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Stanford University



U Chico
USA



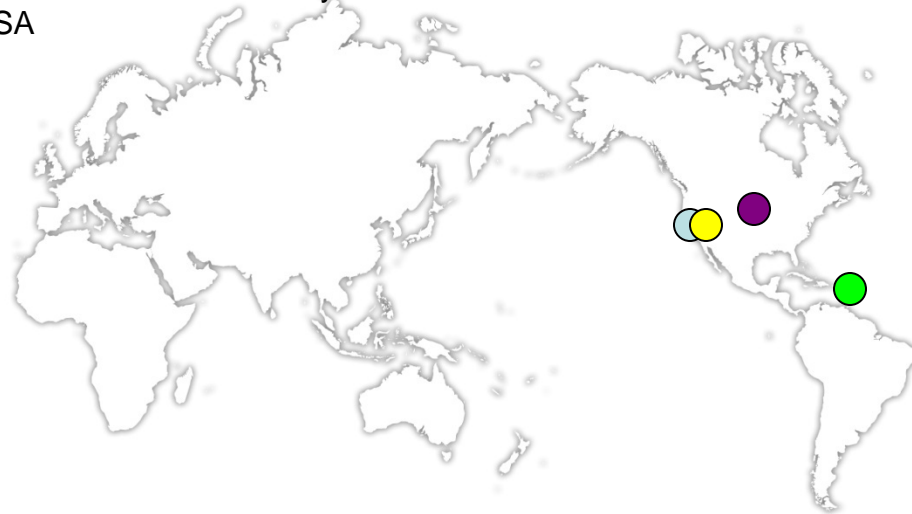
UPR
Puerto Rico



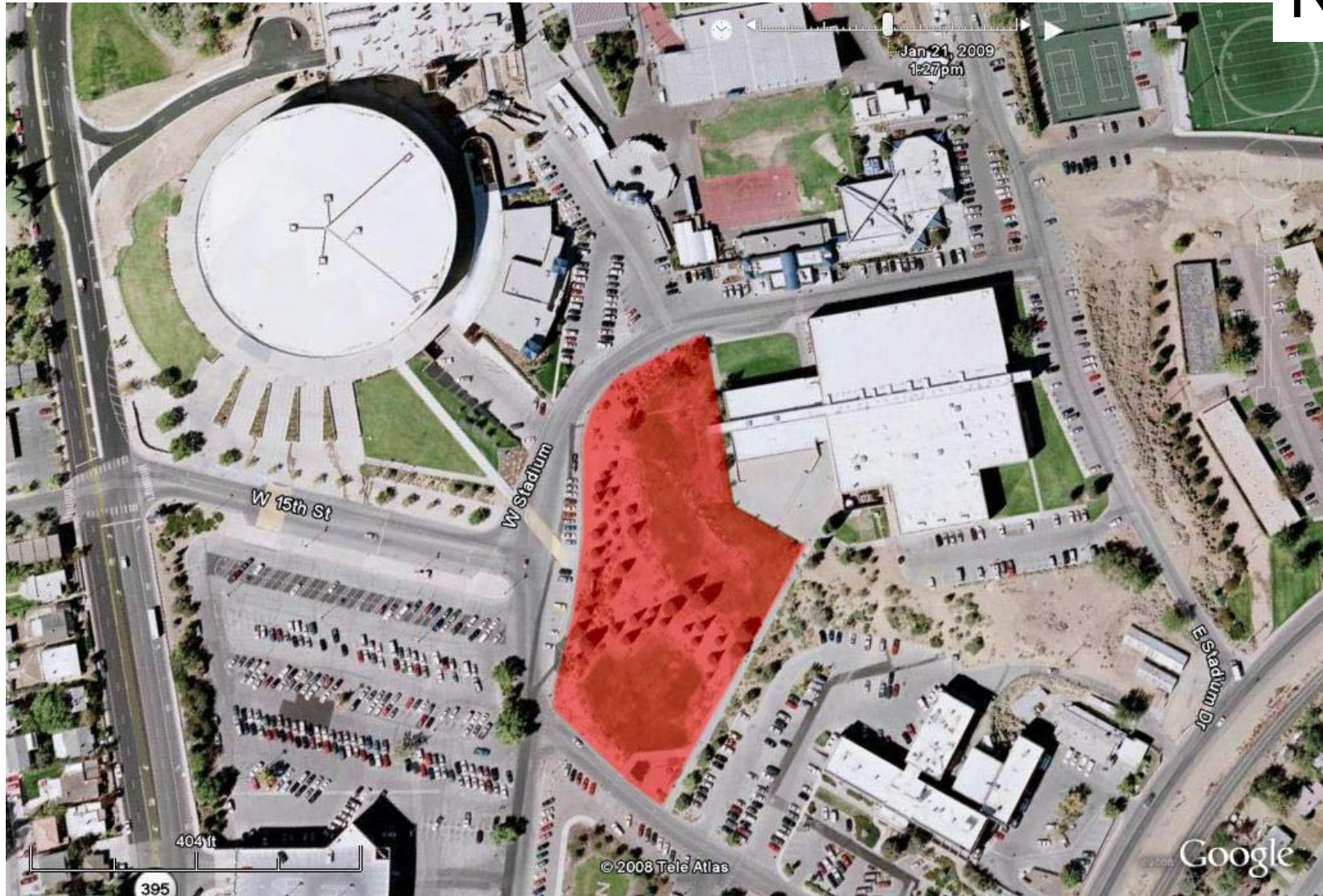
Stanford University



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09 Site Conditions



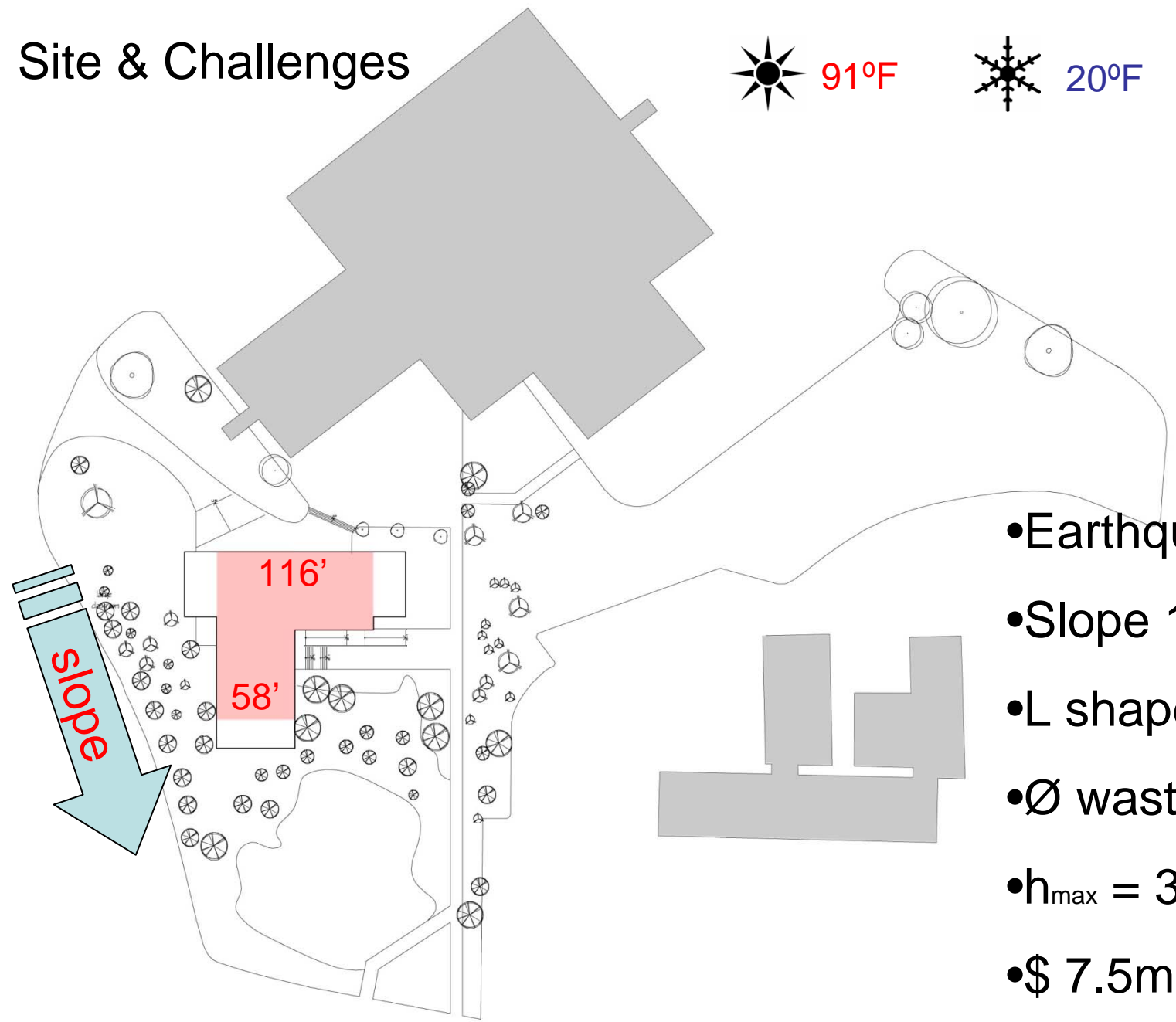
395

© 2008 Tele Atlas

Google

09 Site & Challenges

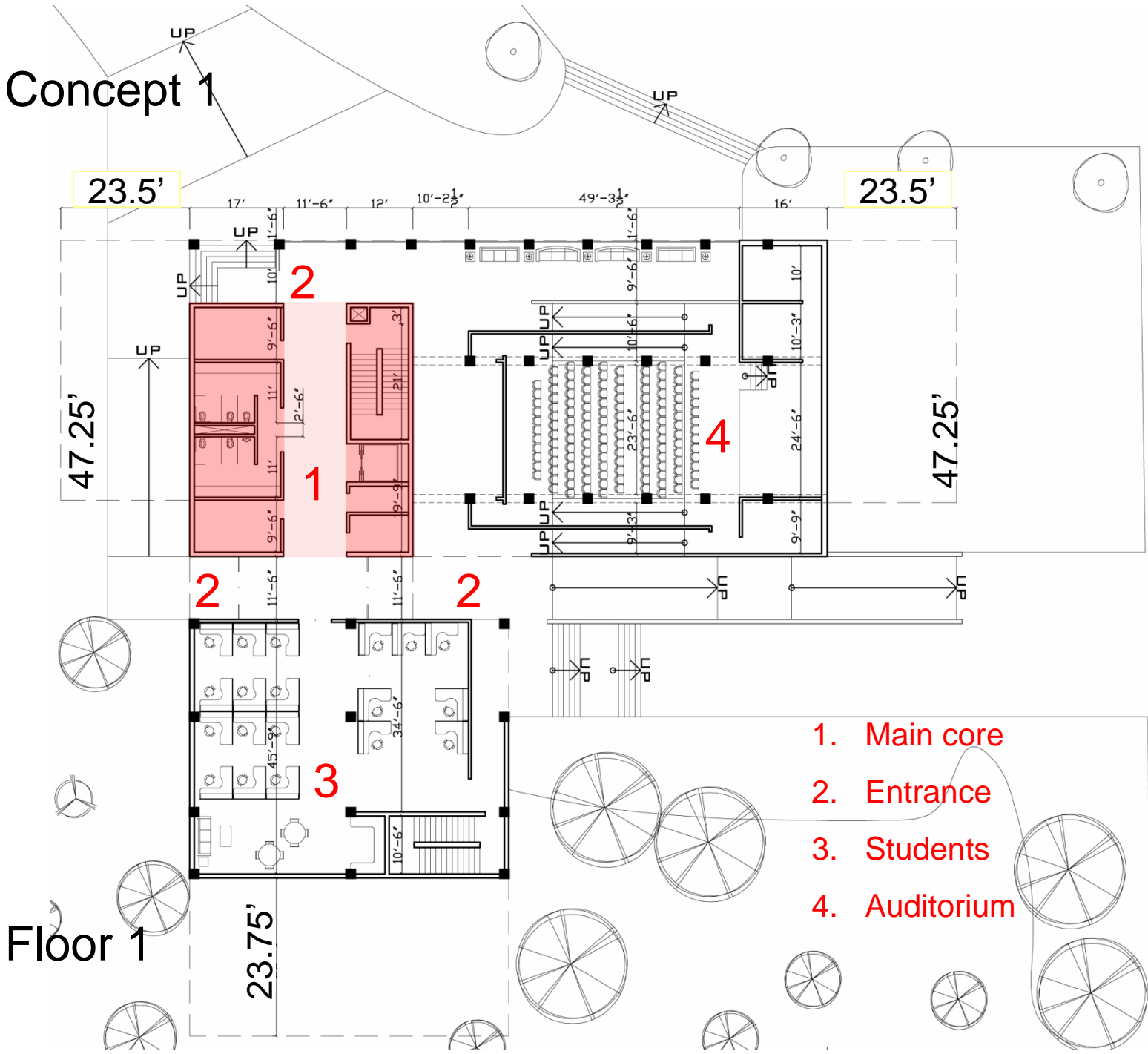
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- Earthquake
- Slope 1:8
- L shape
- Ø waste
- h_{max} = 30'
- \$ 7.5m

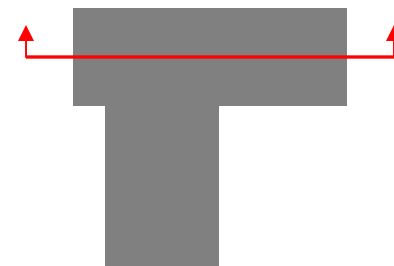
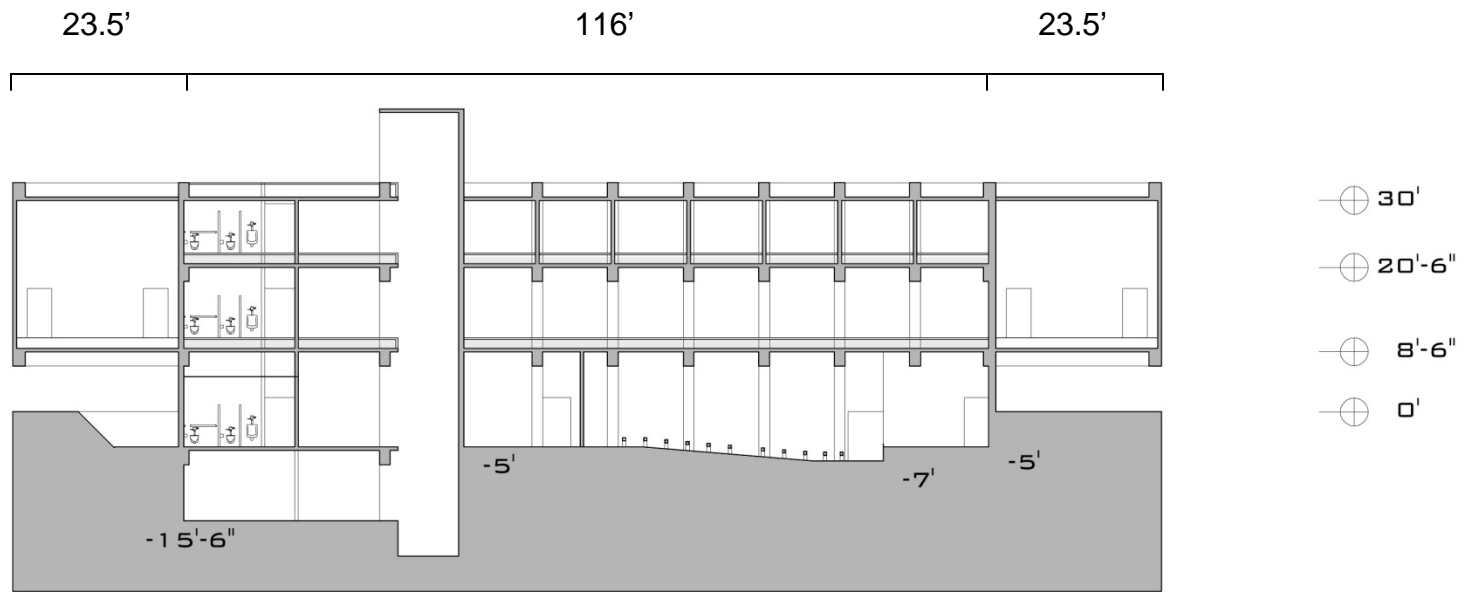
116'
58'

09 Concept 1



09 Concept 1

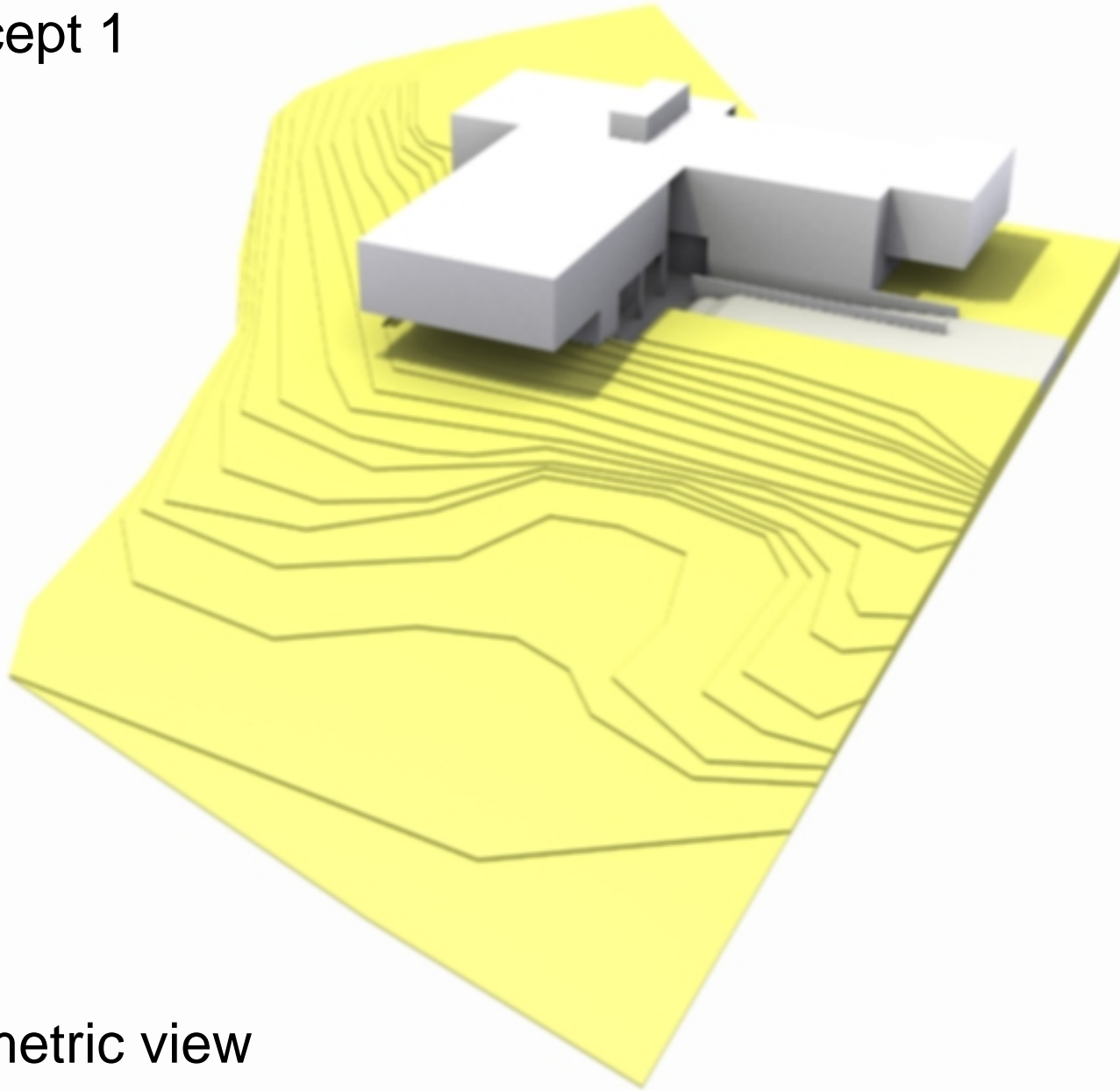
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Section

09 Concept 1

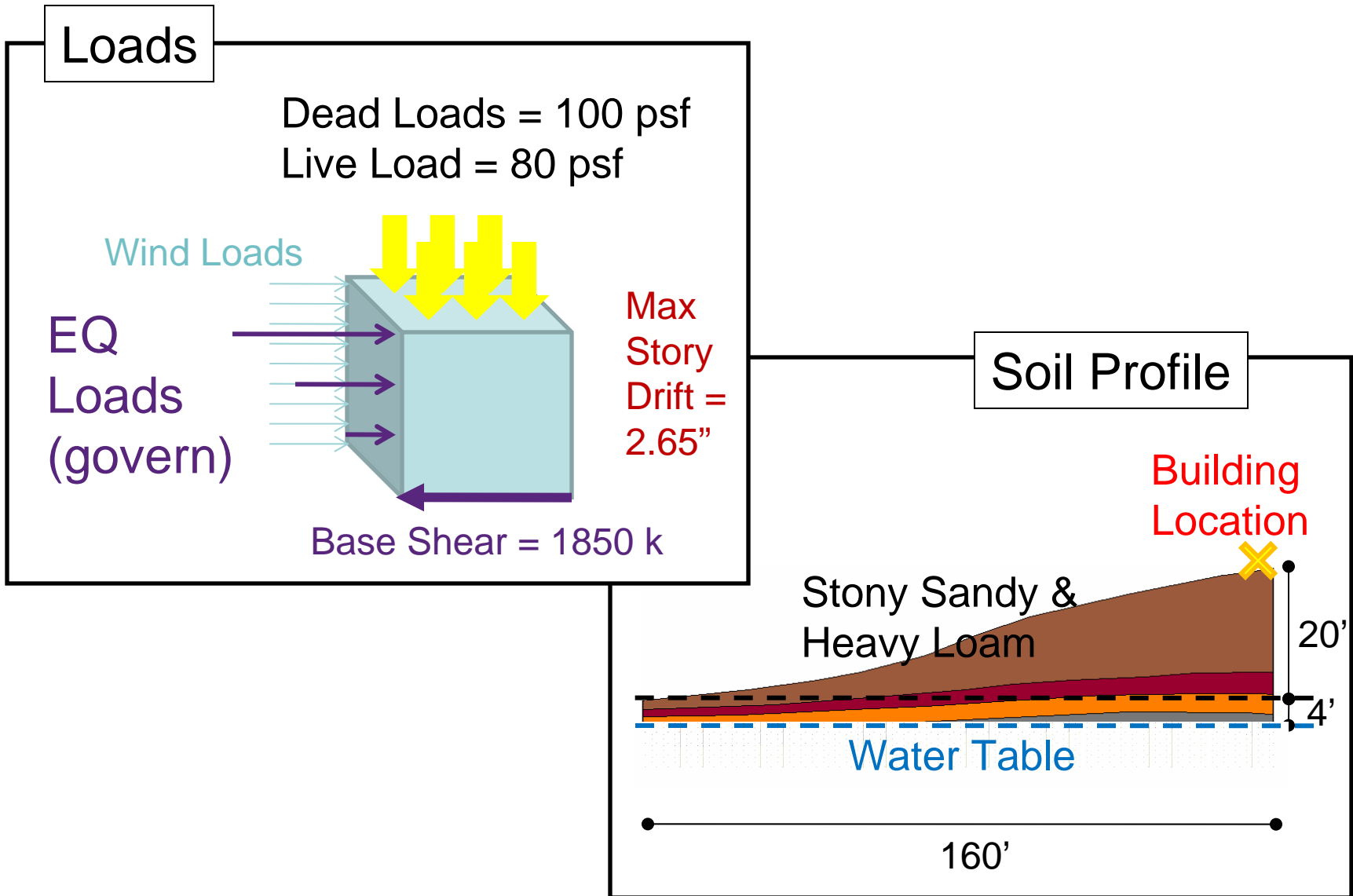
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Volumetric view

09 Design Loads and Soil Profile

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09 Seismic Lateral System Rationale

Concrete Shear Walls

PRO

Seismic rigidity and stiffness

Low redundancy towards Zero Waste

CON

Brittle failure in extreme EQ

High design shear

Complex reinforcing details

Steel BRBs or EBFs

PRO

BRB market popularity

Cheaper connections than MR

Economical

EBF-doorway allowance

Low design shear

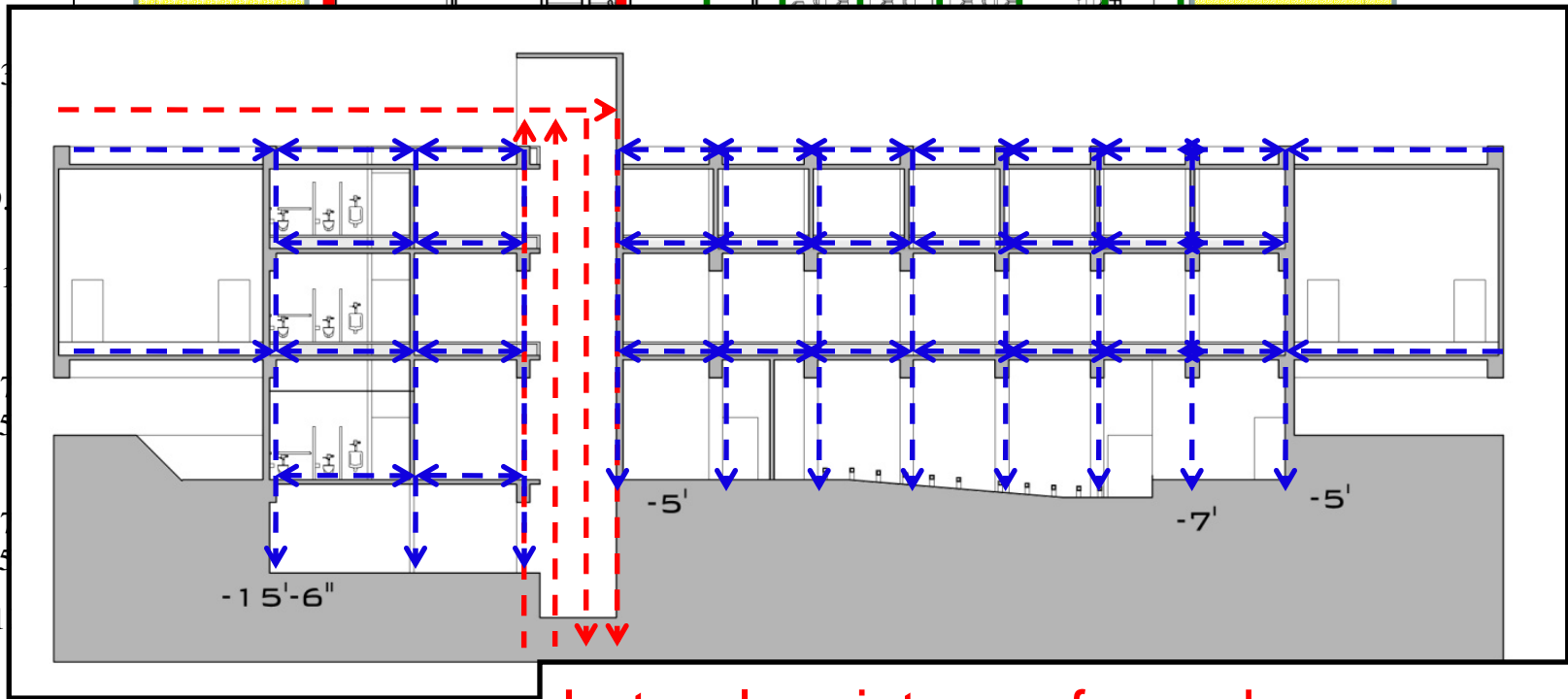
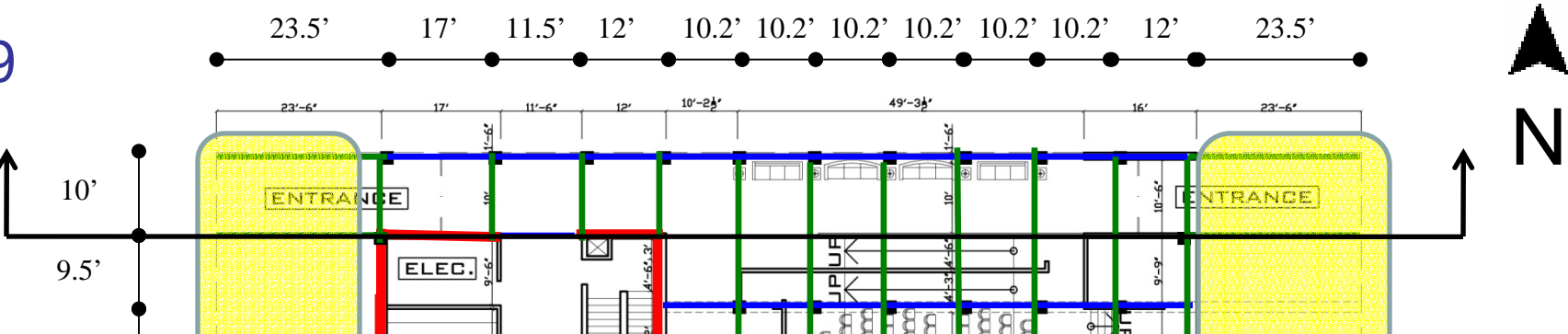
CON

BRB buckling in extreme EQ

Locally available EBF contractors

09

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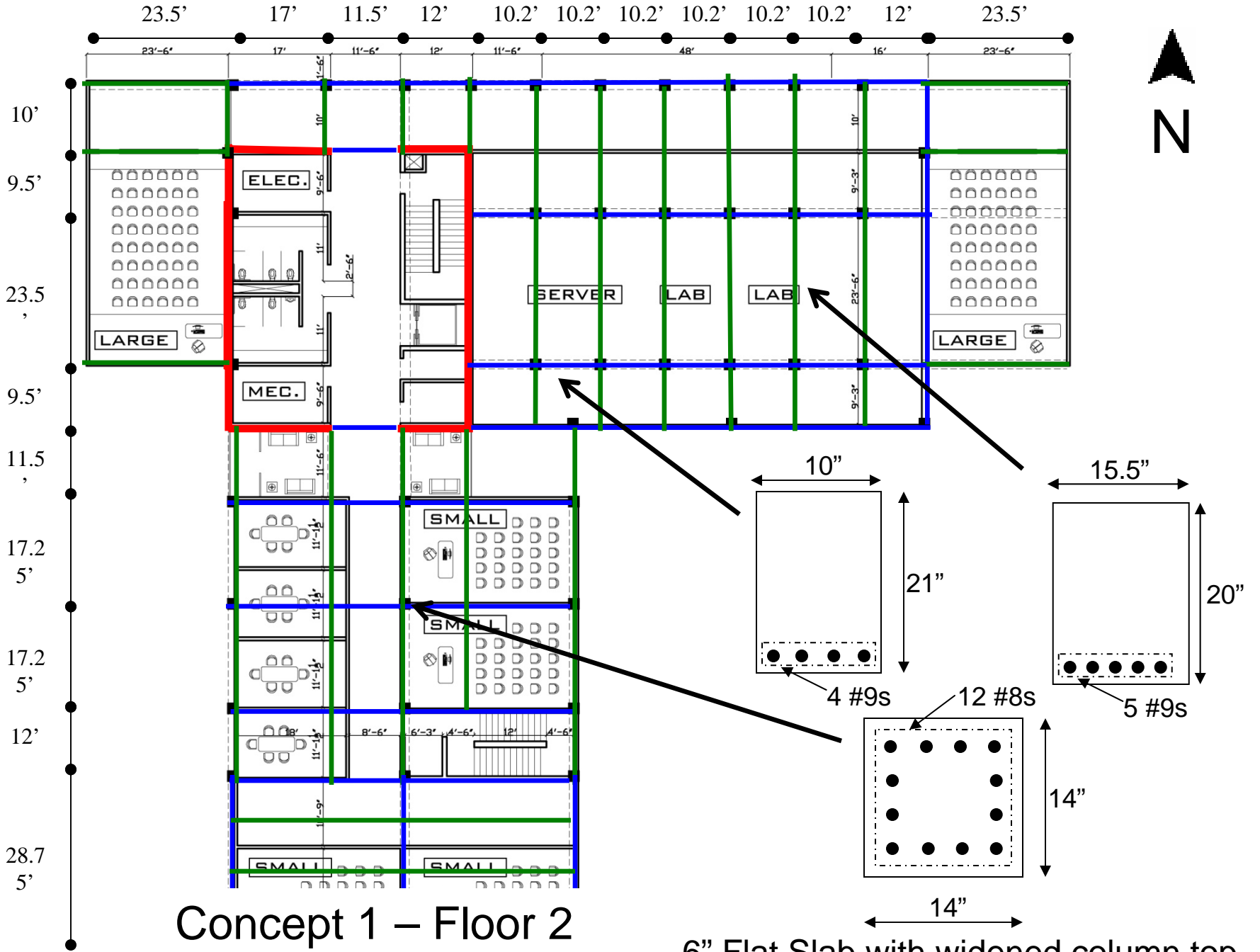
Lateral resistance from shear core
 Gravity resistance beam-column-
 foundation interaction

Concept 1 – Floor 1 – CONCRETE

3'

09

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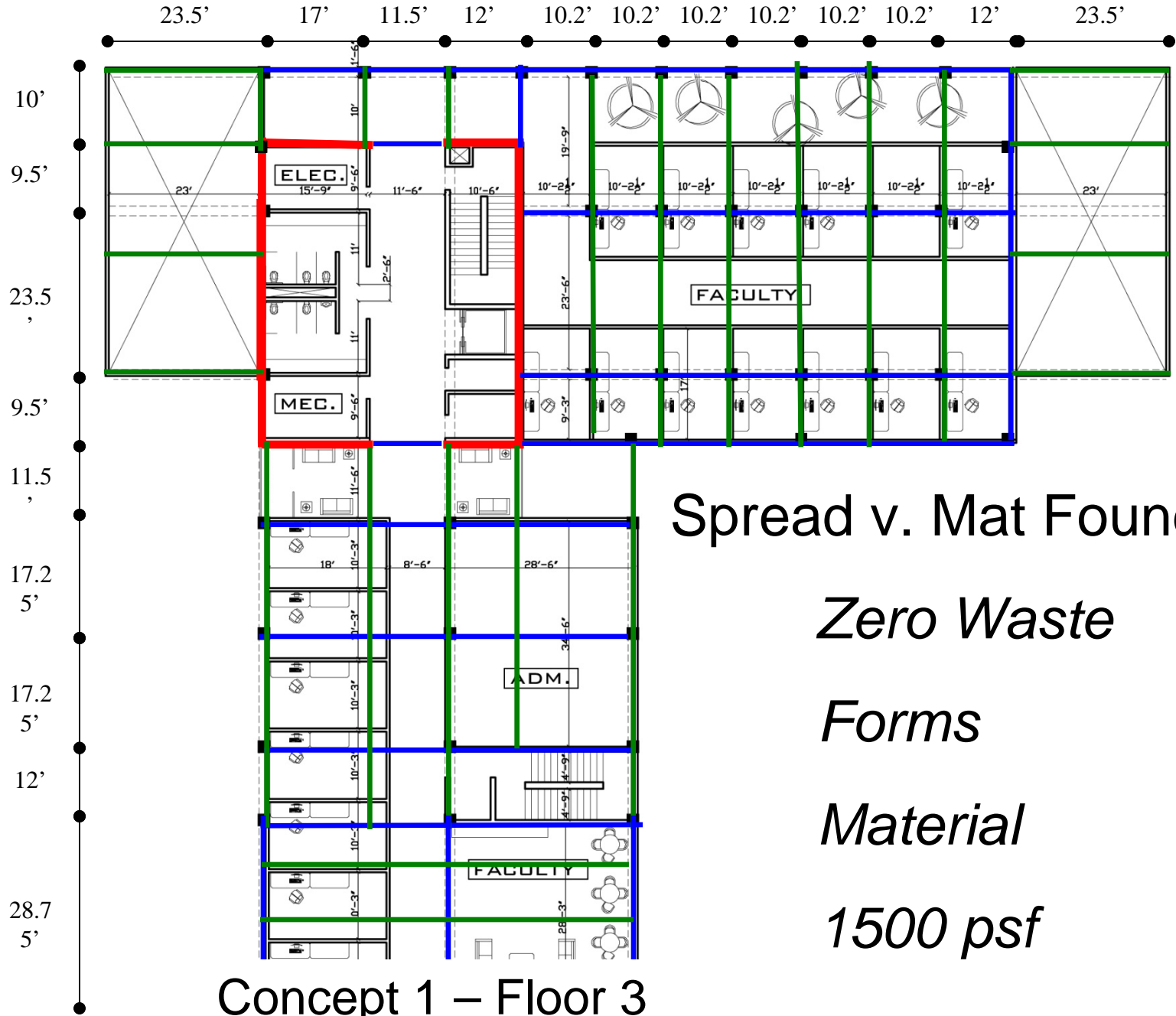


Concept 1 – Floor 2

~6" Flat Slab with widened column top

09

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Spread v. Mat Foundation

Zero Waste

Forms

Material

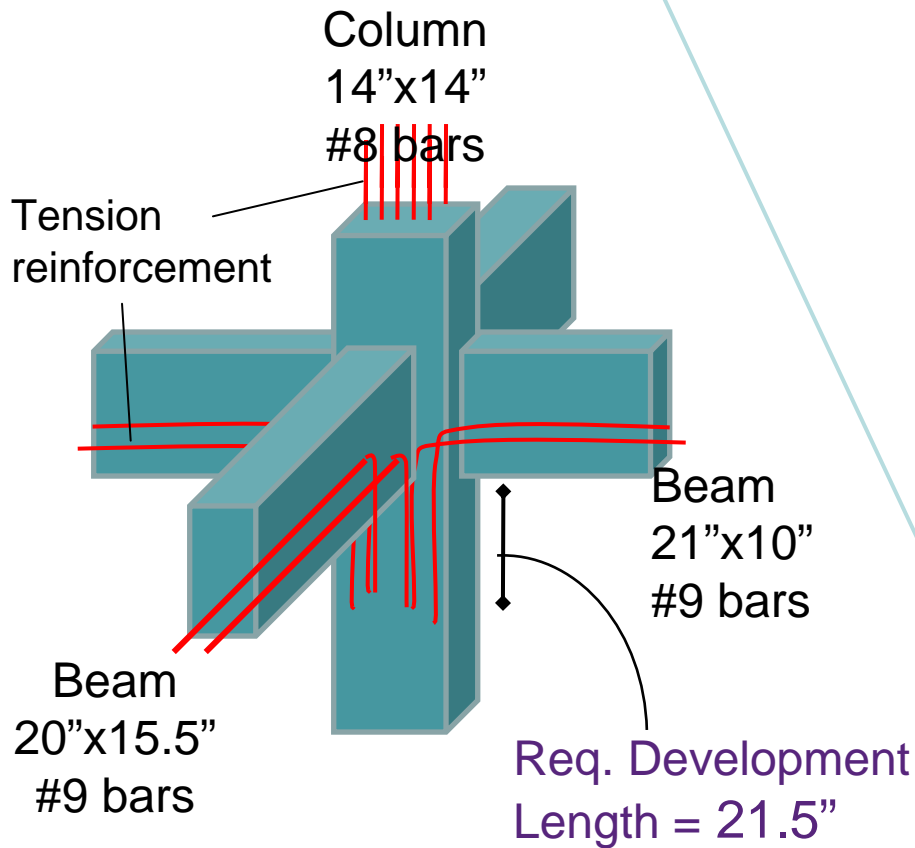
1500 psf

Concept 1 – Floor 3

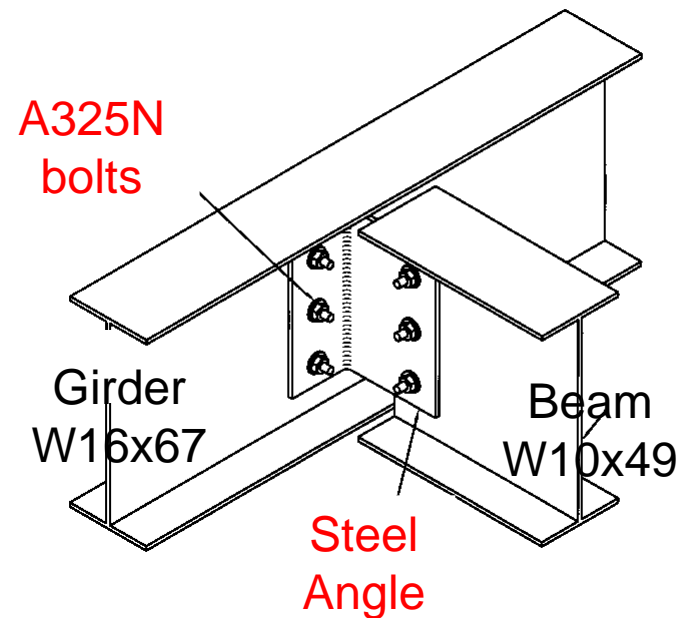
09 Typical Connections

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Concrete

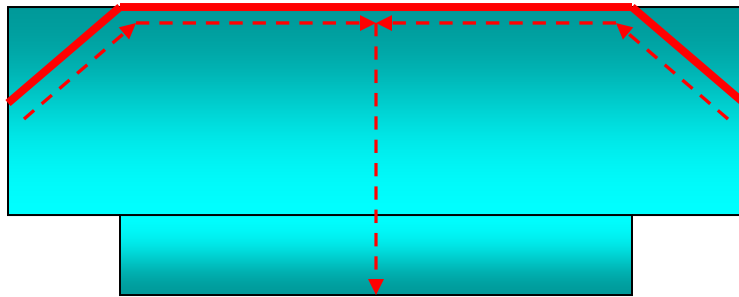


3 Bolts @ ends of Beams
5 Bolts @ ends of Girders

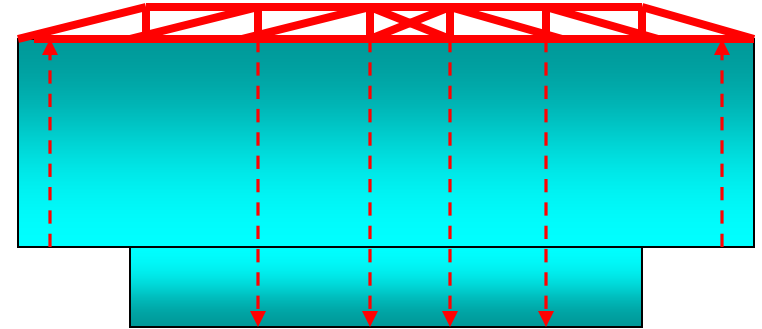


Steel

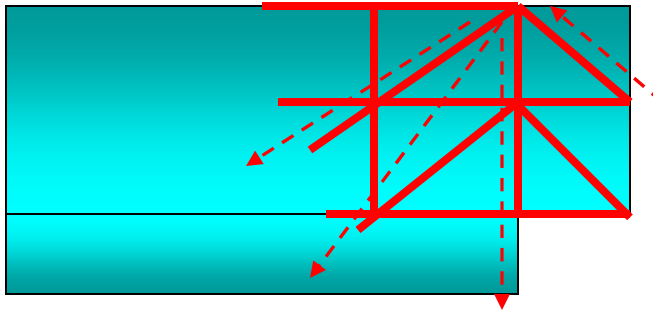
Concept 1 Cantilever Solution Exploration



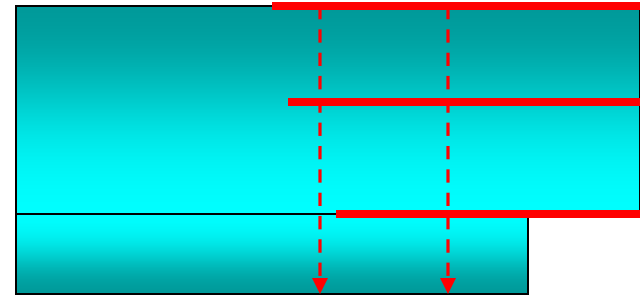
E-W Steel Tension Cables



E-W Steel Truss



N-S Steel Dual Story Truss

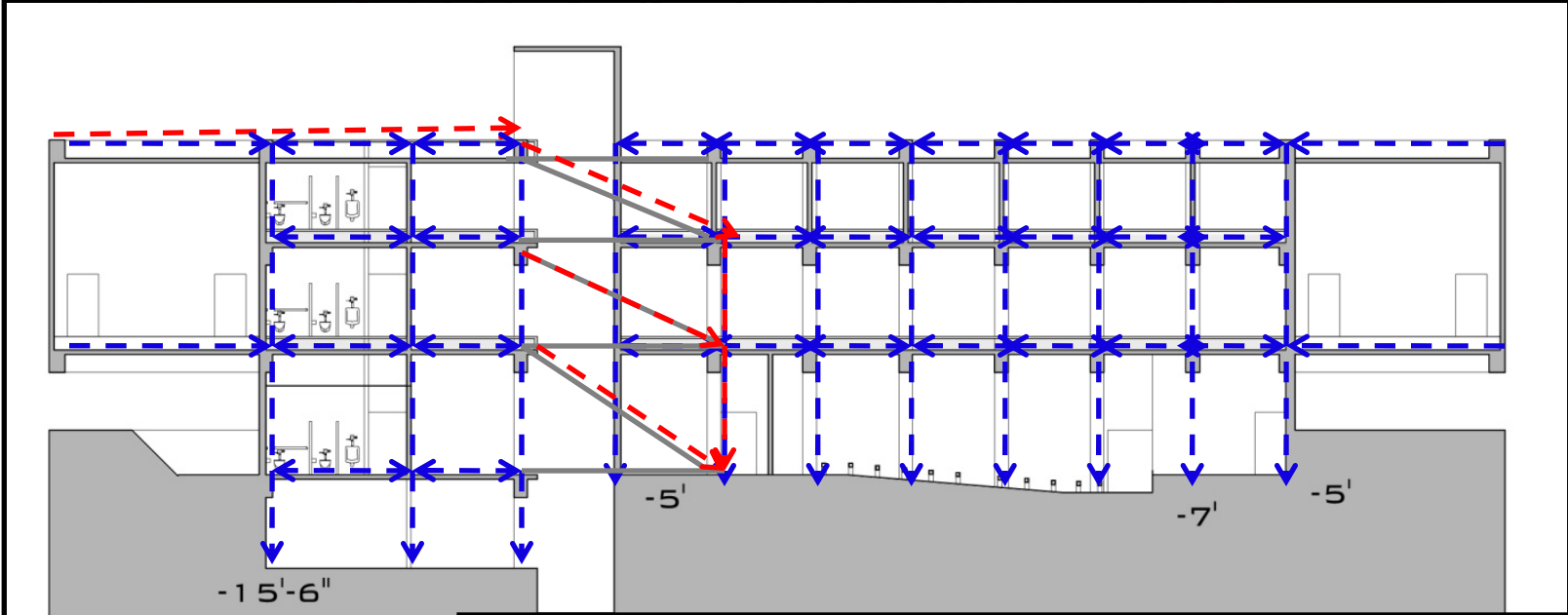
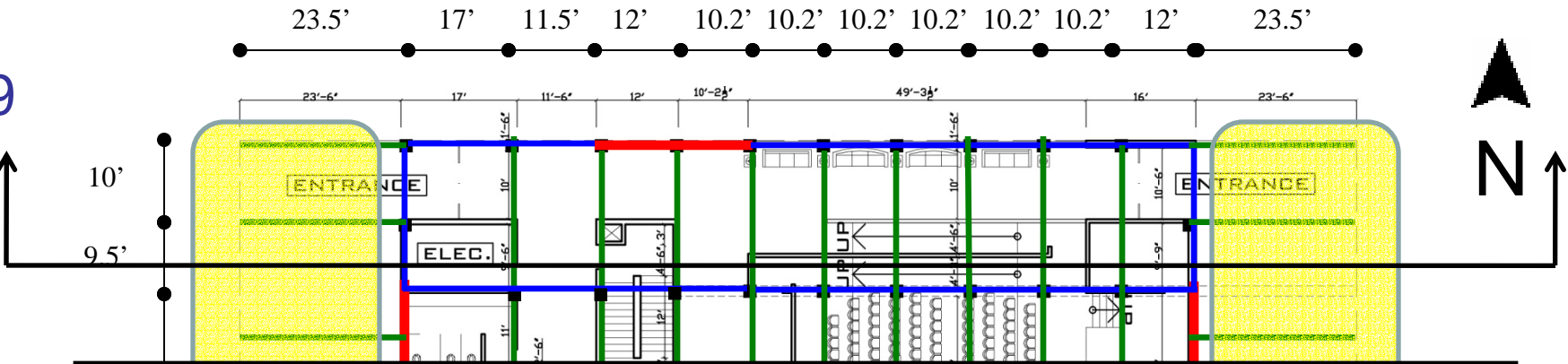


N-S Steel Mini
Truss

Note: Concrete contribution PT slab and inverted beams

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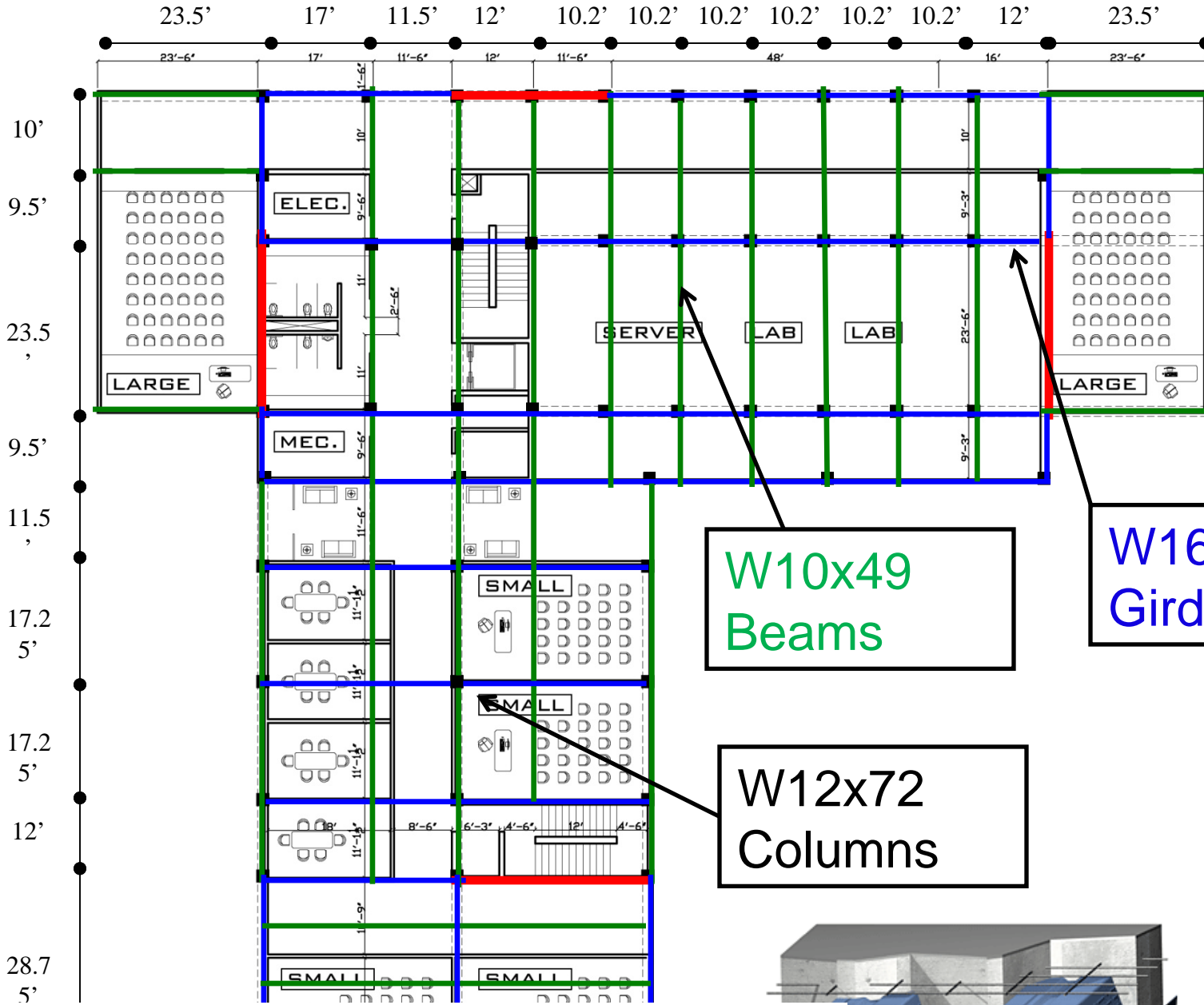
Lateral resistance from braced frames
 Gravity resistance floor-beam-girder-column-foundation-soil interaction

Concept 1 – Floor 1 – STEEL

58'

09

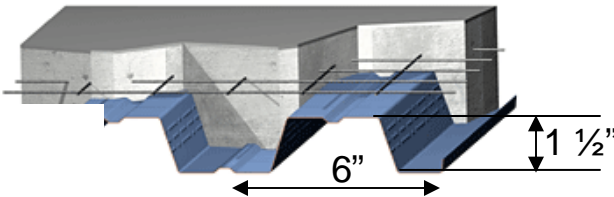
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W10x49
Beams

W16x67
Girders

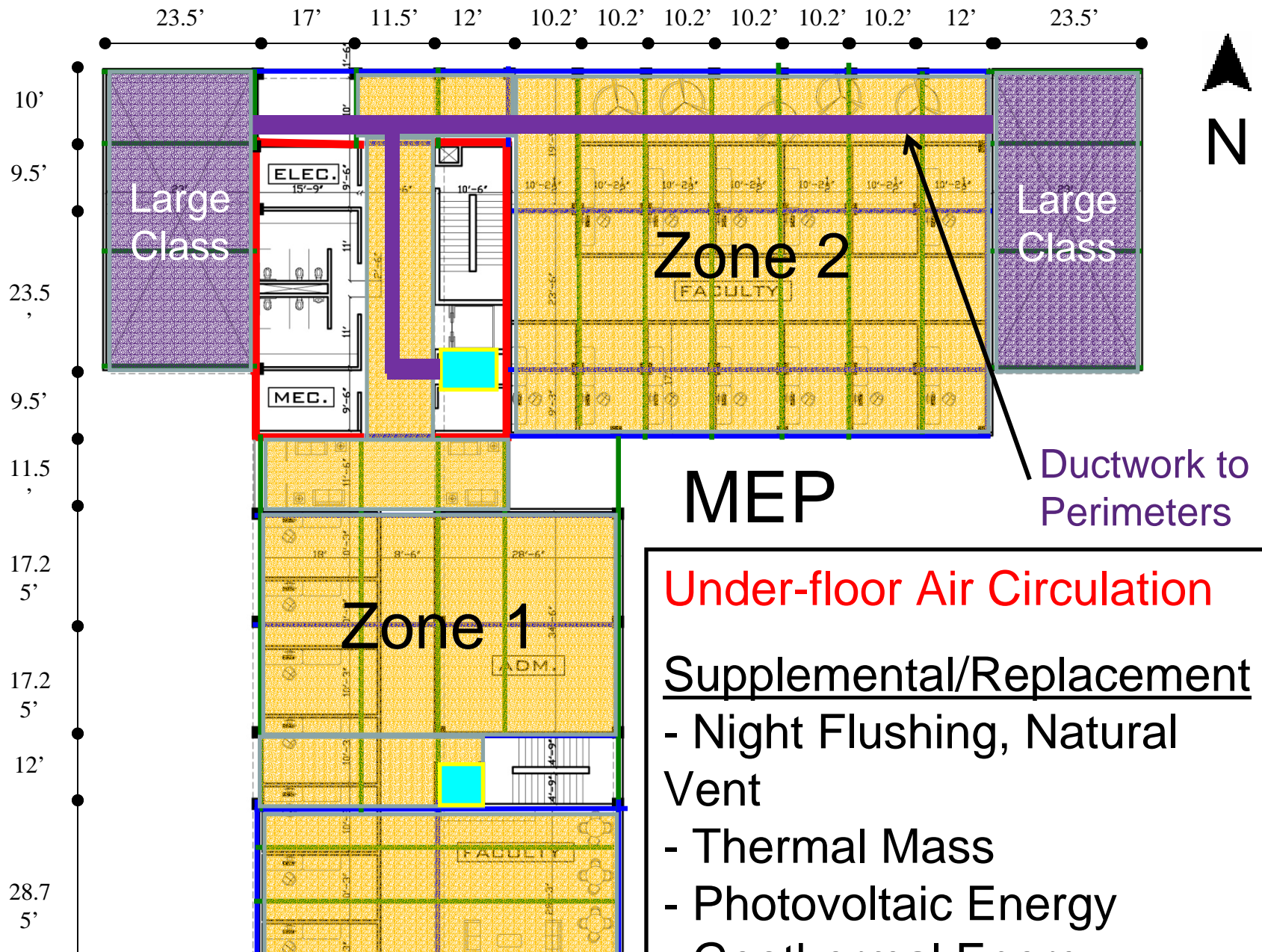
W12x72
Columns



Concept 1 – Floor 2

09

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MEP

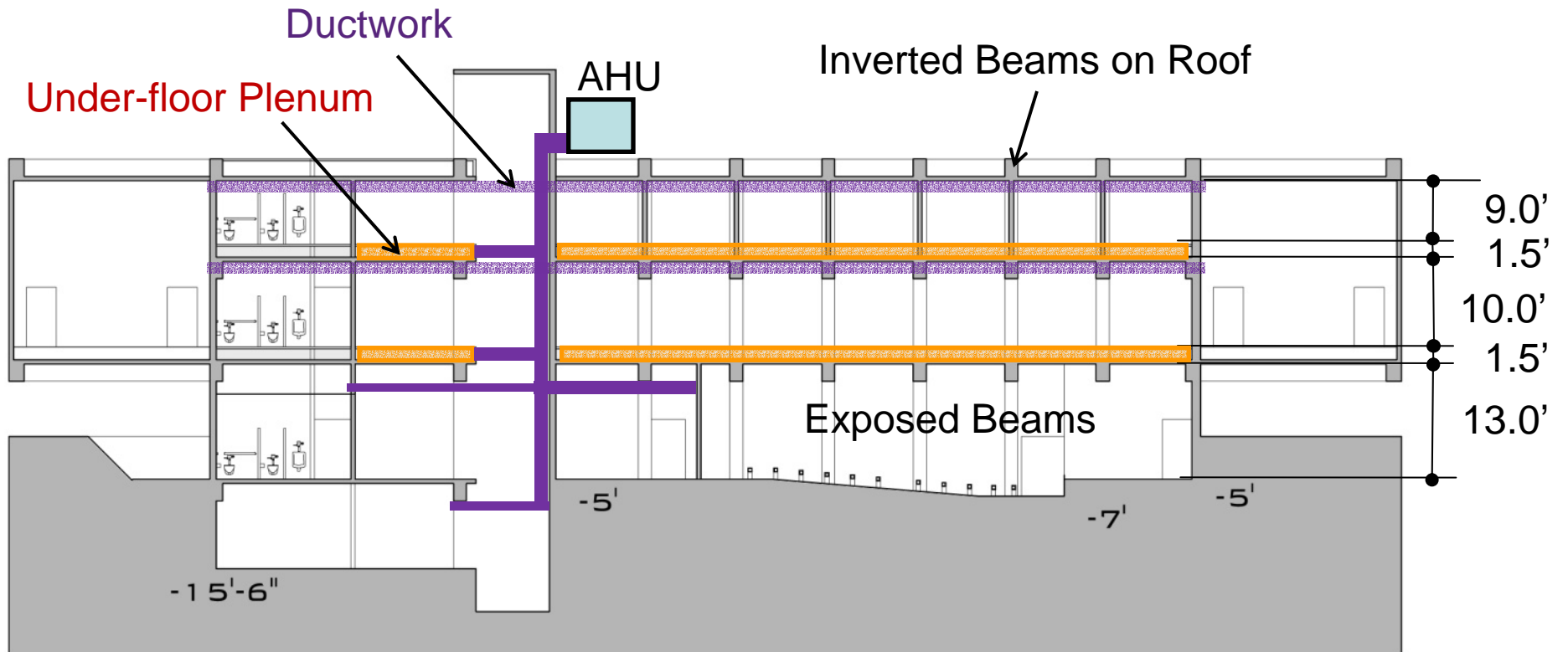
Ductwork to Perimeters

- Under-floor Air Circulation**
- Supplemental/Replacement
- Night Flushing, Natural Vent
- Thermal Mass
- Photovoltaic Energy
- Geothermal Energy

Concept 1 – Floor 3

ENERGY MONITORING

09 MEP Section



12" Under-floor Plenum + 6" flat slab = 1.5'

Section
View



09 Solar Photovoltaic Considerations

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Solar Rooftop – owner recoups costs in 8-10 years

Tax incentives

Technology & lifespan

Model assumptions



09 Equipment Financing: Buy versus Rent

It is less expensive to purchase used equipment and use it for multiple jobs than to rent

Assumptions

Used versus new

Write-offs & depreciator

Zero-waste considerations



09 Zero Waste



Concrete with fly ash & reclaimed aggregate

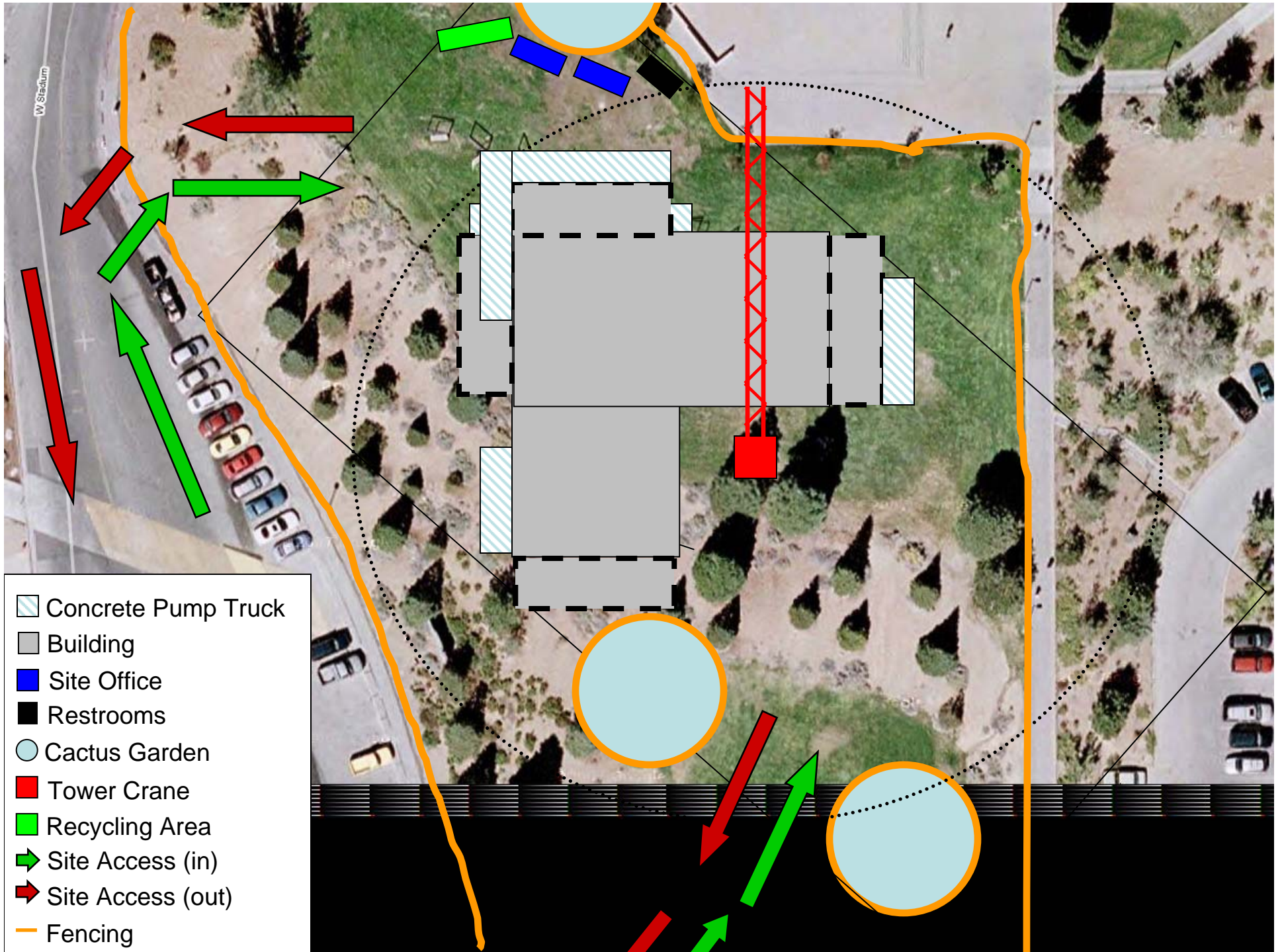
Off-site prefabrication



Reuse excavated soil for topsoil

Scrap art





09

Safety and Noise Considerations

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Safety training

Inform people

Emergency routes

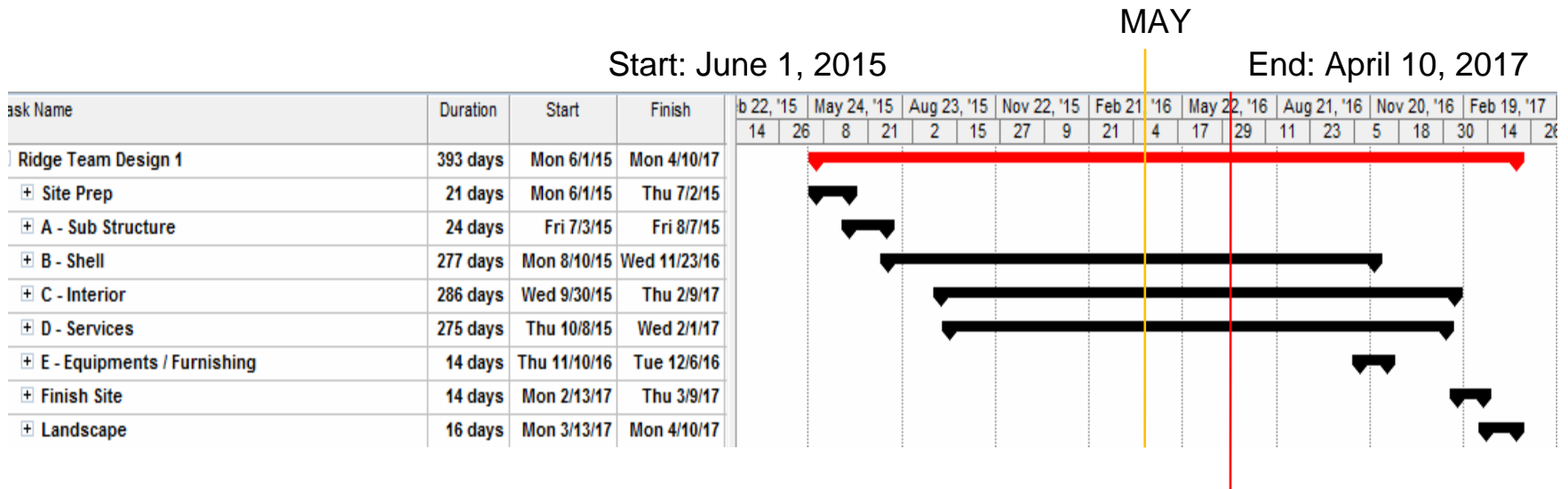
Alternate pedestrian routes

Noise partitions

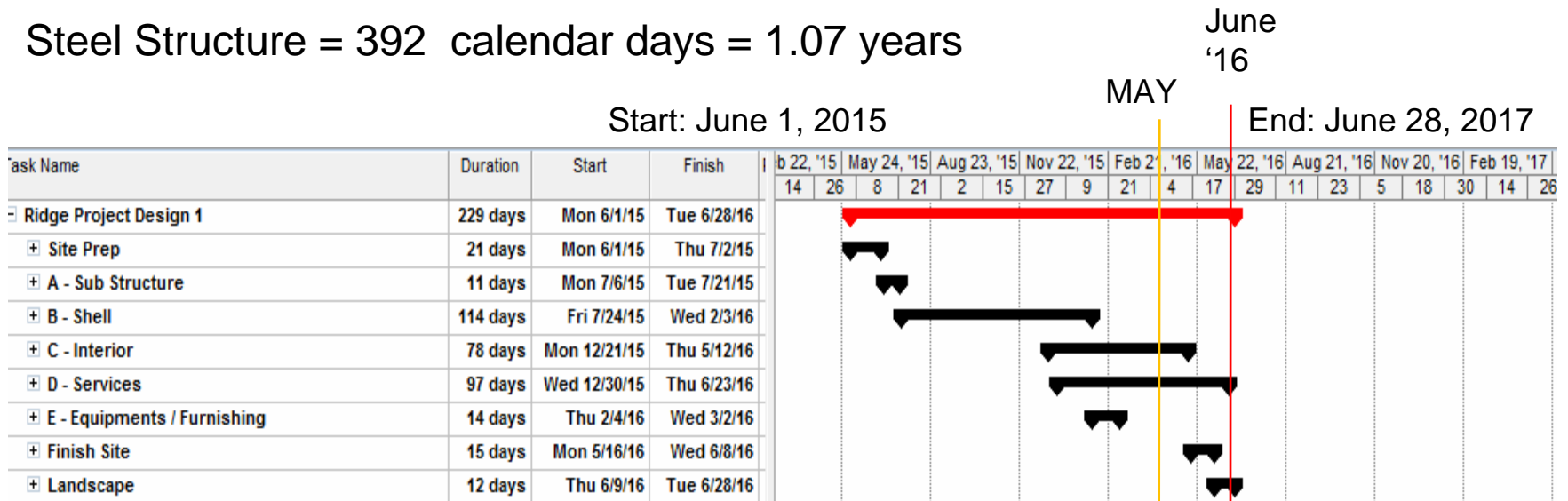


Concept 1 – Scheduling

Cast in Place Concrete = 679 calendar days = 1.86 years



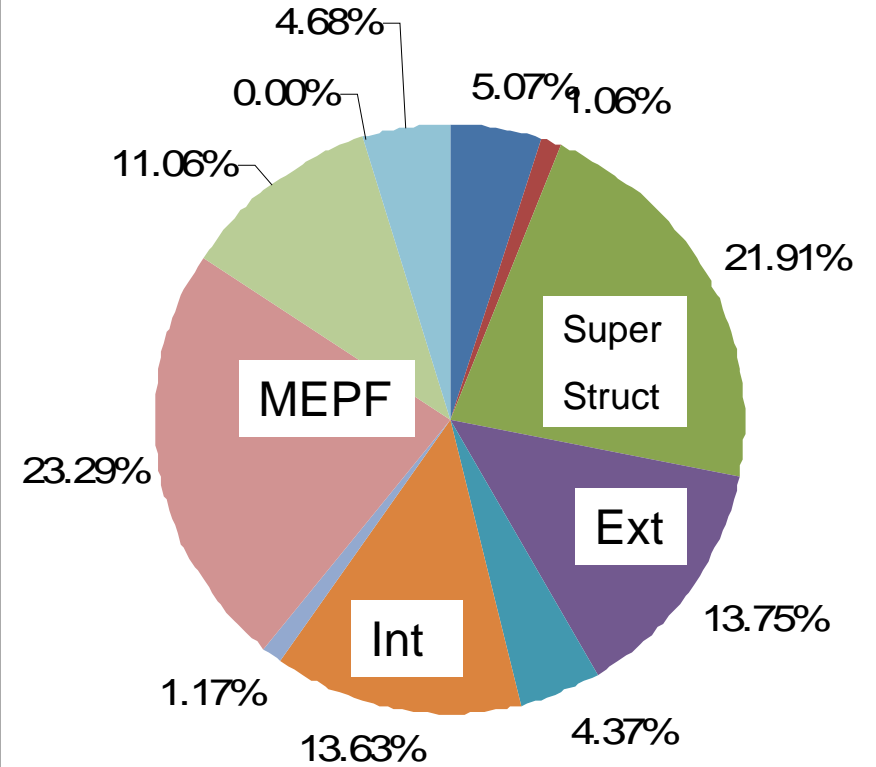
Steel Structure = 392 calendar days = 1.07 years



09 Concept 1 – Concrete Estimate

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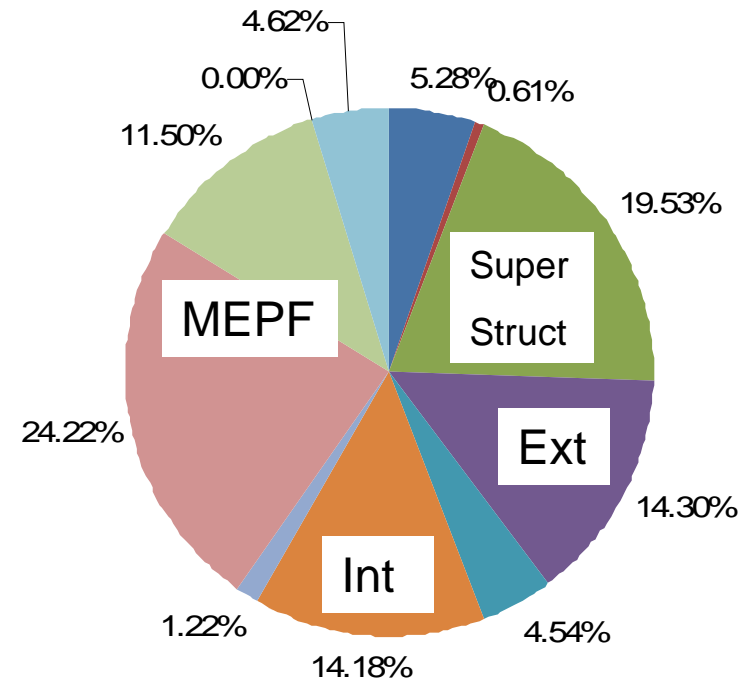
Ridge Project- Concept 1 Concrete	3/10/2009		
ARCHITECT:Jonathan Delgado			
	Building Gross Square Footage	35,000	GSF
Description	Cost	Cost/Sf	Comments
FOUNDATION	\$433,500	\$12.39	5.07%
SUBSTRUCTURE	\$90,900	\$2.60	1.06%
SUPERSTRUCTURE	\$1,872,500	\$53.50	21.91%
EXTERIOR CLOSURE	\$1,099,750	\$31.42	13.75%
ROOFING & WATERPROOFING	\$563,500	\$10.66	4.37%
INTERIOR CONSTRUCTION	\$1,165,00	\$33.29	13.63%
CONVEYING SYSTEM	\$100,000	\$2.86	1.17%
MECH,PLUMB, FP	\$1,990,000	\$56.86	23.29%
ELECTRICAL	\$945,000	\$27.00	11.06%
EQUIPMENT	\$0	\$0.00	0.00%
SITWORK	\$400,000	\$10.86	4.68%
INDIRECT COST	\$8,544,755	\$244.14	
General Conditions (8%)	\$678,380	\$19.53	
Fee (5%)	\$423,988	\$12.21	
Contingency (10%)	\$847,975	\$24.41	
TOTAL COST	\$10,500,000	\$300.29	
inflated to 2015 (3% inflation rate)	\$12,500,000		



09 Concept 1 – Steel Estimate

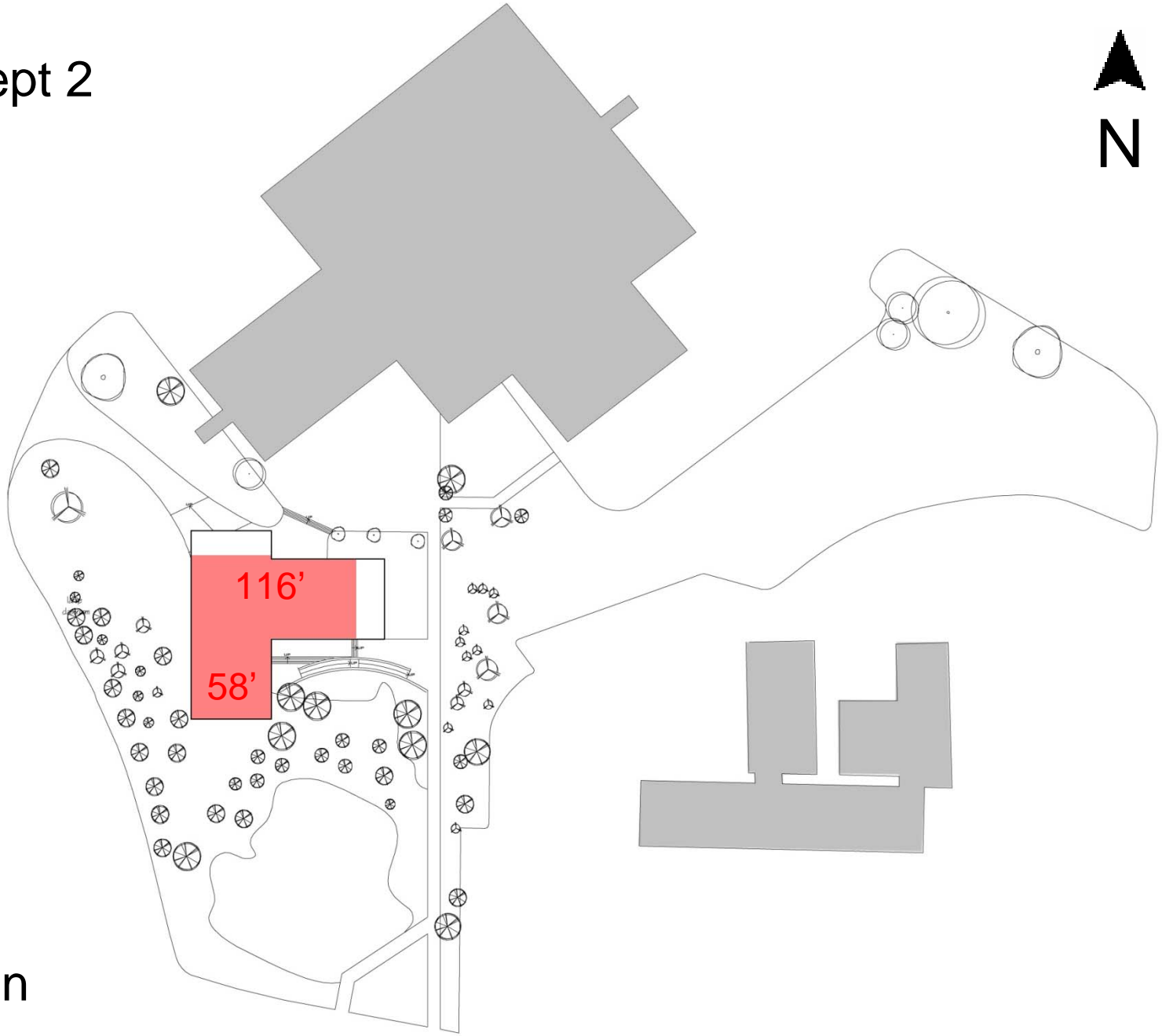
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Ridge Project- Concept 1 Steel			
ARCHITECT: Jonathan Delgado	3/10/2009		
	Building Gross Square Footage	35,000	GSF
Description	Cost	Cost/Sf	Comments
FOUNDATION	\$433,500	\$12.39	5.27%
SUBSTRUCTURE	\$50,500	\$1.44	0.61%
SUPERSTRUCTURE	\$1,605,000	\$45.86	19.31%
EXTERIOR CLOSURE	\$1,174,750	\$33.56	14.29%
ROOFING & WATERPROOFING	\$373,100	\$10.66	4.54%
INTERIOR CONSTRUCTION	\$1,165,00	\$33.29	14.17%
CONVEYING SYSTEM	\$100,000	\$2.86	1.22%
MECH,PLUMB, FP	\$1,990,00	\$56.86	24.21%
ELECTRICAL	\$945,000	\$27.00	11.50%
EQUIPMENT	\$0	\$0.00	0.00%
SITWORK	\$380,000	\$10.86	4.87%
INDIRECT COST	\$8,217,500	\$234.79	
General Conditions (8%)	\$657,348	\$18.78	
Fee (5%)	\$410,843	\$11.74	
Contingency (10%)	\$821,685	\$23.48	
TOTAL COST	\$10,100,000	\$288.79	
inflated to 2015 (3% inflation rate)	\$12,000,000		



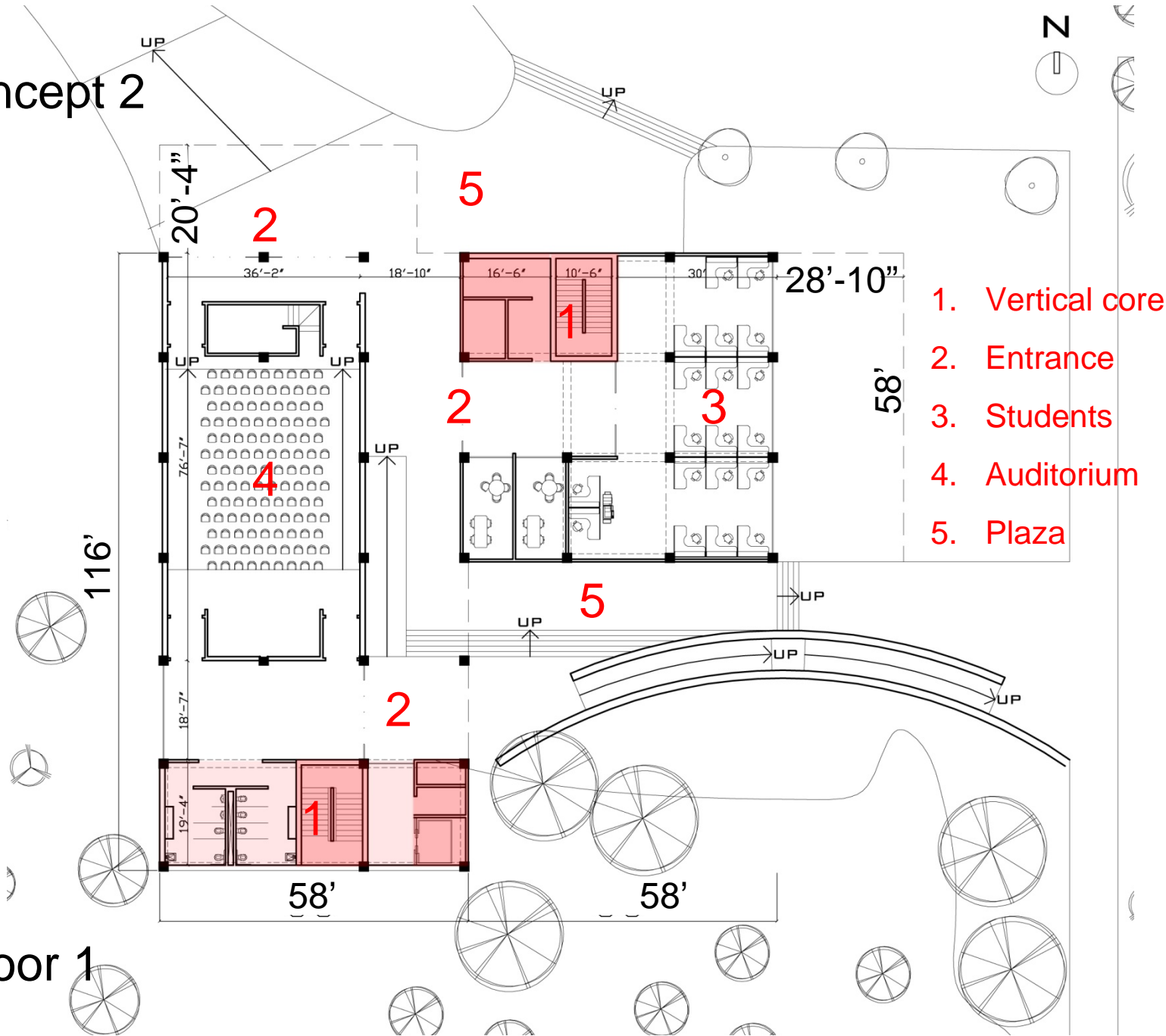
09 Concept 2

Location



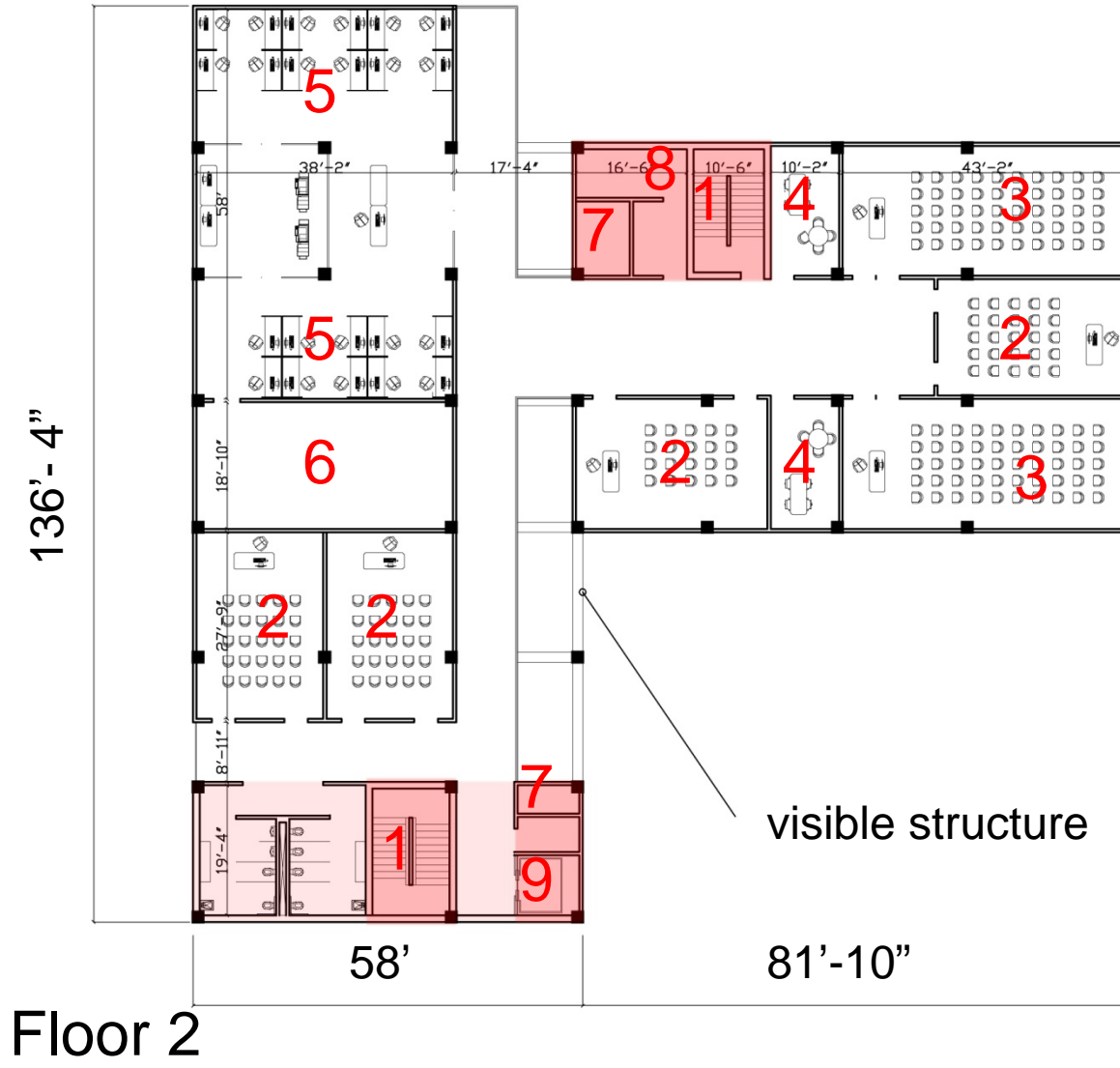
09 Concept 2

Floor 1

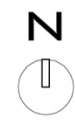


09 Concept 2

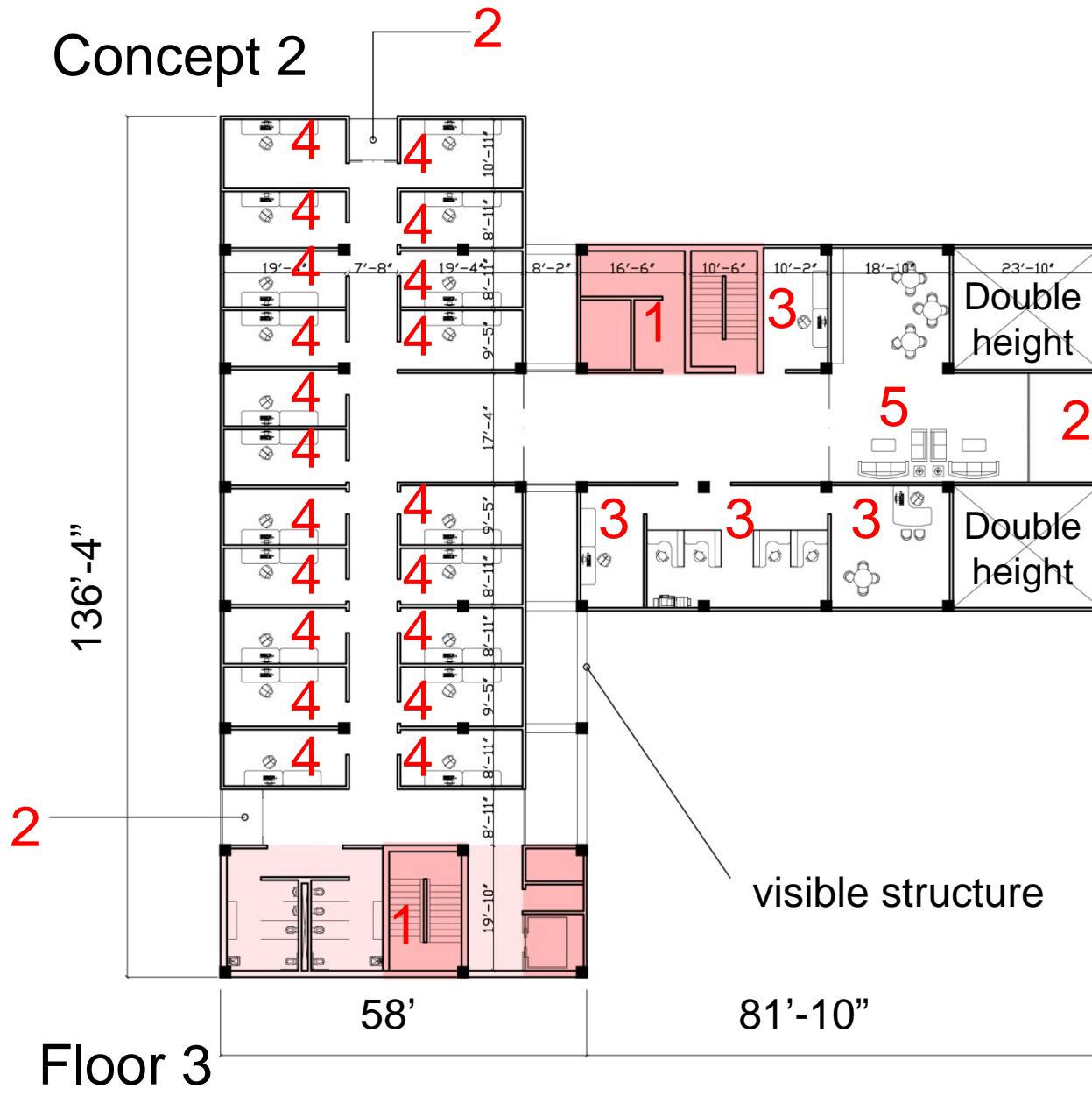
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- 1. Stair
- 2. Small classroom
- 3. Large classroom
- 4. Seminar
- 5. Lab
- 6. Server
- 7. Mechanical shaft
- 8. Electric room
- 9. Elevator



09 Concept 2

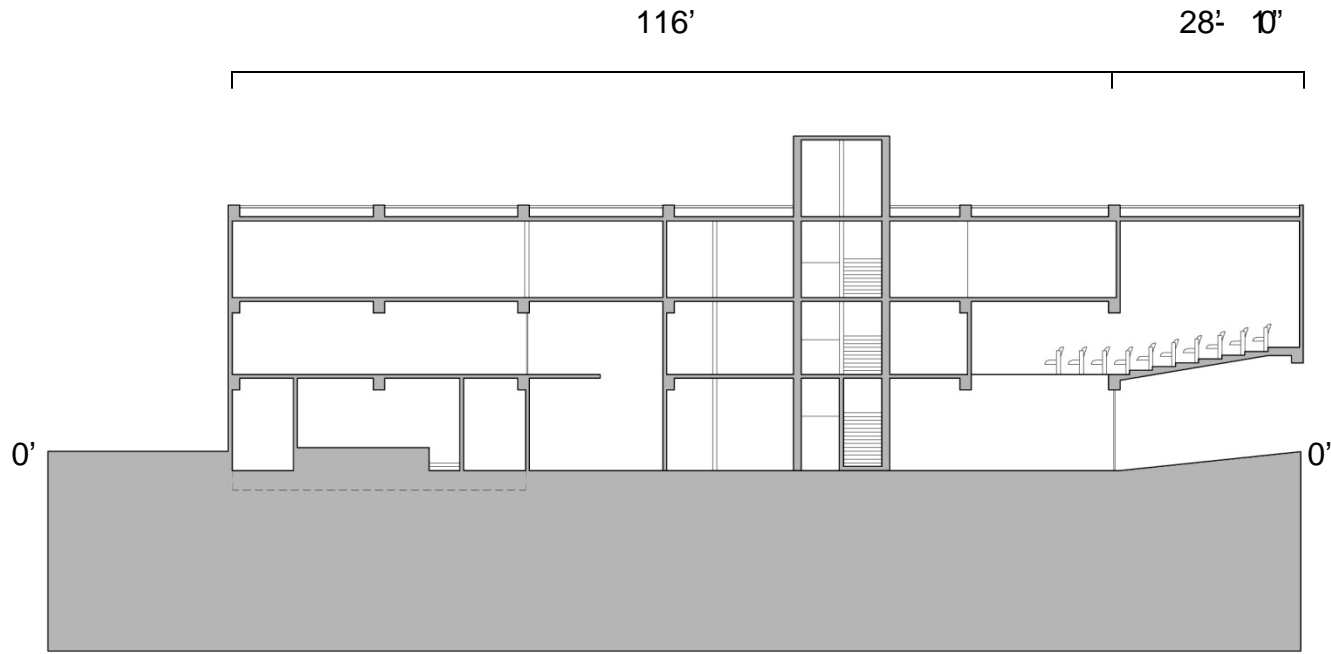


- 1. Core
- 2. Balcony
- 3. Administration
- 4. Faculty office
- 5. Faculty lounge

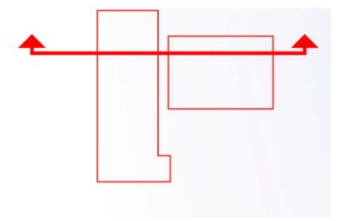
Floor 3

09 Concept 2

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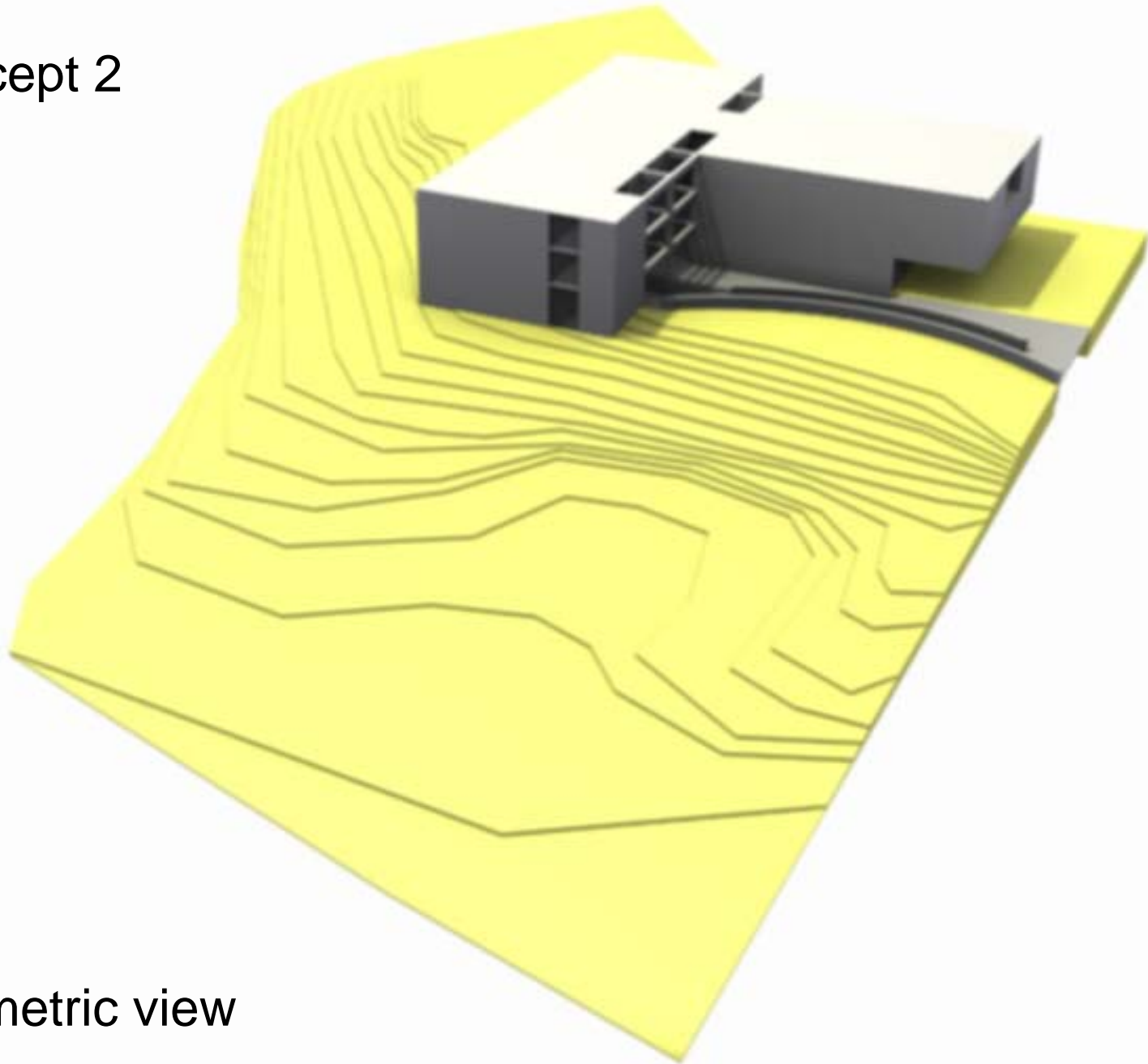
- ⊕ 30'
- ⊕ 20'
- ⊕ 13'-6"
- ⊕ 10'
- ⊕ -2'-6"



Section

09 Concept 2

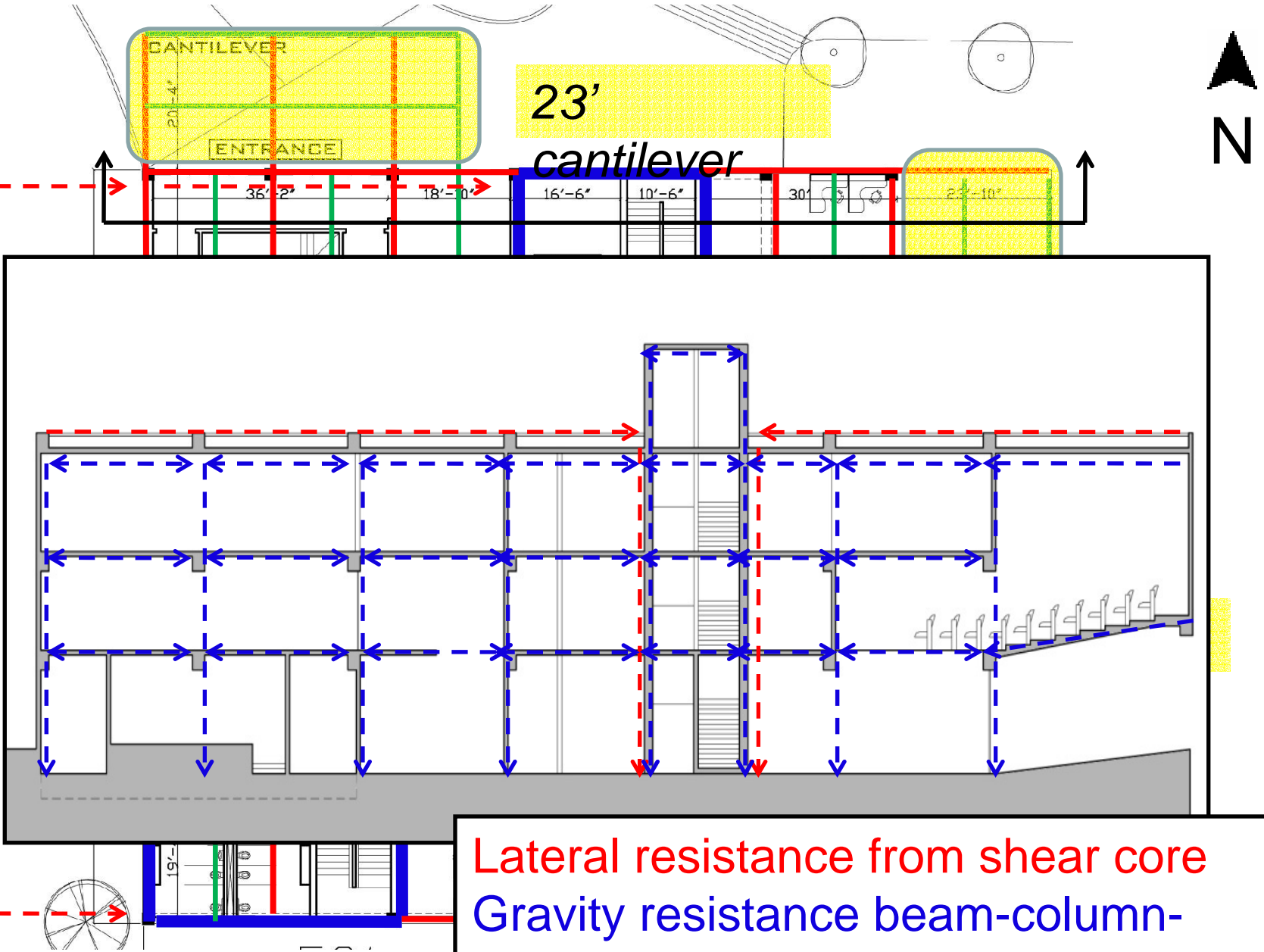
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Volumetric view

09

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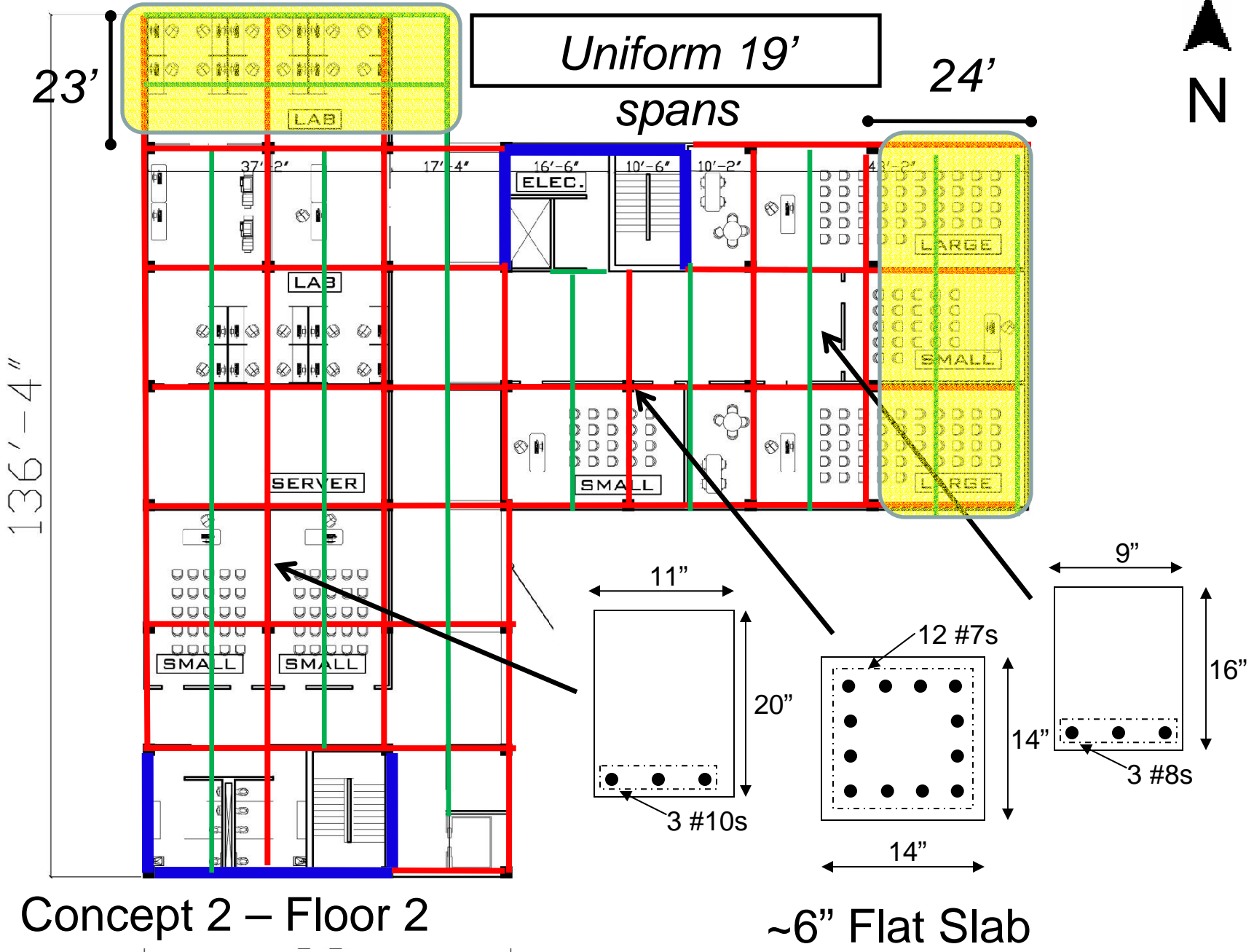


Lateral resistance from shear core
Gravity resistance beam-column-
foundation interaction

Concept 2 - Floor 1

09

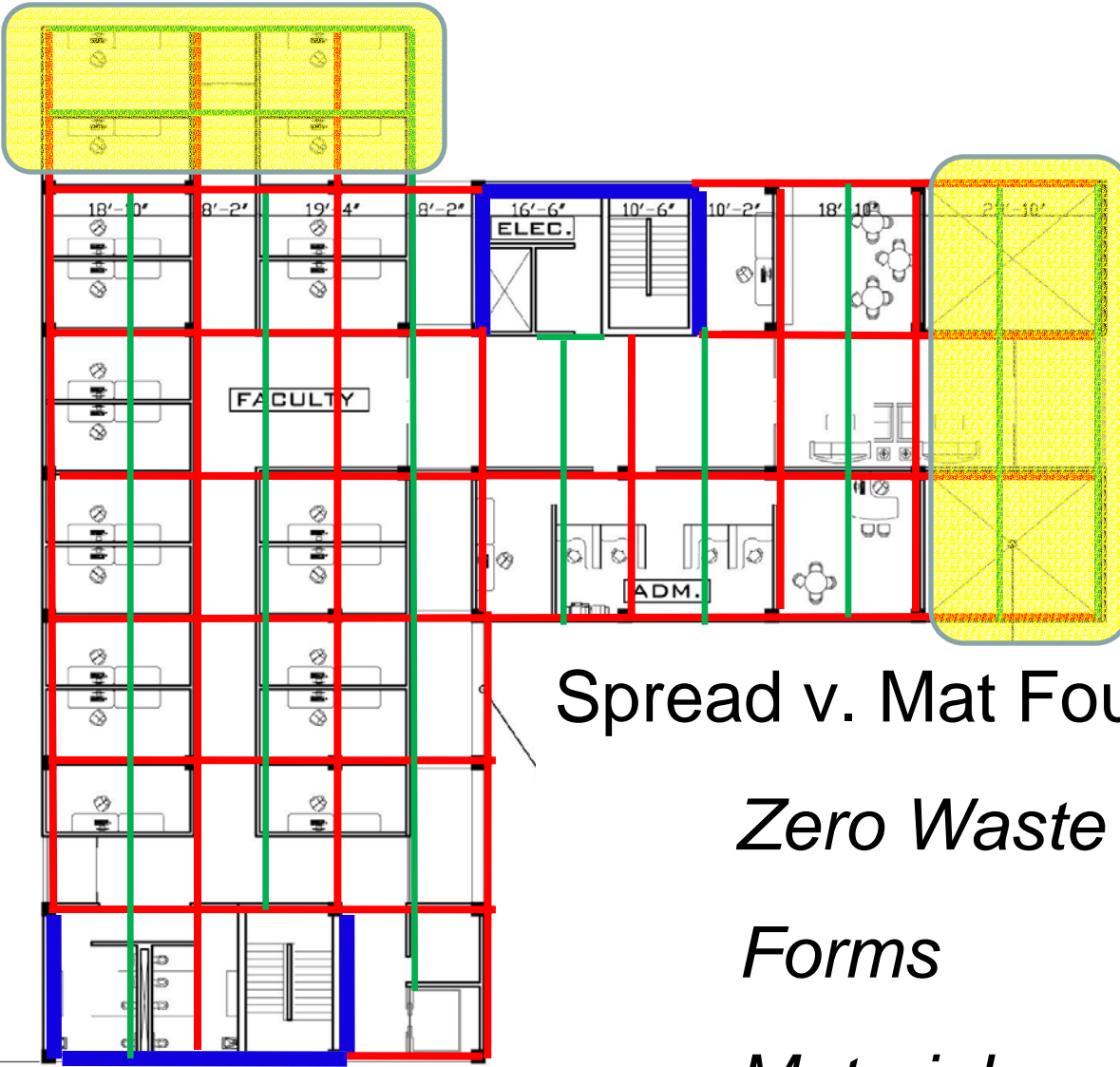
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Concept 2 – Floor 2

~6" Flat Slab

136'-4"



Concept 2 – Floor 3

Spread v. Mat Foundation

Zero Waste

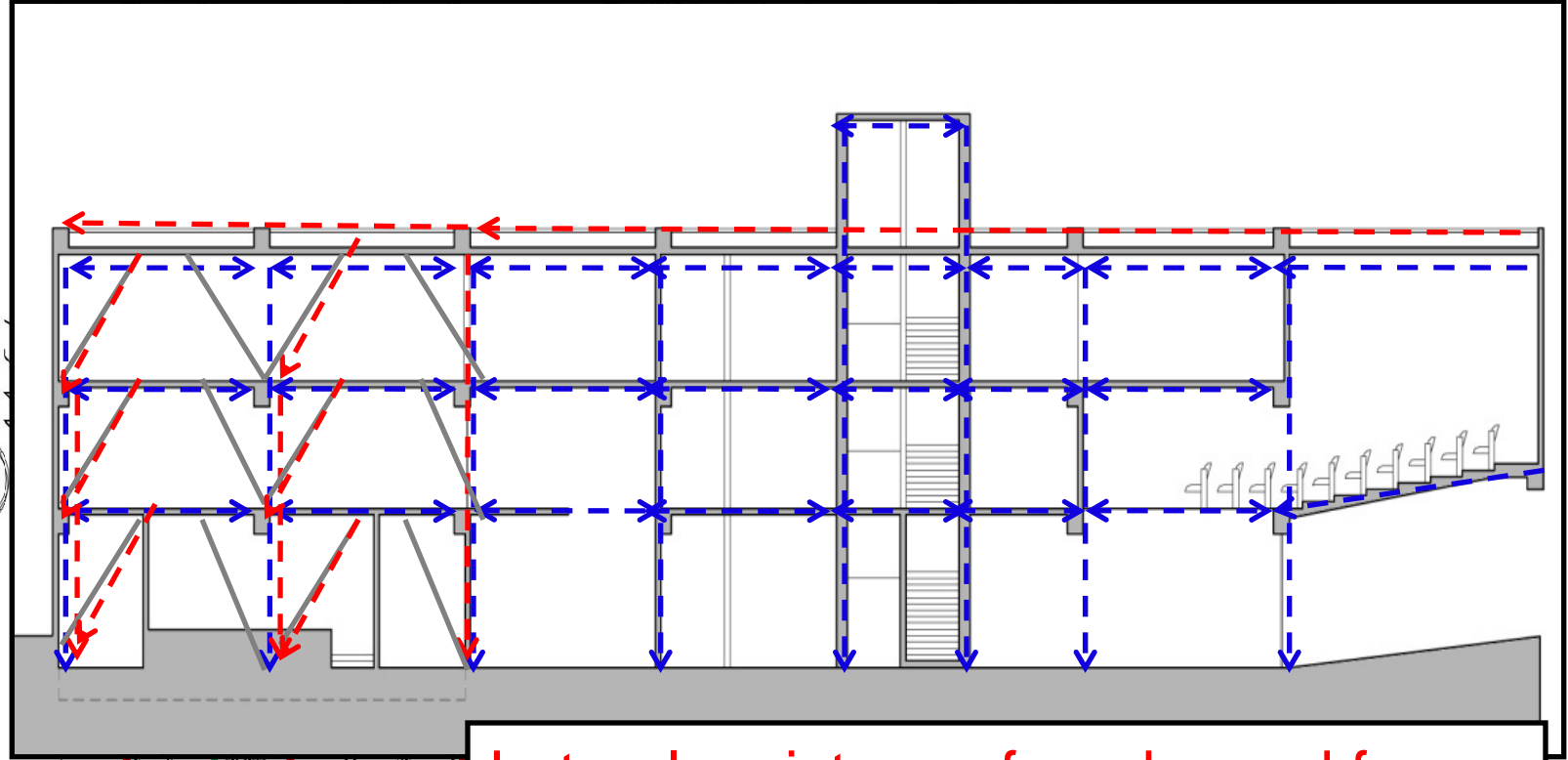
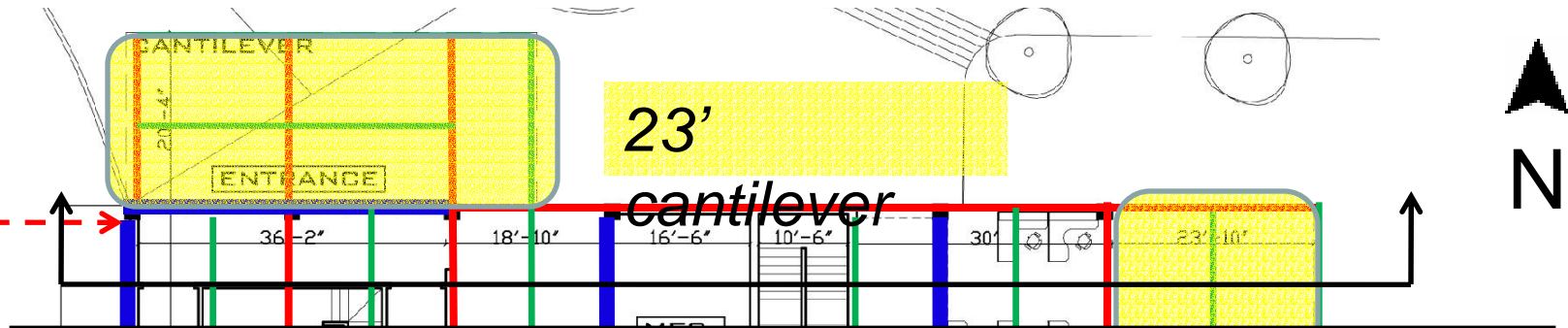
Forms

Material

1500 psf

09

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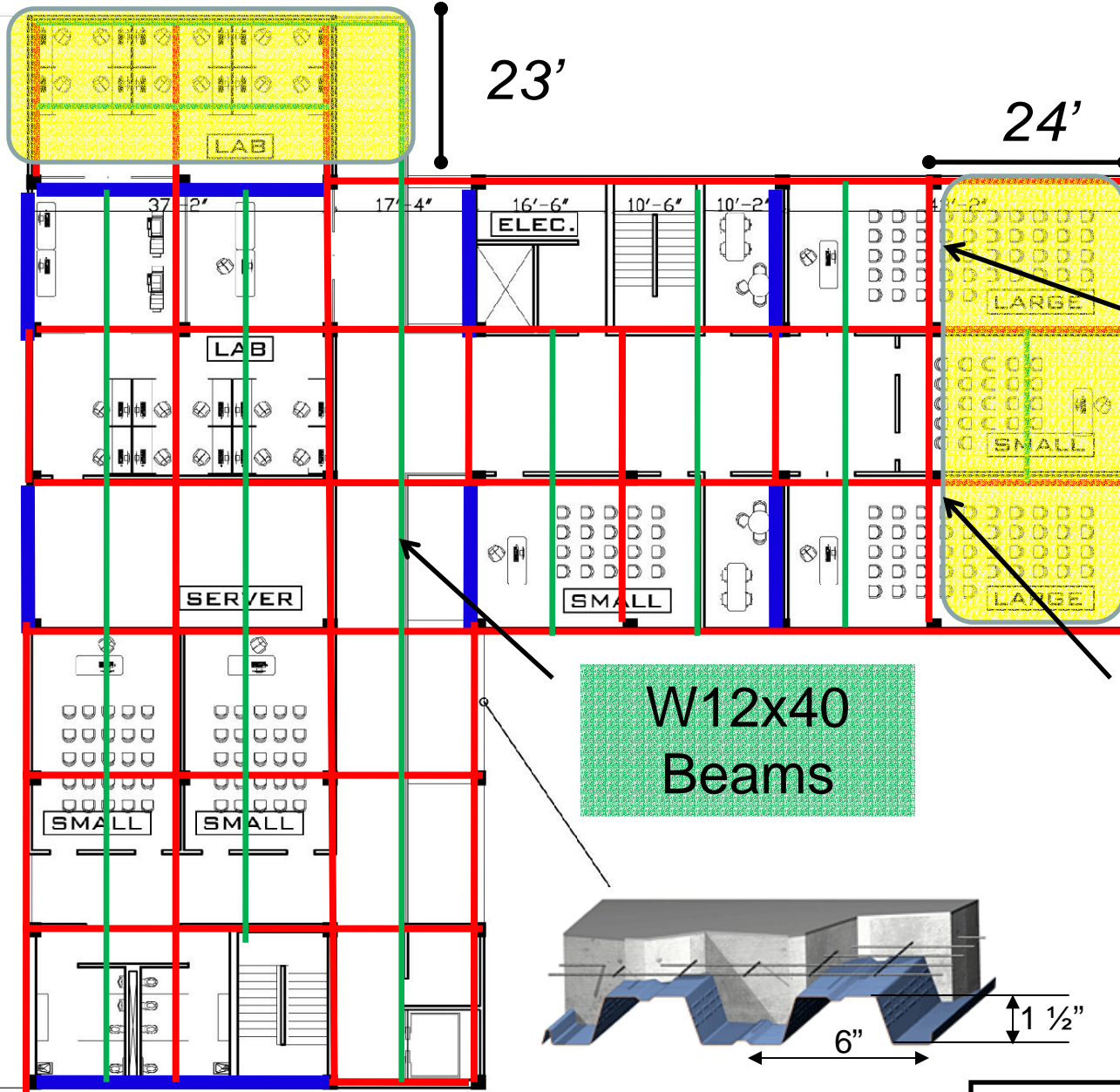


Lateral resistance from braced frame
Gravity Resistance girder-beam-
column-foundation interaction

Concept 2 – Floor



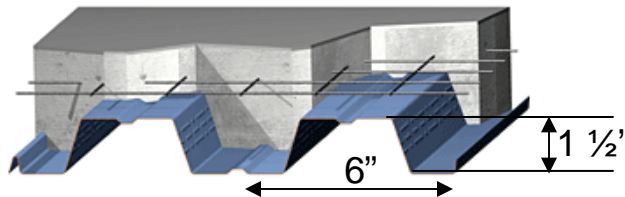
09



W12x53
Girders

W12x40
or W14x48
Columns

W12x40
Beams



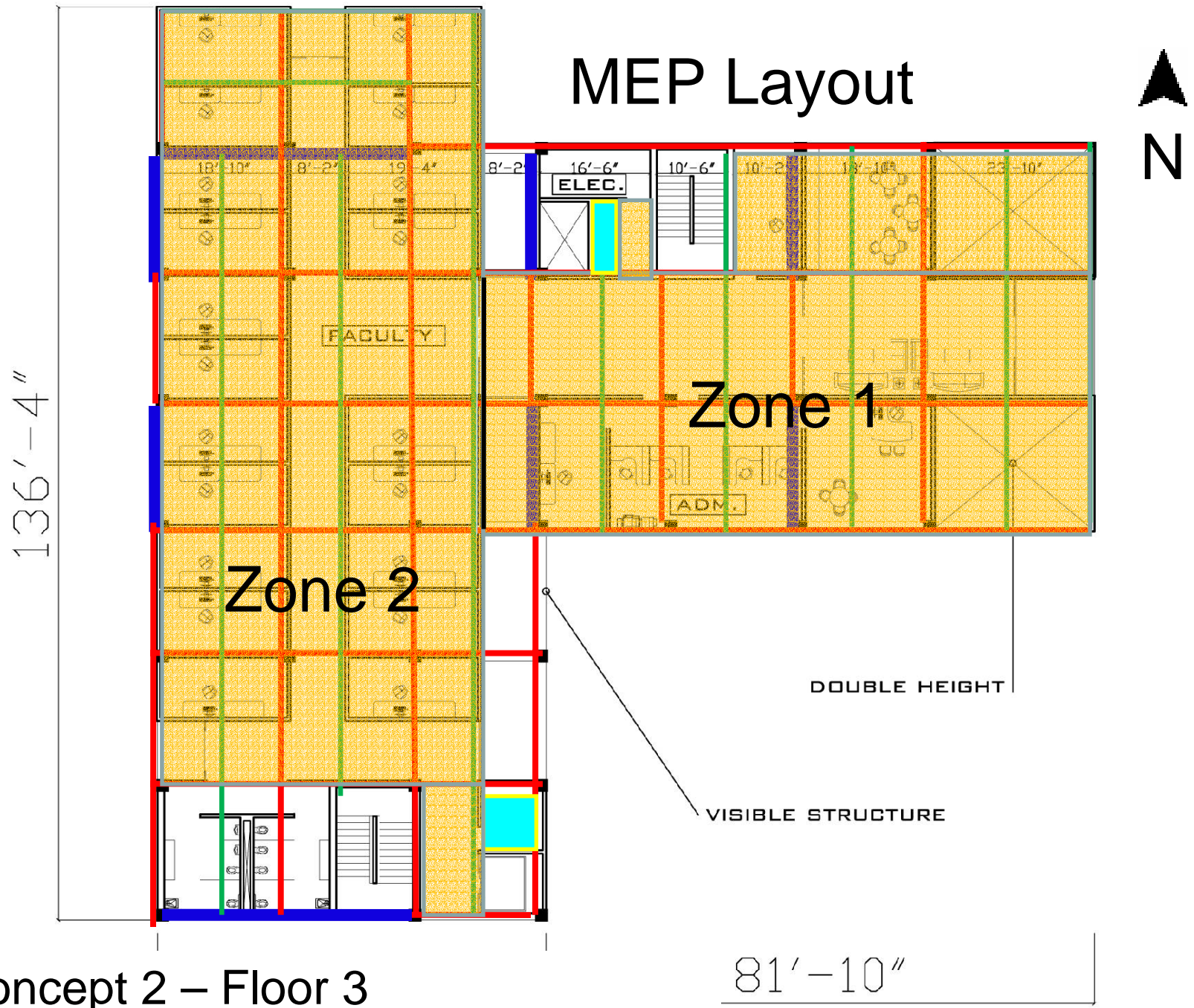
Uniform 19'

spans

Concept 2 – Floor 2

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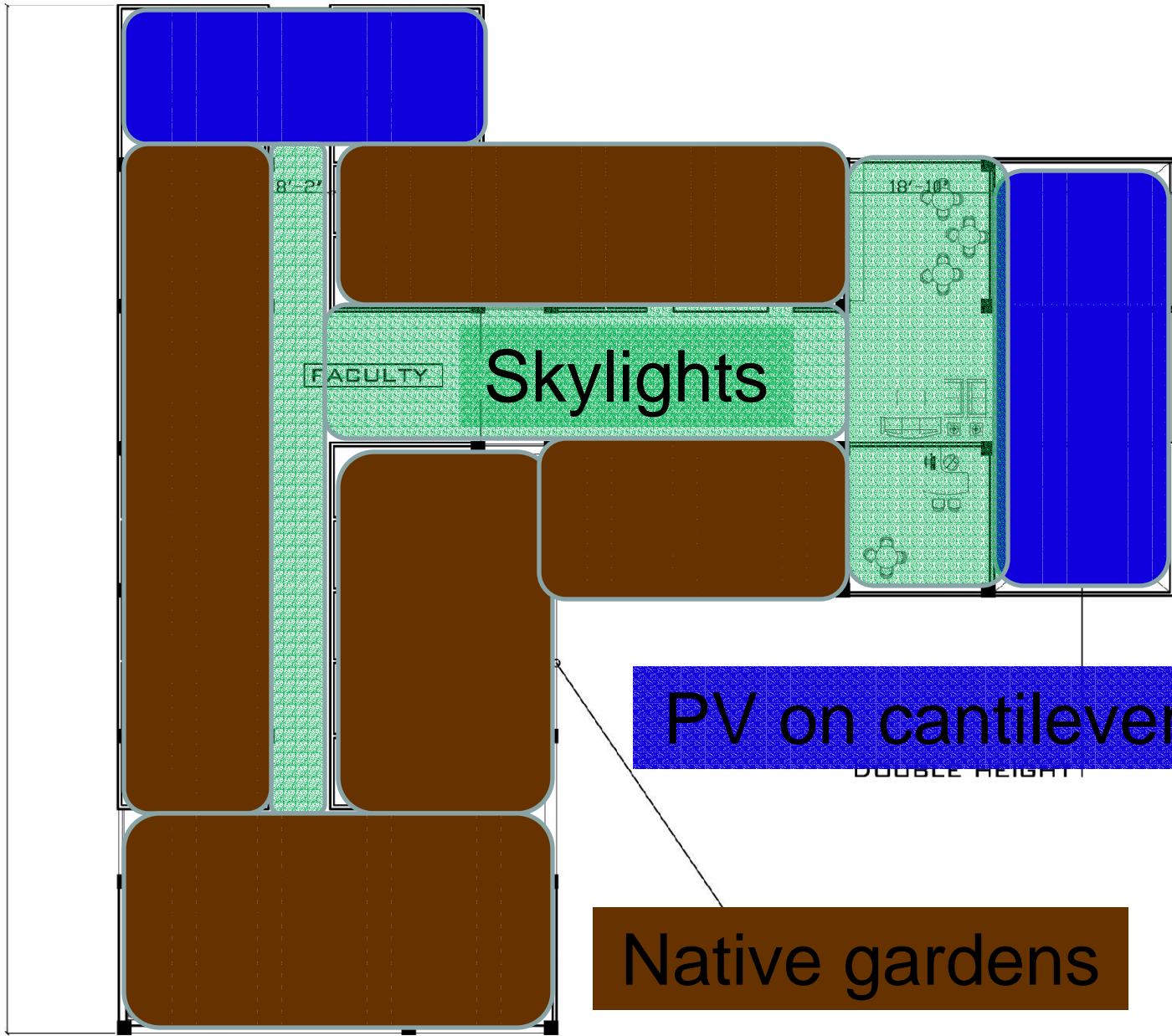
132'-1"



Concept 2 – Floor 3

Concept 2 – Green Roof

136'–4"



81'–10"

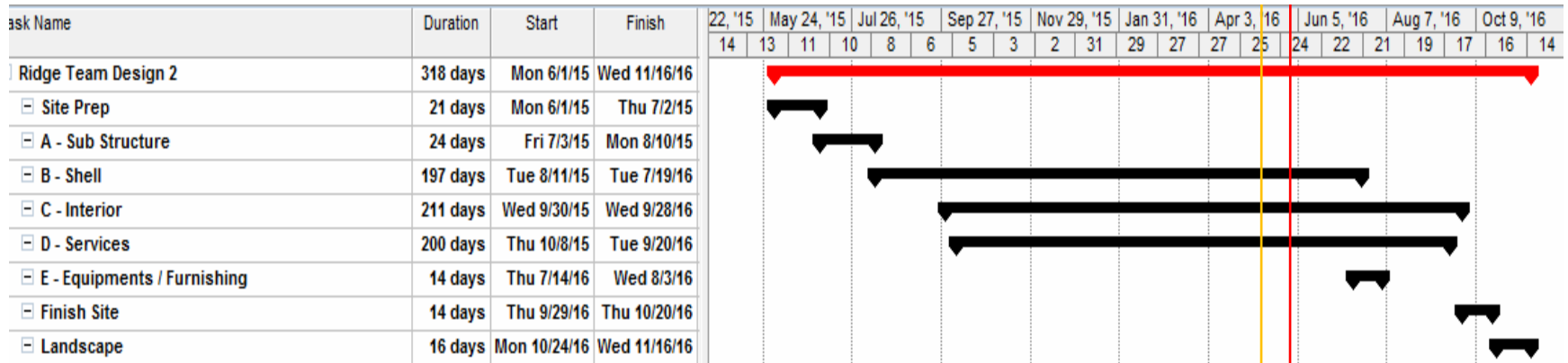


Concept 2 – Scheduling

Cast in Place Concrete = 503 calendar days = 1.38 years

Start: June 1, 2015

End: November 16, 2017



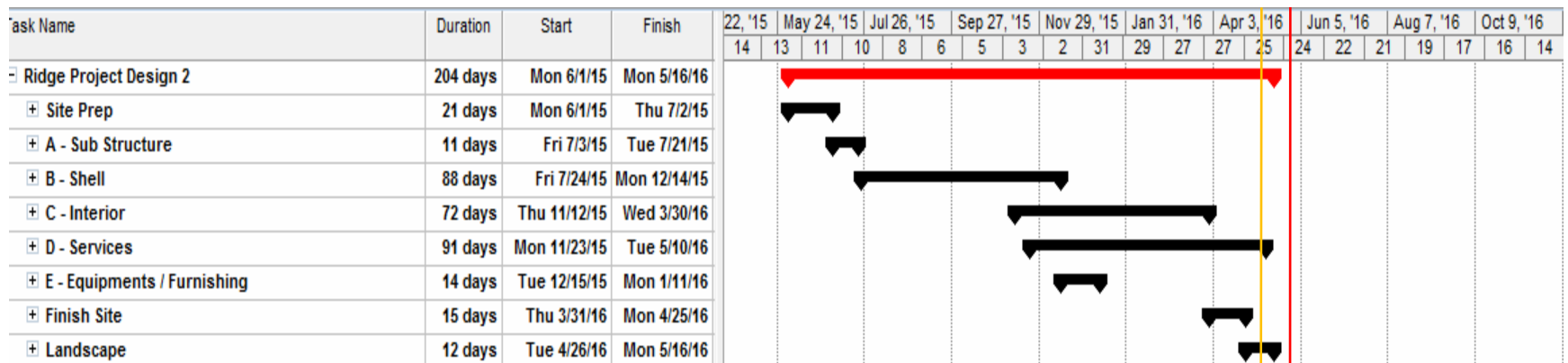
MAY

Steel Structure = 350 calendar days = .96 years

June '16

Start: June 1, 2015

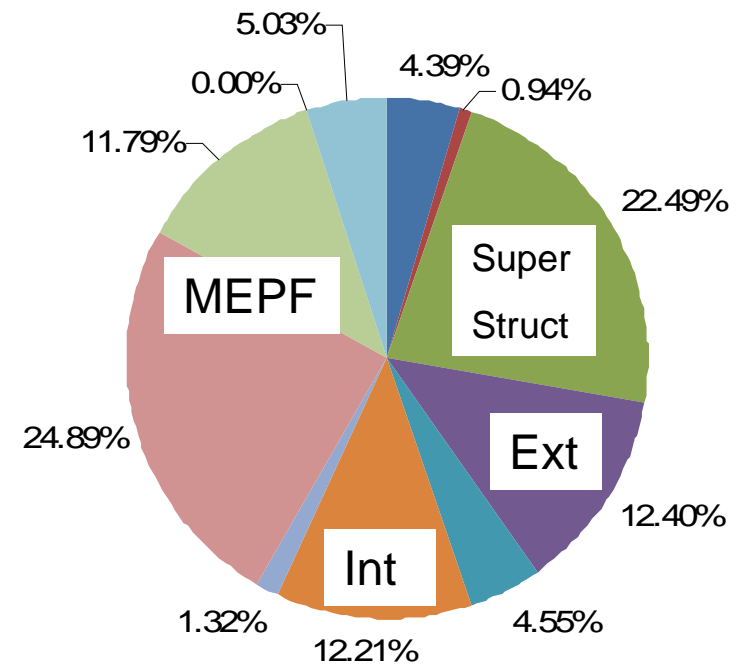
End: May 16, 2017



09 Concept 2 – Concrete Estimate

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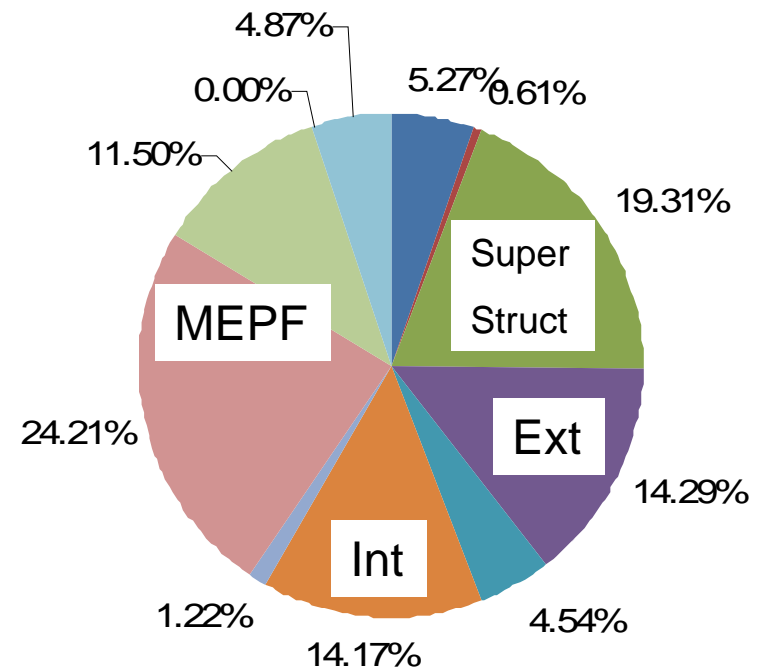
Ridge Project- Concept 2 Concrete			
ARCHITECT: Jonathan Delgado	3/10/2009		
	Building Gross Square Footage	33,000	GSF
Description	Cost	Cost/Sf	Comments
FOUNDATION	\$325,560	\$10.06	4.36%
SUBSTRUCTURE	\$70,700	\$2.14	0.93%
SUPERSTRUCTURE	\$1,699,500	\$51.50	22.49%
EXTERIOR CLOSURE	\$937,000	\$28.39	12.40%
ROOFING & WATERPROOFING	\$344,056	\$10.43	4.55%
INTERIOR CONSTRUCTION	\$923,00	\$27.97	12.21%
CONVEYING SYSTEM	\$100,000	\$3.03	1.32%
MECHANICAL	\$1,881,000	\$57.00	24.89%
ELECTRICAL	\$891,000	\$27.00	11.79%
EQUIPMENT	\$0	\$0.00	0.00%
SITWORK	\$380,000	\$11.52	5.03%
INDIRECT COST	\$7,558,080	\$229.03	
General Conditions (8%)	\$604,646	\$18.32	
Fee (5%)	\$377,904	\$11.45	
Contingency (10%)	\$755,808	\$22.90	
TOTAL COST	\$9,300,000	\$284.17	
inflated to 2015 (3% inflation rate)	\$11,100,000		



09 Concept 2 – Steel Estimates

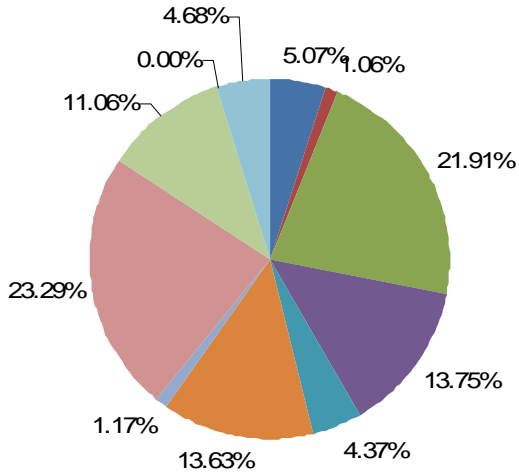
plummer.augelli.lock.landmann.delgado.yuen.kode

Ridge Project- Concept 2 Steel			
ARCHITECT: Jonathan Delgado	3/10/2009		
	Building Gross Square Footage	33,000	GSF
Description	Cost	Cost/Sf	Comments
FOUNDATION	\$331,824	\$10.06	4.54%
SUBSTRUCTURE	\$50,500	\$1.53	0.69%
SUPERSTRUCTURE	\$1,468,500	\$44.50	20.09%
EXTERIOR CLOSURE	\$937,000	\$28.39	12.82%
ROOFING & WATERPROOFING	\$344,056	\$10.43	4.71%
INTERIOR CONSTRUCTION	\$923,000	\$27.97	12.63%
CONVEYING SYSTEM	\$100,000	\$3.03	1.37%
MECHANICAL	\$1,884,000	\$57.00	25.77%
ELECTRICAL	\$891,000	\$27.00	12.19%
EQUIPMENT	\$0	\$0.00	0.00%
SITWORK	\$380,000	\$11.52	5.20%
INDIRECT COST	\$7,309,880	\$221.51	
General Conditions (8%)	\$584,790	\$17.72	
Fee (5%)	\$365,494	\$11.08	
Contingency (10%)	\$730,988	\$22.15	
TOTAL COST	\$9,000,000	\$272.46	
inflated to 2015 (3% inflation rate)	\$10,800,000		

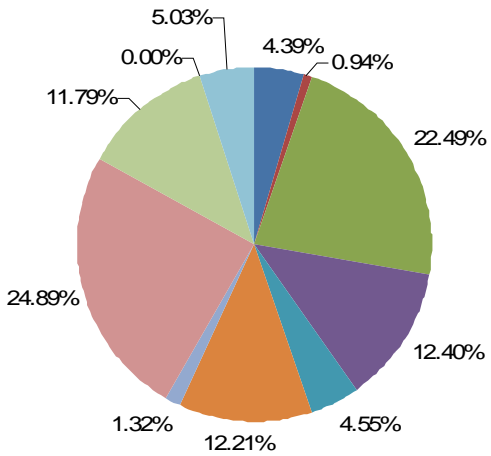


Overall Cost Comparison

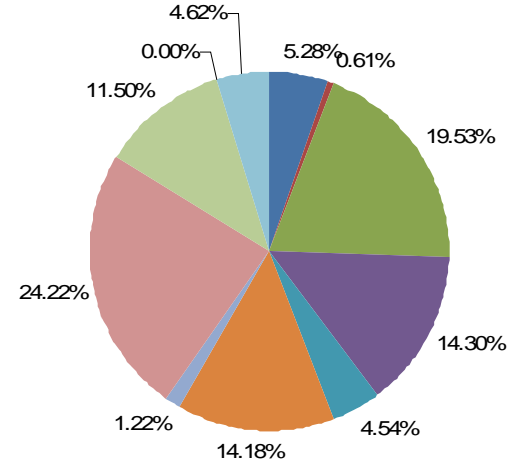
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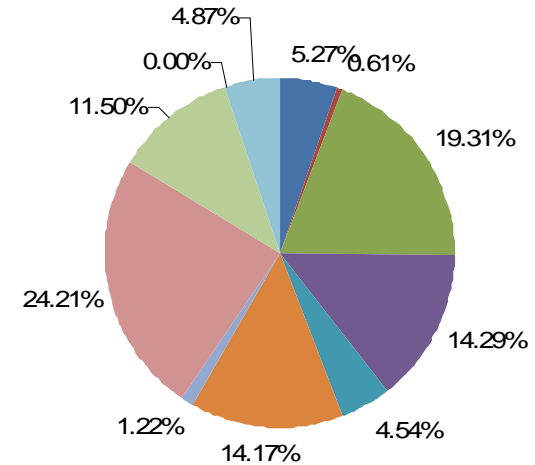
Concrete 1 – \$10.5M



Concrete 2 – \$9.4M



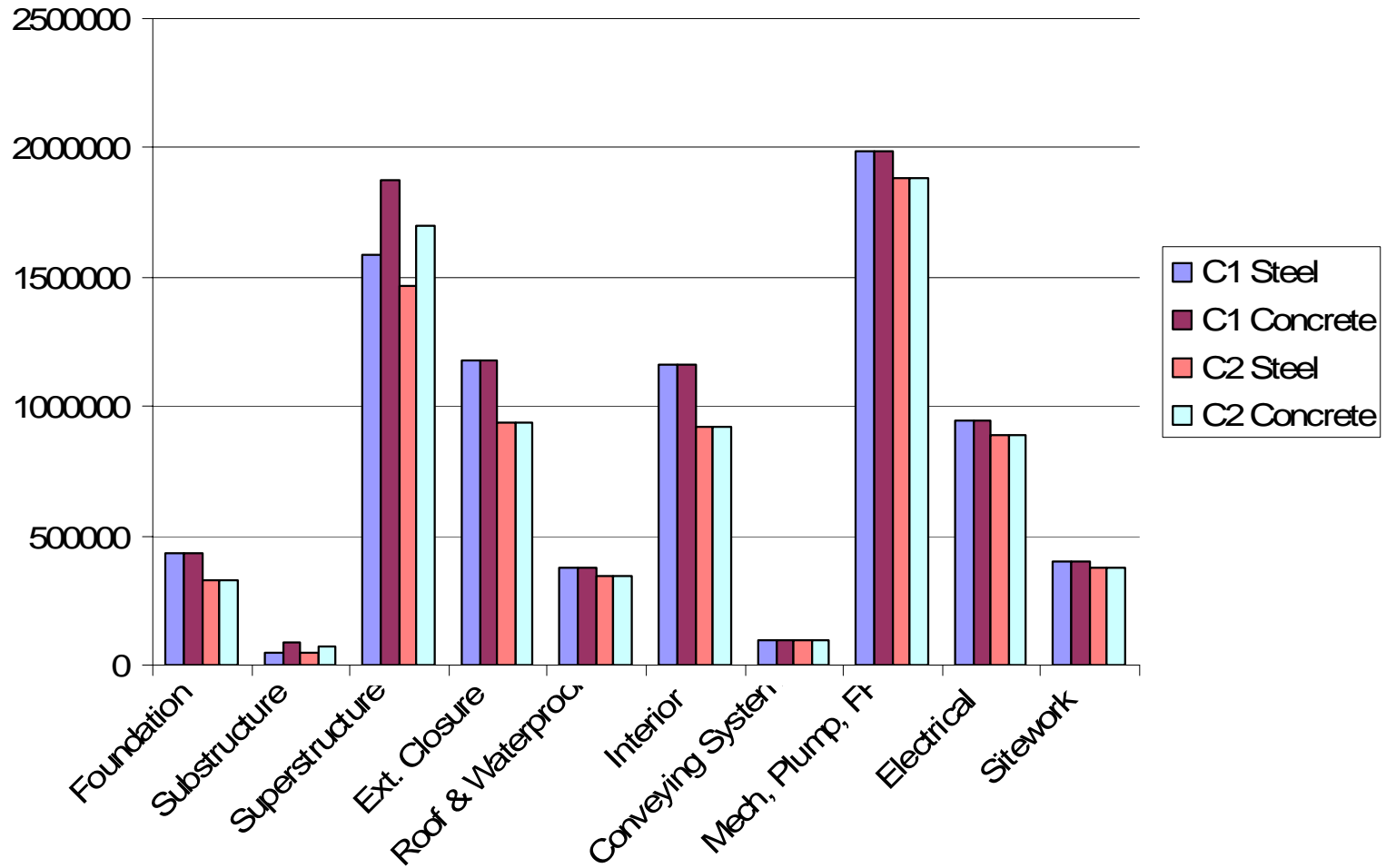
Steel 1 – \$10.1M



Steel 2 – \$9.0M

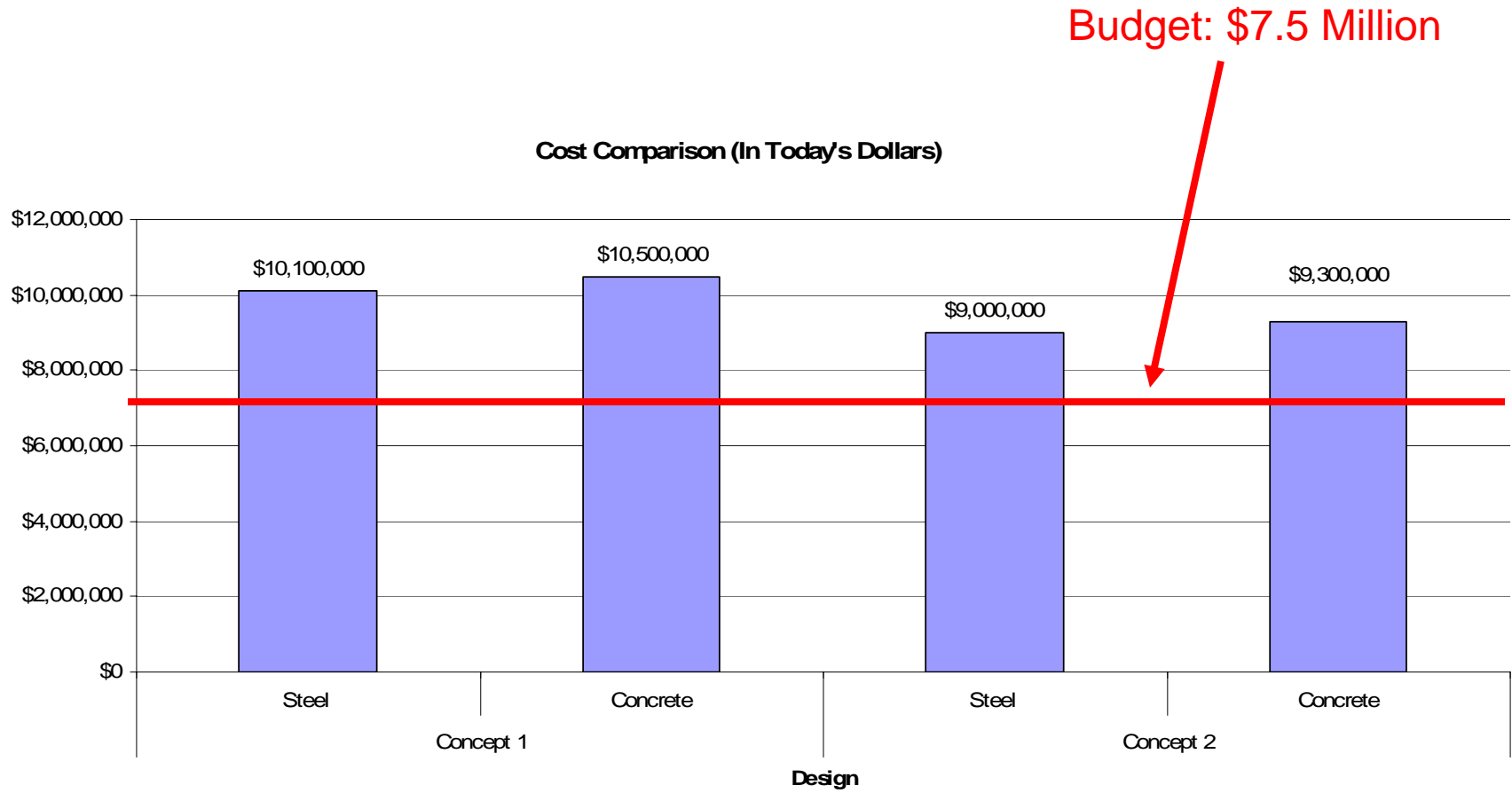
Budget: \$7.5 Million

Overall Cost Comparison



09 Overall Cost Comparison

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Team Process

Logistics

Naming convention

Filing

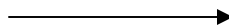
Meetings

The Process

Between Meetings

Working The Plan

Following up

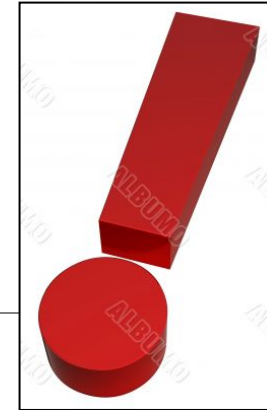


Needs Work

Effective use of to-do list by everyone

Reviewing work

Staying on people about deadlines



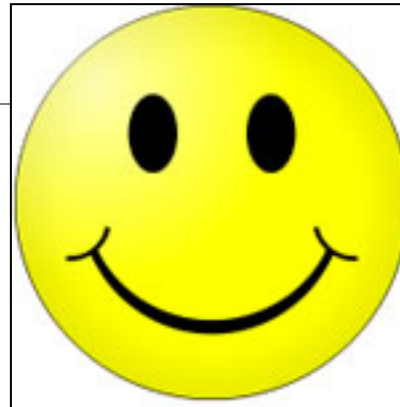
Working Well

Collaboration of ideas

Interdisciplinary understanding

Group problem solving

Socializing beyond work



09 1:1, Sub-group, Team Communication

Synchronous



Asynchronous

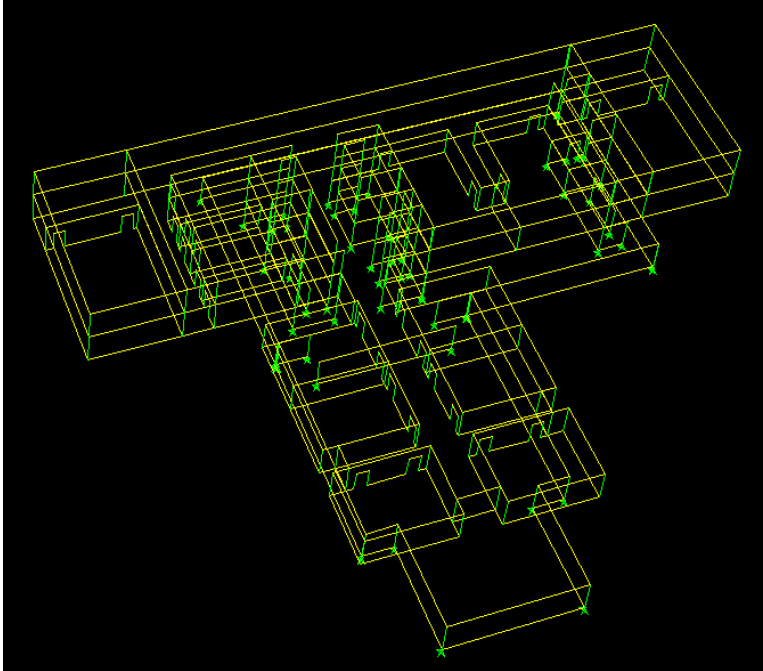


E-mail



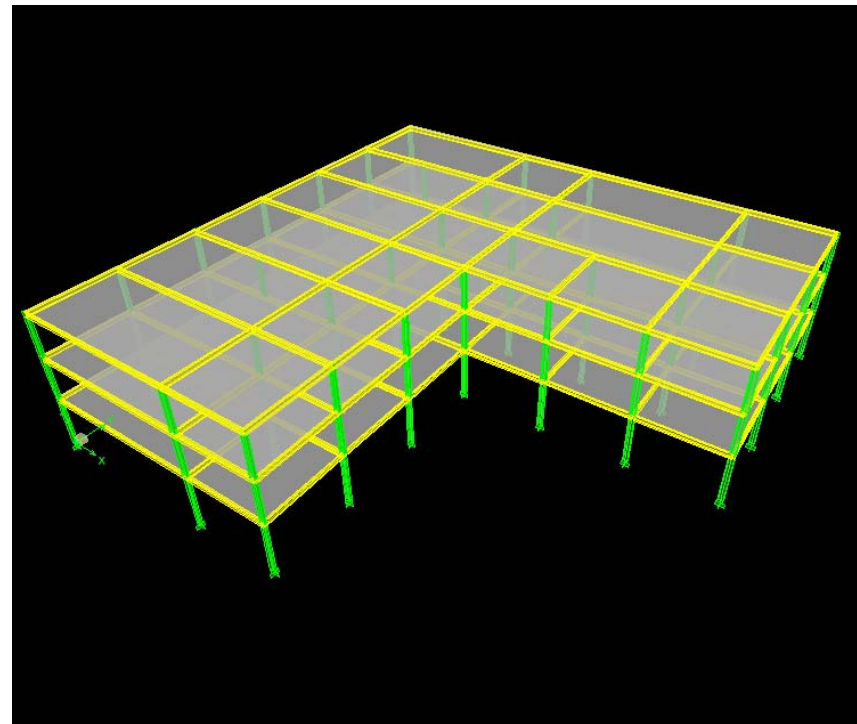
Phone



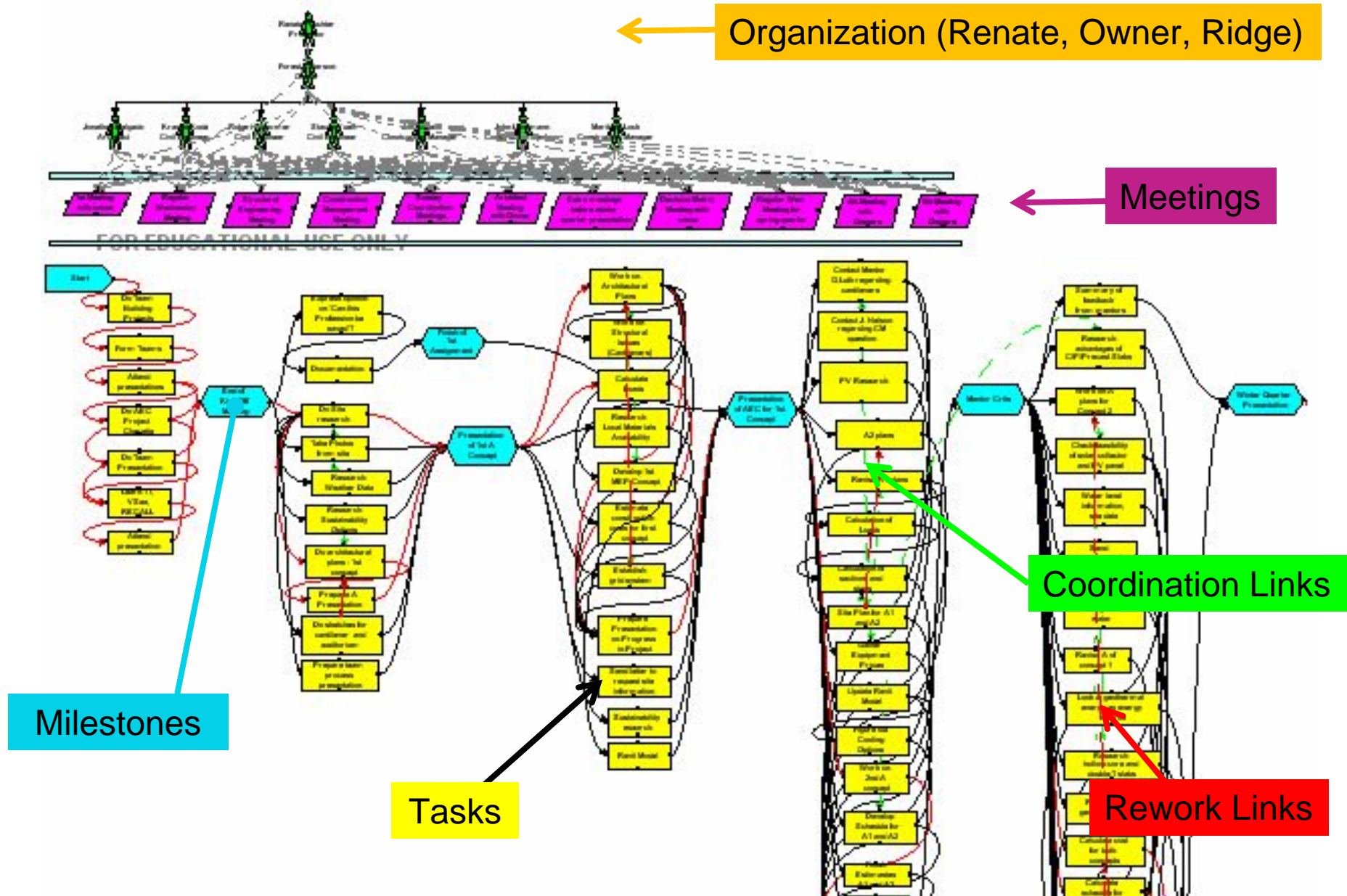


Revit Model of Concept 1
after importing in ETABS

ETABS Model of Concept 2

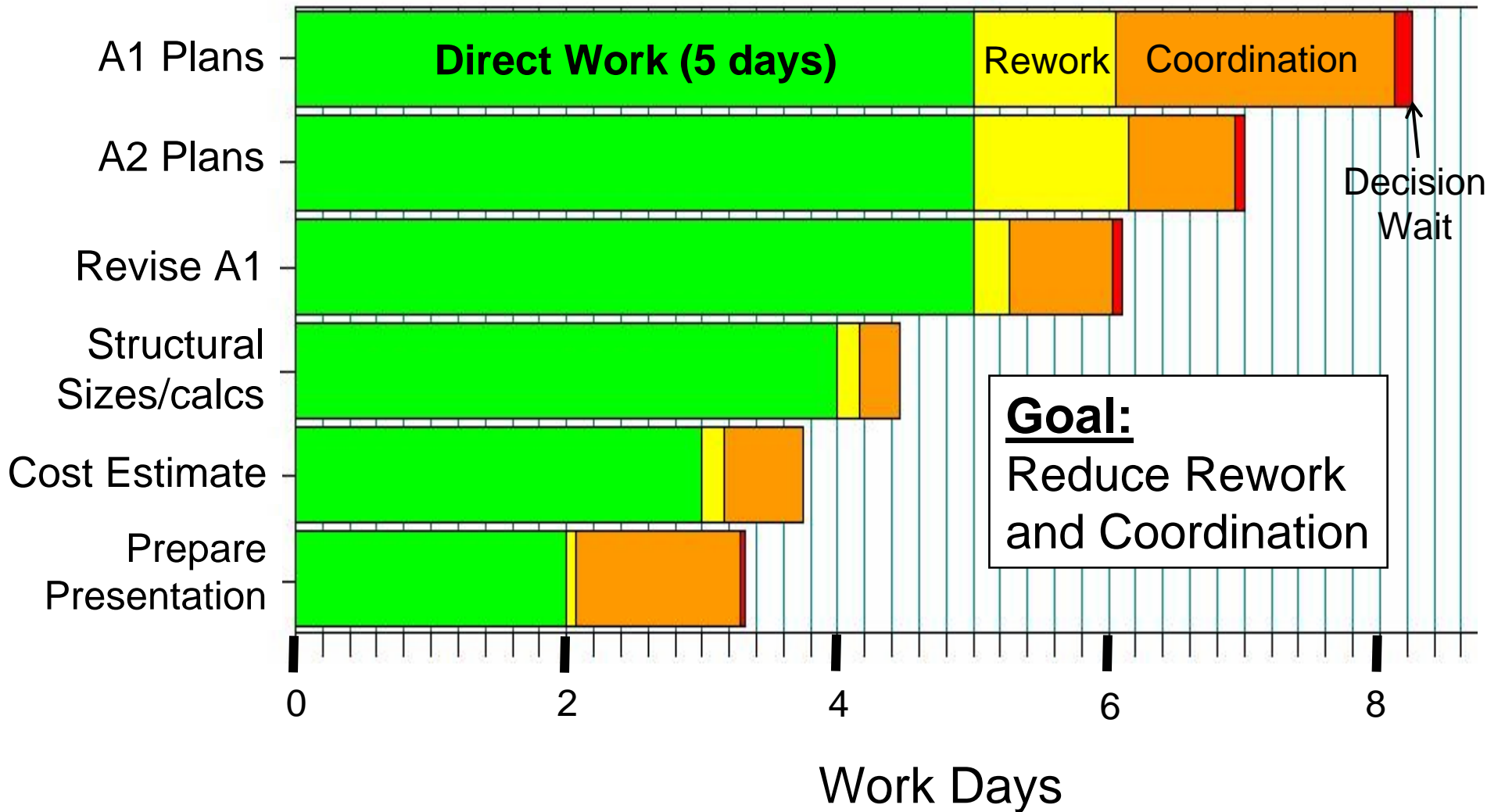


09 SimVision – Organization Modeling

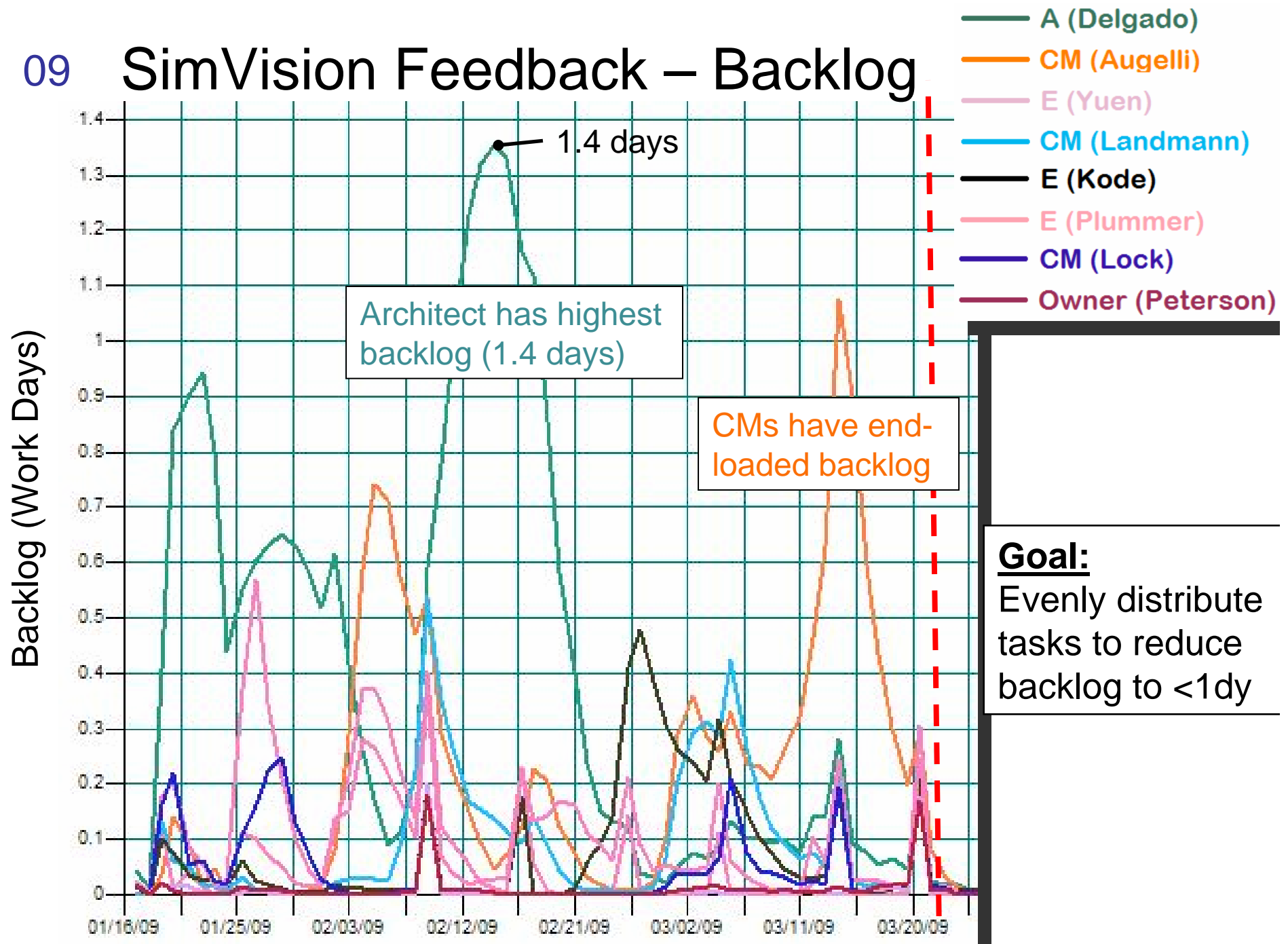


09 SimVision Feedback – Work Breakdown

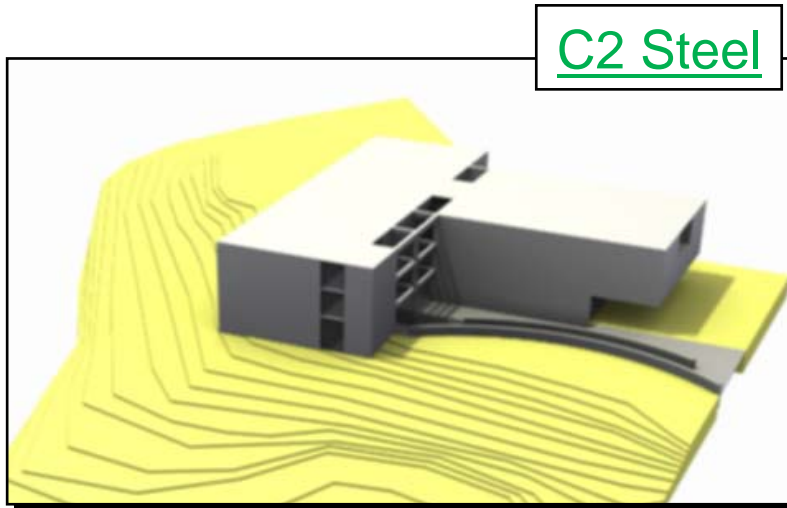
“Hidden Work” (3+ days)



09 SimVision Feedback – Backlog



09 Final Choice – Moving Forward



Explore integration of natural heating & cooling

Explore local materials & native plants

Cultivate value & design aesthetic

Push sustainability in A/E/C design decisions

Zero Waste



09 Team Process Improvements

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Rework and Coordination (by ½)



Member Backlog (everyone <1 day)



Team Efficiency (Deadlines!)



Questions?