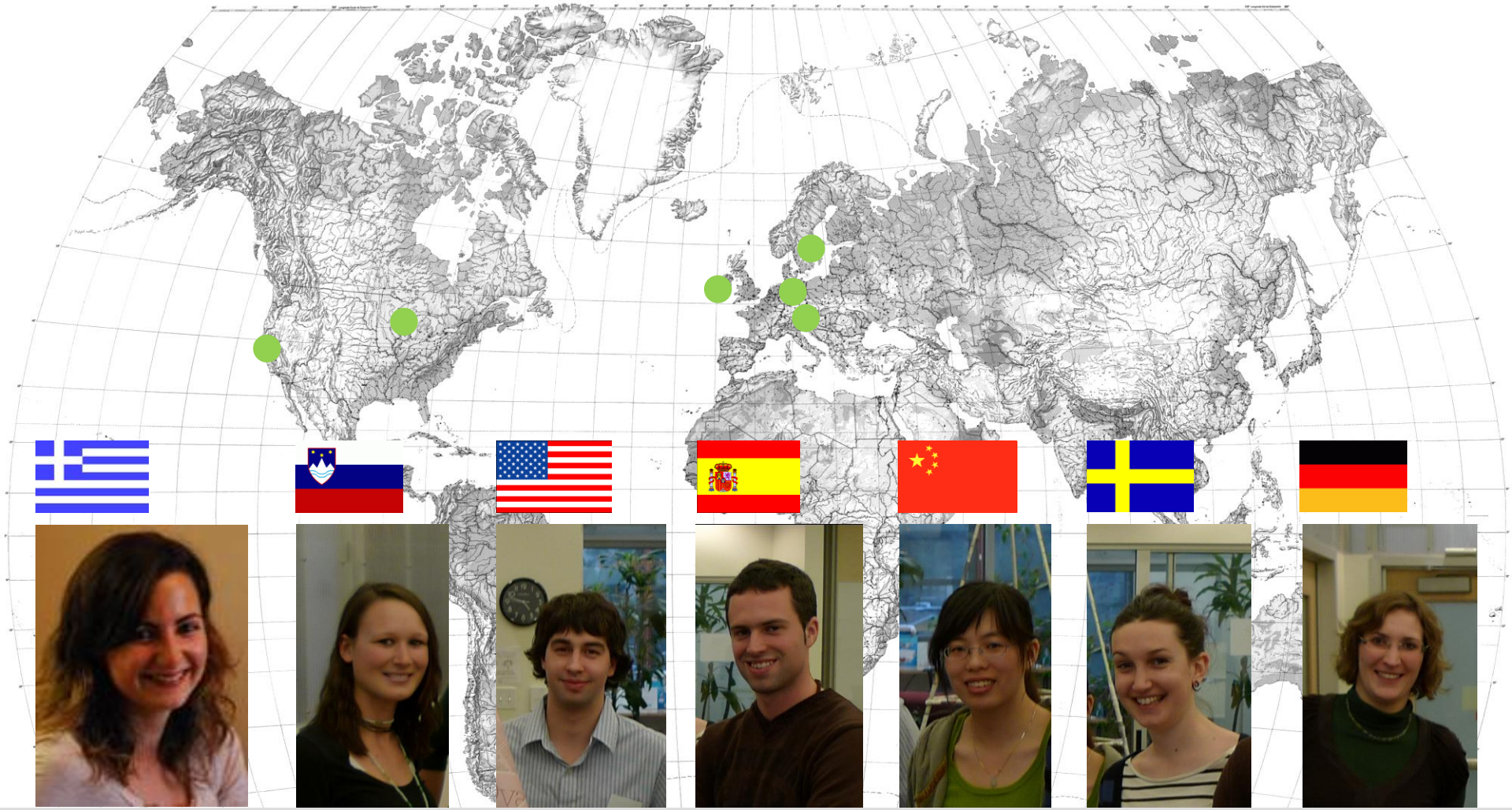
CENTRAL TEAM

MERGE



Dimitra Ioannidou

Lana Topolovec

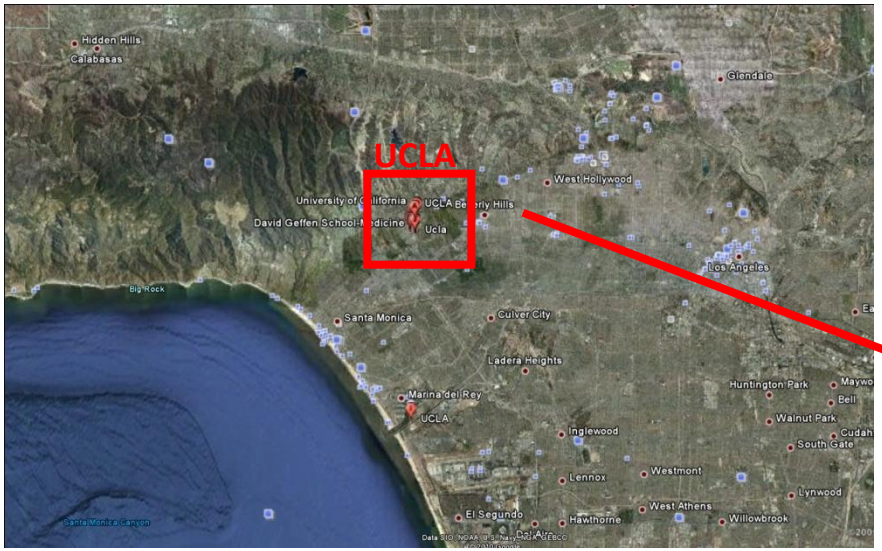
Tyler Hoehn + Abel Diaz

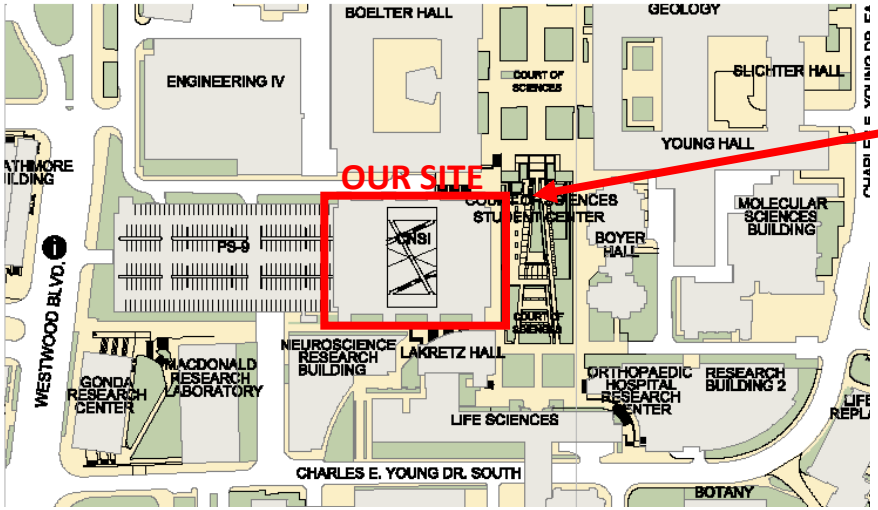
Hang Yin

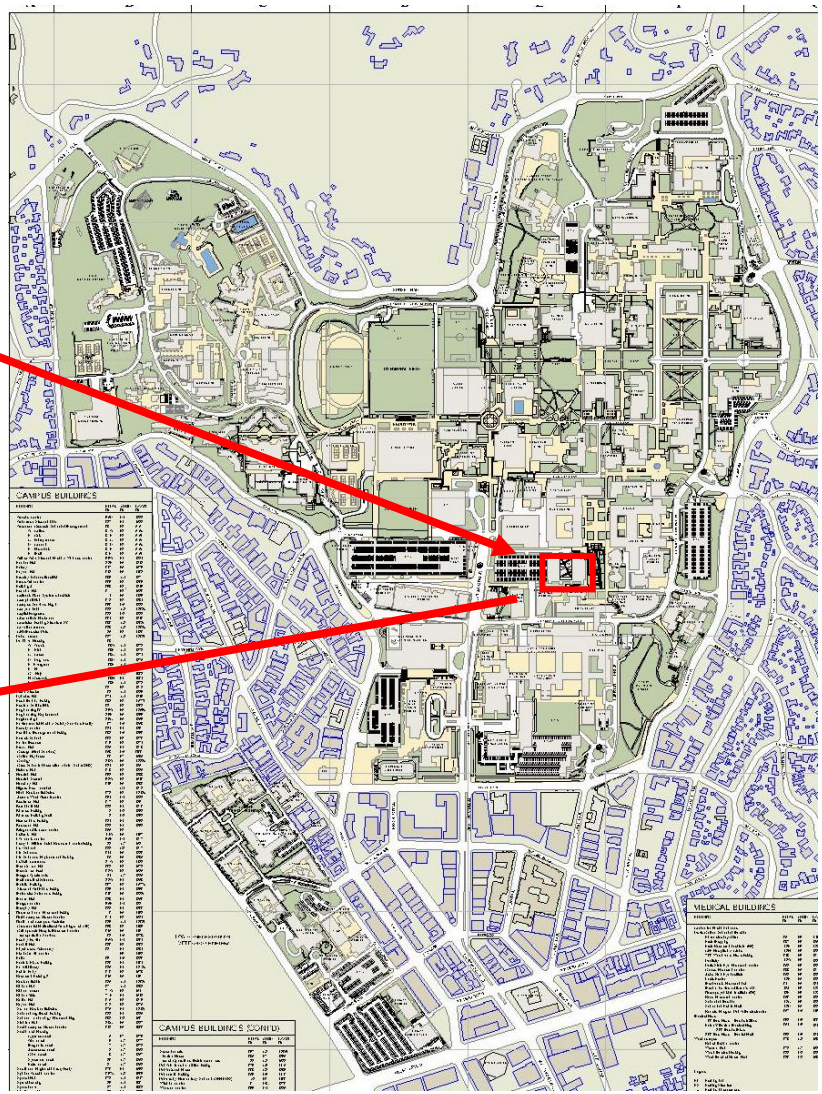
Sandrine Rivoire

Charlotte Thomas

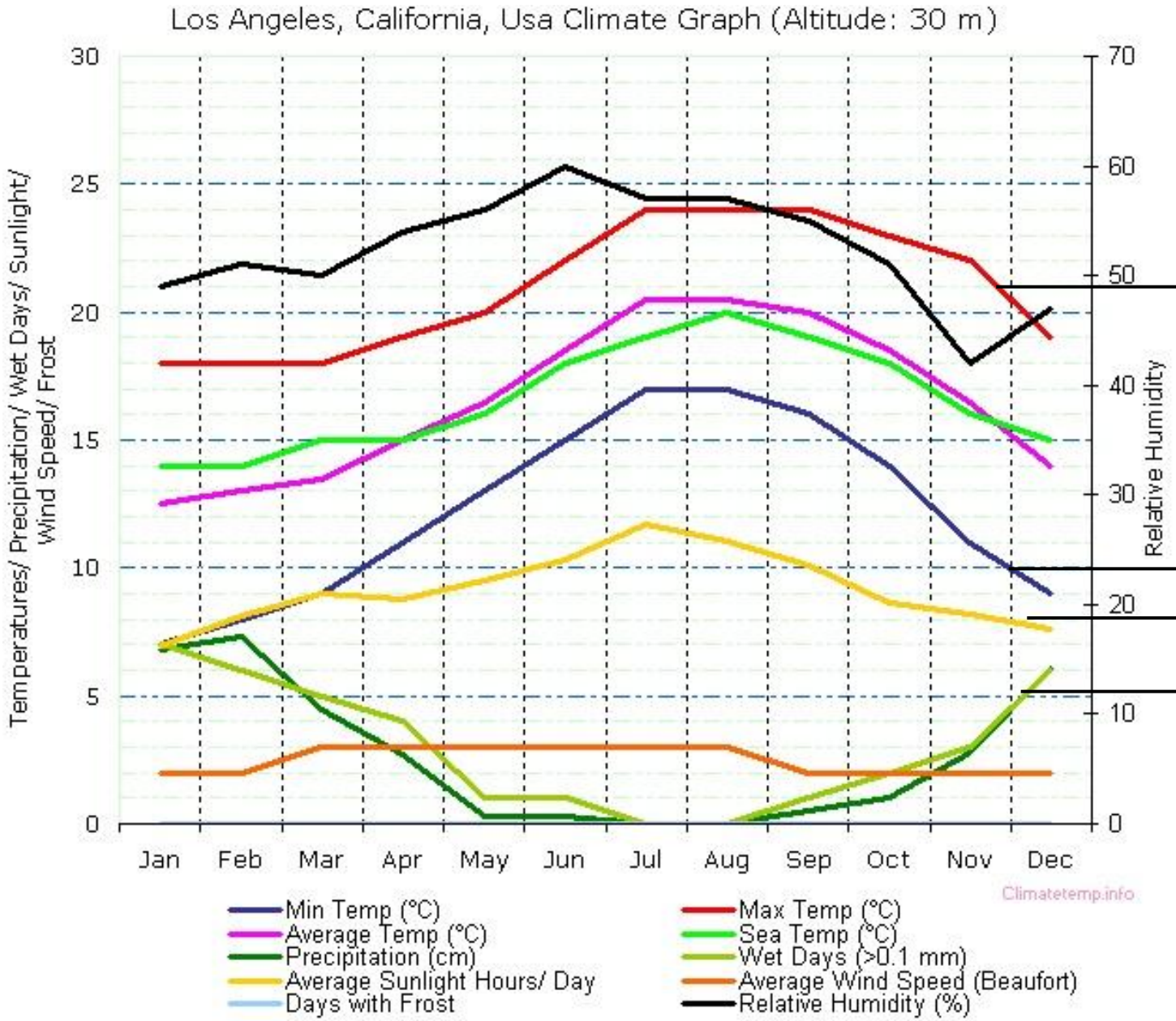
Site location







Climate Data



MAX TEMPERATURE

MIN TEMPERATURE

AVERAGE SUNLIGHT HOURS

WET DAYS

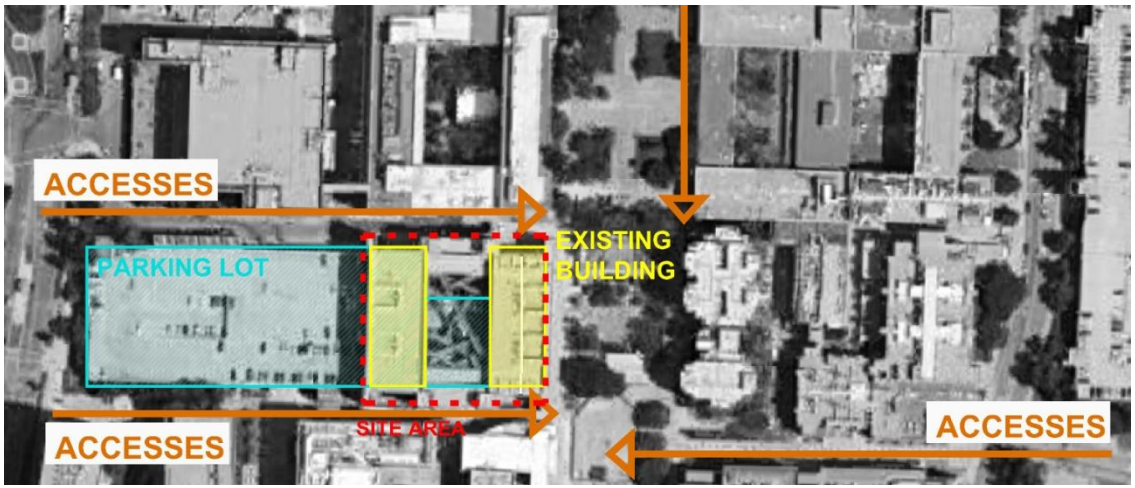
MERGE

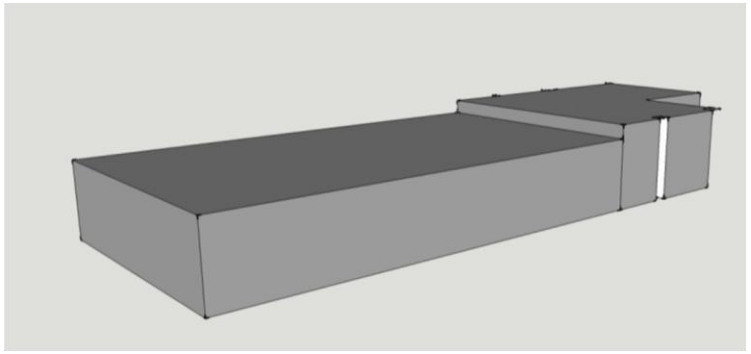
Site Analysis

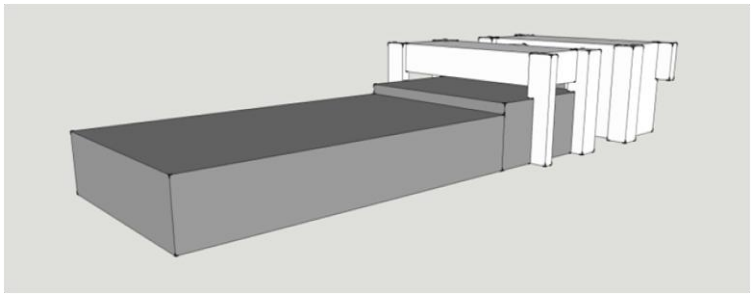
MERGE

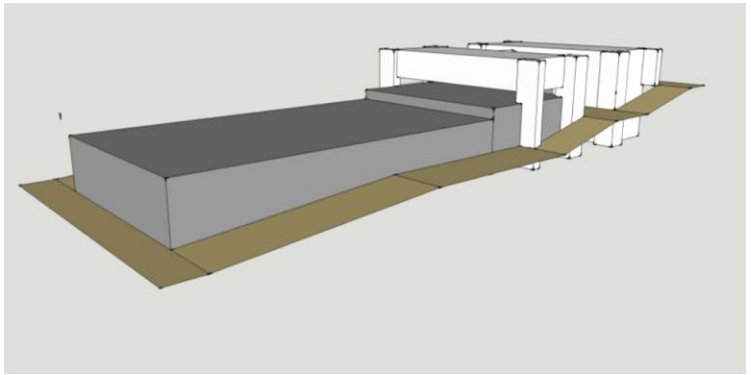
Site Analysis

MERGE



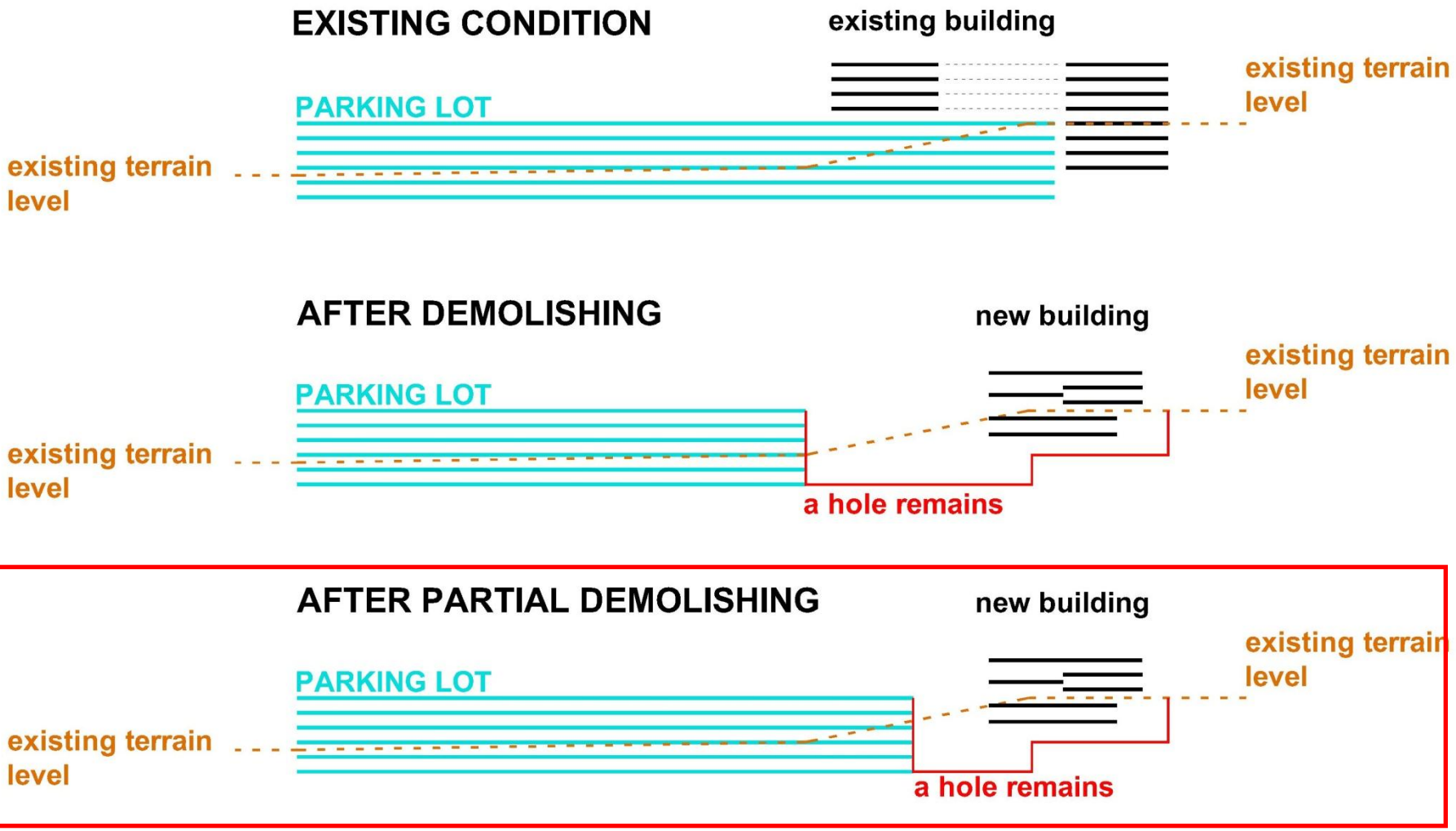






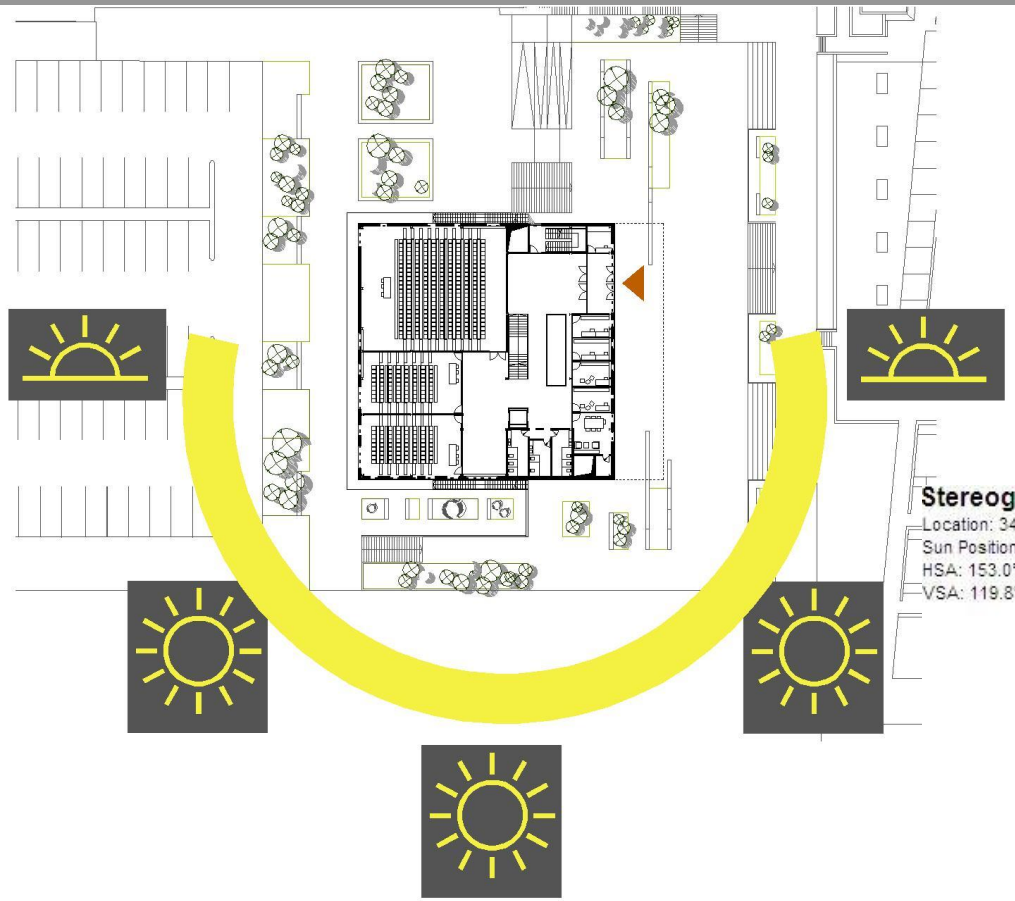
MERGE

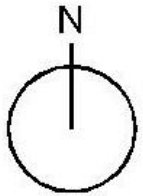
ELEVATION OF EXISTING CONDITION and our OPTIONS



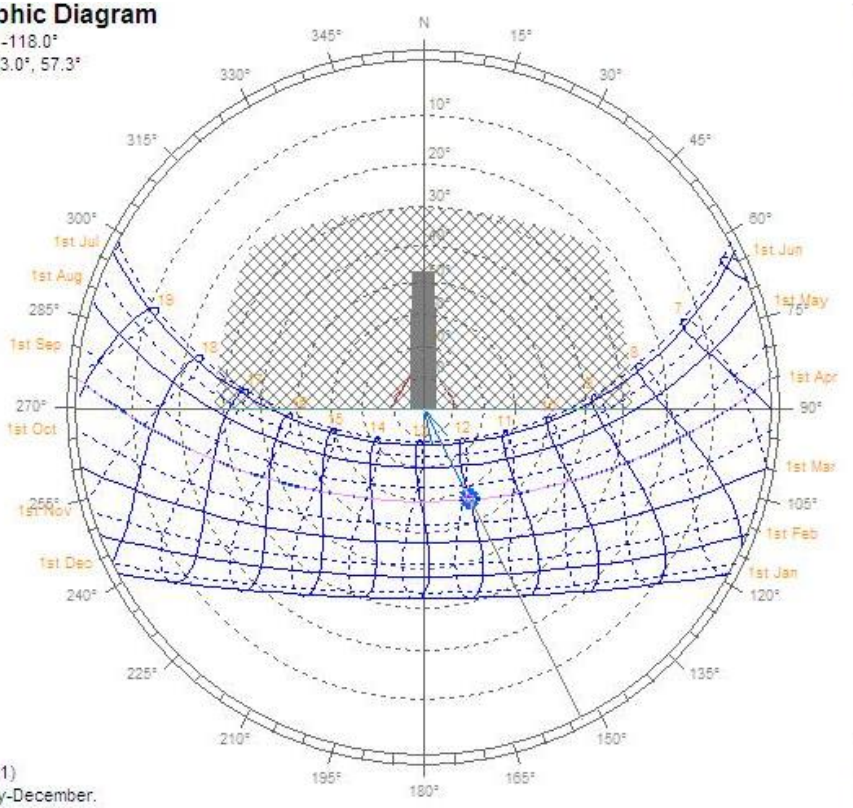
Site Analysis – Sun Path

MERGE



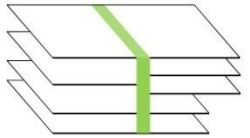


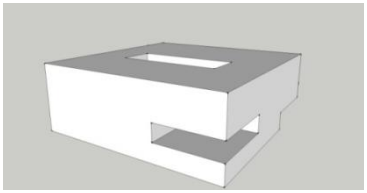
Stereographic Diagram
Location: 34.0°, -118.0°
Sun Position: 153.0°, 57.3°
HSA: 153.0°
VSA: 119.8°

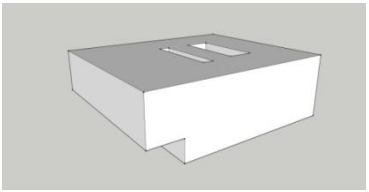


Time: 12:00
Date: 1st Apr (91)
Dotted lines: July-December.

Decision Matrix – Winter Presentation

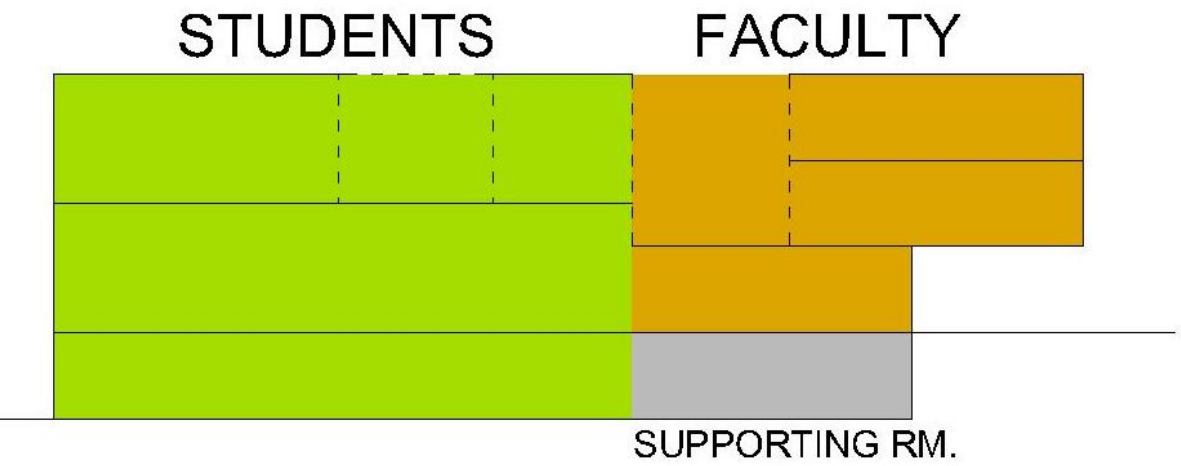


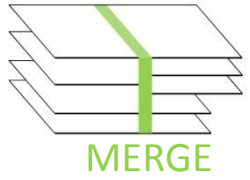


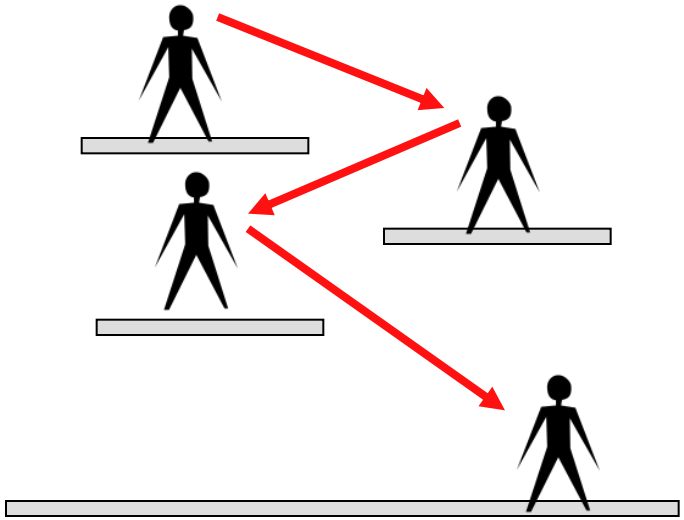


Key points	Weight	Hollowing				Merge			
		Steel		Concrete		Steel		Concrete	
Strengh of Concept	7	2	14	2	14	4	28	4	28
Design/Astehic	8	2	16	2	16	4	32	4	32
Integration	10	2	20	3	30	4	40	4	40
Efficient lateral system	6	3	18	1	6	4	24	2	12
Quality of Space	10	2	20	2	20	4	40	4	40
Flexibility	5	4	20	3	15	3	15	2	10
Sustainability	12	3	36	2	24	4	48	3	36
Life Cycle Cost	15	4	60	4	60	3	45	3	45
Building Cost	11	2	22	2	22	3	33	1	11
Construction Time - Constructability	6	4	24	3	18	3	18	2	12
Indoor Quality	10	2	20	3	30	3	30	4	40
	100		270		255		353		306
RANKING			3		4		1		2

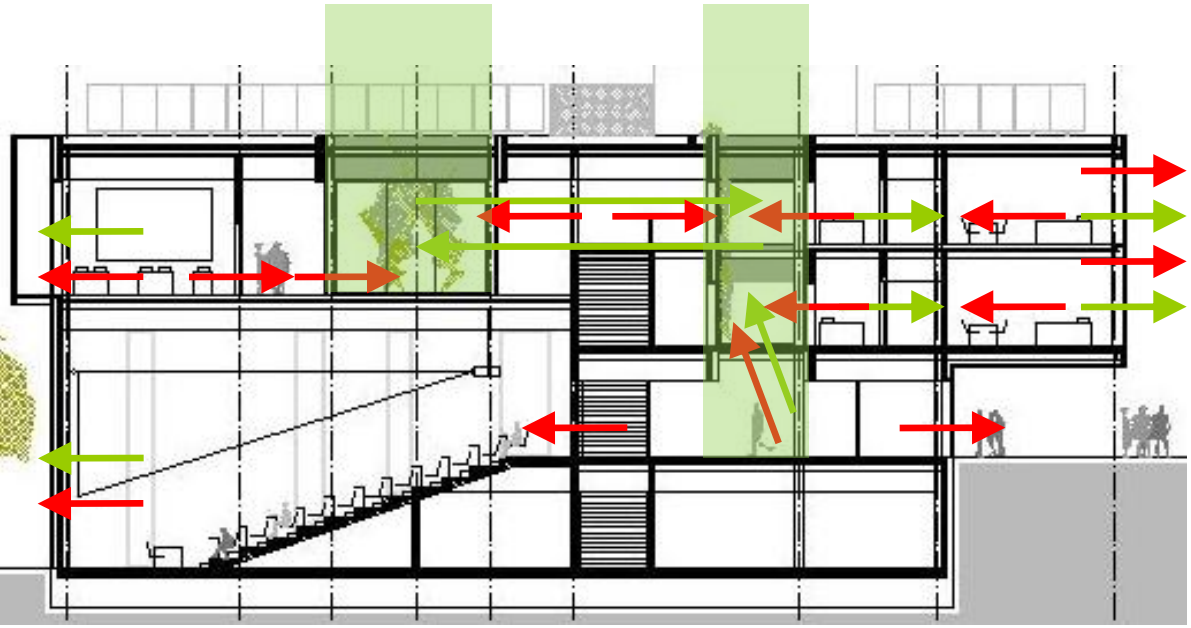
Big Idea

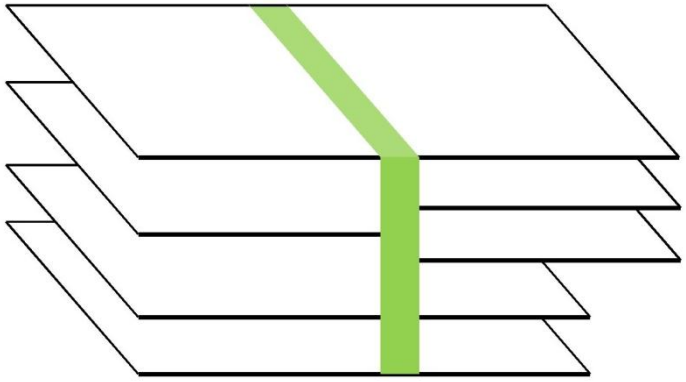






VISUAL CONNECTION

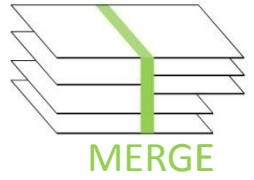


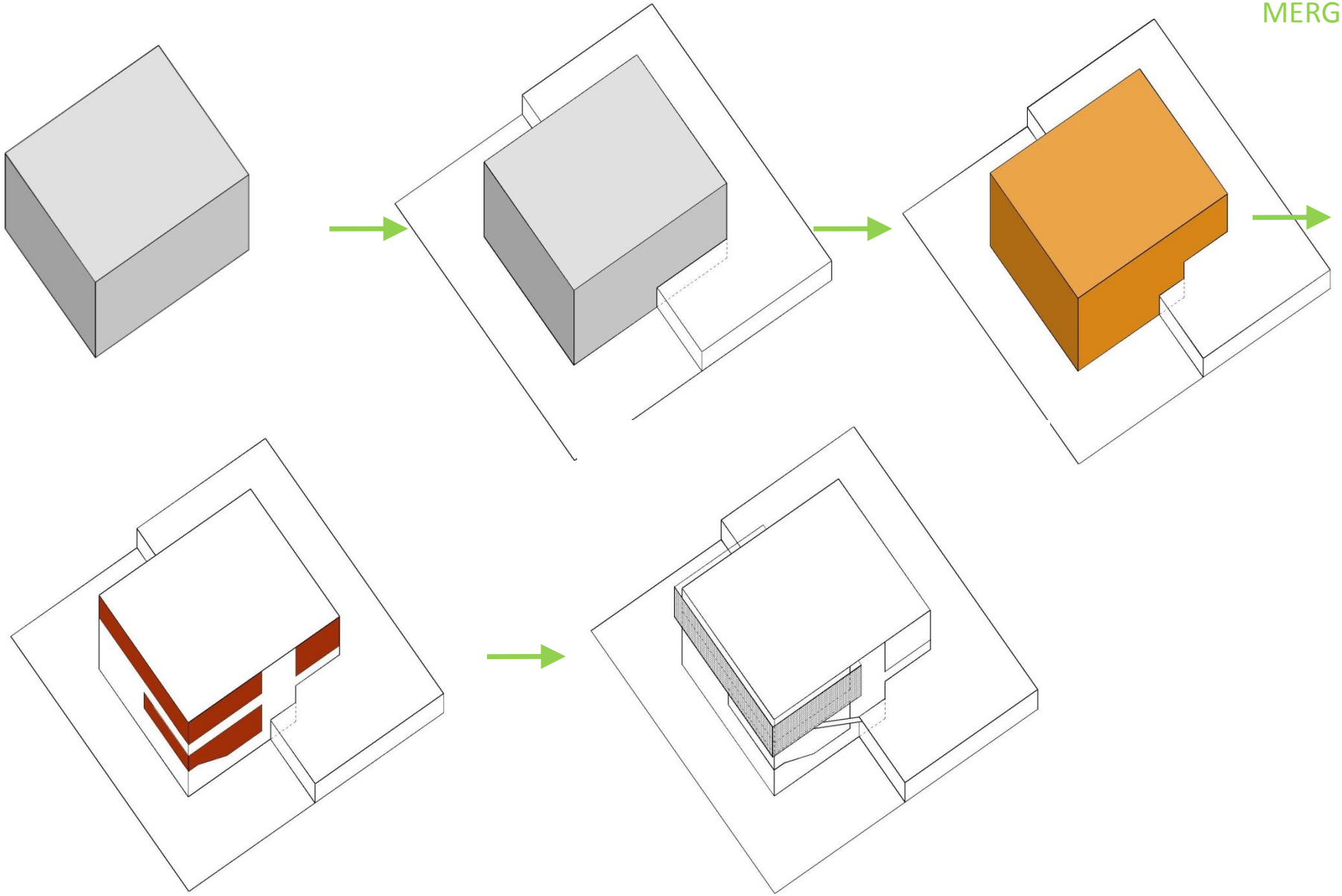


GREEN CONNECTION

VISUAL CONNECTION

Concept Development



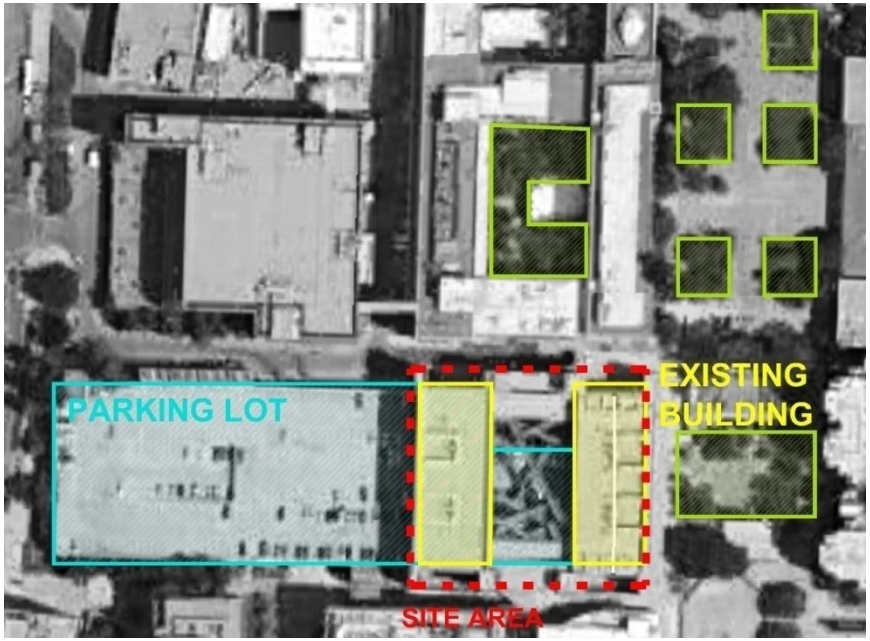


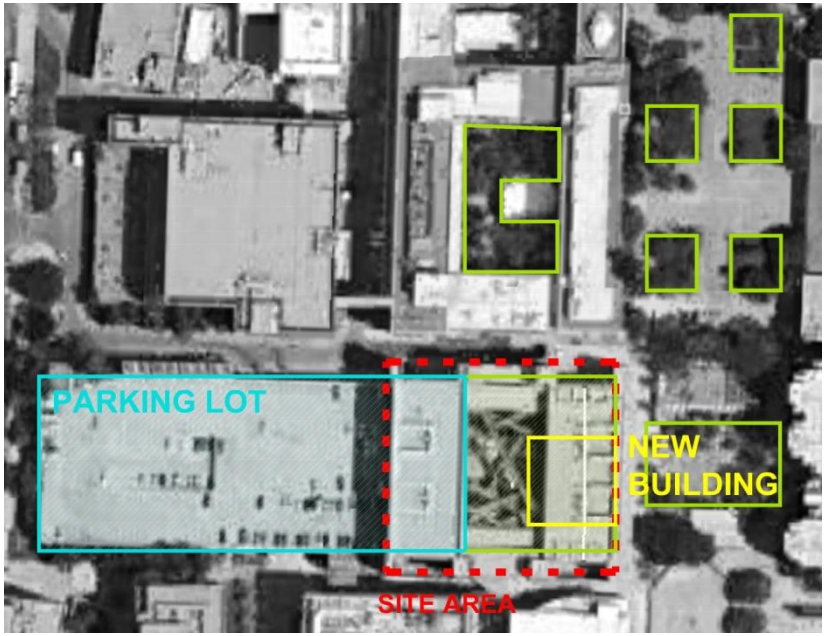
Key Challenge

MERGE

EXISTING CONDITION

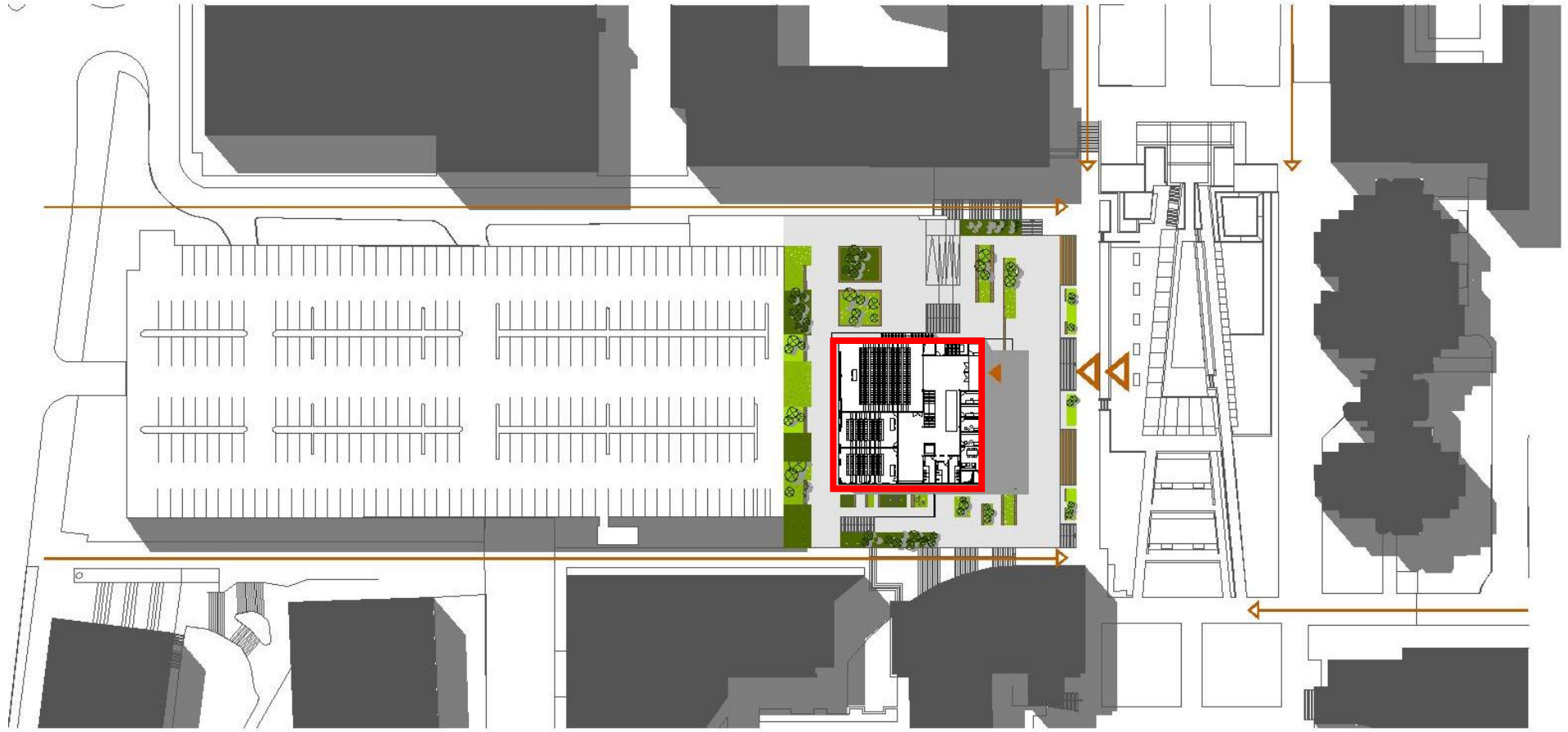
NEW CONDITION





Footprint position

MERGE

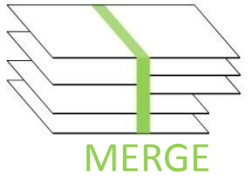


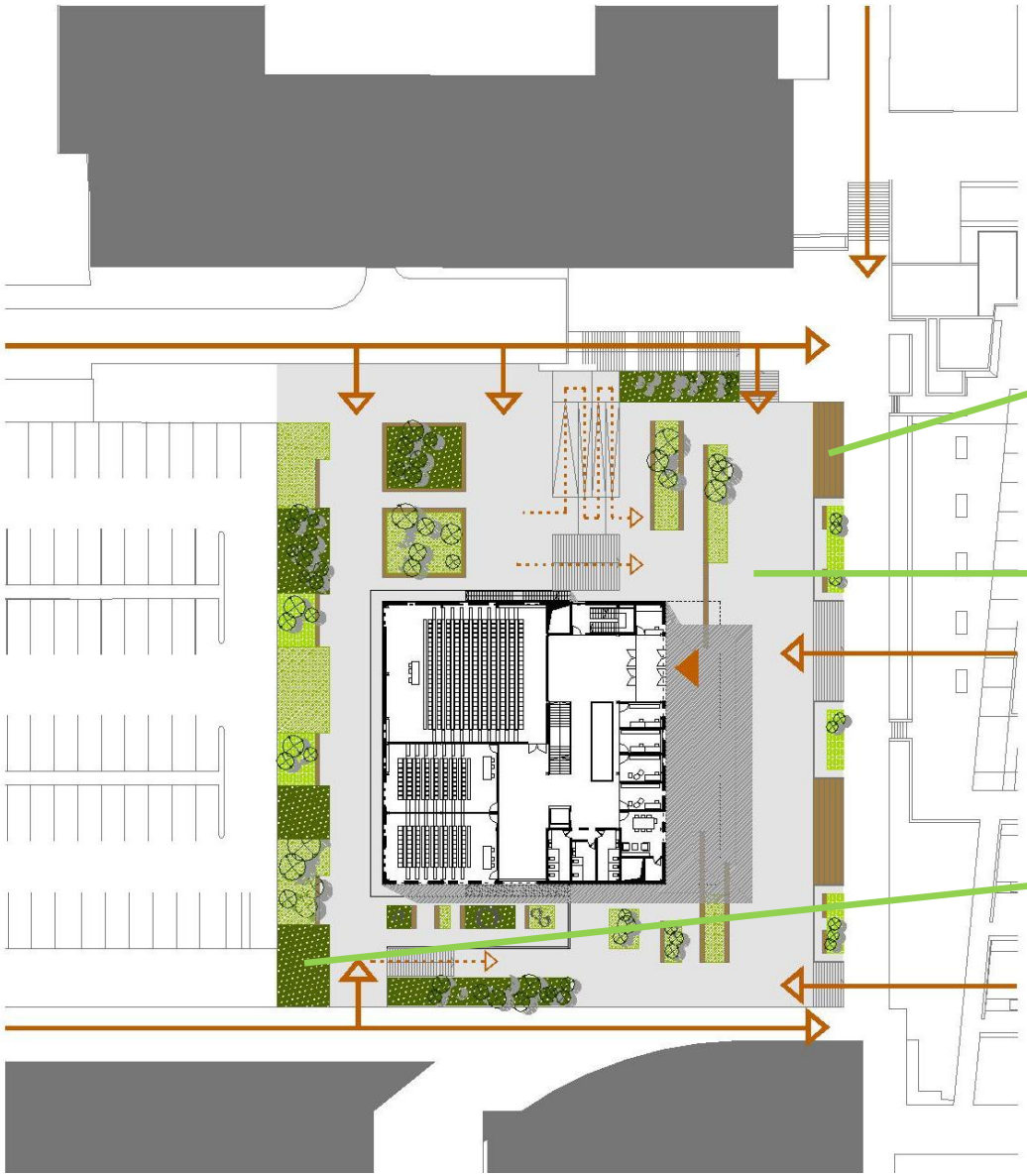
ACCESSES TO THE SITE

MAIN ENTRANCE

N

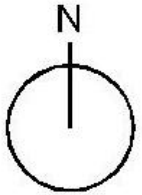
Accesses and Materials Used





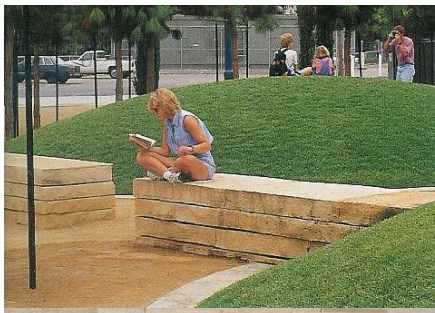
MAIN ACCESSES TO THE SITE

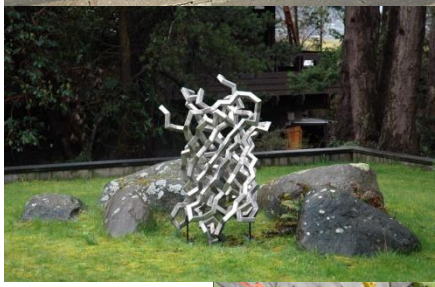
SECONDARY ACCESSES



Landscape Architecture

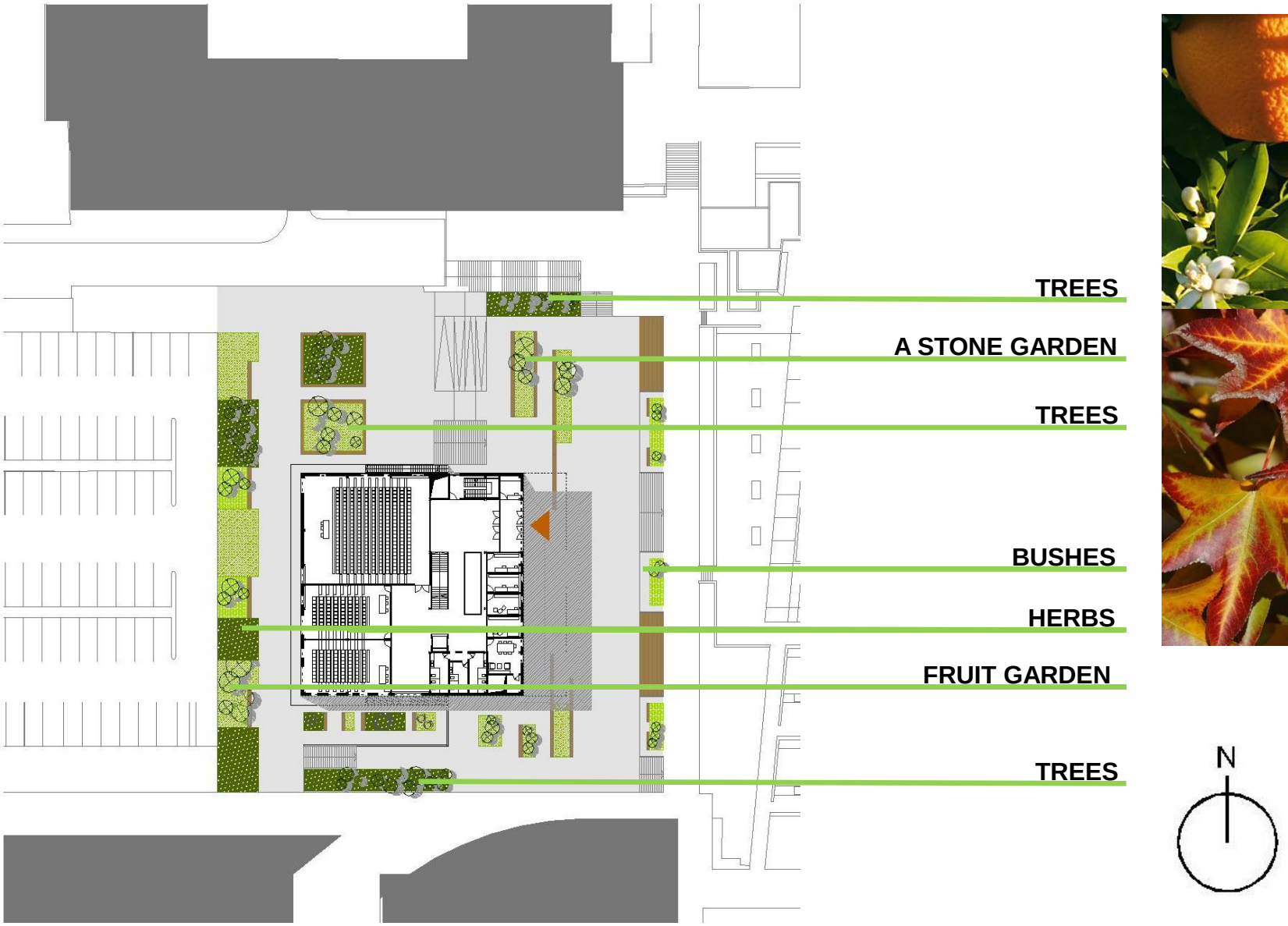
MERGE





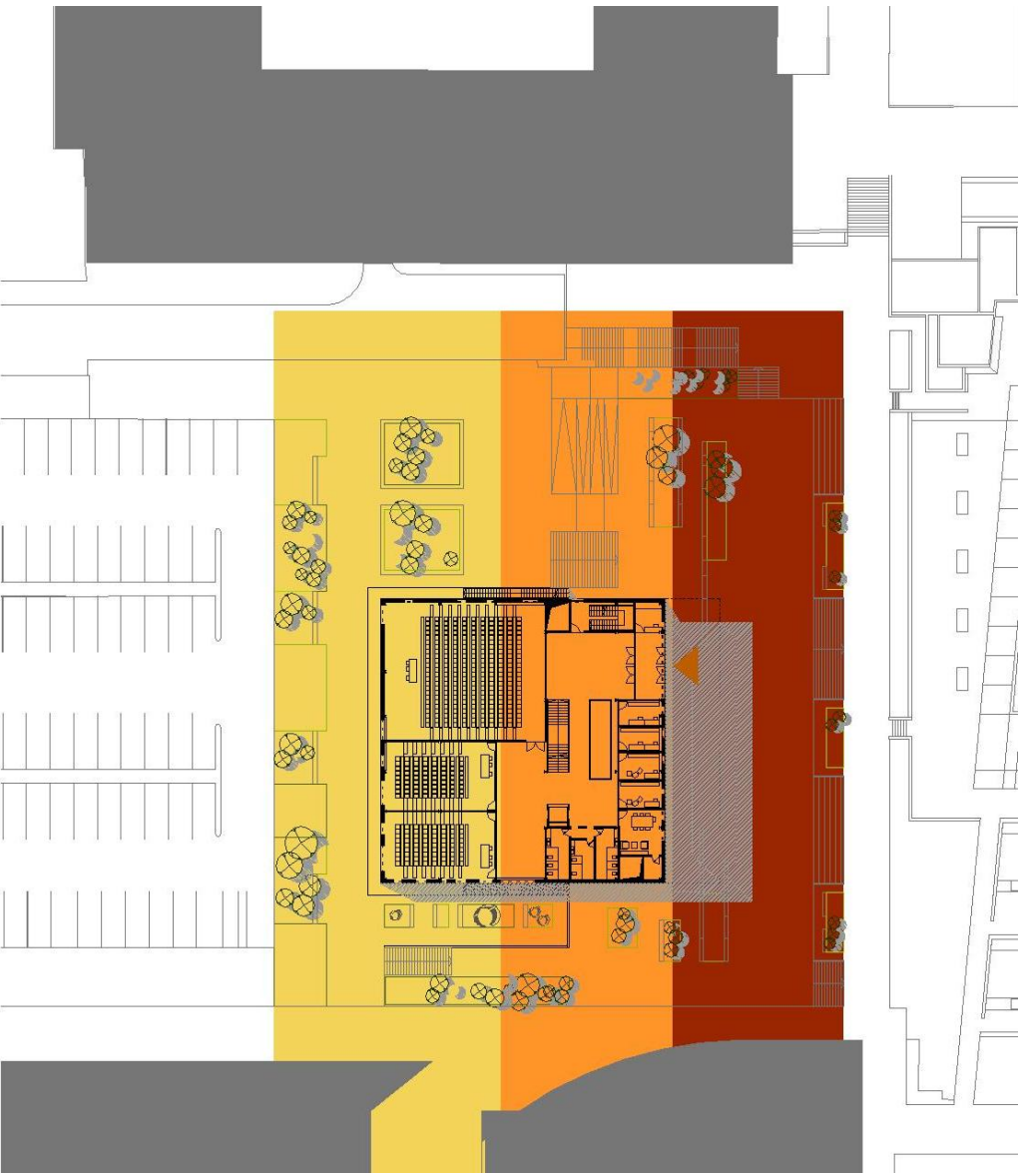
Vegetation

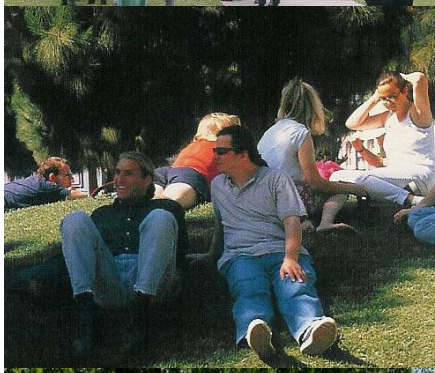
MERGE



Circulation Density

MERGE





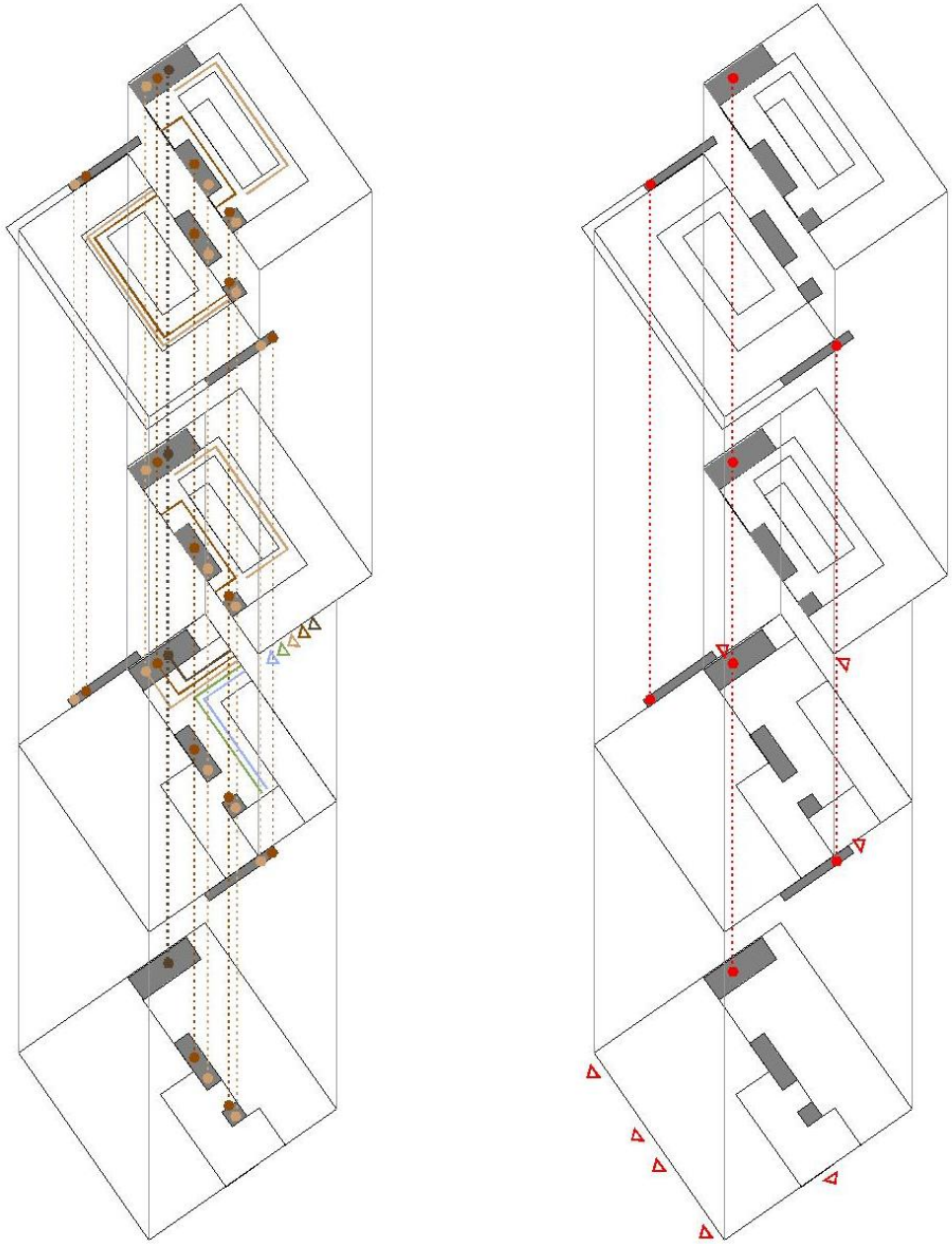
LOW DENSITY

MEDIUM DENSITY

HIGH DENSITY

N

Activity Model



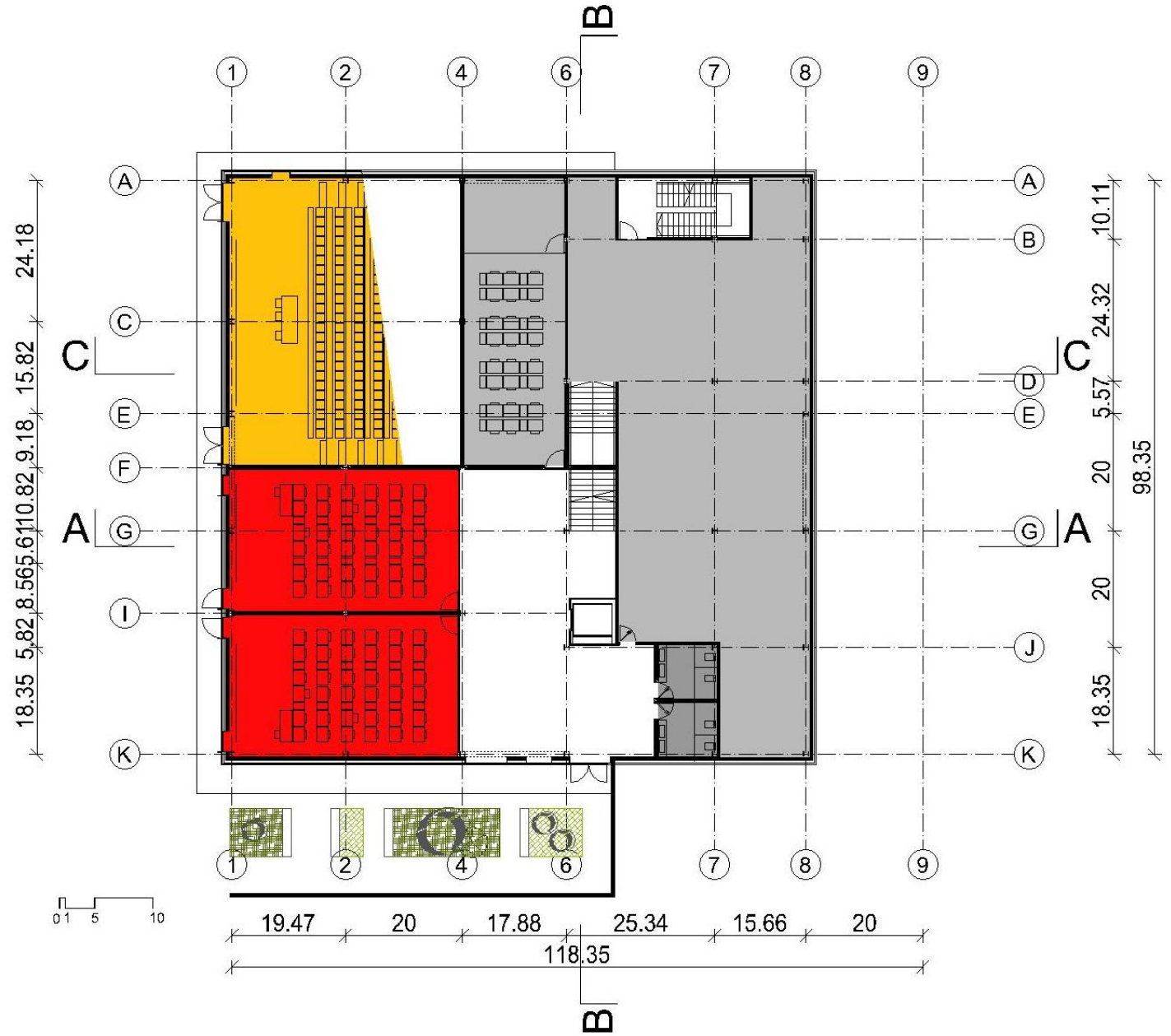
MERGE

ENTRENCES

- PROFESSORS
- STUDENTS
- ADMINISTRATION
- SERVIS
- VISITORS

- EXITS IN CASE OF EMERGENCY

Basement



AUDITORIUM

INSTRUCTIONAL LABS

SUPPORTING ROOMS

RESTROOMS

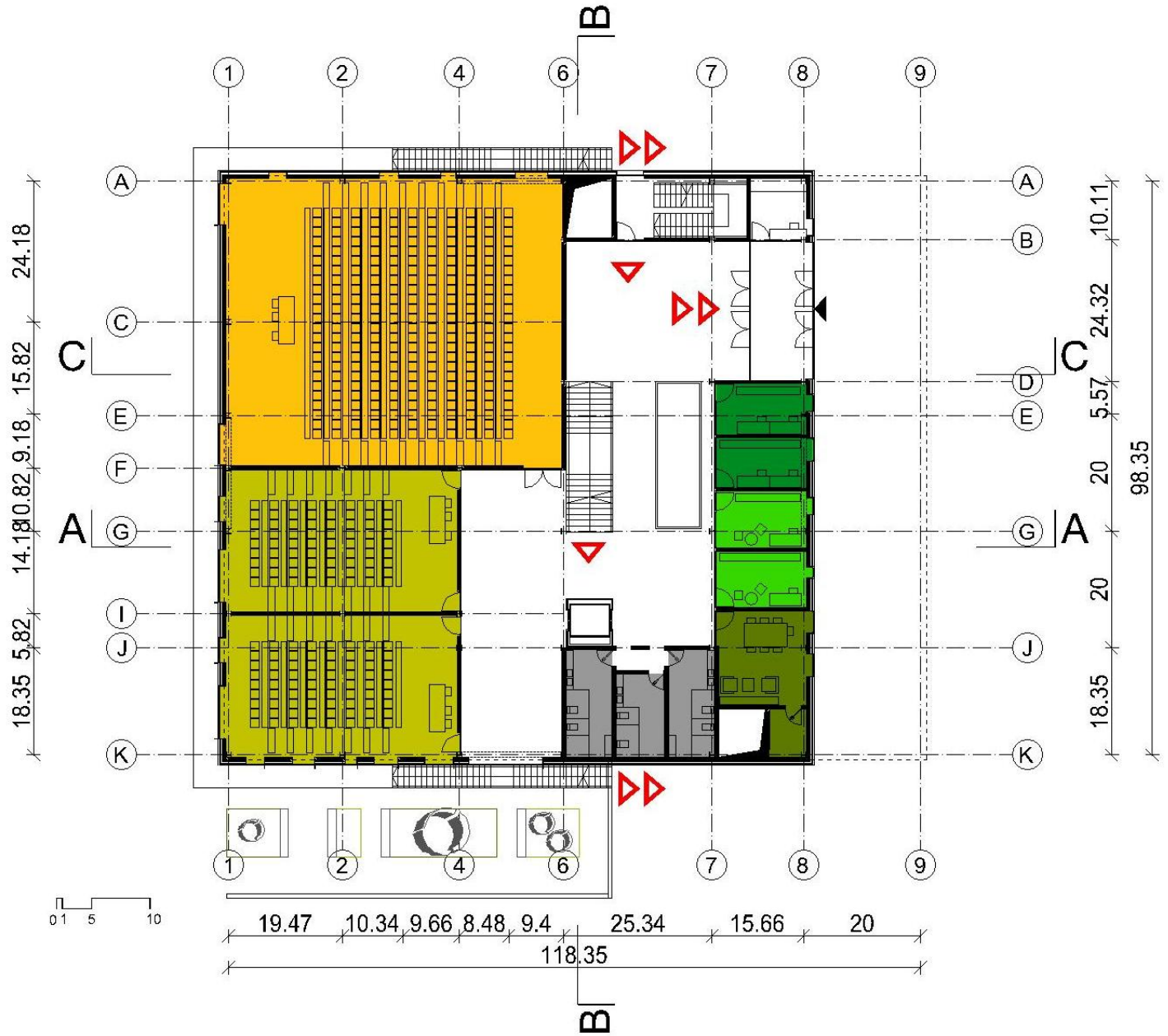
CORRIDORS

MERGE

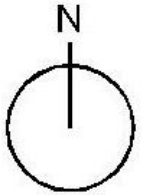
N

Ground Floor

MERGE

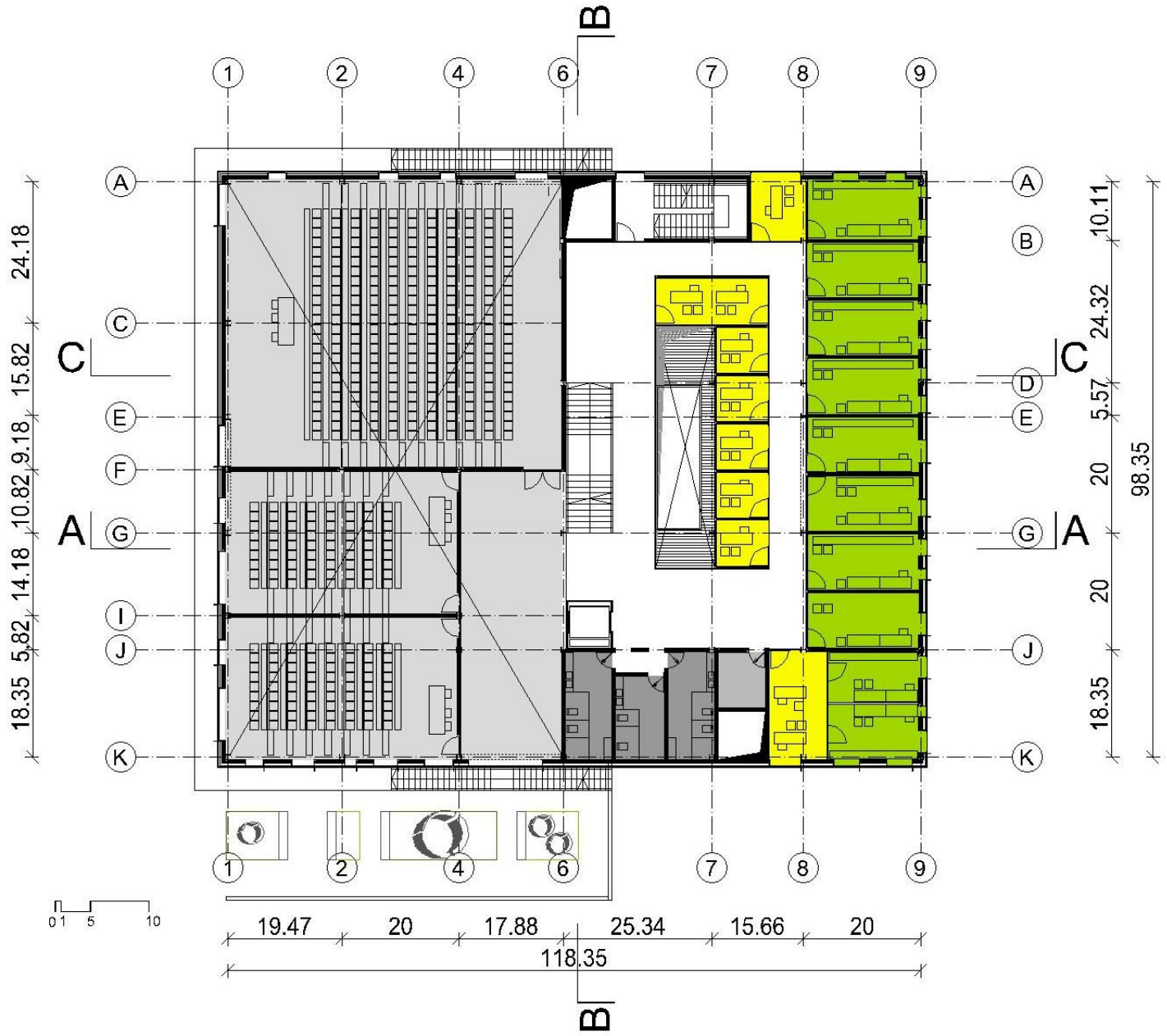


DEPARTMENT CHAIR'S OFFICE
SENIOR ADMINISTRATION OFFICE
ADMINISTRATIVE ASSISTANTS
AUDITORIUM
LARGE CLASSROOMS
SUPPORTING ROOMS
RESTROOMS
CORRIDORS



First Floor

MERGE



Second Floor

MERGE

SMALL CLASSROOMS

SEMINAR ROOMS

SUPPORTING ROOMS

RESTROOMS

CORRIDORS

N

Third Floor

MERGE

FACULTY OFFICES

STUDENT OFFICES

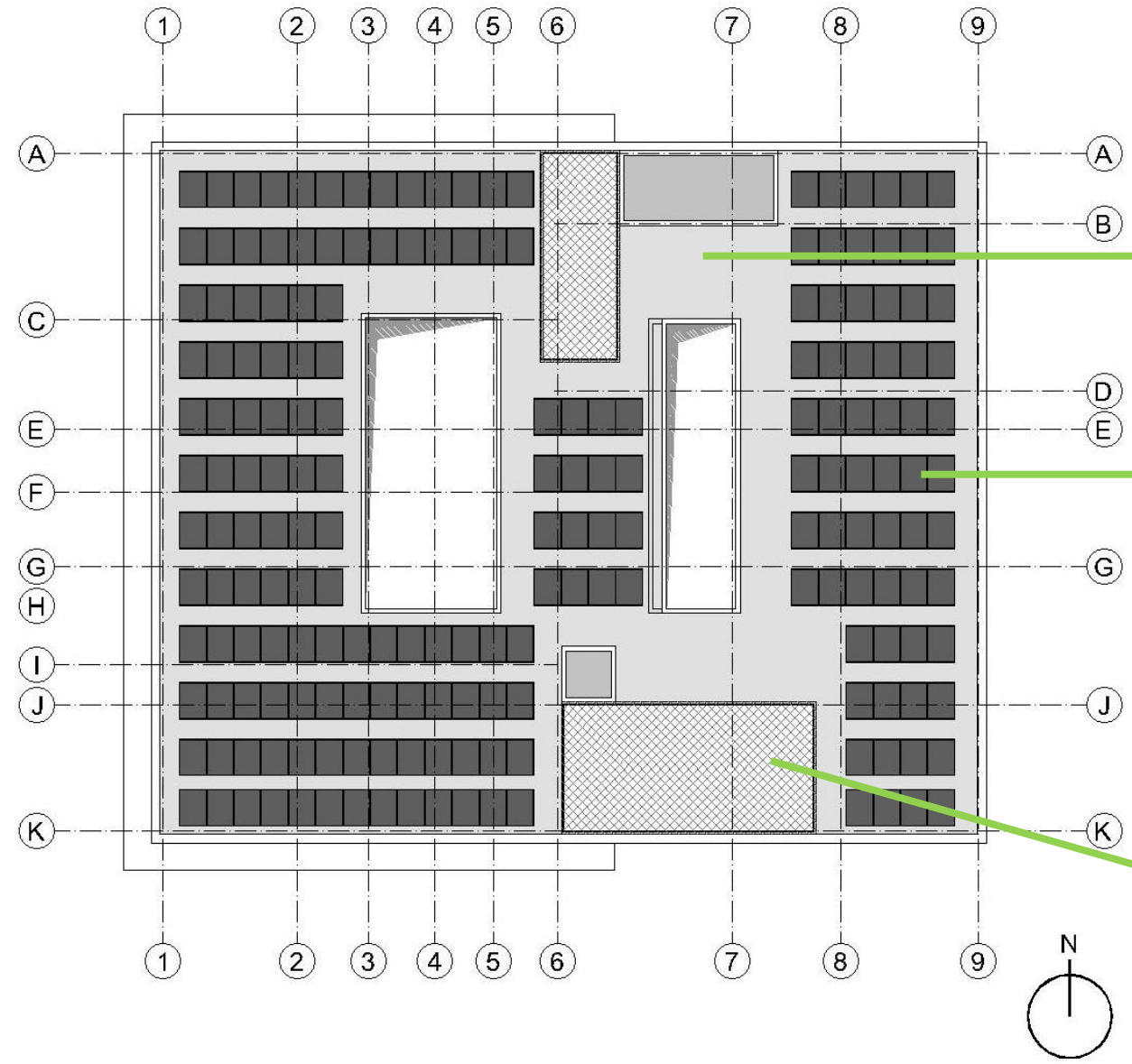
SUPPORTING ROOMS

RESTROOMS

CORRIDORS

N

Roof



BITUMEN MEMBRANE

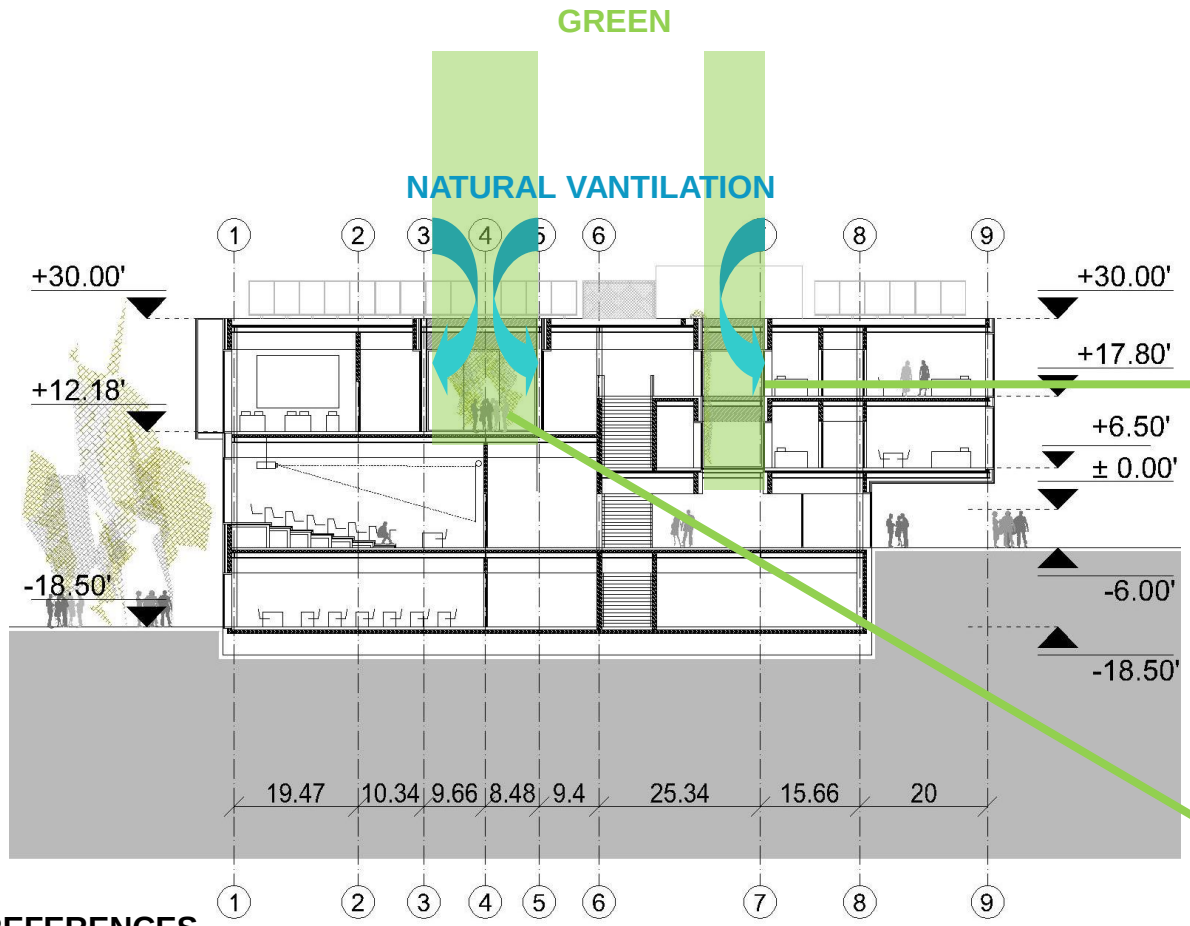
SOLAR PANELS

STEEL-MESH

MERGE

Atriums

MERGE



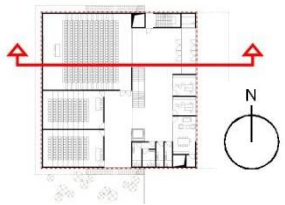
HANGING GARDEN

GREEN SPOTS

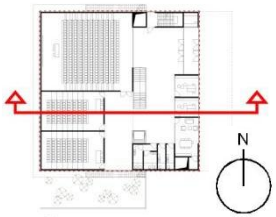
REFERENCES

Cross - sections

MERGE



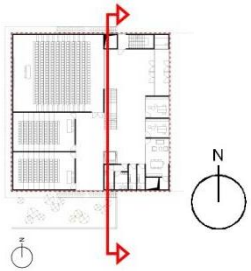
+30.00'
+17.80'
+6.50'
± 0.00'
-6.00'
-18.50'

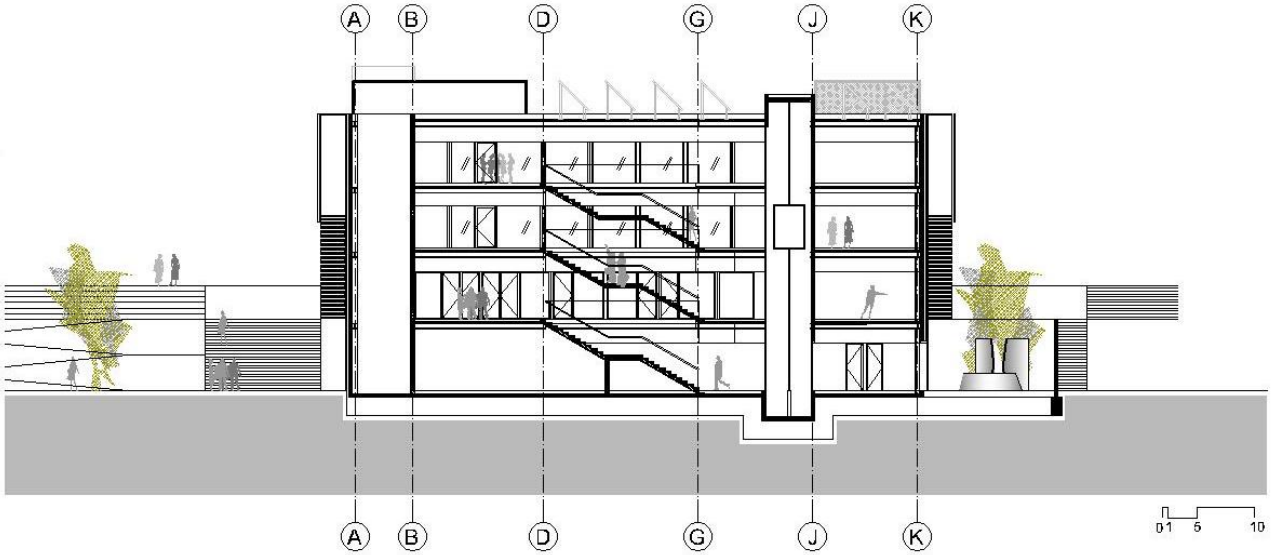


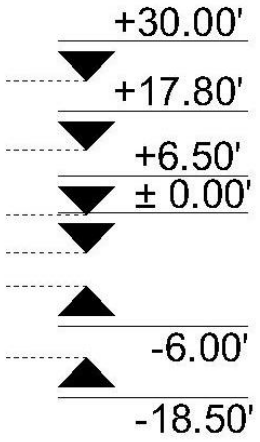
+30.00'
+17.80'
+6.50'
± 0.00'
-6.00'
-18.50'

Cross - sections

MERGE

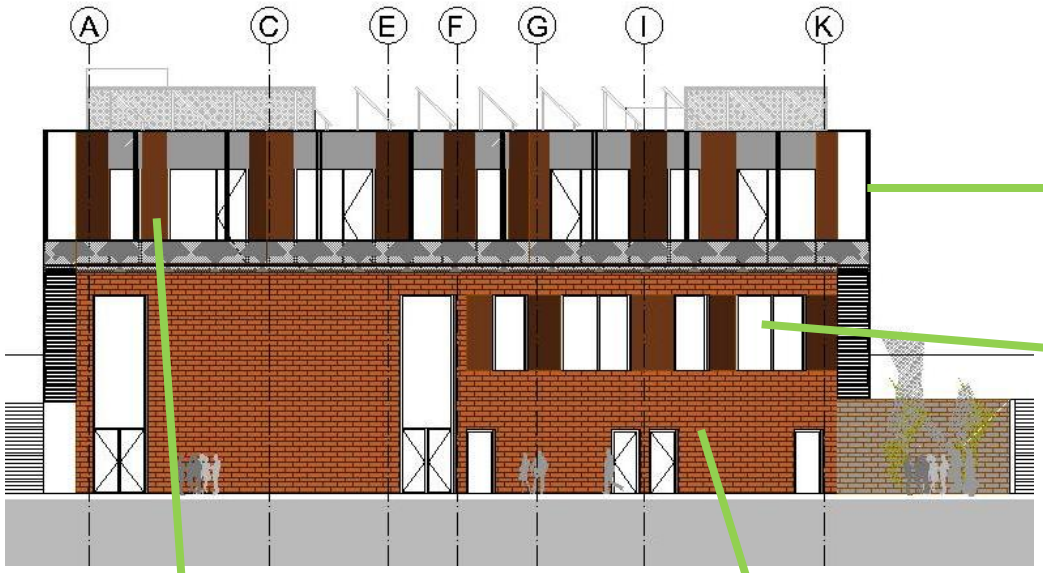






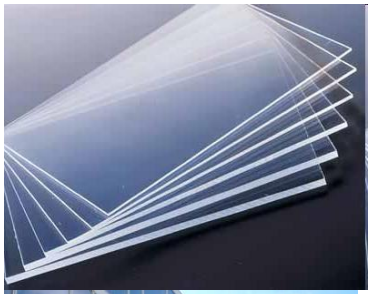
Material Used

MERGE



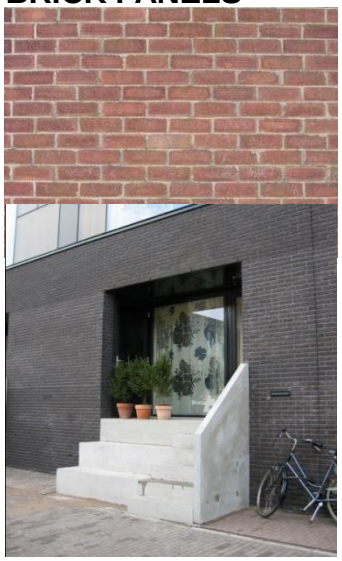
STEEL - NET

GLASS



FURNIR PANELS

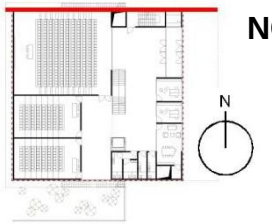
BRICK PANELS

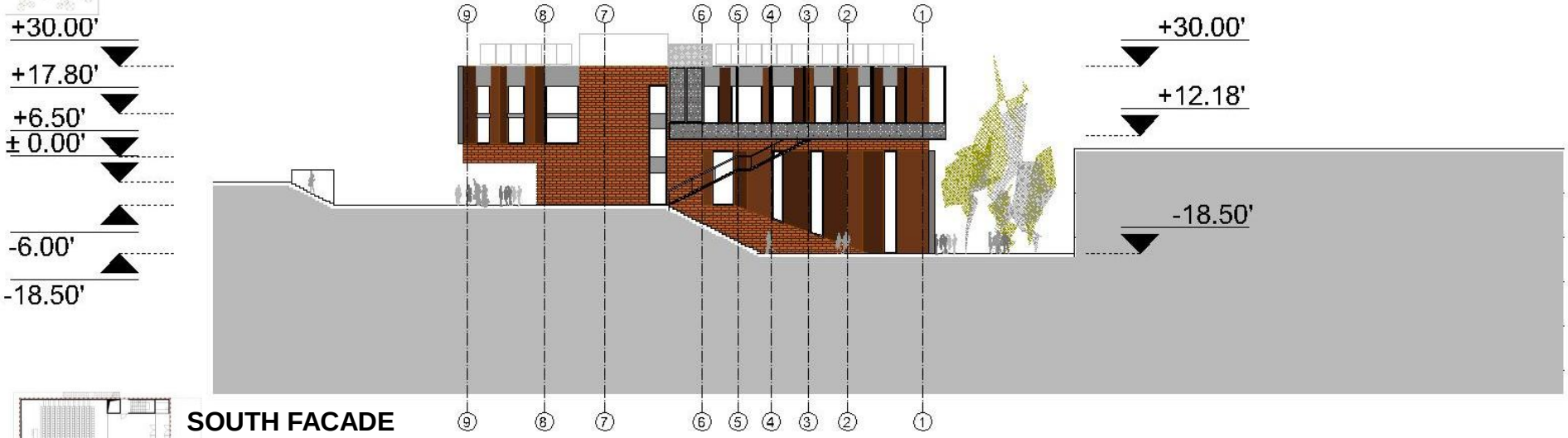


Facades

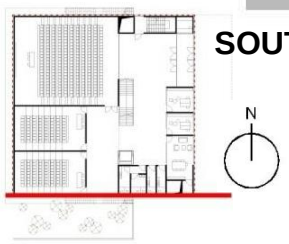
MERGE

NORTH FACADE

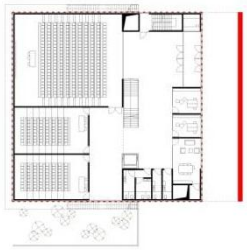




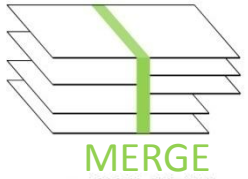
SOUTH FACADE

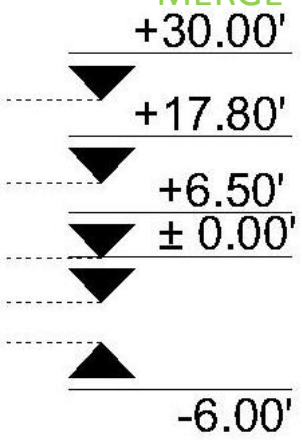


Facades

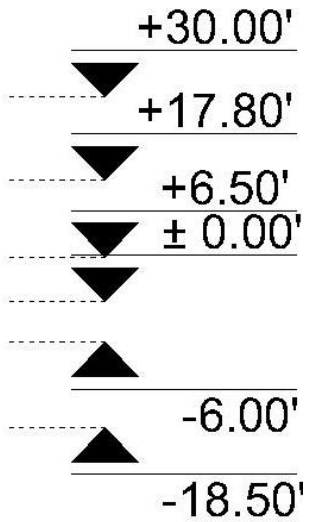


EAST FACADE



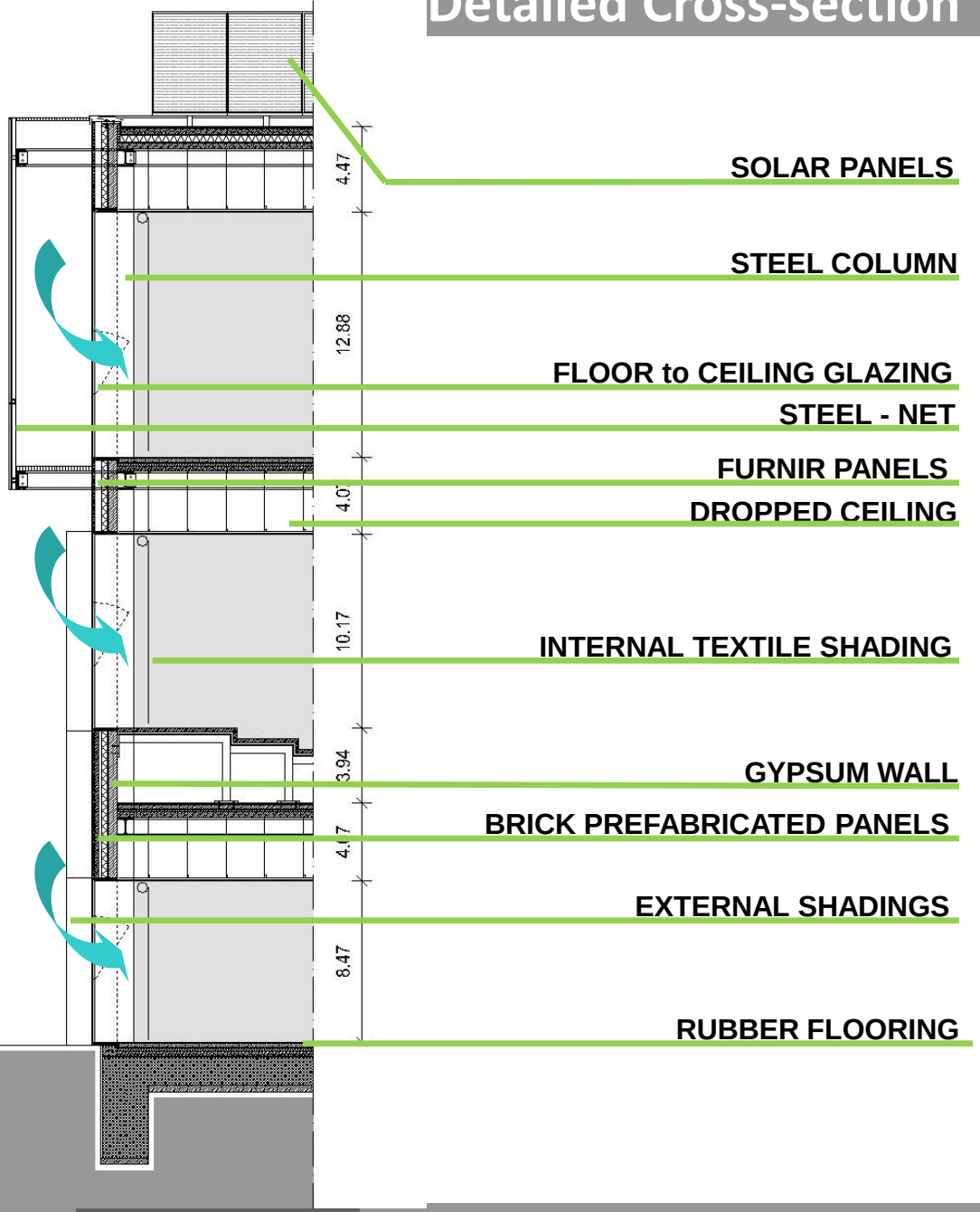


WEST FACADE



Detailed Cross-section

MERGE



NATURAL VANTILATION

NATURAL VANTILATION

NATURAL VANTILATION

SOLAR PANELS

STEEL COLUMN

FLOOR to CEILING GLAZING

STEEL - NET

FURNIR PANELS

DROPPED CEILING

INTERNAL TEXTILE SHADING

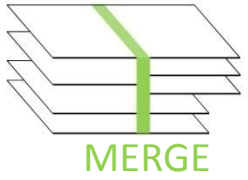
GYPSUM WALL

BRICK PREFABRICATED PANELS

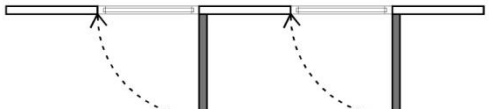
EXTERNAL SHADINGS

RUBBER FLOORING

Shading

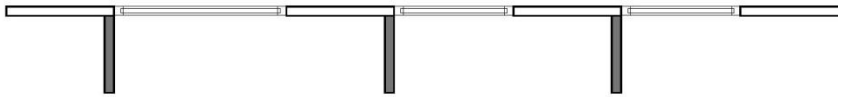


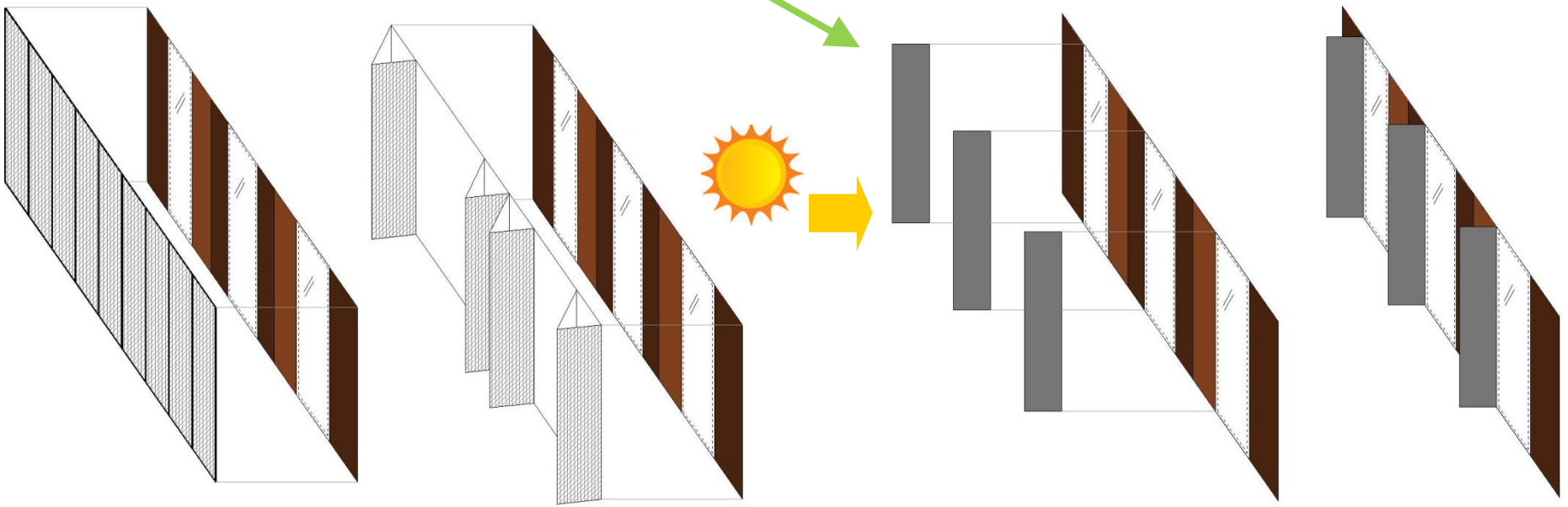
SOUTH SHADES



STEEL – NET SHADING (W,S)

W and E SHADES





INTERIOR SHADING – TEXTILE SHADES

EXTERIOR LANDSCAPE SHADING

3D Visualisation

MERGE

3D Visualisation

MERGE

3D Visualisation

MERGE

3D Visualisation

MERGE

3D Visualisation

MERGE

3D Visualisation

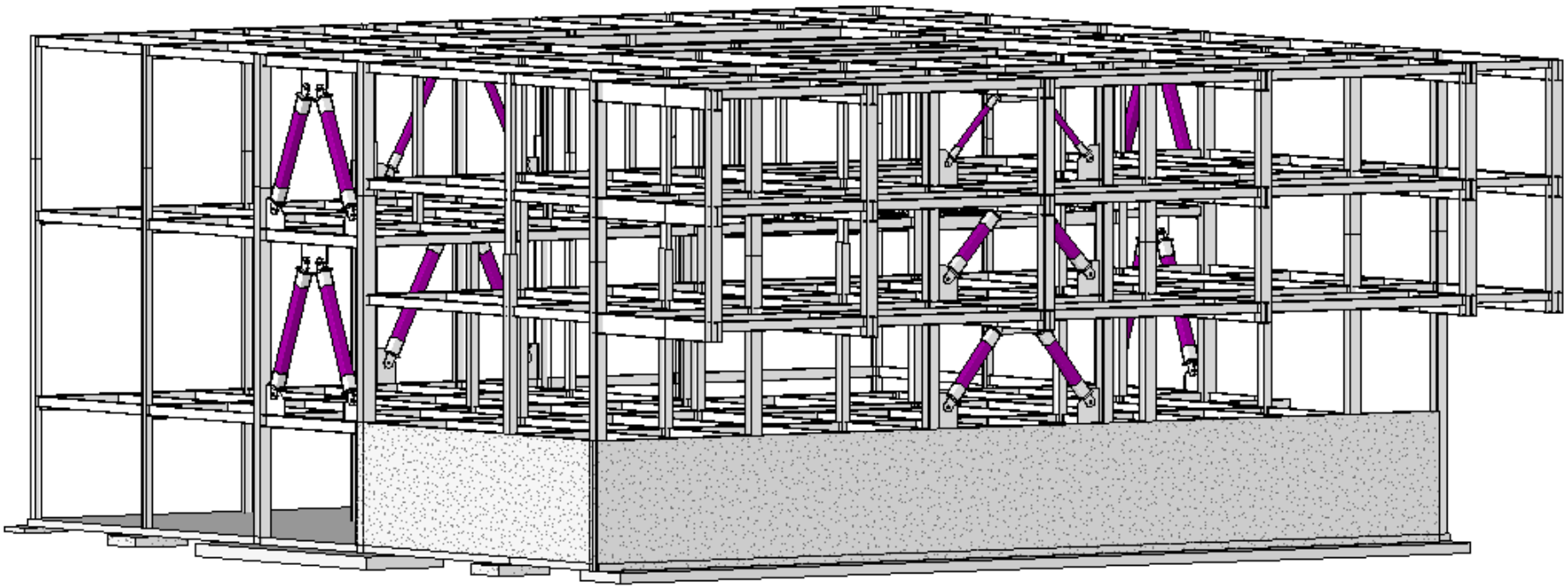
MERGE

3D Visualisation

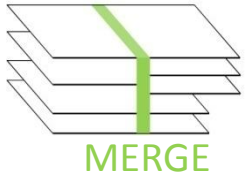
MERGE

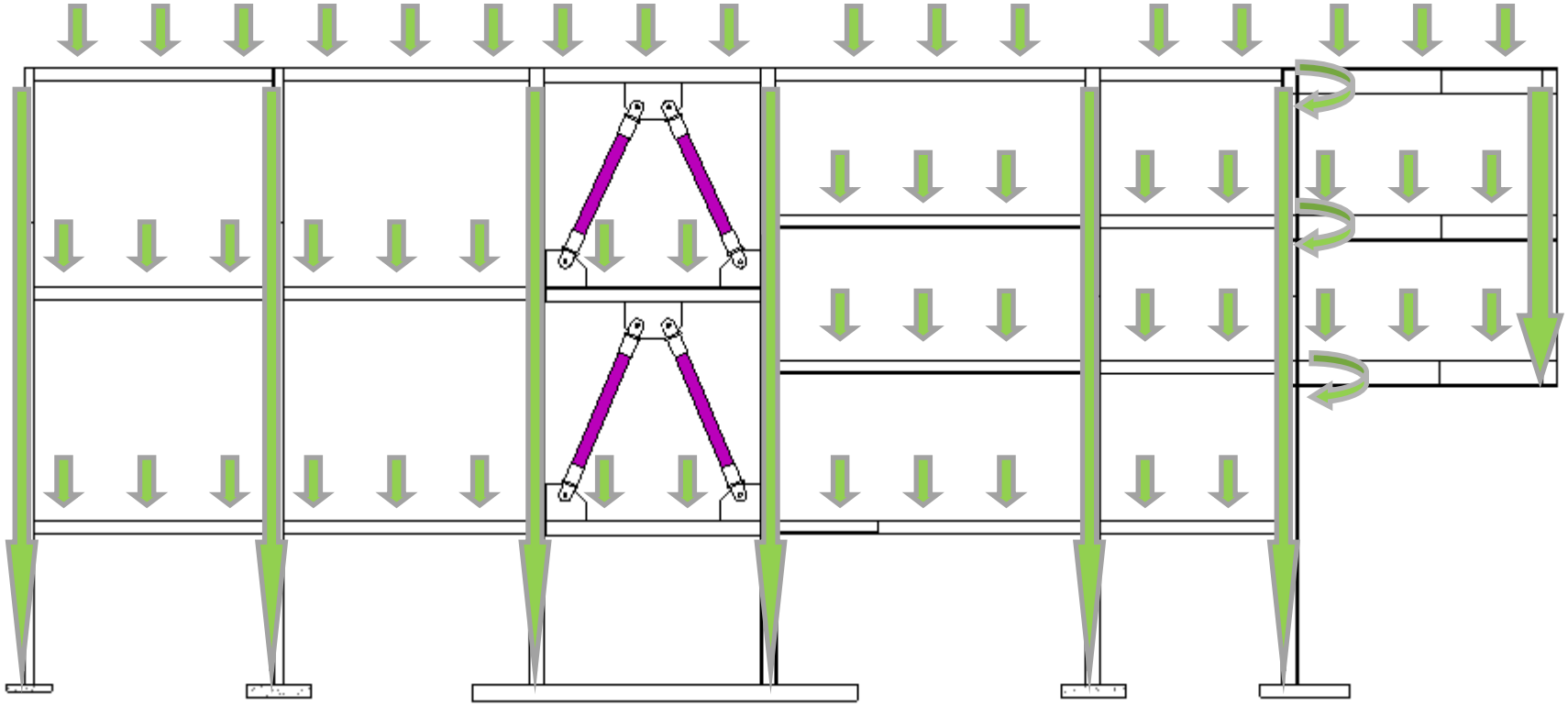
Structural System

MERGE



Free Body Diagram and Building Loads





LOADS

Dead Loads:

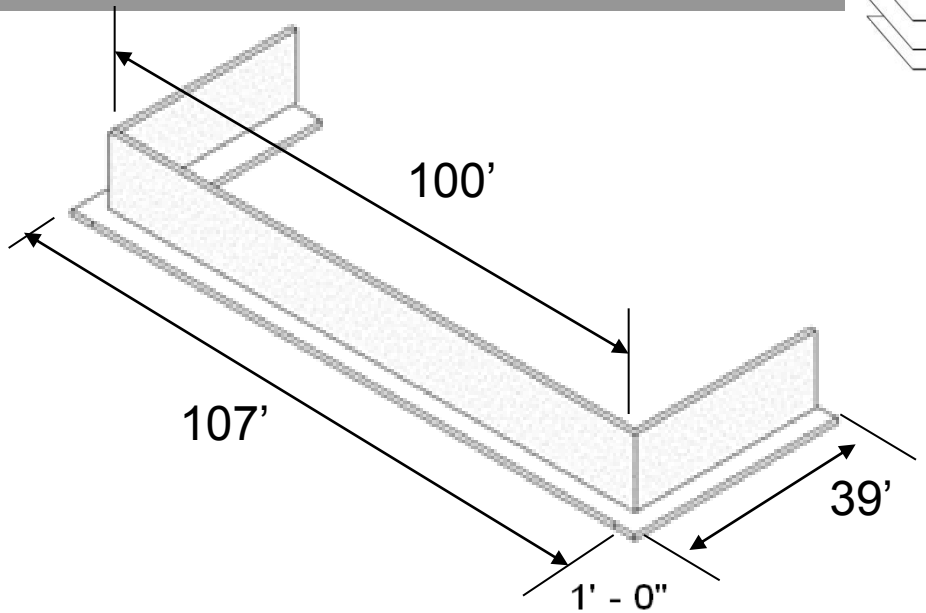
Miscellaneous Loads: 30 psf

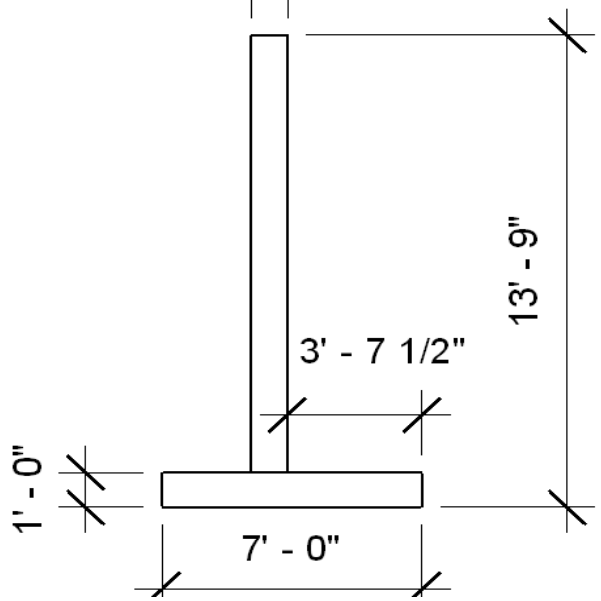
Concrete and Decking: 60 psf

Live Loads:

For Flexibility: 100 psf

Retaining Wall



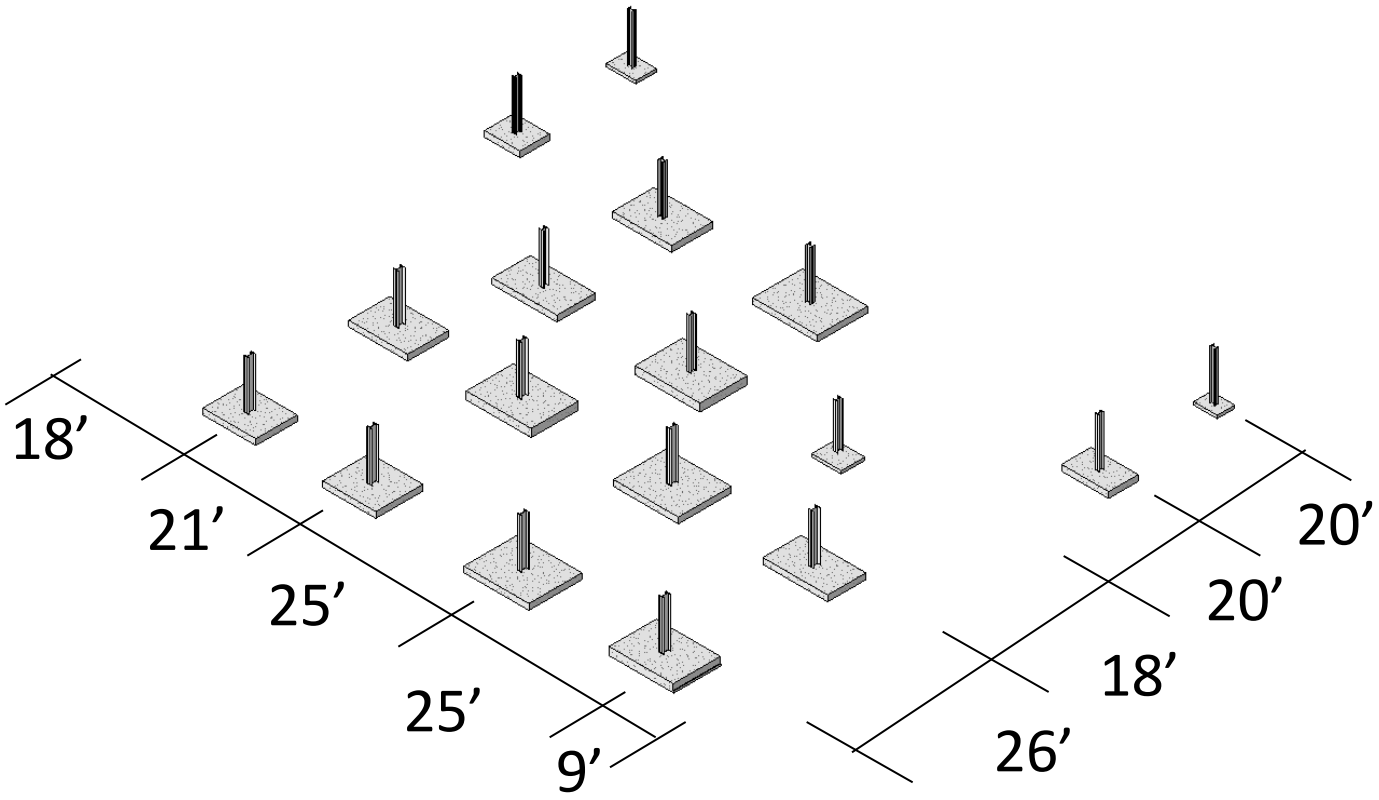


Retaining wall designed for multiple loads

Earth Pressure
P = 3 Kips

Lateral Structural System
Vu = 410 kips

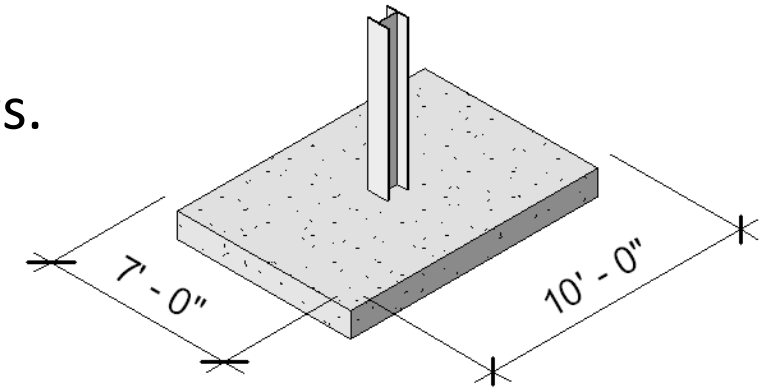
MERGE



Column Foundations: Rectangular Footings.

Bearing Pressure: 5 ksf

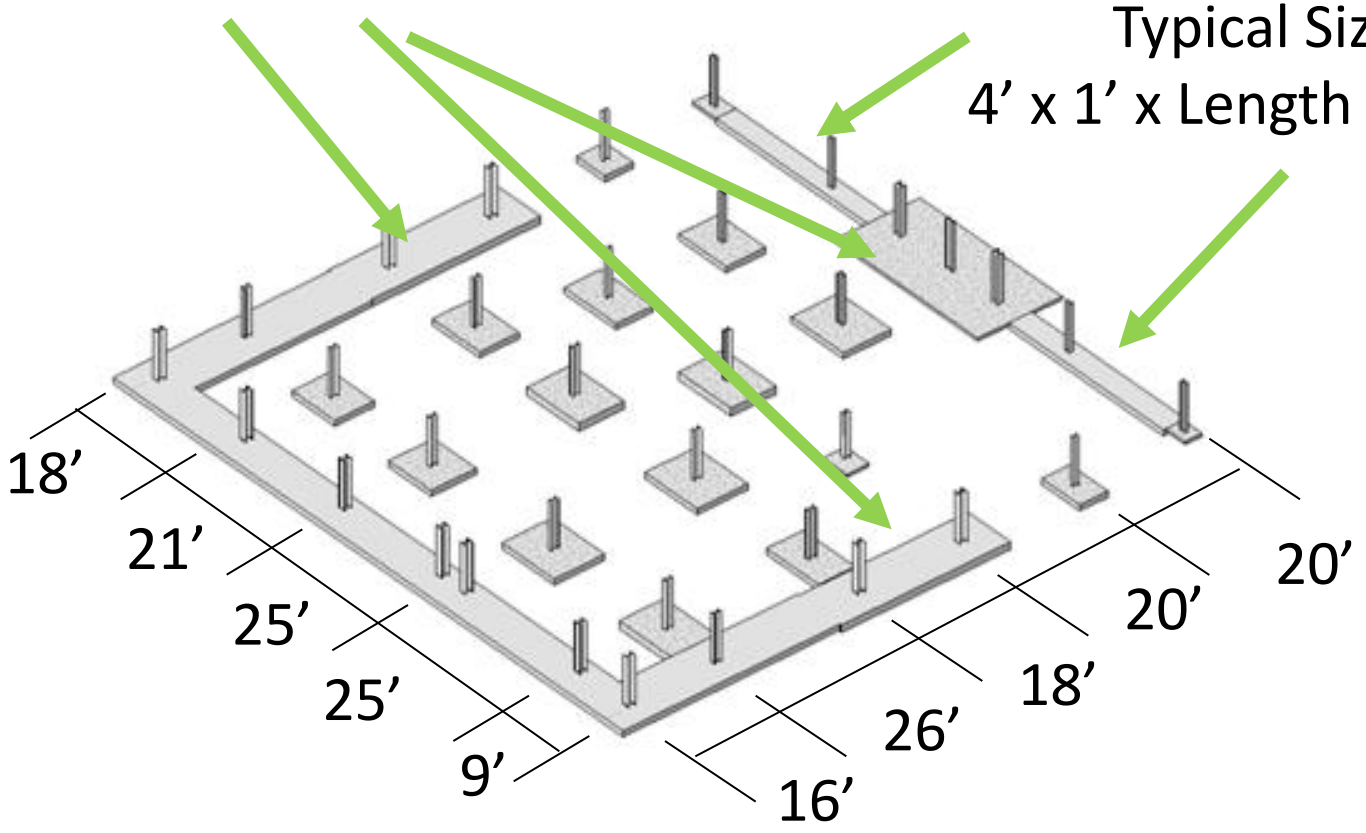
Typical Size: 6’ x 8’ x 1’



MERGE

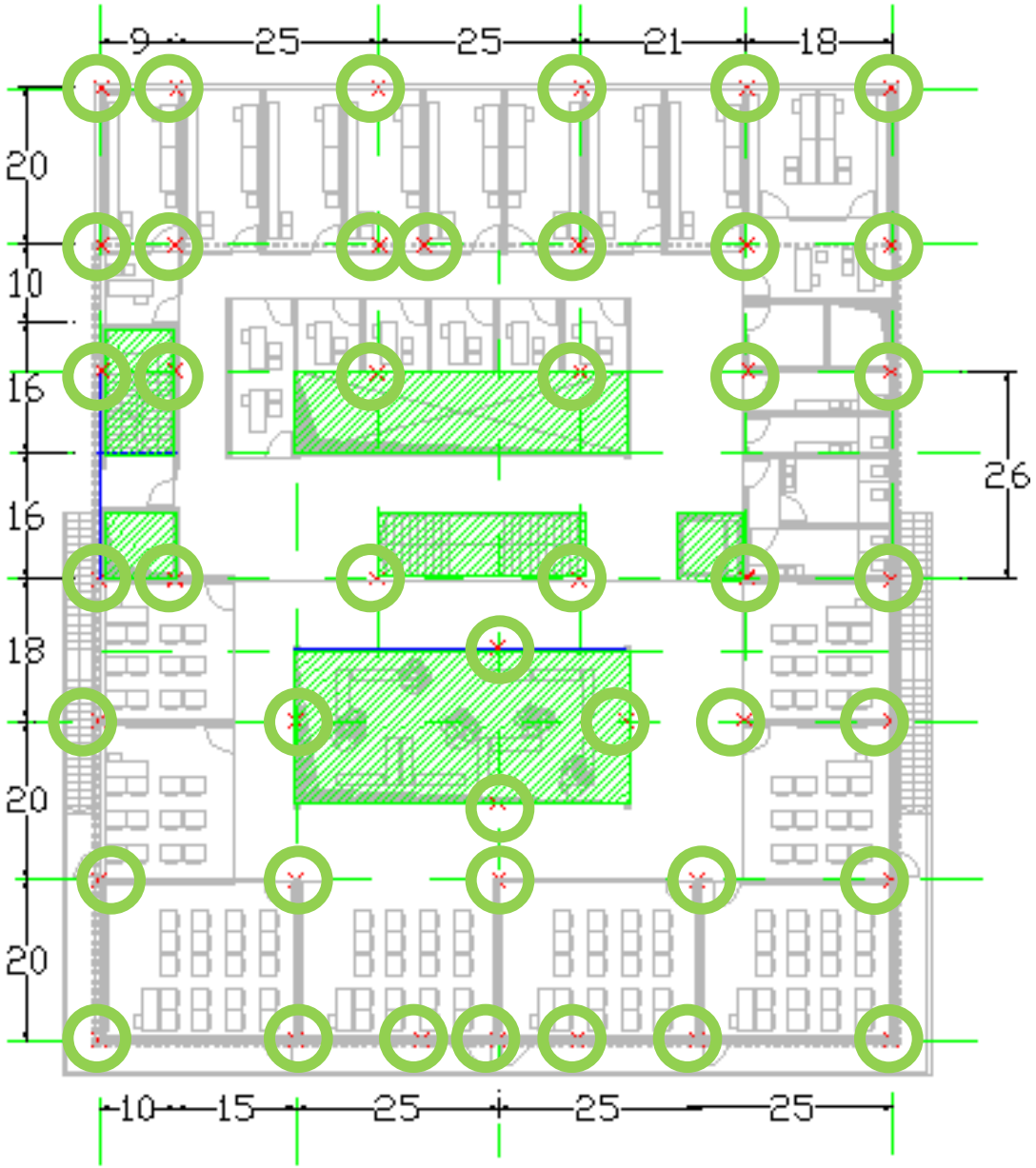
BRB Foundation Typical Size
30’ x 15’ x 1’

Shear Wall Foundation
Typical Size
4’ x 1’ x Length of Wall



BRB and Shear Wall Foundations: Strip Footings
Bearing Pressure: 5 ksf

Column Layout



Column Sizes

W10x33 W14x61

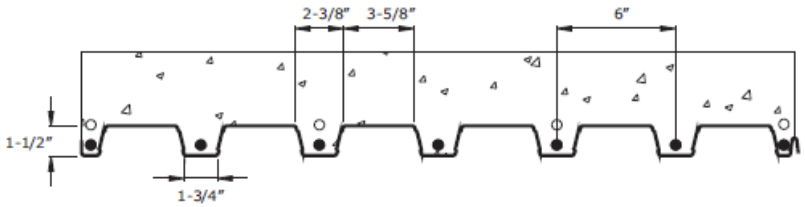
W14x120 W14x132

W14x145 W14x90

All columns are topped with a column splice with a W10x33 on top.

MERGE

B-36 Composite Floor Deck



ASC STEEL DECK

B-36 Section Properties

Gauge	Weight (psf)	I (In4)	S+ (In3)	S- (In3)
22	1.68	0.178	0.180	0.195
20	2.04	0.220	0.235	0.246
18	2.70	0.302	0.321	0.336
16	3.36	0.379	0.407	0.415

1. Section Properties are based on minimum 38 ksi steel (Fy)

Steel Deck: ASC Steel Deck B-36

Gauge: 18

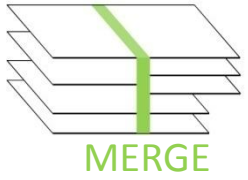
Height of Steel Deck Ribs: 1.5”

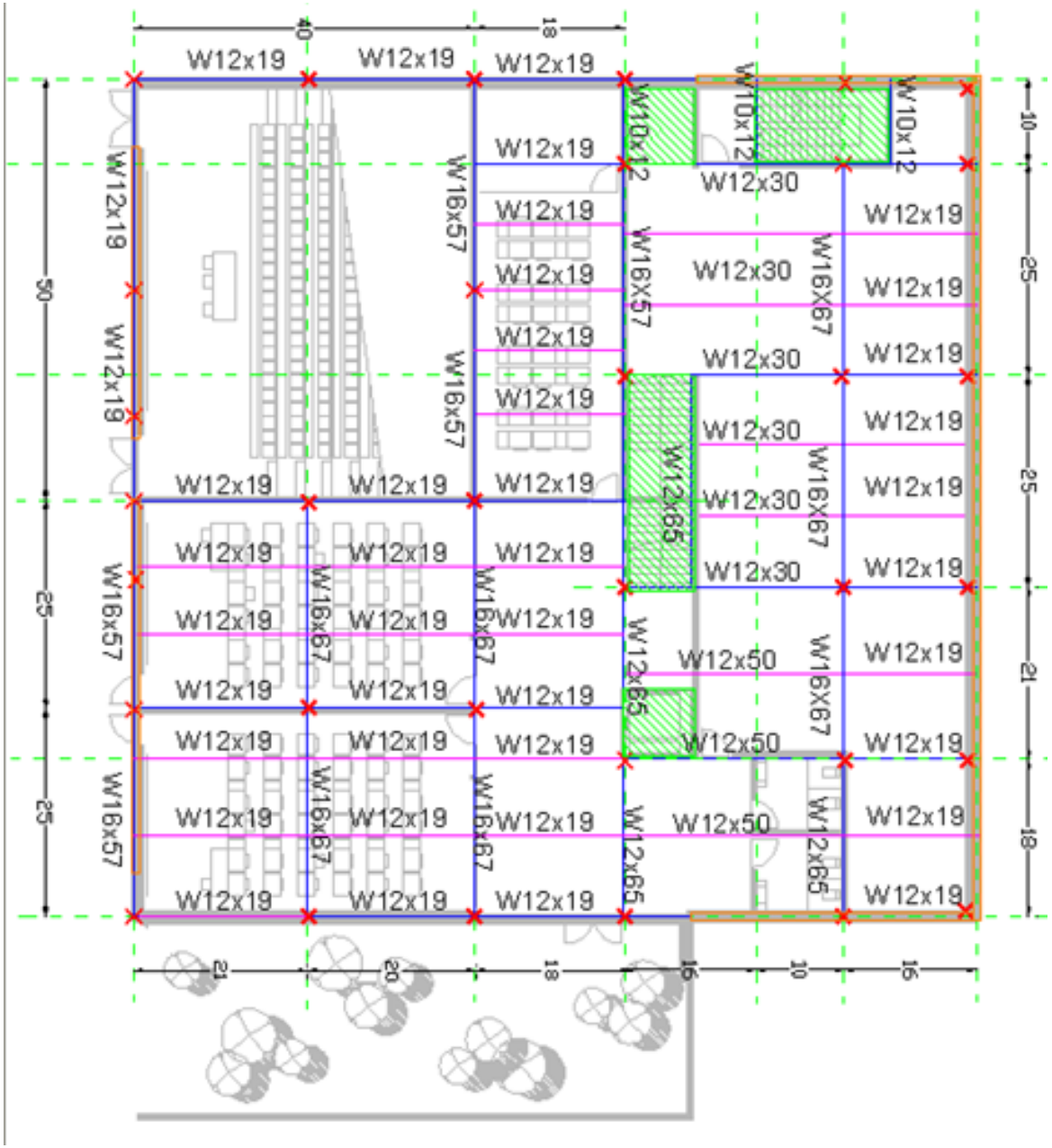
Concrete Thickness: 4.5”

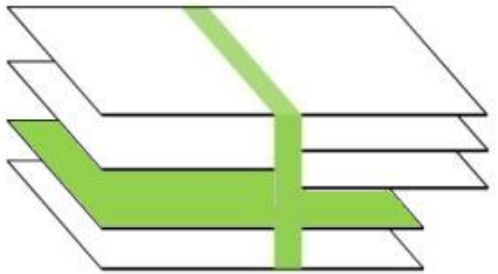
Concrete: 4 ksi, Normal Weight

Steel Beam: W12x19 Typical

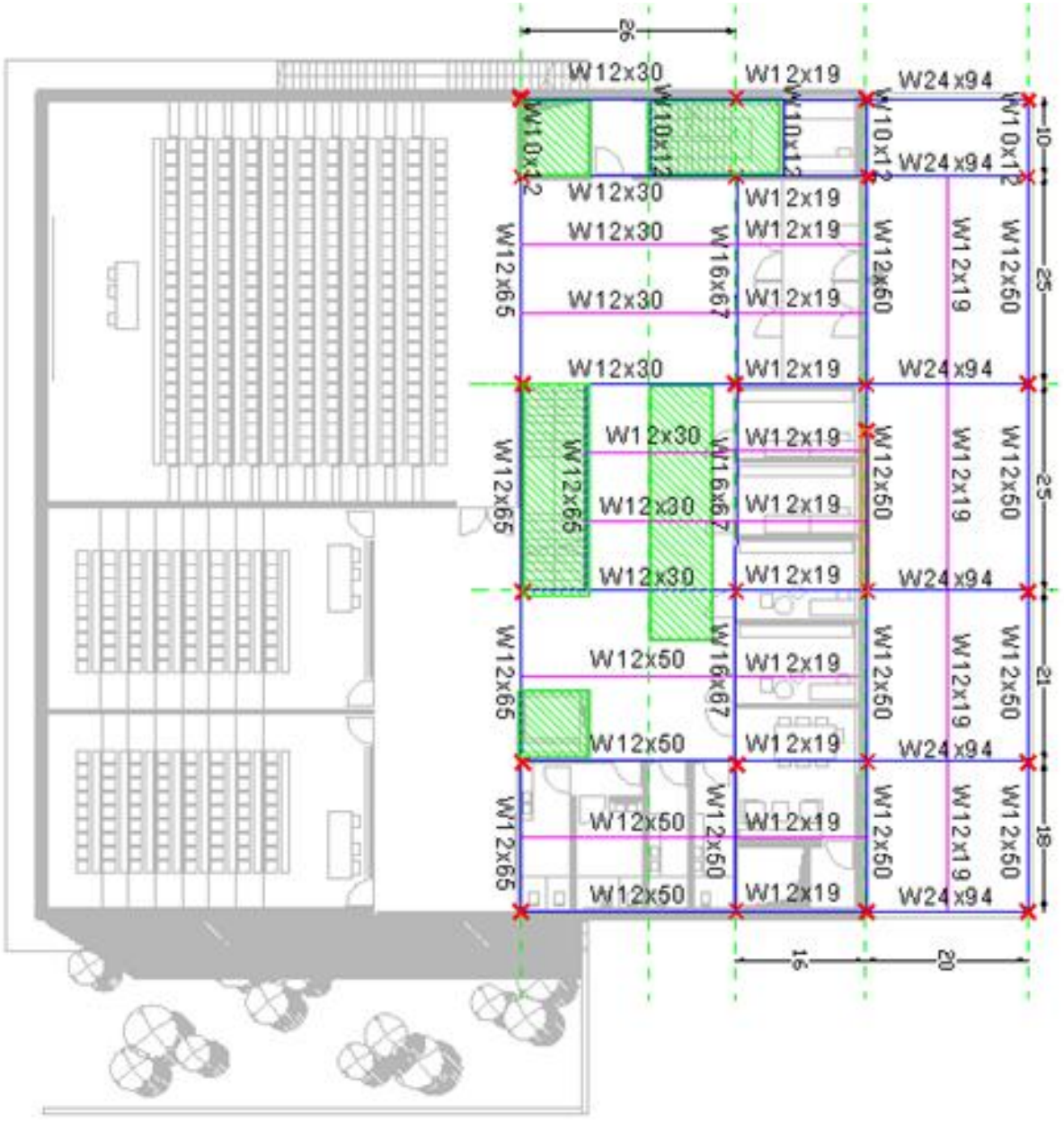
First Floor Framing

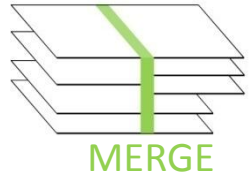




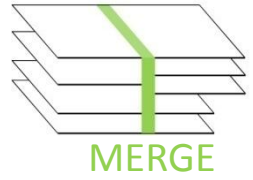


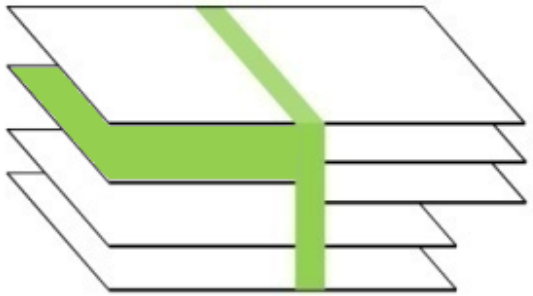
Second Floor East Framing



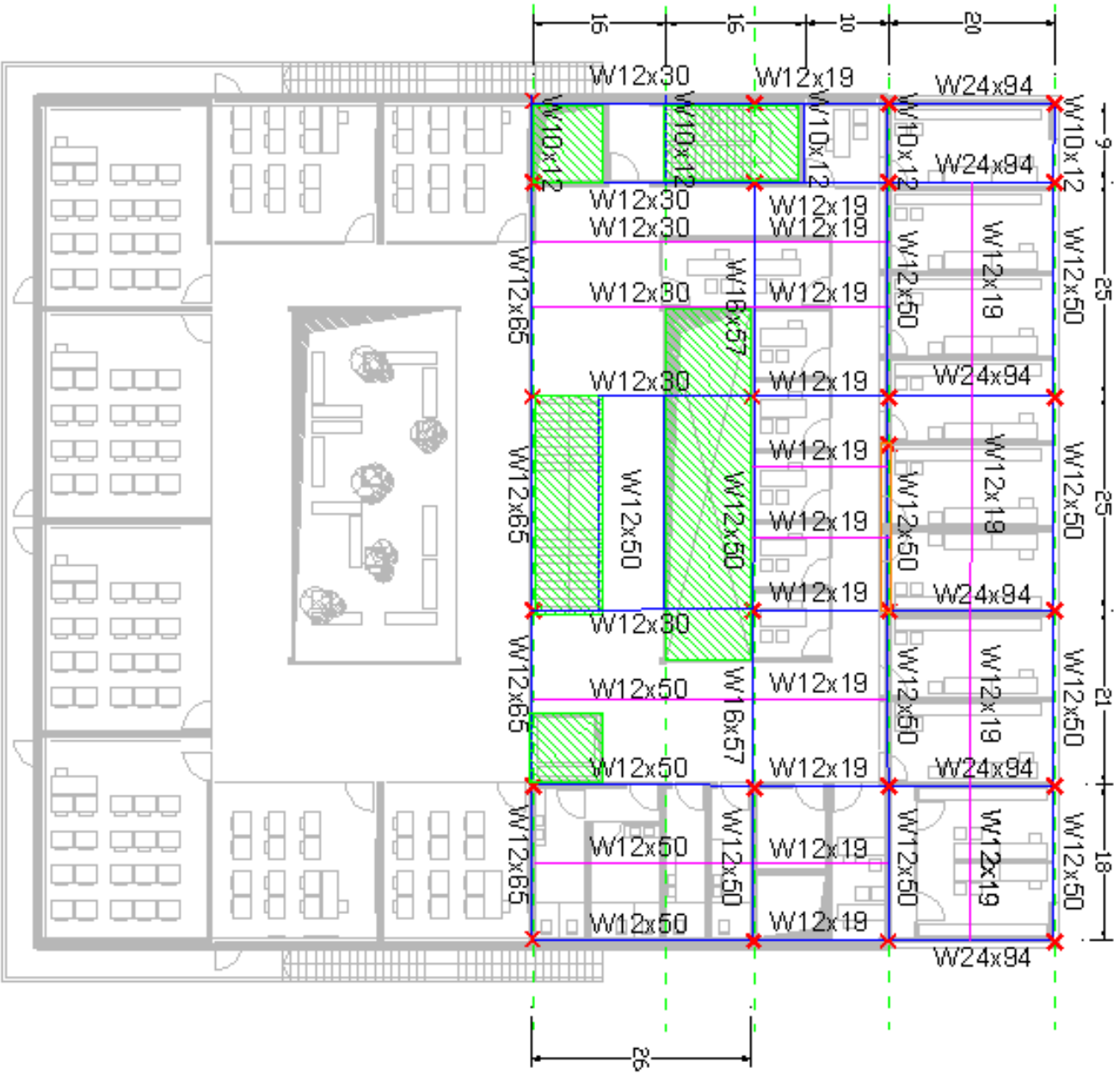


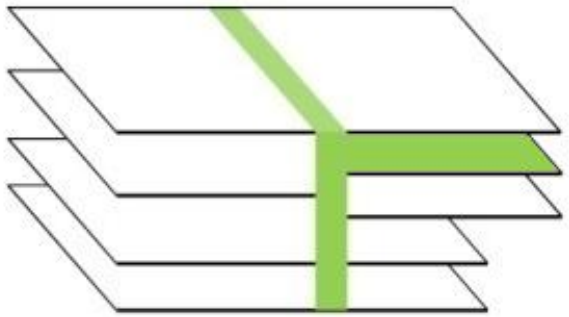
Second West Floor Framing

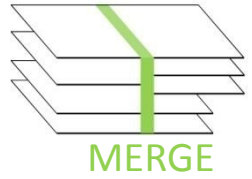




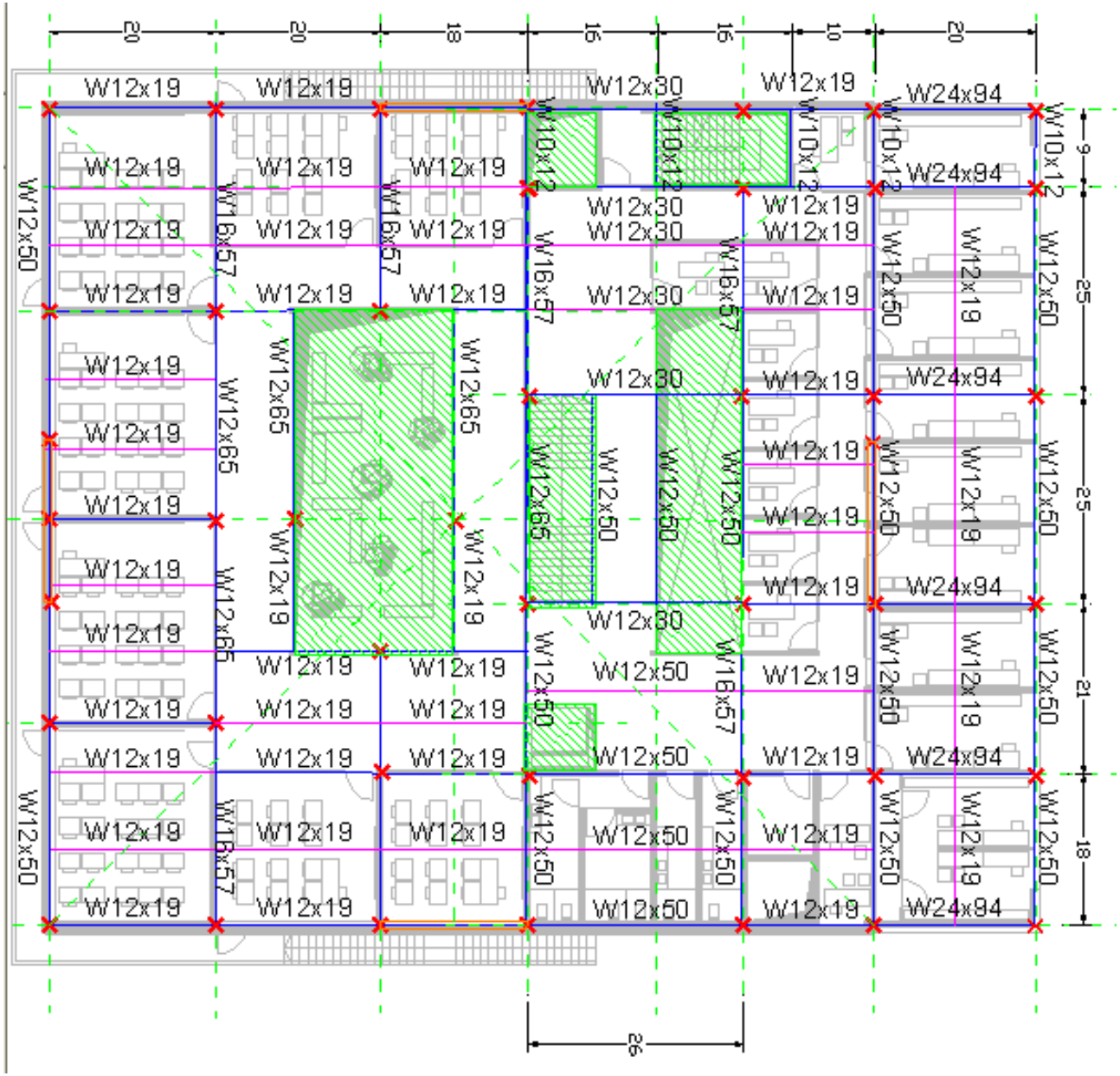
Third Floor East Framing





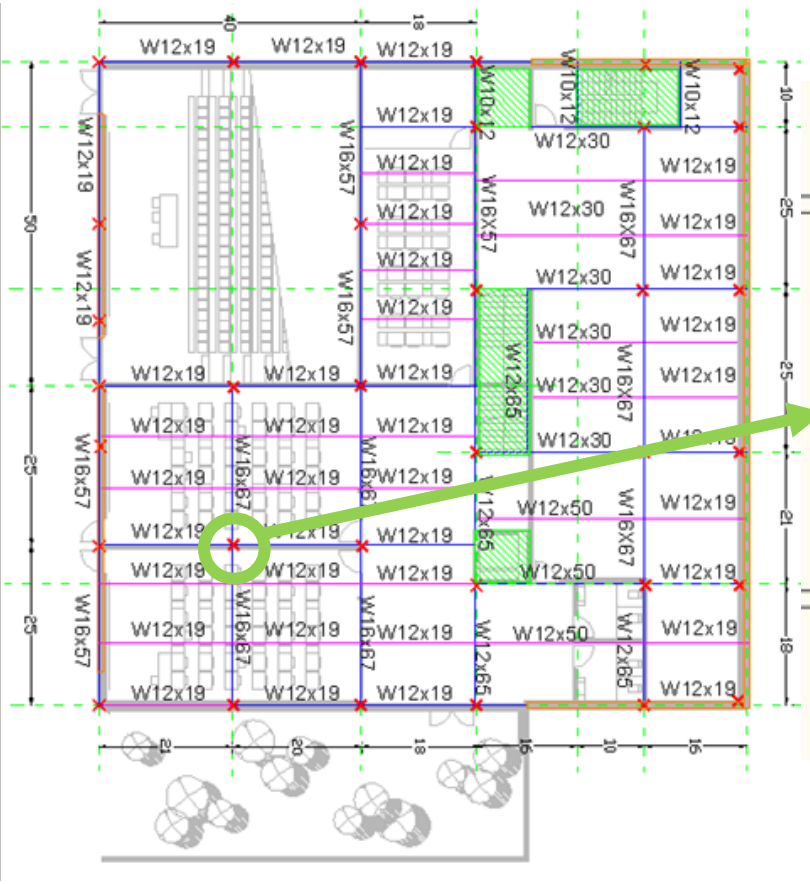


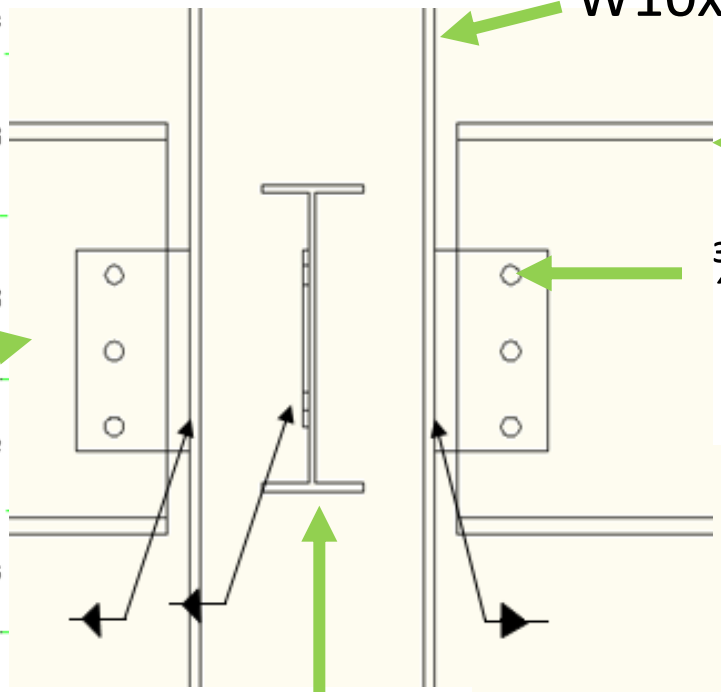
Roof Framing

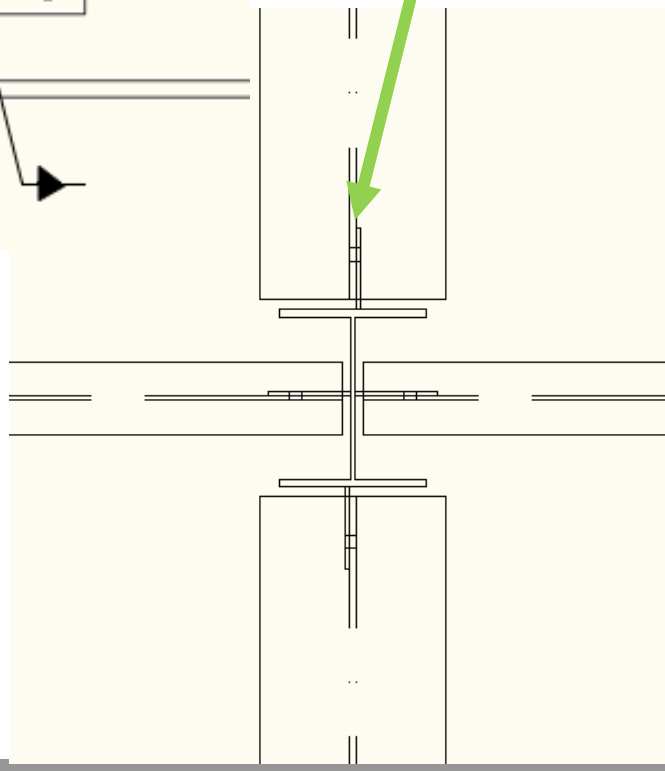


MERGE

Simple Column-Girder Connection

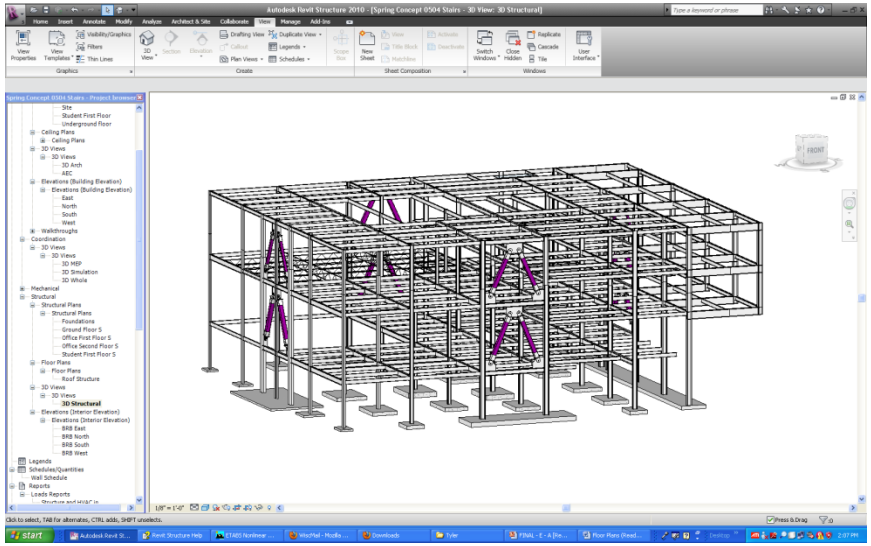




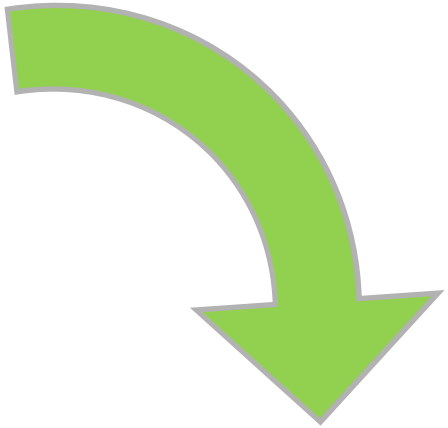


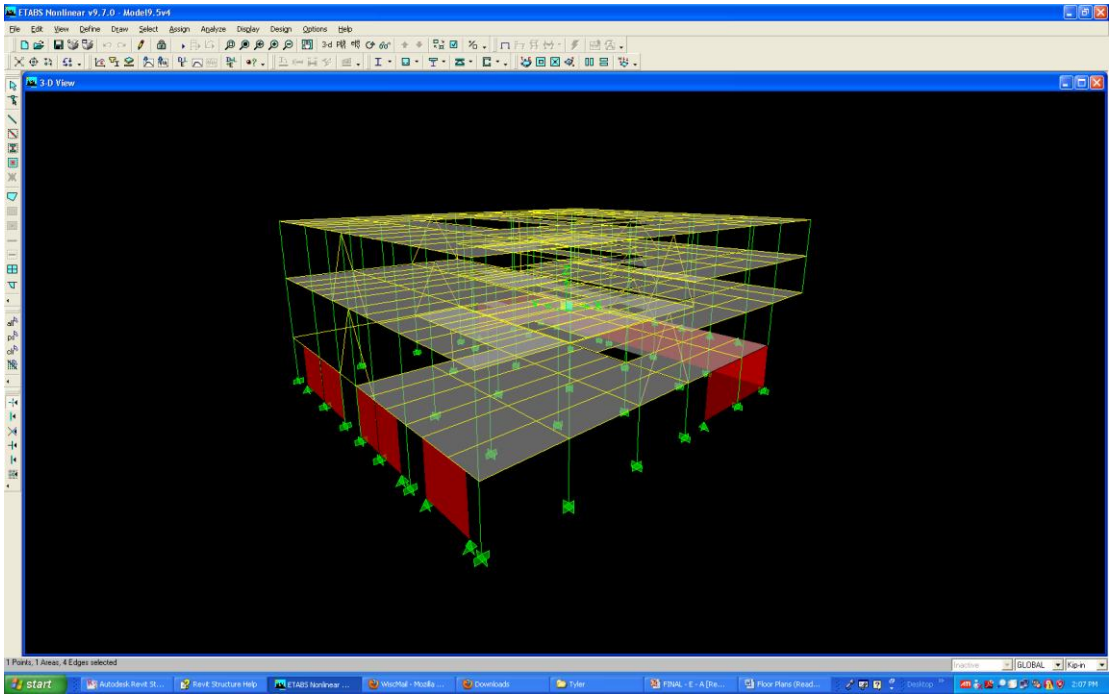
Single-Plate Connection
Plate is 1/4”
Two 3/4” Diameter Bolts
3/16” Field Welds for Plate to Column

Revit and ETABS File Transfer

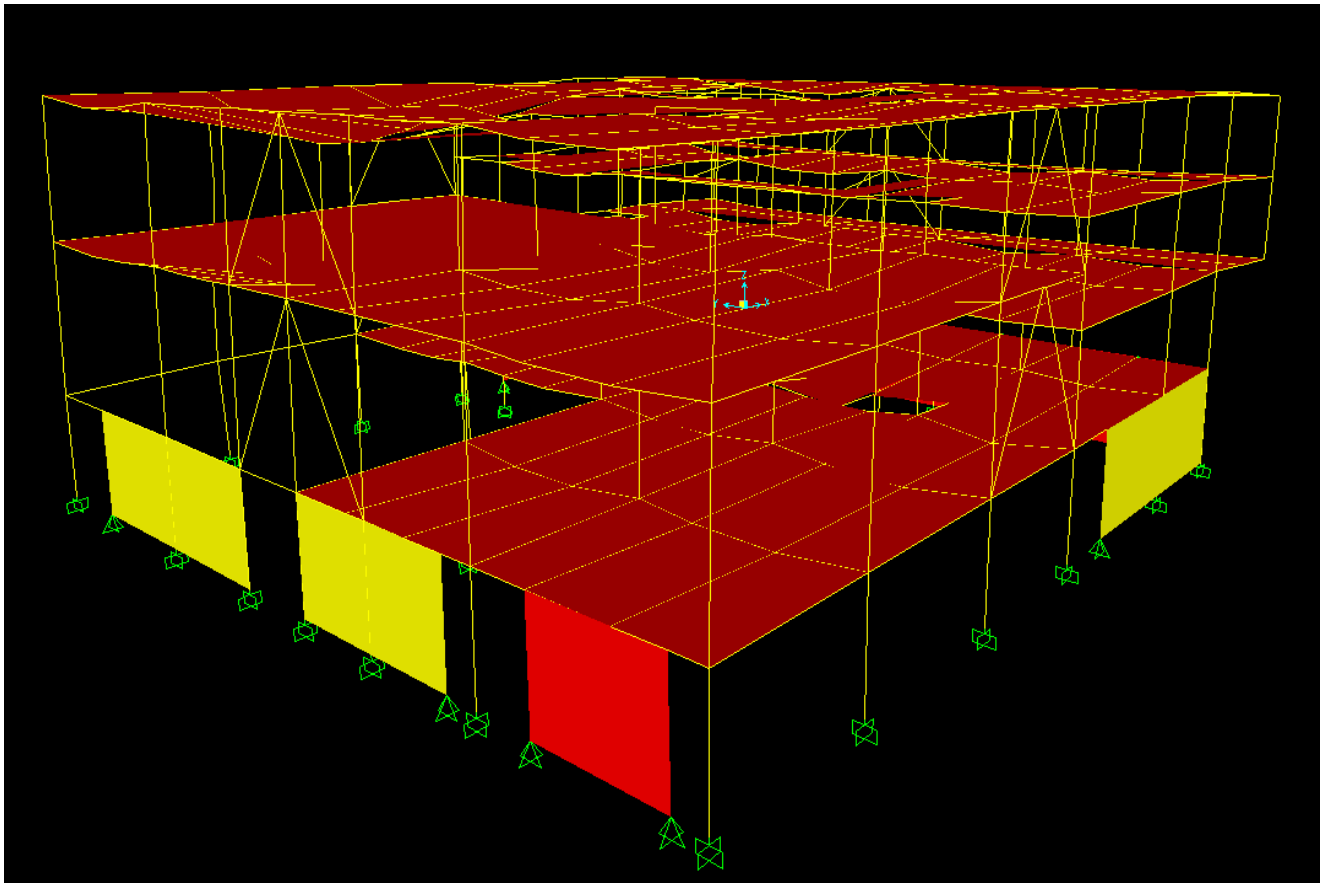


MERGE





ETABS Check

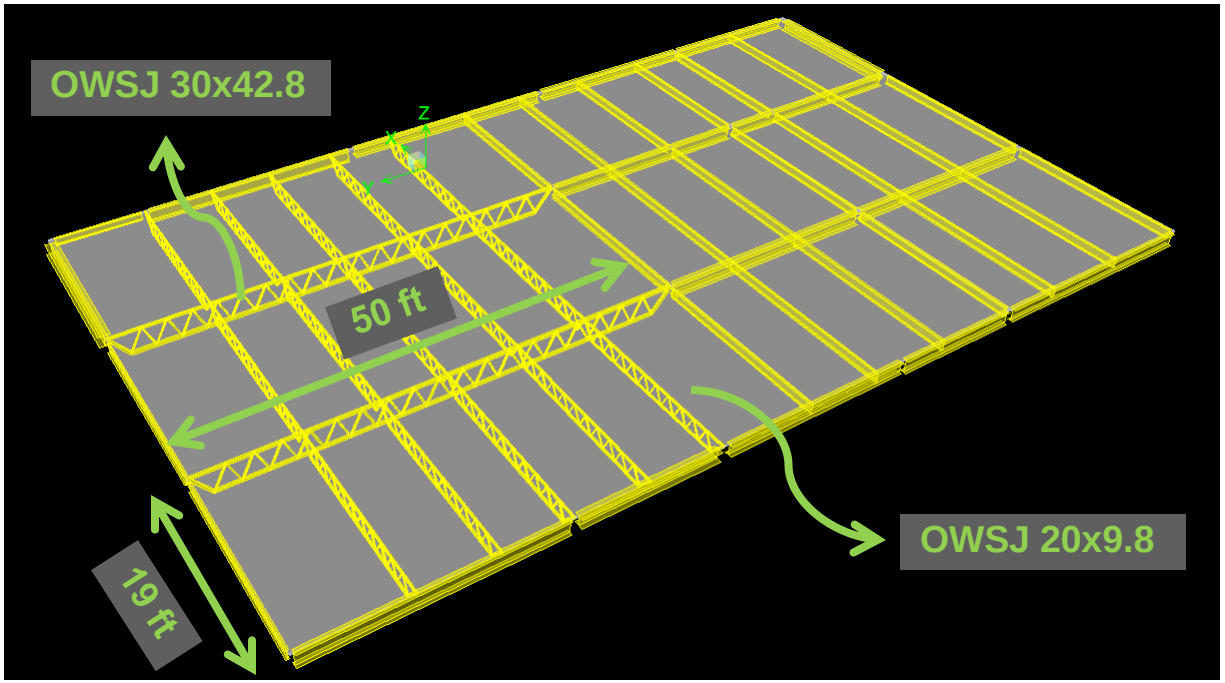


ETABS Strength Check
All Members Pass
Composite Check

ETABS Deflection Check
Length/360
Max Allowable: .83”
Max Actual: .8”
All Members Pass

Auditorium

ETABS modeling

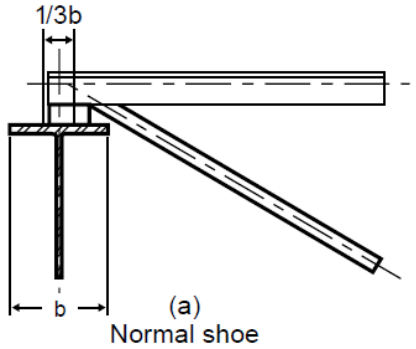


Deflection:

$\delta_{LL,max}$ = 1.6 in

$\delta_{allowable}$ =L/360 = 1.9 in

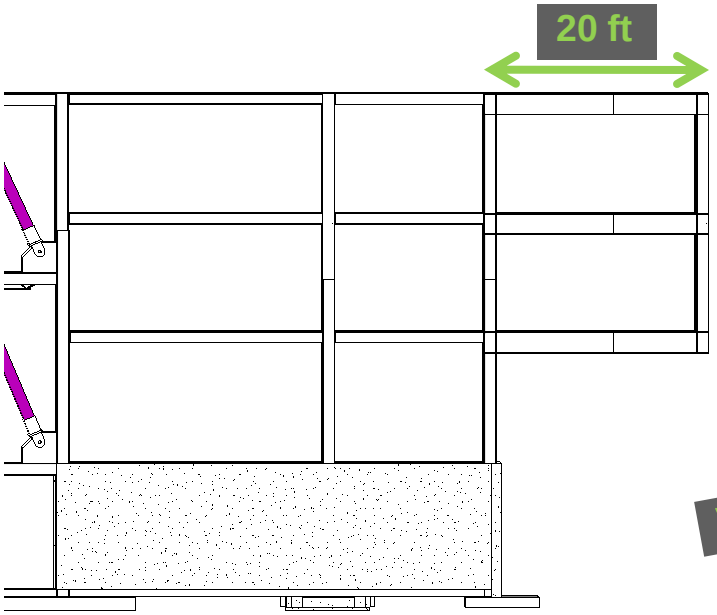
Connection details and design tables

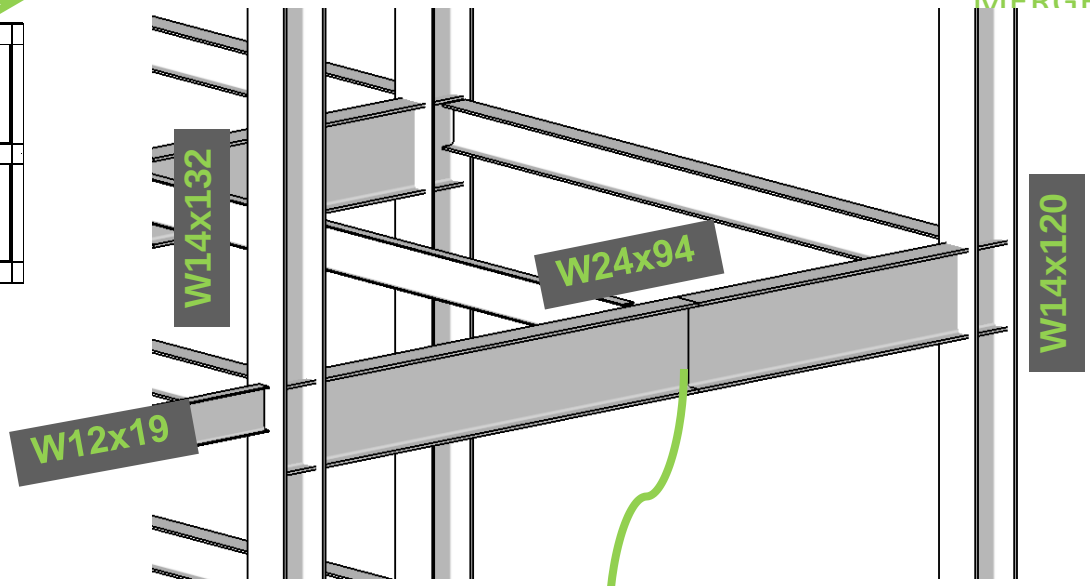


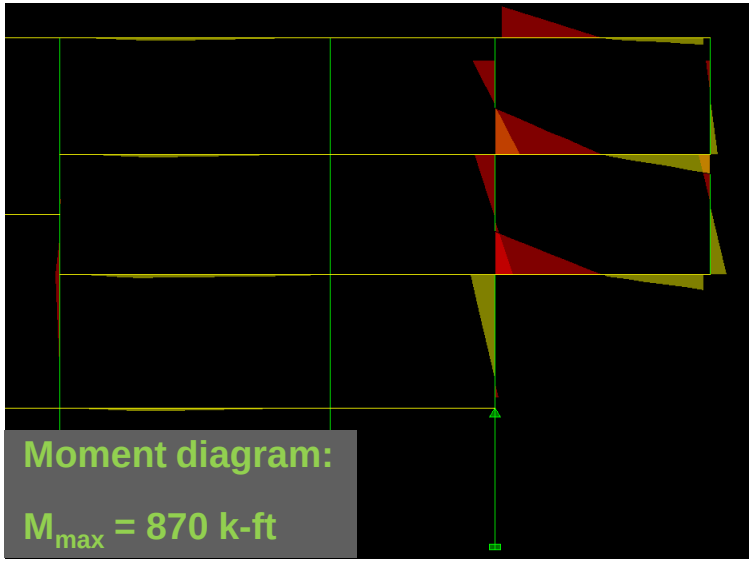
XXX
XXX
: Joist Weight (lb./ft.)
: % of service load to produce a deflection of L/360

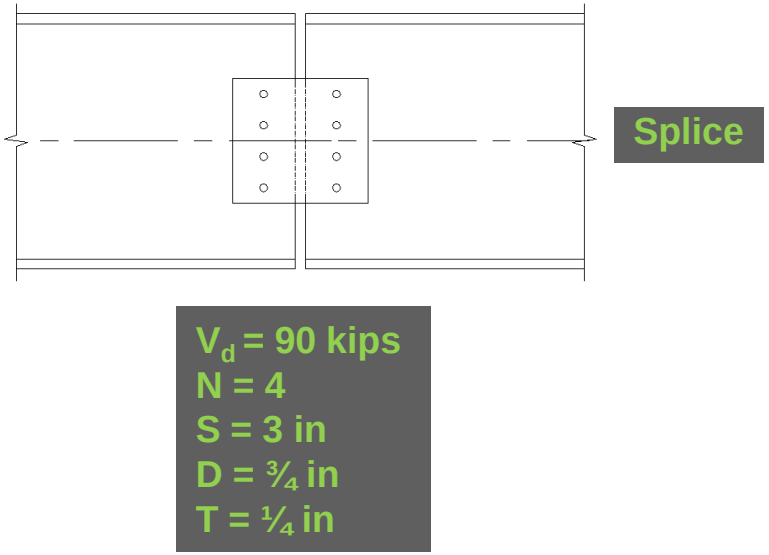
Span (ft.)	Joist Depth (in.)	Factored load (lb./ft.) / Service load (lb./ft.)												
		300 / 200	405 / 270	510 / 340	615 / 410	720 / 480	825 / 550	930 / 620	1035 / 690	1140 / 760	1245 / 830	1350 / 900	1455 / 970	1560 / 1040
49	30	9.4 / 68	12.0 / 64	14.2 / 64	17.0 / 64	20.0 / 64	23.0 / 64	26.1 / 65	28.5 / 64	31.5 / 64	36.1 / 69	36.7 / 64	42.8 / 66	45.9 / 66
	32	9.3 / 72	10.9 / 64	12.9 / 64	15.4 / 64	18.0 / 65	20.5 / 64	23.0 / 64	25.2 / 63	29.1 / 66	31.3 / 67	34.4 / 67	37.0 / 68	40.3 / 67
	36	9.5 / 92	9.8 / 73	12.1 / 74	13.7 / 70	16.1 / 70	17.7 / 68	20.4 / 69	21.5 / 67	25.4 / 70	28.3 / 73	31.6 / 74	32.3 / 73	34.7 / 74
	40	9.6 / 114	10.0 / 85	11.3 / 88	13.2 / 81	15.1 / 79	16.9 / 80	18.4 / 77	21.2 / 77	22.6 / 76	25.2 / 78	29.1 / 82	31.7 / 86	32.7 / 83
	44	10.0 / 139	10.1 / 103	11.5 / 91	12.8 / 89	14.2 / 90	15.7 / 89	18.1 / 86	20.2 / 87	22.6 / 85	23.6 / 84	28.1 / 95	28.1 / 90	31.9 / 95
	48	10.5 / 166	10.4 / 123	11.6 / 101	12.9 / 106	14.4 / 100	15.8 / 98	18.5 / 99	20.0 / 98	21.3 / 96	22.2 / 96	25.0 / 99	26.3 / 97	28.5 / 101
	52	10.6 / 200	10.8 / 149	11.8 / 119	13.0 / 116	15.0 / 115	15.9 / 109	18.7 / 113	20.2 / 108	21.5 / 112	22.5 / 106	23.9 / 106	25.6 / 108	28.5 / 112

Cantilever



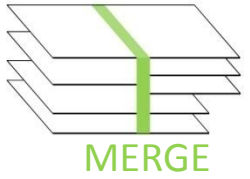


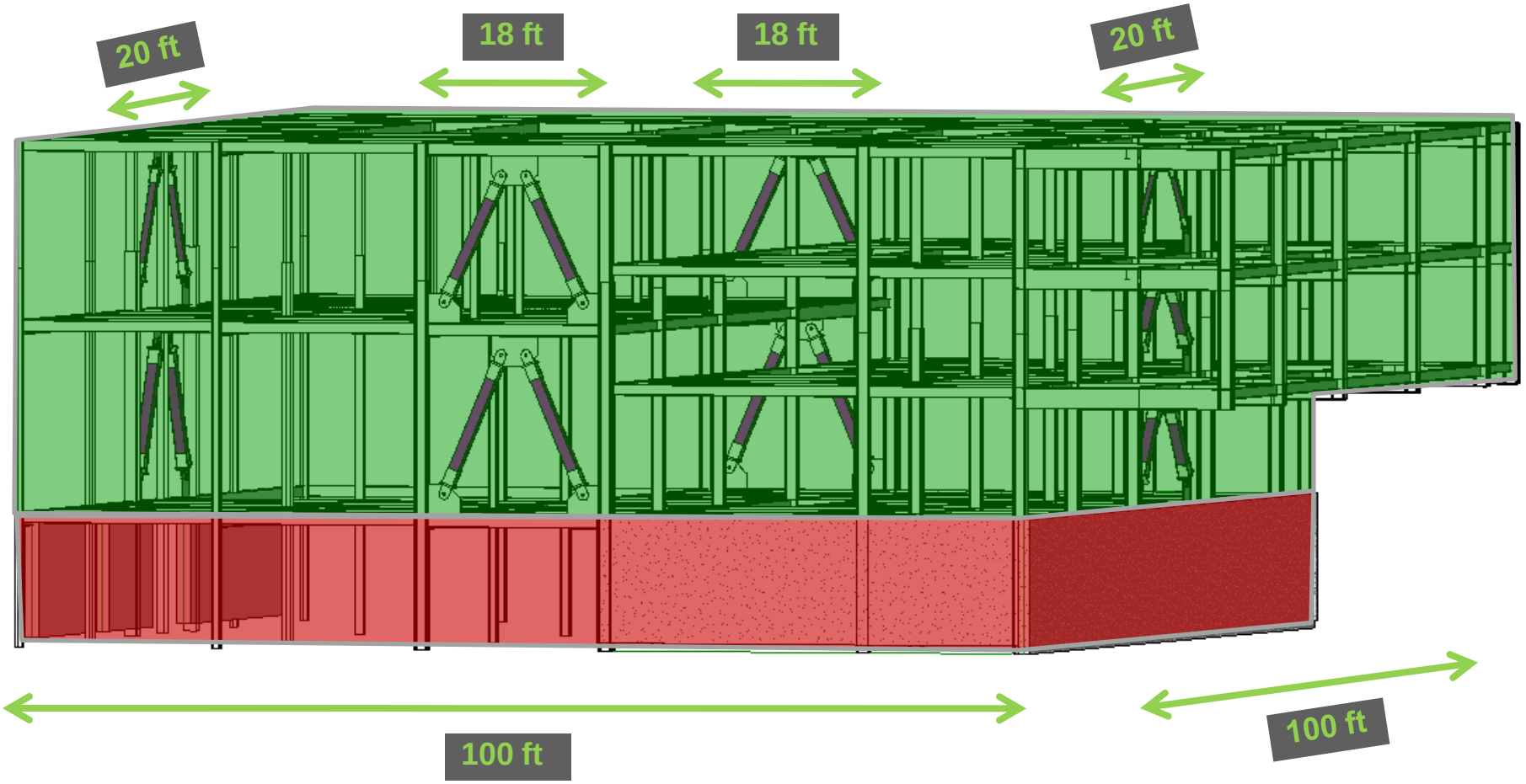




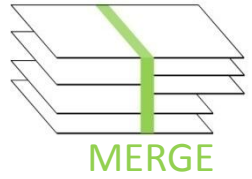
V_d = 90 kips
N = 4
S = 3 in
D = ¾ in
T = ¼ in

Lateral System



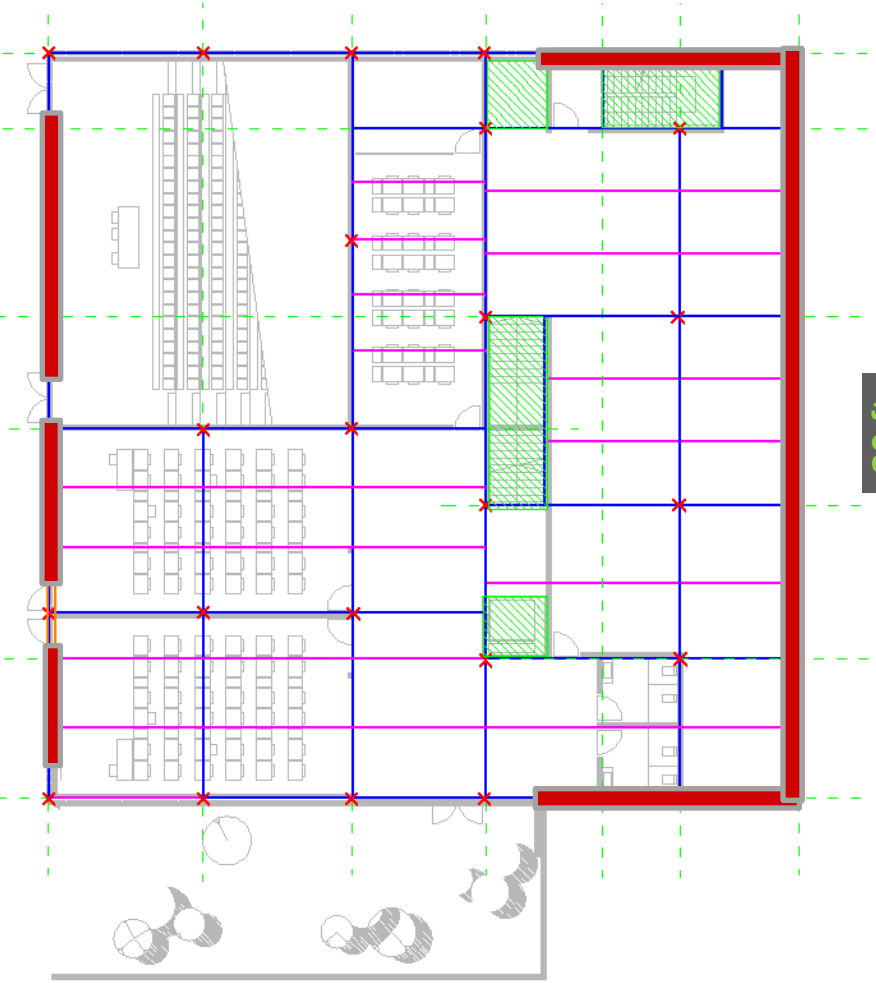


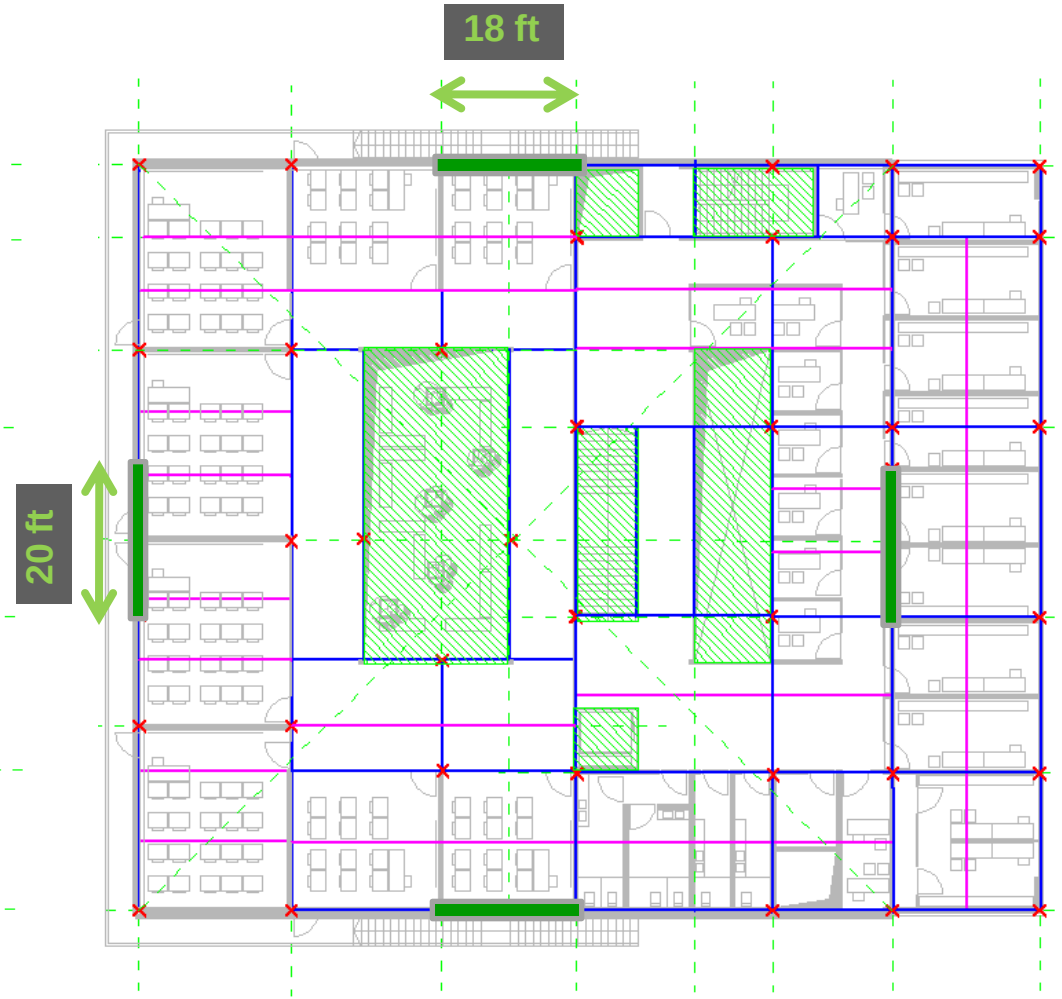
Lateral System



BRB Frame

Wall

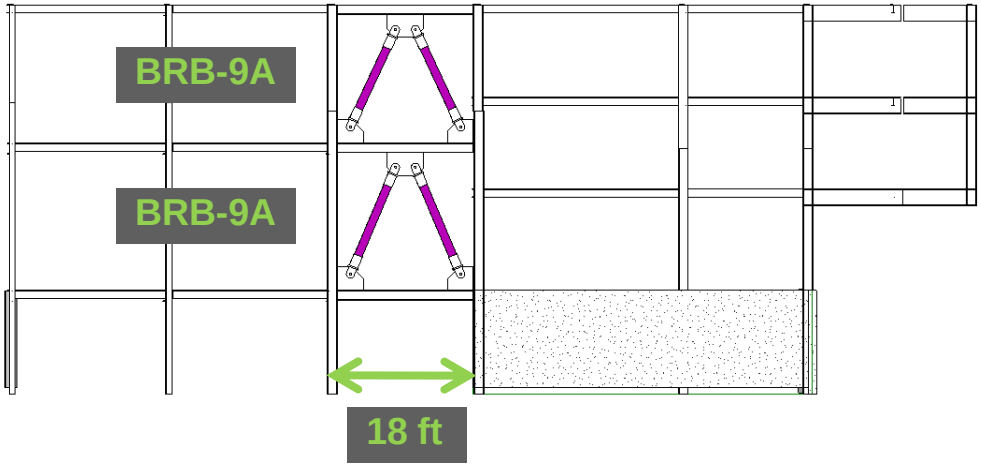




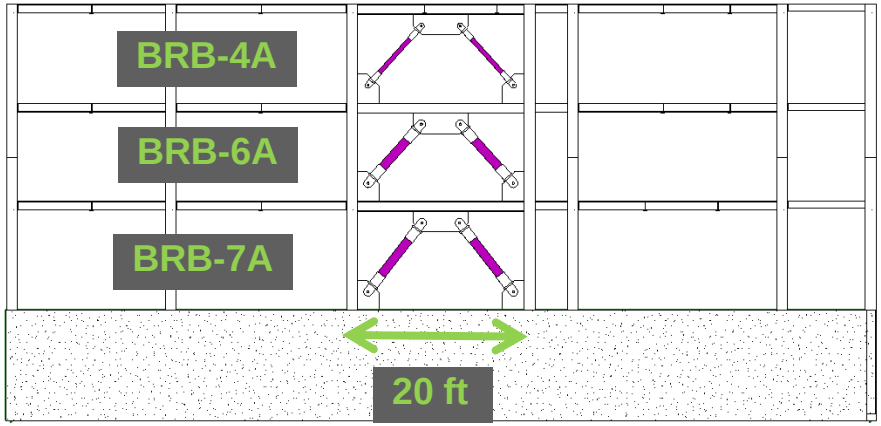
Buckling Restrained Braces

MERGE

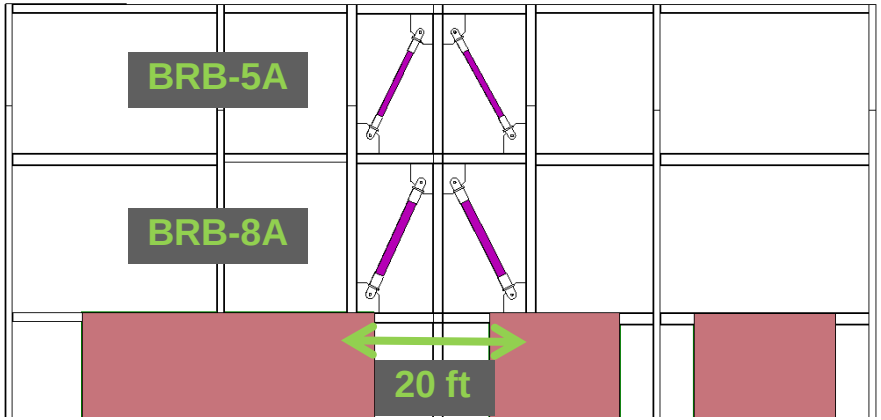
North and South Frames



East Frame

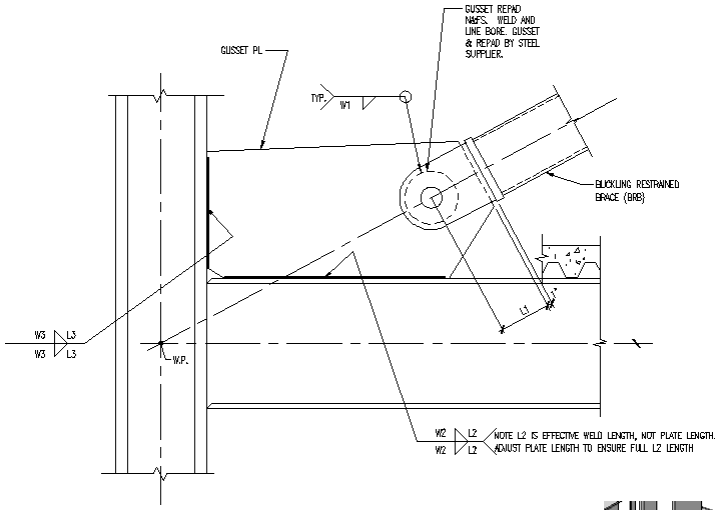


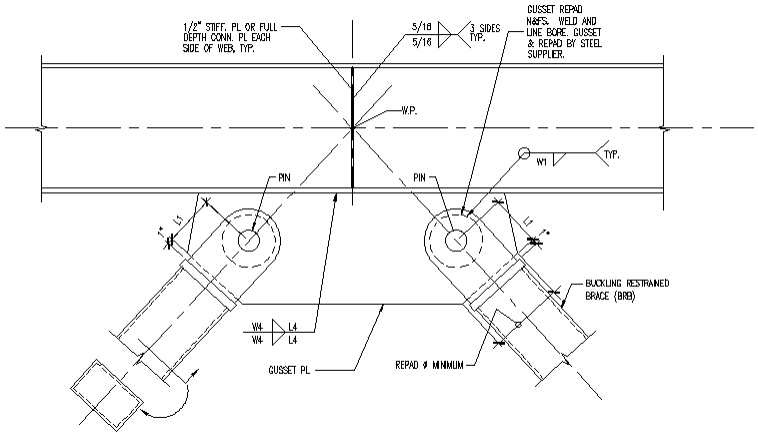
West Frame

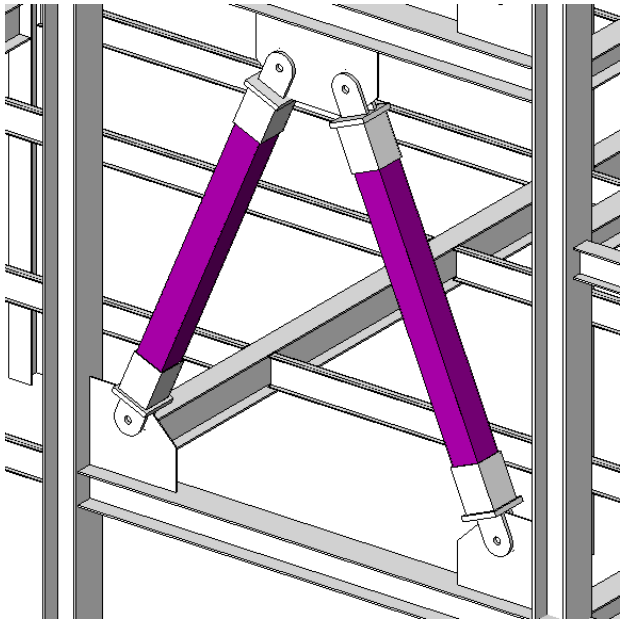


Buckling Restrained Braces

Gusset Plates (Star Seismic)

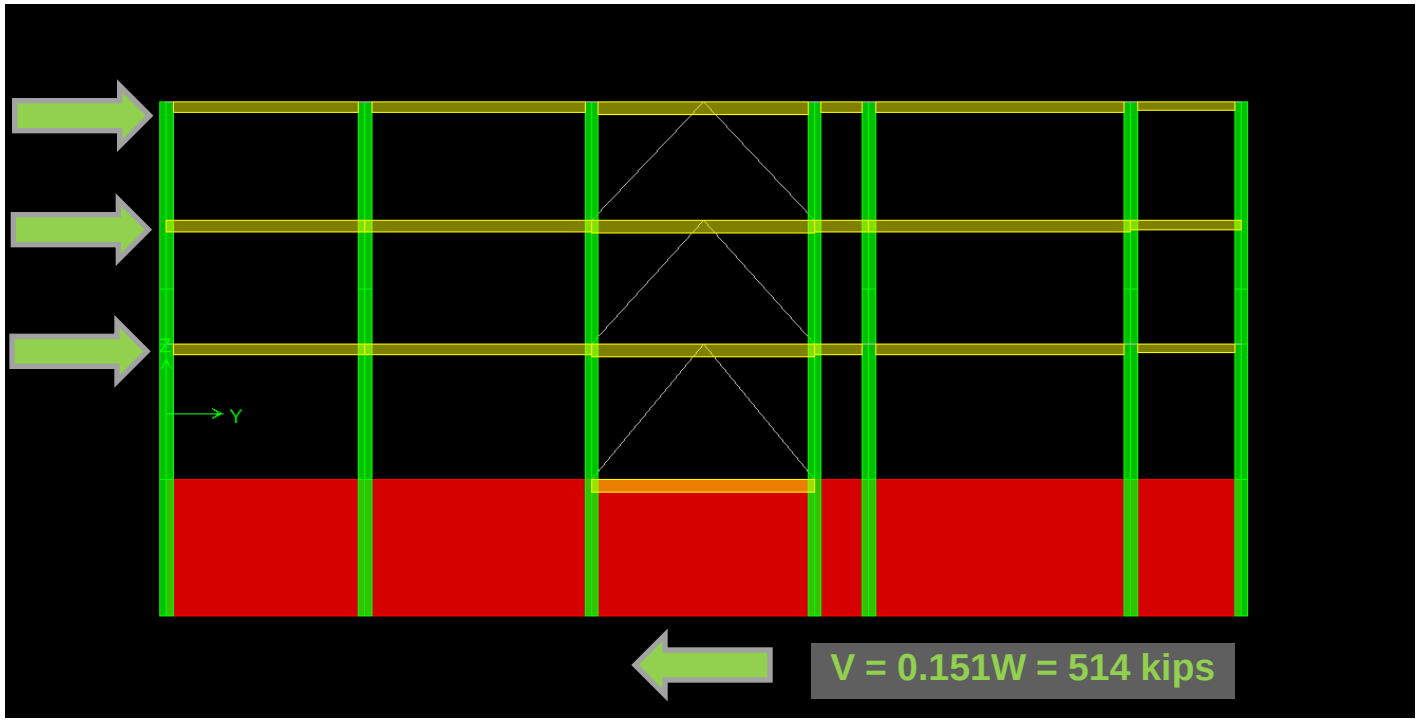






Equivalent Lateral Force Procedure

MERGE



Main parameters:

- S_{DS} = 1.19g
- S_{D1} = 0.61g
- T = 0.63 s (approximate)
- Occupancy category III
- I = 1.25

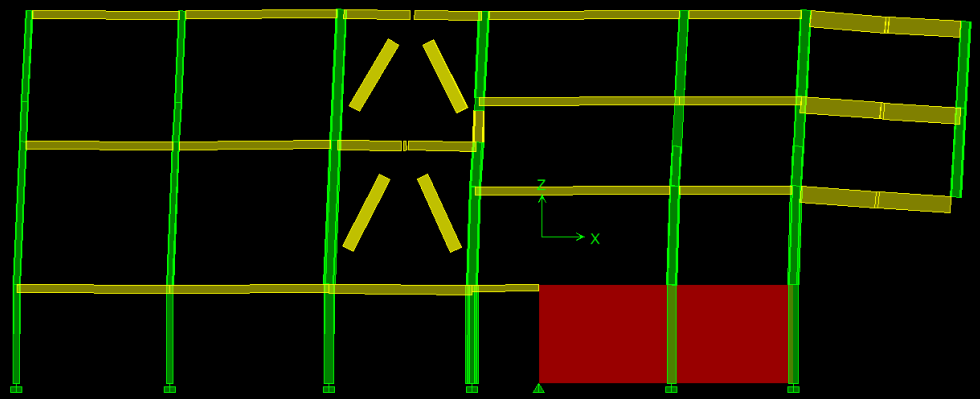
Strength and drift factors:

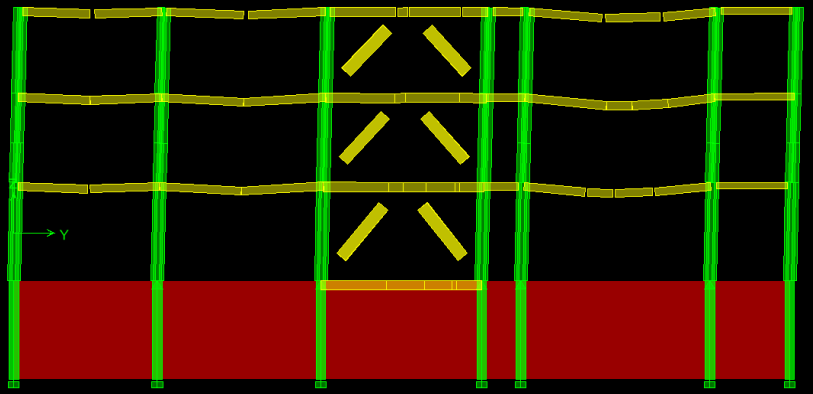
- R = 8 (BRBs)
- R = 5 (Walls)
- Ω_0 = 2.5
- C_d = 5
- ρ = 1.3

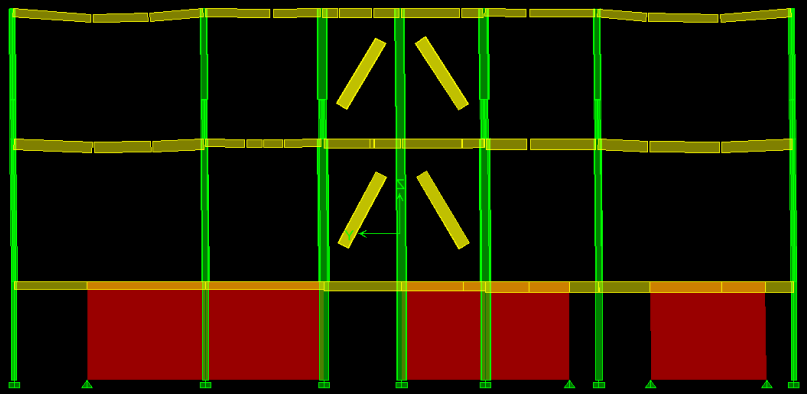
Load combinations:

- $(1.2+0.2S_{DS})D+0.5L+\rho Exc$
- $(1.2+0.2S_{DS})D+0.5L+\rho Eyc$
- $(1.2+0.2S_{DS})D+0.5L+\Omega_0 Exc$
- $(1.2+0.2S_{DS})D+0.5L+\Omega_0 Exc$

Equivalent Lateral Force Procedure







MERGE

Story drifts (N/S frames):

Δ_3 = 4.30 in (2.0%)

Δ_2 = 4.30 in (2.0%)

$\Delta_1 \approx 0$ in (0%)

BRB forces:

F_3 = 376 k (91%F_y)

F_2 = 347 k (84%F_y)

Story drifts (E frames):

Δ_4 = 1.75 in (1.2%)

Δ_3 = 1.75 in (1.2%)

Δ_2 = 1.65 in (1.1%)

$\Delta_1 \approx 0$ in (0%)

BRB forces:

F_4 = 154 k (84%F_y)

F_3 = 217 k (79%F_y)

F_2 = 234 k (73%F_y)

Story drifts (W frames):

Δ_3 = 2.45 in (1.1%)

Δ_2 = 2.65 in (1.2%)

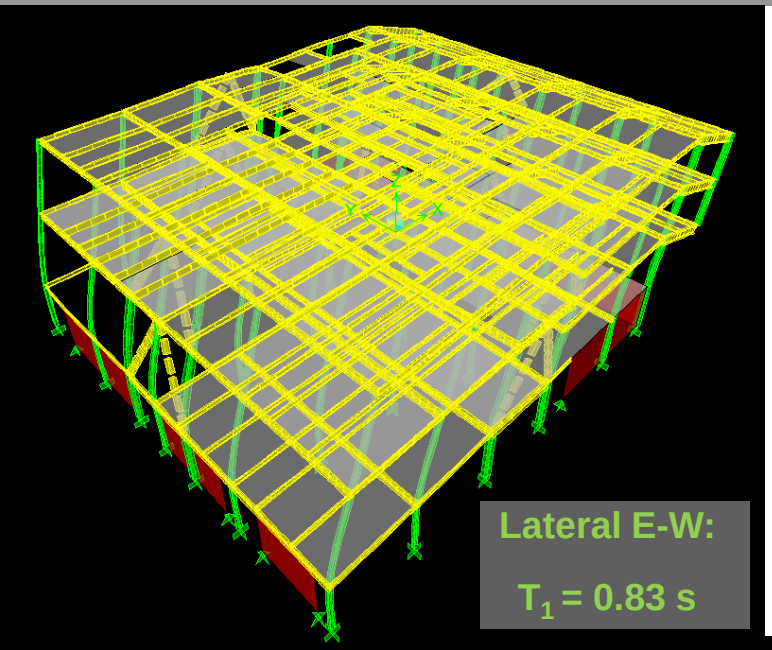
$\Delta_1 \approx 0$ in (0%)

BRB forces:

F_3 = 128 k (56%F_y)

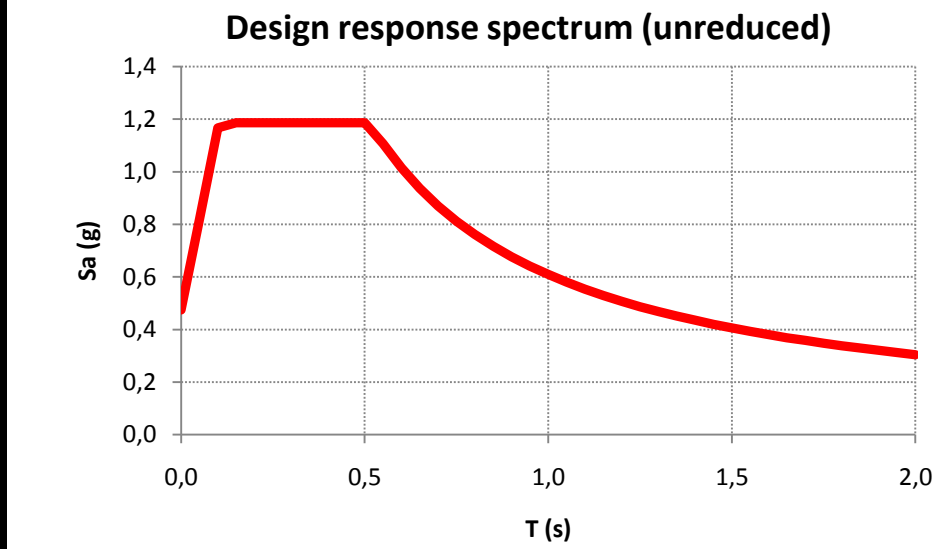
F_2 = 241 k (65%F_y)

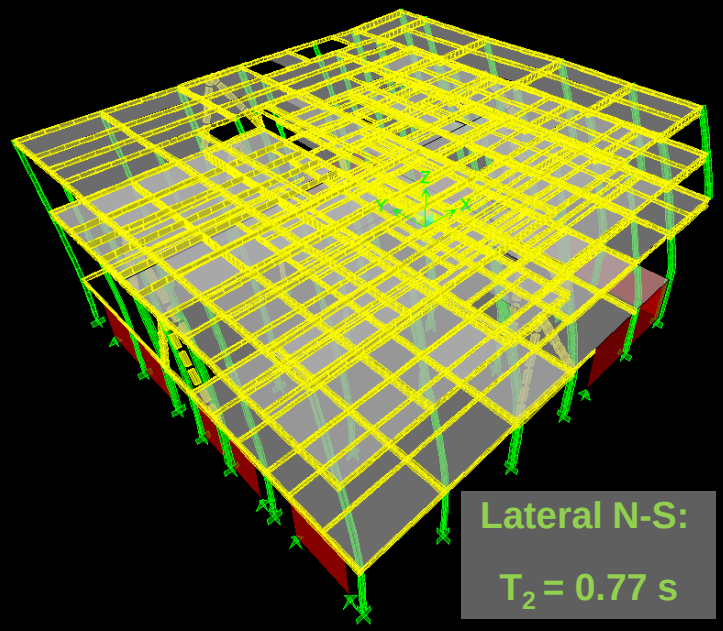
Modal Response Spectrum Analysis



Lateral E-W:

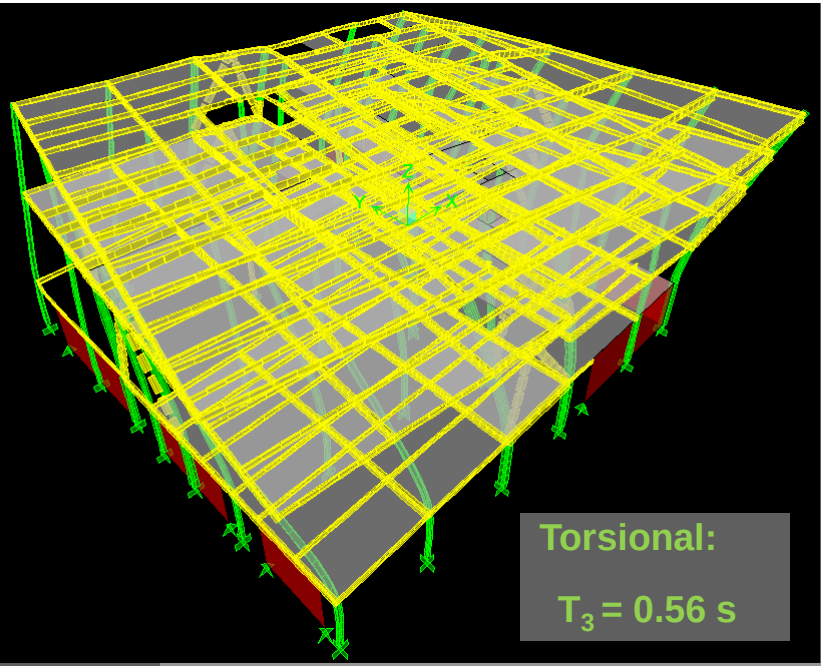
$T_1 = 0.83$ s





Lateral N-S:

$T_2 = 0.77$ s



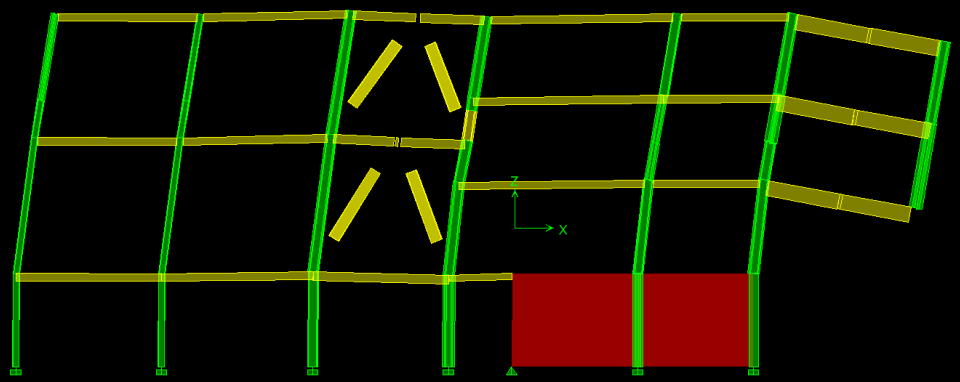
Torsional:

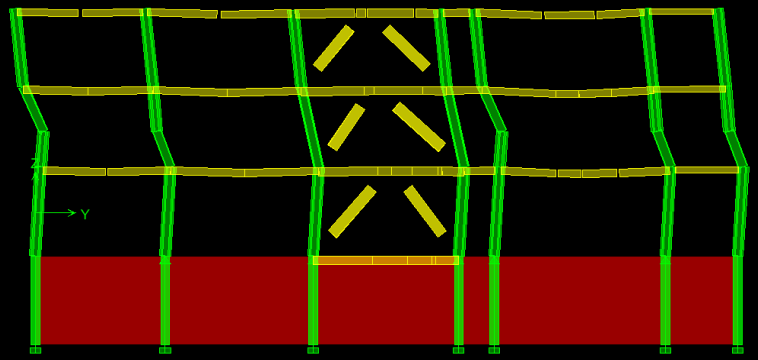
$T_3 = 0.56$ s

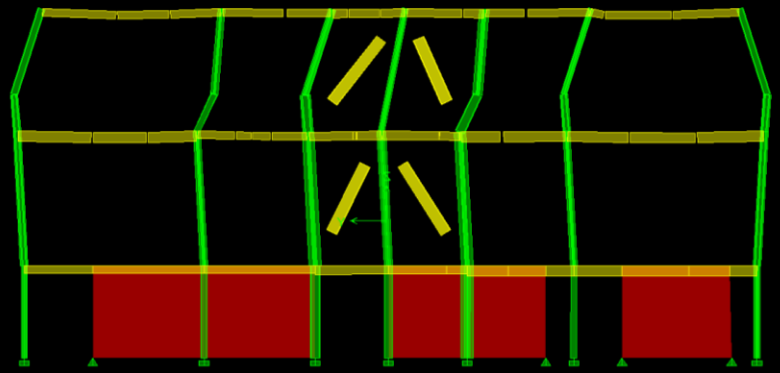
ETABS Eigenvalue analysis:

10 modes considered

Modal Response Spectrum Analysis







CQC Envelopes

Story drifts (N/S frames):

Δ_3 = 2.11 in (1.0%)

Δ_2 = 1.88 in (0.9%)

$\Delta_1 \approx$ 0 in (0%)

BRB forces:

F_3 = 167 k (40%F_y)

F_2 = 145 k (35%F_y)

Story drifts (E frames):

Δ_4 = 1.28 in (0.9%)

Δ_3 = 1.08 in (0.8%)

Δ_2 = 0.88 in (0.6%)

$\Delta_1 \approx$ 0 in (0%)

BRB forces:

F_4 = 131 k (71%F_y)

F_3 = 162 k (59%F_y)

F_2 = 152 k (47%F_y)

Story drifts (W frames):

Δ_3 = 1.53 in (0.7%)

Δ_2 = 1.12 in (0.5%)

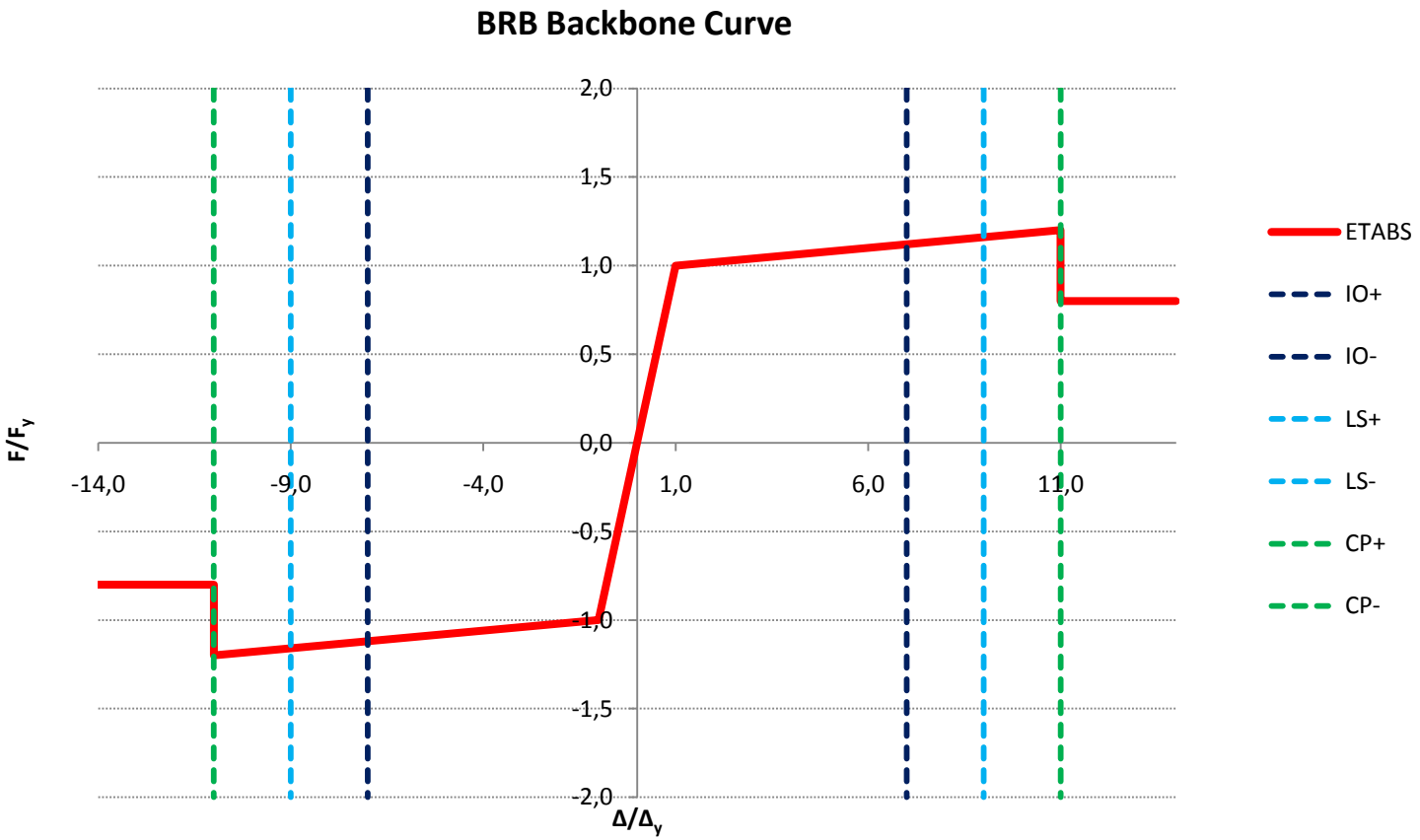
$\Delta_1 \approx$ 0 in (0%)

BRB forces:

F_3 = 43 k (19%F_y)

F_2 = 129 k (35%F_y)

Static Nonlinear (Pushover) Analysis

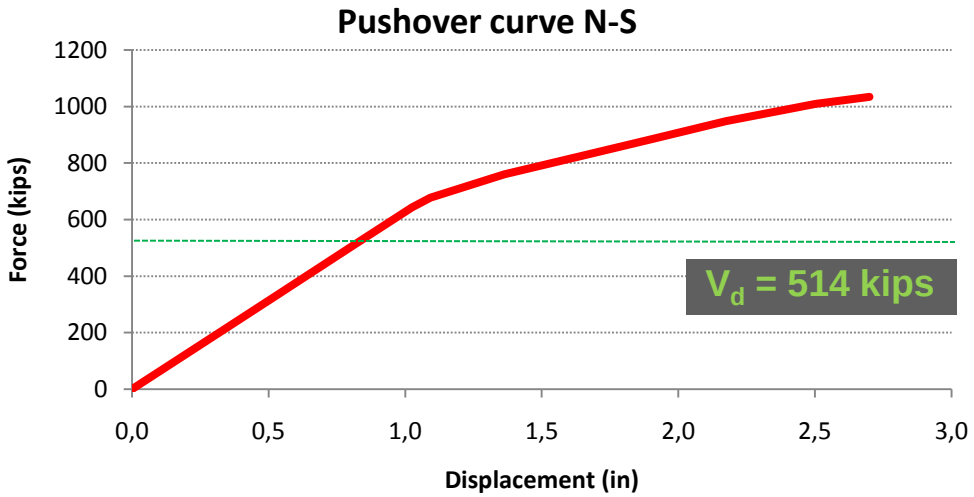


Target displacement:

E-W: δ_t = 3.49 in

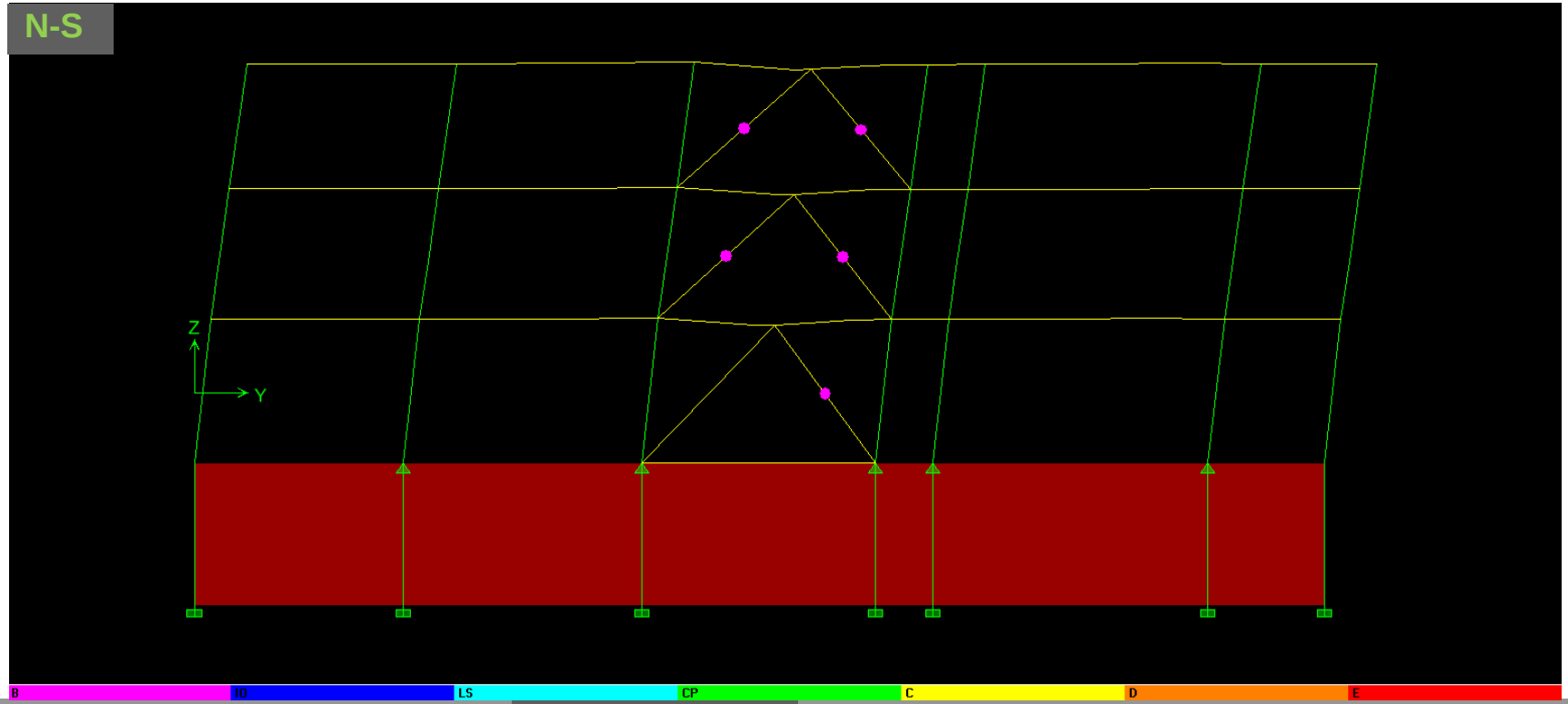
N-S: δ_t = 2.77 in

Static Nonlinear (Pushover) Analysis

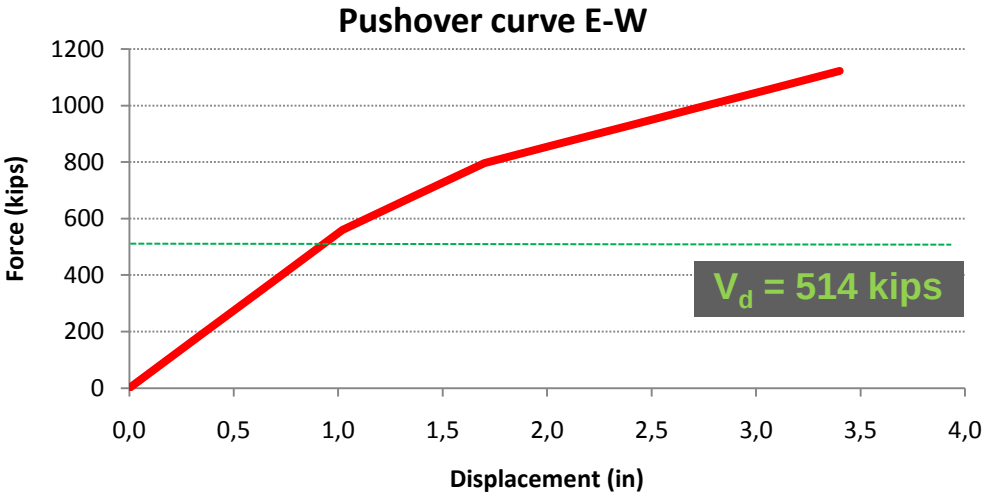


Performance level:

Operational

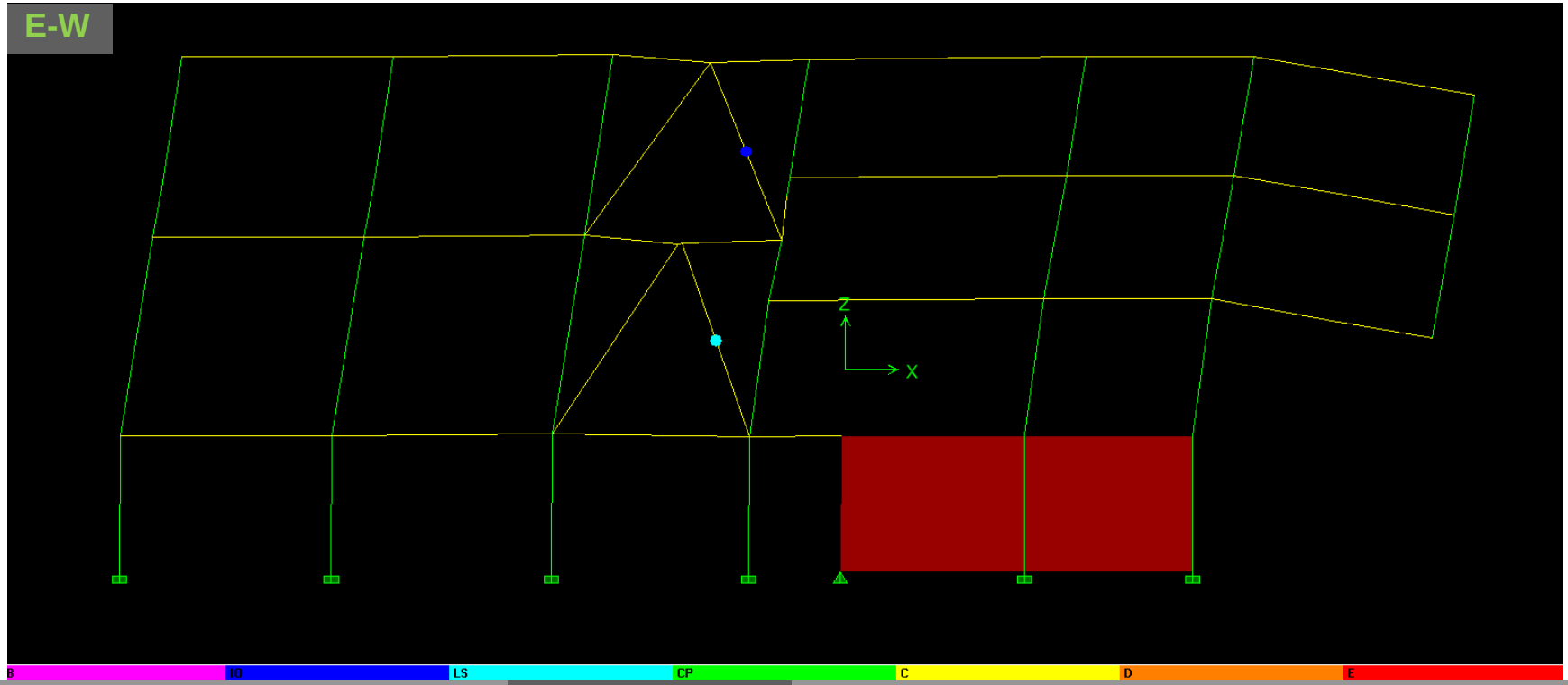


Static Nonlinear (Pushover) Analysis

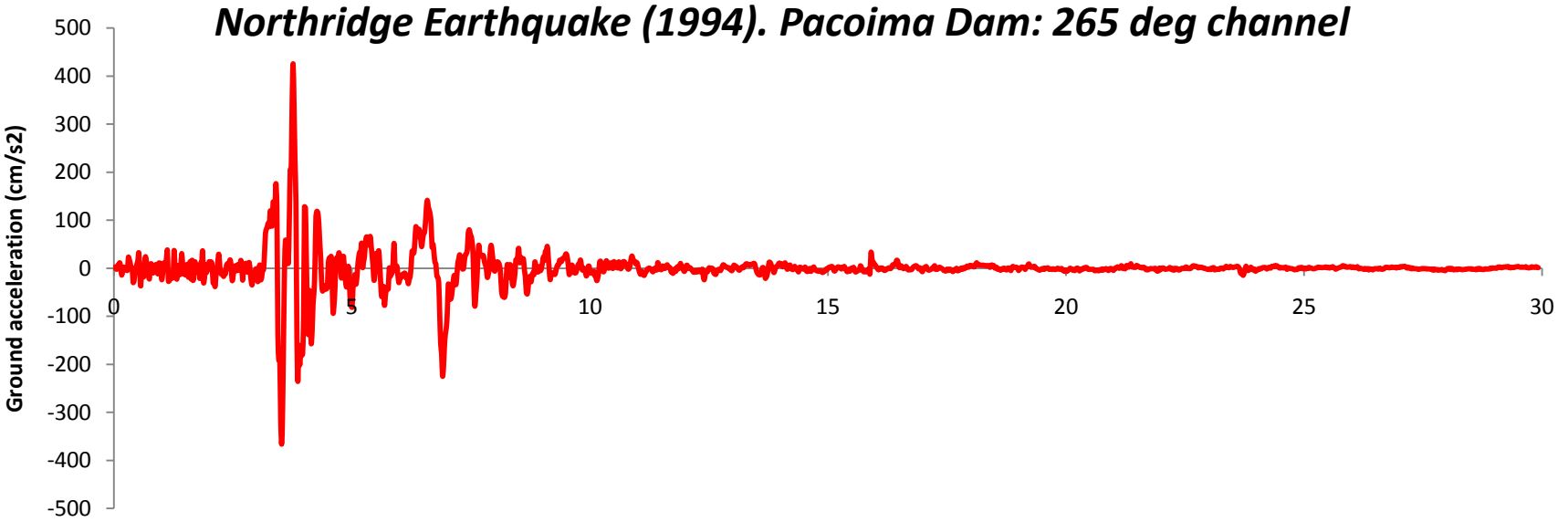


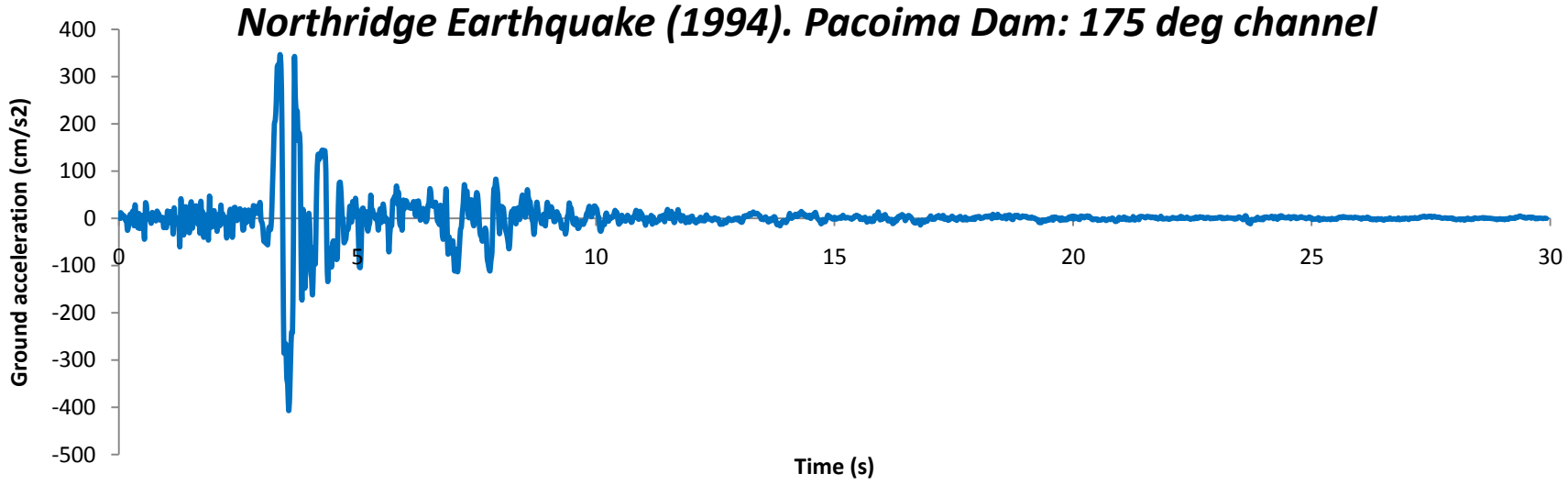
Performance level:

Life Safety



MERGE

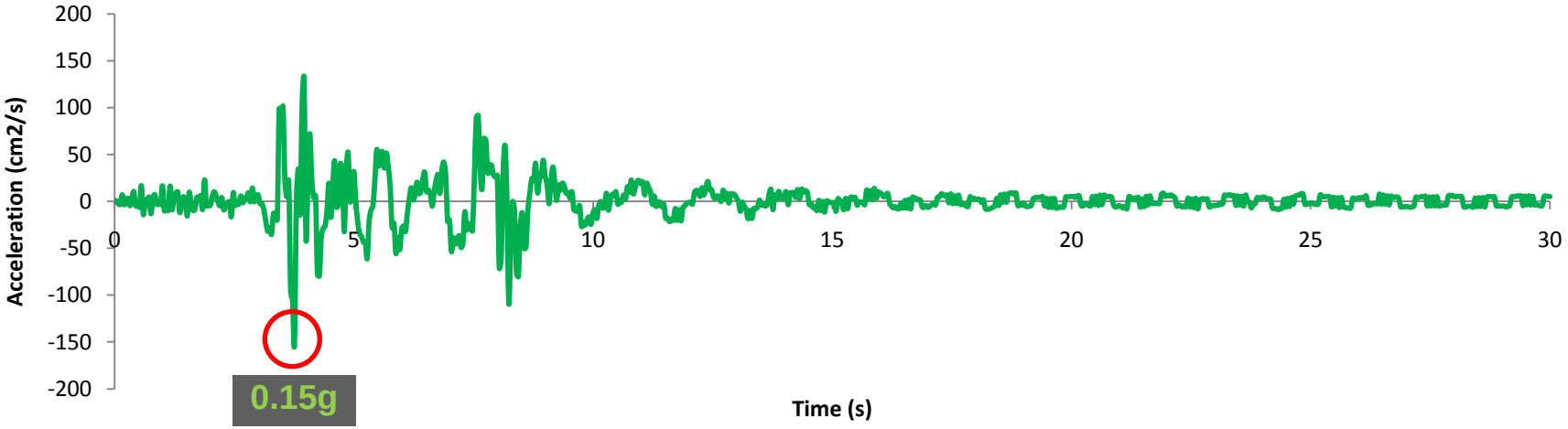

Northridge Earthquake (1994). Pacoima Dam: 265 deg channel
Ground acceleration (cm/s2)
500
400
300
200
100
0
-100
-200
-300
-400
-500
0
5
10
15
20
25
30


Northridge Earthquake (1994). Pacoima Dam: 175 deg channel
Ground acceleration (cm/s2)
400
300
200
100
0
-100
-200
-300
-400
-500
0
5
10
15
20
25
30
Time (s)

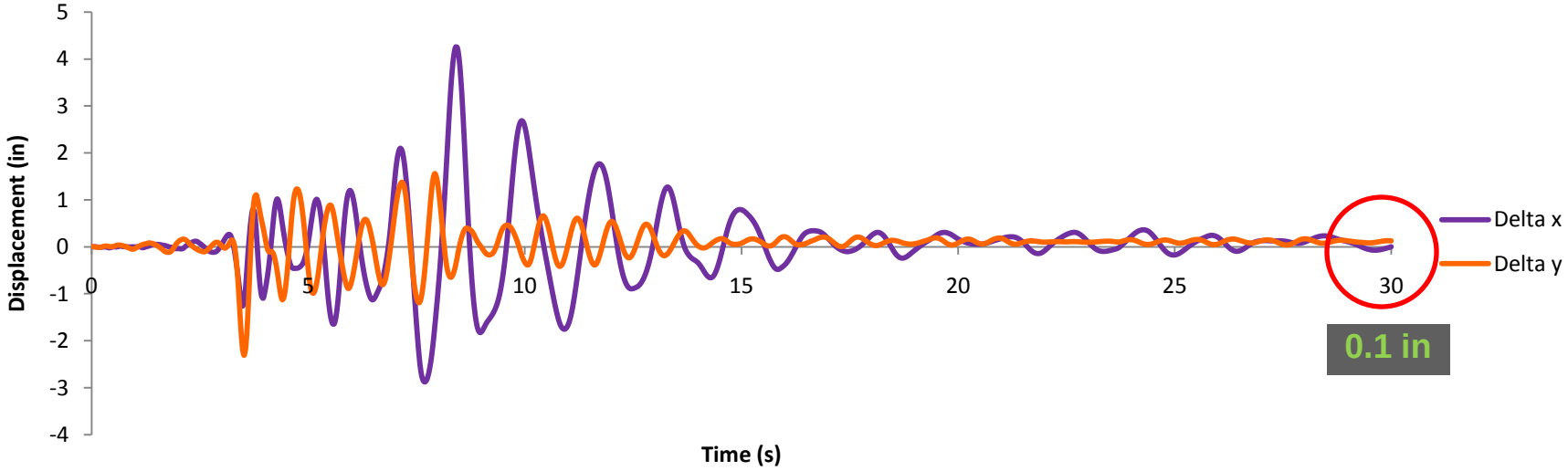
Nonlinear Time History Analysis

MERGE

Roof accelerations



Roof displacements



MEP Options

MERGE

Option 1 Mixed-mode Conditioning System – Existing CHP (power + heat/cooling water)		Option 2 Radiant Heating/Cooling System with Dehumidified Ventilation System	
Scenario 1	Scenario 2	Scenario 1	Scenario 2
Natural ventilation + Overhead air distribution	Natural Ventilation + UFAD (large classrooms, auditorium etc.) + Overhead air distribution (offices, small spaces)	- Existing CHP (heat/cool water and power)	-Existing CHP (heat/cool water) - Solar Photovoltaic (power)

Merge – MEP Solution

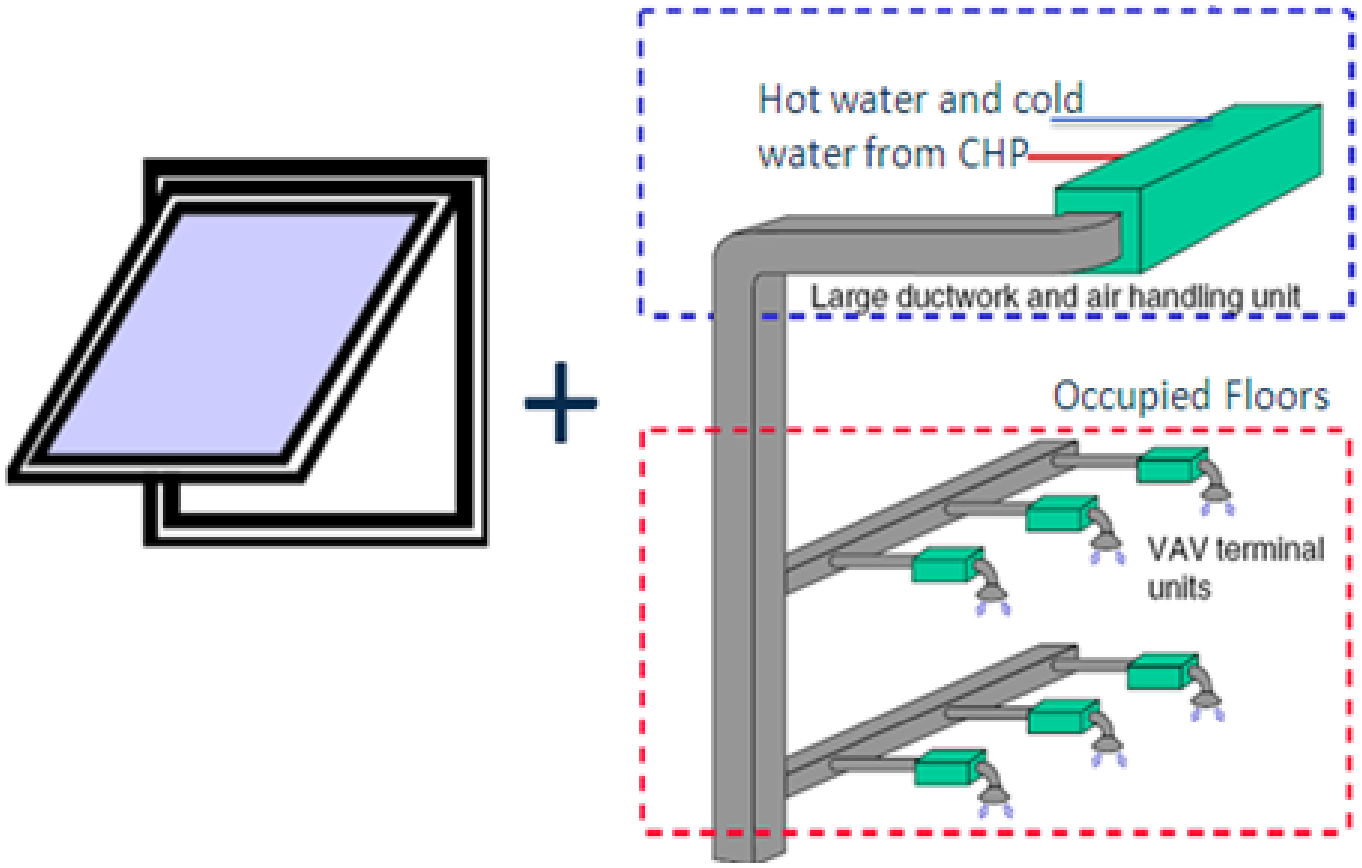
MERGE

Option 1 Mixed-mode Conditioning System – Existing CHP (power + heat/cooling water)		Option 2 Radiant Heating/Cooling System with Dehumidified Ventilation System	
Scenario 1	Scenario 2	Scenario 1	Scenario 2
Natural ventilation + Overhead air distribution	Natural Ventilation + UFAD (large classrooms, auditorium etc.) + Overhead air distribution (offices, small spaces)	- Existing CHP (heat/cool water and power)	-Existing CHP (heat/cool water) - Solar Photovoltaic (power)

- Existing CHP + Solar PV
- CHP capacity - Serves 18 buildings on campus
  Circulates cool water in underground loops at 5.3 ^{O}C

MERGE

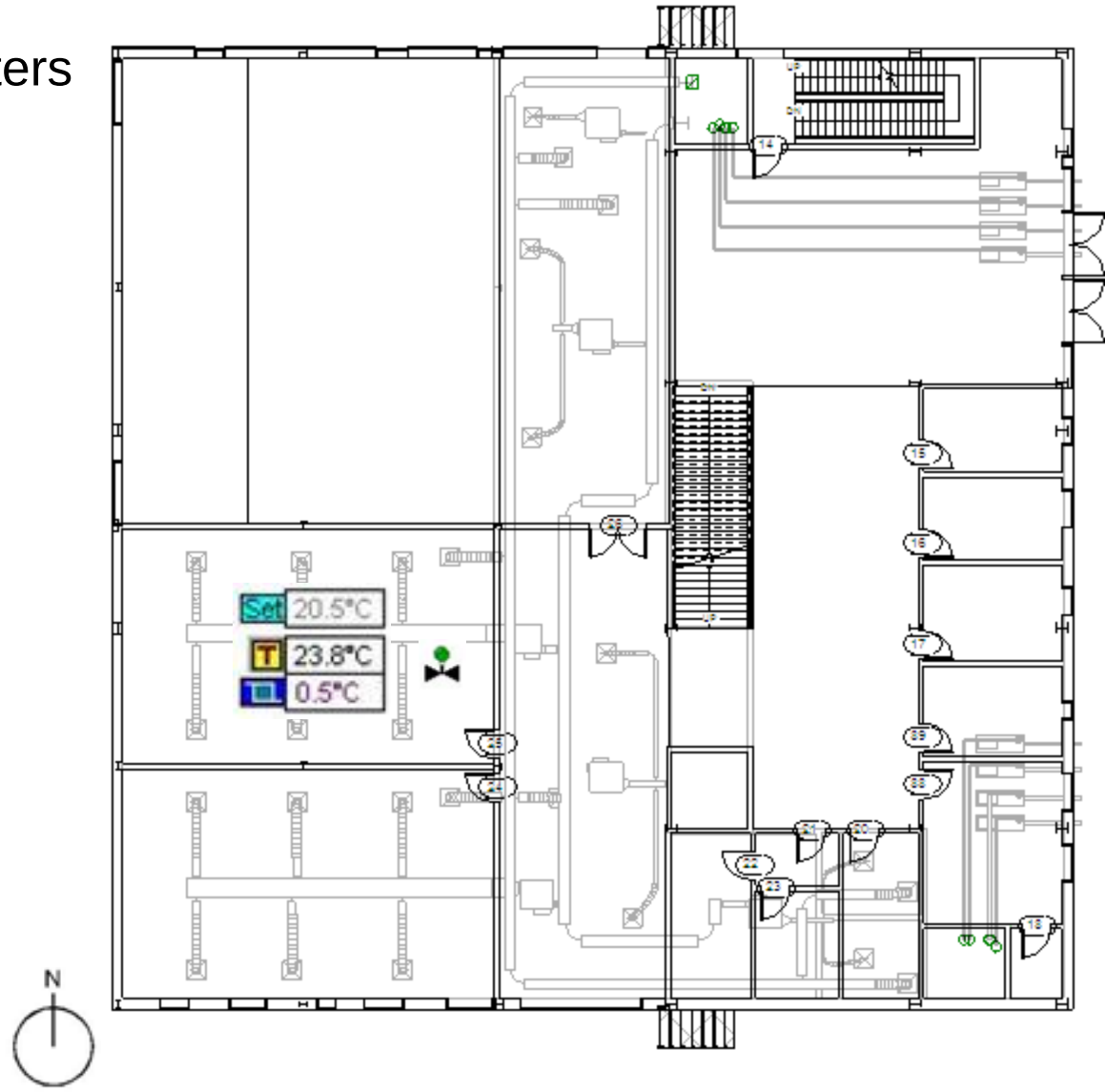
- Mixed-mode Conditioning System is a two-mode system which employs natural ventilation and air conditioning at different periods of the day or season of the year to provide a comfortable working environment and a good indoor quality air.



Operation Strategies

MERGE

- BMS tracks sensors and meters
  - Sensor: Temperature: 68 - 75
    - Humidity: 68
    - Bypass valve: 68
  - T Set point: 20.5 ^{o}C
  - T Sensitivity level: 0.5 ^{o}C
- HVAC Operation time
  - Students' part: class time
  - Offices' part: work time
- Natural Ventilation
  - Windows: Openable
    - Automatically open at night



HVAC System– Building Energy Simulation

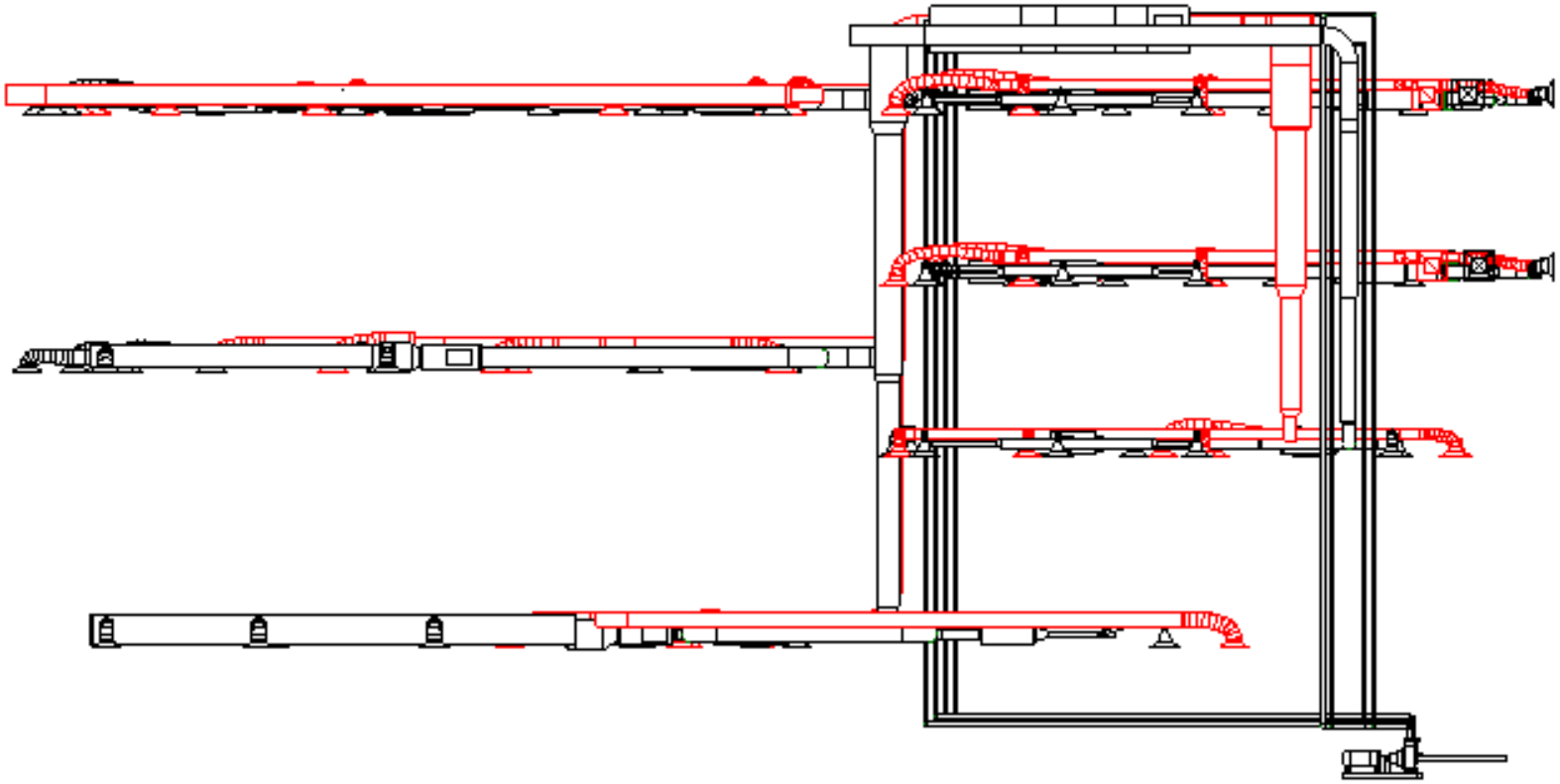
MERGE

Inputs	
Building Type	SchoolOrUniversity
Area (m^2)	2,955
Volume (m^3)	9,797.41
Calculated Results	
Peak Cooling Total Load (W)	**338,933**
Peak Cooling Month and Hour	September 2:00 PM
Peak Cooling Sensible Load (W)	301,014
Peak Cooling Latent Load (W)	37,919
Maximum Cooling Capacity (W)	**406,418**
Peak Cooling Airflow (L/s)	27,427.10
Peak Heating Load (W)	**62,895**
Peak Heating Airflow (L/s)	3,615.70
Checksums	
Cooling Load Density (W/m^2)	114.7
Cooling Flow Density ($L/(s \cdot m^2)$)	9.28
Cooling Flow / Load ($L/(s \cdot kW)$)	80.92
Cooling Area / Load (m^2/kW)	8.72
Heating Load Density (W/m^2)	21.29
Heating Flow Density ($L/(s \cdot m^2)$)	1.22

HVAC System – Cross Section

MERGE

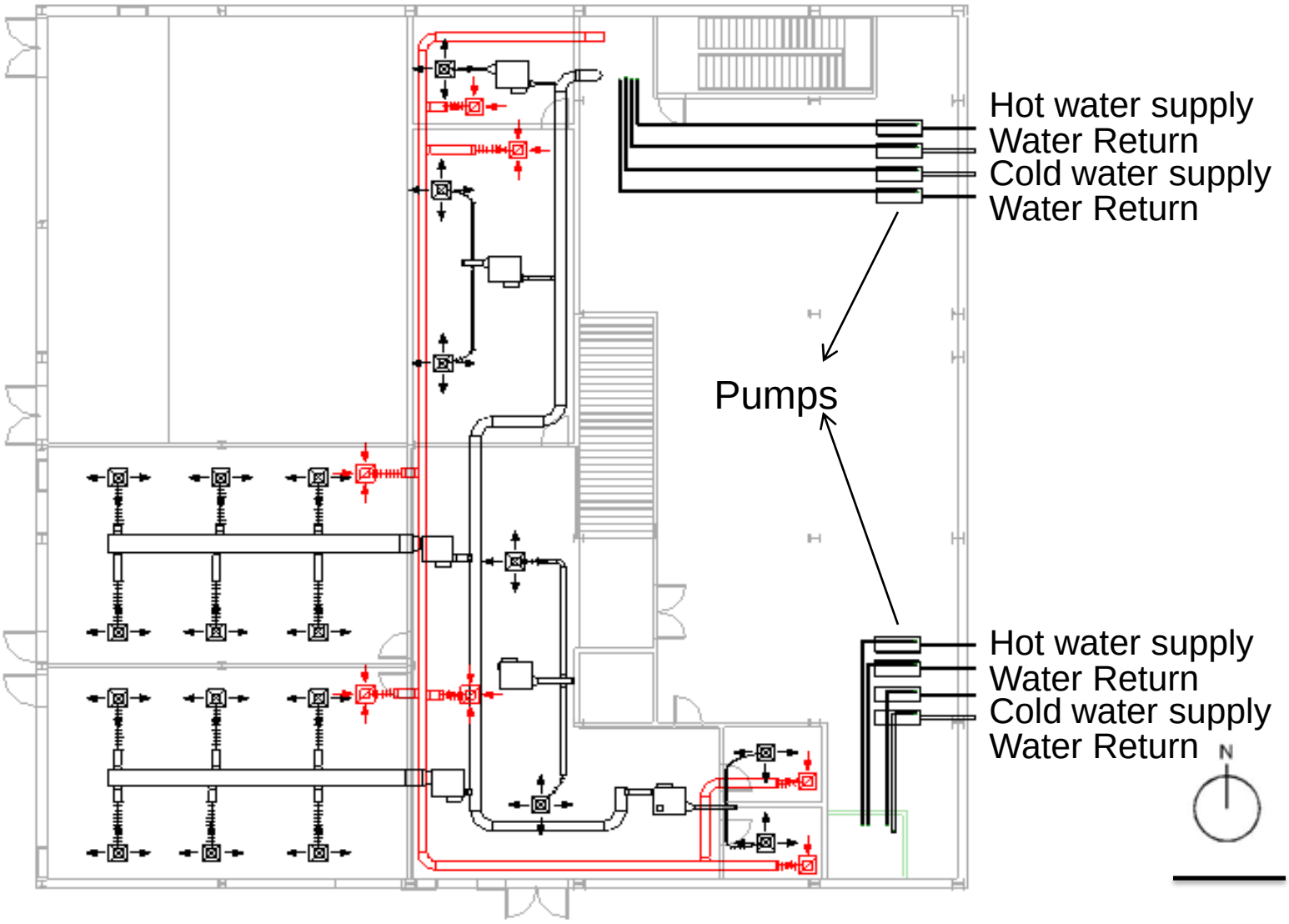
South View



Supply air

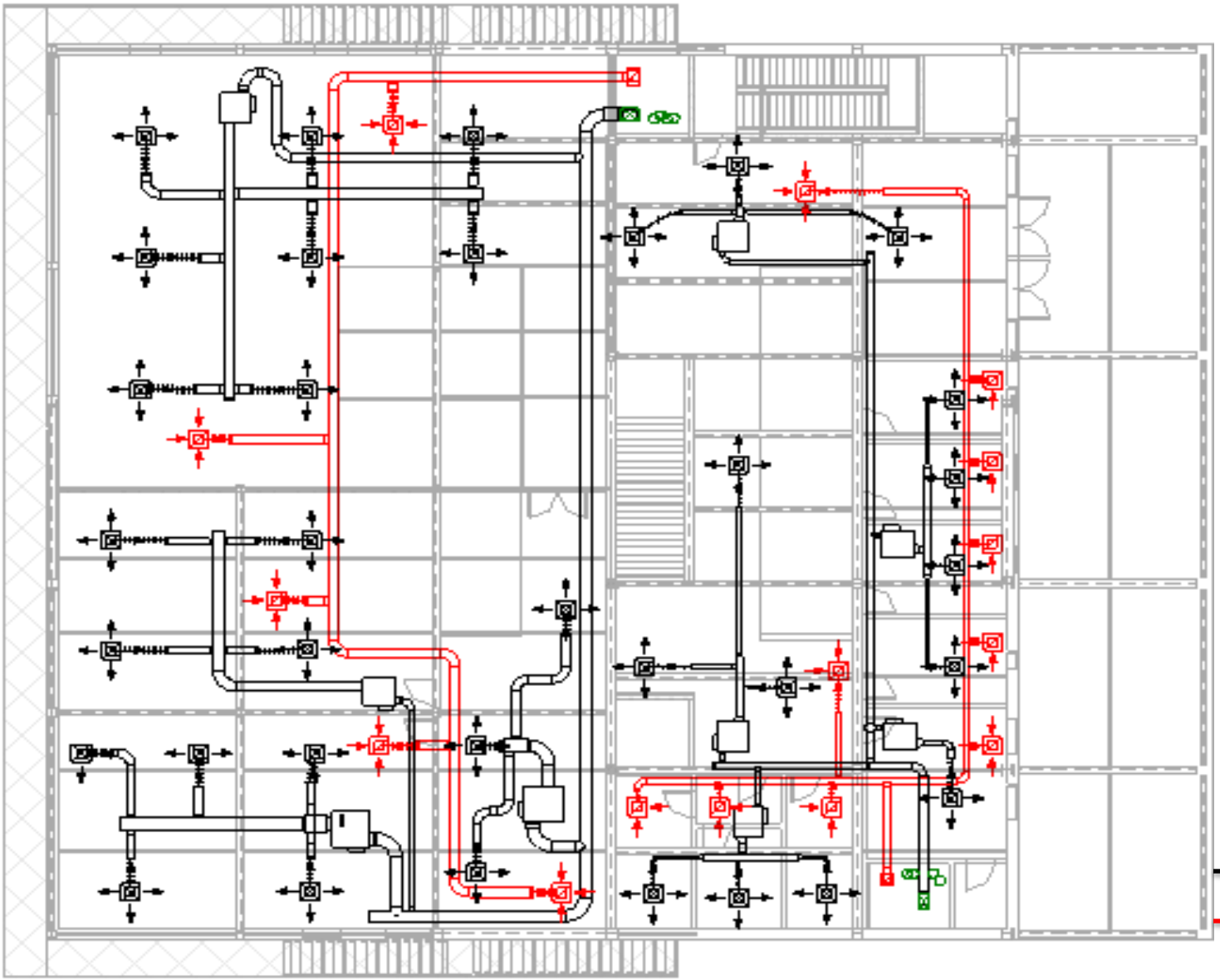
Return air

HVAC System – Basement



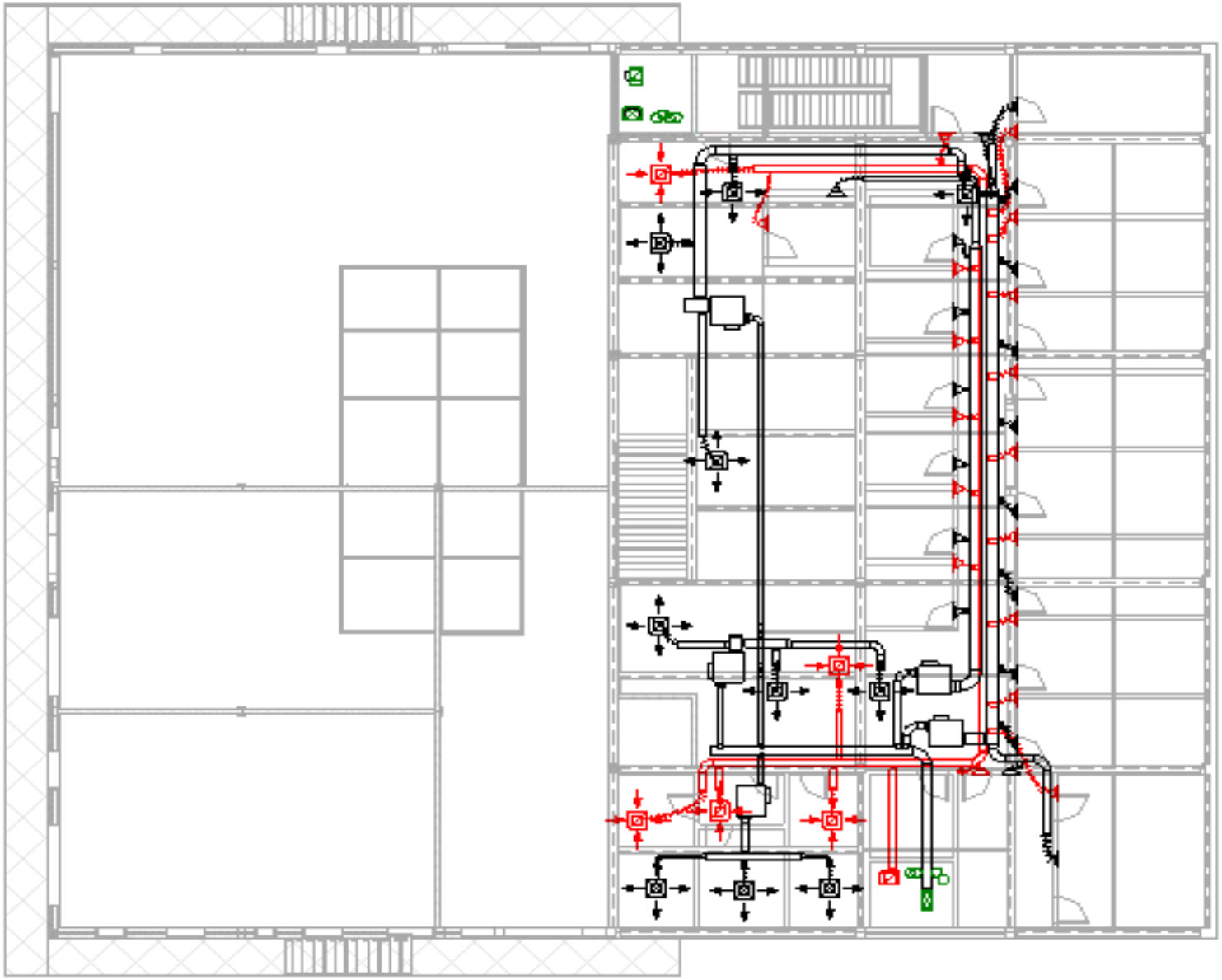
HVAC System – Ground Floor

MERGE



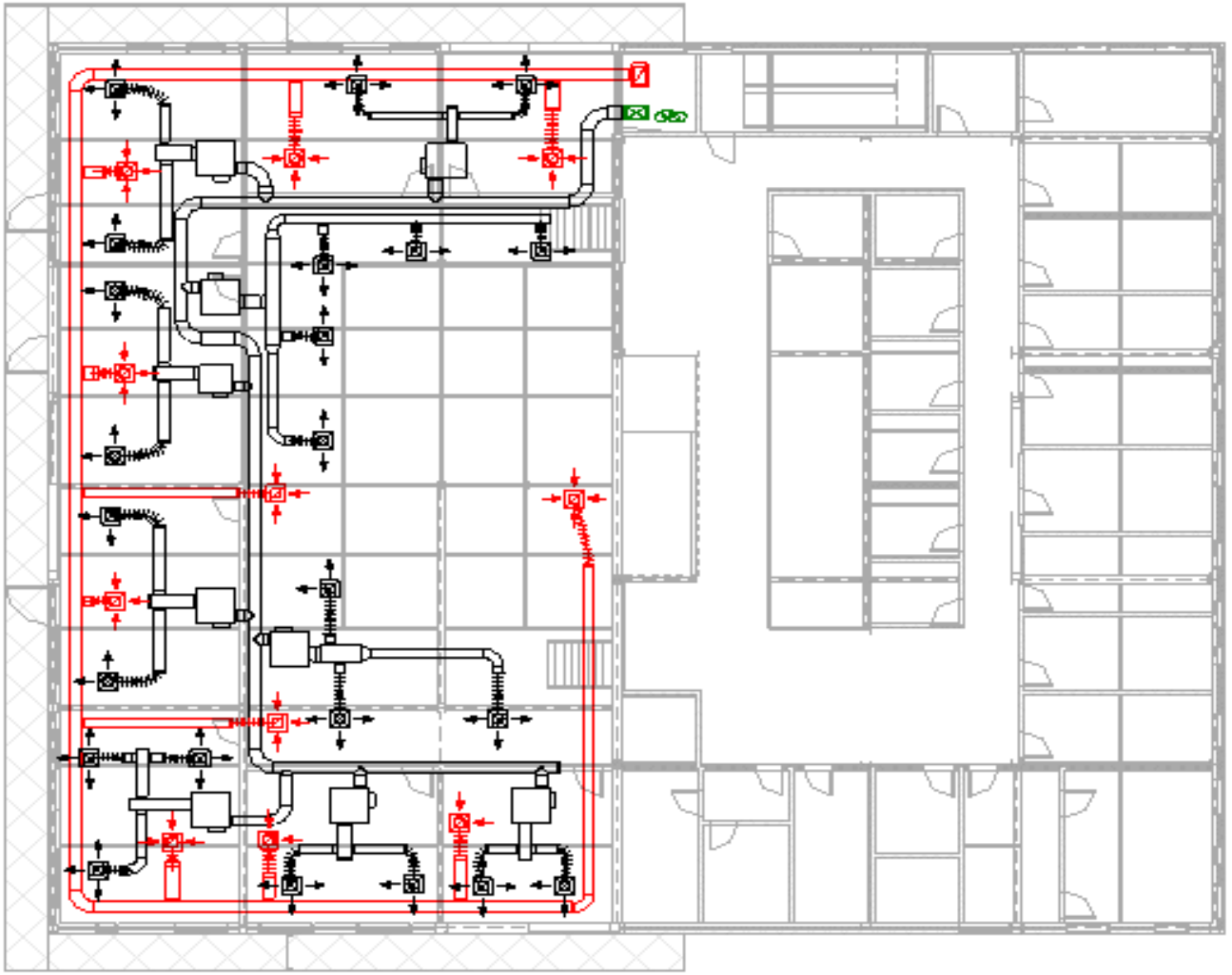
HVAC System – First Floor

MERGE



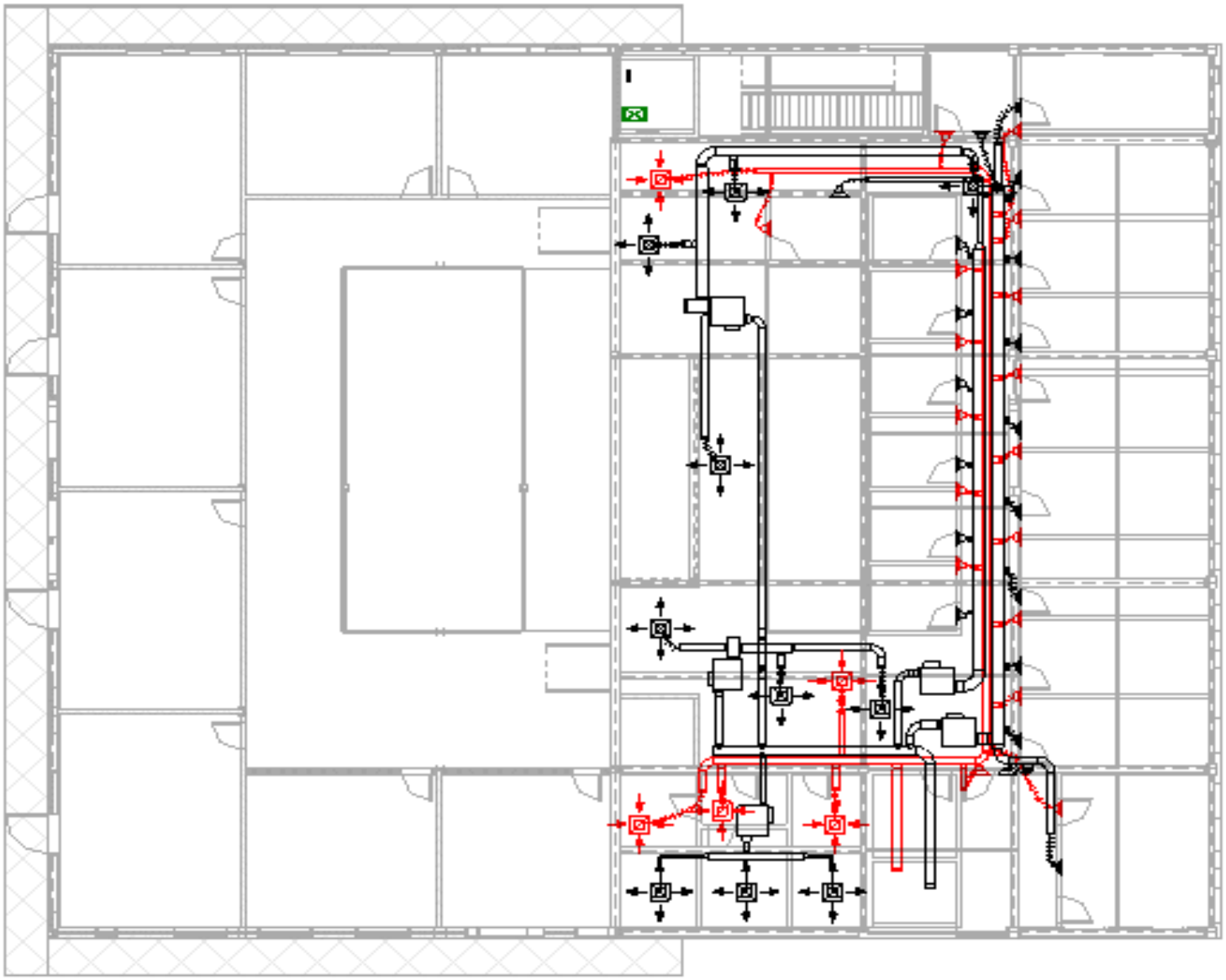
HVAC System – Second Floor

MERGE



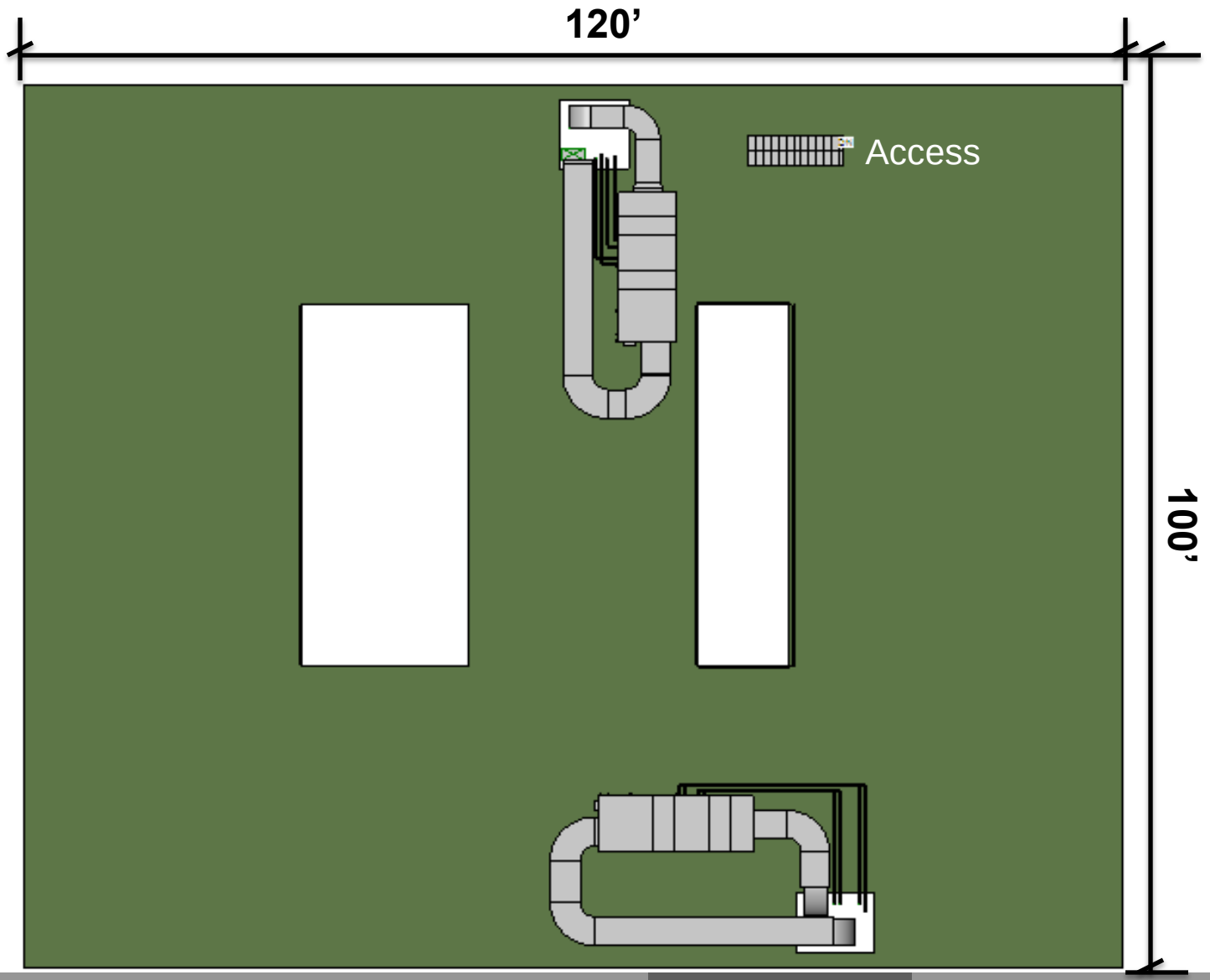
HVAC System – Third Floor

MERGE

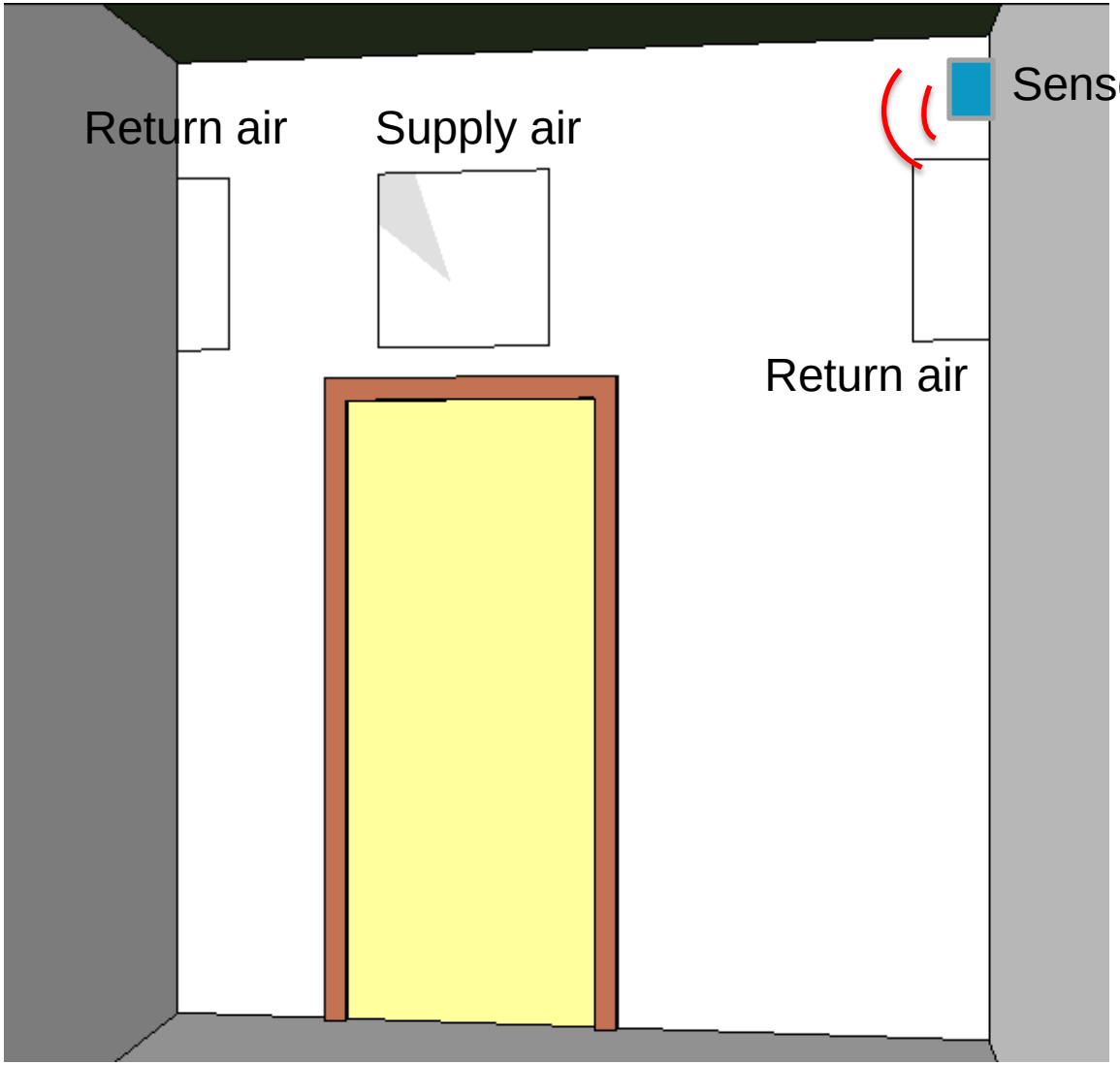


HVAC System – Roof

MERGE

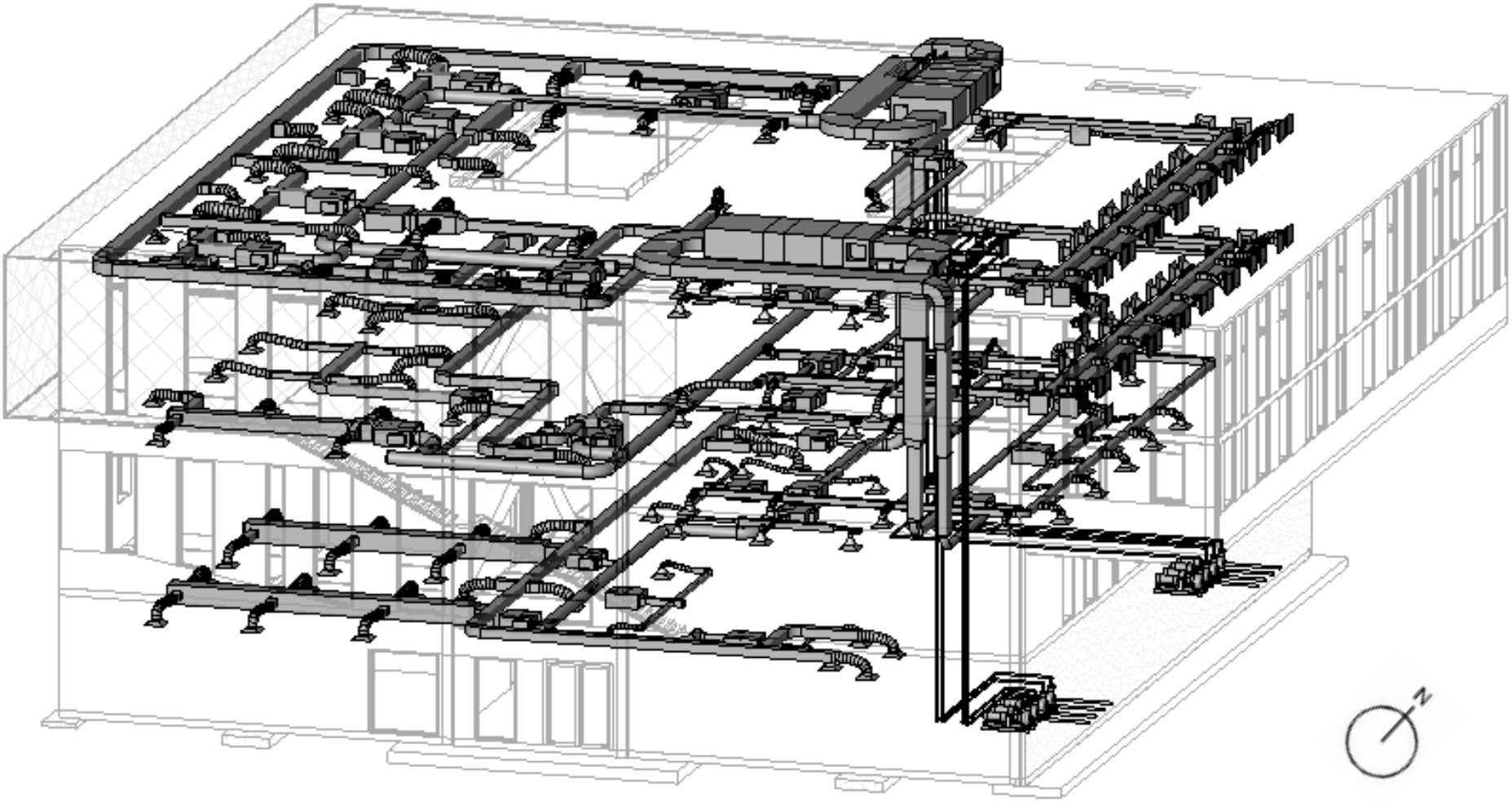


HVAC System – Office



HVAC System – Revit Model

MERGE

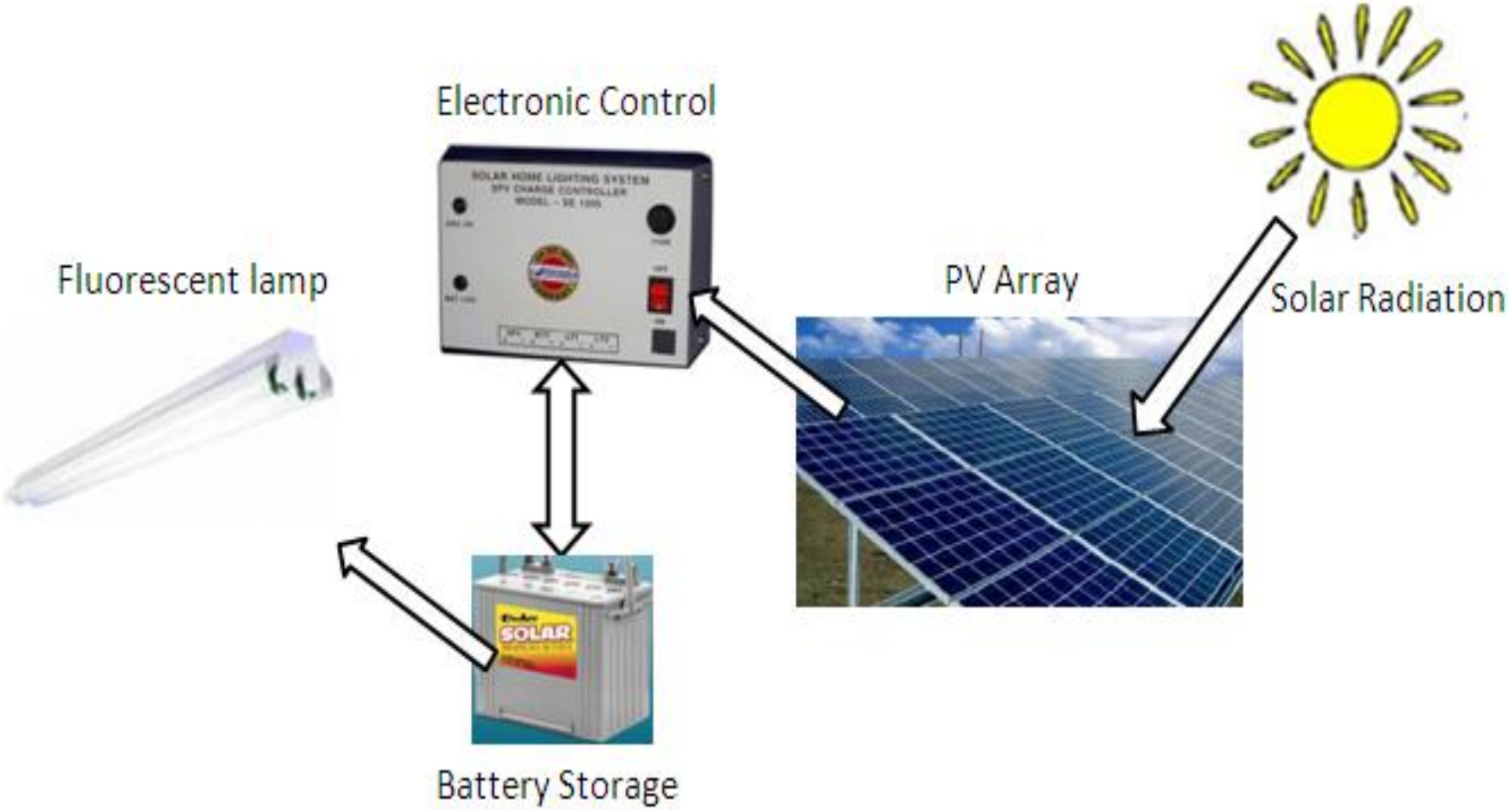


MERGE

- **Solar Photovoltaic (PV) Lighting system**
  - the Grid-Interactive with Battery Backup
- **Location**
  - Roof mount
- **PV Panels**
  - Tilt angle: 7:12
  - South facing

Lighting System

MERGE



MERGE

❑ Power Requirement: 83 kW

AHUs + Pumps + Lighting system:
37+15+1.5x8+19 = 83kW

❑ PV panels

Our building needs 8041ft^2 (97 ft^2/kW)

❑ Solution

Not enough space for 8041ft^2
Put 3875ft^2 solar panels for 40kW
(one AHU with four pumps + Lighting system).

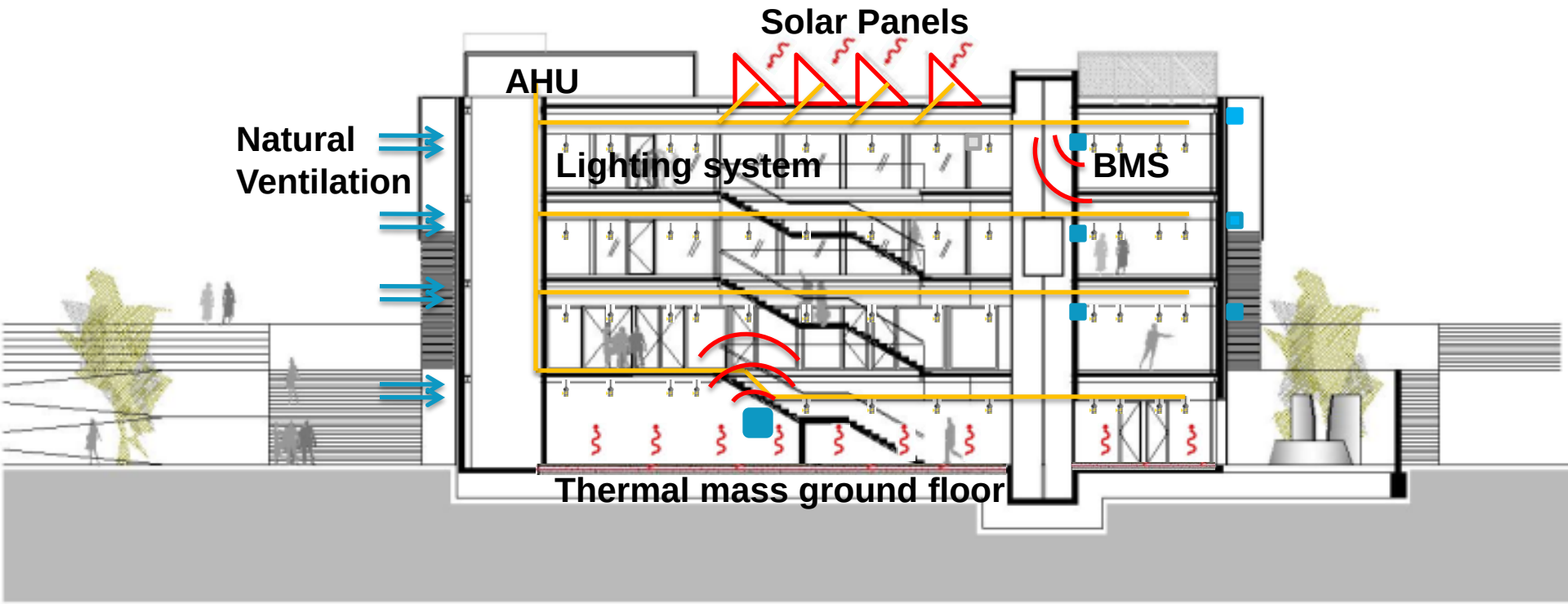
MERGE

❑ Energy Saving

- BMS can save 15% - 20% energy costs
- Less operation hours. (class time)
- Thermal mass ground floor.

❑ Free Power

- PV for Lighting system and one AHU with four pumps.



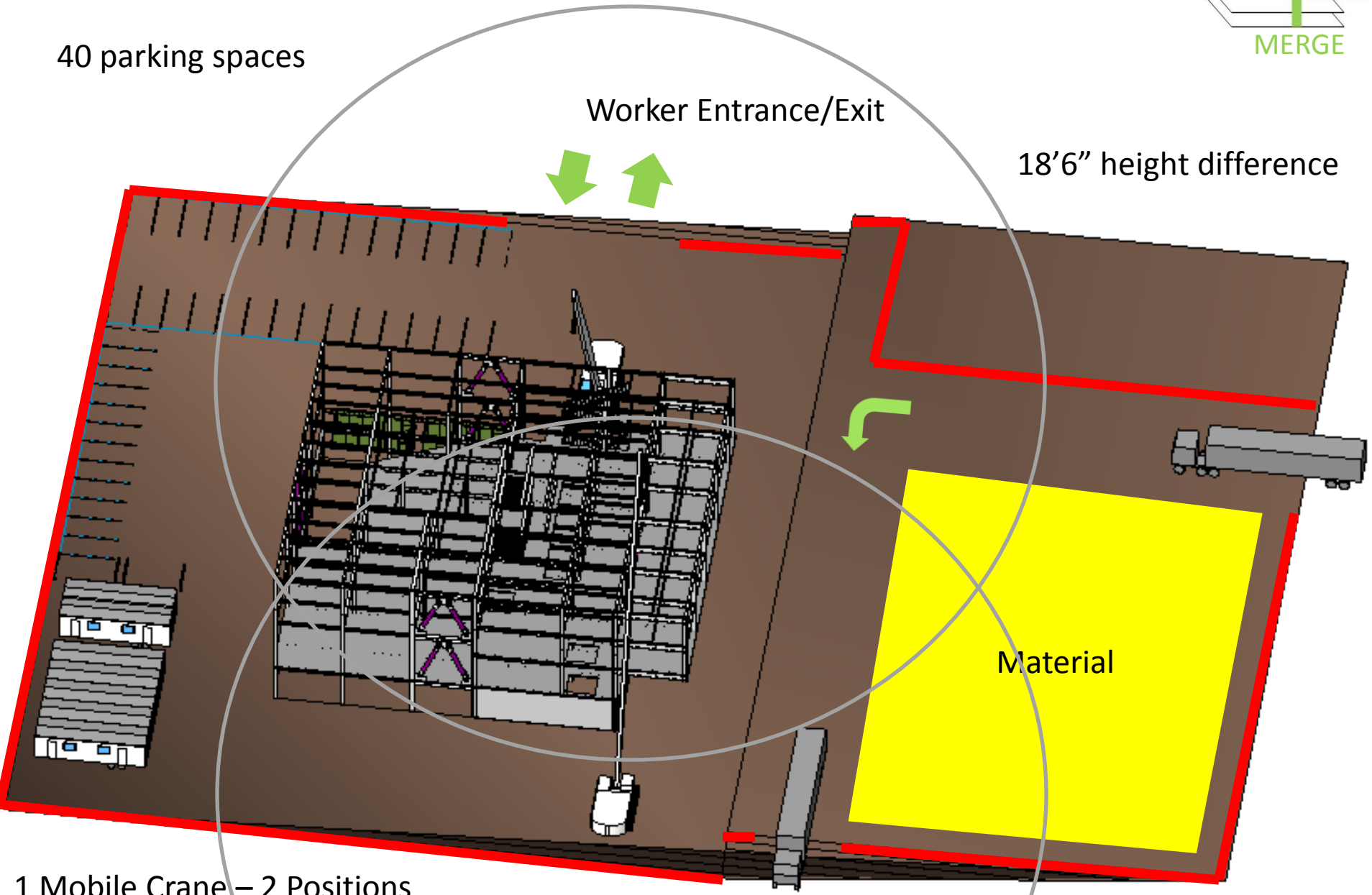
Site Plan

MERGE

40 parking spaces

Worker Entrance/Exit

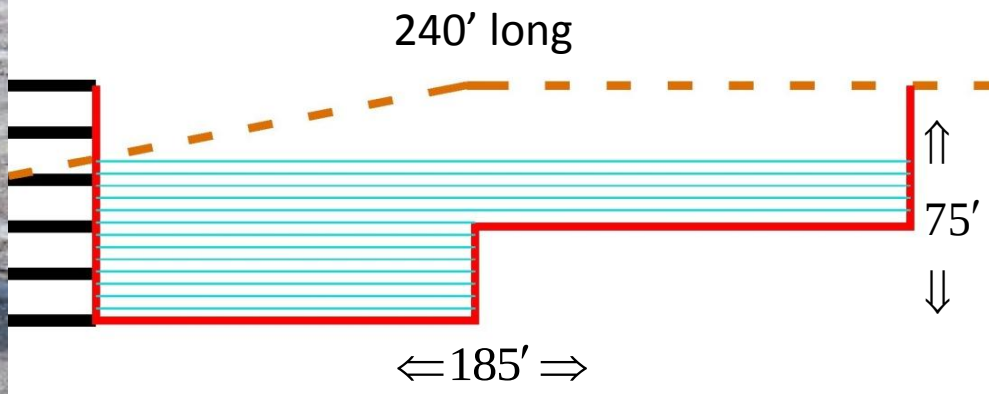
18’6” height difference

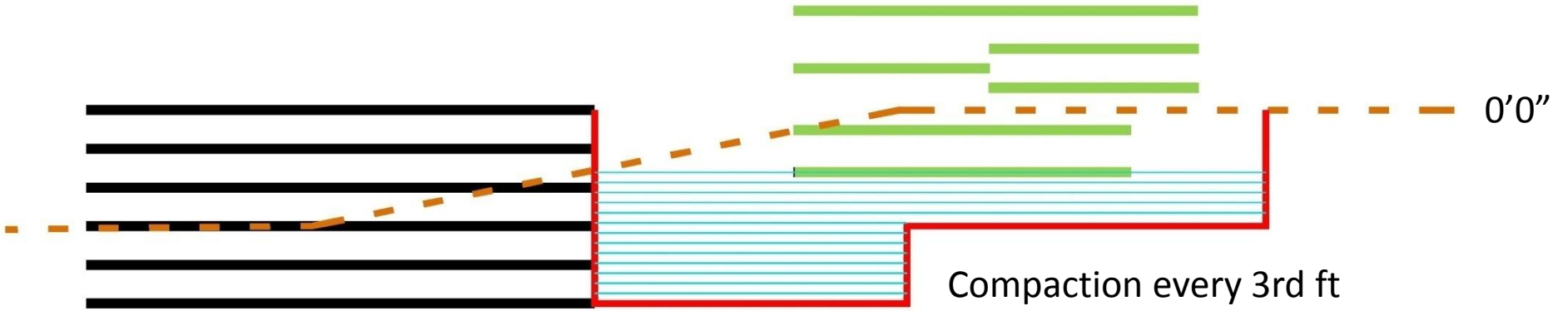


1 Mobile Crane – 2 Positions

Construction Methods – Filling the Hole

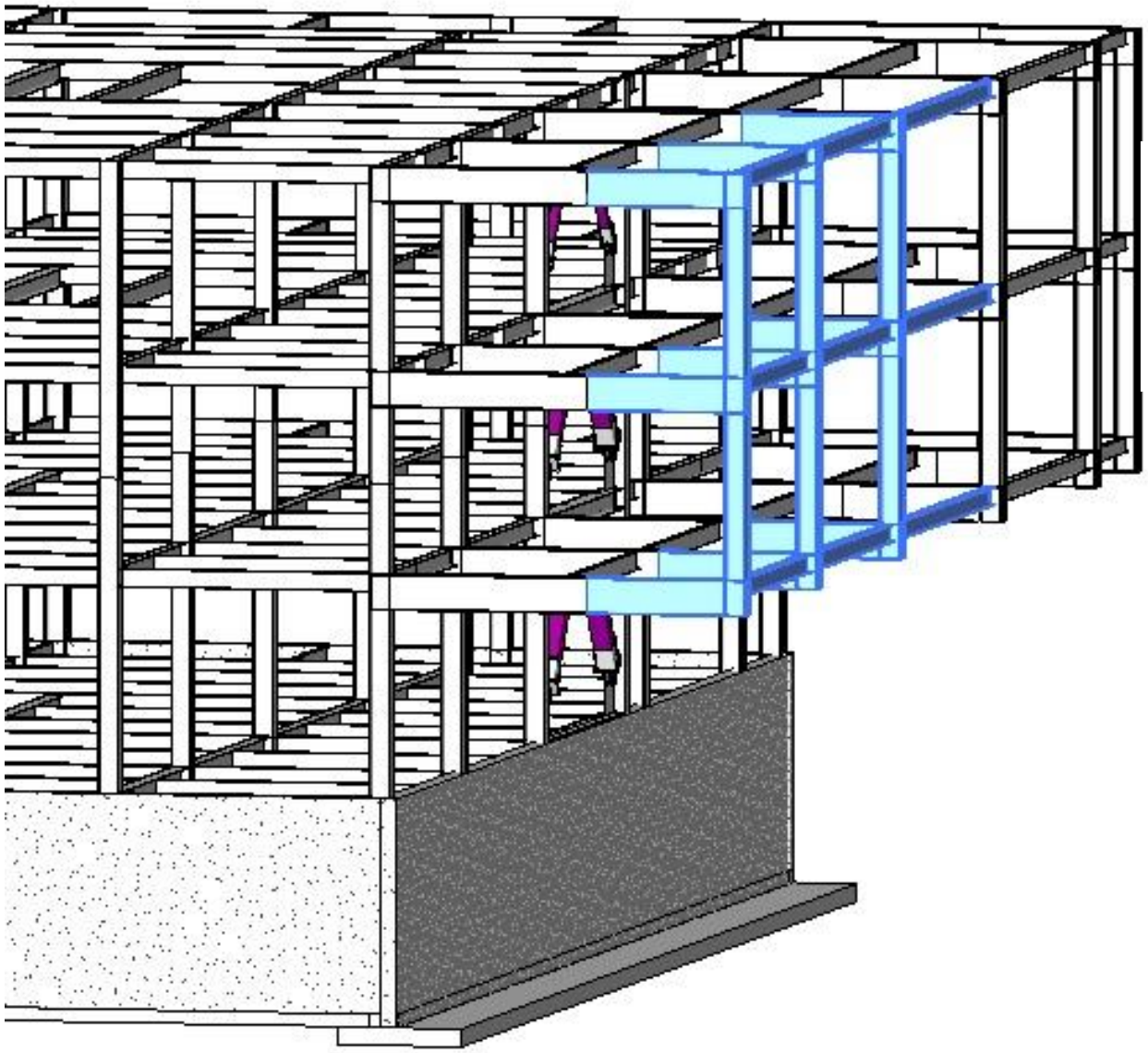
MERGE





Construction Methods – Cantilever Construction

MERGE



Construction Methods – Reused Brick Precast Panels

MERGE

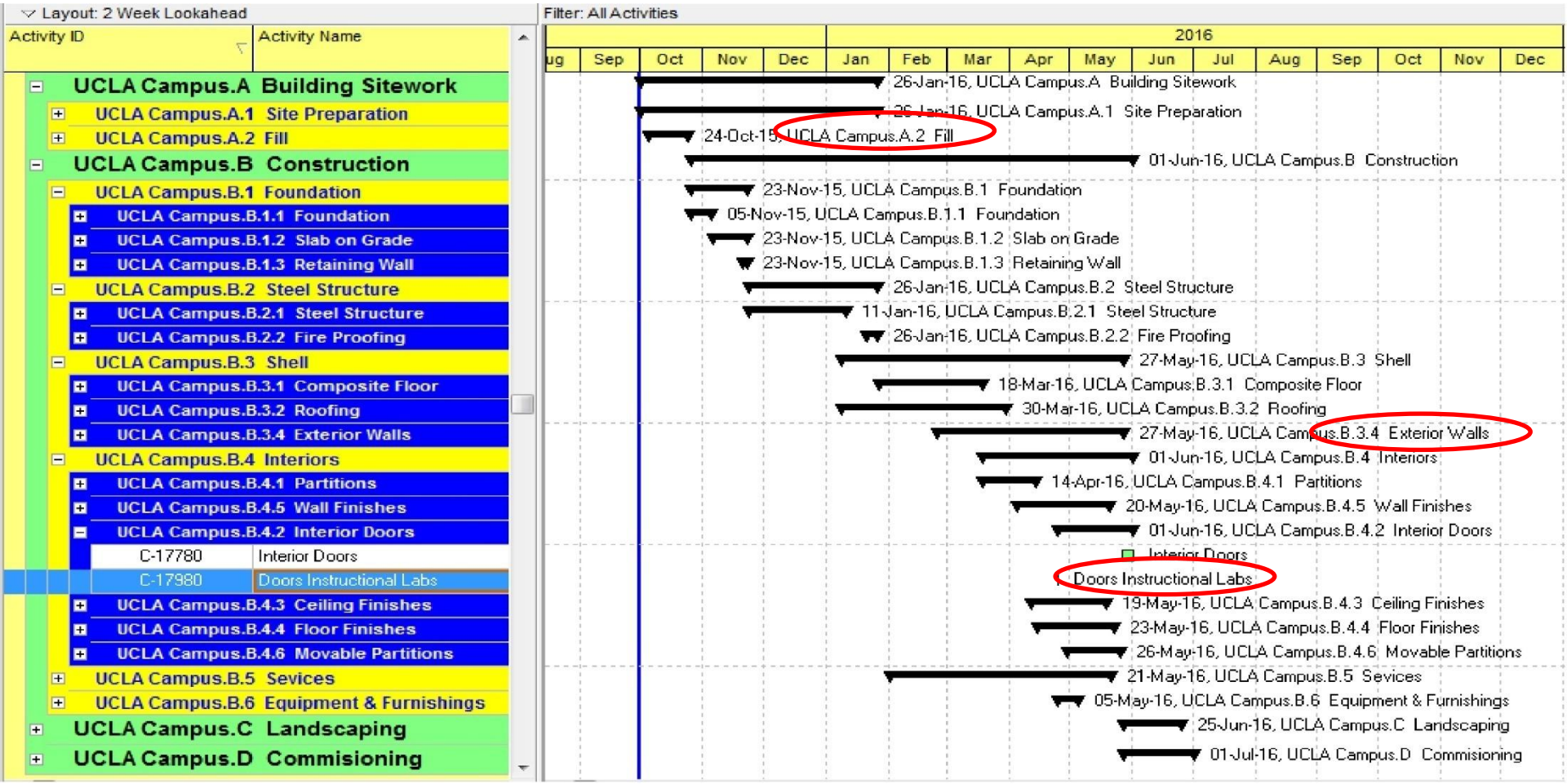
Schedule - Milestones

MERGE

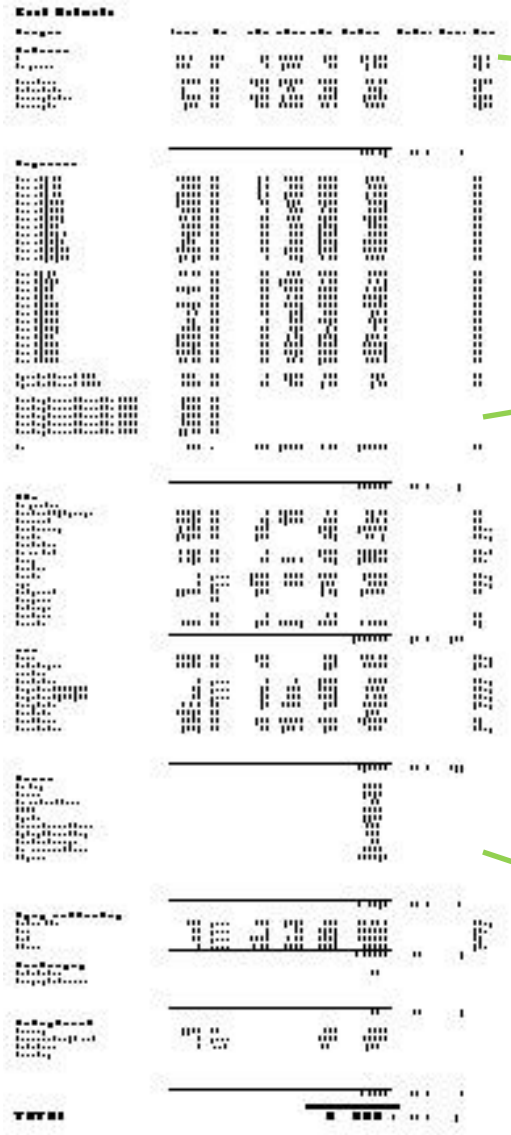
Oct 24th
Fill of Hole

April 25th
Move-In

May 27th
Crane Removal



Cost Estimation – Estimated Inflation 1,5%



Fill + Compaction: $ 140,930

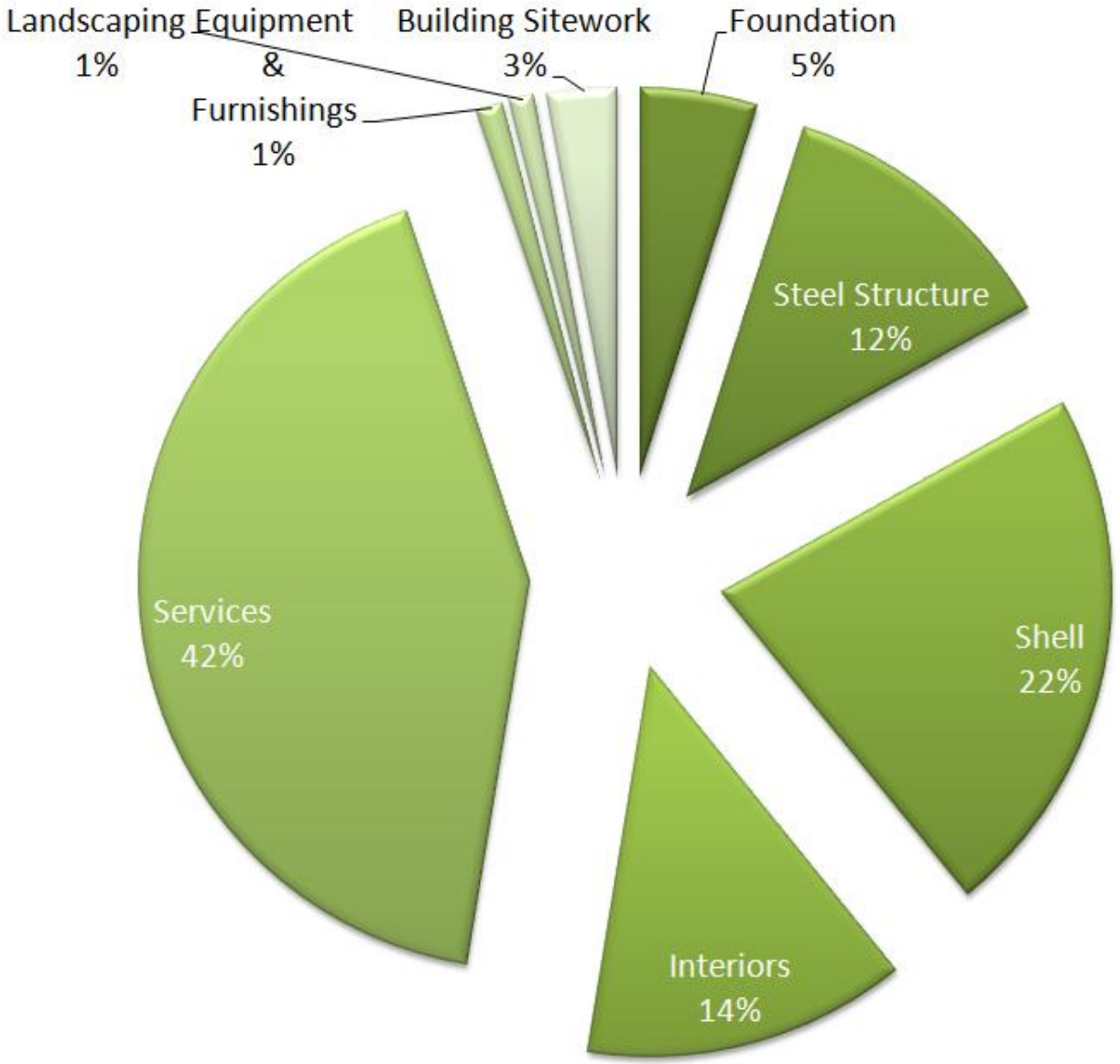
BRB's: $ 129,920

Windows: $ 582,230

PV-panels: $ 252,000

TOTAL: $ 7,647,760

Cost Estimation



MERGE

Project Structure

MERGE

Public
UCLA

User
students + faculty

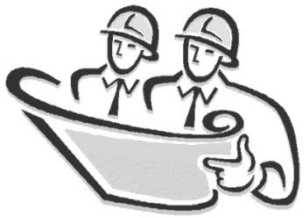
Rental fee

Public sector

Private sector

Project Company

Contractor



Bank

Investor

Insurance Company

Building Areas

MERGE

Gross Floor Area - GFA - (ft²) 34.443		
Net usable area - UFA - (ft²) 29.999		Structural area - (ft²) 4.444
Net assignable area - (ft²) 15.210	Non-assignable area - (ft²) 14.790	

consists of major space use categories:

auditorium	*2.745*
classrooms	*3.660*
faculty offices	*3.380*
student offices	*1.582*
seminar rooms	*1.152*
instructural labs	*1.873*
administration	*538*
chair´s offices	*280*

consists of:

Service Area	*2.110*
Circulation	*9.623*
Mechanical	*3.057*

Life Cycle Benchmarks

Ratio	Value	Goal
Building Surface/Building volume (S/V)	0,22	as small as possible
Usable floor area/gross floor area (UFA/GFA)	0,87	should be > 0,6
Circulation area /usable floor area (CA/UFA)	0,32	as small as possible
Building Volume/gross floor area (V/GFA)	2,93	should be around 3
non-assignable area/ net assignable area	0,97	as small as possible

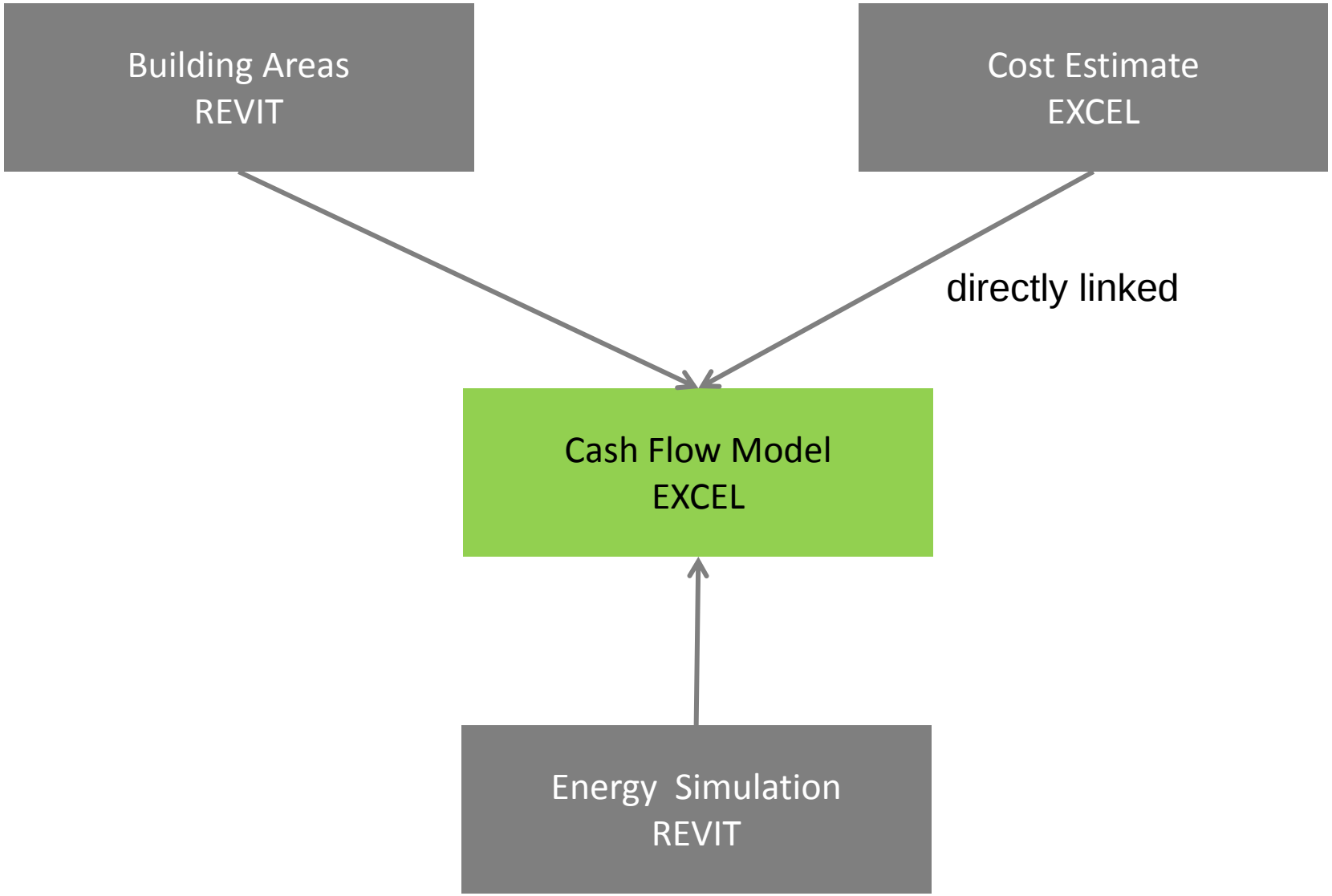
Cash Flow Model – Input Data

MERGE

Revenues	Rental fee
Expenses	Construction / Investment costs Operation costs Maintenance costs Service costs Risk charge

Work process with the Cash Flow Model

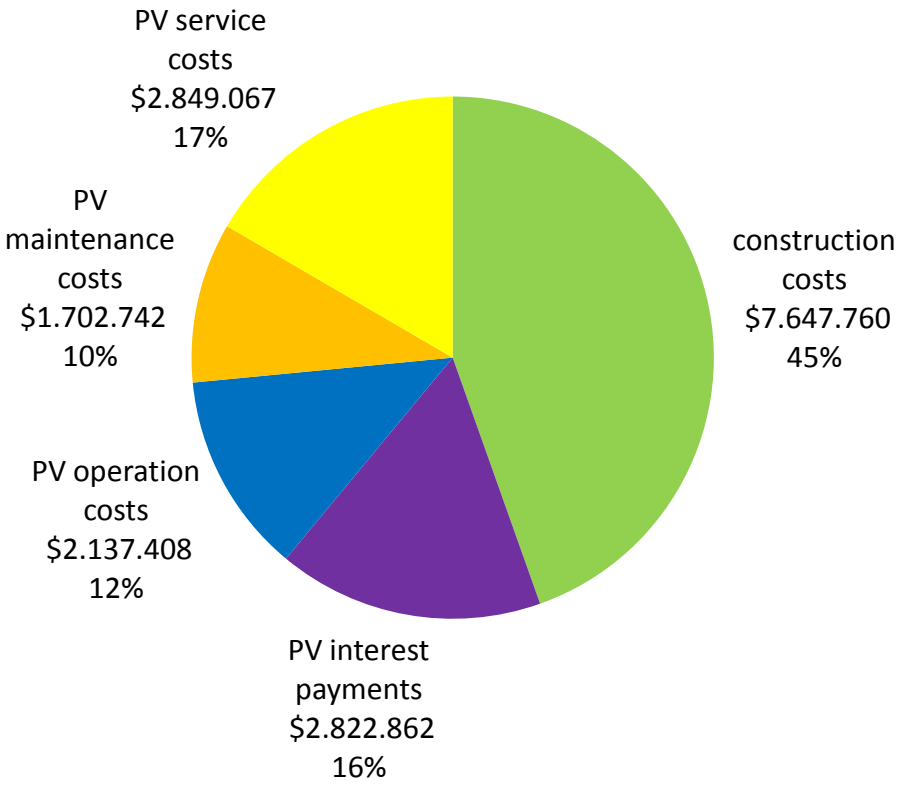
MERGE



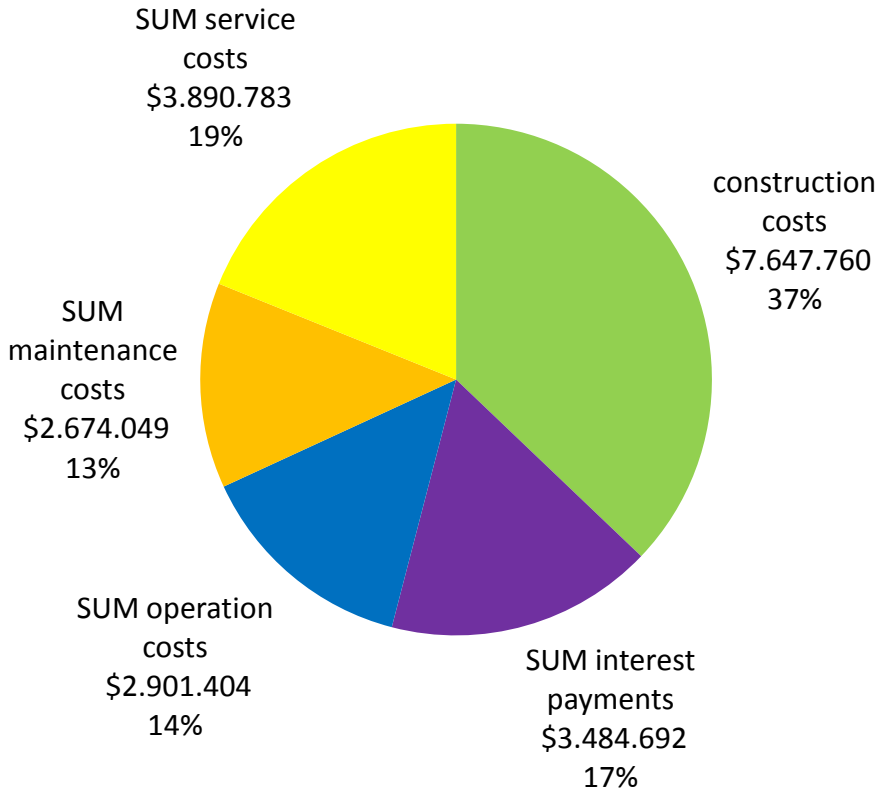
Life Cycle Costs – with financing costs

MERGE

Present Value Life Cycle Costs



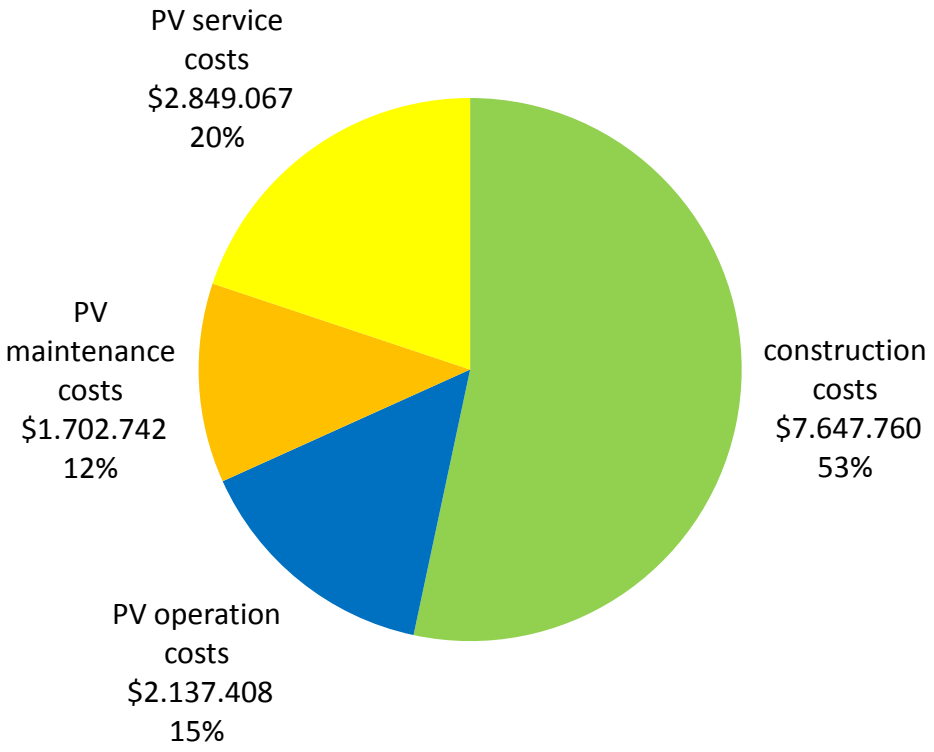
Total Life Cycle Costs



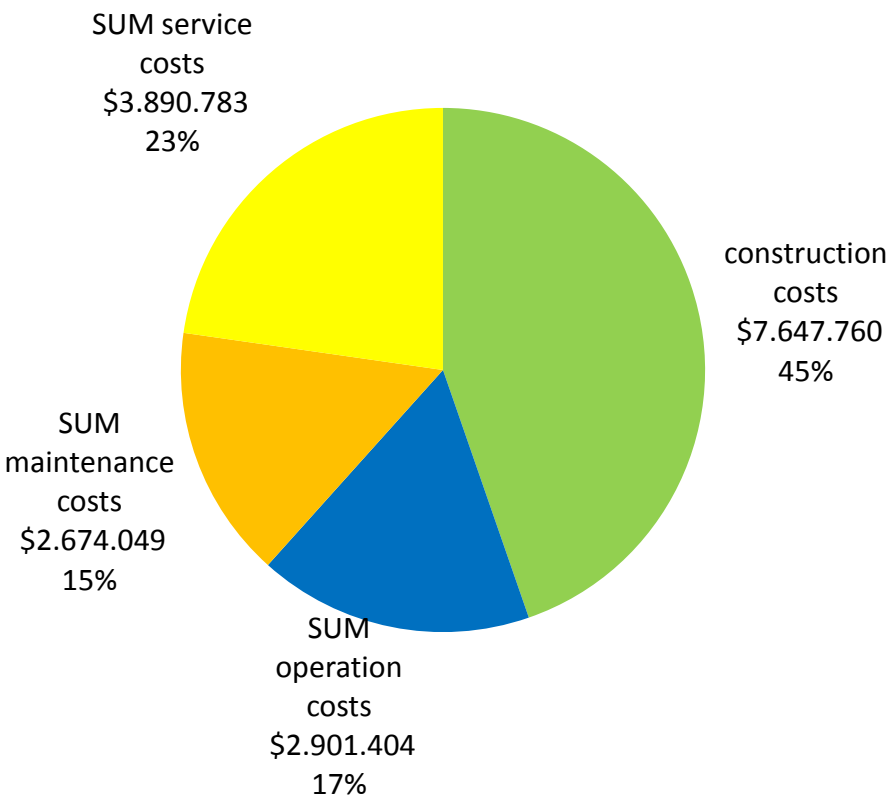
Life Cycle Costs – without financing costs

MERGE

Present Value Life Cycle Costs

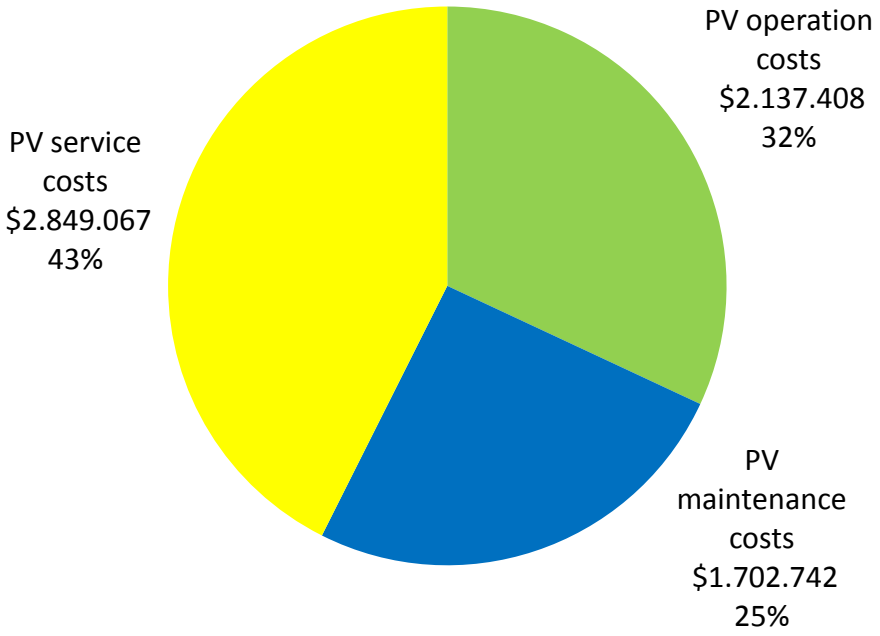


Total Life Cycle Costs

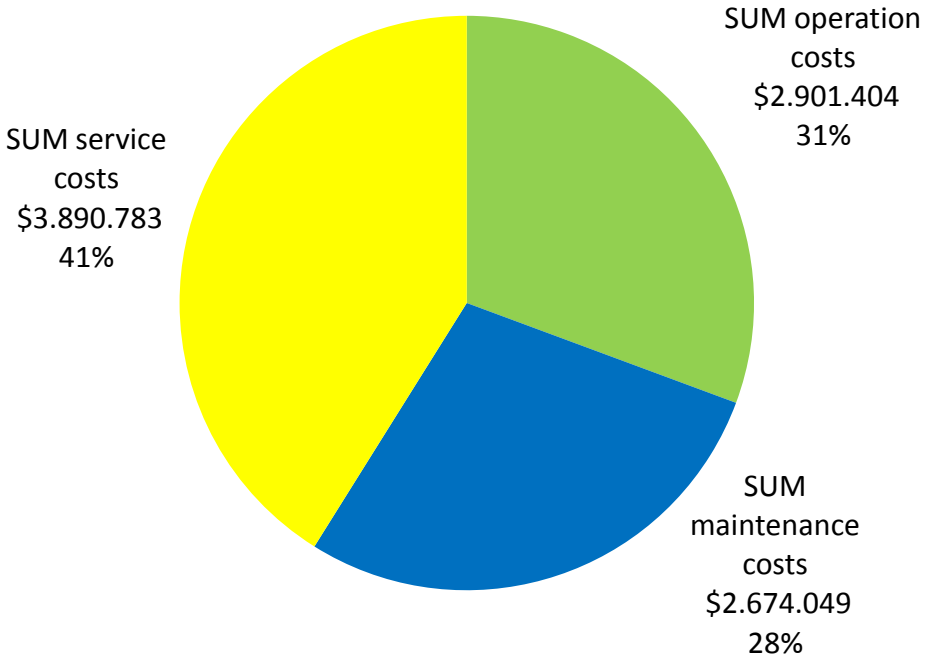


Operation, Maintenance & Service Costs - Distribution

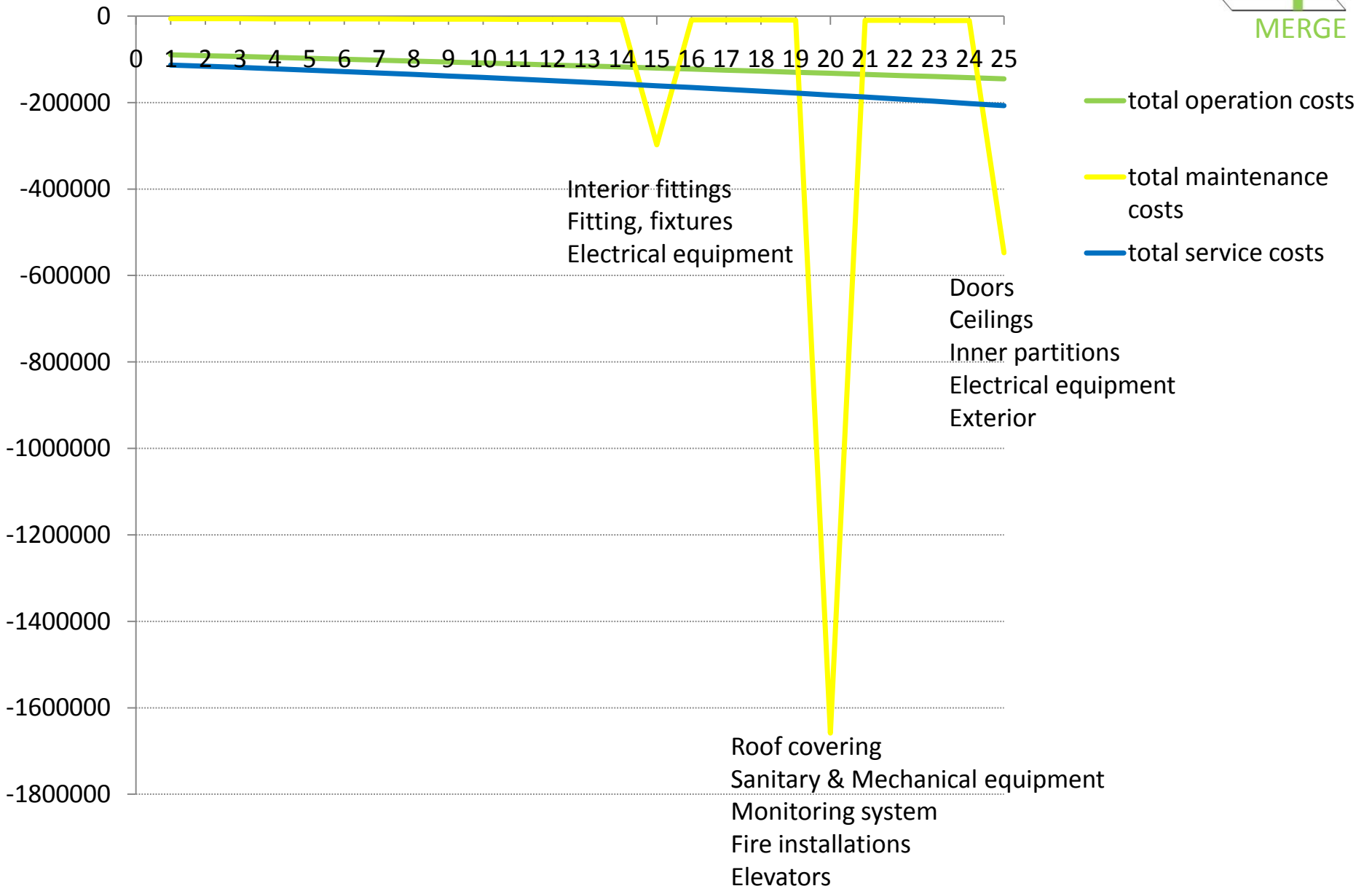
Present Value Operation, Maintenance & Service Costs



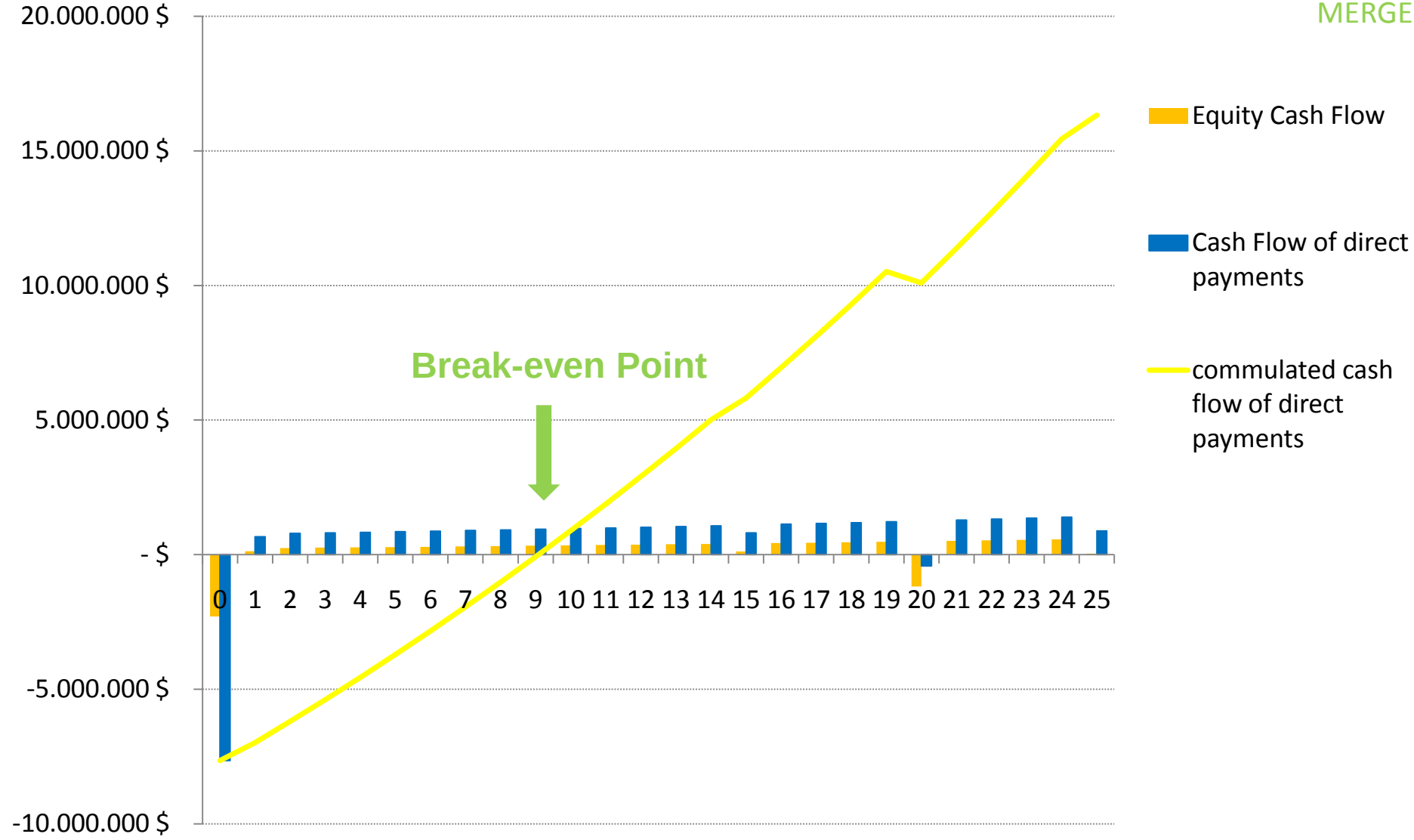
Total Operation, Maintenance & Service Costs



Operation, Maintenance & Service Costs - Development



Break Even Point



Calculated Rent for Owner

MERGE

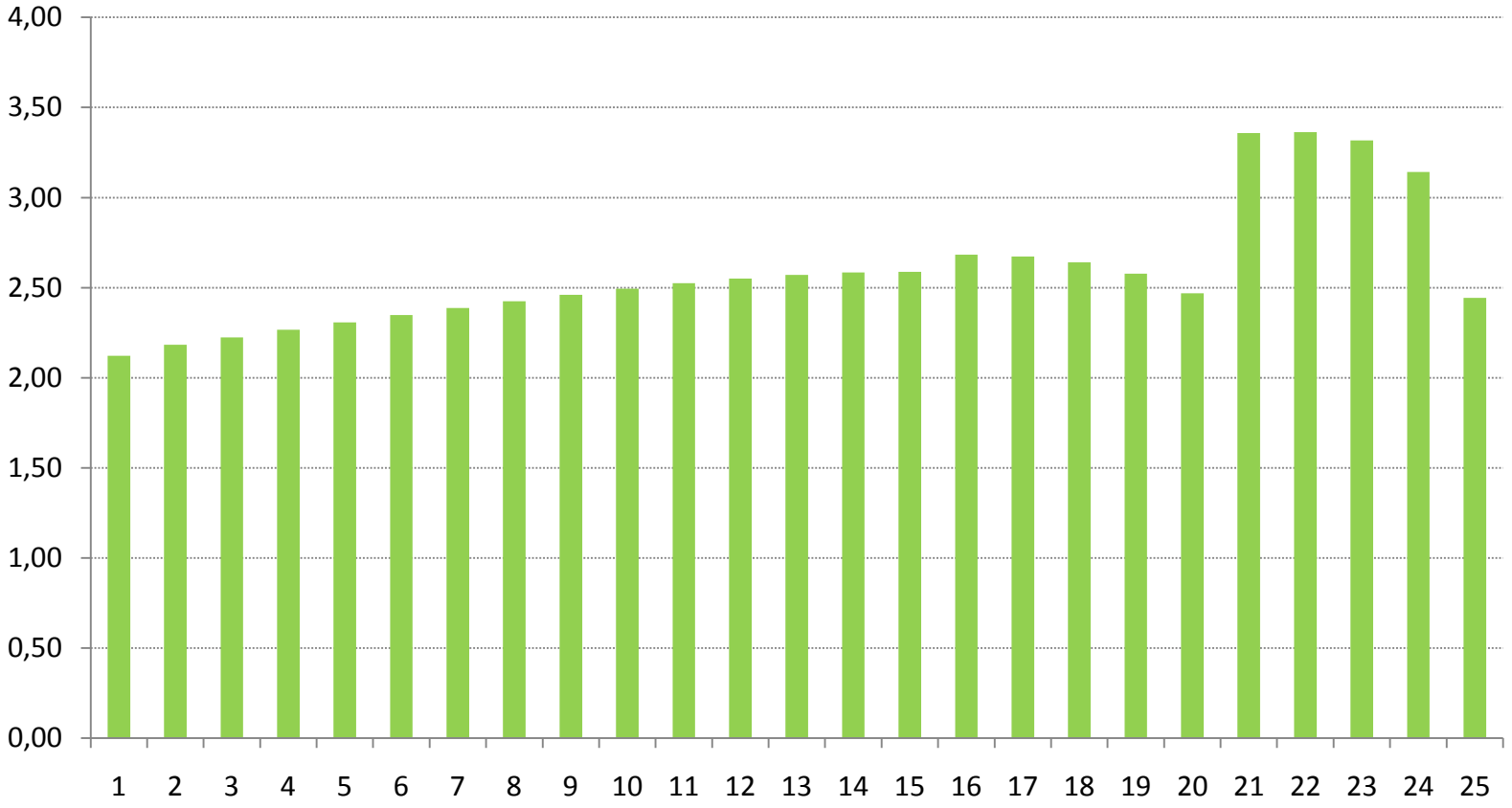
Internal Rate of Return = 11 %

rent at beginning

980.000 $ per year

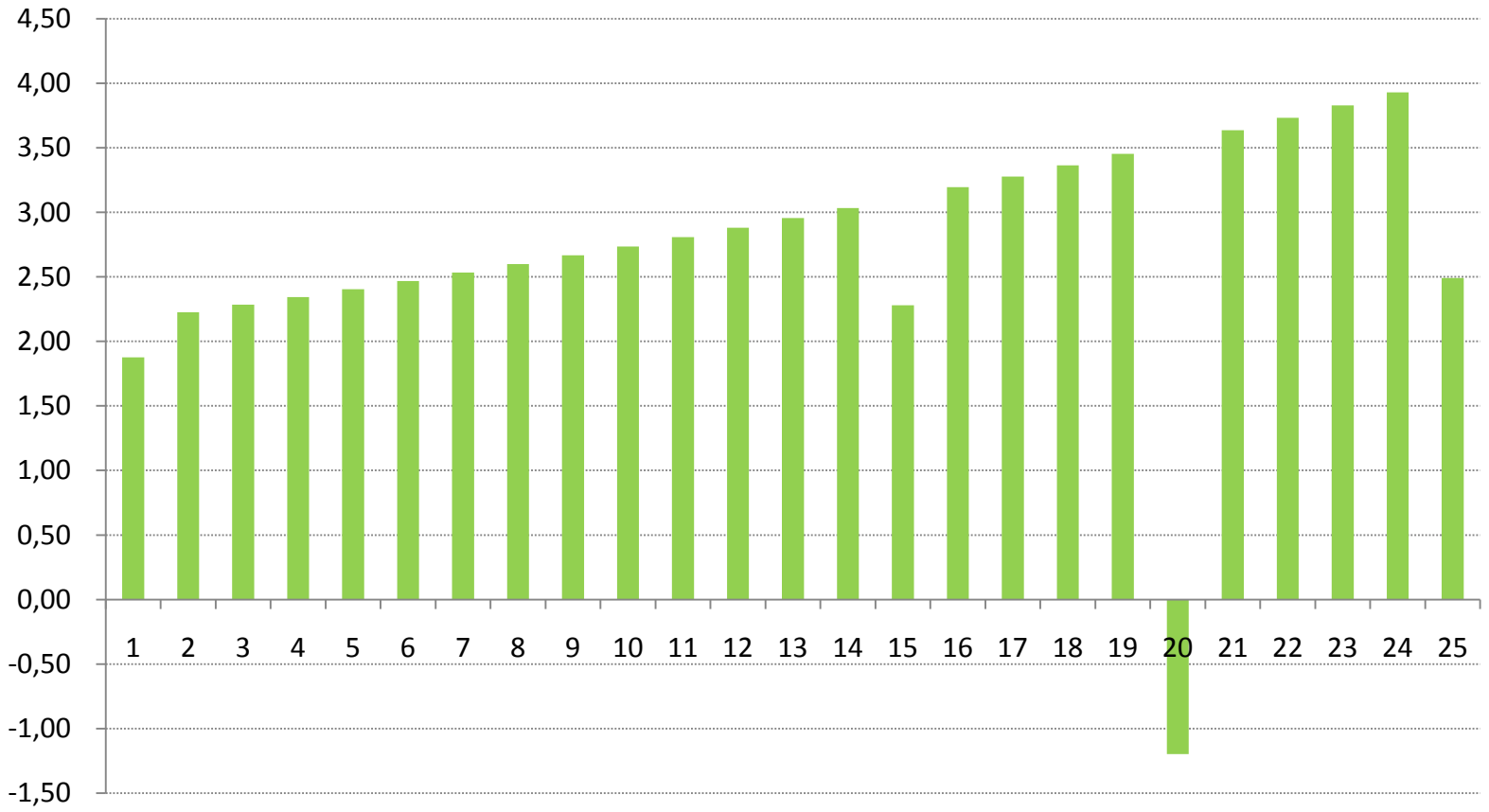
28 $/ft² GFA per month

Loan Life Cover Ratio



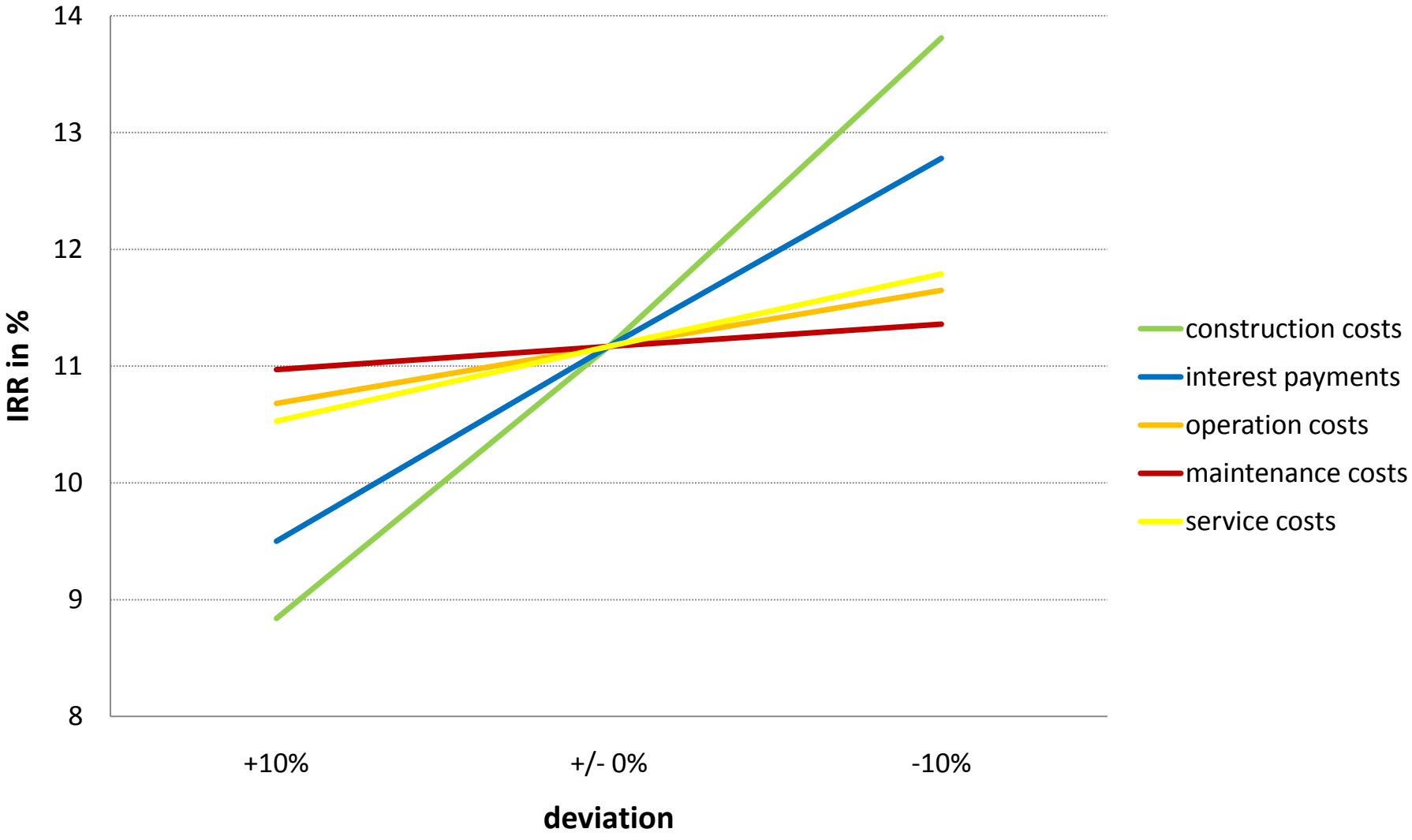
min 1.25

Debt Service Cover Ratio



min 1.15

Sensitivity analysis



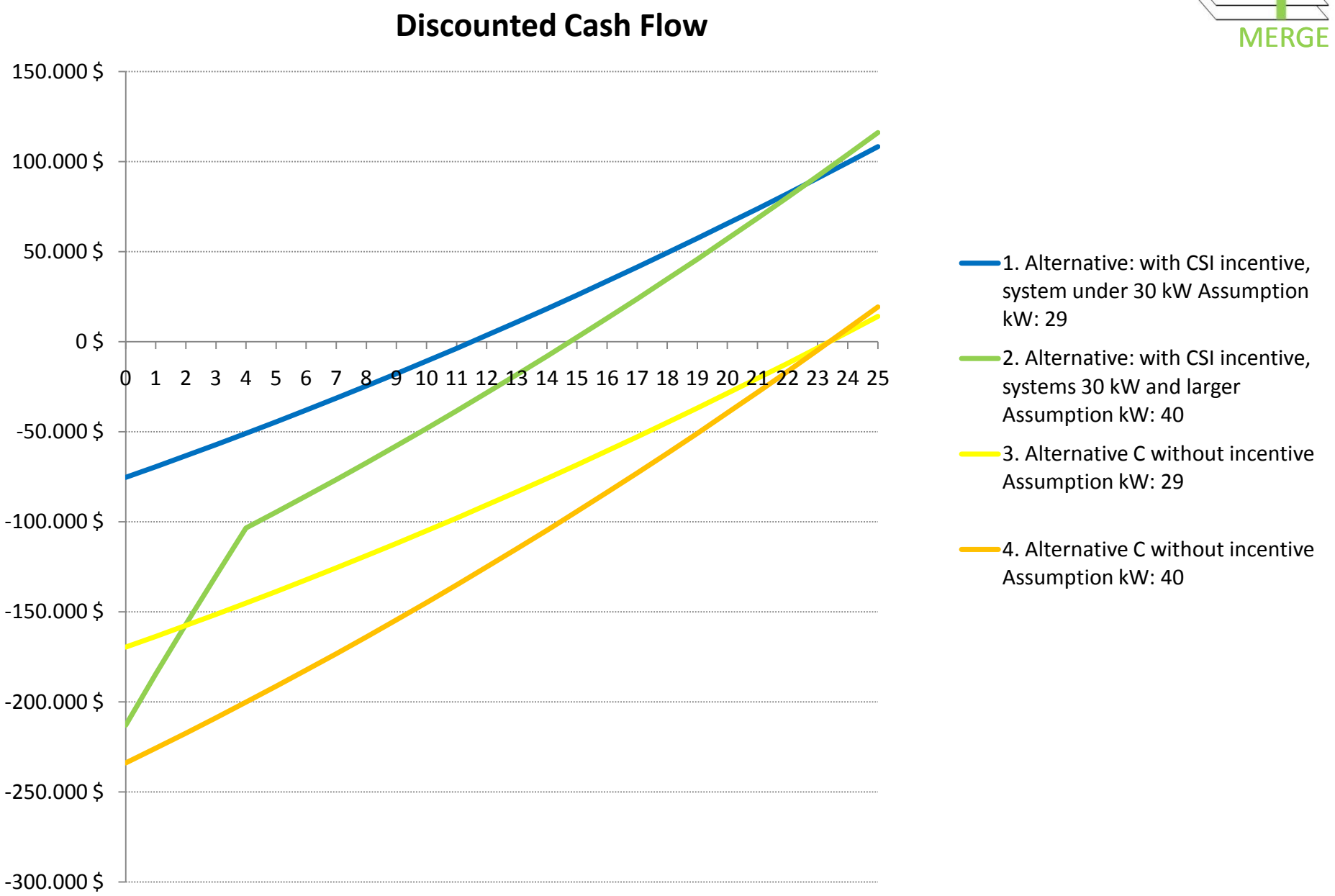
Financial Incentives

- California Solar Initiative started 2007, 10 year program
- programs for different systems sizes:

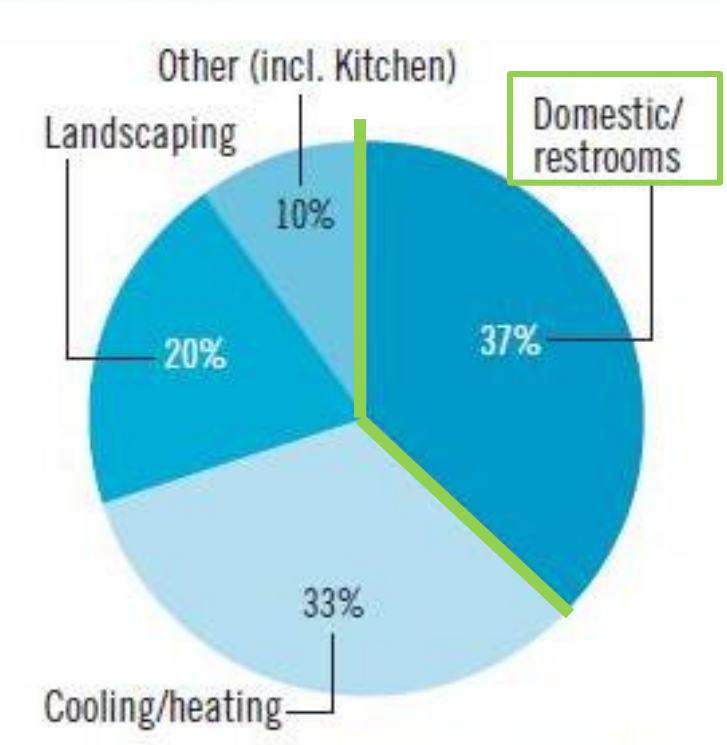
Expected Performance-Based Buydowns (EPBB)
for systems under 30kW
  - $ 3,25/W
  - Upfront payments based on expected performance

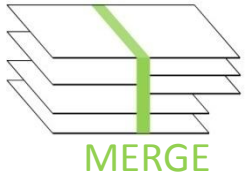
Expected Performance-Based Incentives (PBI)
for systems 30 kW and larger
  - $ 0,50/kWh for the first 5
  - monthly paid based on actual amount of energy produced

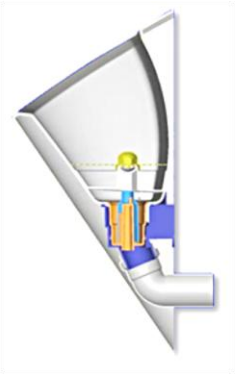
Trade-Off analysis of Photovoltaic system



Save drinkable water







Waterless Urinal

Saving: 3-5 l per flushing

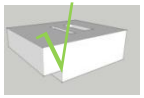
Water saving Toilet

Saving: instead of 9 l per flushing
4l or 6l per flushing

Water saving Faucet
Percolation regulator

Saving: 40-60% of power + water

LEED – Rating

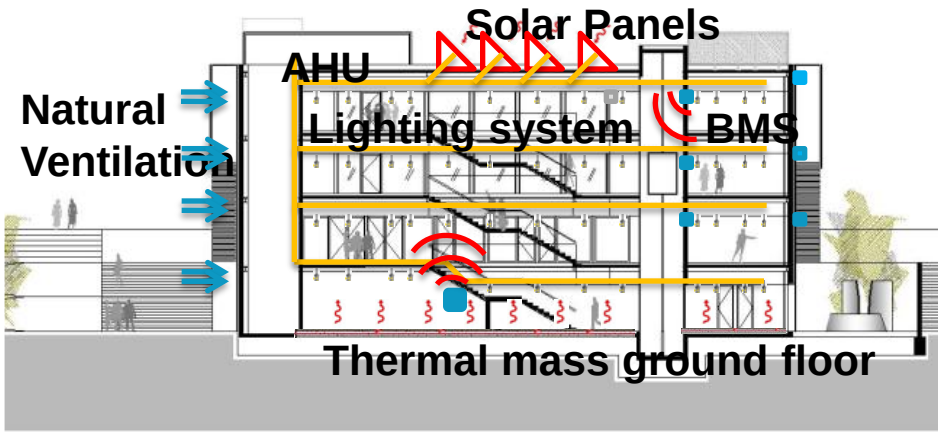
 Sustainable Sites (SS)	16
 Water Efficiency (WE)	4
 Energy and Atmosphere (EA)	15
 Materials and Resources (MR)	6
 Indoor Environmental Quality (IEQ)	12
 Innovation in Design (ID)	3
 Regional Priority (RP)	2
SUM	**58**

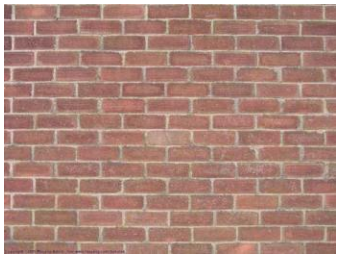
SILVER

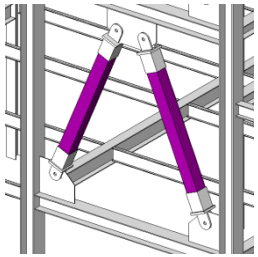
Sustainability

MERGE

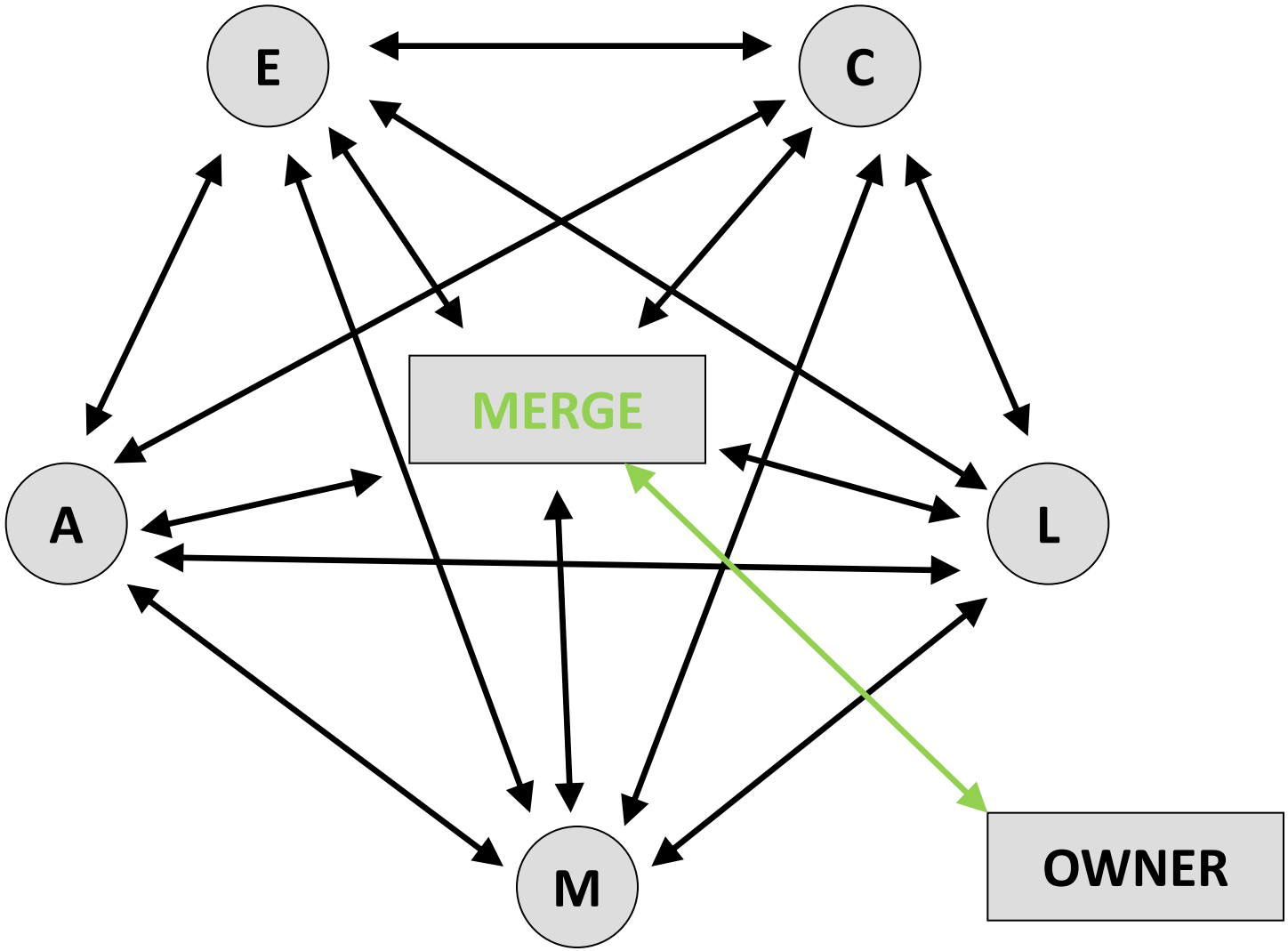
- Photovoltaic panels
- Natural Ventilation
- Thermal Mass
- Reuse Brick for Brick Panels
- Save drinkable Water
- Steel Structure / BRB
- Flexible Floor Plans



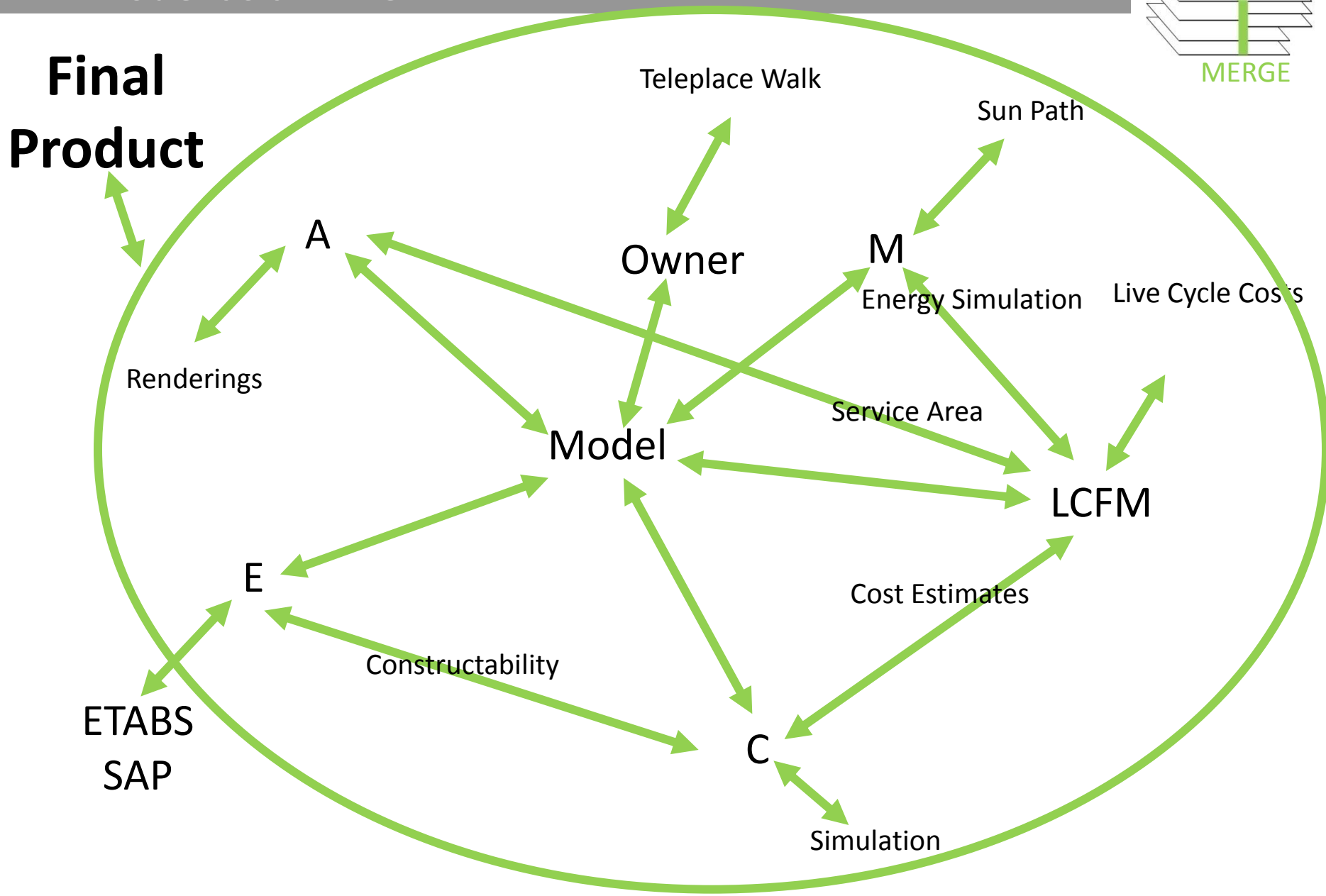




Cross-Disciplinary Decision Process

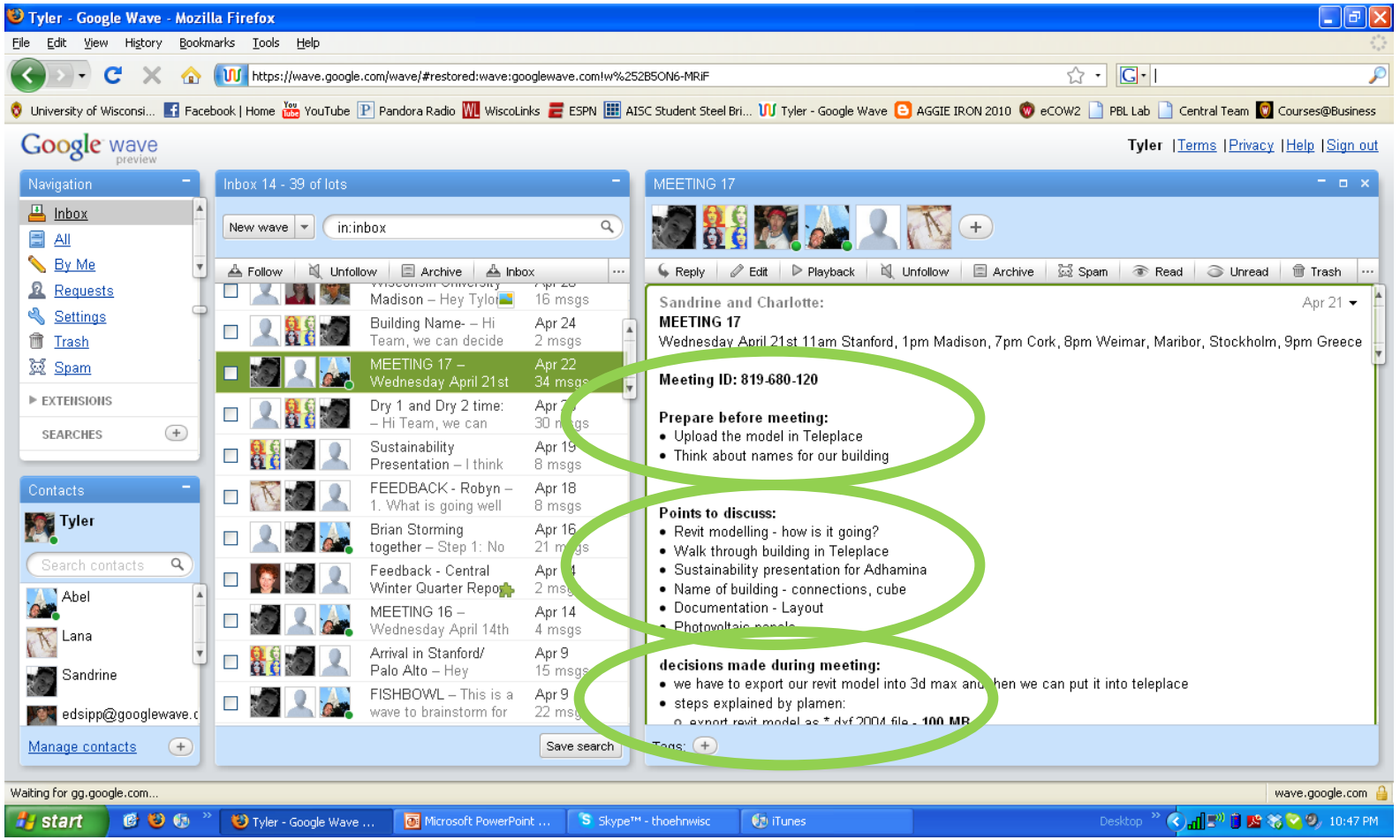


IPD – Model as a Driver



IPD – Integrated Meeting Notes

MERGE

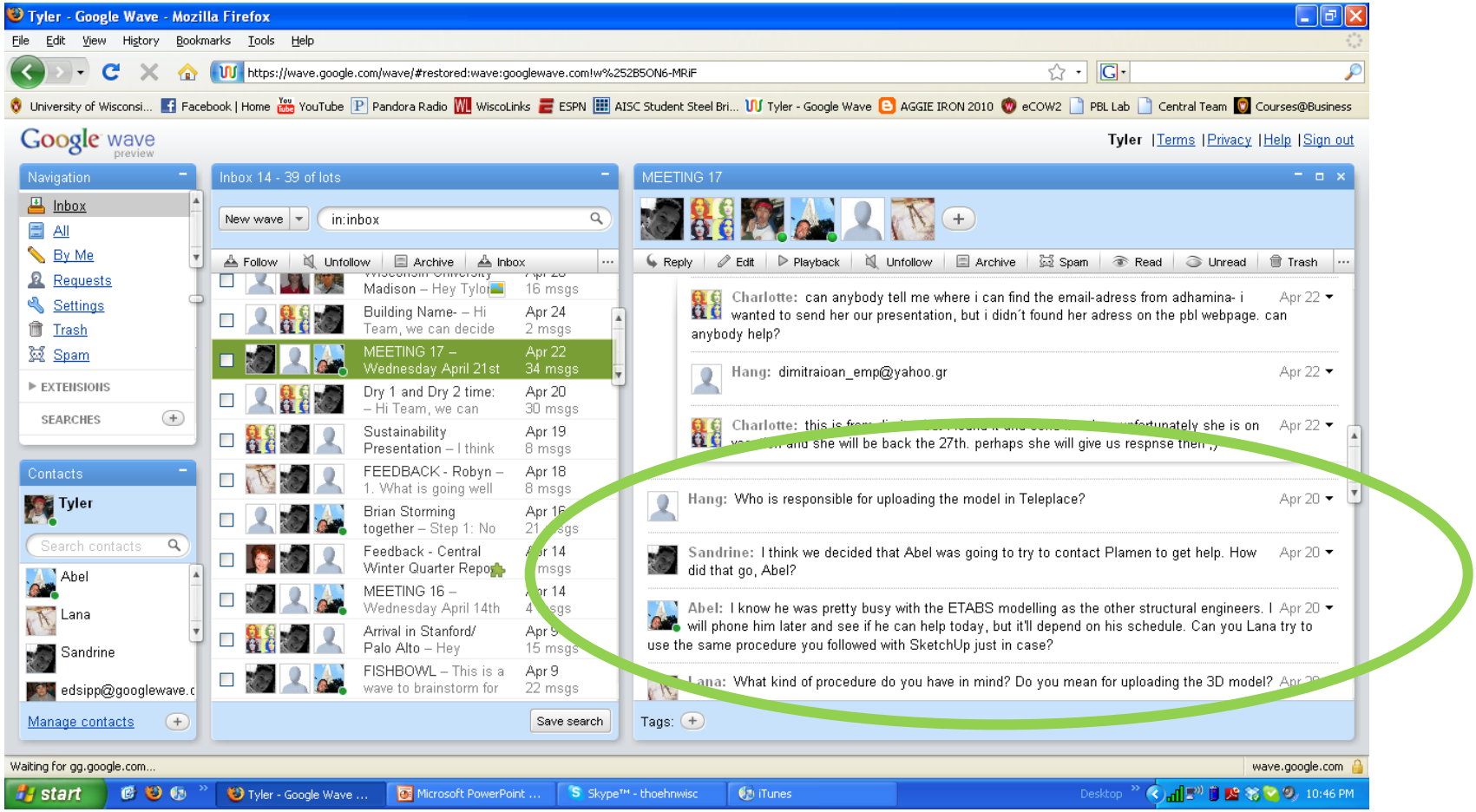


Notes with <u>goals</u> for before and during meeting

Google Wave allowed for <u>live meeting notes</u>

IPD – Integrated Meeting Notes

MERGE

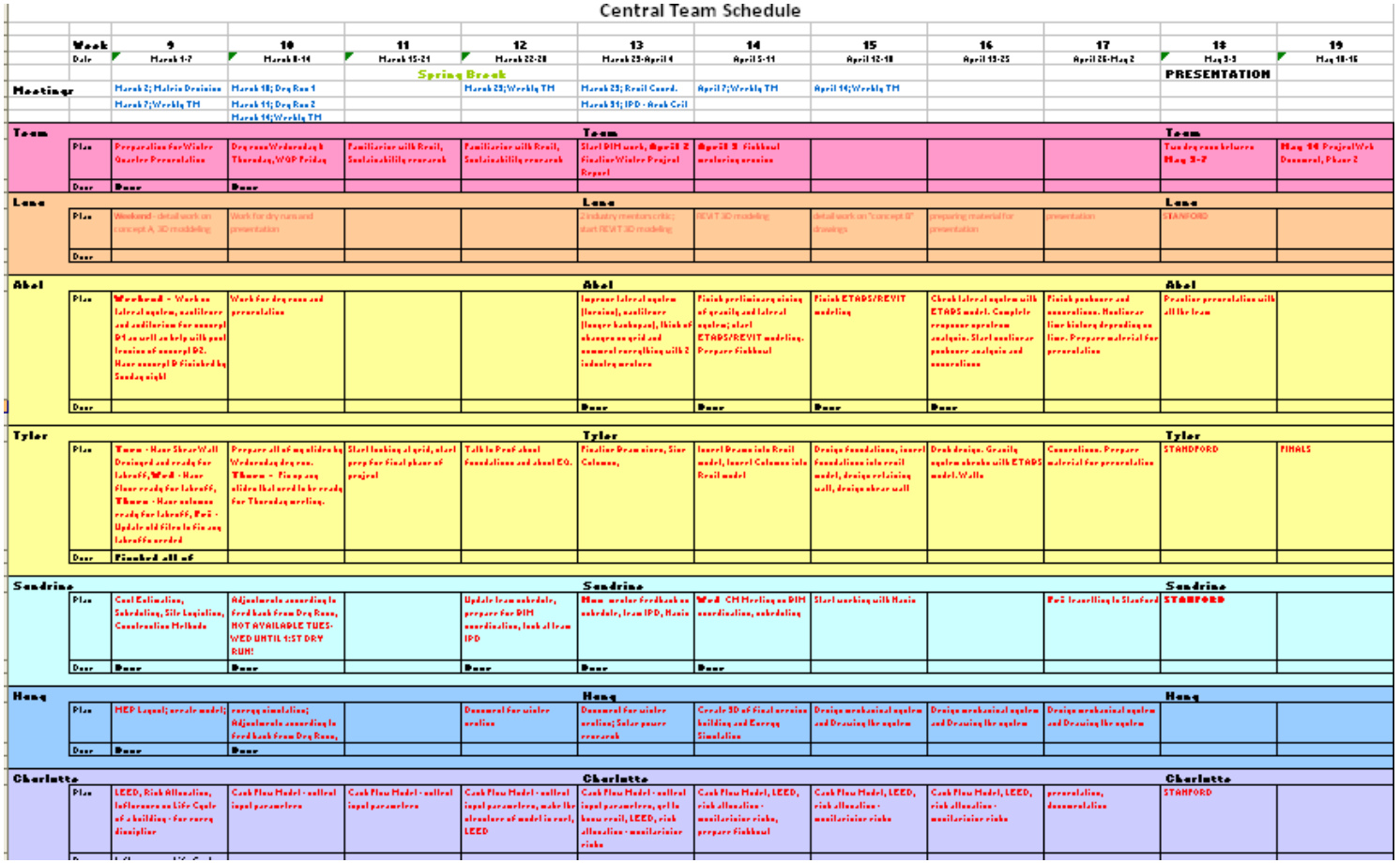


Meeting wave became <u>written forum</u> for meeting

Now <u>spoken and written communication eliminated miscommunication</u>

IPD – Schedule

MERGE



Central Team Schedule

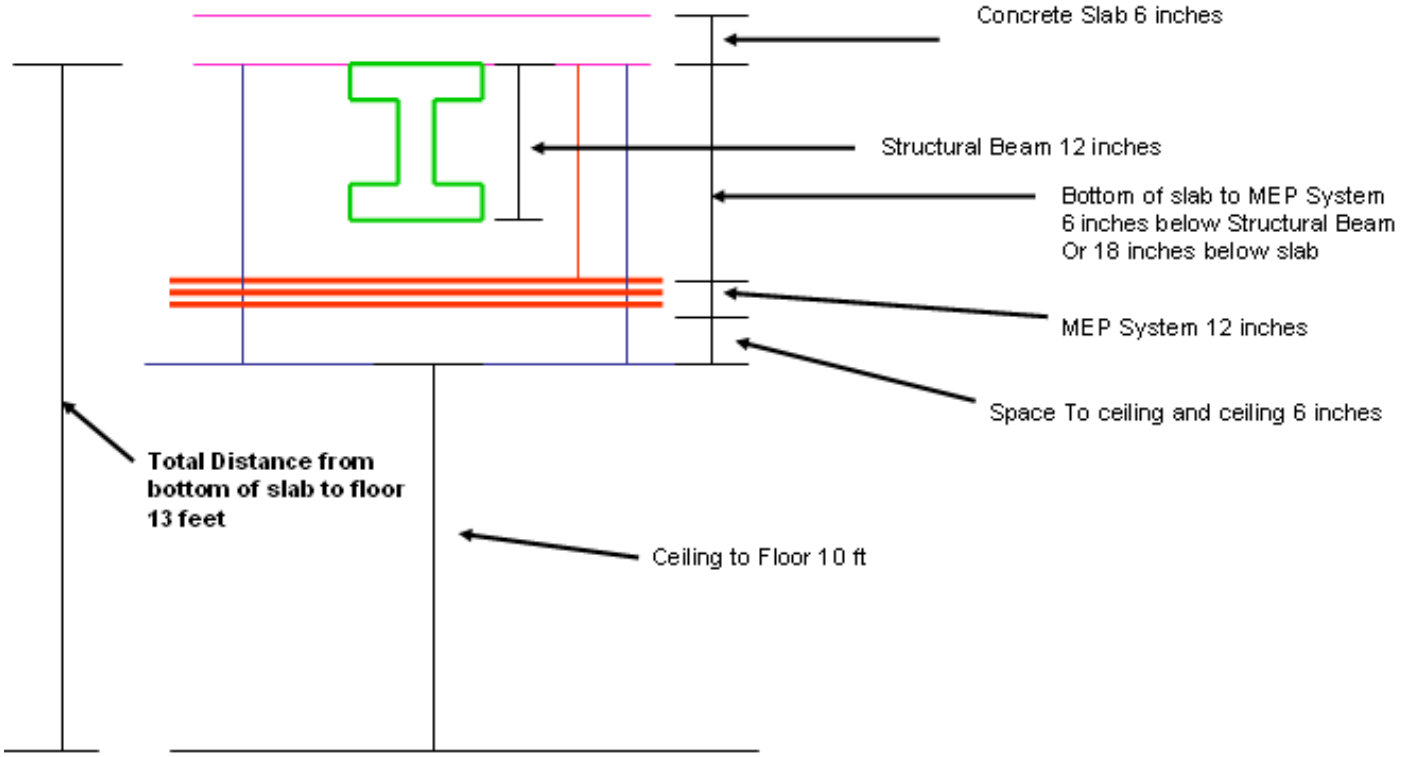
	Week	9	10	11	12	13	14	15	16	17	18	19
	Date	March 1-7	March 8-14	March 15-21	March 22-28	March 29-April 4	April 5-11	April 12-18	April 19-25	April 26-May 2	May 3-9	May 10-16
				Spring Break							PRESENTATION	
Meetings		March 2; Mahrin Decision March 7; Weekly TM	March 18; Dry Run 1 March 11; Dry Run 2 March 14; Weekly TM		March 28; Weekly TM	March 29; Revit Coord. March 31; IPD - Arak Civil	April 7; Weekly TM	April 14; Weekly TM				
Team						Team					Team	
	Plan	Preparation For Winter Quarter Presentation	Dry runs Wednesday & Thursday, WQP Friday	Familiarize with Revit, Sustainability research	Familiarize with Revit, Sustainability research	Start BIM work, April 2 Finalize Winter Project Report	April 3 Fishbowl mentoring session				Two dry runs between May 3-7	May 14 Project Work Document, Phase 2
	Done	Done	Done									
Lana						Lana					Lana	
	Plan	Weekend - detail work on concept A, 3D modeling	Work for dry runs and presentation			- industry members critic; start REVIT 3D modeling	REVIT 3D modeling	detail work on "concept B" drawings	preparing material for presentation	presentation	STANFORD	
	Done											
Abel						Abel					Abel	
	Plan	Weekend - Work on lateral system, modifiers and addition for concept B1 as well as help with pool house of concept B2. Have concept B finished by Sunday night	Work for dry runs and presentation			Improve lateral system (torsion), modifiers (longer bucks and), think of changes on grid and numerical everything with 2 industry members	Finish preliminary sizing of gravity and lateral system; start ETABS/REVIT modeling. Prepare Fishbowl	Finish ETABS/REVIT modeling	Check lateral system with ETABS model. Complete response spectrum analysis. Start nonlinear pushover analysis and connections	Finish pushover and connections. Nonlinear time history depending on time. Prepare material for presentation	Practice presentation with all the team	
	Done					Done	Done	Done	Done			
Tyler						Tyler					Tyler	
	Plan	Thurs - Have Shear Wall Designed and ready for Isharff, Wed - Have floor ready for Isharff, Thurs - Have columns ready for Isharff, Fri - Update old files in Sig and Isharffs needed	Prepare all of my slides by Wednesday dry run. Thurs - Fix up any slides that need to be ready for Thursday meeting.	Start looking at grid, start prep for final phase of project	Talk to Prof about foundations and about EQ.	Finalize Beam sizes, Size Columns,	Insert Beams into Revit model, Insert Columns into Revit model	Design foundations, insert foundations into revit model, design retaining wall, design shear wall	Draft design. Gravity system check with ETABS model. Walls	Connections. Prepare material for presentation	STANFORD	FINALS
	Done	Finished all of										
Sandrine						Sandrine					Sandrine	
	Plan	Cost Estimation, Scheduling, Site Logistics, Construction Methods	Adjustments according to feedback from Dry Runs, NOT AVAILABLE TUES-WED UNTIL 4:ST DRY RUN!		Update from schedule, prepare for BIM coordination, look at from IPD	How earlier feedback on schedule, from IPD, Mario	Wed - CM Meeting on BIM coordination, scheduling	Start working with Mario		Fri travelling to Stanford	STANFORD	
	Done	Done	Done		Done	Done	Done					
Hong						Hong					Hong	
	Plan	MEP Layout; acoustic model;	energy simulation; Adjustments according to feedback from Dry Runs,		Document for winter version	Document for winter version; Solar power research	Create 3D of Final version building and Energy Simulation	Design mechanical system and Drawing the system	Design mechanical system and Drawing the system	Design mechanical system and Drawing the system		
	Done	Done	Done									
Charlotte						Charlotte					Charlotte	
	Plan	LEED; Risk Allocation, Influences on Life Cycle of a building - for every discipline	Cash Flow Model - collect input parameters	Cash Flow Model - collect input parameters	Cash Flow Model - collect input parameters, make the structure of model in excel, LEED	Cash Flow Model - collect input parameters, get to know excel, LEED, risk allocation - mutilarisier risks	Cash Flow Model, LEED, risk allocation - mutilarisier risks, prepare Fishbowl	Cash Flow Model, LEED, risk allocation - mutilarisier risks	Cash Flow Model, LEED, risk allocation - mutilarisier risks	presentation, documentation	STANFORD	

See what other team members are working on, increase transparency

Coordinate work with other team members

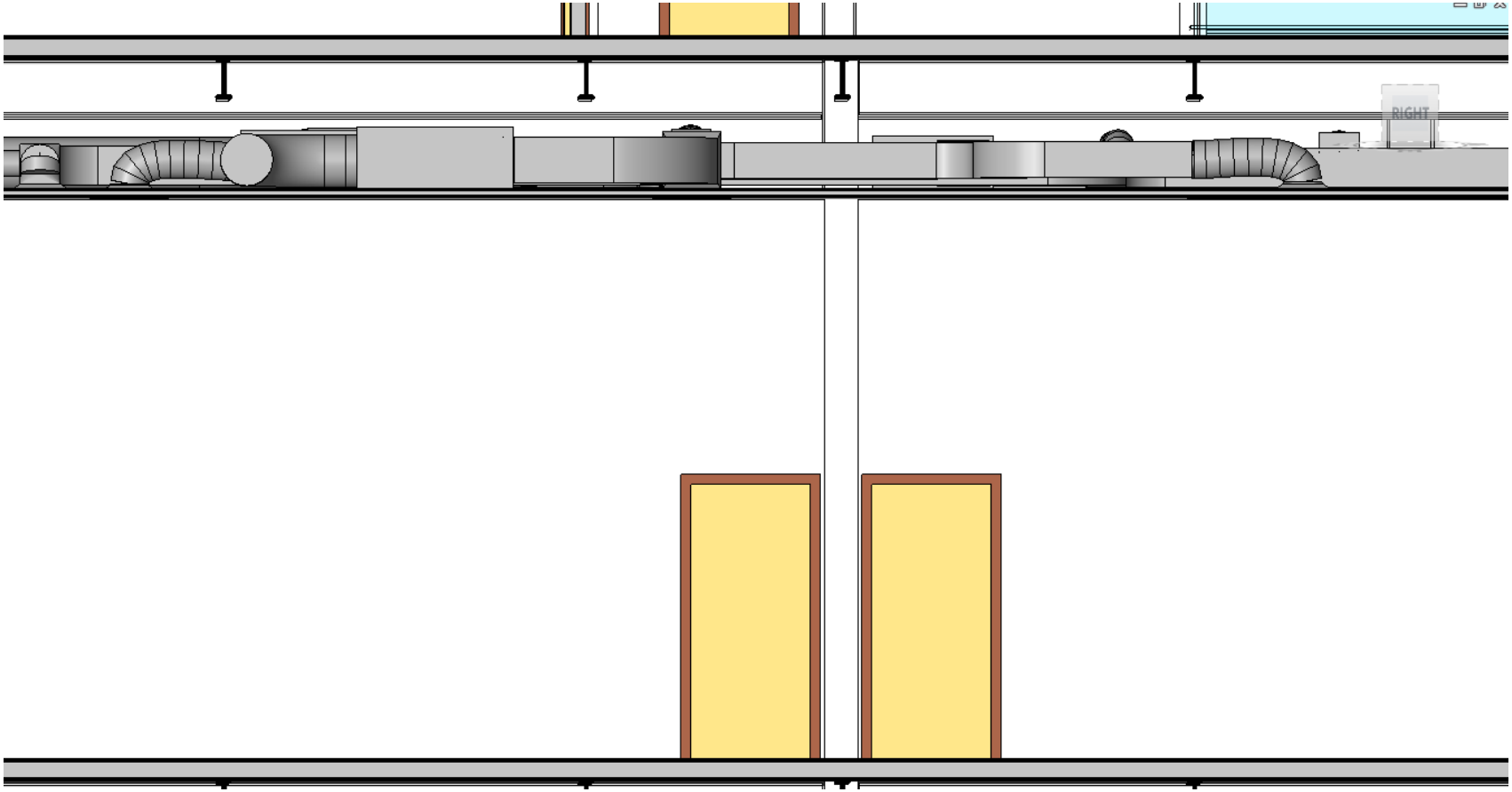
MERGE

Floor to Ceiling Height



We had early <u>understanding</u> of challenges and made <u>design decisions</u>
<u>Early standards eliminate issues</u> that could occur later in project

MERGE

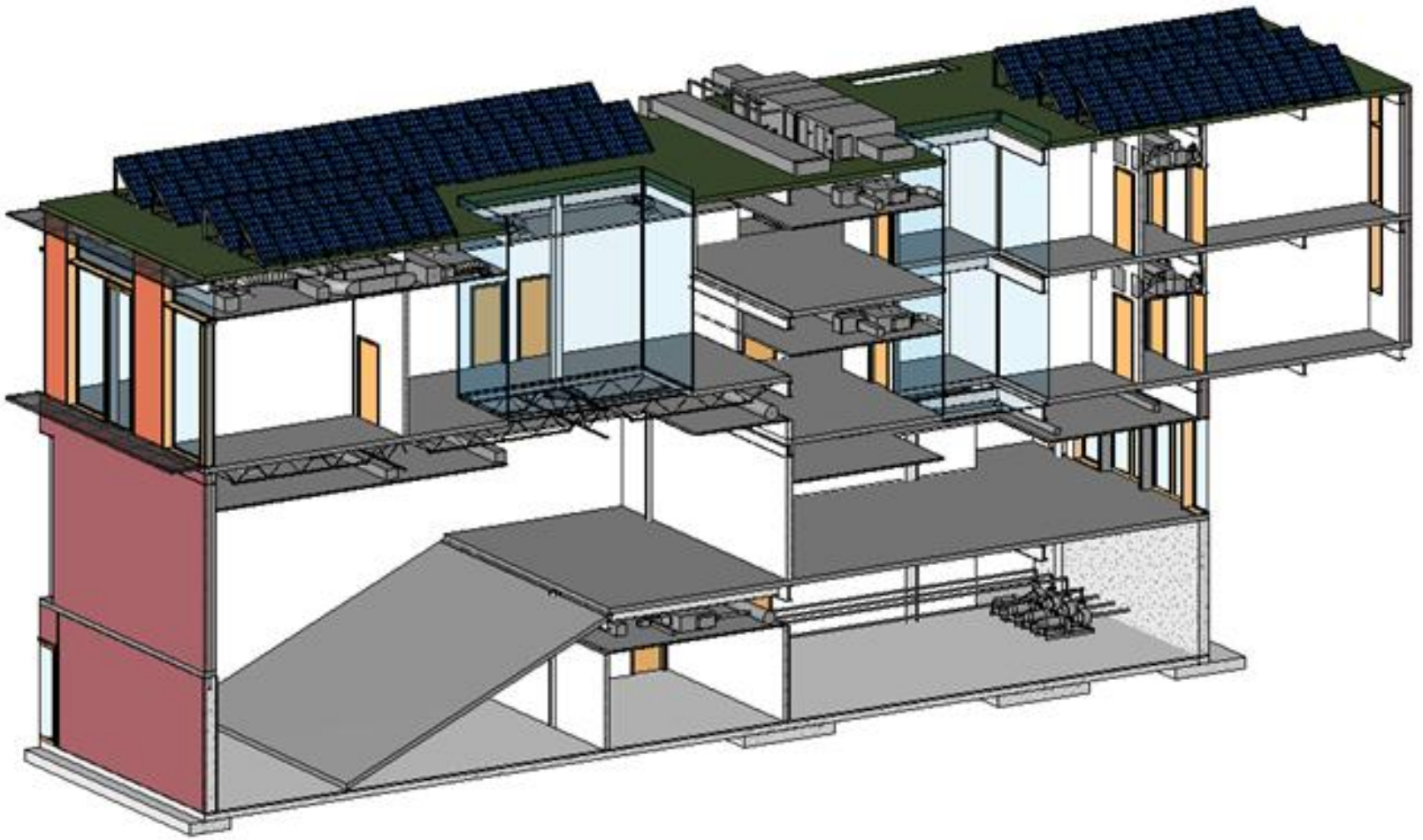


Actual floor section cut

Early decisions help for successful design

IPD – One Model

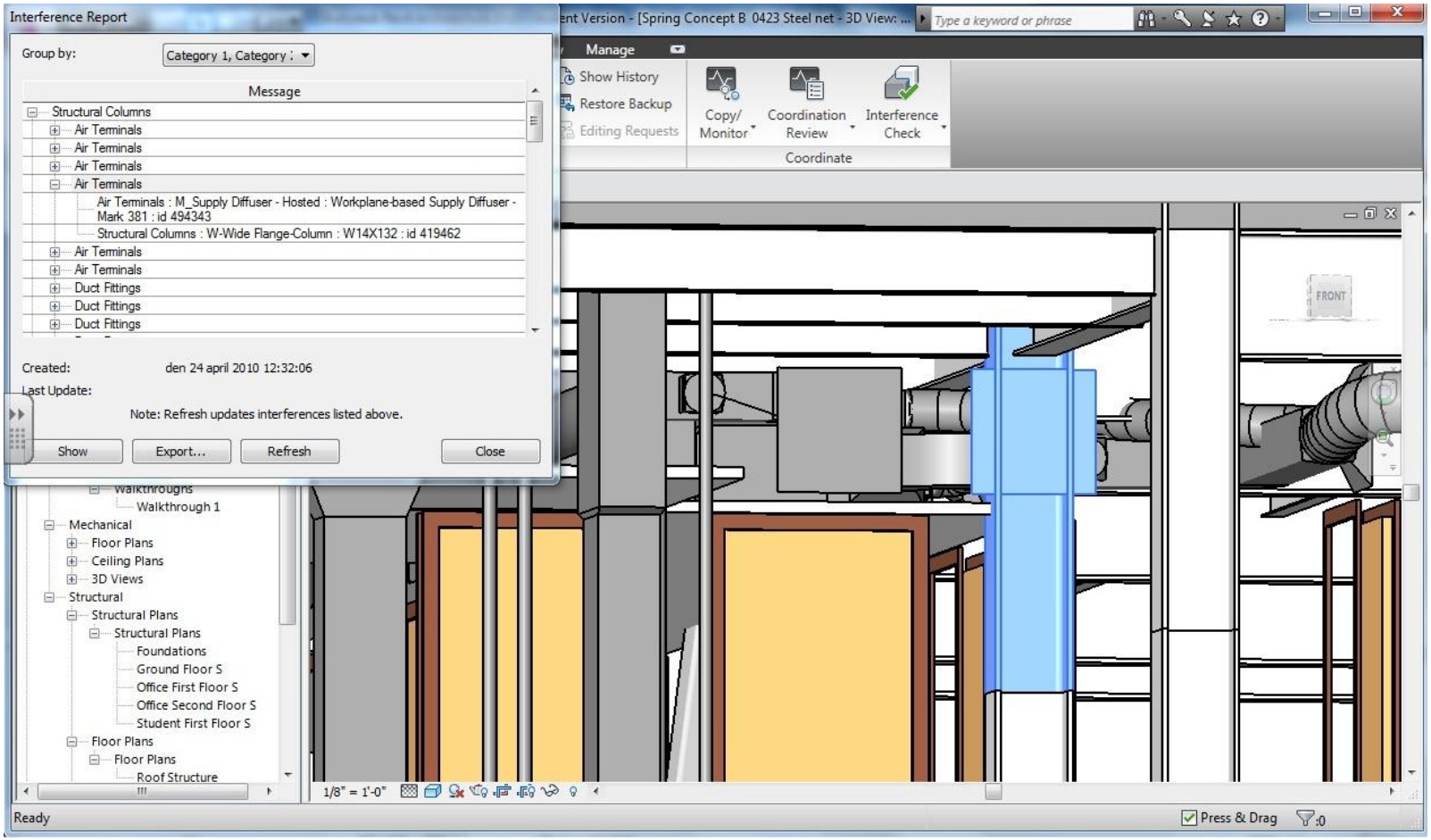
MERGE



One complex Revit model
Allowed real collaborative work

Clash Control

MERGE

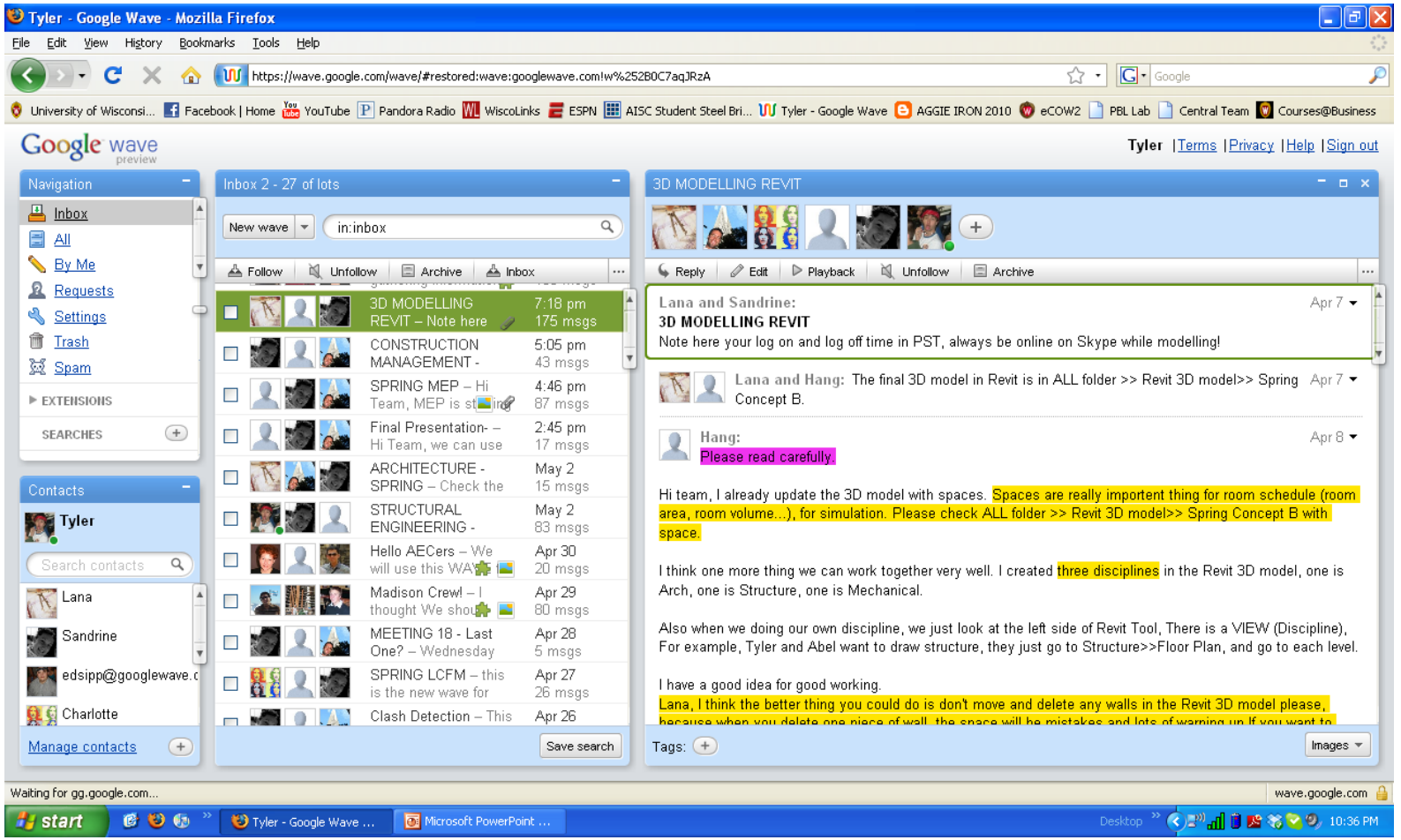


Early design decisions eleminated later possible clashes

Structure – Mechanical System: 58 clashes

IPD – Check In – Check Out

MERGE

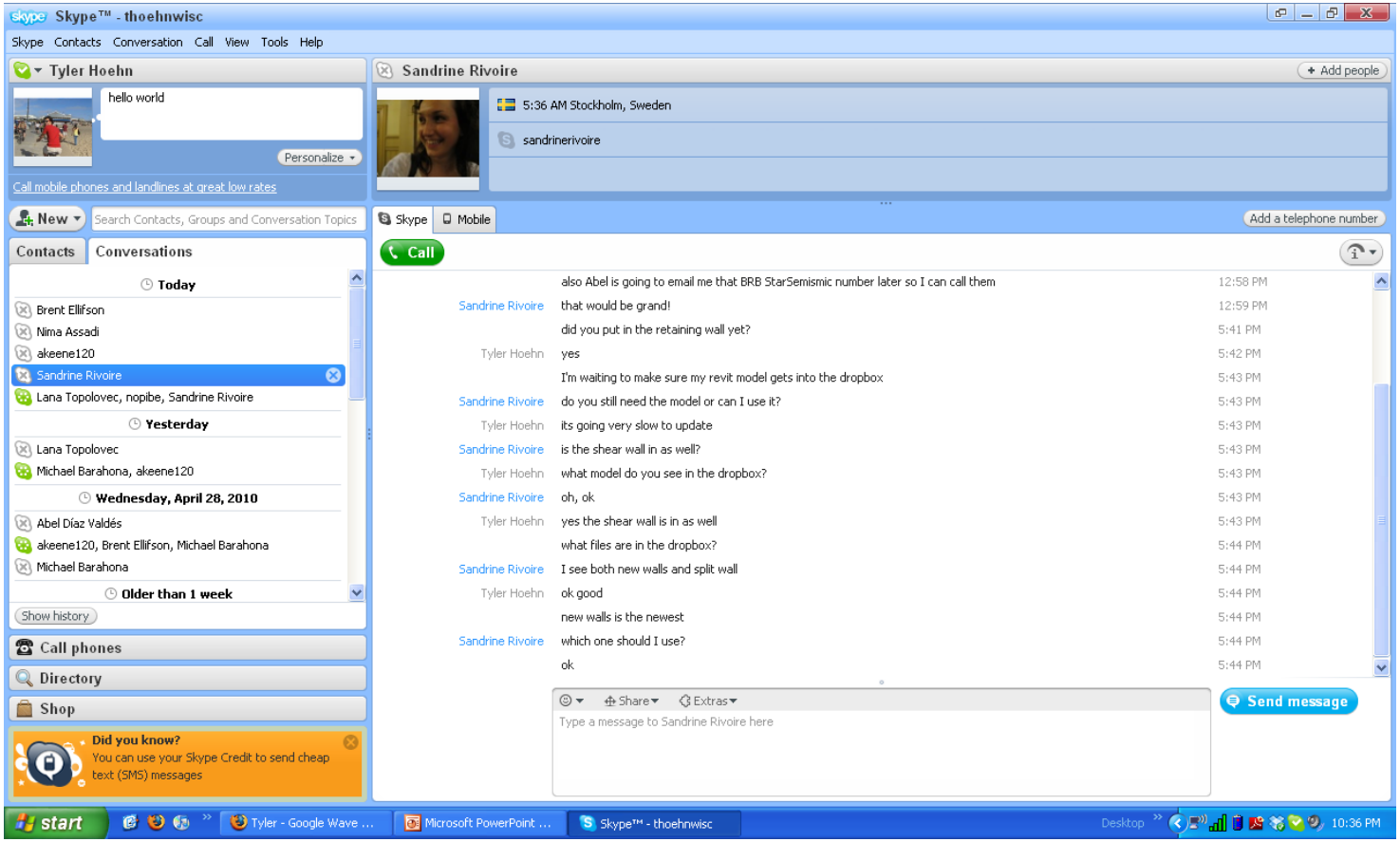


Check into Google wave when working on Revit model

Forum to <u>understand other disciplines work</u> on Revit model

IPD – Check In – Check Out

MERGE



Skype allowed for <u>live communication</u> with current user of Revit model

MERGE

As a team we learned how to deliver an integrated project
Technology was only a mechanism to help our team process

We now have completed an integrated project for our owner and have had an integrated team experience

Lessons learned

“Teamwork divides the tasks and multiplies the success” - Hang

“People working in many timezones on a project enables 24h/day work. ” - Lana

“You don´t know what you don´t know” - Tyler

“A simple sketch is worth it more than thousands of words” - Abel

“Make agreements as soon as possible” - Charlotte

“Meeting people in person is unbeatable” - Sandrine

CENTRAL TEAM

MERGE

THANK YOU FOR YOUR ATTENTION

THANK YOU!

Renate Fruchter

Architecture

Ales Vodopivec
Humberto Cavallin
David Bendet
Willem Kymell
Robert Alvarado

Structural Engineering

Greg Luth
Helmut Krawinkler
Erik Kneer

MEP

Afaan Naqvi
John Nelson
Kasten Menzel

Dimitra Ioannidou

Construction Management

Adhamina Rodriguez
Rikard Espling
Daniel Gonzales
Erik Helgegren
Forest Peterson
Andreas Udd
Alex Ershov

Life Cycle and Financial Management

Andrea Frank-Jungbecker
Axel Seifert
Matthias Ehrlich