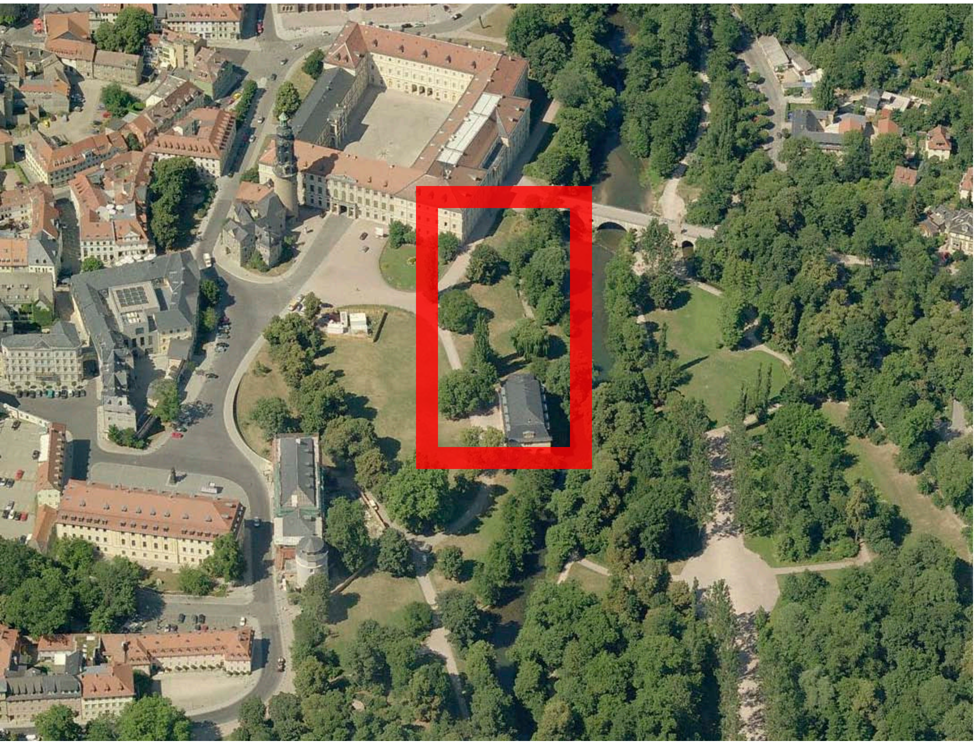
River Team 2010

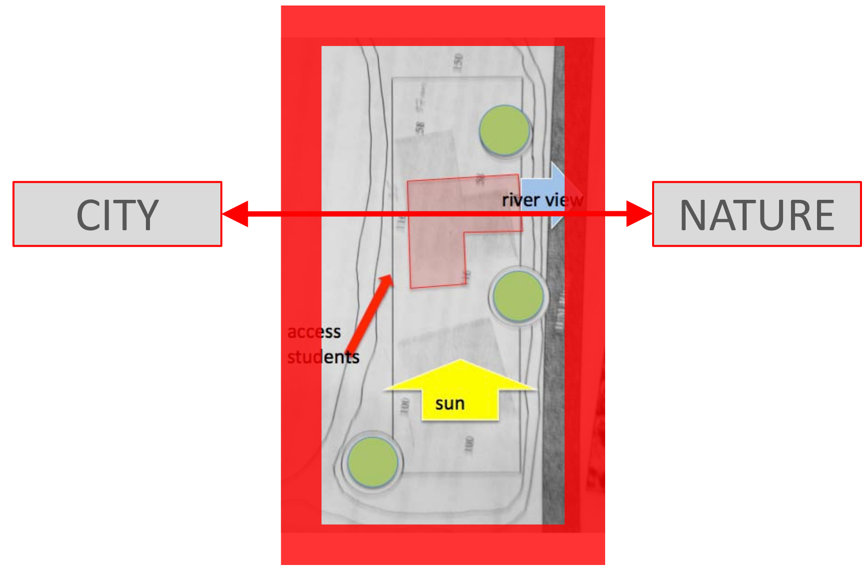
Winter Presentation

Owner	A	E	C	L	S
David	Urszula	Joanna	Nima	Sebastian	Alex
		Brent	Martin		

Site Conditions

University building in Weimar, Germany

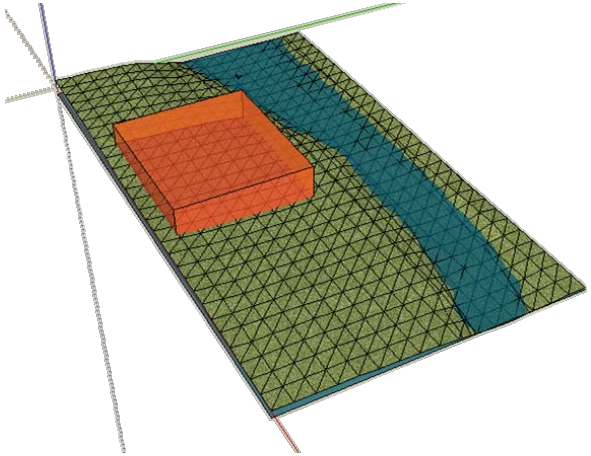




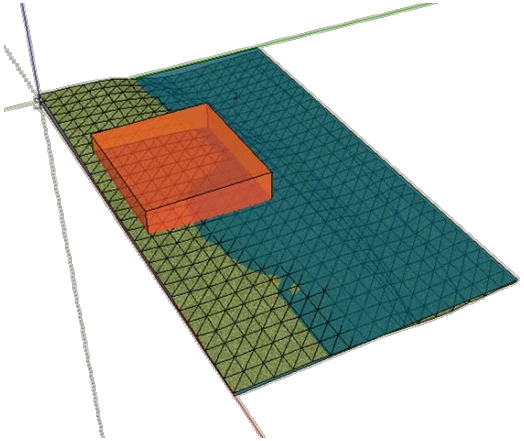
A
E
C
L
S

Flooding Challenge

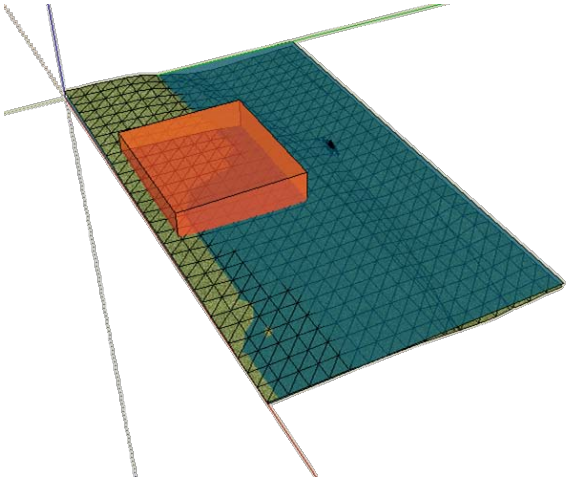
detailed terrain profile and different water levels



Normal water level



33 year flood



100 year flood

A

E

C

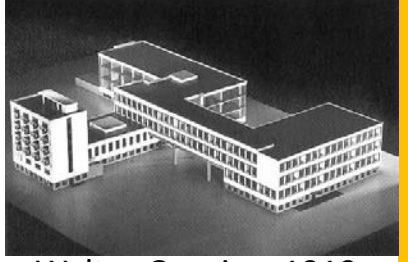
L

S

Big Idea: Transparency

Showing interior processes and actions

Inspiration: Bauhaus



University Building in Dessau by Walter Gropius, 1919

- innovation
- **visual comunication**
- **no barriers** between students and profs
- functionality / simplicity

<u>Our goals:</u>

- NO: naive copy of the building
- YES: use the way of thinking

A

E

C

L

S

3D views

South view

West facade

A

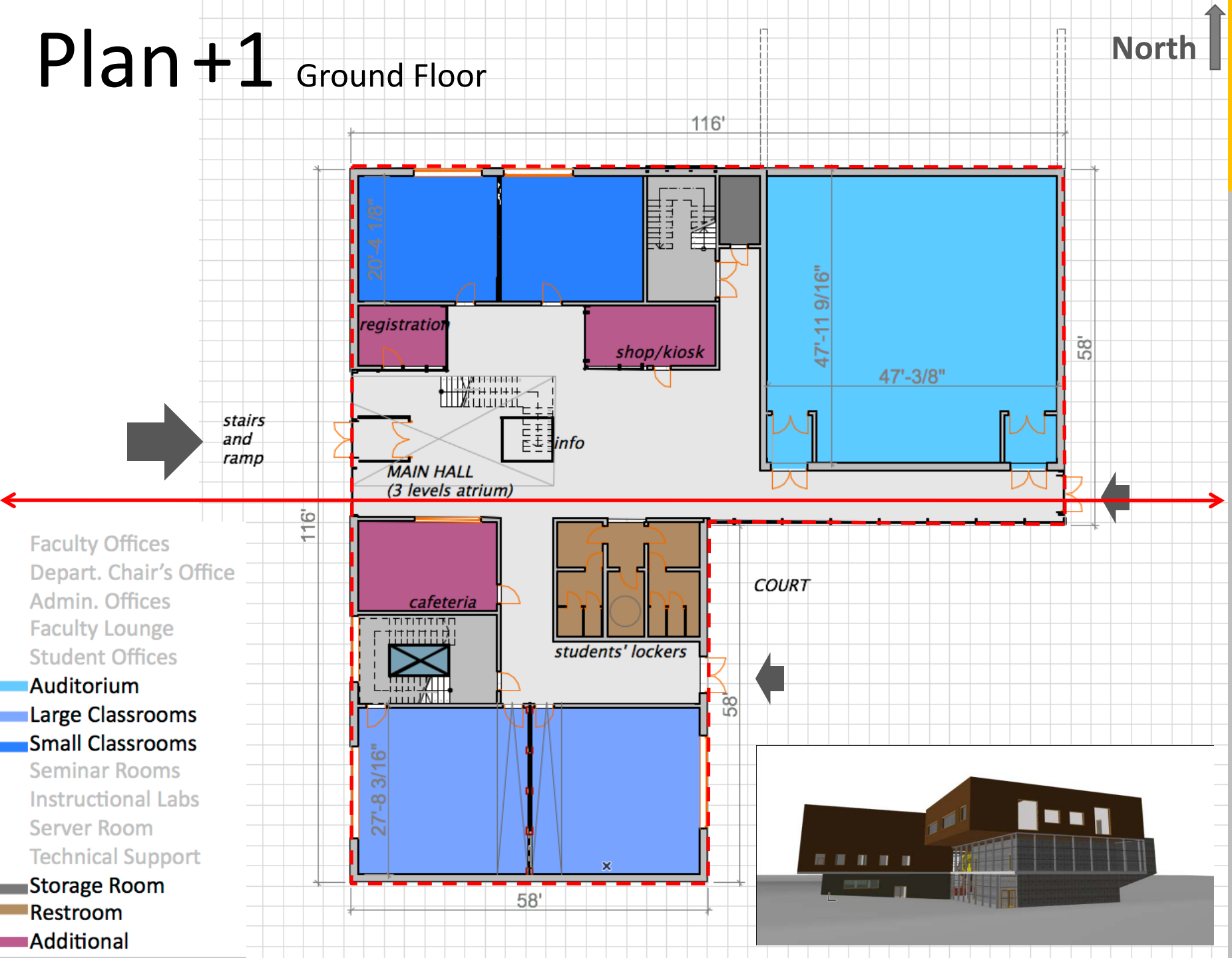
E

C

L

S

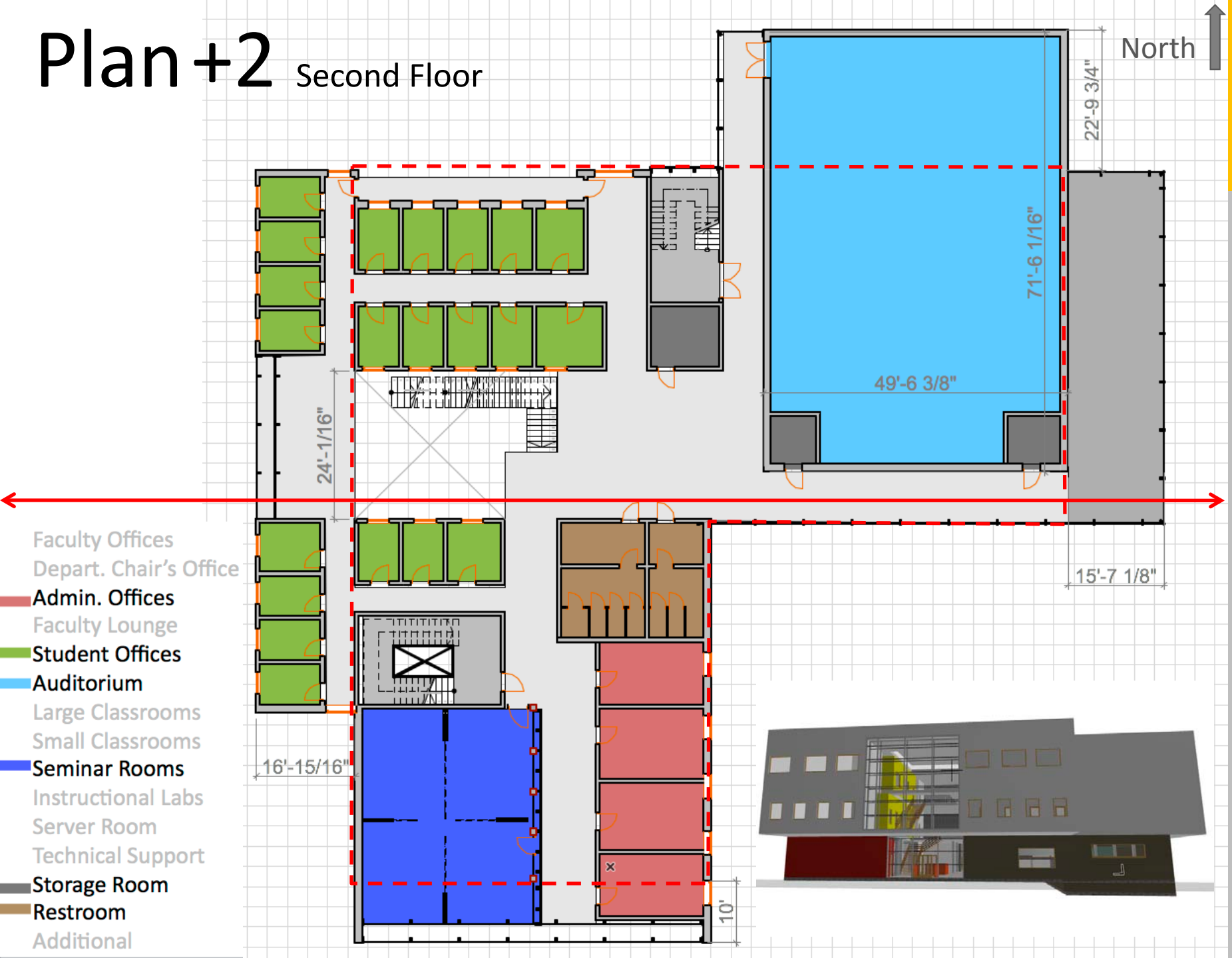
Plan +1 Ground Floor



Faculty Offices
Depart. Chair's Office
Admin. Offices
Faculty Lounge
Student Offices
Auditorium
Large Classrooms
Small Classrooms
Seminar Rooms
Instructional Labs
Server Room
Technical Support
Storage Room
Restroom
Additional

A
E
C
L
S

Plan +2 Second Floor



A

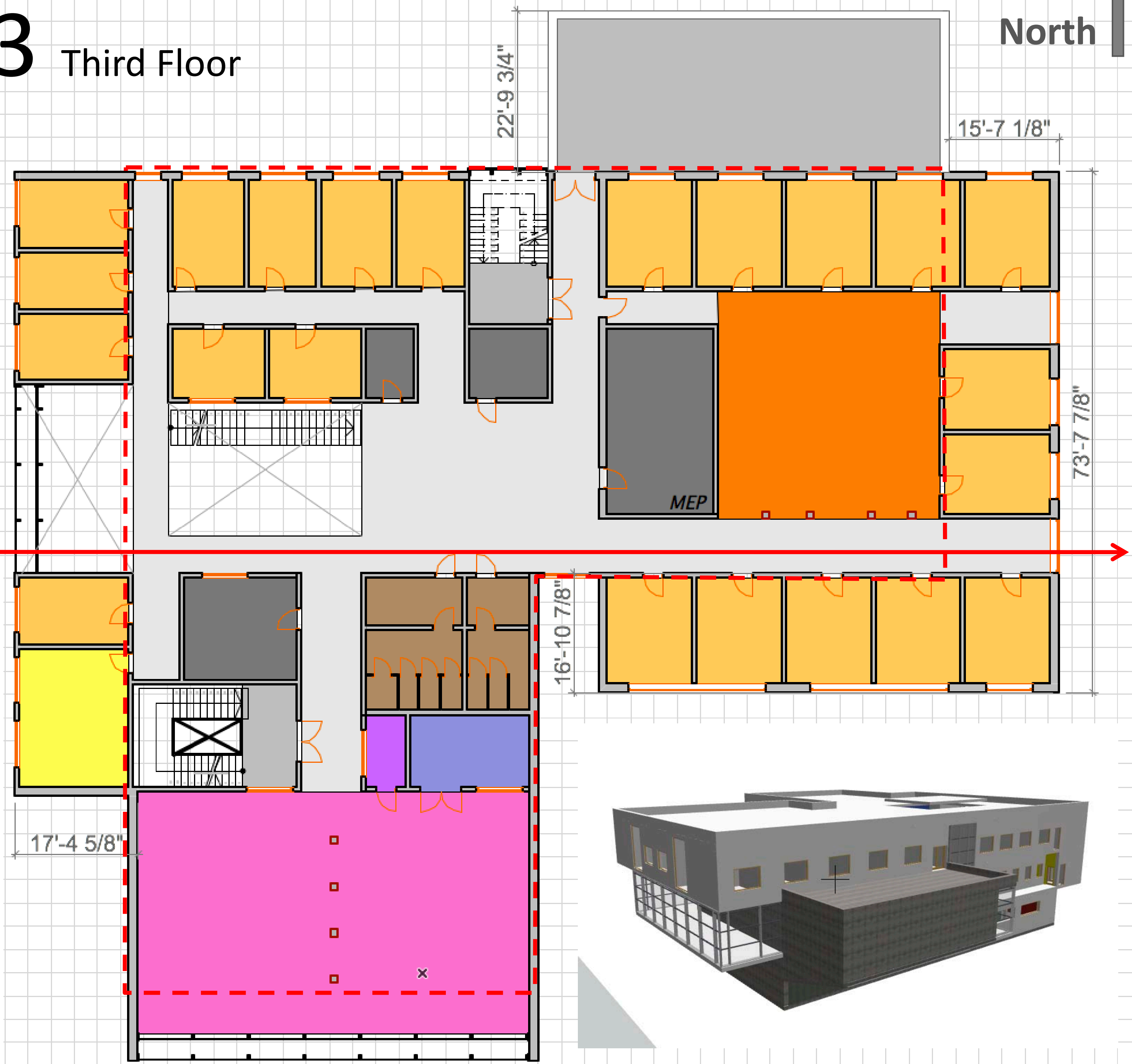
E

C

L

S

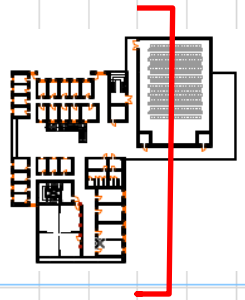
Plan +3 Third Floor

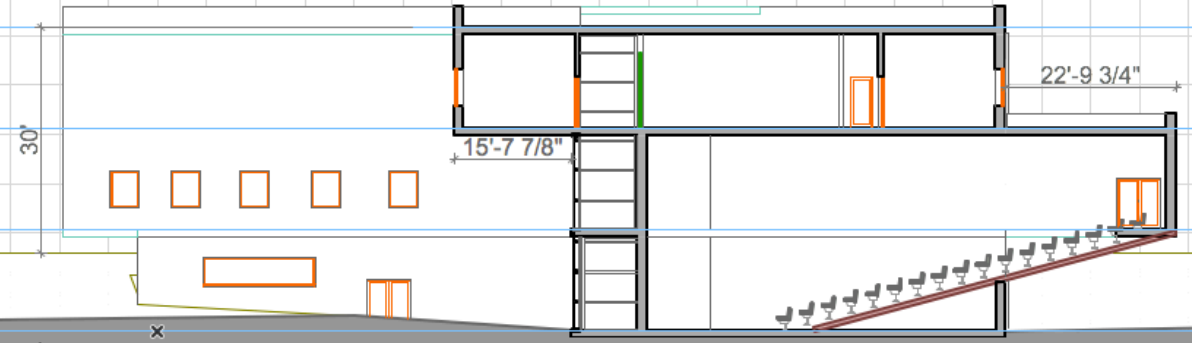


Faculty Offices
Depart. Chair's Office
Admin. Offices
Faculty Lounge
Student Offices
Auditorium
Large Classrooms
Small Classrooms
Seminar Rooms
Instructional Labs
Server Room
Technical Support
Storage Room
Restroom
Additional

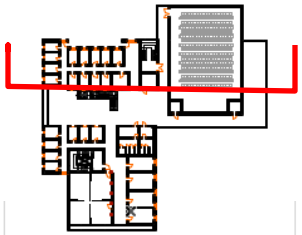
A
E
C
L
S

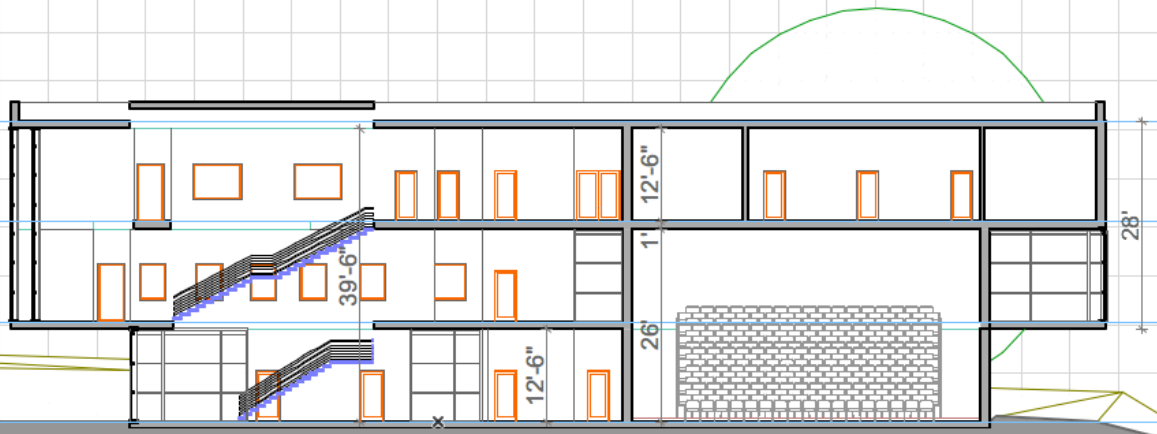
Sections





North-South
through cantilevered auditorium





West-East
through atrium (verticular circulation) and auditorium

A
E
C
L
S

Loading Considerations

Gravity Loads

DEAD LOADS:

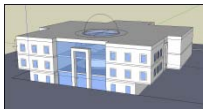
MEP	5 psf
CLADDING	20 psf
MISC	12 psf
SELF-WEIGH	80 to 100 psf

LIVE LOADS:

ROOF	20 psf
SNOW	9 psf
GREEN ROOF	25 psf
CLASSROOM	50 psf
OFFICE	50 psf
AUDITORIUM	60 psf
LABORATORY ROOM	100 psf
CORRIDOR	100 psf
STORAGE	120 psf
PARTITIONS	*20 psf*

Lateral Loads

Later Load Distribution

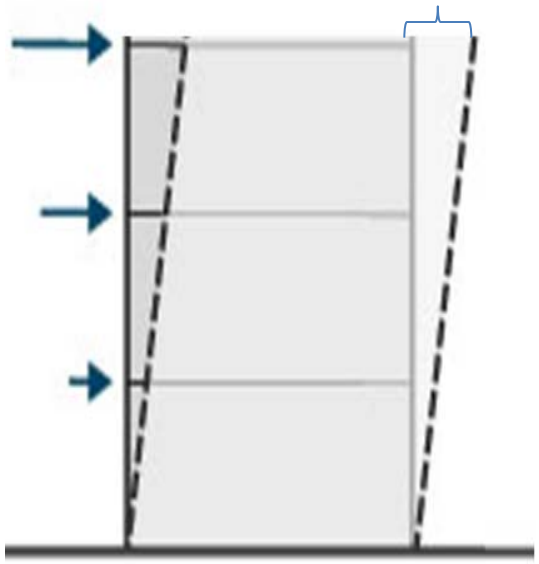


Roof Displacement

17.8 k 14.6 k

16.2 k 13.3 k

13.8 k 11.4 k



Average wind load = 12 mph

Design wind load = 60 mph

Solution = Lateral Braces & Shear Walls

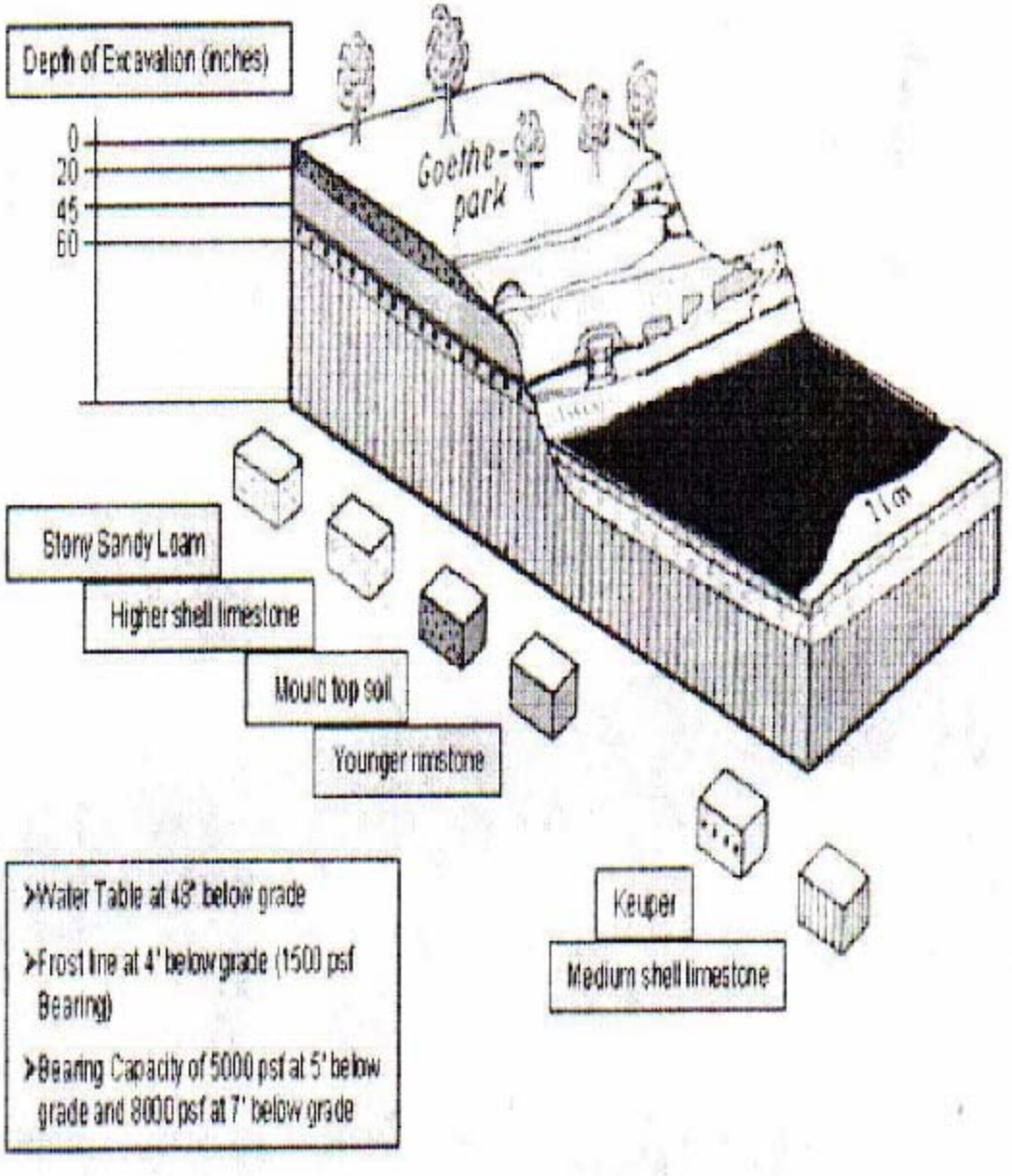
A E C L S

Soil Considerations

High Water Table

Bearing capacity 8000 psf

Excavation needed



A

E

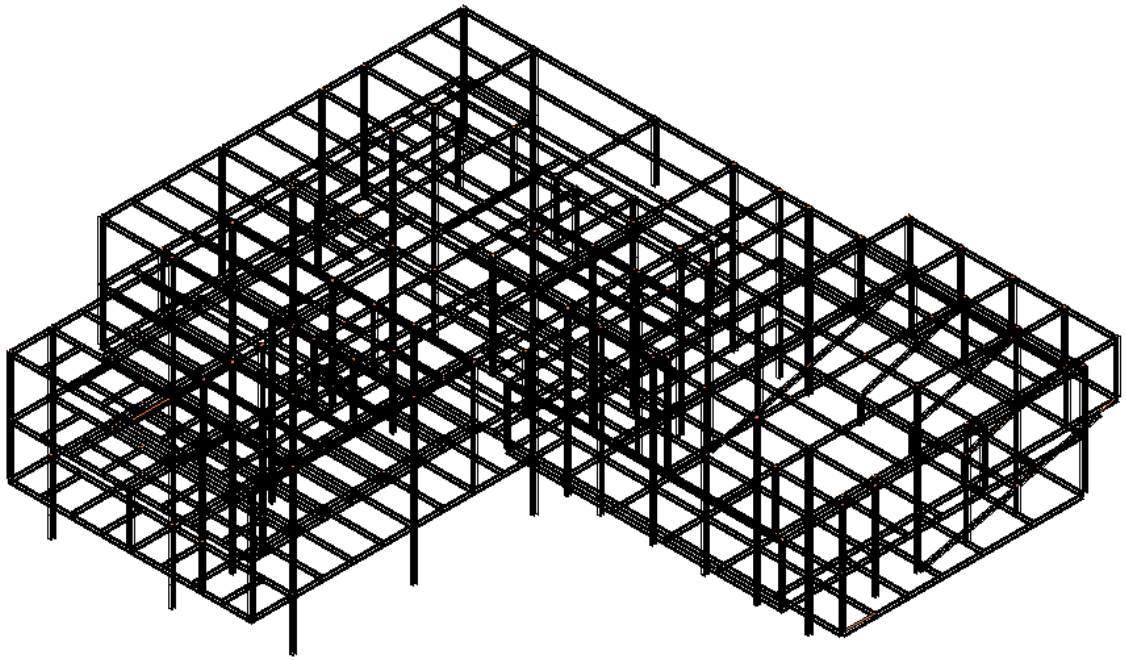
C

L

S

Structural Steel Transparency

L-Shaped



Typical Member Sizes

Beam: W16 x67

Girder: W18x71

Column: W12 x 40

Composite Floor System:
3” decking + 3” LWC slab

Lateral System:
HSS21/2”x1/2”x1/4”

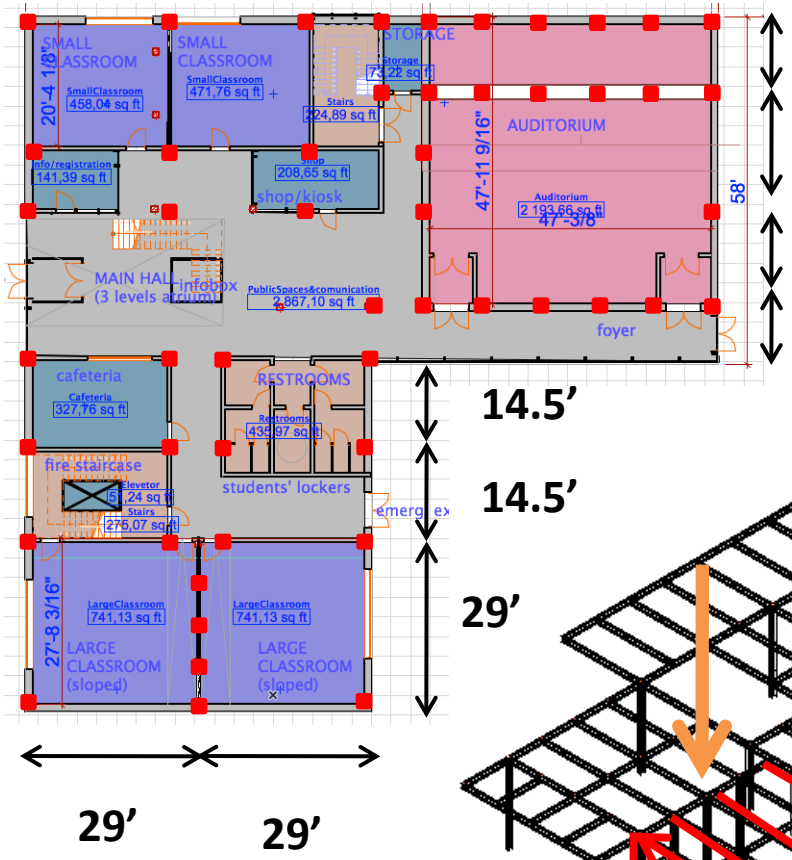
Foundation:

Square Footing (8’ x 8’)
2 Layers of No. 9 bars @ 6” (Bottom)
2 Layer of No. 3 bars @ 18”(top)

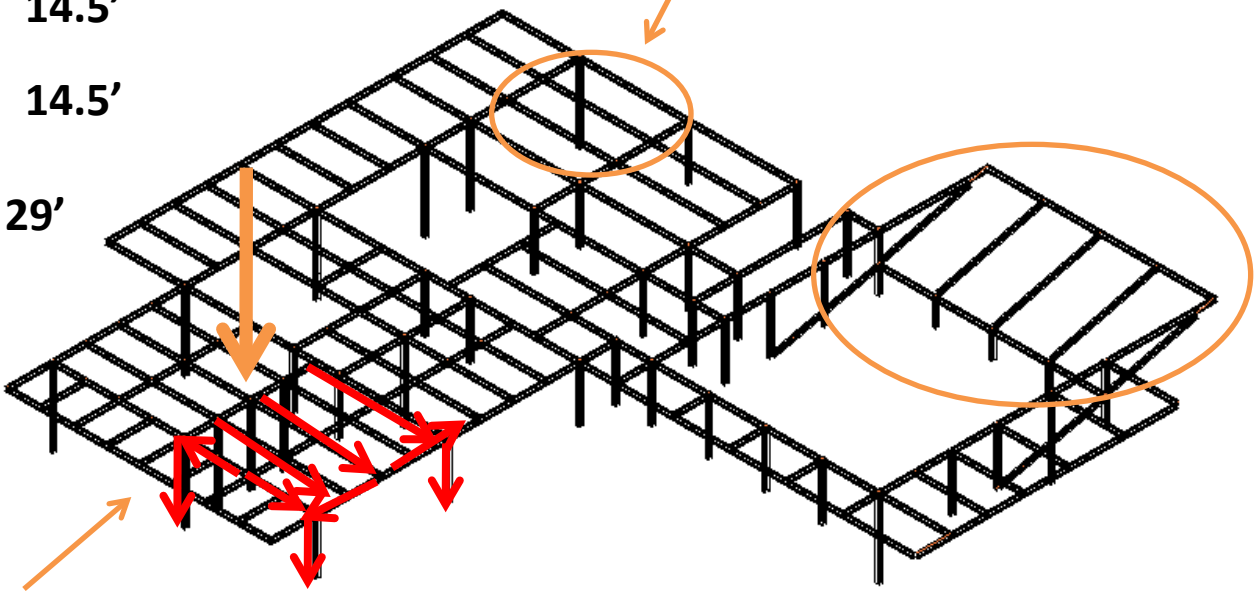
A E C L S

Structural Steel Transparency

Ground Floor



Typical Bay Size: 24' x 12.5'

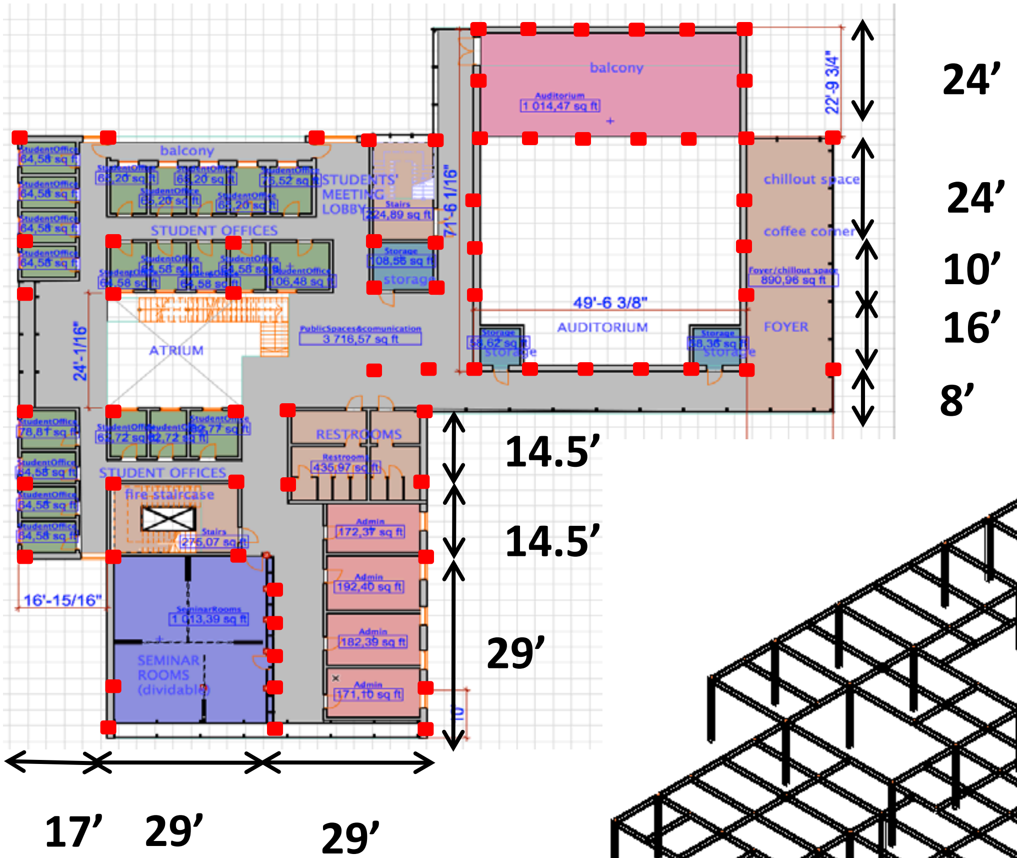


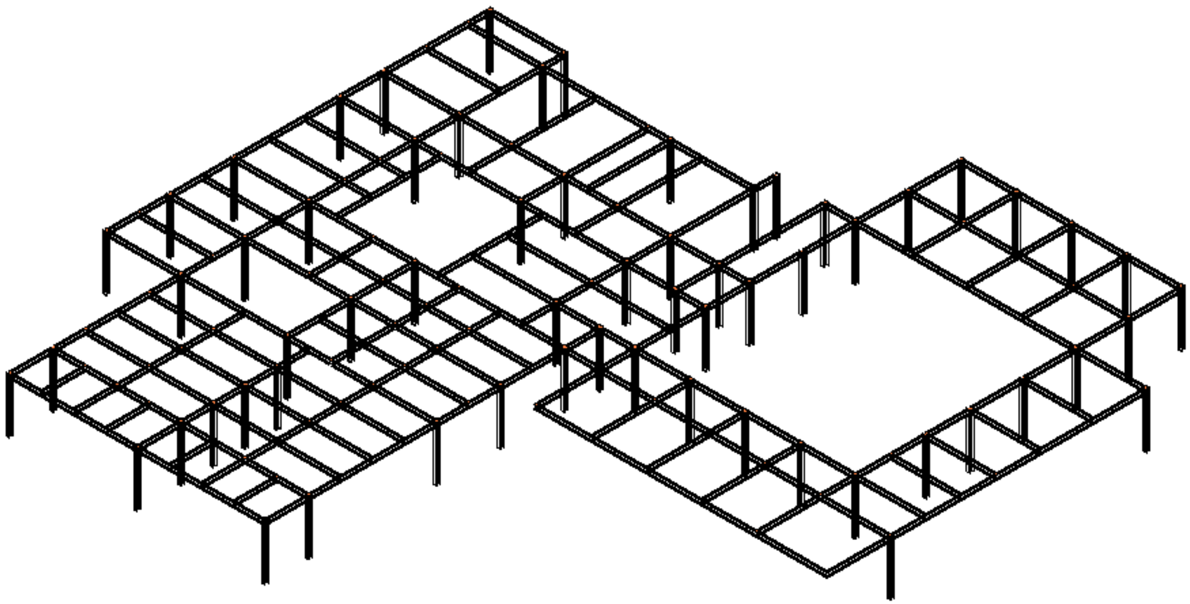
Max Bay Size: 29' x 29'

A E C L S

Structural Steel Transparency

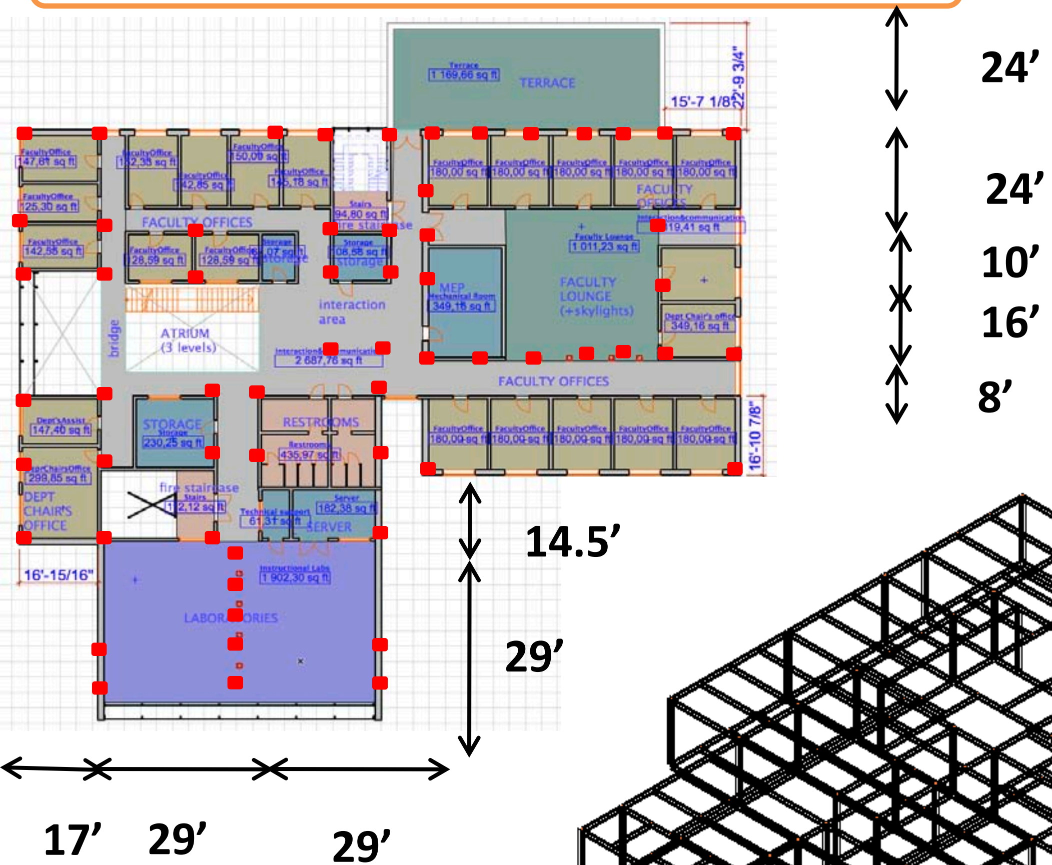
Second Floor

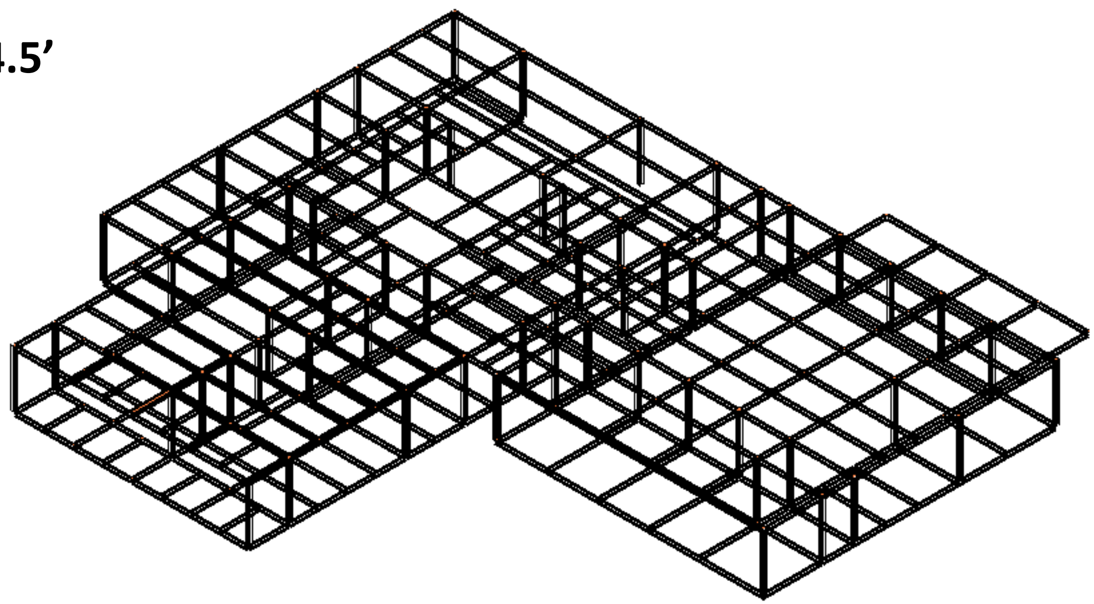




Structural Steel Transparency

Third & Roof Floor





A
E
C
L
S

Reinforced Concrete Transparency

Typical Member

Floor: 5”

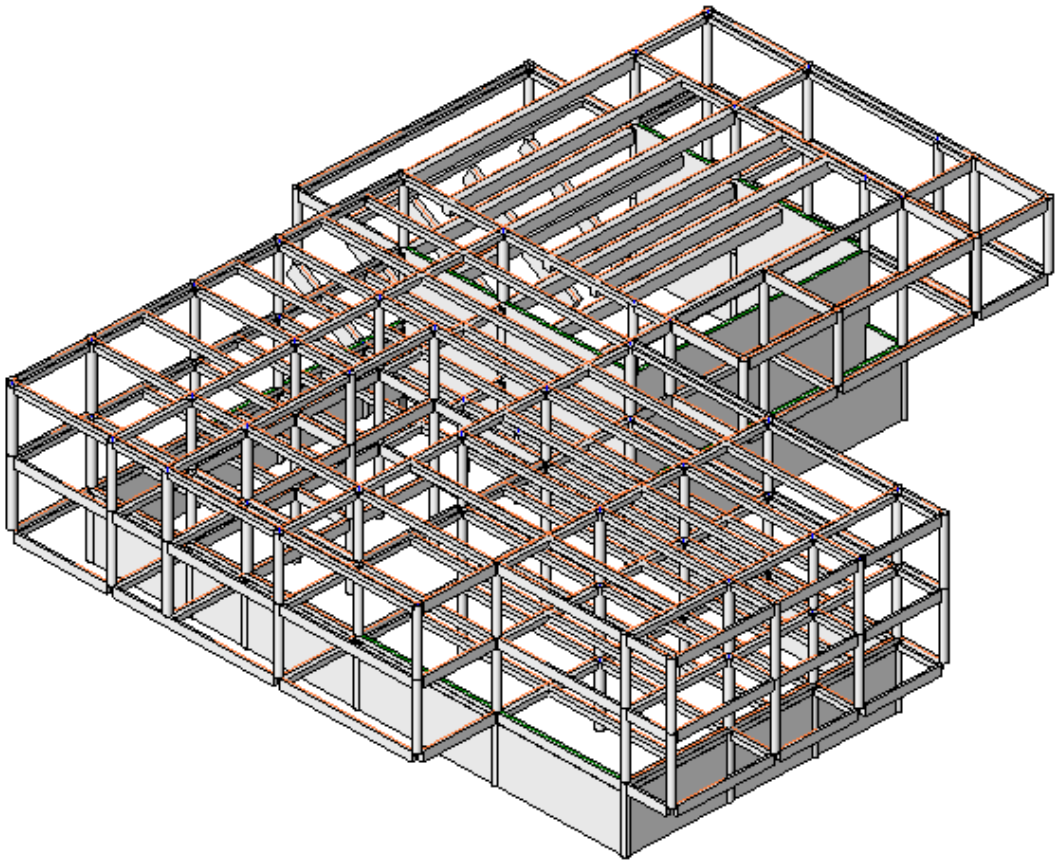
Column: 14”

Beam: 14” x 20”

Girder: 12” x 20”

Shear Wall: 10” x 6’

Foundation: 10’ Square Spread

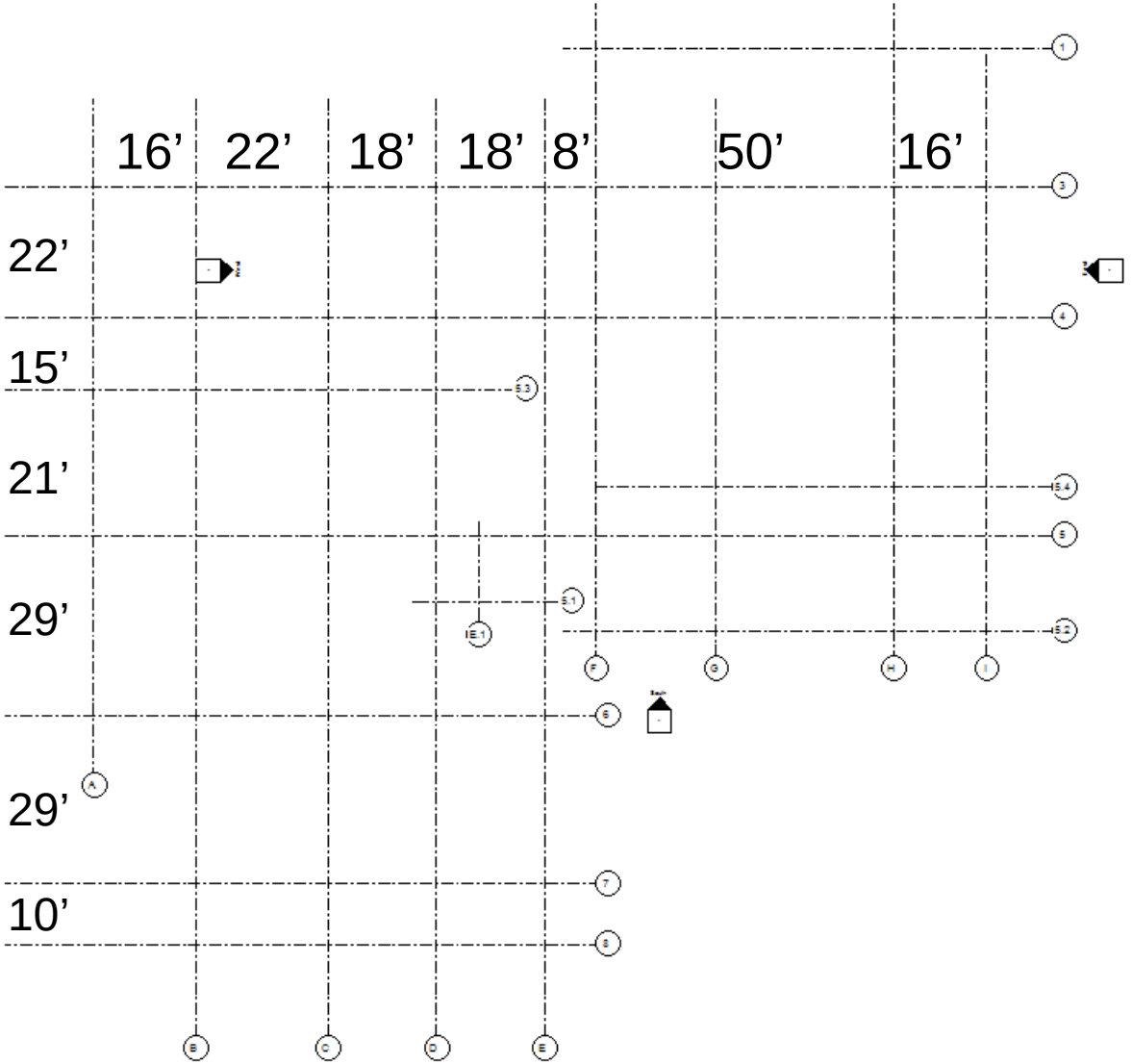


Reinforced Concrete Transparency

Grid Layout

Largest Bay Size

29’ x 22’



A

E

C

L

S

Reinforced Concrete Transparency

A

E

C

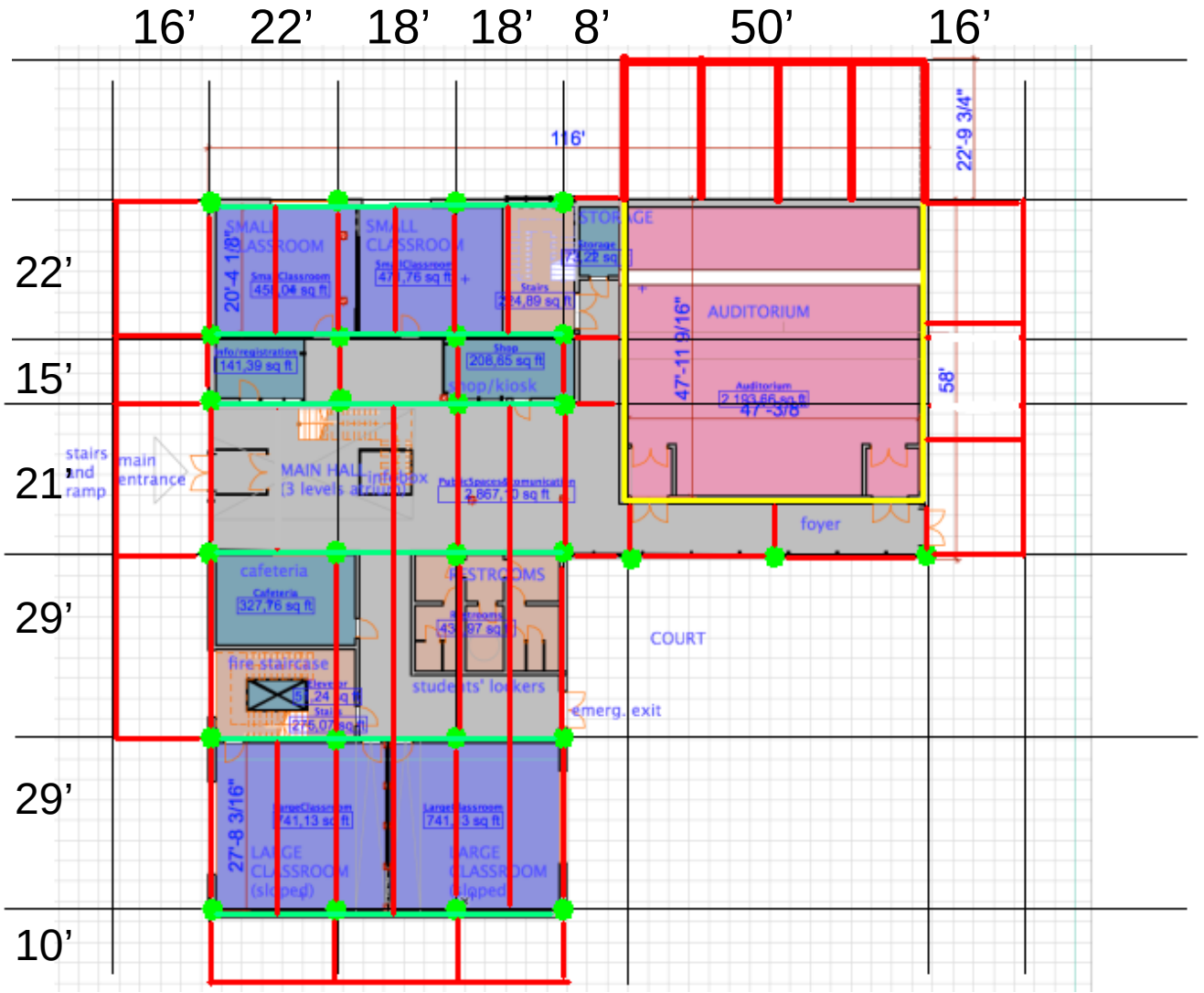
L

S

First Floor

- Column
- Beam
- Girder
- Bearing Walls

Cantilever: 24” x 50”



Reinforced Concrete Transparency

A

E

C

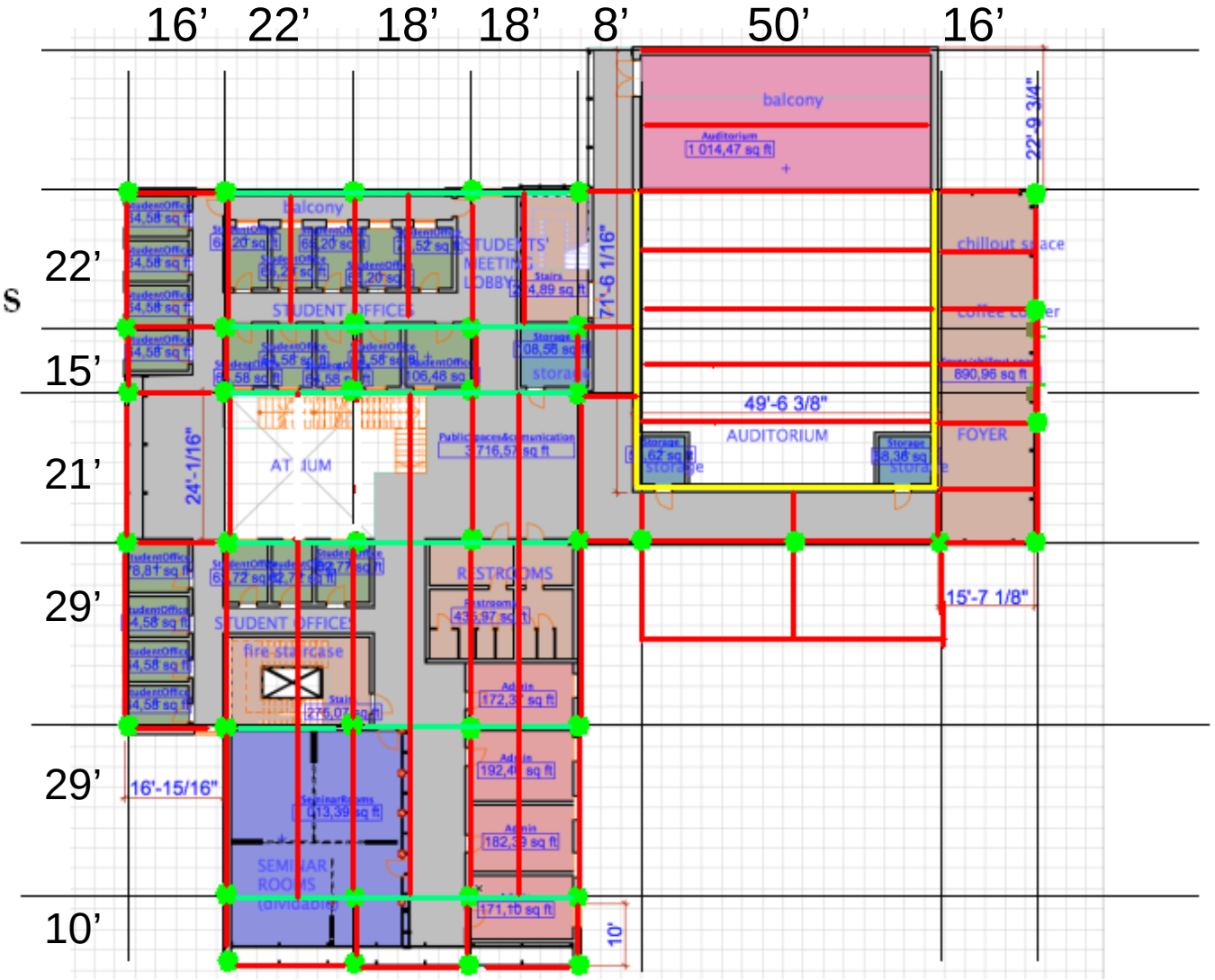
L

S

Second Floor

- Column
- Beam
- Girder
- Bearing Walls

Auditorium
Span: 50’ Long
18”x32” Beams
every 10’



Reinforced Concrete Transparency

A

E

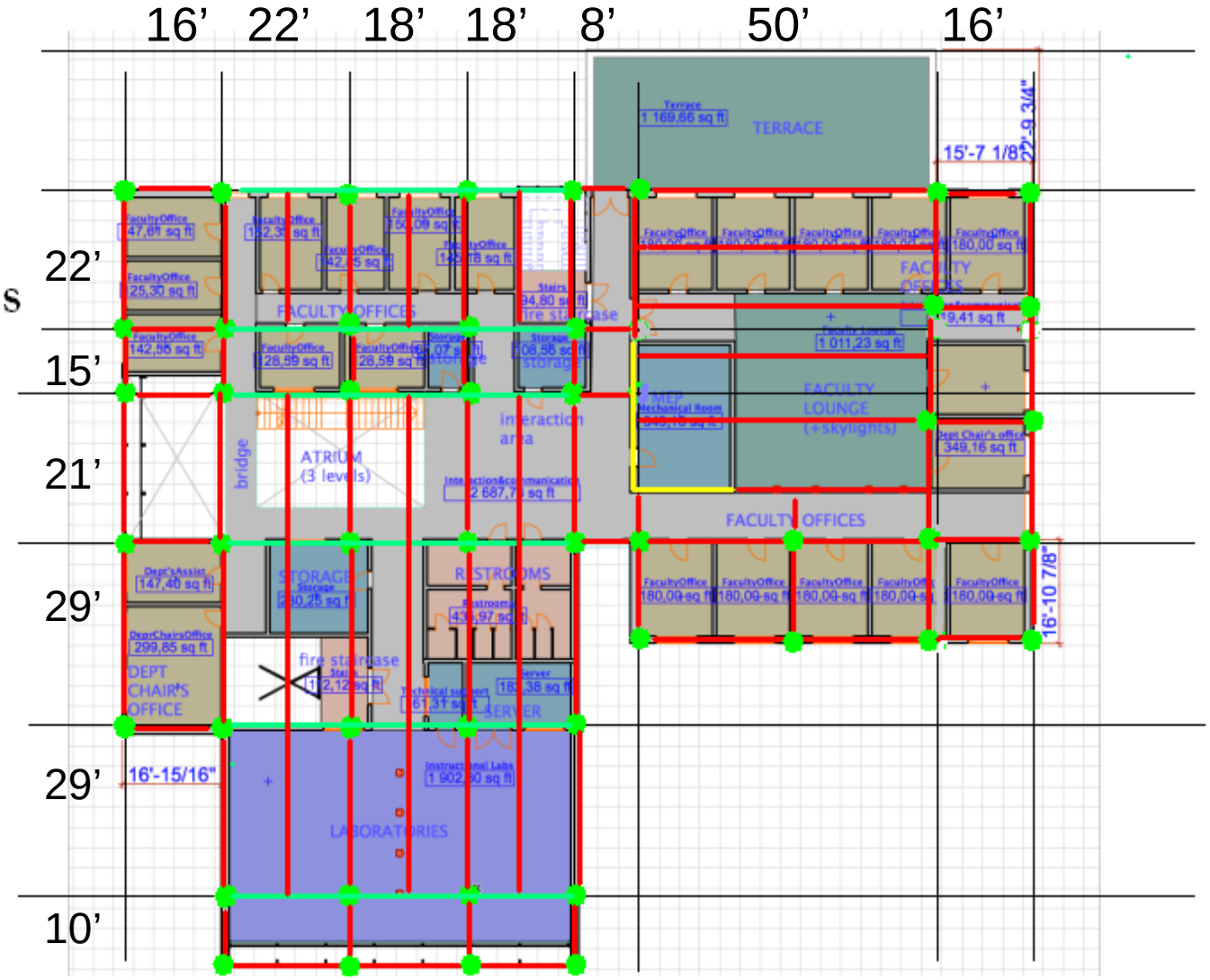
C

L

S

Third Floor

- Column
- Beam
- Girder
- Bearing Walls



Reinforced Concrete Transparency

A

E

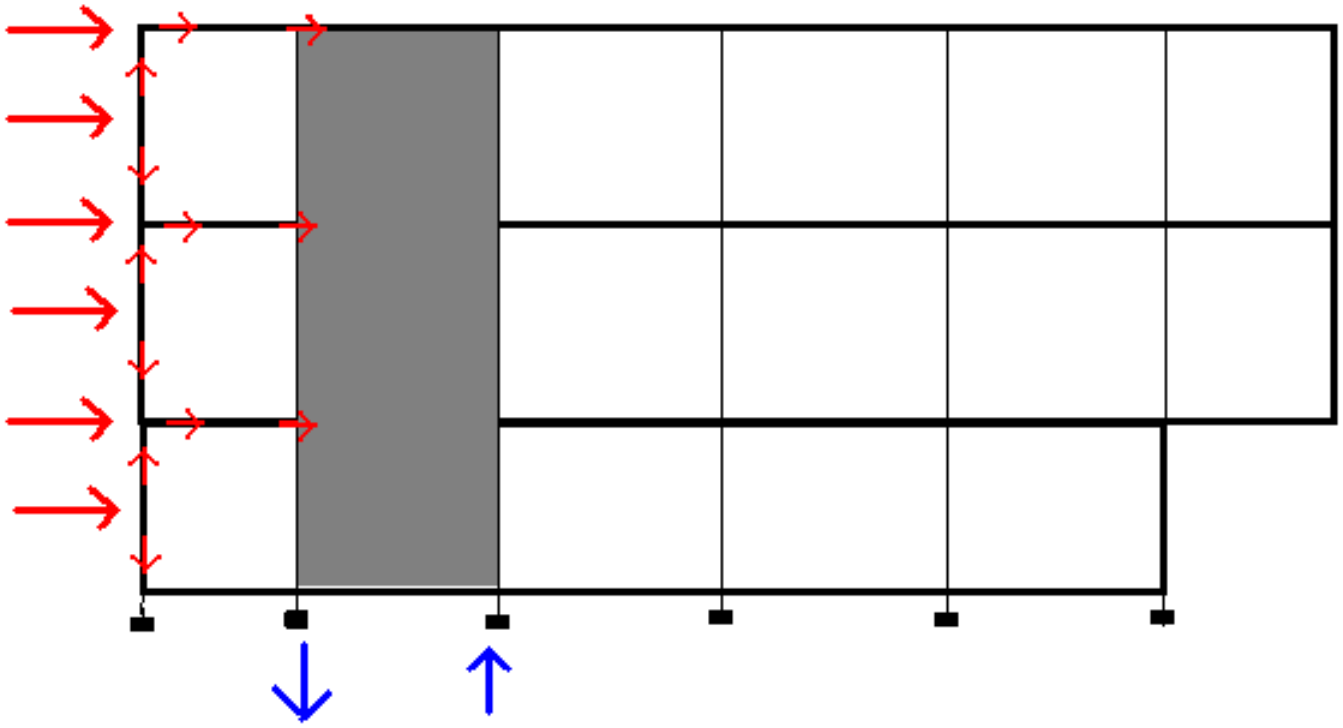
C

L

S

Wind Load

- Diaphragm Action
- Shear Walls Carry Load

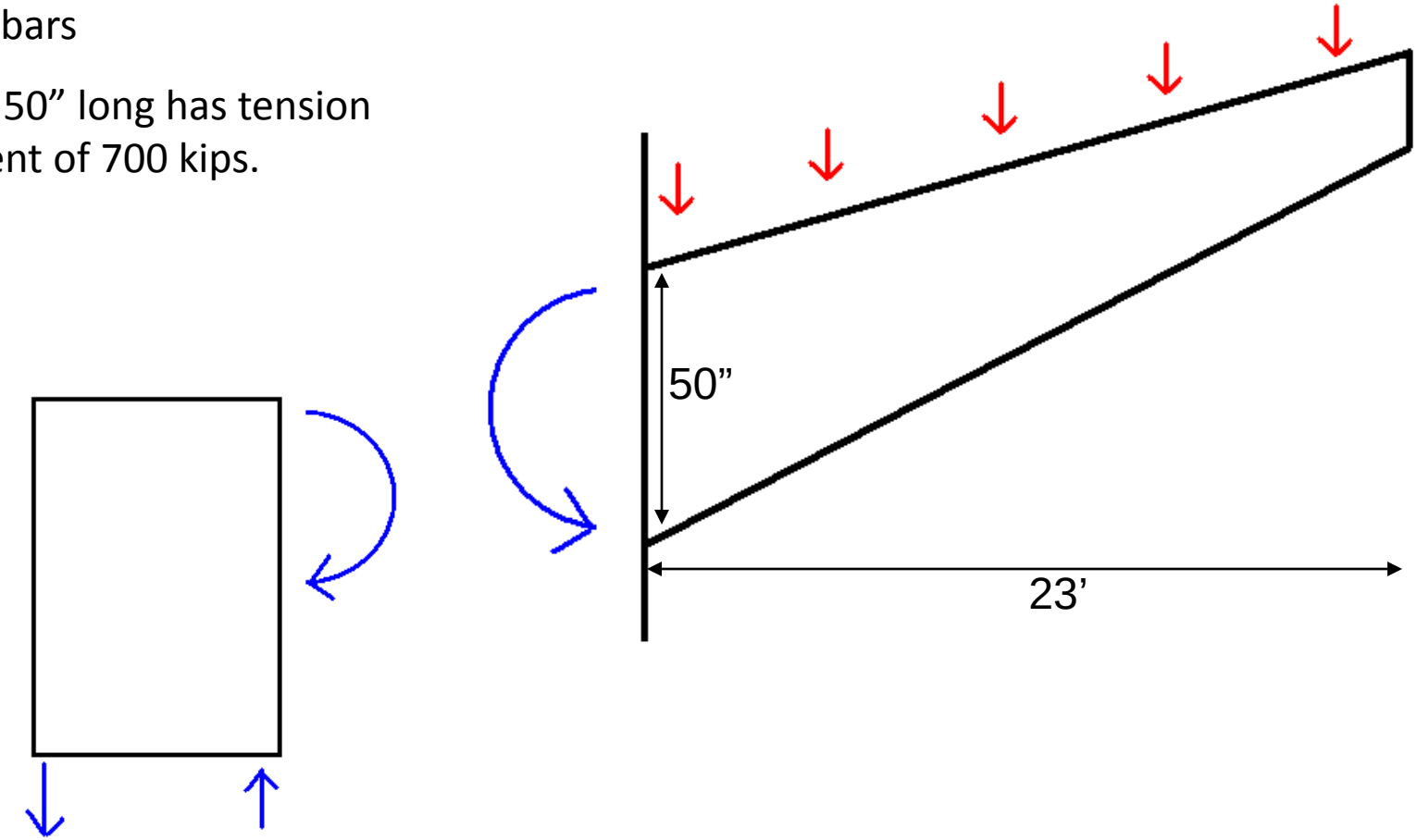


Reinforced Concrete Transparency

A E C L S

Cantilever Load Path

- Large Moment Reaction
- Requires beam 24”x50”
- 13 #10 bars
- Wall at 50” long has tension component of 700 kips.



Structural Comparison

Transparency

Floor to floor: 13’6”

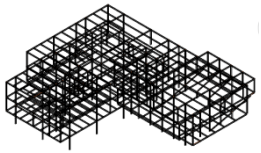
Slab

Floor to ceiling

MEP

RC Depth: 20"

SS Depth: 18"

System	Advantages	Disadvantages
	Lightweight, Shorter Depth	Expensive
	Cheap, Thermal Mass	Schedule, Larger members

MEP: 24”

Site Layout Transparency

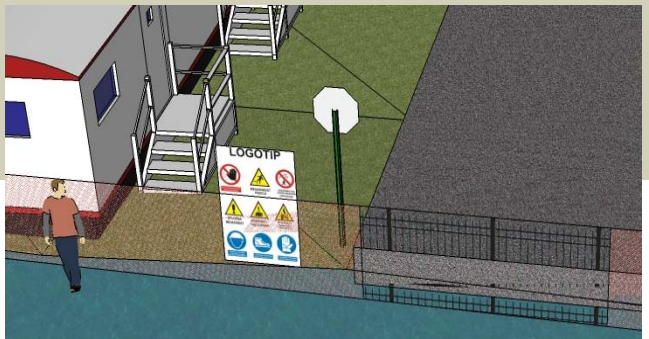
- Offices
- Trailers
- Toilets
- Storage container (tools)

Storage:

- Storage: 4000 SF
- Earth: 2300 SF

Recycling

Signs (stop, warnings)



- 25 Parking lots (4000 SF)

A E C L S

Site Layout Transparency

A

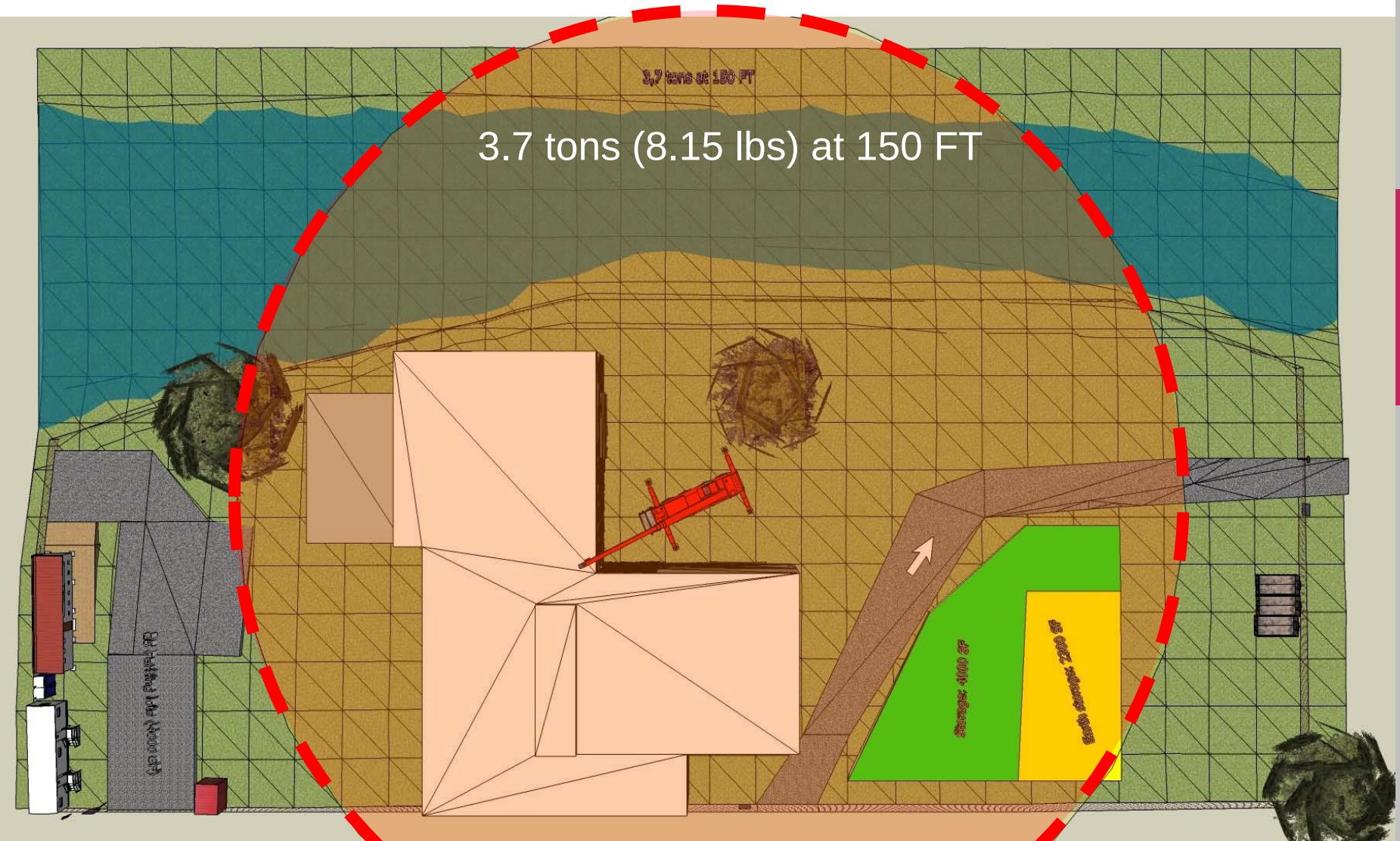
E

C

L

S

Normal Water Level



Site Layout Transparency

33 Year Flood

A

E

C

L

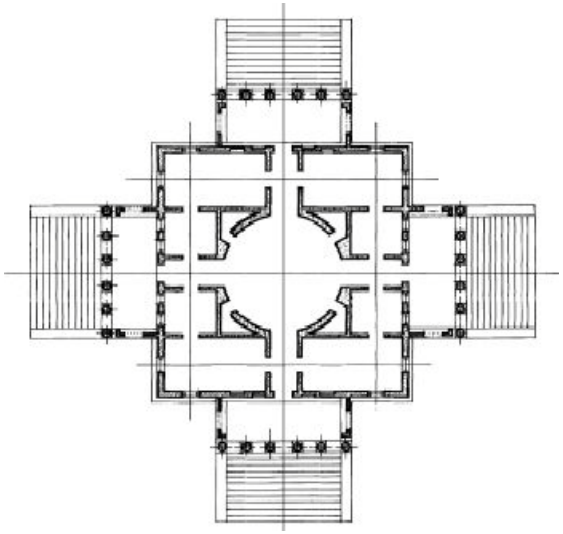
S

Second Big Idea Inspiration

Historical buildings

Features

- **Symmetry**
- **Simple mass**
- **Detail**



Harmony and Proportions

- **Function**
- **Structure**
- **Form**

A

E

C

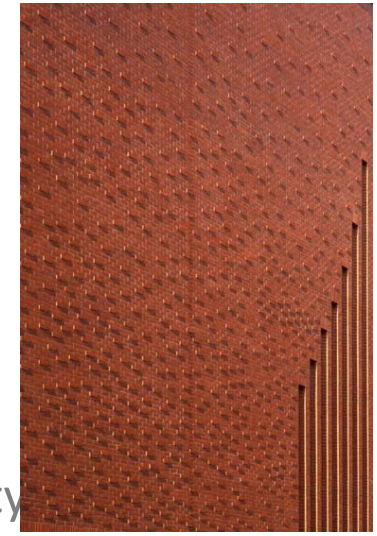
L

S

Big Idea: ReUse

How do we understand it?

- reusing the **historical style**
(composition)



- reusing **old materials**
(from existing building – sustainability)

- reusing the **water**
(gathering rain water)

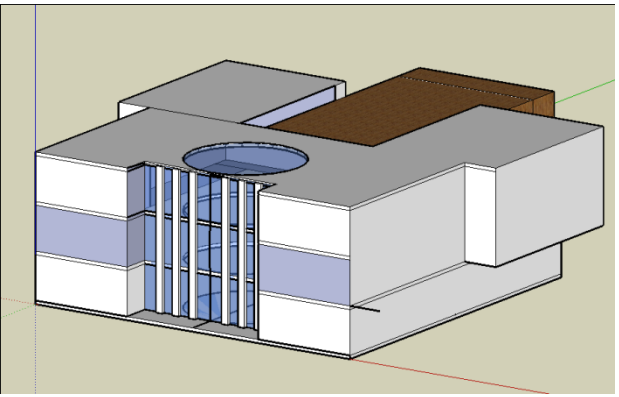
- “reusing” **sunlight**
-(ex. light shelves)

- reusing **rooms**
(flexibility of spaces)

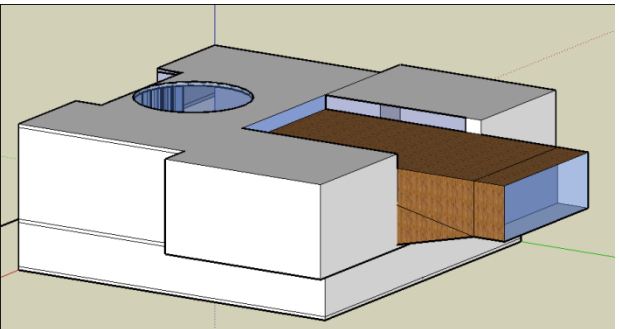
A E C L S

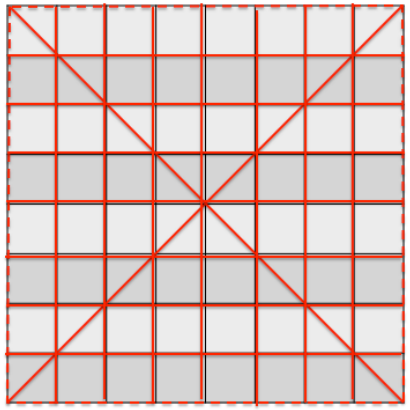
Building Mass General Idea

Formal goals:
- symmetry in plan
- axes
- atrium – focal core area
- historical facade feeling

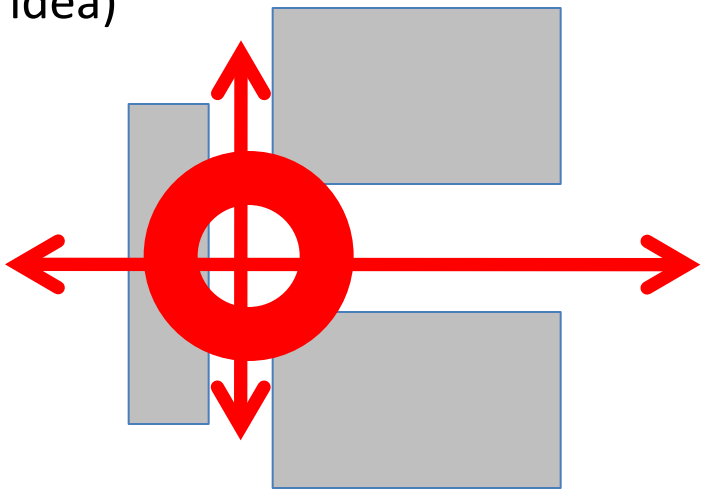


- view to the river and parc
- cantilevered auditorium
- modern structure





Modularity in plan
(reuse of “ad quadratum” idea)



A E C L S

Façade Explorations

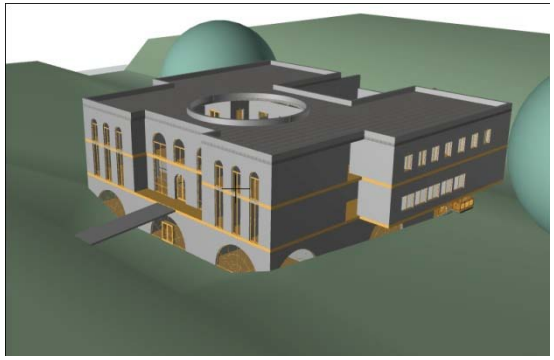
Start:

Historical building…

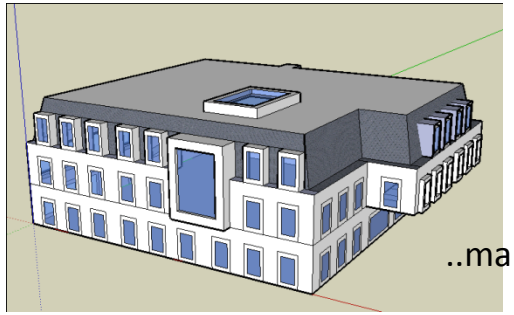
..use symmetry!

..boooring…

..too monumental…

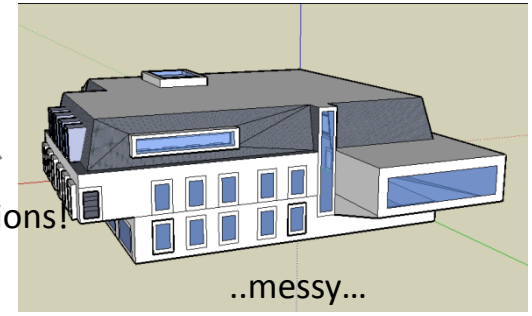


..no more symmetry!



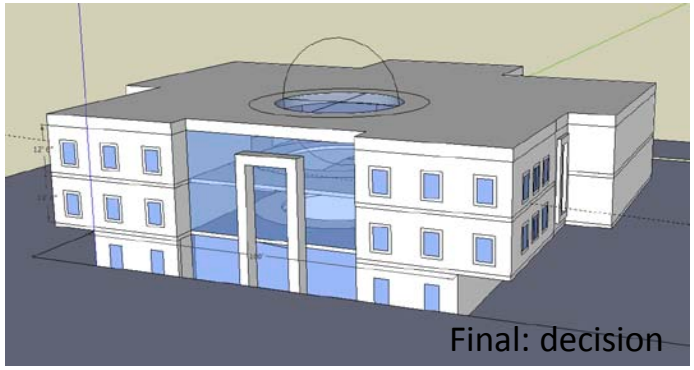
..make it modern!

..play with it!



..messy…

..look for inspirations!



Final: decision

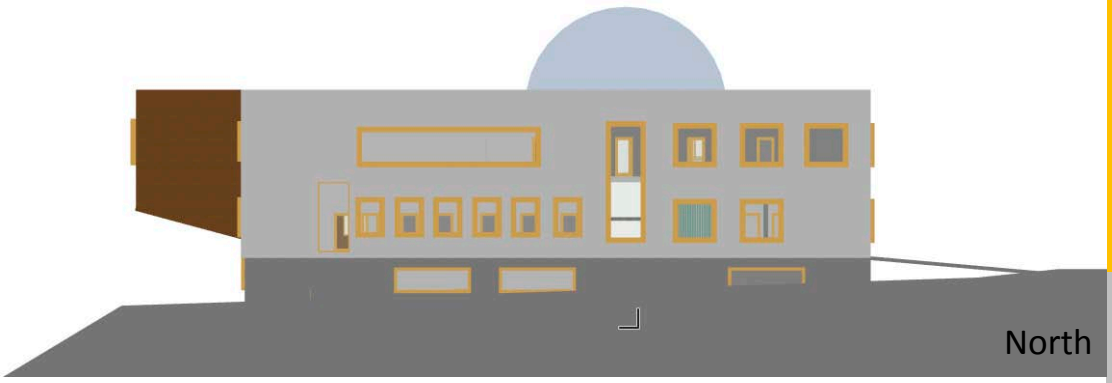
..put it together!

Schulhaus Eichi
Ort: Niederglatt
Architekt: Lüthi + Partner AG

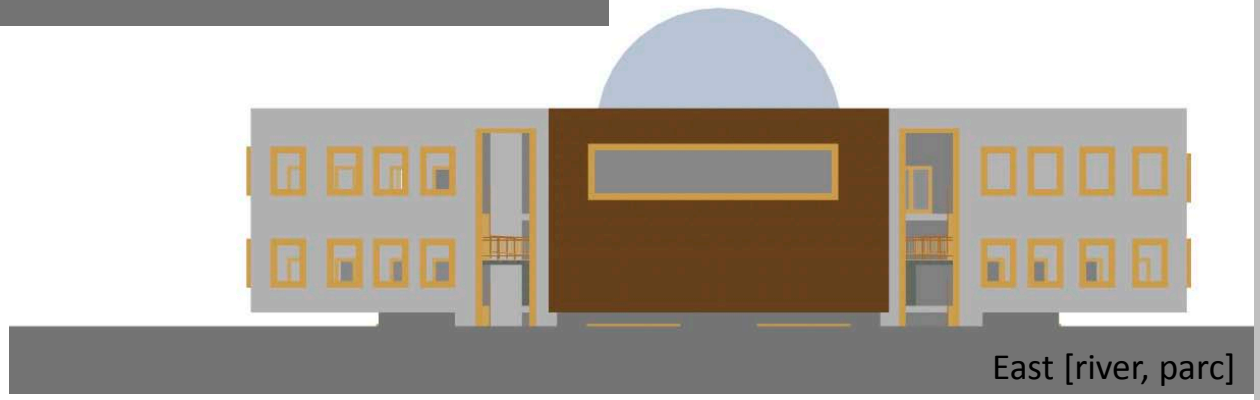
..go back to symmetry!

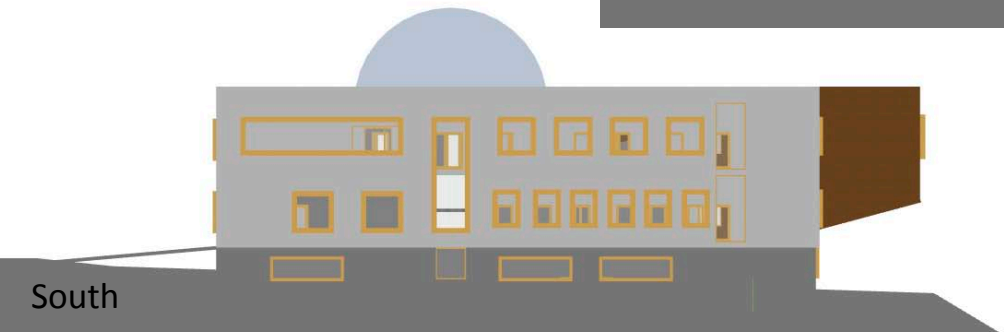
A E C L S

Façade ReUse


North


West [city, entrance]


East [river, parc]


South

A

E

C

L

S

Plan +1

North

- Faculty Offices
- Depart. Chair's Office
- Admin. Offices
- Faculty Lounge
- Student Offices
- Auditorium
- Large Classrooms
- Small Classrooms
- Seminar Rooms
- Instructional Labs
- Server Room
- Technical Support
- Storage Room
- Restroom
- Additional

A

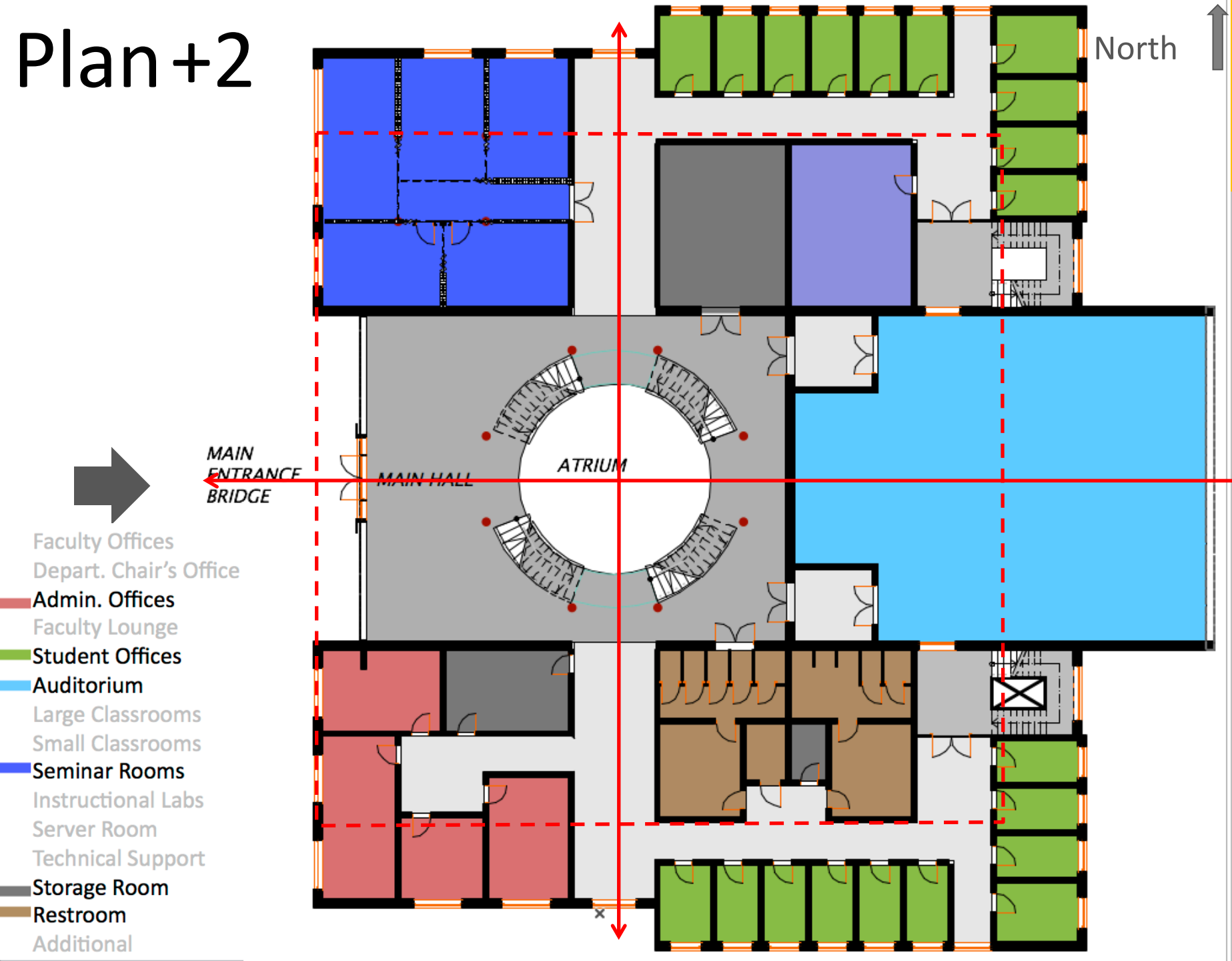
E

C

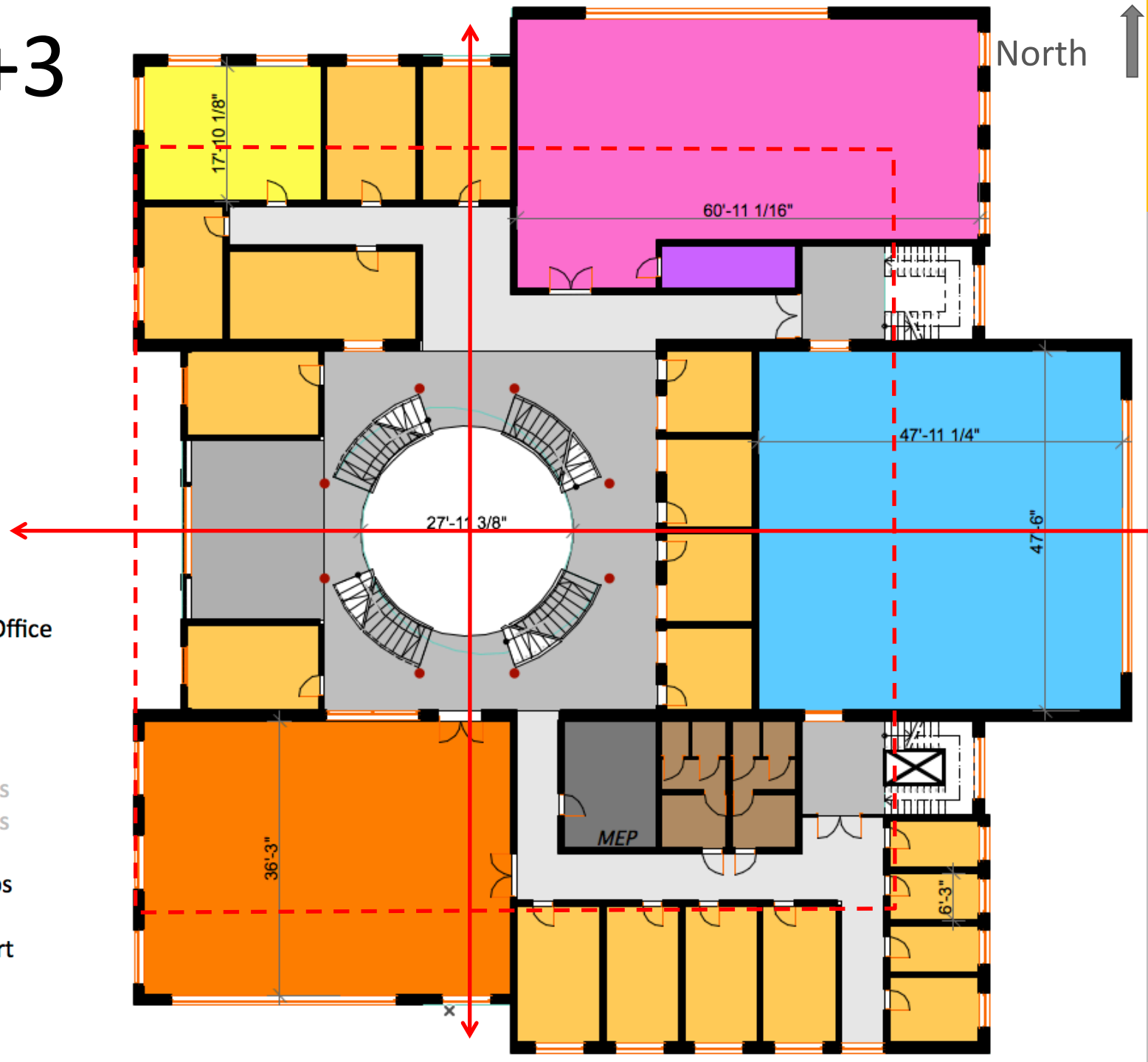
L

S

Plan +2


North
MAIN ENTRANCE BRIDGE
MAIN HALL
ATRIUM
Faculty Offices
Depart. Chair's Office
Admin. Offices
Faculty Lounge
Student Offices
Auditorium
Large Classrooms
Small Classrooms
Seminar Rooms
Instructional Labs
Server Room
Technical Support
Storage Room
Restroom
Additional
A
E
C
L
S

Plan +3



- Faculty Offices
- Depart. Chair's Office
- Admin. Offices
- Faculty Lounge
- Student Offices
- Auditorium
- Large Classrooms
- Small Classrooms
- Seminar Rooms
- Instructional Labs
- Server Room
- Technical Support
- Storage Room
- Restroom
- Additional

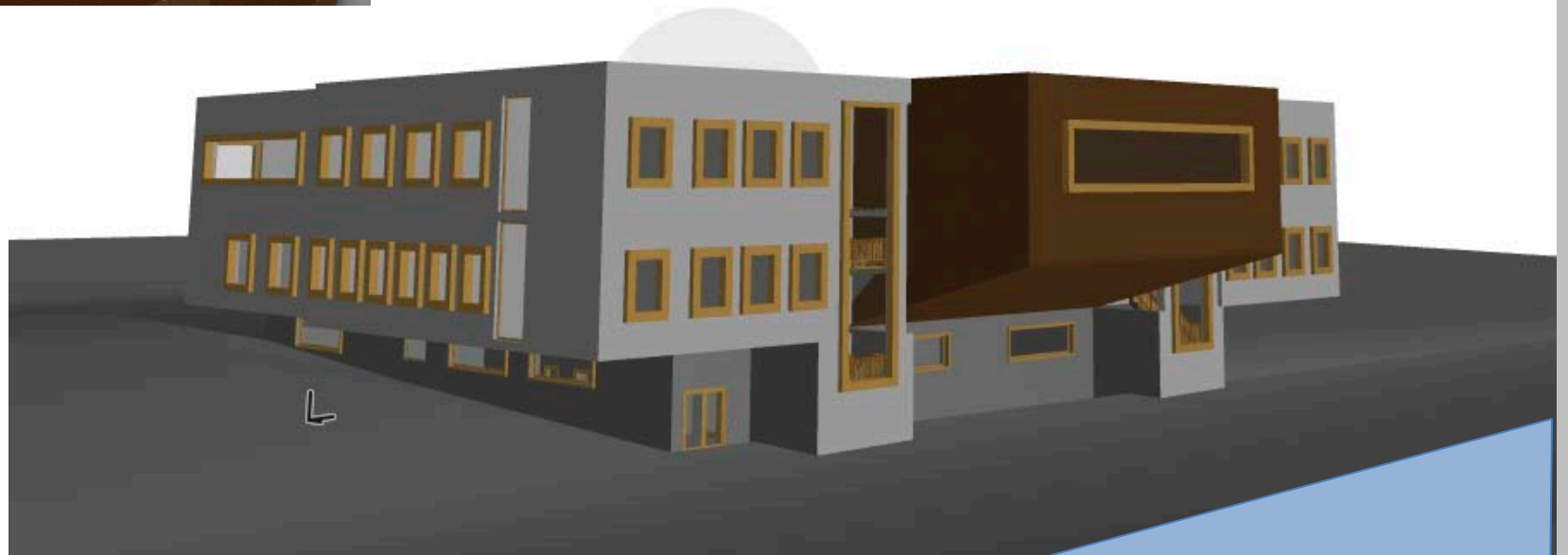
A

E

L

S

3D Views



A

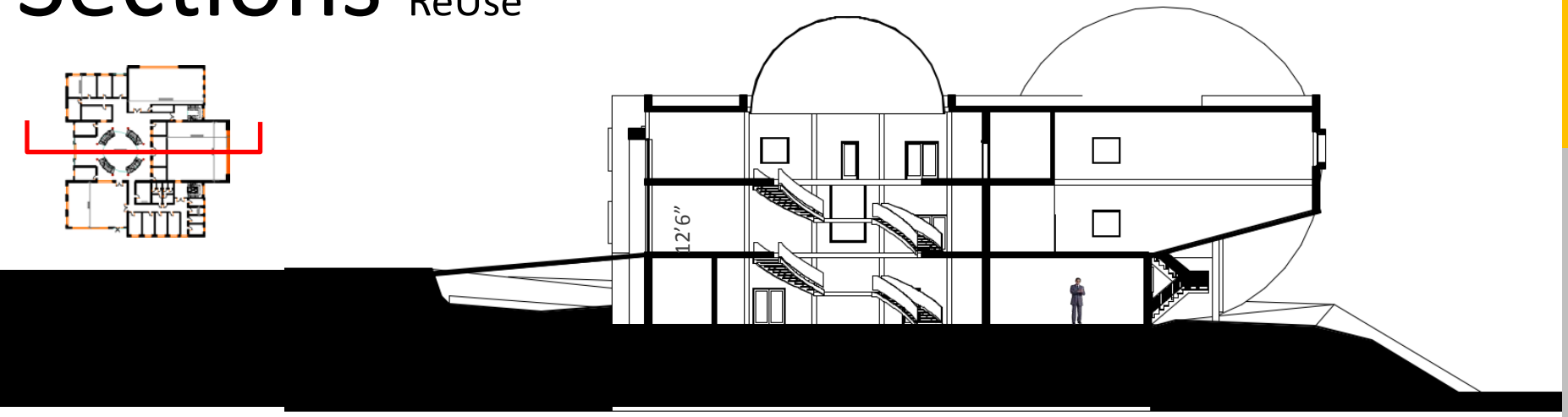
E

C

L

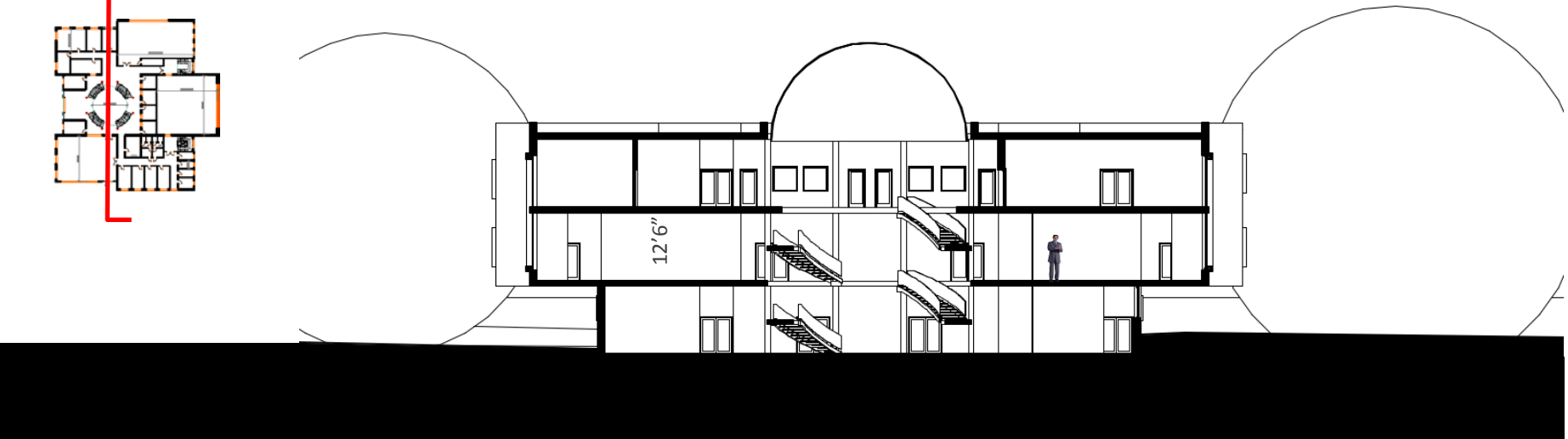
S

Sections ReUse



N-S, through entrance bridge and auditorium cantilevering over the river

W-E, throuhg atrium core (verticular circulation)



A

E

C

L

S

The Signature Spiral ReUse

Core area

A

E

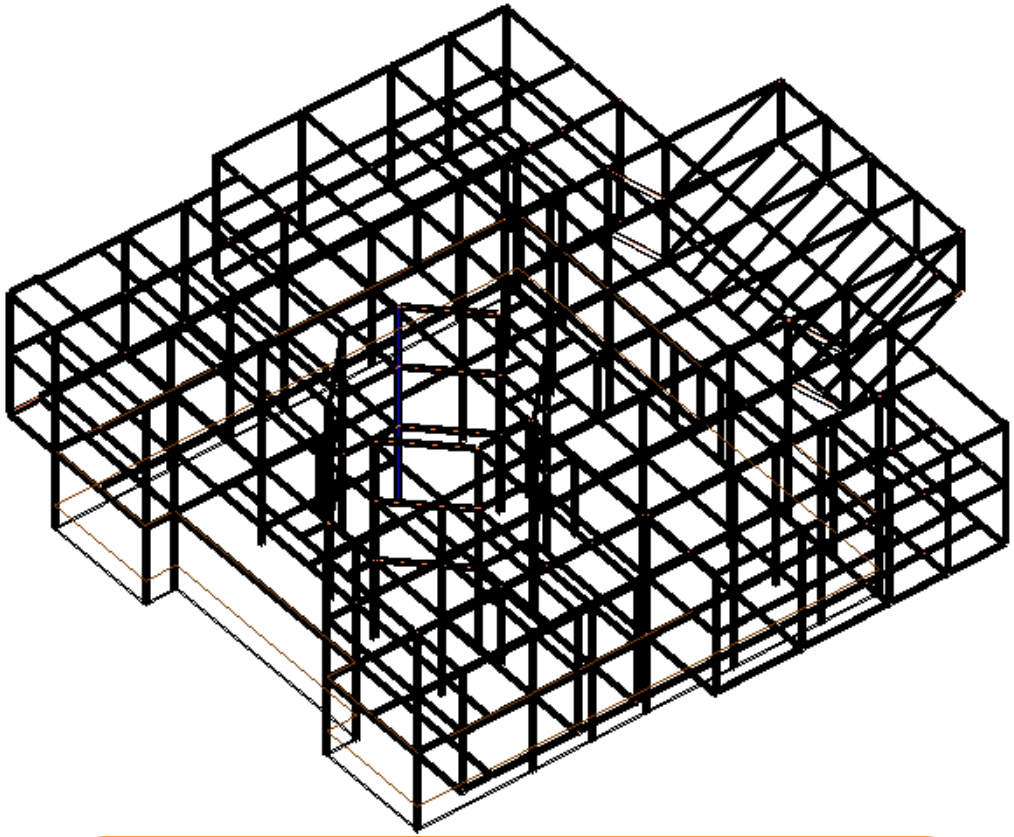
C

L

S

Structural Steel ReUse

Square Shape – Steel frame



Typical Member Sizes

Beam: W14x30

Girder: W16x77

Column: W14x61

Composite Floor System:
3” deck + 3.5” LWC Slab

Lateral System:
HSS2”x2”x1/4”

Foundation:

Square Footing (10’ x 10’)
2 Layers of No. 9 bars @ 6” (Bottom)
2 Layer of No. 3 bars @ 18”(top)

A
E
C
L
S

Structural Steel ReUse

A

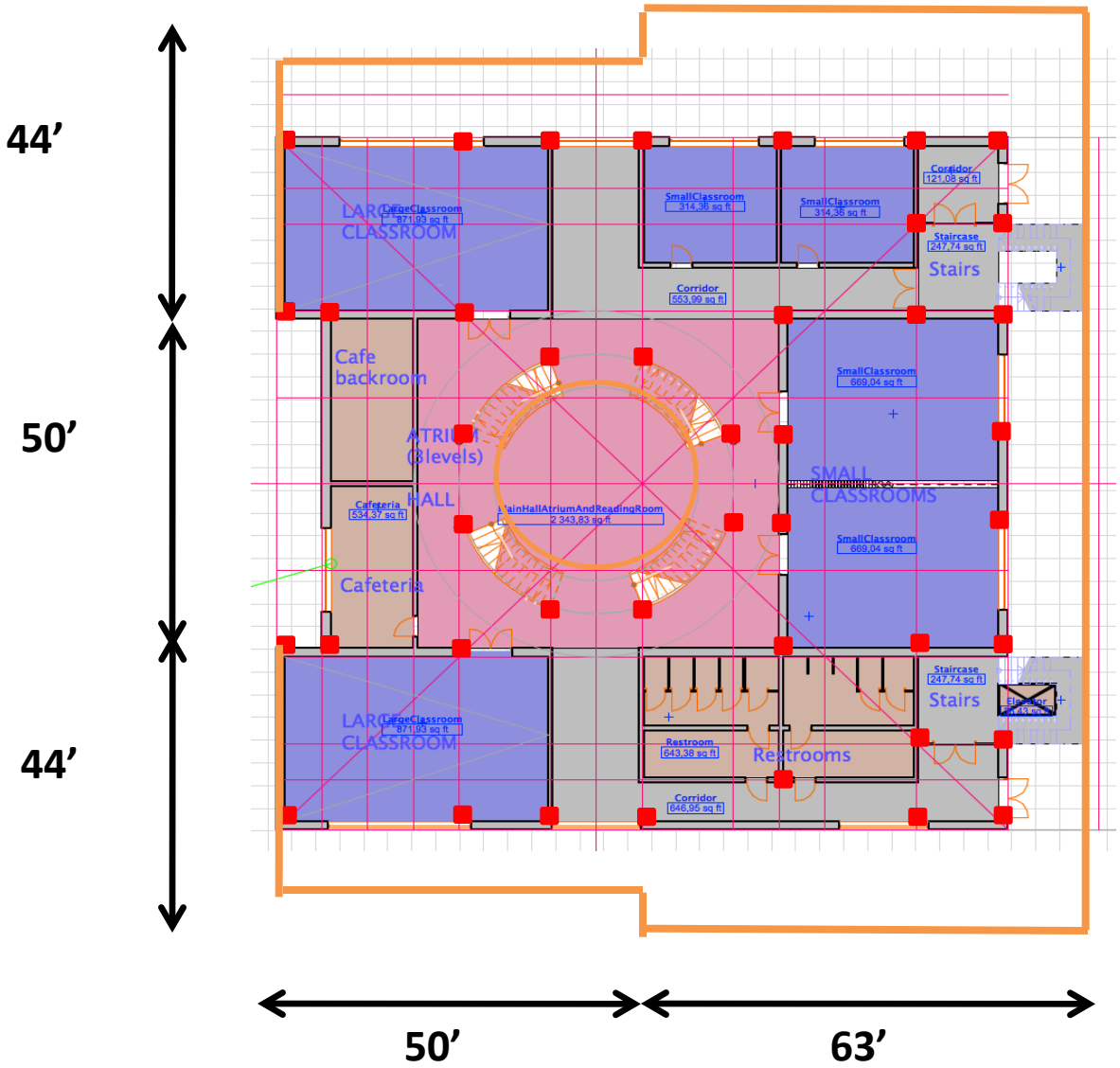
E

C

L

S

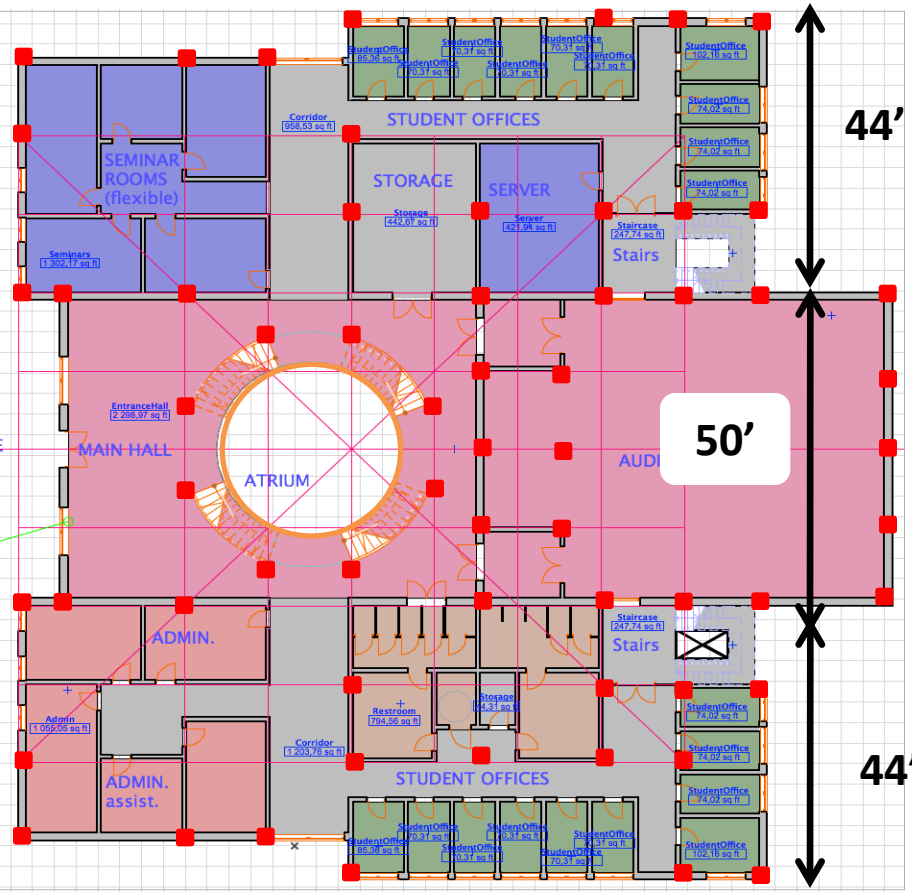
Ground Floor

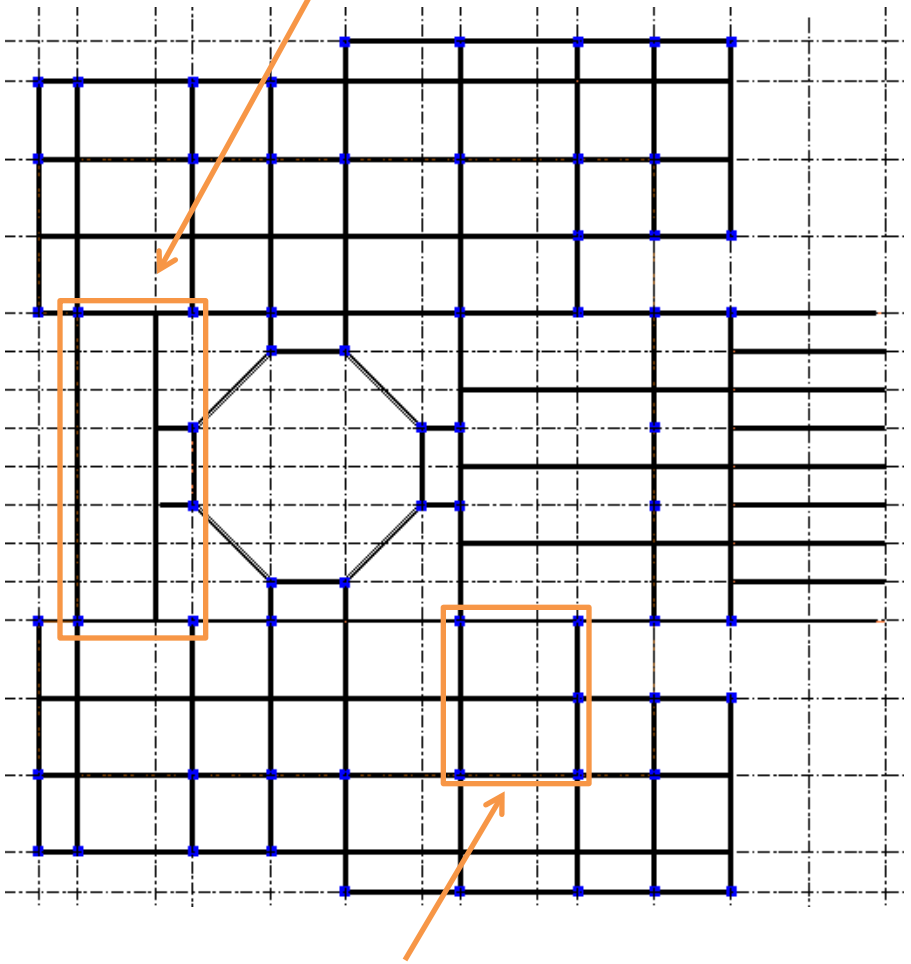


Structural Steel ReUse

Second Floor

Max Bay Size: 50’ x 19’





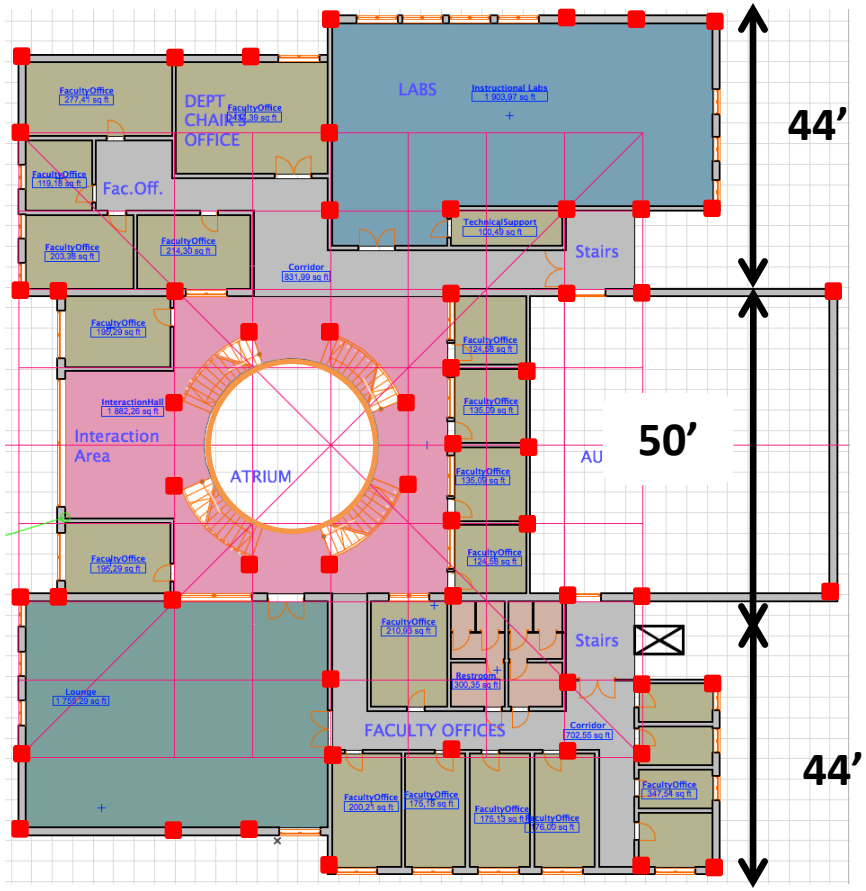
Typical Bay Size: 19’ x 25’

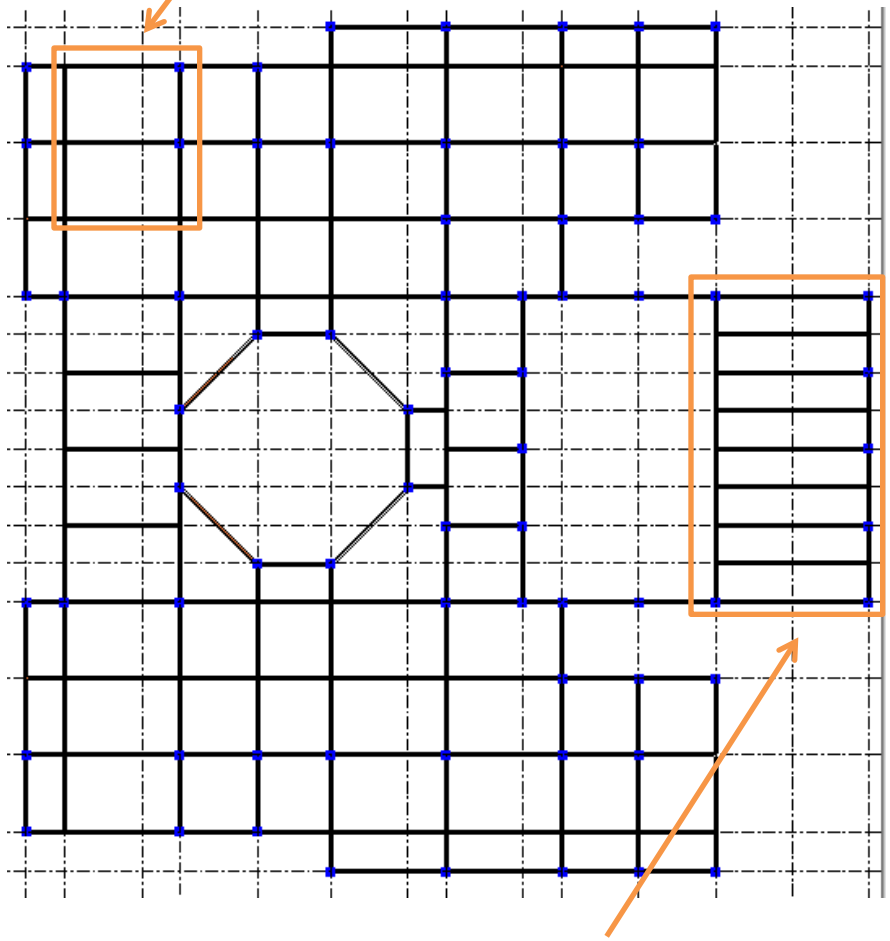
A E C L S

Structural Steel ReUse

Third Floor

Typical Bay Size: 19’ x 19’





Max Bay Size: 50’ x 25’ (sloped)

A

E

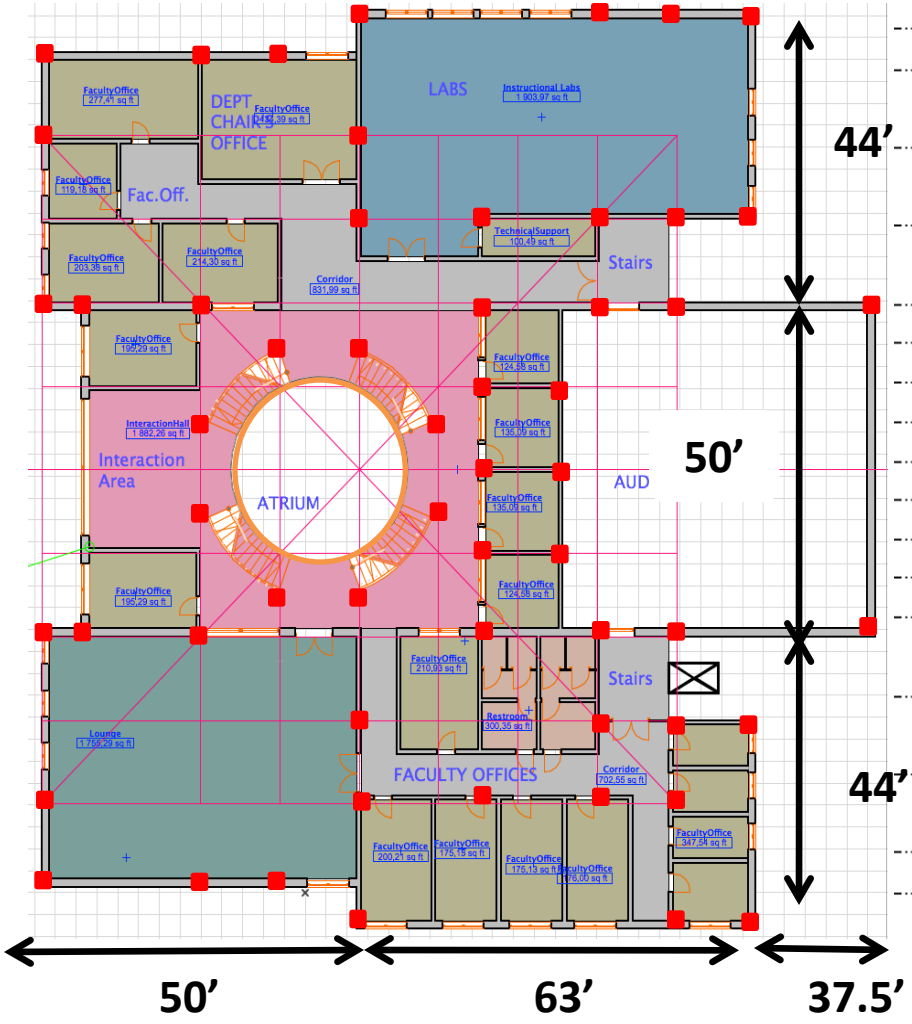
C

L

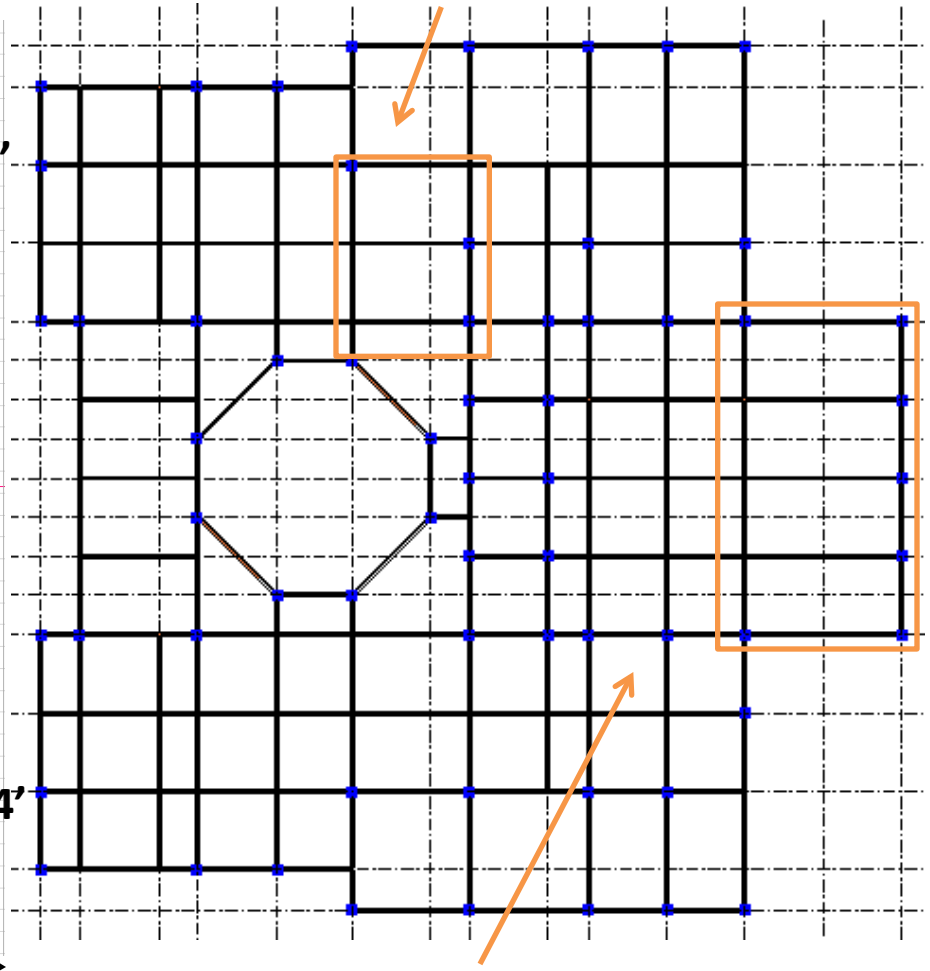
S

Structural Alternative Reuse

Roof Floor



Typical Bay Size: 19' x 25'



Max Bay Size: 50' x 25'

A

E

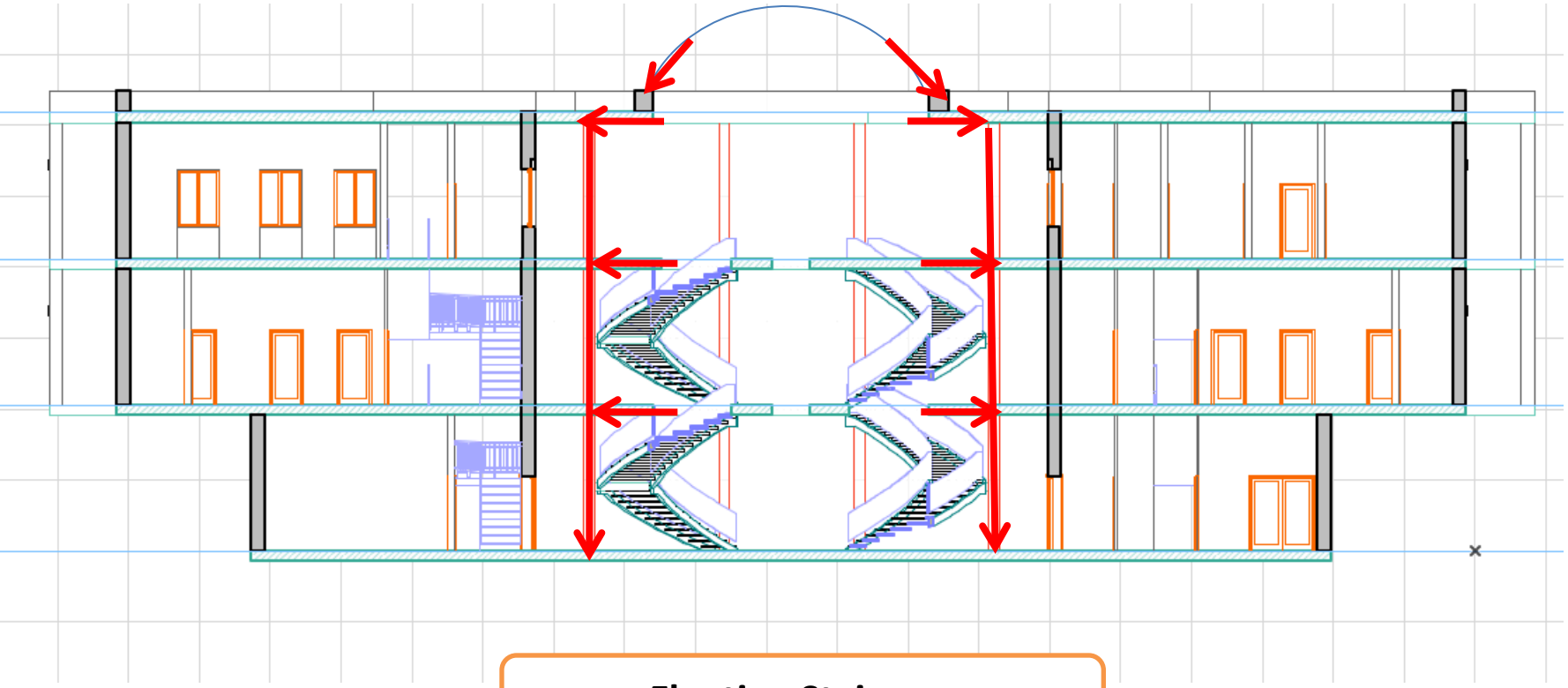
C

L

S

Structural Steel ReUse

Staircase Solution (NS X-section)



Floating Staircase

A

E

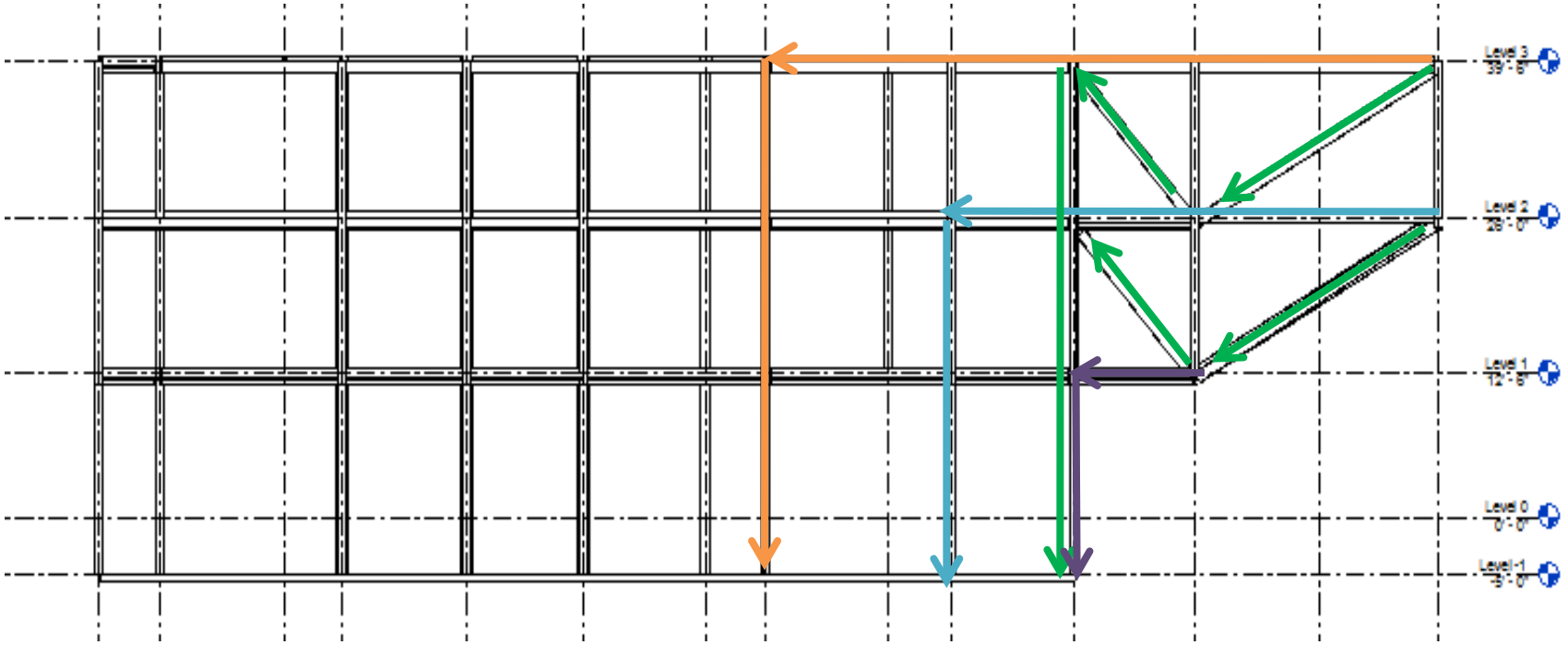
C

L

S

Structural Steel ReUse

Cantilever Auditorium Solution (EW X-section)



Reinforced Concrete ReUse

Typical Member

Floor: 6”

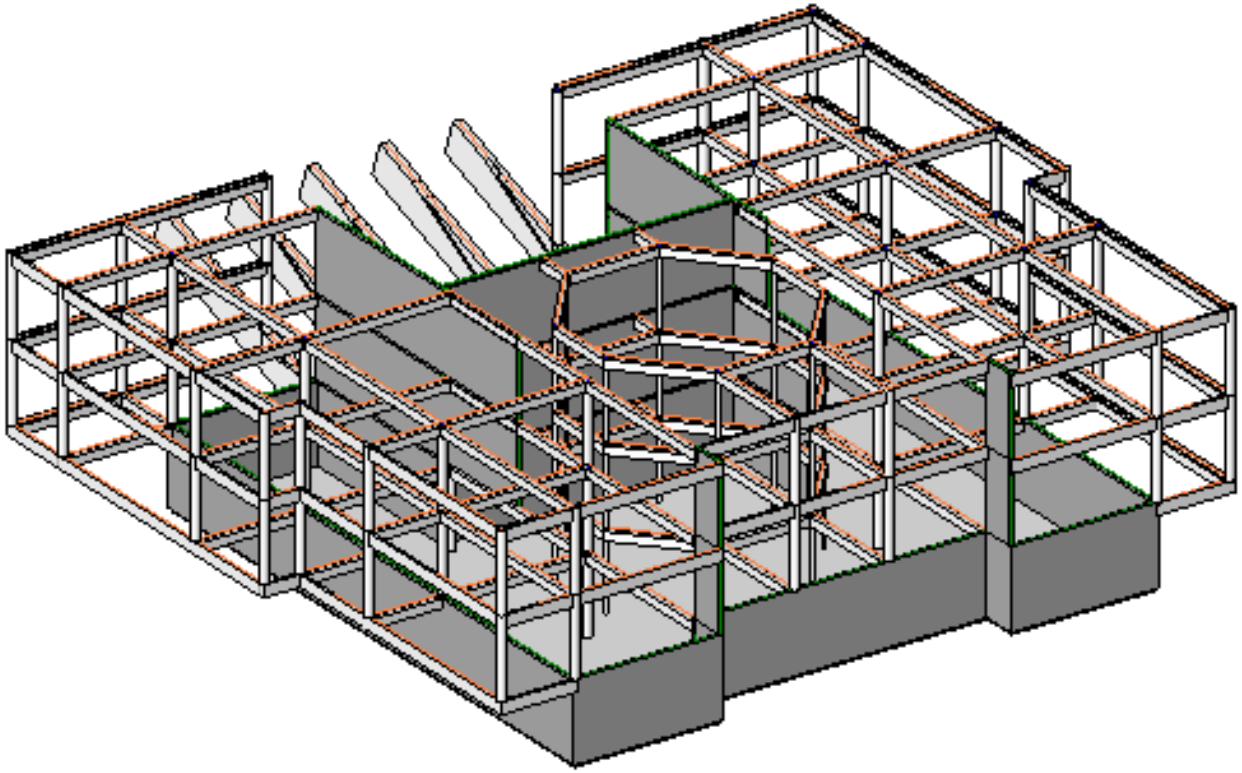
Column: 18”

Beam: 16” x 25”

Girder: 10” x 25”

Shear Wall: 10” x 6’

Foundation: 10’ Square Spread

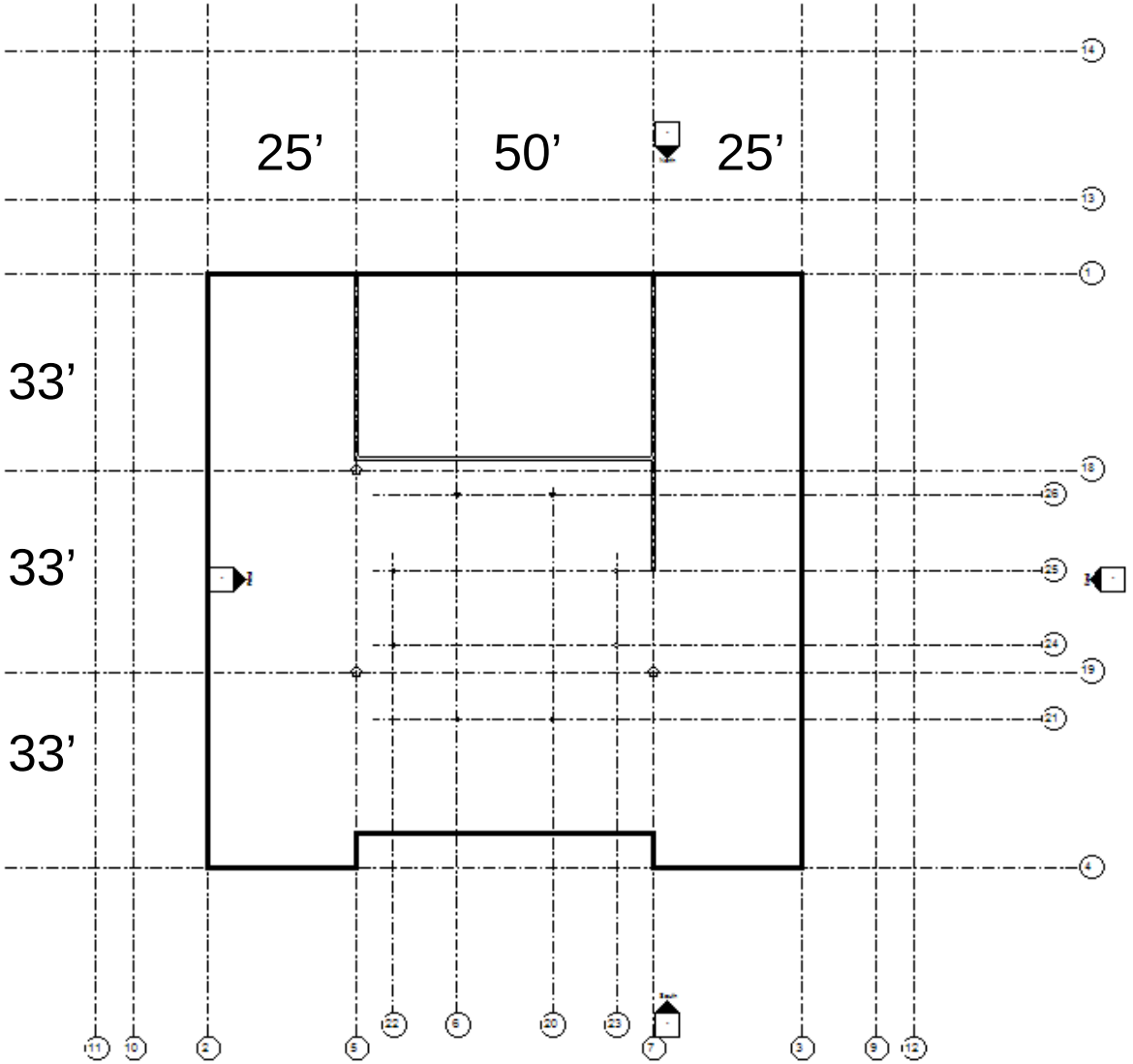


Reinforced Concrete ReUse

Grid Layout

Largest Bay Size

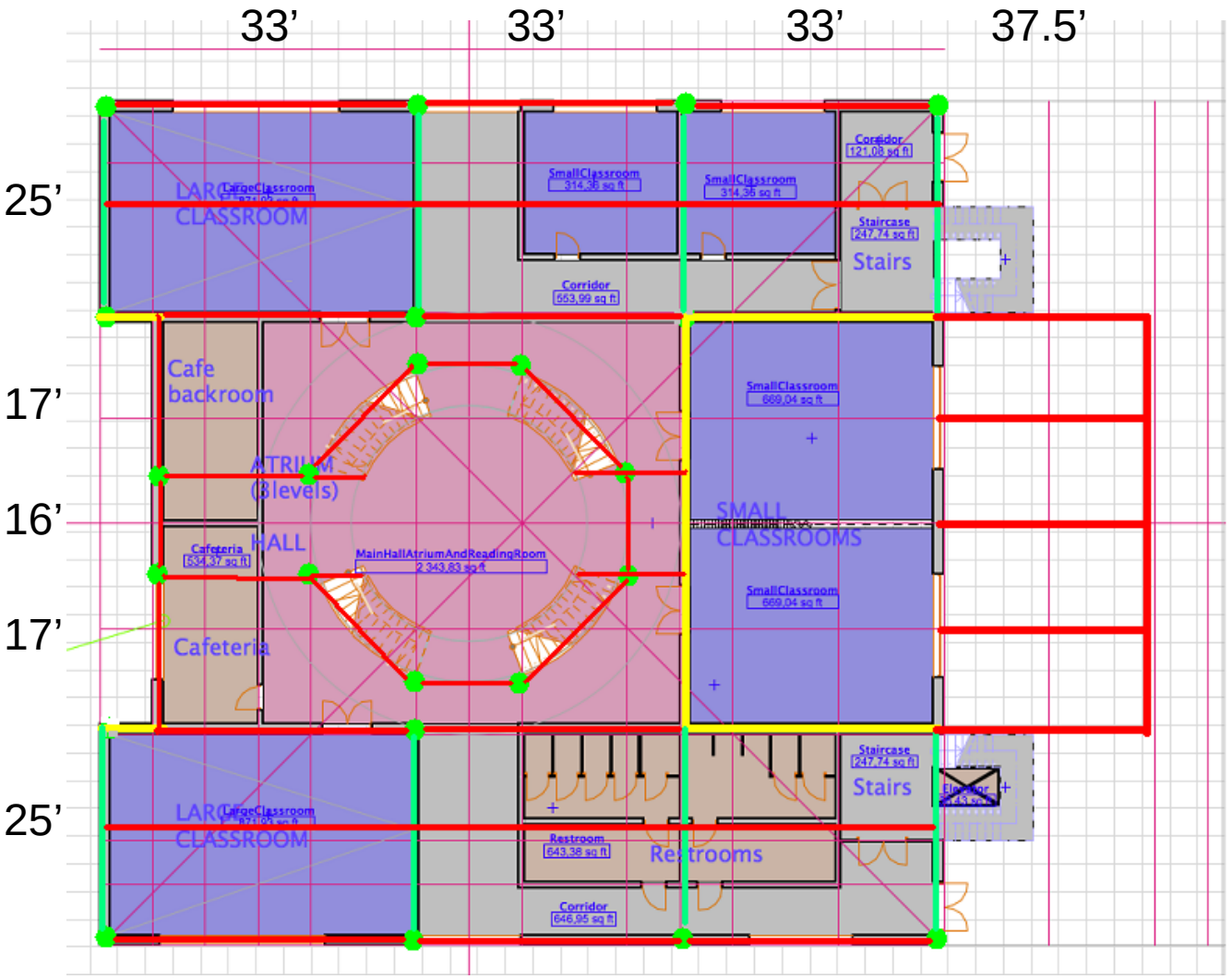
25’ x 33’



Reinforced Concrete ReUse

First Floor

- Column
- Beam
- Girder
- Bearing Walls

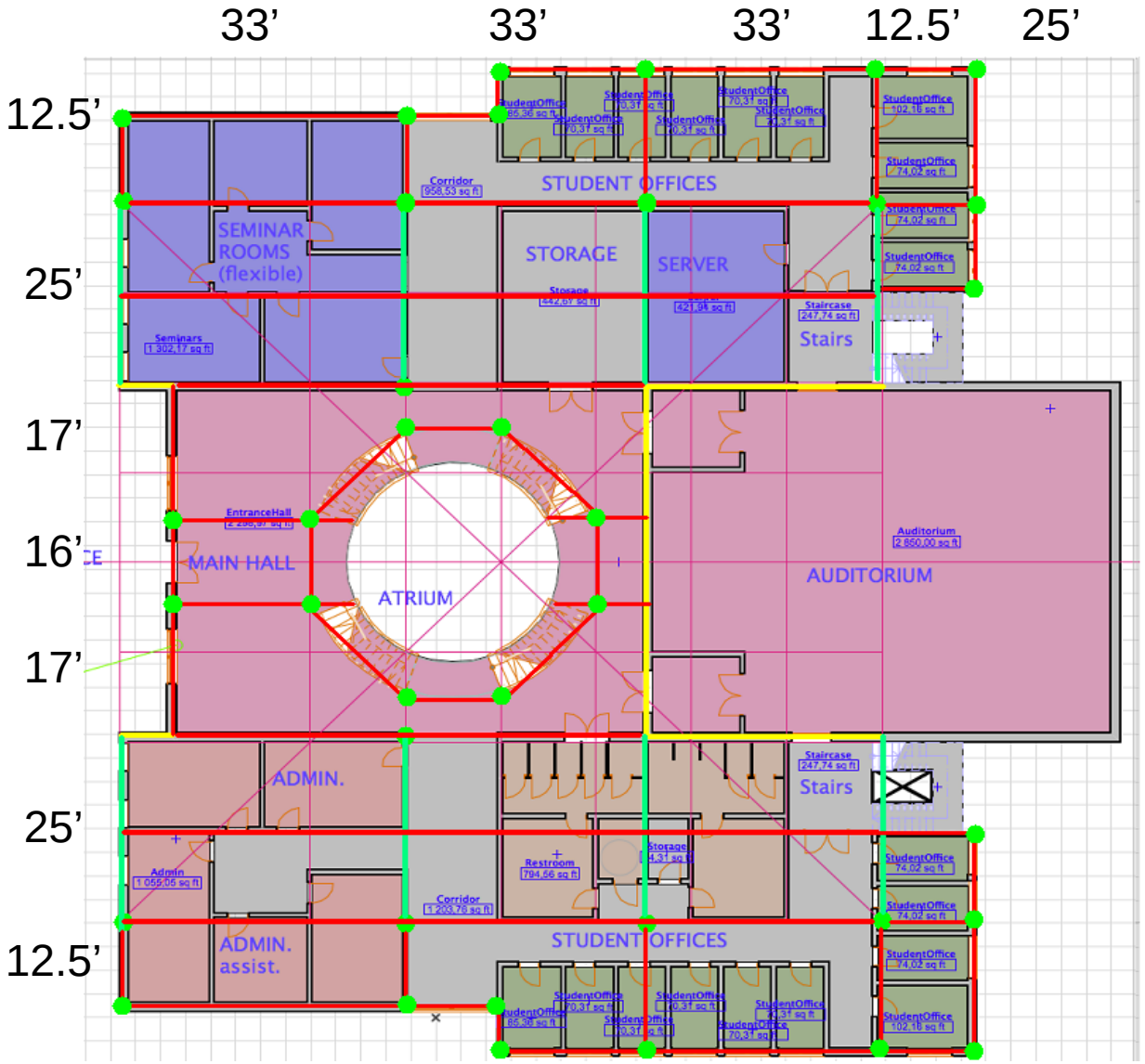


A E C L S

Structural System

Second Floor

- Column
- Beam
- Girder
- Bearing Walls



A

E

C

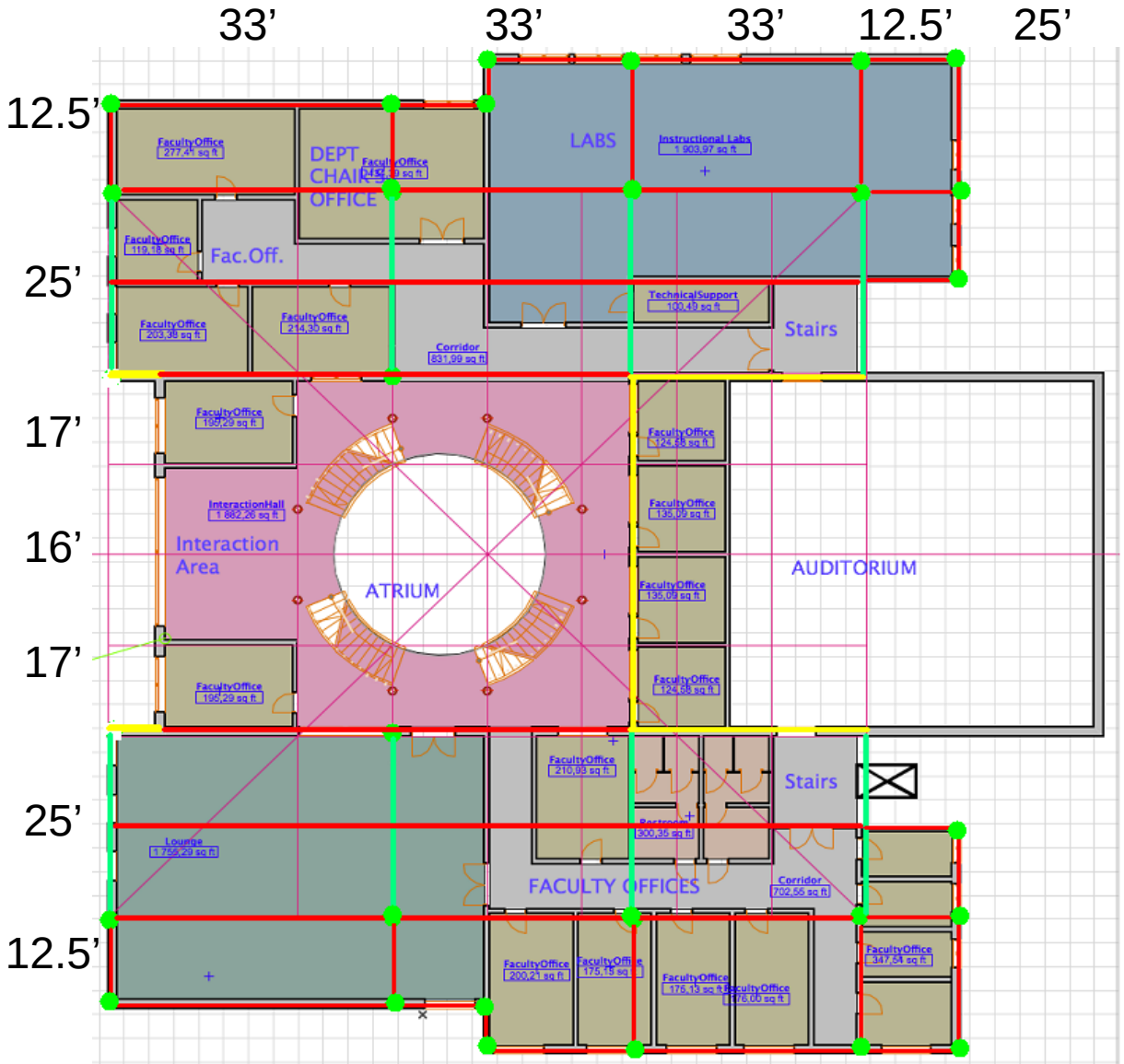
L

S

Structural System

Third Floor

- Column
- Beam
- Girder
- Bearing Walls



A

E

C

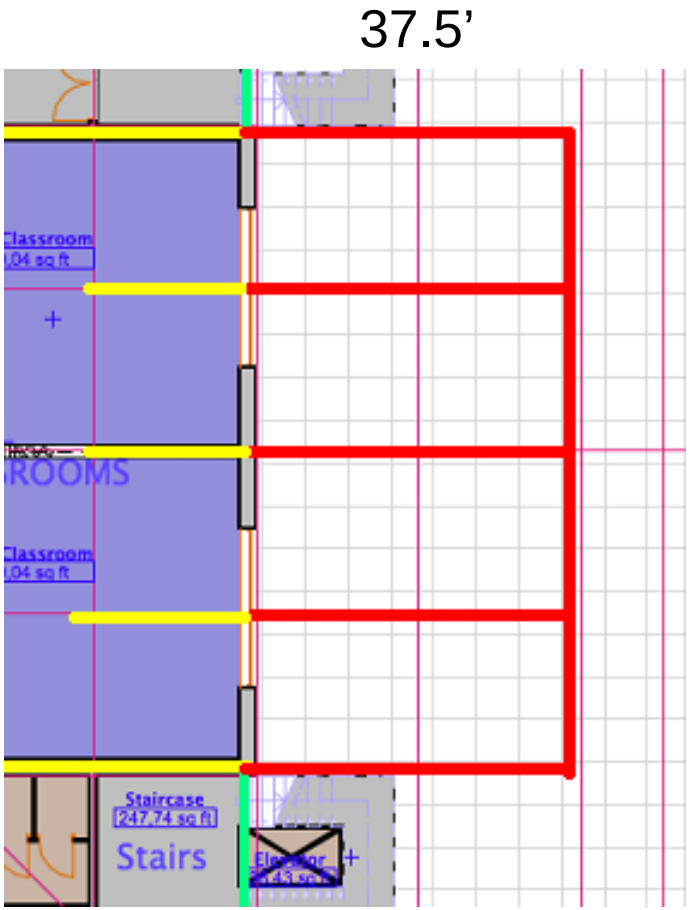
L

S

Structural System

Cantilever Load Path

- Large Moment Reaction
- Requires beam 24”x68”
- 14 #10 bars
- Wall at 68” long has tension component of 966 kips.



Reinforced Concrete ReUse

A

E

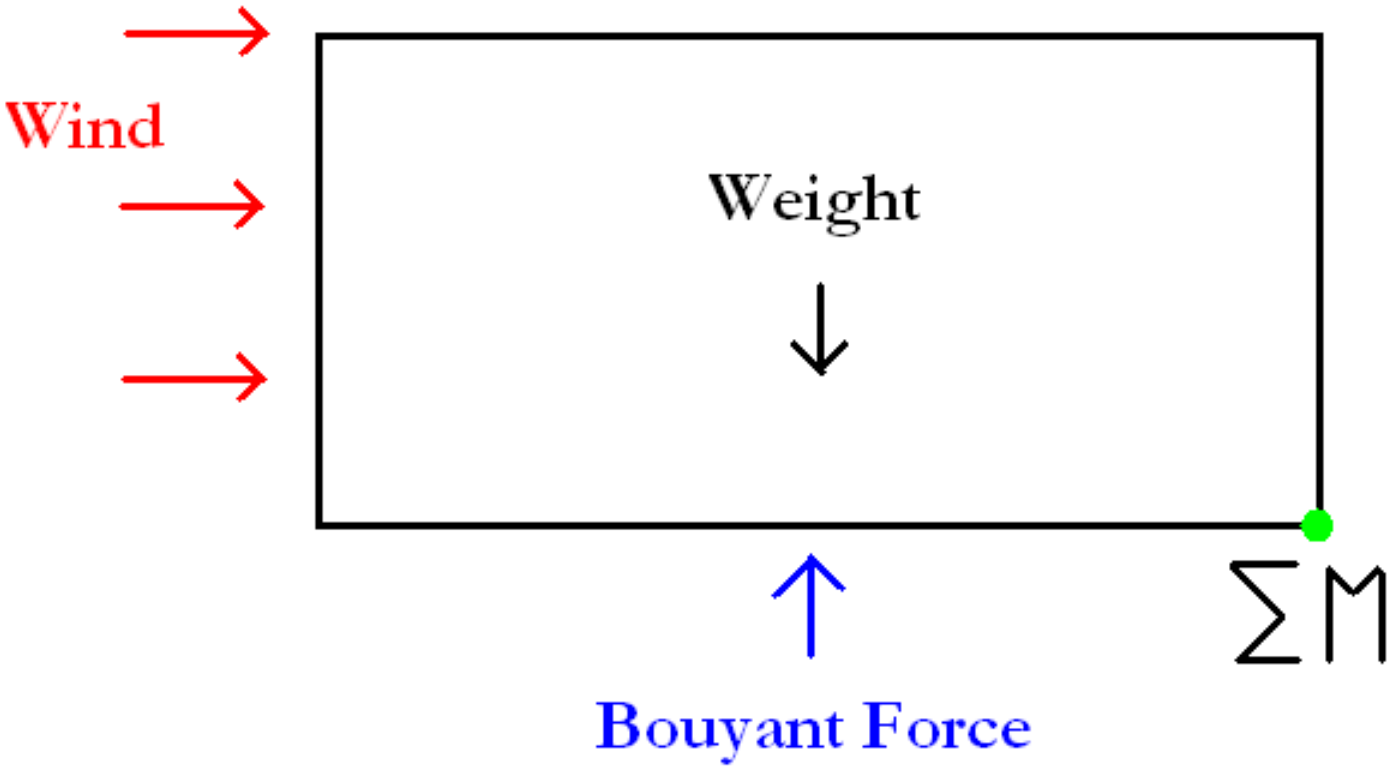
C

L

S

Overturning Moment

Check Under Most Extreme Case



Reinforced Concrete ReUse

Comparison

Floor to floor: 13’6”

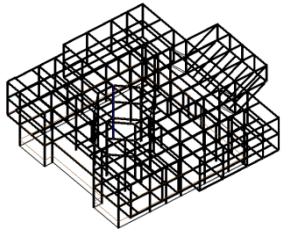
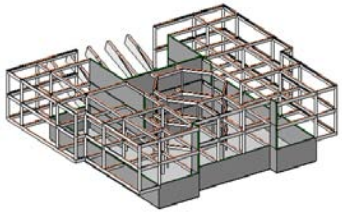
Slab

Floor to ceiling

MEP

RC Depth: 25"

SS Depth: 16"

System	Advantages	Disadvantages
	Lightweight, Shorter Depth, Balance Cantilevers	Expensive
	Cheap, Historic Material	Schedule, Difficult Cantilever

MEP: 24”

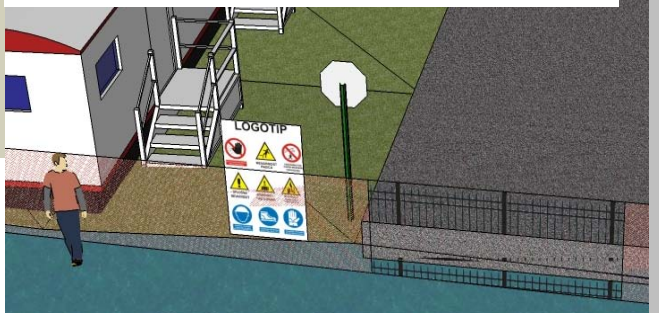
Site Layout Concrete Option - ReUse

- Offices
- Trailers
- Toilets
- Storage container (tools)

Storage:
- Rebar: 1400 SF
- Formwork: 2200 SF
- Earth: 2300 SF

Recycling

Signs (stop, warnings)

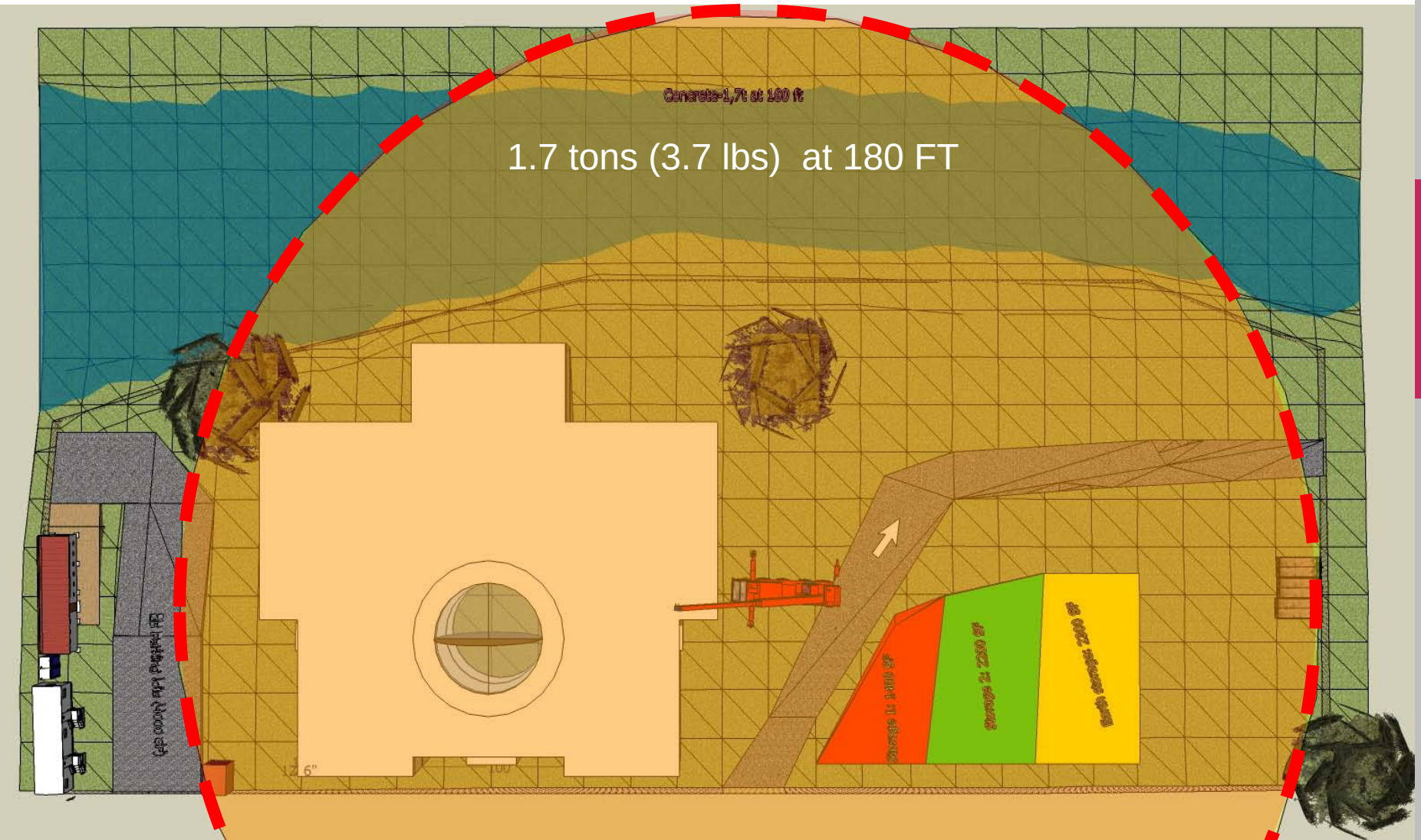


- 25 Parking lots (4000 SF)

A E C L S

Site Layout Concrete Option - ReUse

Normal Water Level



A

E

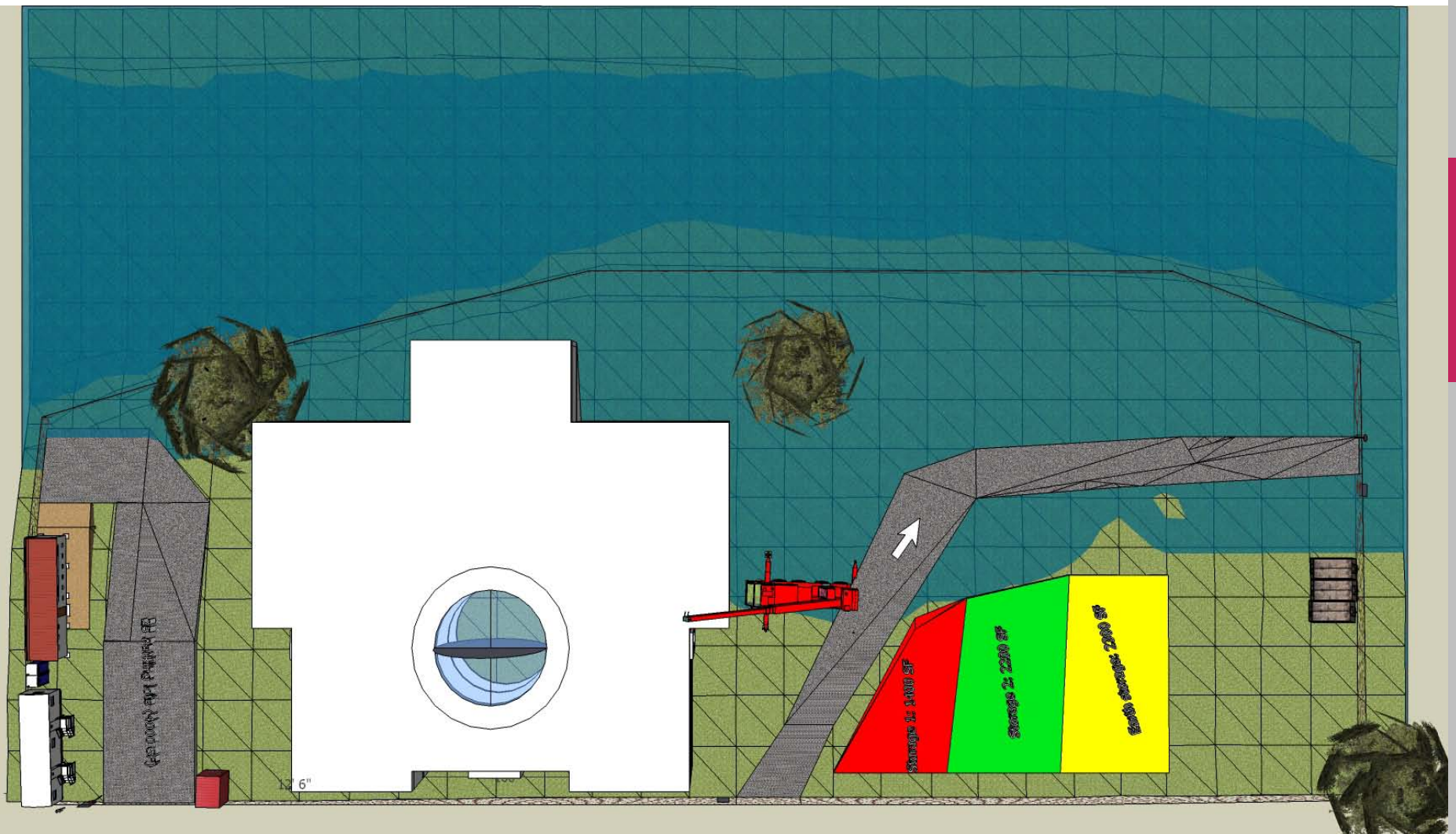
C

L

S

Site Layout Concrete Option - ReUse

33 Year Flood



A

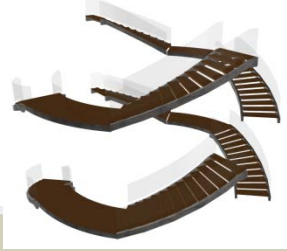
E

C

L

S

Site Layout Steel Option - ReUse



- Storage:
- Steel: 1400 SF
- Steel: 1900 SF
- Earth: 2200 SF

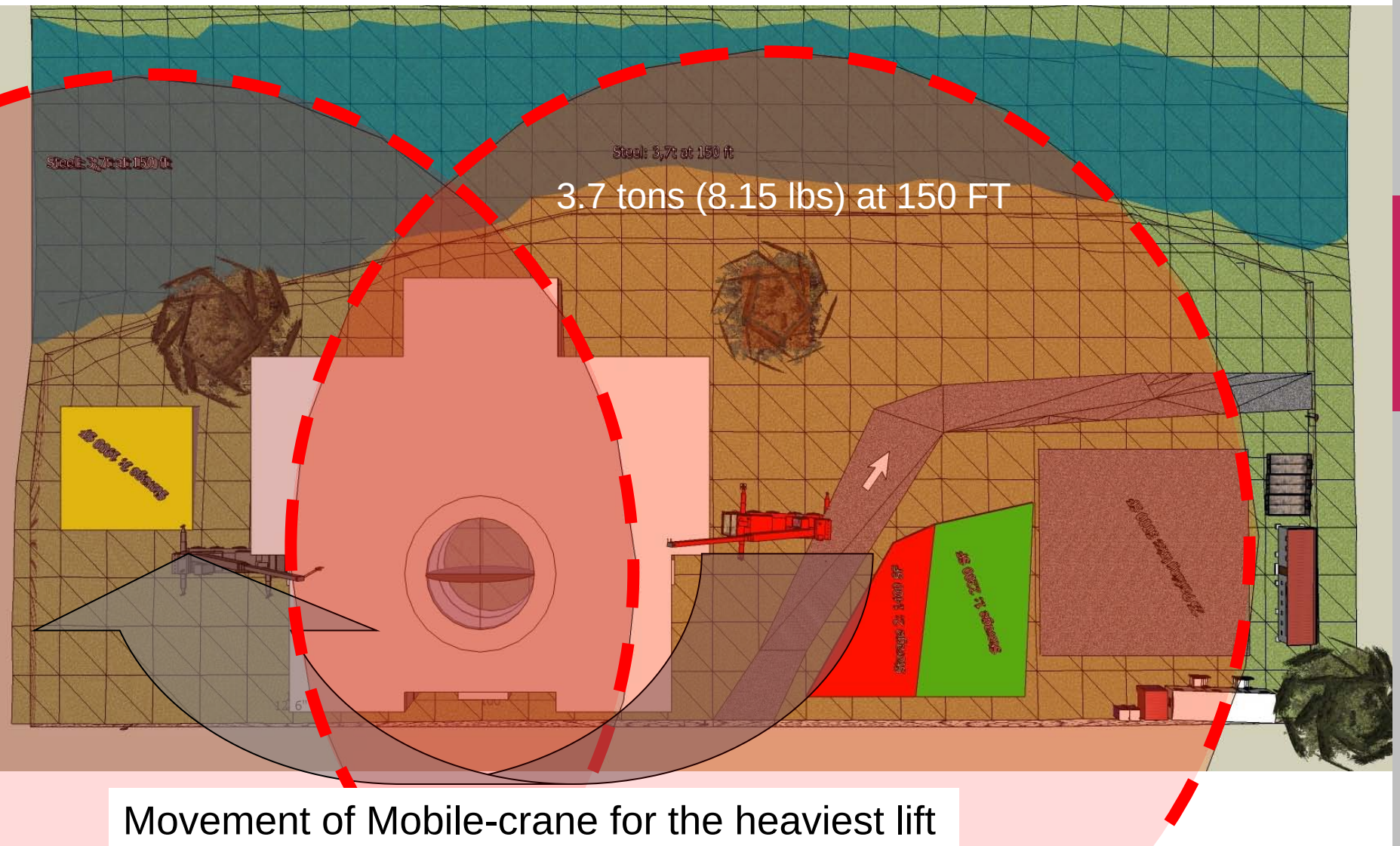
- Offices
- Trailers
- Toilets
- Storage container (tools)
- Recycling

- 25 Parking lots (5000 SF)

A E C L S

Site Layout Steel Option - ReUse

Normal Water Level

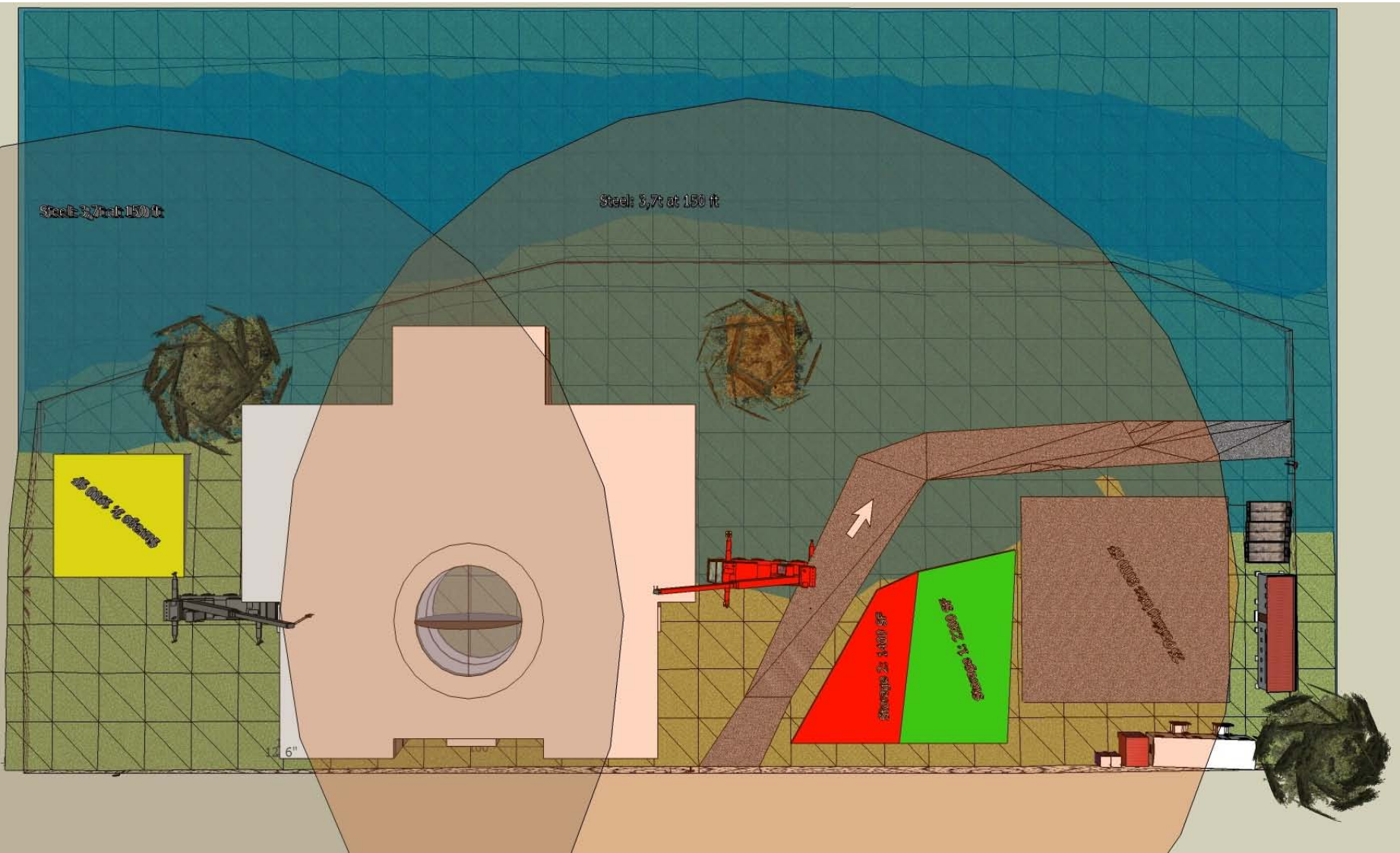


Movement of Mobile-crane for the heaviest lift

A E C L S

Site Layout Steel Option - ReUse

33 Year Flood



A

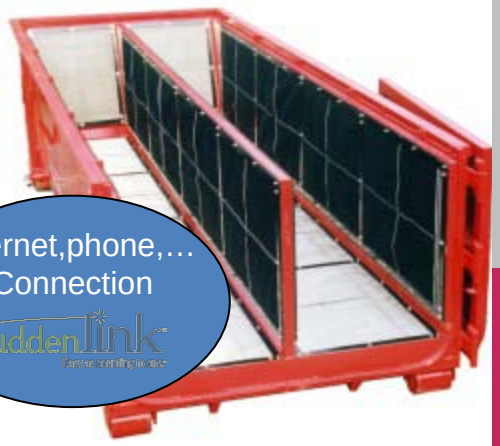
E

C

L

S

General Issues



Sewer system

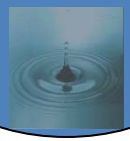
Gas station

Electricity

300 FT

2 MILES

Potable water



Internet,phone,… Connection

suddenlink

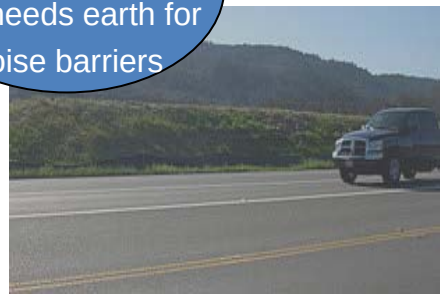
4 MILES

15 MILES

Glazing

EuroLam® INTERNATIONAL

Earth removal: Highway construction Site needs earth for noise barriers



2 MILES

2,5 MILES

2 MILES

Local Hospital

Steel structure Manufacture

stm

Concrete, asphalt batching plant

A

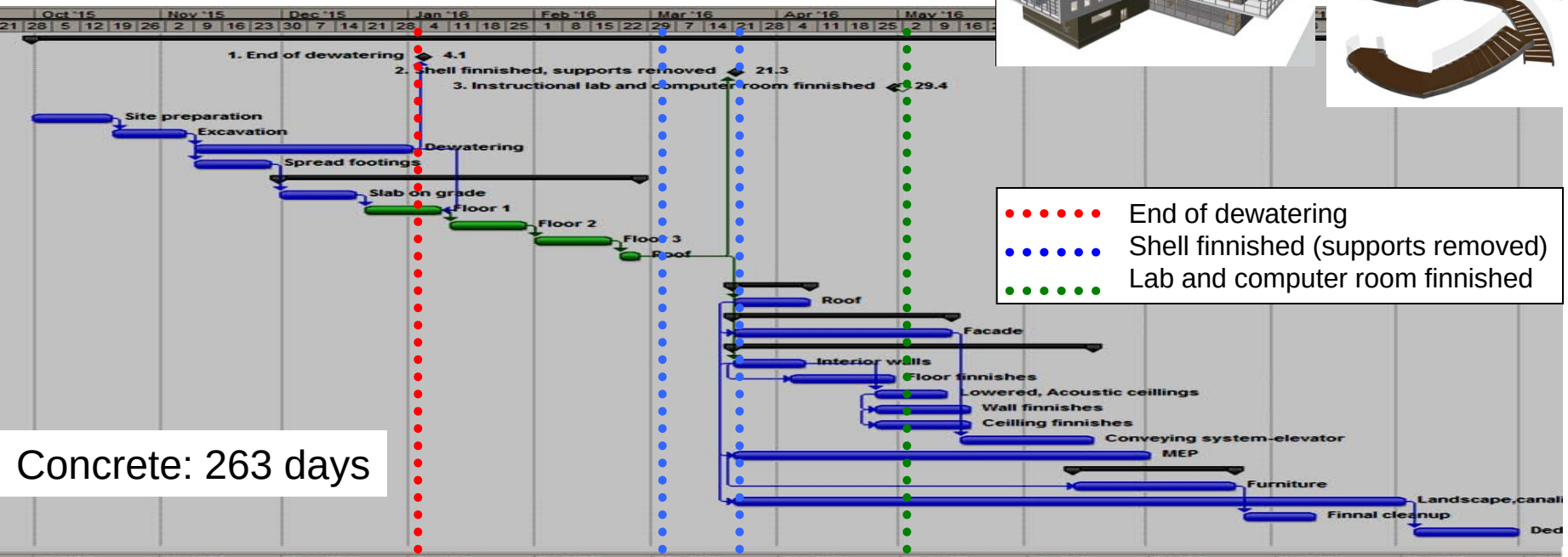
E

C

L

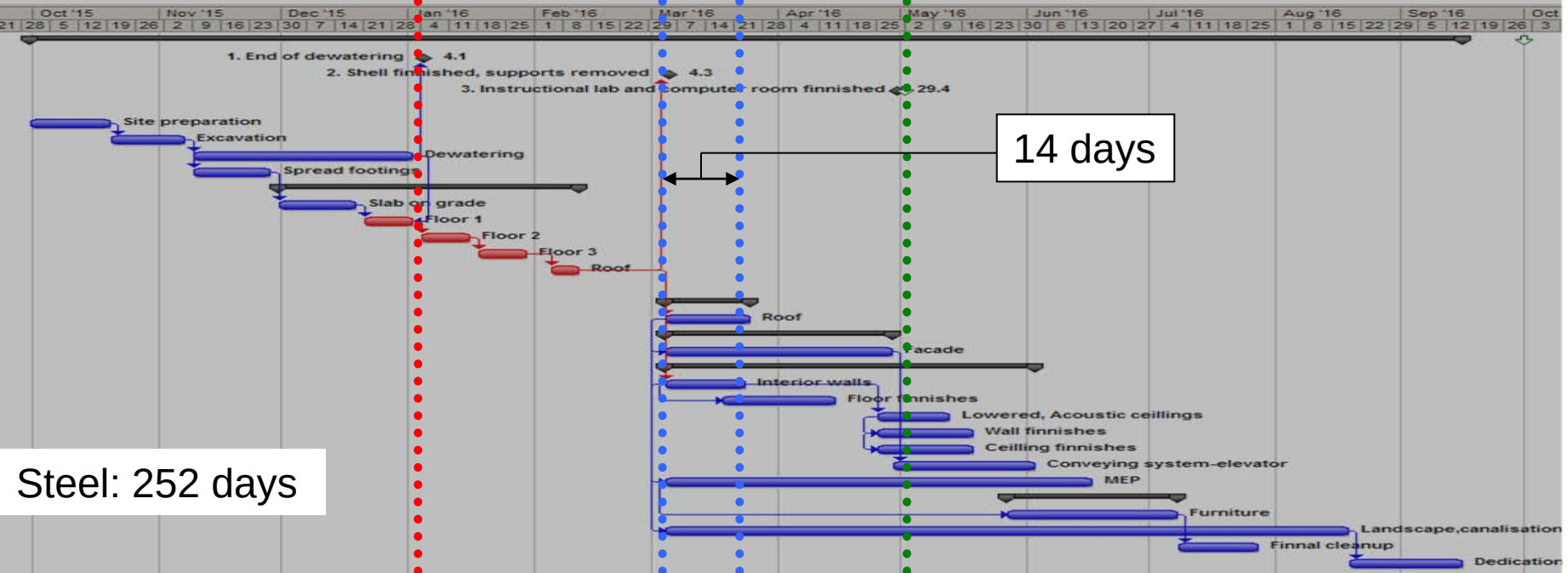
S

General Issues



End of dewatering
Shell finnished (supports removed)
Lab and computer room finnished

Concrete: 263 days



14 days

Steel: 252 days

A E C L S

Equipment

- **Alternative fuels**: Biodiesel, Dimethyletheris (DME): close to CO2 neutral
- **95% of the machine recyclable**
- **Reduced external sound levels**
- **Rental**: 2 miles from site
- 1 excavator, 1 Mini excavator, 2 Dumpers

Transport: 15 miles
Excavation: 90 000 CF
Duration of task: 10 days

- **Mobile crane: Liebherr LTM 1160 5.1**
  Capacity at 180 ft: 1,7 tons – Concrete
  Capacity at 150 ft: 3,7 tons – Steel
  Heaviest lift: steel structure: 2,8 tons
- **Concrete pump:** Radius 35 FT
- **Pilling rig**

A E C L S

Cost Estimates Methods

- Four different methods
  - RSMeans SQFE-Estimator
  - German SQFE-Estimator
  - Own Calculations with RSMeans as base
  - Reference Project

A

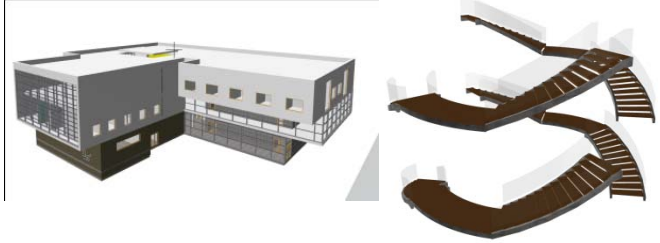
E

C

L

S

Cost Estimates SQFE Parameters



RSMeans SQFE

(Based on basic constructions)

- Building Type
- Story Count
- Story Height
- Floor Area
- Perimeter

German SQFE

(Based on 13 universities with advanced laboratory facilities)

- Site Total
- Gross Floor Space
- Outside Area
- Excavation
- Footprint
- Exterior Walls
- Interior Walls
- Ceiling
- Roof

Cost Estimates Reference Project

- Project Name: Arrheniuslaboratoriet
- Building Type: School Building
- Location: Stockholm, Sweden
- Floor Area: 27 000 SF
- Cost: $6 150 000
- Cost/SF: $228
- Similar Building Program

A

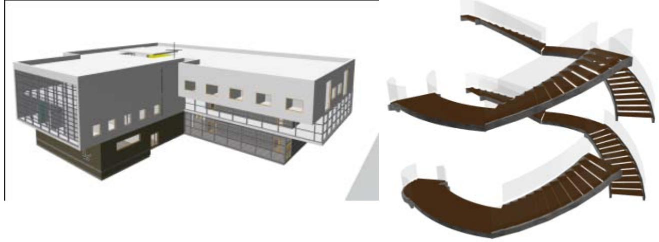
E

C

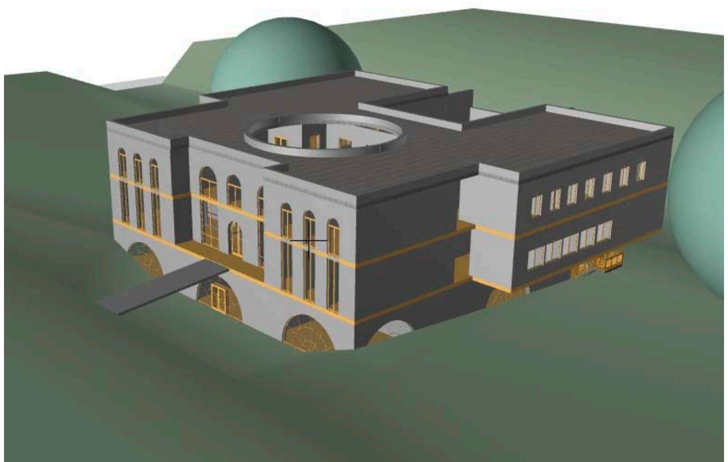
L

S

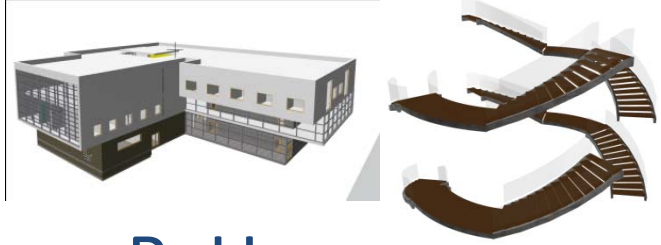
Cost Estimates Result Data



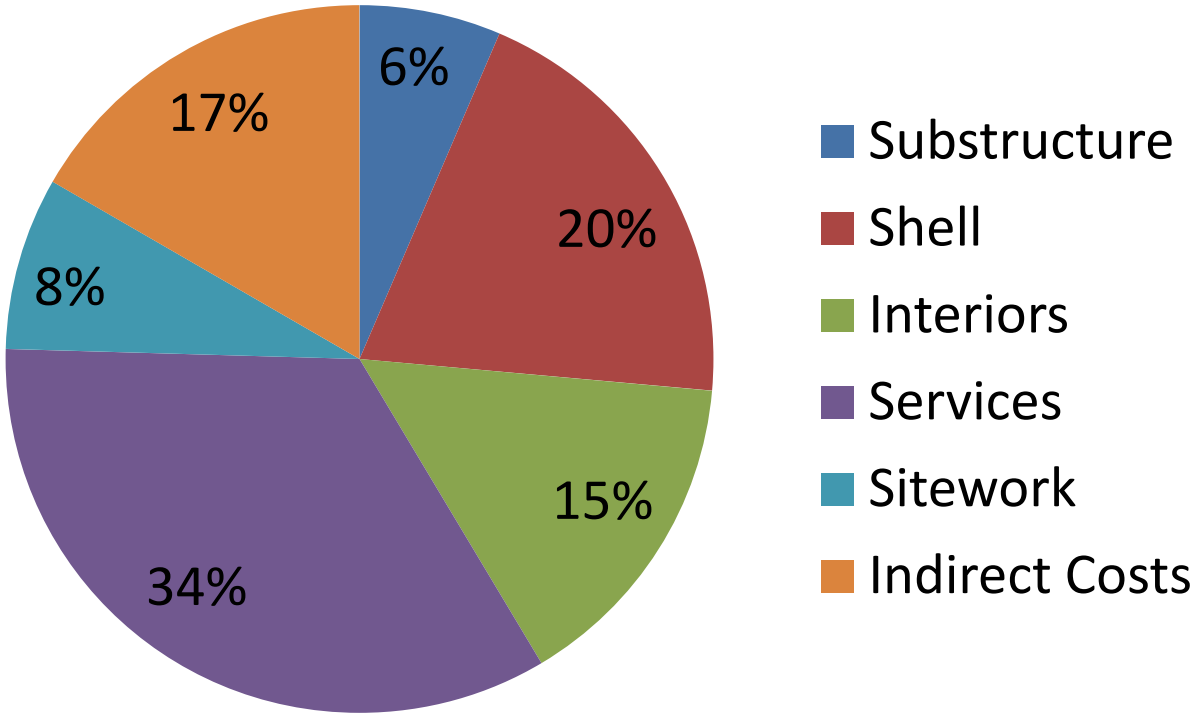
	Transparency		ReUse	
	Concrete	Steel	Concrete	Steel
RSMeans SQFE	$5 647 000 ($179/SF)	$5 835 500 ($185/SF)	$5 764 500 ($173/SF)	$5 992 000 ($180/SF)
German SQFE	$7 361 000 ($233/SF)	$7 361 000 ($233/SF)	$7 660 000 ($230/SF)	$7 660 000 ($230/SF)
Reference Project w. factor	$6 866 000 ($217/SF)	$6 866 000 ($217/SF)	$7 437 500 ($223/SF)	$7 437 500 ($223/SF)



Cost Estimates Calculations

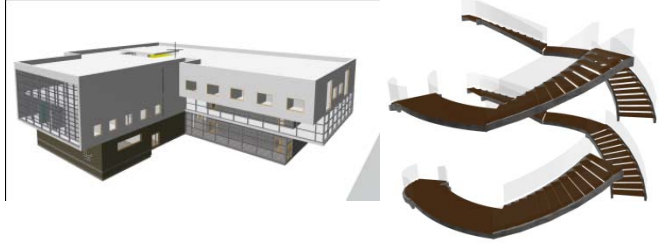


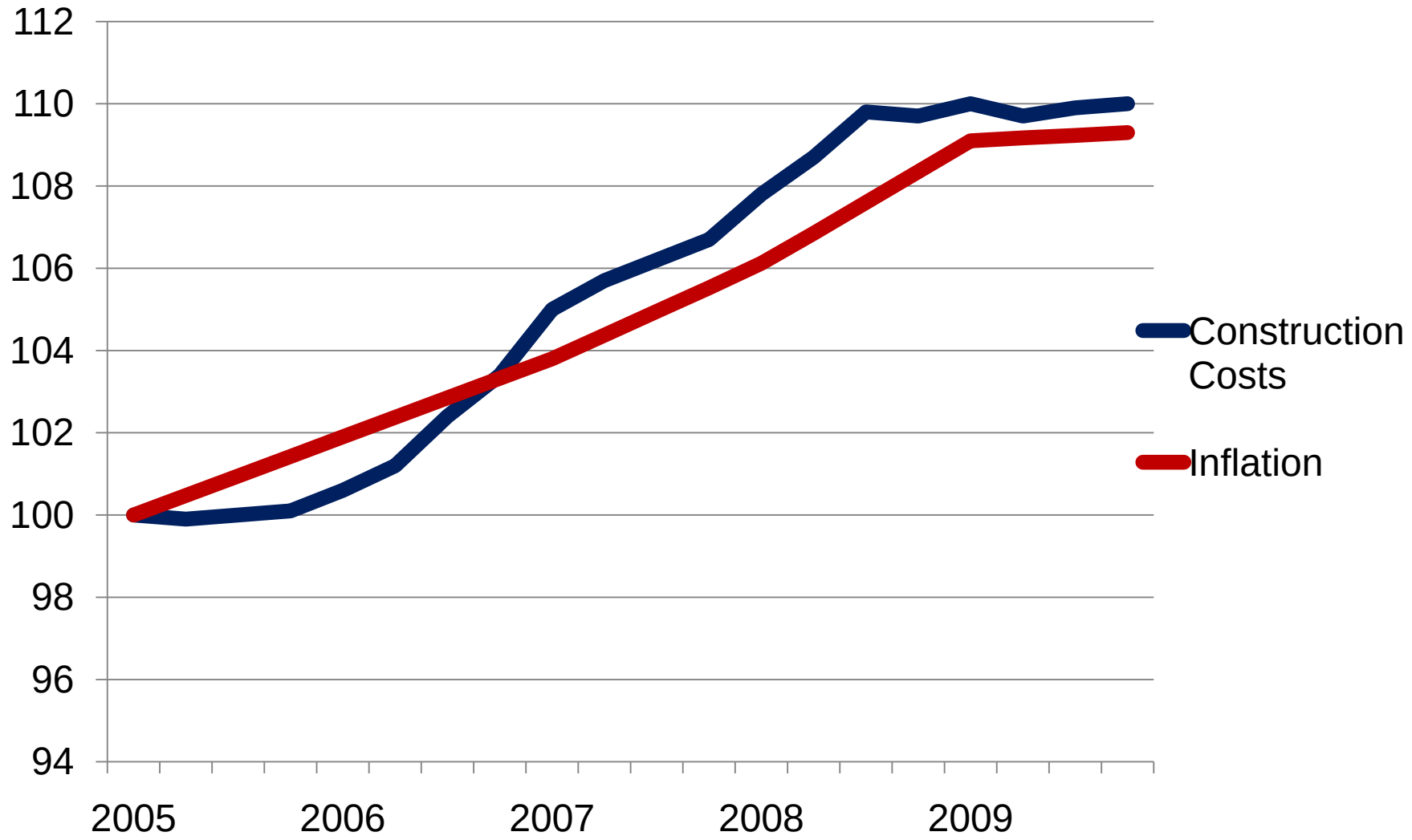
	Transparency		ReUse	
	Concrete	Steel	Concrete	Steel
Own Calcs.	$6 767 000 ($214/SF)	$6 930 000 ($219/SF)	$6 677 000 ($200/SF)	$6 858 000 ($206/SF)



A E C L S

Cost Estimates Inflation Data

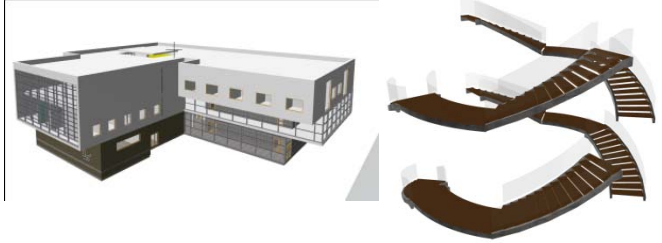


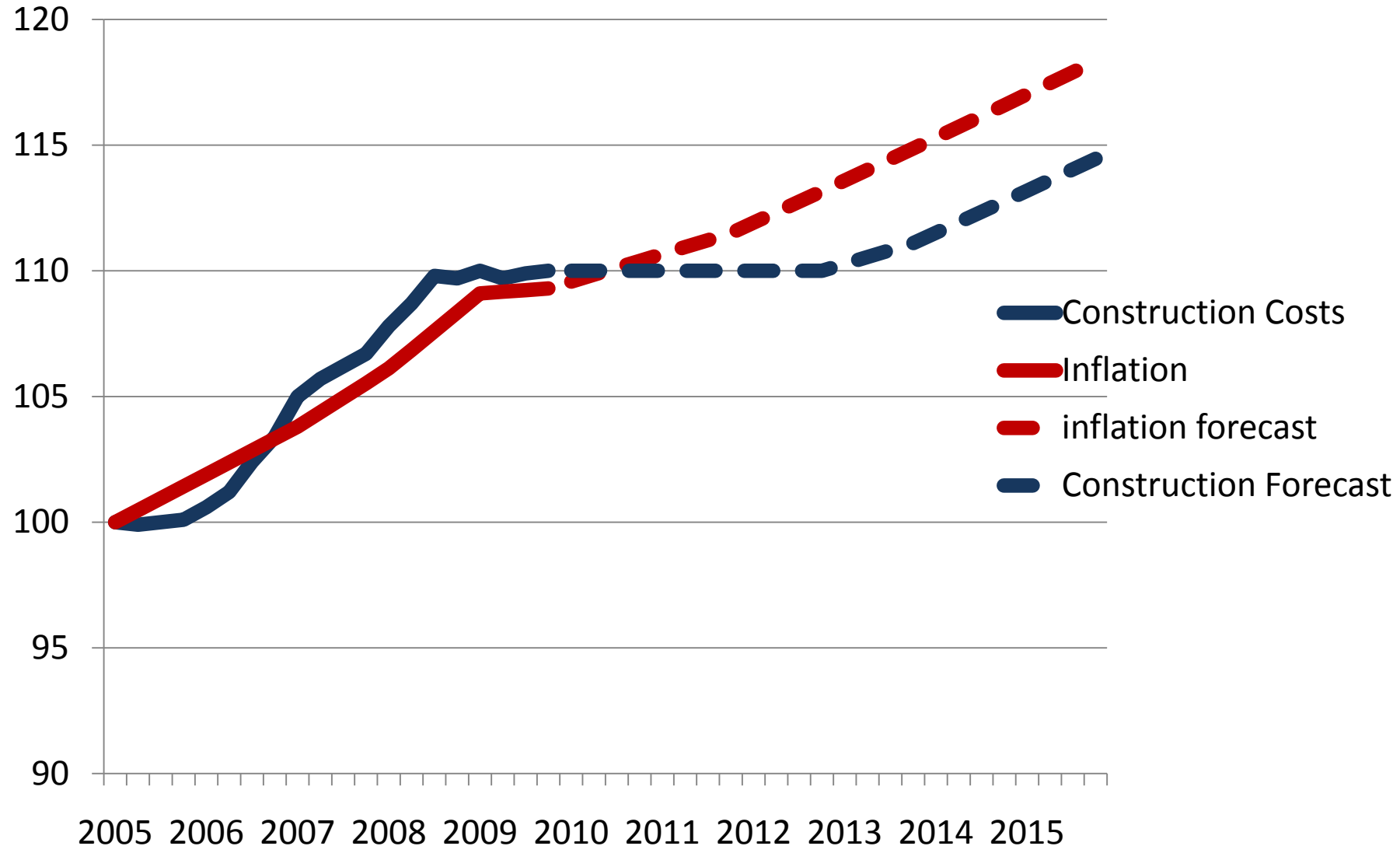


A E C L S

Cost Estimates

Inflation Forecast





Construction Methods

- Cast-in-place concrete (prefab auditorium roof)
- Similar beam sizes
- No building components greater than 50’
- Just in time delivery

Risk Items

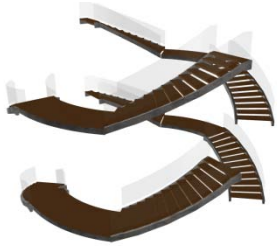
Period	Risk Category	Risk name	Risk Allocation		Responsible
			Contractor	Owner	
Construction Period	political risks	changes of principles (DIN, Euro code)	x		all
		permission problems	x	x	owner
		party political changes	x	x	owner
		restrictions on import/export		x	owner
	commercial risks	increasing prices of resources	x		CM, LCFM
	legal risks	changes in law		x	owner
		building license		x	owner
		change of sales tax		x	owner
		purchase of sight		x	owner
	force majeur	war		x	all
		storm	x	x	all
		flooding risk	x		all
	planning risks	wrong sizing	x		A, E
		structural risk	x		E
	construction risks	divergence of masses	x		
		exceeding construction schedule	x		CM
		defective material	x		
		time lag project start	x		
		accessibility building site	x		
		resident risk	x		
		fire risk	x		
	financing risks	changes of interests	x		
		inflation risk		x	
		illiquidity of customer	x		
		depression	x		
	personnel risks	illness/accidents	x		CM
		mistakes from workers	x		CM, LCFM
		loss of workers	x		CM
		liability in case of damage	x		CM, LCFM
		strike	x		CM, LCFM
n Period	political risks	changes of principles (DIN, Euro code)	x		all
	legal risks	changes in law		x	owner
		change of sales tax		x	owner
	operation risks	operation efficiency			

A E C L S

Flooding Strategy

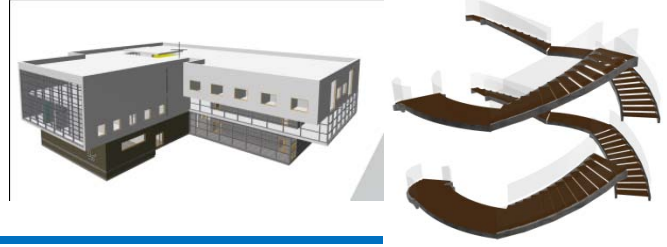
Idea	Doable?
Lifting the building up	No
Reduced damages	Yes
Aqua Barrier	No
Manual flood barrier	No
Automatic flood barrier	No
Building a dam	No
Impermeable bowl	Yes

Strategy for „Transparent“



Strategy for „ReUse“

Flooding Strategy



"Let it in"

Reduced damages

Arrangement of rooms and facilities

easy to clean

Action plan for tenant

Present value of future payments: $25,000

"Keep it out"

Impermeable bowl

Bowl of water impermeable concrete

Windows above flood level

No doors in first floor

Present value of future payments: $15,000

A

E

C

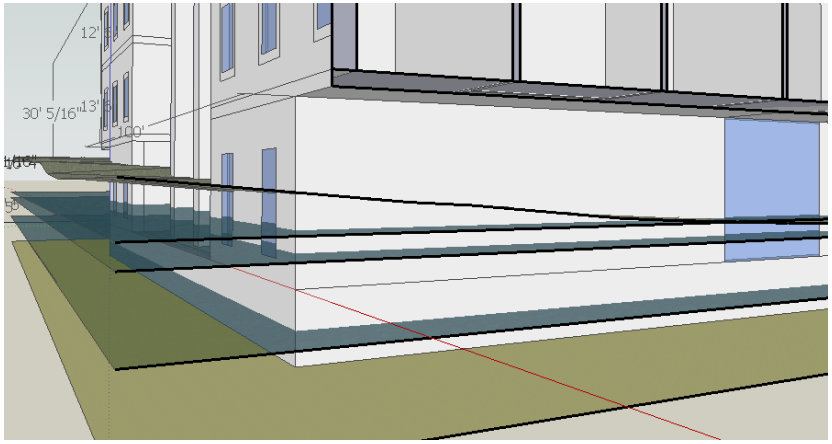
L

S

Flooding Integration

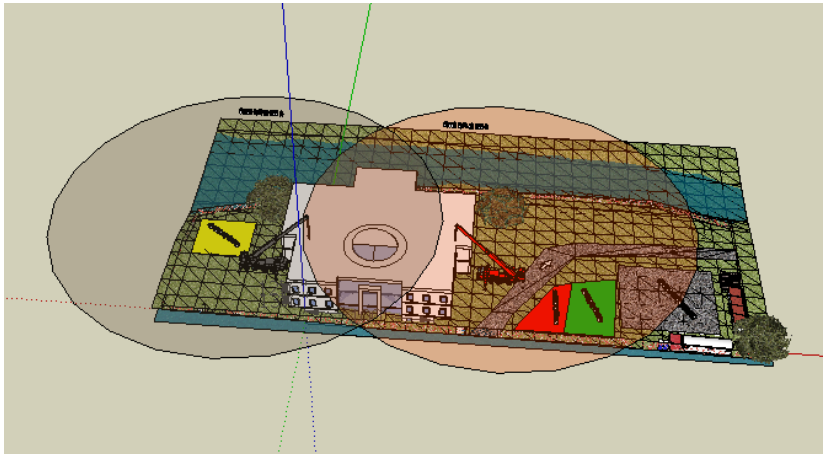
Architect:

Placing windows



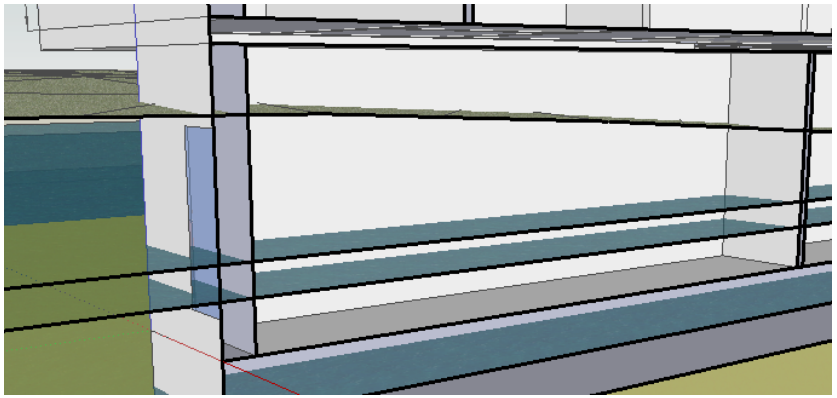
Construction Managers:

Site layout



LCFM:

Repair costs



A

E

C

L

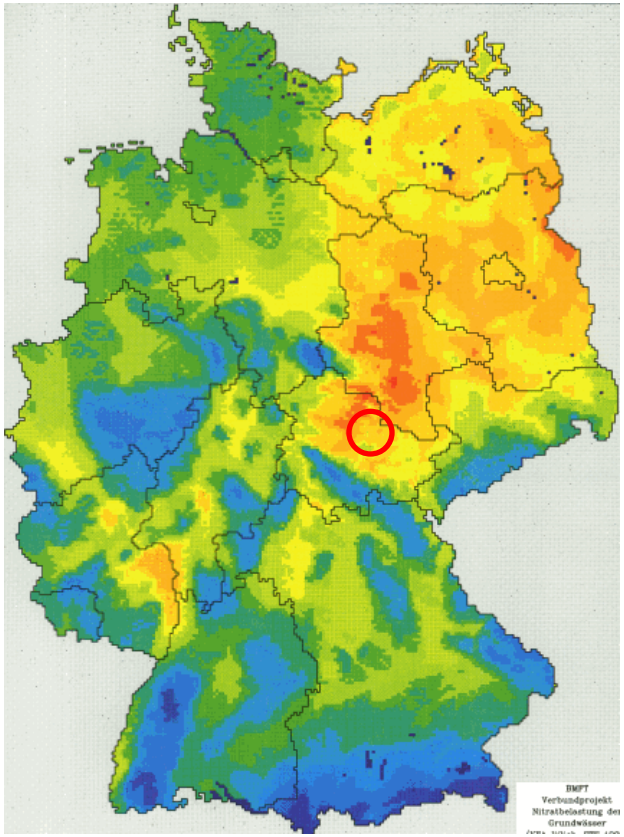
S

Sustainability

Focus on water reuse and geothermal energy

No focus on photovoltaic

Precipitation



Soil conditions

A

E

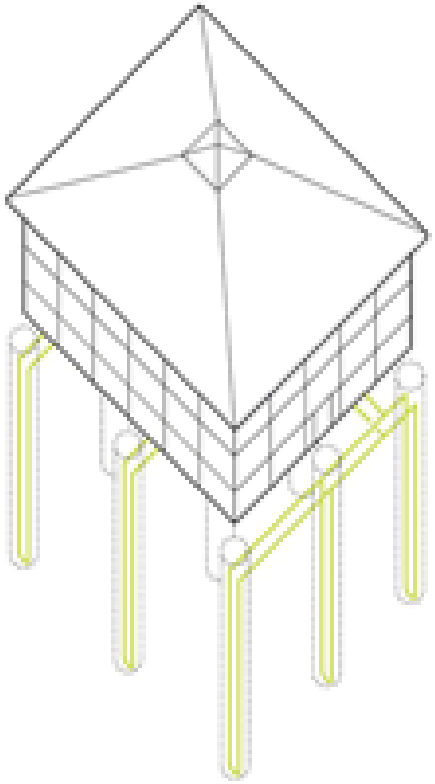
C

L

S

Geothermal

- Excellent site conditions for geothermal system, heat transfer in moist soil
- Geothermal cages around pile foundation
  - Minimal ground disturbance
  - no extra boreholes



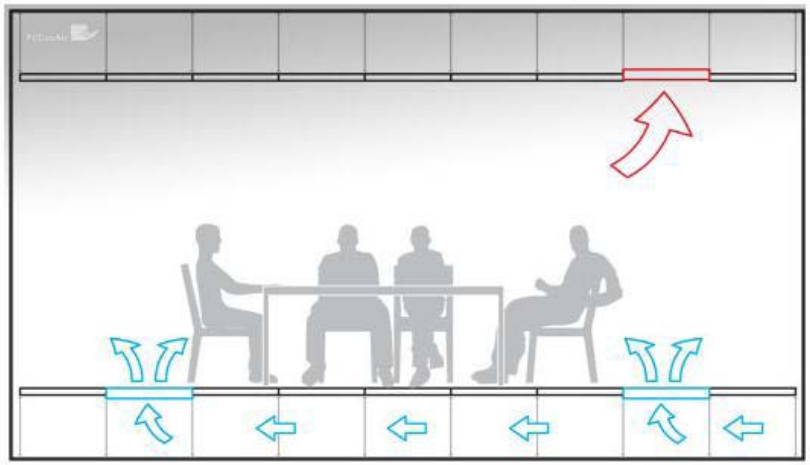
MEP Transparency

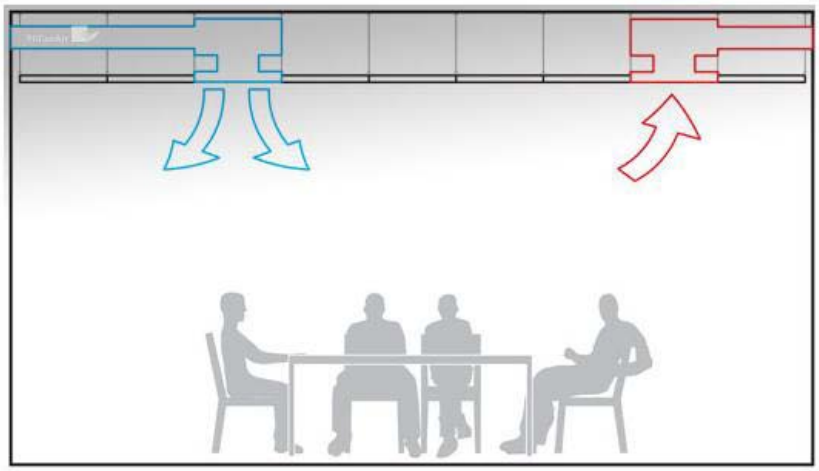
Combination underfloor and ceiling air distribution

LEVEL 3: Underfloor Distribution

LEVEL 2: Underfloor distribution

LEVEL 1: Ceiling Distribution





A

E

C

L

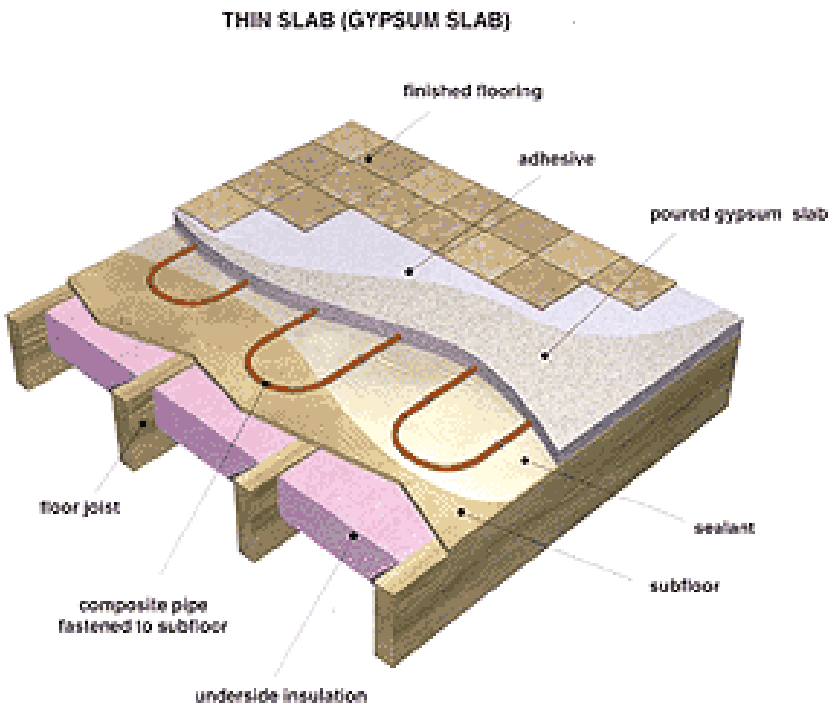
S

MEP ReUse

Radiant heating: tubing embedded in concrete slab will be safe from flooding

Minimal mechanical ventilation in offices and classrooms

Underfloor distribution for auditorium



A

E

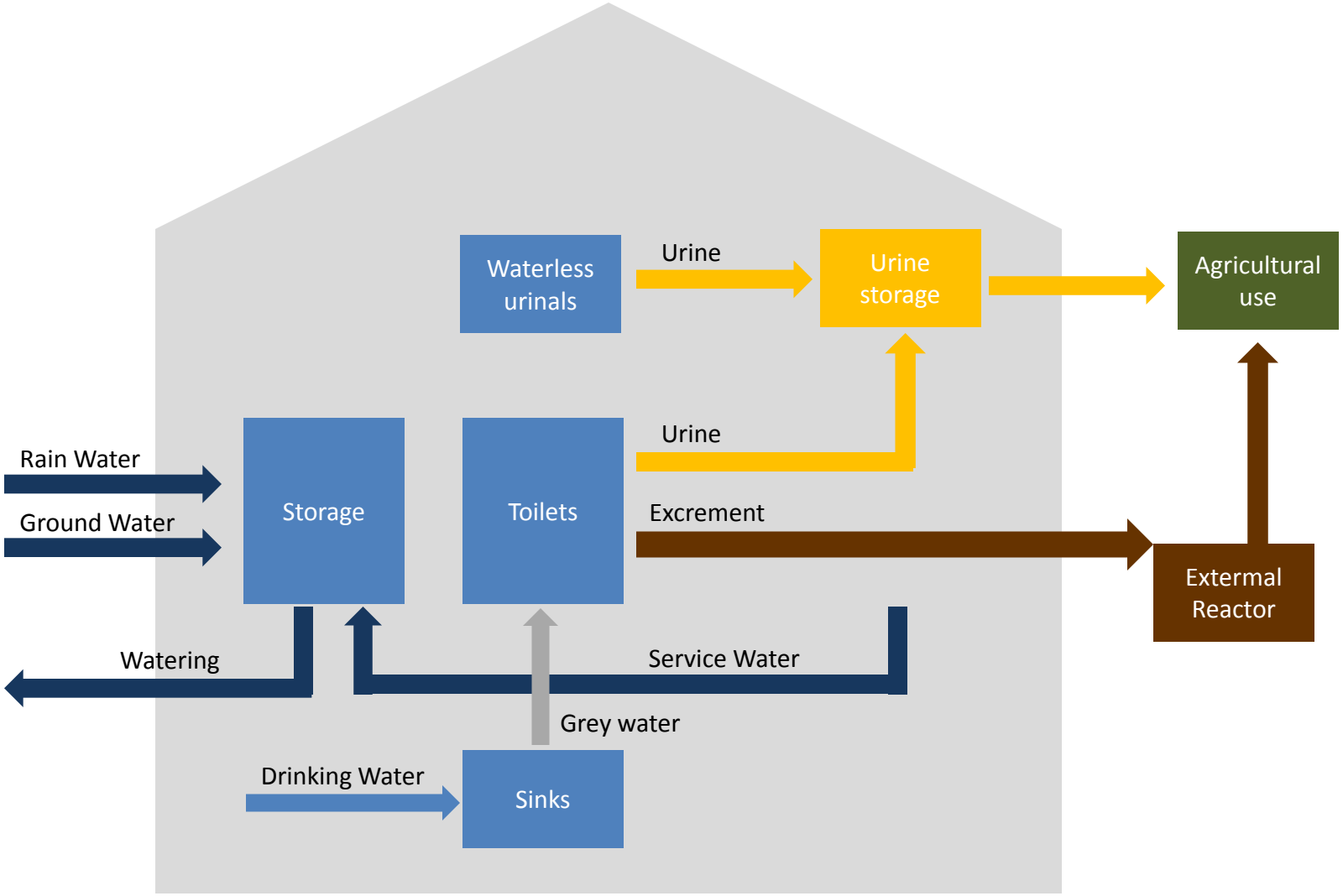
C

L

S

Water Reuse

Pretreatment system for greywater
Rainwater directly to storage tank



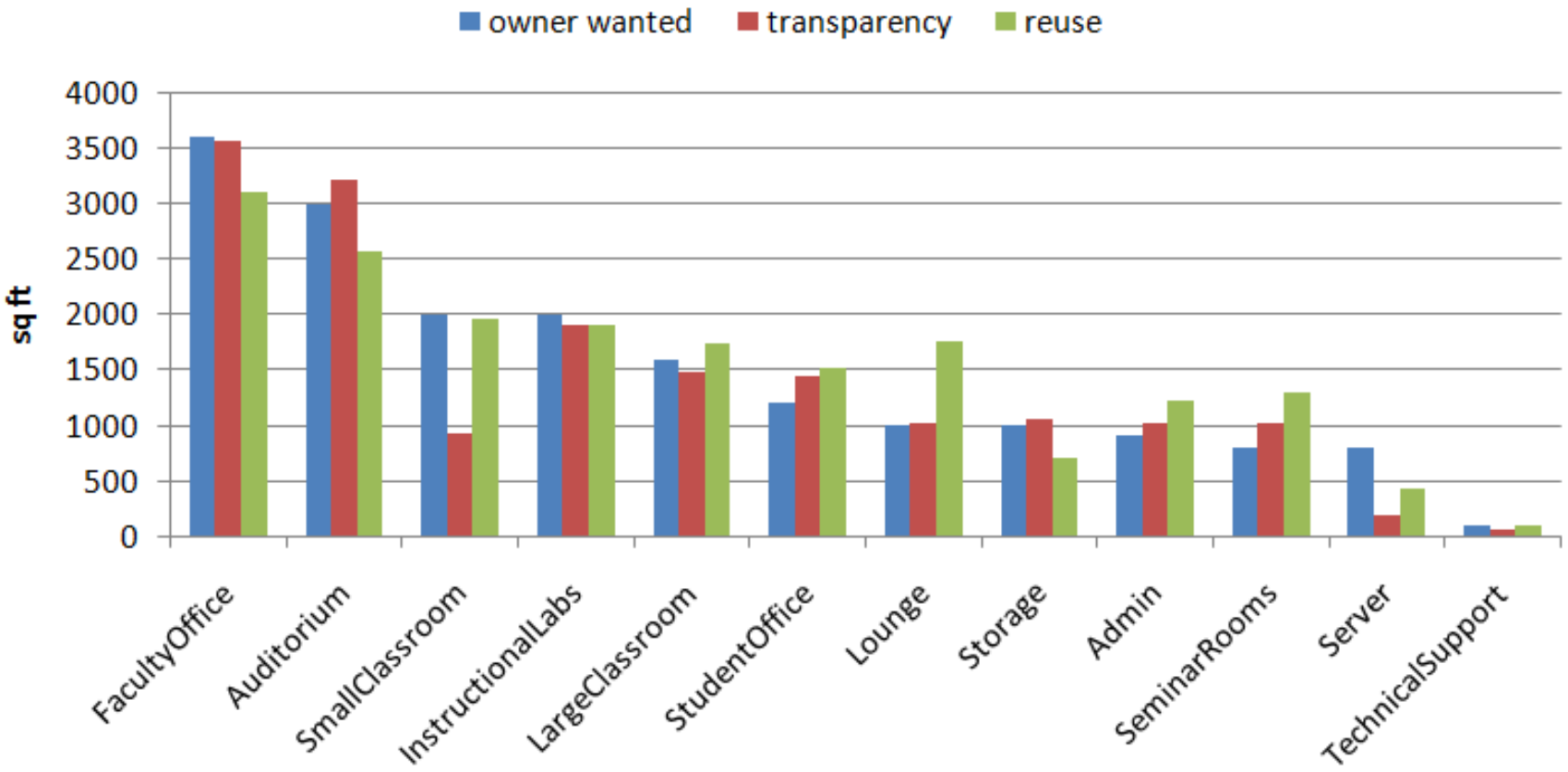
A
E
C
L
S

LEED

- Minimal site disturbance and filters for runoff during construction
- Reuse of existing building materials for façade and interior
- Efficient HVAC systems and heat recovery
- Graywater reuse/rainwater harvesting
- On site renewables: geothermal
- Maximum daylight and natural ventilation strategies
- Maximum occupant comfort and safety:
  - Low VOC materials, occupant control of windows and task lighting,
- Measurement and verification strategies
  - Flexible systems like underfloor allow for reconfiguration according to performance evaluations

A
E
C
L
S

Building Program



A

E

C

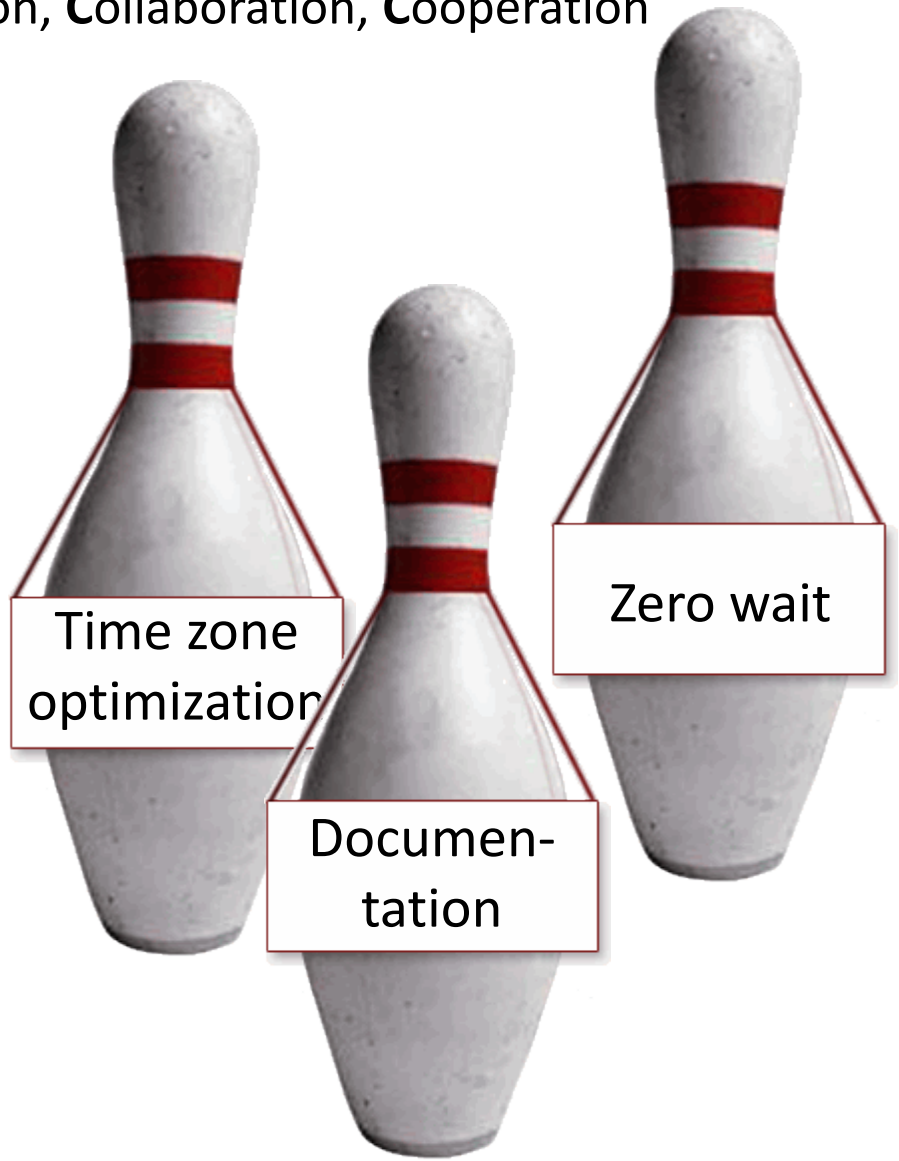
L

S

Life Cycle Benchmarks

Ratio	Transparency	Reuse	Goal
non assignable area / assignable area	0,421	0,403	minimize
circulation area / usable area	0,244	0,229	minimize
building surface / building volume	0,099	0,093	minimize

River Team **C**ommunication, **C**ollaboration, **C**ooperation



A

E

C

L

S

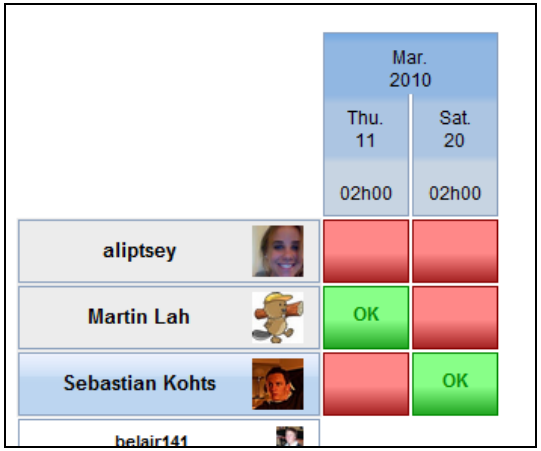
Communication Wave

1200 messages in 64 Waves

Mainly discipline Waves

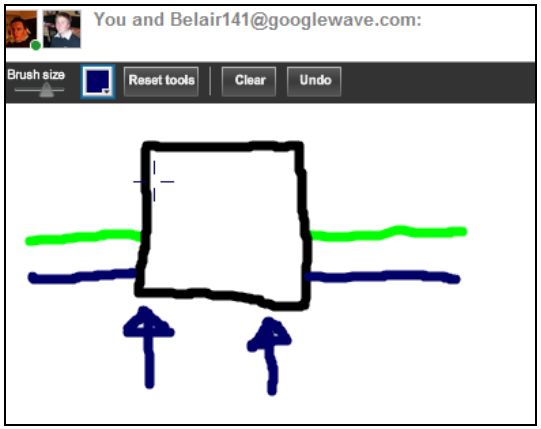
Gadgets to expand functional range

Planning Gadget



Mind Map Gadget

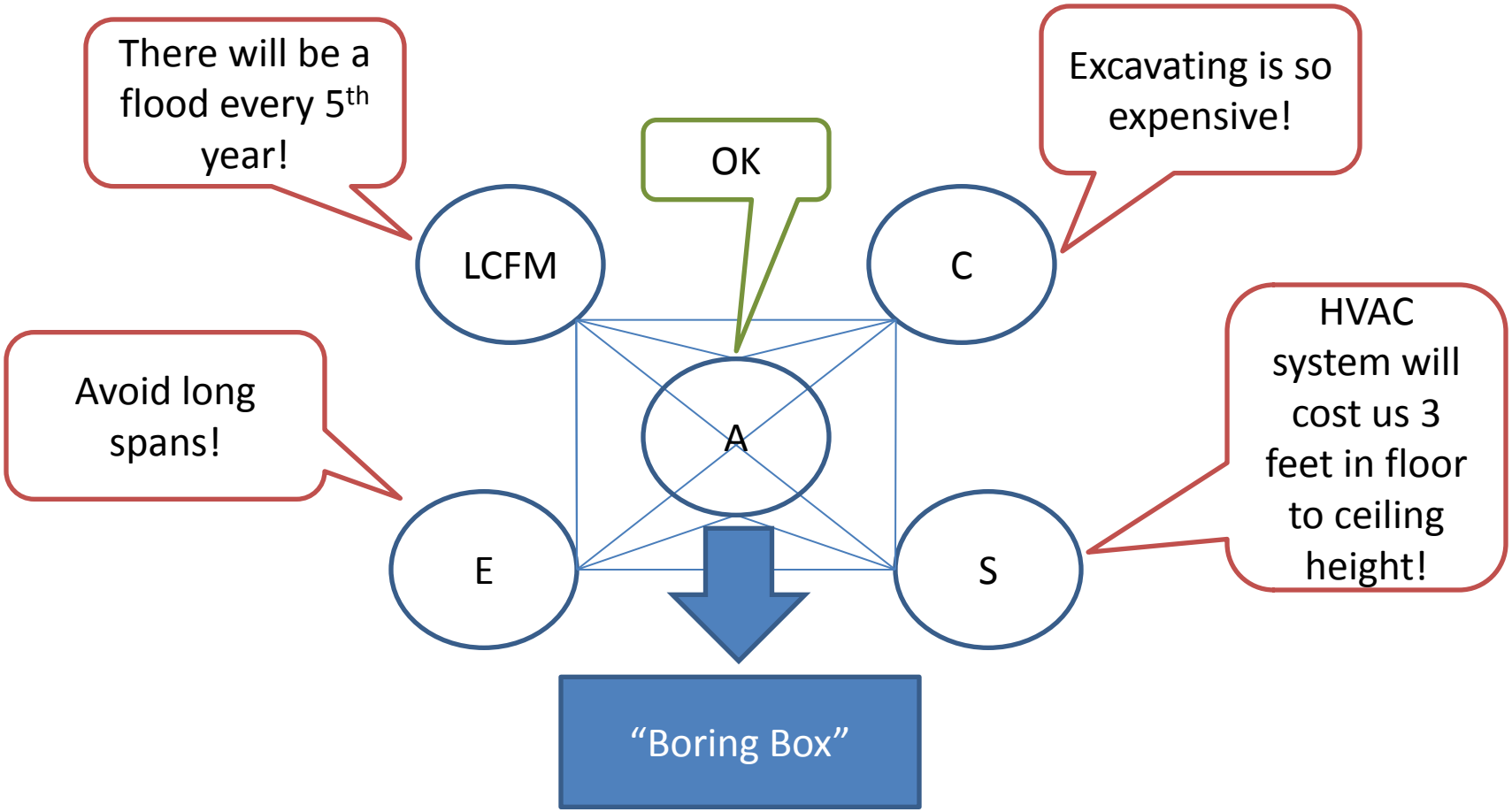
Napkin Gadget



A E C L S

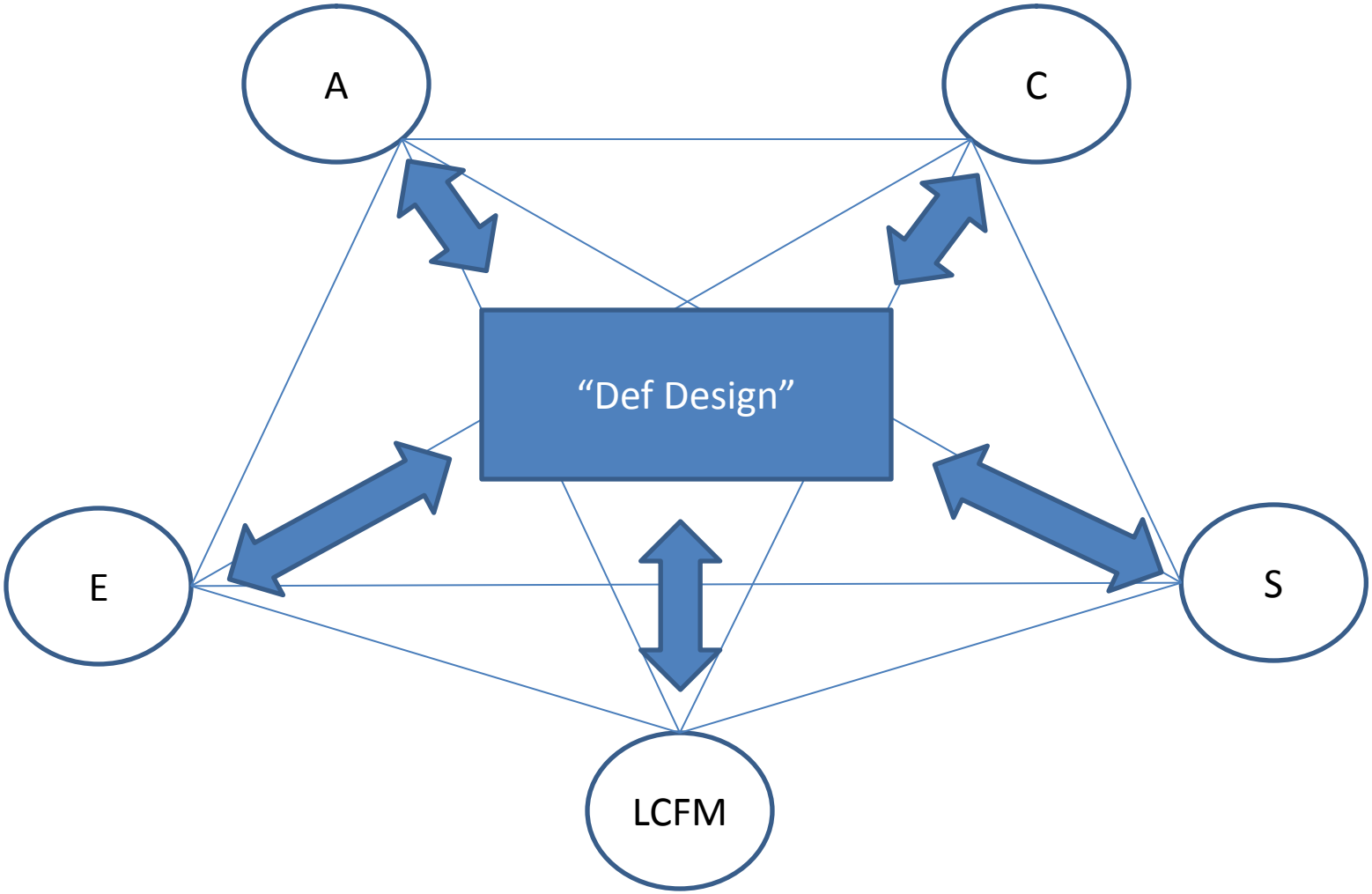
Collaboration Eliminating creativity

“”



A
E
C
L
S

Cooperation Integration



A
E
C
L
S

Decision Matrix

Rating: 1 low - 5 high

	TRANSPARENCY		REUSE	
aspect	concrete	steel	concrete	steel
Program fulfill	4	4	2	2
Response to the context	3	3	5	5
Big idea	2	2	4	4
Innovation	3	3	4	4
Floor to ceiling height	4	2	3	5
Cantiliver support	2	4	3	5
Lateral System	4	2	5	3
Connections	3	5	3	4
Construction costs	3	1	4	2
Constructability	2	4	3	5
Construction schedule	4	5	4	5
Prefabrication	1	4	2	5
Flexibility of spaces	4	5	3	2
Space efficiency	3	3	4	4
Flood prevention	2	2	4	4
Sustainability	2	2	4	4
Future design potentials	3	3	5	5
sum	**49**	**54**	**62**	**68**

A

E

C

L

S

River Team Presents

ReUse

A

E

C

L

S