LET

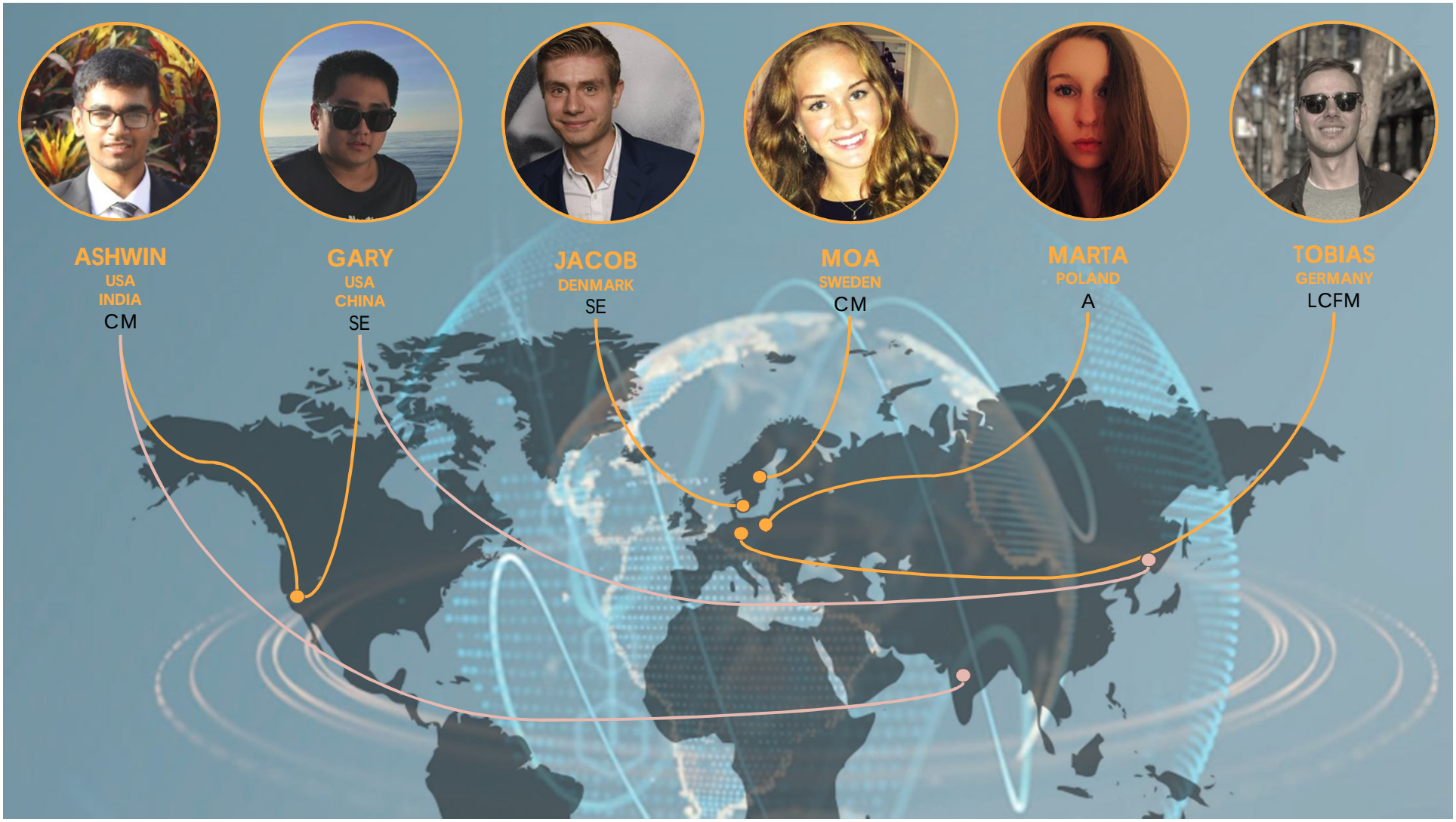
THE JOURNEY

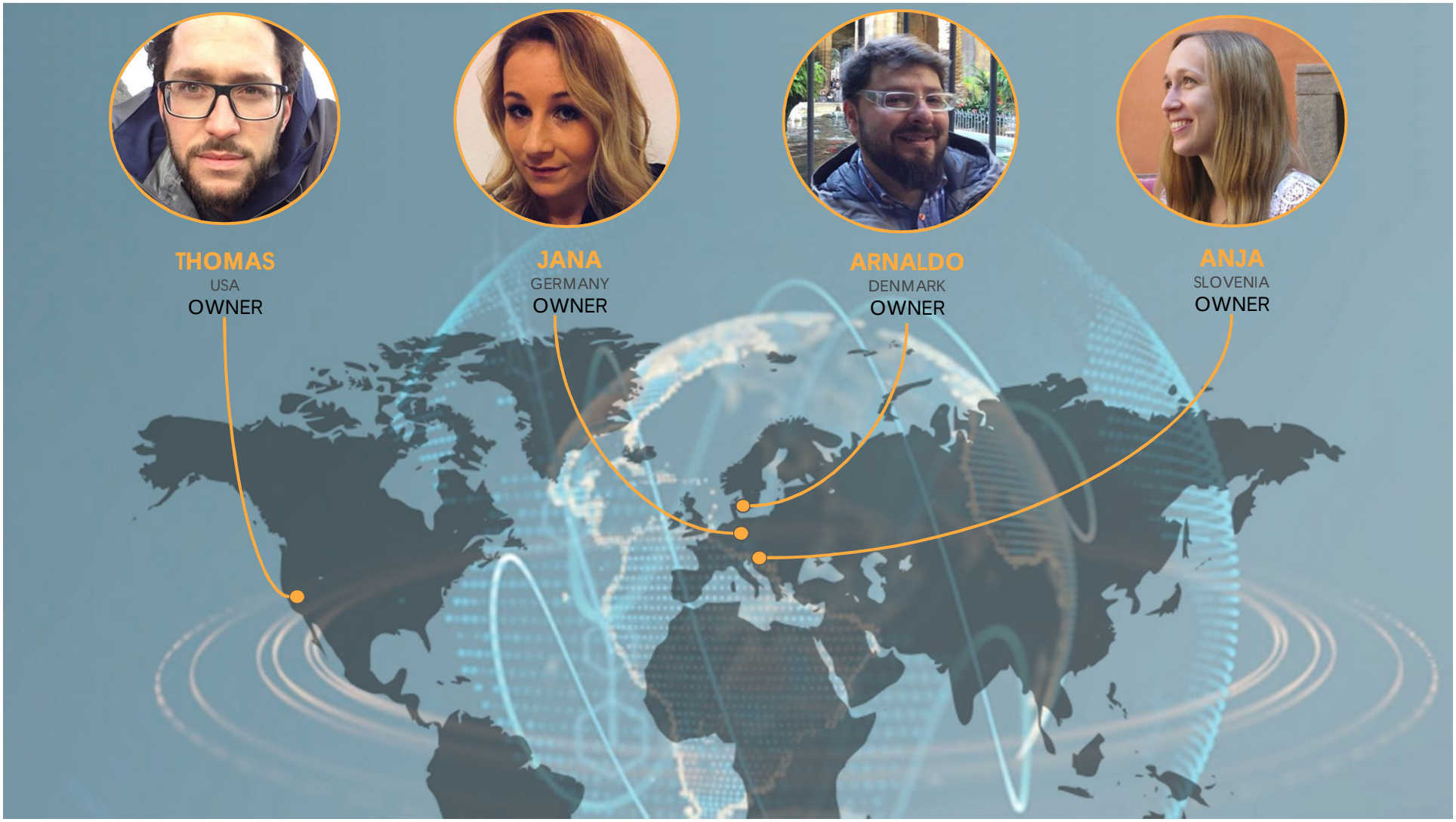
BEGIN

TEAM

CENTRAL 2018

TEAM CENTRAL 2018


ASHWIN
USA
INDIA
CM
GARY
USA
CHINA
SE
JACOB
DENMARK
SE
MOA
SWEDEN
CM
MARTA
POLAND
A
TOBIAS
GERMANY
LCFM

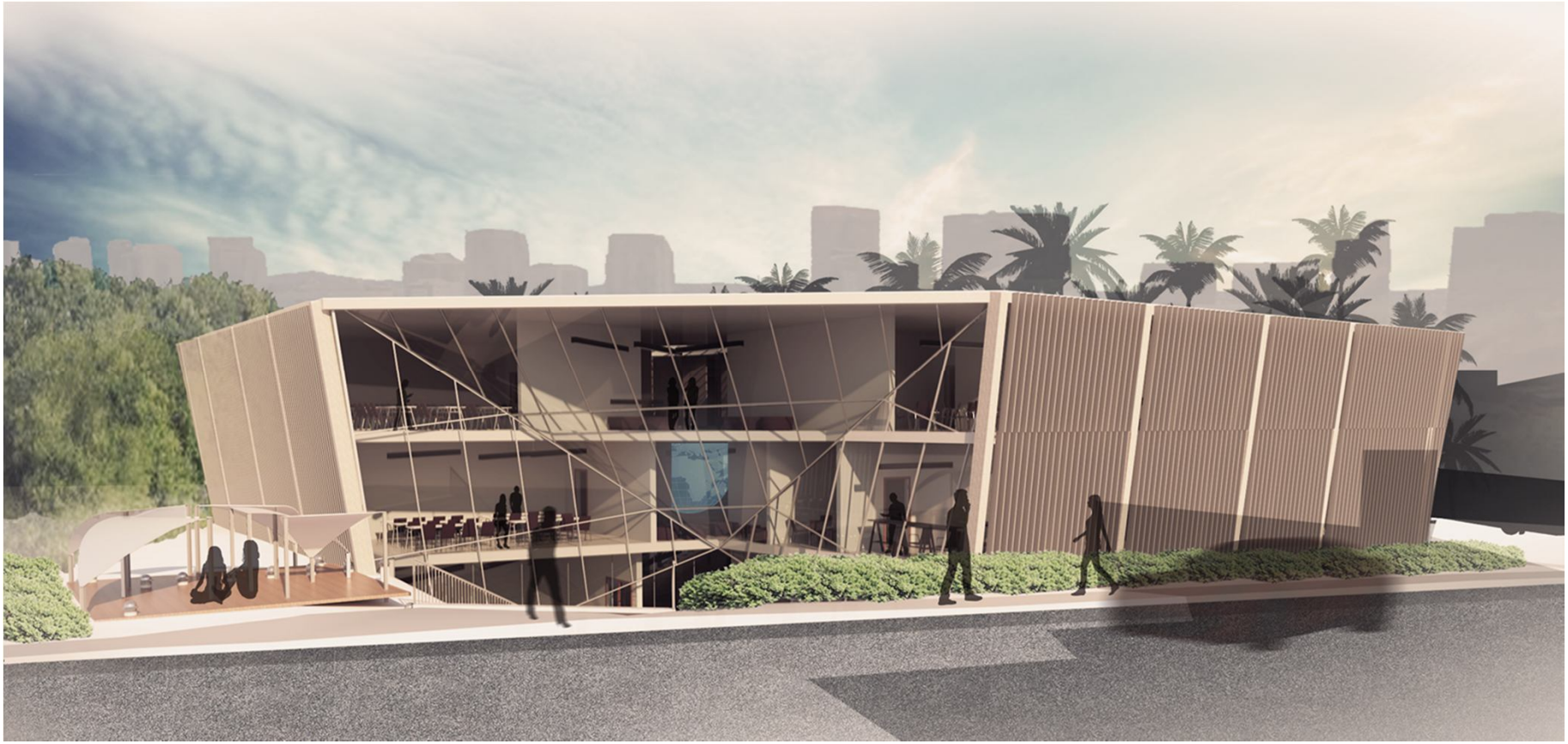

THOMAS
USA
OWNER
JANA
GERMANY
OWNER
ARNALDO
DENMARK
OWNER
ANJA
SLOVENIA
OWNER



AEC Global Teamwork: The Journey Continues

2017-2018

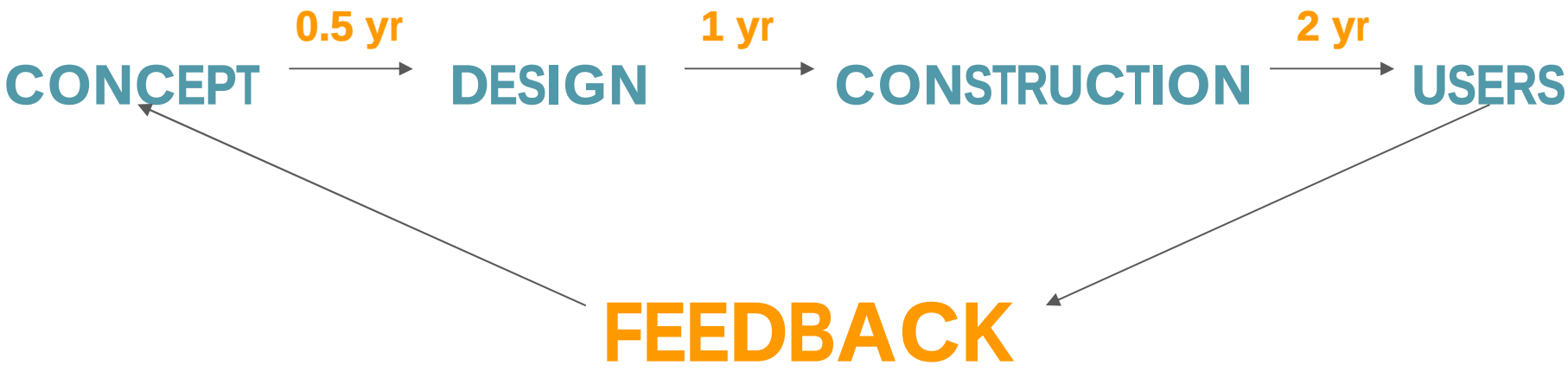
WINTER CONCEPT 1: TREASURE



WINTER CONCEPT 2: SYNERGY



FEEDBACK LOOP



Survey from UCLA Students

DECISION MATRIX

Factors	Weight	Models			
		Treasure Steel	Treasure Timber	Synergy Steel	Synergy Timber
Costs	**20,0%**				
Construction Costs	5,0%	0,9	1,1	0,6	0,5
Life-Cycle-Costs	10,0%	2,0	2,2	1,4	1,2
Risk-Costs	5,0%	0,9	0,6	1,0	0,8
Sustainibility	**35,0%**				
Water consumption	10%	1,3	1,8	1,3	1,8
Carbon footprint	10%	0,7	1,0	0,7	1,0
Energy efficiency	10%	1,9	2,9	0,9	3,0
Replacement of components	5%	0,8	0,8	0,7	0,7
Prefrabrication	**2,5%**	0,5	0,4	0,5	0,4
Constructability	**5%**	**1,0**	**0,9**	**1,0**	**0,9**
Interior	**17,5%**				
Air Quality	5,0%	0,8	0,9	0,7	0,7
User Experience	2,5%	1,0	1,0	0,7	0,7
Innovation	5,0%	0,4	0,5	0,4	0,5
User Comfort	2,5%	0,4	0,5	0,5	0,5
Thermal Comfort	2,5%	0,4	0,5	0,4	0,4
Exterior	**7,5%**				
Appeal/urban design	2,5%	**0,5**	**0,5**	**0,4**	**0,4**
Neighbourhood integration	2,5%	0,9	0,9	0,8	0,9
Impact on surroundings	2,5%	0,4	0,5	0,5	0,5
Transparency	**2,5%**	0,4	0,5	0,4	0,4
Functionality	**2,5%**	0,5	0,5	0,4	0,4
Earthquake resilience	**2,5%**	0,9	0,9	0,7	0,7
Consistence of big idea	**2,5%**	0,4	0,5	0,4	0,4
Survey Feedback UCLA	**2,5%**	0,3	0,5	0,3	0,3
	100,0%	17,3	20	15	17,1

=



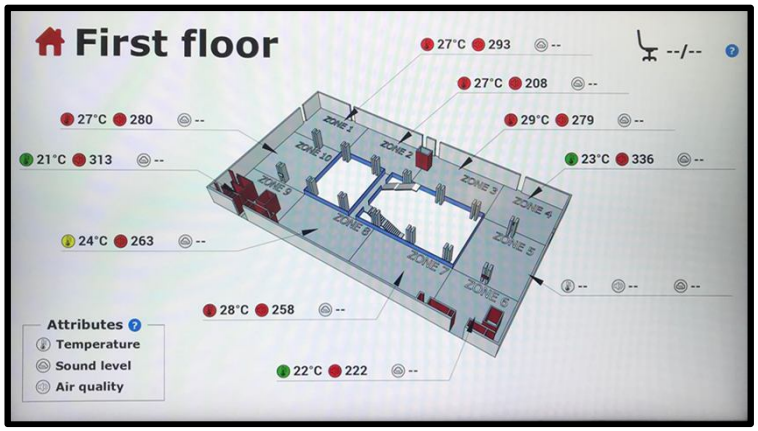
TREASURE TIMBER


72%
54%
96%
82%
THE TREASURE
MARTA//ASHWIN//GARY//JACOB//MOA//TOBIAS

BIG IDEA 1.0

TREASURE = KNOWLEDGE





TECHNOLOGY

A JOURNEY FROM KNOWLEDGE TO WISDOM

"Technology as a means and not an end in itself"



KNOWLEDGE





VIA TECHNOLOGY

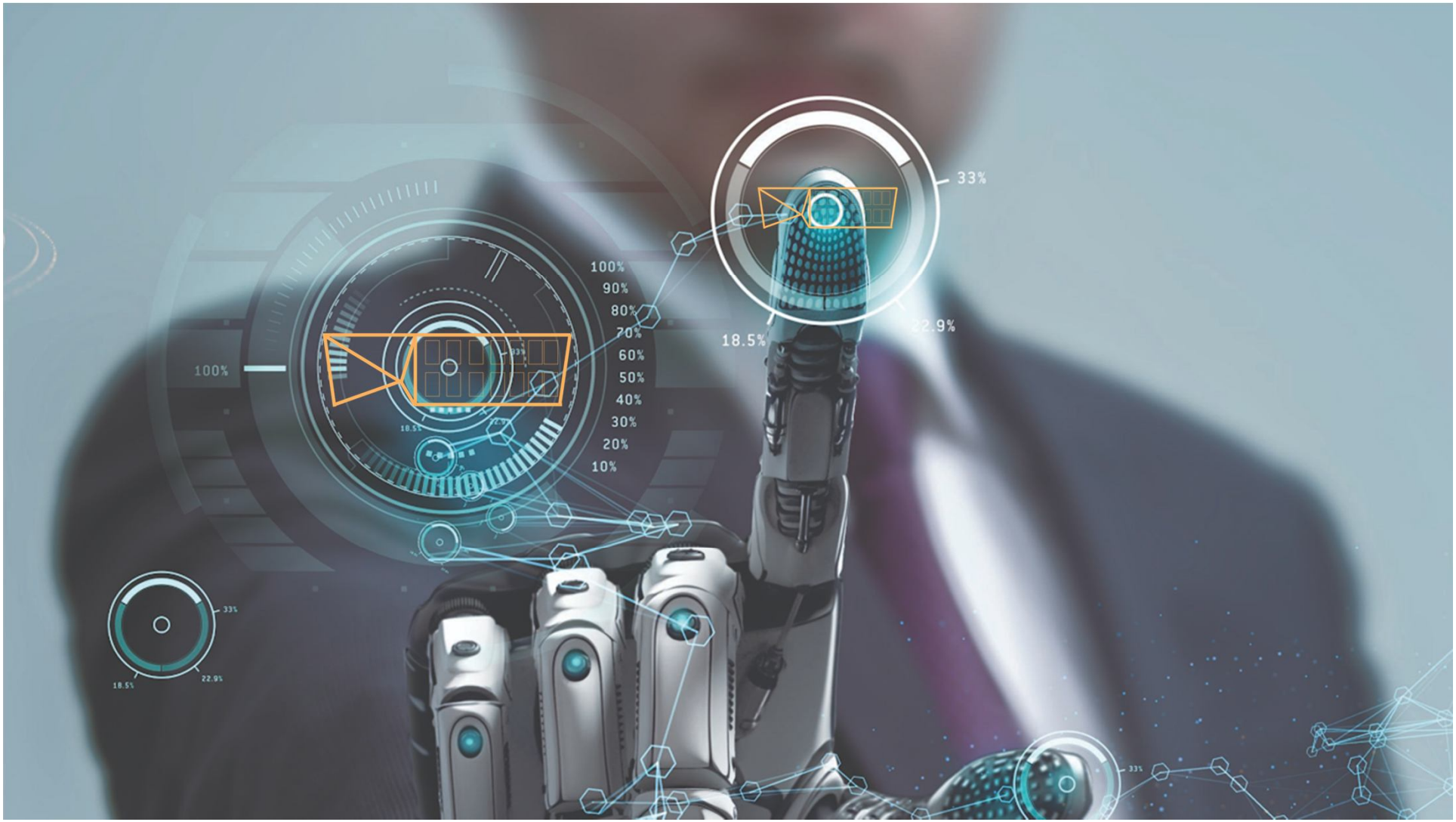


WISDOM

TREASURE = WISDOM

MAKE PEOPLE ACT VIA HUMAN - TECHNOLOGY INTERACTION




33%
18.5%
22.9%
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
100%

HUMAN AND TECHNOLOGY

WHAT HAPPENS WHEN HUMAN MEETS TECHNOLOGY?



i- Building



NET ZERO



LESS M&O



CHANGE HUMANS BEHAVIOR

TEAM CENTRAL

i- Team





- HUMAN + ARTIFICIAL INTELLIGENCE
- REAL TIME CLASH DETECTION
- PREDICTIVE DESIGN SOLUTIONS



"Data driven approach to complete the **sustainability puzzle**"

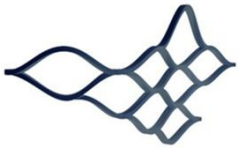
SUSTAINABILITY GOALS



AI + HUMAN



SENSORS IN BUILDING



PARAMETRIC DESIGN

Changing Human Behaviour



FUTURE CLIMATE



LEED CERTIFICATE



SOLAR PANEL

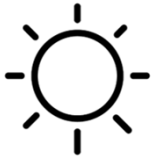
Integration with future



NEIGHBORHOOD



SUSTAINABLE MATERIAL



DAYLIGHT ANALYSIS

Integration with present



SAFE SITE



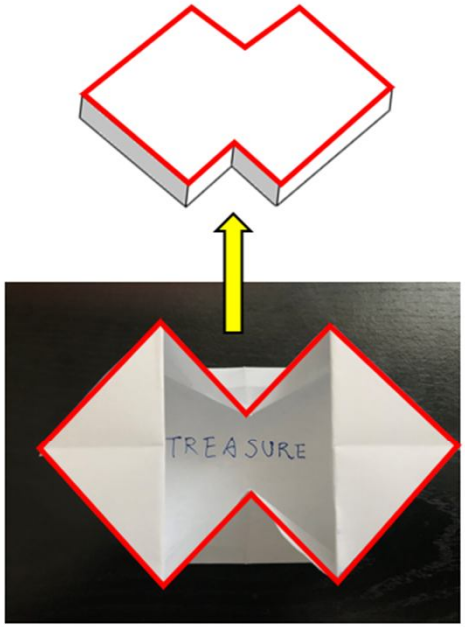
PREFABRICATION



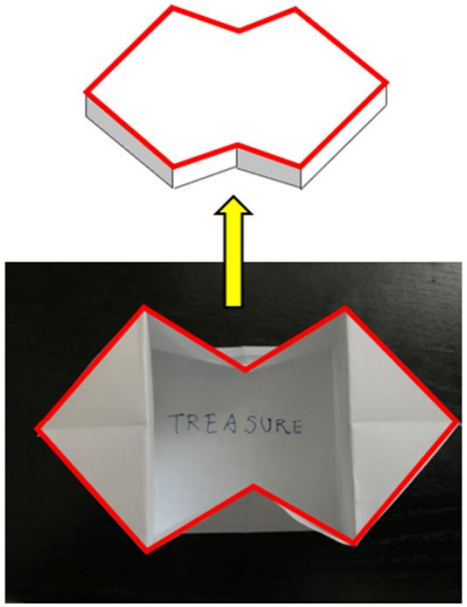
RISK REDUCTION

Integration with operations

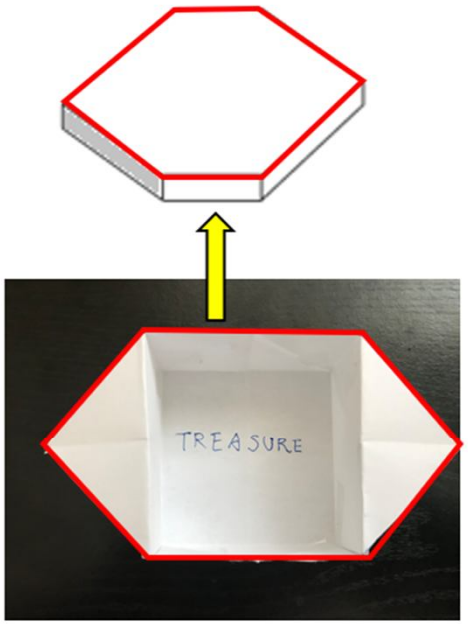
DESIGN EVOLUTION



1st floor:
Closed box
(Double Diamond)

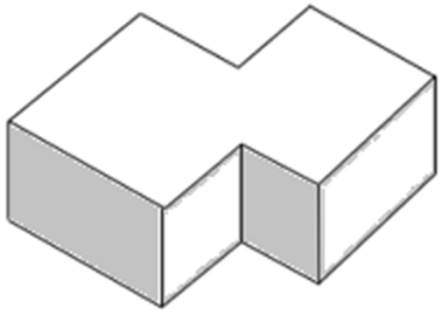


2nd floor:
Half-opened box



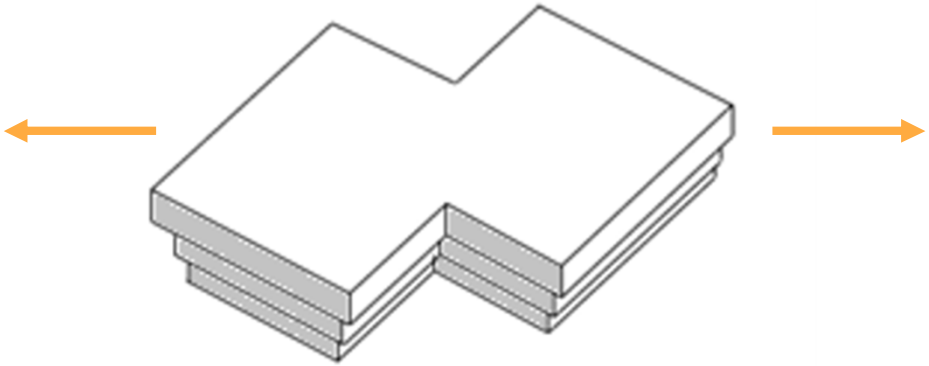
3rd floor:
Completely
opened box

ORIGINAL SHAPE



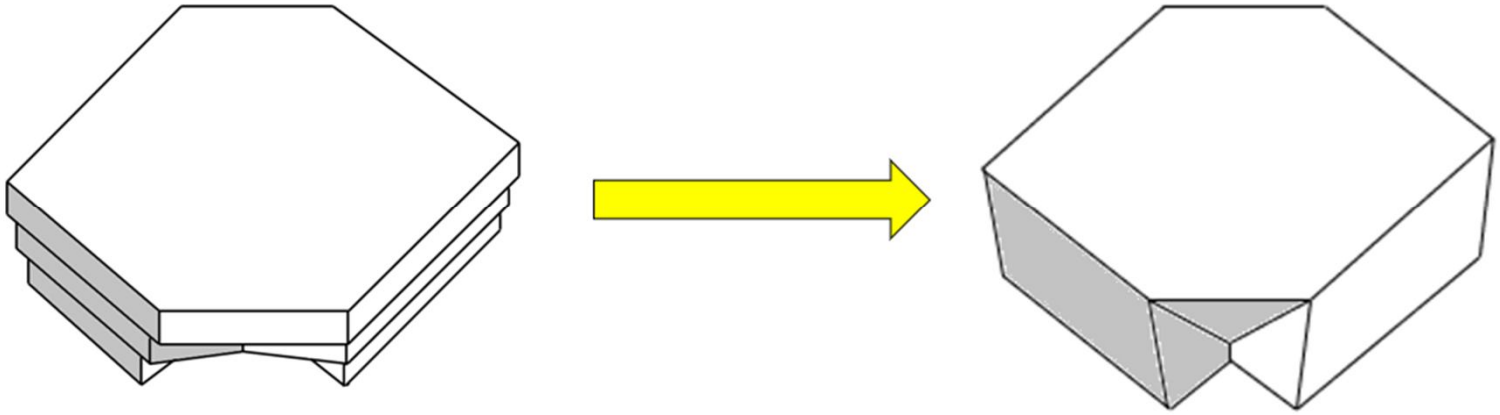
Double-
diamond
on site

ADD EXTRA SPACE TO FLOOR PLANS



Design 3
floors
separately

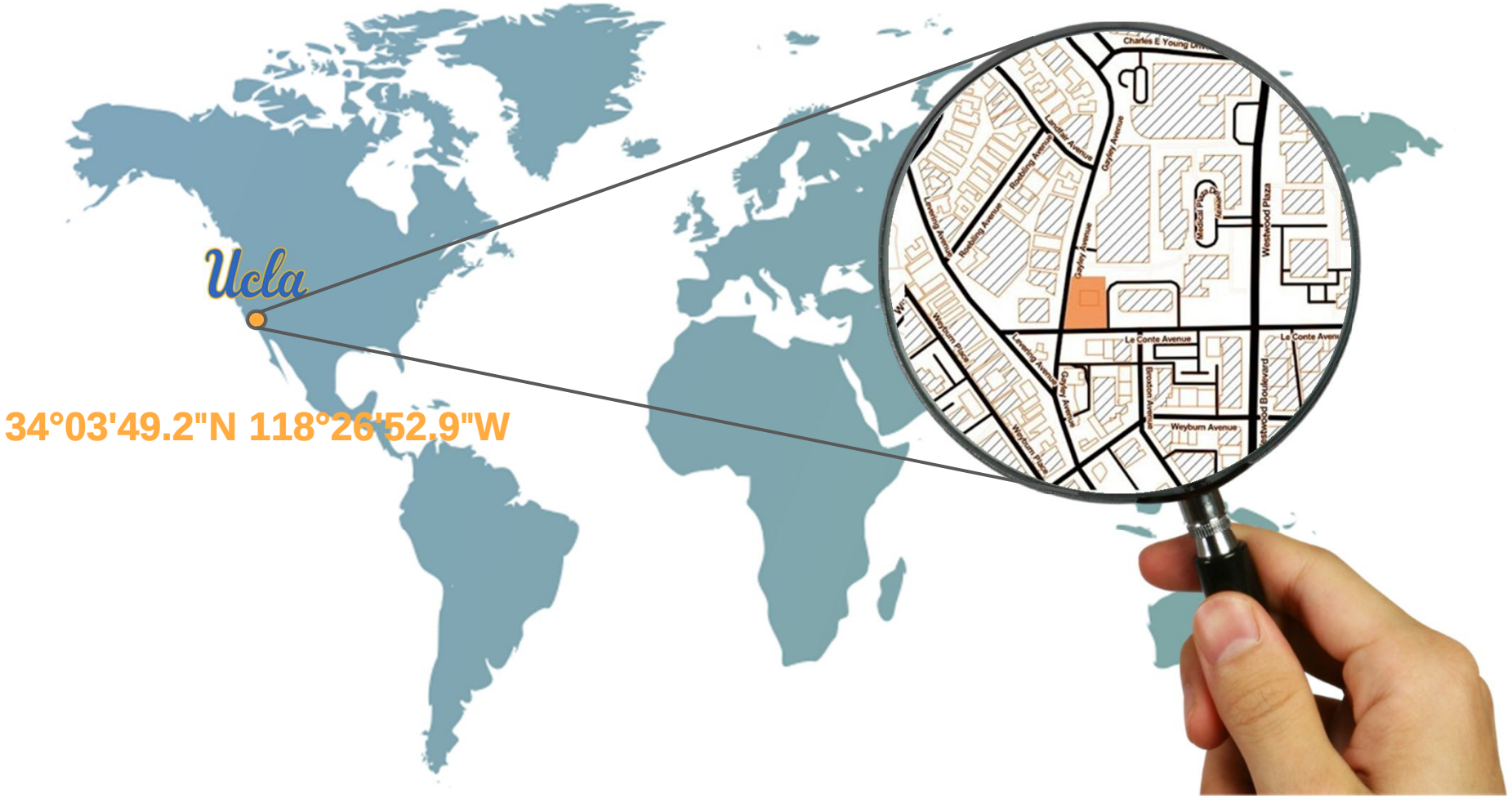
OPENING THE BOX - TREASURE



Synchronize 3 floors together

Final design with slanted walls

PROJECT LOCATION



34°03'49.2"N 118°26'52.9"W

SITE



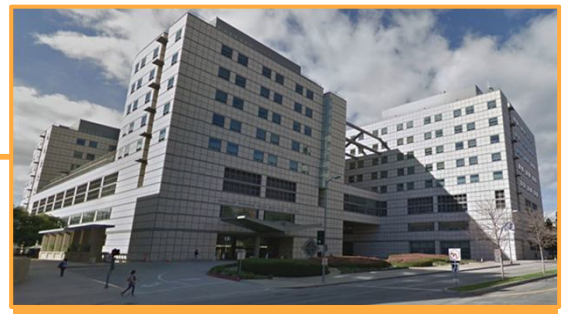
Gayley Ave

Le Conte Ave

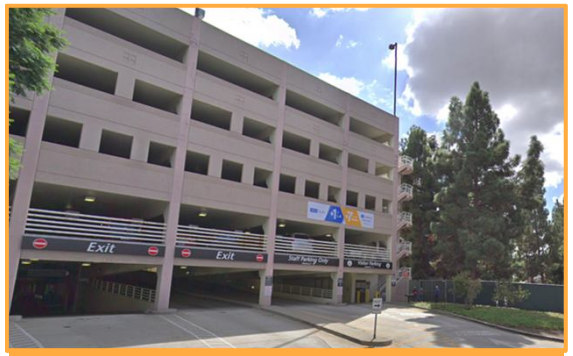
SURROUNDING CONDITIONS



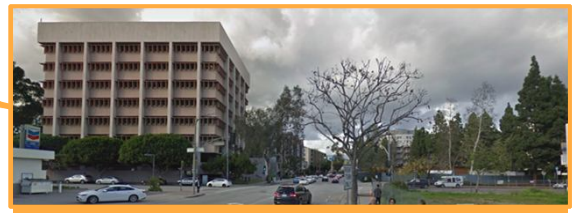
SURROUNDING CONDITIONS



Rectangular buildings



Visible structure



Shadings

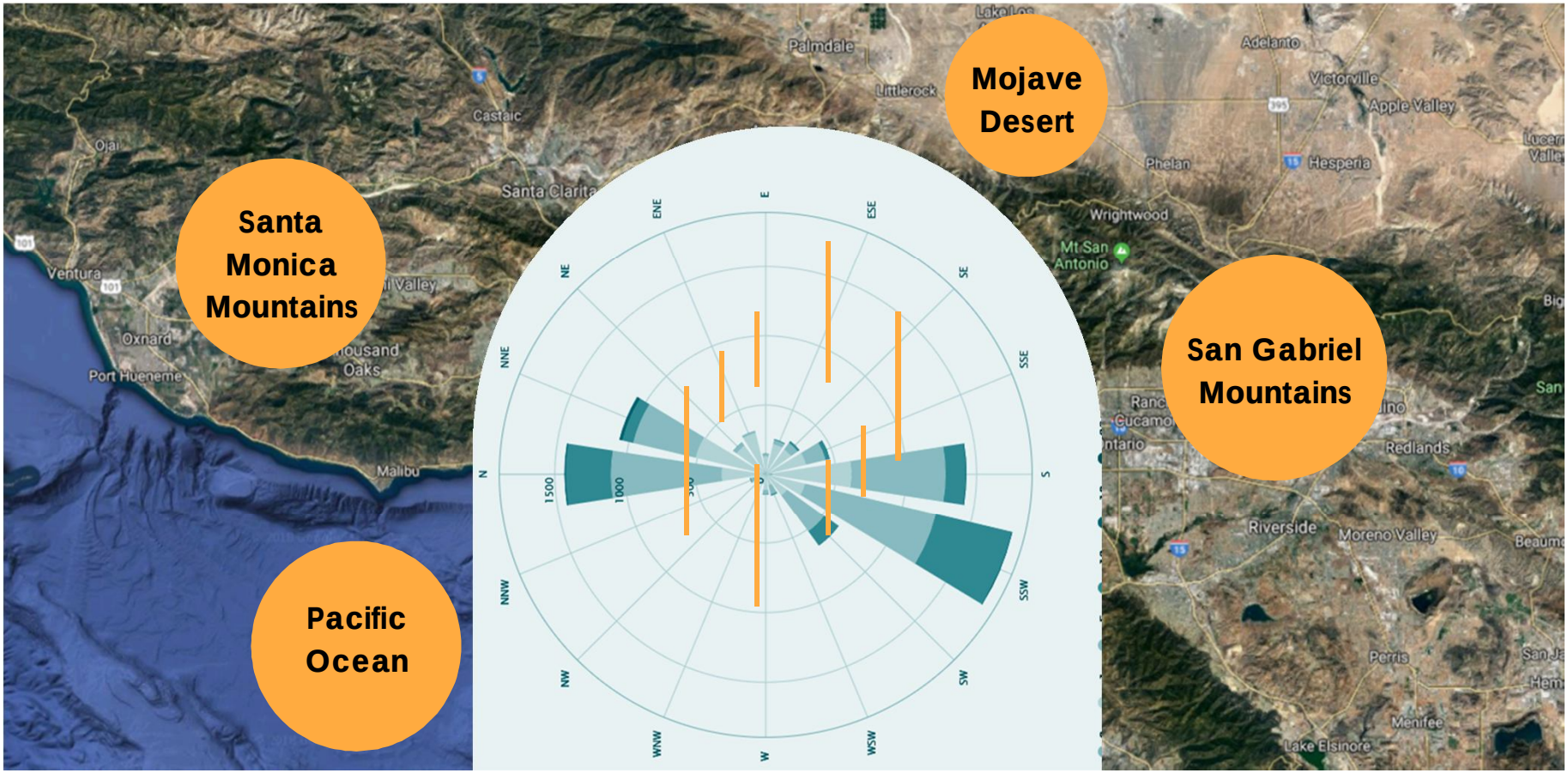


Bright facade material

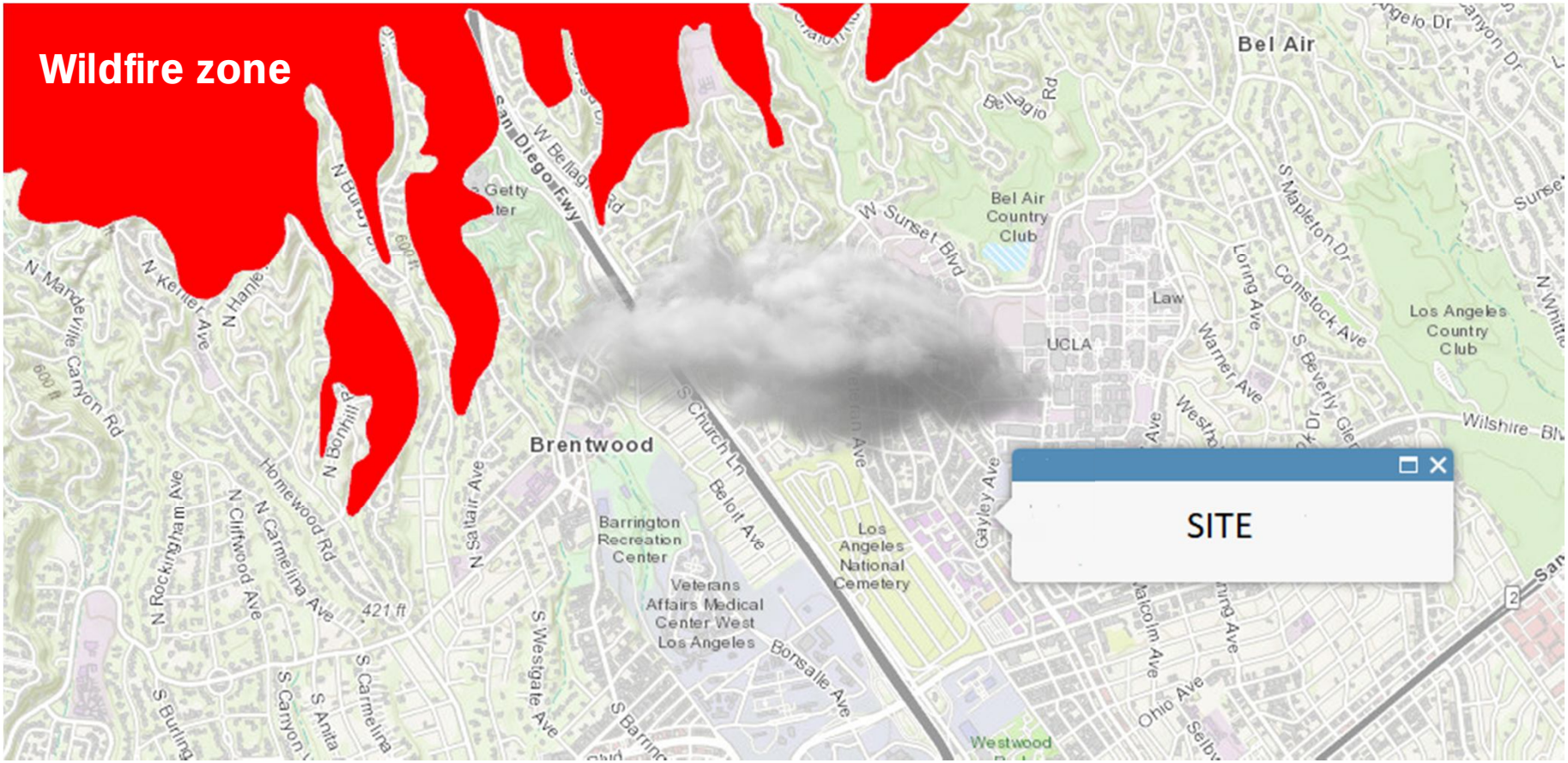


Visible structure

WIND

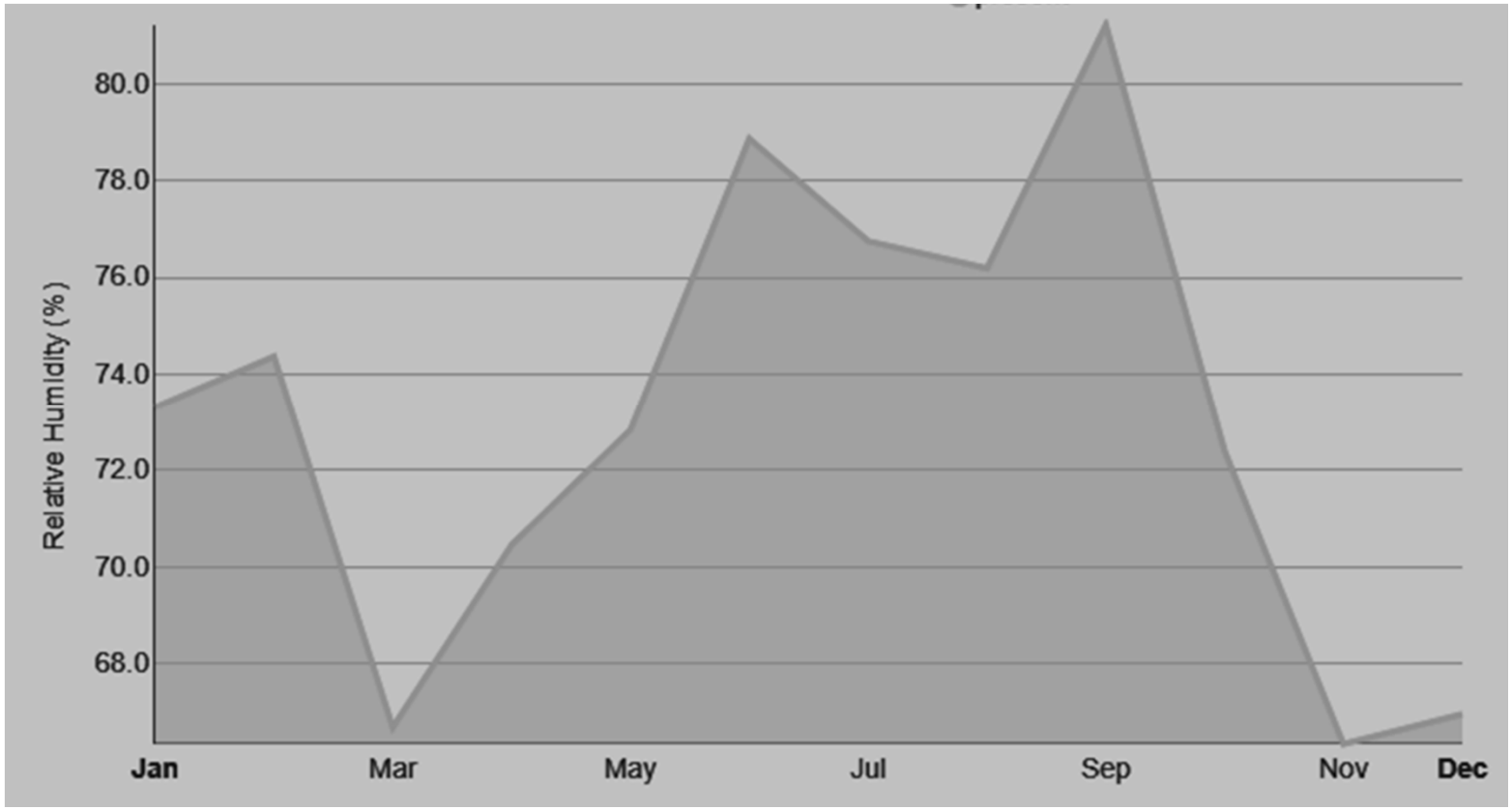

Mojave Desert
Santa Monica Mountains
San Gabriel Mountains
Pacific Ocean
Palmdale
Littlerock
Adelanto
Victorville
Apple Valley
Castaic
Ojai
Santa Clarita
Phelan
Hesperia
Wrightwood
Mt San Antonio
Ventura
Oxnard
Port Hueneme
Malibu
Redlands
Riverside
Moreno Valley
Perris
Menifee
Lake Elsinore
N
NNE
NE
ENE
E
ESE
SE
SSE
S
SSW
SW
WSW
W
WNW
NW
NNW
1000
1500

WILDFIRE



ArcGIS.com

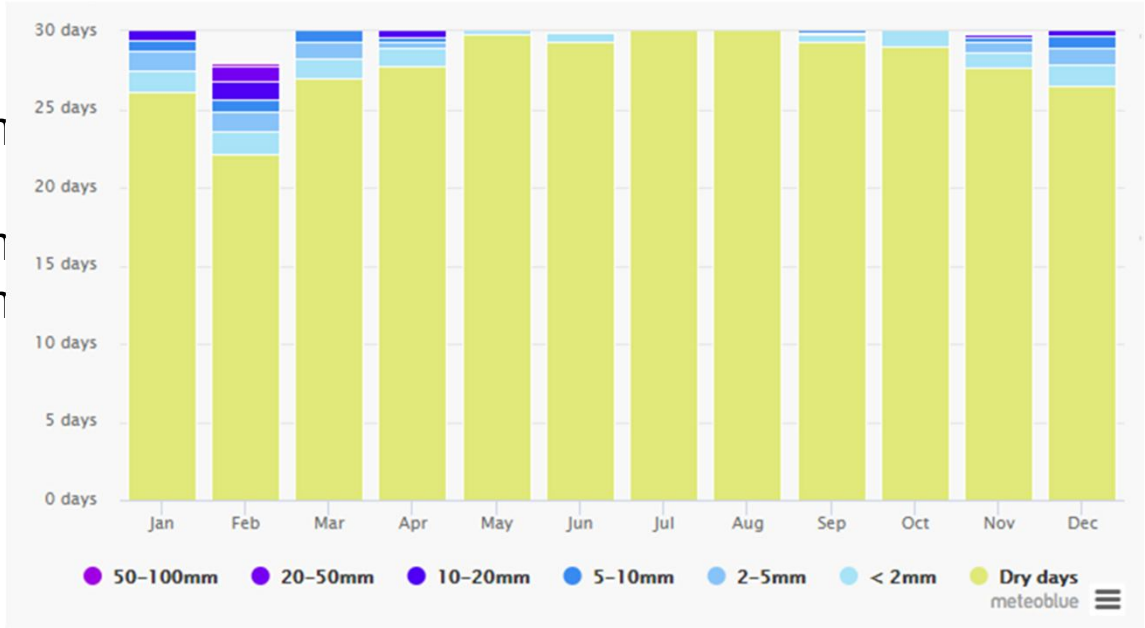
RELATIVE HUMIDITY



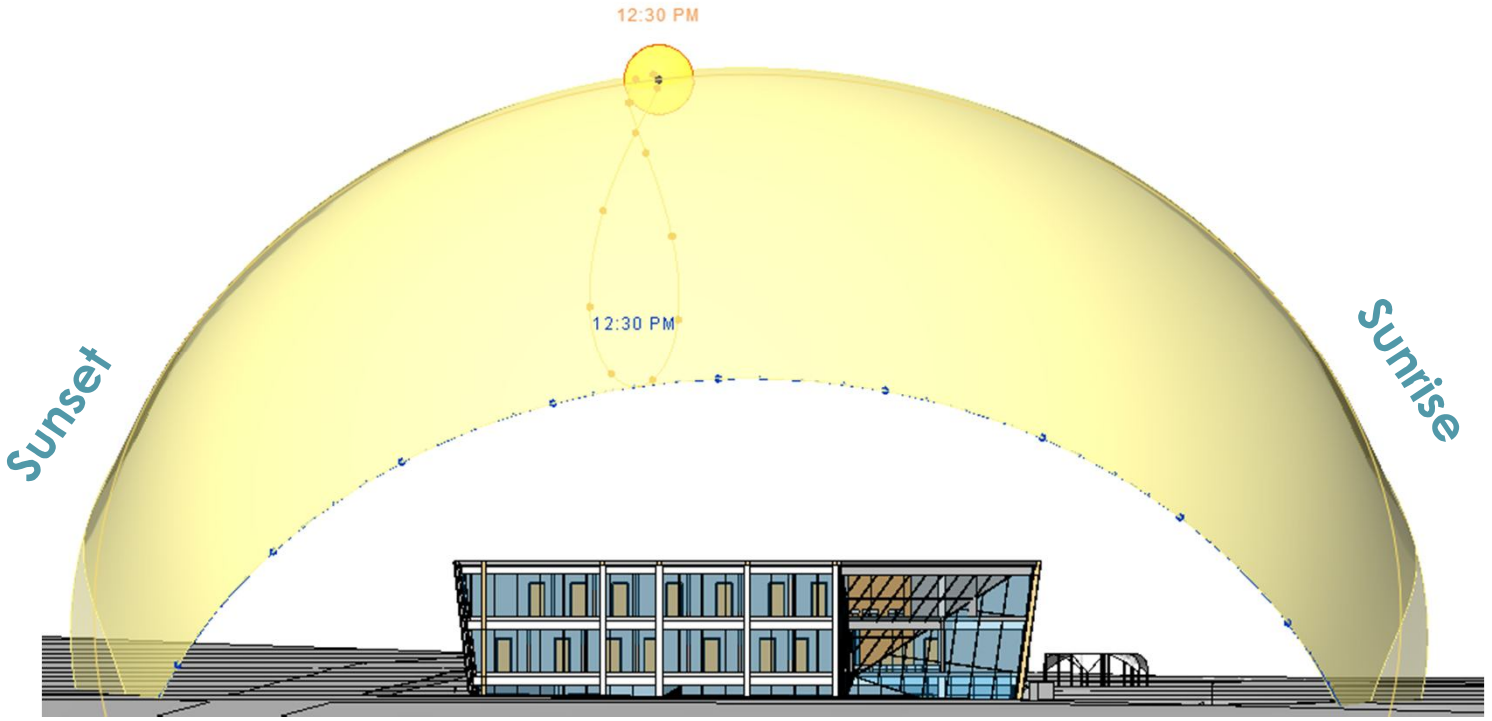
PRECIPITATION

Precipitation Amounts

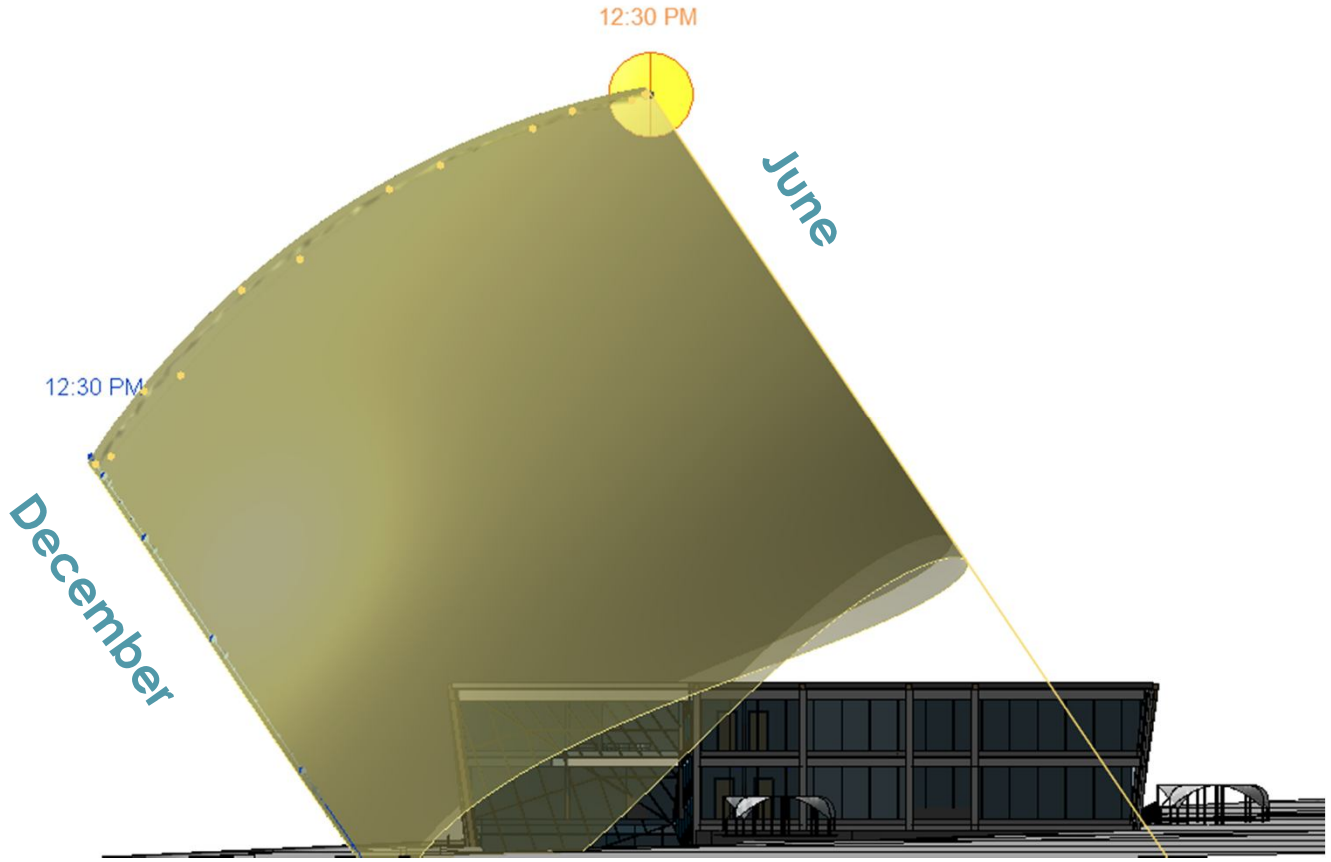
Jan:	83.8 mm
Feb:	110.5 mm
Mar:	57.6 mm
Apr:	20.2 mm
May:	6.4 mm
Jun:	1.2 mm
Jul:	0.8 mm
Aug:	0.4 mm
Sep:	2.5 mm
Oct:	14.9 mm
Nov:	17.3 mm
Dec:	62.8 mm
Total:	**378.4 mm/year**



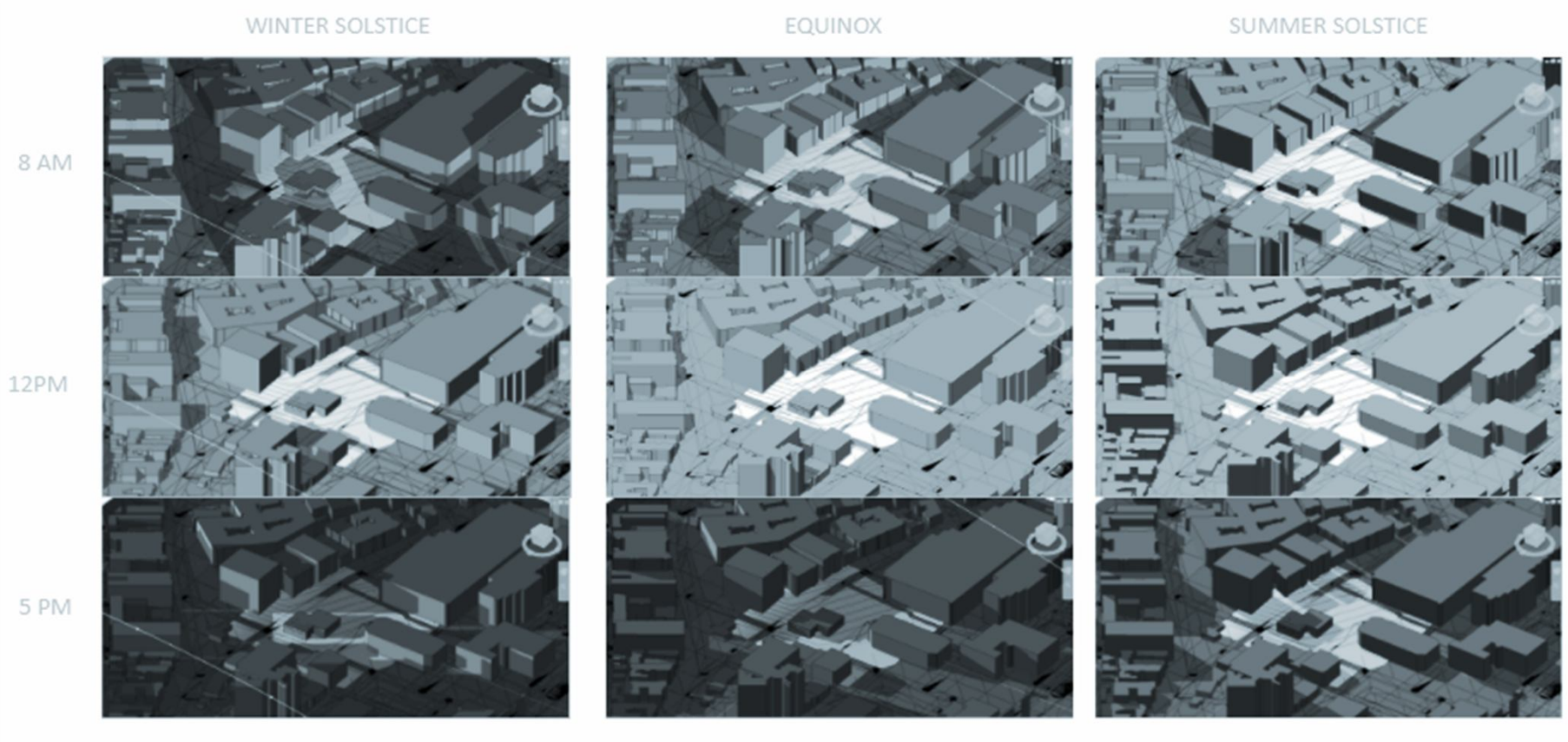
DAILY SOLAR CONDITION



MONTHLY SOLAR CONDITION



SURROUNDING SHADING ANALYSIS



SITE CHALLENGES



Air Pollution

- Wildfires
- Car exhaust gasses



Neighbourhood

- Bright facade materials
- Messy architecture



Heavy traffic

- Street corner
- Rush hour traffic



Weather

- Sun low on horizon
- Daylight 14 hours
- No shading



Fire

- Nearby wildfire zone
- High risk of fire
- Dry Climate

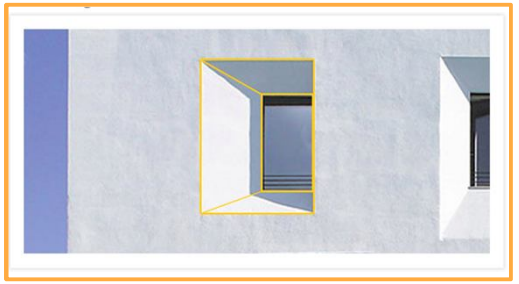


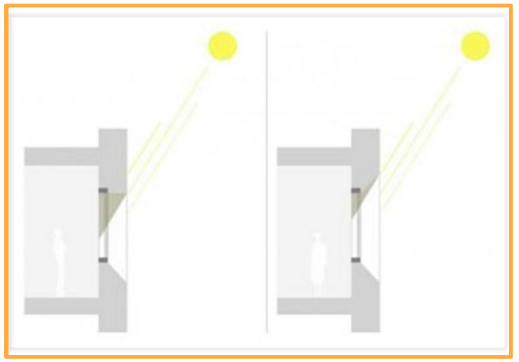
Earthquake

- Seismic active area
- Increasing size of earthquakes

SITE PLAN







VIEW FROM NORTH - WEST



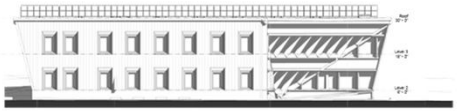
east



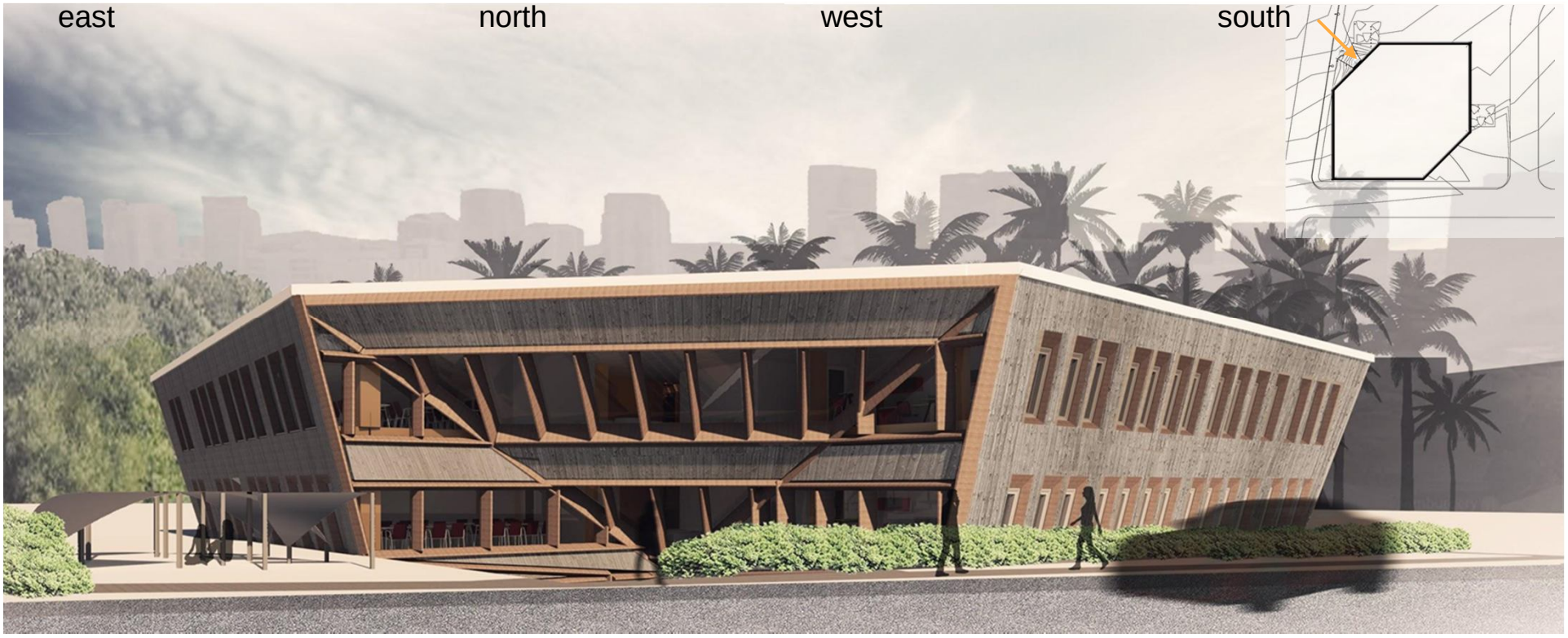
north



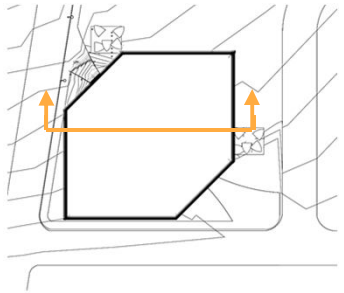
west



south



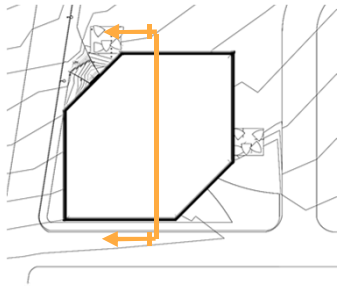
SECTION TOWARDS NORTH





- auditorium
- classrooms
- seminar
- student offices
- faculty ofiices
- administration
- department chair's office
- faculty lounge
- student lounge
- cafe
- restrooms

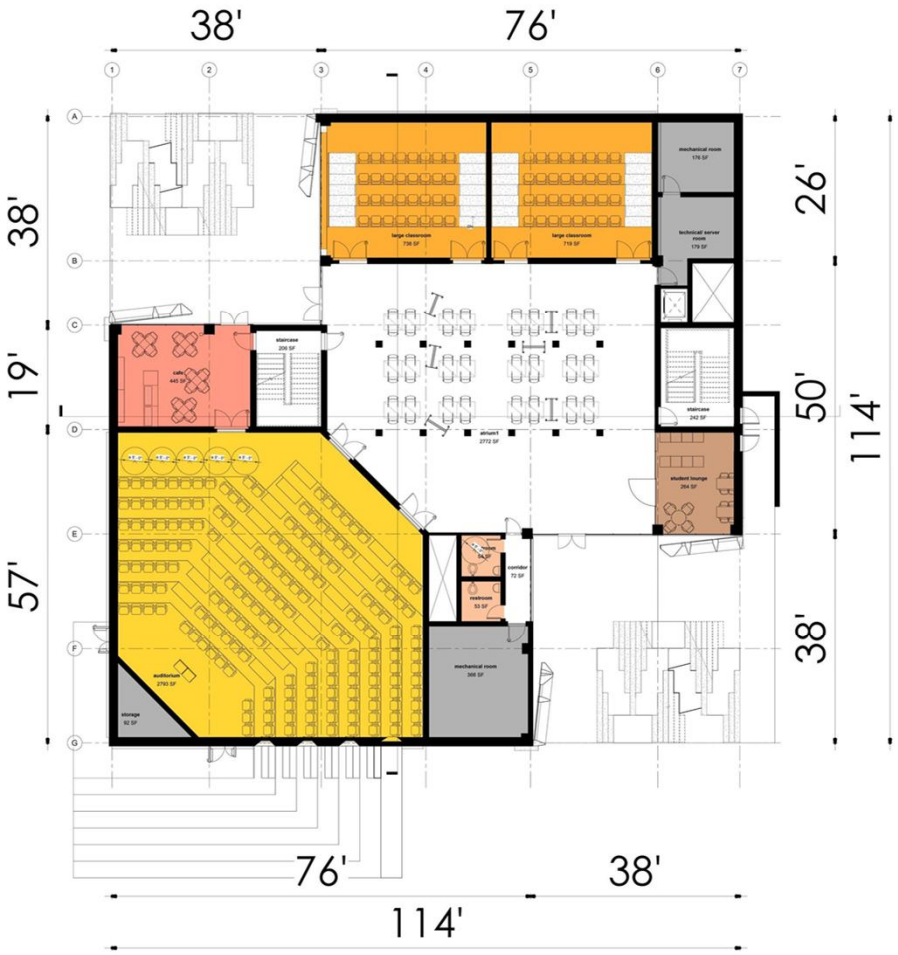
SECTION TOWARDS WEST



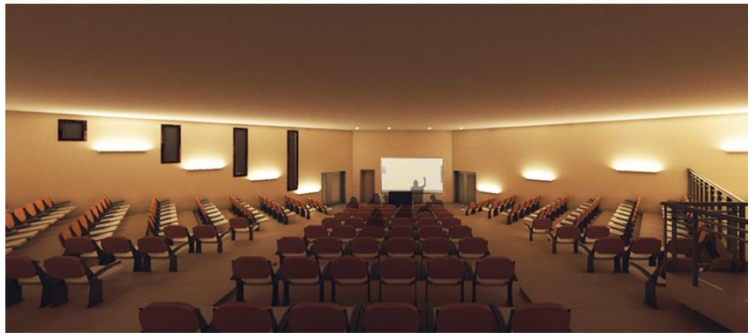


- auditorium
- classrooms
- seminar
- student offices
- faculty ofiices
- administration
- department chair's office
- faculty lounge
- student lounge
- cafe
- restrooms

FLOOR 1

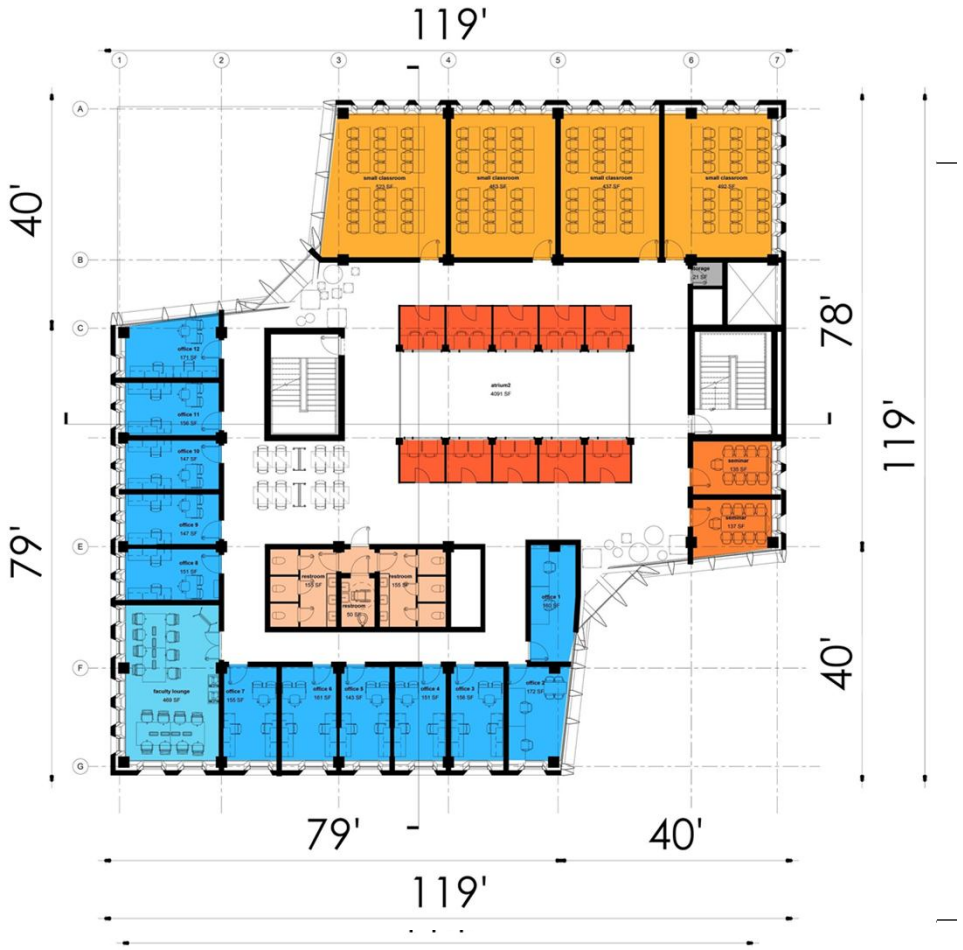






auditorium
classrooms
student lounge
cafe
restrooms

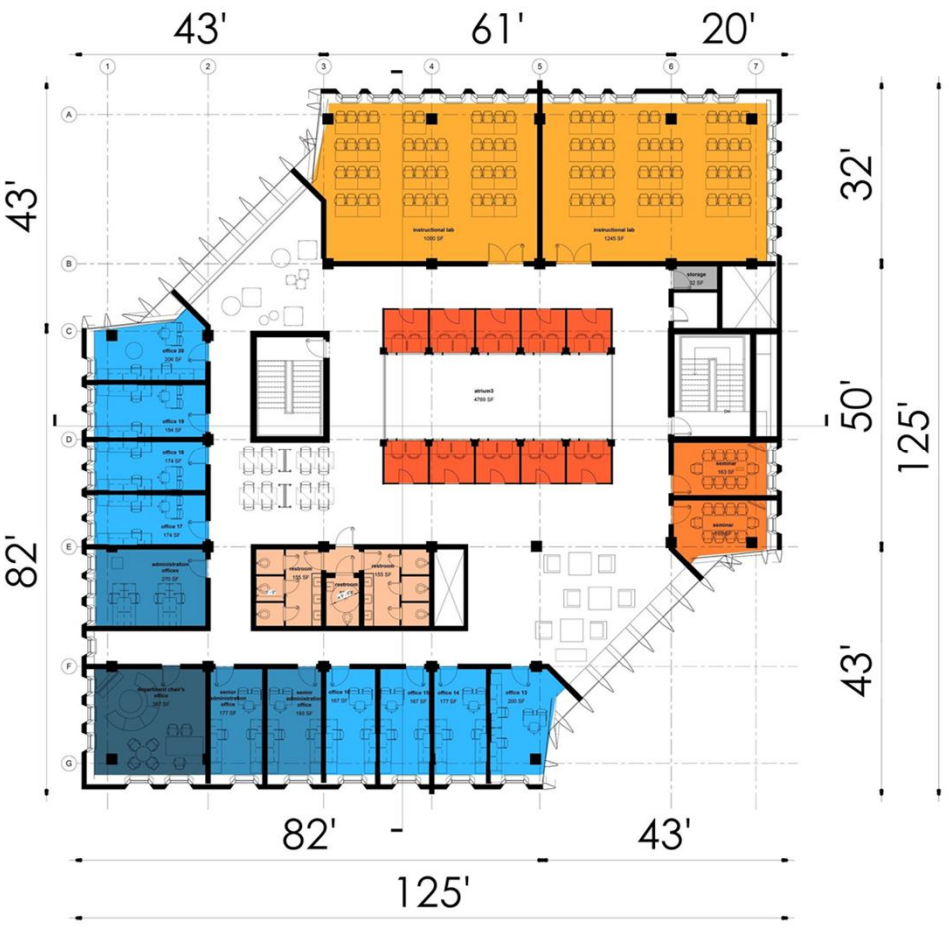
FLOOR 2





classrooms
seminar
student offices
faculty ofiices
faculty lounge
restrooms

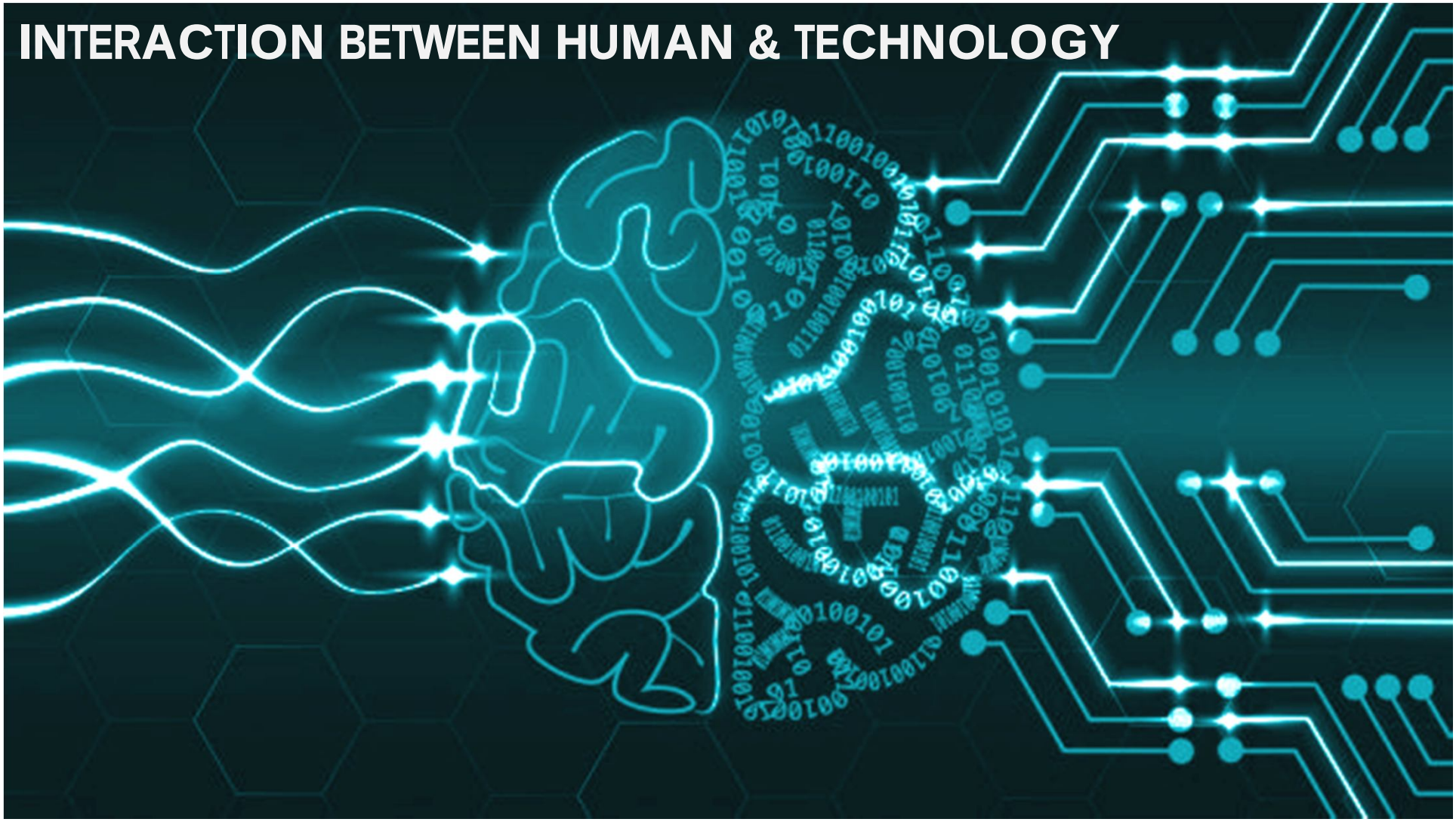
FLOOR 3





- classrooms
- seminar
- student offices
- faculty ofiices
- administration
- department chair's office
- faculty lounge
- restrooms

INTERACTION BETWEEN HUMAN & TECHNOLOGY

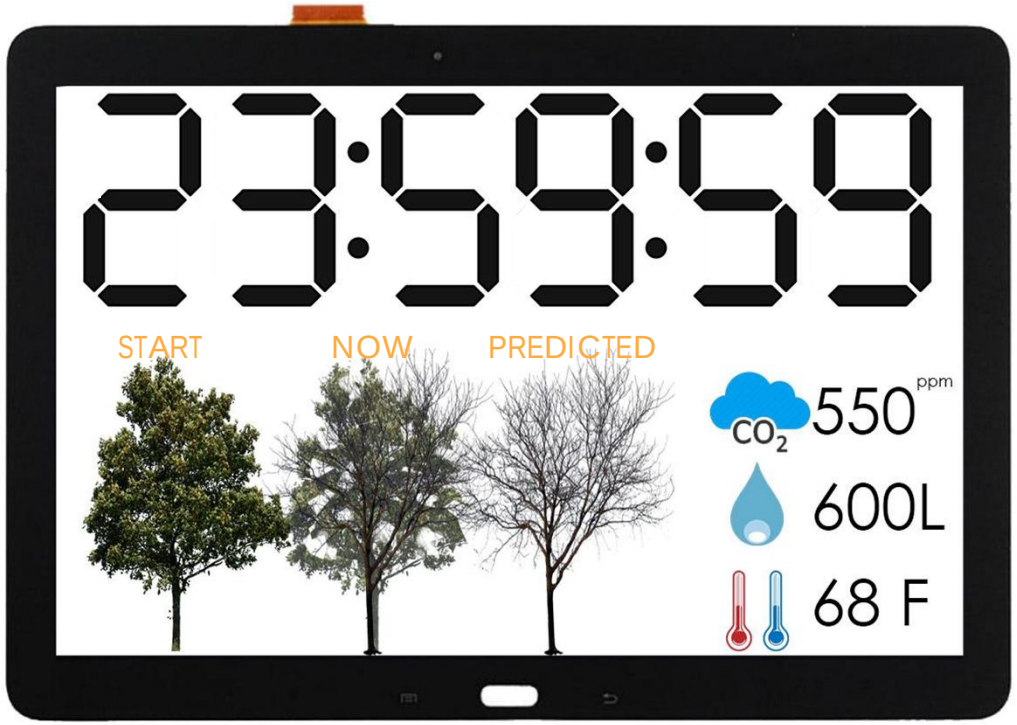


HOLOGRAM IN ATRIUM





HUMAN-TECHNOLOGY INTERACTION



EVOLUTION of ACTING

“We believe that it is data and its digital technology that is going to lead the transformation” - TEAM CENTRAL



STRUCTURAL

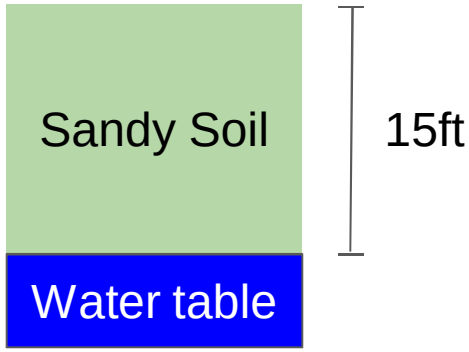
ENGINEERING



SITE CONDITIONS - SOIL

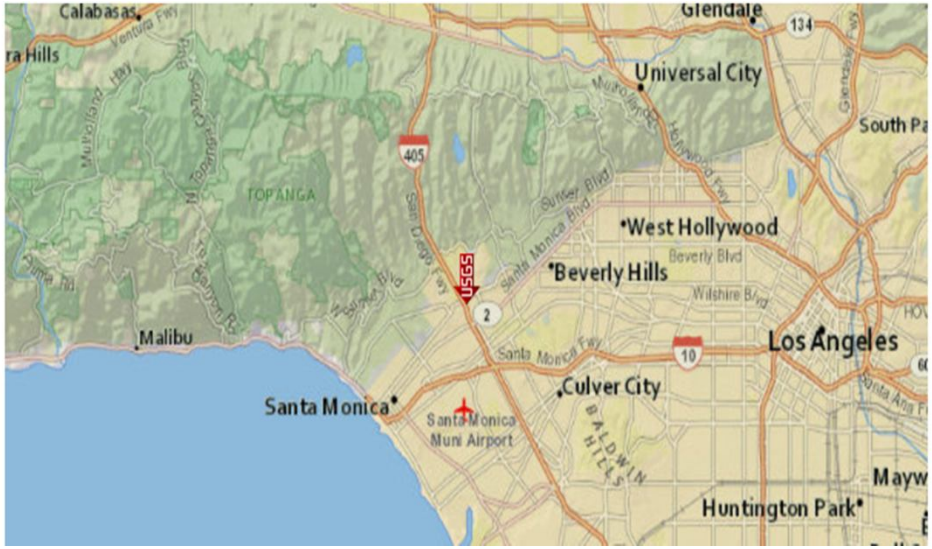
Soil Conditions

- Shallow / Deep water table
- 5000 SF Bearing



Earthquake Risk Category

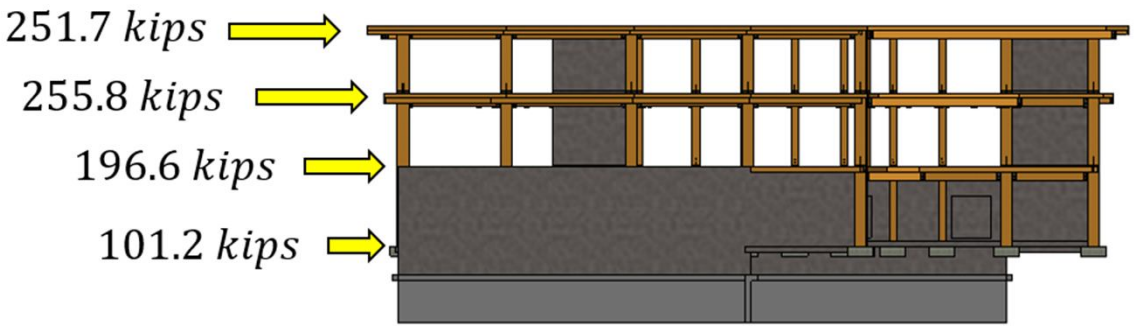
- Risk Category: II



Live Loads

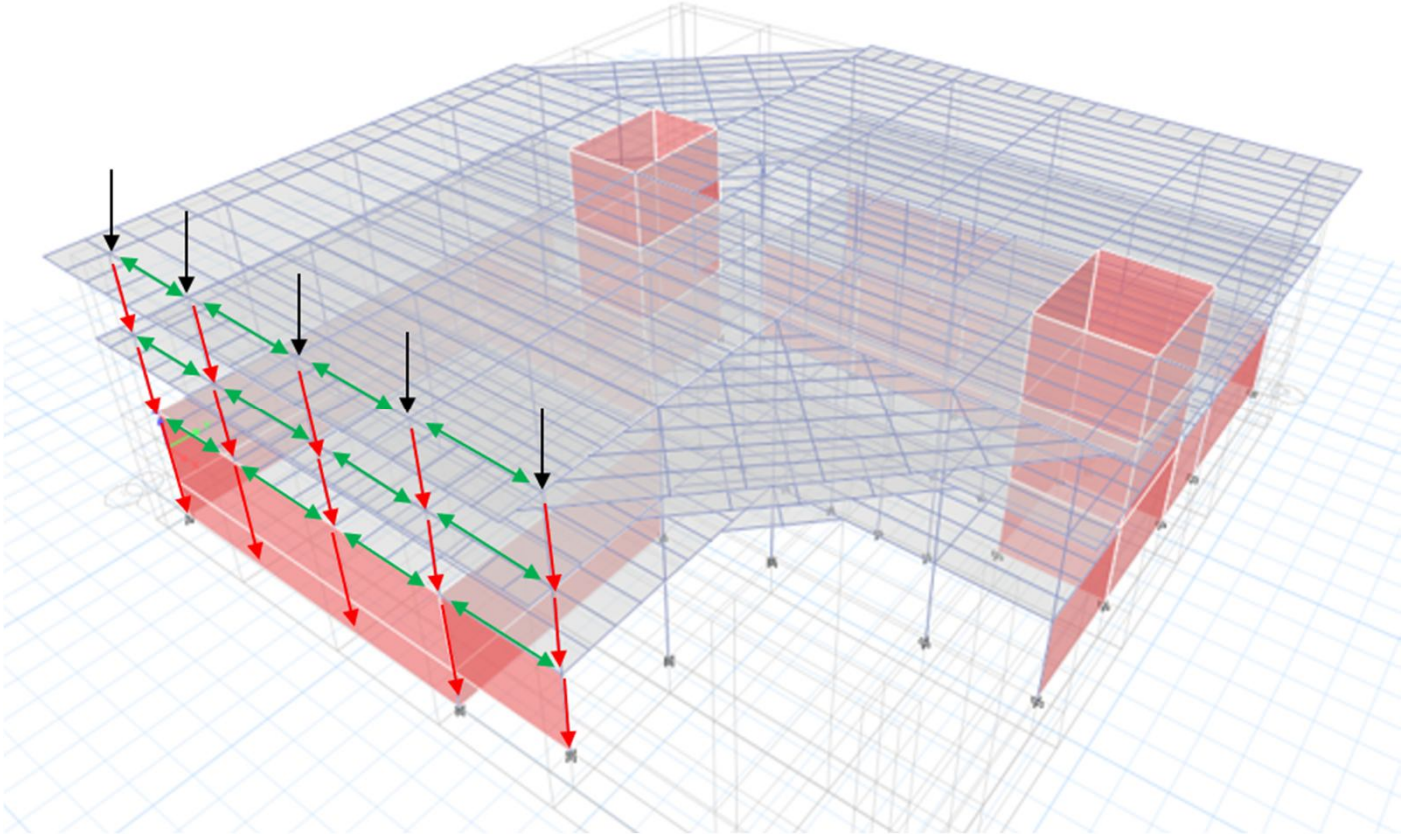
Type of Room	Uniform [psf]
Student & Faculty offices	50
Classrooms	40
Stairs	100
Roof	40
Auditorium	100

Earthquake Loads



Total Base Shear = 805.3 kips

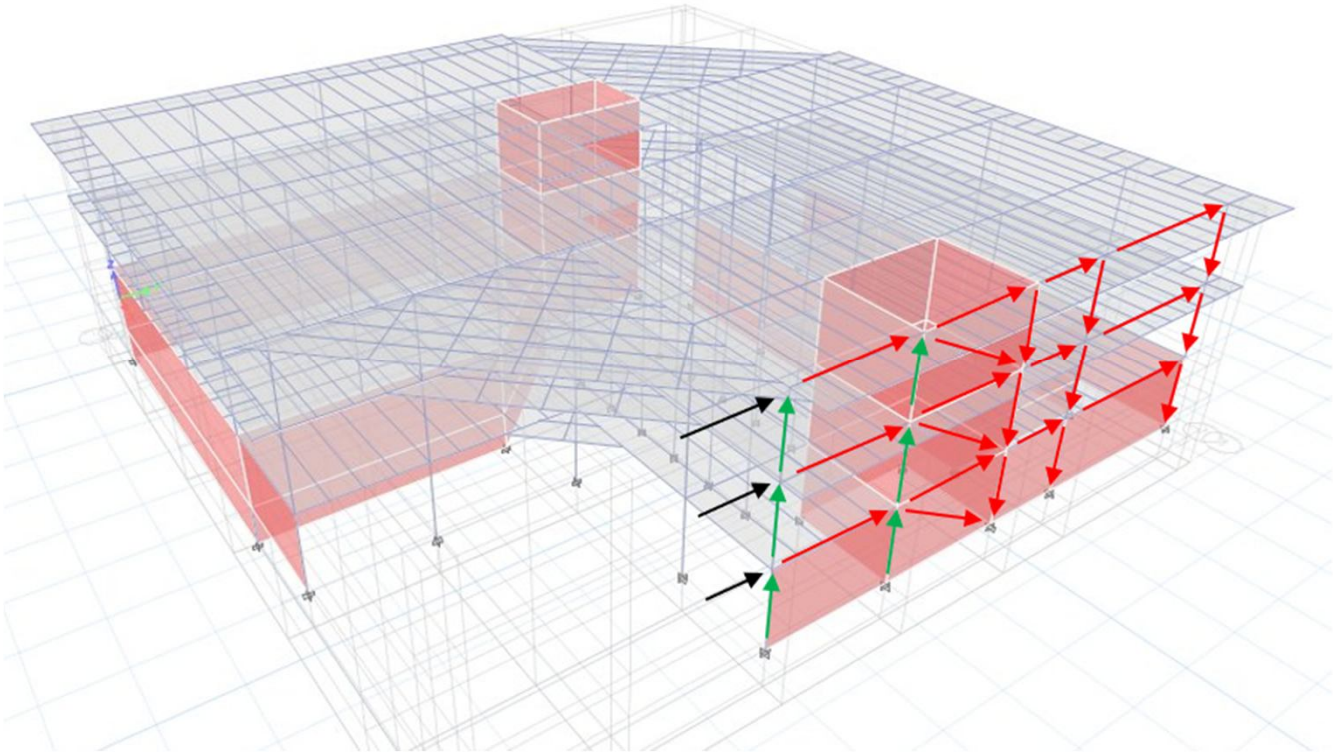
VERTICAL LOAD PATH



TENSION

COMPRESSION

HORIZONTAL LOAD PATH

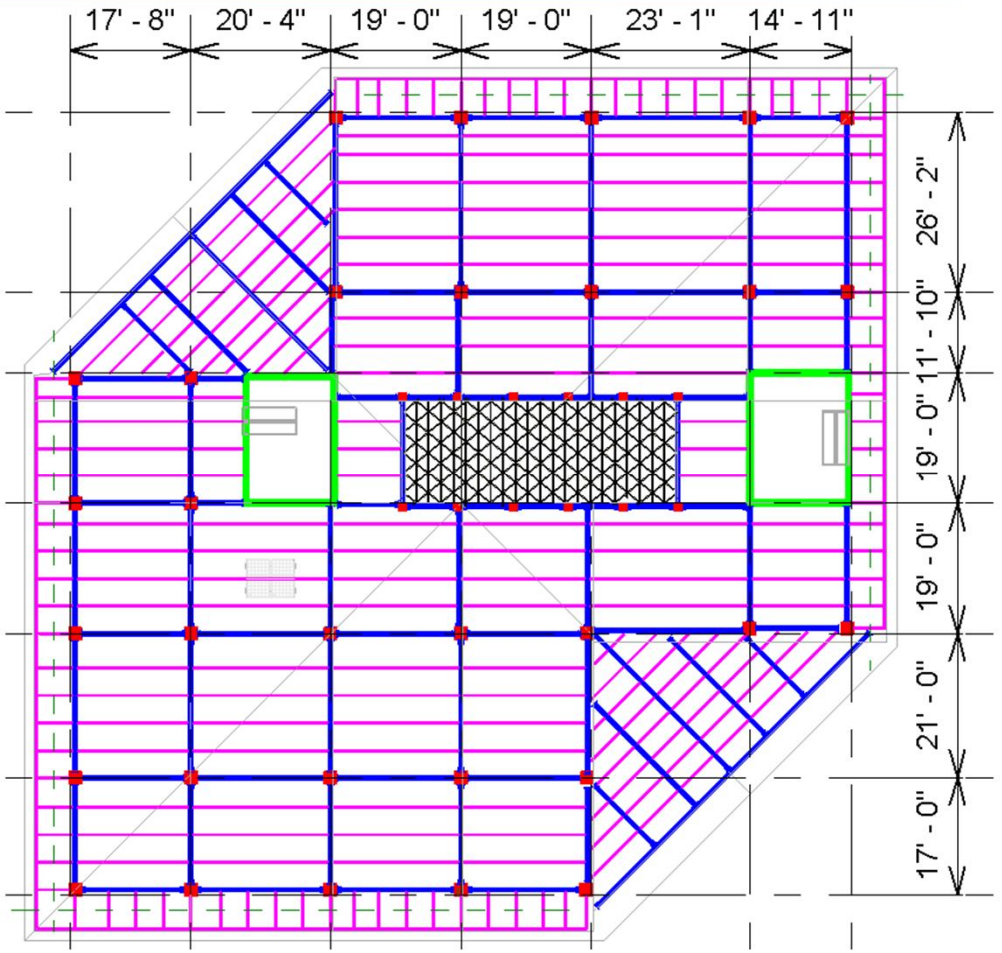


TENSION

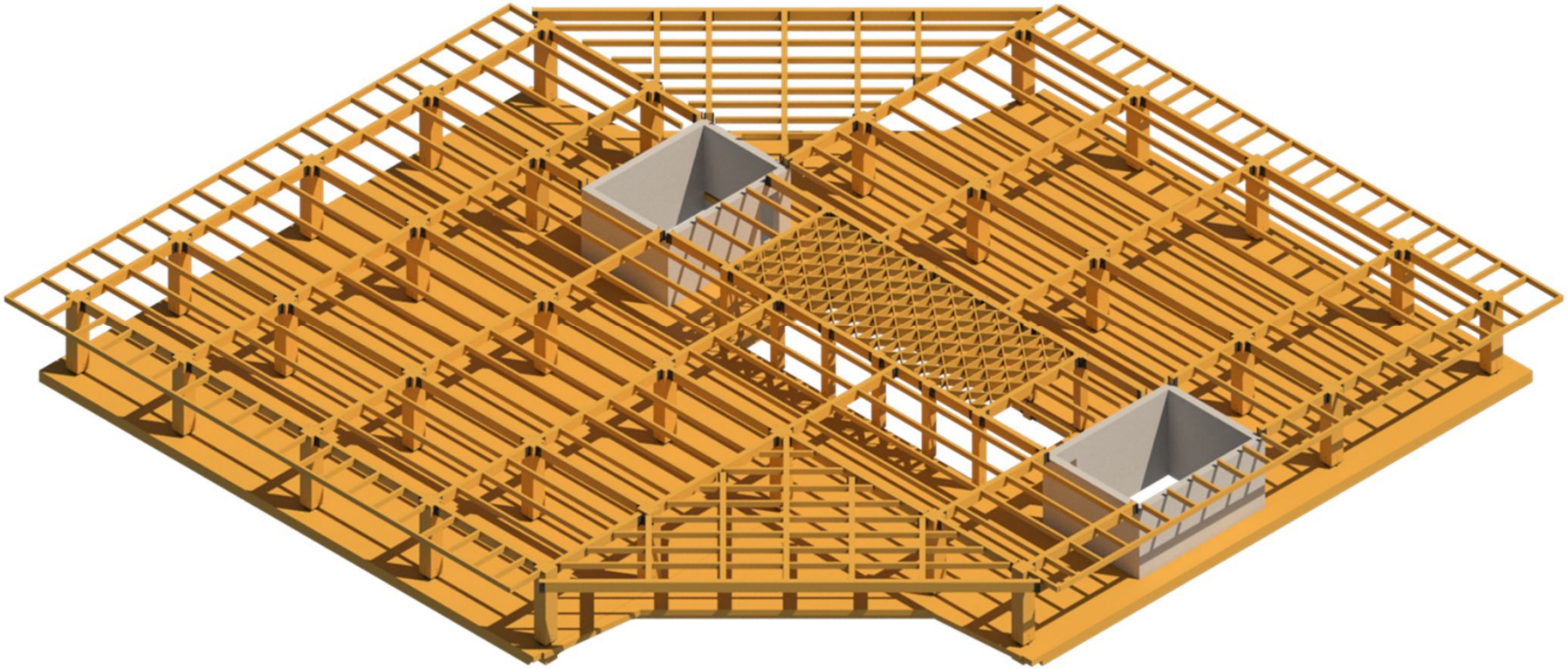
COMPRESSION

FLOOR 3

- 22.5”x22.5” Glulam Column
- 12”x16.5” Primary Timber Beam
- 4”x9” Secondary Timber Beam
- 1-ft Shear Walls



FLOOR 3



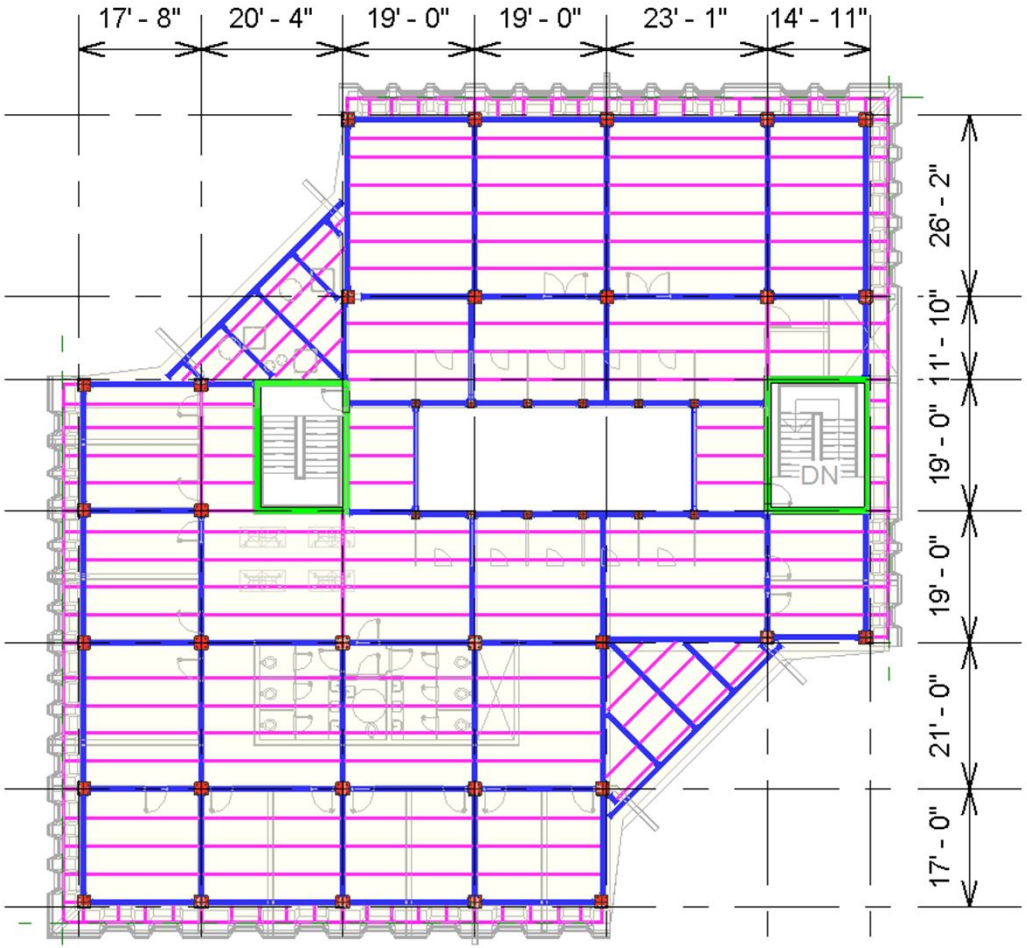
FLOOR 2

22.5”x22.5”
Glulam Column

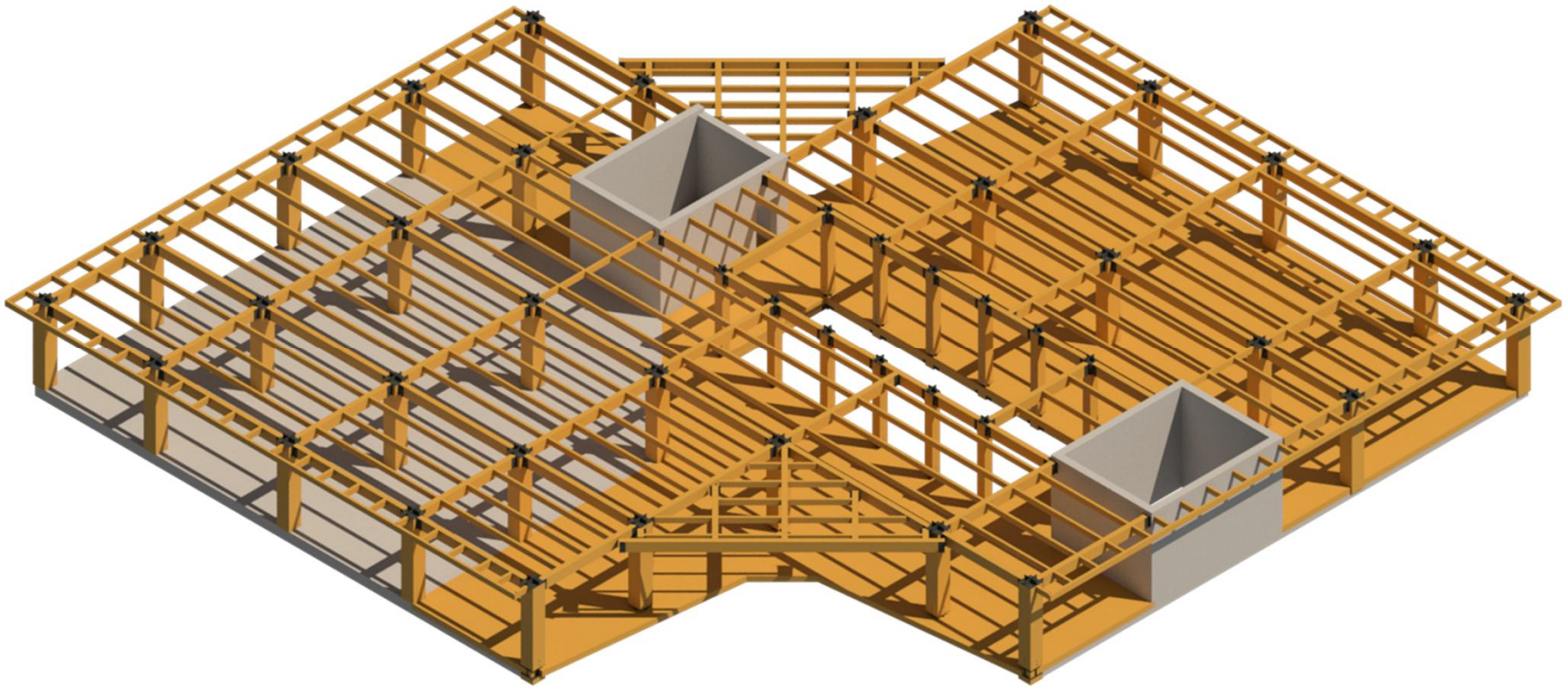
12”x16.5”
Primary Timber Beam

4”x9”
Secondary Timber Beam

1-ft Shear Walls

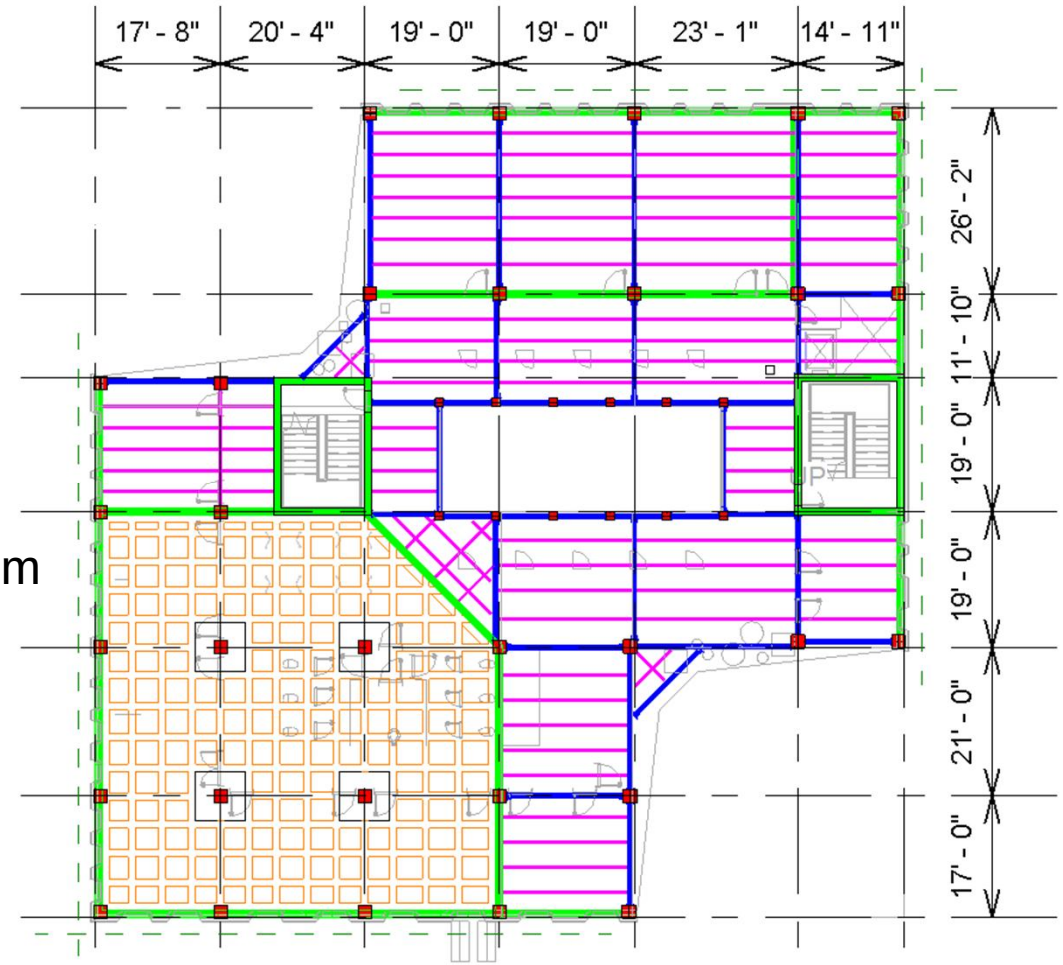


FLOOR 2

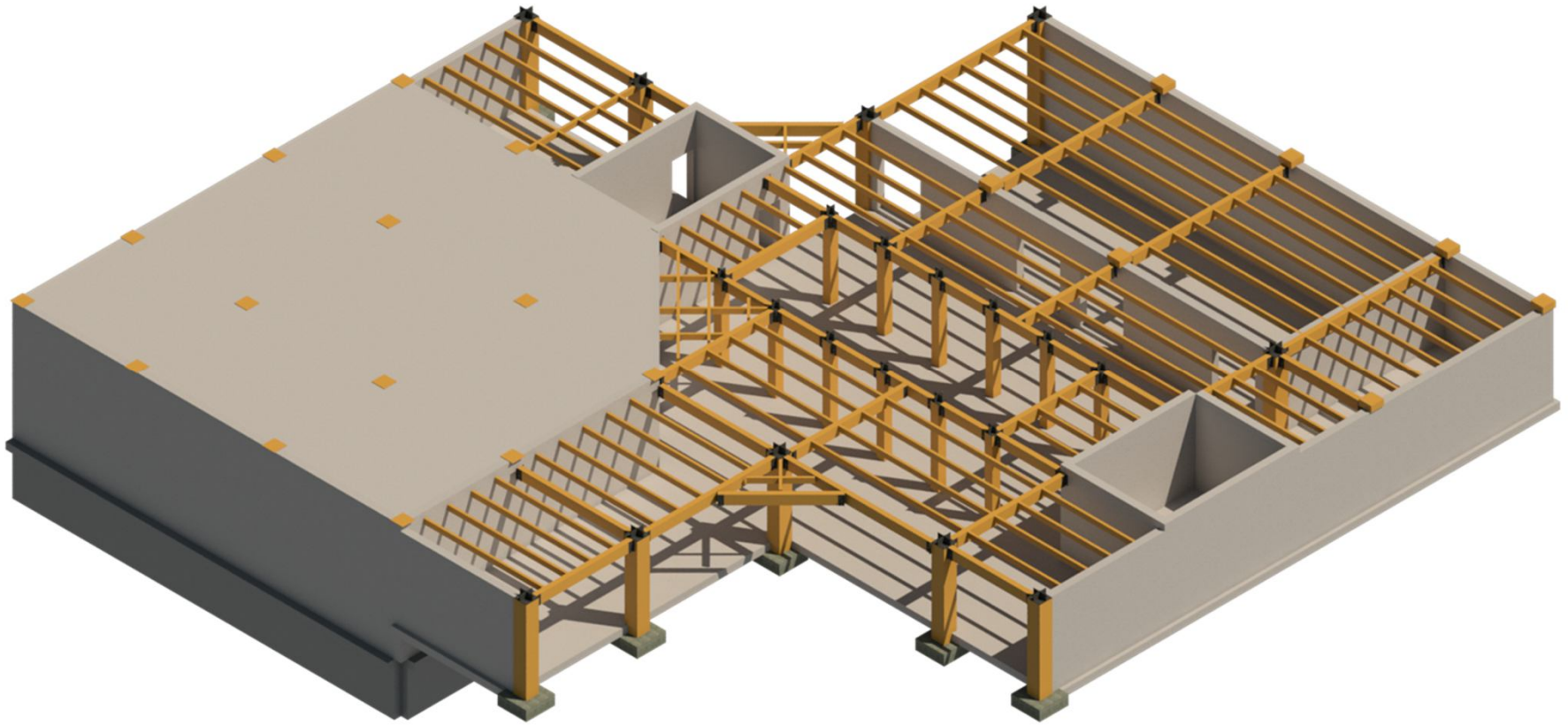


FLOOR 1

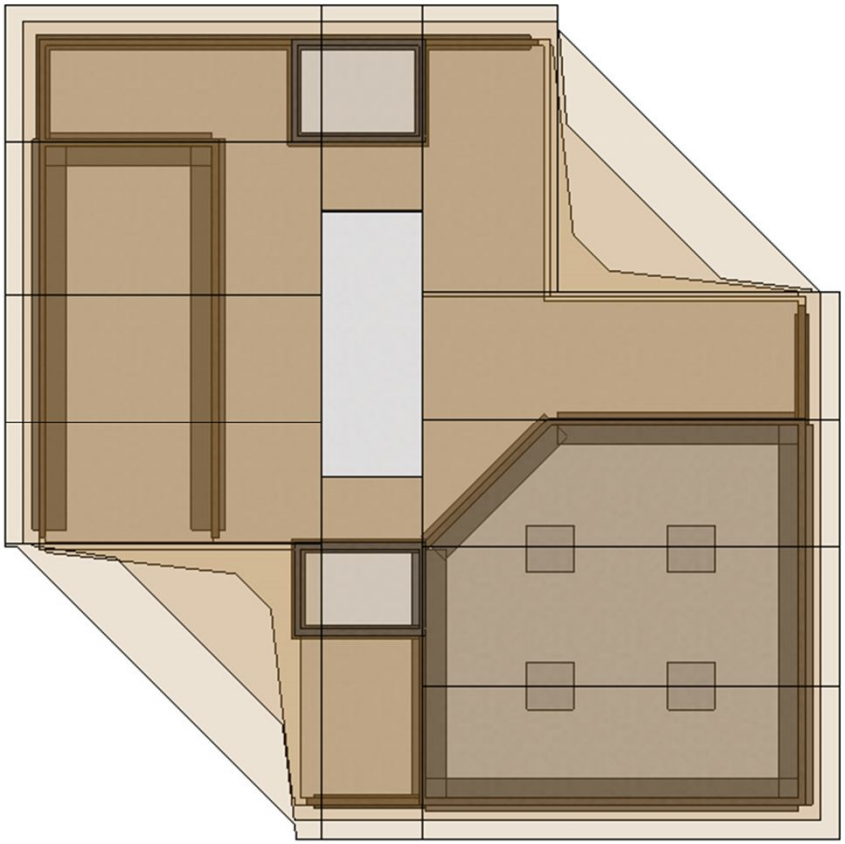
- 22.5”x22.5” Glulam Column
- 12”x16.5” Primary Timber Beam
- 4”x9” Secondary Timber Beam
- 1-ft Shear/Retaining Walls
- Waffle Slab



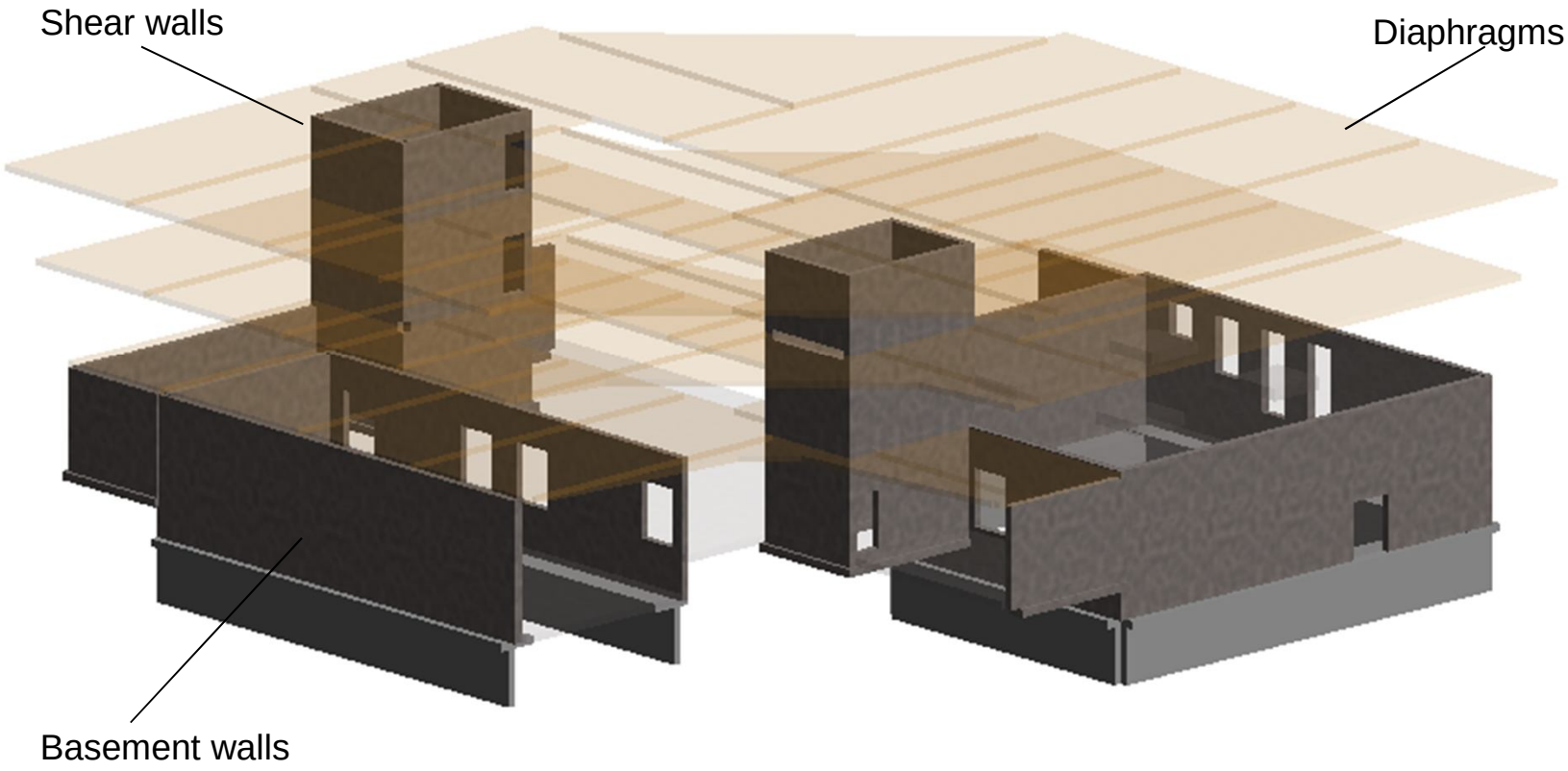
FLOOR 1



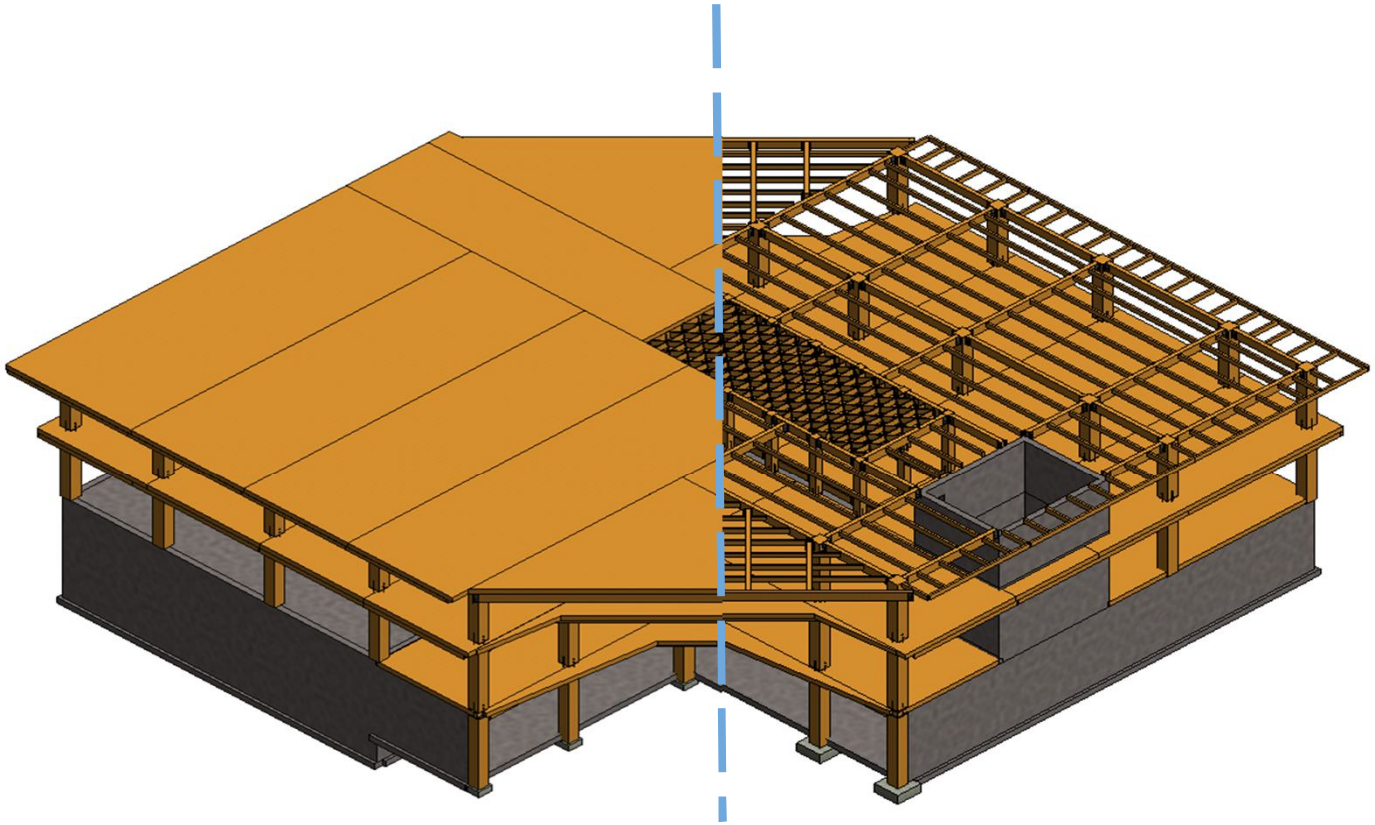
LATERAL LOAD RESISTING SYSTEM



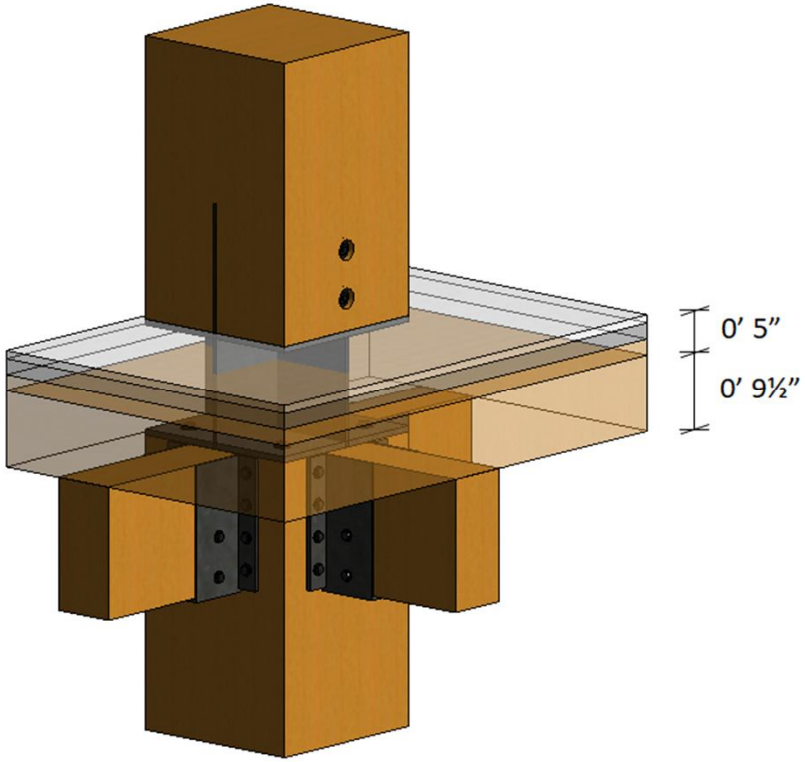
LATERAL LOAD RESISTING SYSTEM



DIAPHRAGMS



STRUCTURAL CONNECTION





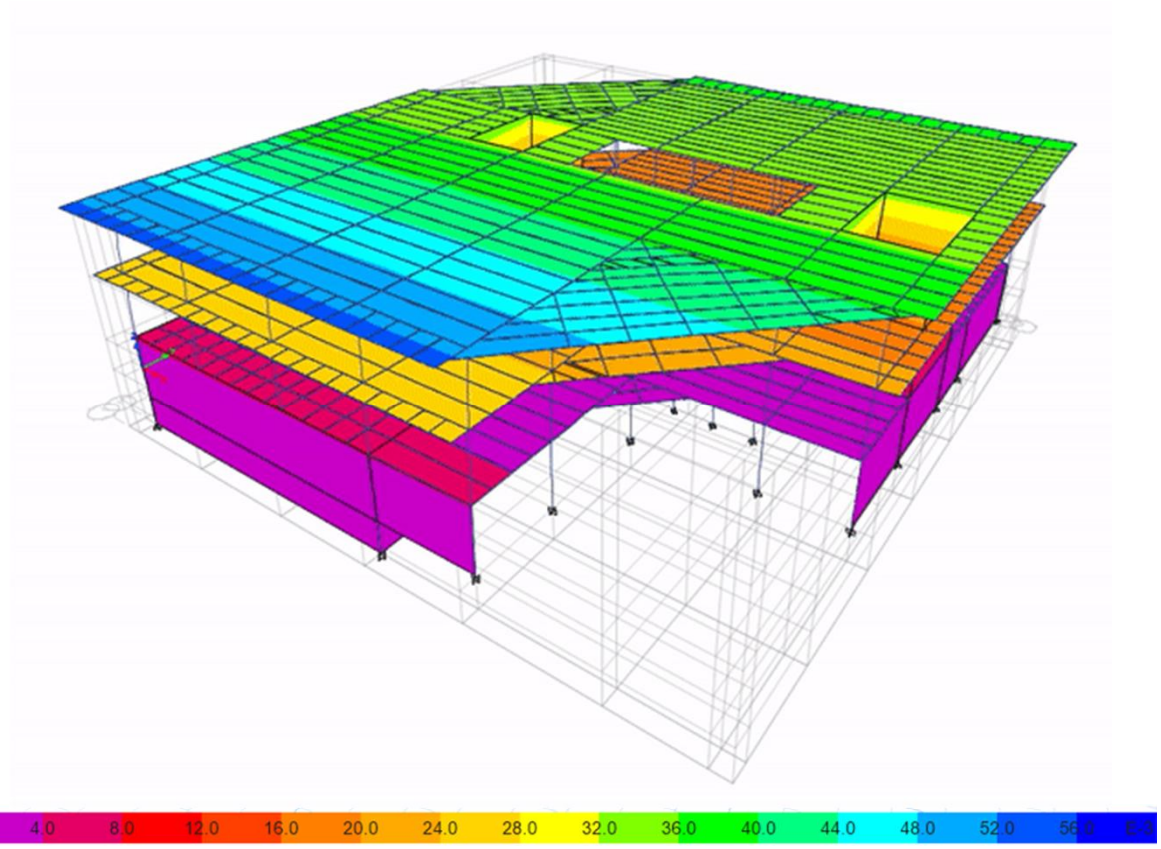
Natural Frequency for slab

$$f := \frac{2.188}{2 \cdot l^2} \cdot \sqrt{\frac{EI_{app}}{\rho \cdot A_{eff}}} = 10.173\ Hz \geq 9\ Hz$$

Seismic Response:

Scale Factor = 300

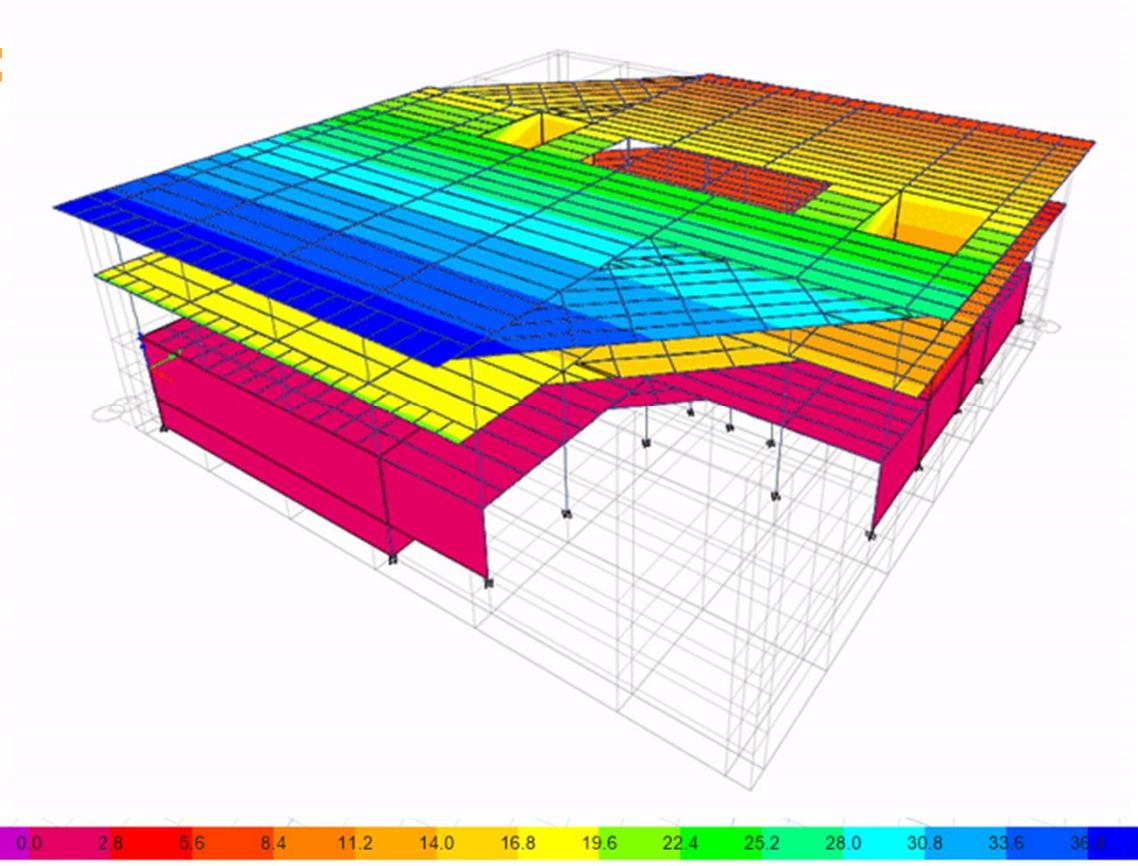
From USGS:
Ss = 2.246 g
S1 = 0.822 g



PERFORMANCE SIMULATION

1st Modal Response:

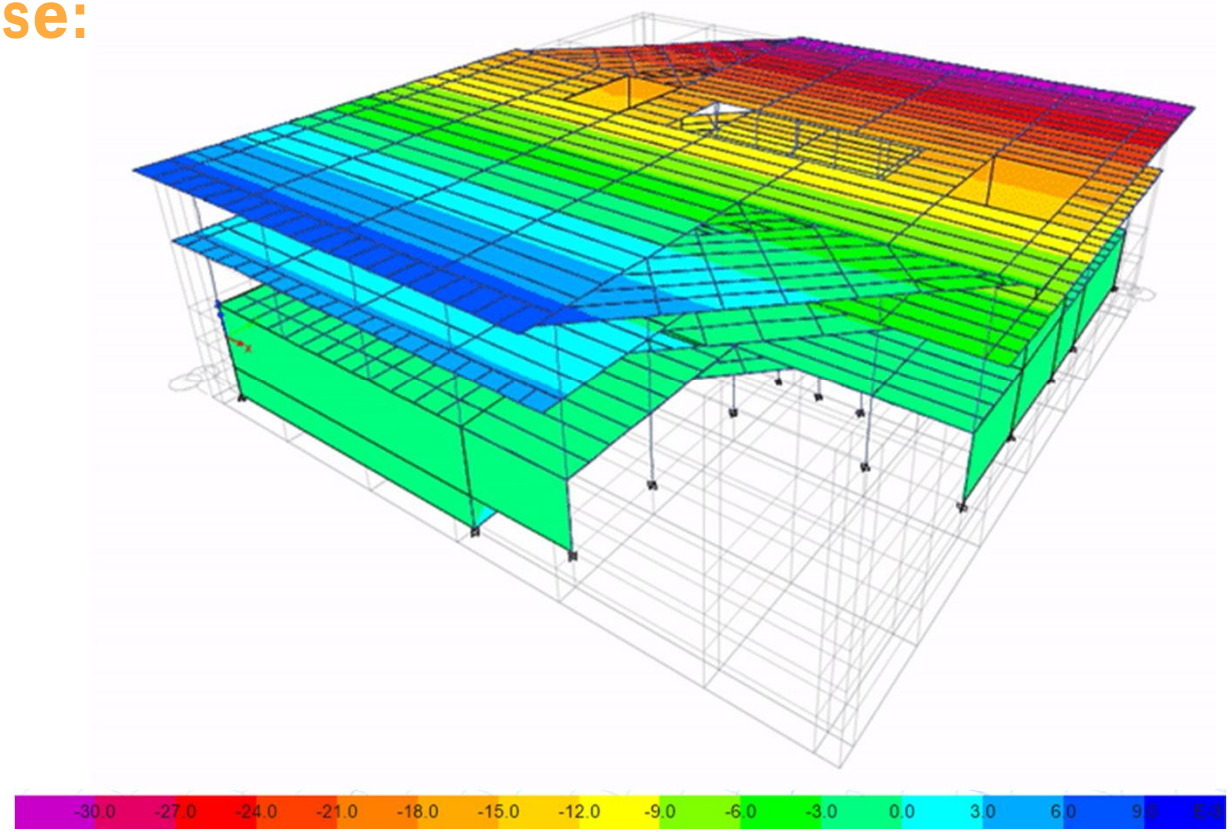
Scale Factor = 300
Modal Participation Ratio = 31%



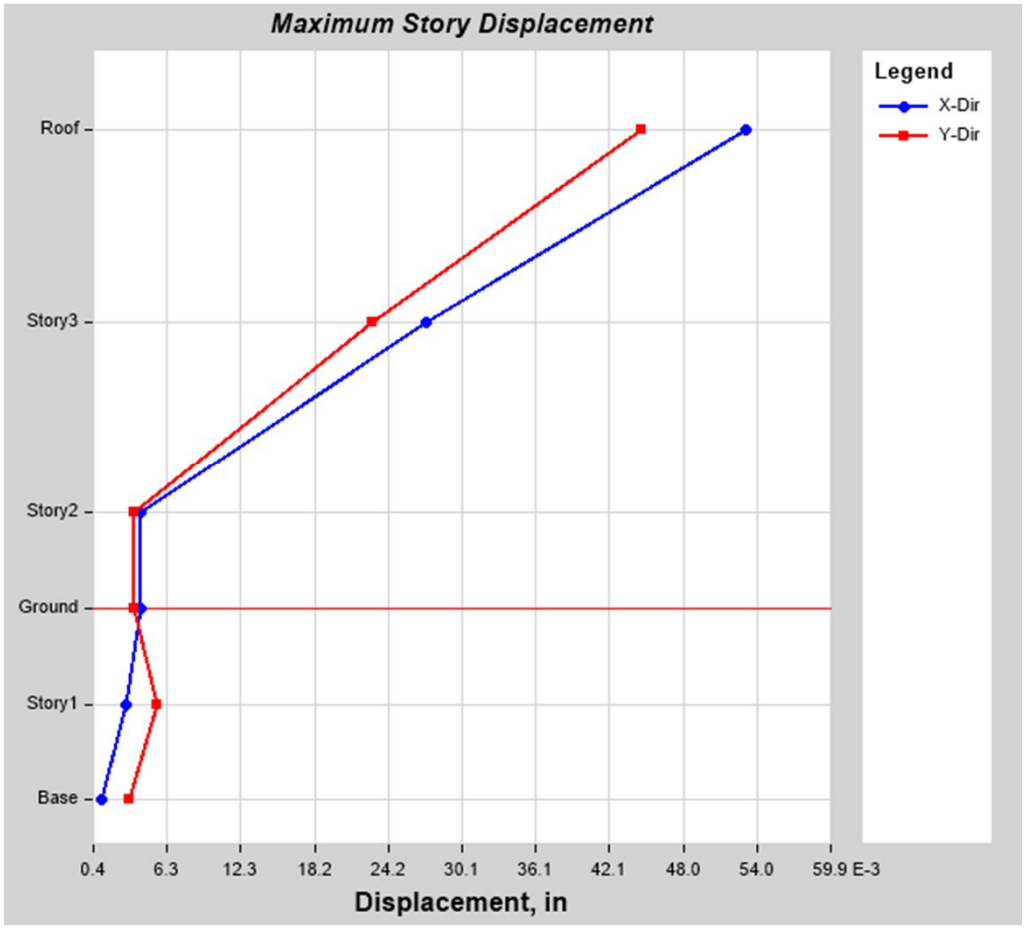
2nd Modal Response:

Scale Factor = 300
Modal Participation Ratio = 18%





PERFORMANCE SIMULATION



Max Story Disp:

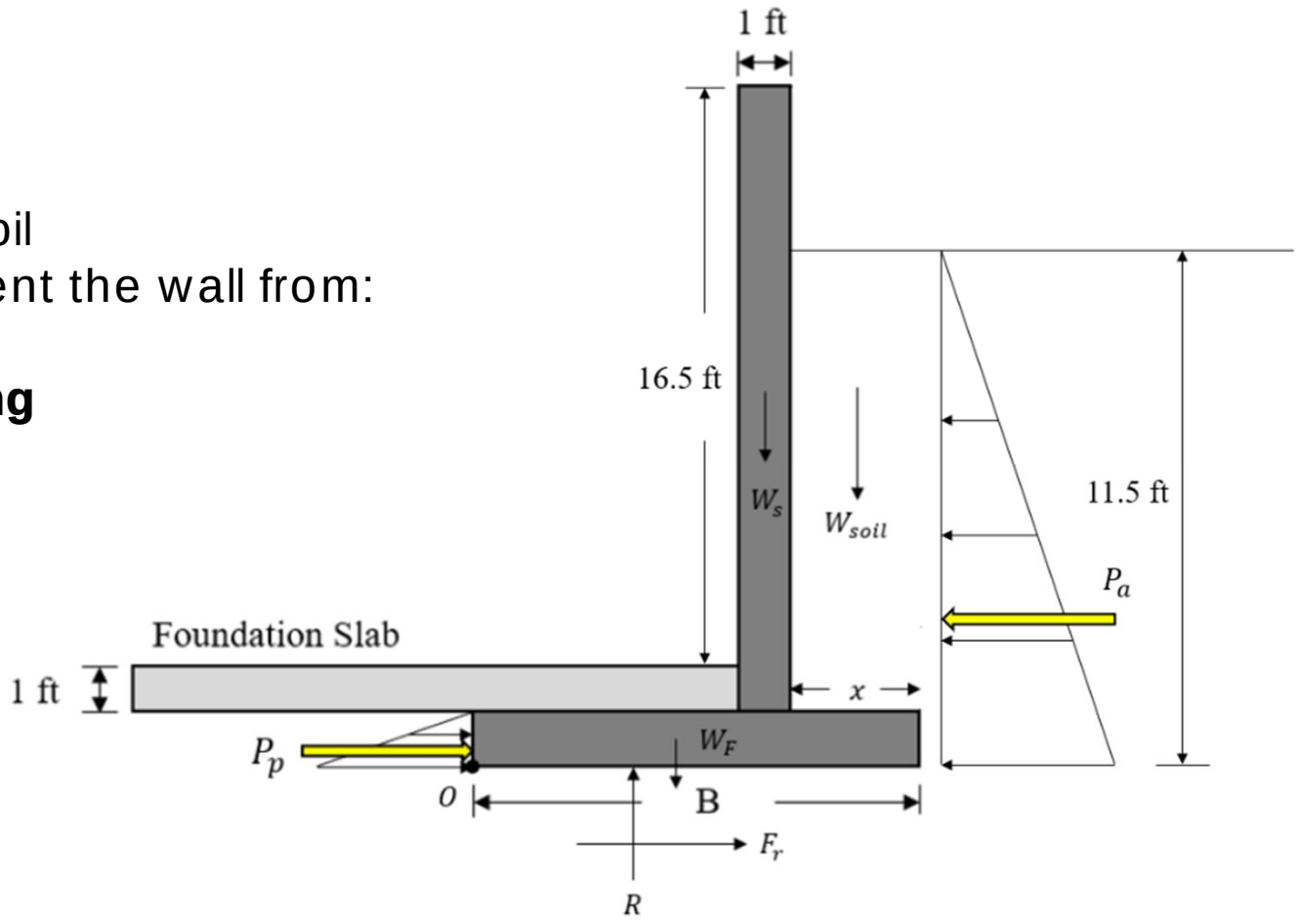
Roof:
UX_max = **0.053 in**
UY_max = **0.045 in**

3rd floor:
UX_max = **0.027 in**
UY_max = **0.023 in**

Allowable Story Disp:
Roof: **1.05 in**
3rd floor: **0.75 in**

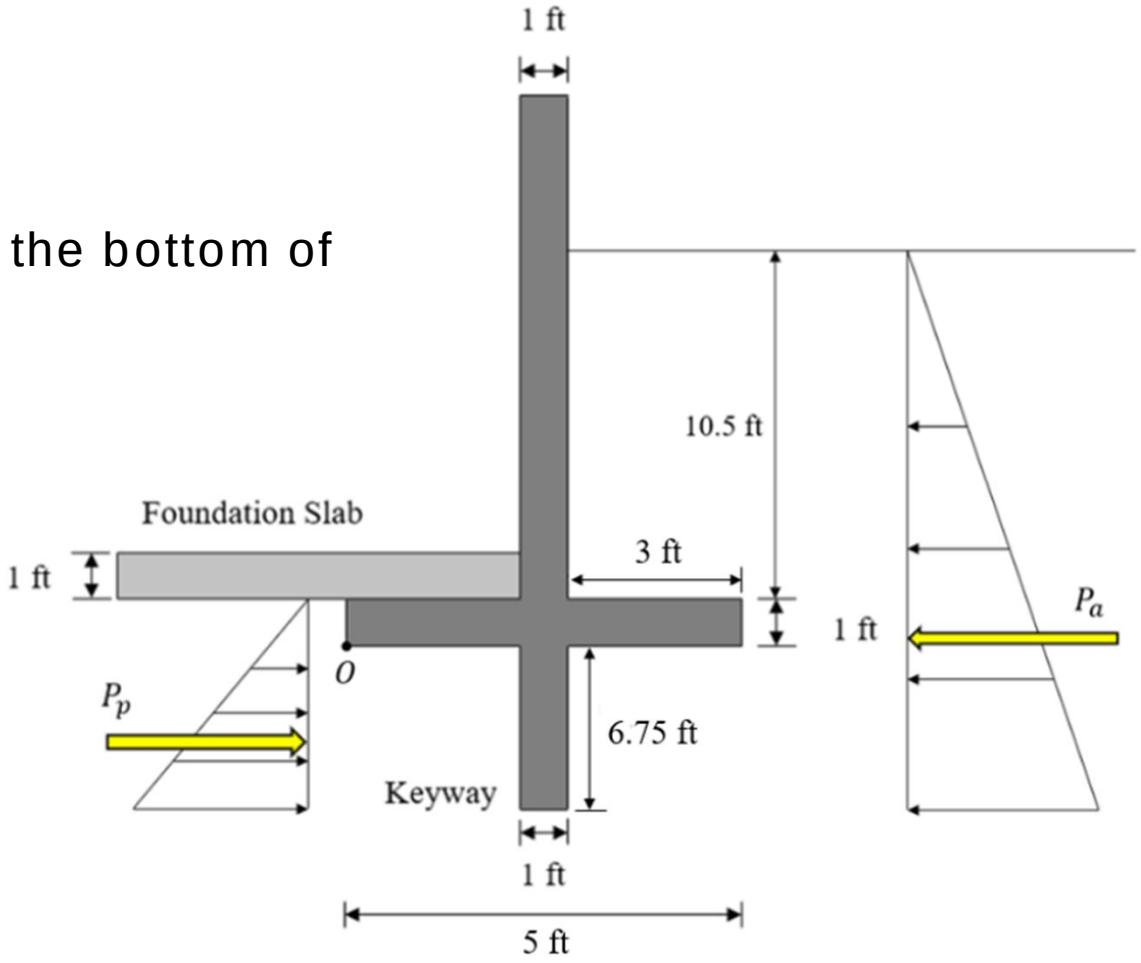
First iteration

- 11.5-ft deep soil
- Need to prevent the wall from:
  - **Sliding**
  - **Overturning**

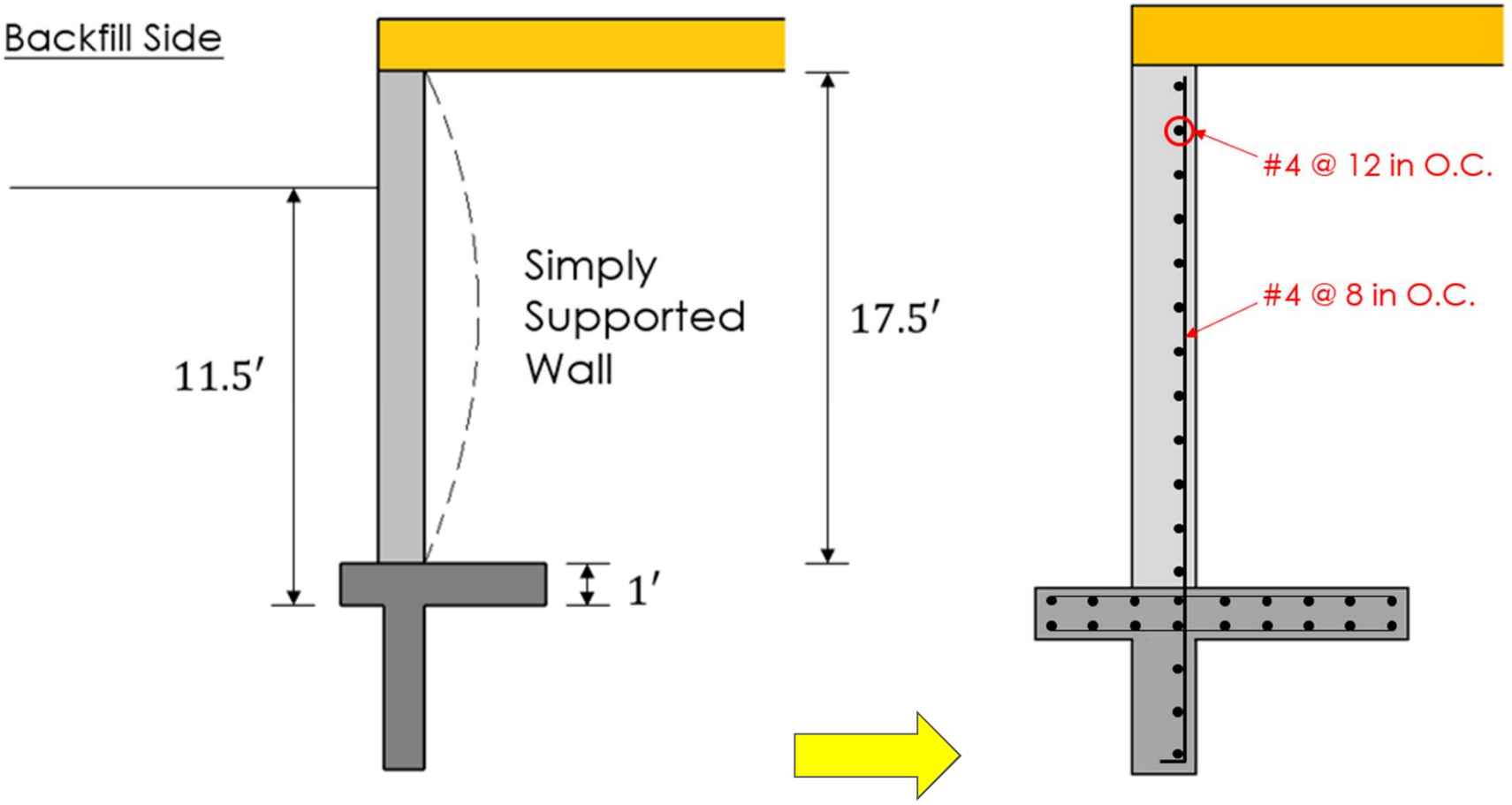


Improved solution:

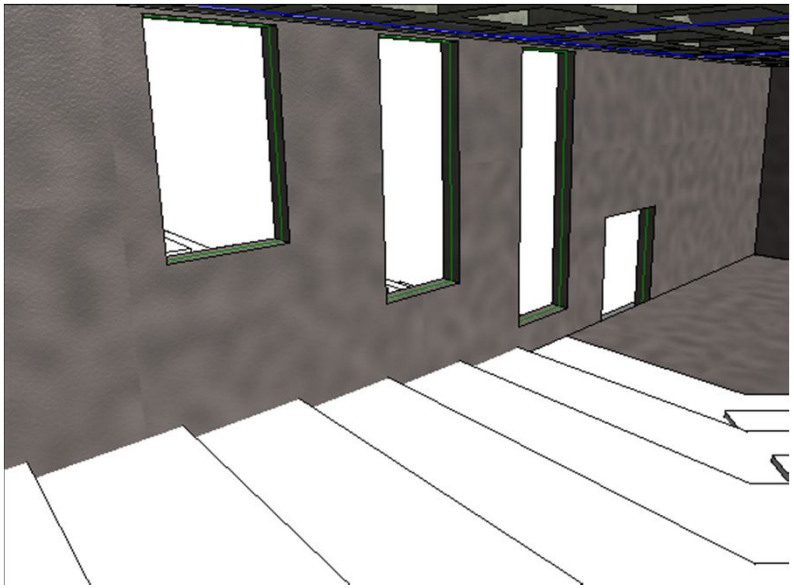
Attach a **6.75-ft keyway** to the bottom of the wall foundation

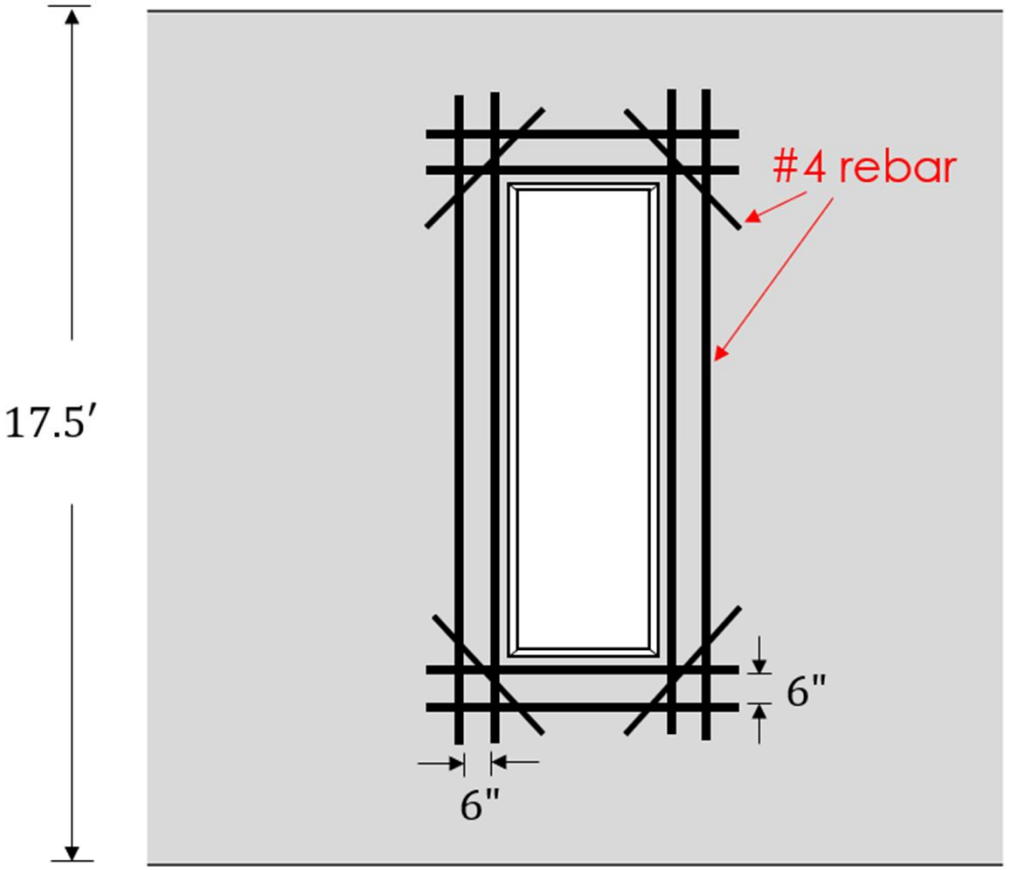


RETAINING WALL DESIGN



RETAINING WALL DESIGN







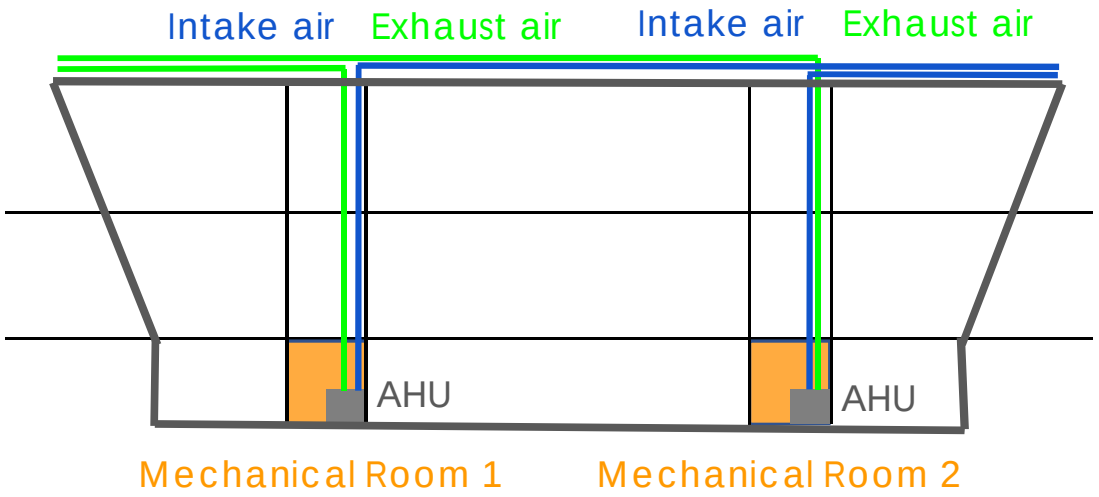


MEP



VENTILATION CONCEPT







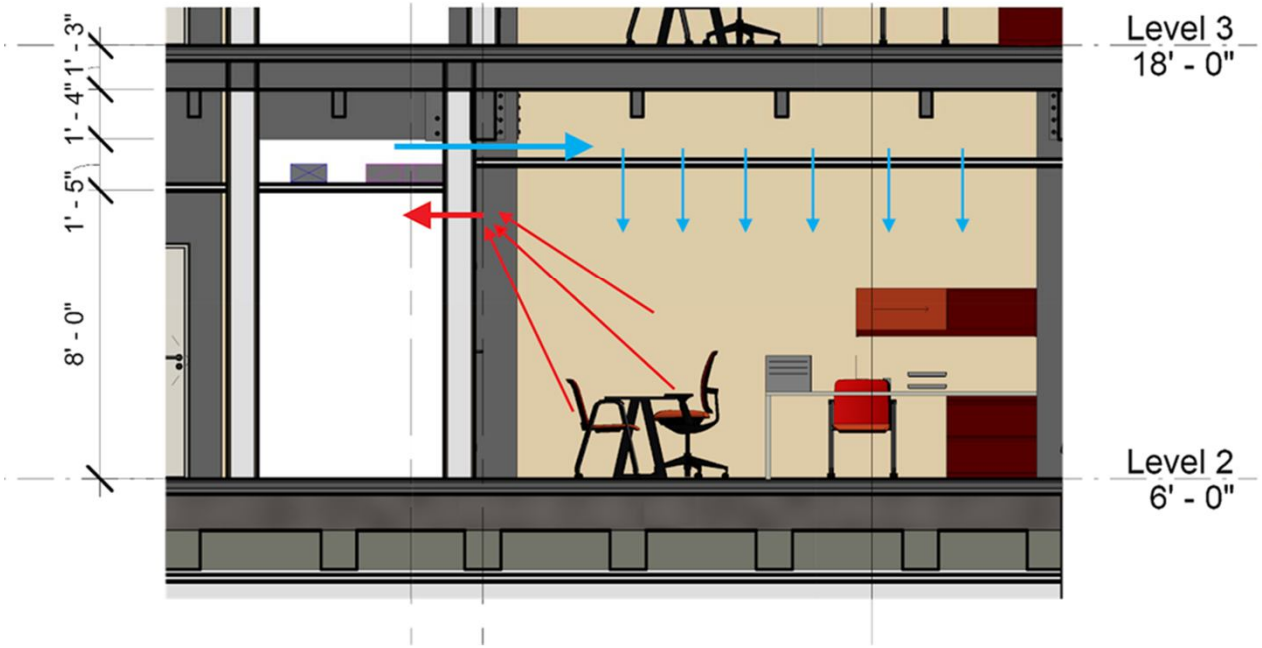
VENTILATION OPTIONS

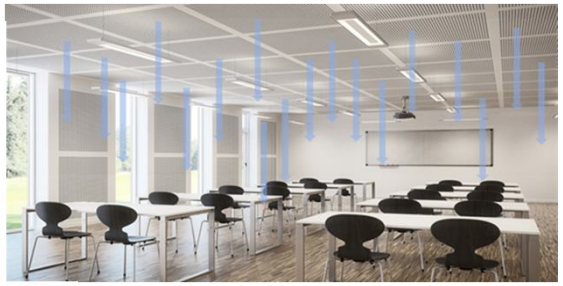
2ND WINTER 1ST SPRING

Component	Efficiency	Price	Downdraft	Space need
Ceiling diffusers				
Displacement ventilation (2ND)				
Diffuse ceiling ventilation (1ST)				
Natural ventilation	• High air pollution → bad air quality • High humidity + cooling devices → condensation problems			

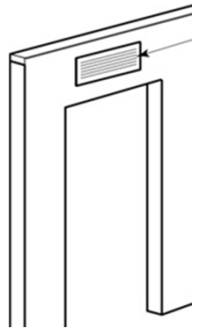


DIFFUSE CEILING CONCEPT



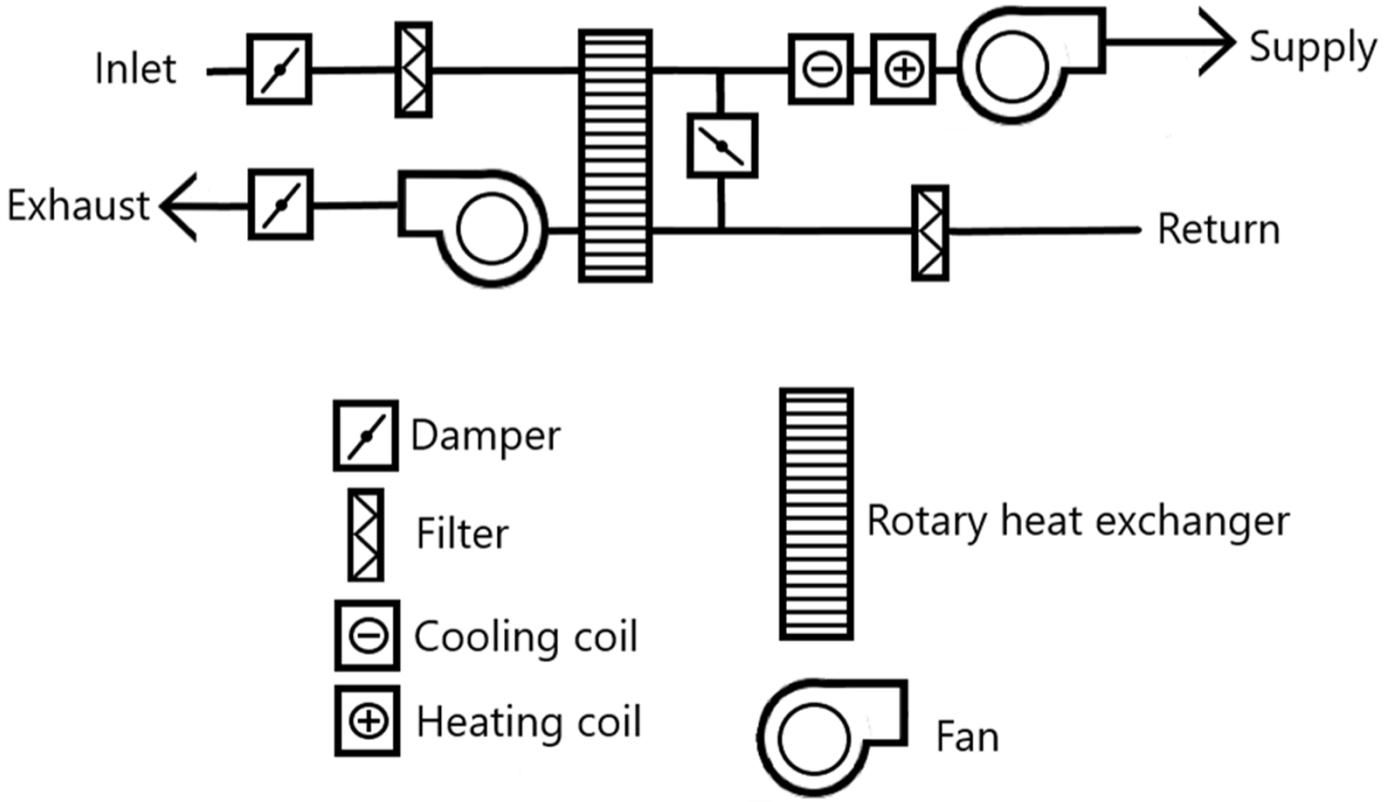


low air velocities



Exhaust grill with silencer

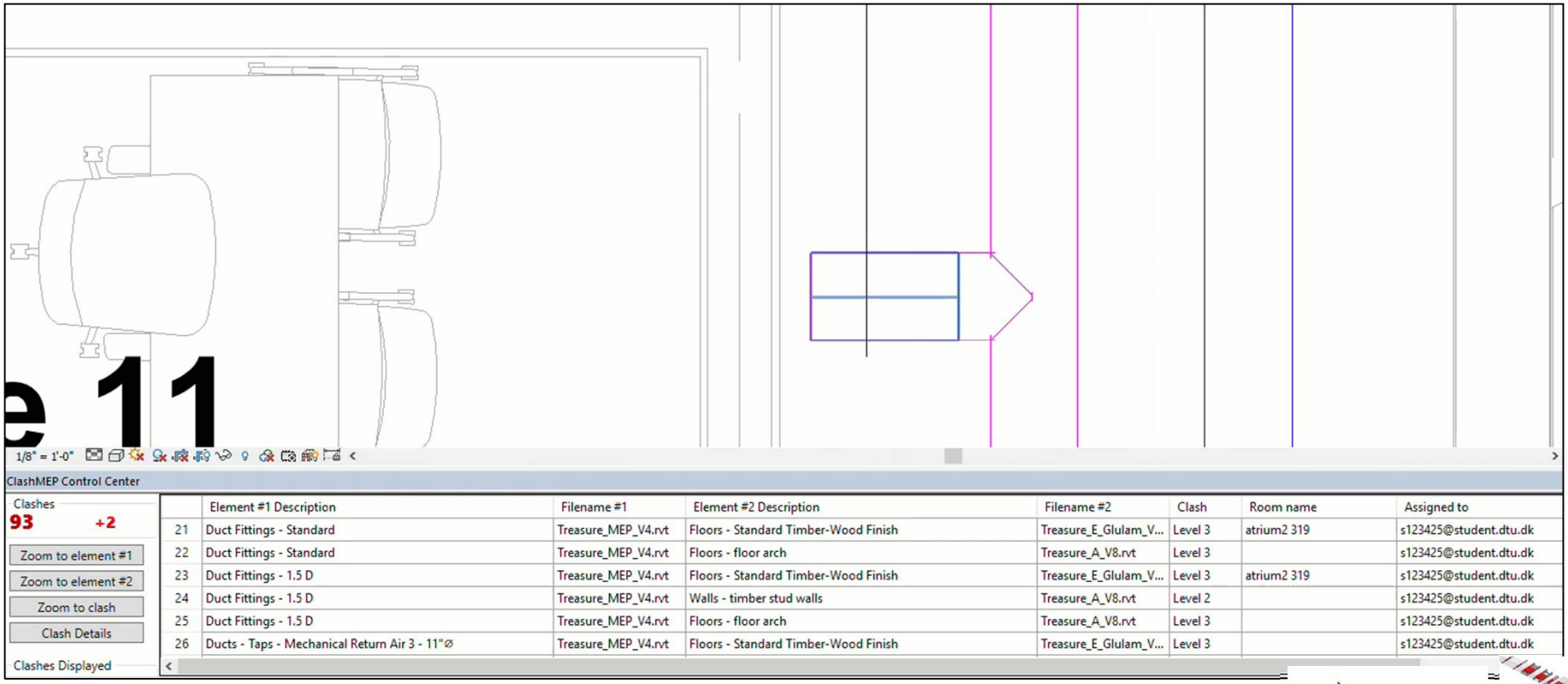
VENTILATION DIAGRAM





Real-Time Clash Detection

Live Clash Detection in Revit

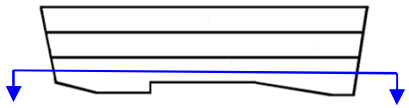


	Element #1 Description	Filename #1	Element #2 Description	Filename #2	Clash	Room name	Assigned to
21	Duct Fittings - Standard	Treasure_MEP_V4.rvt	Floors - Standard Timber-Wood Finish	Treasure_E_Glulam_V...	Level 3	atrium2 319	s123425@student.dtu.dk
22	Duct Fittings - Standard	Treasure_MEP_V4.rvt	Floors - floor arch	Treasure_A_V8.rvt	Level 3		s123425@student.dtu.dk
23	Duct Fittings - 1.5 D	Treasure_MEP_V4.rvt	Floors - Standard Timber-Wood Finish	Treasure_E_Glulam_V...	Level 3	atrium2 319	s123425@student.dtu.dk
24	Duct Fittings - 1.5 D	Treasure_MEP_V4.rvt	Walls - timber stud walls	Treasure_A_V8.rvt	Level 2		s123425@student.dtu.dk
25	Duct Fittings - 1.5 D	Treasure_MEP_V4.rvt	Floors - floor arch	Treasure_A_V8.rvt	Level 3		s123425@student.dtu.dk
26	Ducts - Taps - Mechanical Return Air 3 - 11"⌀	Treasure_MEP_V4.rvt	Floors - Standard Timber-Wood Finish	Treasure_E_Glulam_V...	Level 3		s123425@student.dtu.dk

BUILDING SYSTEM PLANNING, INC.

ClashMEP
Real-time & Interactive Clash Detection for Revit

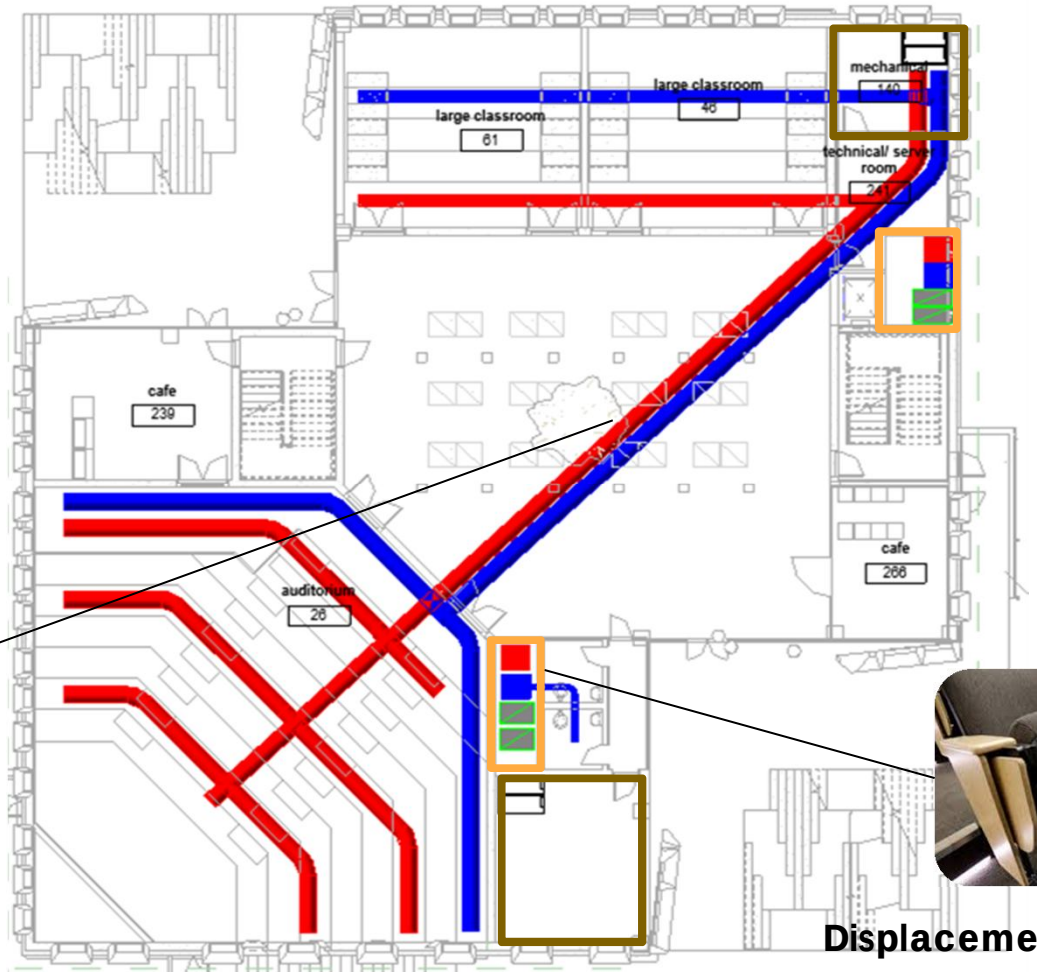
HVAC ROUTING - FLOOR 1



- Supply Air
- Return Air
- Shaft
- Mech Room
- AHU



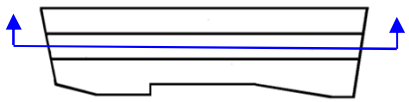
Ducts 24”
Underfloor HVAC





Displacement Ventilation

HVAC ROUTING - FLOOR 2

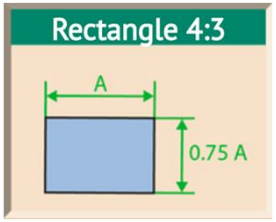


Supply Air

Return Air

Shaft

Ducts



Supply Air: 30mm insulation

Return Air: No insulation



HVAC ROUTING - FLOOR 3

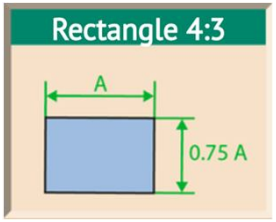


Supply Air

Return Air

Shaft

Ducts



Supply Air: 30mm insulation

Return Air: No insulation



FACADE EVOLUTION



Winter Quarter Proposal

- Glare issues
- Cooling needed was very high



Spring Quarter - Next Iteration

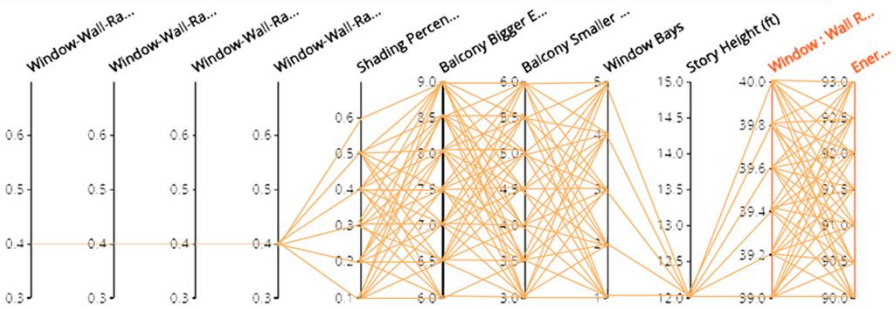
- Less glare issues
- Cooling reduced but still high

PARAMETRIC DESIGN OPTIMISATION

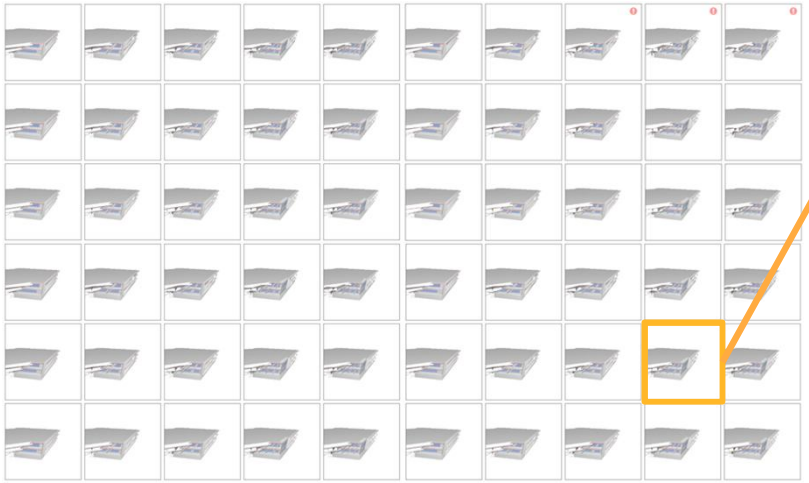


EXPLORING ALTERNATIVES

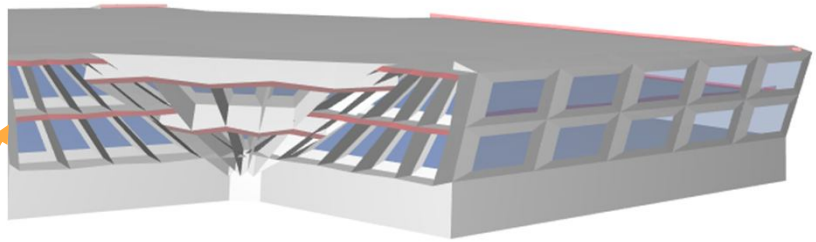
aec final v2 Project Fractal



270 different alternatives



...



Parametric Design Optimisation

- Energy Balance: 90 kWh/m2

Dynamo +

FINAL FACADE DESIGN

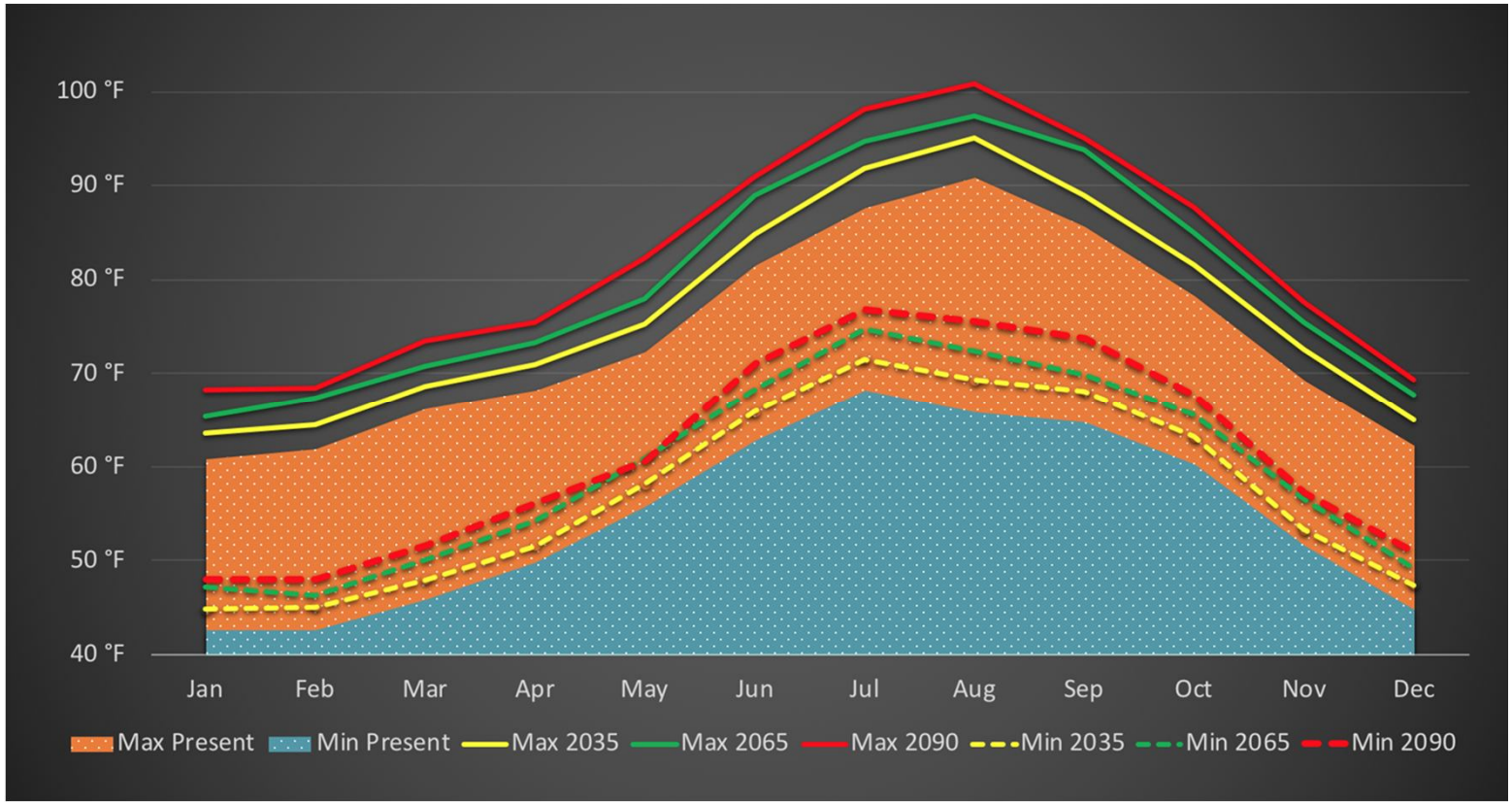
FINAL DESIGN

- Good daylight factor
- Minimized glare issues
- Energy Balance = **66.5 kWh/m2**





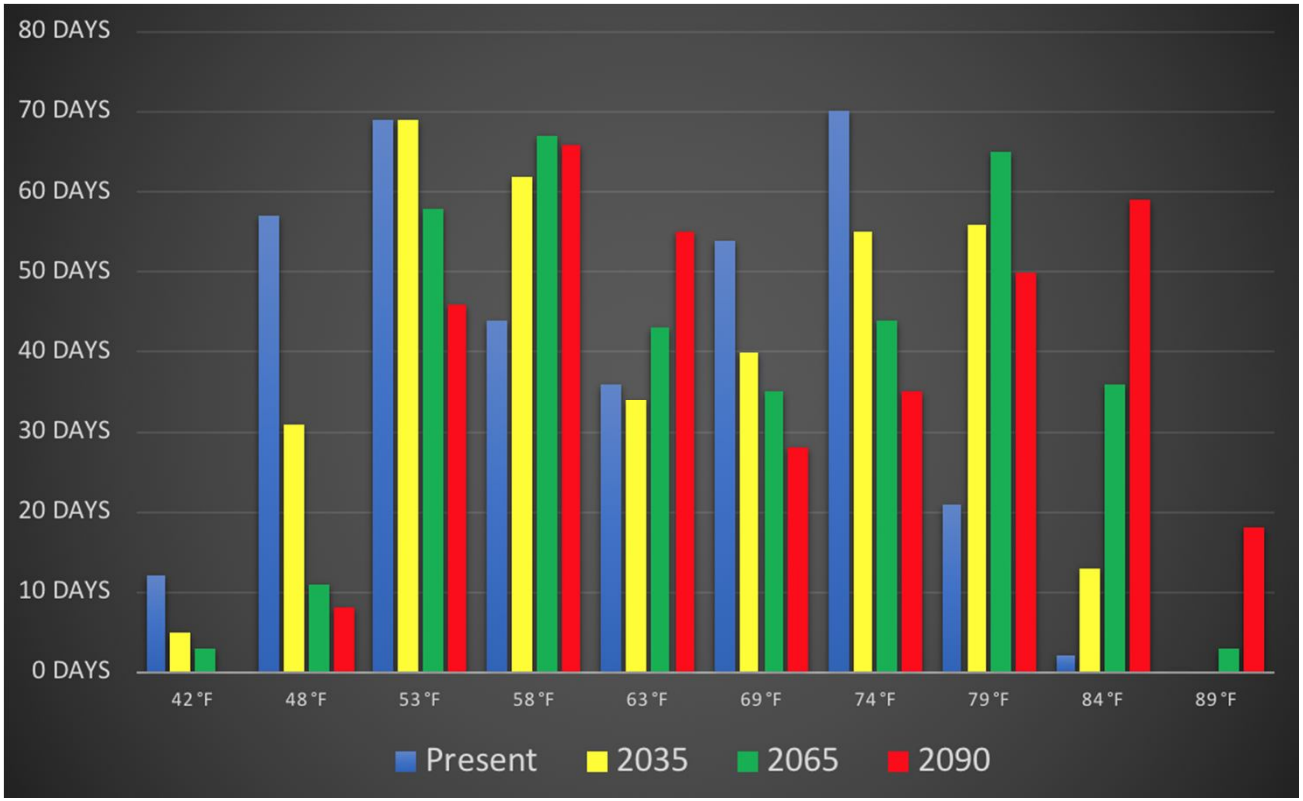
FUTURE TEMPERATURE PREDICTION



ARUP WEATHERSHIFT™ v2.0

http://weathershift.com/

FUTURE TEMPERATURE PREDICTION



ARUP WEATHERSHIFT™ v2.0

http://weathershift.com/



ENERGY BALANCE

Present

		Purchased energy		Peak demand
		kWh	kWh/m²	kW
	Lighting, facility	8398	3.1	6.48
	Electric cooling	47699	17.5	33.37
	HVAC aux	19118	7.0	6.45
	Total, Facility electric	75215	27.6	
	Domestic hot water	28937	10.6	7.15
	Total, Facility fuel*	28937	10.6	
	District heating	8474	3.1	44.0
	Total, Facility district	8474	3.1	
	Total	112626	41.3	
	Equipment, tenant	51601	18.9	17.6
	Total, Tenant electric	51601	18.9	
	Grand total	164227	60.1	

2065

		Purchased energy		Peak demand
		kWh	kWh/m²	kW
	Lighting, facility	8396	3.1	6.49
	Electric cooling	69331	25.4	42.9
	HVAC aux	19396	7.1	6.57
	Total, Facility electric	97123	35.6	
	Domestic hot water	28937	10.6	7.15
	Total, Facility fuel*	28937	10.6	
	District heating	4000	1.5	32.17
	Total, Facility district	4000	1.5	
	Total	130060	47.6	
	Equipment, tenant	51594	18.9	17.6
	Total, Tenant electric	51594	18.9	
	Grand total	181654	66.5	

60.1 kWh/m2 → **66.5 kWh/m2**

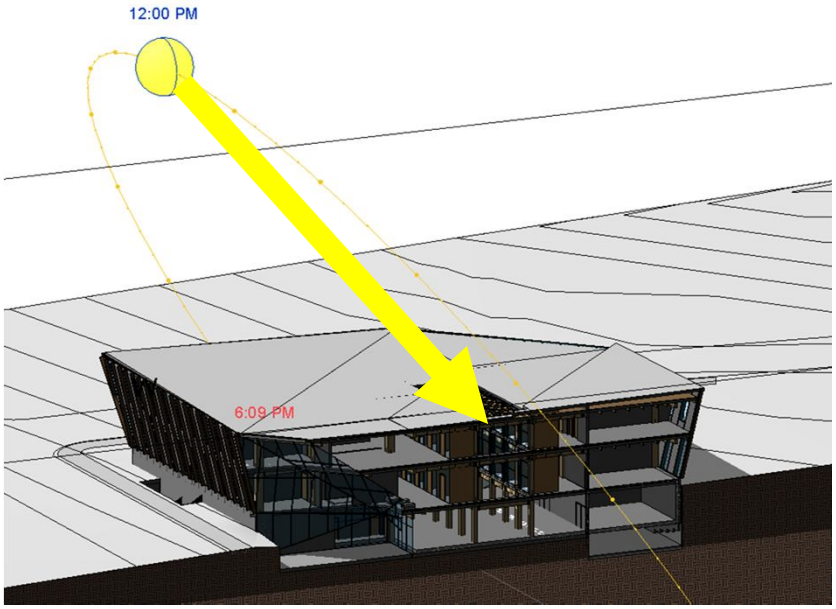
EQUA
IDA Indoor Climate and Energy

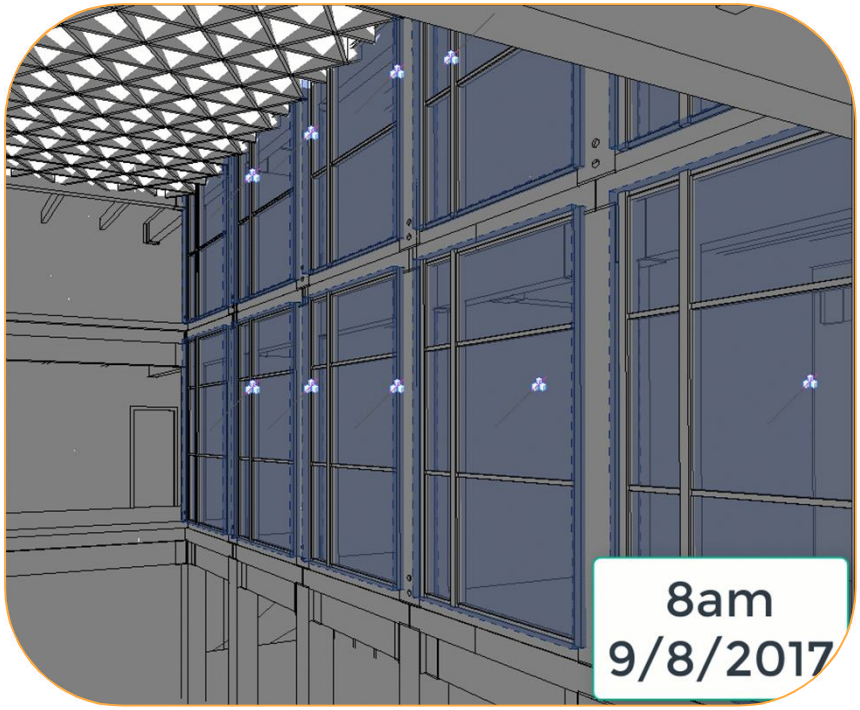
COOLING OPTIONS

2ND WINTER 1ST SPRING

Component	Efficiency	Price	Downdraft	Space need
Chilled ceiling (2ND)	Change			
Fan coils (1ST)				
Active chilled beams				
Thermal active building slabs				
Cooling by ventilation				

SOLAR ANALYSIS IN ATRIUM

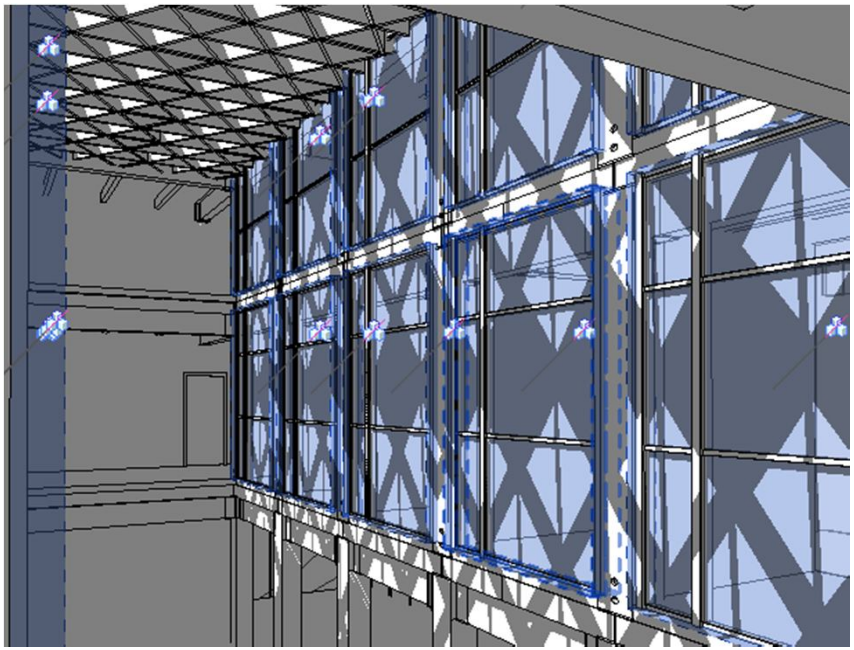


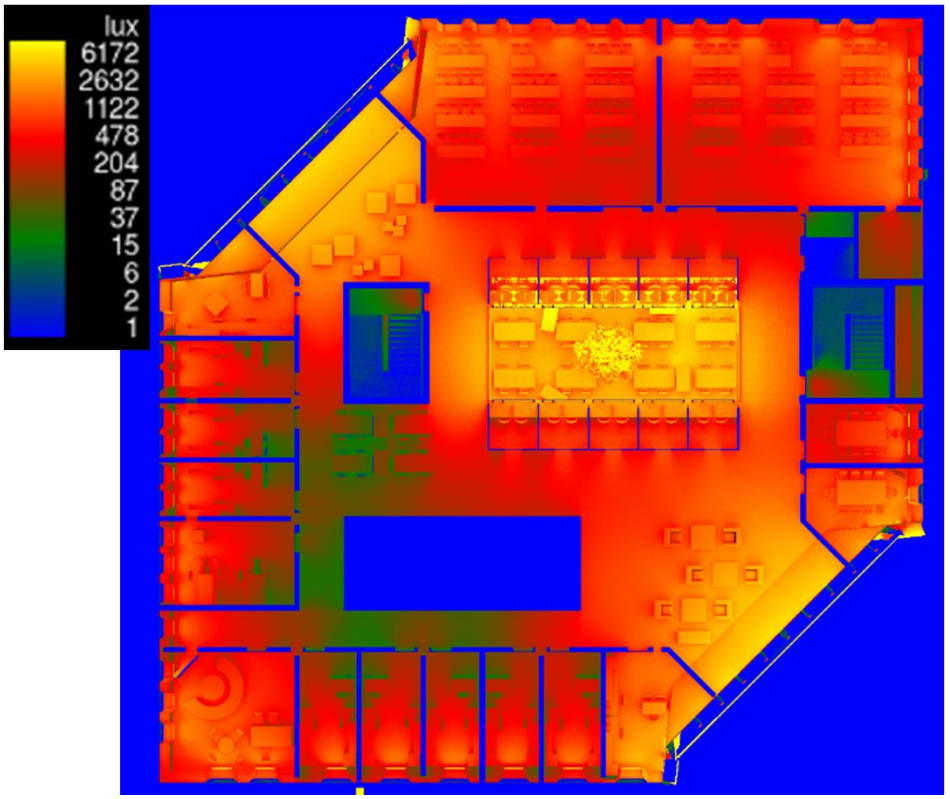


Challenge: Student offices in northern part of atrium

revizto™

GLARE IN ATRIUM

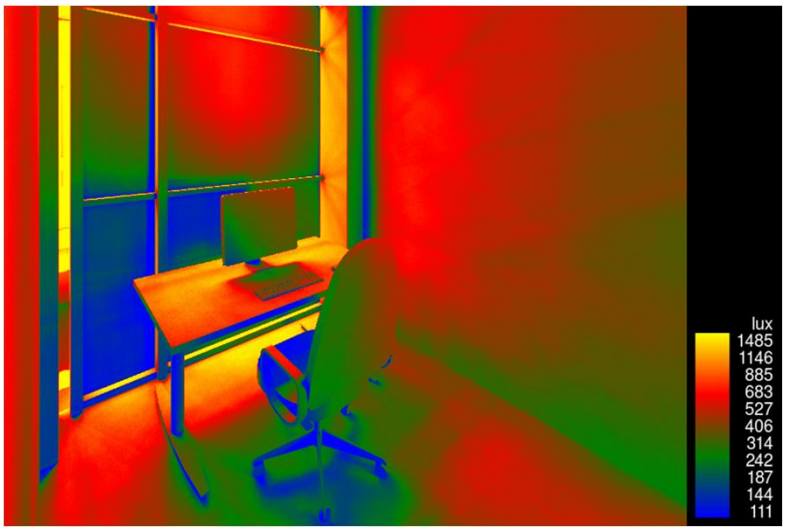




- Triple-Layer Window
- Visible Transmittance 60%
- Shading Structure

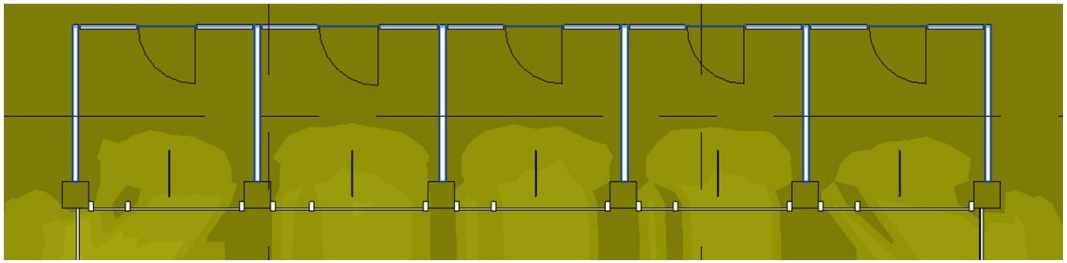
SOLAR ANALYSIS IN STUDENT OFFICES

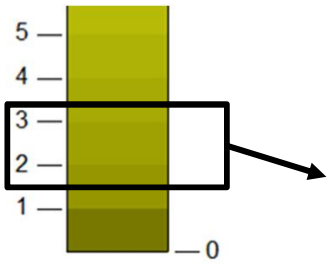
Glare analysis





Daylight factor

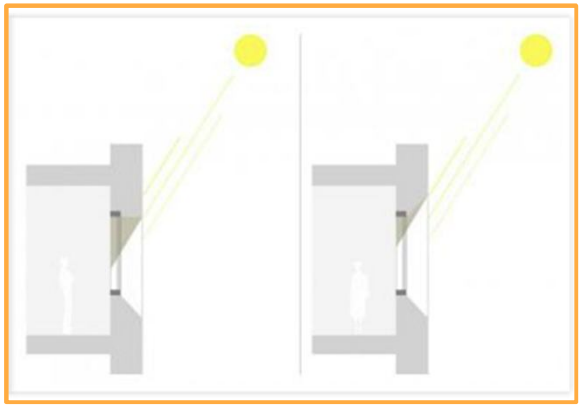


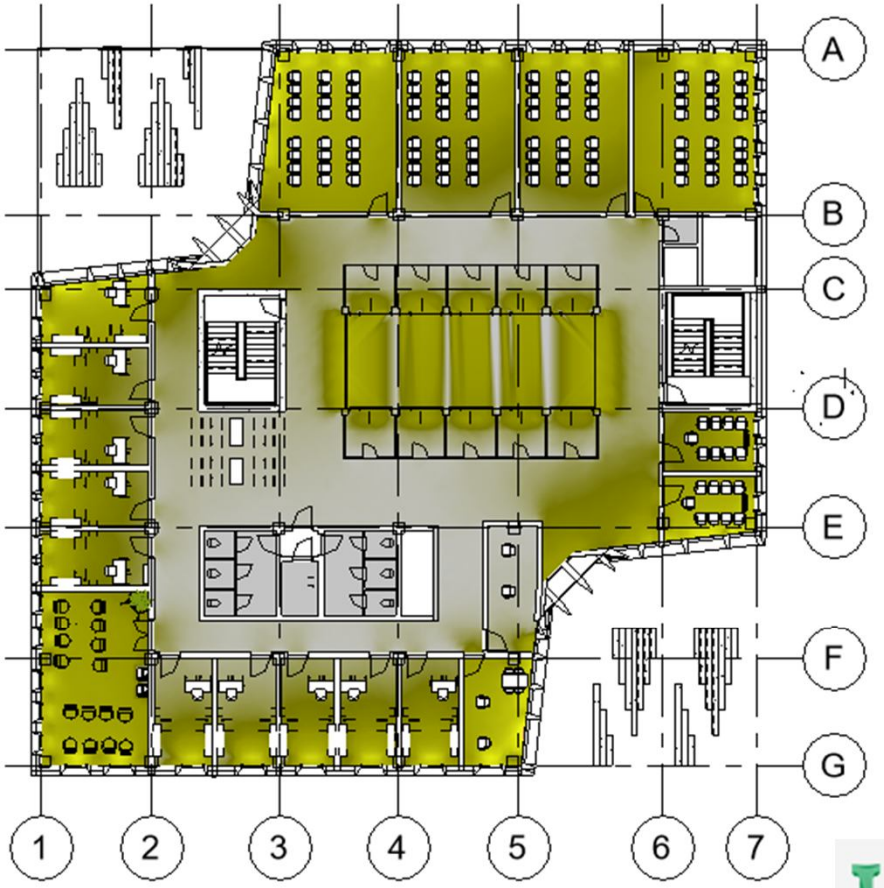


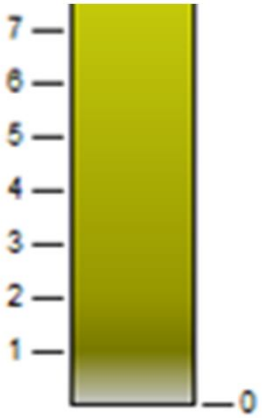
Factor 2-3%
200-300 Lux

DAYLIGHT FACTOR - FLOOR 2









AUTODESK® INSIGHT

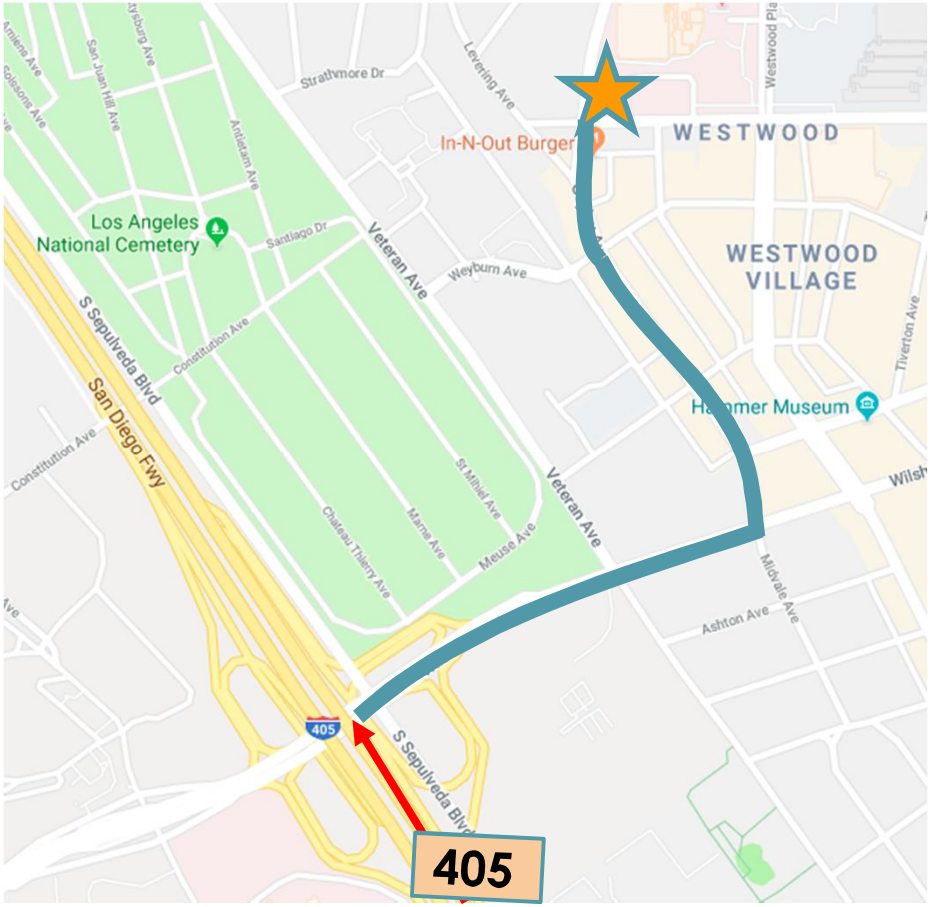


CONSTRUCTION

MANAGEMENT



CONSTRUCTION SITE ACCESS

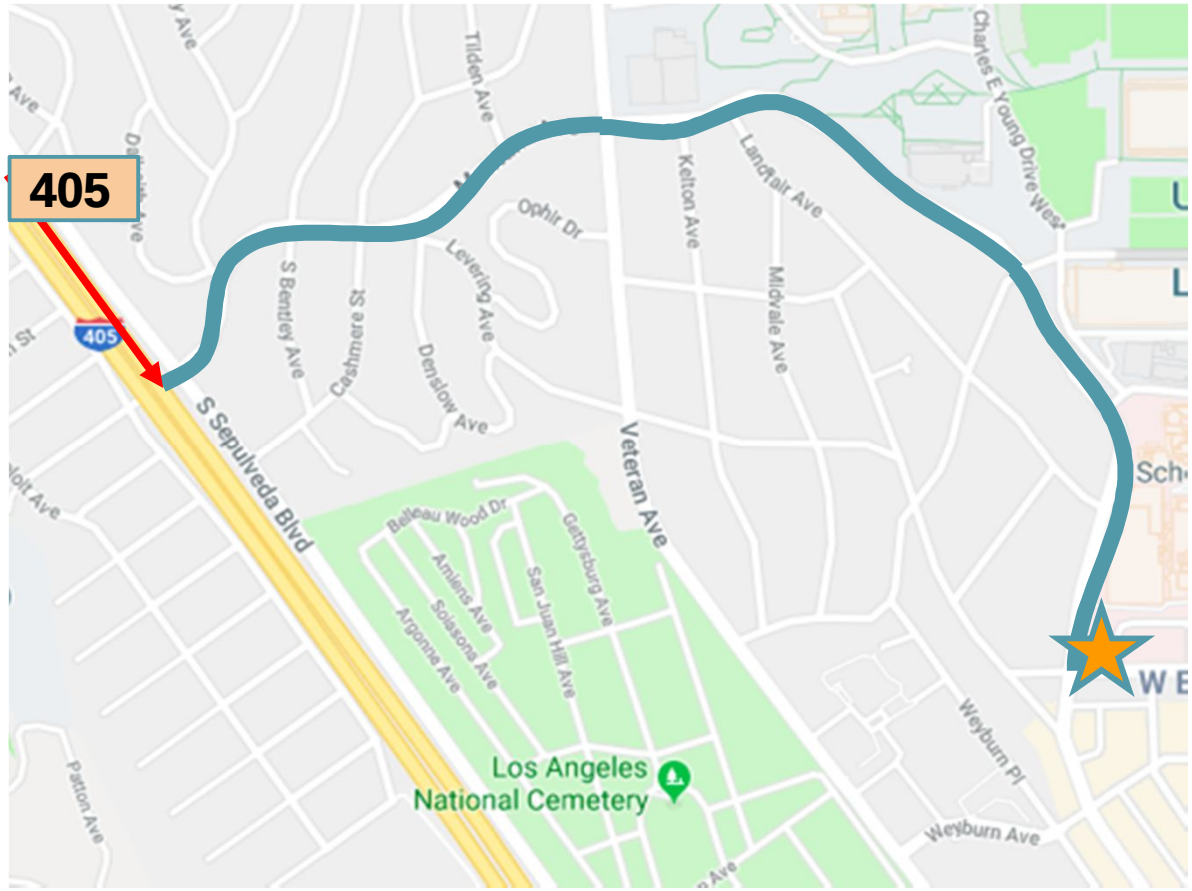


CONSTRUCTION SITE

HEAVY TRAFFIC

RUSH HOUR:
7AM - 9AM
5PM - 7.30PM

CONSTRUCTION SITE ACCESS



CONSTRUCTION SITE

HEAVY TRAFFIC

RUSH HOUR:
7AM - 9AM
5PM - 7.30PM

CONSTRUCTION SITE ACCESS

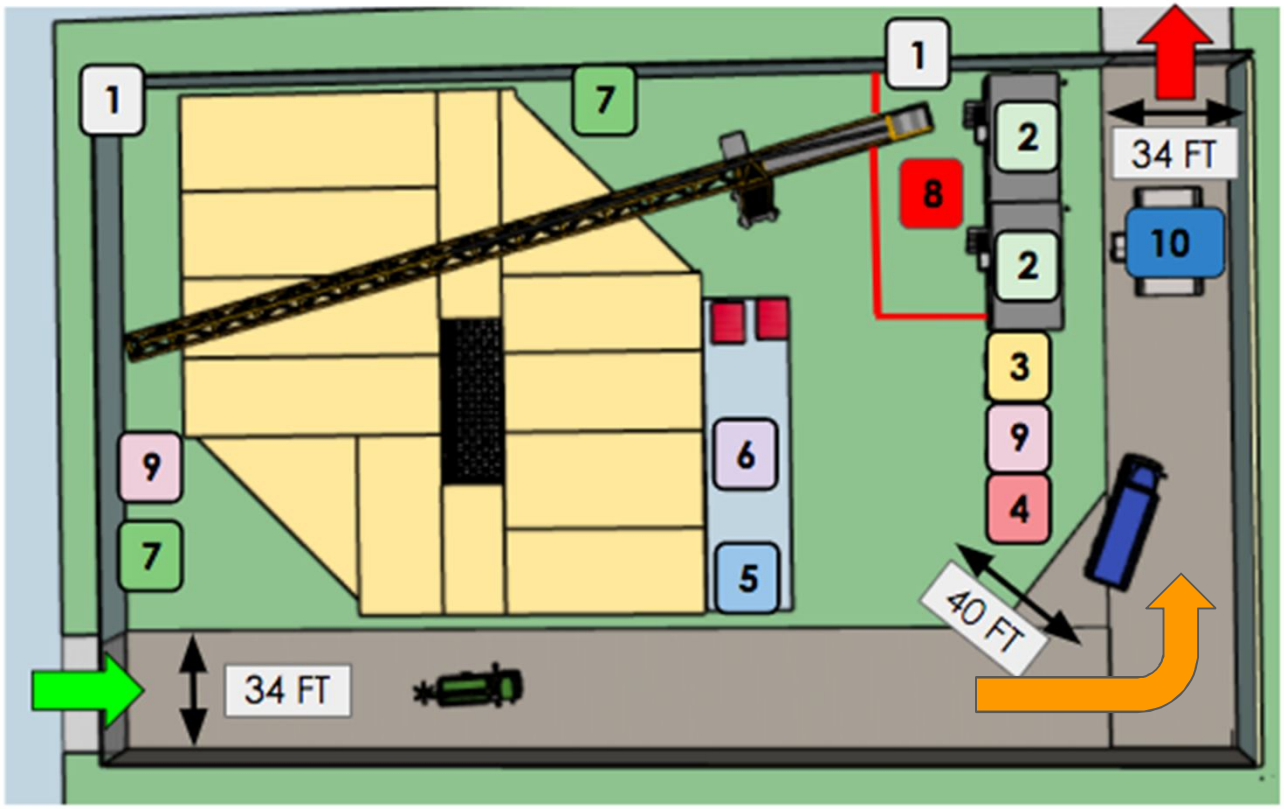


ENTRANCE TRUCKS

EXIT TRUCKS

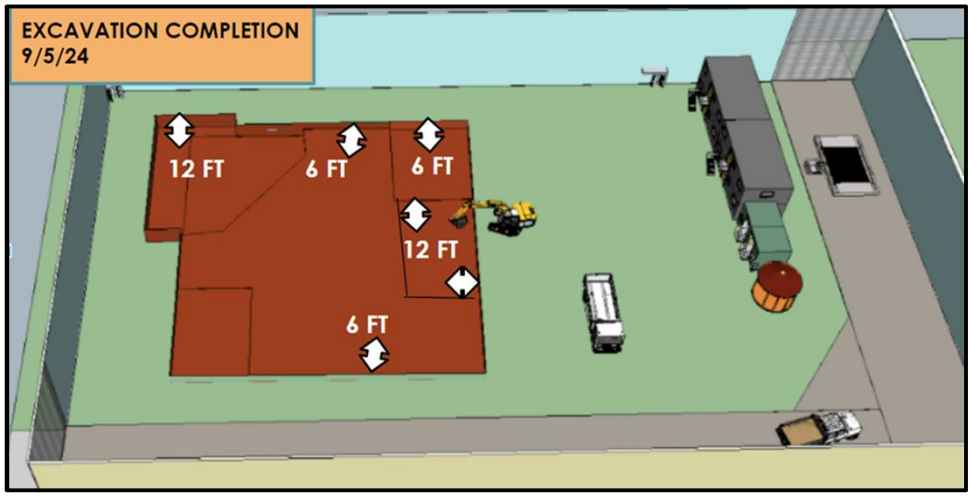
E EMERGENCY AREA

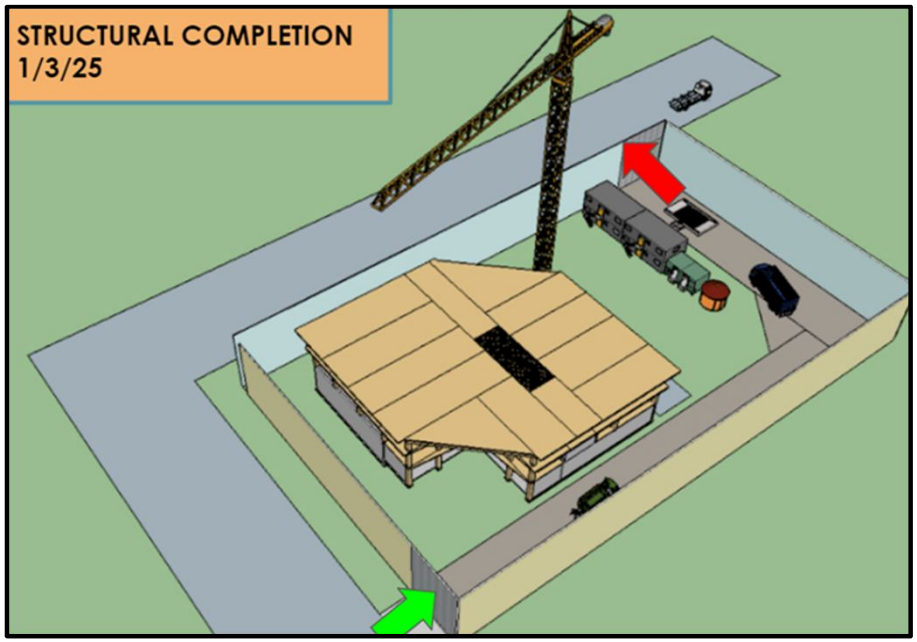
CONSTRUCTION SITE LOGISTICS



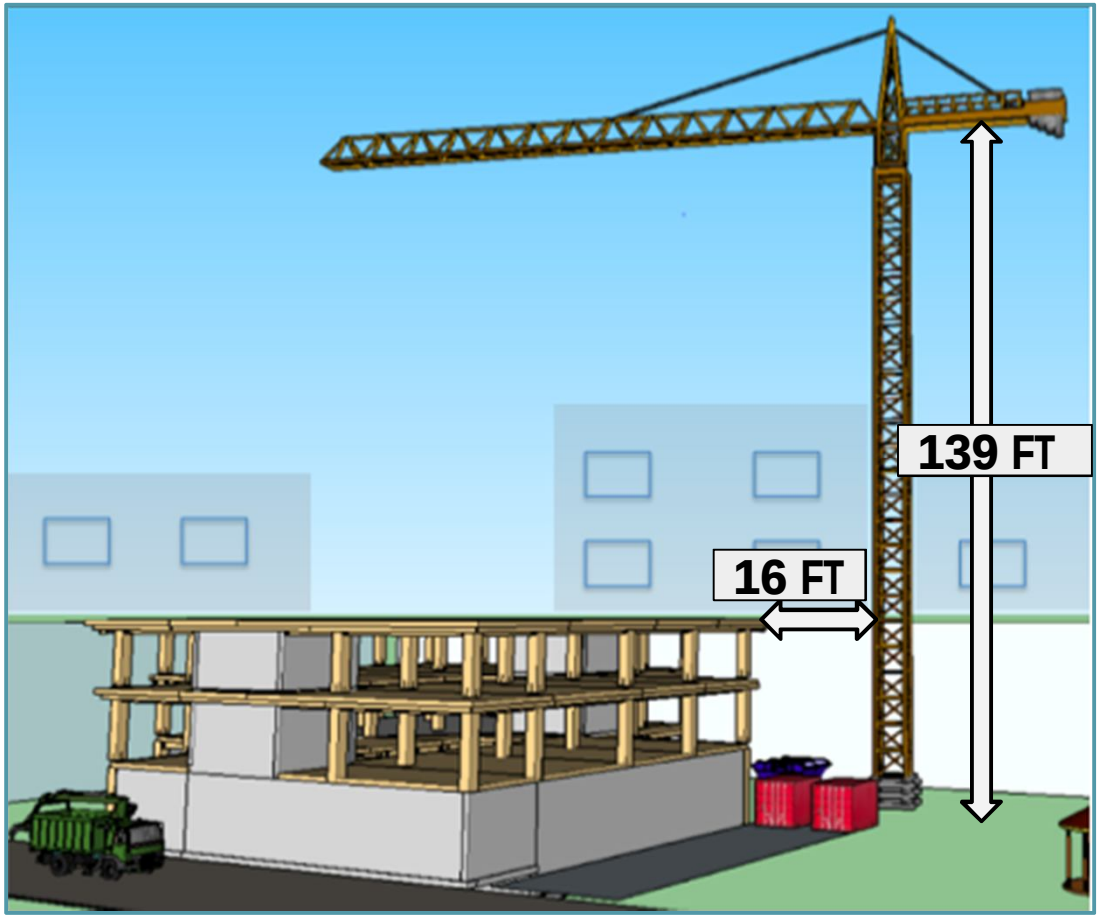
1 EXIT/ENTRANCE EMPLOYEES
2 SITE OFFICES
3 RESTROOMS
4 SHADED AREA
5 LOADING AREA
6 MATERIAL LAYDOWN AREA
7 RECYCLING AREA
8 EMERGENCY AREA
9 FIRST AID KIT STATION
10 TRUCK WASH

LOGISTICS

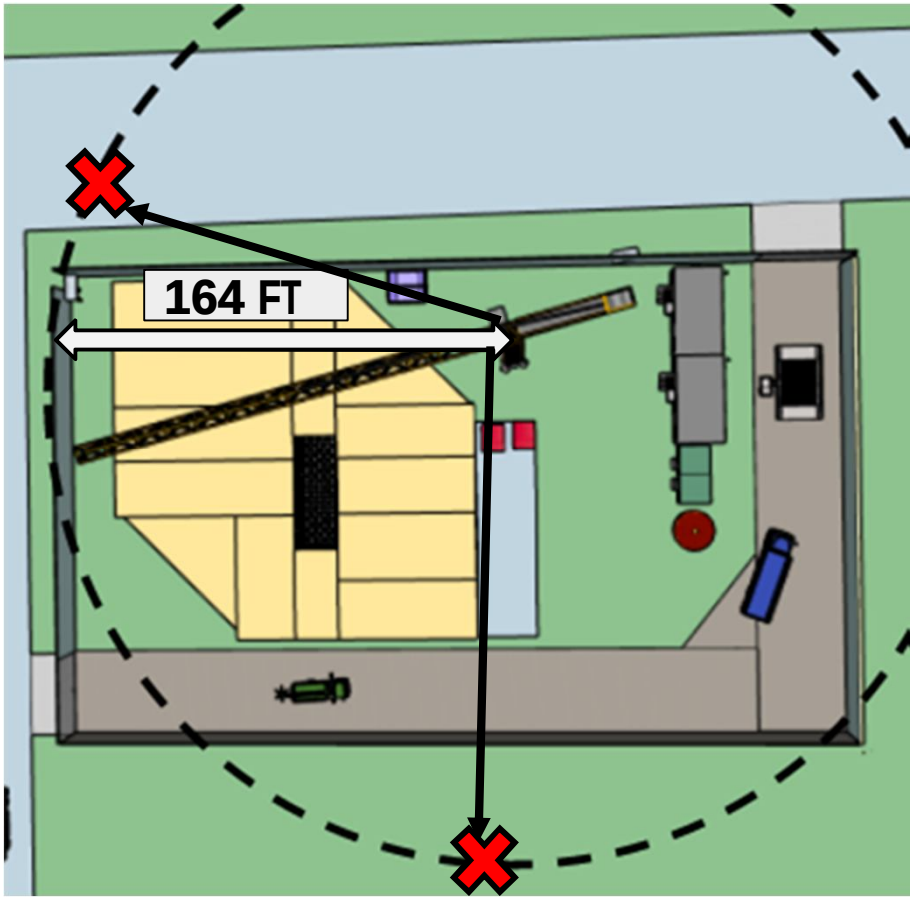

EXCAVATION COMPLETION
9/5/24
12 FT
6 FT
6 FT
12 FT
6 FT


STRUCTURAL COMPLETION
1/3/25

SECTION TOWER CRANE



TOWER CRANE LOGISTICS



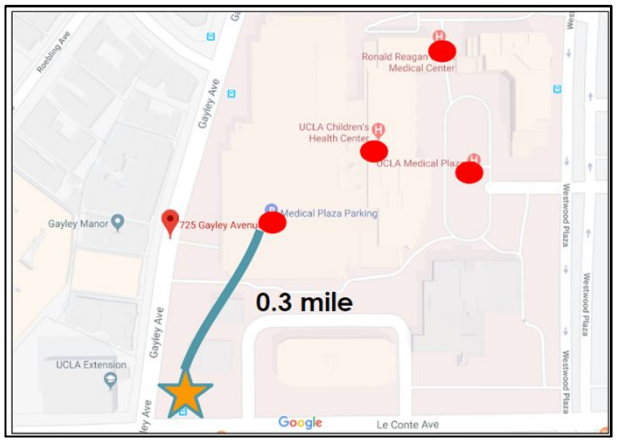
Specifications	Liebherr *85 EC-B 5 FR.tronic*
Max radius	164 ft
Max capacity	11,023 lbs
Lifting capacity at max radius	2,866 lbs

EQUIPMENT

	Equipment name	Capacity	Quantity	Total cost (Equipment + Labor)
	Excavator	3-4 cy	1	3500$
	Dump Truck	12 cy	18	54,000$
	Compactor		1	600$

HEALTH AND SAFETY

Hospital map



First aid kit stations



Compulsory to use safety equipment



Fall protection



Prohibited to pass the truck route





Evacuation plan - Evacuation Area

Earthquake



Construction site



Warning signal!

stop & listen
Standard Emergency Warning Signal

Fire

Fire alarm!



Fire points



FIRE HYDRANTS MAP



CONSTRUCTION SITE

BEAT THE HEAT

Portable fans



Report heart symptoms!



Shadowed area for rest



Fresh and pure water tanks





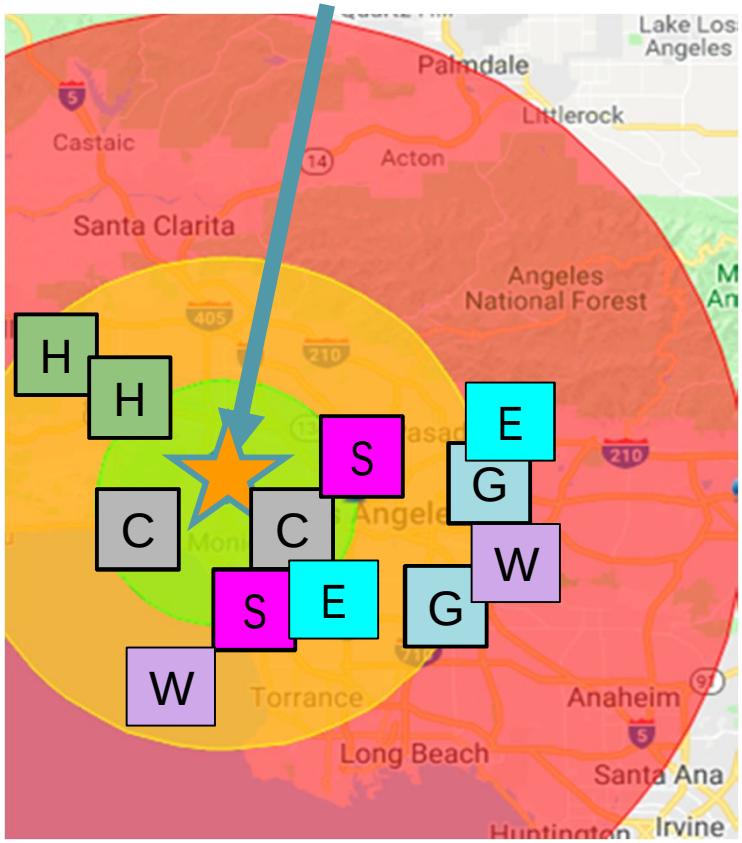
SUPPLIER PROXIMITY

Radius distance from construction site

- 10 MILES
- 20 MILES
- 40 MILES

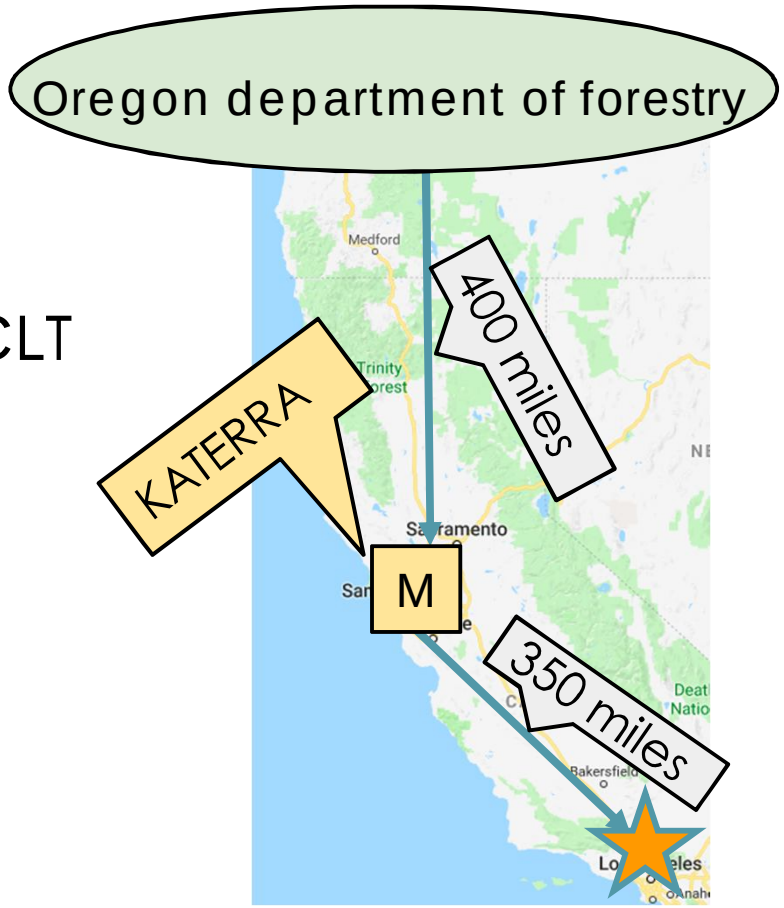
- H HVAC supplier
- S Steel supplier
- C Concrete supplier
- G Lumber supplier Glulam
- E Construction site equipment
- W Construction workwear and safety gear

CONSTRUCTION SITE



CLT SUPPLIER

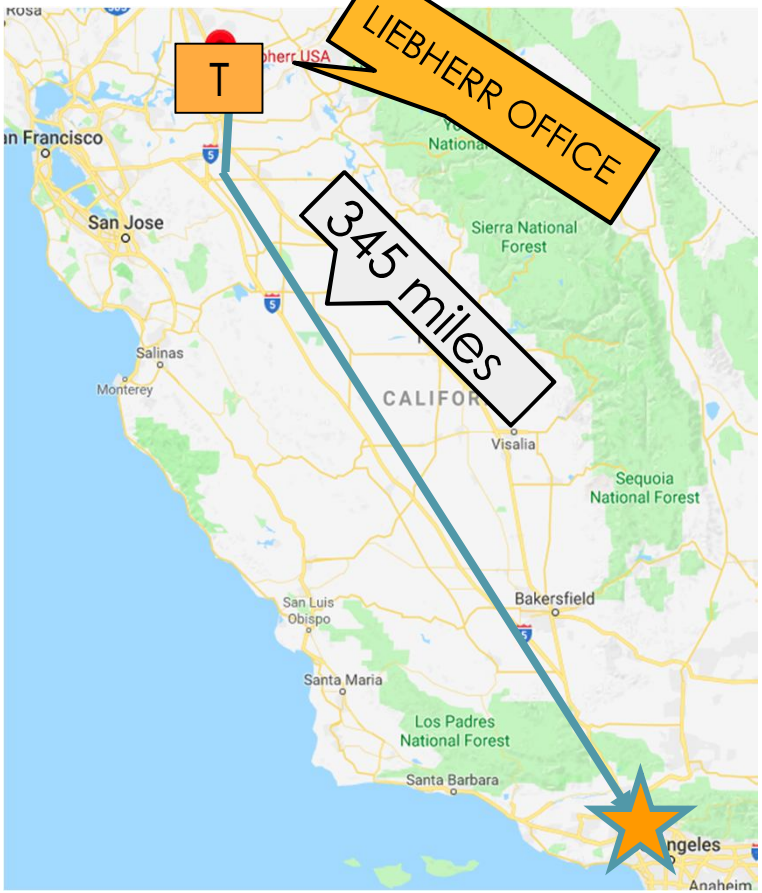
M Mass timber supplier CLT



LOCAL VENDOR SUPPLIER

T Tower crane





CONSTRUCTABILITY

SMOOTH CONSTRUCTION

PRECAST WAFFLE SLAB



CLT SLAB/ GLULAM BEAMS



STRUCTURAL CONNECTIONS



PREFAB CONCRETE WALLS



CURTAIN WALLS



FACADE



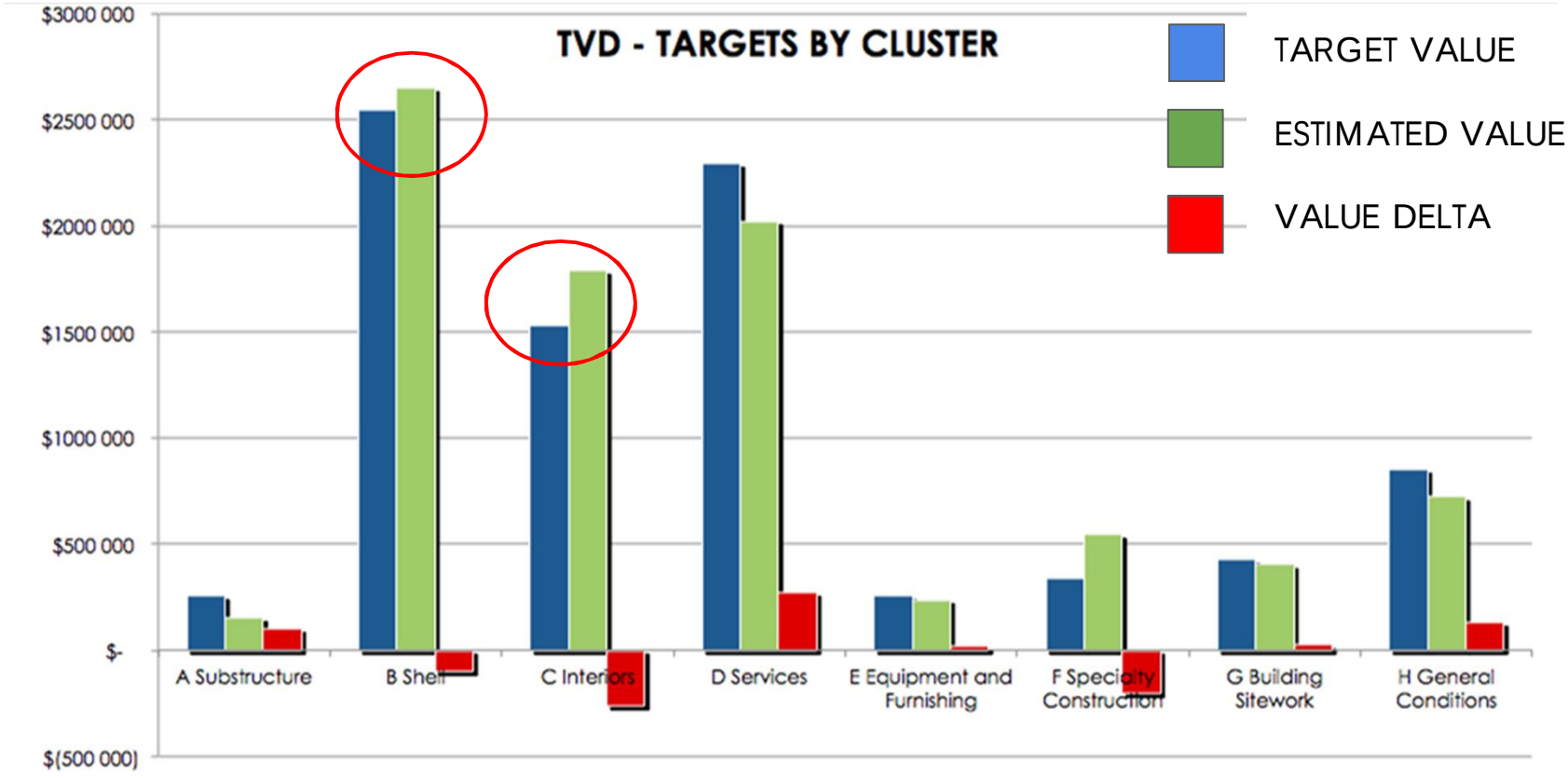
TARGET VALUE

Overall Budget and Target		
Construction Grant from Donor	$	10 000 000
Grant Year		2018
Construction Year		2024
Expected Inflation		3,00%
Return on Investment		2,00%
BUDGET	$	9 414 801
TARGET	$	8 500 000

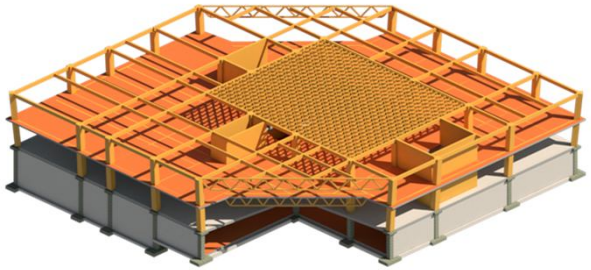
Cluster Targets (%)		Based on RS Means SF Estimate	Based on Previous Projects (1)	Based on Previous Projects (2)	TARGETS
A	Substructure	10%	6%	4%	**3%**
B	Shell	30%	27%	35%	**30%**
C	Interiors	12%	12%	14%	**18%**
D	Services	35%	24%	28%	**27%**
E	Equipment and Furnishings	5%	9%	1%	**3%**
F	Specialty Construction	5%	3%	5%	**4%**
G	Building Sitework	1%	5%	6%	**5%**
H	General Conditions	2%	14%	9%	**10%**
SUM		100%	100%	102%	100%

Higher Interiors costs

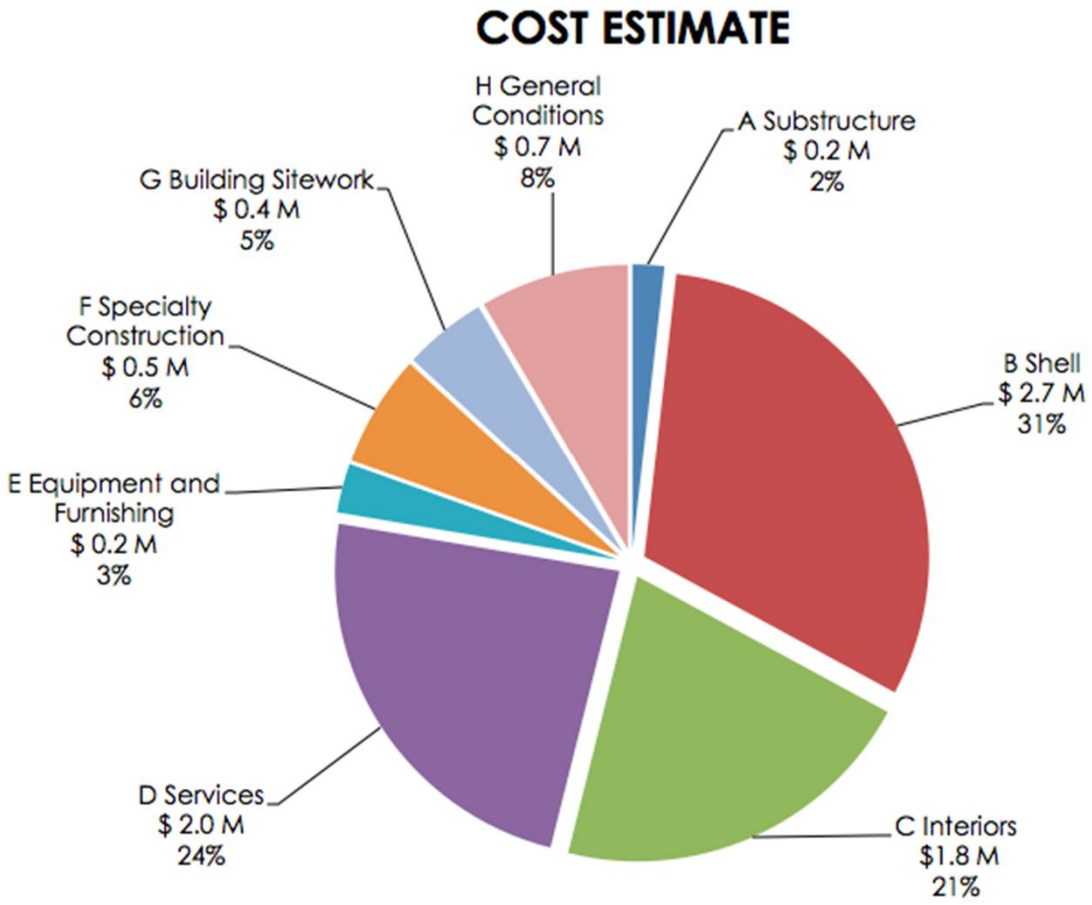
TVD


TVD - TARGETS BY CLUSTER
TARGET VALUE
ESTIMATED VALUE
VALUE DELTA
$3000 000
$2500 000
$2000 000
$1500 000
$1000 000
$500 000
$-
$(500 000)
A Substructure
B Shell
C Interiors
D Services
E Equipment and Furnishing
F Specialty Construction
G Building Sitework
H General Conditions

COST ESTIMATE



TOTAL COST: $8.52 M

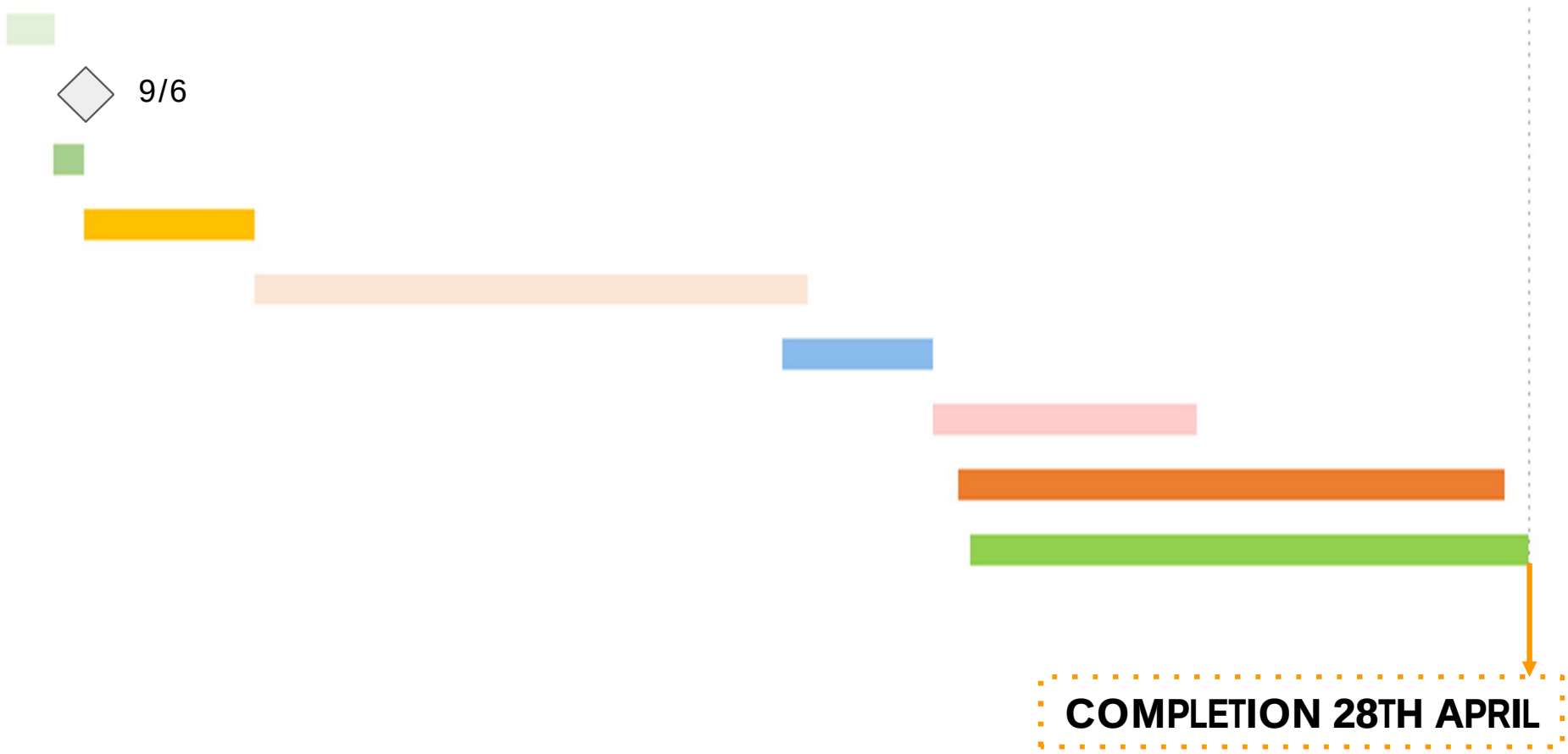


HUMAN INTELLIGENCE SCHEDULE

Excavation	5 days	Fri 8/30/24	Thu 9/5/24
Tower crane installed	0 days	Fri 9/6/24	Fri 9/6/24
Auditorium stair outside	3 days	Fri 9/6/24	Tue 9/10/24
Foundation	19 days	Wed 9/11/24	Mon 10/7/24
Superstructure	64 days	Tue 10/8/24	Fri 1/3/25
Roof	18 days	Tue 12/31/24	Thu 1/23/25
Exterior closure	30 days	Fri 1/24/25	Thu 3/6/25
MEP	63 days	Tue 1/28/25	Thu 4/24/25
Interior	63 days	Thu 1/30/25	Mon 4/28/25

HUMAN INTELLIGENCE SCHEDULE

A SE MEP CM LCFM T





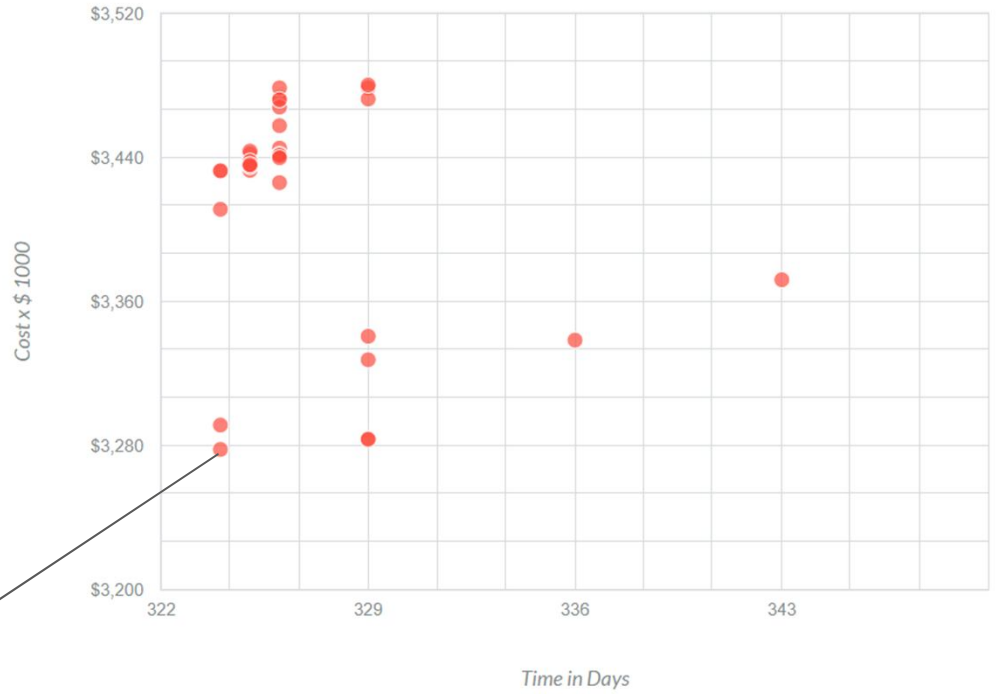
ARTIFICIAL INTELLIGENCE

ALICE Technologies

3 MILLION ITERATIONS

$ 3.2 MILLION

210 days



Human Intelligence Schedule in ALICE



HOW IS IT POSSIBLE?

Human Schedule Prediction = Superstructure in 104 days

v/s

AI Schedule simulation = Superstructure in 210 days





UNLIMITED?

CRITICAL DECISIONS

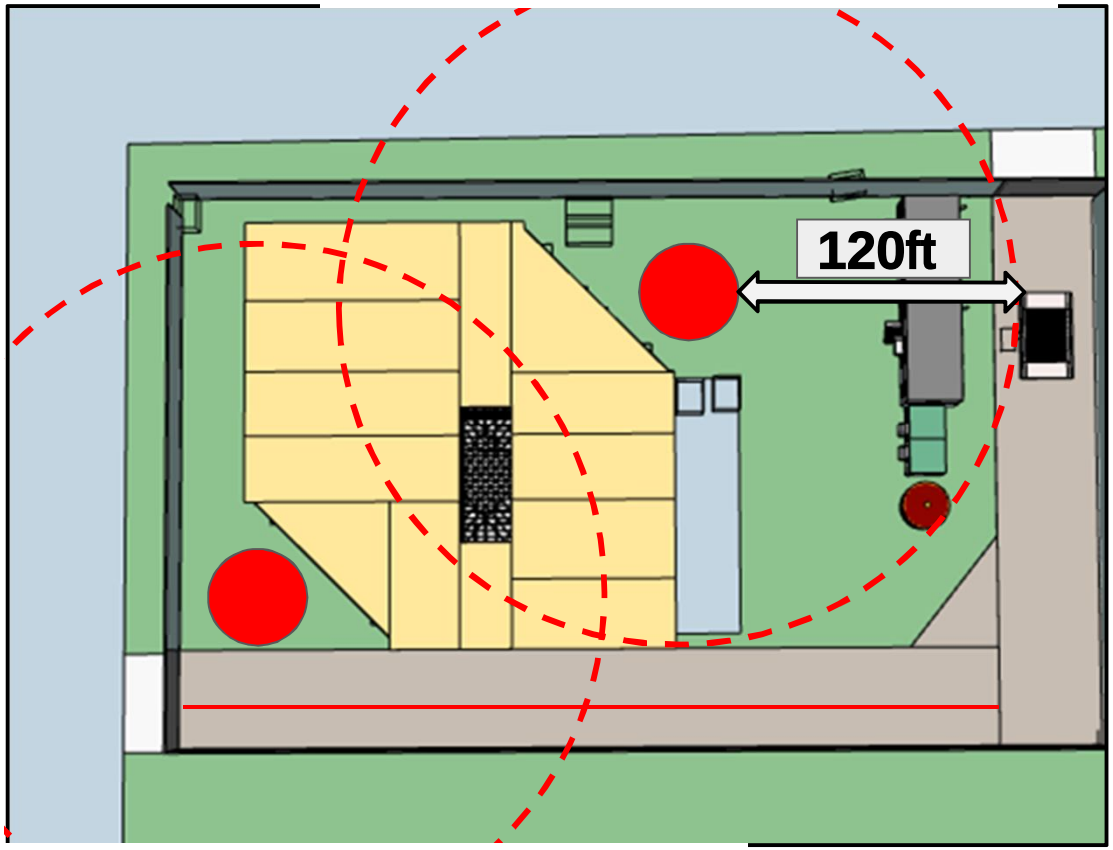
- Crane and Carpenter crew - Critical Factors
- Most optimized duration with 1 crane = 204 days
- Cost = 3.2m $

2 Mobile cranes on site

Night Construction

15% premium to labourers

SITE LOGISTICS



Mobile Crane

1 Side of road open in night



ARTIFICIAL INTELLIGENCE SCHEDULE





Artificial Intelligence

110 days **2.98m $**

Human Intelligence

104 days **2.7m $**

Insight:

- **2 mobile cranes**
- **Crew Utilization**



HUMAN + ARTIFICIAL INTELLIGENCE

So why do we need CM's from now?

- Most optimum AI Solution not constructible
- Construction Constraints
- Crew and Equipment Selection





Human+ Artificial Intelligence

117 days	3.01m $

ANIMATION

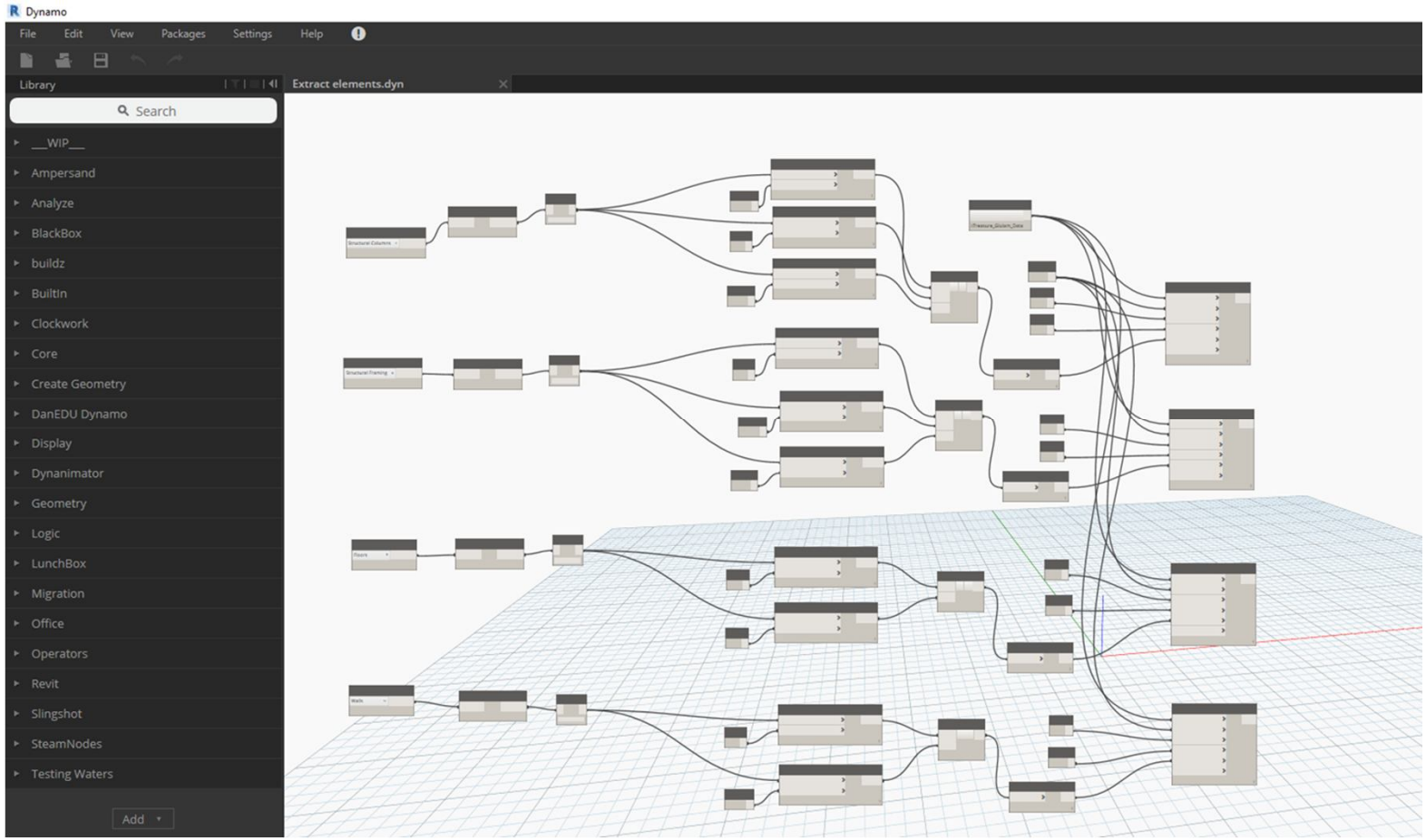
ANIMATION

ANIMATION

CONCLUSION

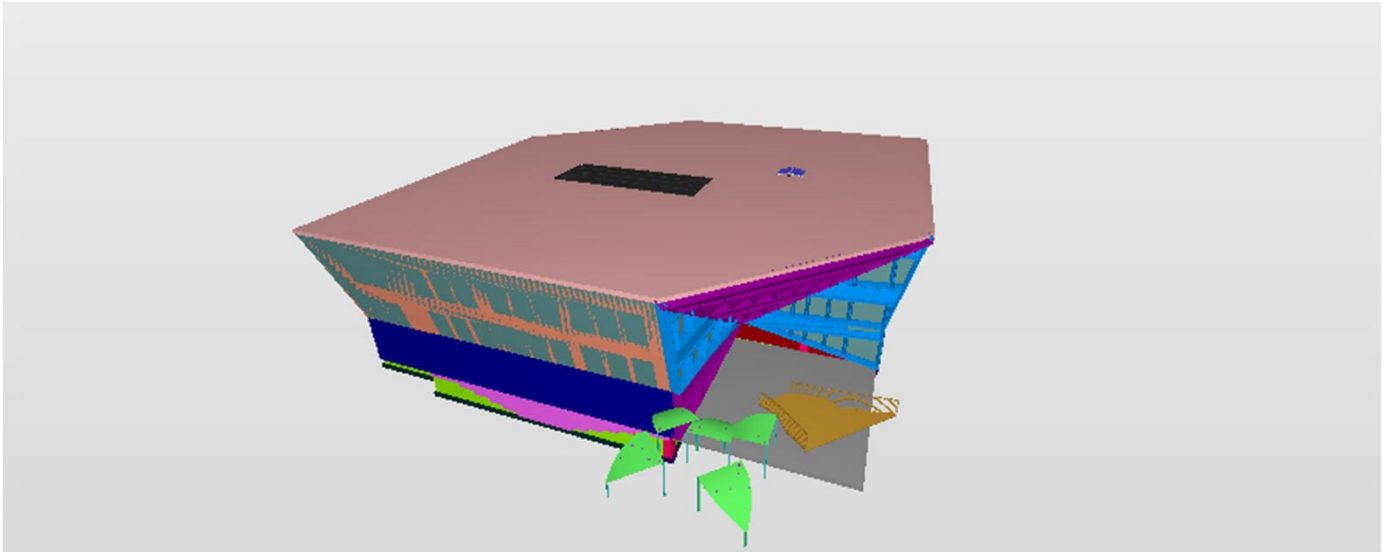
“Technology as a means and not an end in itself”

CROSS DISCIPLINE INTEGRATION



DYNAMO SCRIPT

CROSS DISCIPLINE INTEGRATION



INFORMATION TAKEOFF | Takeoff All | Building Element Quant... | Report

Building Element Type	Type	Net Area	Length	Volume	Count	Color
Beams	12'' x 18''		1,504'-8 7/8"	50.76 cu yd	38	
Beams	12x16.5 2		3,103'-4"	101.74 cu yd	199	
Beams	4" x 9"		7,051'-6 9/16"	62.93 cu yd	594	
Beams	44X302		895'-10 9/16"	4.40 cu yd	53	
Columns	14'' x 14''		395'	18.55 cu yd	36	
Columns	22.5'' x 22.5''		786'-7 9/16"	101.47 cu yd	72	
External Walls	5' x 10'	2,035.91 sq ft	230'-8 1/2"	47.47 cu yd	6	

WHAT's NEW HERE?

1. Site Sensors: To monitor temperature, noise, pollution etc. for workers safety.





2. Drones: Site surveying for safety and Information updates.



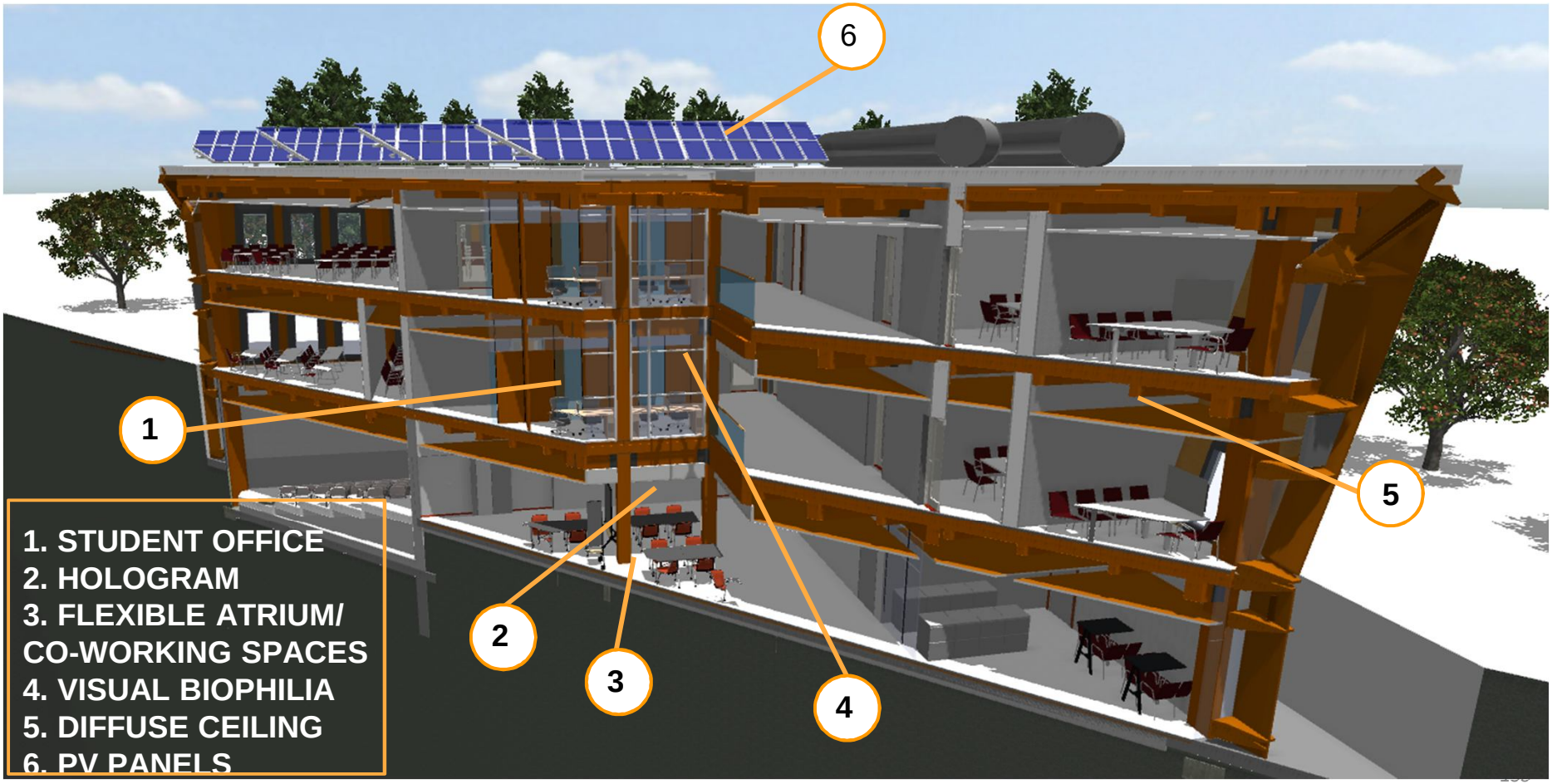
INTEGRATION WITH PAST

25'th year of AEC Global Teamwork
A stroll down **Memory Lane**



2011-2012: Biomimicry	• Inspiration - Tree ○ External Shading ○ Enhance Solar PV Use ○ Embody carbon in timber structure
2012-2013: Leapfrog	• Changing human behavior with Hologram
2013-2014: Building Health	• Visual biophilia with timber
2014-2015: Water	• Water measurement system
2015-2016: Air Quality	• Diffuse ceiling
2016-2017: Space Efficiency	• Collaborative spaces

INTEGRATION - SUMMARY



LIFE

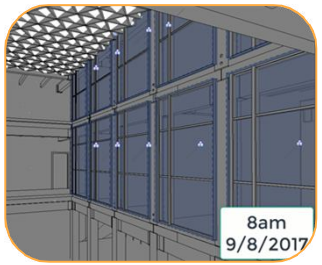
CYCLE

FINANCIAL

MANAGEMENT

LCC - INTEGRATION





MARTA
ARCH

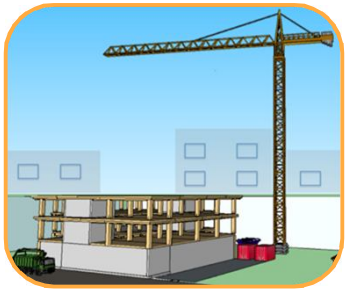
MOA / ASHWIN
CM

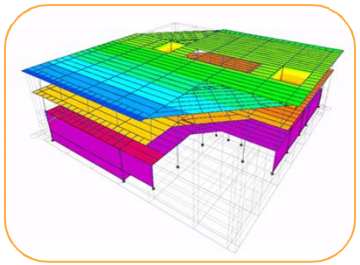
TREASURE

TEAM
MEP

GARY / JACOB
SE

TOBI
LCFM



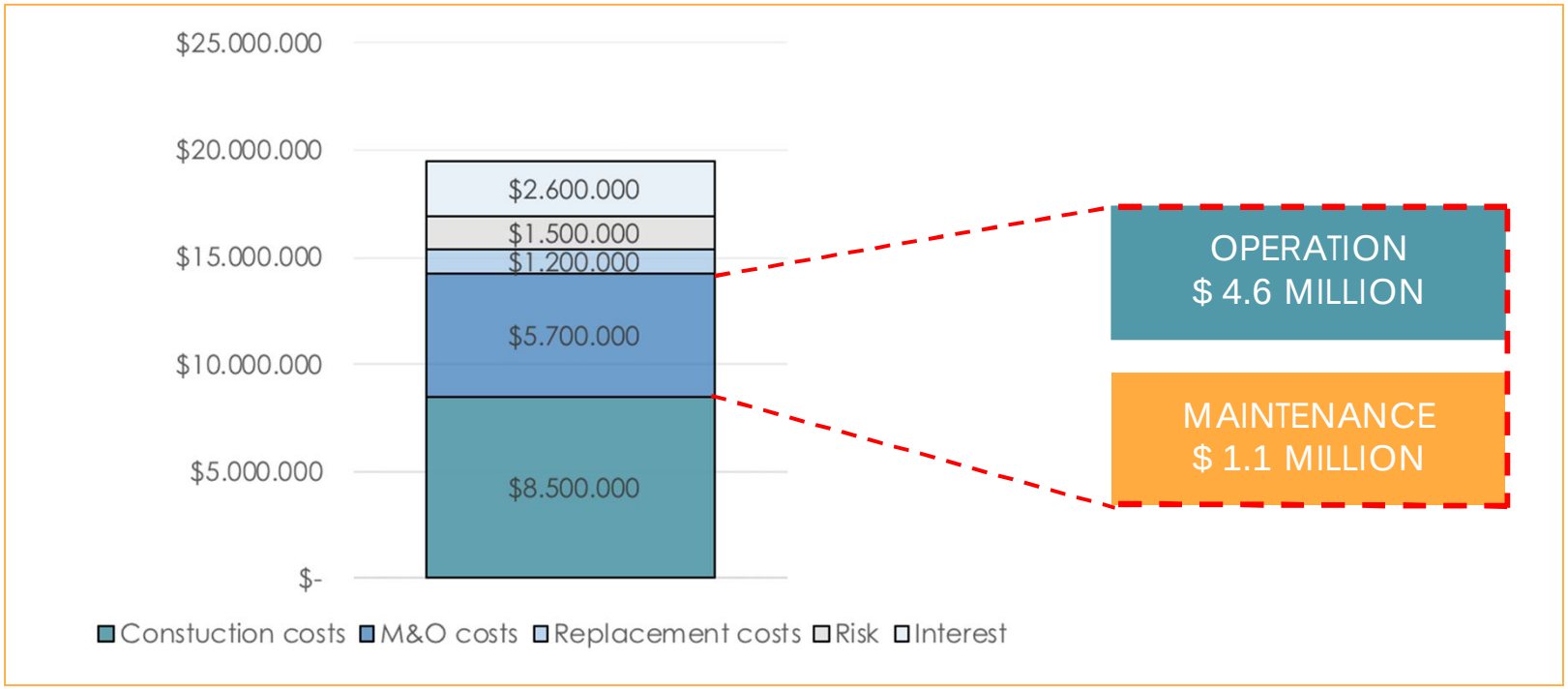


RENT

VALUE FOR
MONEY

COST

LIFE - CYCLE - COSTS



OVERALL COSTS = $ 19.4 Million

REPLACEMENT STRATEGY



SAFE THE QUALITY

PROVISIONS over 25 years

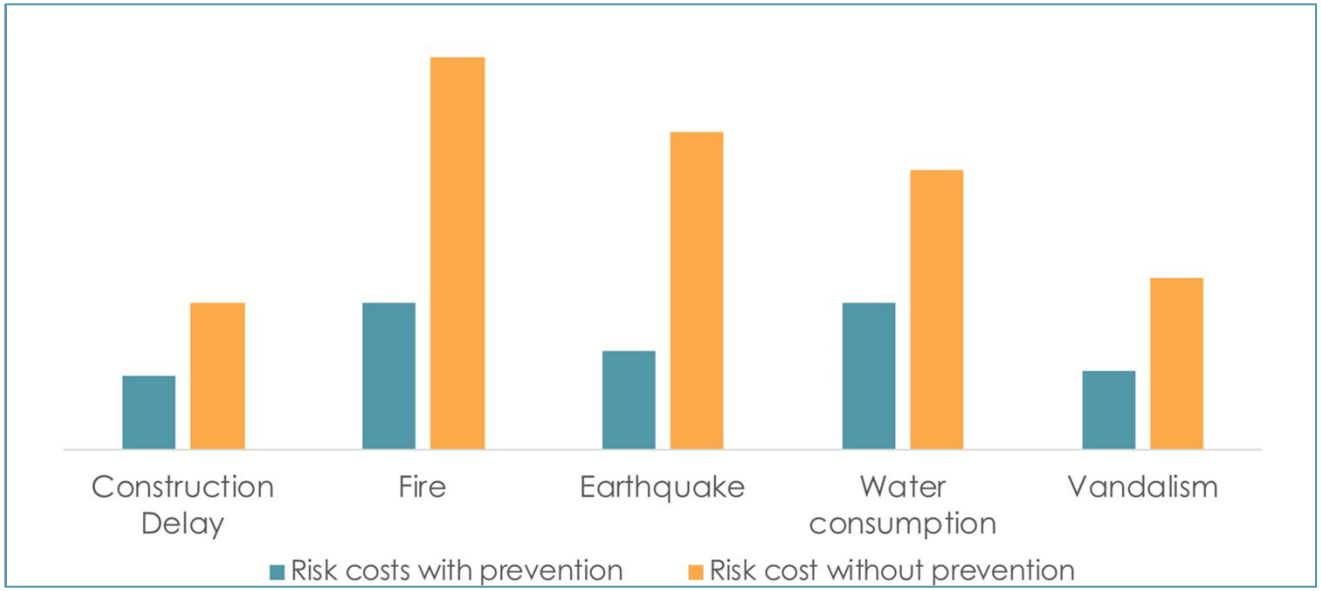
REPLACEMENT
$ 1.2 MILLION



CONTROL THE BUDGET

$ 45k	+	$ 45k	+	$ 45k	+	$ 45k
YEAR 1	. . .	YEAR 10	. . .	YEAR 20	. . .	YEAR 25

RISK IDENTIFICATION & STRATEGY



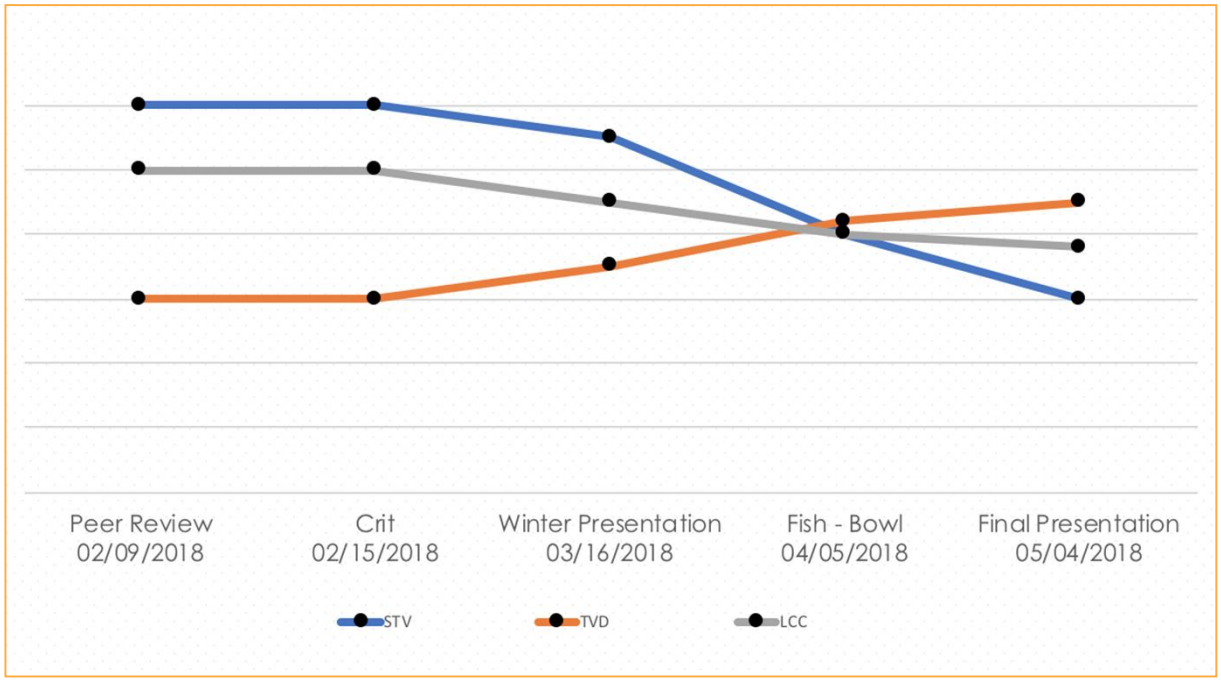
RISK COST
$ 2.1 Million

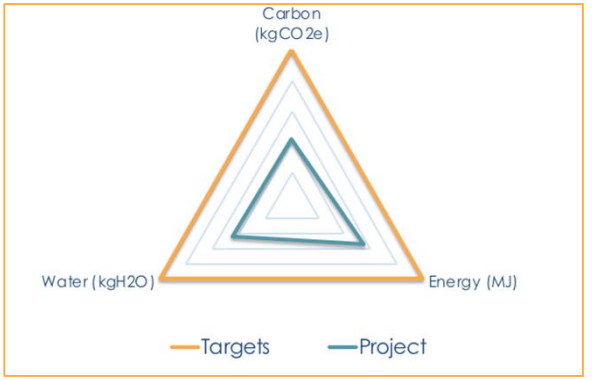


RISK COST
$ 1.5 Million



LCC - TVD - STV Evolution





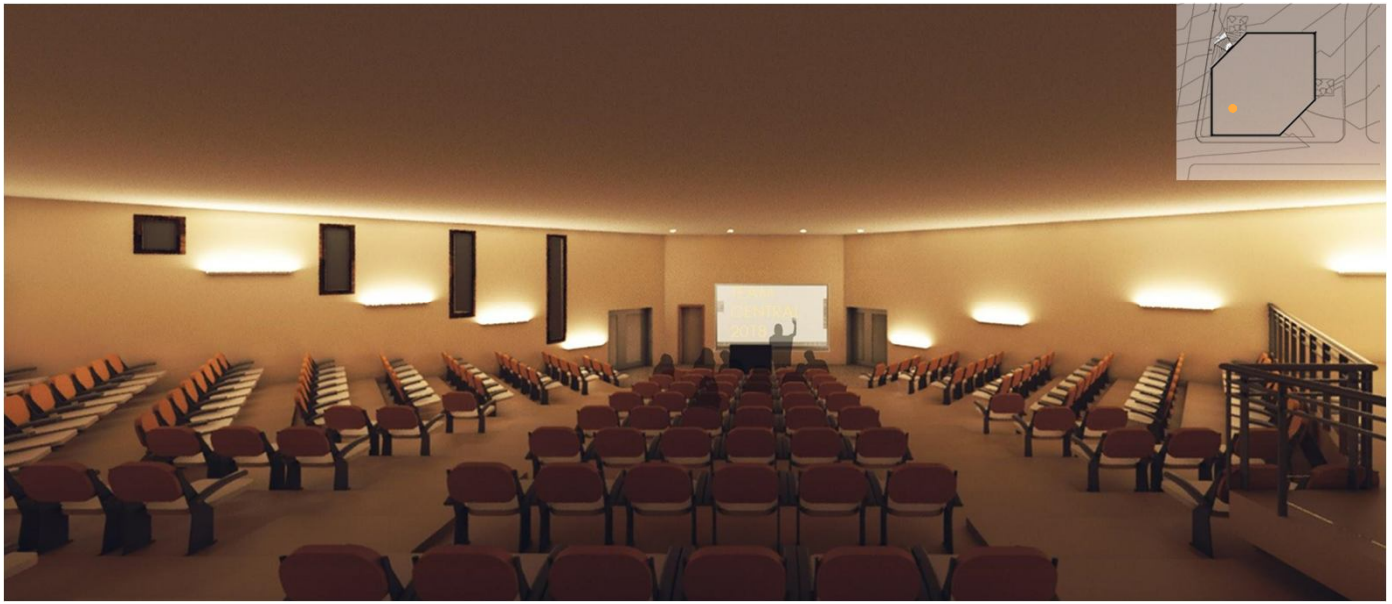
ADDITIONAL RENT CAFÉ



Costs per month	
$	-4.500,00
Costs p.a.	
$	-54.000,00
costs for employees p.a.	
$	-39.216,00
sales per day	
$	600,00
sales per month	
$	12.900,00
sales per year	
$	154.800,00
Overall income	
$	61.584,00



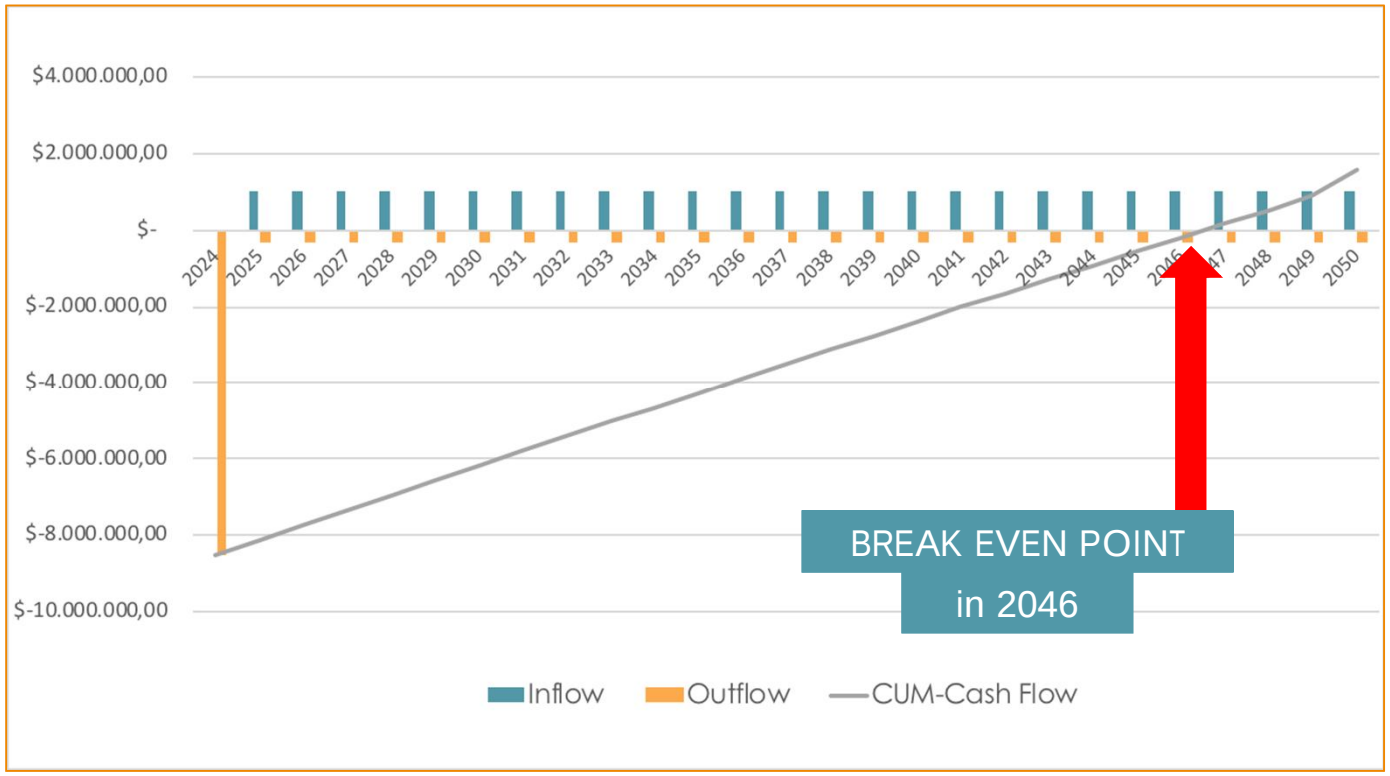
ADDITIONAL RENT AUDITORIUM



Number of seats	183
Number of rented seats	83
Price per seat	$ 200,00
Renting Amount	$ 14.940,00
Overall renting amount	$ 80.676,00
Costs for Catering	$ -3.500,00
Overall costs for catering	$ -21.000,00
Overall income	$ 59.676,00



CASH FLOW



INFLOW

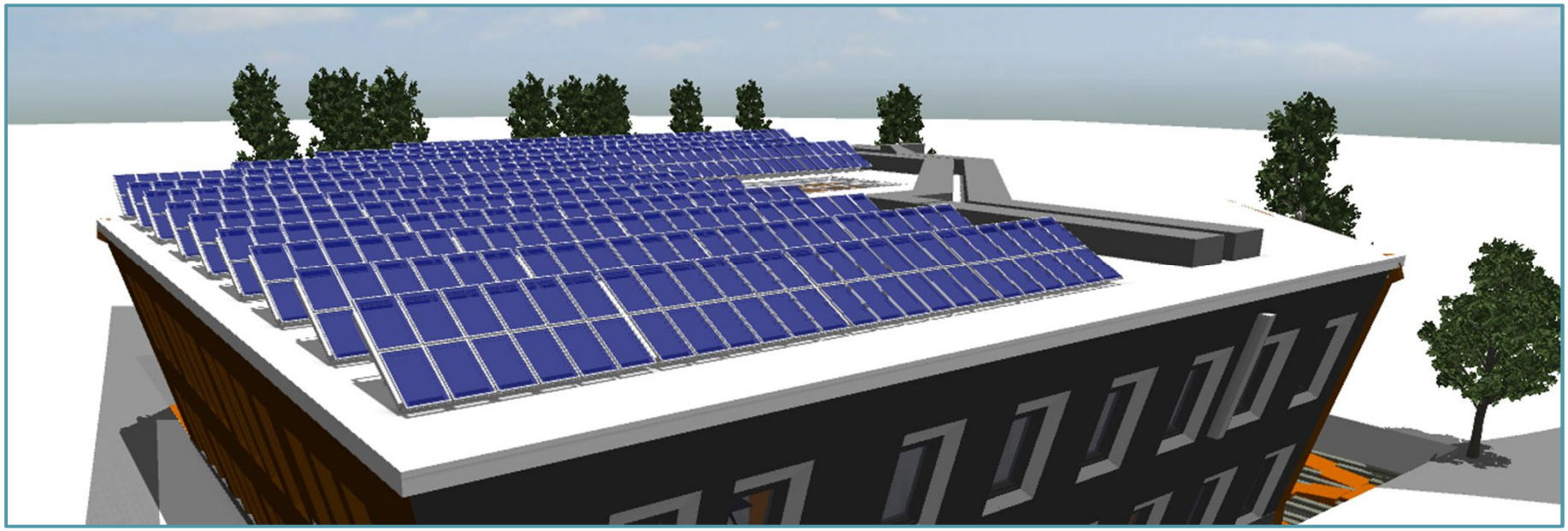
- Rent
- Café
- Auditorium

RENT
$910.000 p.a.

OUTFLOW

- Construction costs
- M&O costs
- Replacement
- Risk
- Interest payment

ROOF + PV PANELS



VALUE FOR MONEY

Necessary roof area		450 m2
Area per PV-Panel		1,63 m2
Amount of panels		276
sum of performance		205.970 kW/h
Costs (PV-Panels)	$	208.587

TESLA POWERBACK

+



TESLA POWERBACK

ACQUISITION COSTS
$ 75k



=

	Purchased Energy	
	kWh	kWh/m2
Lighting, facility	8.396,0	3,1
Electric cooling	69.331,0	25,4
HVAC aux	19.396,0	7,1
Total Facility electric	**97.123,0**	**35,6**
Domestic hot water	28.937,0	10,6
Total, facility fuel	**28.937,0**	**10,6**
District heating	4.000,0	1,5
Total, Facility district	**4.000,0**	**1,5**
Total overall	**130.060,0**	**47,6**
Equipment tenant	51.594,0	8,9
Total tenant electric	**51.594,0**	**8,9**
Grand total	**181.654,0**	**66,5**

Roof Surface	14.350 SF	1.333 m²

Necessary roof area		450 m2
Area per PV-Panel		1,63 m2
Amount of panels		276
sum of performance		205.970 kW/h
Costs (PV-Panels)	$	208.587

LEED





73 / 110 Points	LEED v4 - Schools

LOCATION & TRANSPORT 10/15	SUSTAINABLE SITES 7/12	WATER EFFICIENCY 8/12	ENERGY & ATMOSPHERE 21/31	MATERIALS & RESOURCES 9/13	INDOOR ENVIRONMENTAL QUALITY 14/16	INNOVATION 4/6

DPR - TRANSPARENCY CHALLENGE

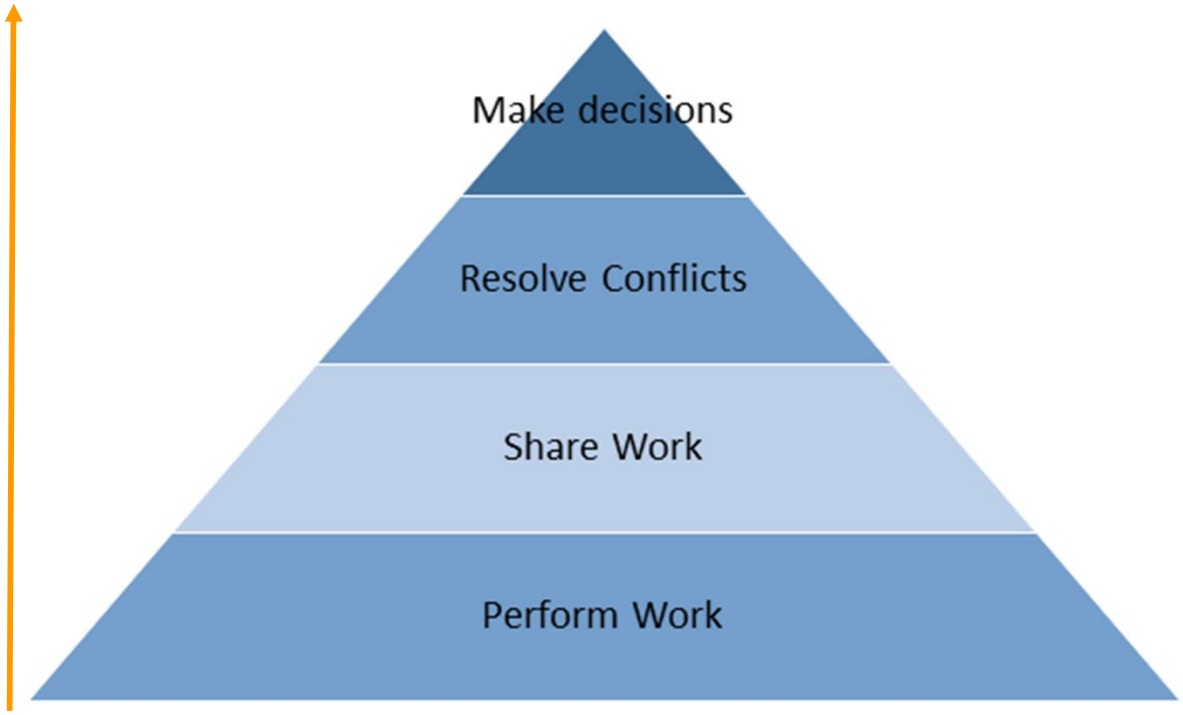
Inspiration: “Pro-active prevention is better than cure”

Definition:

“Ability to **detect** and **predict** the possibilities for ‘dropping the ball’ “

“Team Engagement”

DPR - TRANSPARENCY CHALLENGE



KPI
Post Meeting Survey
Sub-Group Meetings
Communication analytics
% Complete pull plan

"Central Team's Hierarchy of Work"

DPR - TRANSPARENCY CHALLENGE

- 6 Atrium Ideas
- 9 Facade Ideas

→ None of them Used

"We always have great concepts, but nothing to implement"

-Jacob (Struct. Eng. , Team Central)

- 5-6 meetings in Spring Break

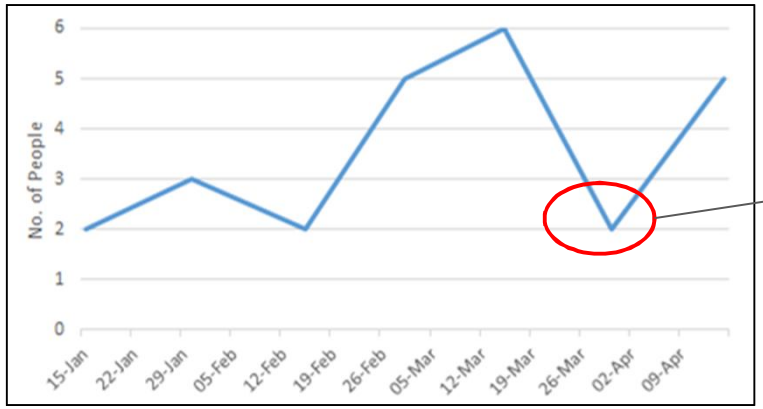
"Yet 5 out of 6 people felt we were least involved in the spring break"

- " How can you not have columns in a 60 ft timber span atrium? "

\- Fishbowl 2018

DPR - TRANSPARENCY CHALLENGE

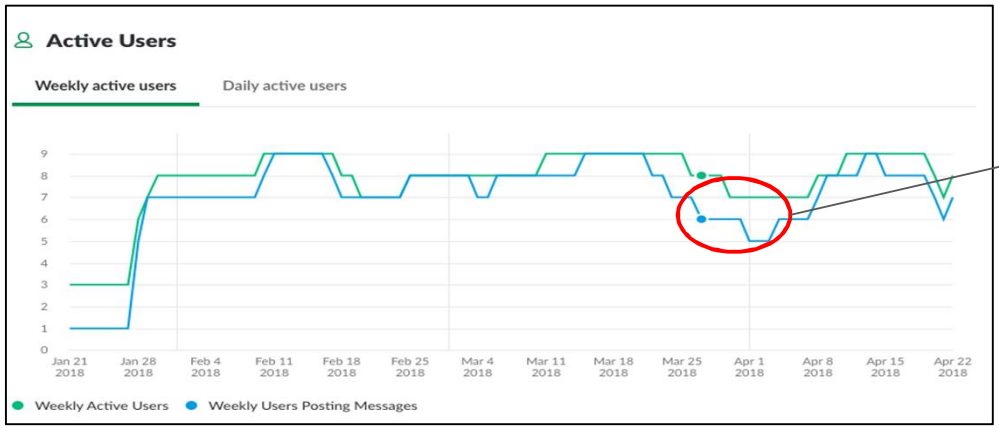
ENGAGEMENT PROGRESS



Ball was dropped

"No Pull Planning"

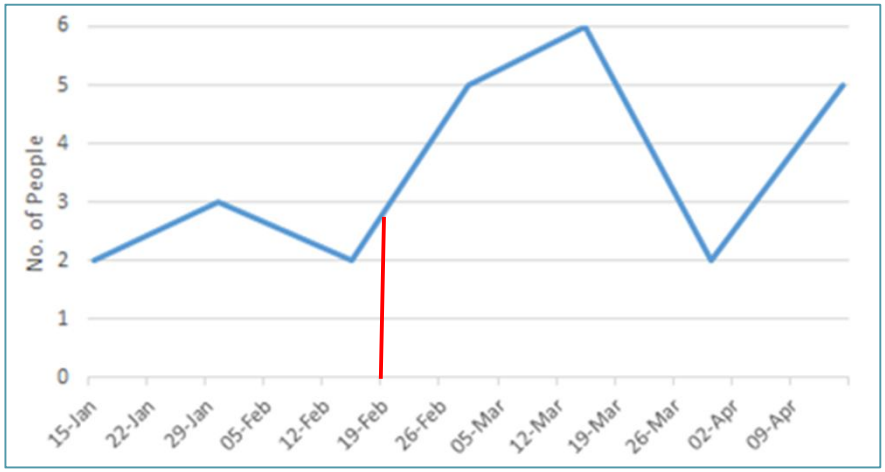
SLACK ANALYTICS



Ball was dropped

DPR - TRANSPARENCY CHALLENGE

ENGAGEMENT PROGRESS

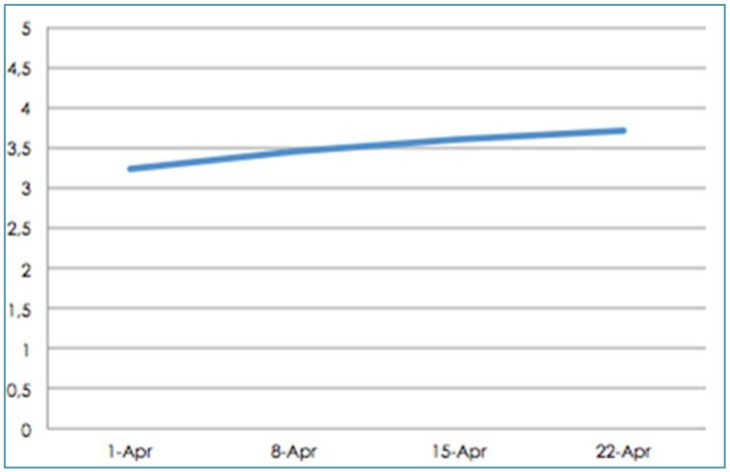


SUB-GROUP MEETINGS

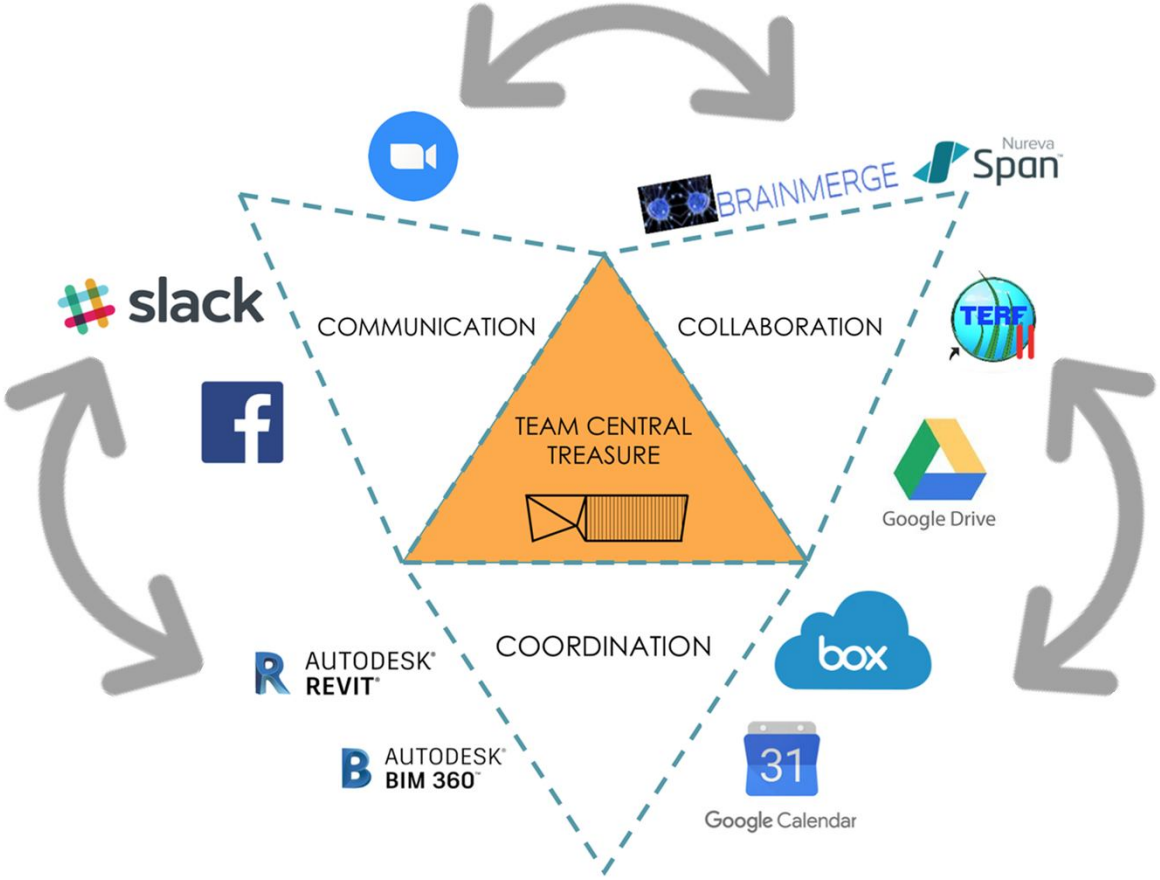
MEETING INVOLVEMENT

Pro-active Prevention

MEETING INVOLVEMENT



TEAM PROCESS



OPEN ZOOM SESSIONS



What are our **BENEFITS?**

- **TRUST**
- **TRANSPARENCY**
- **DEDICATION**
- **JOY**

What are we **TAKING** with us?

- **FRIENDSHIP**
- **IMPROVED TEAMWORK**
- **KNOWLEDGE as our TREASURE**

TECHNOLOGY USED

Generation	2004-2008	2008-2010	2011-2014	2015	2016	2018
Conceptual Design	Sketch Up	Sketch Up	Sketch Up	Revit	Revit	Revit Dynamo + Project Fractal
Detailed Model	Revit	Revit	Revit	Revit	Revit	Revit
Model Sharing	Central model everyone worked on	Discipline models linked by CM	Discipline models linked by CM or Dropbox model server	Dropbox with shared file path	A360-cloud shared central model	A360-cloud shared central model
Version Control	Manual	Manual	Manual	Manual	A360	A360
Linking – Edit	Revit	Revit	Revit	Revit with local copy of central model	Revit with local copy of central model	Revit with local copy of central model
Integrating – Alternative exploration	–	–	–	BIM360 Glue	BIM360 Glue	BIM360 Glue Virtual Reality (HTC Vive)
Clash Detection	40 CAD/Navisworks (after 2006)	Navisworks	Navisworks	BIM360 Glue/Navisworks	BIM360 Glue	BIM360 Glue
Control	Individual discipline member	Individual discipline member	Individual discipline member	All team member	All team members	All team members
Integration Management	CM	CM	CM	Team/BIM Manager	Team/BIM Manager	Team/BIM Manager

Curtesy of : Fruchter, Katz, and Grey, 2016 – “Transforming the BIM Mindset”

TERF - MEETINGS



CONFERENCE ROOM



3D – MODEL

WALKING IN THE MODEL IN TERF



MENTORS

THANK YOU SUPER OWNER RENATE, IT WAS AN AWESOME JOURNEY !

THANK YOU OWNERS FOR YOUR PRECIOUS TIME AND HELP!

THANK YOU ALL MENTORS FOR TEACHING, MENTORING AND HELPING US THROUGH THE JOURNEY!

SEE YOU SOON AEC-GLOBAL TEAMWORK FAMILY !!



THANK YOU!



MARTA	ASHWIN	GARY	JACOB	MOA	TOBIAS
POLAND	USA	USA	DENMARK	SWEDEN	GERMANY
A	CM	SE	SE	CM	LCFM

PANORAMA VIEW IN THE ATRIUM



LESSONS LEARNED



ASHWIN
USA
INDIA
CM

" It's your responsibility if the team isn't performing well. No one else is to be blamed as you didn't interfere to stop the downfall"

"Developing ideas and solving problems from different perspectives often results in innovative ideas and more interesting solutions."



MOA
SWEDEN
CM



GARY
USA
CHINA
SE

"Talk, discuss, and argue with your teammates! The idea agreed by 6 people is usually more comprehensive than the one from your own."

LESSONS LEARNED



MARTA
POLAND
A

"Design coordination does not exist when working in disciplinary silos. Breaking the silos and working together on ideas gives better solutions"

"Don't stay in your comfort zone, but interact with everyone from the first second on."



TOBIAS
GERMANY
LCFM



JACOB
DENMARK
SE

"Be open for other opinions and engage in a dialog to find the best solution. Answering "hmm", "yes" or "okay, does not challenge the opinion"

TEAM CENTRAL 2018

