

TEAMM

ATLA

NTIC



Jinzhi Jingxuan Eric Yue Lucas Dominik Jakob



MEP



SE



MEP



SE



CM

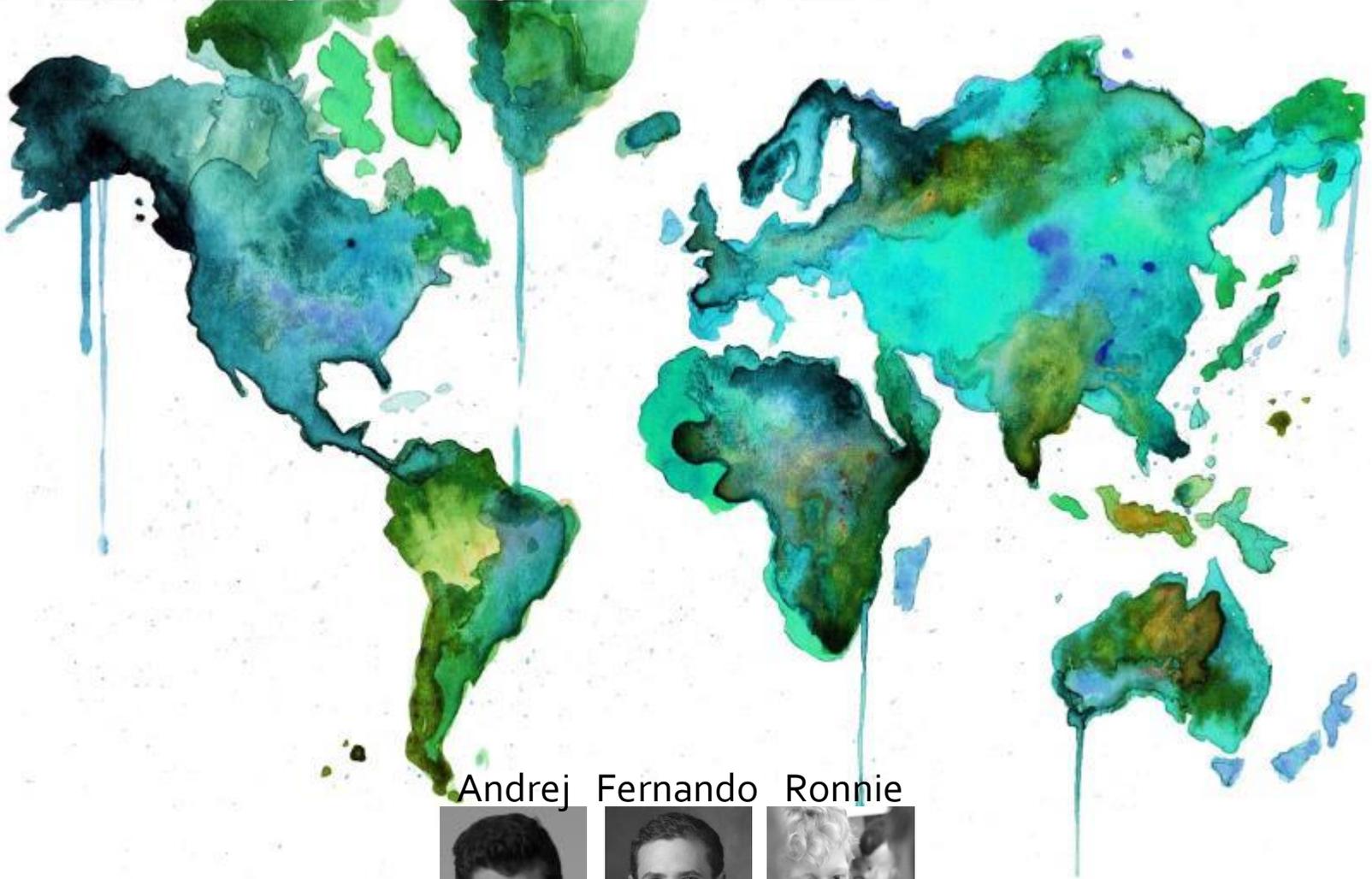


CEM



A

Team

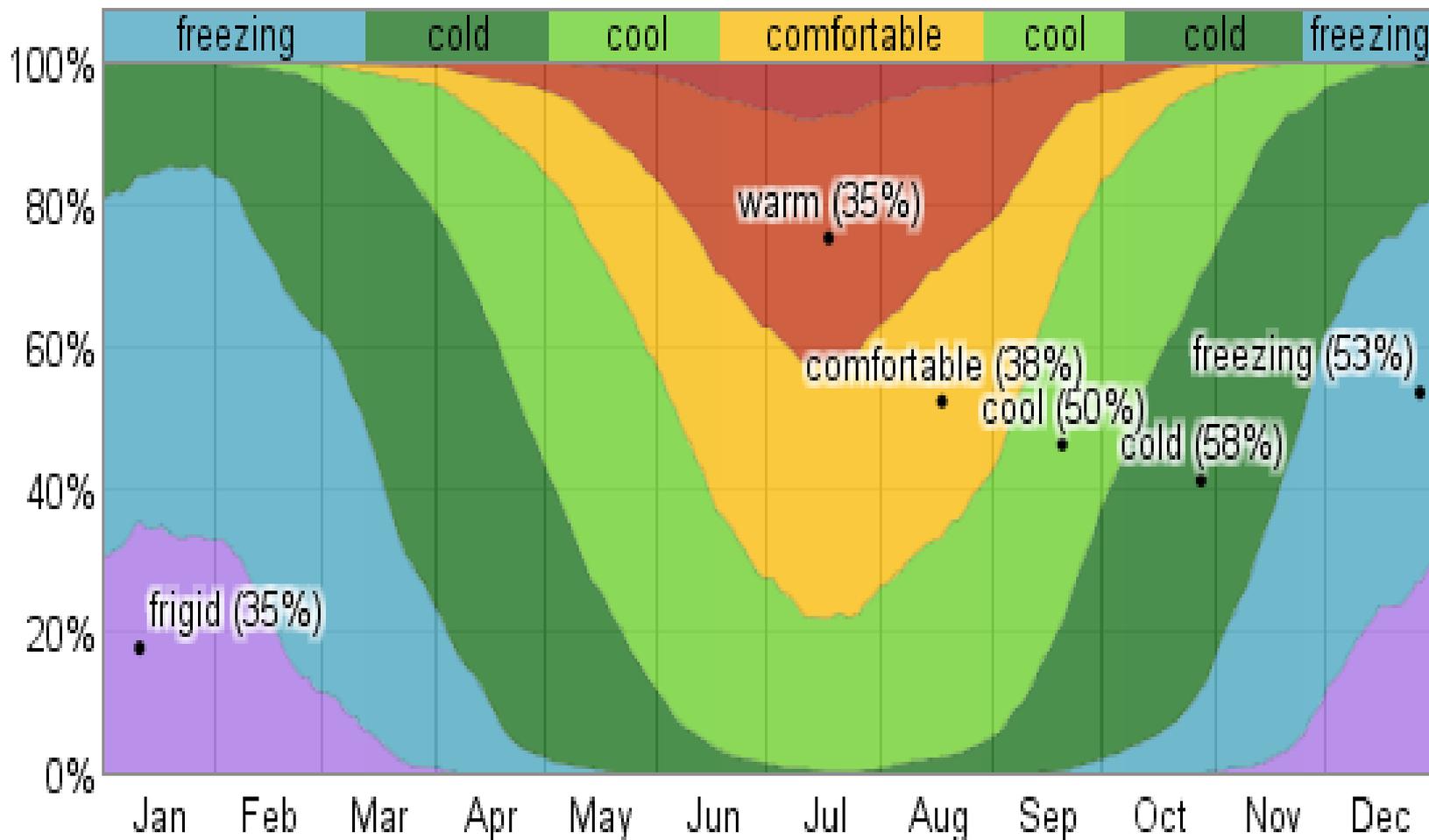


Andrej Fernando Ronnie



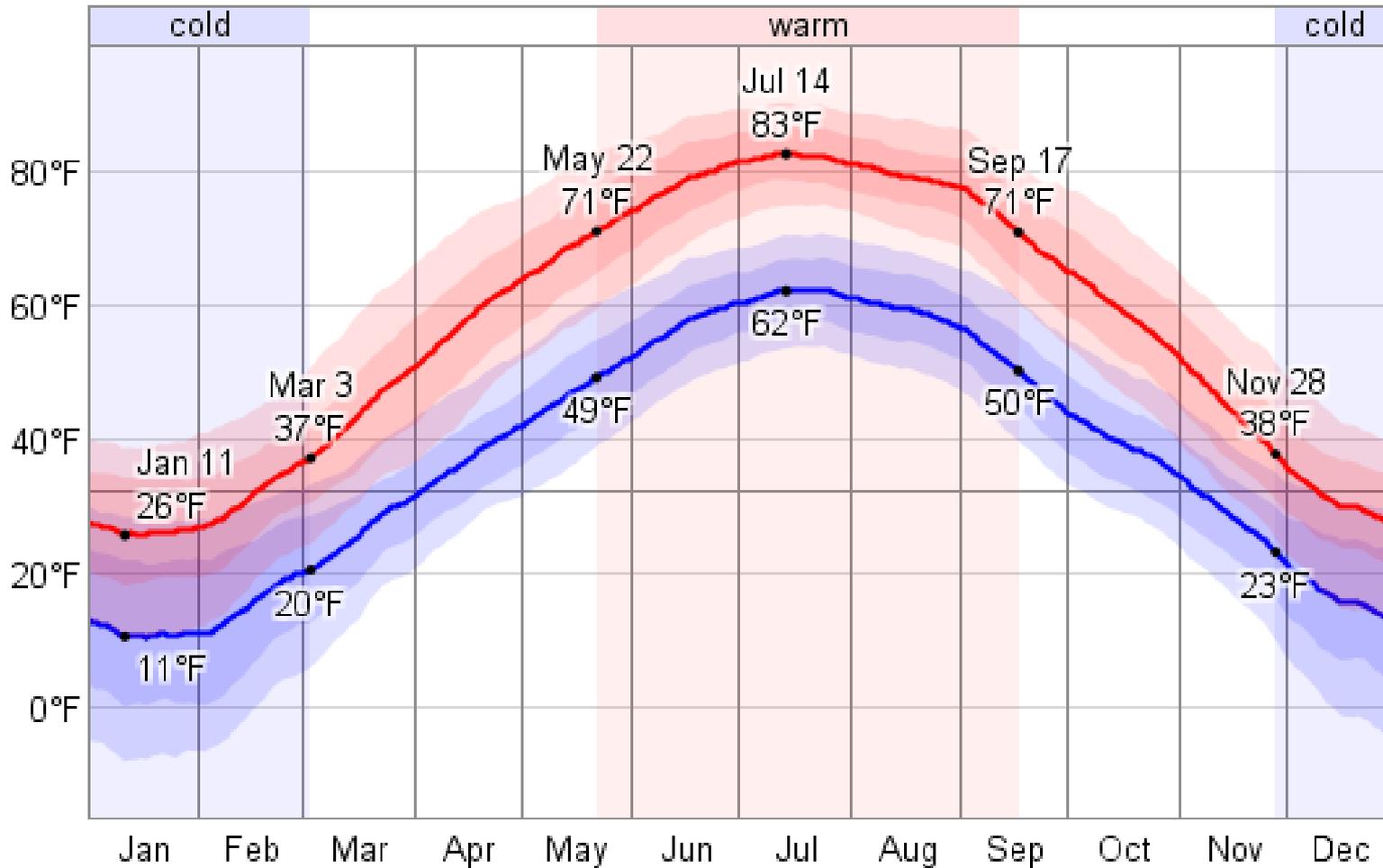
Owners

Weather



Weather

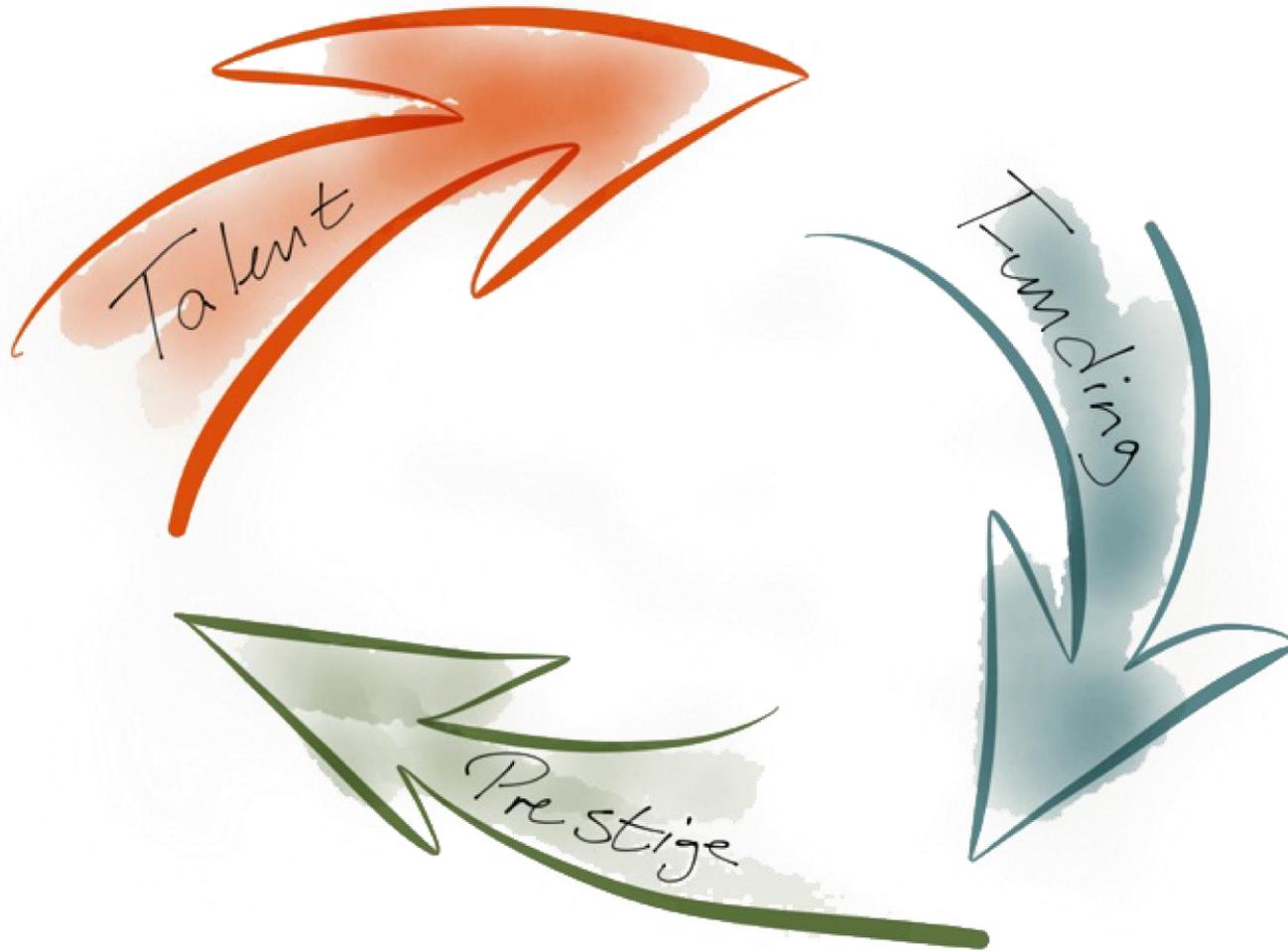
Average High Low Temp



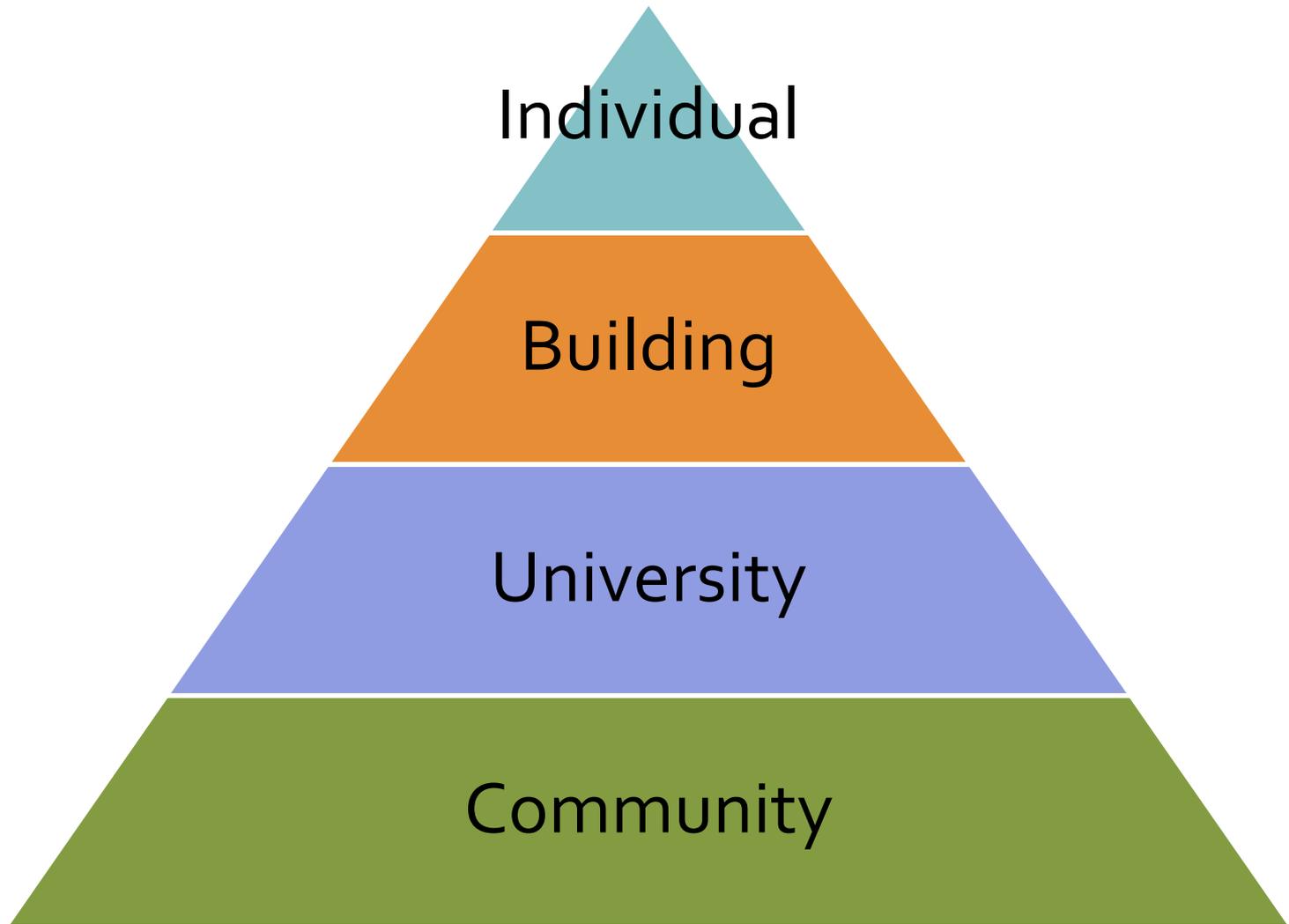
Site



Total Value to the Owner



Hierarchy of Health

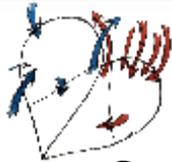




Our Choice



Decision Matrix



Concrete
+UFAD

Steel
+ACB

Project Goals

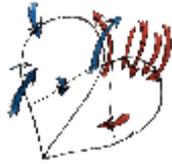


Steel
+VAV

Steel
+ACB

3	3	Lighting and Views	2	2
2	2	Site Relations	3	3
2	2	Effectiveness	2	2
3	3	Learning Conduciveness	3	3
3	4	Comfort	3	4
3	3	Environmental Impact	2	2
3	3	Aesthetics	4	4
3	3	Campus Meeting	4	4
3	3	Value	4	4
3	4	Schedule	3	3
28	30		30	31

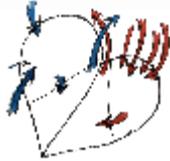
Decision Matrix



Concrete + UFAD	Steel +ACB		Steel + VAV	Steel + ACB
28	30	Total Points	30	31
\$6.9	\$6.7	Value for Cost*	\$6.4	\$6.6
\$183	\$191	First Cost*	\$181	\$193
\$11	\$11	O+M Cost*	\$12	\$12

*in \$/SF

Decision Matrix



Why?

- | | |
|---|---|
| <ul style="list-style-type: none">• Easier for Every Profession• Favorable to Sustainable Design | <ul style="list-style-type: none">• Awesome Learning Experience• Challenging Design• Iconic Doncept |
|---|---|

Why Not?

- | | |
|--|--|
| <ul style="list-style-type: none">• More "Conventional" Building Shape• Too Many Spaces Created | <ul style="list-style-type: none">• Very Difficult for MEP Systems• Way too Many Spaces Created• Challenge to Justify Costs/ Value |
|--|--|

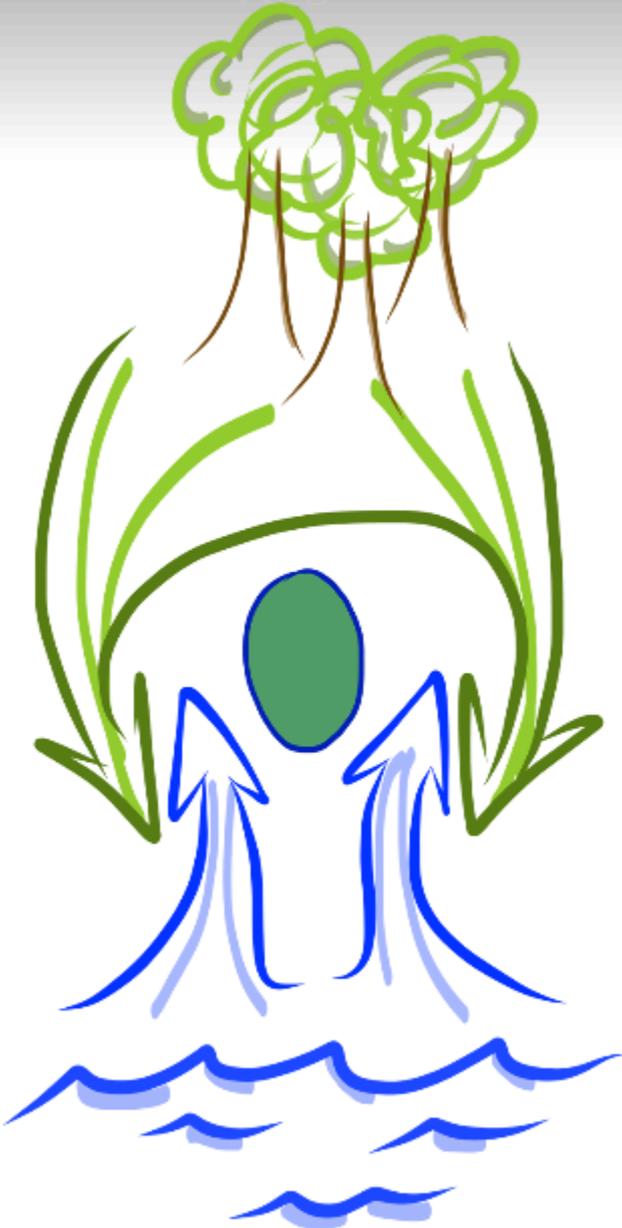
Jakob



Architecture

Embrace





EMBRACE

Best Conditions

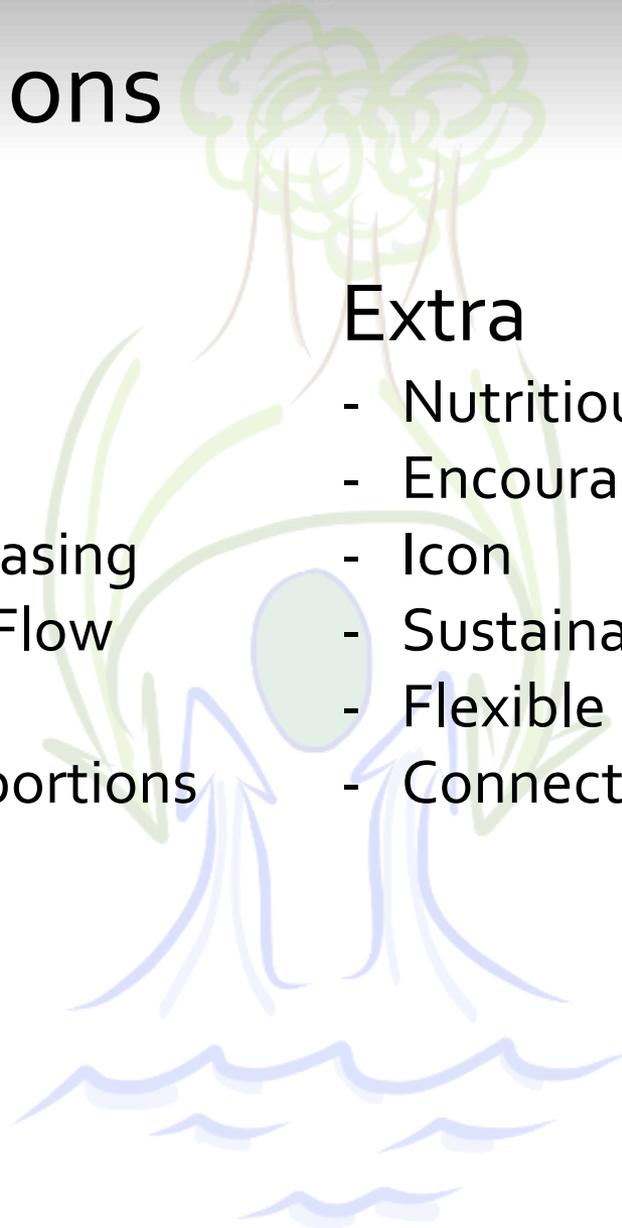
Minimum

- Natural Light
- Fresh Air
- Aesthetically Pleasing
- Efficient People Flow
- Icon
- Right Room Proportions
- Good Acoustics

Extra

- Nutritious Food
- Encourages Exercise
- Icon
- Sustainable
- Flexible
- Connection to the Site

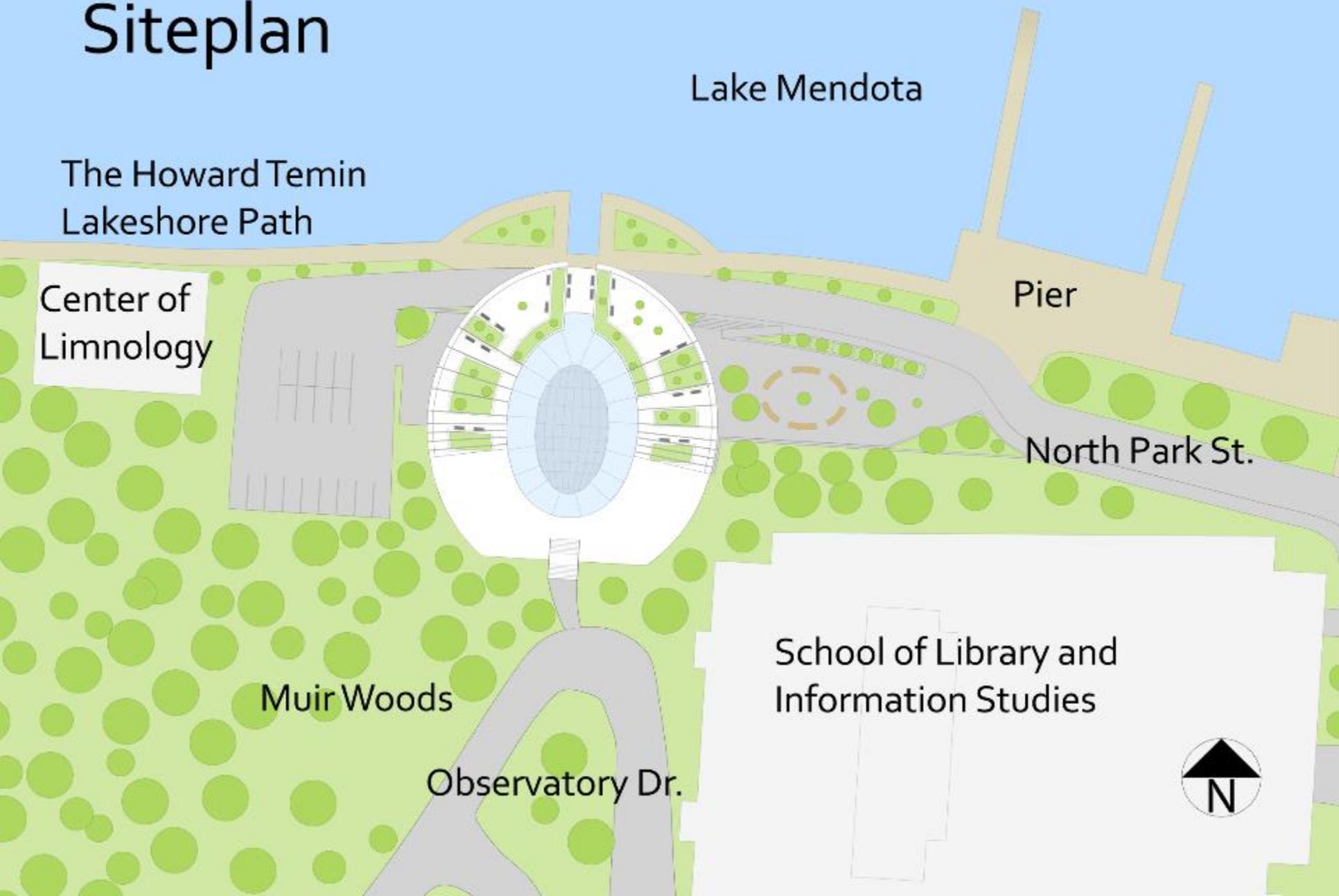
EMBRACE



Actual Context



Siteplan



Lake Mendota

The Howard Temin
Lakeshore Path

Center of
Limnology

Pier

North Park St.

Muir Woods

Observatory Dr.

School of Library and
Information Studies



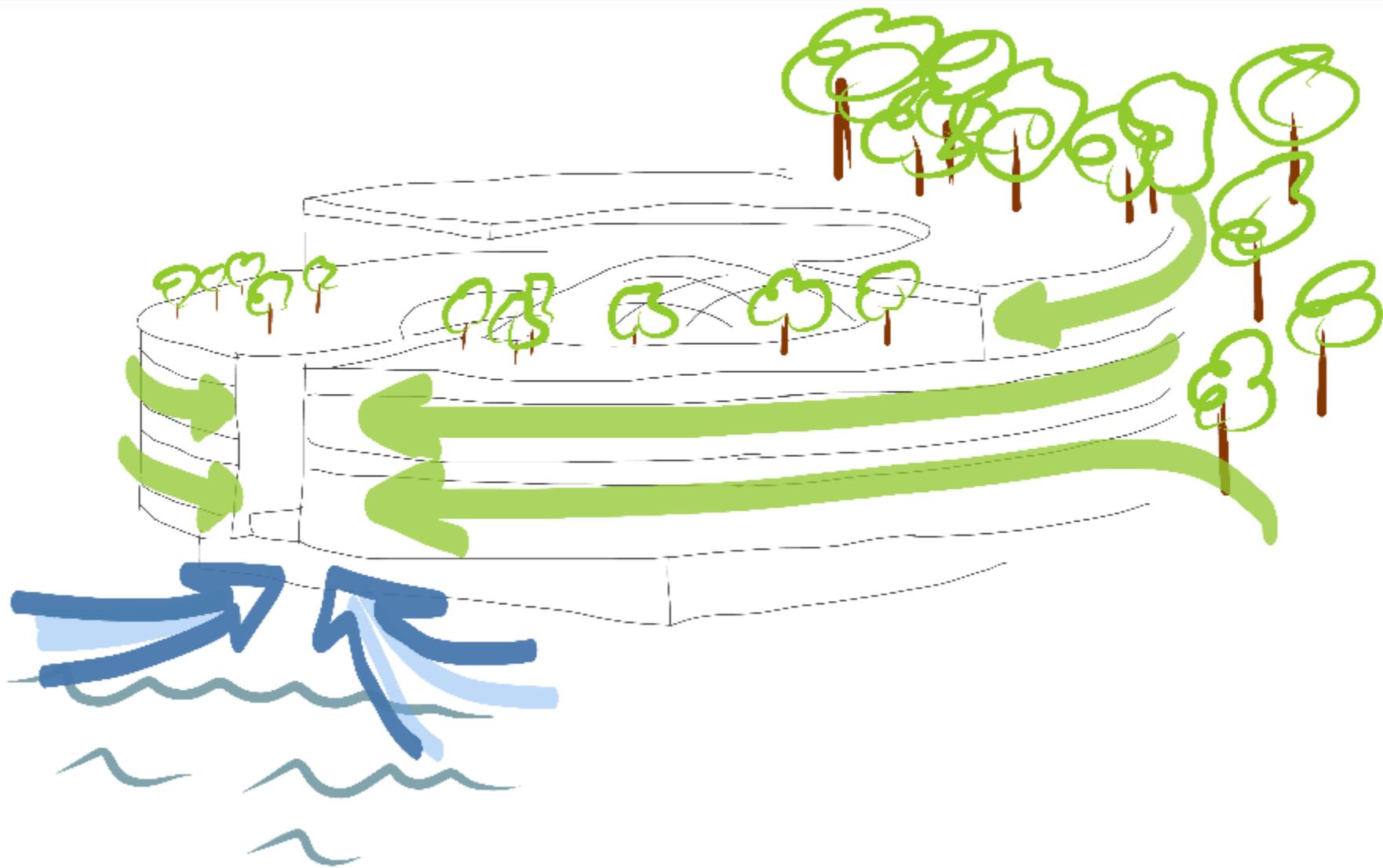
Embrace in Context



Flow Through the Building



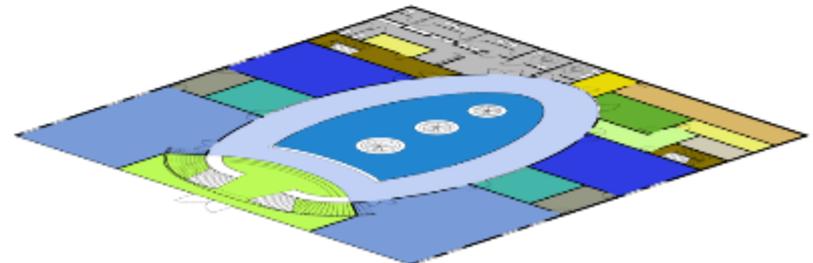
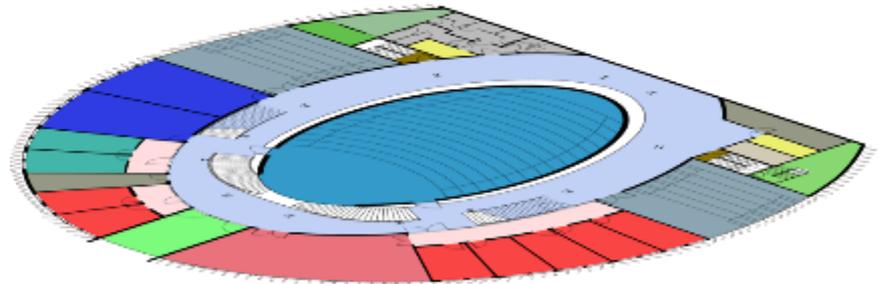
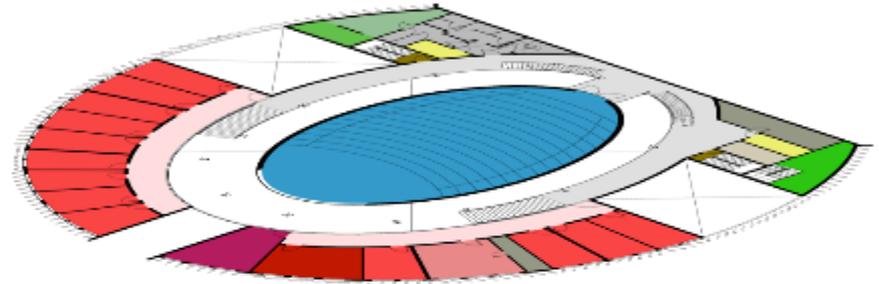
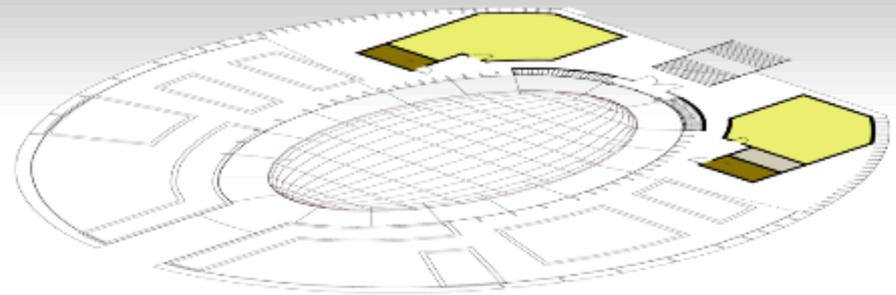
Elements Meet



Floors

Room Legend

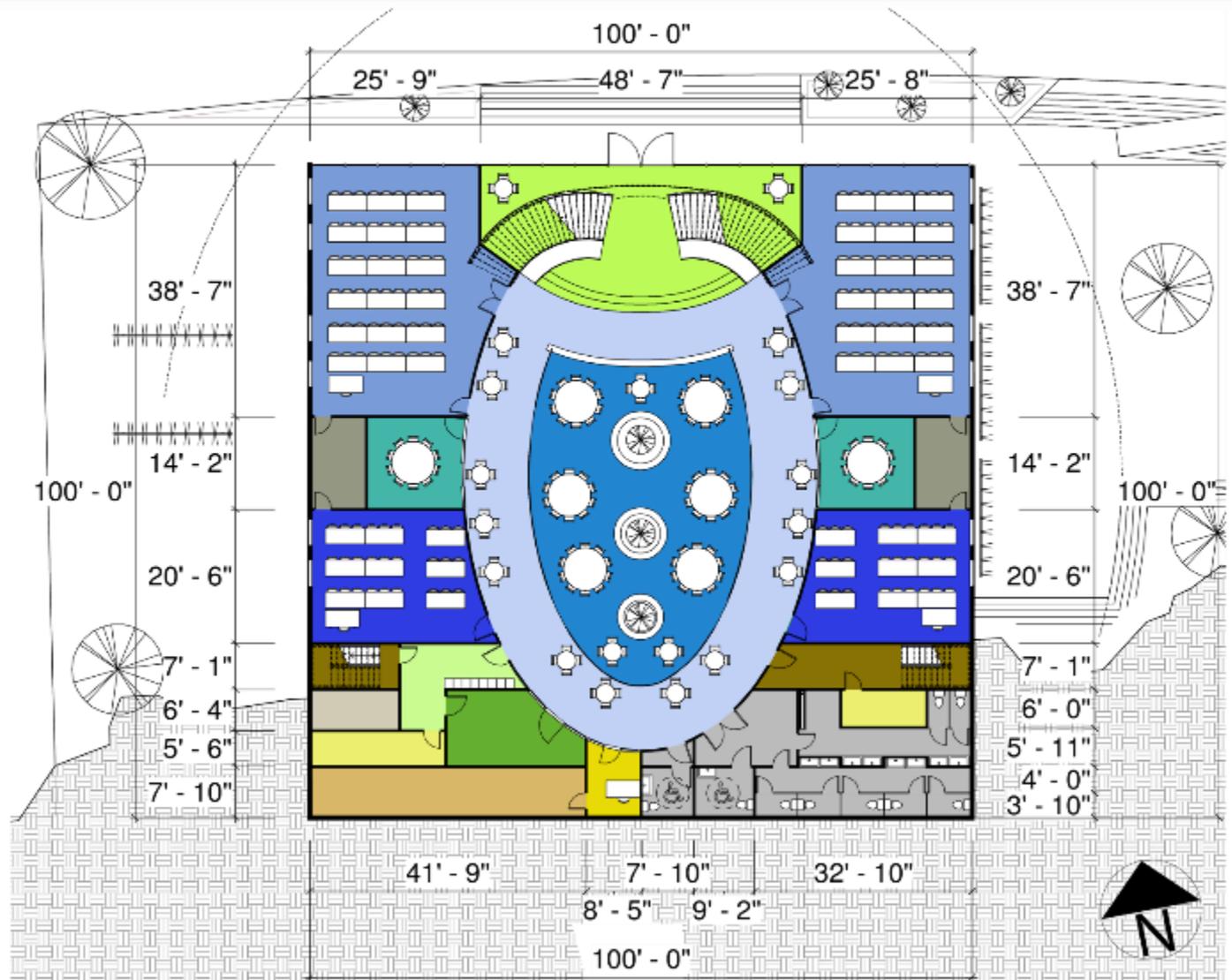
	Adm. Ass. Office		Large Classroom
	Auditorium		Lobby/Hall
	Cafe		MEP Room
	Change		Restroom
	Collaborative Space		Seminar Room
	E-Exit		Sen. Adm. Office
	Elevator		Server Room
	Faculty Lounge		Shower
	Faculty Office		Small Classroom
	Foyer		Storage
	Hall		Student Office
	Instructional Labs		Technical Support
	Kitchen		Terracebe
	Kitchen Storage		Wardrobe



1st Floor

Room Legend

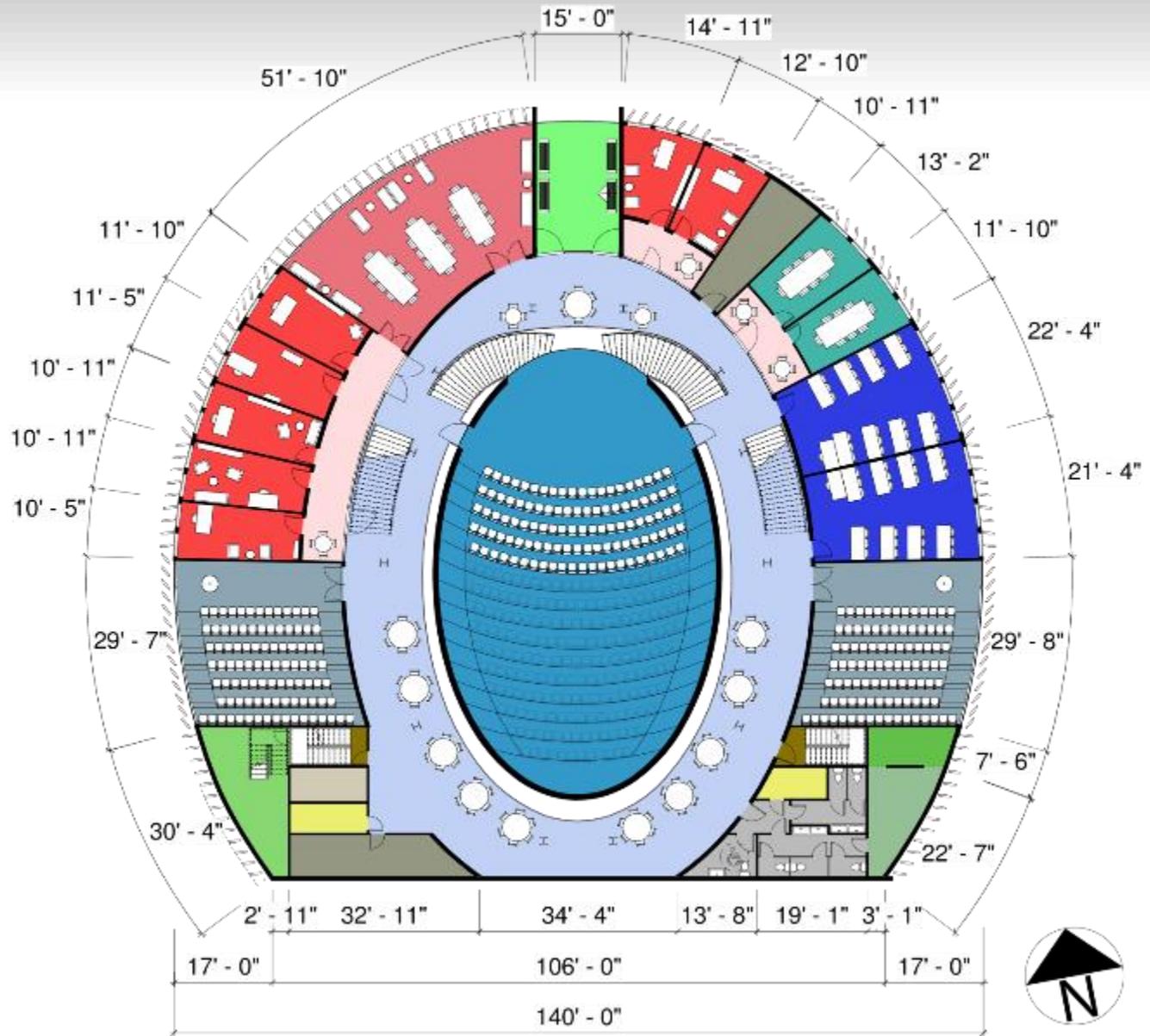
- Cafe
- Collaborative space
- E-Exit
- Elevator
- Foyer
- Instructional Labs
- MEP Room
- Restroom
- Room
- Seminar Room
- Server Room
- Small Classroom
- Storage
- Student Office
- Technical Support
- Wardrobe



2nd Floor

Room Legend

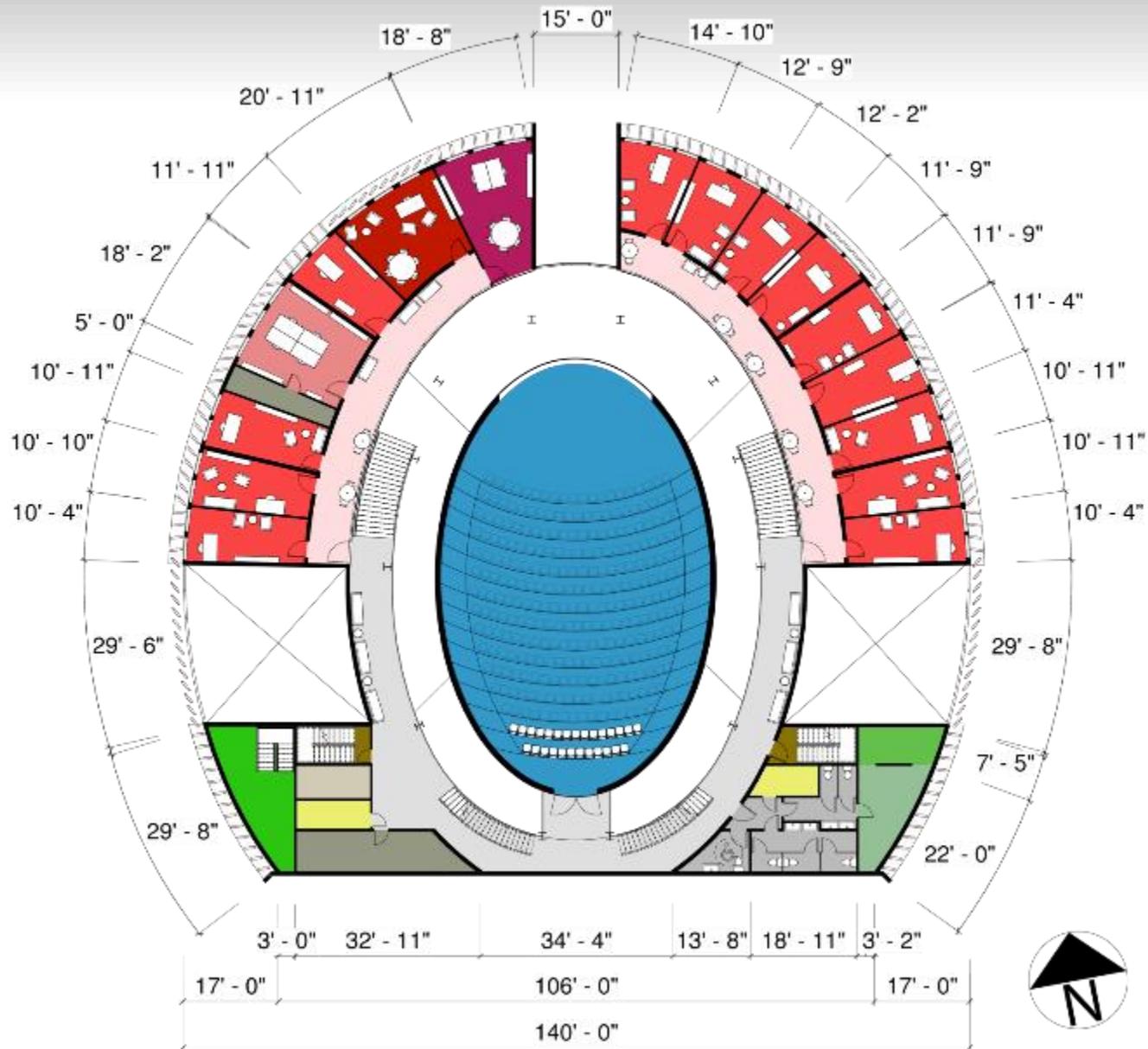
- Auditorium
- Change
- Collaborative Space
- E-Exit
- Elevator
- Faculty Lounge
- Faculty Office
- Hall
- Kitchen Storage
- Large Classroom
- MEP Room
- Restroom
- Seminar Room
- Shower
- Small Classroom
- Storage
- Terrace



3rd Floor

Room Legend

- Adm. Ass. Office
- Change
- Dep. Chair Office
- E-Exit
- Elevator
- Faculty Office
- Hall
- Kitchen
- Lobby/Hall
- MEP Room
- Restroom
- Sen. Adm. Office
- Shower
- Storage



A

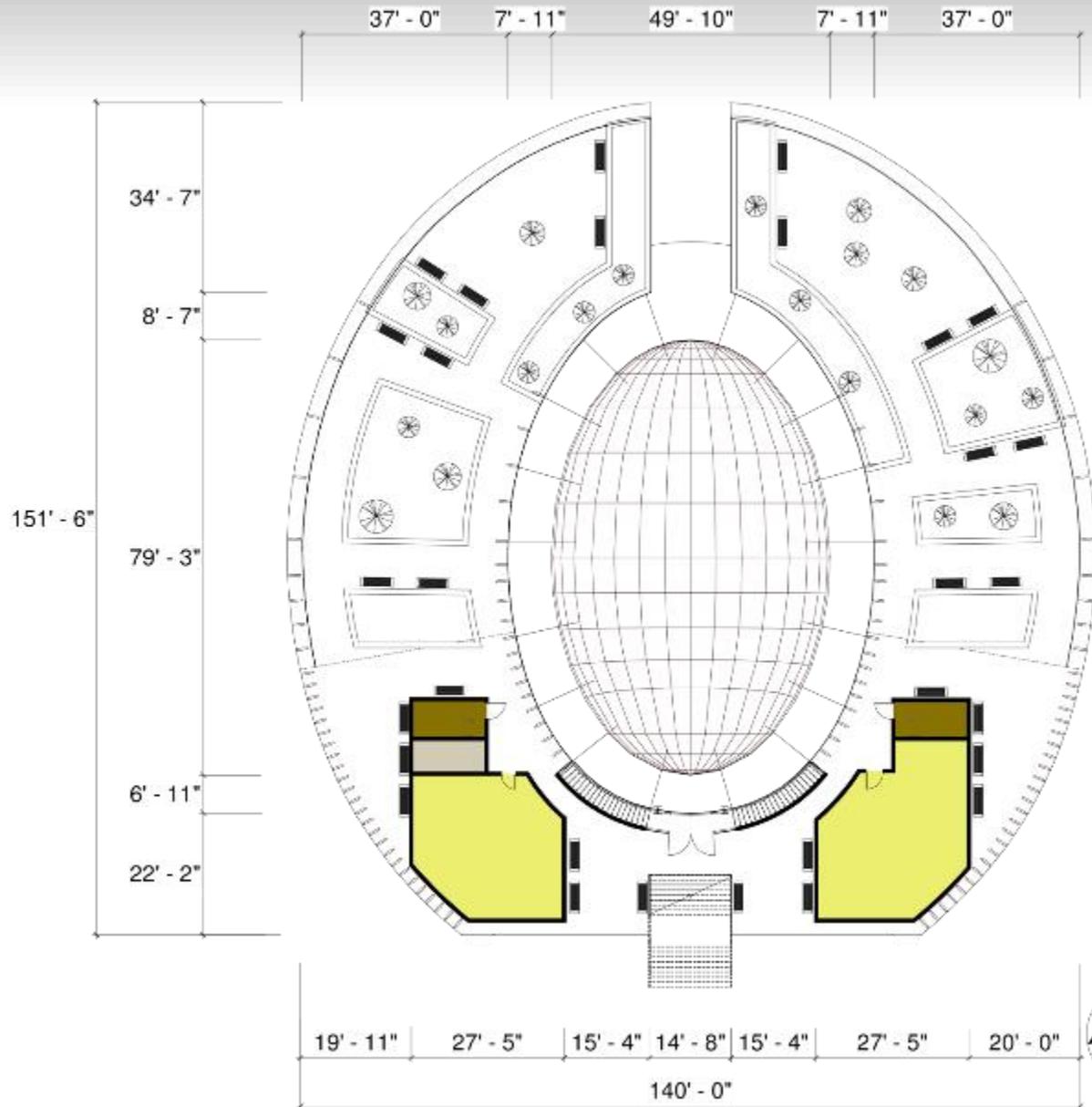
E

MEP

CM

LCFM

4th Floor

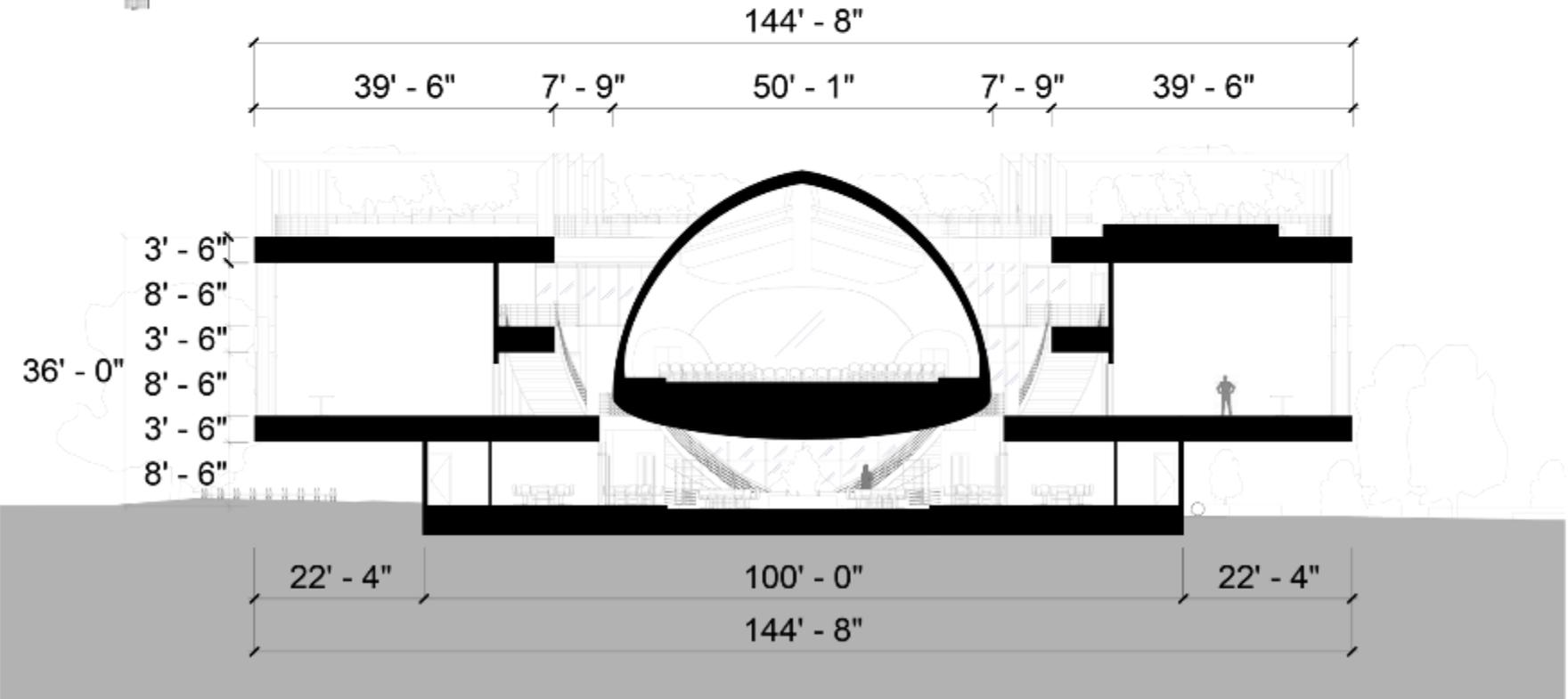
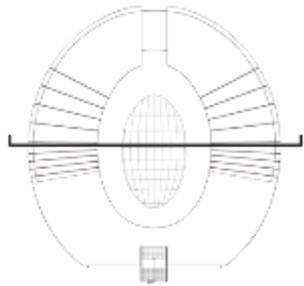


Room Legend

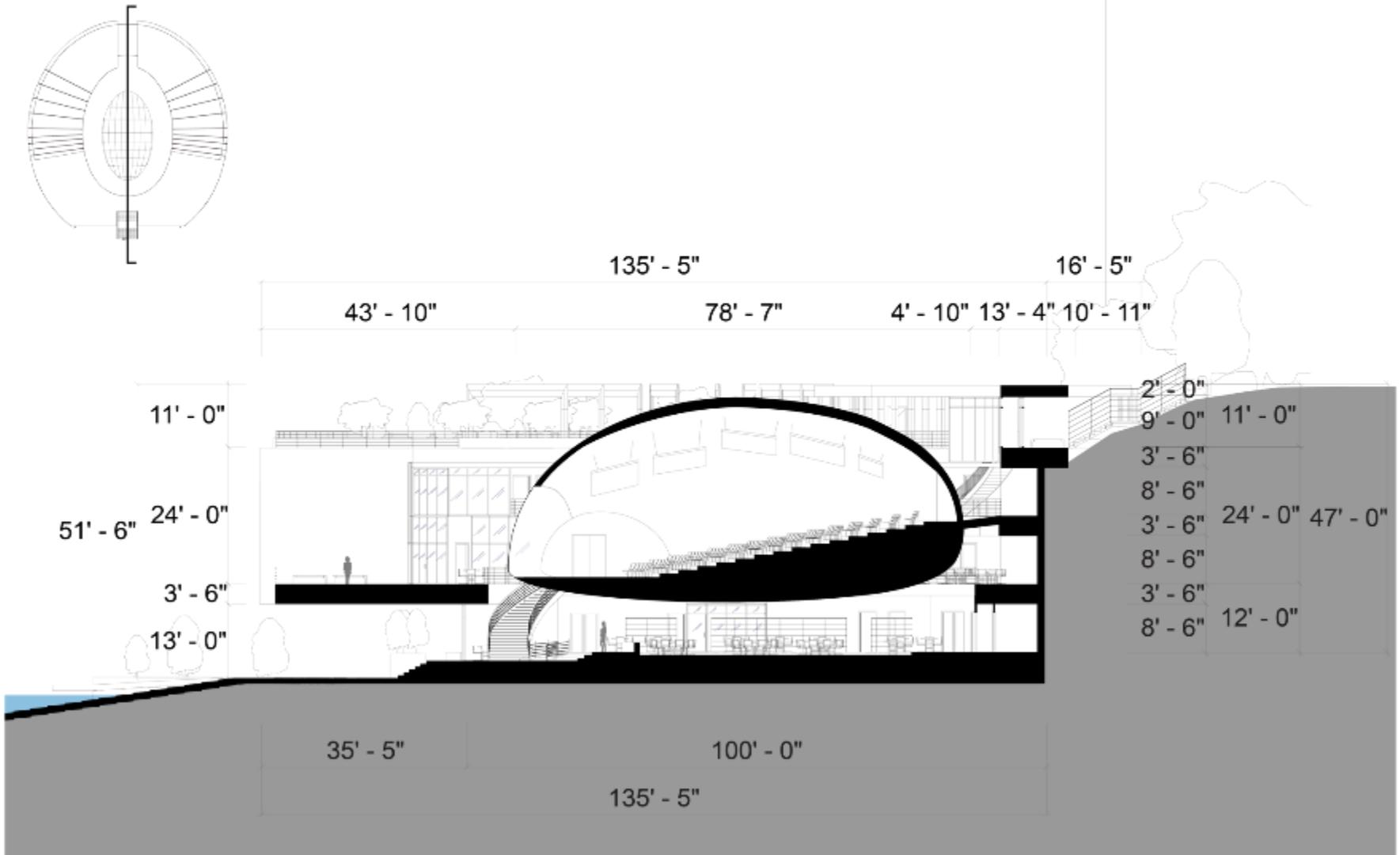
- E-Exit
- Elevator
- MEP Room



Section - West to East



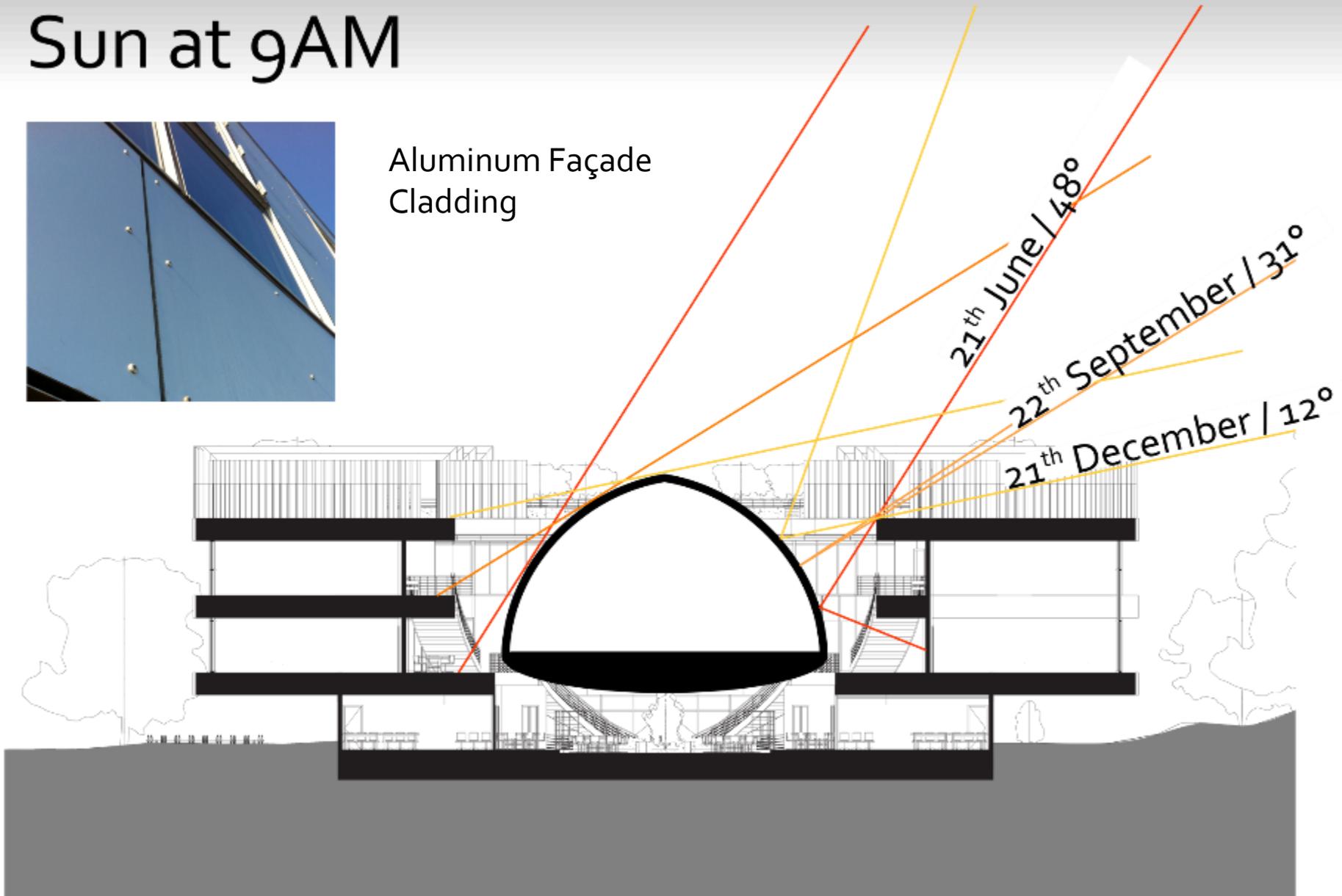
Section - North to South



Sun at 9AM



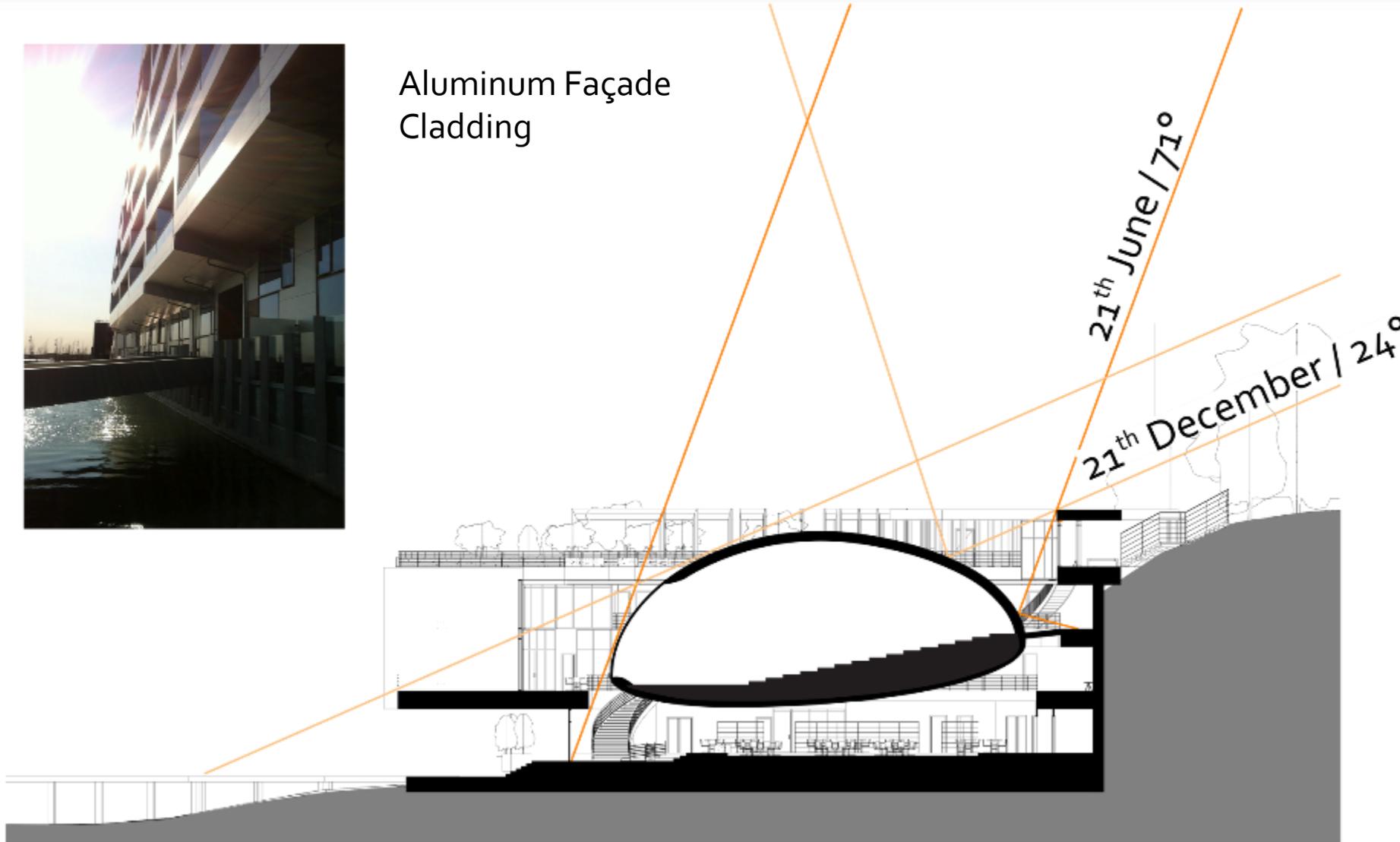
Aluminum Façade Cladding



Sun at 12PM



Aluminum Façade Cladding



Professor McKay

- A random day in the life

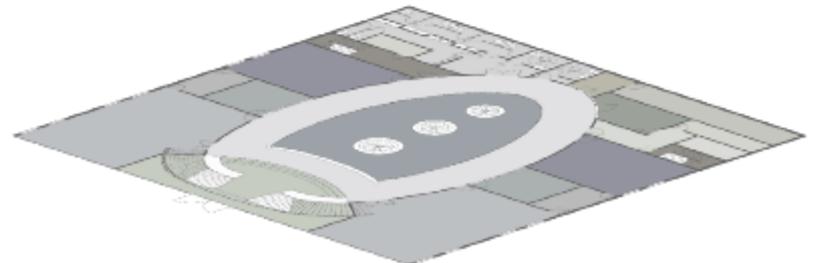
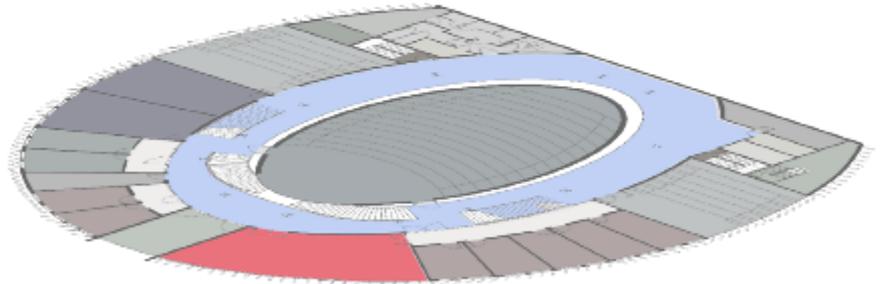
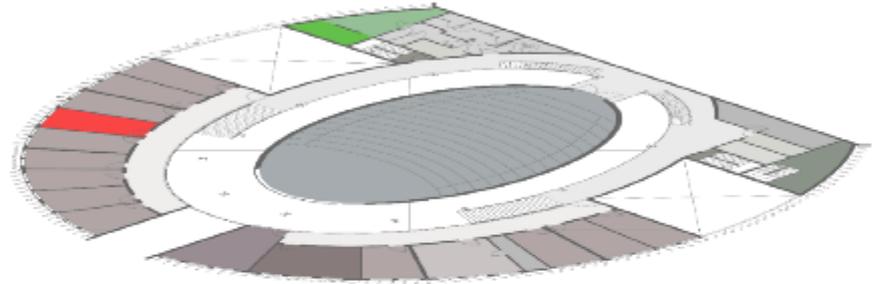
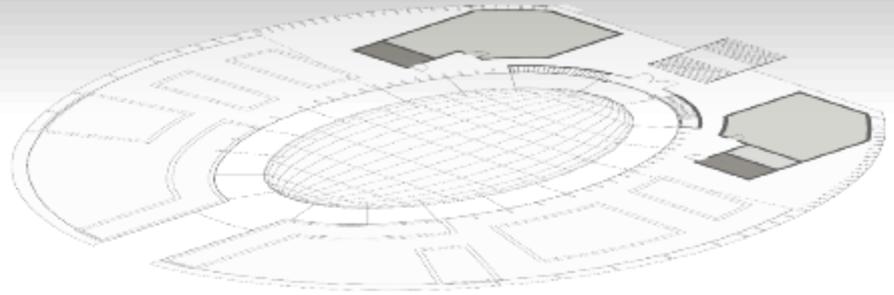
Shower

Meeting with Colleagues

Lunch

Work in Office

Meeting with Student



View from the Pier



East Side



Lobby

-3rd Floor



Rebecca

- 1st year PhD Student

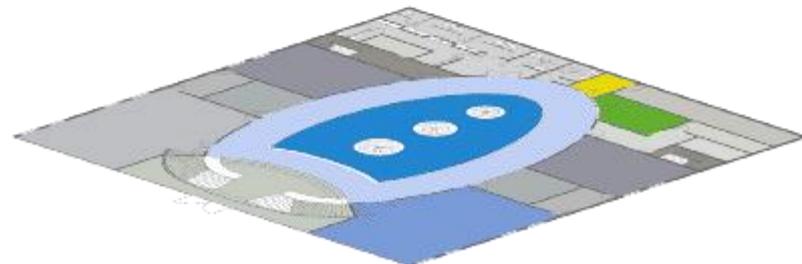
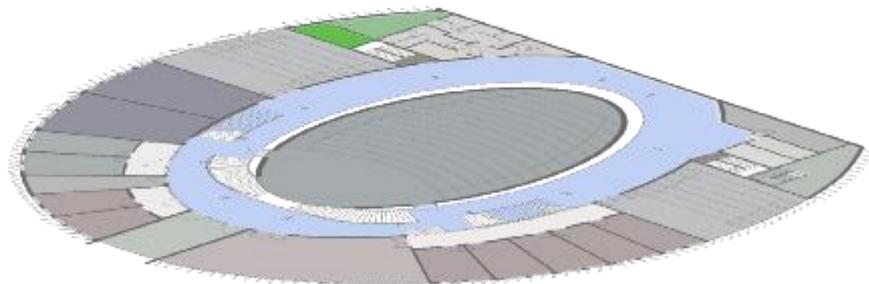
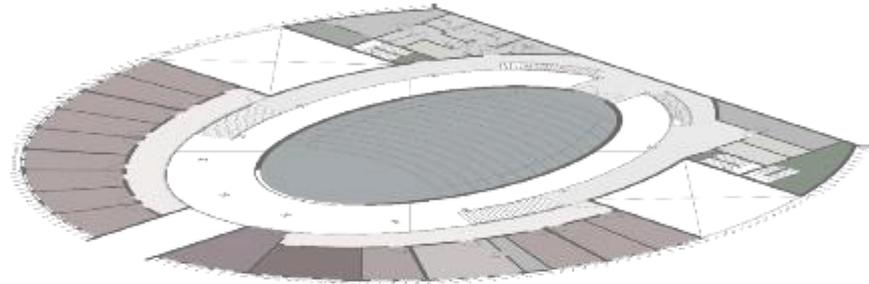
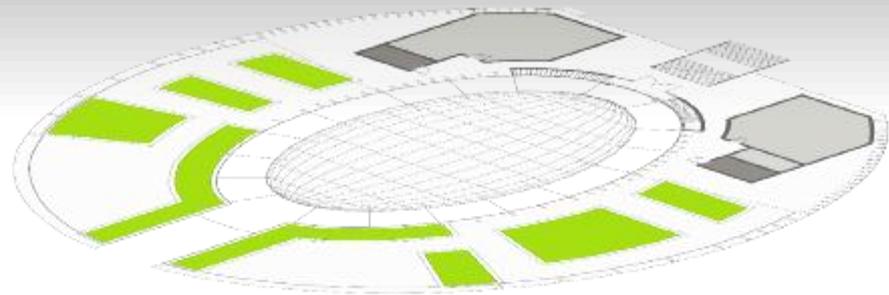
Preparing Lecture

Spare Time

Lunch

Teaches

Meeting with Professor



Collaborative Space // Student Office

- 1st Floor



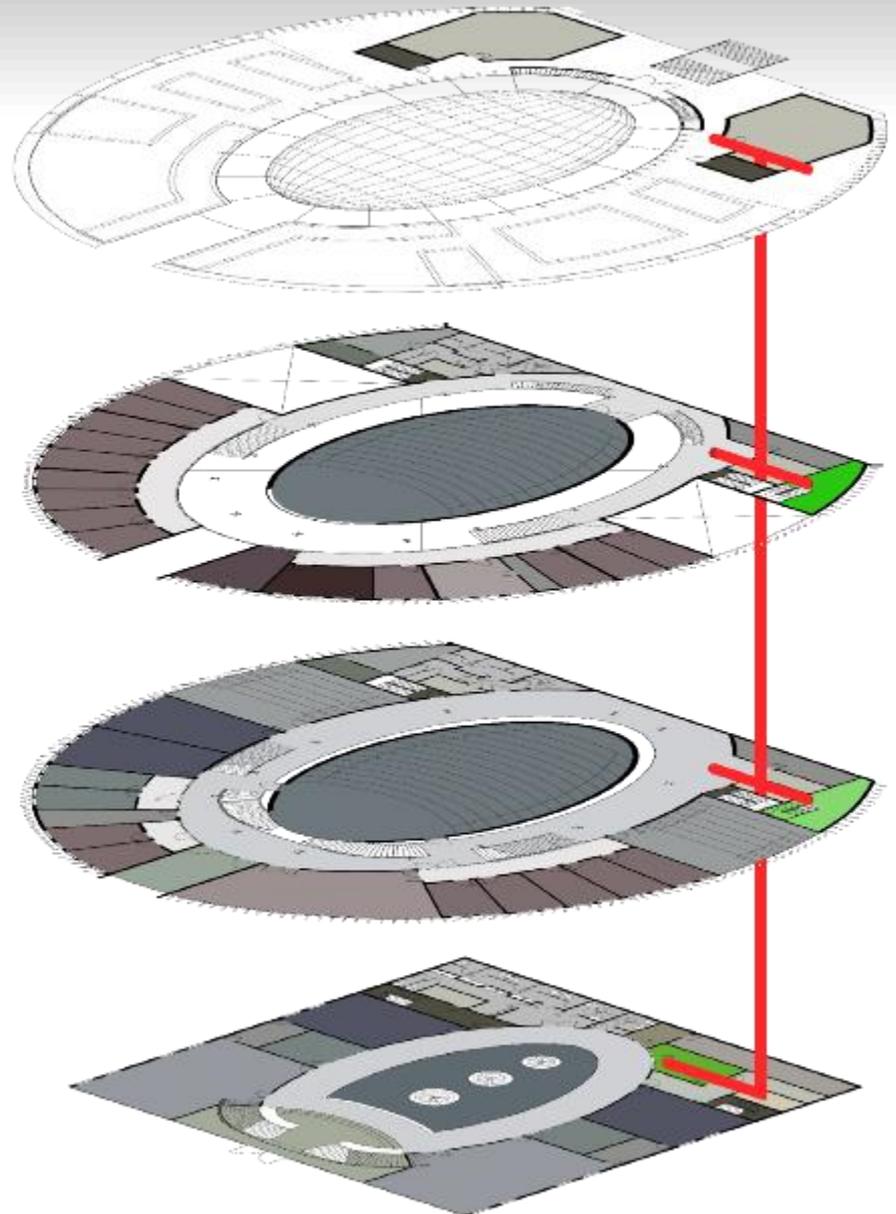
Cafe

- *Fuel for the mind*

Slow Food

Produced in the Building

Access to all Floors



Collaborative Space

- 2nd Floor



Roof Garden



Mike

- *Visiting Conference Attendee*

Expectations

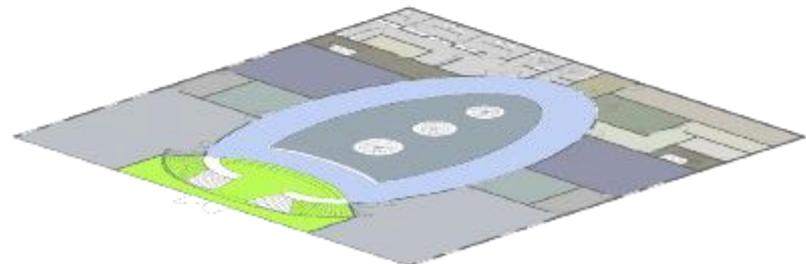
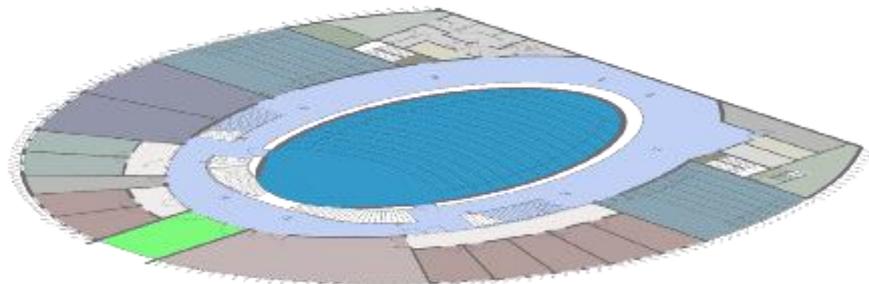
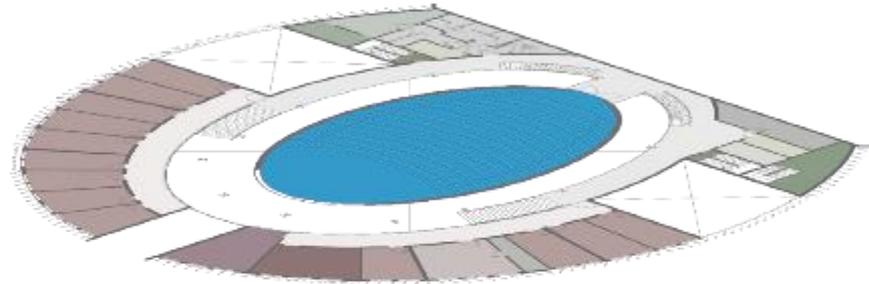
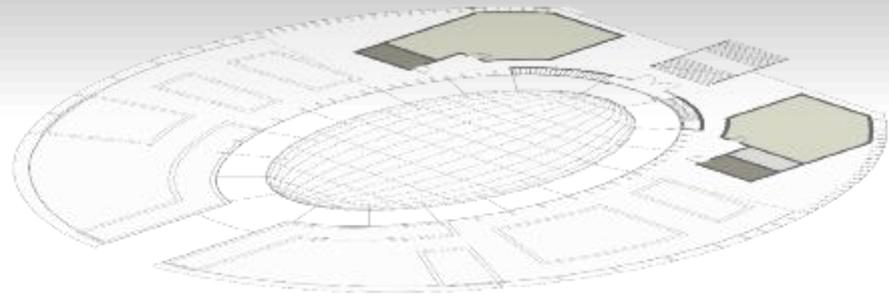
Arriving

Conference

Café

Scenic walk

Starts wondering...



West Side





Foyer

- 1st Floor



Entrance to Auditorium

- 2nd Floor



Jingxuan Yue



Structural

Load Estimation

Dead Load

Self-Weight

- Steel

Deck + Concrete: ~46 psf

Structural Member: ~62plf

- Concrete

Concrete: ~80 psf

Fixed Equipment: 30 psf

Live Load

Assembly Area: 100 psf

Auditorium: 60 psf

Classroom: 40 psf

Corridor: 100/80 psf

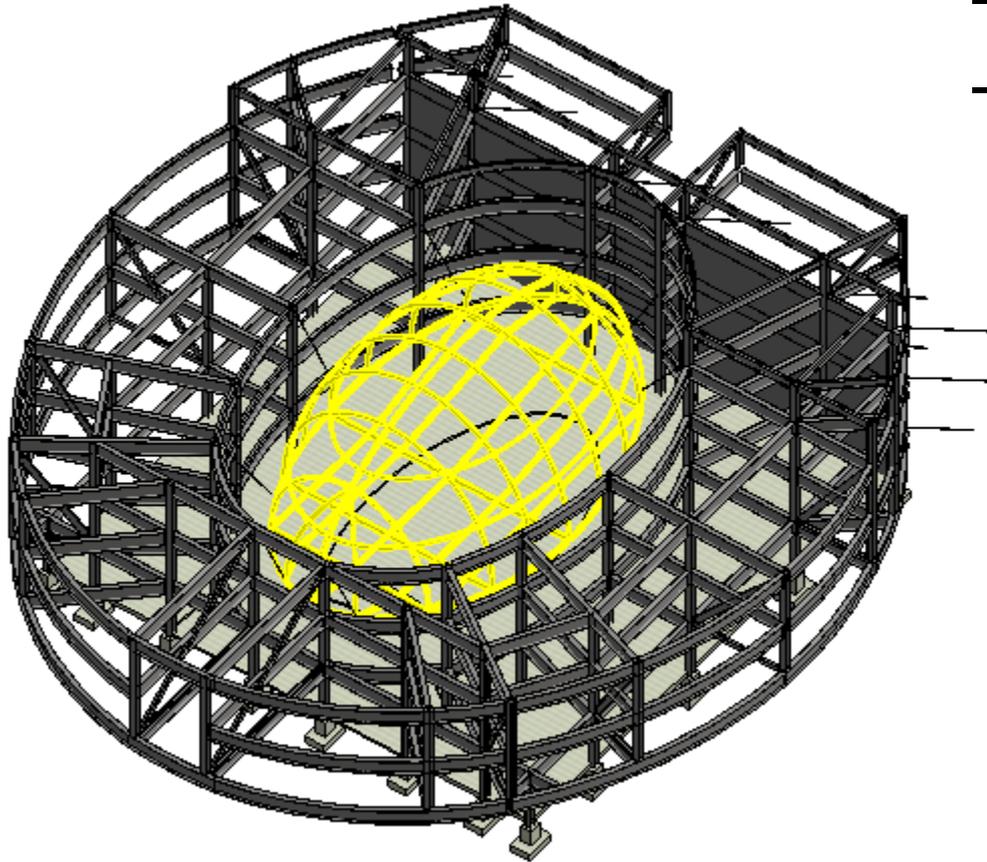
Office: 50 psf

Roof: 20 psf

*Partition: 15 psf

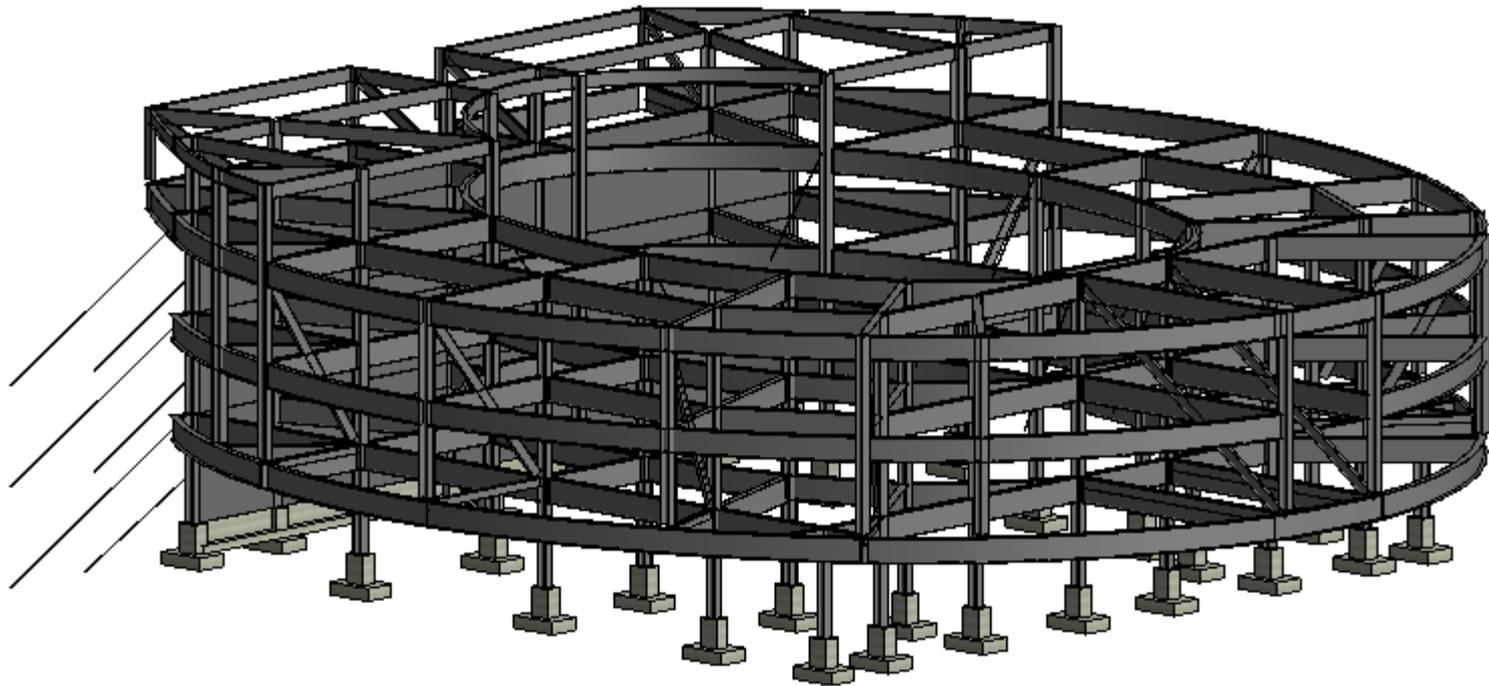
	Wind Load (kip)		Seismic (kip)	Snow (psf)
	Floors	Roof	Base	Roof
Heart	47	23.5	150	36
Embrace	50	25	215	36+ Effect of Snow Drifting Auditorium: 0

Structural System

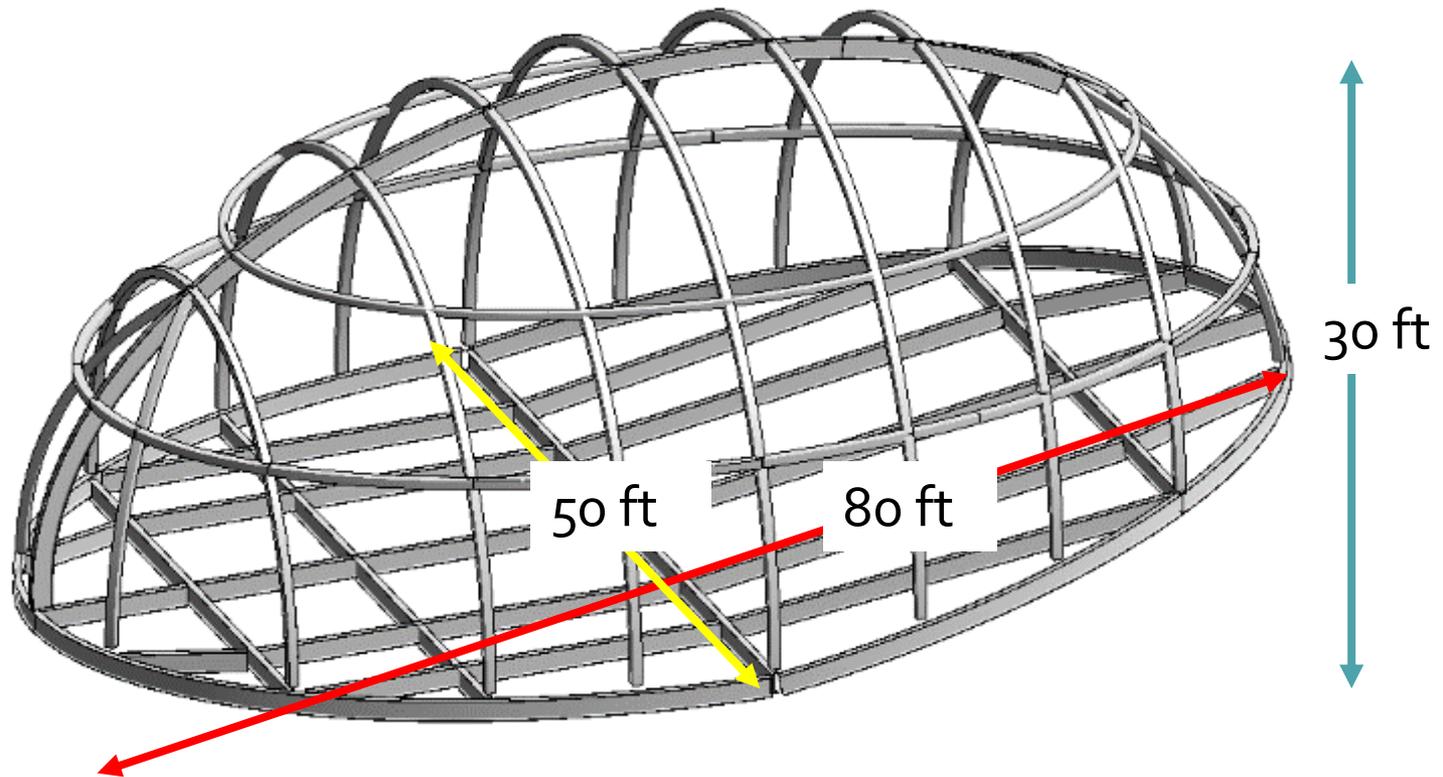


- Perimeter Building
- Central Auditorium

Perimeter Building

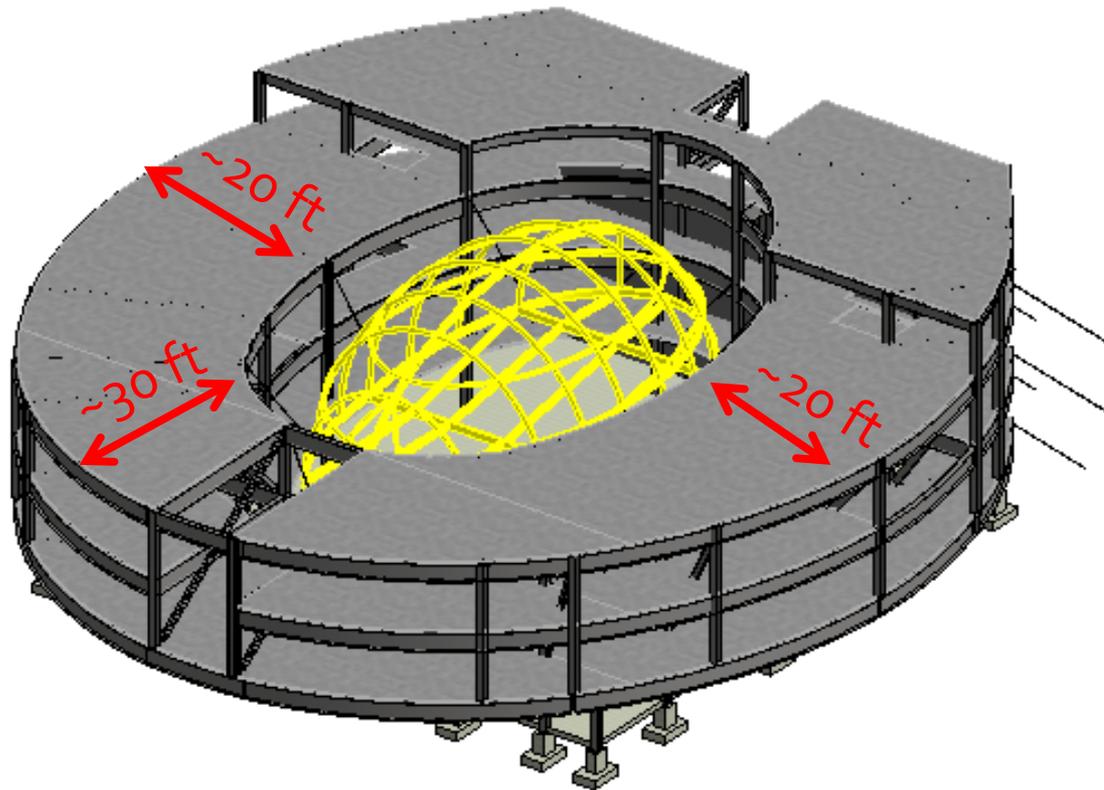


Auditorium

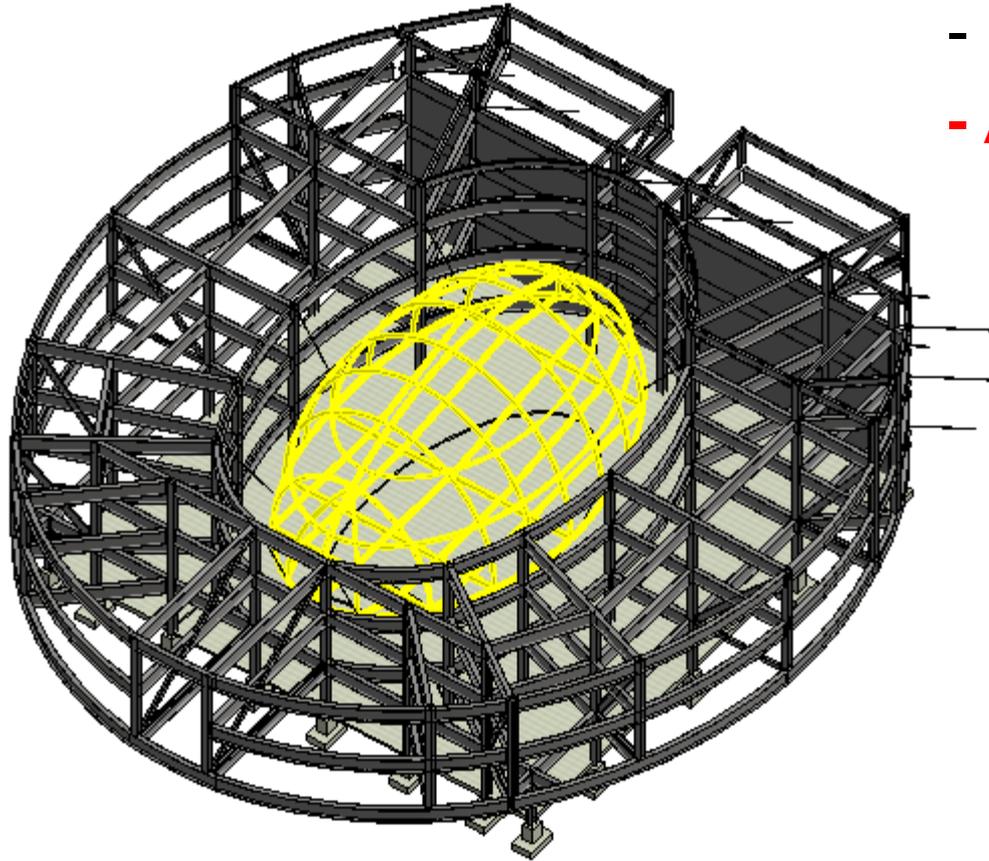


Challenges

- **Perimeter Cantilever**
- Auditorium

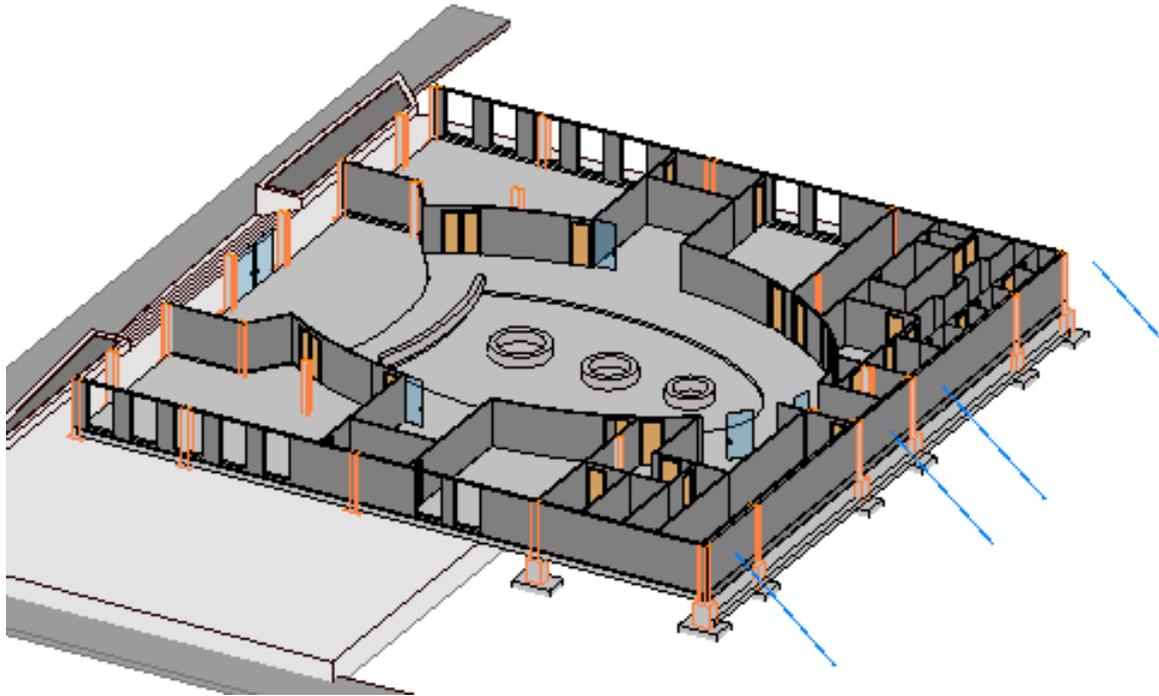


Challenges



- Perimeter Cantilever
- **Auditorium**

Floor Plan – 1st floor



Column: W14X132

Girder: W24x94 @ Front Cantilever (Curved)

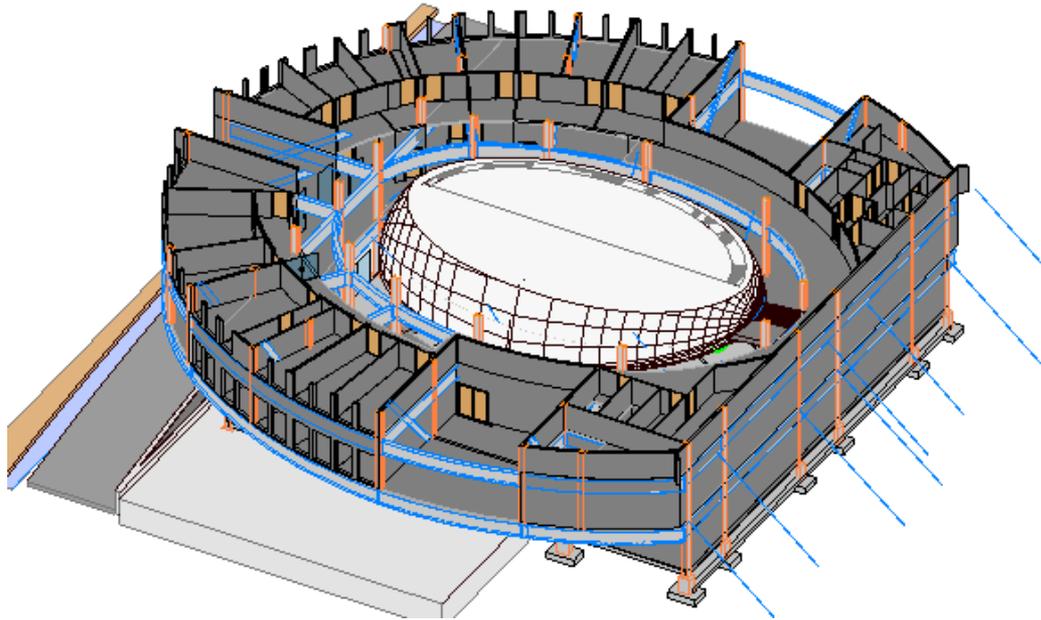
Girder: W18x65 Other (Curved)

Beam: W18x65 (Curved)

Brace: W16x45

Composite Slab: 2" Deck + 4" Concrete Cover

Floor Plan – 3rd floor



Column: W14X132

Girder: W24x94 @ Front Cantilever (Curved)

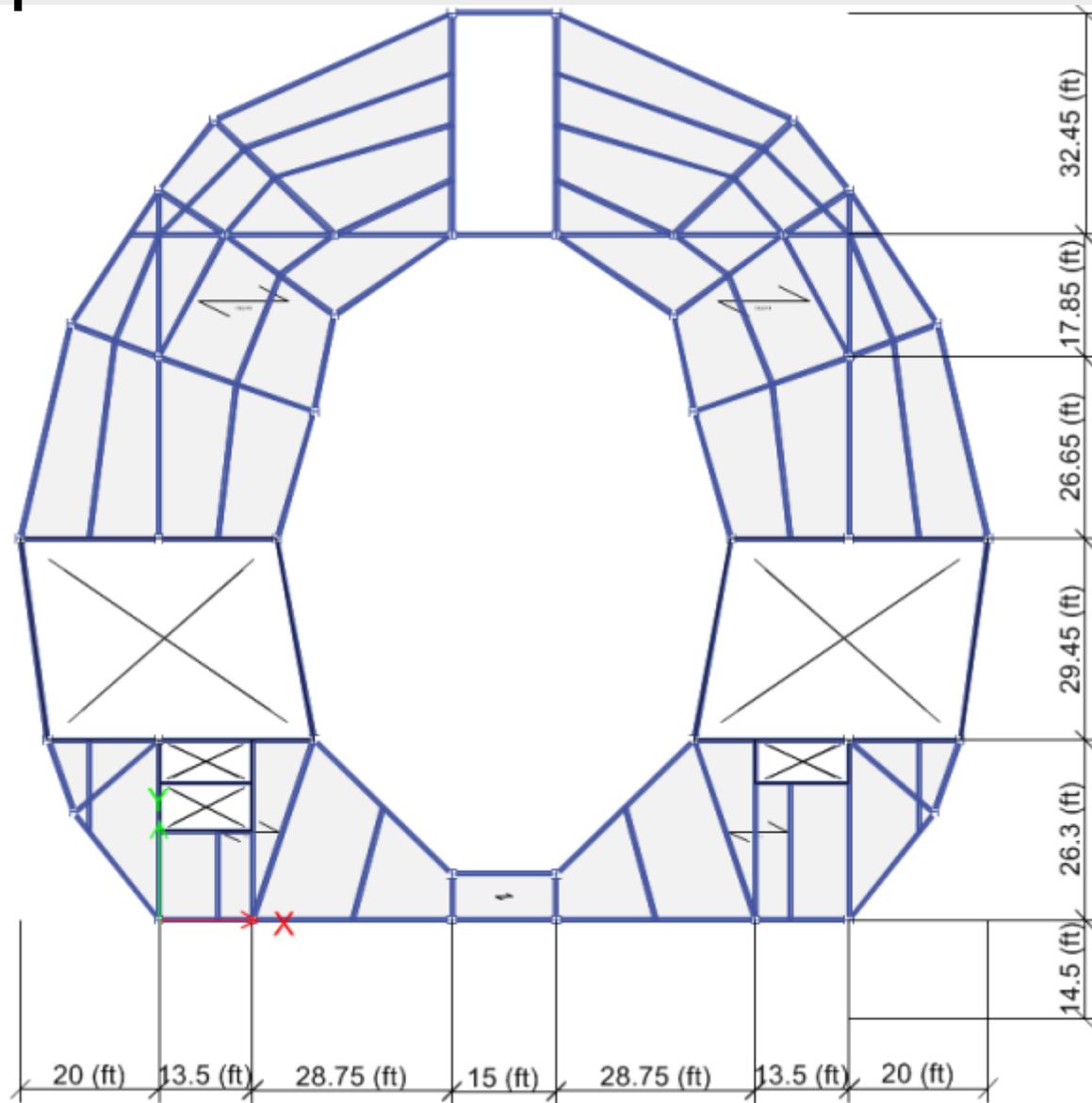
Girder: W18x65 Other (Curved)

Beam: W18x65 (Curved)

Brace: W16x45

Composite Slab: 2" Deck + 4" Concrete Cover

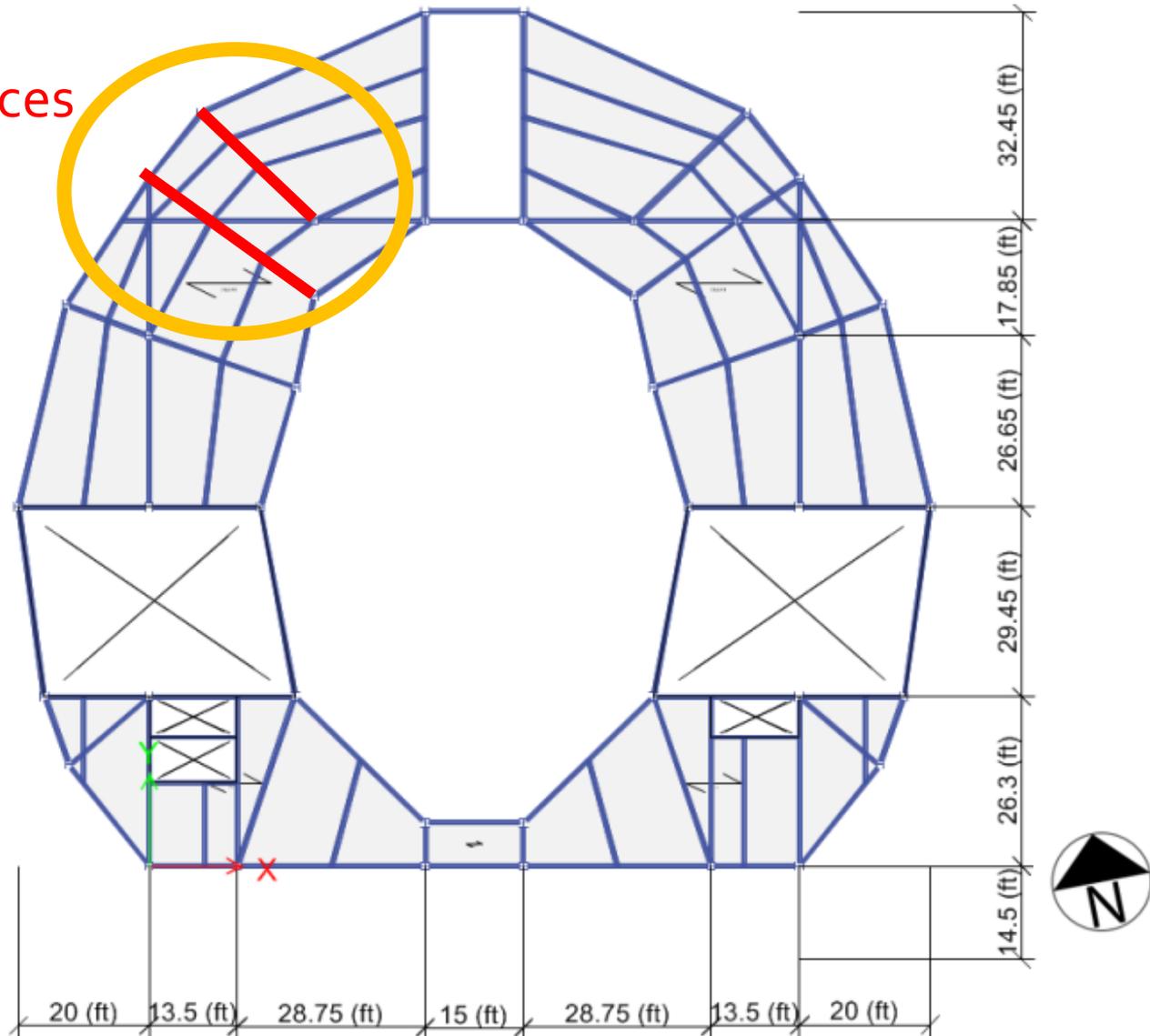
3rd Floor



Rearrangement with Architect

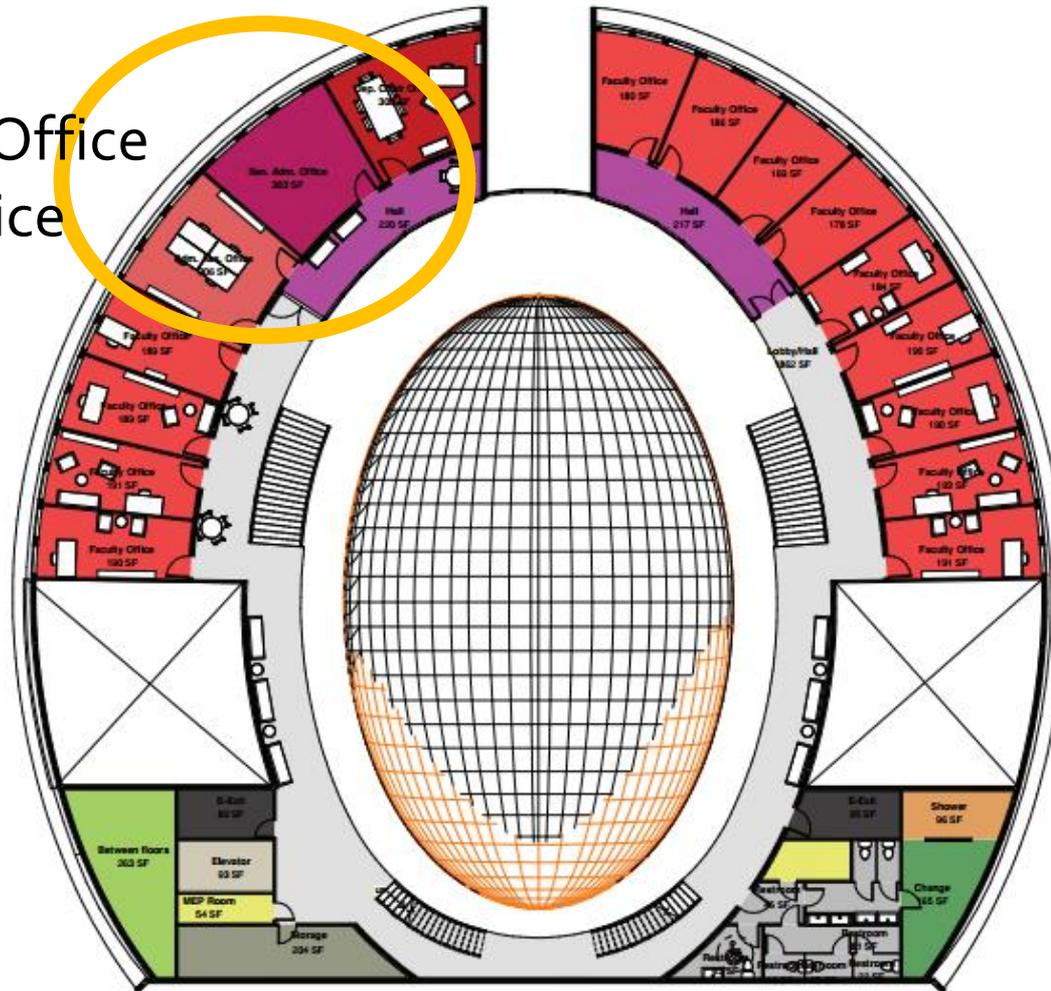
Diagonal Braces

3rd Floor



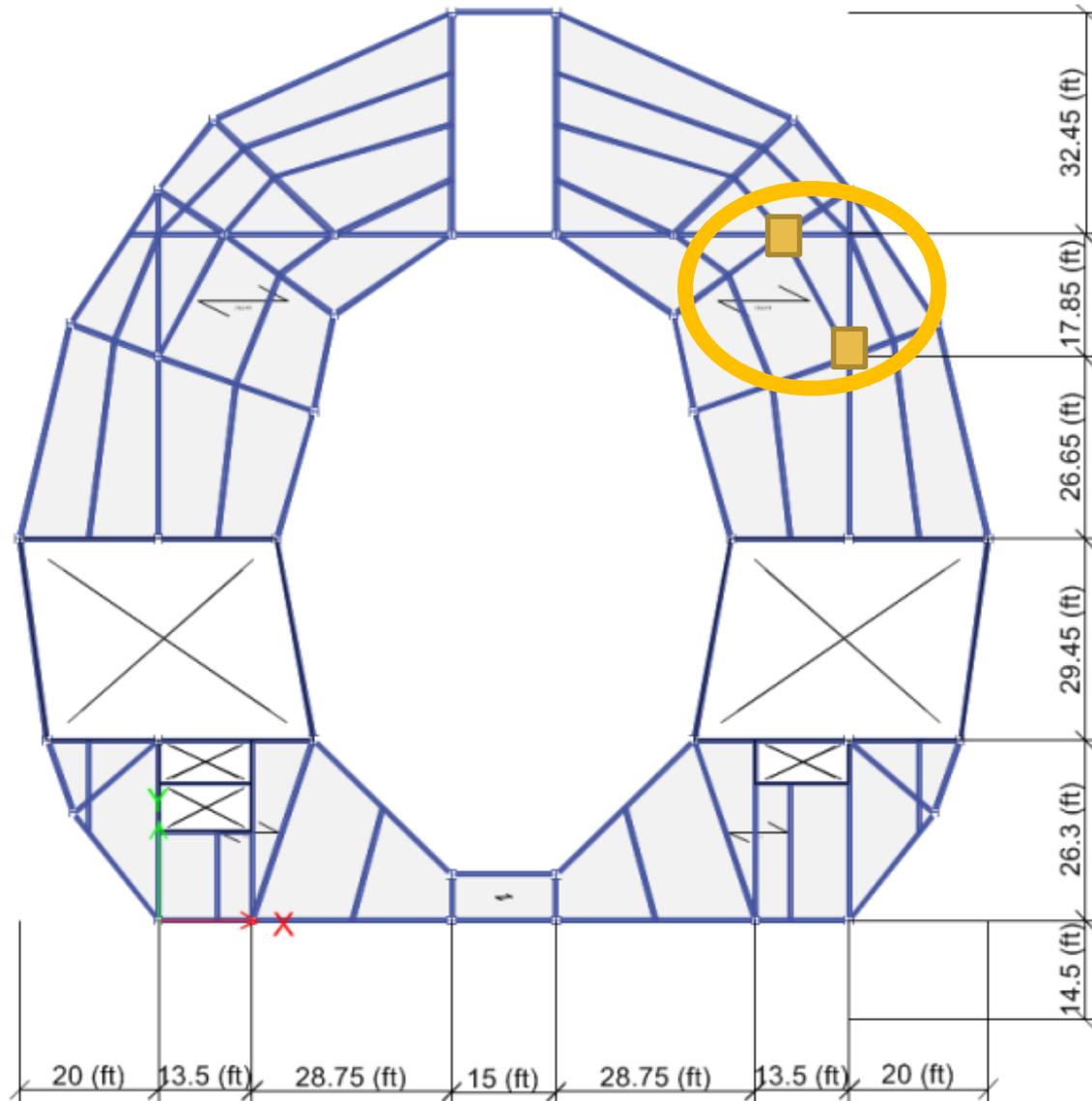
Previous 3rd Floor Plan

Senior Adm. Office
Assistant Office



Rearrangement with Architect

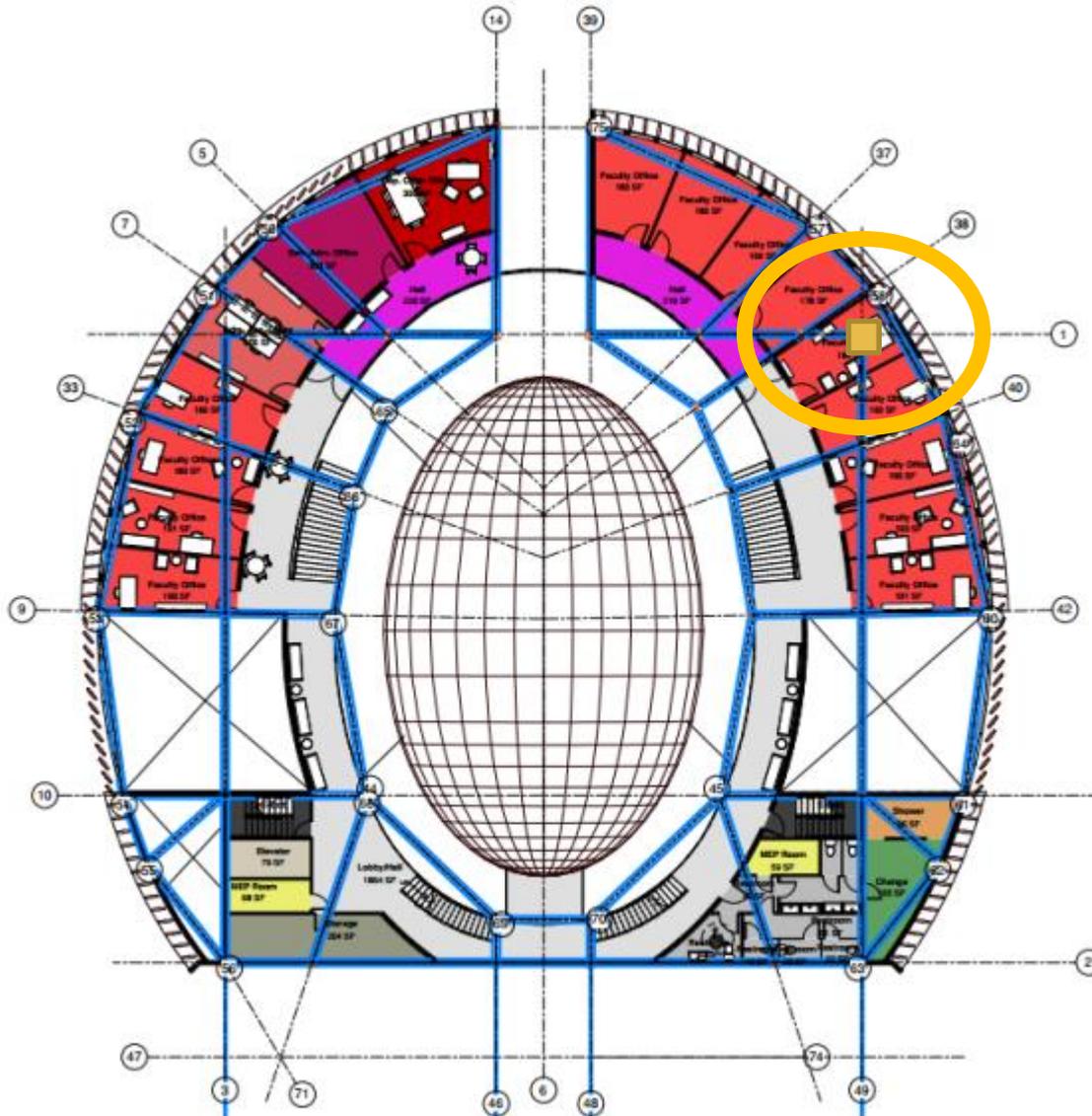
3rd Floor



Current
Columns



Previous 3rd floor plan

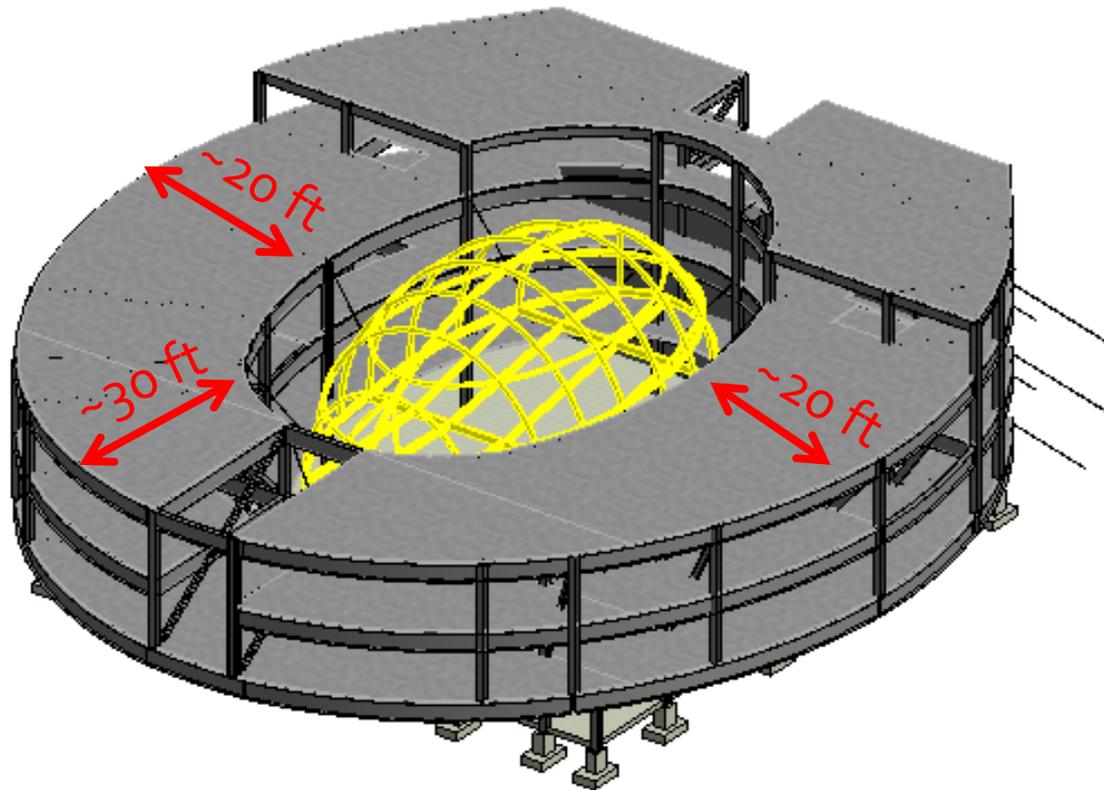


Column in the
faculty room!!!



Challenges

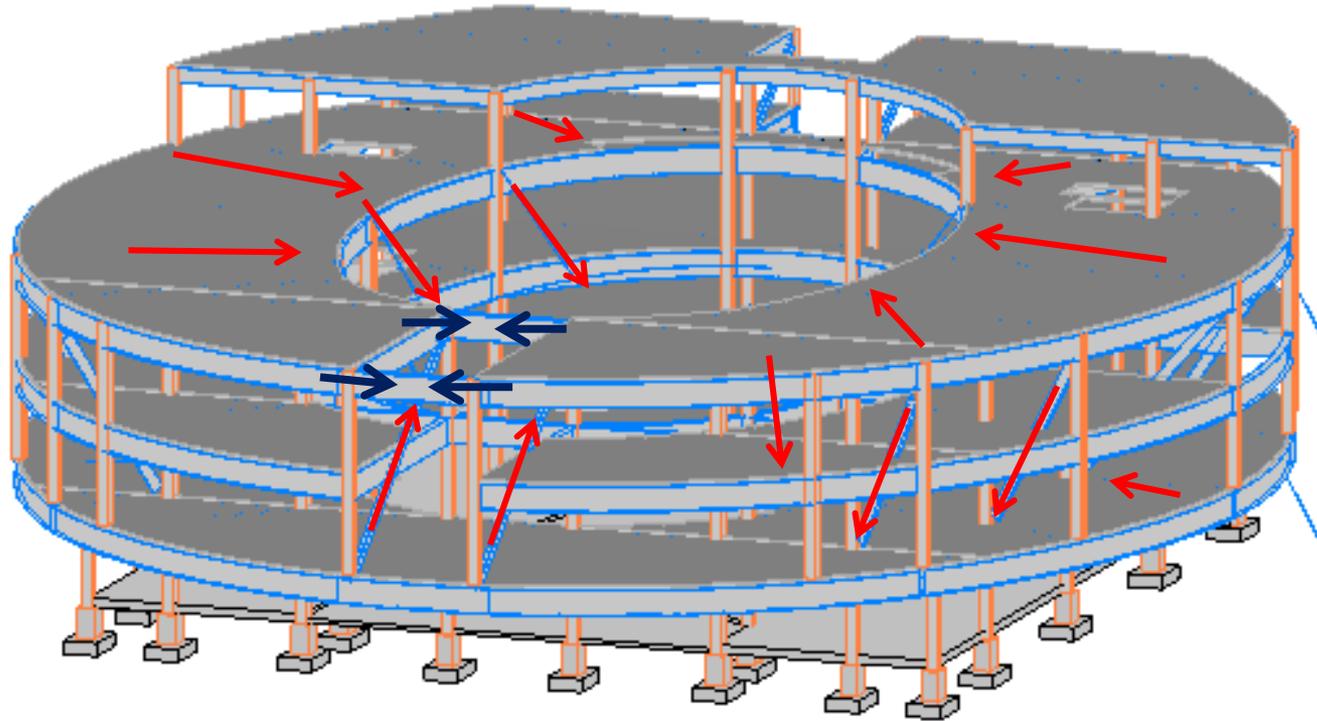
- **Perimeter Cantilever**
- Auditorium



Cantilever

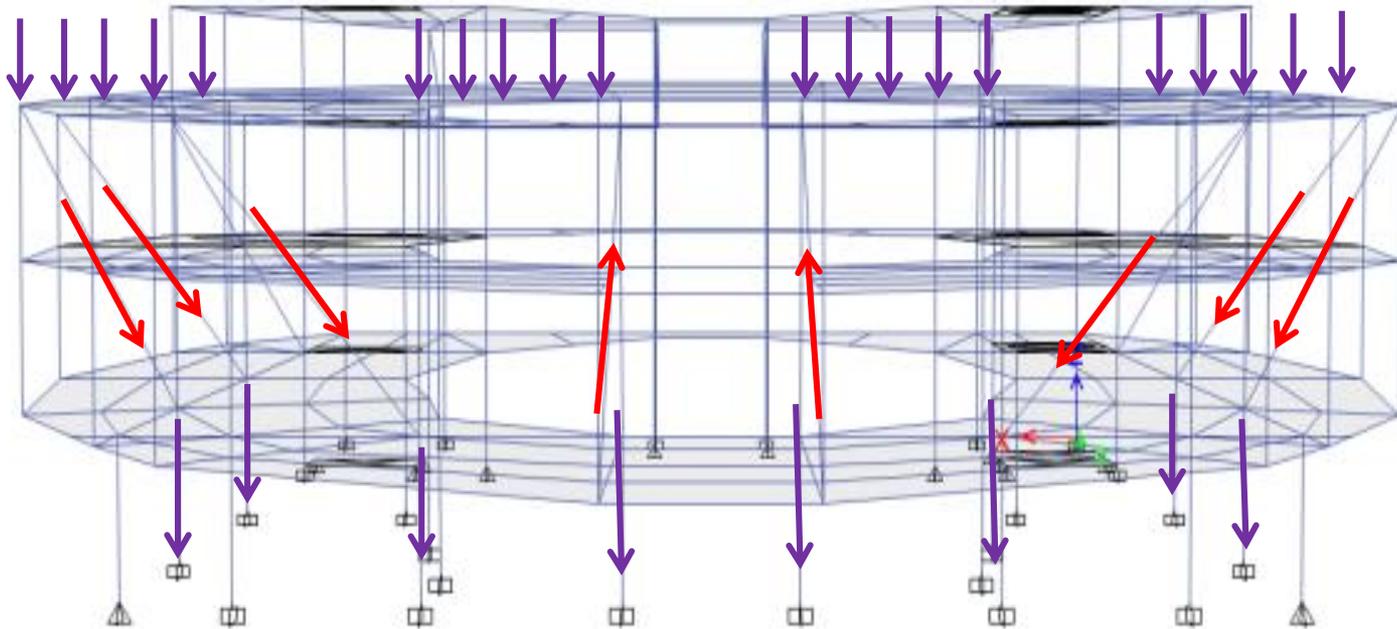


Cantilever

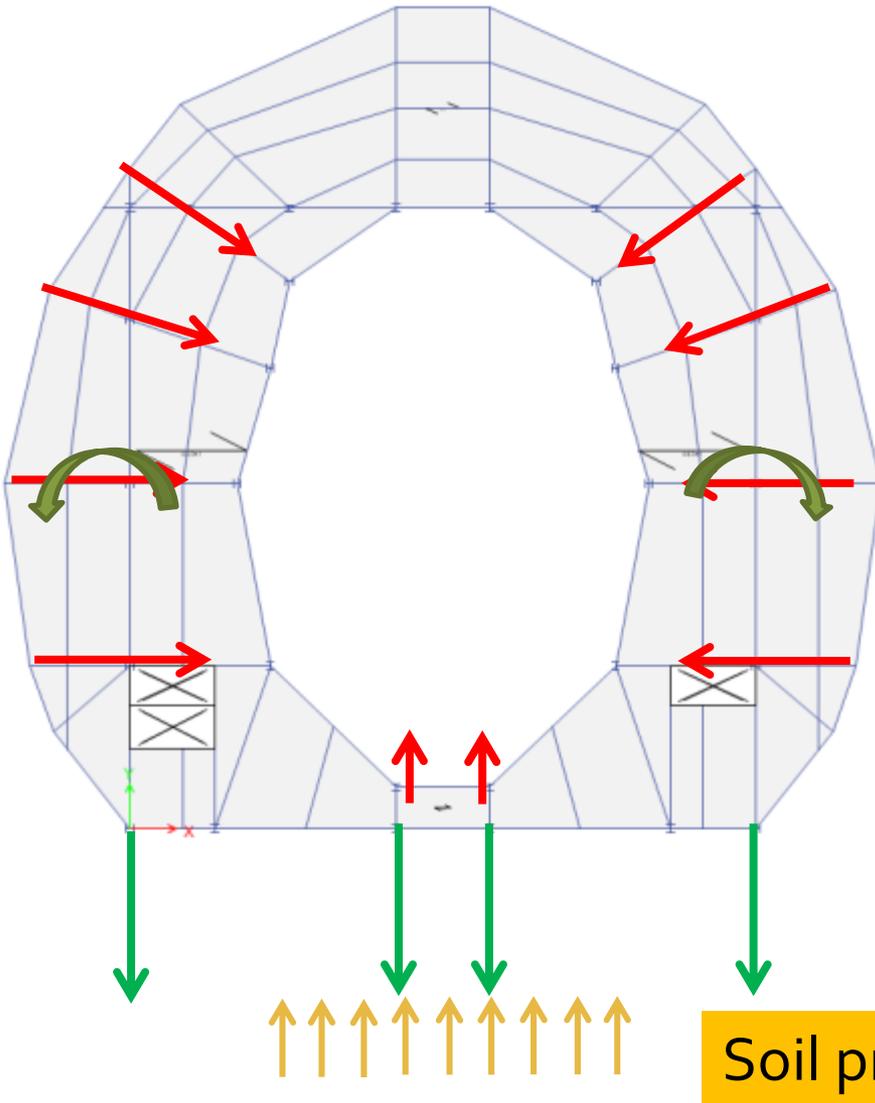


Diagonal Braces – transfer vertical load to horizontal load

Cantilever



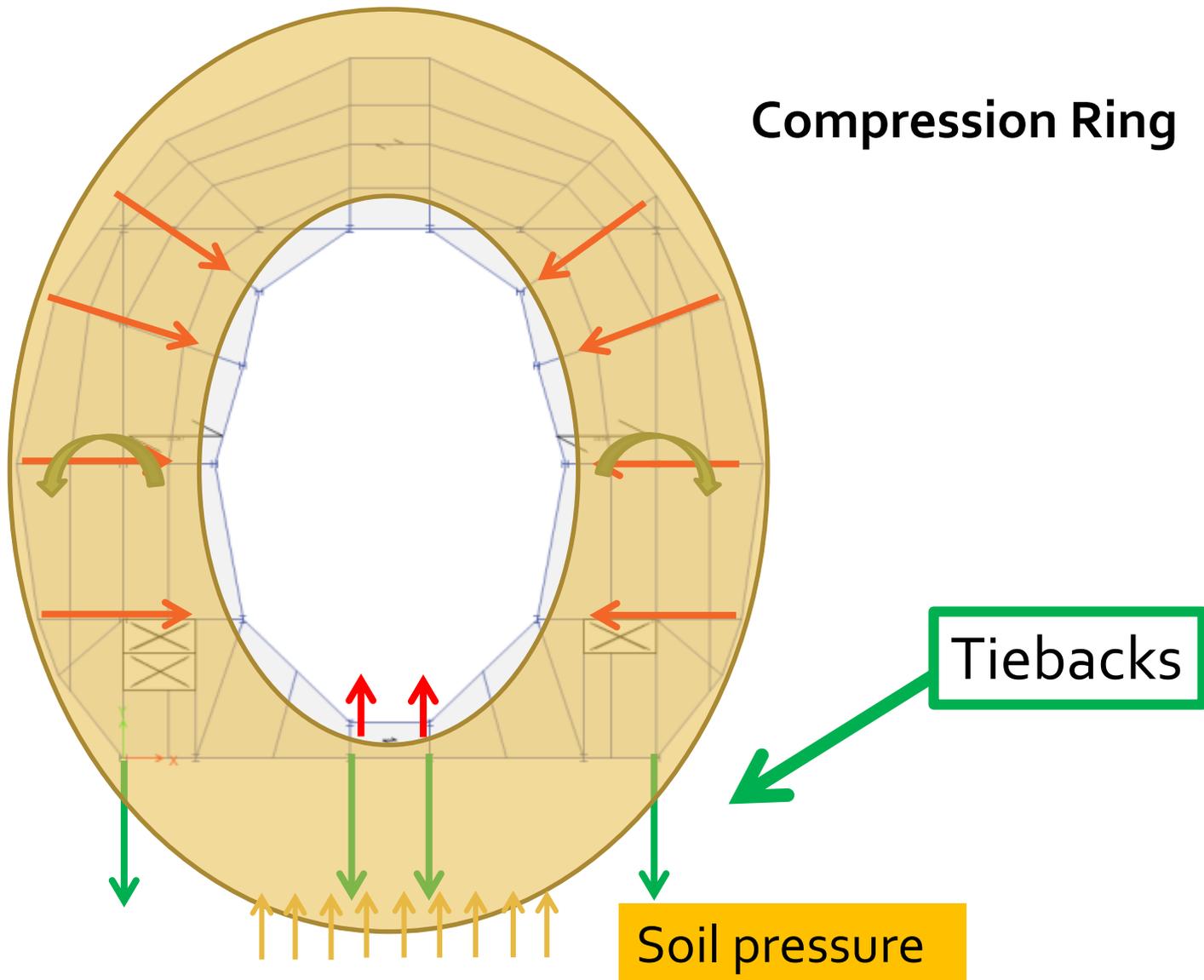
Cantilever



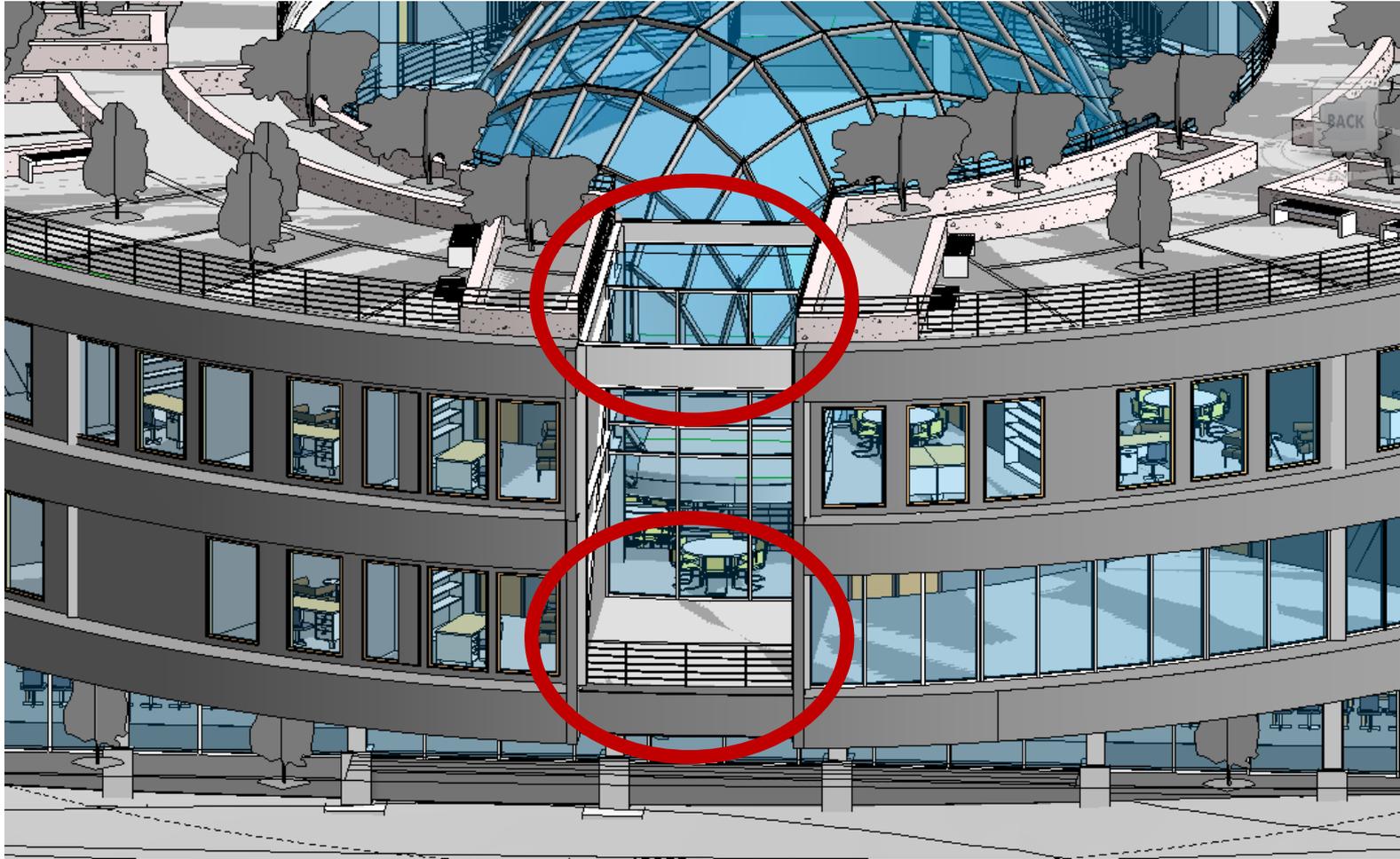
2nd & 4th Floor:

Diaphragm

Cantilever



Redesign with Architect: Front Terrace



Cantilever- Hand Calculations

$T_{in\ each} = 200\ k \times 4$
 $T_{in\ the\ ring} = 200\ k$
 $A = \frac{200\ k}{60\ kpsi} = 3.3\ in^2$
 use 4 # 4 rebars

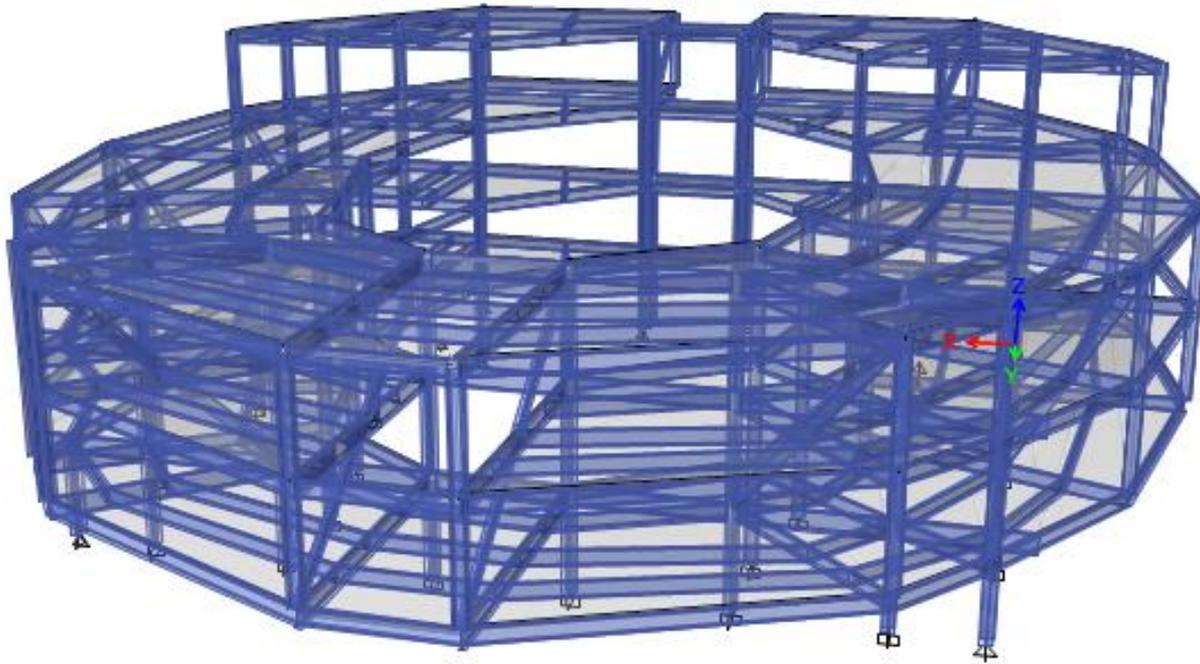
Length of cantilever = 70'
 4 cables outside

Force from cantilever @ each cable: $P_1 = (4 \times 0.250 + 12 \times 0.08) \times 200' \times 52' = 1.67\ k$
 $+ \text{roof load } (1.2 \times 4) \times 200' \times 52' = 15.72\ k$
 $M_1 = 87.7 = 129.5\ k$
 $= 215.5\ k$

Force from cantilever @ each cable: $P_2 = (1.2 \times 0.07 + 12 \times 0.02) \times (40 + 20) \times 30 = 26\ k$
 $M_2 = 22\ k$
 $M_2 - M_1 = 107.5\ k$

$T = \frac{4 \times 107.5\ k}{2} = 215\ k$
 $w_{req} = \frac{4 \times 107.5}{60} = 7.17\ kpsi$
 $M = \frac{1}{8} \times 1.5 \times 20^3 = 93.75\ k$
 $T = c \times \frac{93.75}{10} = 937.5\ k$

Cantilever - Etabs Modeling

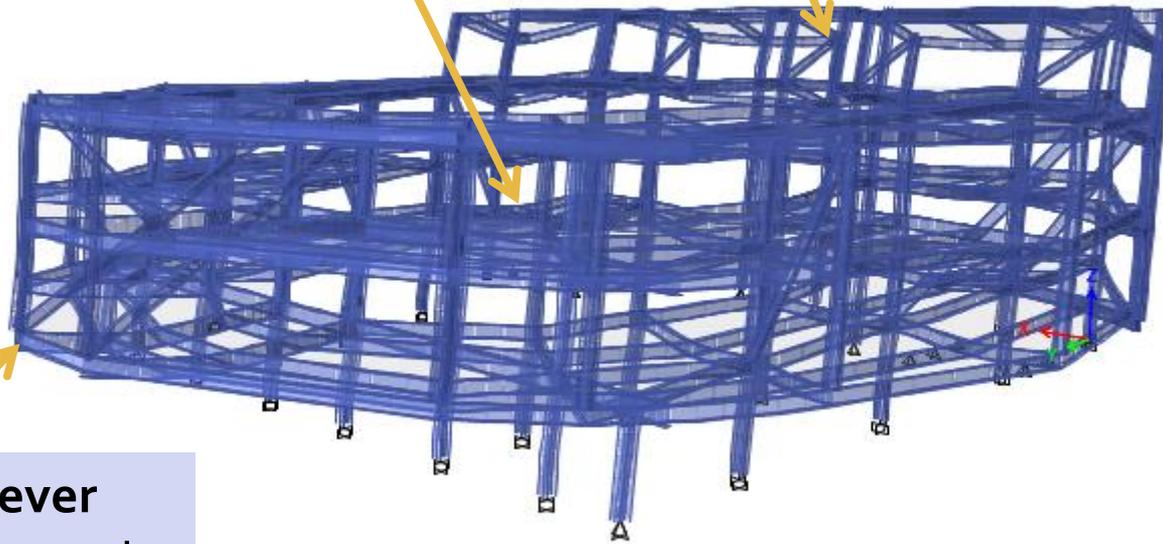


Cantilever - Etabs Modeling

Maximum Displacement

Z-Direction: 1.52 in

Y-Direction: 0.45 in

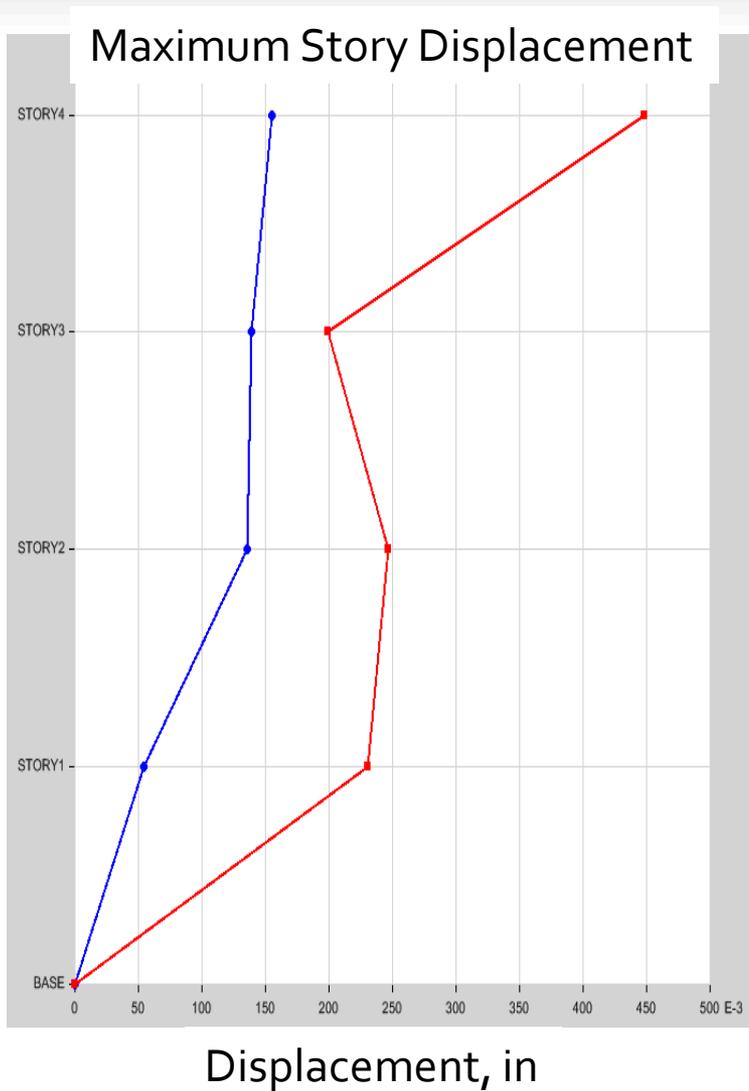


Front Cantilever

Z-Direction: -0.75 in

Y-Direction: -0.22 in

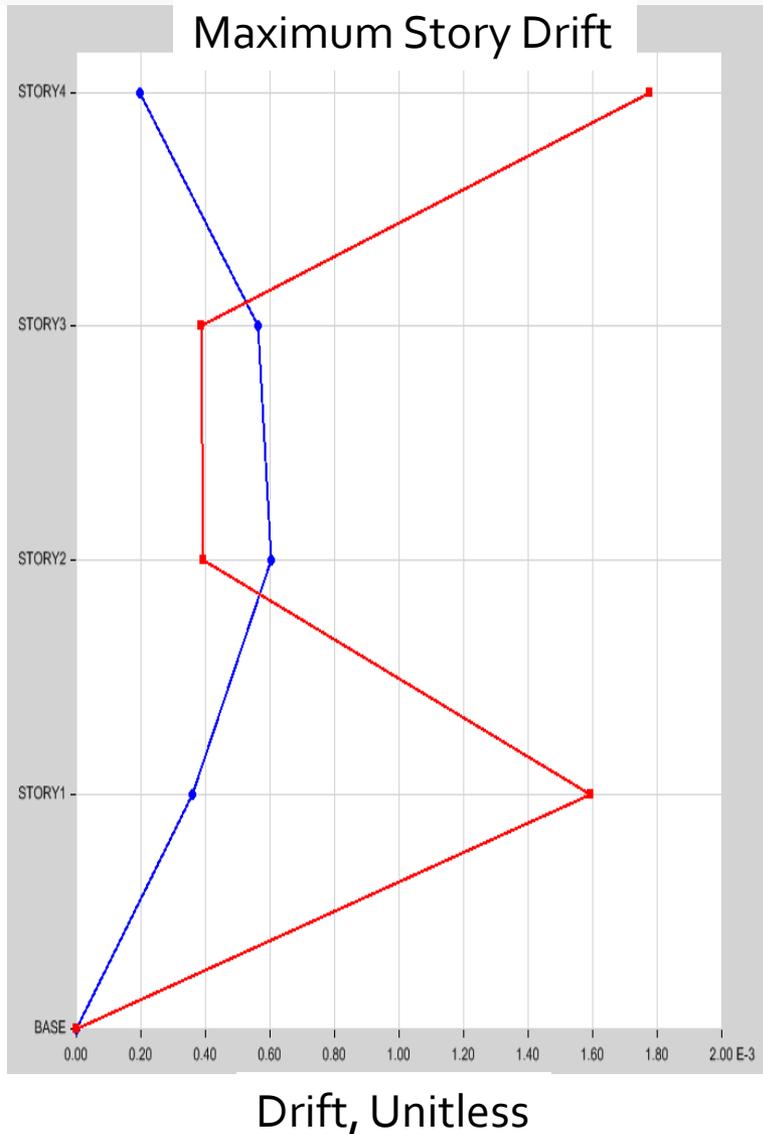
Cantilever - Etabs Modeling



Story Displacement

Maximum 0.5 in

Cantilever - Etabs Modeling

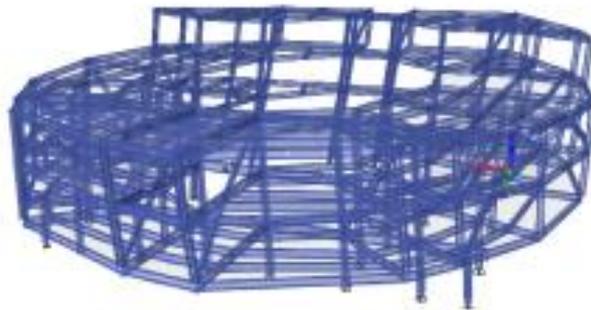


Interstory Drift Ratio

Maximum $1.78E-03$

Cantilever - Etabs Modeling

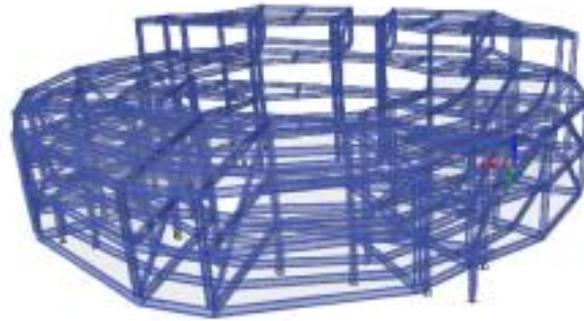
1st Mode



Torsion: $T = 0.406$ sec.

Cantilever - Etabs Modeling

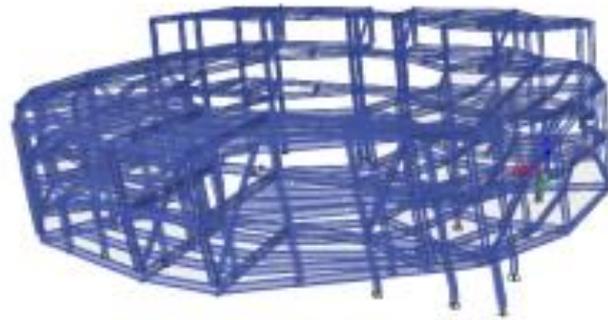
1st Mode



Y-Direction: $T = 0.371$ sec.

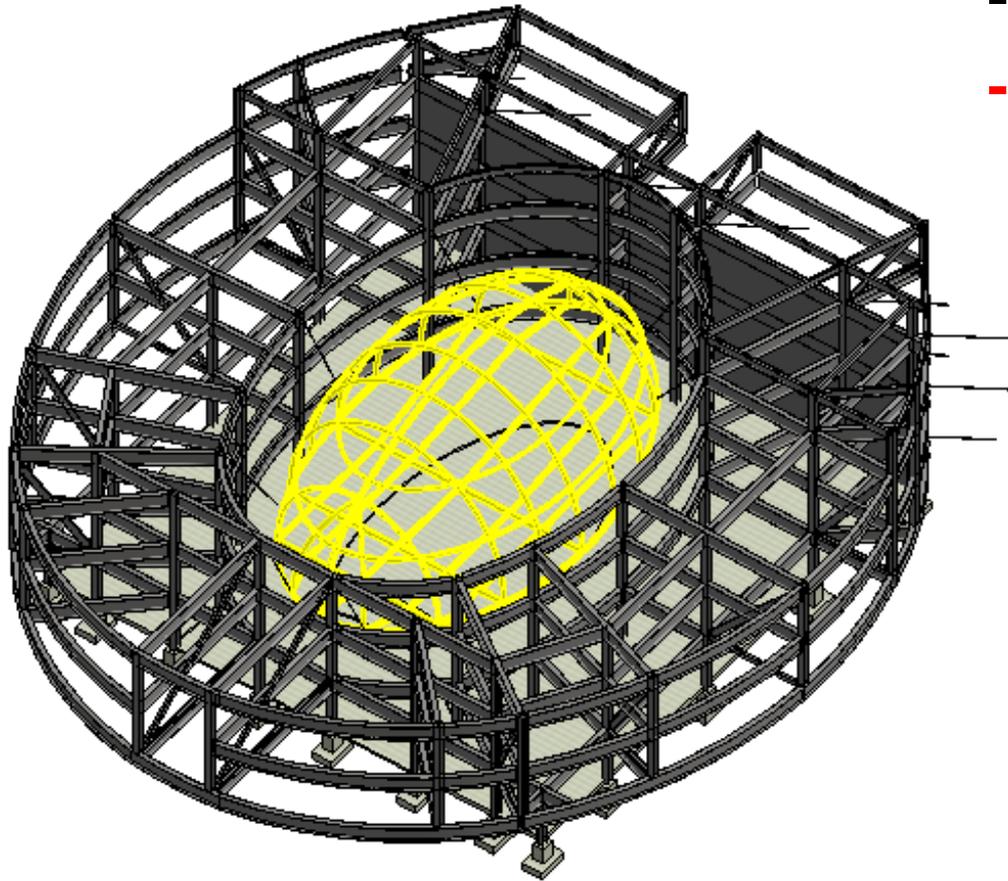
Cantilever - Etabs Modeling

1st Mode



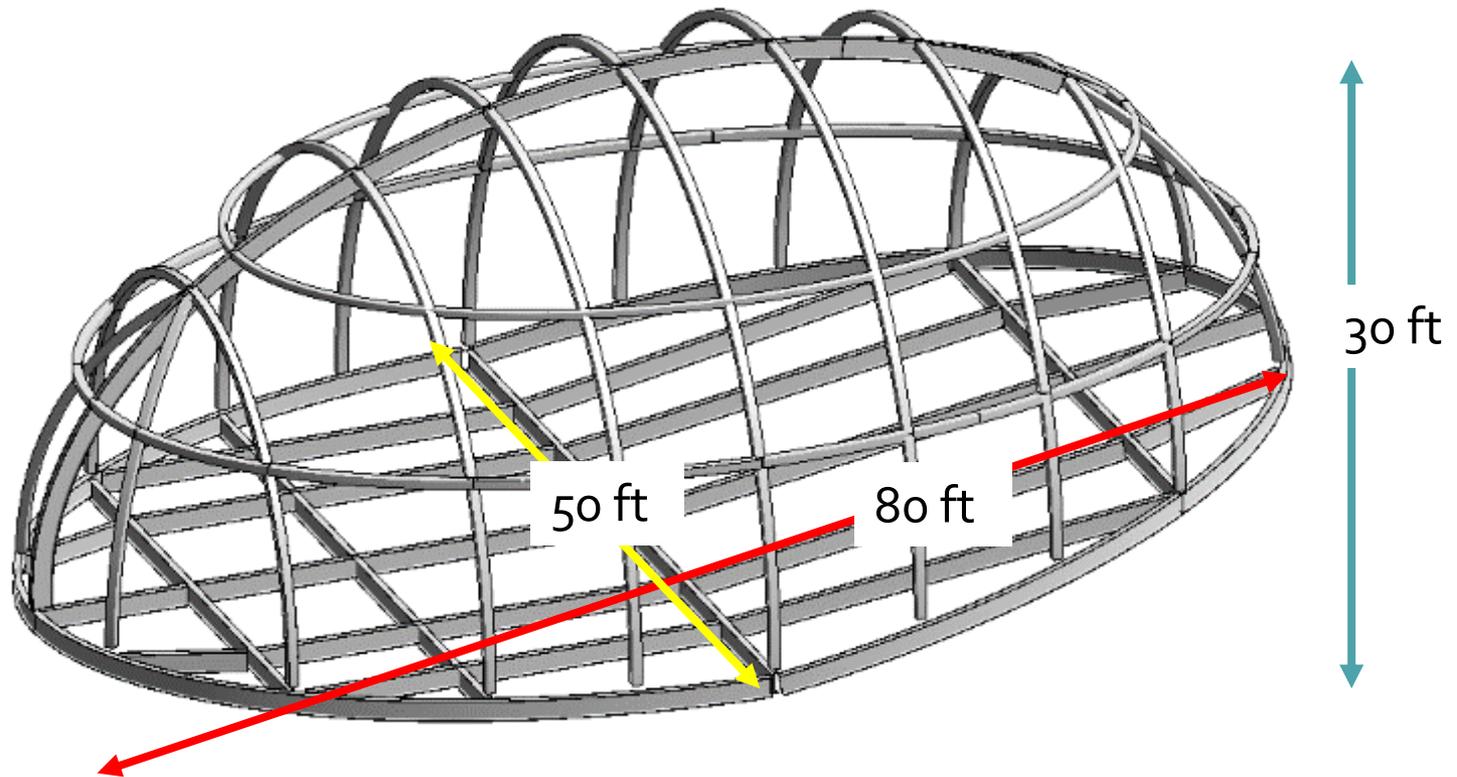
X-Direction: $T = 0.31$ sec.

Challenges

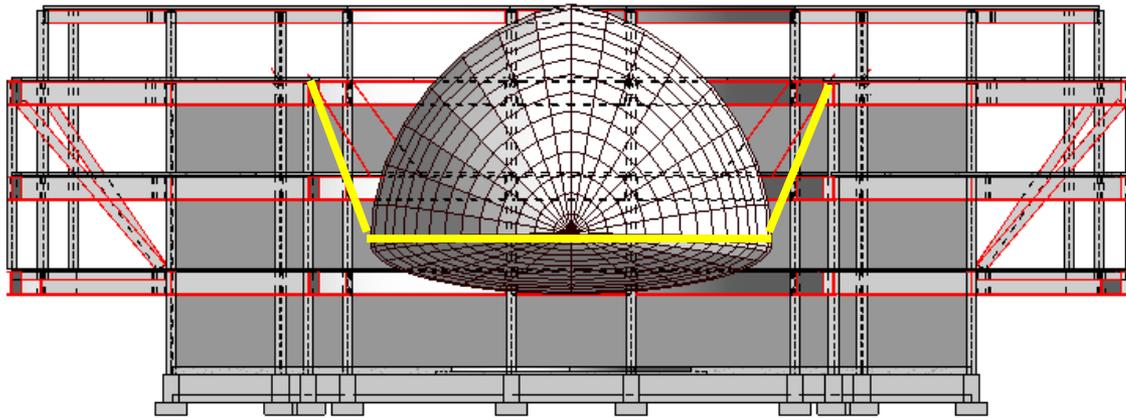


- Perimeter Cantilever
- **Auditorium**

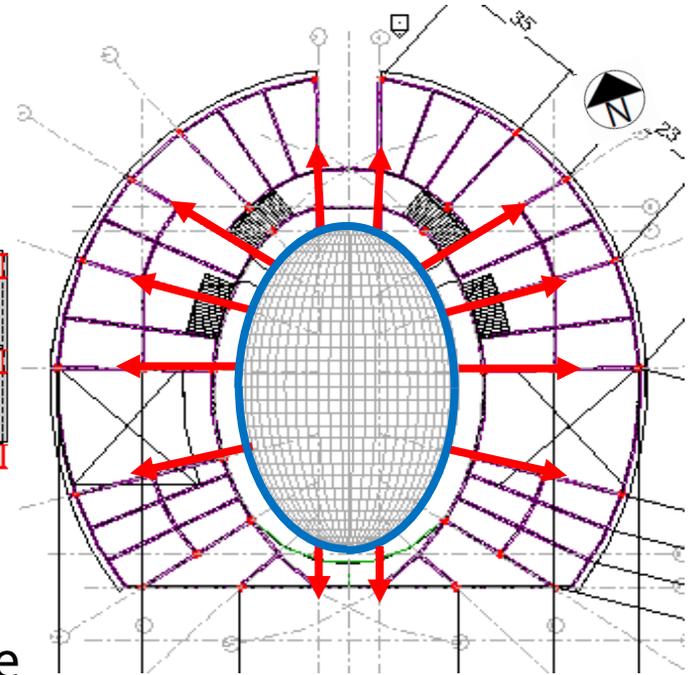
Auditorium



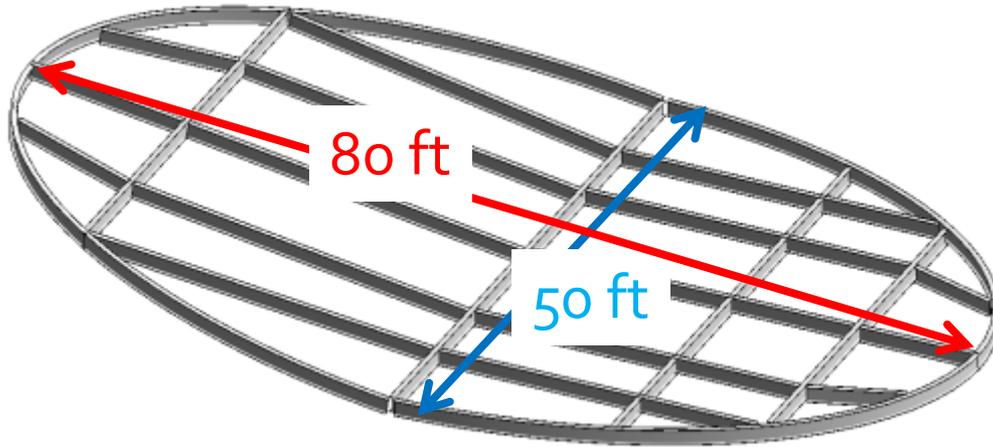
Auditorium



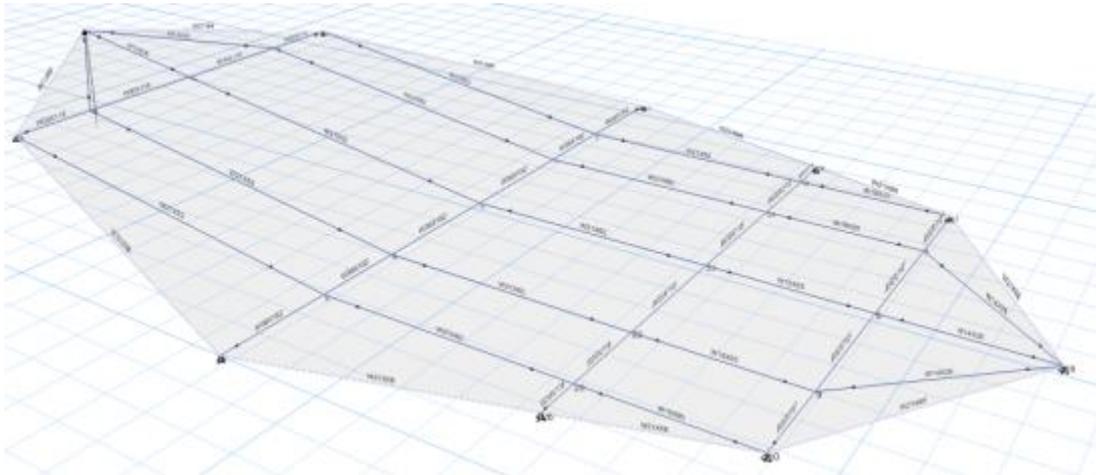
2 in Diameter Steel Cable



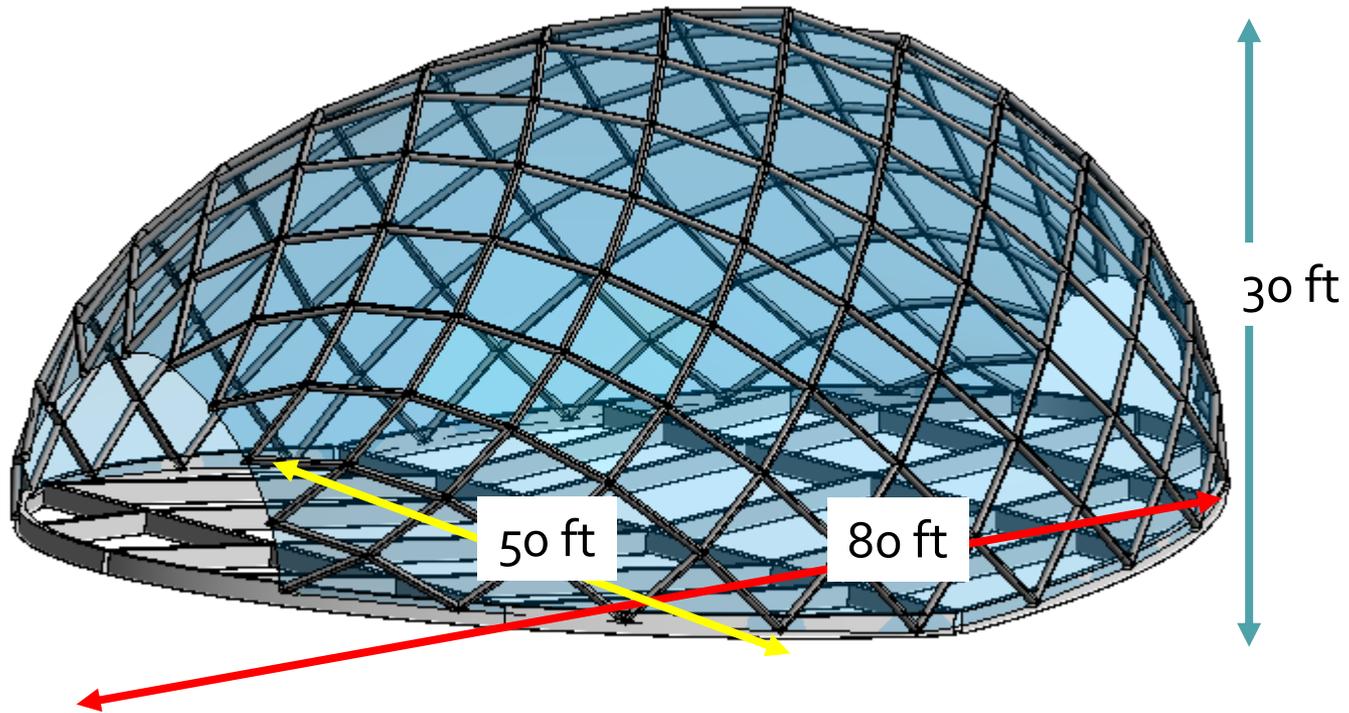
Auditorium – Lower Half



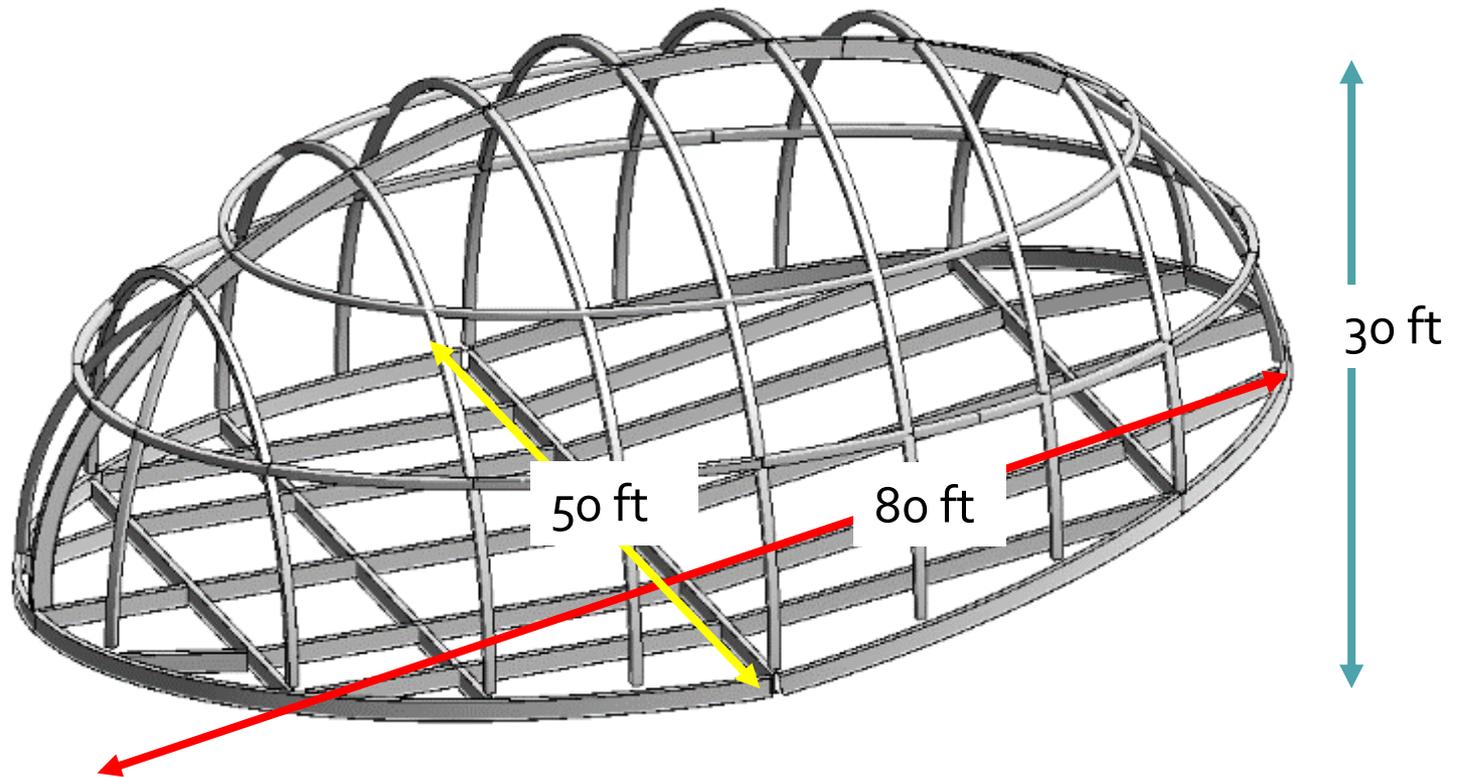
Girder: W30 x 108; W27 x 84
Beam: W21 x 62; W18 x 55;
W14 x 26
Max Deflection: 2 in



Auditorium

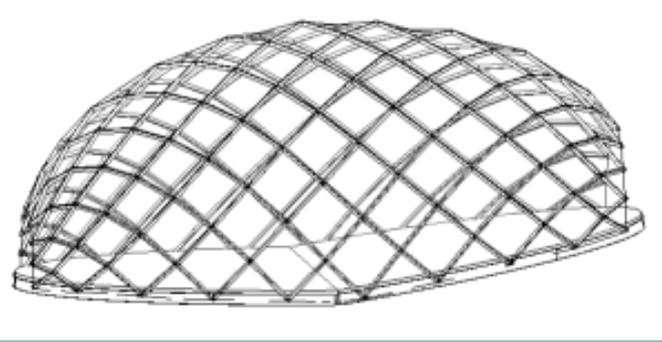
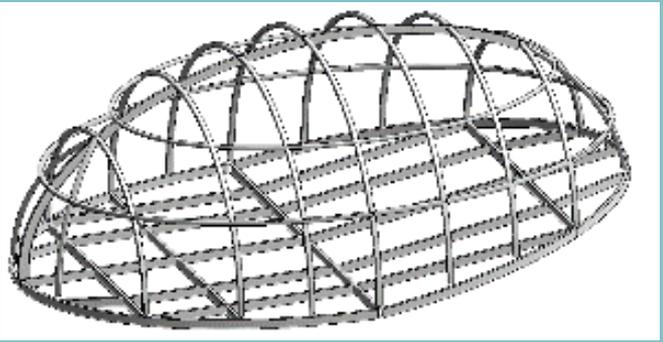


Auditorium

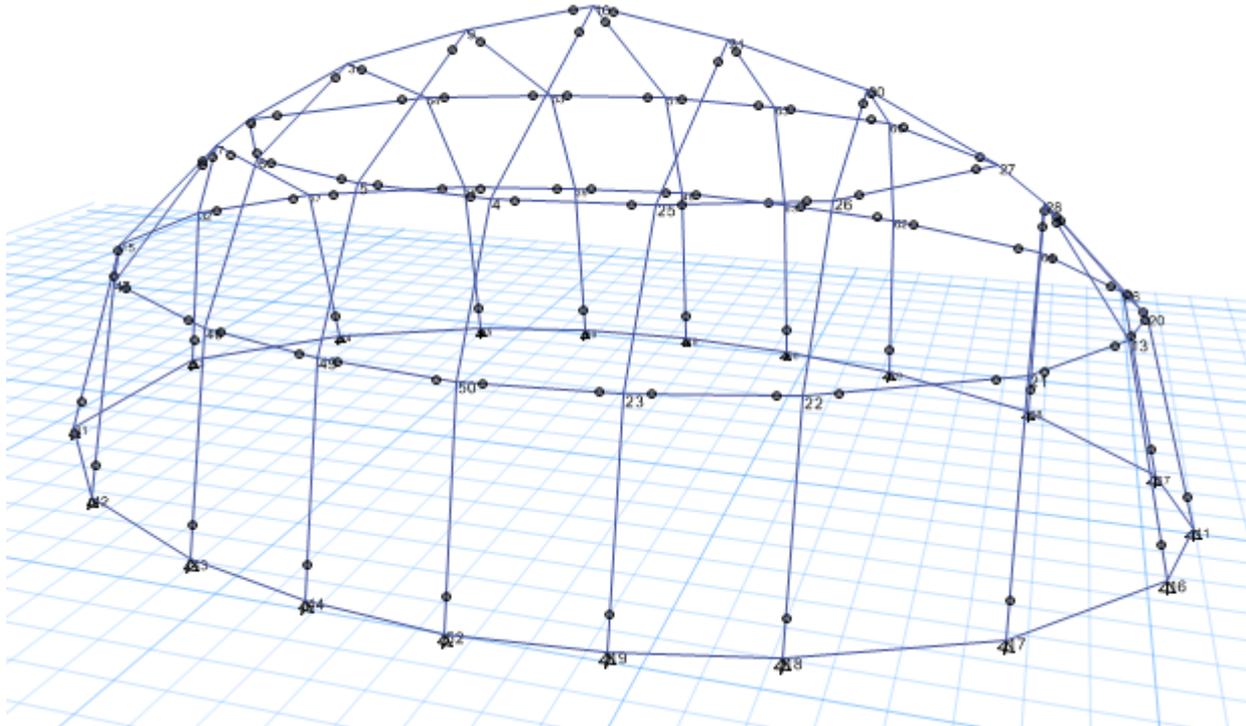


Auditorium – Upper Half

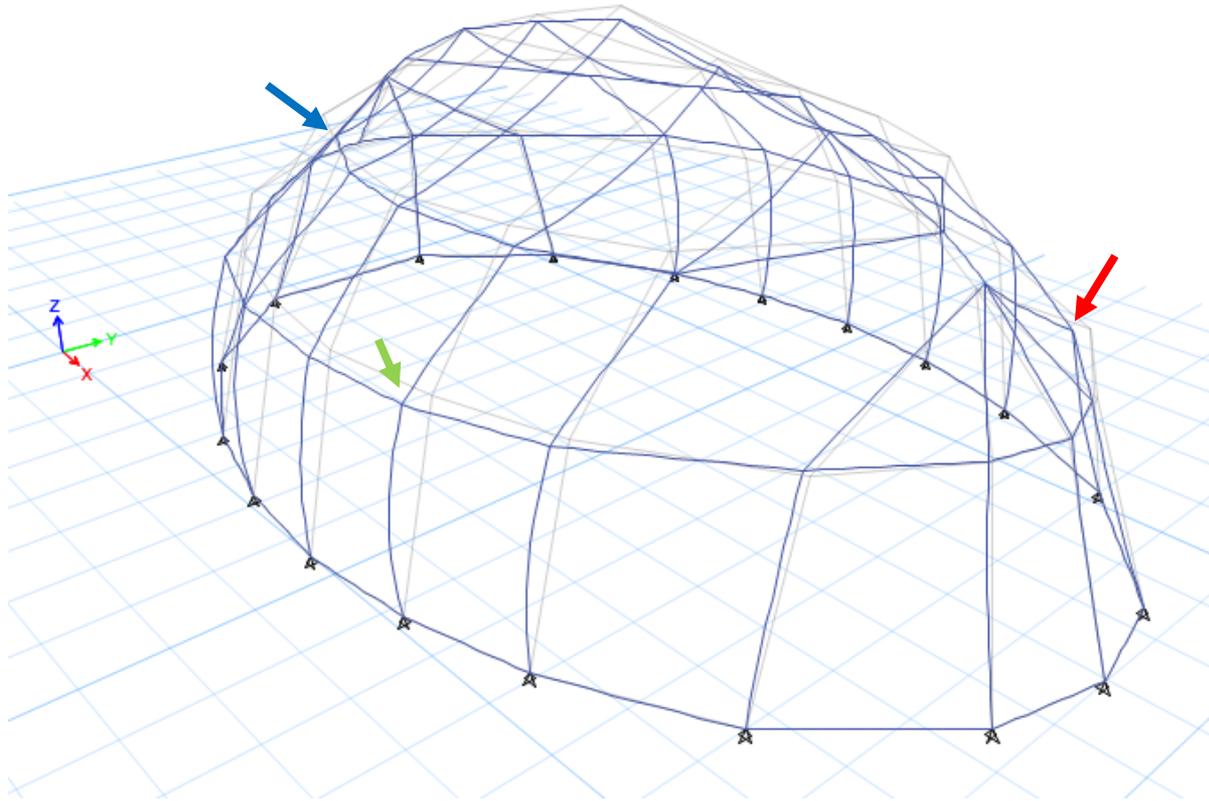
Comparisons

	Diagrid	Parallel
		
Pros	Aesthetics	Easier to Construct
Cons	May be hard to construct Cost	Buckling

Auditorium – Upper Half



Auditorium – Upper Half



Member Sizes

Center:

W14x61

Parallel:

HSS 7x5x1/8

Horizontal:

HSS 5x5x3/16

HSS 6x6x5/8

Max Deflections:

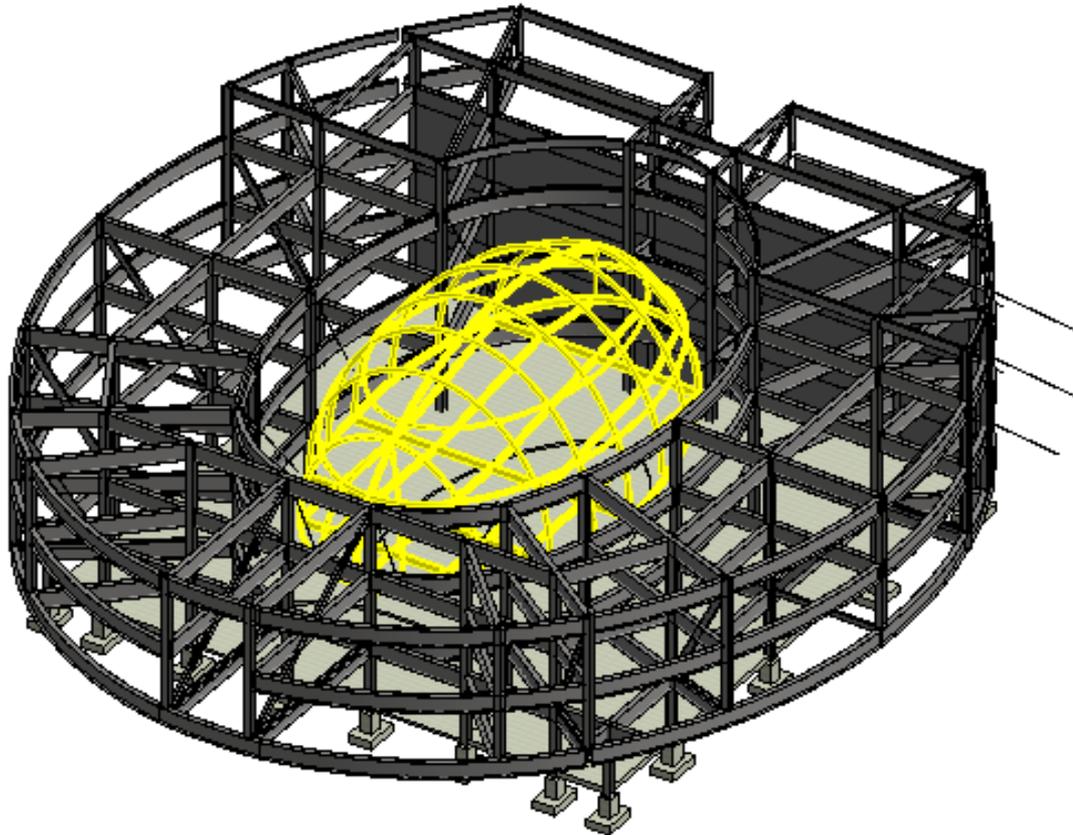
X: -0.27 in (node 61)

Y: -0.62 in (node 23)

Z: -0.46 in (node 6)

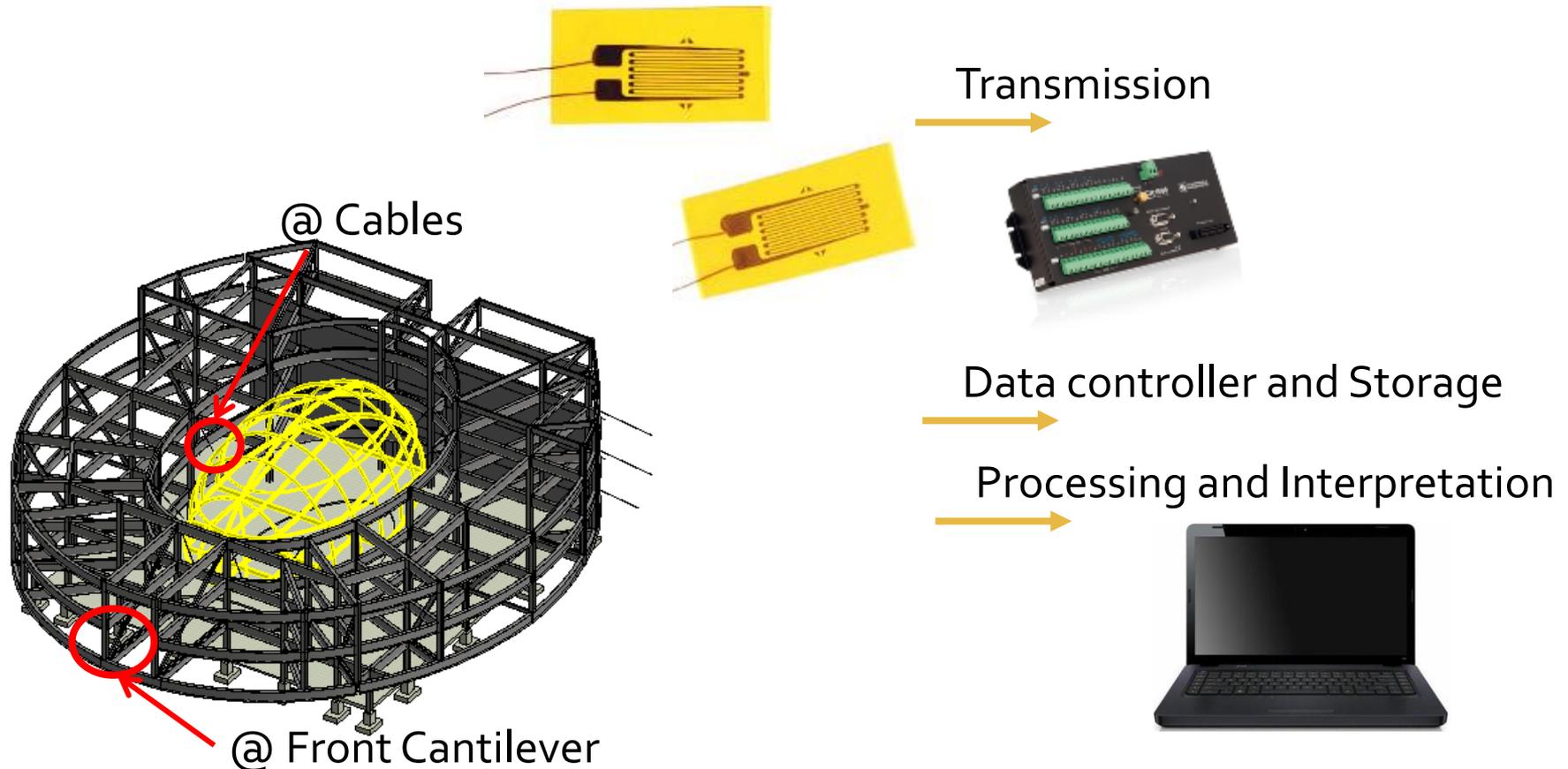
Healthy Building

1. Mentally - Structural solutions remind people to embrace the challenges

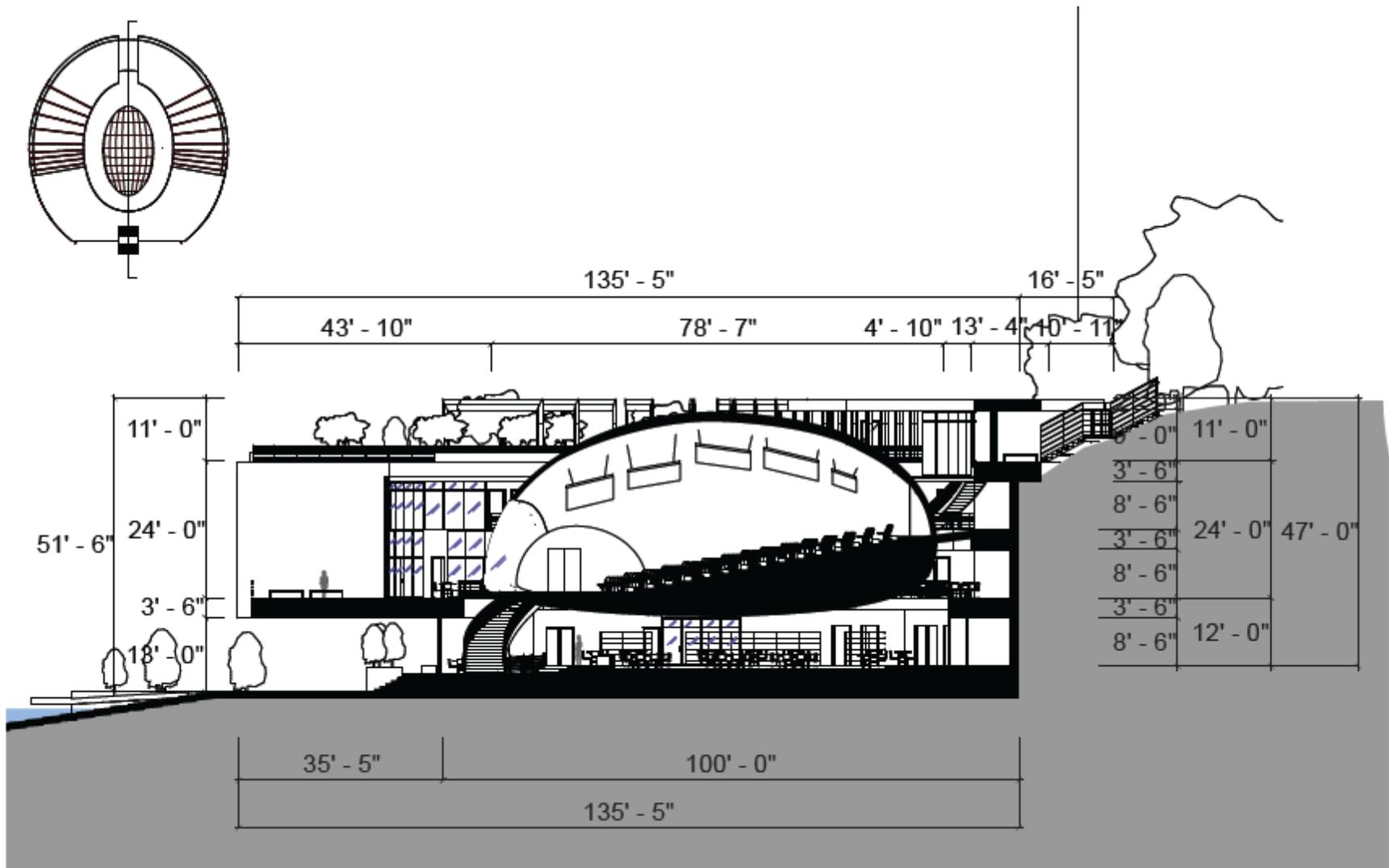


Healthy Building

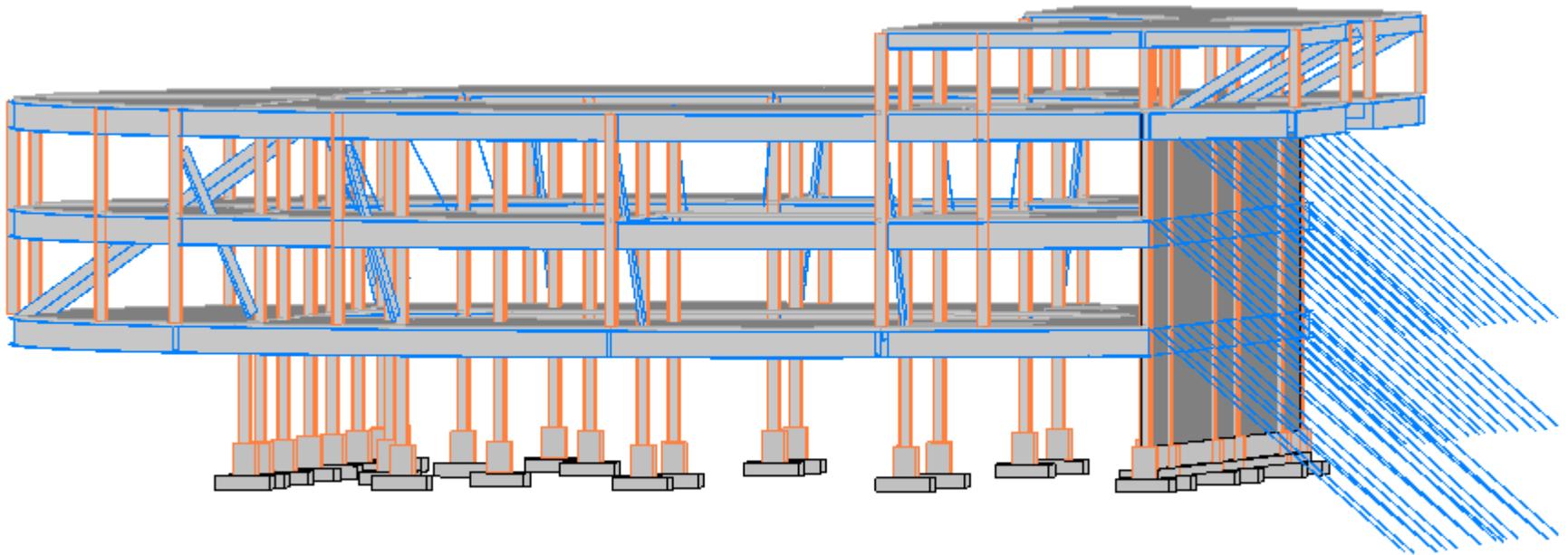
2. Physically – Structural health monitoring



Retaining Walls

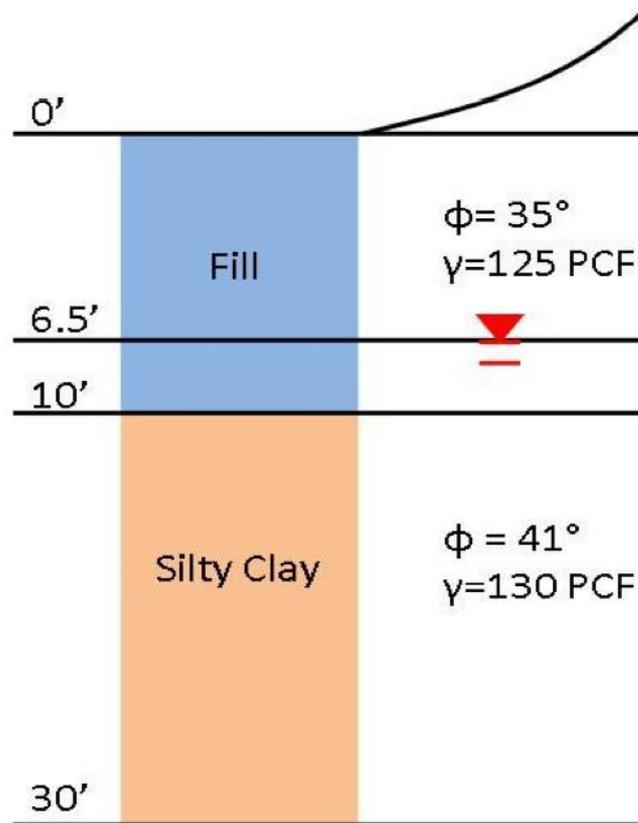


Retaining Walls





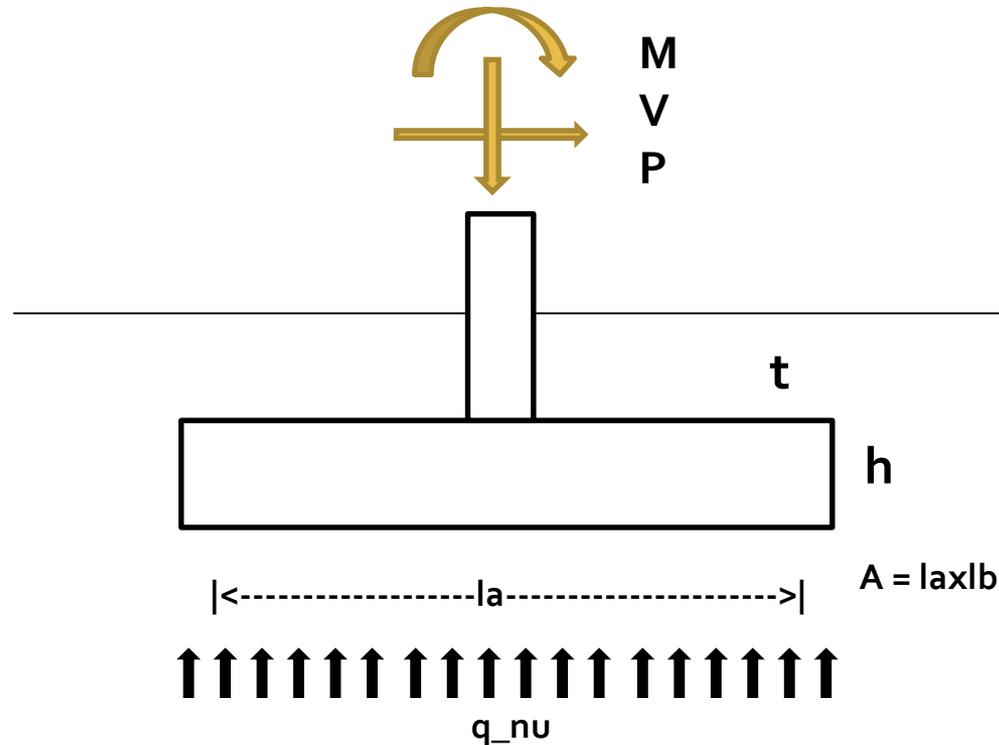
Foundation



$t + h = 3.08\text{ft} < 6.5 \text{ ft}$
Do not touch water table

Bearing Capacity: 4 ksf

Foundation



Soil Thickness: $t = 16$ in

Footing Thickness $h = 21$ in

Footing Width and Length: 6ft x 10ft

Jinzhi



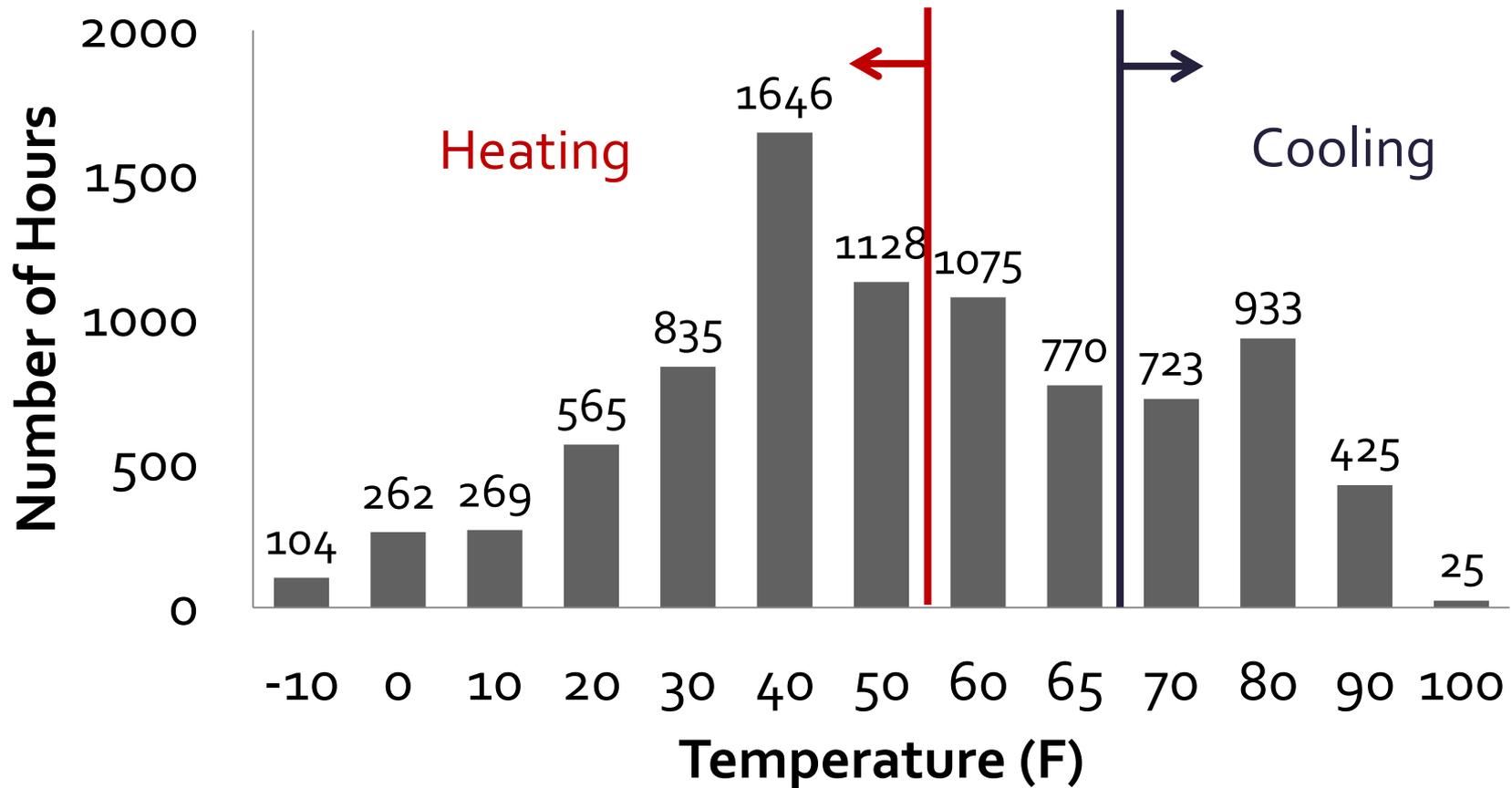
Eric



Mechanical

Challenges - Temperature

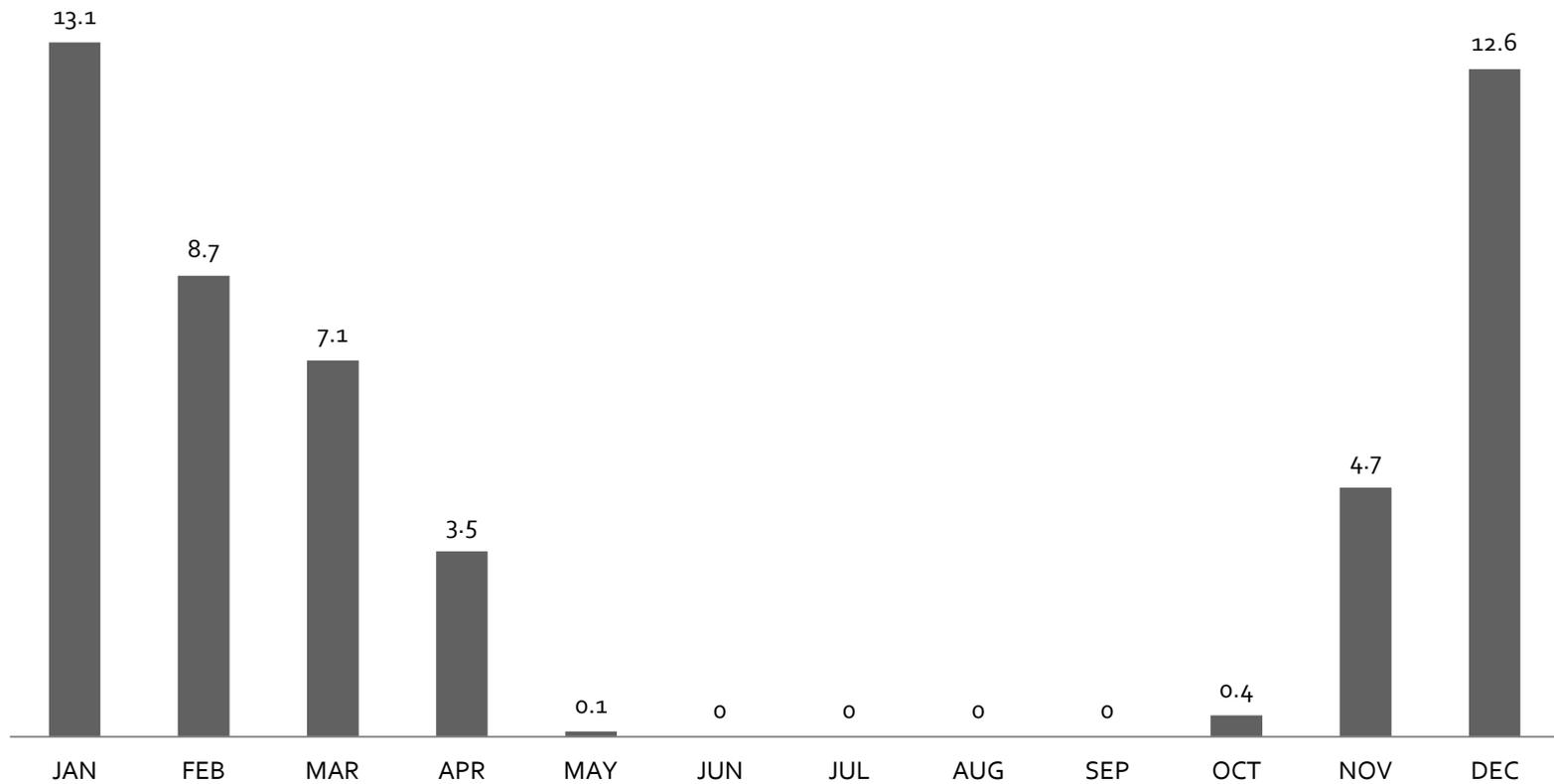
Distribution of Air Temperatures in Madison



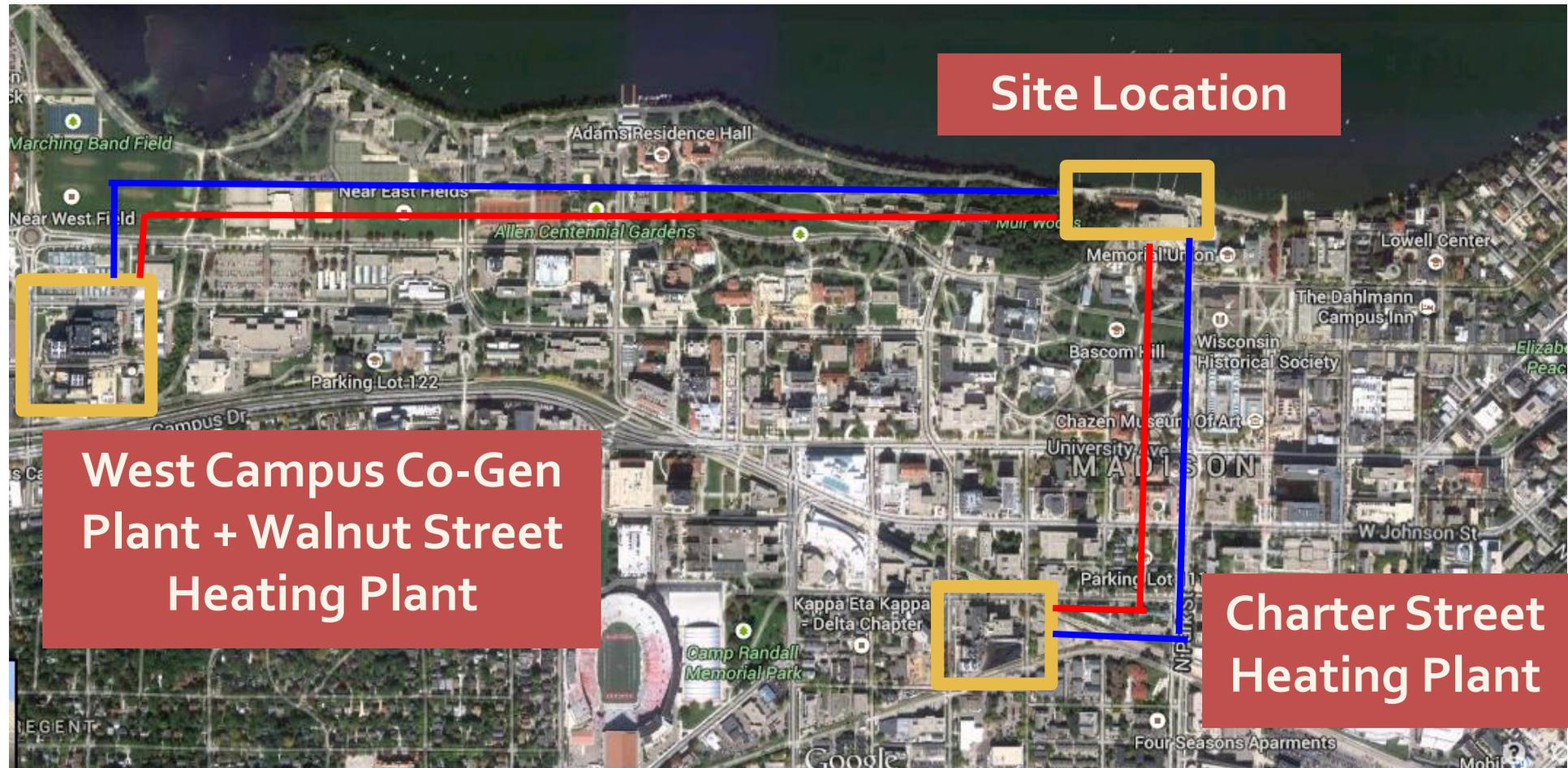
Challenges - Winter

Snowfall (in)

■ Snowfall (in)



Campus Energy



Site Location

West Campus Co-Gen Plant + Walnut Street Heating Plant

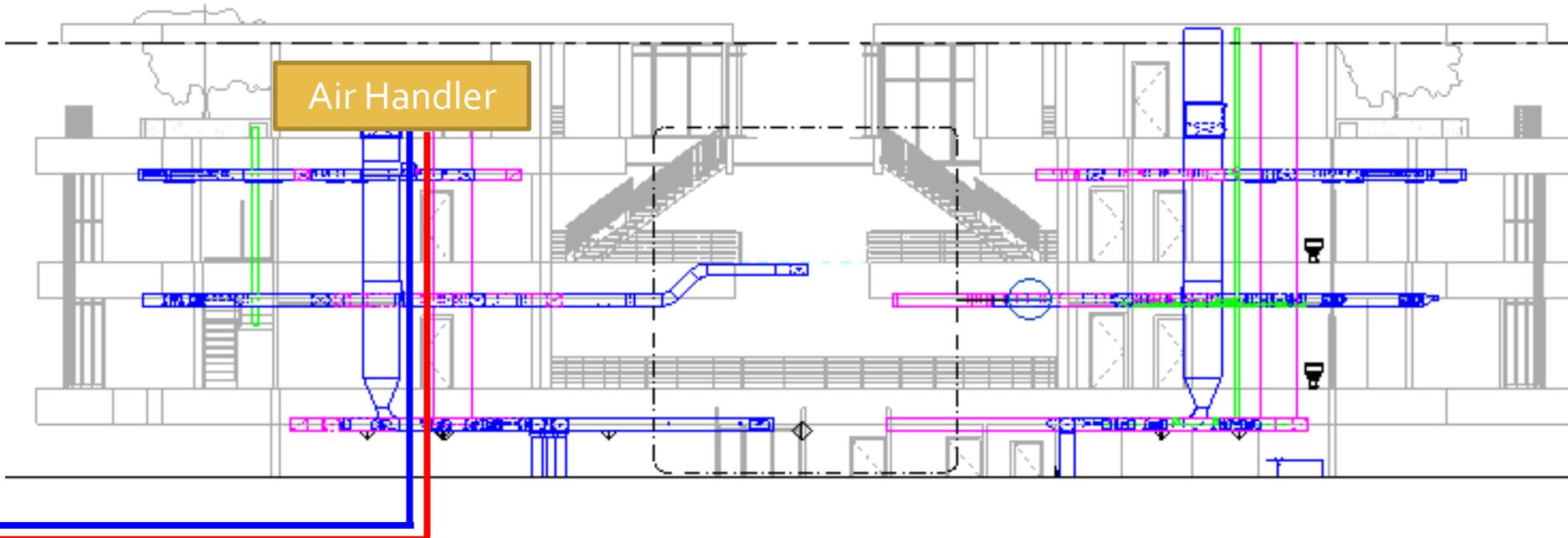
Charter Street Heating Plant

Building System Scope

Secondary Systems: Air Handler Unit, Fans, Ducts

Return
Supply
Exhaust

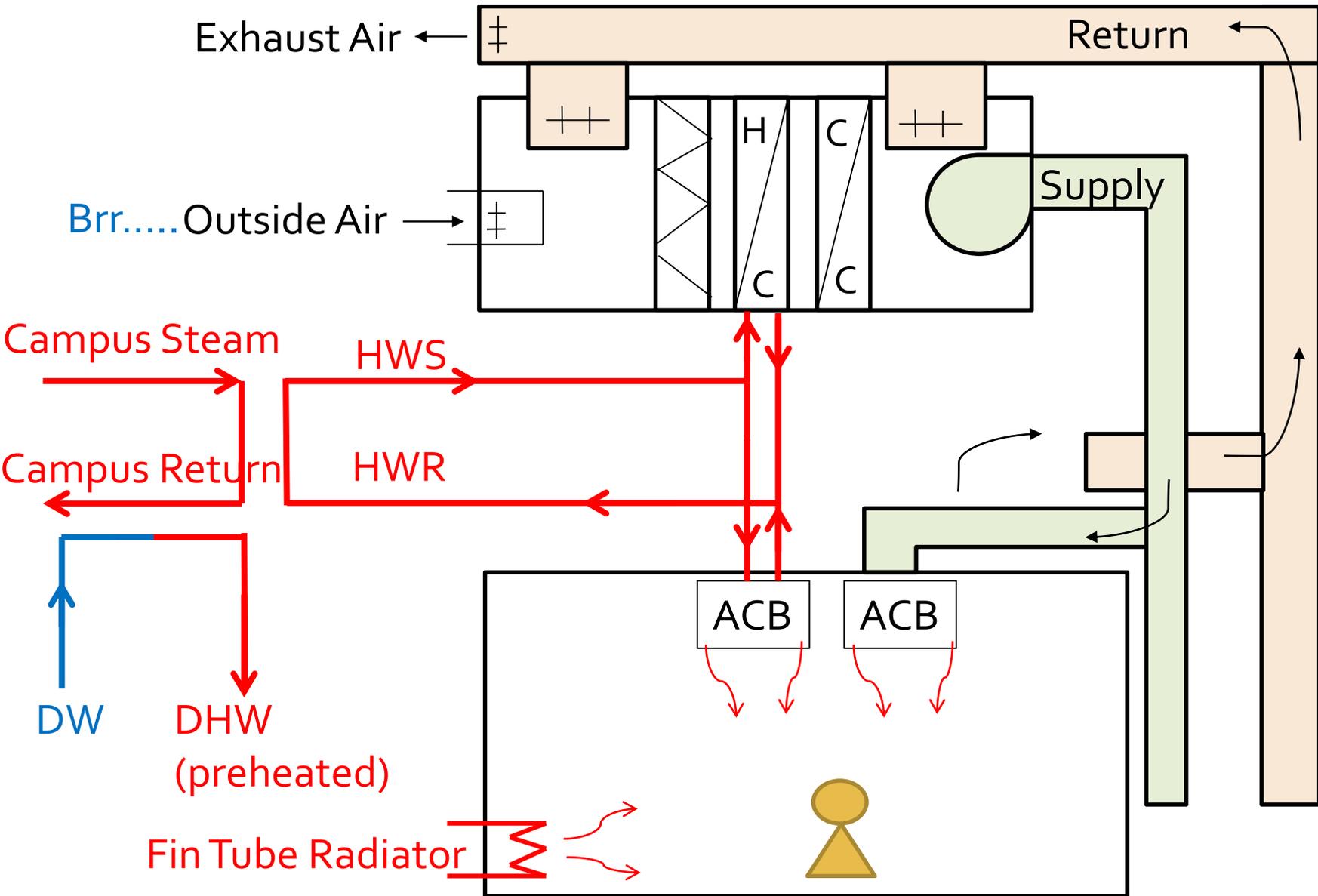
Air Handler



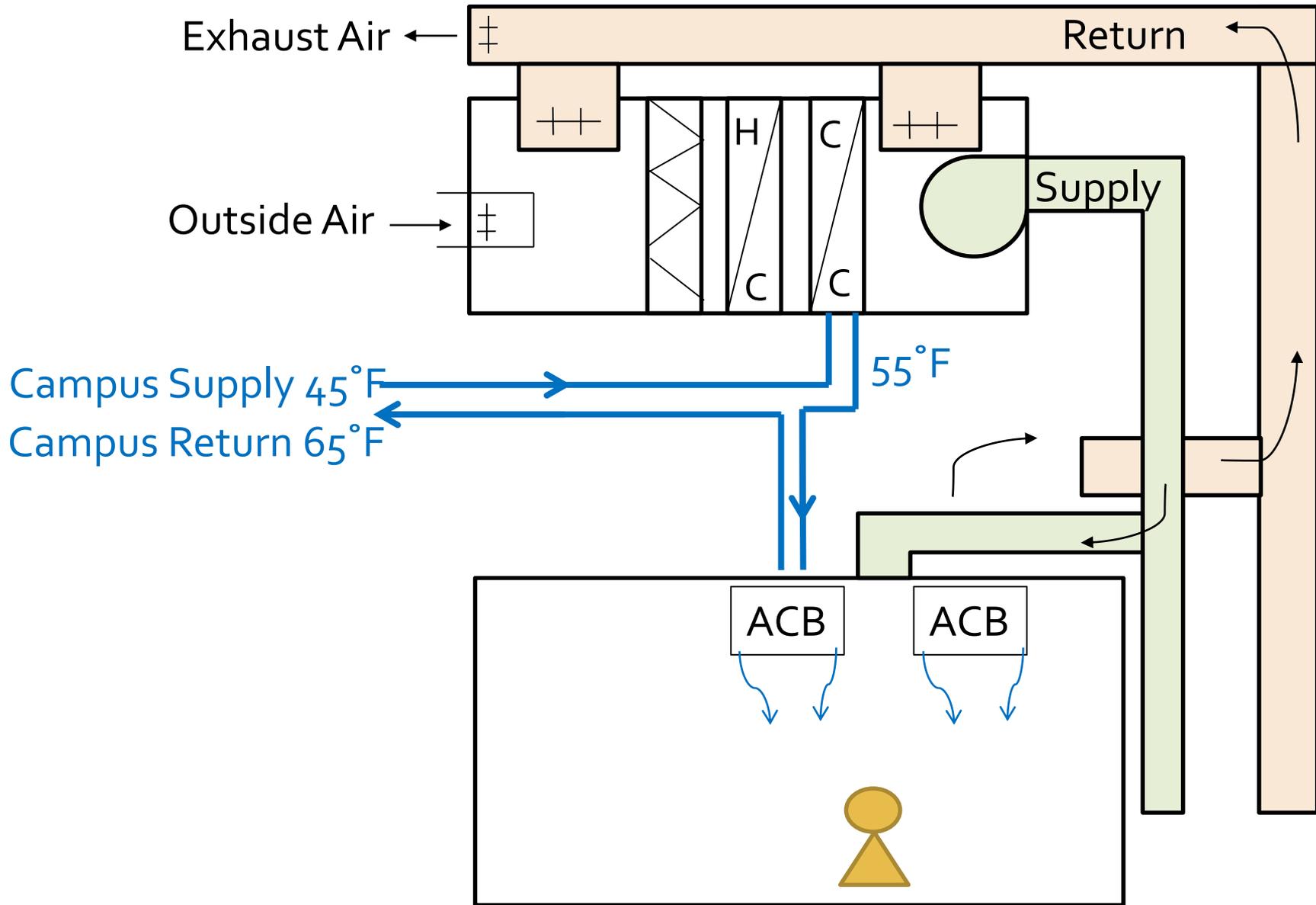
Primary System: Chilled Water, Steam

Terminal Systems: Active Chilled Beams, HW Radiators

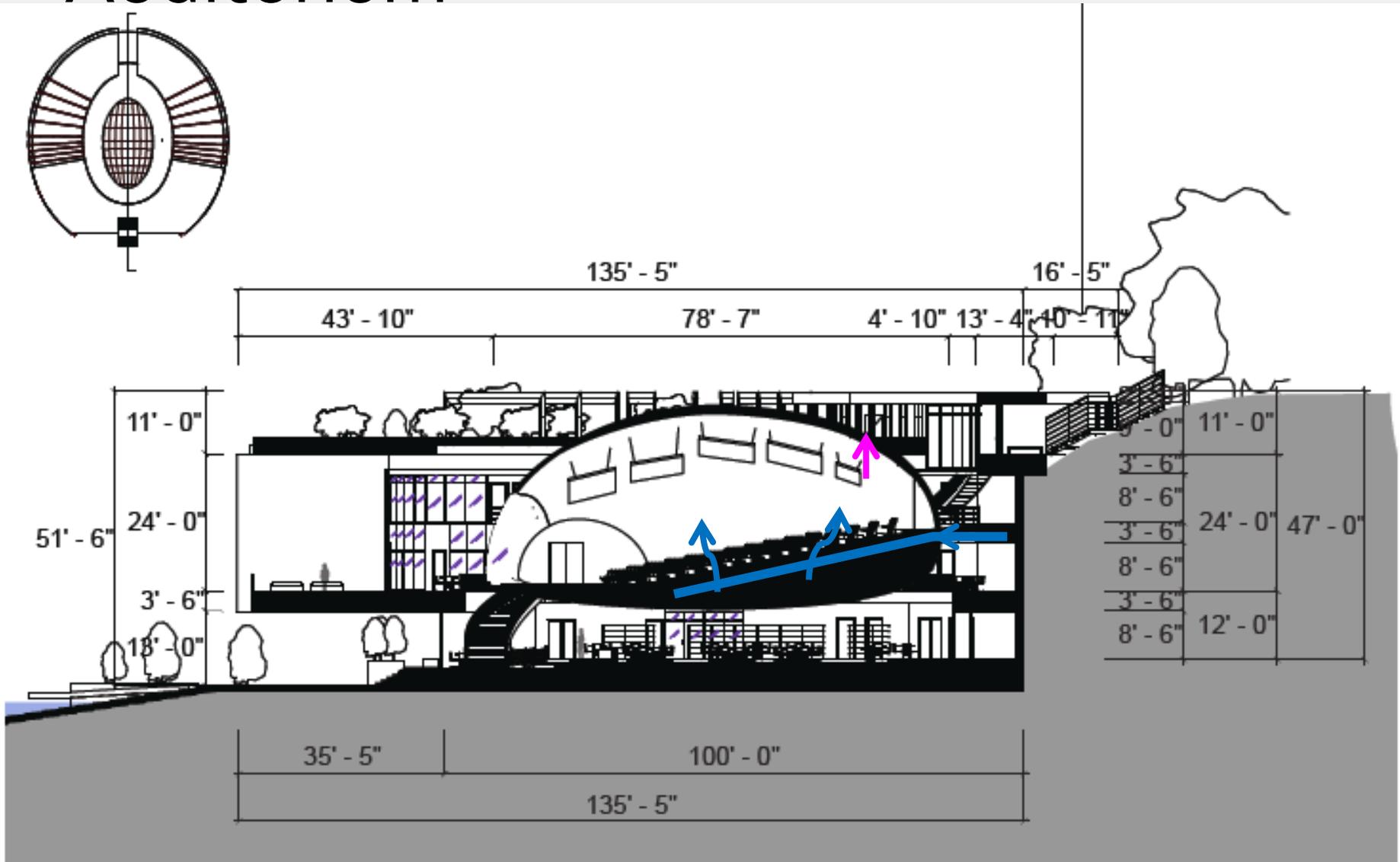
Heating Mode



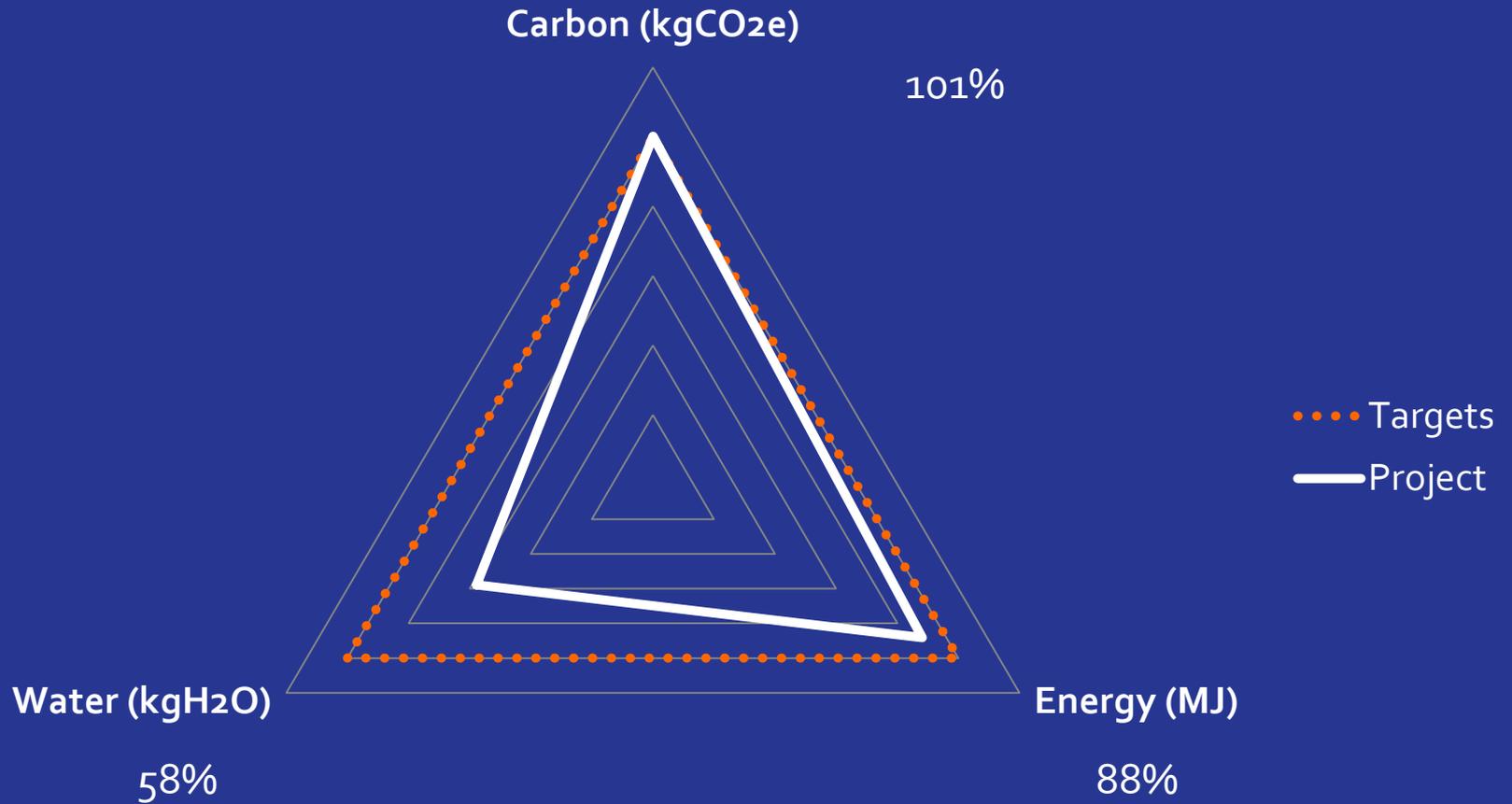
Cooling Mode



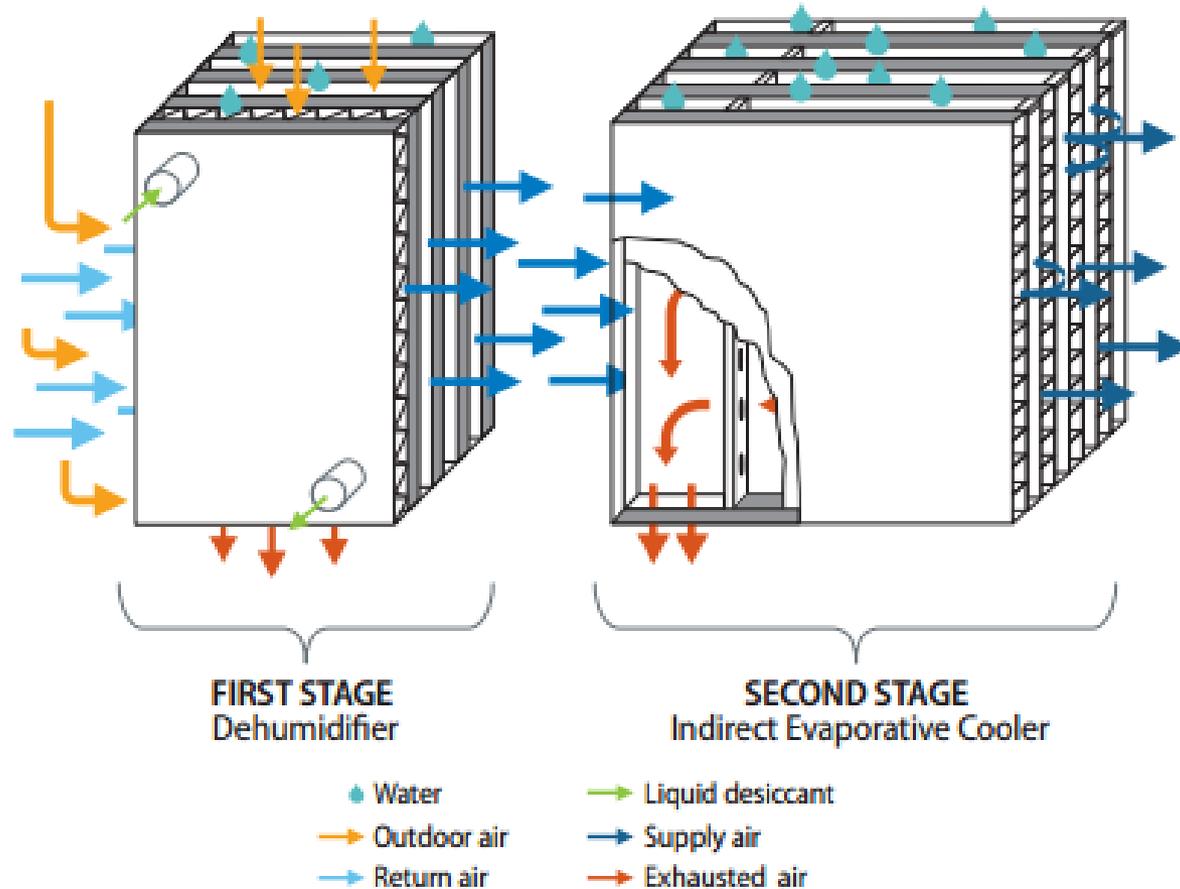
Auditorium



Sustainable Target Values



Dessicant Cooling with DEVap



Dessicant Cooling with DEVap

Liquid Desiccant

Indirect Evaporative Cooling

Exhaust Air ←

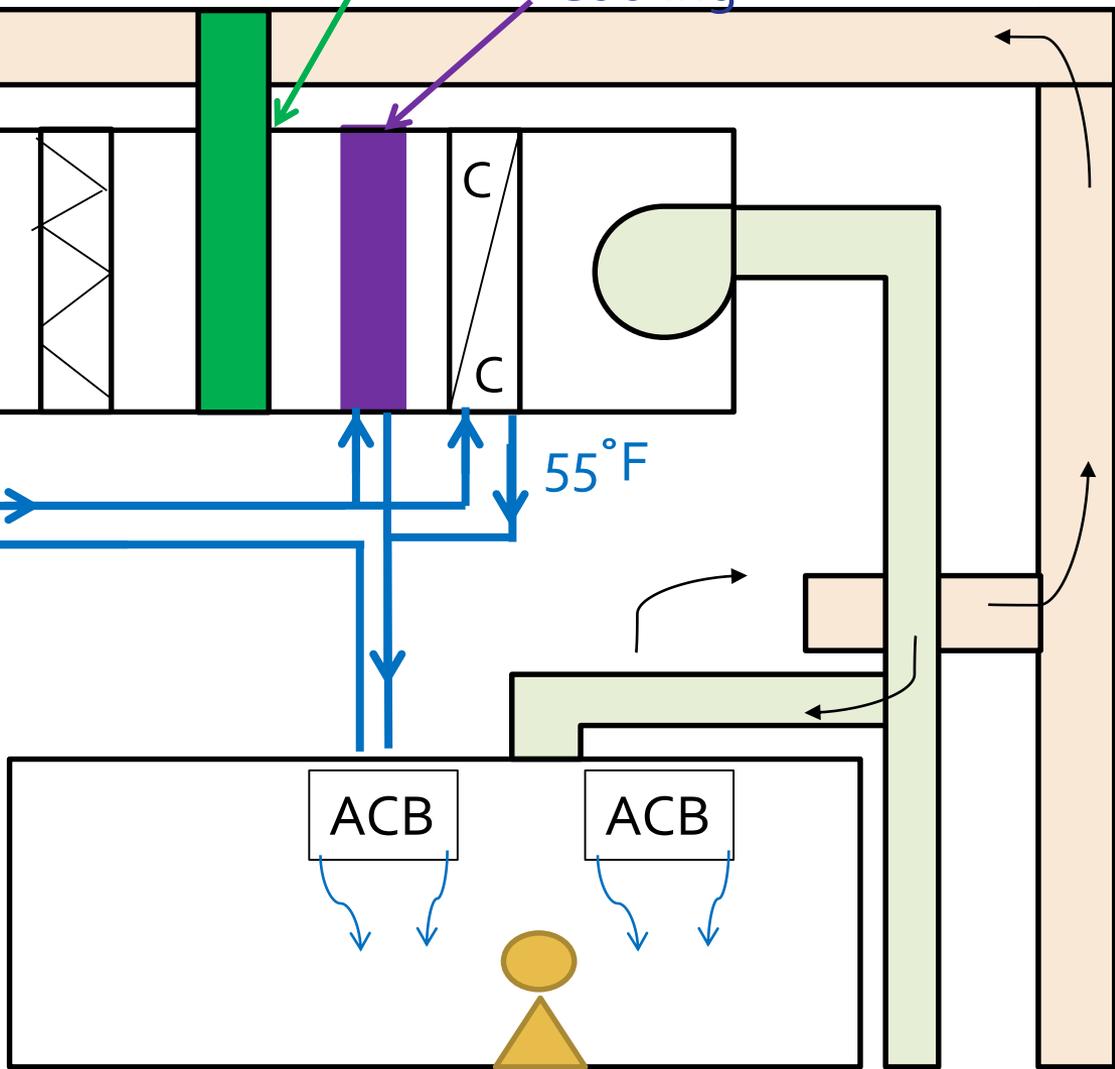
Outside Air →

Campus Supply 45°F
Campus Return 65°F

55°F

ACB

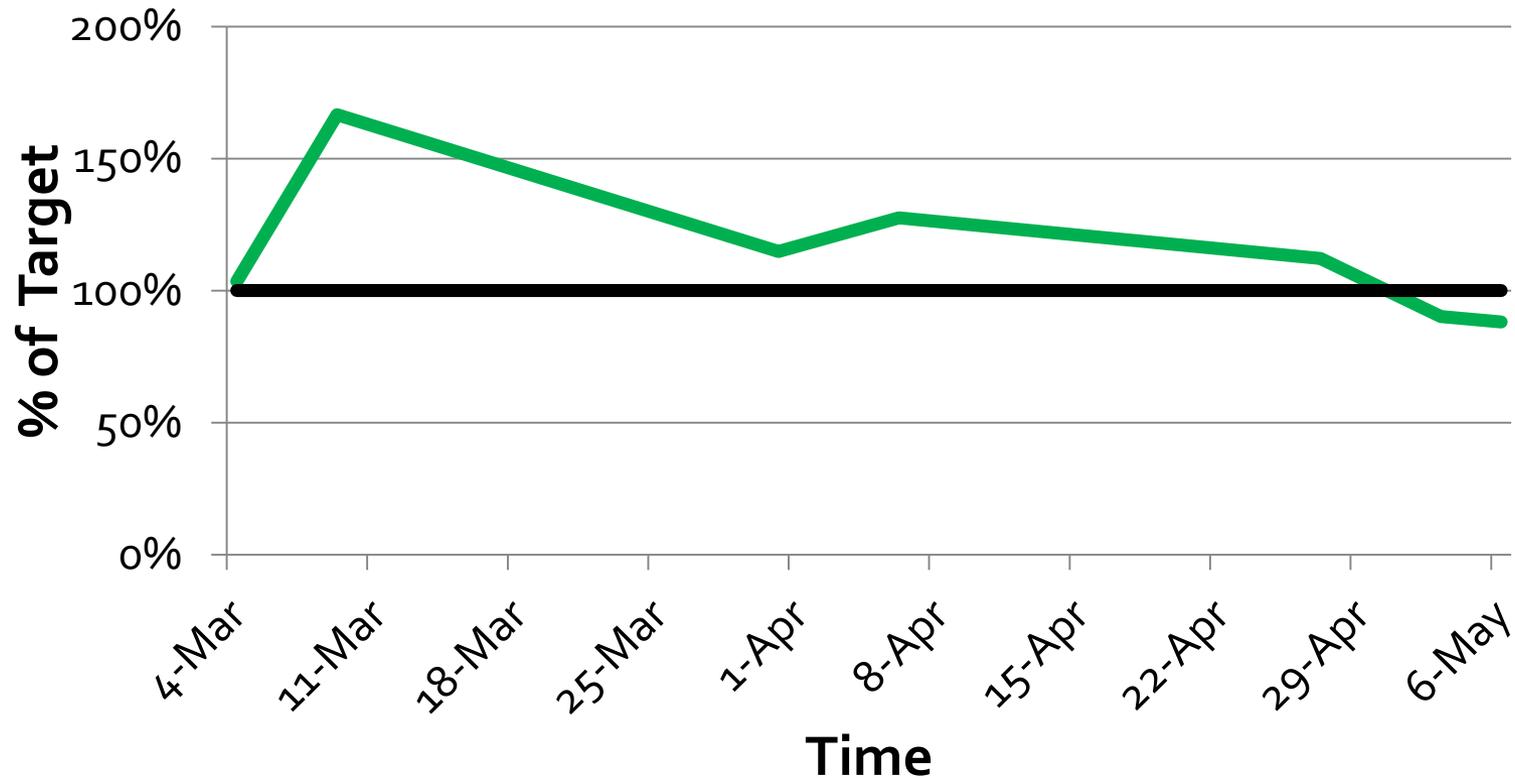
ACB



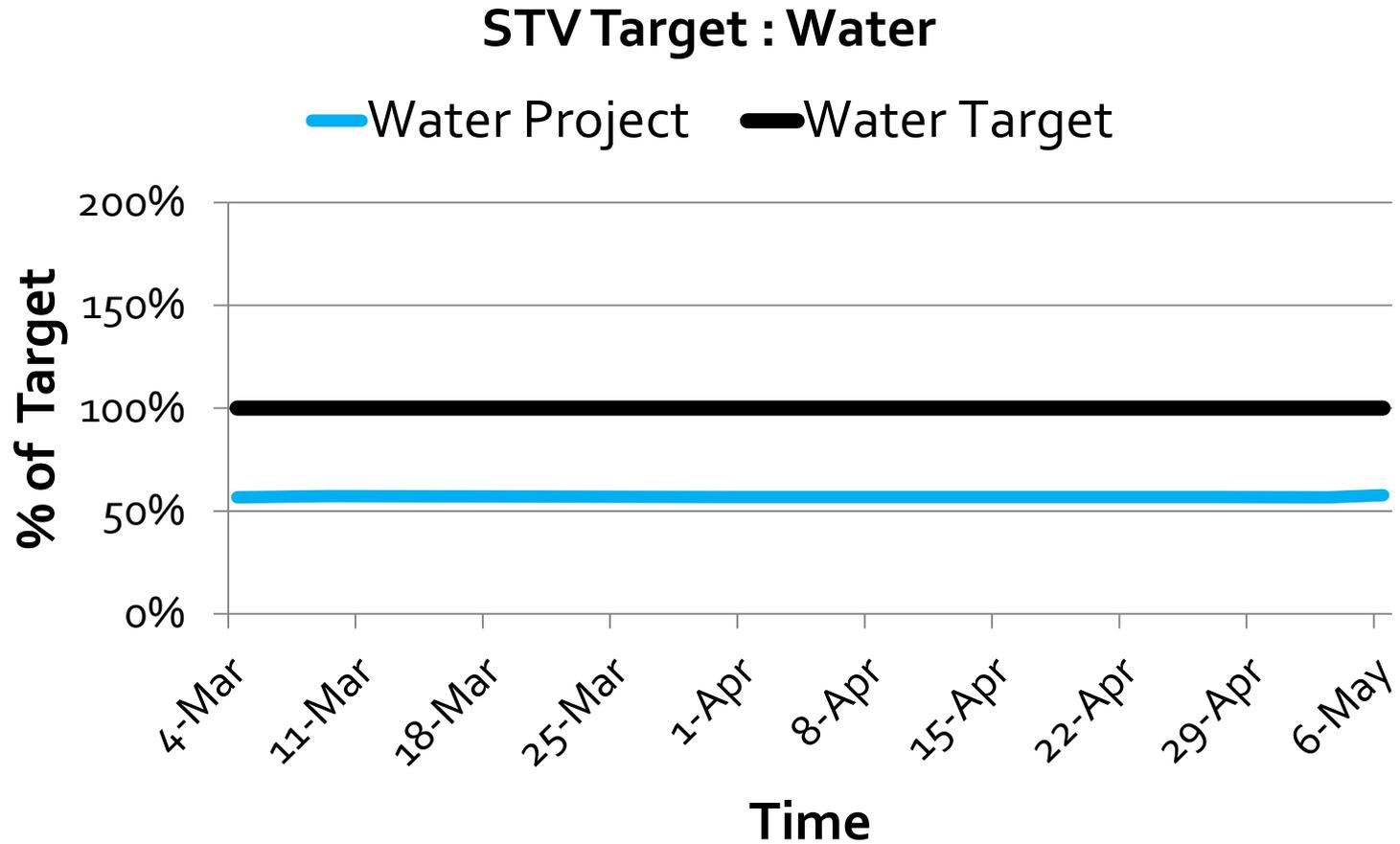
Sustainable Target Values

STV Target : Energy

— Energy Project — Energy Target



Sustainable Target Values

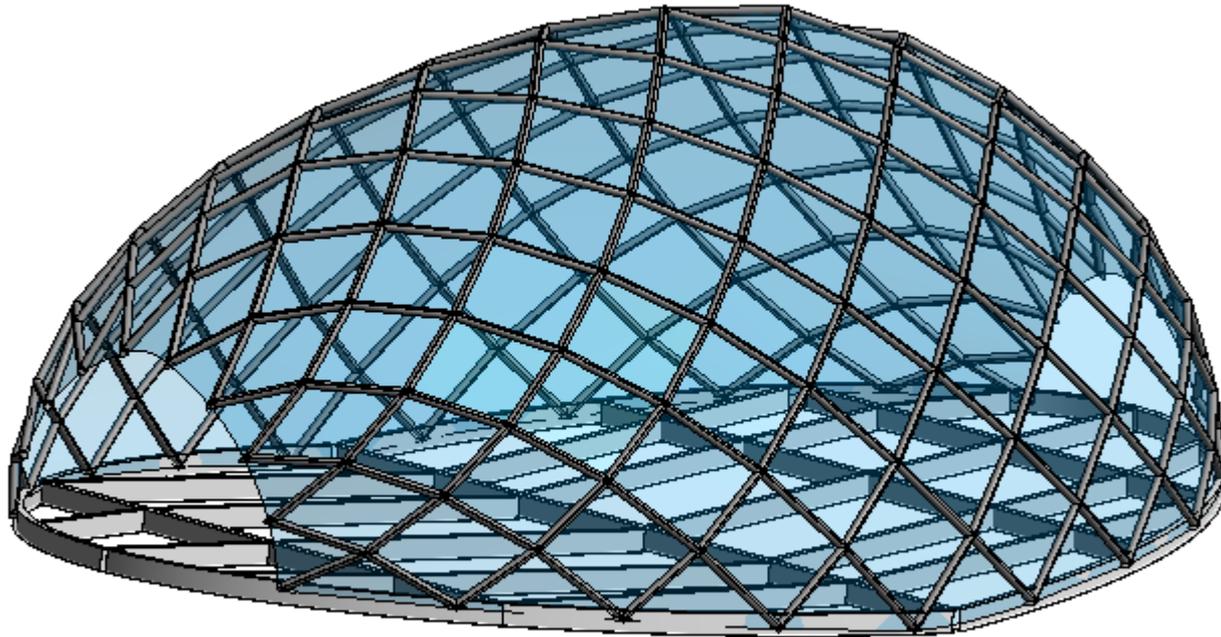


Calera Cement

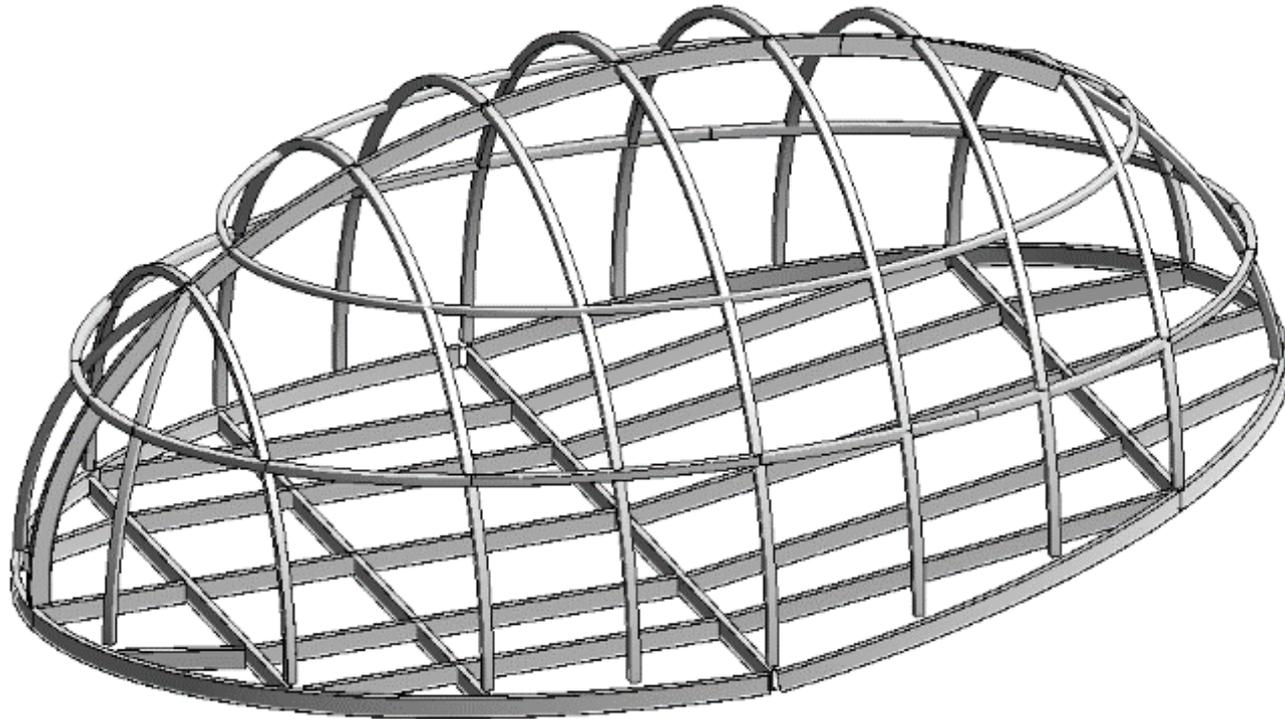
THE PROCESS



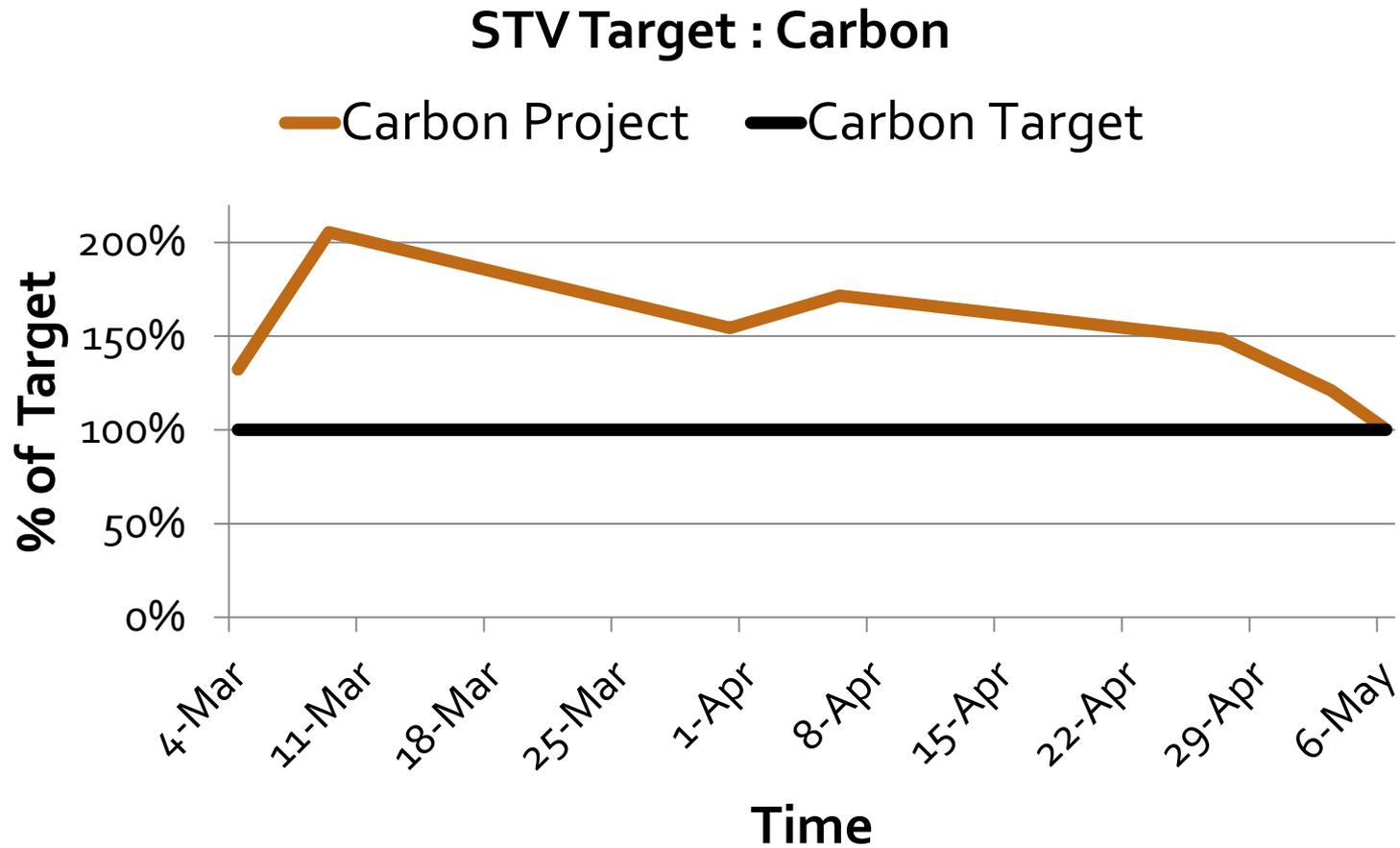
Auditorium - Before



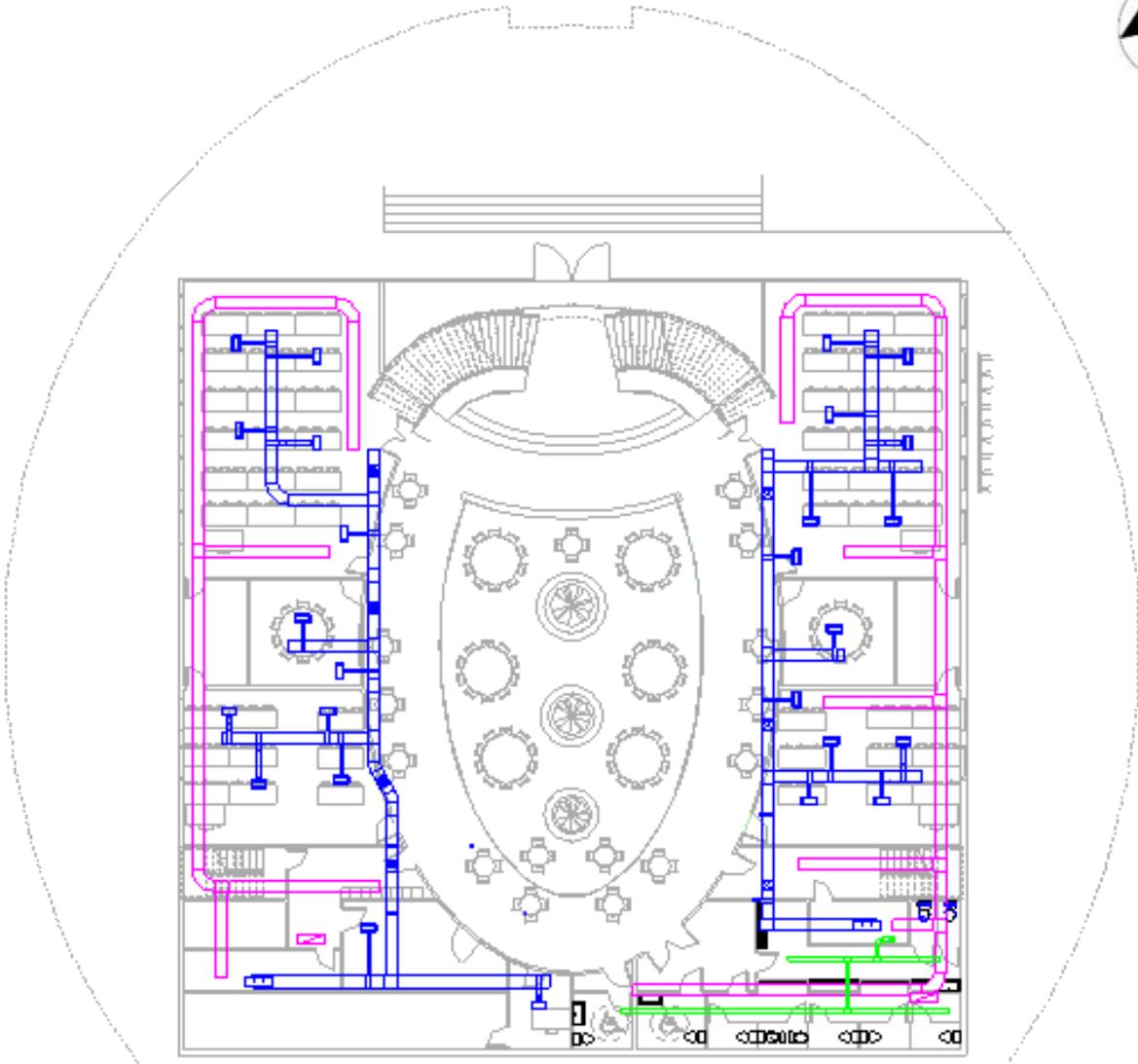
Auditorium - After



Sustainable Target Values

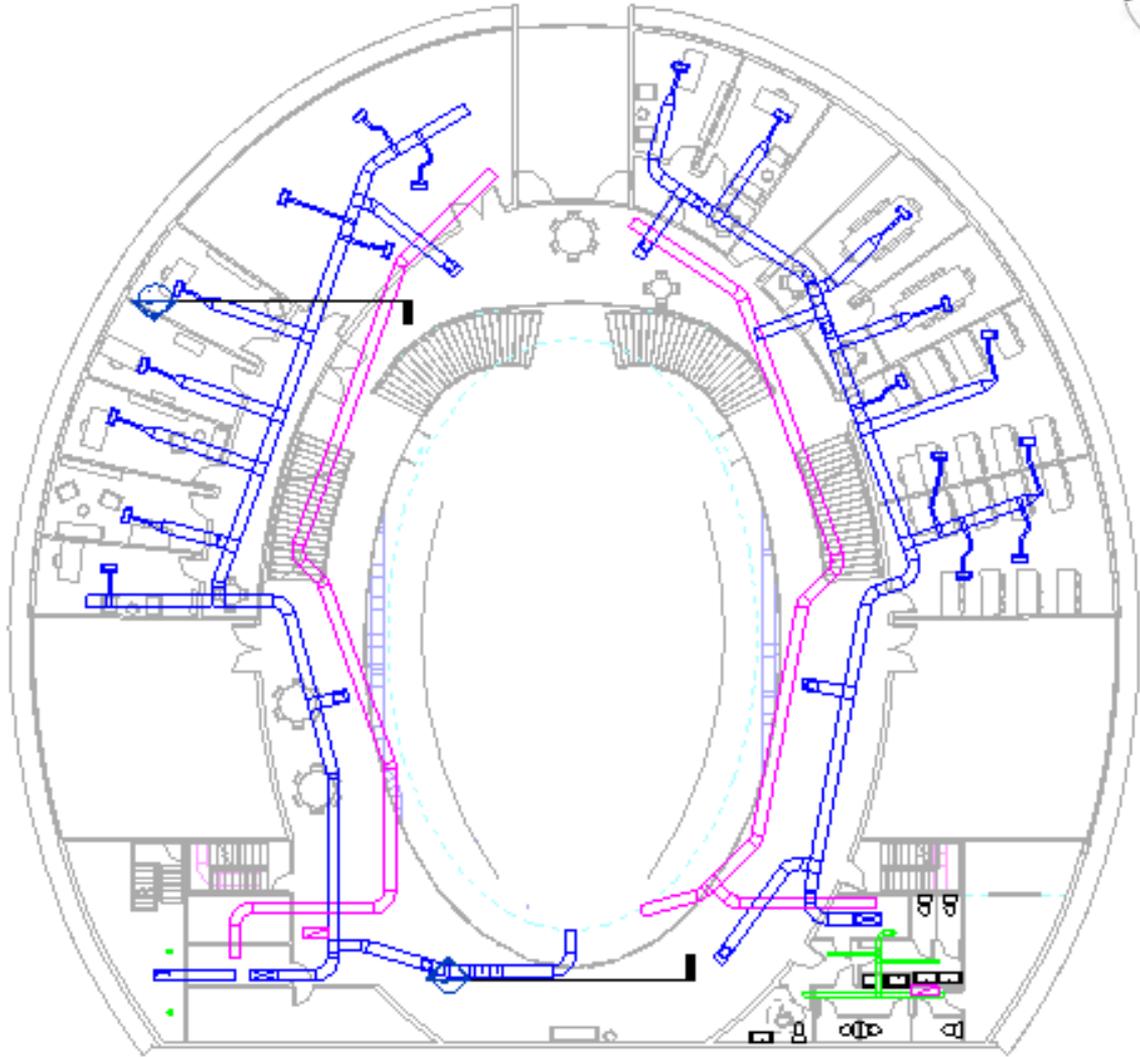


Distribution Floor 1



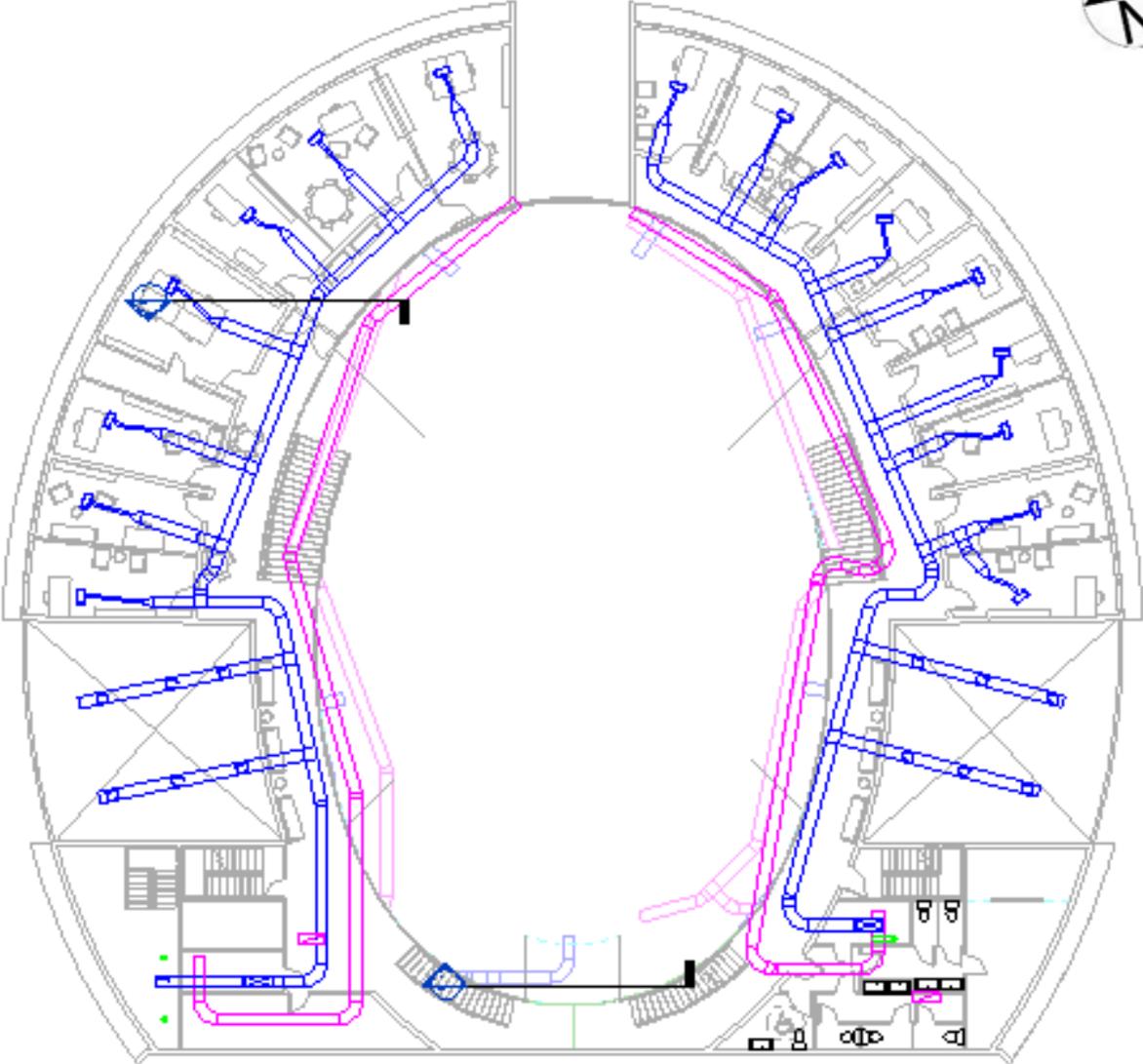
Return
Supply
Exhaust

Distribution Floor 2



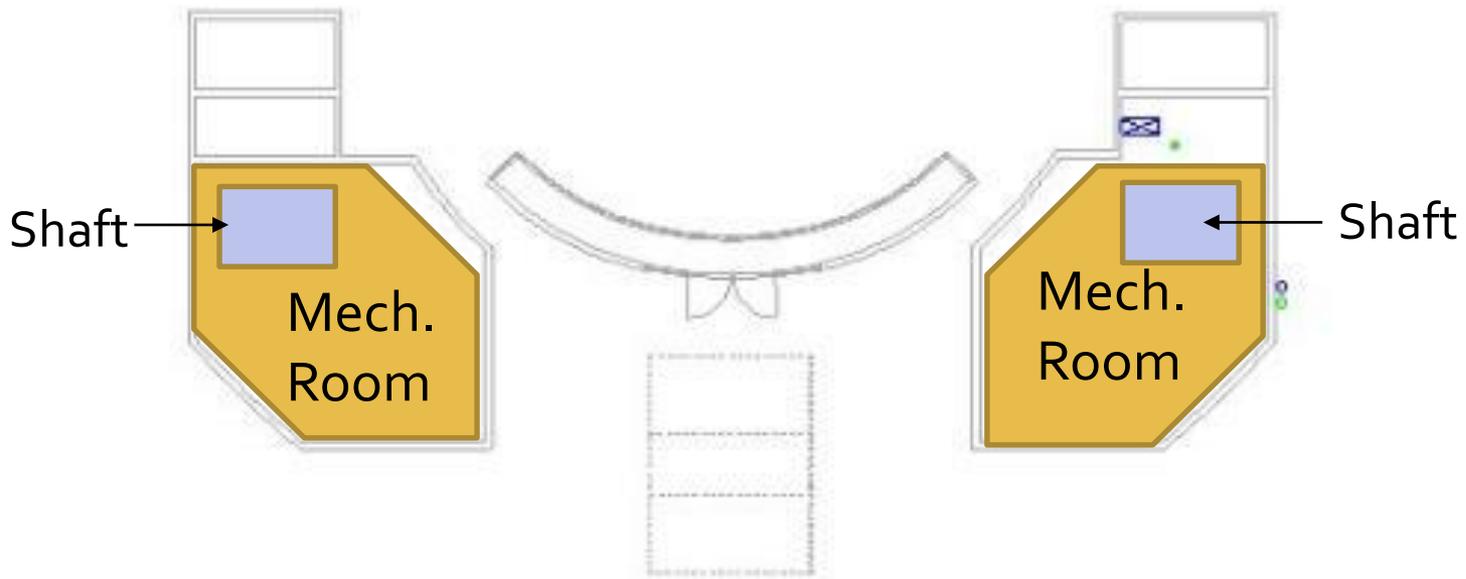
Return
Supply
Exhaust

Distribution Floor 3

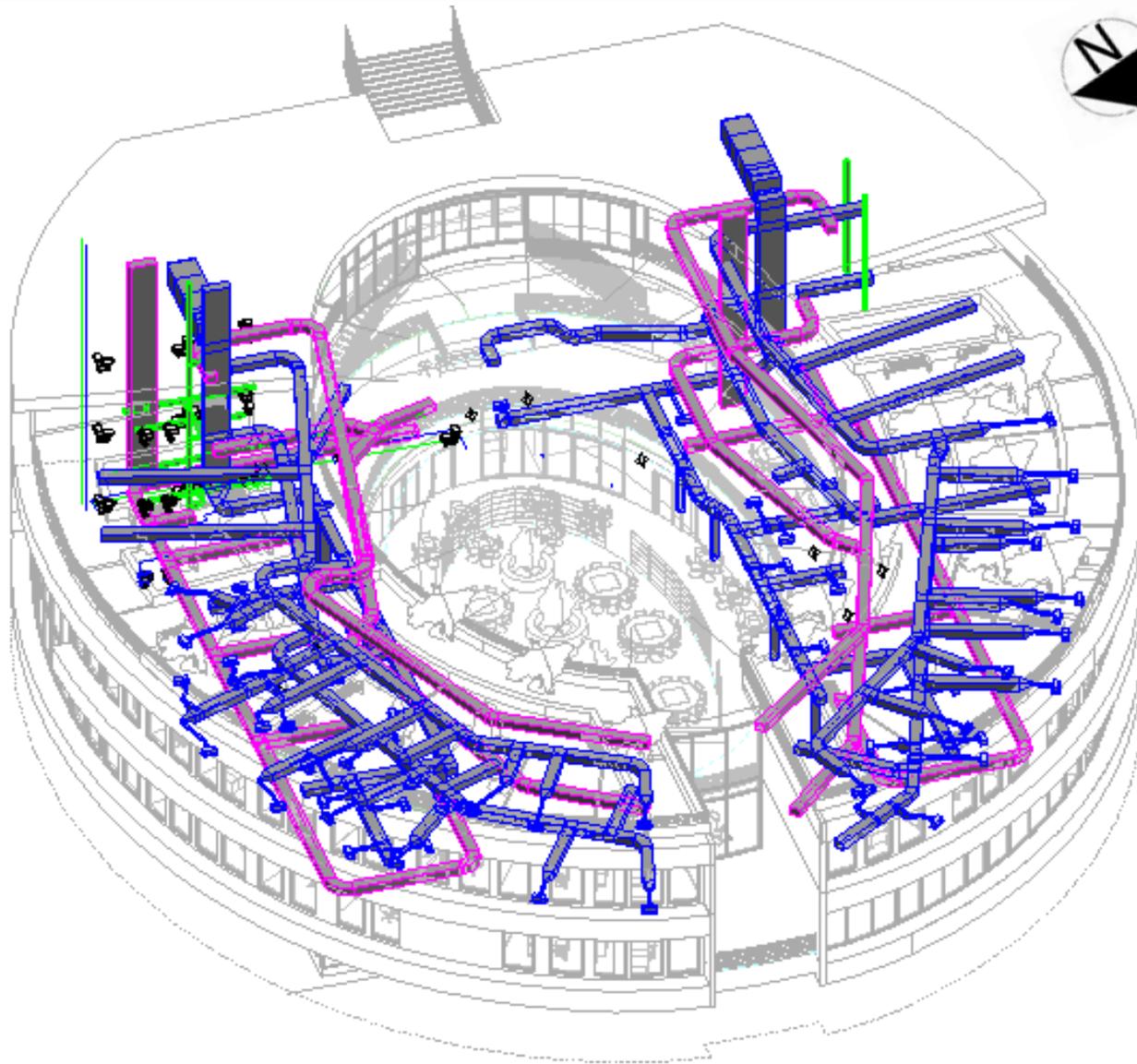


Return
Supply
Exhaust

Distribution Floor 4

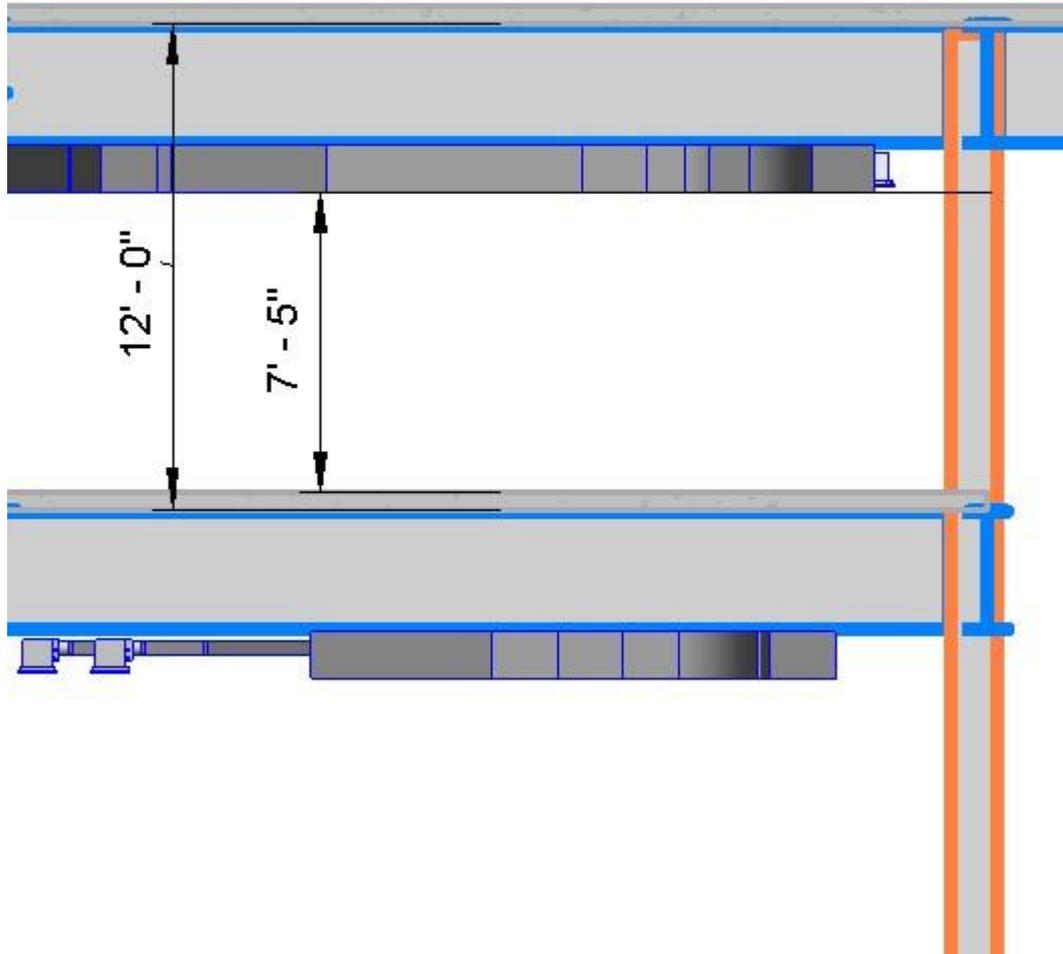


Distribution (3D)

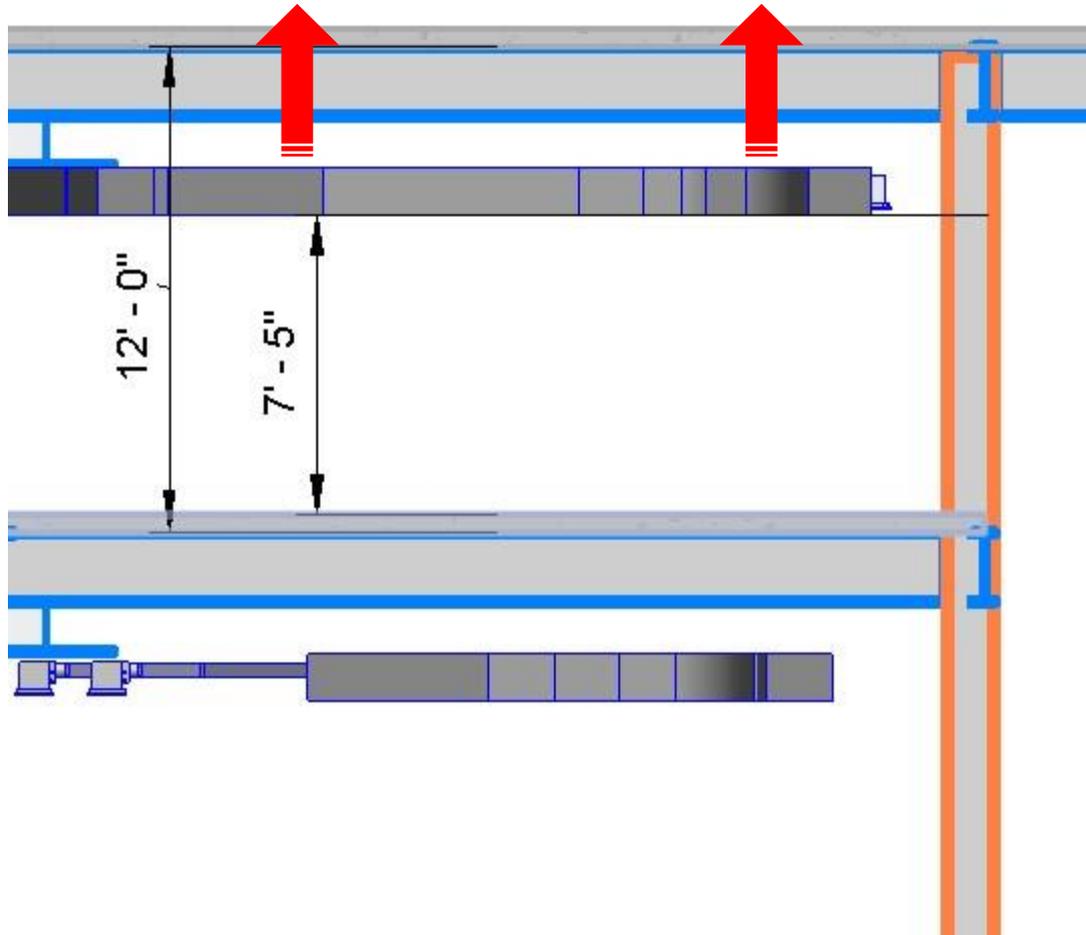


Return
Supply
Exhaust

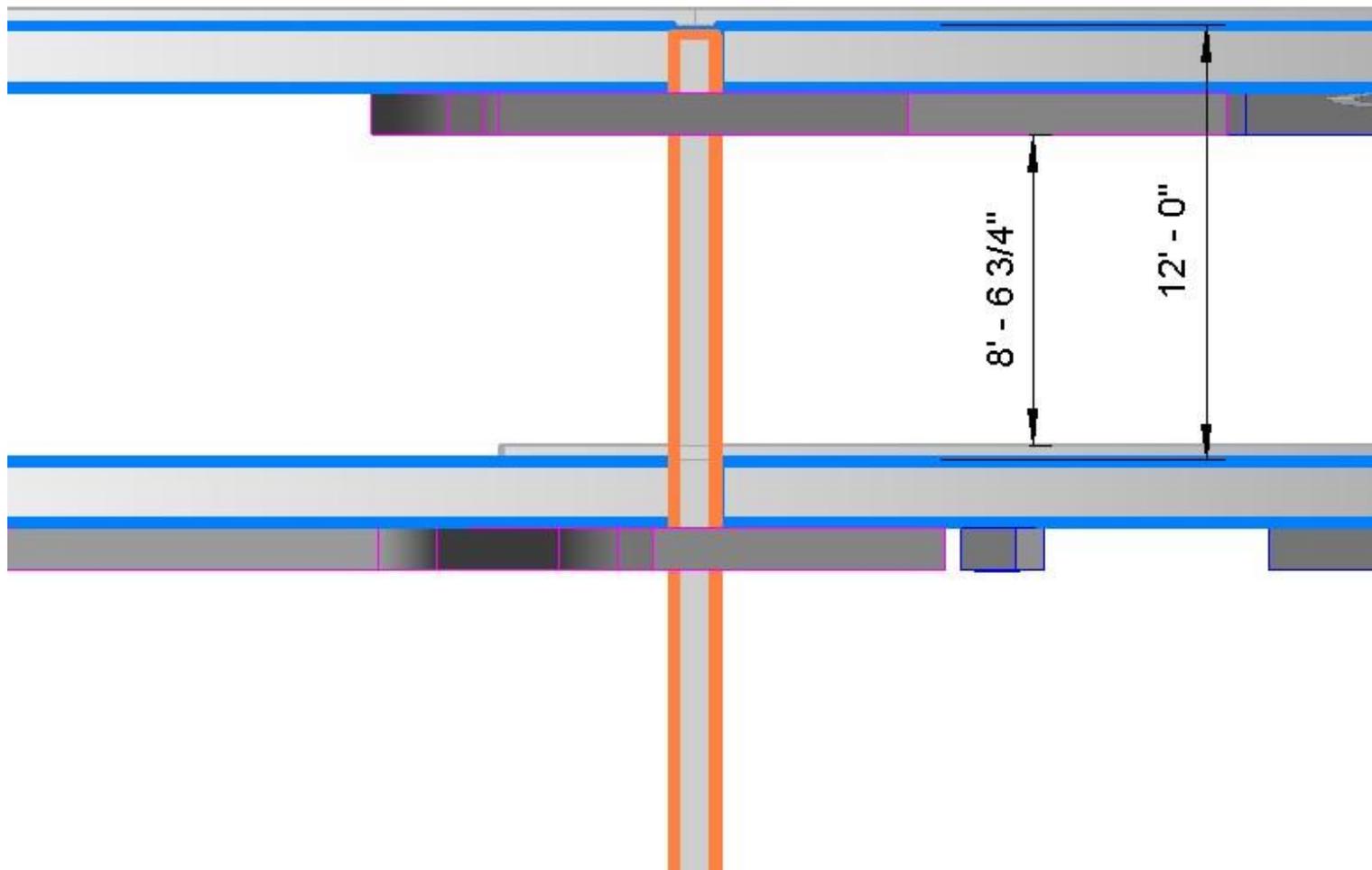
Floor Sandwich - Before



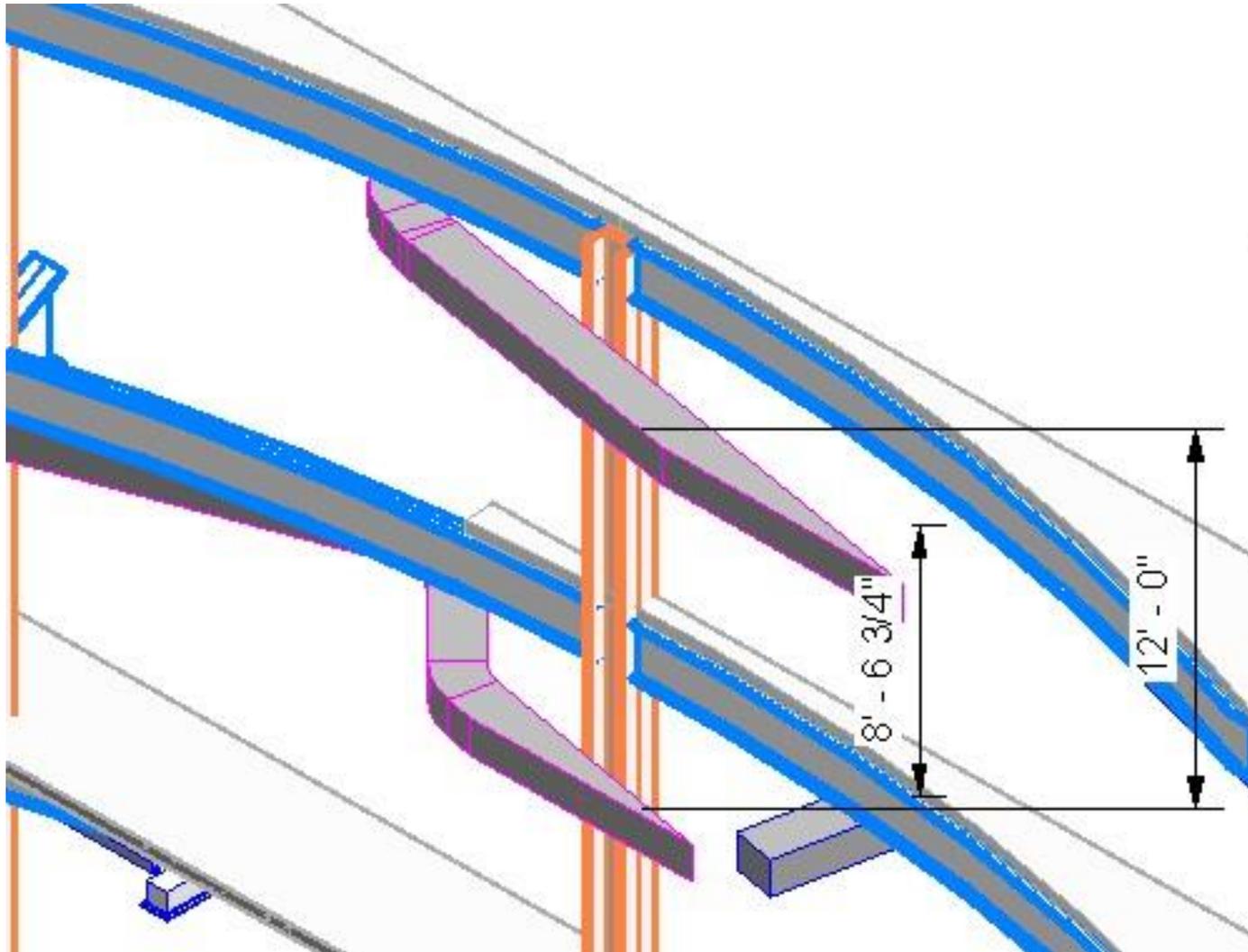
Rearrangement with Structure



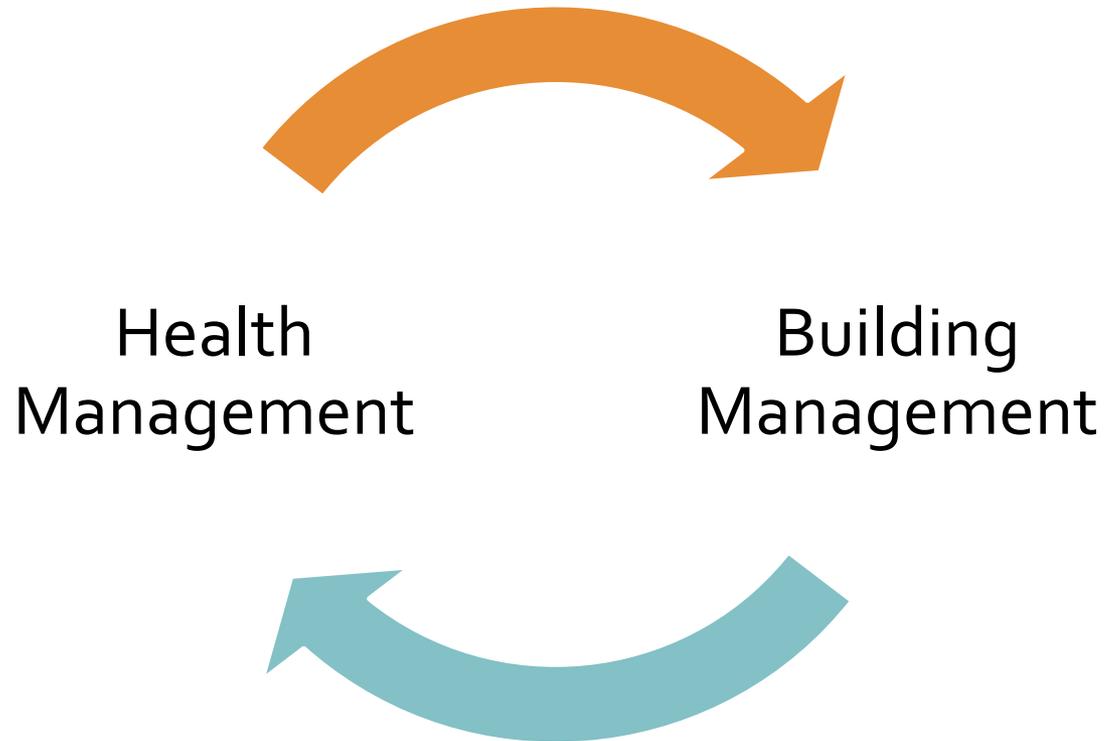
Floor Sandwich - After



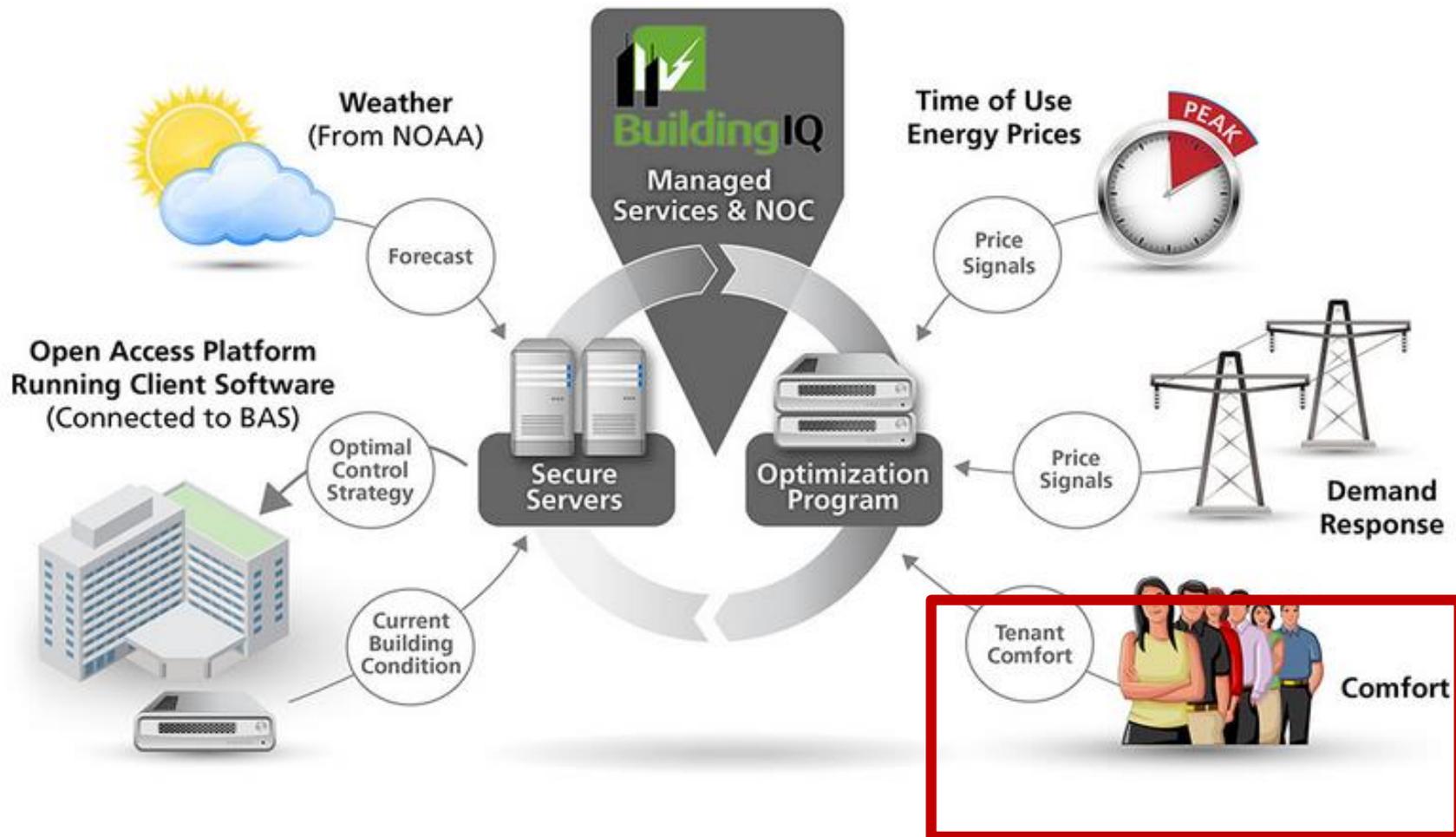
Floor Sandwich - After



Positive Feedback



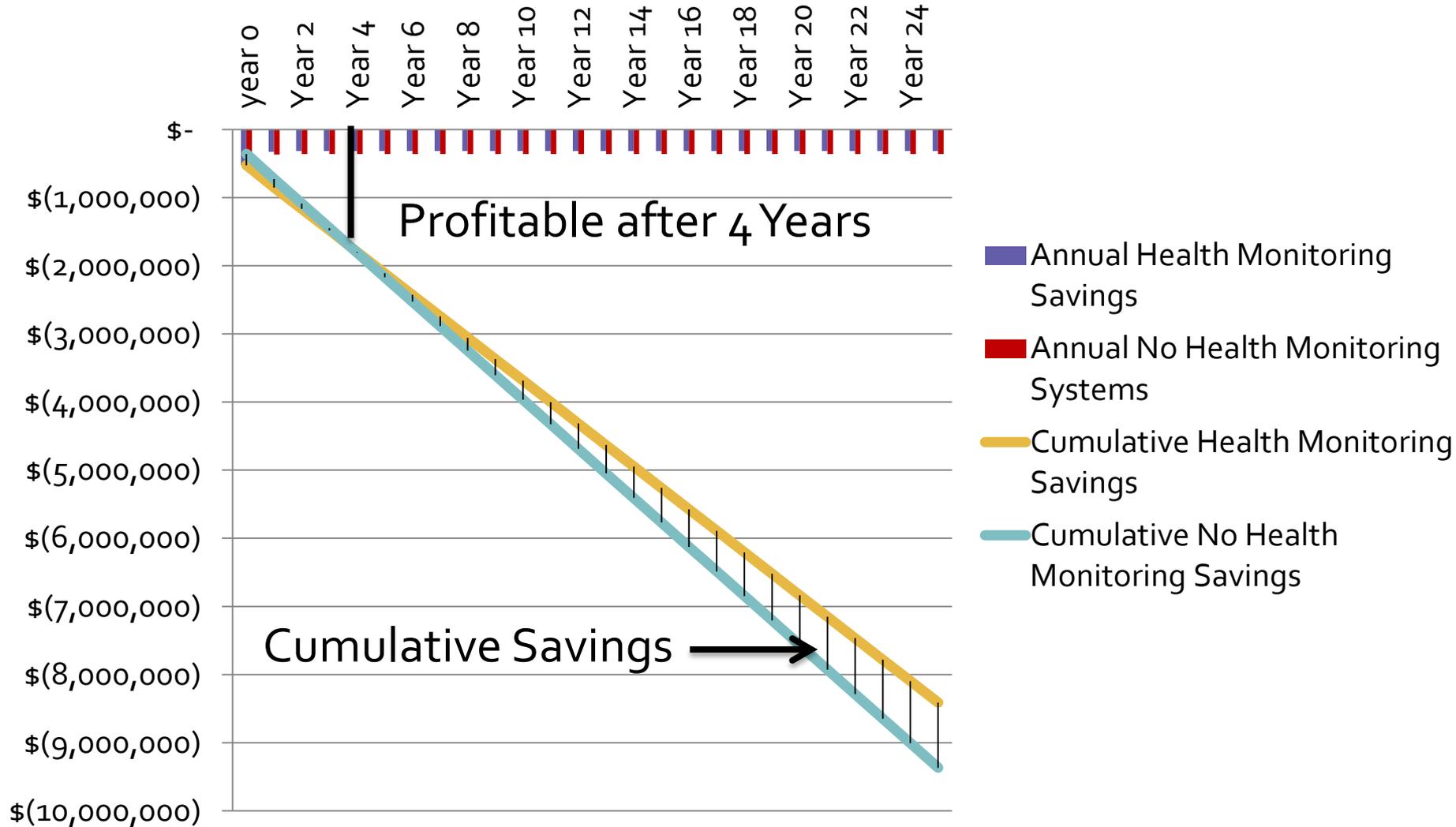
BuildingIQ



Health Monitoring



Savings with Health Monitoring



Lucas



Construction Management

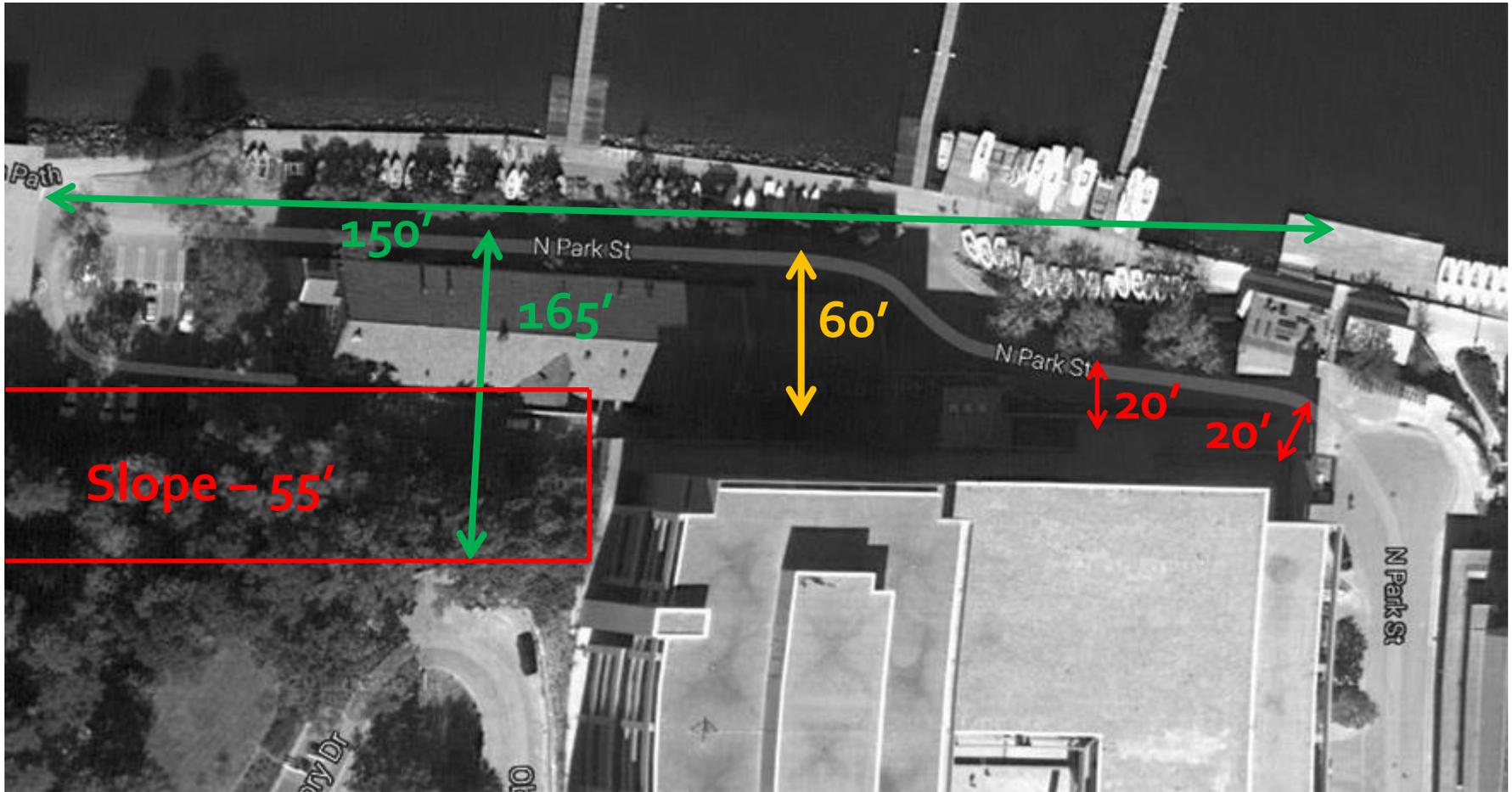
Lake Mendota



View Looking West



Site Access



Construction Site Constraints

- Constricted/Narrow Site
- Steep Slope
- High Water Table
- Soil Conditions
- Weather Conditions



North Road and Path



Hill to South



Site Layout - Crane

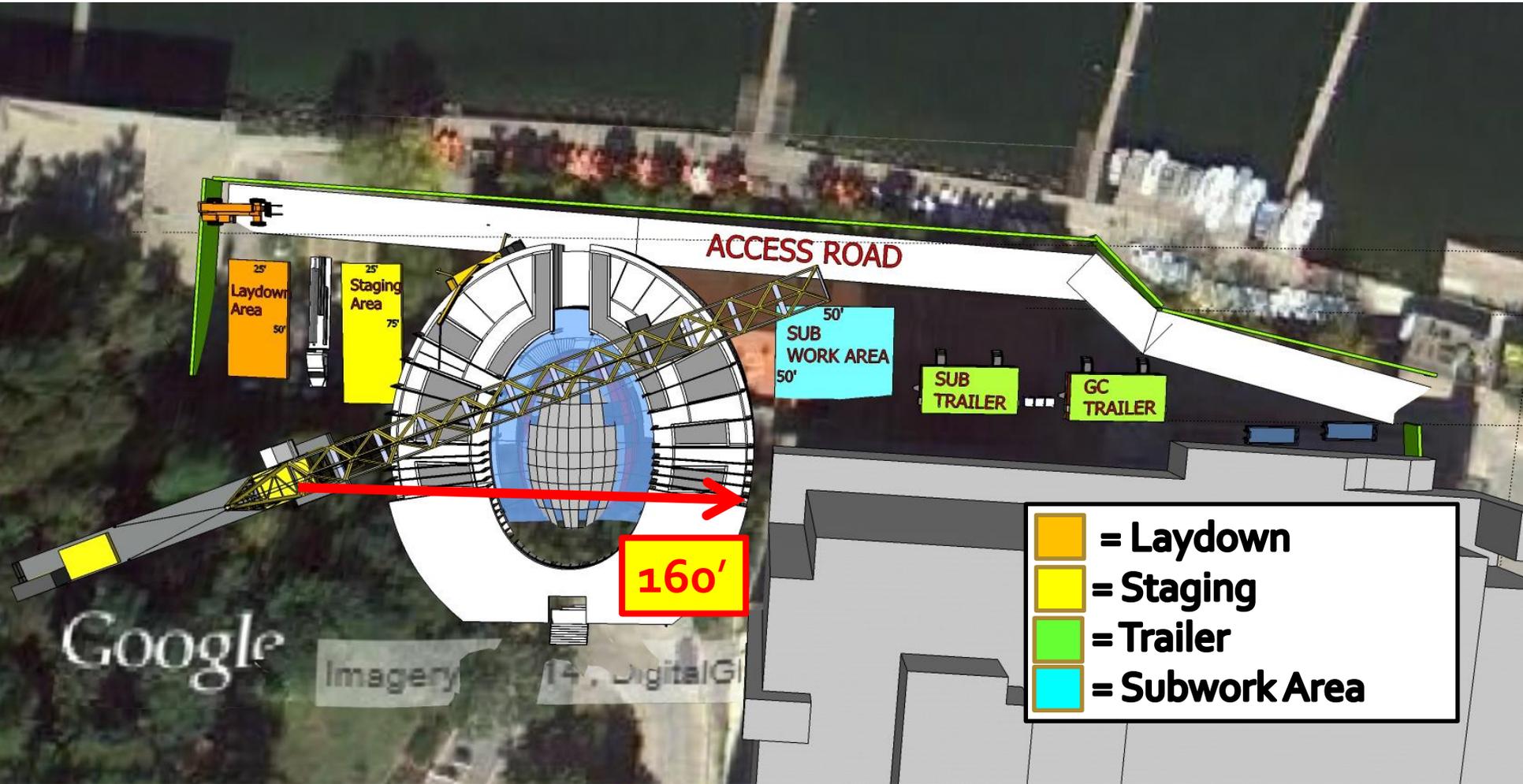
Category	Tower Crane	Rough Terrain Crane	All Terrain Crane	Crawler Crane
Mobilization	Yes (\$60,000)	Yes	No	Yes
Stability	Good	Good – Hydraulic Outriggers	Good – Hydraulic Outriggers	Needs level platform
Price	High (10-15k)	Low	Medium (6-10k)	High
Reach/Mobility	High	Medium	Medium	High-Tracks
Space Needed	Low	High	High	Medium

Terex CTL 140
8.8 Ton

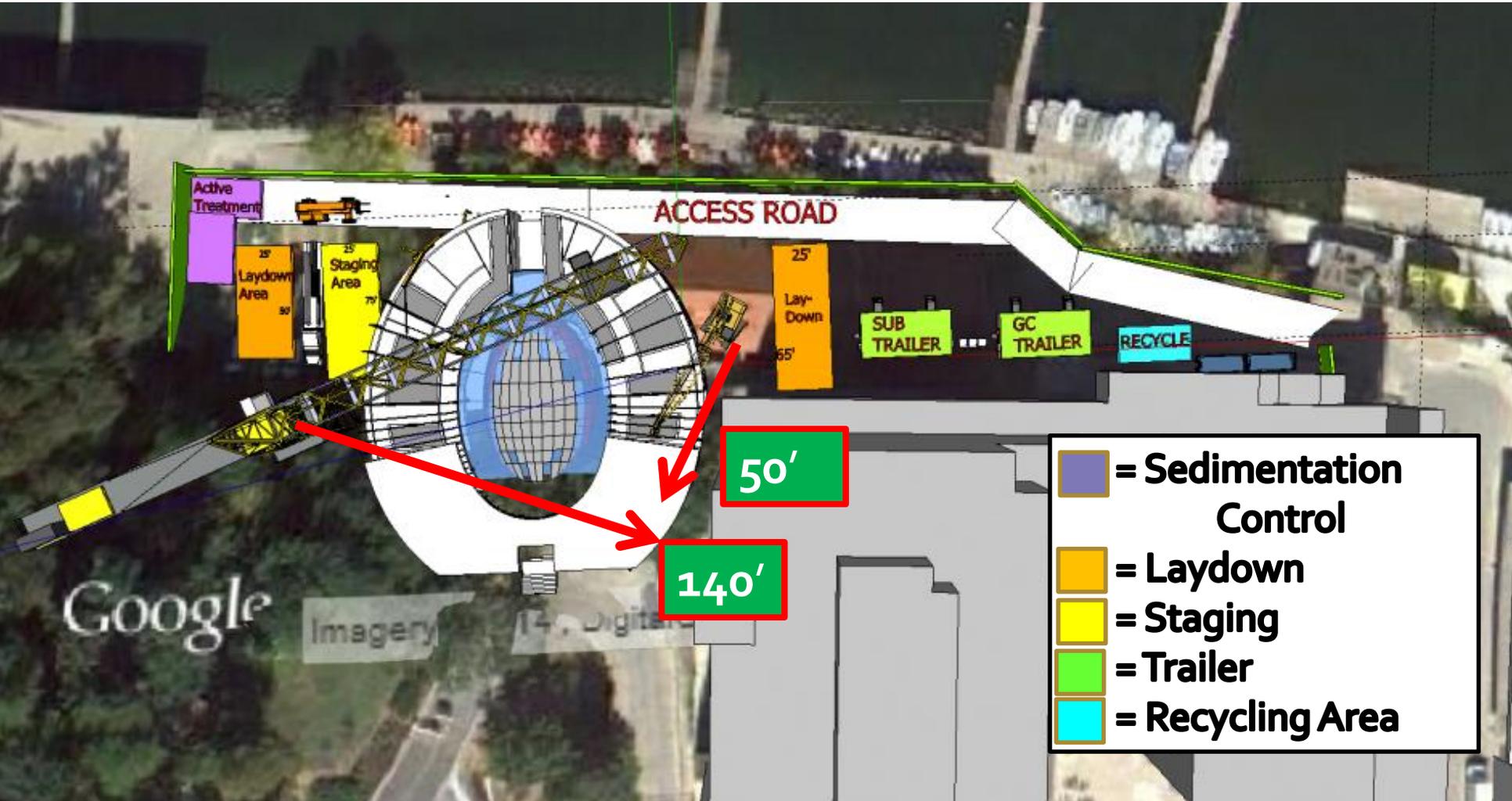


Liebherr
LTM 1030
35 ton

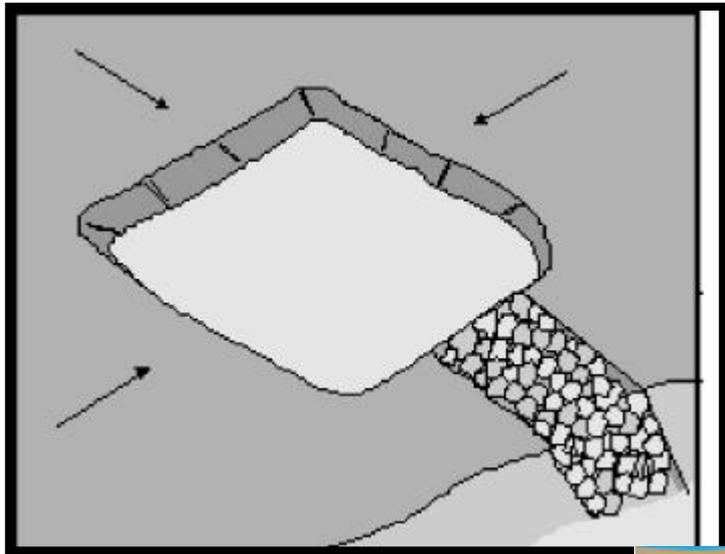
Site Layout - Initial



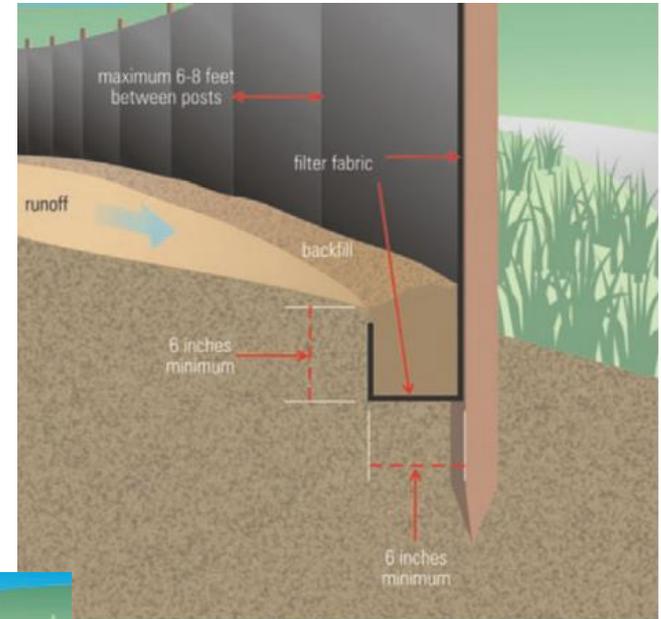
Site Layout - Final



Site Health - Typical



Stone Entrance



Silt Fence

Sediment Trap

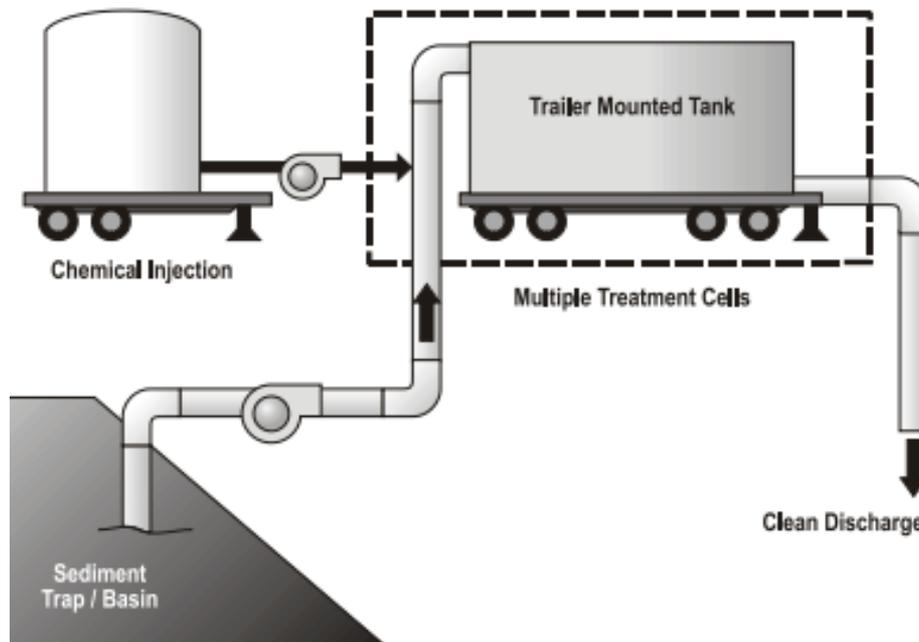


Site Health – Active Treatment System

Less sediment

Cleaner Lakes

Better Quality for
Building Users



Site Health – Bike Path

- To remain open during construction
- Safety barrier at path
- Minimize construction interference



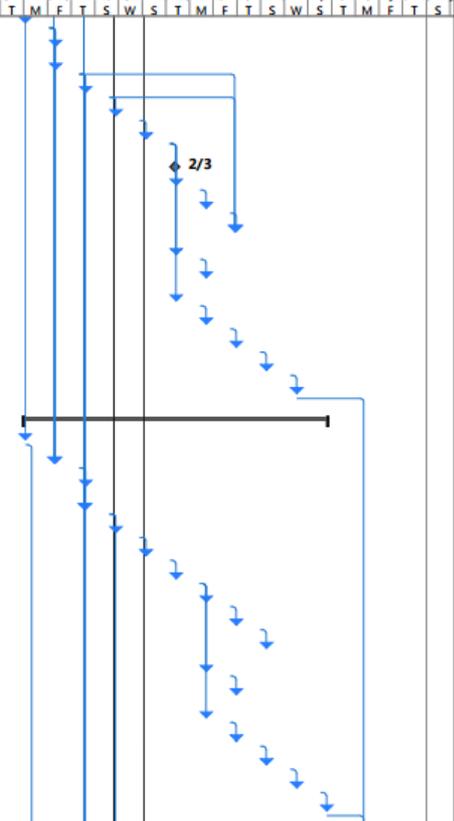
Instructional Labs



Schedule Instructional Labs

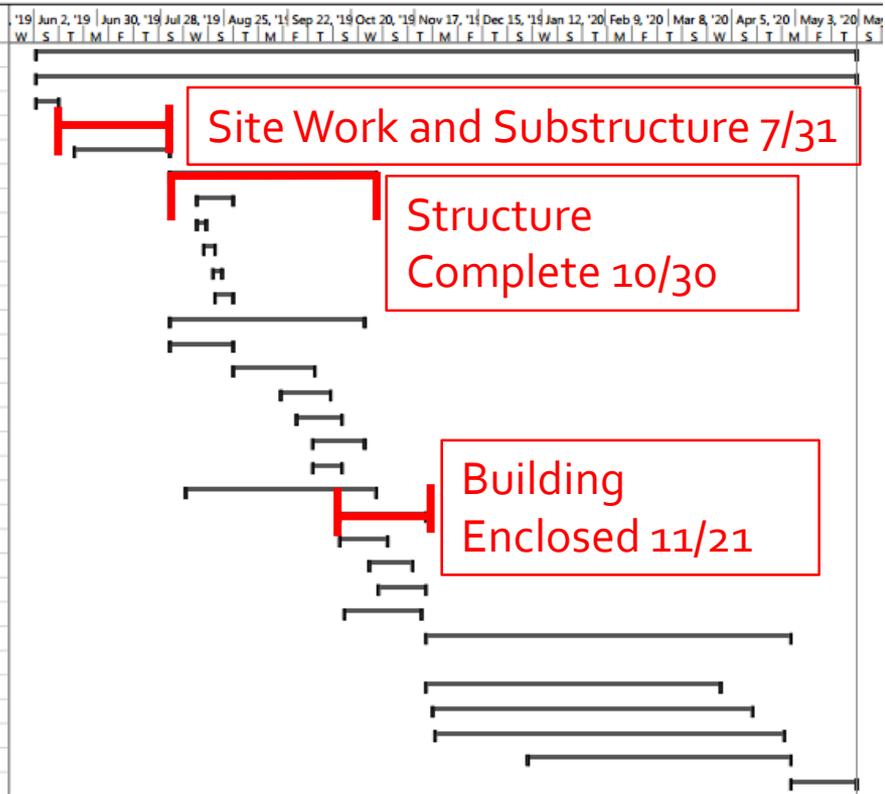
ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors	'19	Jun 2, '19	Jun 30, '19	Jul 28, '19	Aug 25, '19	Sep 22, '19	Oct 20, '19	Nov 17, '19	Dec 15, '19	Jan 12, '20	Feb 9, '20	Mar 8, '20	Apr 5, '20	May 3, '20	May							
							W	S	T	M	F	T	S	W	S	T	M	F	T	S	W	S	T	M	F	T	S	
101		Wall layout and Top track install	10 days	Mon 11/25/19	Fri 12/6/19	100																						
102		Frame walls/door frames	10 days	Mon 12/9/19	Fri 12/20/19	101																						
103		Above ceiling MEPF rough-in	10 days	Mon 12/9/19	Fri 12/20/19	101																						
104		In wall MEPF-Tough-in	10 days	Mon 12/23/19	Fri 1/3/20	103																						
105		Drywall/Tape/Finish	10 days	Mon 1/6/20	Fri 1/17/20	104																						
106		Prime and Paint first coat	10 days	Mon 1/20/20	Fri 1/31/20	105																						
107		Instructional Labs Complete	0 days	Mon 2/3/20	Mon 2/3/20																							
108		Ceiling Grid	10 days	Mon 2/3/20	Fri 2/14/20	106																						
109		Lights	10 days	Mon 2/17/20	Fri 2/28/20	108																						
110		Grilles/Ductwork connections	10 days	Mon 3/2/20	Fri 3/13/20	109,103,104																						
111		Casework	10 days	Mon 2/3/20	Fri 2/14/20	106																						
112		Flooring	10 days	Mon 2/17/20	Fri 2/28/20	111																						
113		Paint Final Coat/Base	10 days	Mon 2/3/20	Fri 2/14/20	106																						
114		Accessories	10 days	Mon 2/17/20	Fri 2/28/20	113																						
115		Doors/Hardware	10 days	Mon 3/2/20	Fri 3/13/20	114																						
116		Drop Ceiling Tile	10 days	Mon 3/16/20	Fri 3/27/20	115																						
117		Final Clean	1 day	Mon 3/30/20	Mon 3/30/20	116																						
118		2nd Floor	101 days	Mon 11/25/19	Mon 4/13/20																							
119		Install curved stairs	1 day	Mon 11/25/19	Mon 11/25/19	100																						
120		Wall layout and Top track install	10 days	Mon 12/9/19	Fri 12/20/19	101,82																						
121		Frame walls/door frames	10 days	Mon 12/23/19	Fri 1/3/20	120																						
122		Above ceiling MEPF rough-in	10 days	Mon 12/23/19	Fri 1/3/20	103,82																						
123		In wall MEPF-Tough-in	10 days	Mon 1/6/20	Fri 1/17/20	122																						
124		Drywall/Tape/Finish	10 days	Mon 1/20/20	Fri 1/31/20	123																						
125		Prime and Paint first coat	10 days	Mon 2/3/20	Fri 2/14/20	124																						
126		Ceiling Grid	10 days	Mon 2/17/20	Fri 2/28/20	125																						
127		Lights	10 days	Mon 3/2/20	Fri 3/13/20	126																						
128		Grilles/Ductwork connections	10 days	Mon 3/16/20	Fri 3/27/20	127																						
129		Casework	10 days	Mon 2/17/20	Fri 2/28/20	125																						
130		Flooring	10 days	Mon 3/2/20	Fri 3/13/20	129																						
131		Paint Final Coat/Base	10 days	Mon 2/17/20	Fri 2/28/20	125																						
132		Accessories	10 days	Mon 3/2/20	Fri 3/13/20	131																						
133		Doors/Hardware	10 days	Mon 3/16/20	Fri 3/27/20	132																						
134		Drop Ceiling Tile	10 days	Mon 3/30/20	Fri 4/10/20	133																						
135		Final Clean	1 day	Mon 4/13/20	Mon 4/13/20	134																						

Instructional
Labs Complete:
Feb 3, 2020

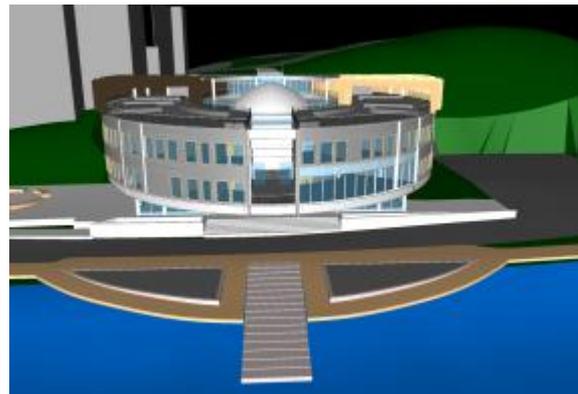
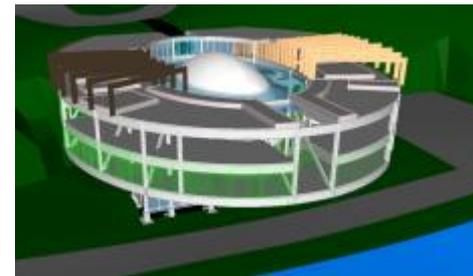
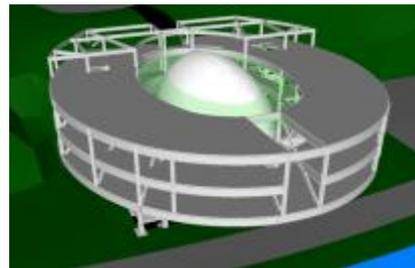
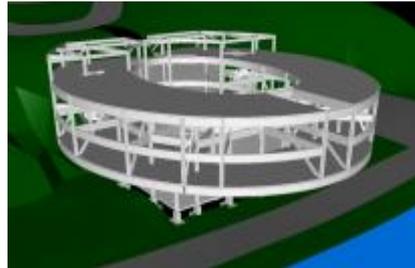
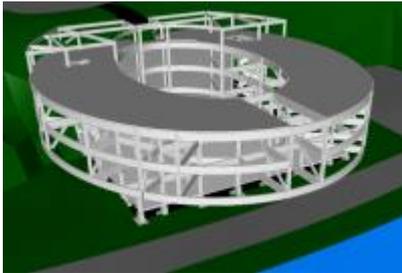
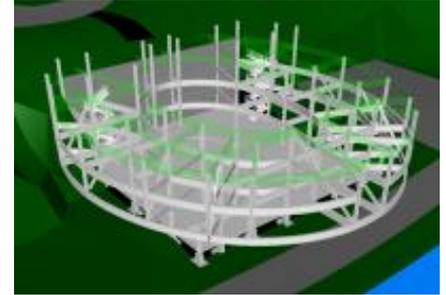
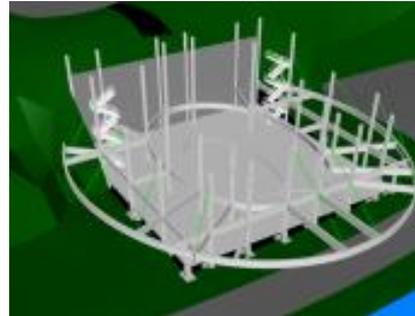
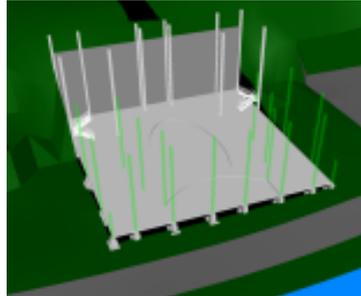
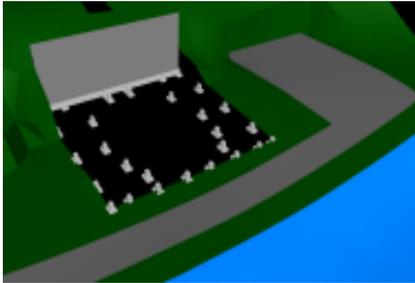


Schedule Summary

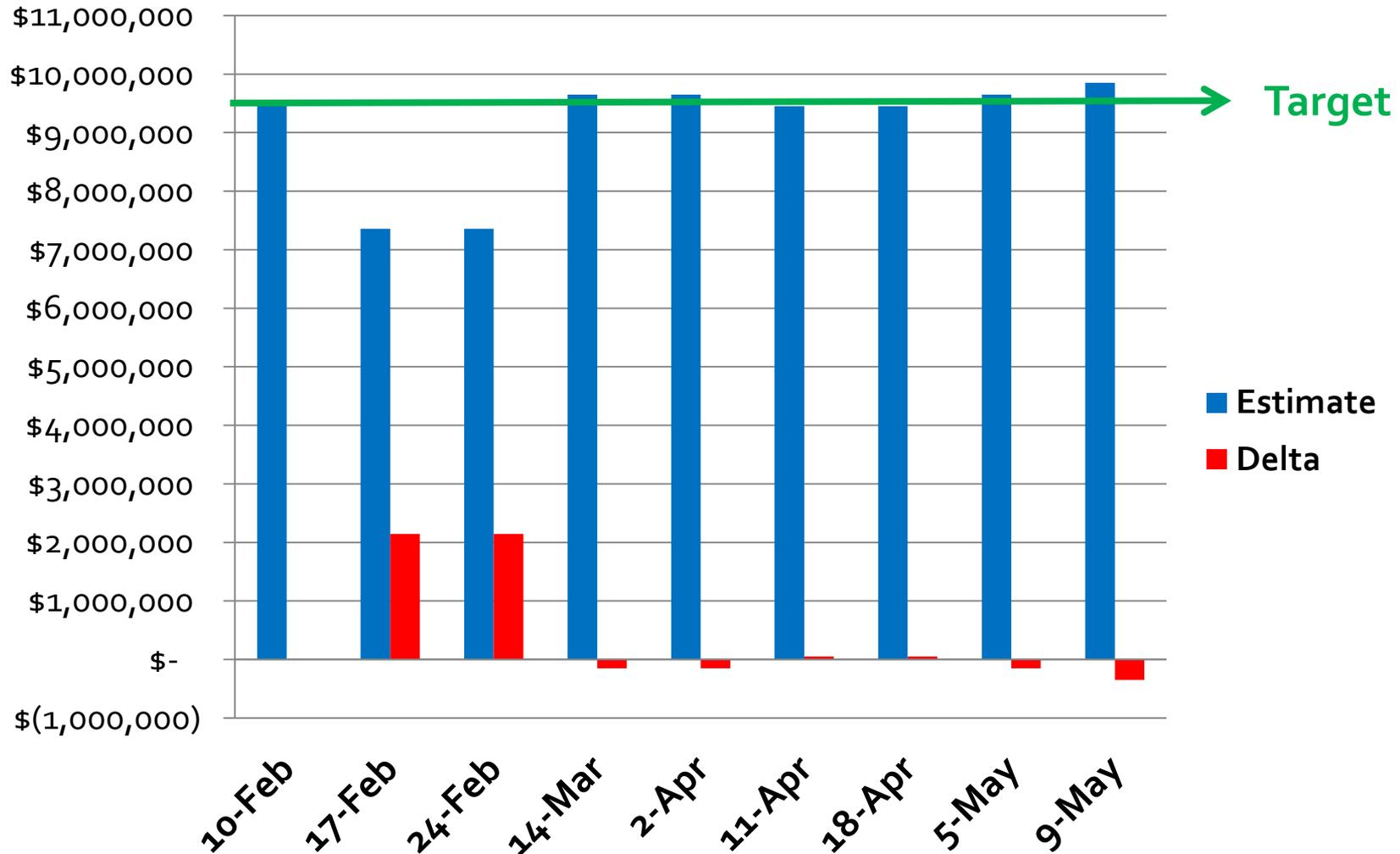
ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		Atlantic building	260 days	Mon 6/3/19	Fri 5/29/20	
2		Construction	260 days	Mon 6/3/19	Fri 5/29/20	
3		Mobilization	8 days	Mon 6/3/19	Wed 6/12/19	
7		Sitework and Site Utilities	35 days	Thu 6/13/19	Wed 7/31/19	
13		Substructure	30 days	Thu 6/20/19	Wed 7/31/19	
18		Structure	65 days	Thu 8/1/19	Wed 10/30/19	
19		Shaft Walls	12 days	Tue 8/13/19	Wed 8/28/19	
20		1st Floor	4 days	Tue 8/13/19	Fri 8/16/19	
23		2nd floor	3 days	Fri 8/16/19	Tue 8/20/19	
26		3rd Floor	4 days	Tue 8/20/19	Fri 8/23/19	
29		4th Floor	6 days	Wed 8/21/19	Wed 8/28/19	
32		Steel Structure	62 days	Thu 8/1/19	Fri 10/25/19	
33		1st Floor	20 days	Thu 8/1/19	Wed 8/28/19	
38		2nd floor	26 days	Thu 8/29/19	Thu 10/3/19	
45		3rd Floor	16 days	Thu 9/19/19	Thu 10/10/19	
50		4th Floor/Lower Roof	14 days	Thu 9/26/19	Tue 10/15/19	
55		Auditorium	17 days	Thu 10/3/19	Fri 10/25/19	
60		Upper Roof	9 days	Thu 10/3/19	Tue 10/15/19	
65		Concrete Pours	60 days	Thu 8/8/19	Wed 10/30/19	
74		Exterior Skin	28 days	Tue 10/15/19	Thu 11/21/19	
75		Level 1	15 days	Tue 10/15/19	Mon 11/4/19	
79		Level 2	15 days	Mon 10/28/19	Fri 11/15/19	
83		Level 3	15 days	Fri 11/1/19	Thu 11/21/19	
88		Level 4	24 days	Thu 10/17/19	Tue 11/19/19	
97		Fit-out Interiors	115 days	Fri 11/22/19	Thu 4/30/20	
98		Elevator	30 days	Mon 2/3/20	Fri 3/13/20	
99		1st Floor	92 days	Fri 11/22/19	Mon 3/30/20	
118		2nd Floor	101 days	Mon 11/25/19	Mon 4/13/20	
136		3rd Floor	110 days	Tue 11/26/19	Mon 4/27/20	
154		4th Floor	84 days	Mon 1/6/20	Thu 4/30/20	
171		Start Up/Close Out	21 days	Fri 5/1/20	Fri 5/29/20	



Sequencing



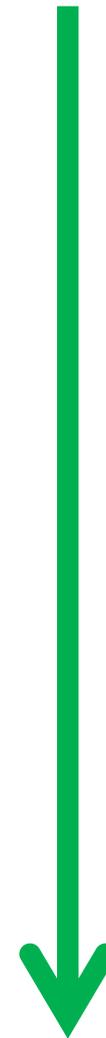
Target Value Design - Evolution



TVD Evolution

Reliability of Estimate

DATE	EVENT	ESTIMATE	DELTA
10-Feb	Target Value Set	\$ 9,500,000	\$ -
17-Feb	RS means SF estimate	\$ 7,355,500	\$ 2,144,500
24-Feb		\$ 7,355,500	\$ 2,144,500
14-Mar	Winter Presentation	\$ 9,650,000	\$ (150,000)
2-Apr		\$ 9,650,000	\$ (150,000)
11-Apr	Floor plan update	\$ 9,450,000	\$ 50,000
18-Apr		\$ 9,450,000	\$ 50,000
2-May	Final Modeling/ Auditorium Structure finalized	\$ 9,650,000	\$ (150,000)
9-May	Final Presentation	\$ 9,850,000	\$ (350,000)



Low

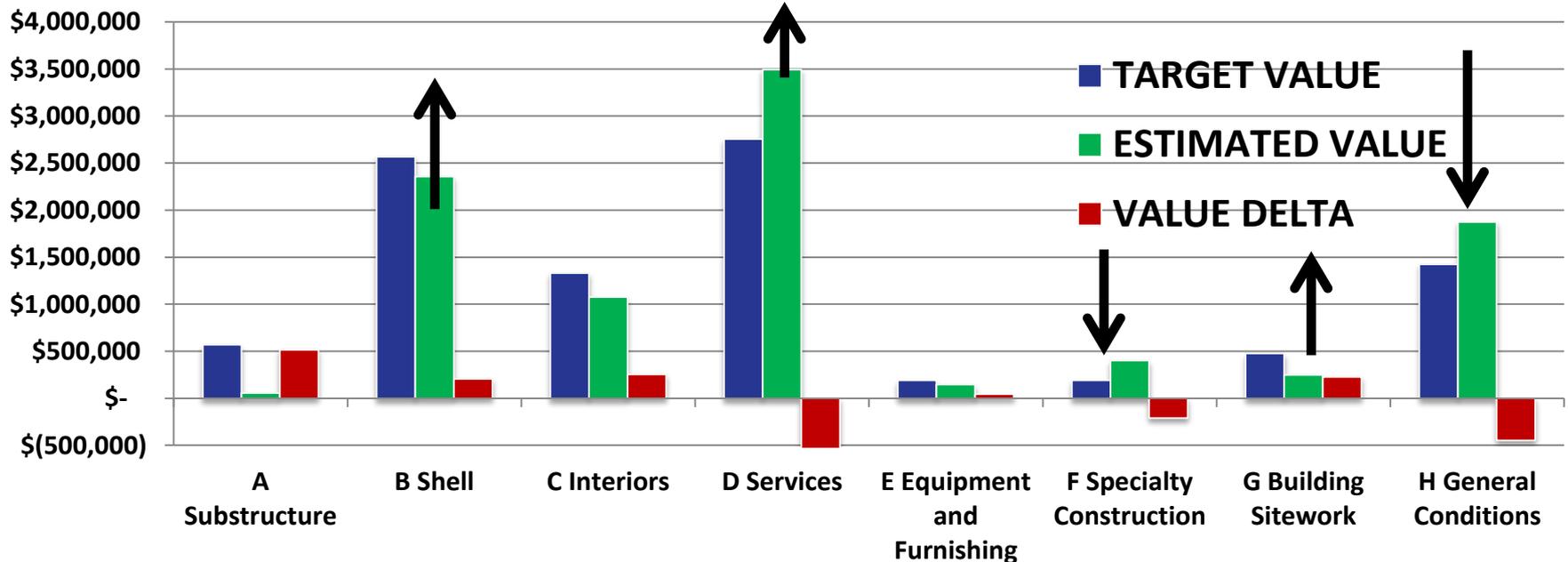
Medium

High

Initial Cost Estimate - Winter

Total: \$ 9,650,000

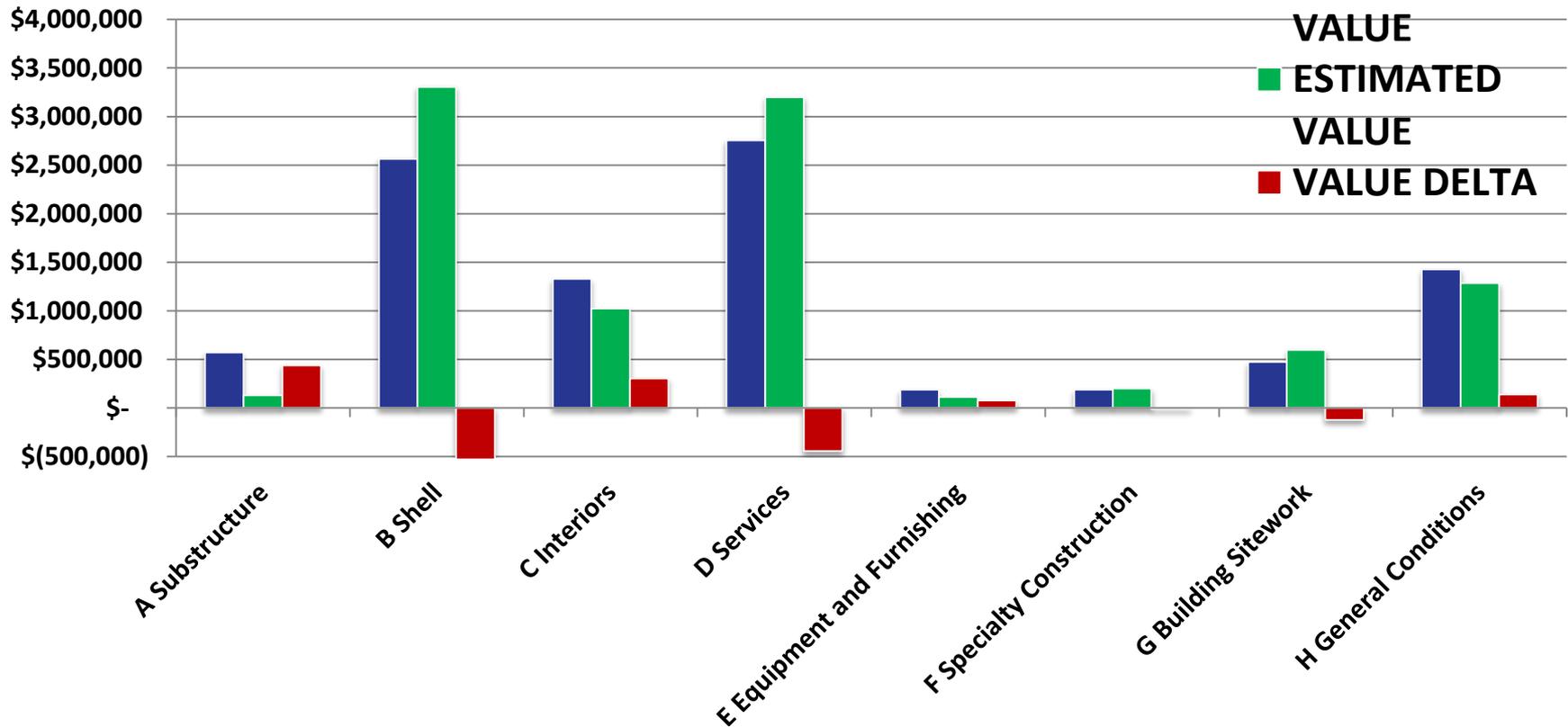
TVD - TARGETS BY CLUSTER



Final Cost Estimate

Total: \$ 9,850,000

TVD - TARGETS BY CLUSTER

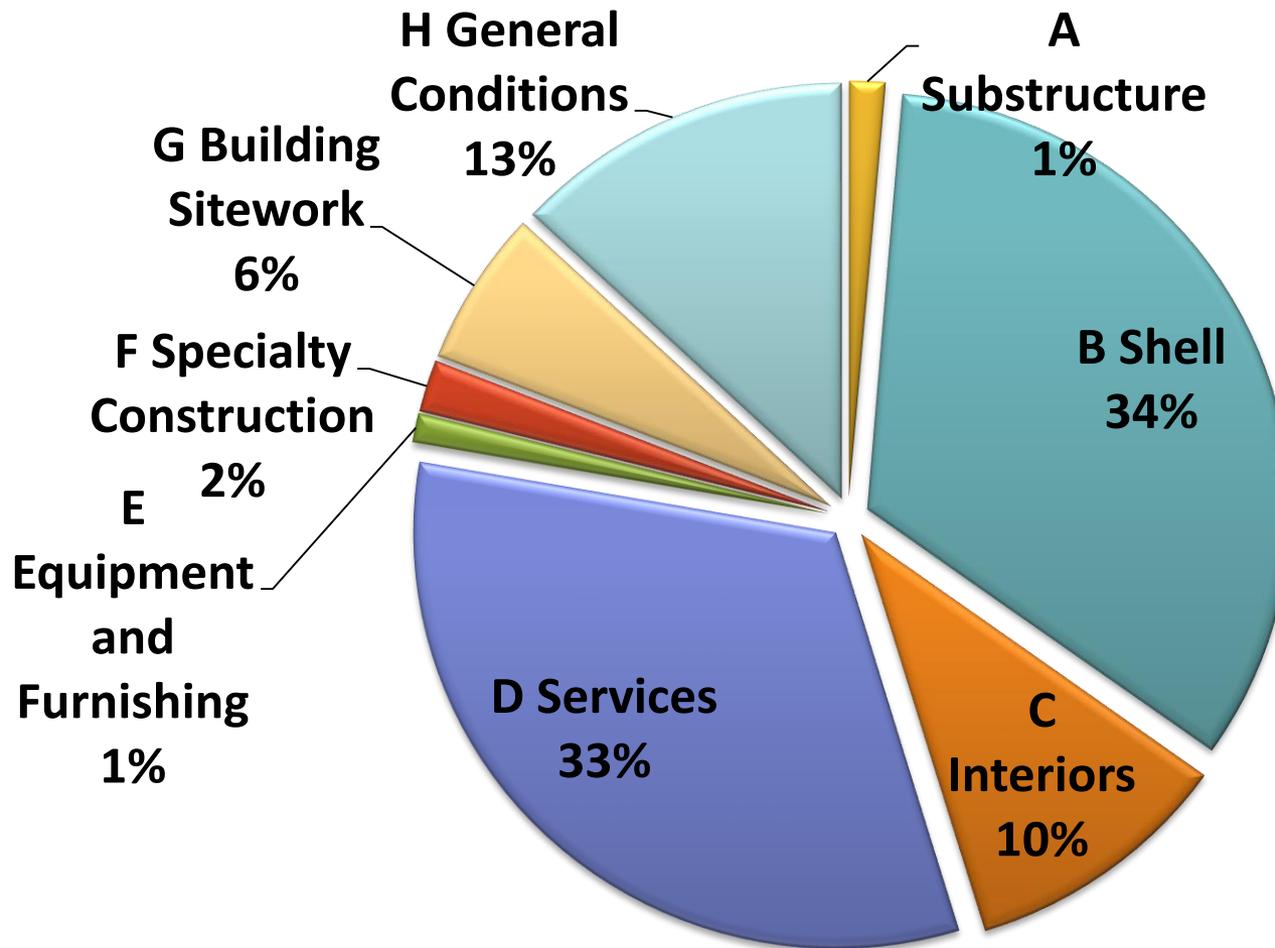


TVD Summary Table

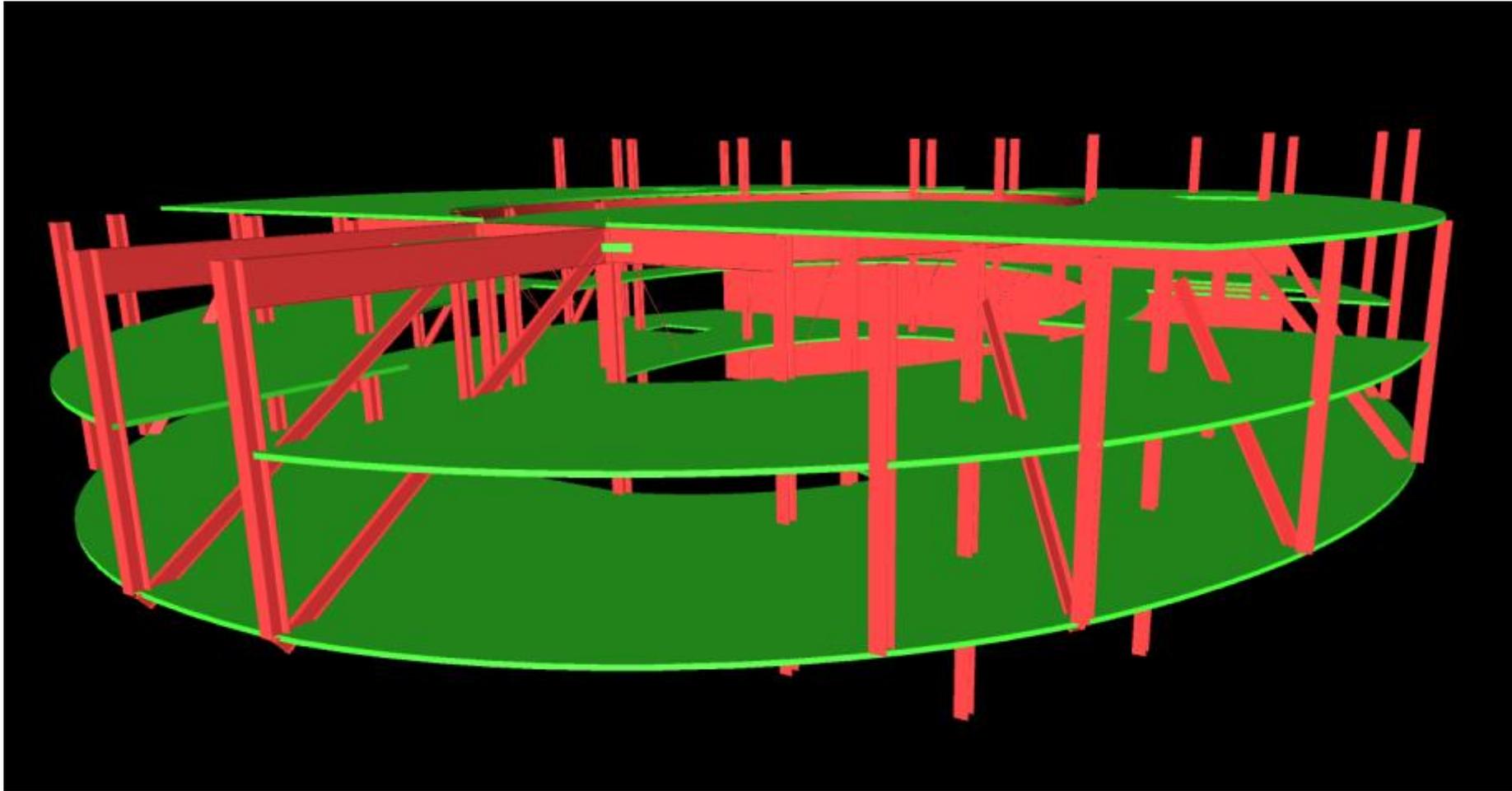
ESTIMATE AND TARGET VALUE - SUMMARY

	ESTIMATED VALUE	TARGET VALUE	VALUE DELTA
TOTAL	\$ 9,850,000	\$ 9,500,000	\$ (350,000)
A Substructure	\$ 131,000	\$ 570,000	\$ 439,000
B Shell	\$ 3,305,000	\$ 2,565,000	\$ (740,000)
C Interiors	\$ 1,026,000	\$ 1,330,000	\$ 304,000
D Services	\$ 3,199,000	\$ 2,755,000	\$ (444,000)
E Equipment and Furnishing	\$ 112,000	\$ 190,000	\$ 78,000
F Specialty Construction	\$ 200,000	\$ 190,000	\$ (10,000)
G Building Sitework	\$ 599,000	\$ 475,000	\$ (124,000)
H General Conditions	\$ 1,286,000	\$ 1,425,000	\$ 139,000

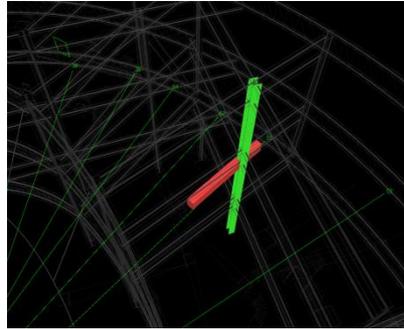
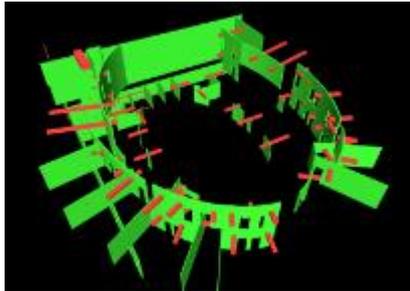
TVD Cluster Breakout



Structure Frame Vs Floors



Clash Resolution Process



Run Clash
Detection

Create Viewpoints
of Clashes Along
With Comments

Find Floor Plan
Location in Revit

Resolve Clashes
and Notify

Meet With
Necessary
Discipline

Autodesk
Revit

Clash Report

Model as Workset: (1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12) (13) (14) (15) (16) (17) (18) (19) (20) (21) (22) (23) (24) (25) (26) (27) (28) (29) (30) (31) (32) (33) (34) (35) (36) (37) (38) (39) (40) (41) (42) (43) (44) (45) (46) (47) (48) (49) (50) (51) (52) (53) (54) (55) (56) (57) (58) (59) (60) (61) (62) (63) (64) (65) (66) (67) (68) (69) (70) (71) (72) (73) (74) (75) (76) (77) (78) (79) (80) (81) (82) (83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93) (94) (95) (96) (97) (98) (99) (100) (101) (102) (103) (104) (105) (106) (107) (108) (109) (110) (111) (112) (113) (114) (115) (116) (117) (118) (119) (120) (121) (122) (123) (124) (125) (126) (127) (128) (129) (130) (131) (132) (133) (134) (135) (136) (137) (138) (139) (140) (141) (142) (143) (144) (145) (146) (147) (148) (149) (150) (151) (152) (153) (154) (155) (156) (157) (158) (159) (160) (161) (162) (163) (164) (165) (166) (167) (168) (169) (170) (171) (172) (173) (174) (175) (176) (177) (178) (179) (180) (181) 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Clash ID	Level	Category	Element 1	Element 2	Element 3
1	Level 1	MEP	MEP Equipment	MEP Equipment	MEP Equipment
2	Level 1	MEP	MEP Equipment	MEP Equipment	MEP Equipment
3	Level 1	MEP	MEP Equipment	MEP Equipment	MEP Equipment
4	Level 1	MEP	MEP Equipment	MEP Equipment	MEP Equipment
5	Level 1	MEP	MEP Equipment	MEP Equipment	MEP Equipment
6	Level 1	MEP	MEP Equipment	MEP Equipment	MEP Equipment
7	Level 1	MEP	MEP Equipment	MEP Equipment	MEP Equipment
8	Level 1	MEP	MEP Equipment	MEP Equipment	MEP Equipment
9	Level 1	MEP	MEP Equipment	MEP Equipment	MEP Equipment
10	Level 1	MEP	MEP Equipment	MEP Equipment	MEP Equipment

Clash Summary Table

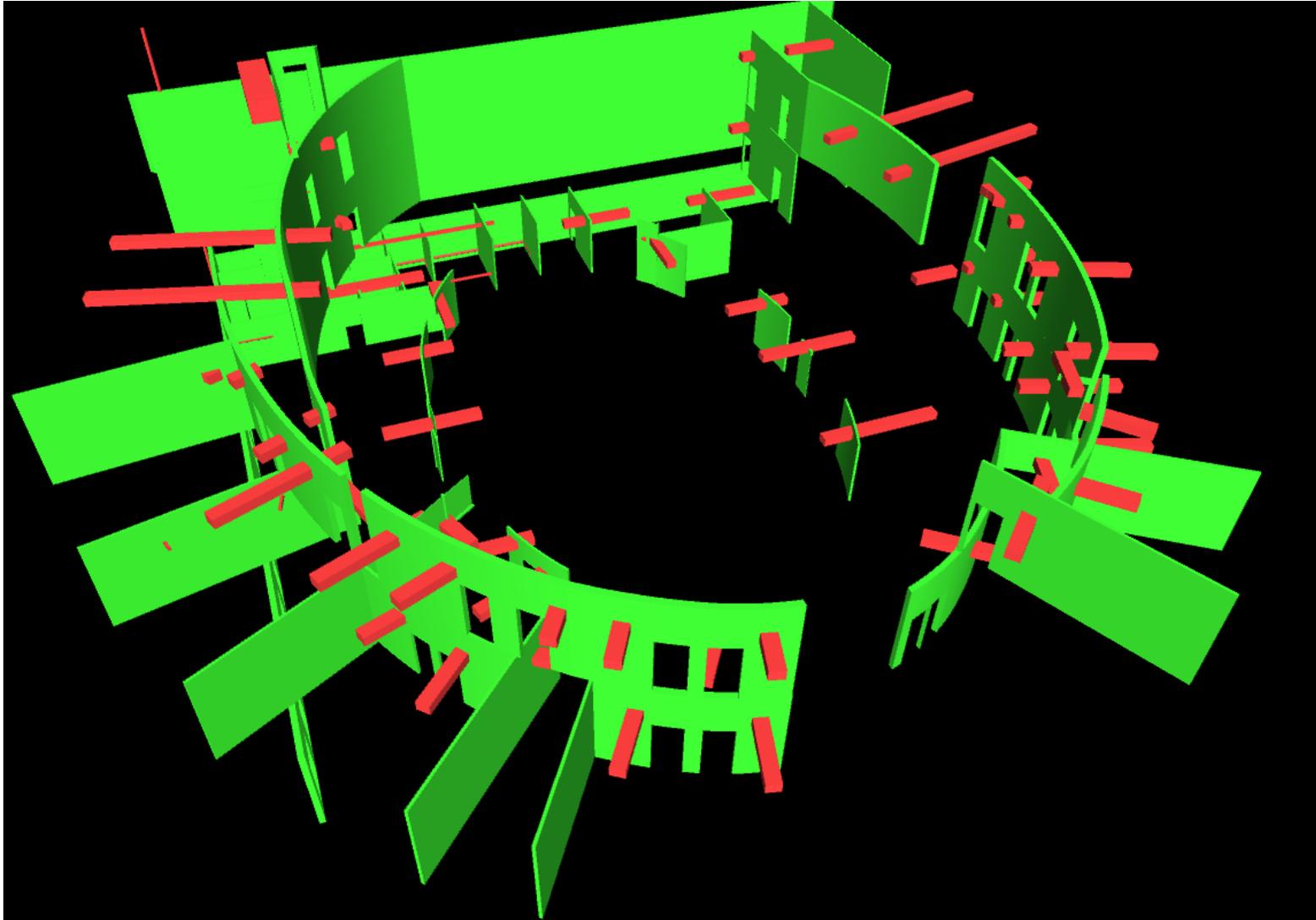
Initial Clash Summary

Name	Status	Clashes	New	Active	Reviewed	Approved	Resolved
MEP vs Steel structure	Done	7	7	0	0	0	0
Mech vs Doors	Done	5	5	0	0	0	0
Mech vs Floors/Roof	Done	19	19	0	0	0	0
Mech vs Stairs and railings	Done	6	6	0	0	0	0
Mech vs Walls	Done	162	162	0	0	0	0
Mech vs auditorium	Done	17	17	0	0	0	0
Struct vs windows	Done	3	3	0	0	0	0
Structure vs Doors	Done	5	5	0	0	0	0
Structure vs Floors/Roof	Done	144	144	0	0	0	0
Structure vs stairs and rails	Done	199	199	0	0	0	0
Structure vs walls	Done	614	614	0	0	0	0
Structure vs aud	Done	18	18	0	0	0	0
Roof arch vs walls/floors	Done	35	35	0	0	0	0

Final Clash Summary

	Arch	Structural	Mech
Arch	-	958	171
Structural	-	0	0
MEP	-	-	0

MEP vs Walls



Building Construction Challenges

How to build auditorium?

Sequence and material

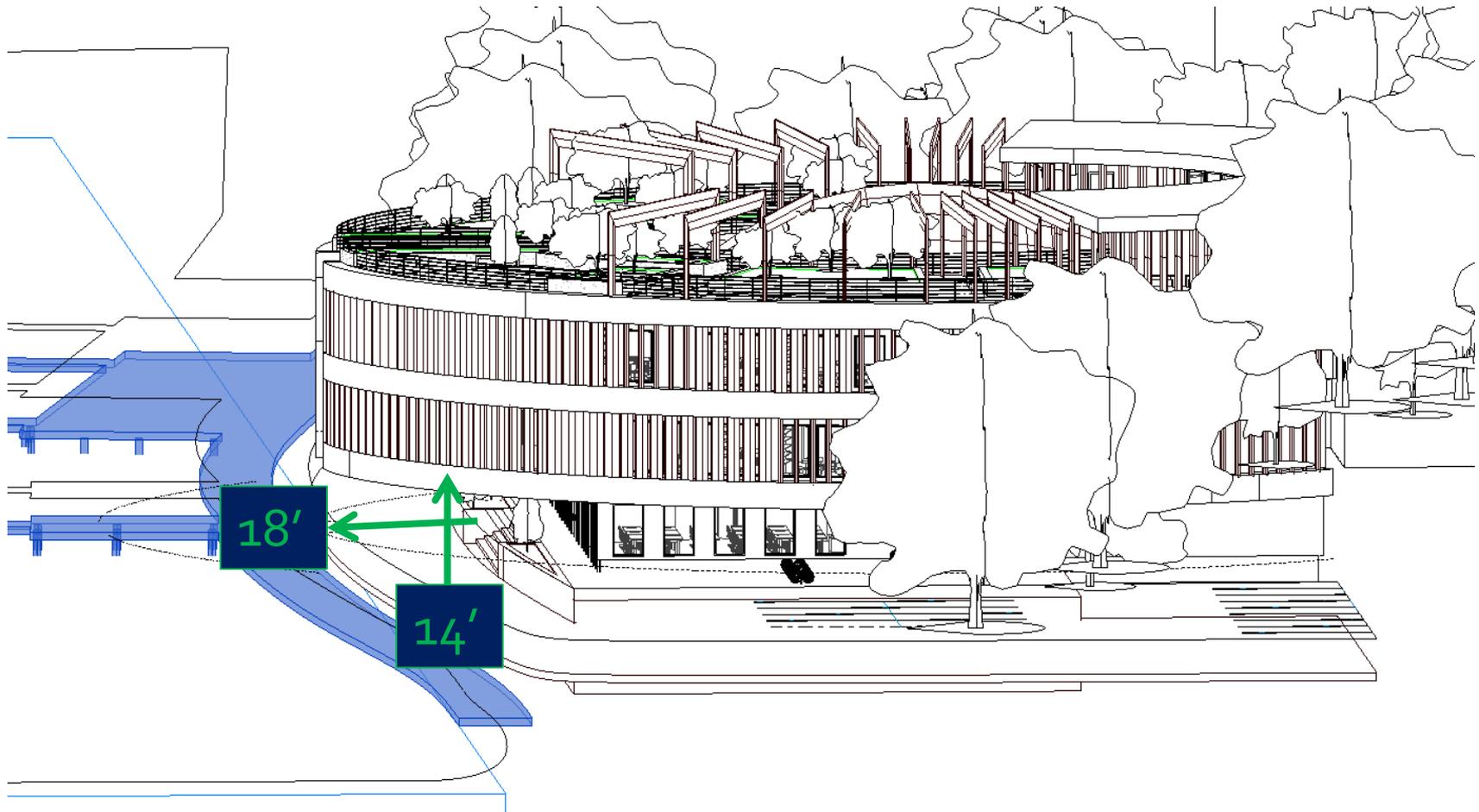


How to build cantilever?

Sequence and safety



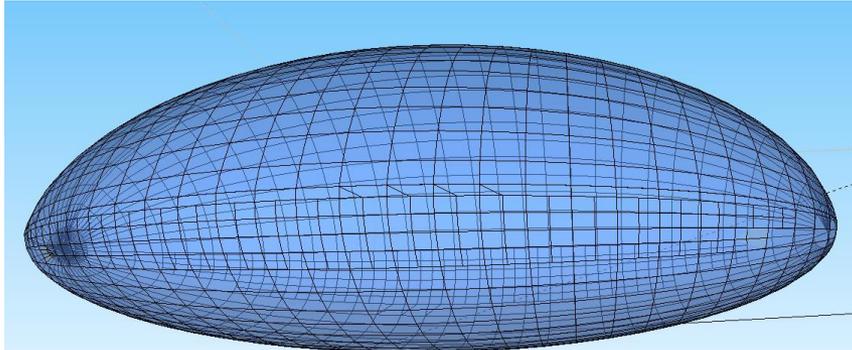
Cantilever Construction/Positioning



Auditorium Construction

Winter Quarter

Auditorium = Curved
ellipsoid shape



Spring Quarter

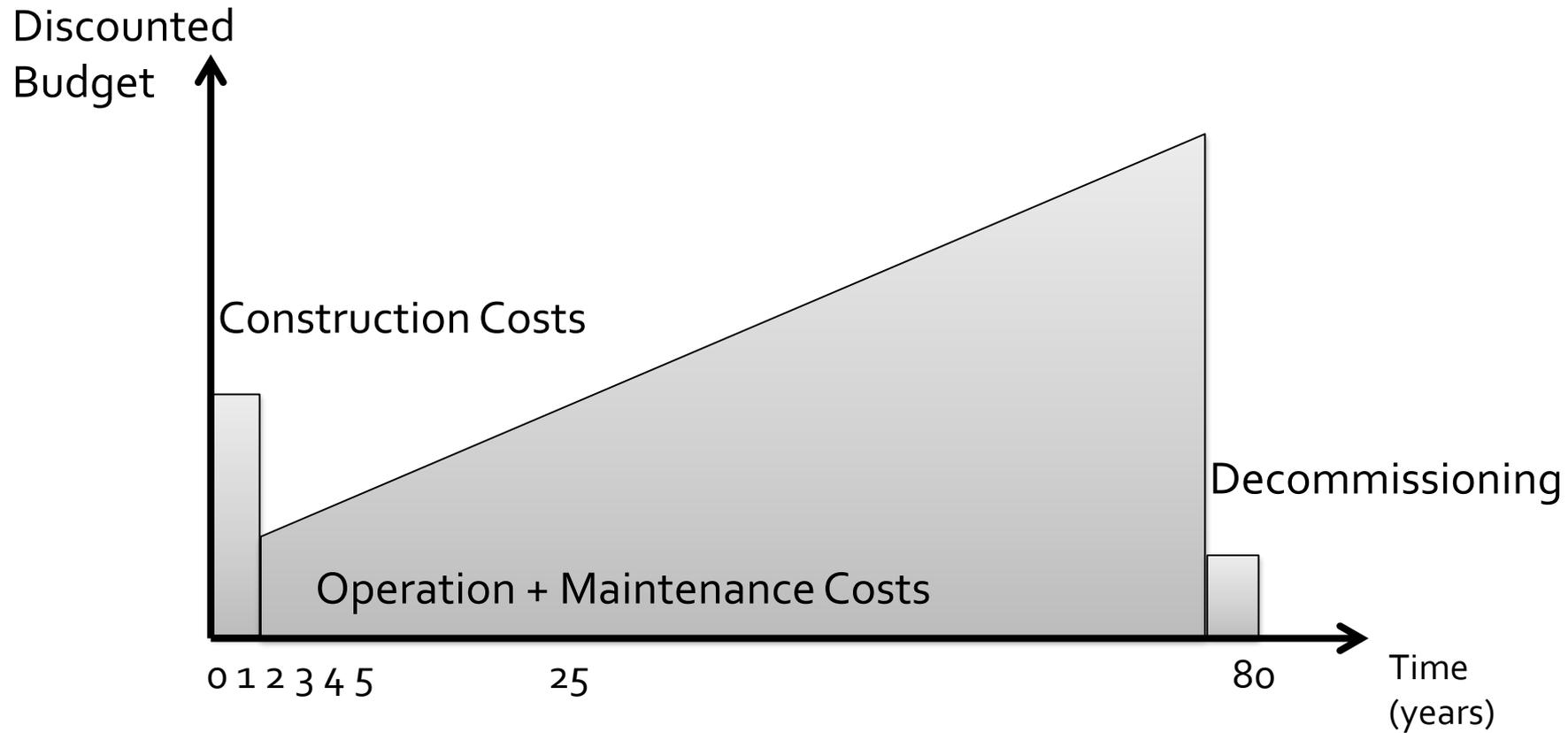
Prefab Double Curvature
Metal Panels



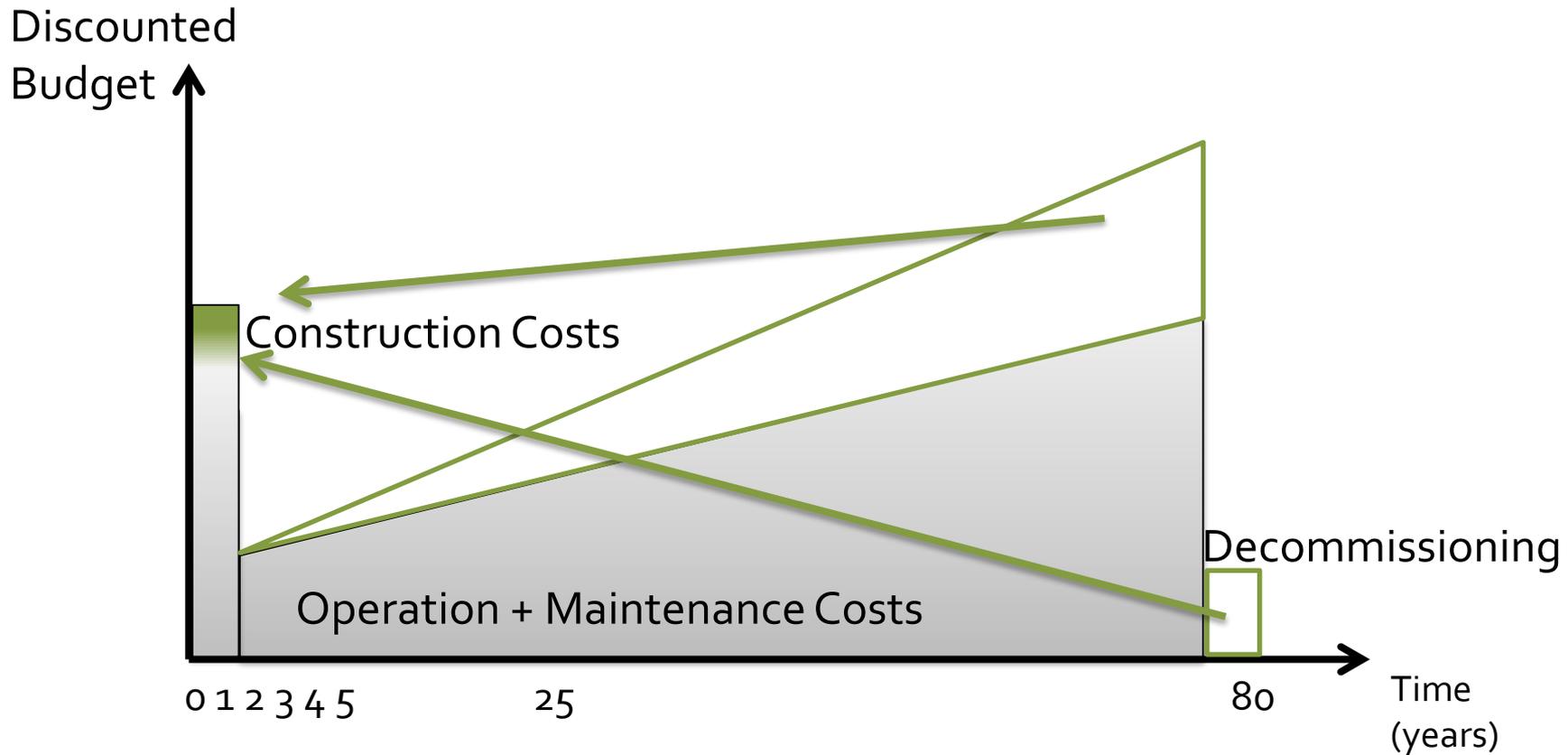


Life Cycle Financial Management

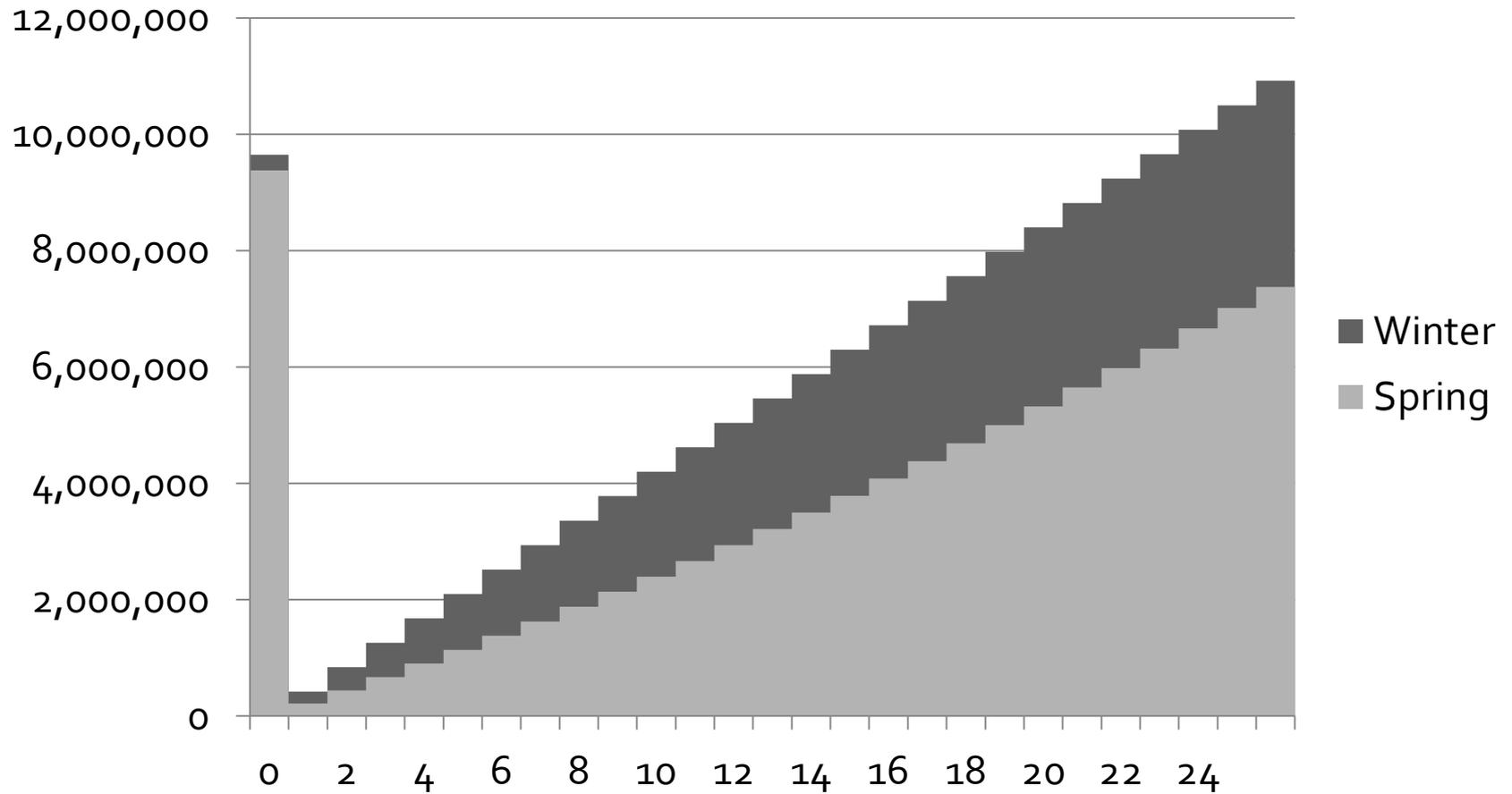
Life Cycle Costs - Generic



Life Cycle Cost - Challenge



Life Cycle Cost - Results



The Results

Winter

Spring

- 31 %



Building Size

49,247 SF

33,928 SF

O+M

\$ 10,080,000

\$ 5,202,000

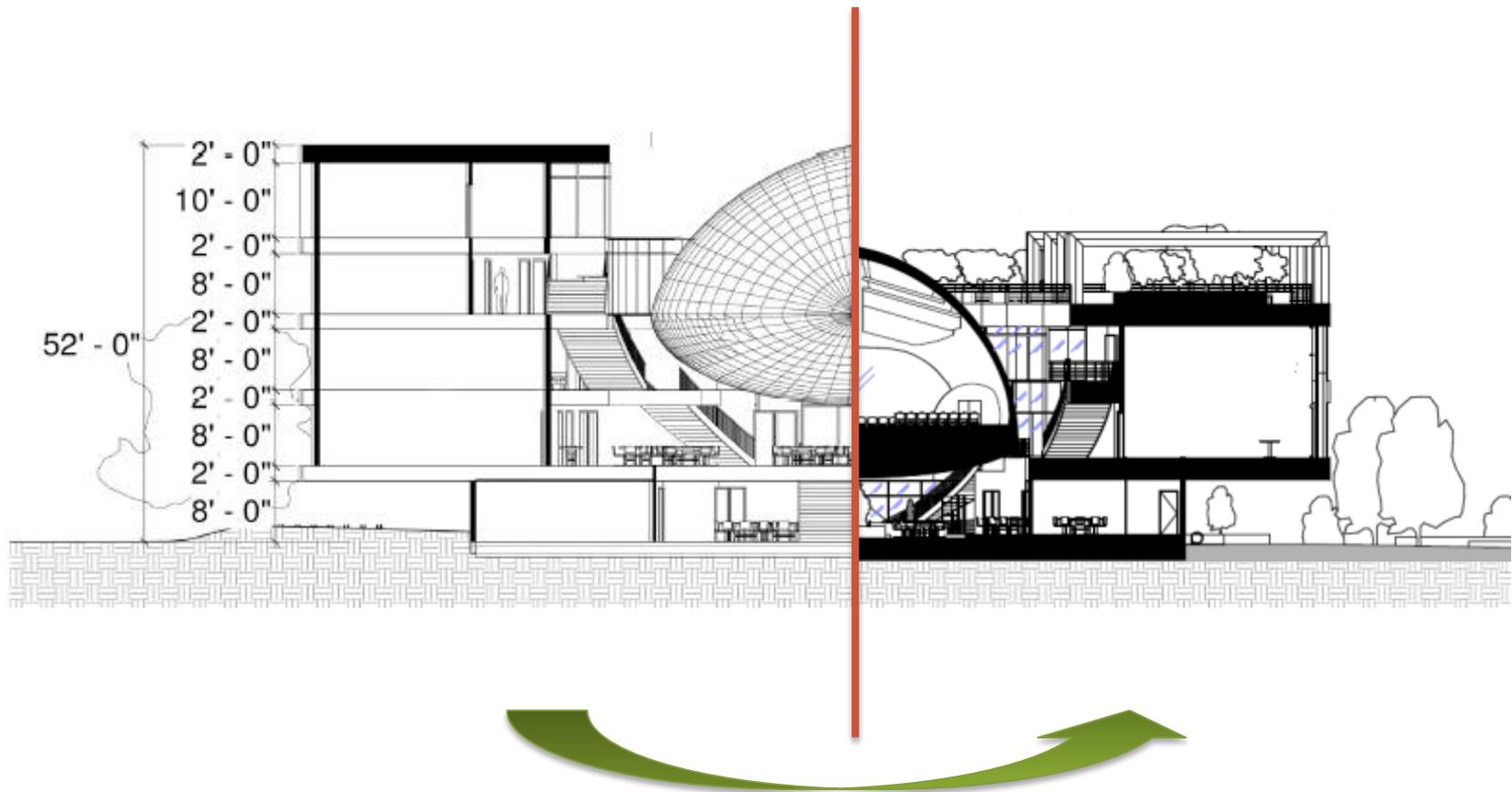
- 48 %



Sections Compared

Winter

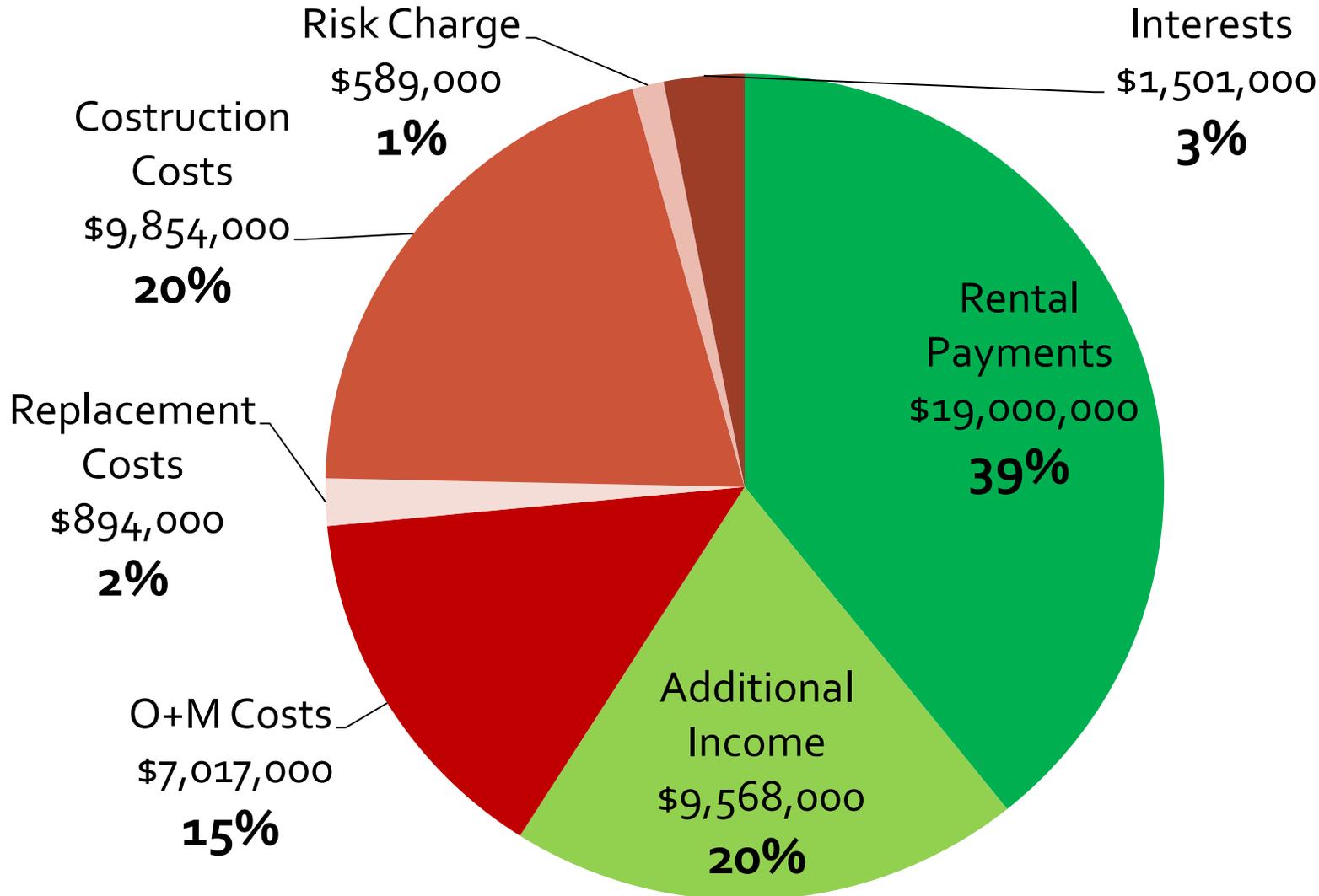
Spring



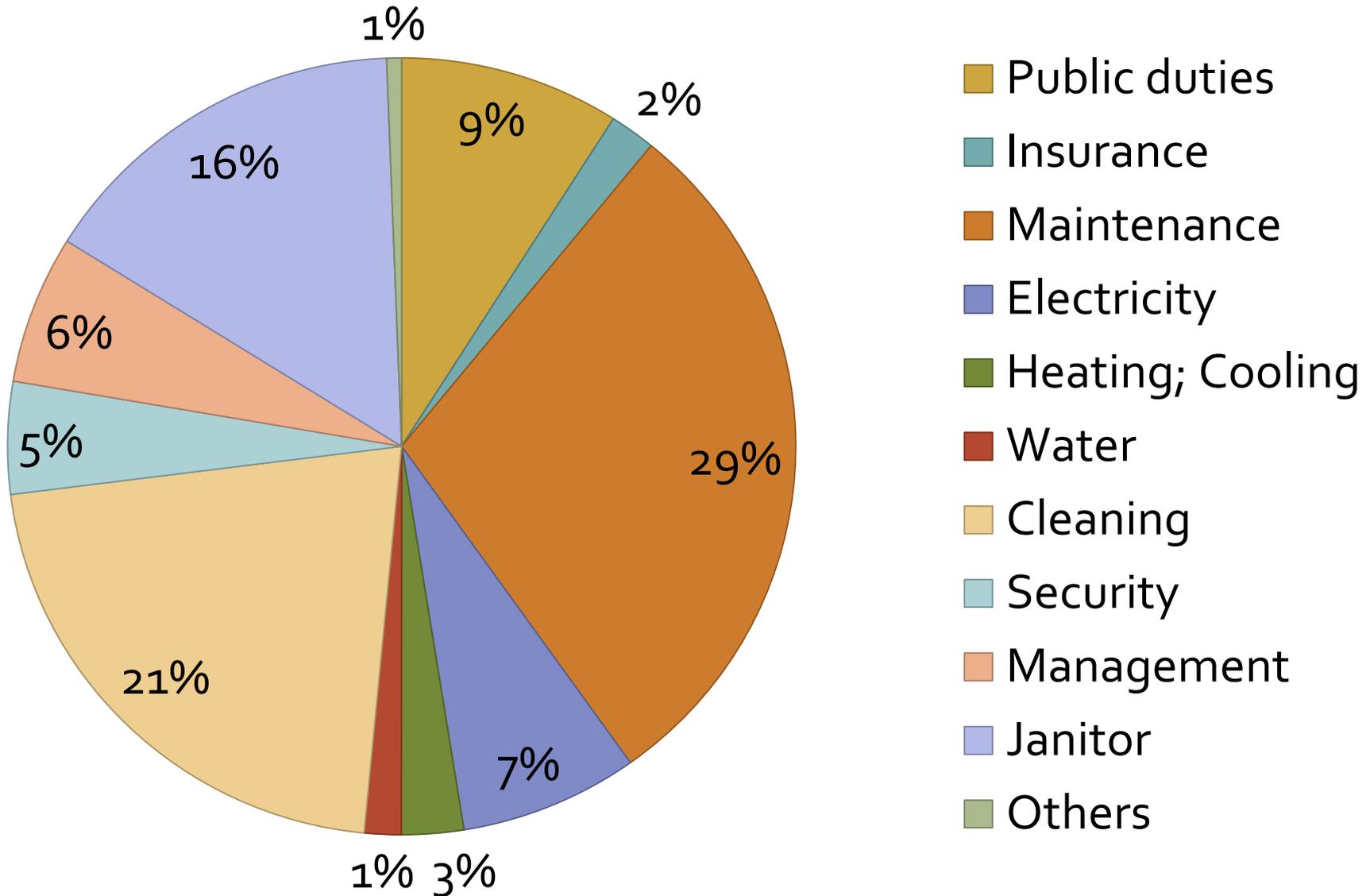
Embrace



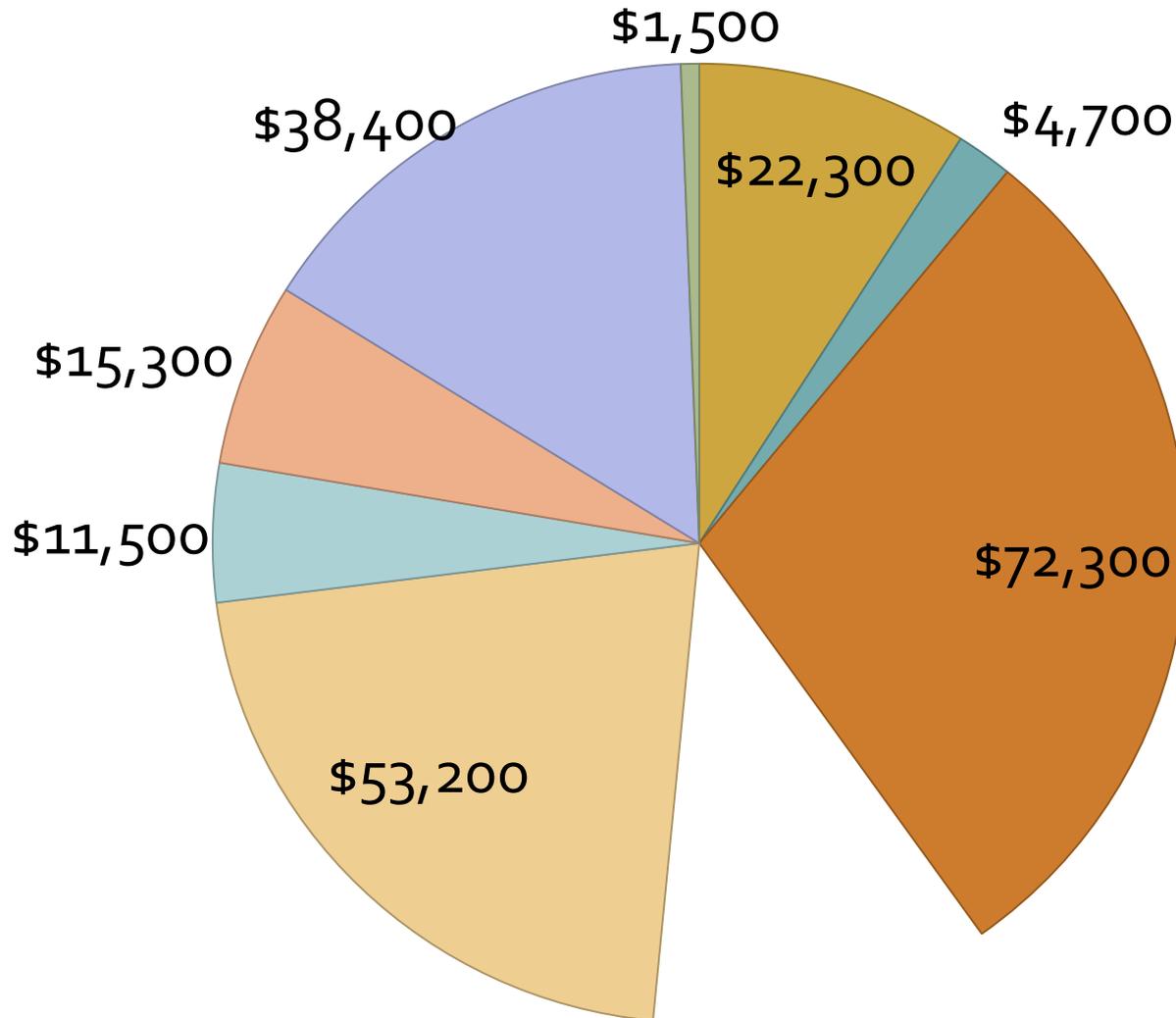
Life Cycle Cost – Contract Period



Operation+Maintenance Cost



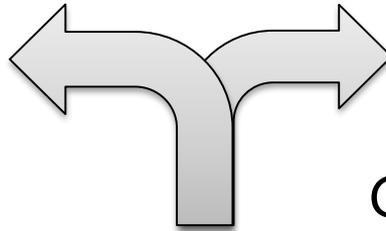
Covered by Annual Rent



Cost Transfer

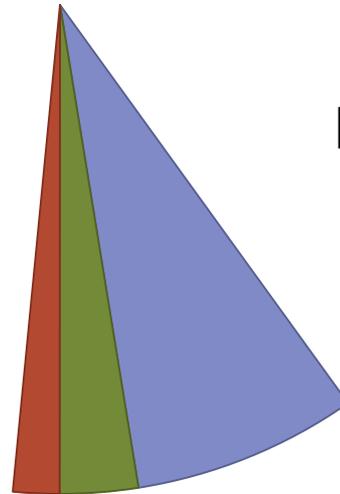


Dynamic Facade System



Grants for Student Research

Water
\$3,700

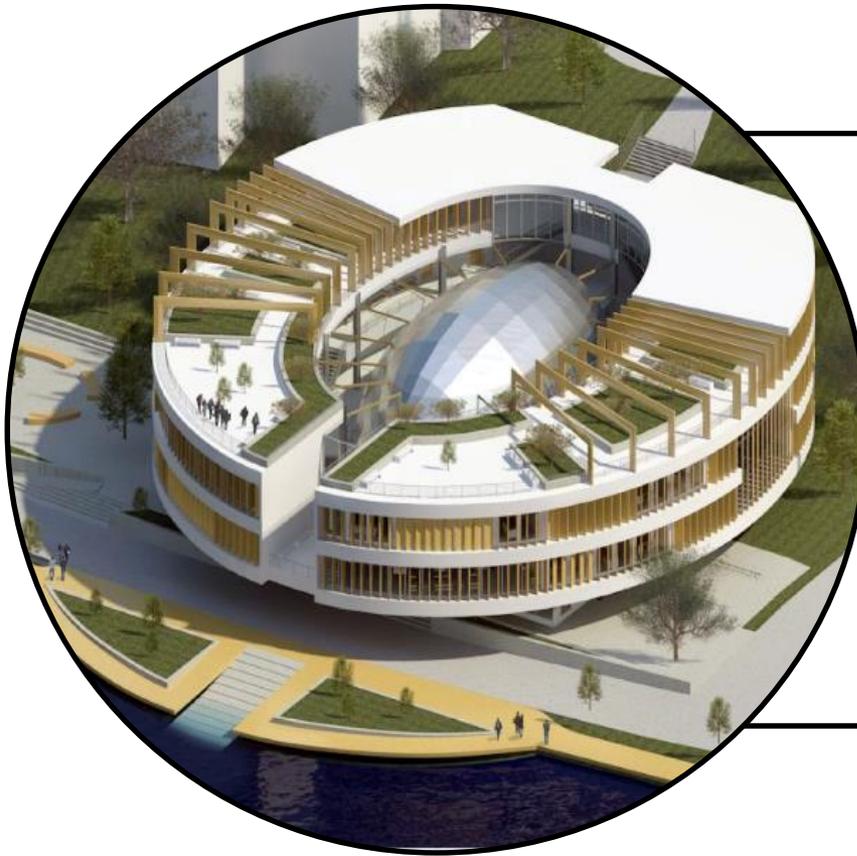


Electricity
\$18,100

Heating;
Cooling
\$6,300



Adding Value



Lowering
Operation
Cost

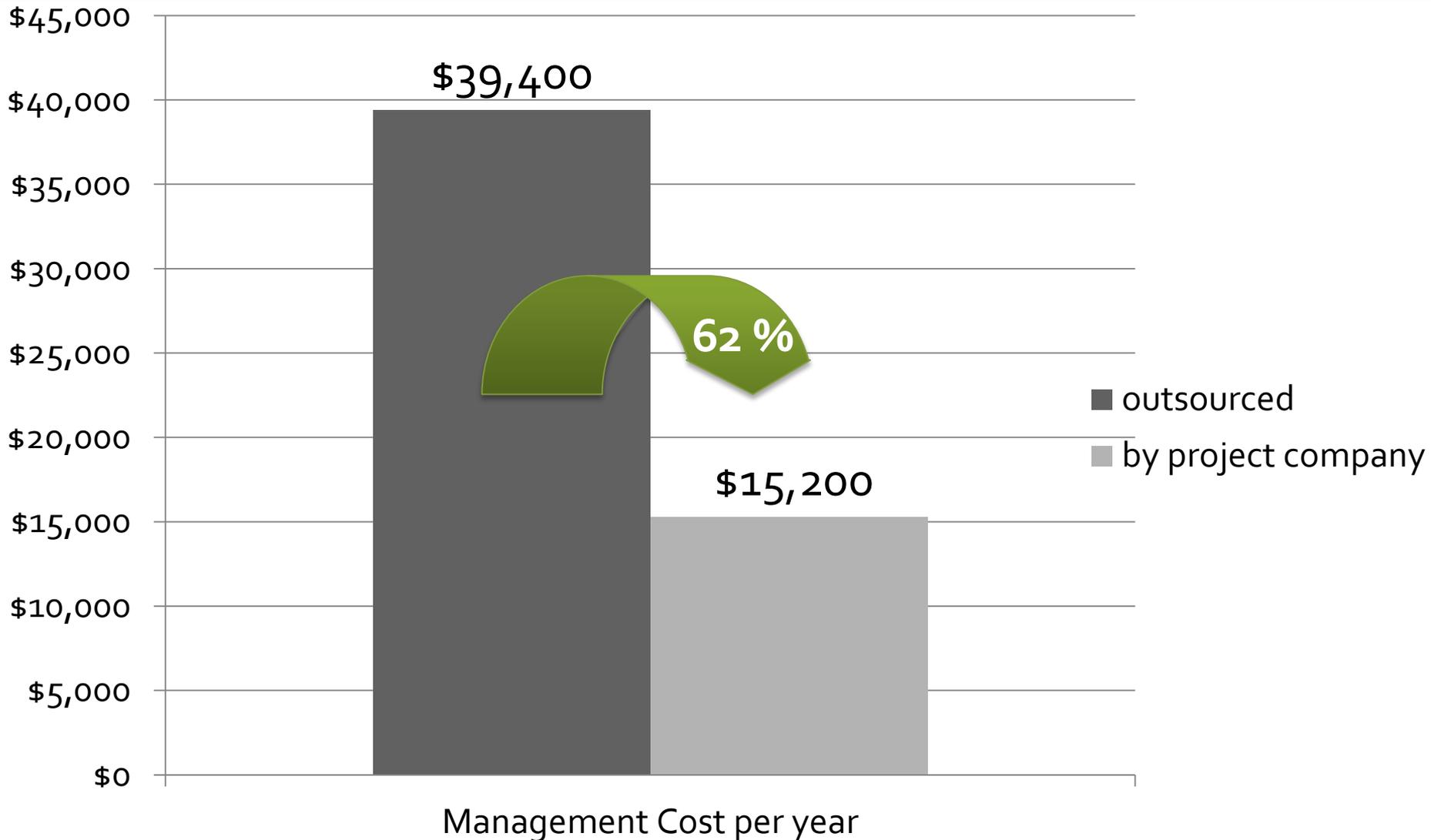


LEED Gold
Certified
Building

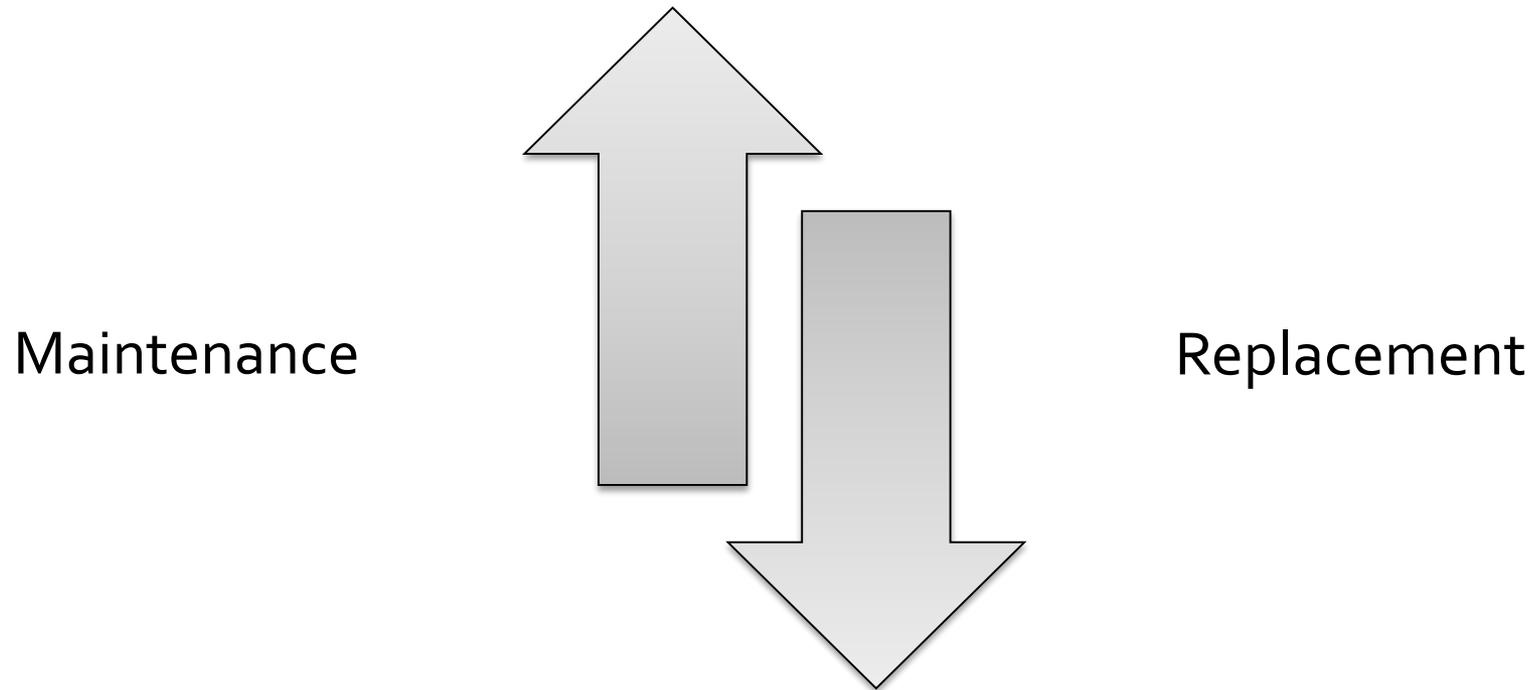


Additional
Income

Example Management Cost



Maintaining a Healthy Building

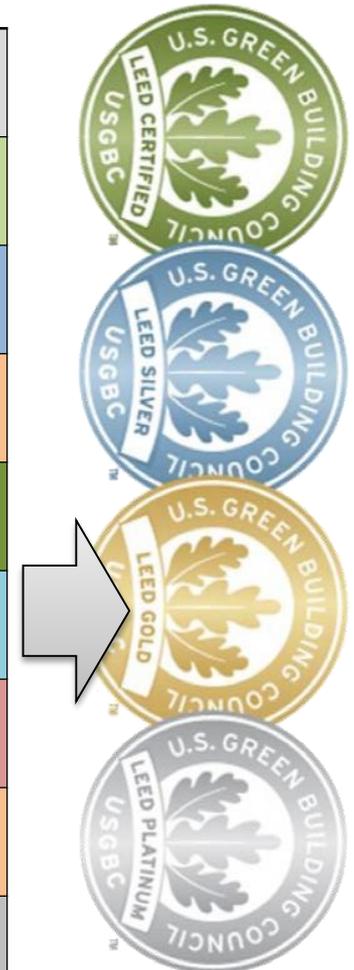


Investment in Maintenance + Late Replacement = Value for Money

LEED Certification

Overview

	Achievable	
 Location and Transportation	15	7
 Sustainable Sites	12	7
 Water Efficiency	12	10
 Energy and Atmosphere	31	15
 Materials and Resources	13	8
 Indoor Environmental Quality	16	15
 Innovation	6	1
 Regional Priority	4	2
Total	110	65



Risk



Major Risks

Construction Phase:

Risk on Deviant Construction Costs in 2020

Operation Phase :

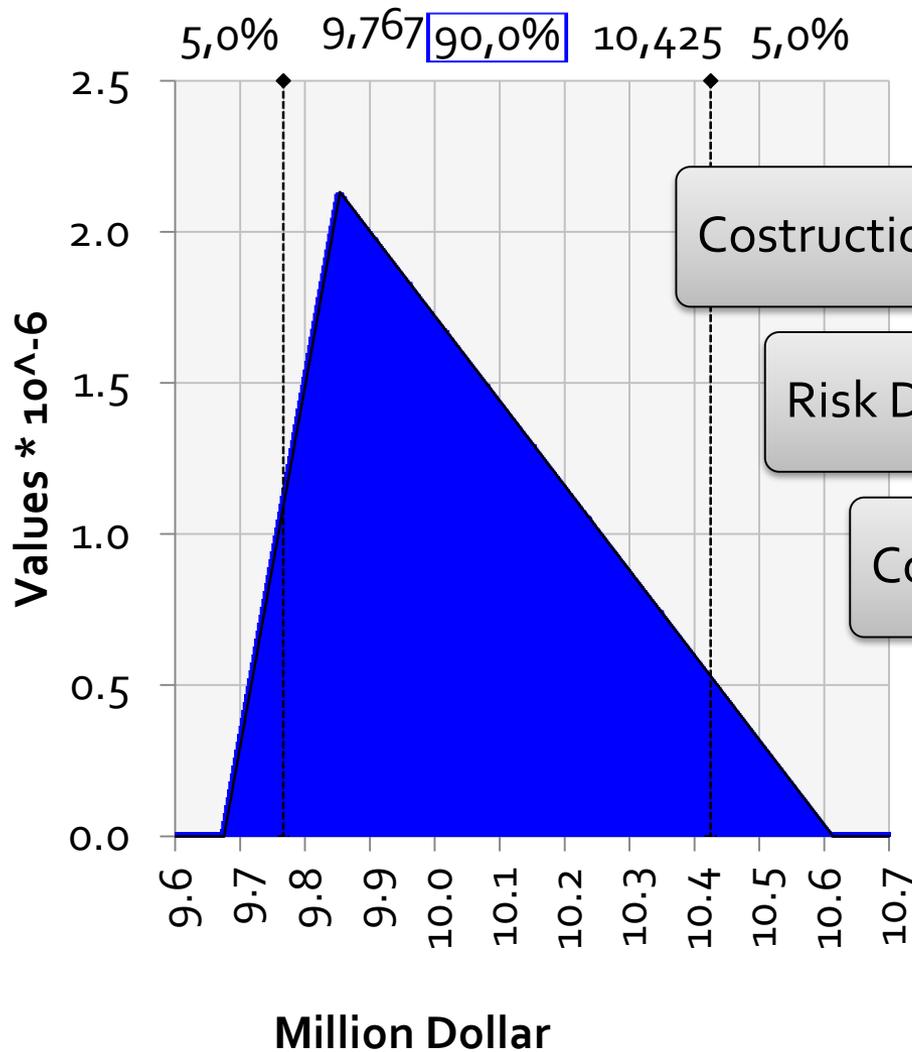
Risk on Deviant O+M Costs

Risk on Deviant Replacement Costs

Risk on Deviant Additional Income

Construction Cost

Probability Distribution



Process and Method

Costruction Cost [CM – TVD]

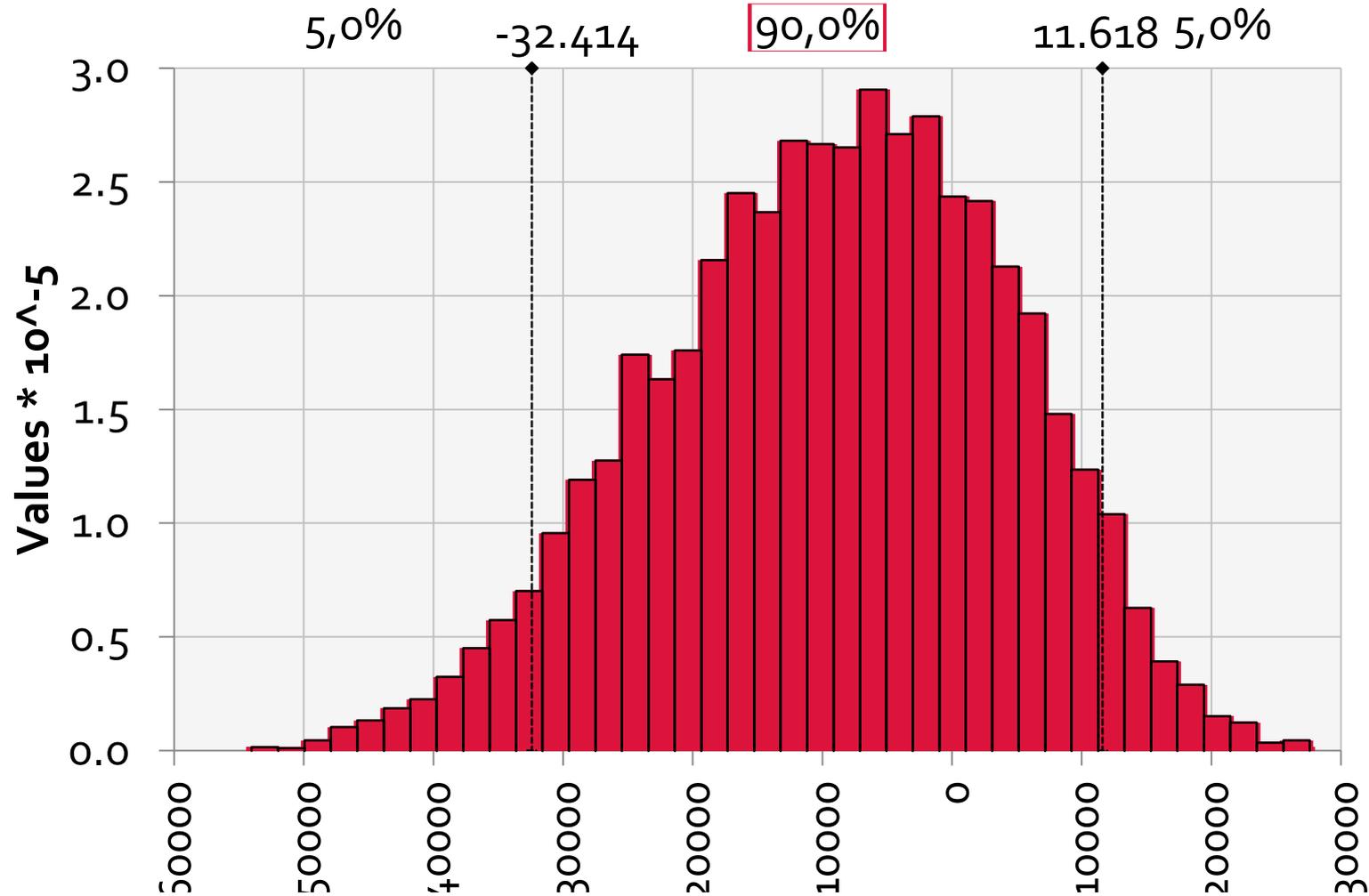
Risk Distribution [LCFM – @Risk]

Cost Distribution [Cash Flow]

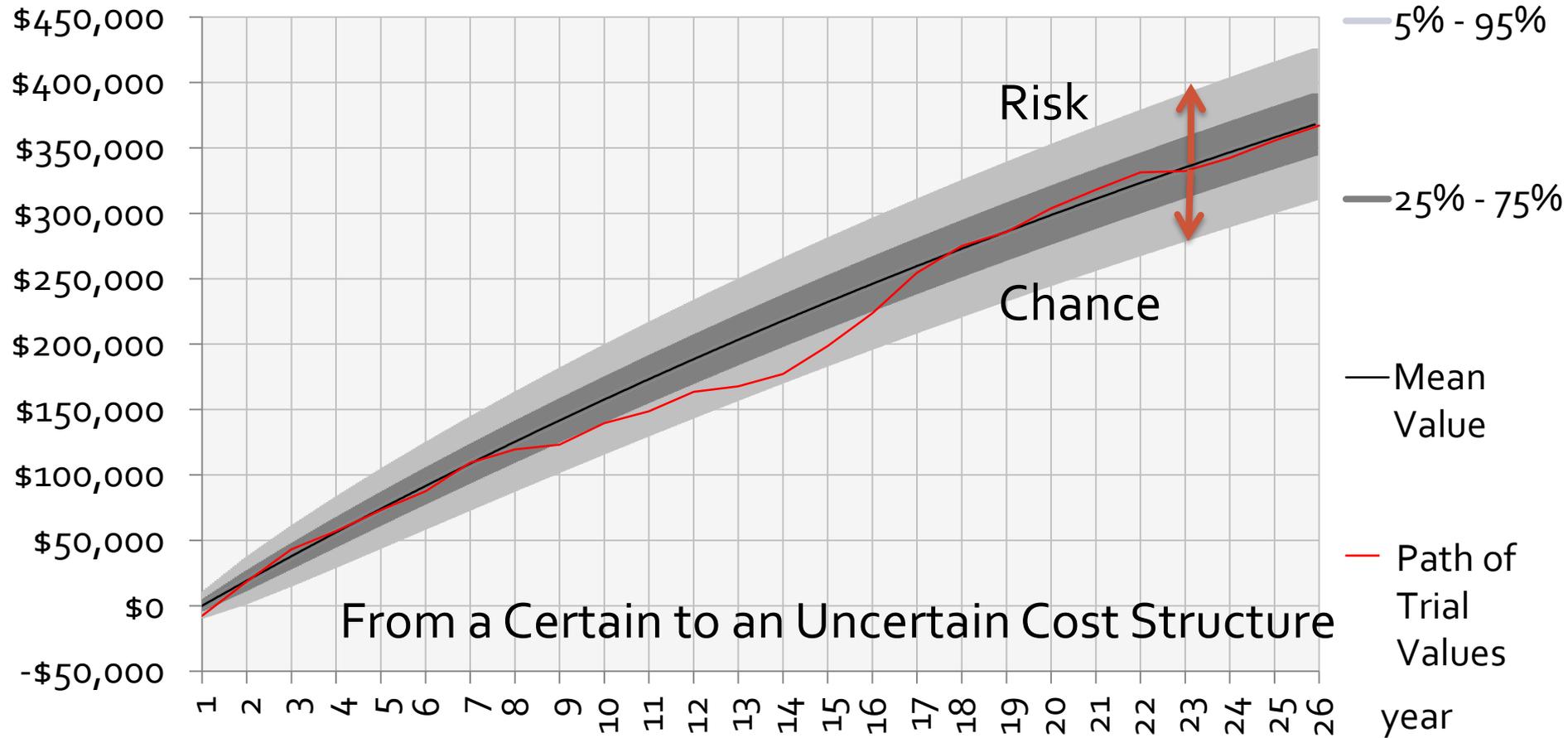
Risk Charge [Cash Flow]

Probability Distribution

Risk Charge per Year

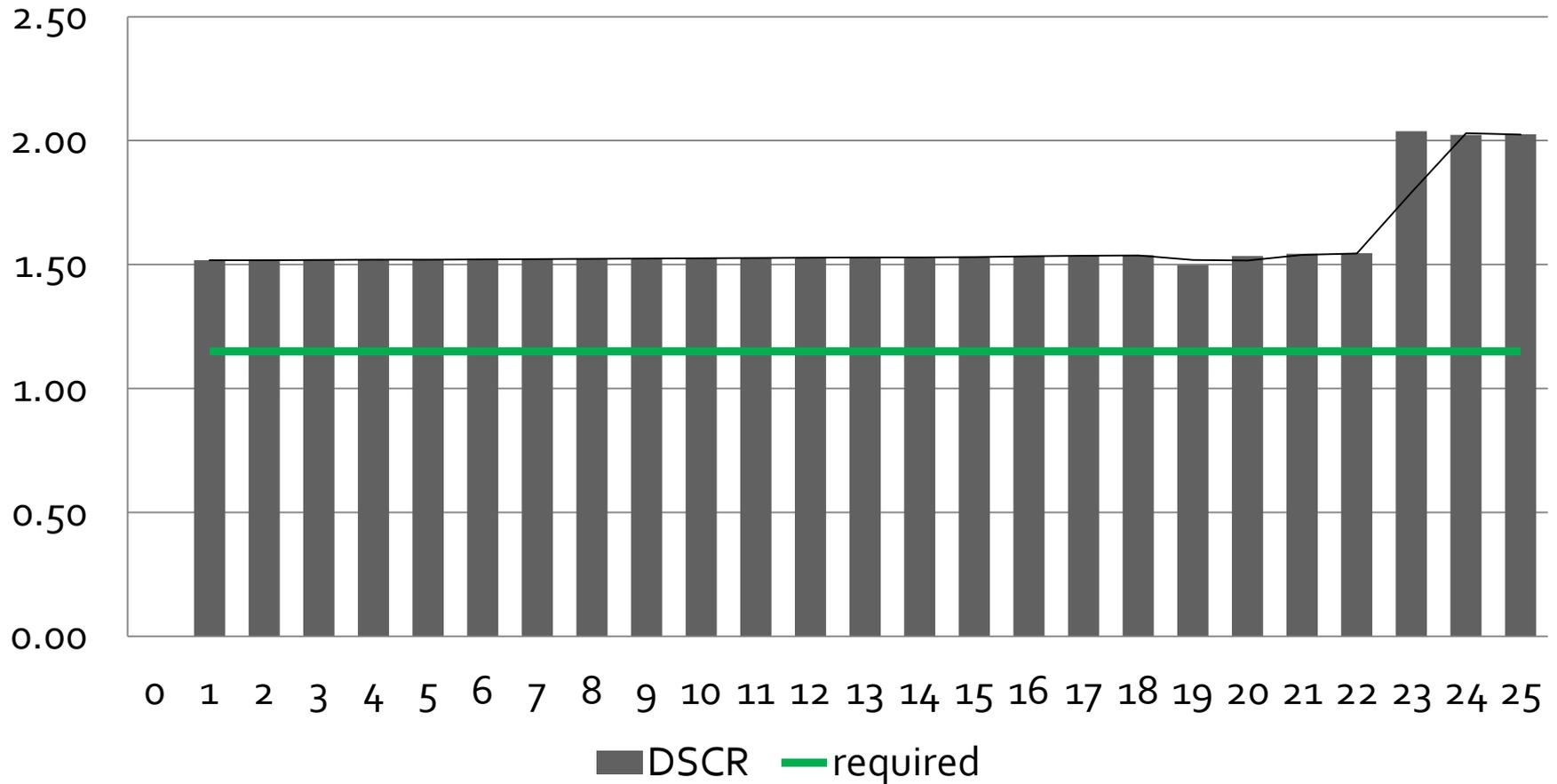


Risk Charge Operating Phase

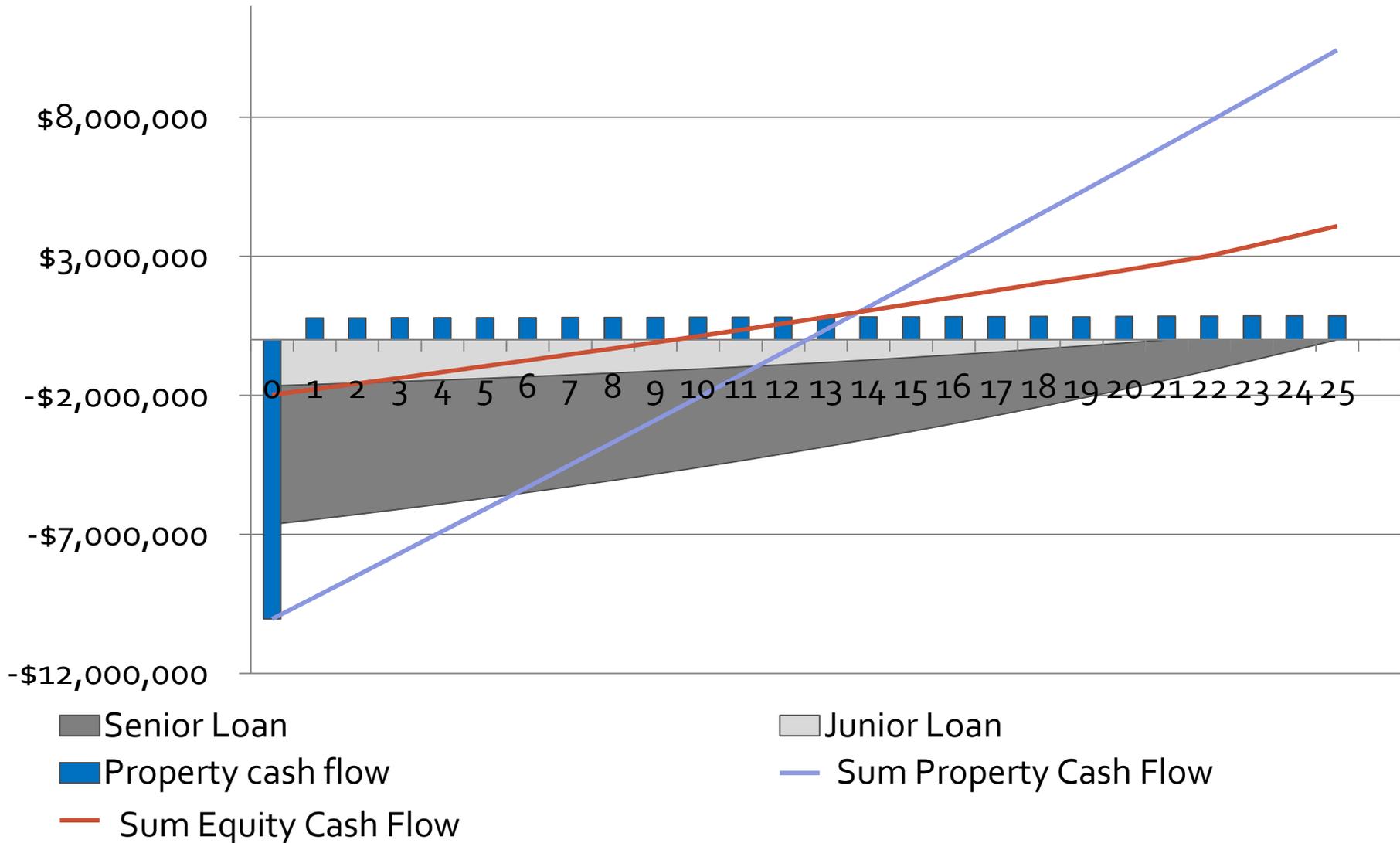


Debt Services Coverage Ratio

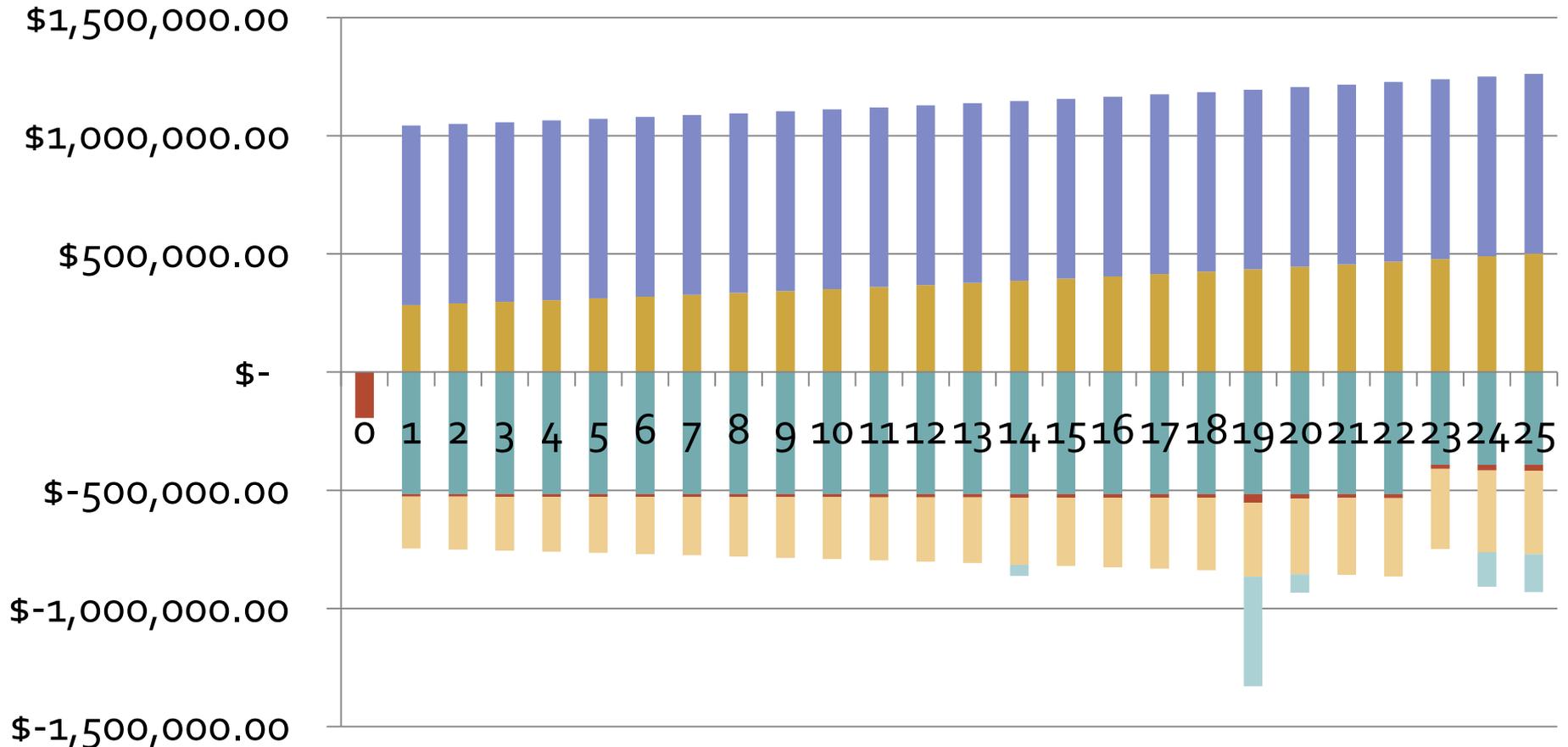
DSCR



Cash Flow



Earnings / Expenses



Replacement Cost

O+M Cost

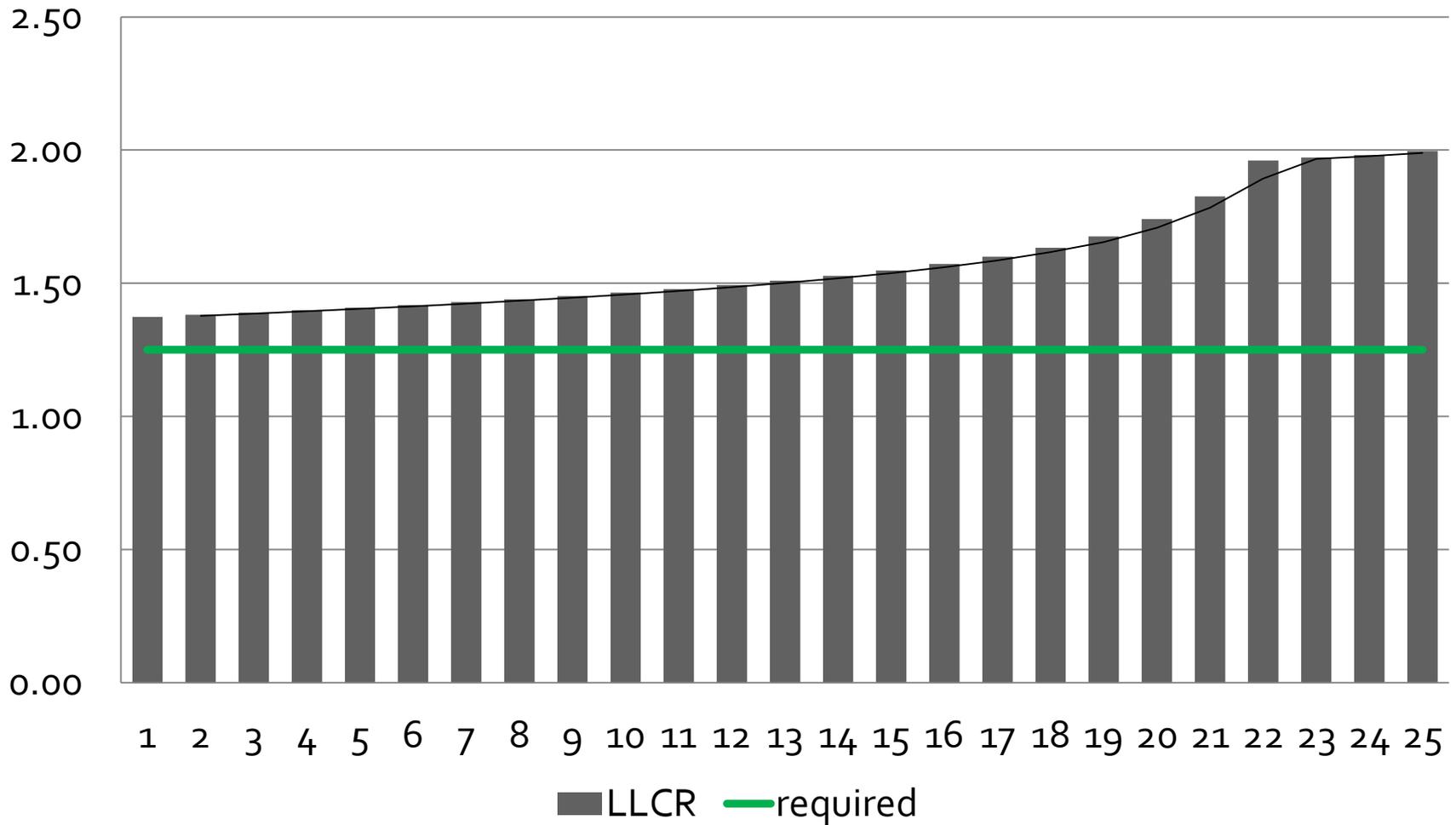
Risk Charge

Building Rent

Debt Services

Additional Income

Loan Life Coverage Ratio



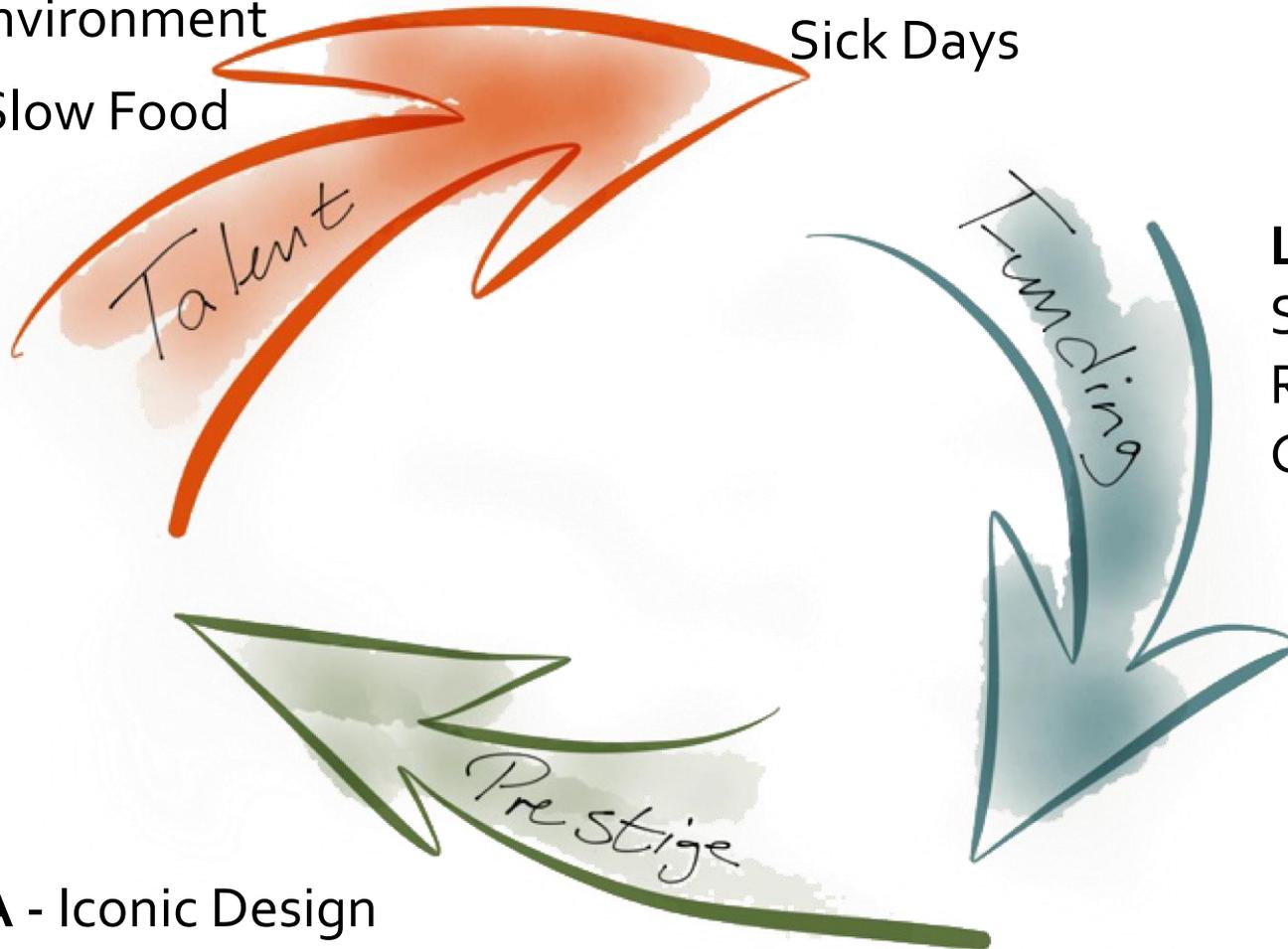
Total Value to the Owner

A – Optimal Learning Environment

MEP – Fewer Sick Days

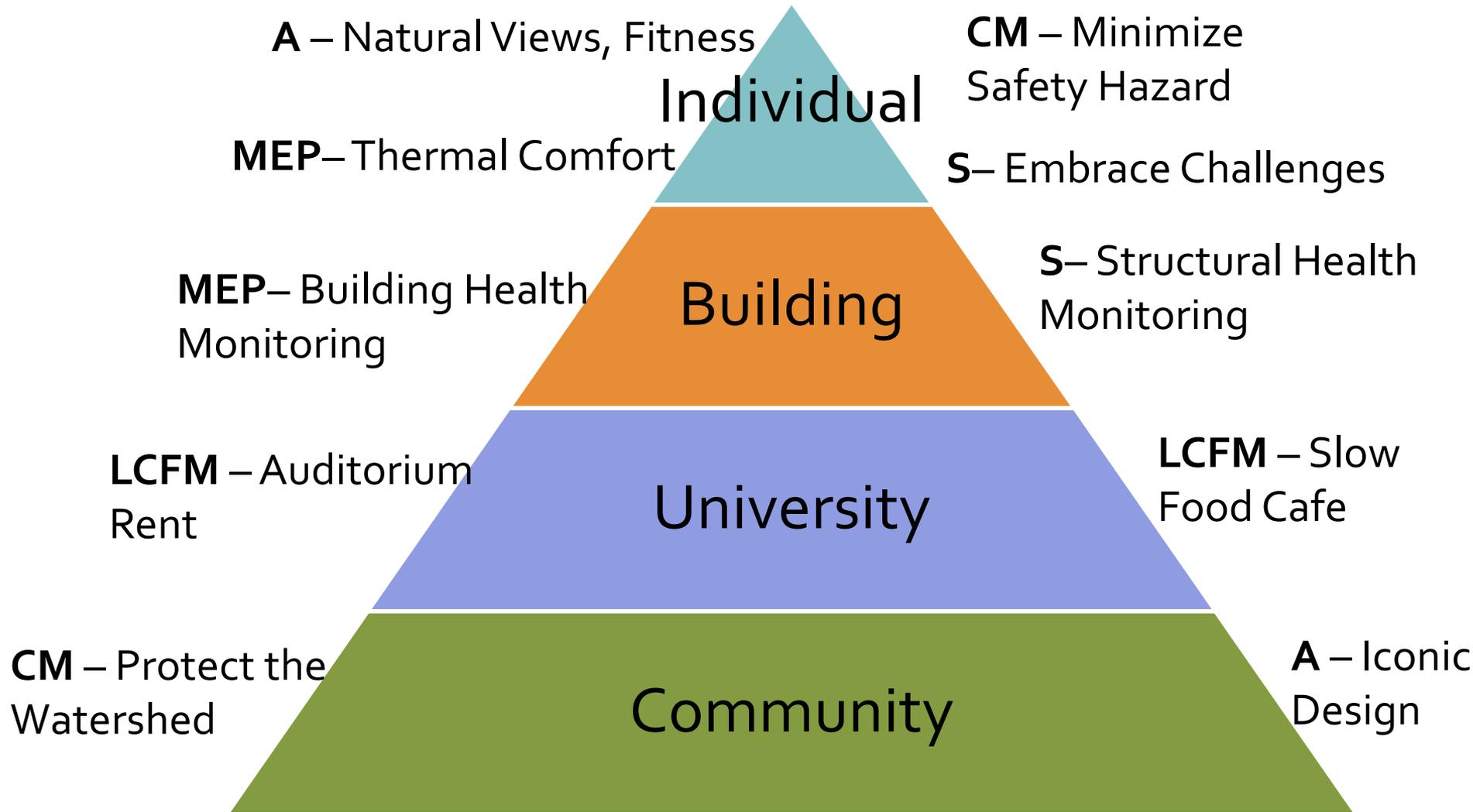
LCFM – Slow Food Cafe

LCFM – Student Research Grants

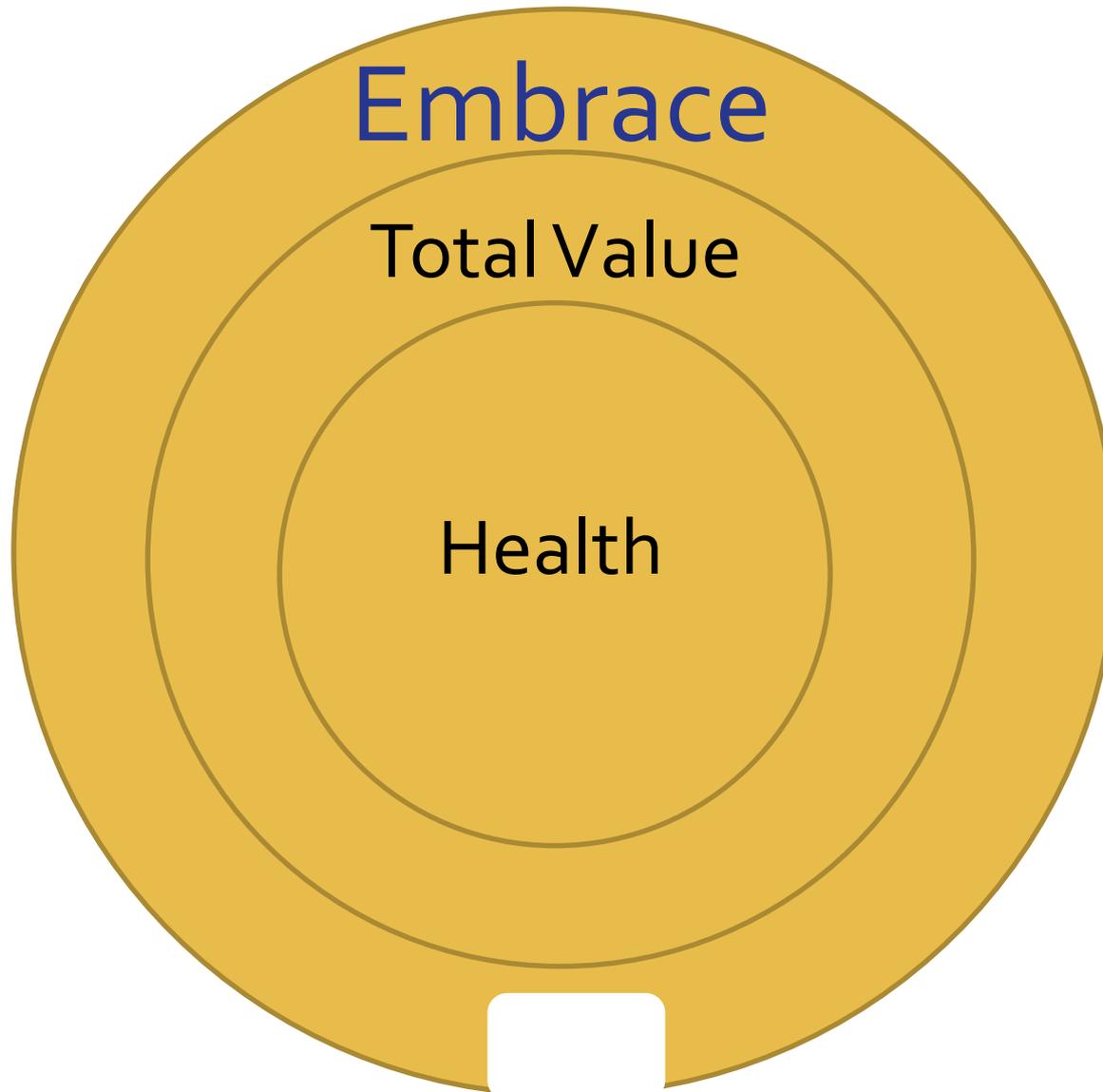


A - Iconic Design

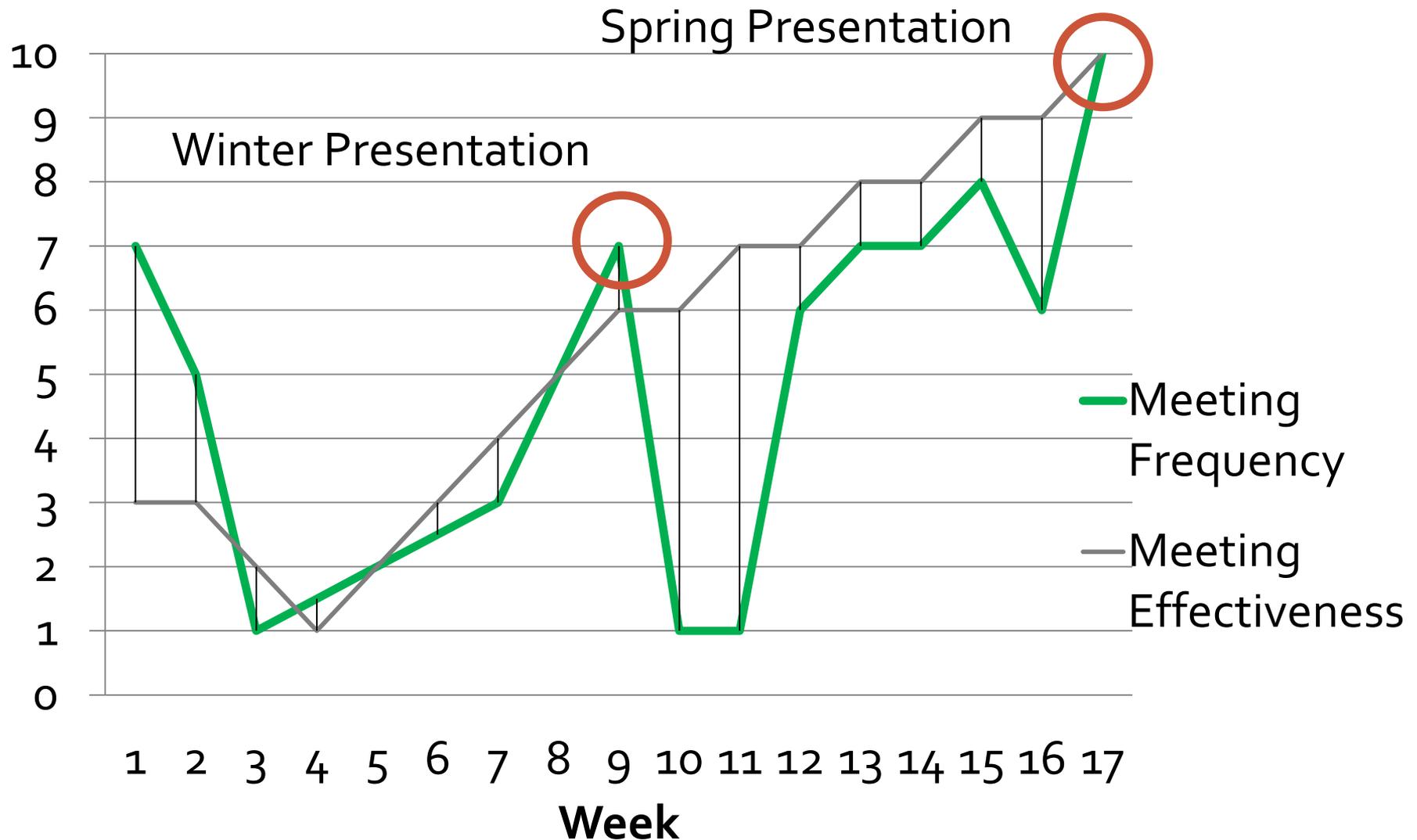
Hierarchy of Health



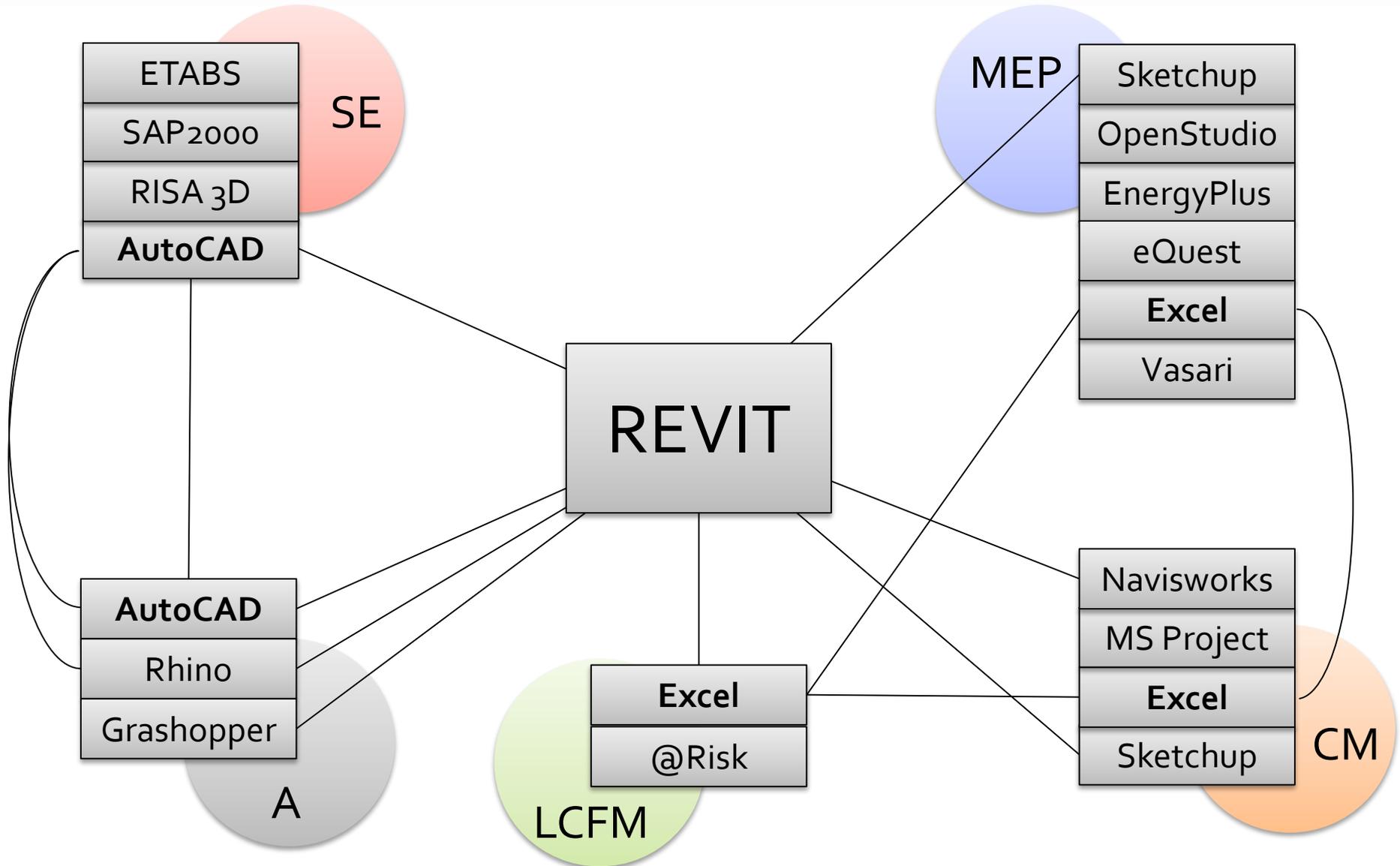
Embrace the Challenges



Team Process – Team Meeting



Team Process – Software Challenge



**Jingxuan:
Embrace the
Challenge**



**Dominik: Keep asking, otherwise
you never get your input**

Propose your ideas with more
than words --- easier to
understand - Jakob



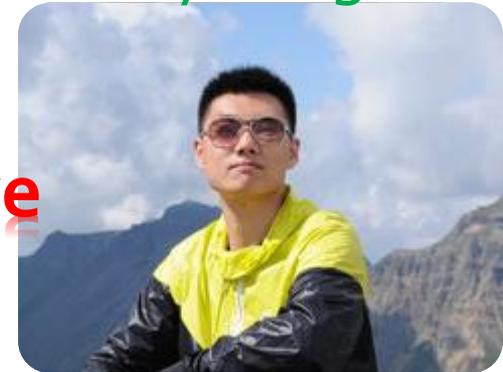
**Eric: Tasks
always take
longer than
you first
imagine**



Lucas: Visualize Perspective



**Yue: There
is always a
solution to
everything**



Jinzhi: No one read your minds. Think something, say something

萱儿: 拥抱挑战



Dominik: Höre niemals auf nachzufragen, anderenfalls bekommst du keine Ergebnisse

Foreslå dine ideer med mere end ord... Det er nemmere at forstå! - Jakob



华悦: 一切问题都可以解决



育偉: 有時任務會比你想像更耗時間



Lucas: Visualize Perspective



王近知: 不要让别人解读你的想法

A Special Thanks to:

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Kyle Adams

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