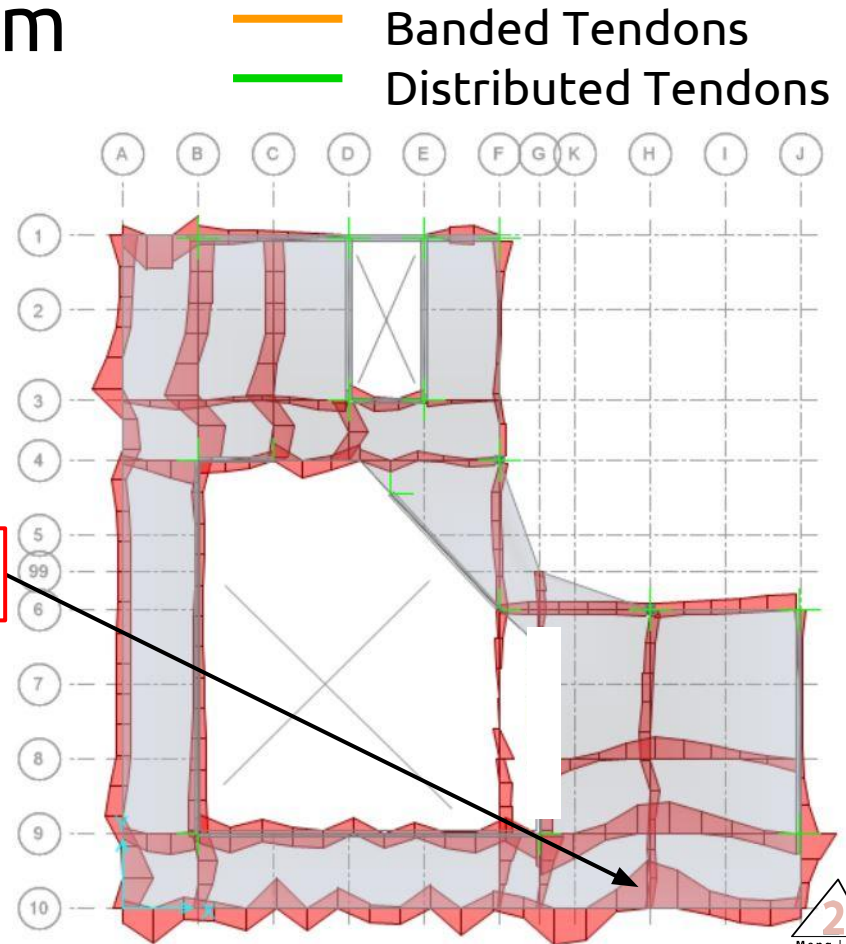
Flexural Stress Check - Long Term:

Dead + PT Final

Dead + 0.5 Live + PT Final



1.71 ksi



Typical Reinforcement

Primary
reinforcement

9' 6"

Cantilever

Column/slab
reinforcement

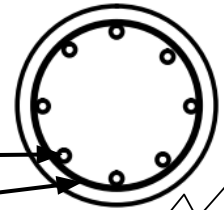
14"

9"

Slab top
Slab bottom

Column
Spiral tie

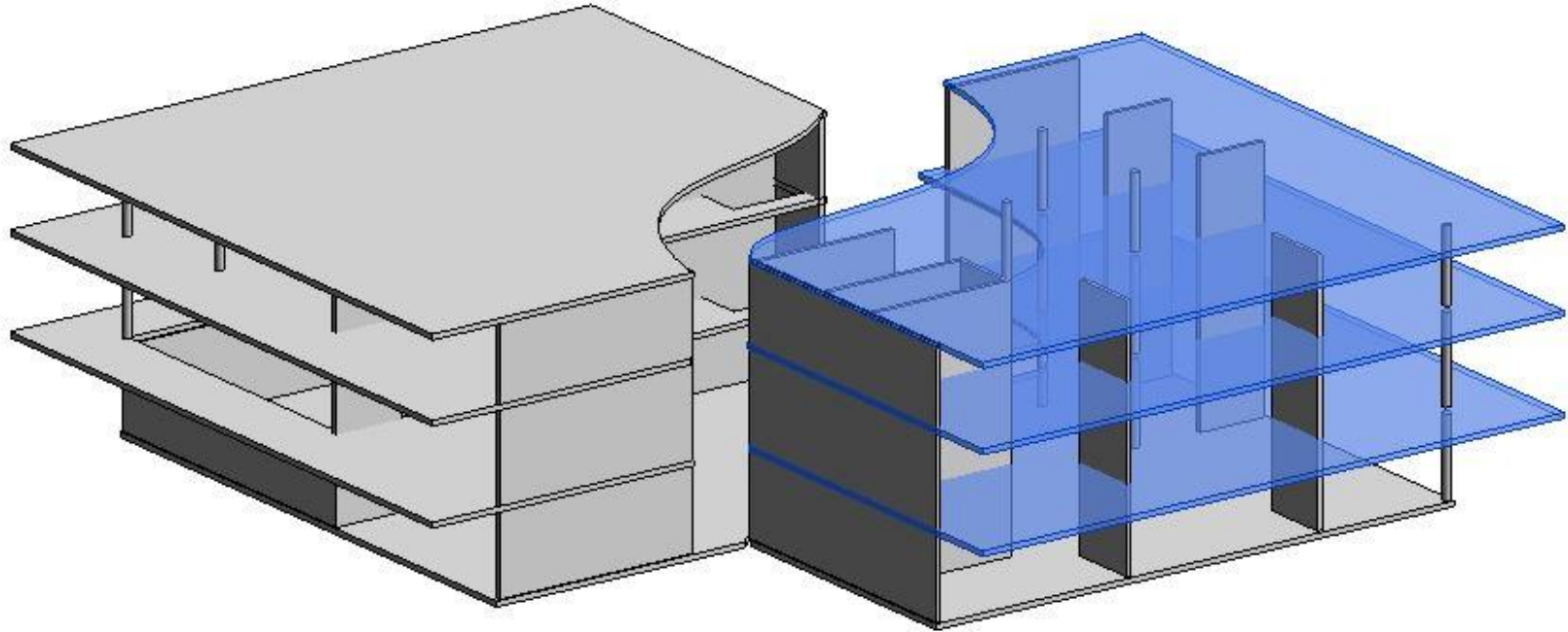
8" Wall



#6 at 6"
#6 at 6"

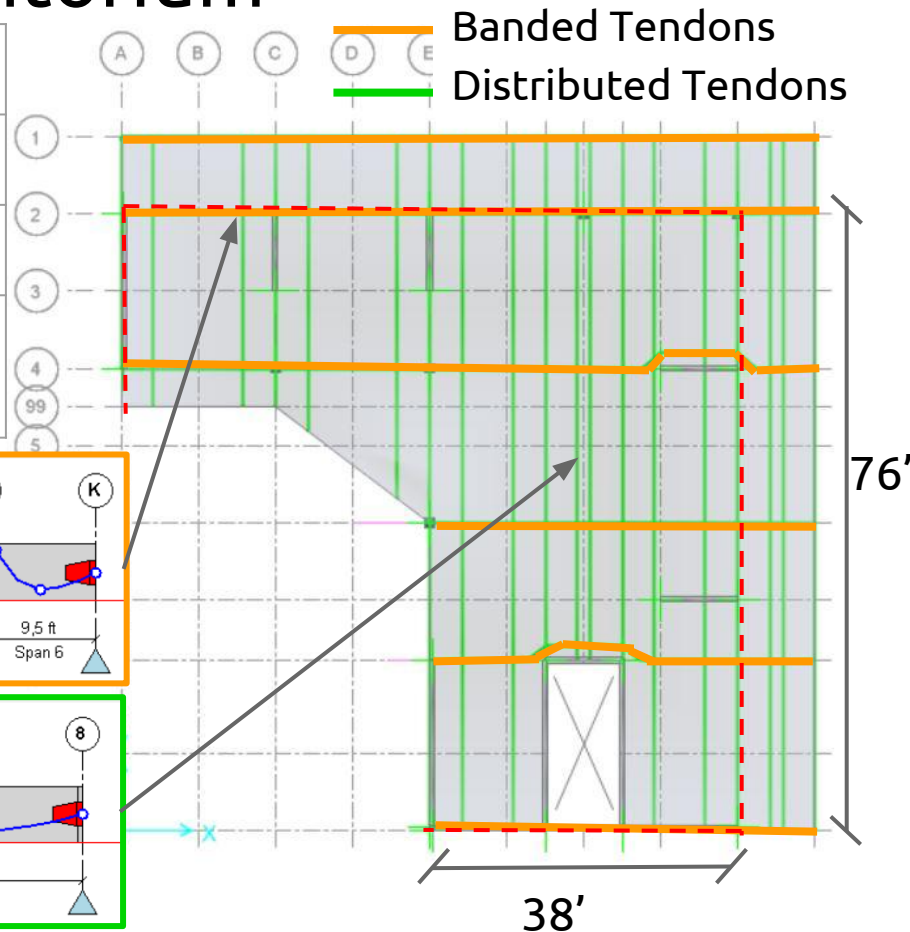
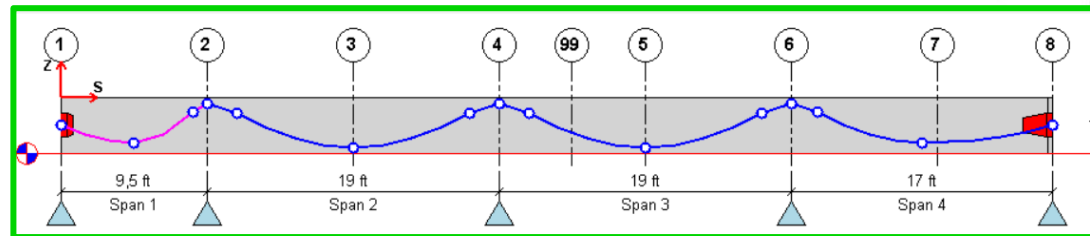
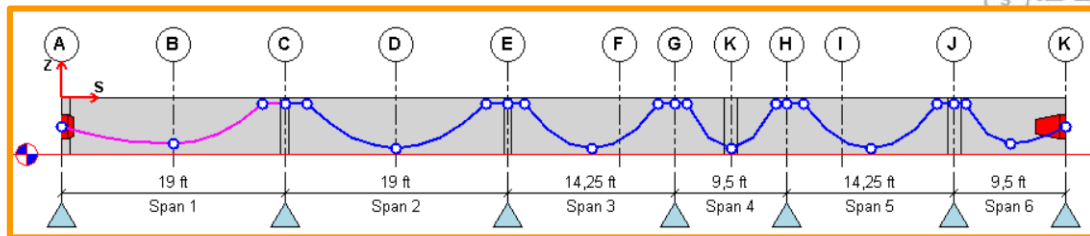
8 #7
#3

Non-Auditorium Wing Slab Analysis



Tendon Layout - Non Auditorium

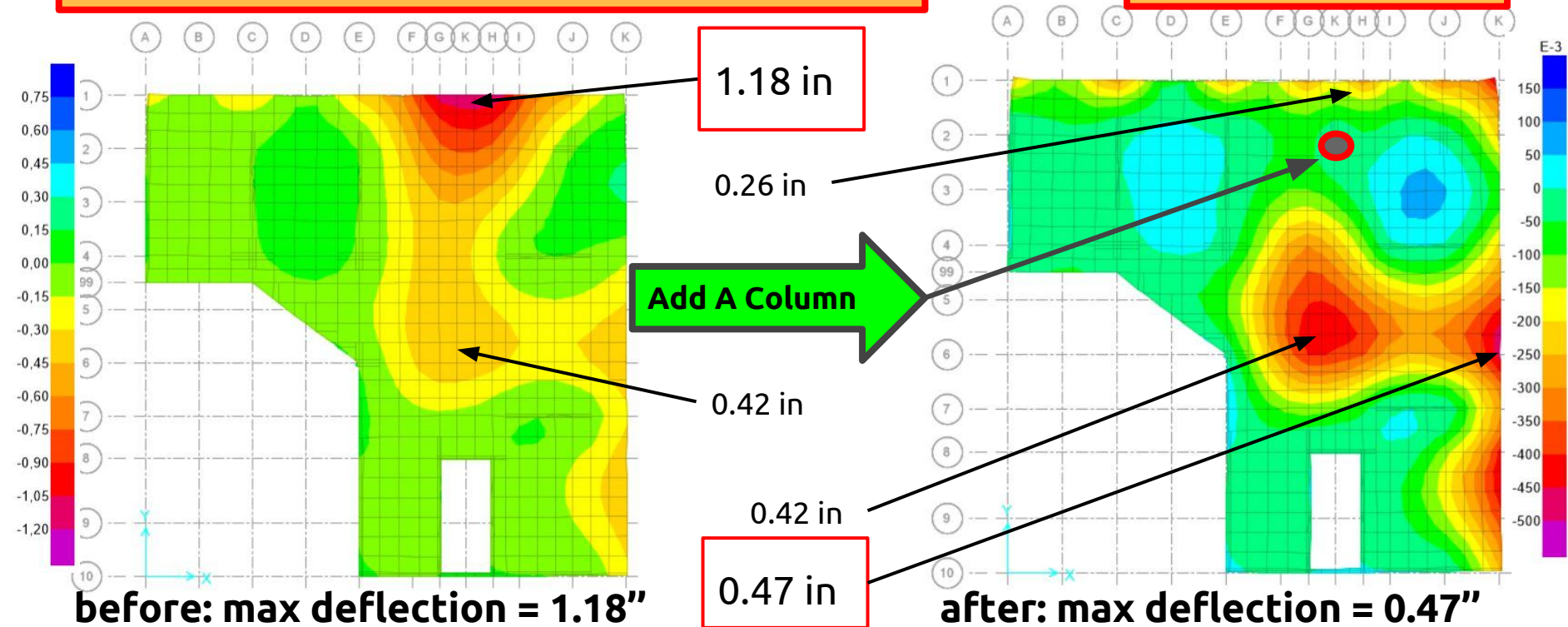
Typical Bay Size	19' x 19'
Tendon Jacking Stress	216 ksi
Strands	//6 (B) //2 (D)
Stressing Losses	27.0 ksi
Long-Term Losses	13.5 ksi



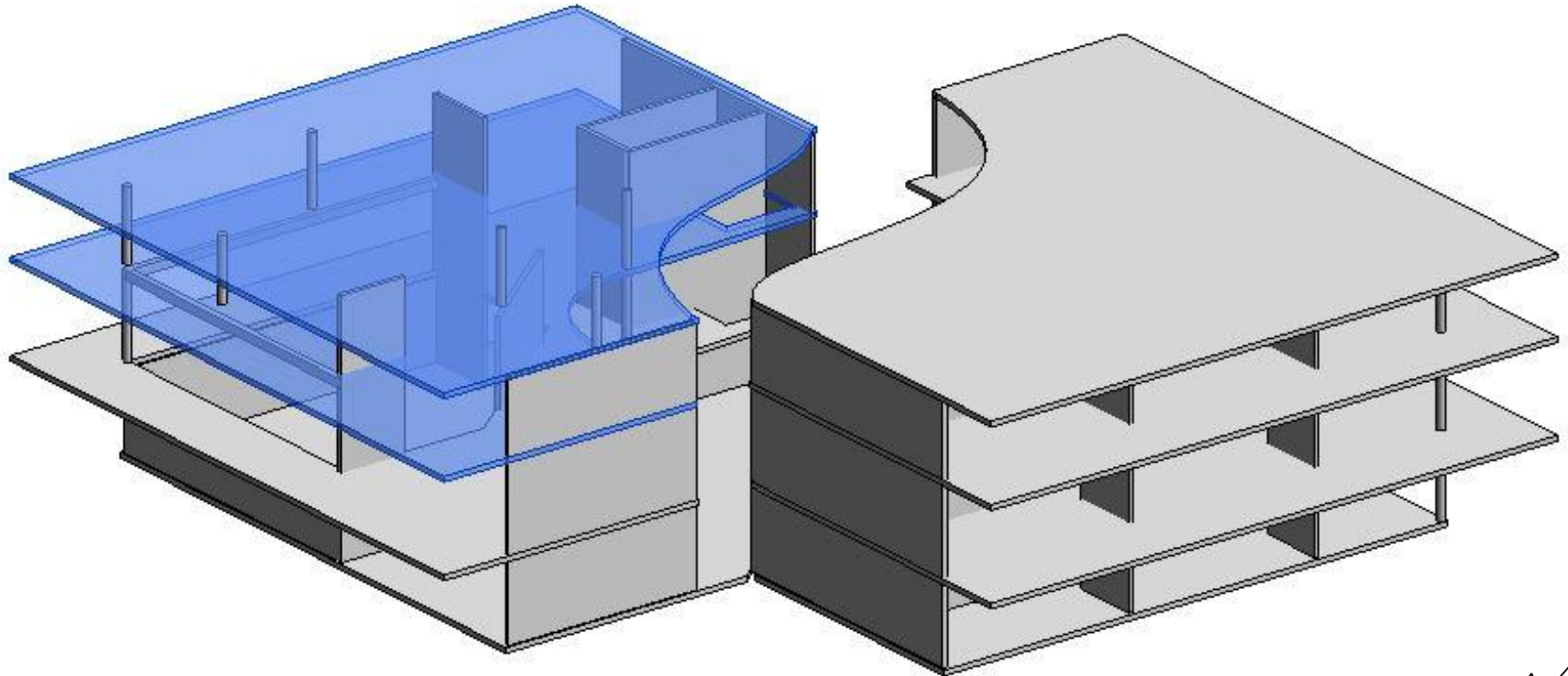
Deflection - Non Auditorium

Load Combination: 1.0 x Dead + 1.0 x Live + 1.0 x PT Final

Criterion: $l/240 = 1.3$ in

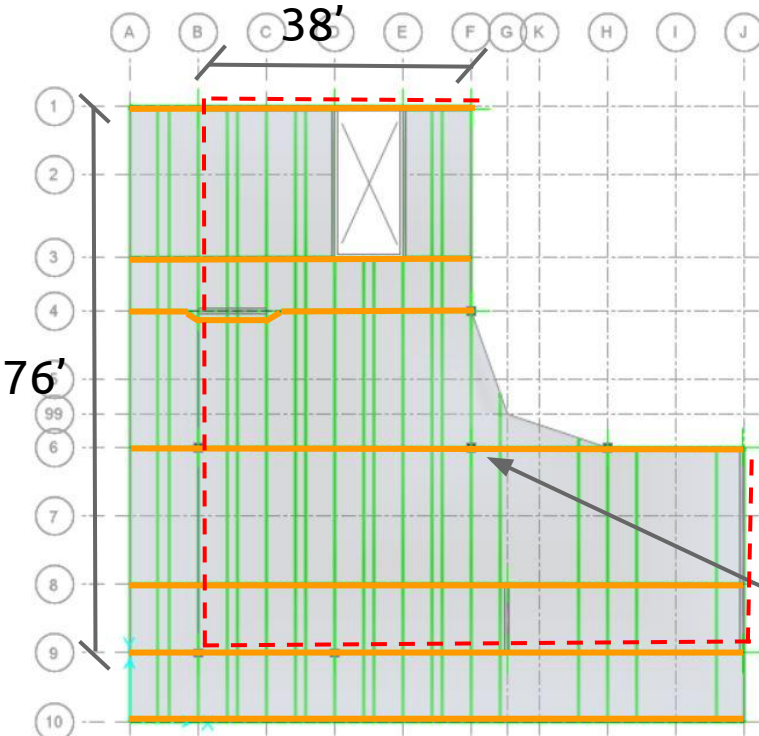


Auditorium Wing Slab Analysis

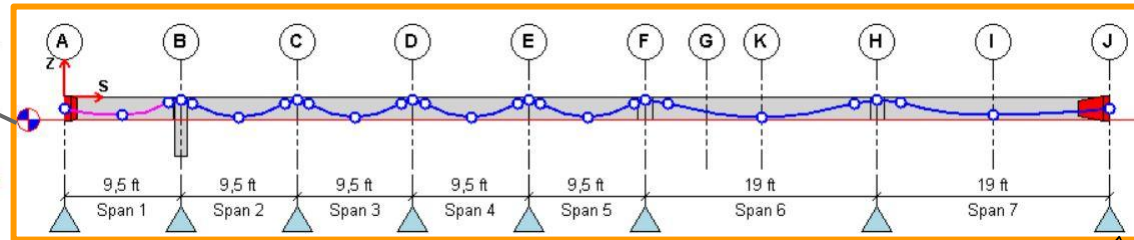


Tendon Layout - Auditorium Wing

— Banded Tendons
— Distributed Tendons



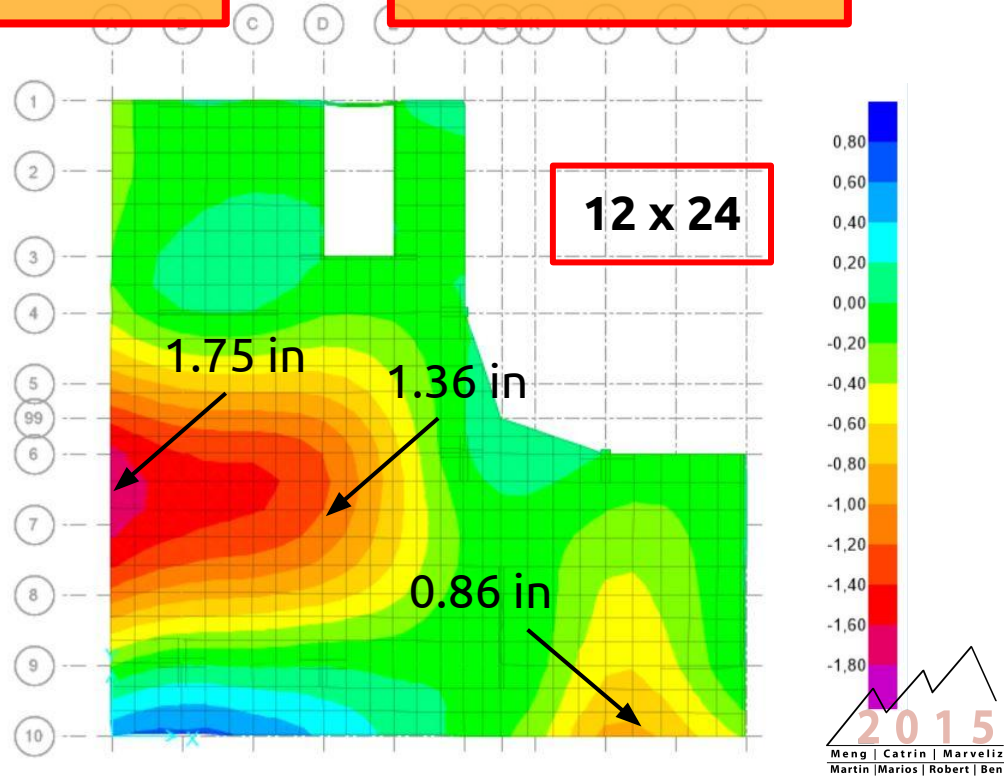
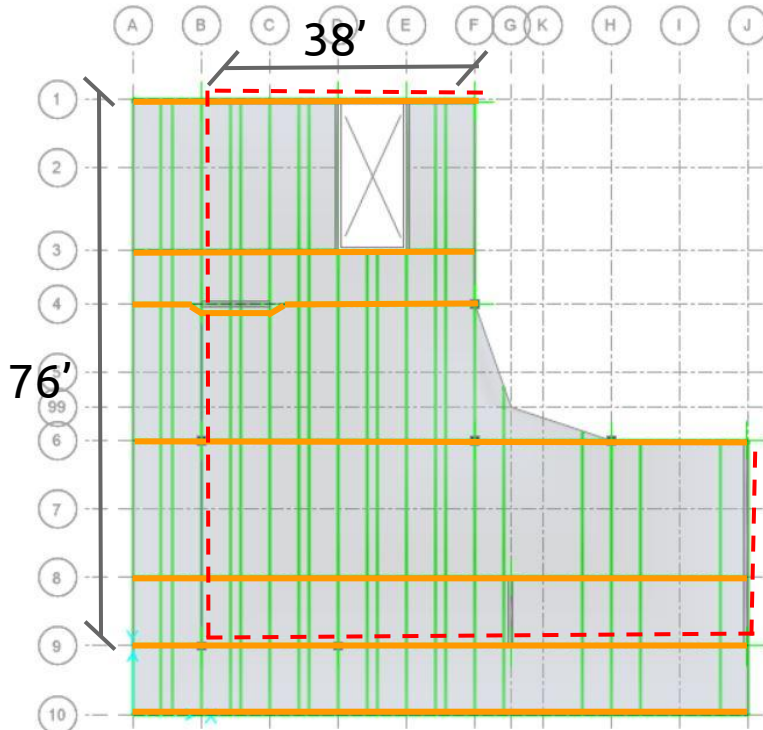
Typical Bay Size	19' x 19'
Tendon Jacking Stress	216 ksi
Strands	//6 (B) //2 (D)
Stressing Losses	27.0 ksi
Long-Term Losses	13.5 ksi



Deflection - Auditorium Wing

Load Combination: 1.0 x Dead + 1.0 x Live + 1.0 x PT Final

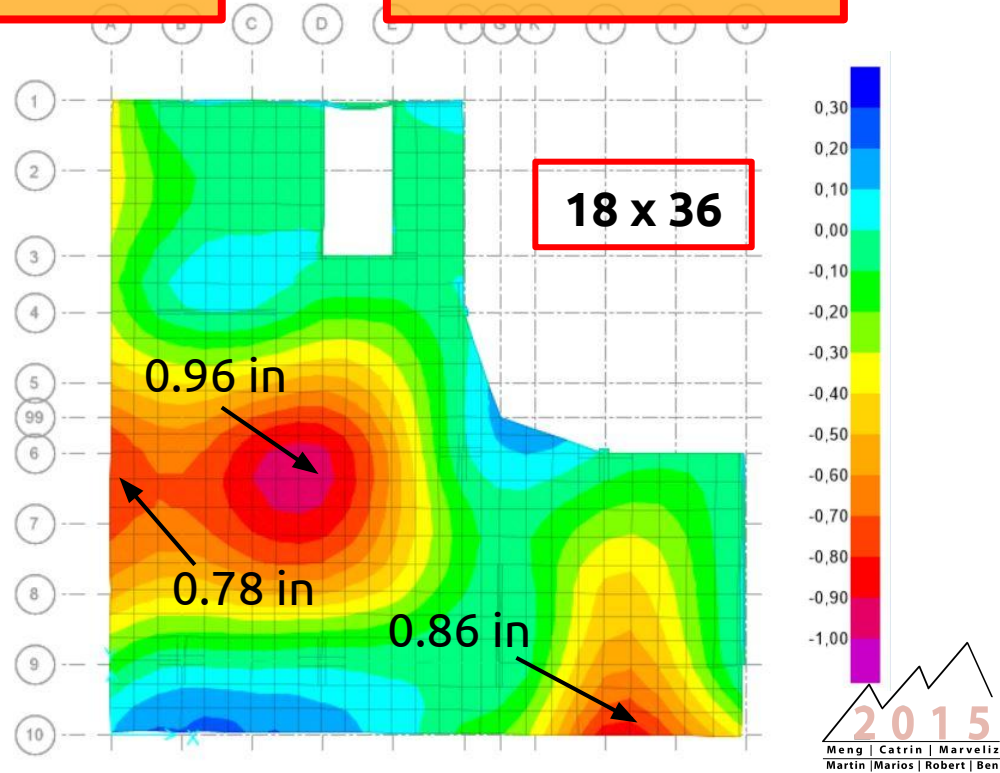
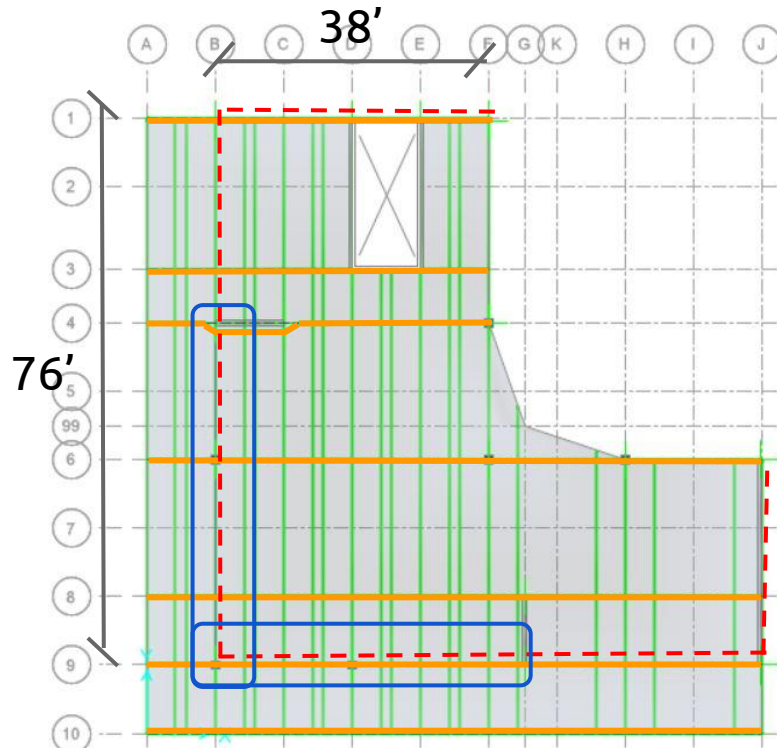
Criterion: $l/240 = 1.6$ in



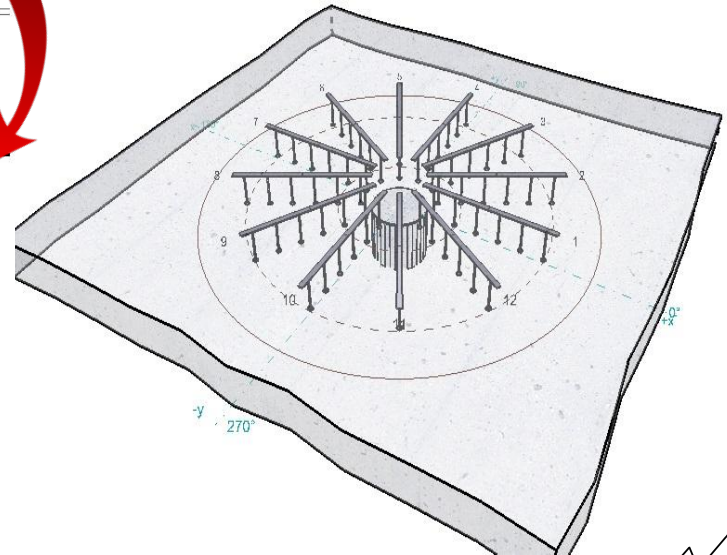
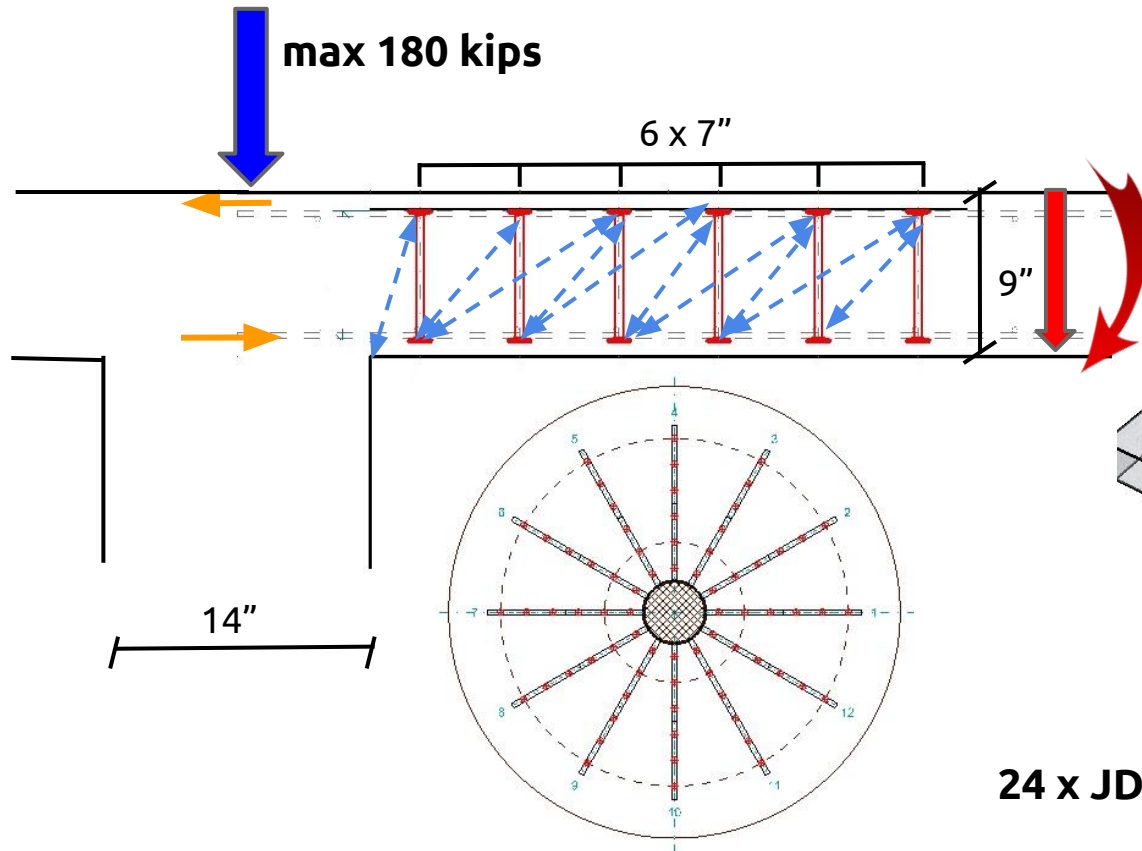
Deflection - Auditorium Wing

Load Combination: 1.0 x Dead + 1.0 x Live + 1.0 x PT Final

Criterion: $l/240 = 1.4$ in

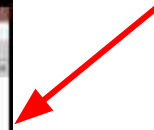


Punching Shear Reinforcement: Stud Rails

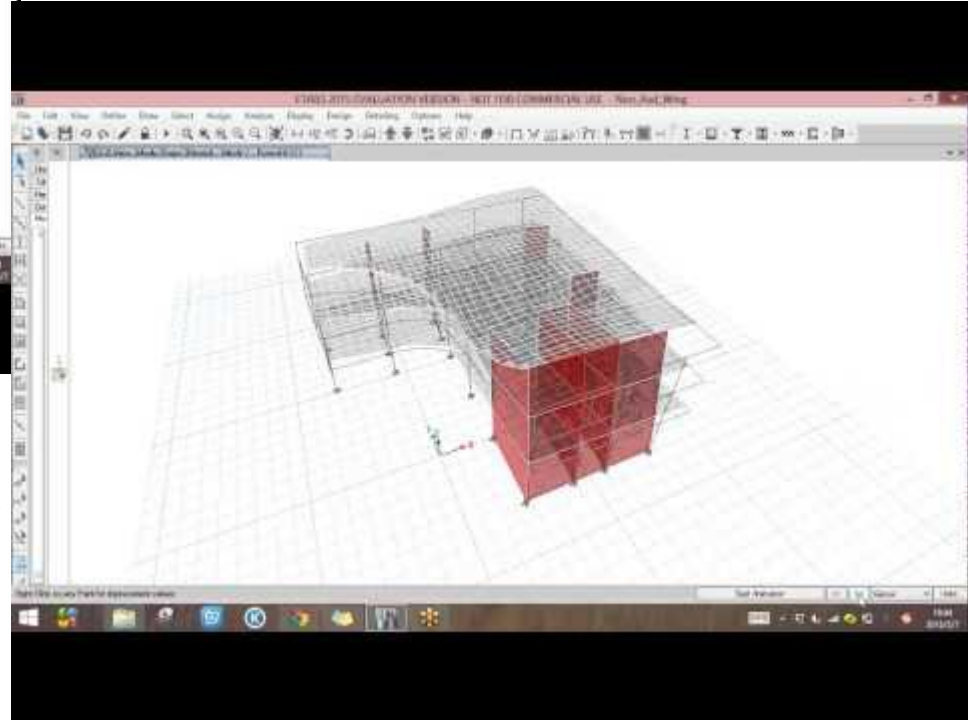


24 x JDA-3/12/185/450

Auditorium Wing



Non-Auditorium Wing

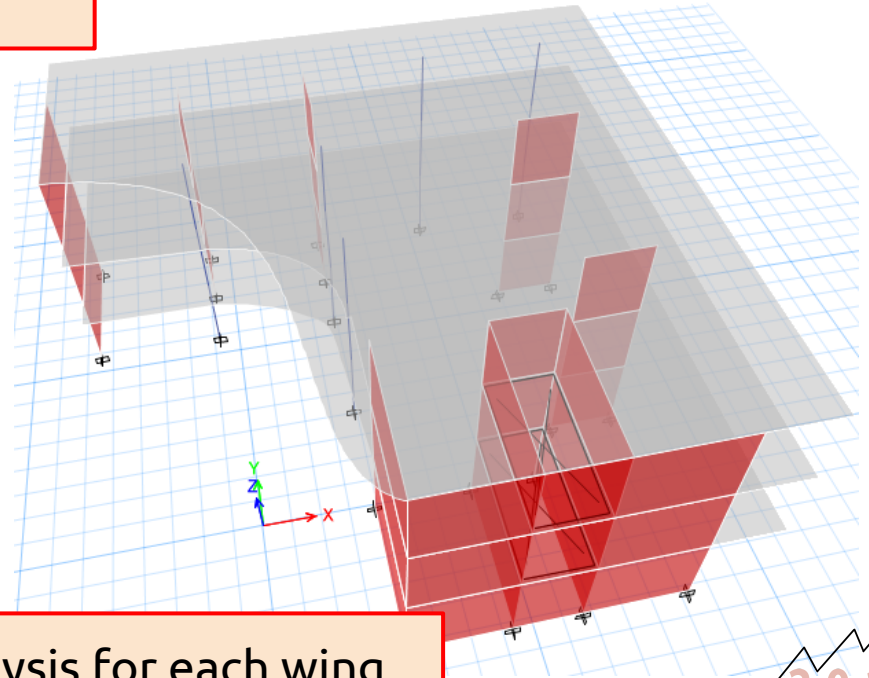
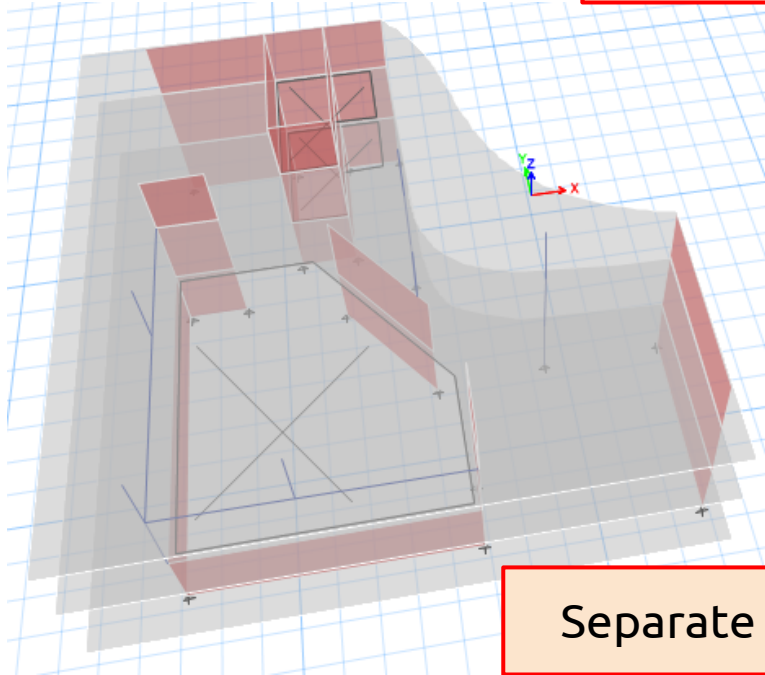


ETABS Response Spectrum Analysis

Auditorium Wing

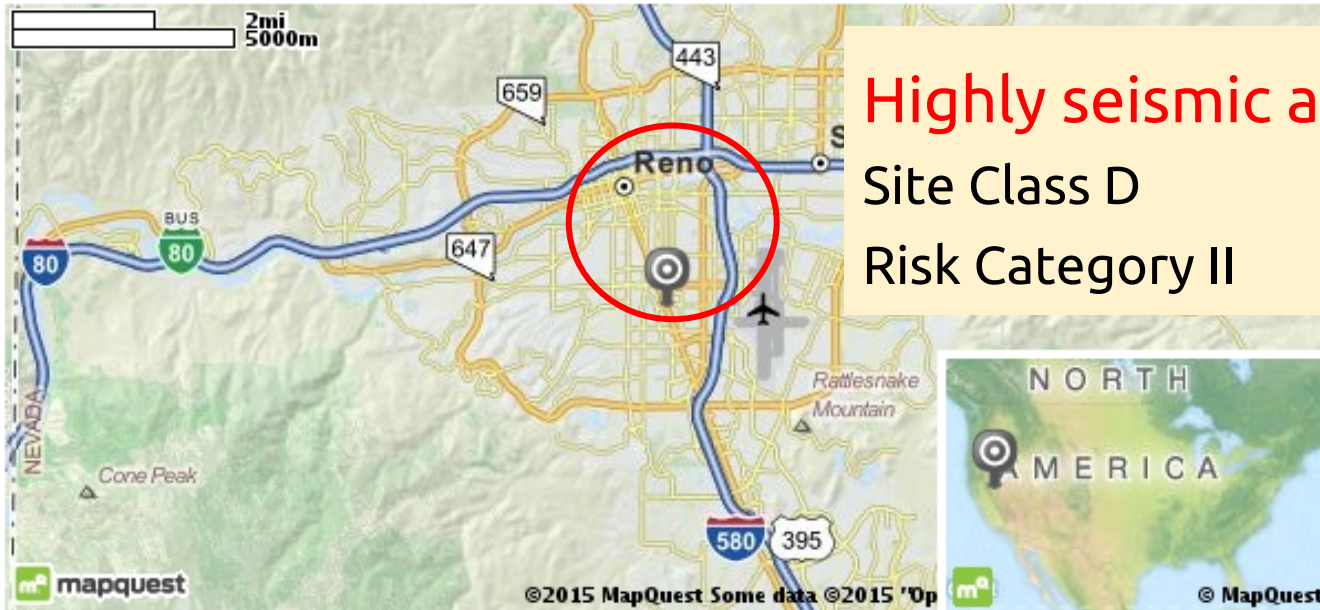
5% damping
SRSS

Non-Auditorium Wing



Separate analysis for each wing

Design Basis Earthquake (DBE)



USGS-Provided Output

 $S_S = 1.963 \text{ g}$ $S_{MS} = 1.963 \text{ g}$ $S_{DS} = 1.308 \text{ g}$ $S_1 = 0.663 \text{ g}$ $S_{M1} = 0.994 \text{ g}$ $S_{D1} = 0.663 \text{ g}$

Auditorium Wing



Mode 1

$T = 0.19 \text{ s}$

Translational mode in E-W



Mode 2

$T = 0.111 \text{ s}$

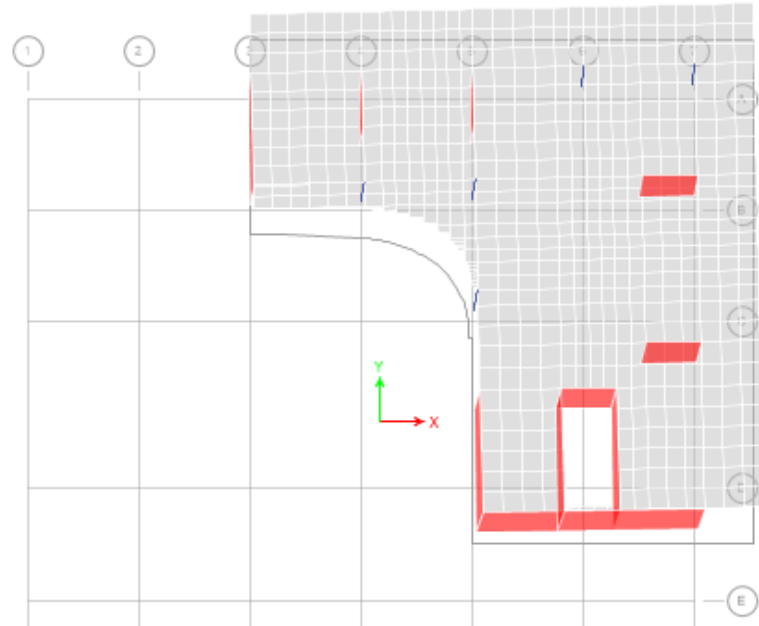
Translational mode in N-S



Non-Auditorium Wing



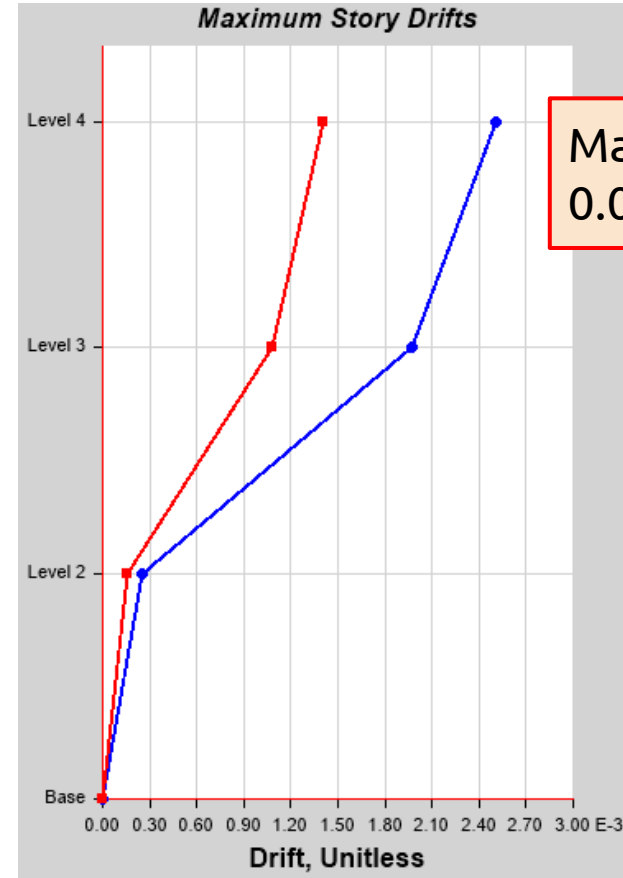
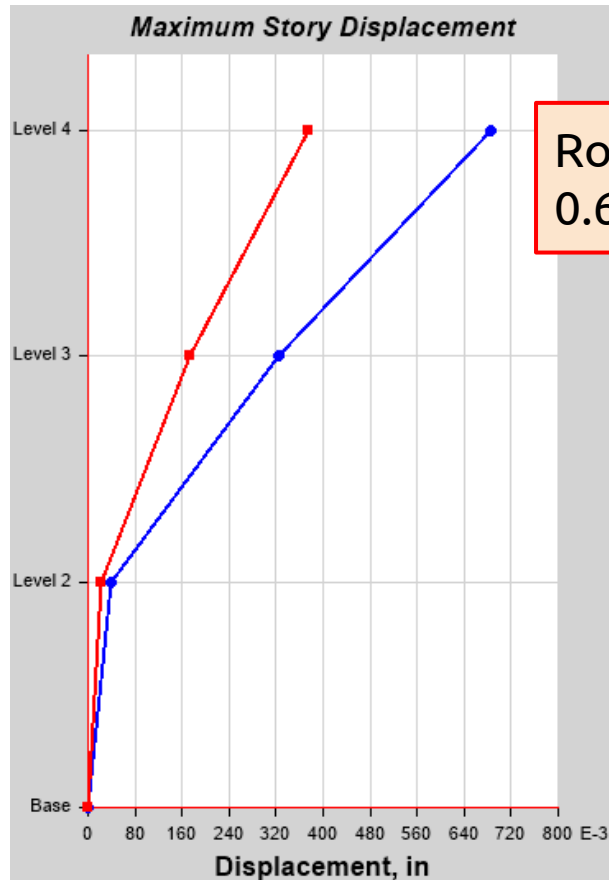
Mode 1
 $T = 0.271 \text{ s}$
translational mode in E-W



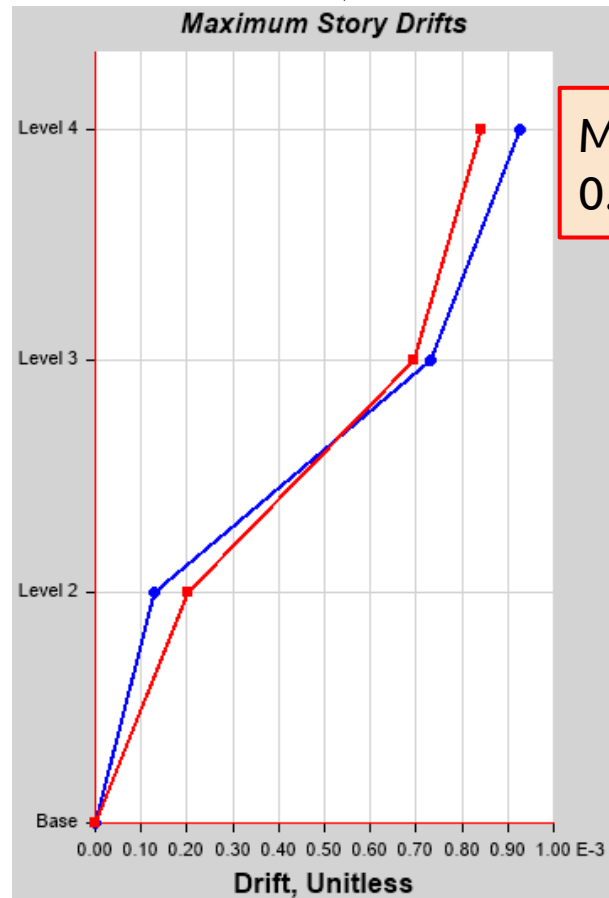
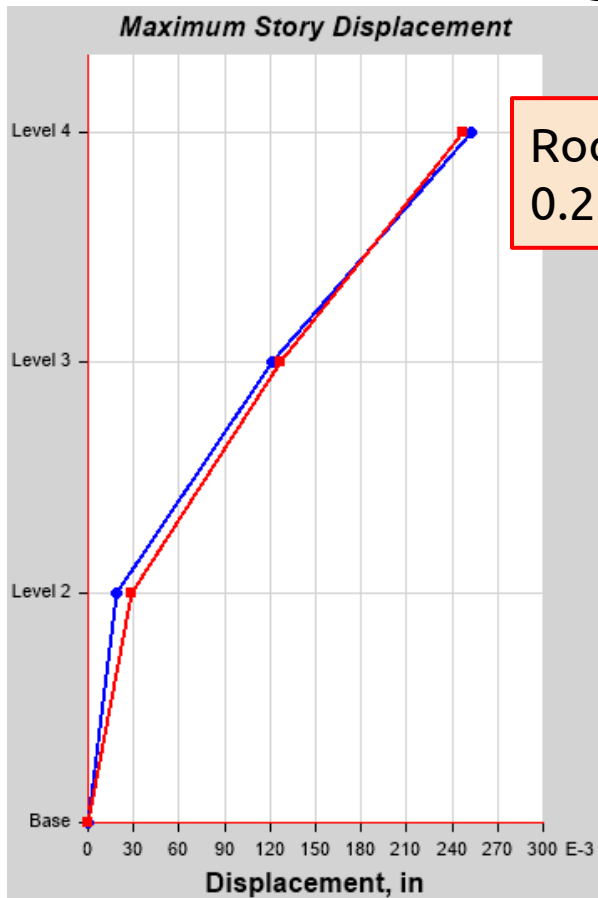
Mode 2
 $T = 0.121 \text{ s}$
translational mode in N-S



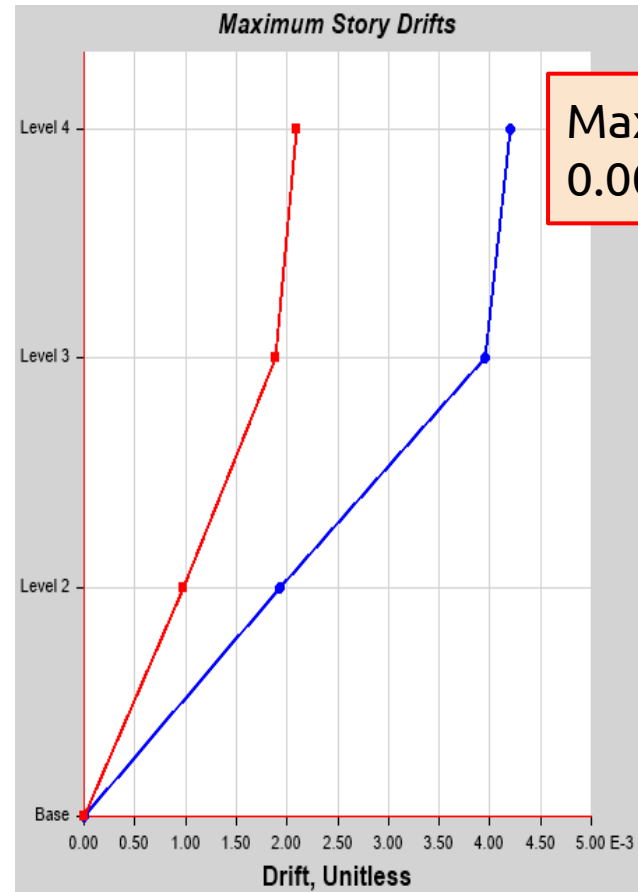
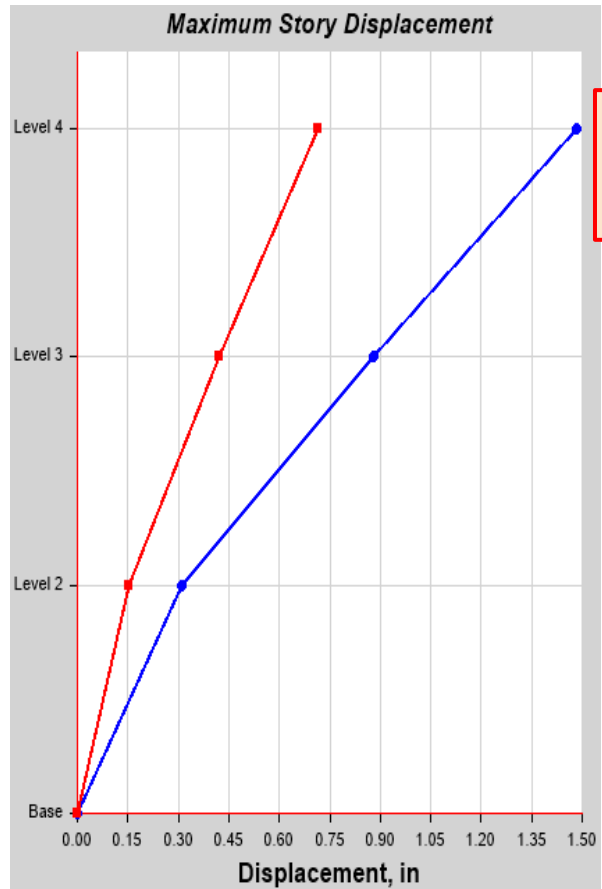
Auditorium Wing (1.0E-W + 0.3N-S)



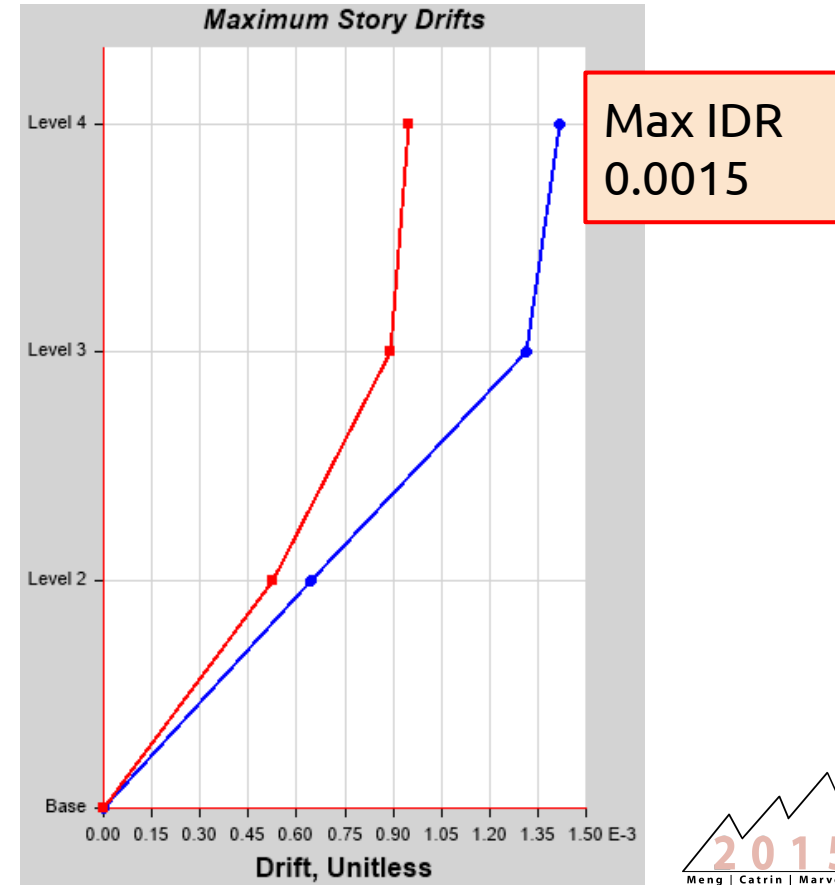
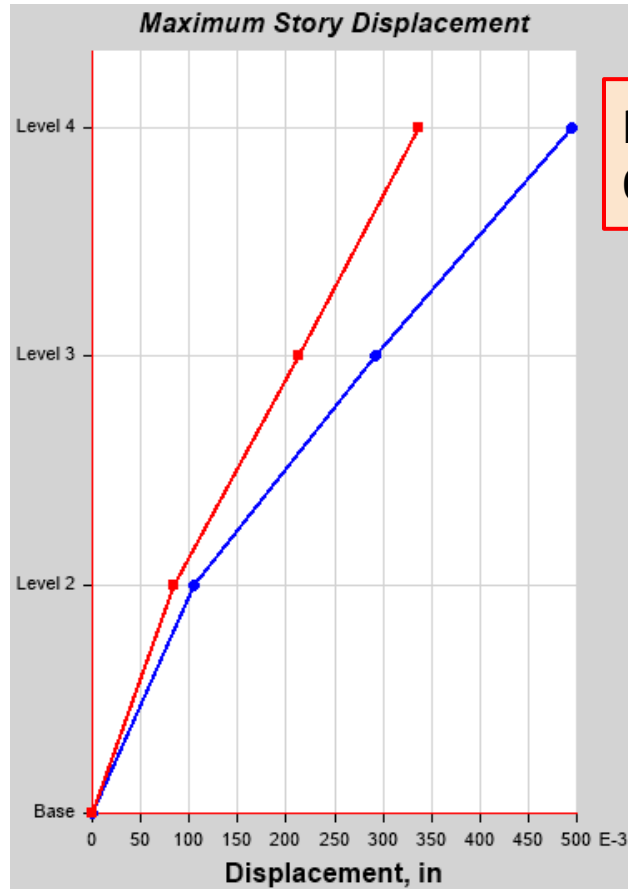
Auditorium Wing (0.3E-W + 1.0N-S)



Non-Auditorium Wing (1.0E-W + 0.3N-S)



Non-Auditorium Wing (0.3E-W + 1.0N-S)



ETABS Analysis Summary

ASCE Design Criterion:
2% story drift

Non-Auditorium Wing

Scenario	Roof Displacement	Max Story Drift
1.0E-W + 0.3N-S	1.5 in	0.004
0.3E-W + 1.0N-S	0.5 in	0.0015



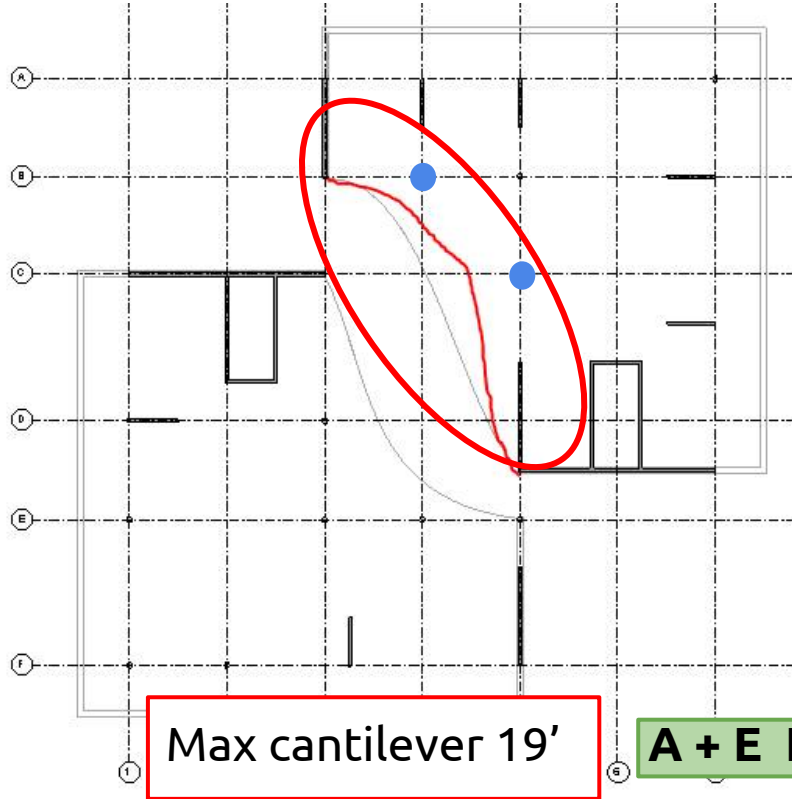
Auditorium Wing

Scenario	Roof Displacement	Max Story Drift
1.0E-W + 0.3N-S	0.68 in	0.0025
0.3E-W + 1.0N-S	0.25 in	0.001

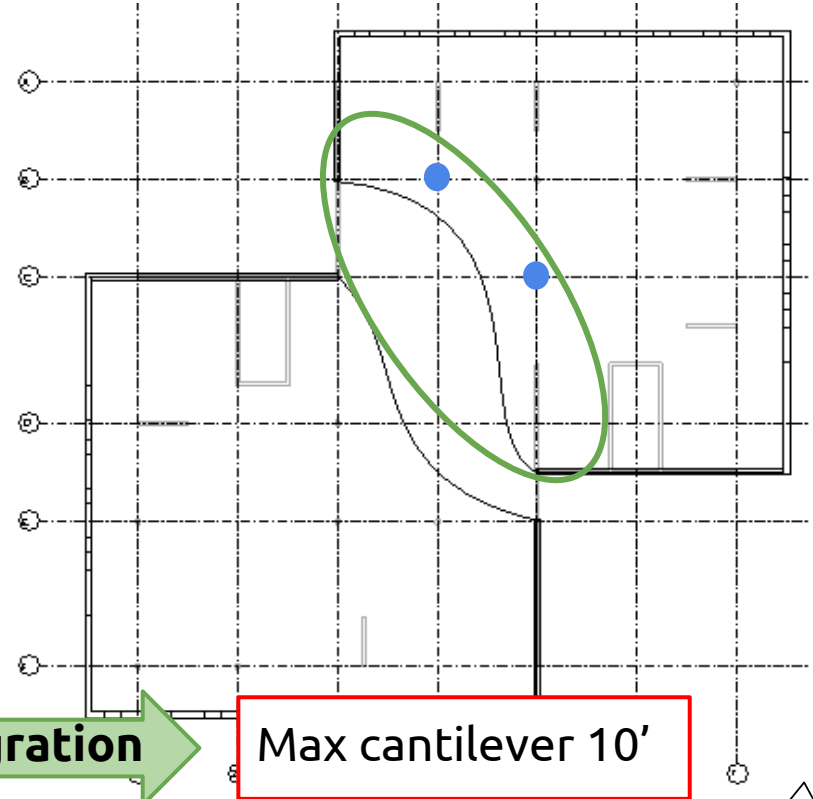


Roof Design

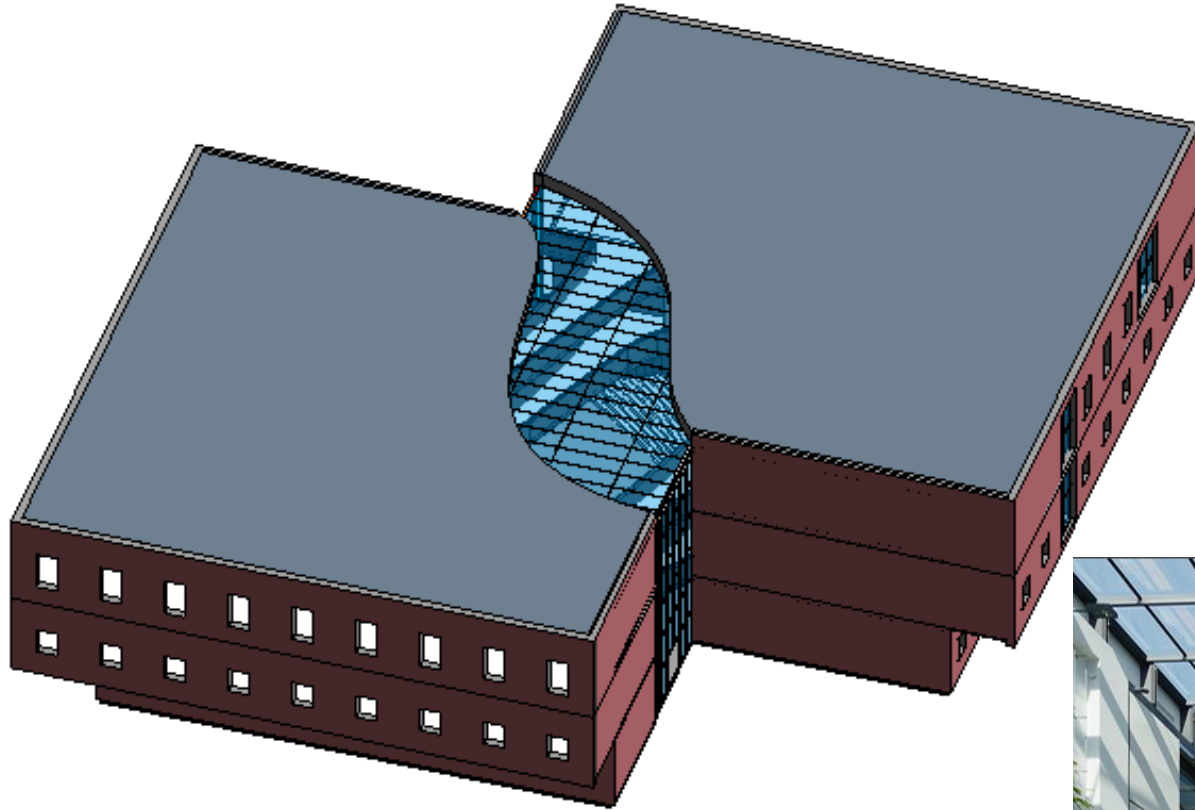
Modified roof slab to reduce cantilever + more daylight

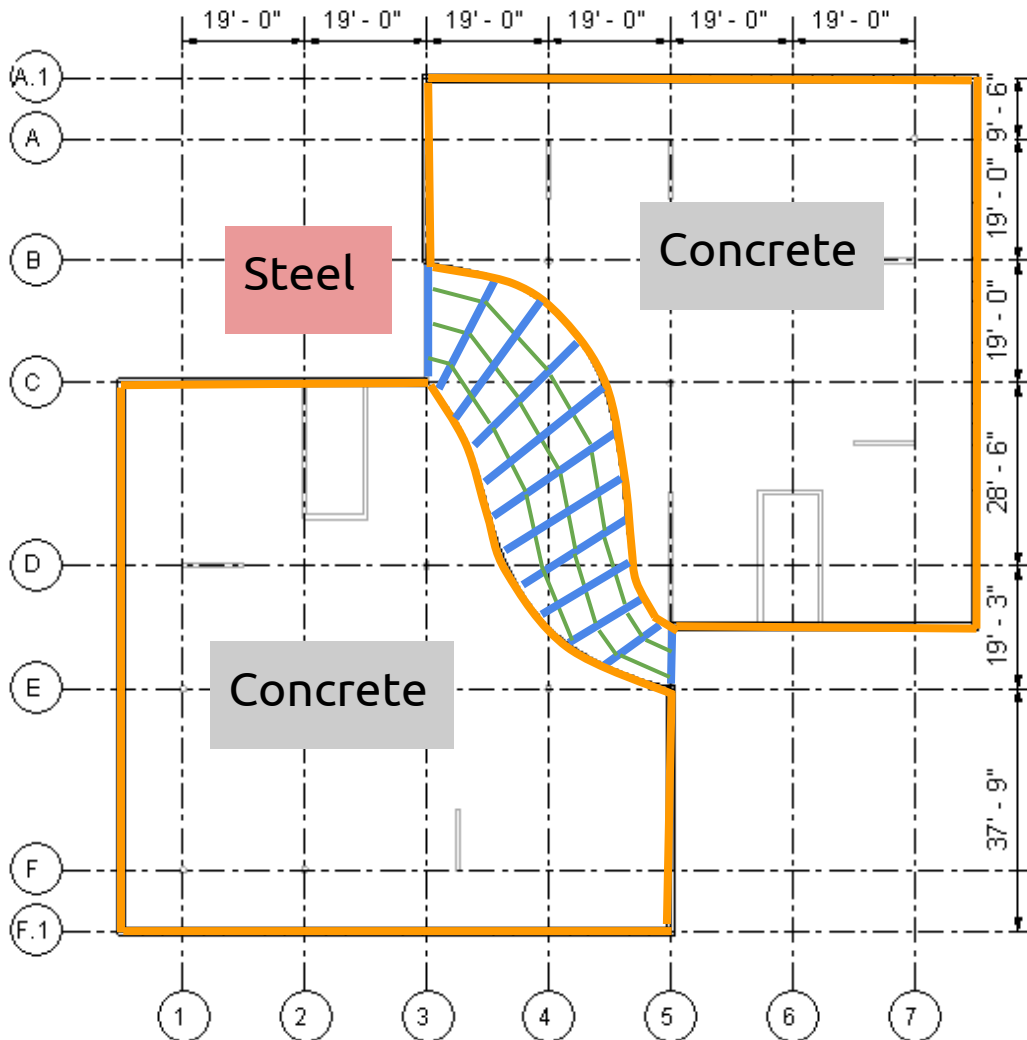


A + E Integration



Glass Roof

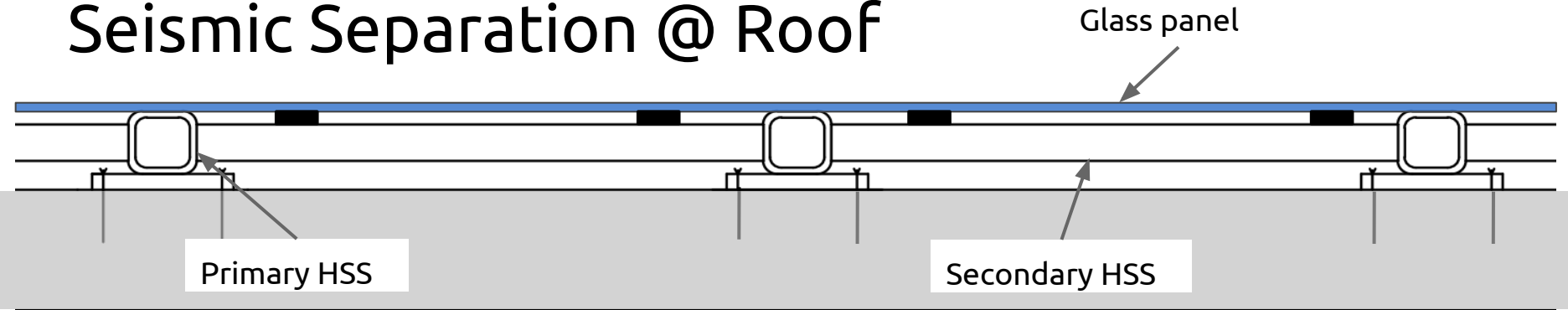




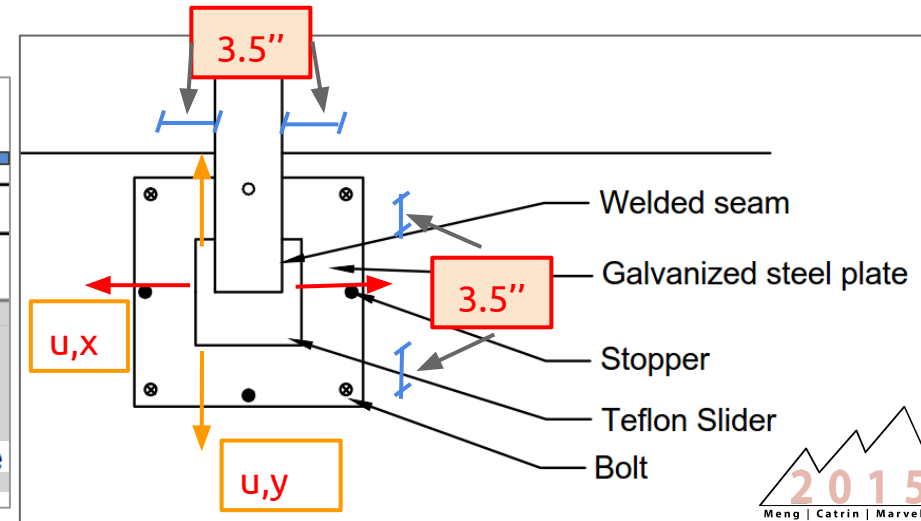
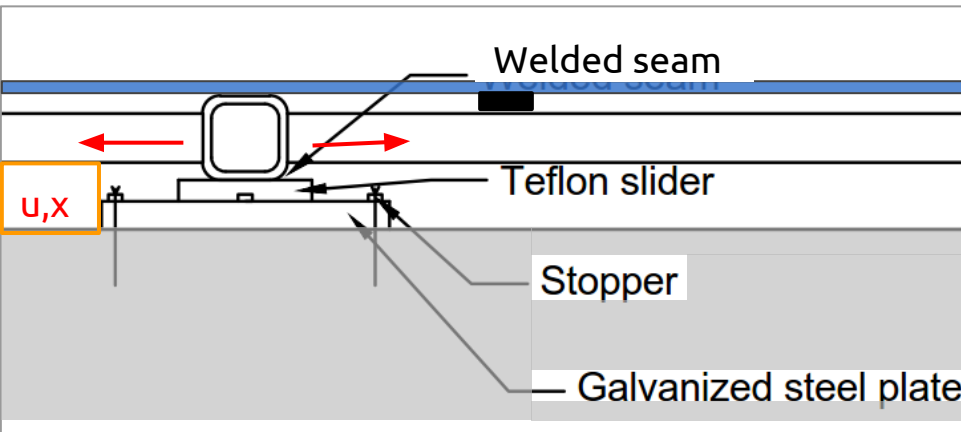
Roof Design

- Concrete Slab
- Primary HSS 4x4x1/8
max span 25'
- Secondary HSS
typ. glass panel 3'x 3'

Seismic Separation @ Roof



$$u_x = u_y = 2.5'' + 2.5'' = 5'' < 7''$$



Level 2

9" PT Flat Slab

Steel Bridges

8" RC Shear Wall

14" RC Column

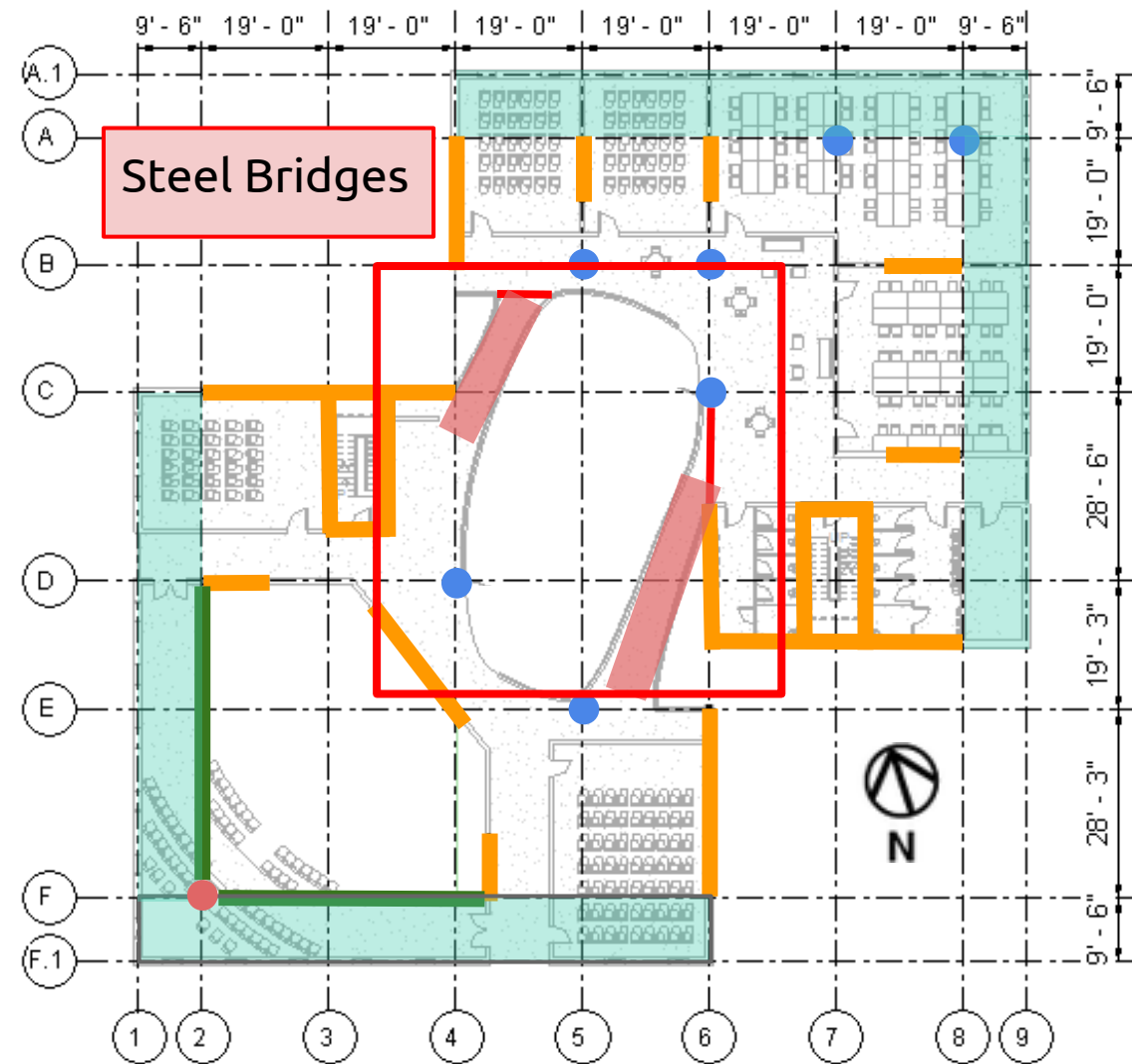
20" RC Column

18 x 36 RC Beam

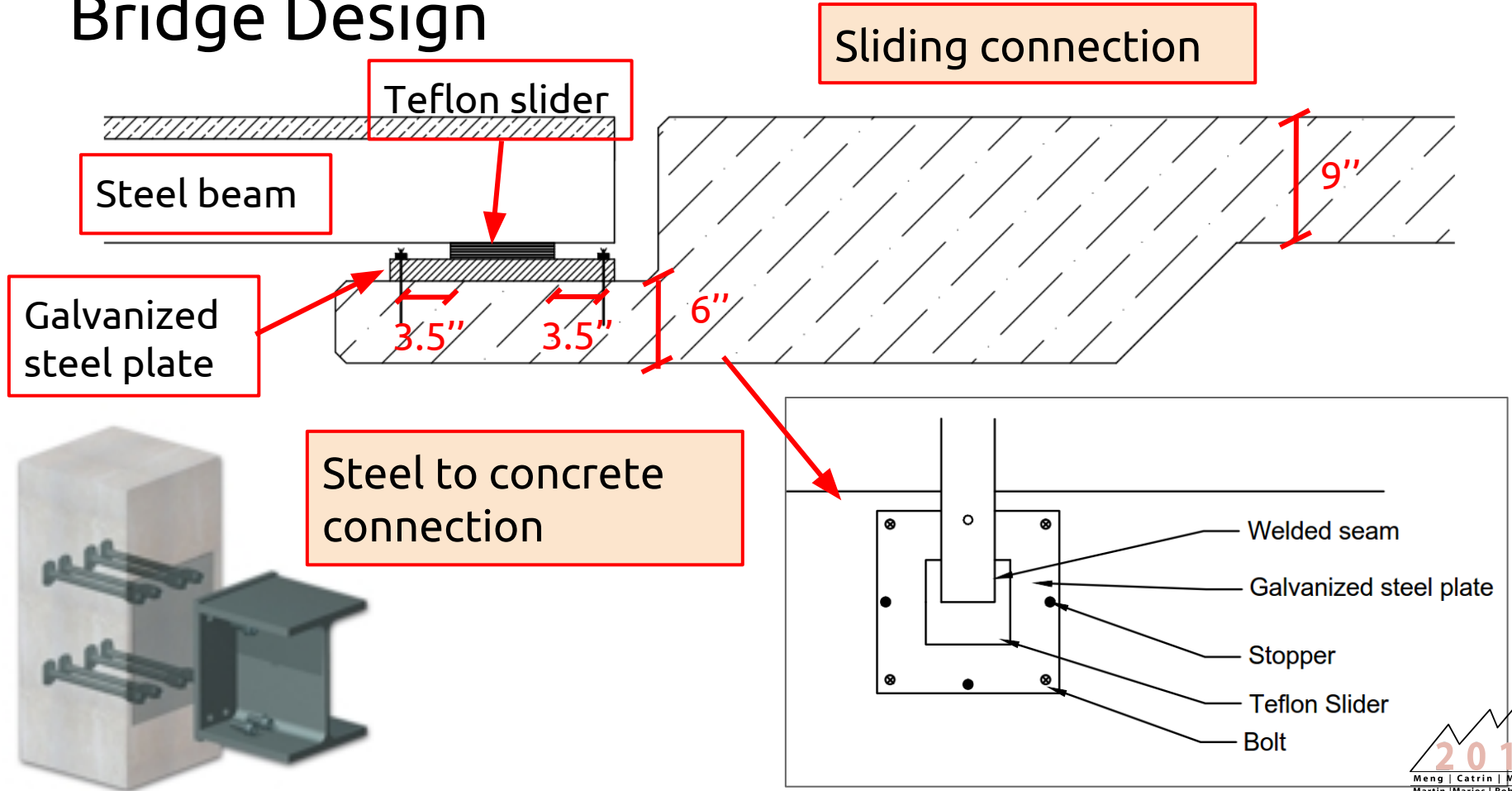
Seismic Separation

9.5' Cantilever

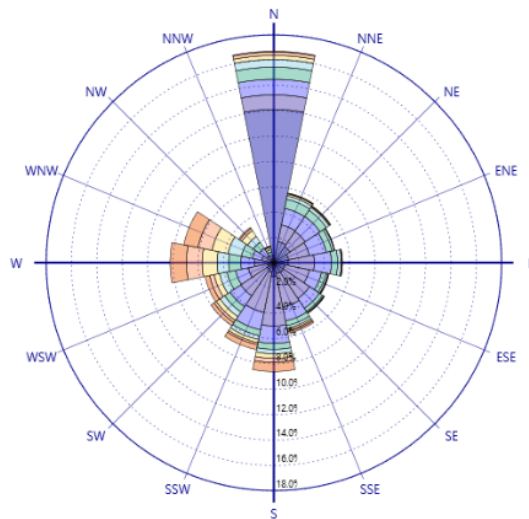
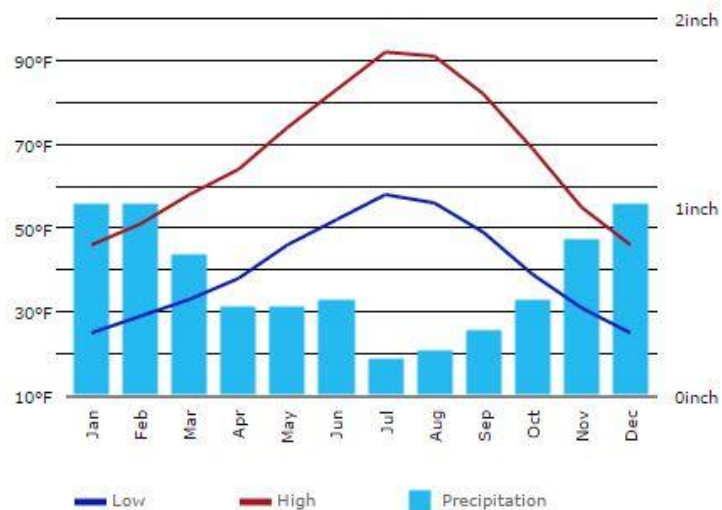
Bridges (steel)



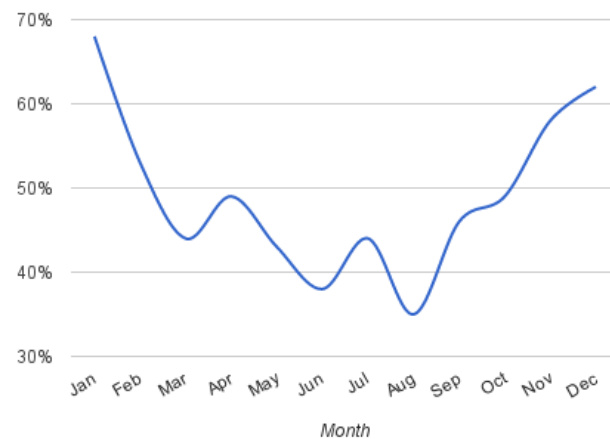
Bridge Design



Climate



Monthly Average Relative Humidity



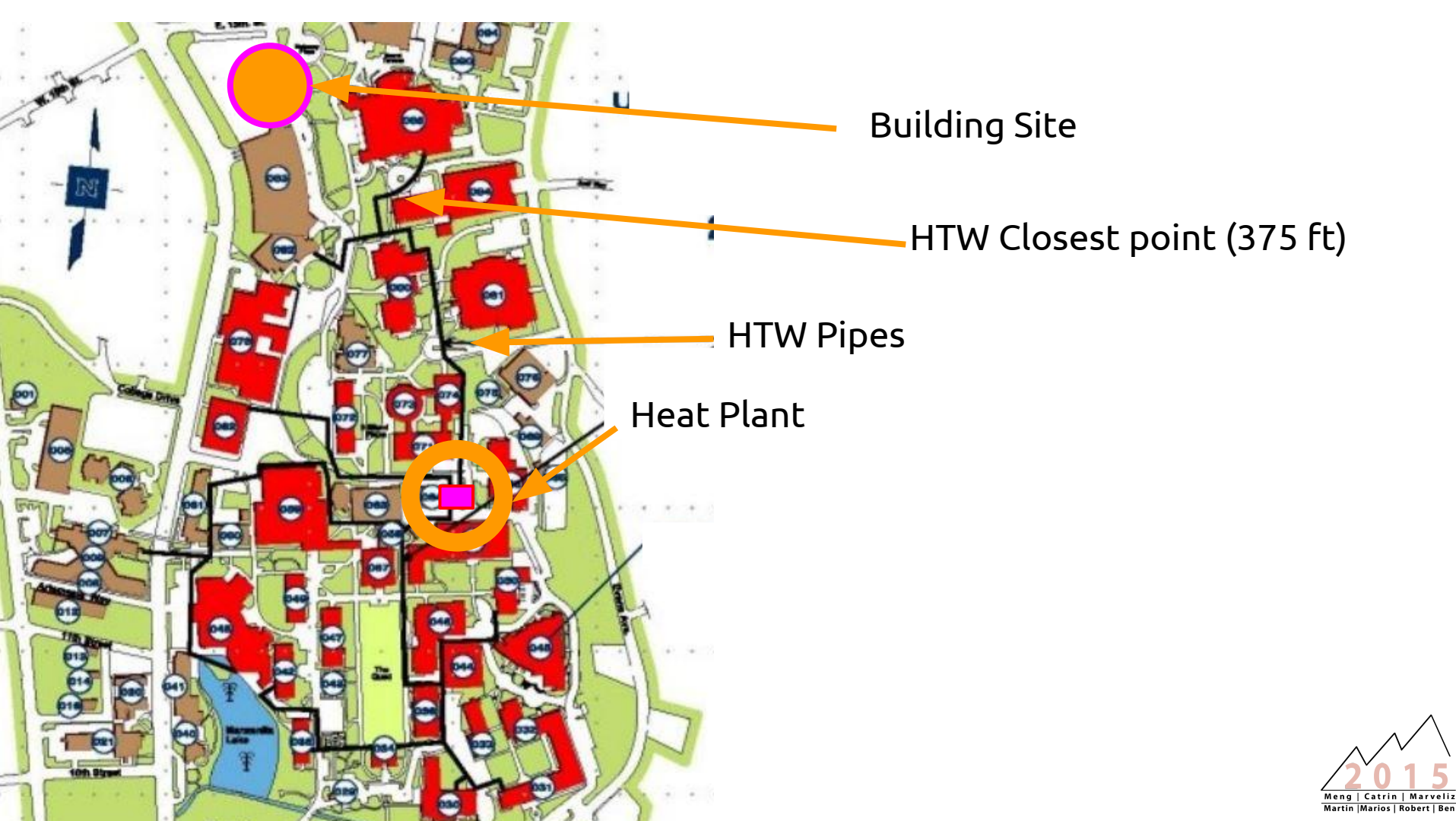
Reno Precipitation

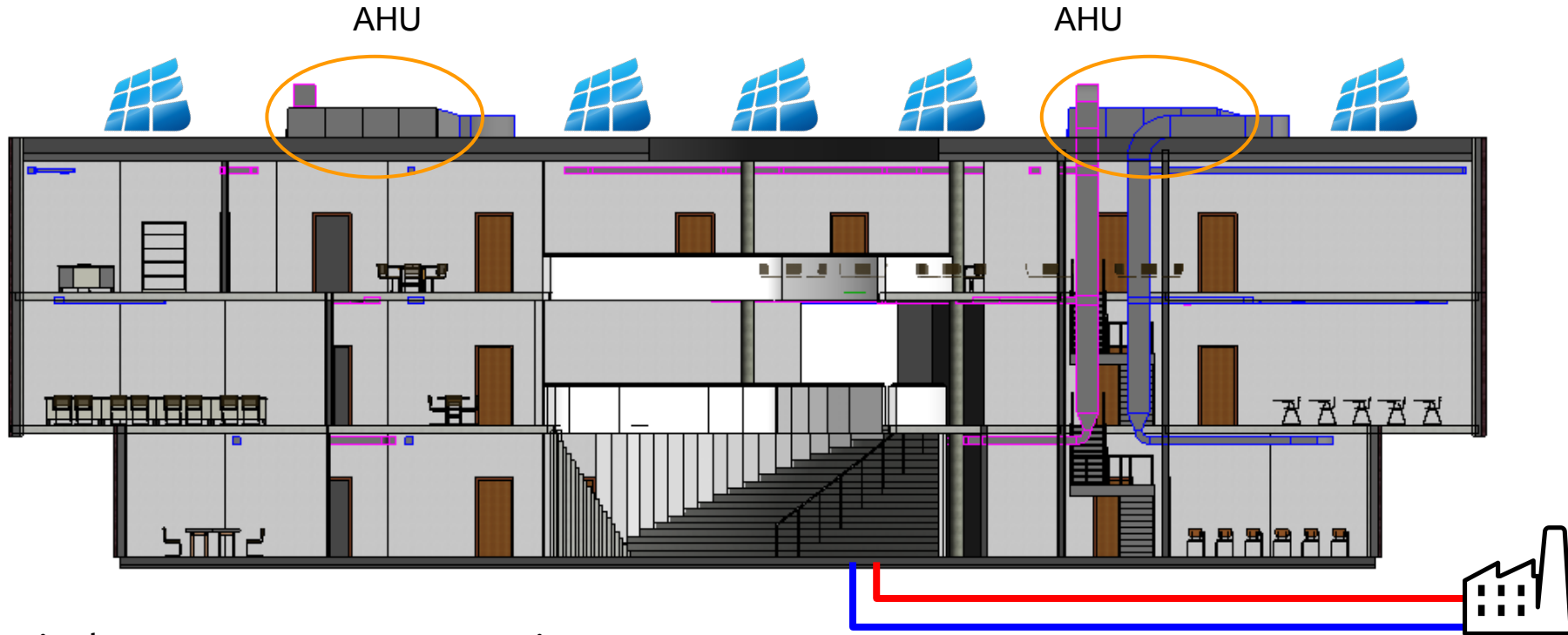
Precipitation (inches)

Days with Precipitation 0.01 inch or More

Monthly Snowfall (inches)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Precipitation (inches)	1.1	1.0	0.7	0.4	0.7	0.5	0.3	0.3	0.4	0.4	0.9	1.0	7.5
Days with Precipitation 0.01 inch or More	6.0	6.0	6.0	4.0	5.0	3.0	2.0	2.0	3.0	3.0	5.0	6.0	51.0
Monthly Snowfall (inches)	5.8	5.2	4.3	1.2	0.8	0.0	0.0	0.0	0.0	0.3	2.4	4.3	24.3





Terminal Systems:

- Radiant Floor
- Chilled Ceiling Panels

Primary Systems:

- District Heating
- Chiller (Mechanical room)

A

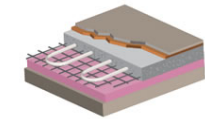
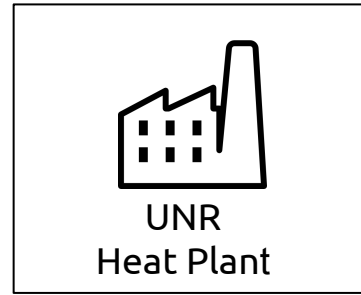
E

MEP

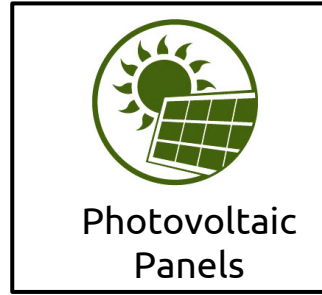
C

Water

Latency



Radiant Floor



Cooling



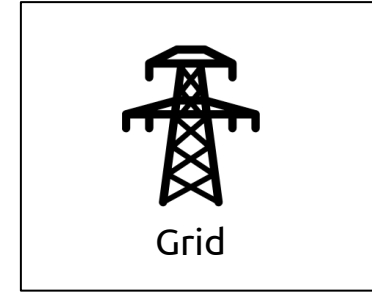
Ventilation
System



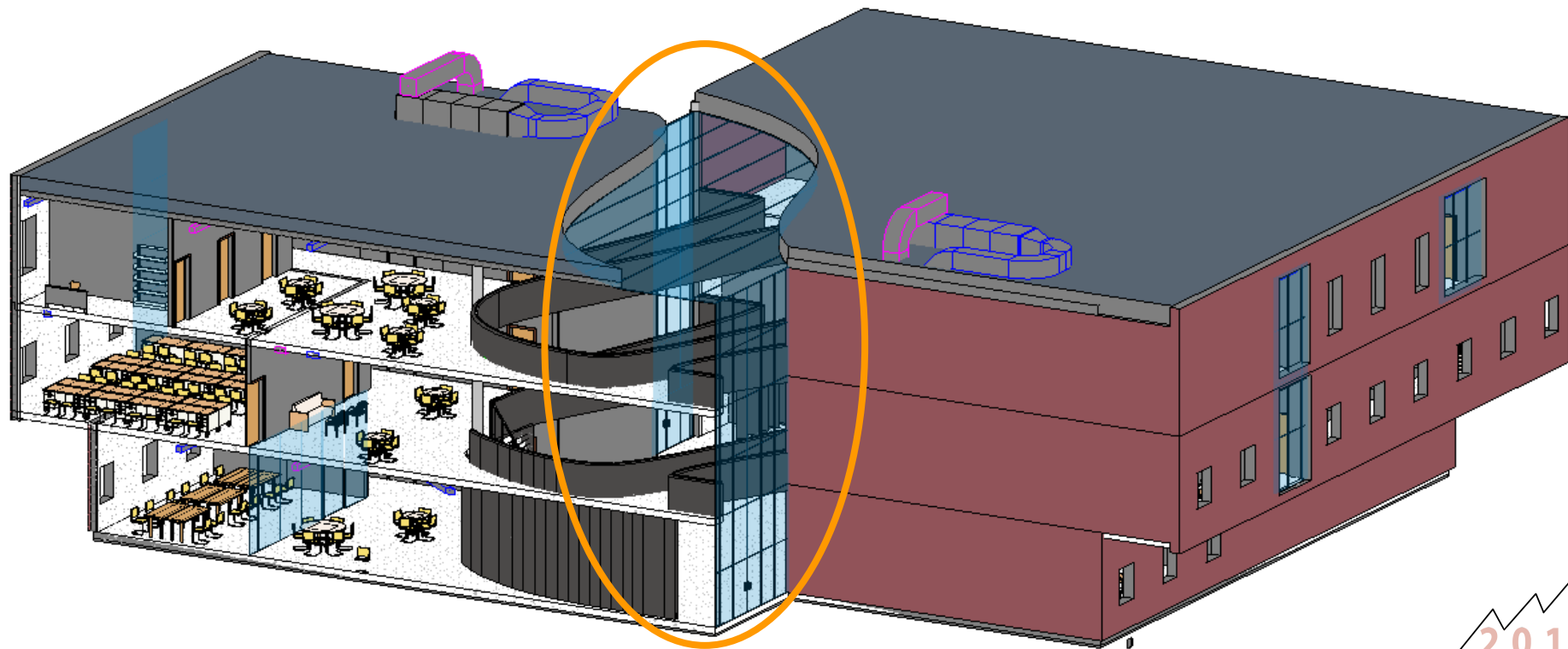
Lighting



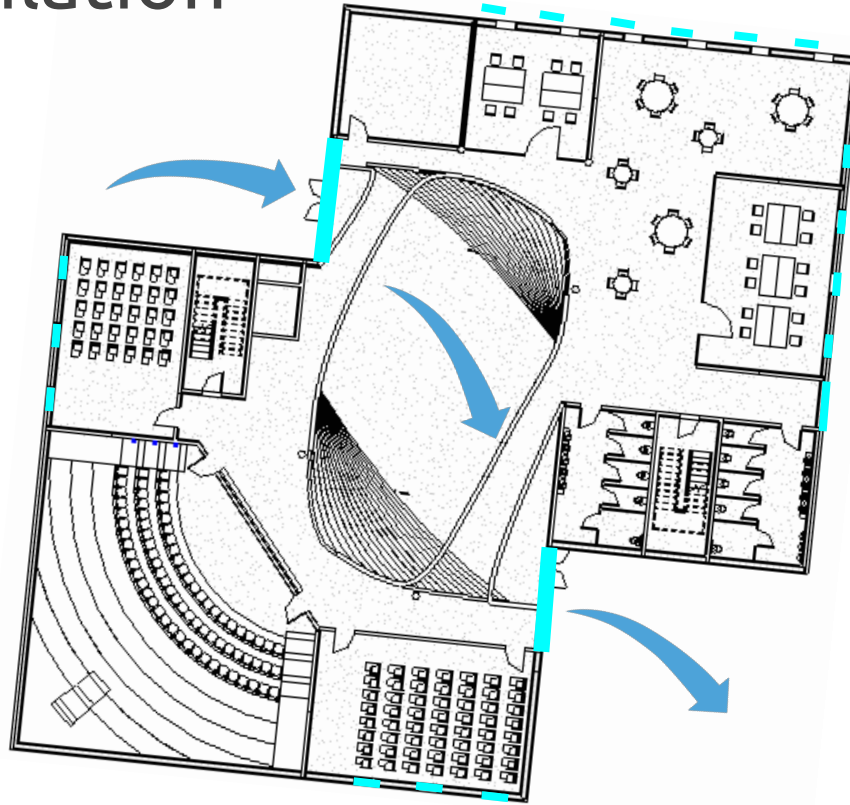
Equipment



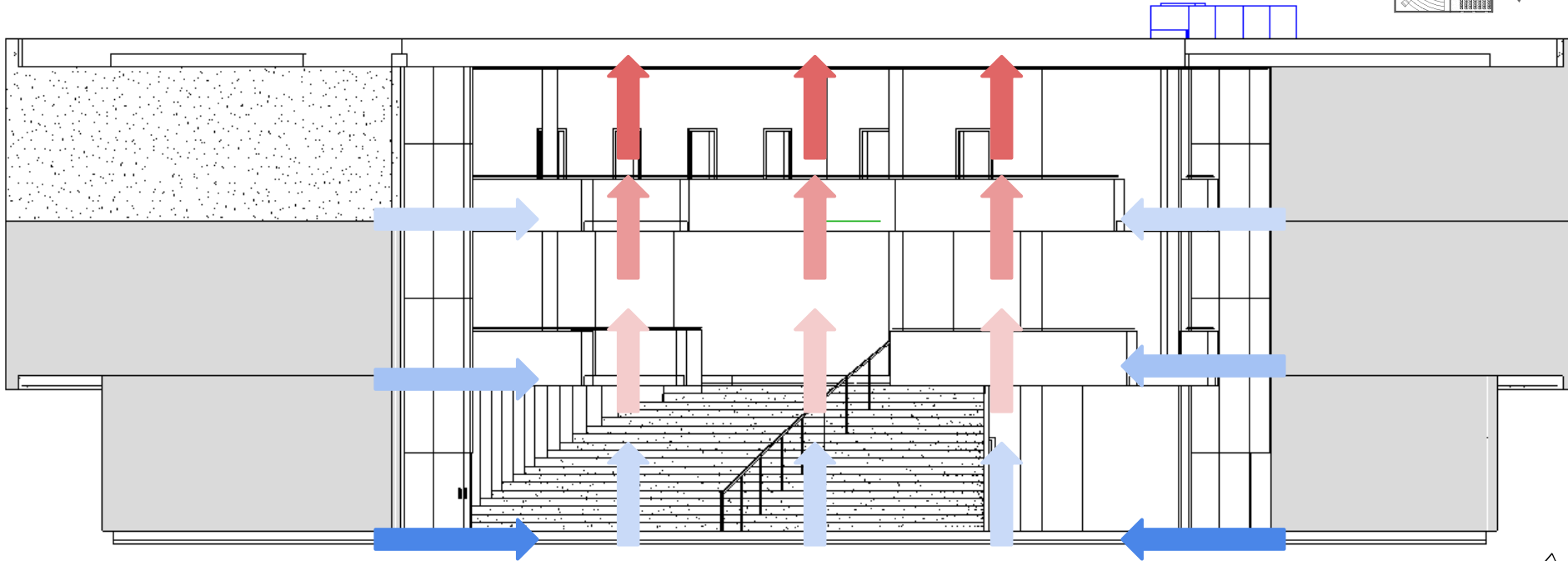
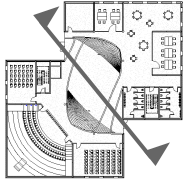
Glass Ceiling and Atrium provides Daylight and Night Flush



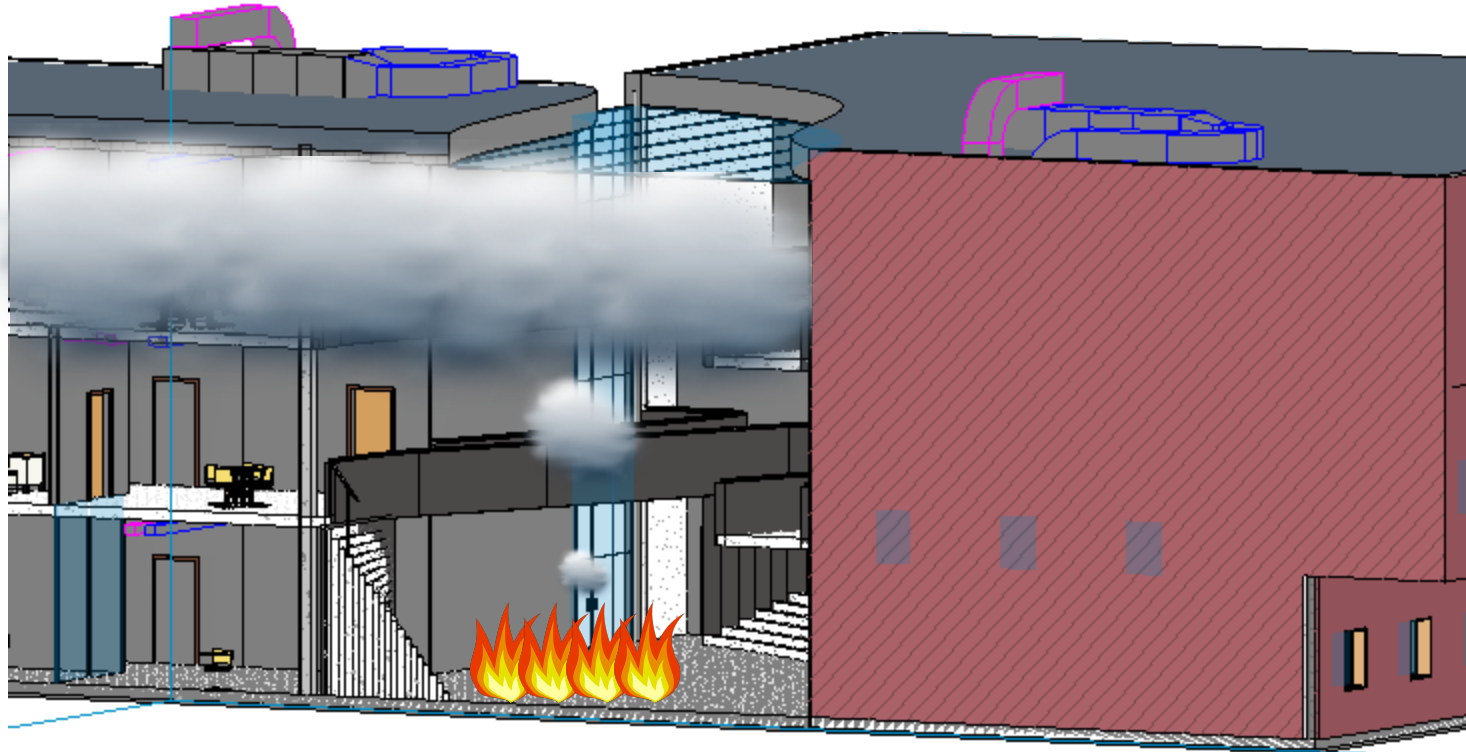
Natural Ventilation



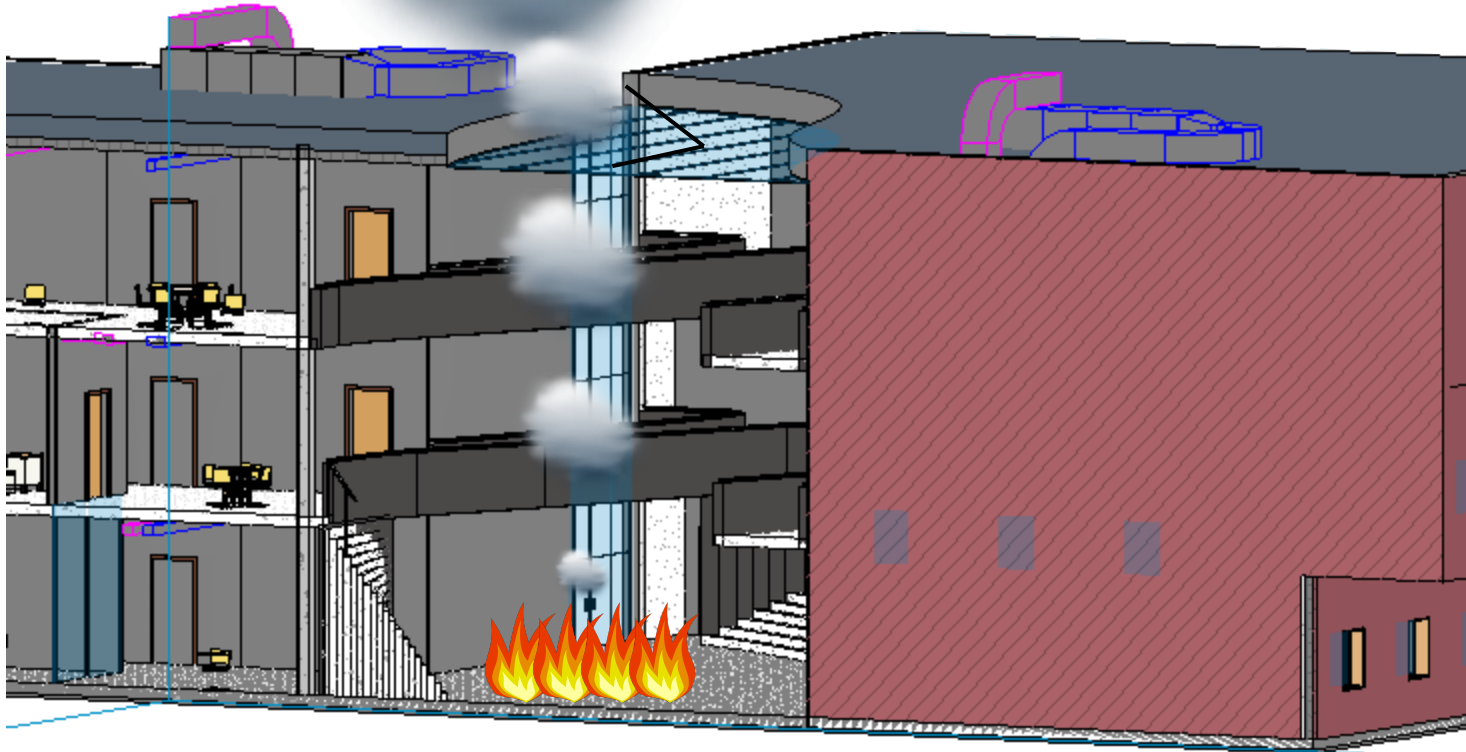
Natural Ventilation



Natural Ventilation



Natural Ventilation



A

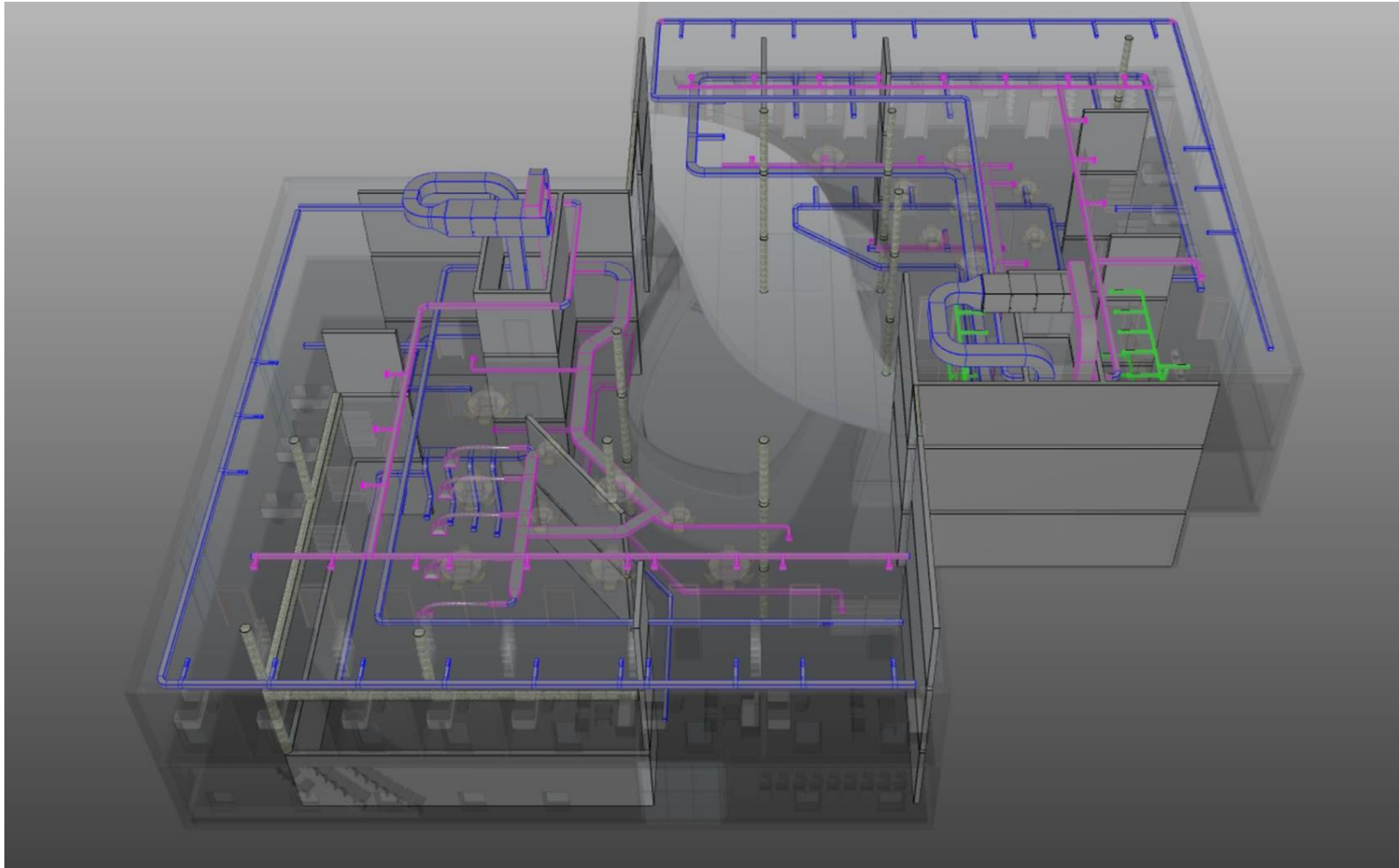
E

MEP

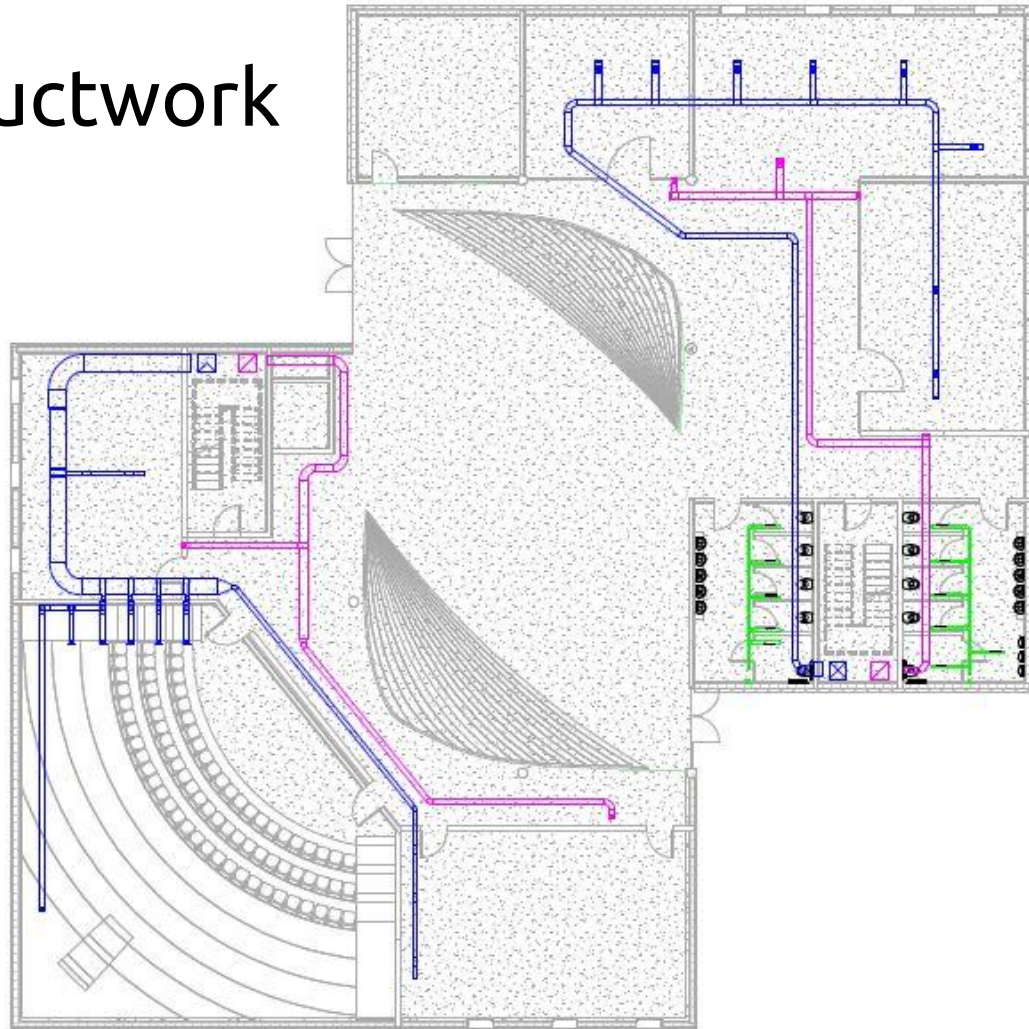
C

Water

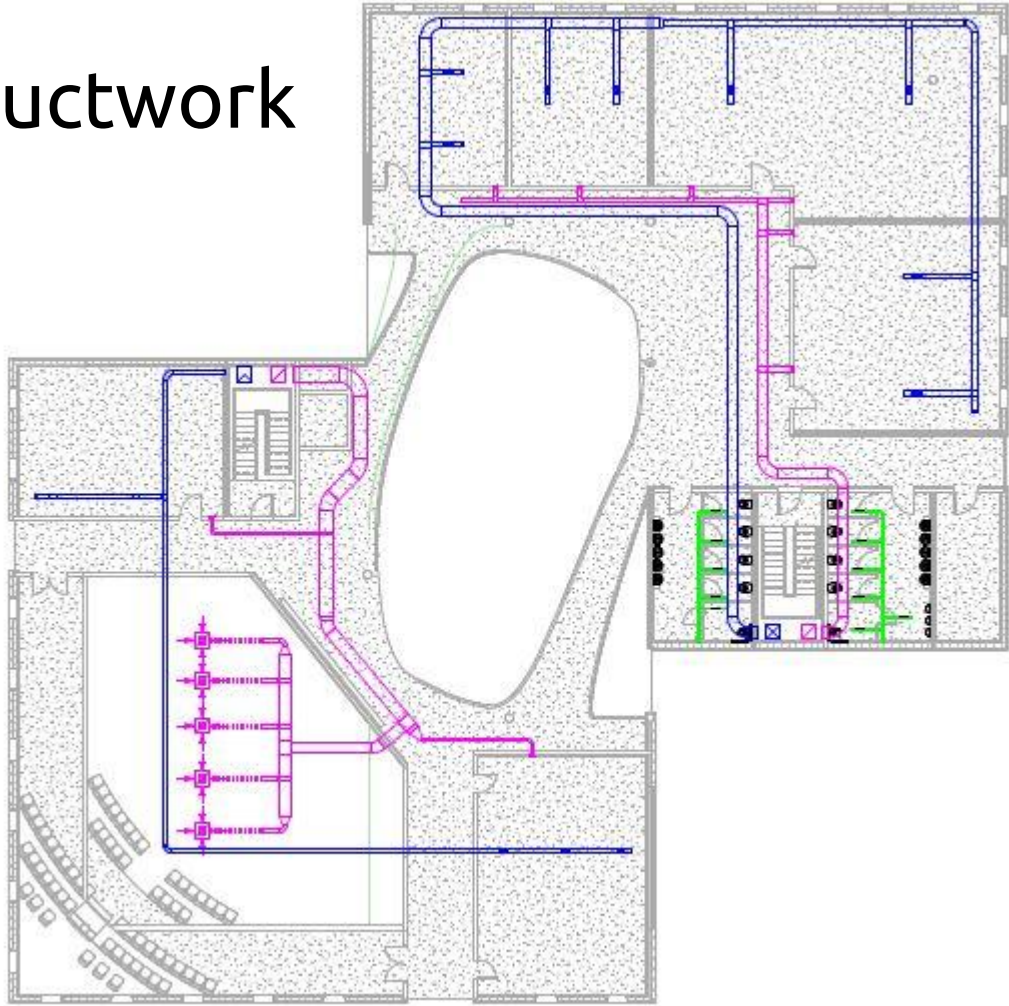
Latency



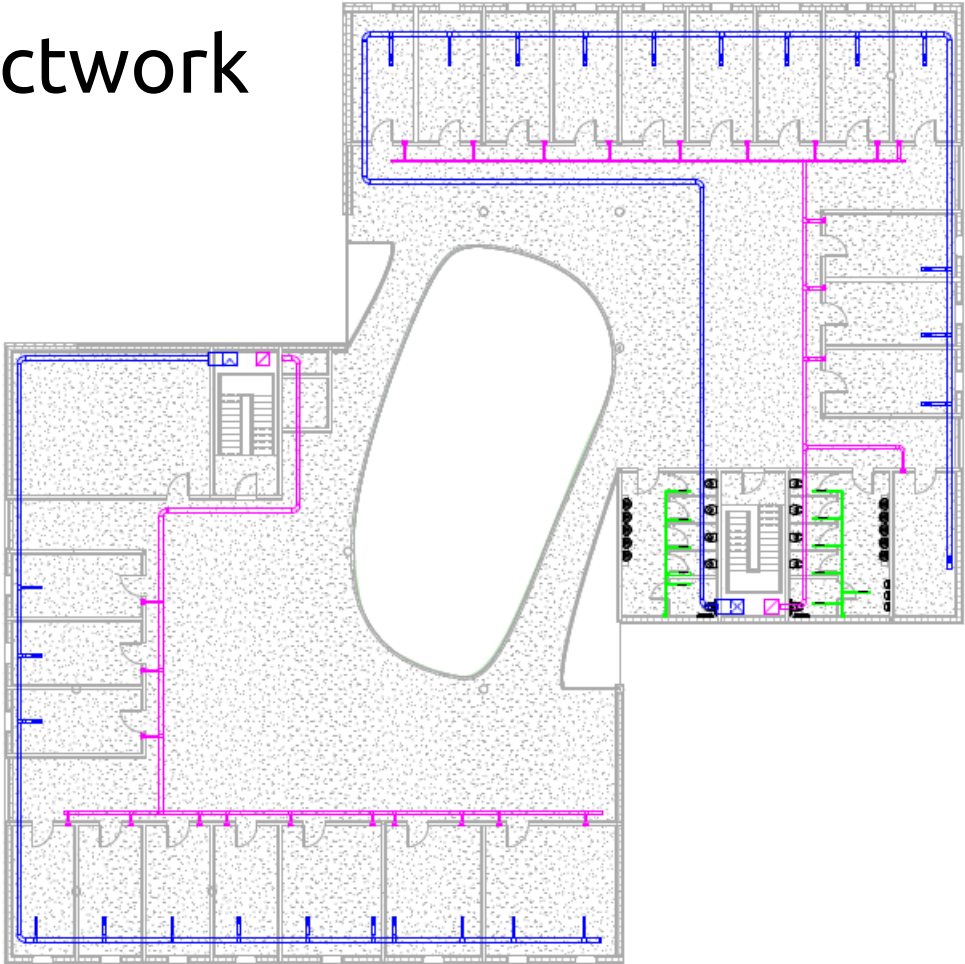
1st Level Ductwork



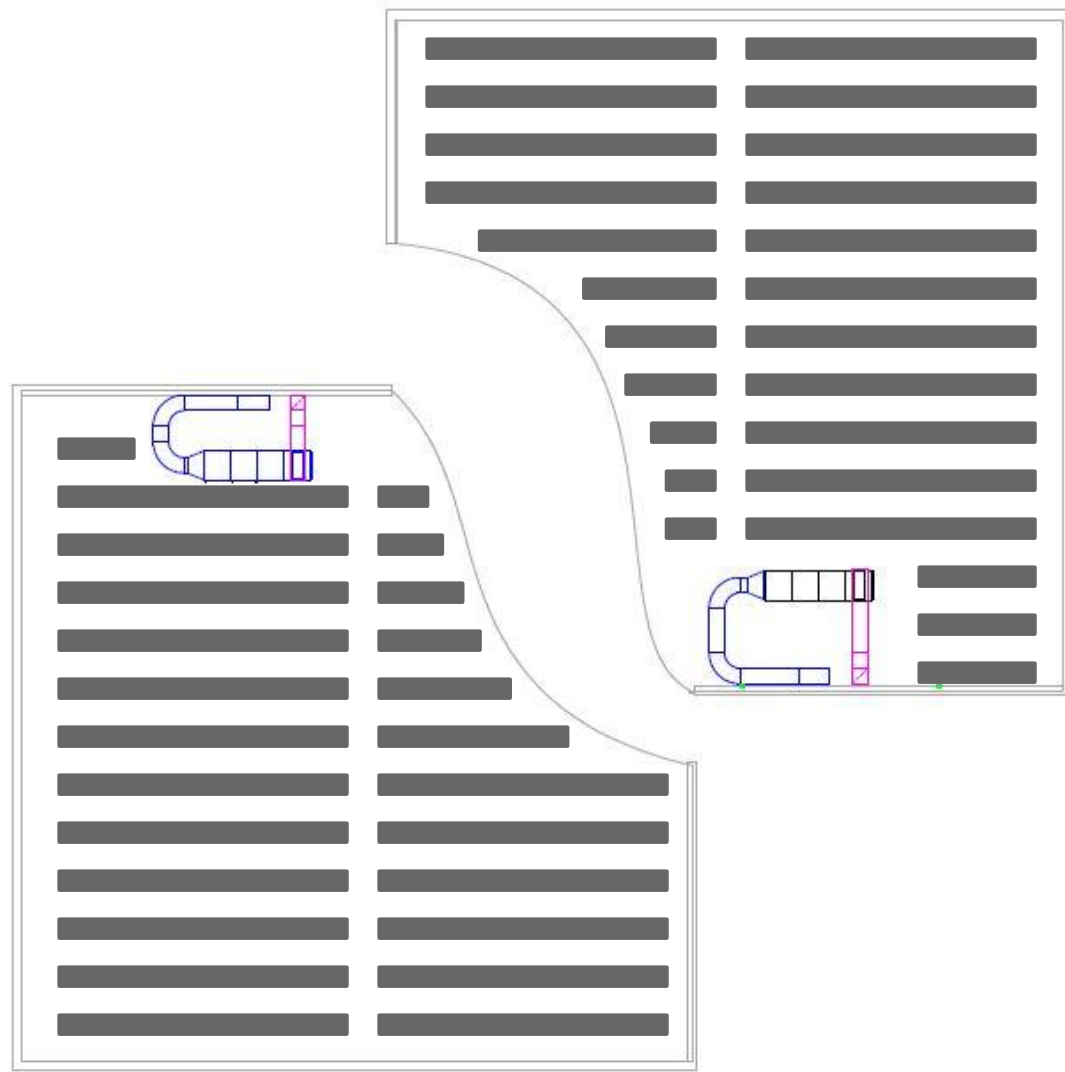
2nd Level Ductwork



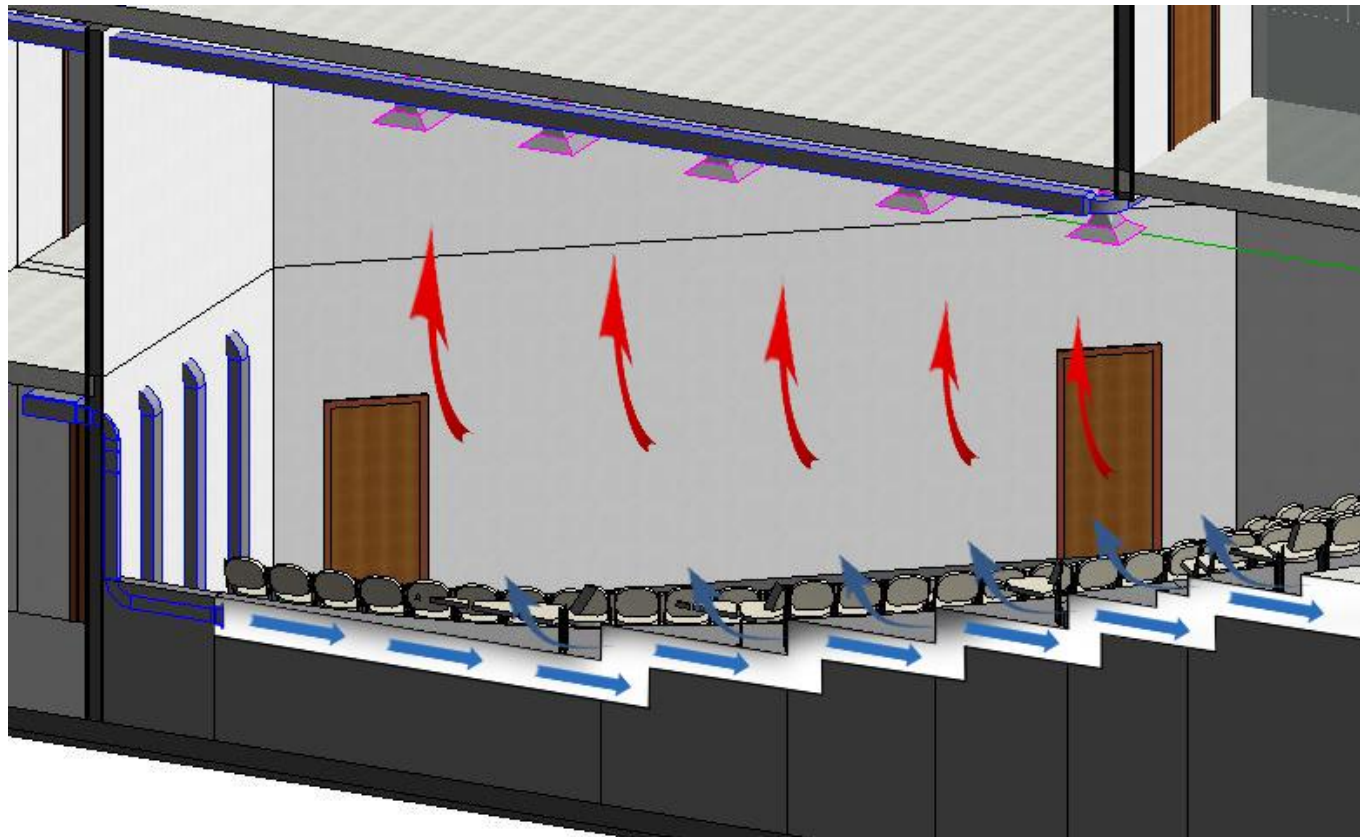
3rd Level Ductwork



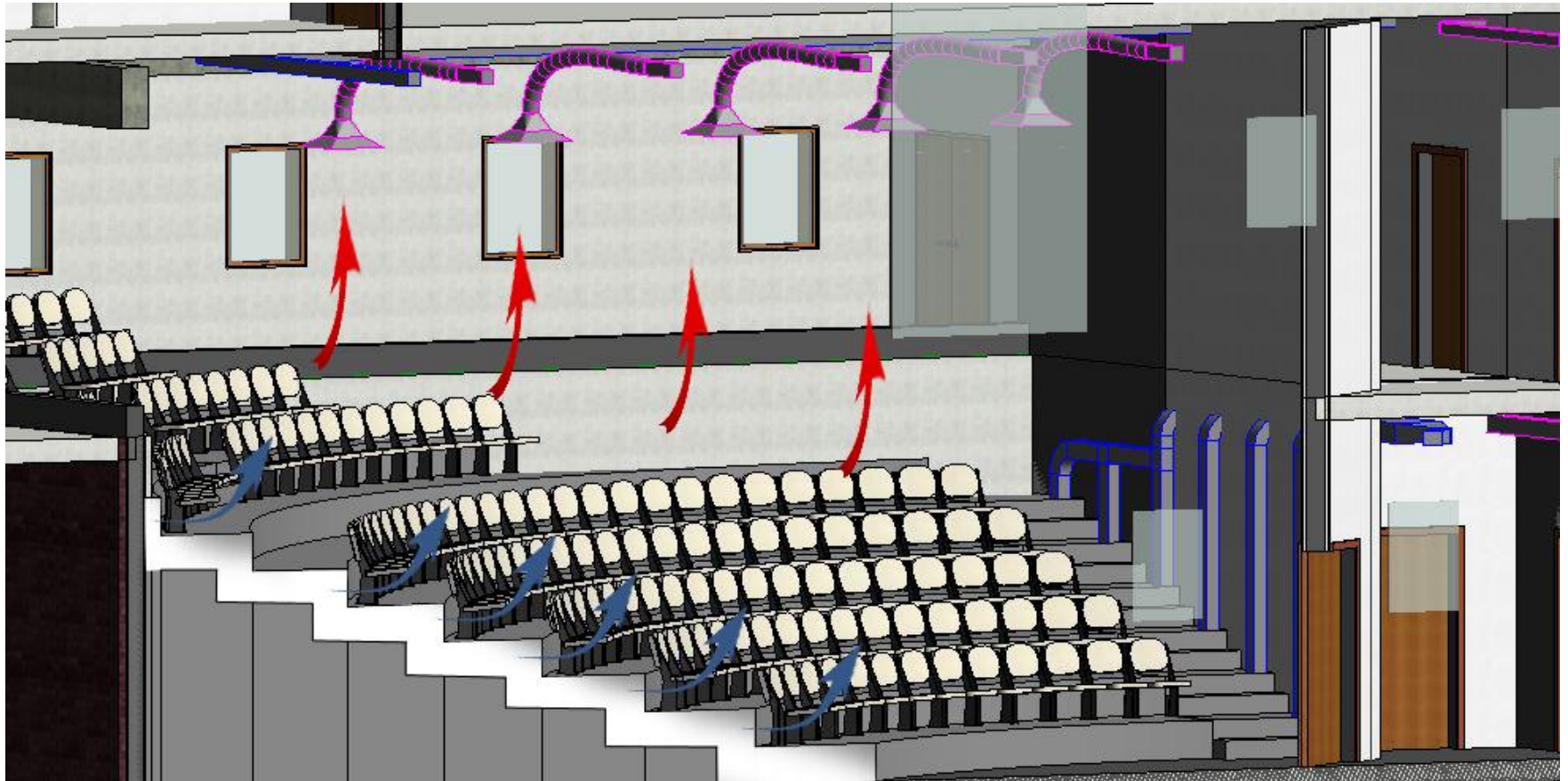
Roof Plan



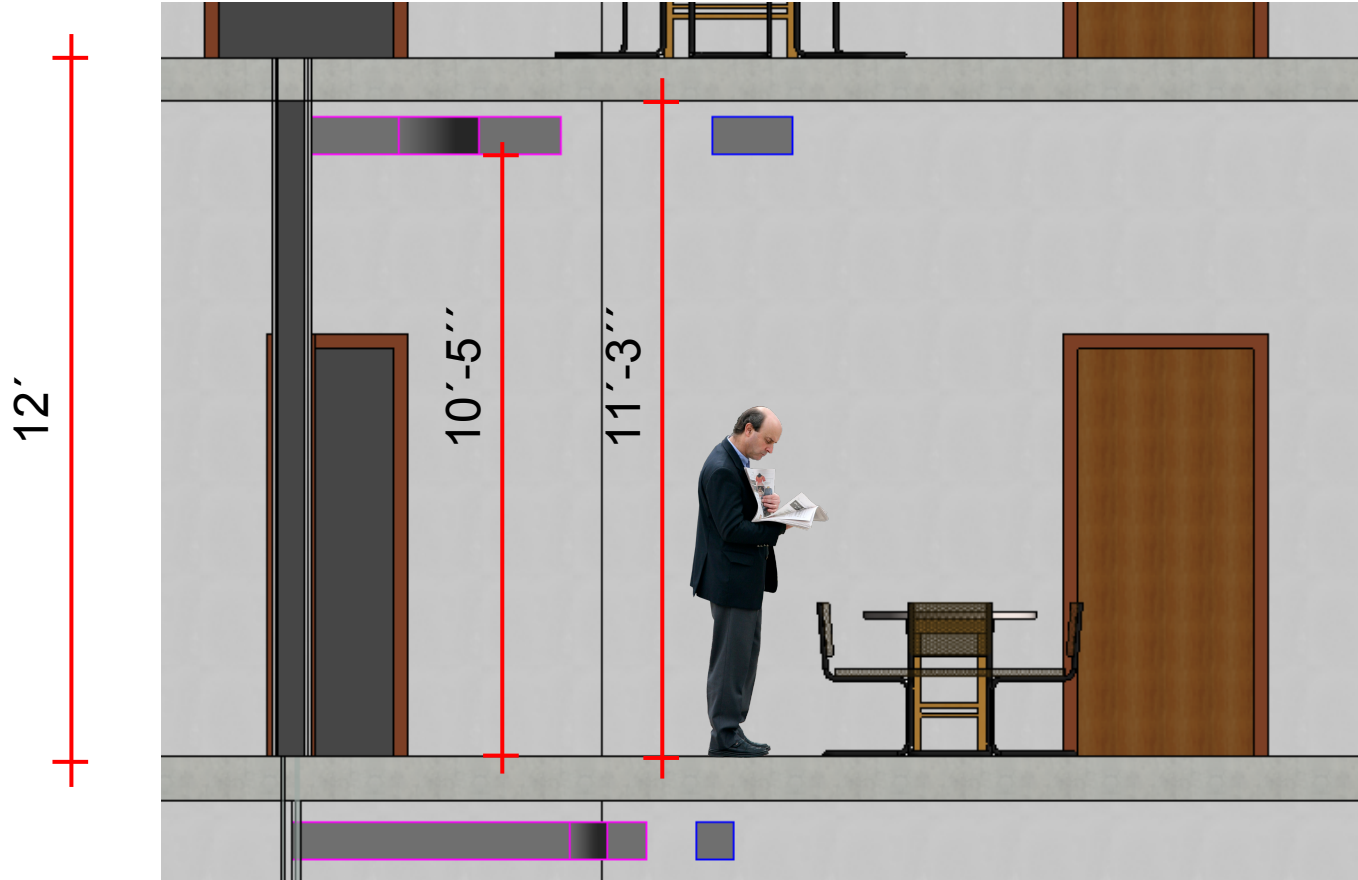
Auditorium UFAD



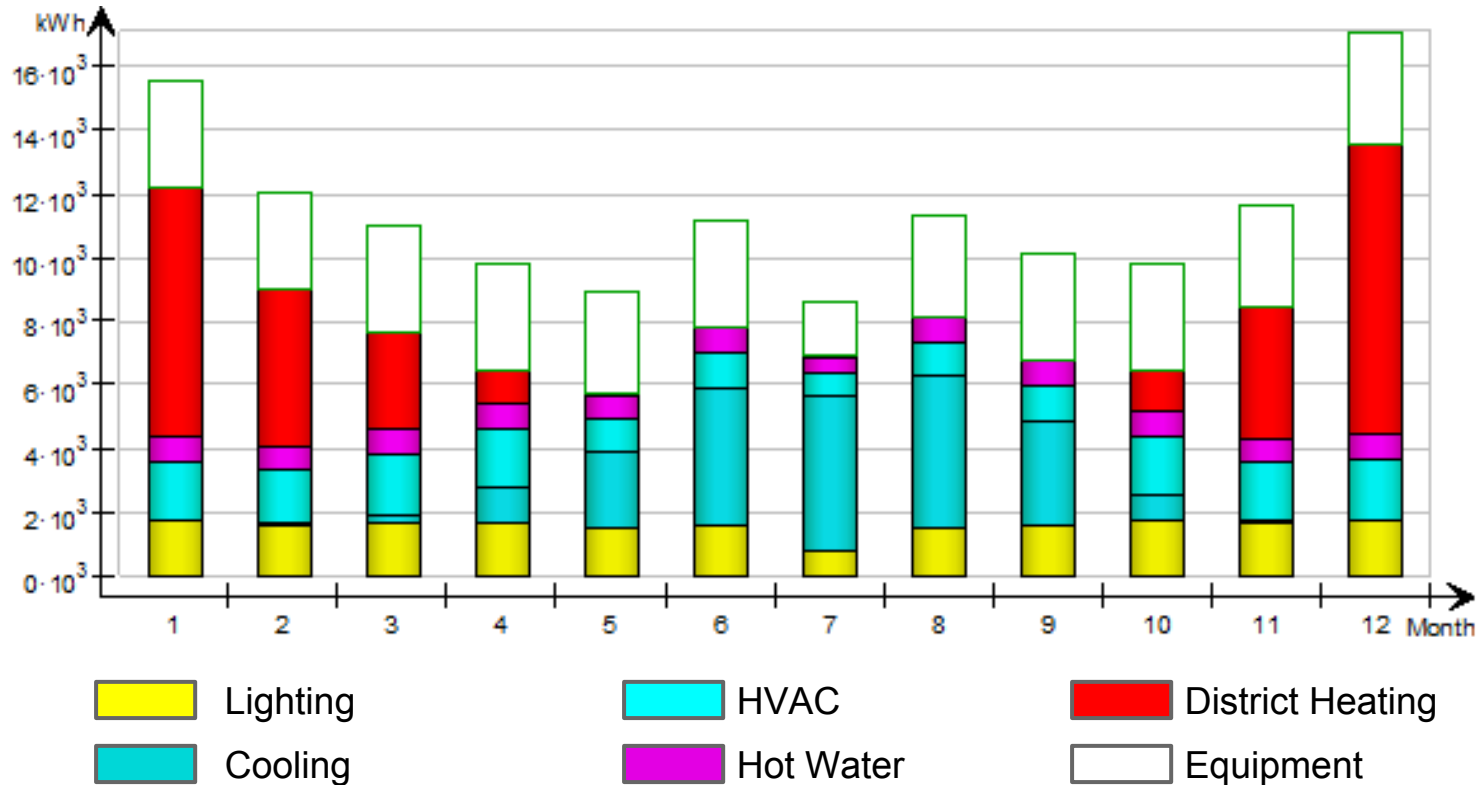
Auditorium UFAD



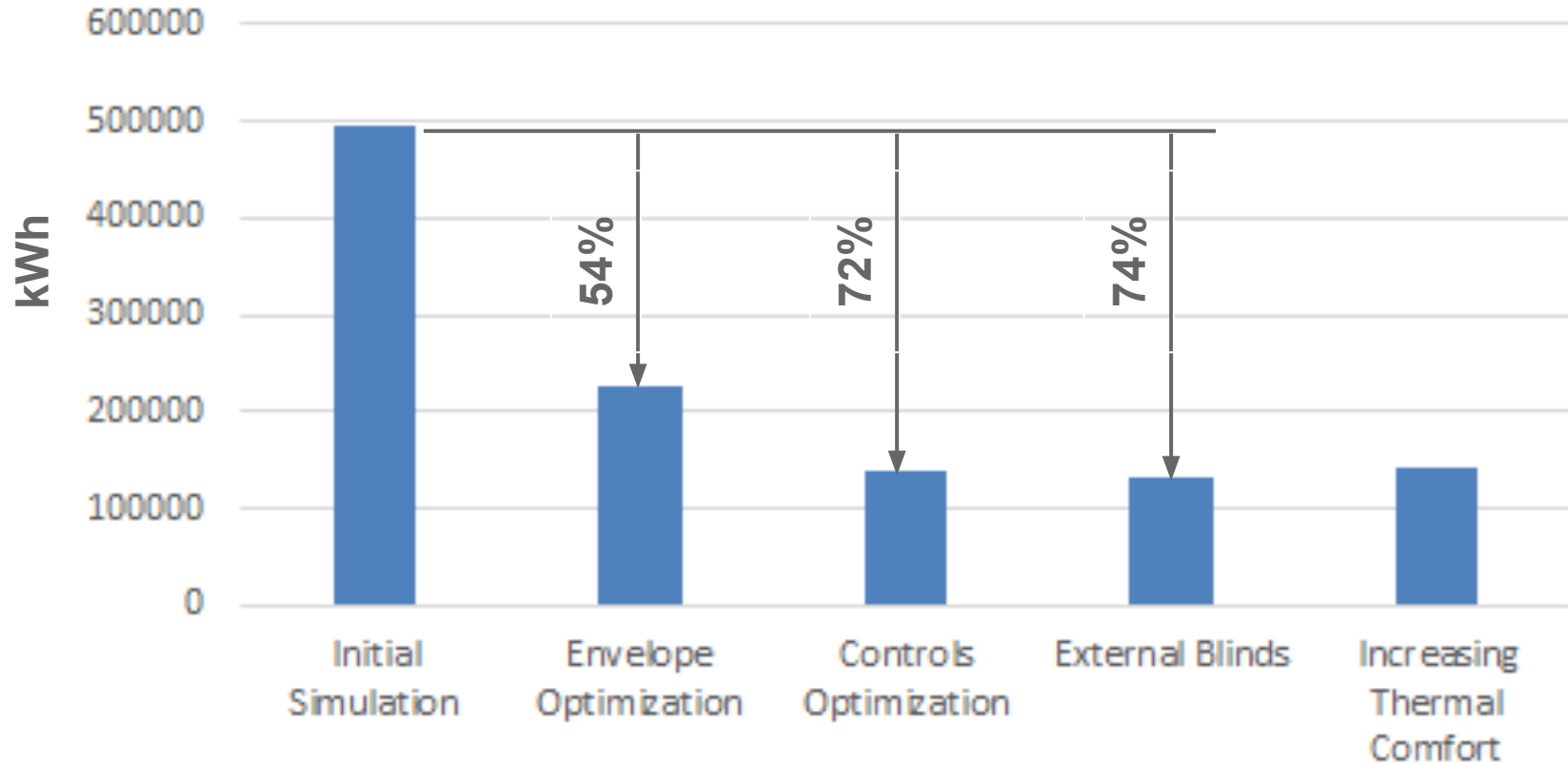
Typical Floor Sandwich



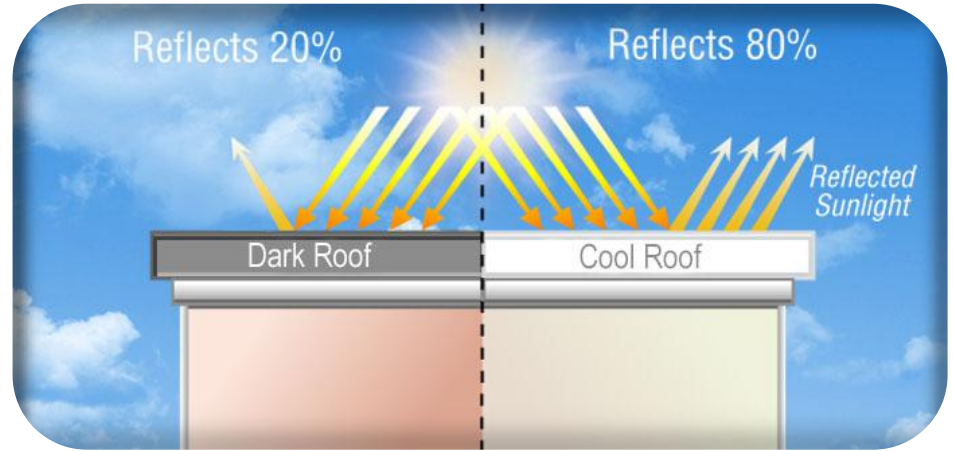
Annual Energy Consumption



Annual Energy Consumption (kWh)

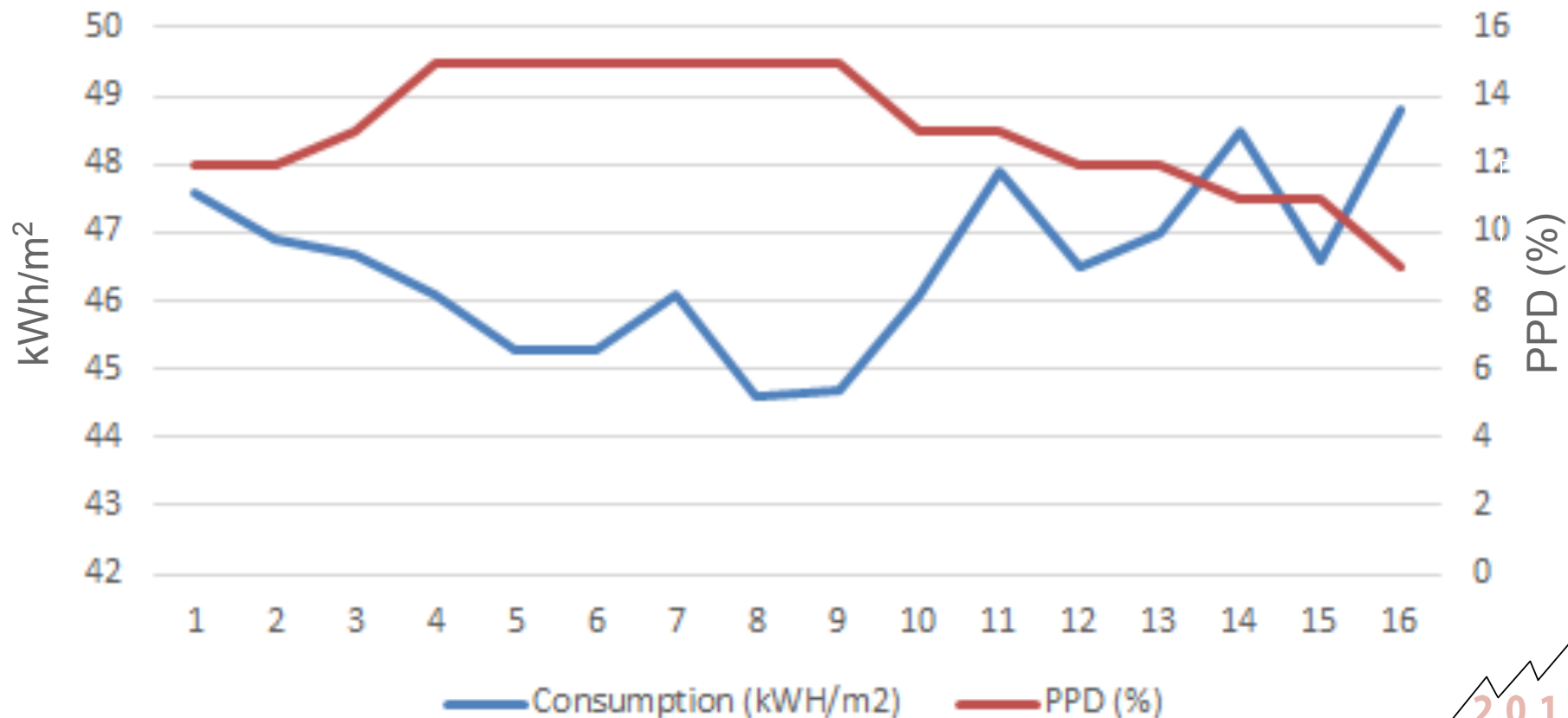


Heat Island Effect

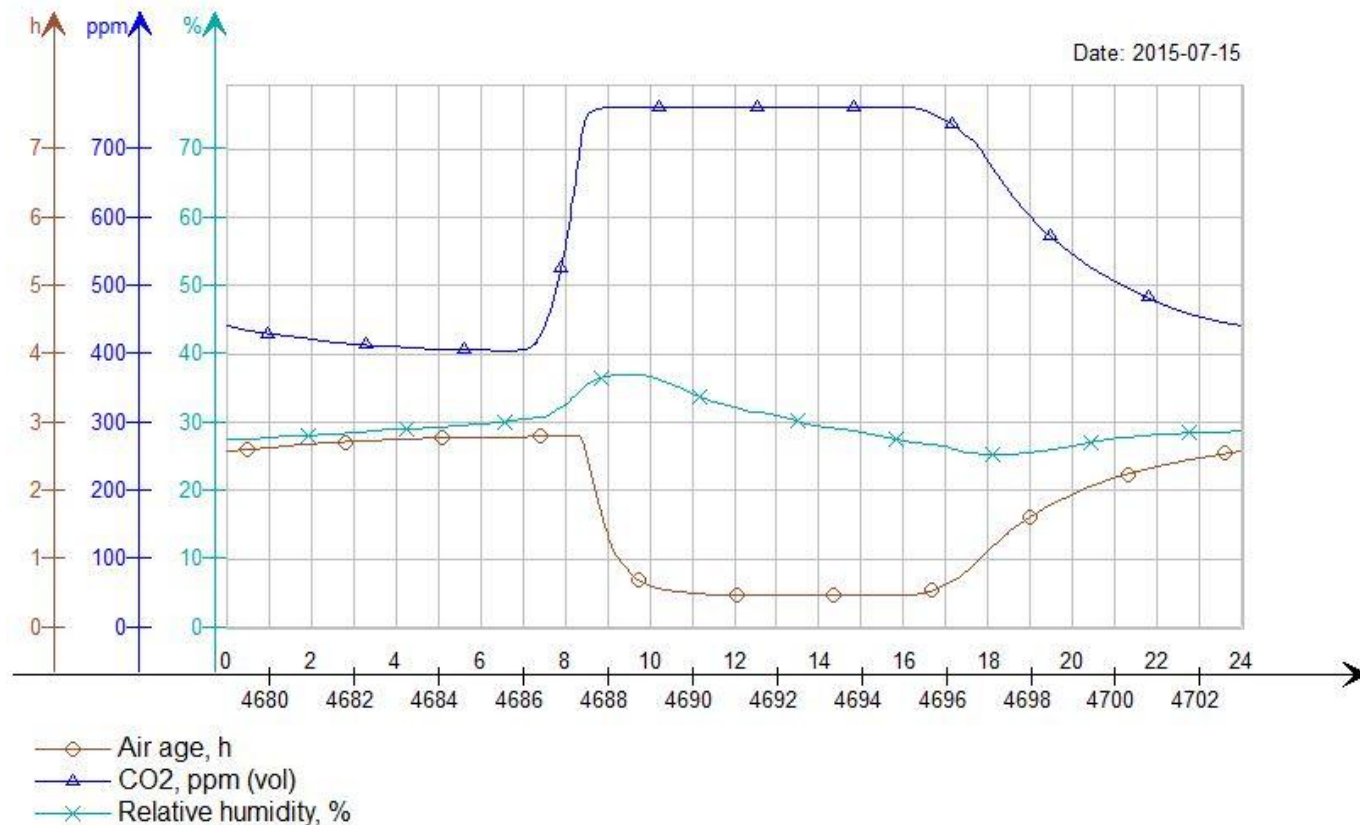


Cool Roof will mitigate Heat Island Effect.

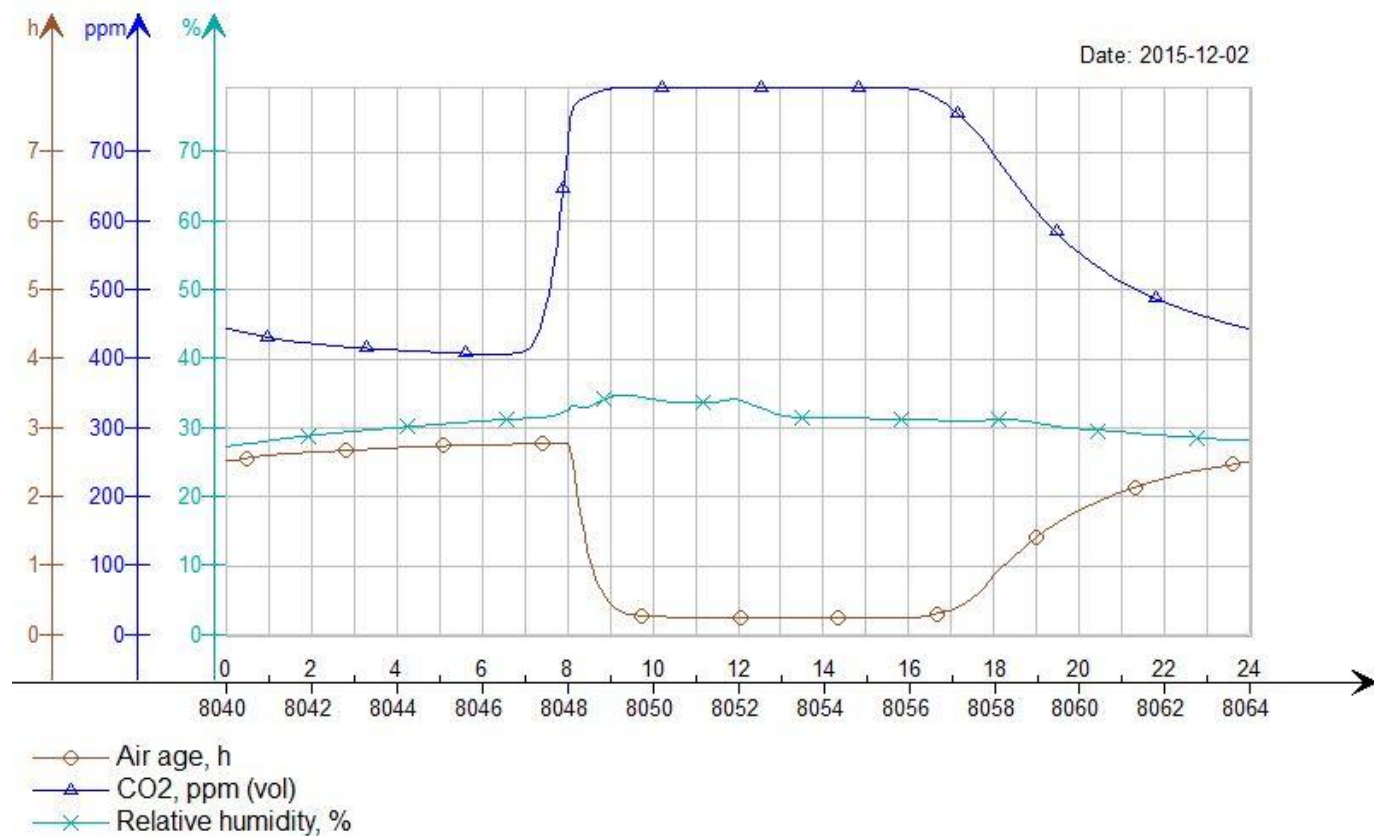
kWh - PPD evolution

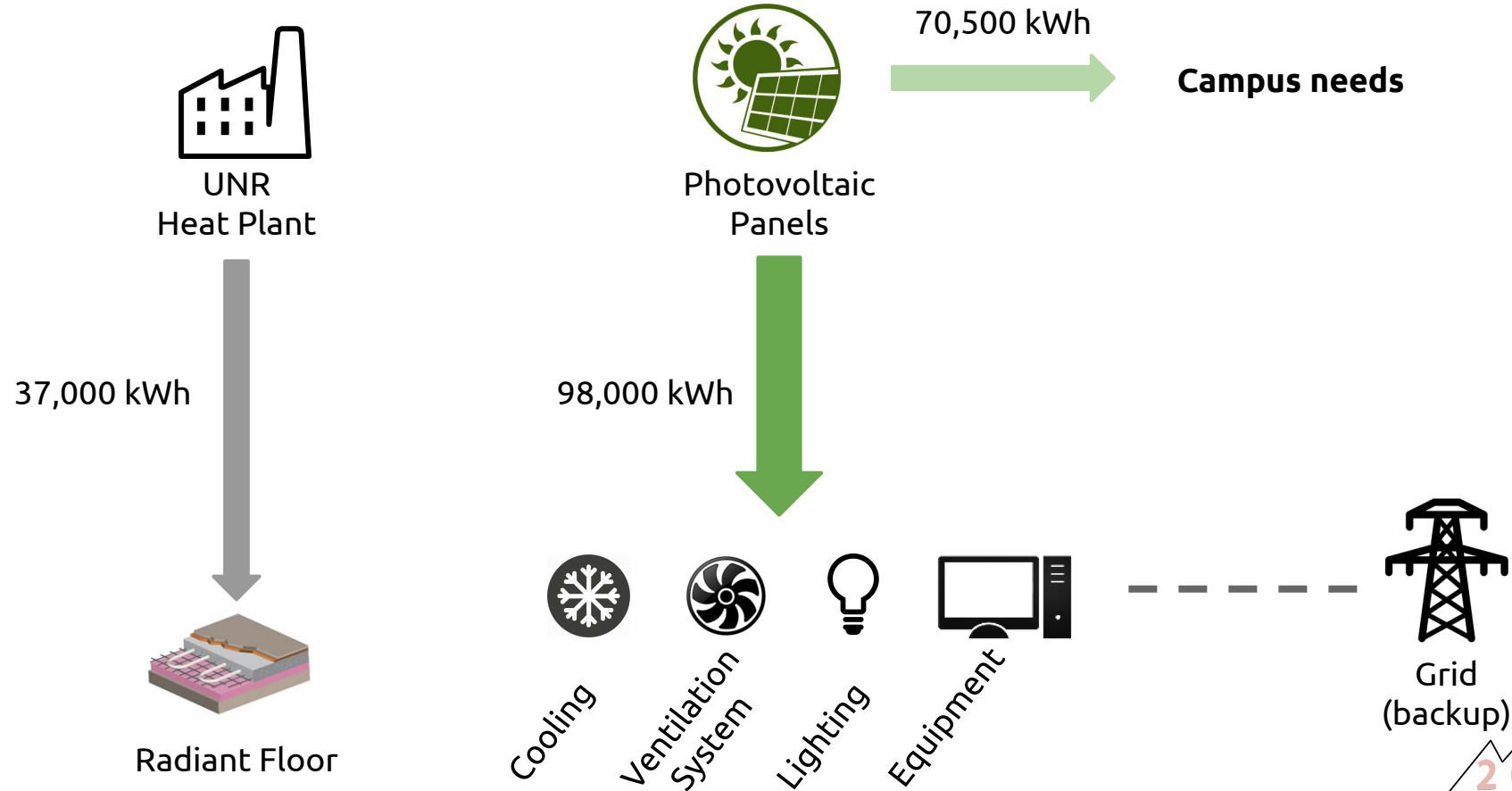


Auditorium Indoor Air quality - Typical Summer Day

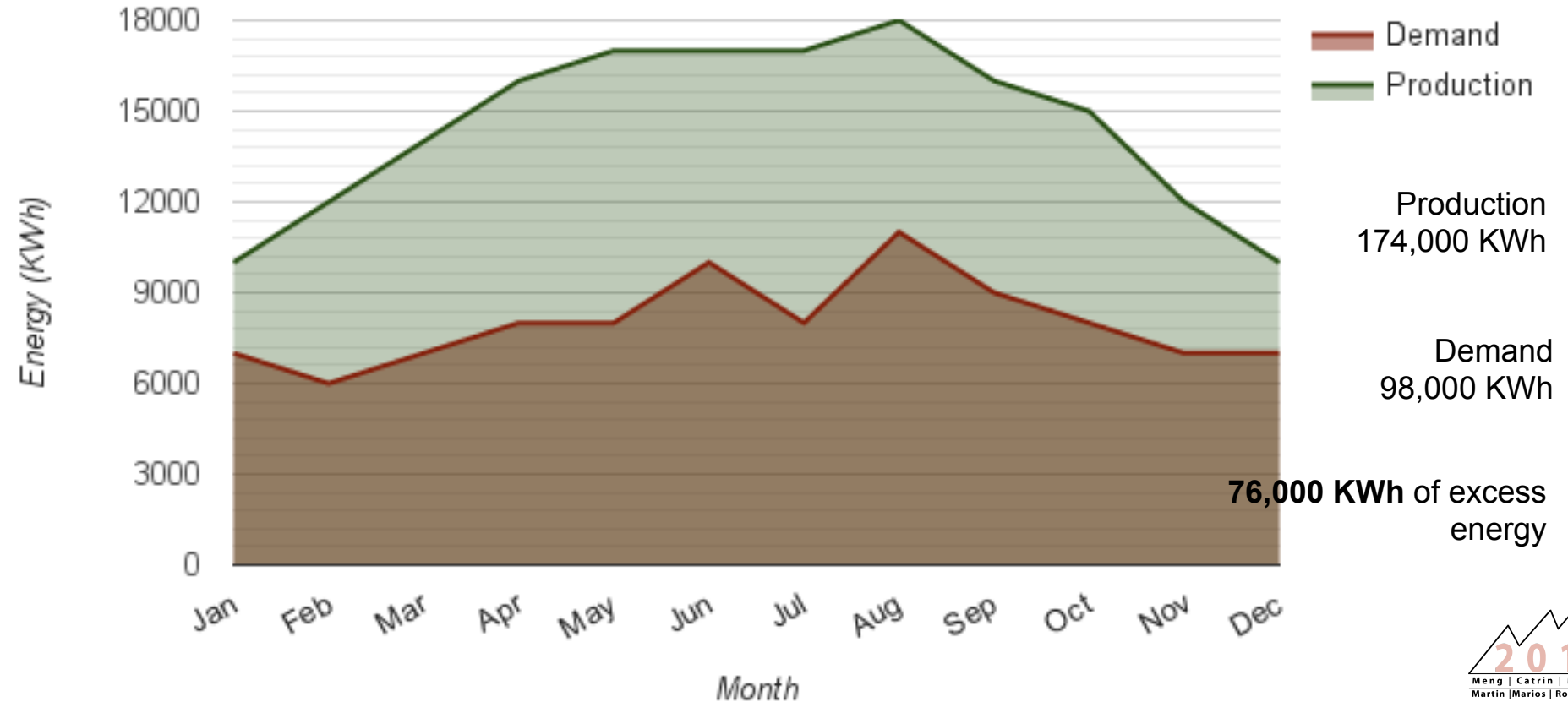


Auditorium Indoor Air quality - Typical Winter Day





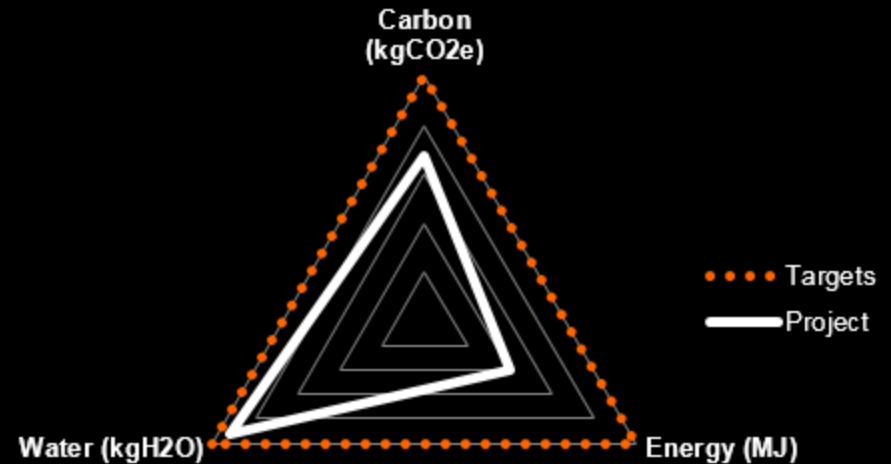
Monthly Electric Demand and Production



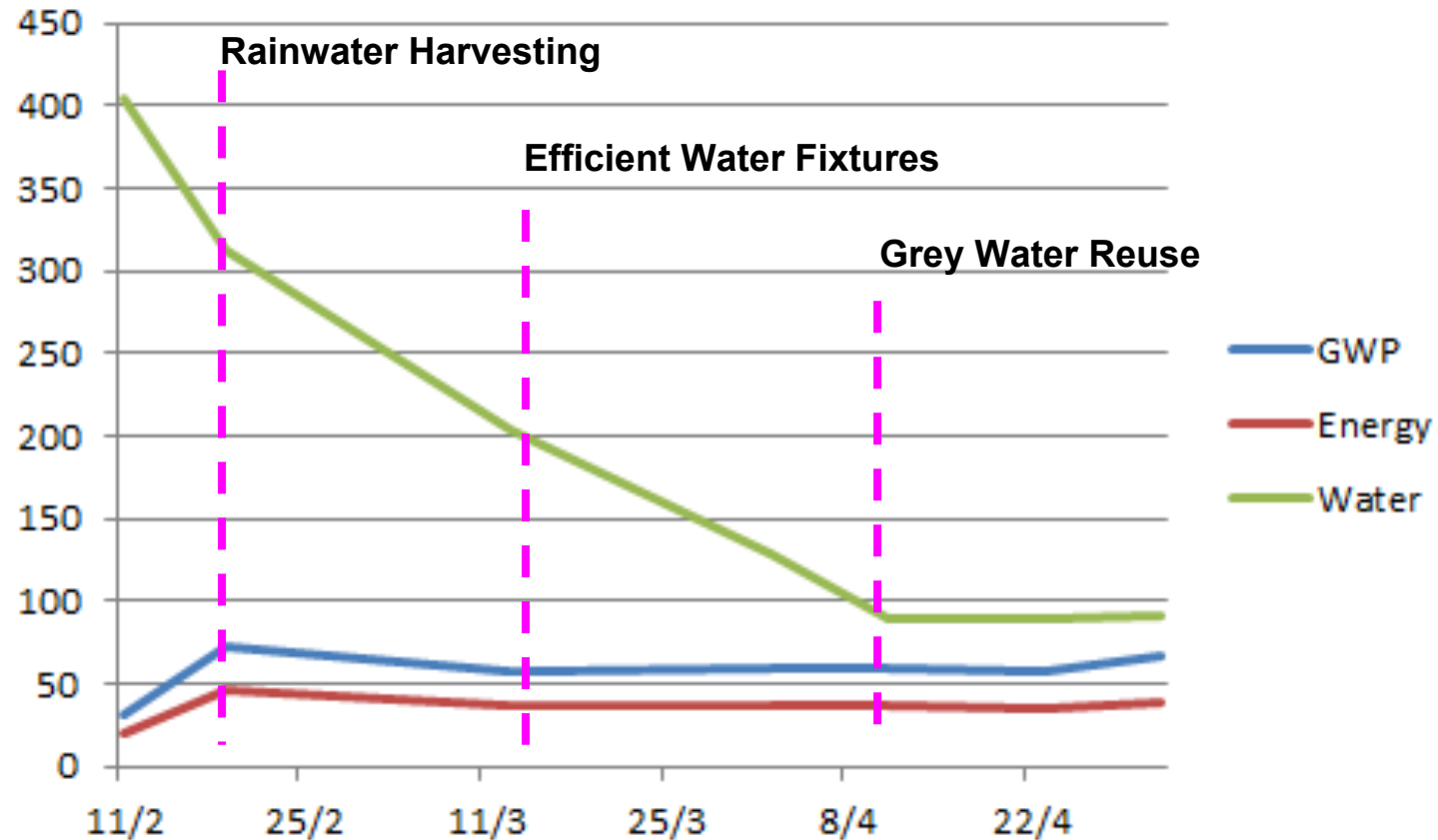
Sustainability Target Value

Performance Relative to Life Cycle Impact Targets

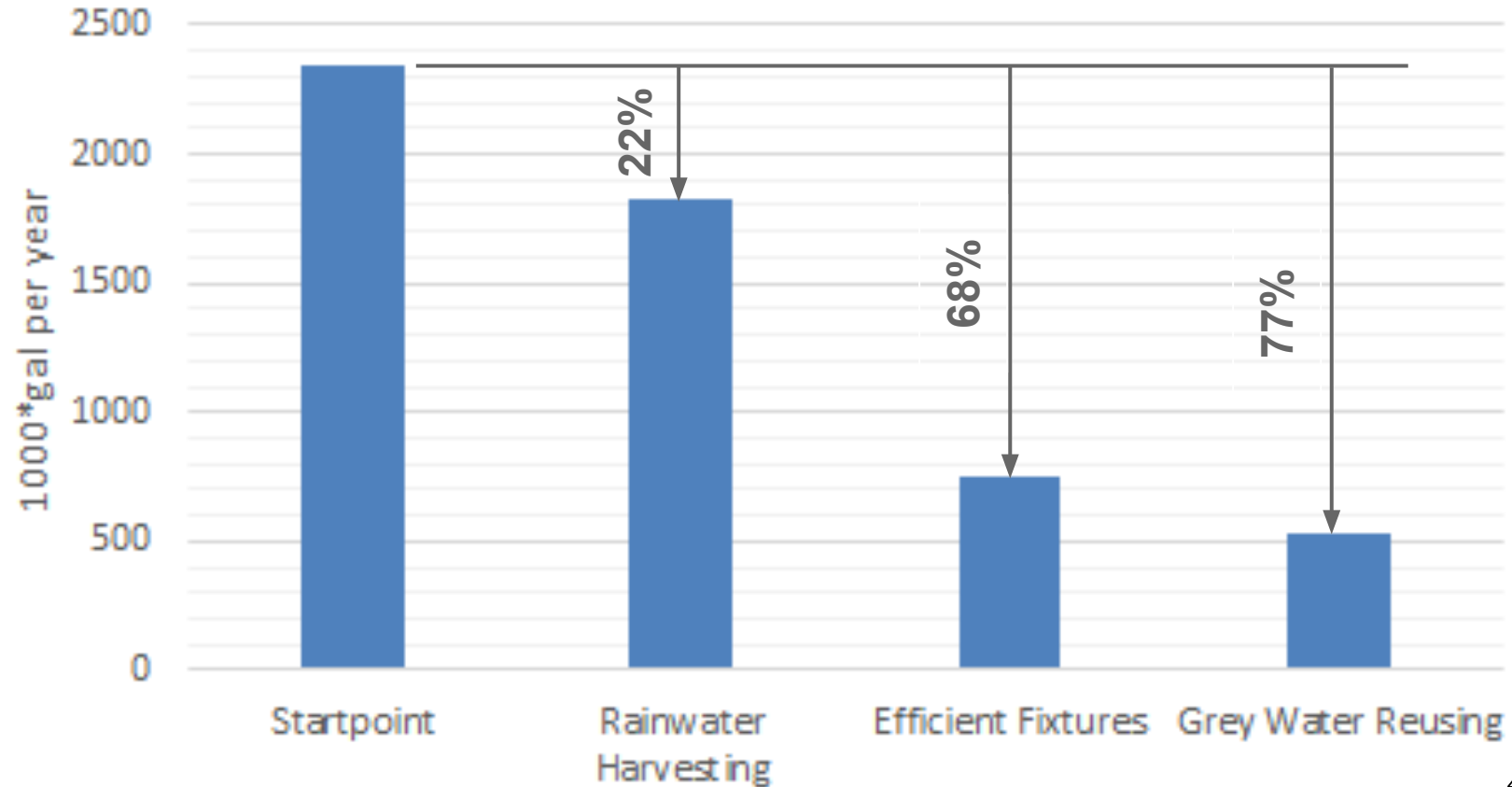
Impact	Target	Project	%
Carbon (kgCO ₂ e)	5.631.313	3.800.274	67%
Energy (MJ)	131.385.813	53.346.657	41%
Water (kgH ₂ O)	110.021.918	101.212.463	92%
Ozone (kgCFC11€)	-	1,61E-01	-



STV Evolution



Water Needs



BBC



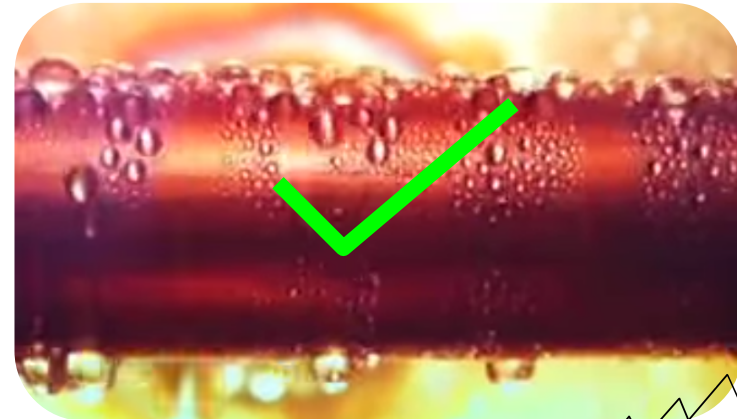
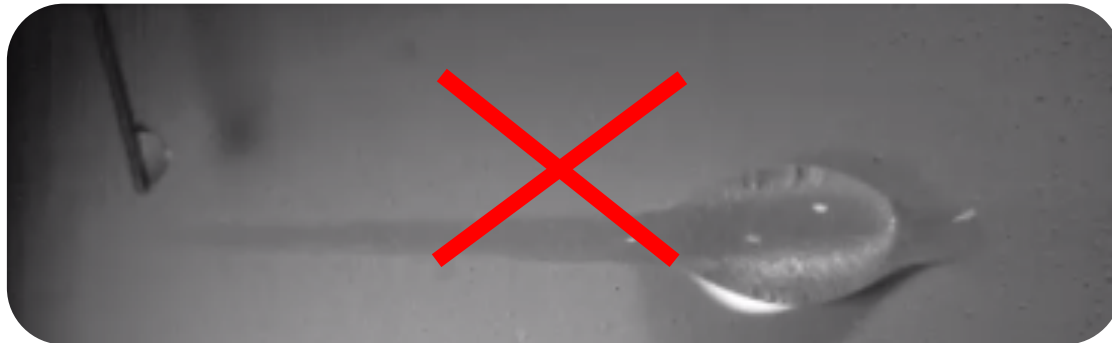
created via
Wincreator.com

Namibia Beetle

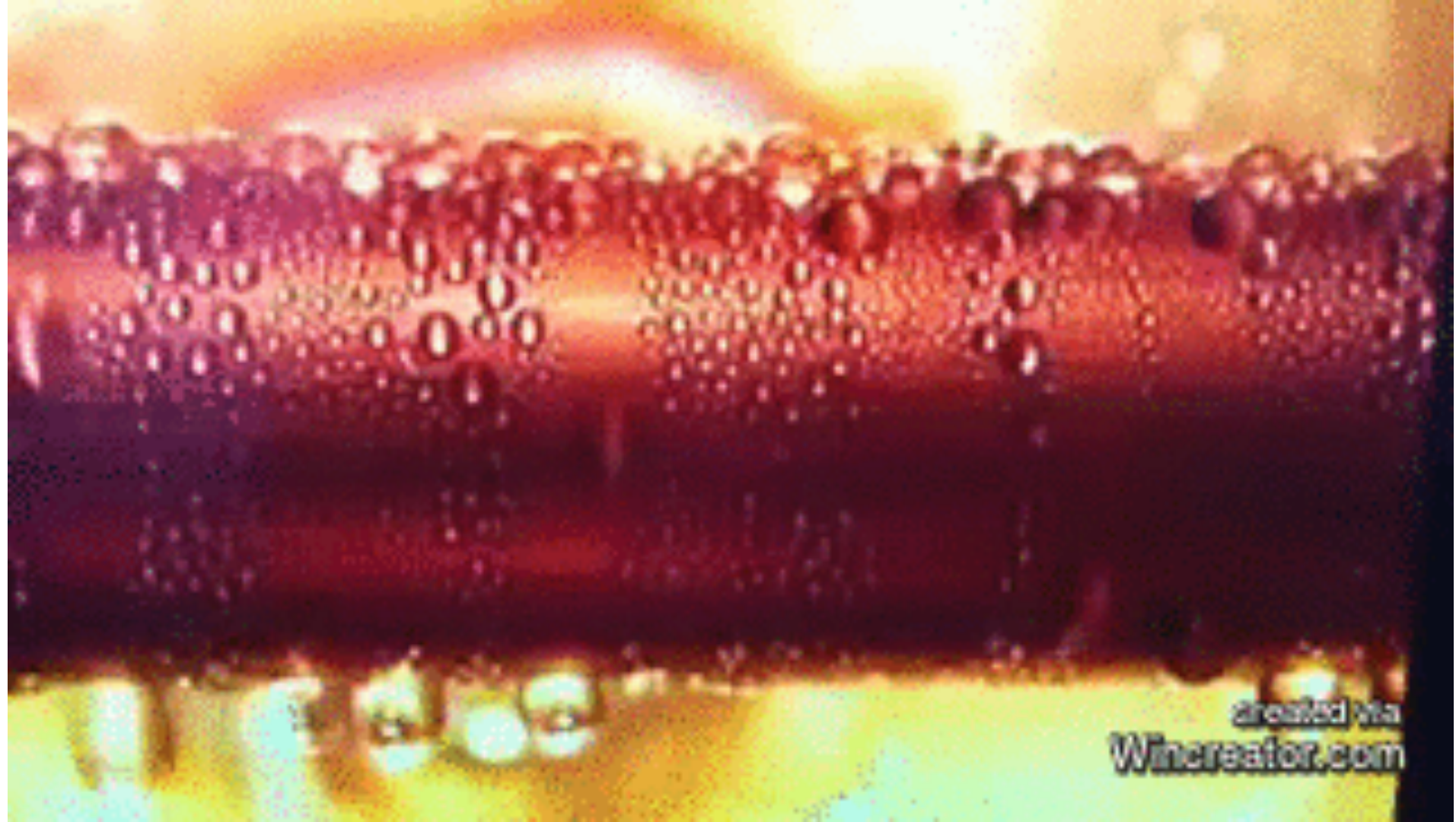


Enhanced Condensation

Patterned Wettability



"Atmospheric Water Capture Using Advanced Nanomaterials" NSF STTR, UIC - NBD Nano



created via
Wincreator.com

A

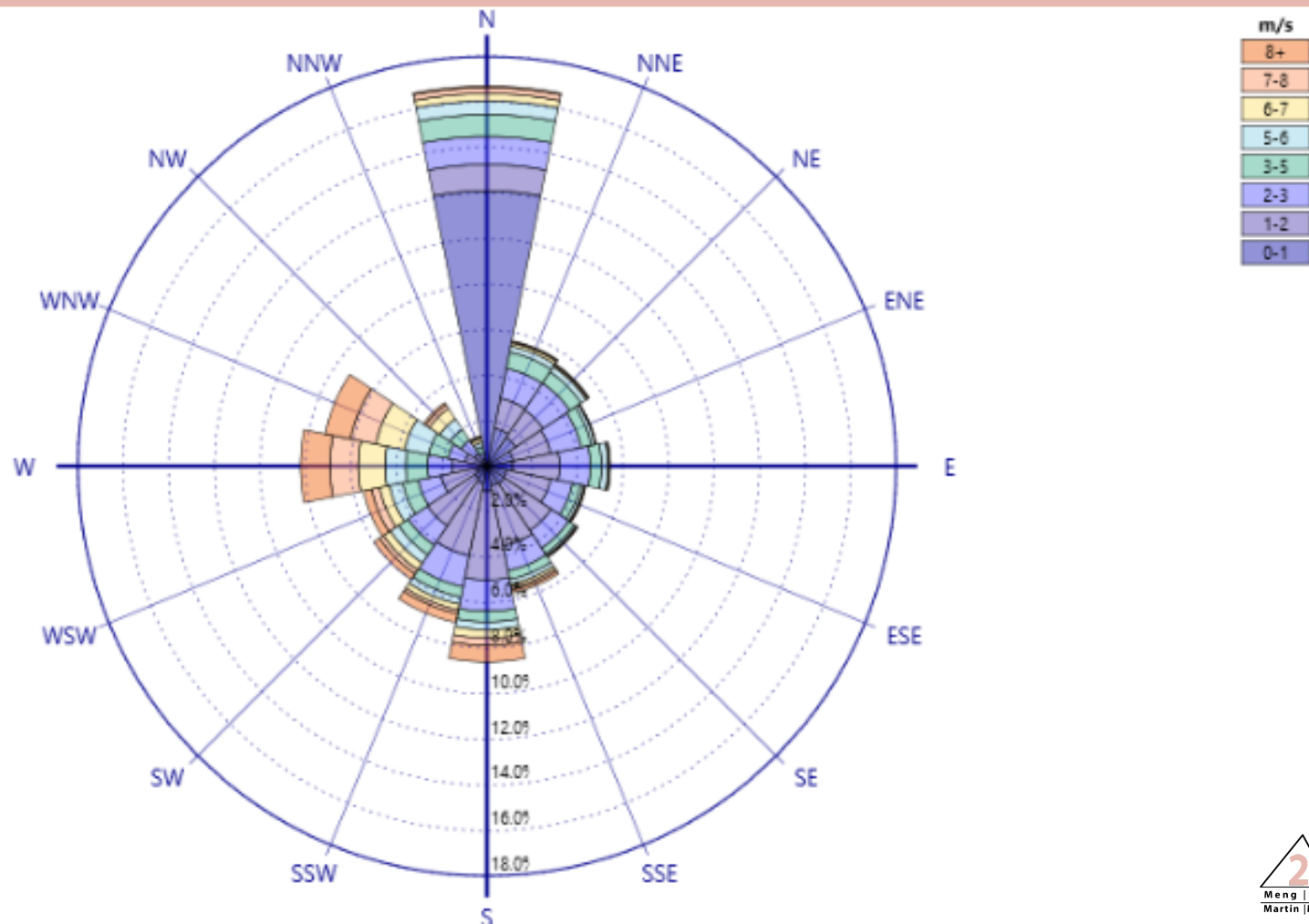
E

MEP

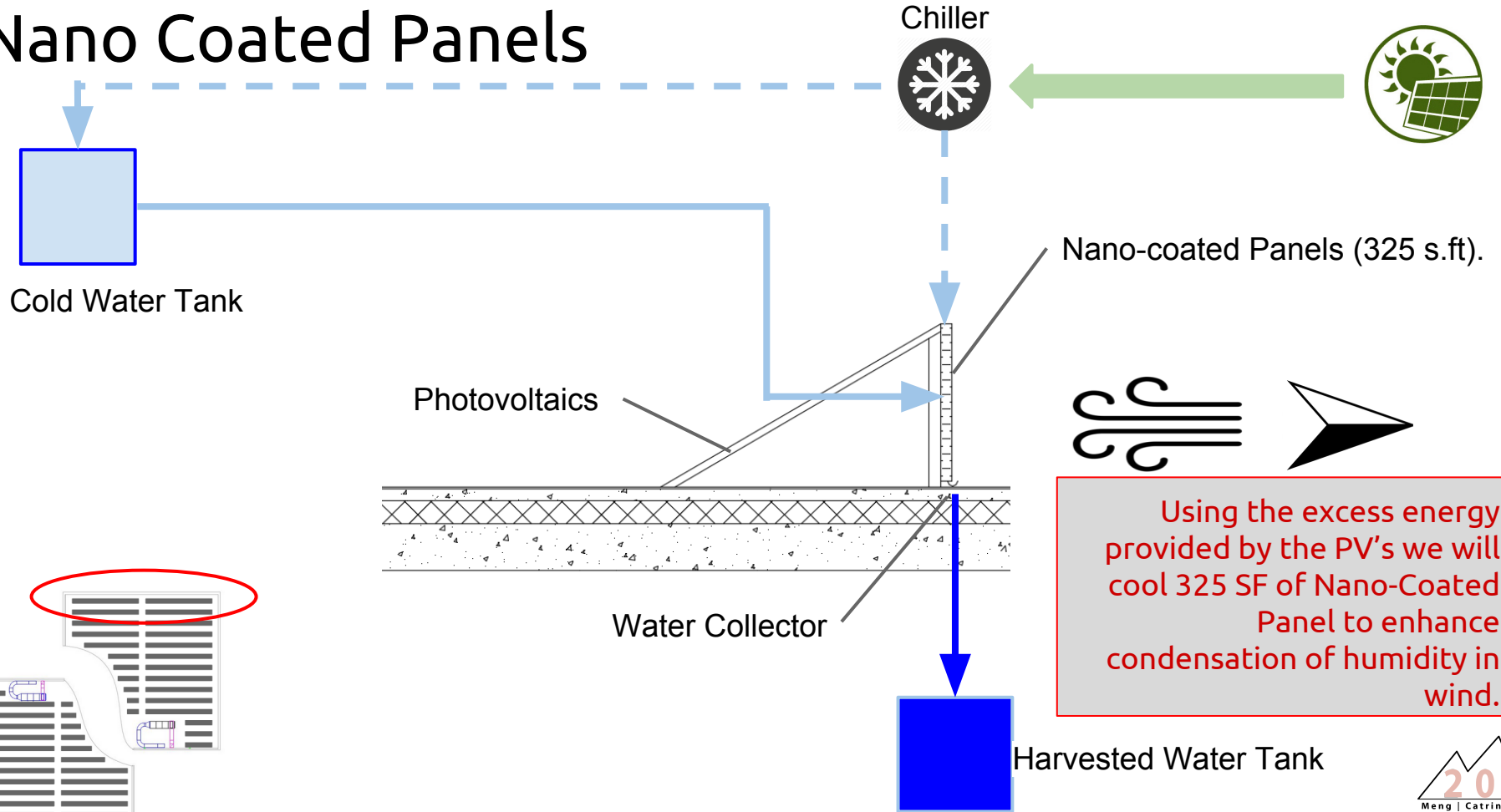
C

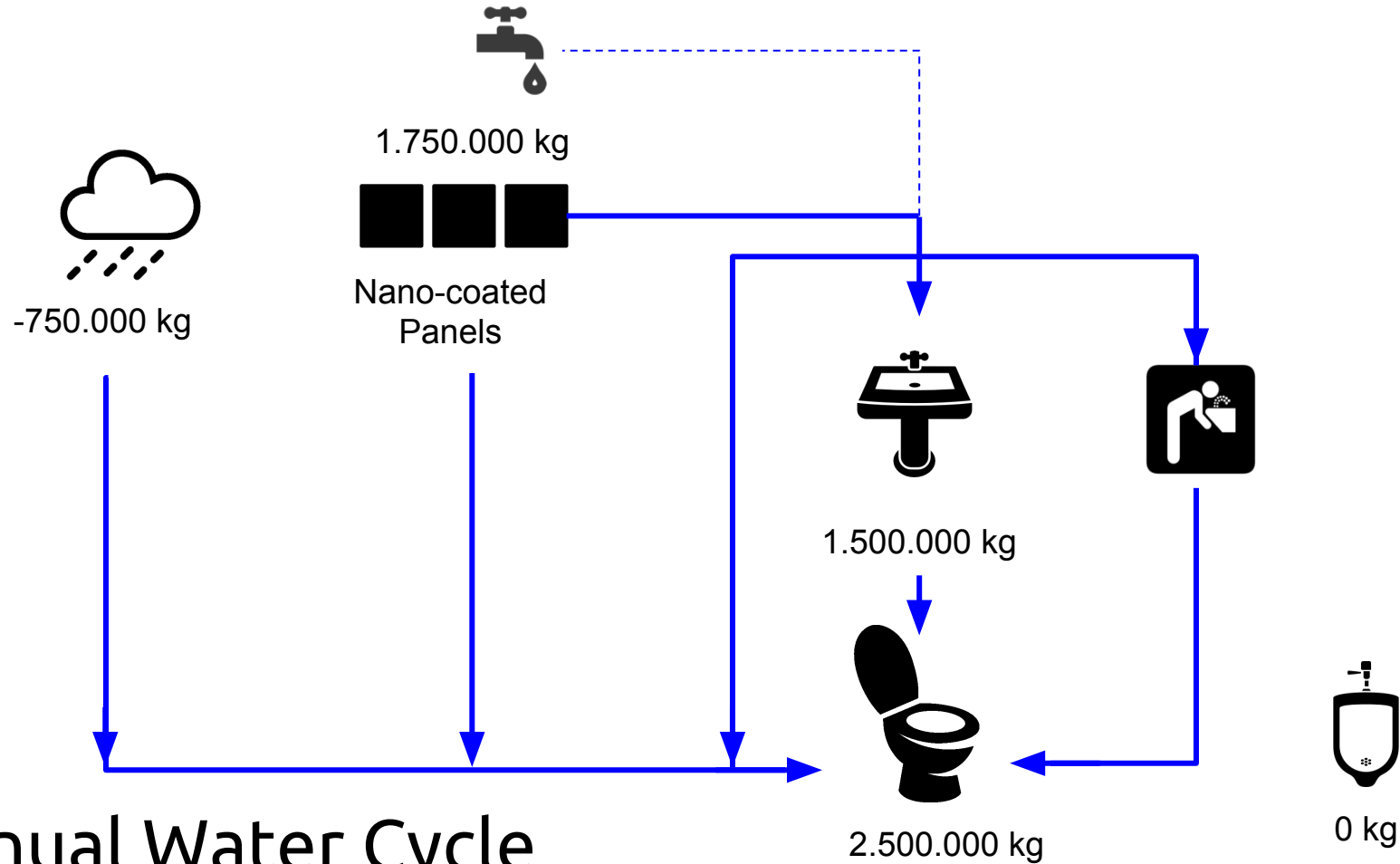
Water

Latency



Nano Coated Panels





LEED Certification

- Rainwater Management 3
- Heat Island Reduction 2
- Outdoor Water Use Reduction 2
- Indoor Water Use Reduction 6
- Optimize Energy Performance 18
- Renewable Energy Production 3
- Thermal Comfort 1
- Daylight 1
- Acoustic Performance 1
- Surrounding Density/Diverse Uses 2

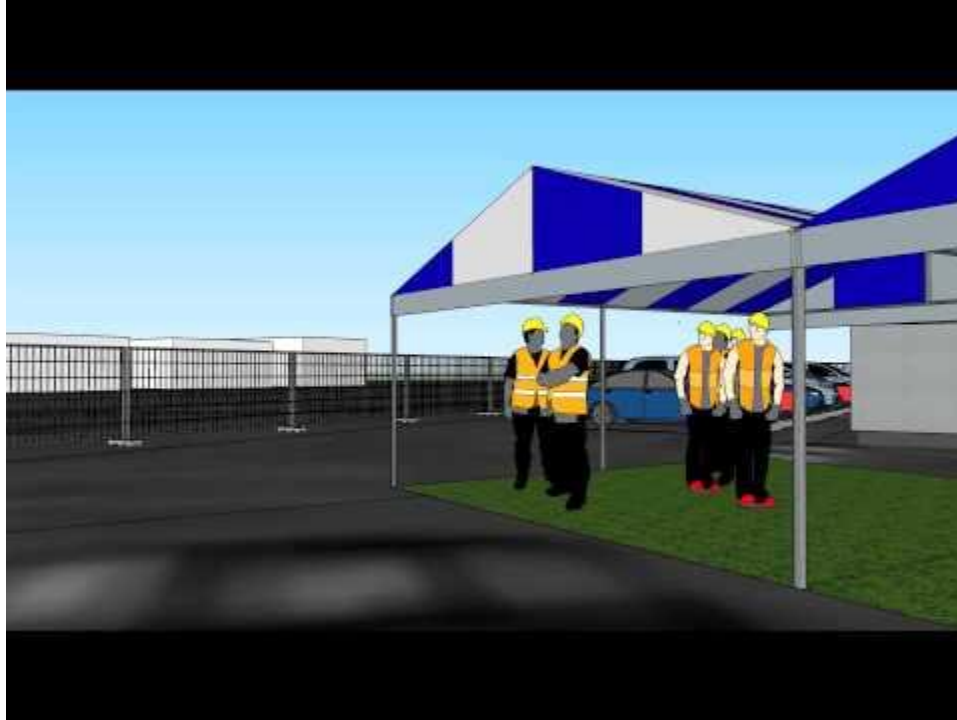
79 points



Site Plan

A scenic photograph of a city at sunset. In the foreground, a city skyline is visible with various buildings, including a prominent orange-brown skyscraper on the left. The city lights are beginning to glow. In the background, a large, rugged mountain with patches of snow or light-colored rock rises against a sky filled with soft, orange and pink clouds. The overall atmosphere is warm and serene.

Site Walkthrough



A

E

MEP

C

Water

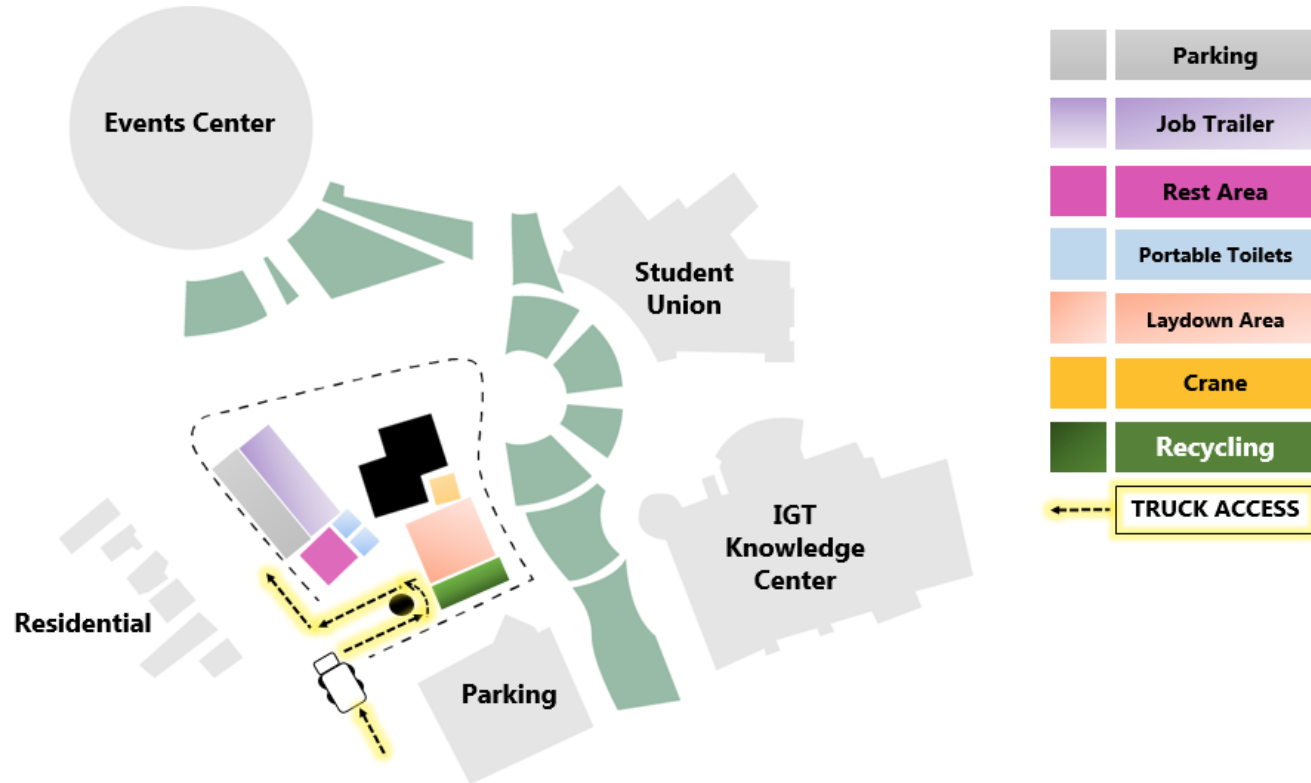
Latency



Site Layout



Site Plan



Code of Considerate Practice

Respect the
Community

Care about
site
appearance

Value the
workforce

Secure
everyone's
safety



Protect the
environment

Protect the Environment

- Wet Curing Blanket
- Reusable Pallets
- Recycling Water used for Wheel Wash



Care about Appearance

- Maintain cleanliness of site
- Enhance appearance of facilities, stored materials, vehicles and equipment



Respect the Community

- Minimize air & noise pollution
- Keep neighbours updated



Secure Everyone's Safety

- Health and Safety Plan
- Fencing around the site
- Embed initiatives and attitudes that enhance safety performance



Value the workforce

- Care for the health and well being of the workforce



A scenic view of a city at sunset. In the foreground, a city skyline is visible with various buildings, including a prominent orange-brown skyscraper on the left. The city is nestled in a valley. In the background, a large, rugged mountain with patches of snow or light-colored rock rises against a sky filled with soft, orange and yellow clouds from the setting sun. The overall atmosphere is warm and picturesque.

Keeping it Local!

Keeping it Local!





Equipment Rentals
4.5 mi



Glazing Contractor
7.7 mi



 **Laborers' Union Local 169**

Labor Union
5.6 mi



Concrete Supplier
6.5 mi

Equipment



Dozer, 70HP Cat
Class Code: 906-2070



CASE 580N Backhoe



LIEBHERR LR1200SX 275 TON



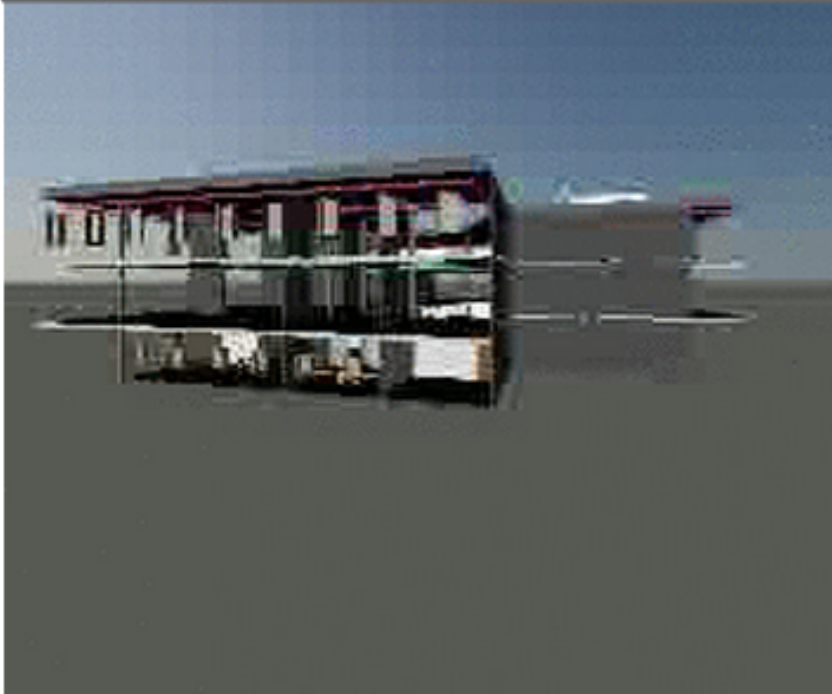
Supports Local Economy

Scheduling

A scenic view of a city at sunset. In the foreground, a city skyline is visible with various buildings, including a prominent orange-brown skyscraper on the left. The city lights are beginning to glow. In the background, a large, rugged mountain with patches of snow or light-colored rock rises against a sky filled with soft, orange and yellow clouds from the setting sun. The word "Scheduling" is overlaid in large, bold, black text across the middle of the image.

Exterior walls omitted to show interior activities

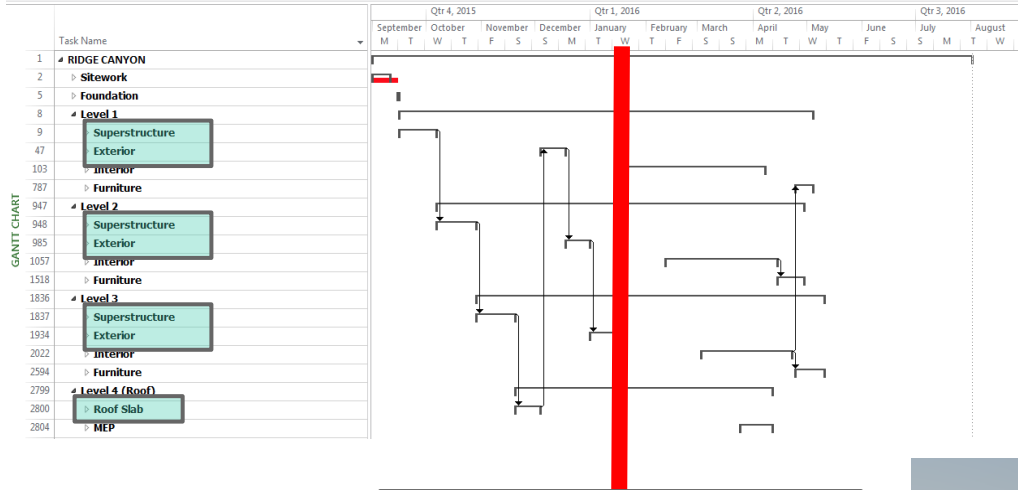
South Facade



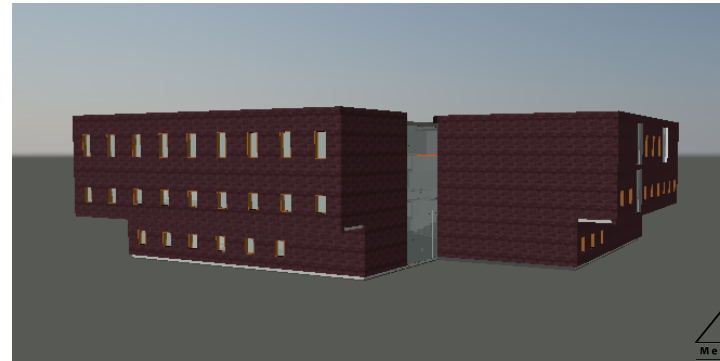
Top View



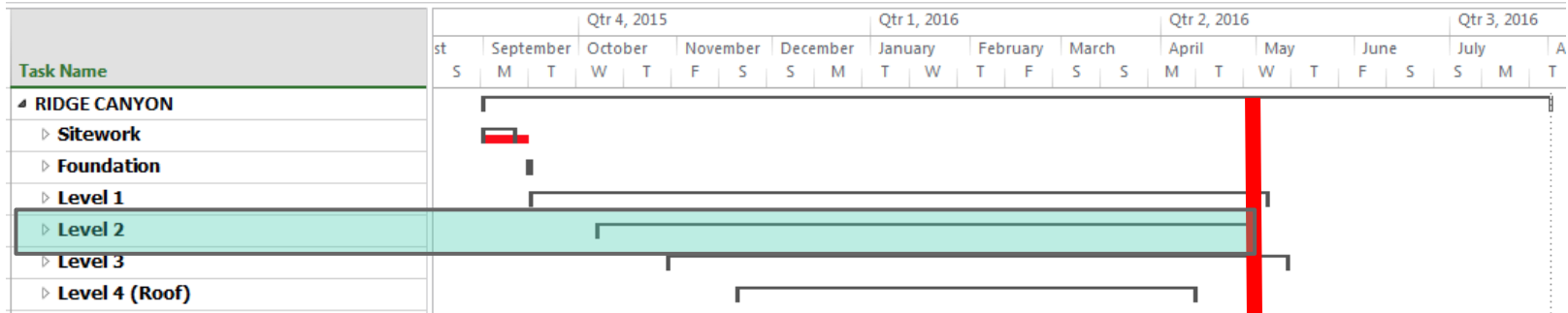
Milestone #1 - Building Covered Up



**Milestone #1
Building Covered Up**



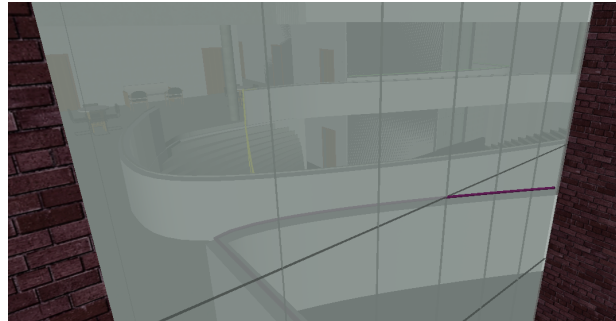
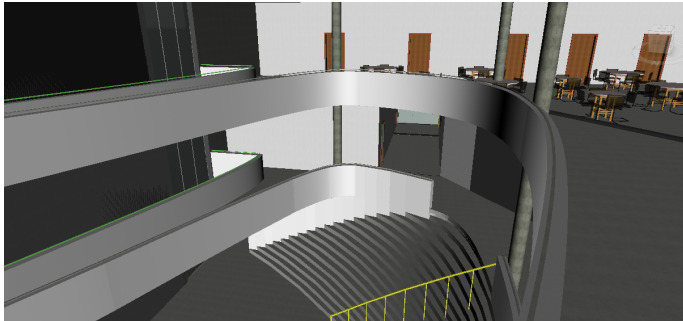
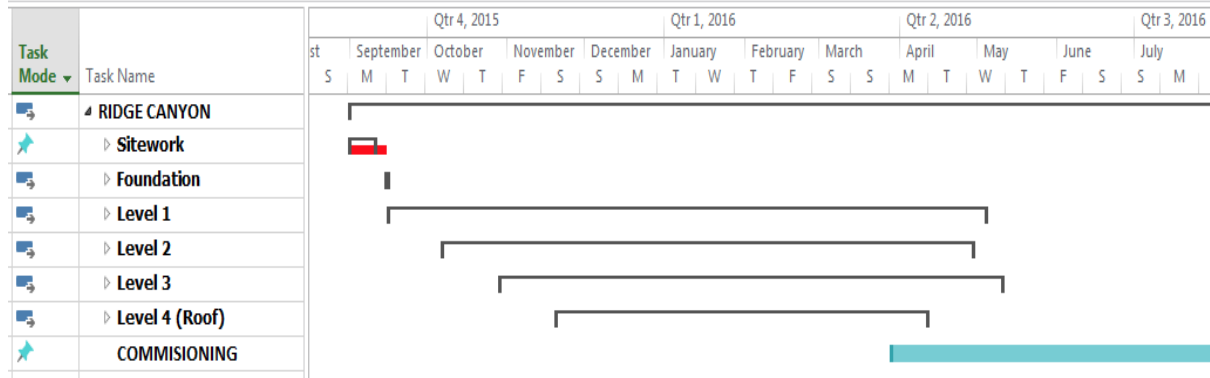
Milestone #2 - Computer Lab Completed by May



**Milestone #2
Computer Lab Move-In**

Schedule - Milestone #3

**Milestone #3
Hand-over to Owners**



A

E

MEP

C

Water

Latency

Construction Starts
1st September 2019



Construction Ends
1st August 2020

Milestone 2:

Building covered up
before January



Milestone 1:

Computer lab move-in
in may



Milestone 3:

1 year maximum
construction duration



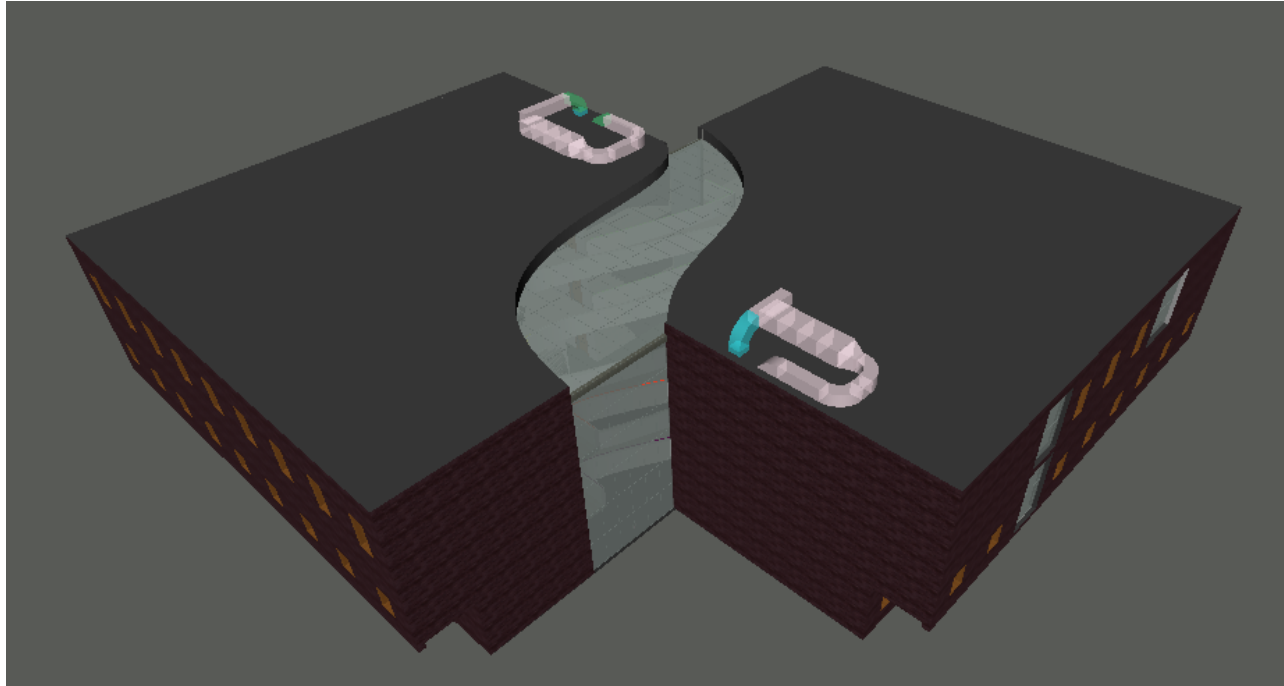
Constructability

A scenic view of a city at sunset. In the foreground, a city skyline is visible with various buildings, including a prominent orange-brown skyscraper on the left. The city lights are beginning to glow. In the background, a large, rugged mountain with patches of snow or light-colored rock rises against a sky filled with soft, orange and yellow clouds from the setting sun.

Constructability - Pre-fabricated Formwork



Constructability - Unitized Curtain Wall



Constructability - Prefab MEP

- 10-15% reduction from RSMeans data
- 20-30% less time spent on site



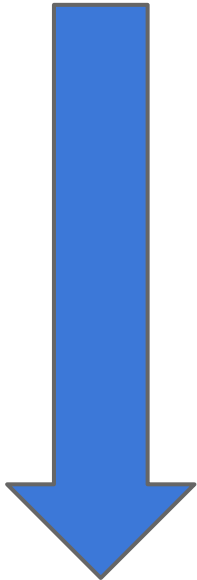
Constructability - Early Elevator Installation

- ❖ Elevator can be used to transport people/material for the remaining construction period.
- ❖ Less obstruction for elevator sub-contractor



Cost Estimation Approach

TVD



Discipline Specific Input

Quantity Take-Offs

RSMeans

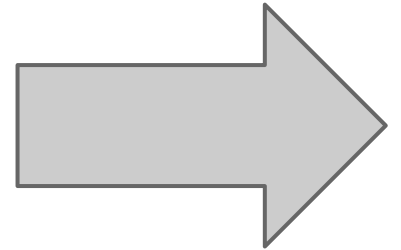
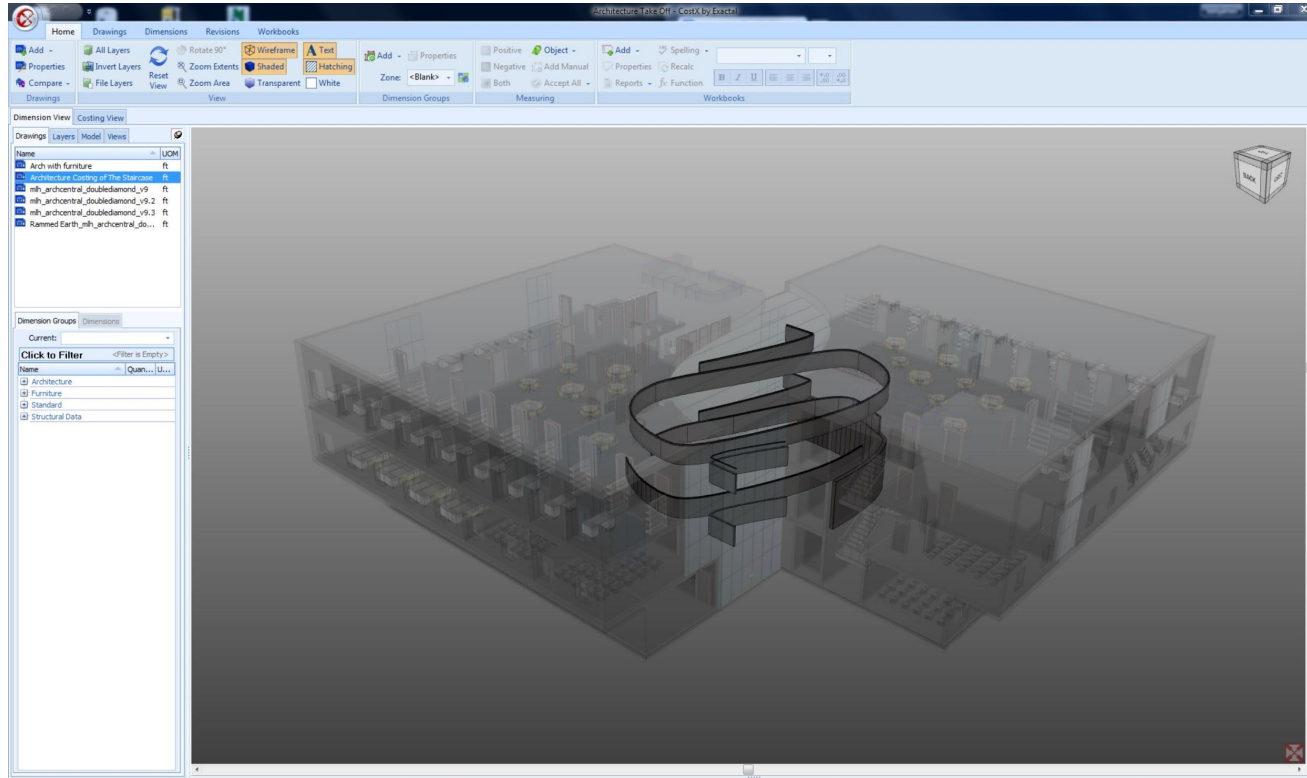
Contacting Vendors and Mentors

TVD Shared with Team

Discipline Specific Input



CostX Quantity Take-Offs



A

E

MEP

C

Water

Latency

RSMMeans

RSMMeansOnline
FROM THE GORDIAN GROUP®

Welcome Lehigh3 Lehigh 

Search Data

Manage Estimates

Square Foot Estimator

Reference Items

☆

Cost Data

Assemblies

Type

Assembly

Labor Type

Standard Union

Location

RENO (894-895)

Search

What are you searching for?

Search

Advanced

☐ Include My Custom Data

Release

Year 2015 Quarter 1

UNIFORMAT II

A Substructure

A10 Foundations

A20 Basement Construction

B Shell

B10 Superstructure

B20 Exterior Enclosure

B30 Roofing

C Interiors

C10 Interior Construction

C20 Stairs

C30 Interior Finishes

D Services

D10 Conveying

D20 Plumbing

D30 HVAC

D40 Fire Protection

D50 Electrical

E Equipment & Furnishings

E10 Equipment

E20 Furnishings

F Special Construction

F10 Special Construction

G Building Sitework

G10 Site Preparation

G20 Site Improvements

G30 Site Mechanical Utilities

G40 Site Electrical Utilities

Assembly Number

A10201202400

A10201202420

A10201202440

A10201202460

A10201202480

A10201202500

A10201202520

A10201202540

A10201202560

A10201202580

A10201202600

A10201202620

A10201202640

A10201204660

A10201204680

A10201204700

A10201204720

A10201204740

A10201204760

A10201204780

A10201204800

A10201204820

A10201204840

A10201204860

A10201204880

A10201204900

A10201204910

A10201204920

A10201204930

Description

Friction type, 8 pile cluster

9 pile cluster

14 pile cluster

400K load, end bearing, 6 pile cluster

8 pile cluster

Friction type, 14 pile cluster

16 pile cluster

18 pile cluster

800K load, end bearing, 12 pile cluster

16 pile cluster

1200K load, end bearing, 19 pile cluster

20 pile cluster

1600K load, end bearing, 19 pile cluster

100' long, 50K load, end bearing, 1 pile

Friction type, 1 pile

2 pile cluster

100K load, end bearing, 2 pile cluster

Friction type, 2 pile cluster

3 pile cluster

4 pile cluster

200K load, end bearing, 3 pile cluster

4 pile cluster

Friction type, 3 pile cluster

5 pile cluster

400K load, end bearing, 6 pile cluster

8 pile cluster

Friction type, 8 pile cluster

10 pile cluster

800K load, end bearing, 13 pile cluster

Unit

Ea.

Ea.

Ea.

Ea.

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Ea.

Ea.

Ea.

Ea.

Fa

Material

11435.60

12852.40

20037.60

6932.20

9234.50

20037.60

22871.20

25704.80

14977.60

18519.60

57684.00

60720.00

57684.00

2201.10

2707.10

5439.50

4427.50

5439.50

8146.60

10828.40

6628.60

8829.70

8146.60

13560.80

13257.20

17710.00

21758.00

27222.80

28740.80

Installation

5395.10

6052.20

9404.90

3889.55

5183.75

9404.90

10742.15

12079.40

8421.20

10369.45

15042.20

15887.60

15042.20

1116.80

1152.46

2318.75

2234.60

2318.75

3466.60

4609.45

3349.40

4469.20

3466.60

5762.30

6703.80

9218.90

11547.65

14517.40

Total

16830.70

18904.60

29442.50

10821.75

14418.25

29442.50

33613.35

37784.20

23398.80

28889.05

72726.20

76607.60

72726.20

3317.90

3859.56

7758.25

6662.10

7758.25

11613.20

15437.85

9978.00

13298.90

11613.20

19323.10

19961.00

26648.40

30976.90

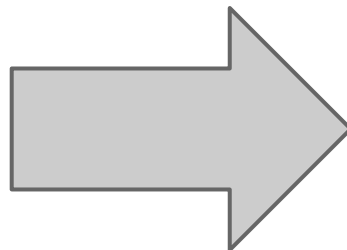
38770.45

43753.20

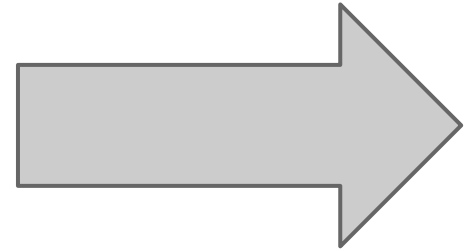
Measurement System : English

+ Create New Estimate

Total 642 records found



Contacting Vendors and Mentors



RAMMED EARTH WORKS

ORIGINAL RAMMED EARTH

Terf TVD

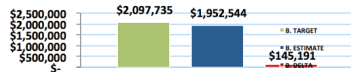
The screenshot displays the Terf TVD software interface, which simulates a virtual meeting environment. The main window shows a large data wall with various charts, tables, and project information. The interface includes a menu bar at the top with options like File, Edit, View, Meeting, Tools, Actions, Forums, Extras, and Help. On the right side, there is a 'People' panel listing online participants: B Cohen-14 (Me), catrinm (Here), Marios (Here), Martin (Here), msantos1 (Here), and ROBERT (Here). Below this is a 'Landmarks' panel listing various URLs. The main data wall features a 'Target Value Design Wall' with cost breakdowns for Canyon and Mountain ideas, including Steel, Timber, and Concrete. There are also pie charts for 'Canyon Idea' and 'Mountain Idea'. A large table on the left shows project details. In the foreground, three avatars (a man in a suit, a woman in a green shirt, and a man in a white shirt) are visible, interacting with the data wall. The bottom status bar shows the text 'B Cohen-14 says Hi!' and various system icons.

TVD Sheet Explained

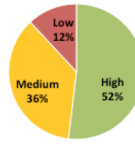
B. SHELL

TOTAL TARGET	\$ 10,000,000
B. TARGET	\$ 2,097,735
B. ESTIMATE	\$ 1,952,544
B. DELTA	\$ 145,191

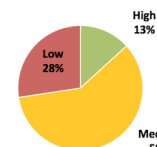
B. SHELL SUMMARY



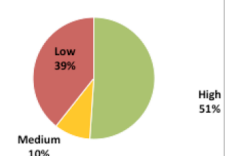
B: Quantity Reliability



B: Cost Data Reliability



B: Overall Reliability



Category	Line Item Description		Cost Data				Quantity		Estimate Reliability			Estimate		Target Value		Value Delta
	Identification Number	Description	Unit	Material O&P	Installation O&P	Total O&P	Quantity	Unit	Quantity Reliability	Cost Data Reliability	Overall Reliability	% of Total	Estimated Cost	% of Total	Target Value	Value Delta
B. SHELL																
B1010 Floor Construction																
	B10102011120	Cast-in-place concrete column, 14" round, tied, 200K load, 10' story height, 150 bal/LF, 4000 psi	V.L.F.	\$ 15.61	\$ 31.42	\$ 47.03	307	V.L.F.	1	1	1	20%	\$ 1,952,544		\$ 2,097,735	\$ 145,191
	B10102203400	Cast-in-place concrete beam and slab, 6" slab, two way, 16" column, 20'x20' bay, 125 PSF superimposed load, 220 PSF total load -- look into 6000 PSI concrete	S.F.	\$ 5.95	\$ 10.10	\$ 16.05	30611	S.F.	1	2	1	10%	\$ 1,013,122		\$ -	\$ (1,013,122)
	B10102135100	Concrete beam, precast, 12" x 28", 350 PLF, 30' span, 1.65 KLF superimposed load	L.F.	\$ 175.62	\$ 11.25	\$ 186.87	43	L.F.	1	2	2		\$ 14,438			
B1020 Roof Construction																
	B10102177500	Cast-in-place concrete slab, 5.5" thick, one way, 20' multi span, 40 PSF superimposed load, 109 PSF total load	S.F.	\$ 5.65	\$ 8.99	\$ 14.64	11720	S.F.	2	1	2	2%	\$ 171,581		\$ -	\$ (171,581)
B2010 Exterior Walls																
	B20101324000	Brick wall, composite double width, roman face/common back-up, 4" thick	S.F.	\$ 11.96	\$ 19.28	\$ 31.24	17124		2	3	3	6%	\$ 618,965		\$ -	\$ (618,965)
	B20202202000	Glazing panel, plate glass, 3/8" thick, clear	S.F.	\$ 13.06	\$ 11.27	\$ 24.33	3453	S.F.	3	2	3		\$ 84,011			
B2020 Exterior Windows																
	B20201045600	Windows, steel, picture window, standard glass, 3' x 3'	Ea	\$ 446.99	\$ 113.81	\$ 560.80	45	Ea	3	1	3	1%	\$ 59,593		\$ -	\$ (59,593)
	B20201045650	Windows, steel, picture window, standard glass, 6' x 4'	Ea	\$ 1,190.03	\$ 303.76	\$ 1,493.79	23	Ea	3	1	3		\$ 25,236			
B2030 Exterior Doors																
	B20301106950	Door, aluminum & glass, with transom, narrow stile, double door, hardware, 6'-0" x 10'-0" opening	Opng.	\$ 3,655.60	\$ 2,807.13	\$ 6,462.73	2	Opng.	3	1	3	0%	\$ 28,157		\$ -	\$ (28,157)
	B20301107200	Door, aluminum & glass, with transom, non-standard, hardware, 3'-0" x 10'-0" opening	Opng.	\$ 2,321.80	\$ 1,486.13	\$ 3,807.93	4	Opng.	3	2	3		\$ 12,925			
B3010 Roof Coverings																
	B30101203400	Roofing, single ply membrane, TPO, 60 mil membrane, heat welded seams, loosely laid and ballasted	S.F.	\$ 1.13	\$ 0.71	\$ 1.84	10000	S.F.	3	2	3	1%	\$ 61,126		\$ -	\$ (61,126)
	B30103202700	Insulation, rigid, roof deck, extruded polystyrene, 40 PSI compressive strength, 4" thick, R20	S.F.	\$ 2.27	\$ 0.82	\$ 3.09	10000	S.F.	3	2	3		\$ 18,400			
	B30104201400	Roof edges, aluminum, duranodic, .050" thick, 6" face	L.F.	\$ 16.35	\$ 14.77	\$ 31.12	380	L.F.	3	2	3		\$ 30,900			
	B30104300040	Flashing, aluminum, no backing sides, .019"	S.F.	\$ 1.31	\$ 5.15	\$ 6.46		S.F.	3	2	3		\$ 11,826			
	B30106305100	Gravel stop, aluminum, extruded, 4", mill finish, .050" thick	L.F.	\$ 7.09	\$ 6.43	\$ 13.52		L.F.	3	2	3					

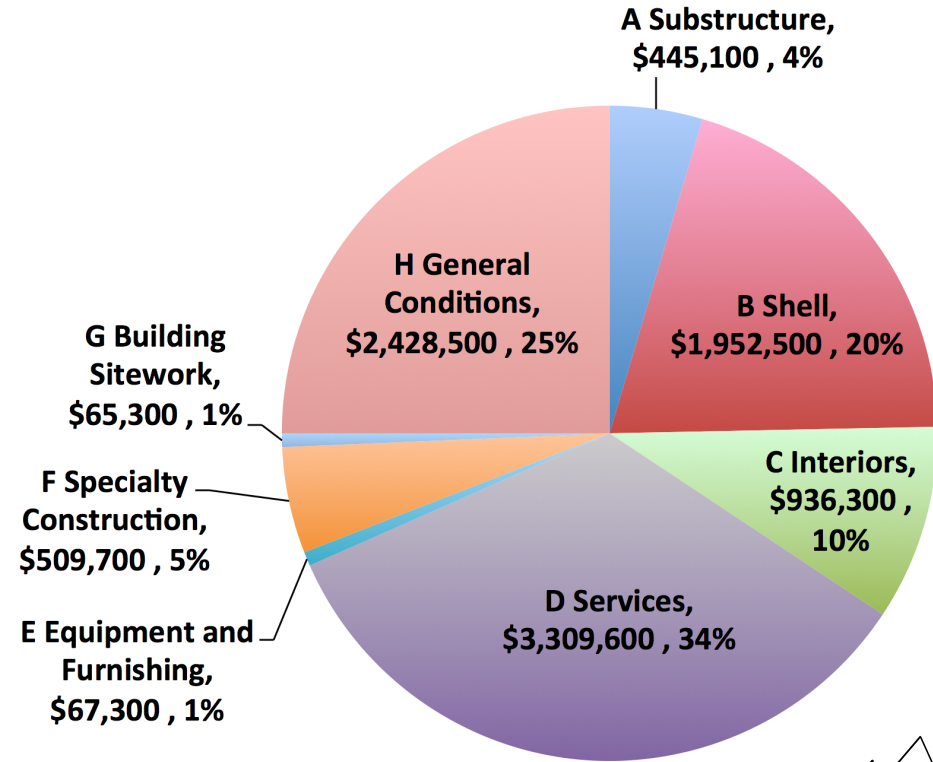
TVD Budget and Target

Budget	\$10,500,000
Expected Inflation	2.34%
5 Year Treasury Bond ROI	1.51%
Target	\$10,000,000

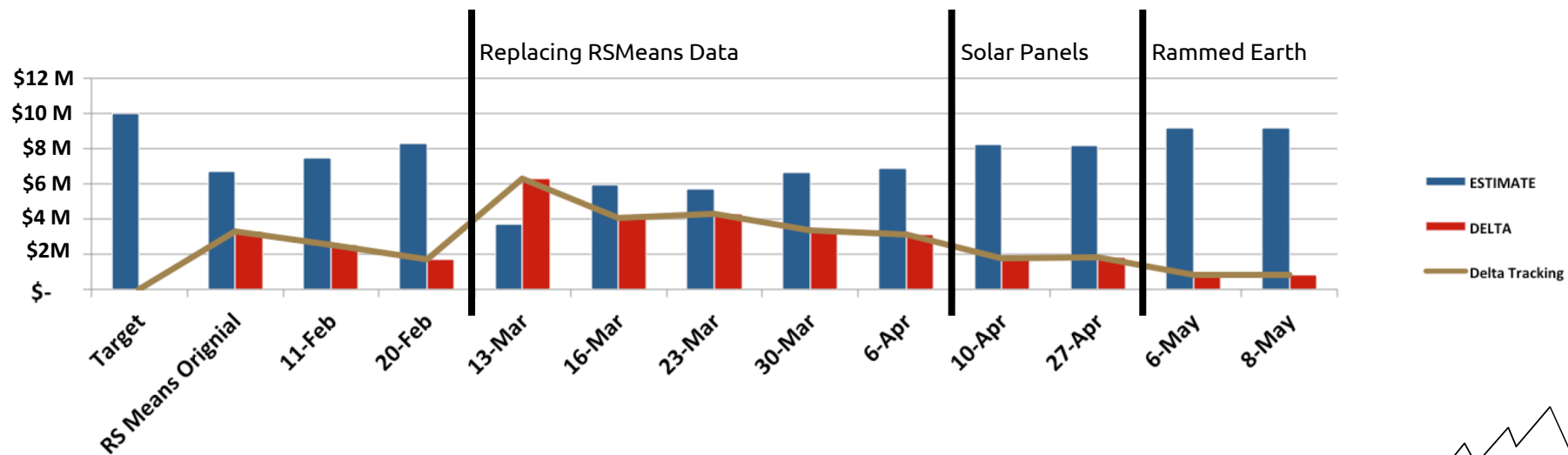
Estimate Summary

ESTIMATE AND TARGET VALUE - SUMMARY

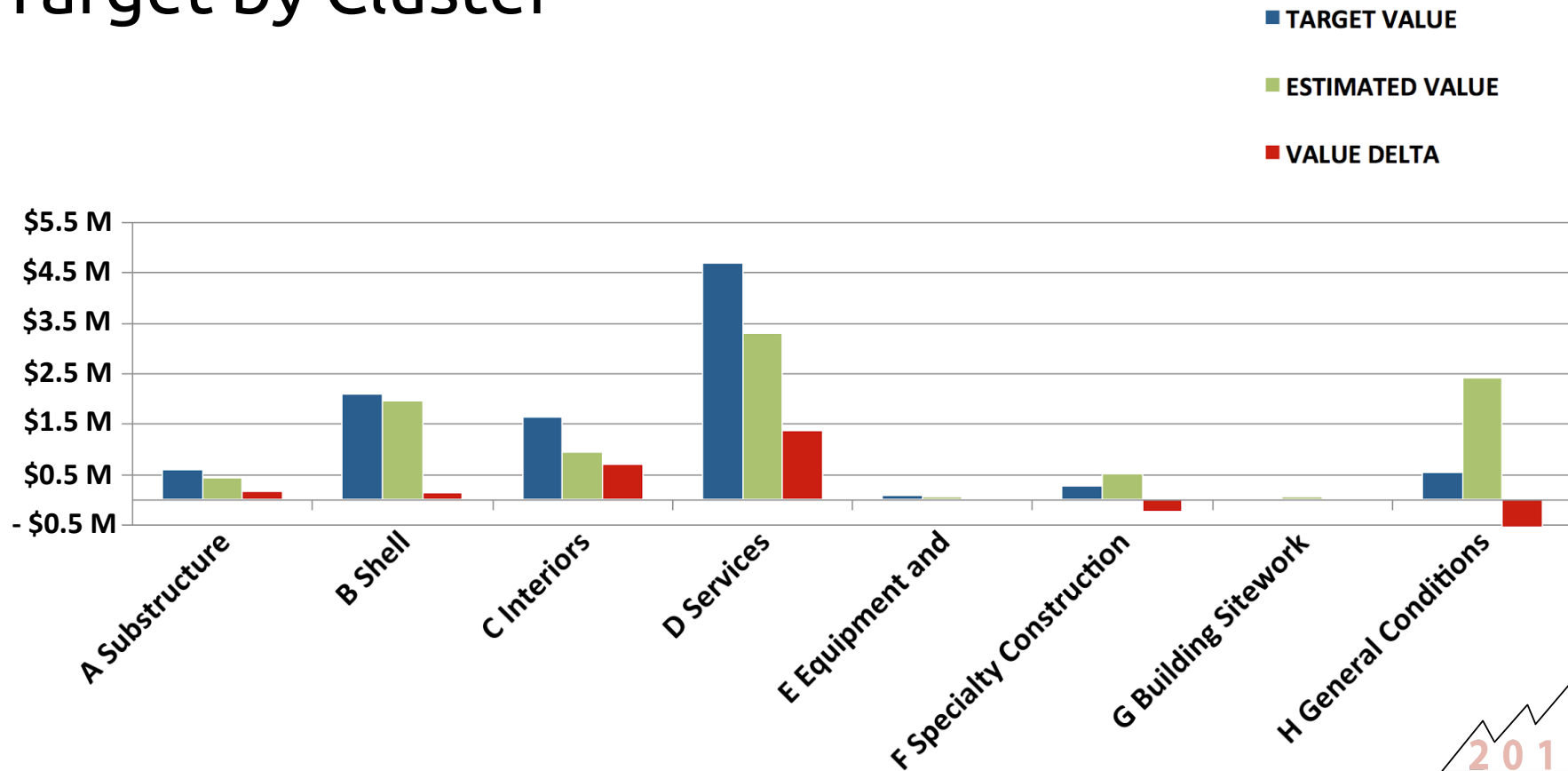
A Substructure	\$	445,100
B Shell	\$	1,952,500
C Interiors	\$	936,300
D Services	\$	3,309,600
E Equipment and Furnishing	\$	67,300
F Specialty Construction	\$	509,700
G Building Sitework	\$	65,300
H General Conditions	\$	2,428,500
Total	\$	9,714,300



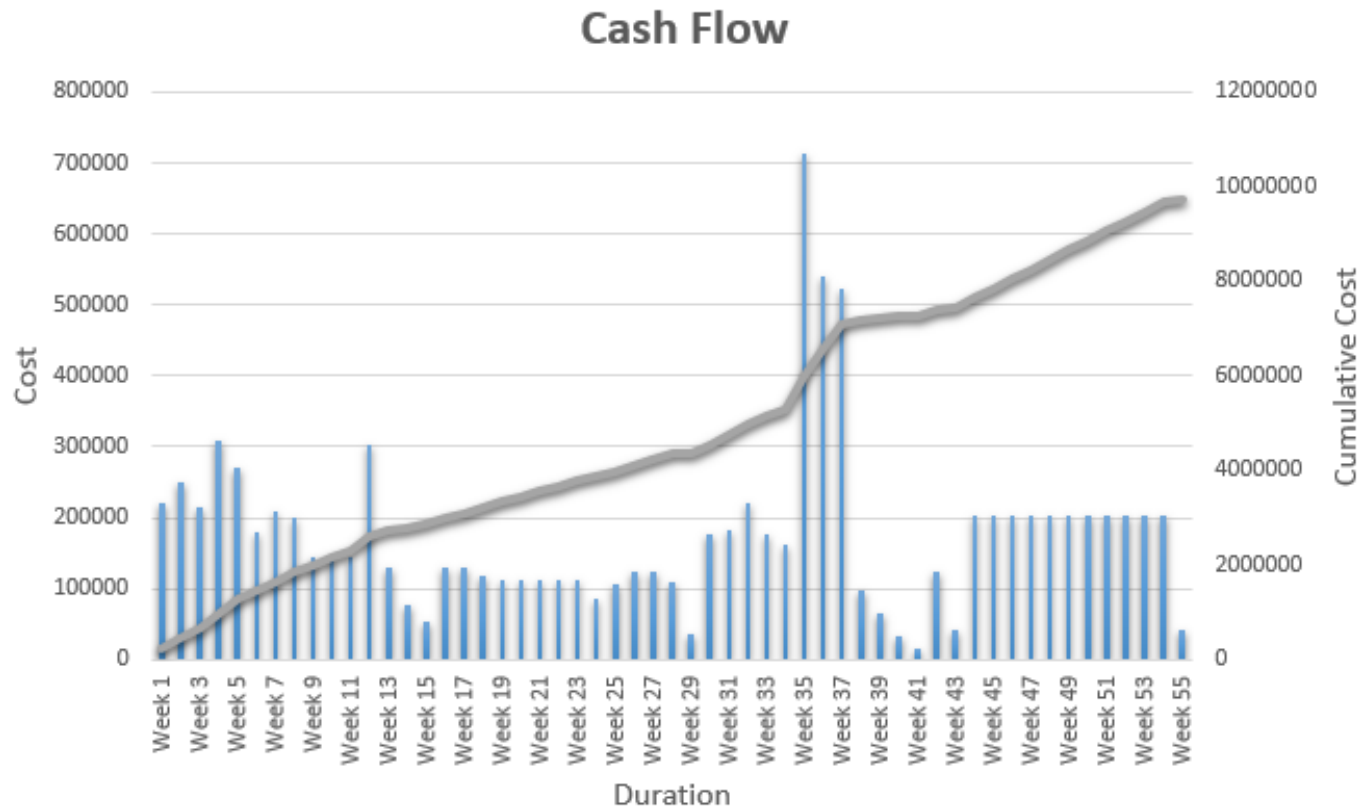
Tracking Over Time



Target by Cluster



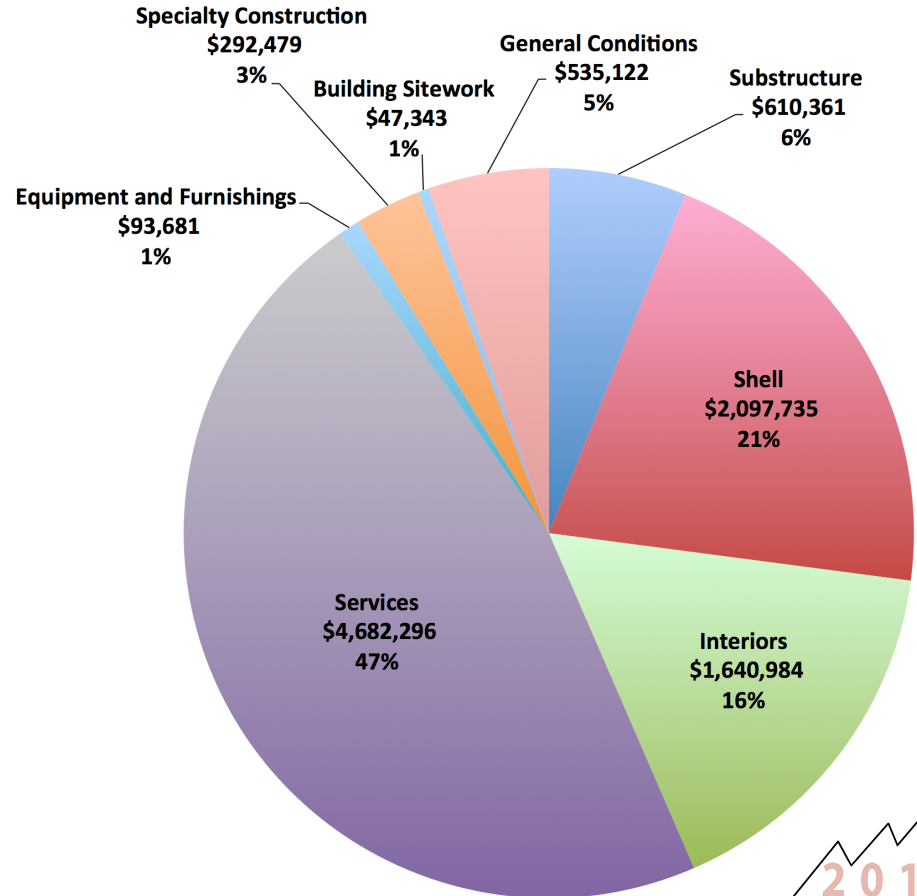
5D Cost Flow Analysis



Estimation Targets

TARGETS

Substructure	6%
Shell	21%
Interiors	16%
Services	47%
Equipment and Furnishings	1%
Specialty Construction	3%
Building Sitework	1%
General Conditions	5%







Water Challenge

Water Wall, **A**

Fly Ash Concrete, **SE**

Namib Beetle, **MEP**

Water Efficient/Waterless Fixtures, **MEP**

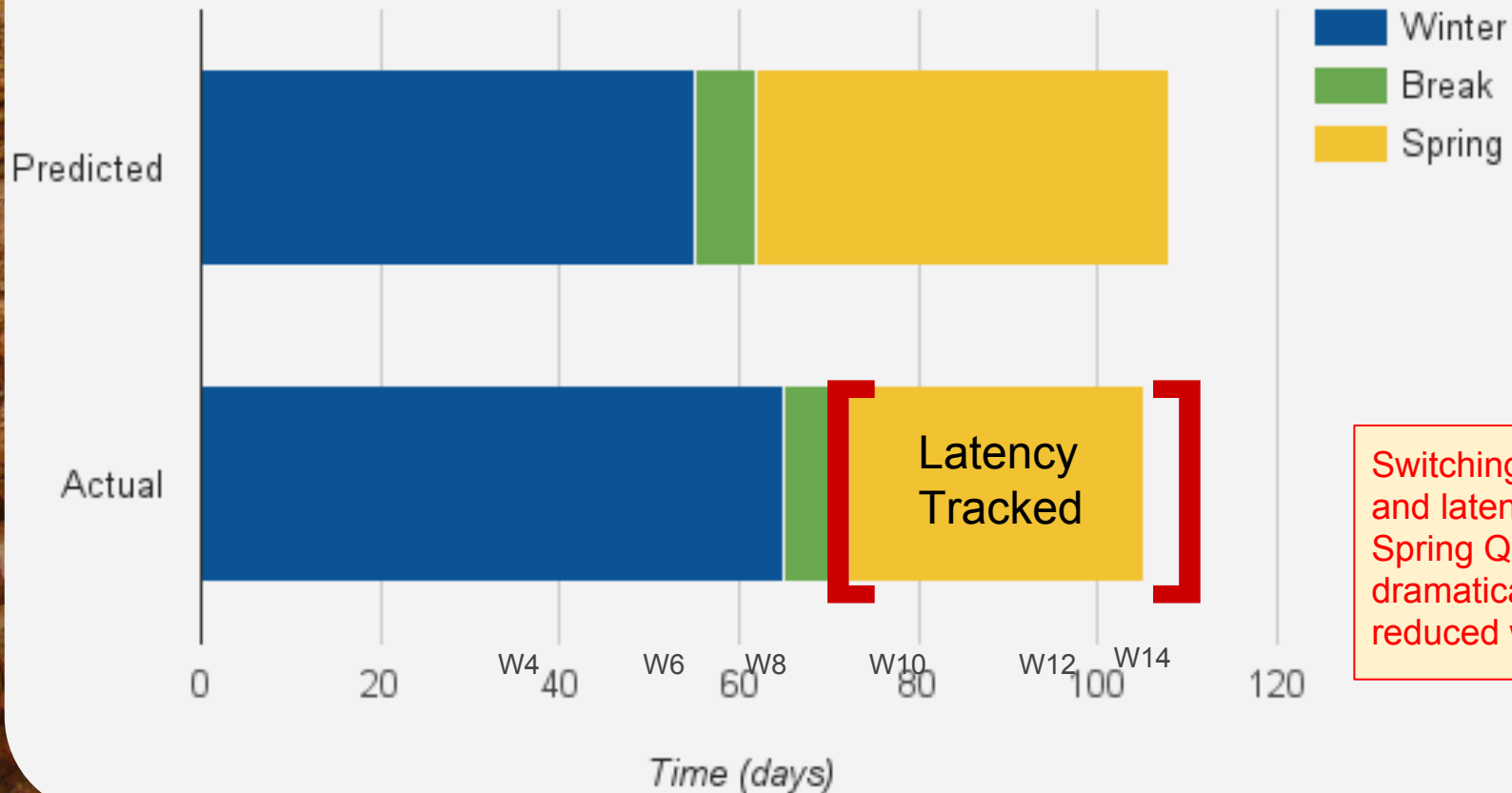
Grey Water Reuse, **MEP**

Recycled Groundwater Wheel Washer, **CM**

Curing Blanket, **CM**



Effect of Latency Tracking on Predicted vs Actual Timescale



Switching to Drive and latency tracking Spring Quarter, dramatically reduced work time



Special Thanks to...

Mentors:

Renate Fruchter (Super Mentor and Super Owner)

Prof. Guido Morgenthal (BUW)

Armin Dariz (SOFiSTiK)

Greg Luth (Gregory P. Luth & Associates)

Eduardo Miranda (Stanford)

Luis Rivera (Arup)

Flavia Grey (AEC Alumni)

Erik Kneer (Holmes Culley)

Mark Barlett (Skanska USA)

Fernando Castillo Cohen (AEC Alumni)

Josh Odelson (AEC Alum)

Willem Kymmell (UCS Chico University)

Michael Luring (AAU)

Andrej Kurent (AEC Alumni)

John Nelson (UW Madison)

Constantine Megaridis (UIC)

Kyle Adams (Arup)

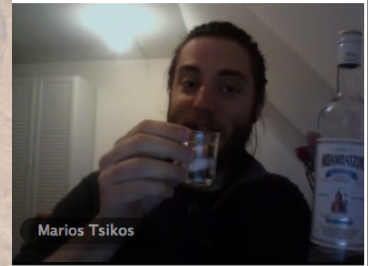
Owners:

Maria Frank

Mike Muller

Ana Sofia

Enrique Hernandez Delgado



Lessons Learned



“Don’t be shy and don’t forget to mute yourself!”