Supporting Documents

APPENDIX A: MEETING MINUTES

Meeting Minutes

350 Mission — Team: 05-2014
350 Mission Street
San Francisco, CA 94105

Team Coordination Meeting #3

Date	Time	Next Meeting (Date/Time)		Team
9/29/2013	2:30 PM	9/30/2013	3:30 PM	AEI 05-2014

Purpose	Location	General Notes
Weekly coordination meeting to discuss the current state of the project, discuss new findings/conflicts, as well as looking ahead to upcoming week's activities	Thesis Studio	M - Mechanical CM - Construction Managmnet E - Electrical/Lighting S - Structural

Attendees		Non-Attendees
Scott Brown	E	
Andrew Levy	E	
Jordan Huey	M	
Helen Leenhouts	M	
Patrick Vogel	CM	
Rebecca Bires	CM	
Jeff Loeb	S	
Scott Eckhart	S	

Item #	Item	Responsible	Status	Date Created	Date required
1	**Hot Items:**				
	Google sketchup model to import into IES				
	All options to have powerpoint slide completed by Sunday				
2	**Mechanical**				
	Narrow down Net Zero definition to combining definitions			9/29/2013	
	Floor plan design to be finalized				
3	**Lighting/Electrical**			9/9/2013	
	To determine lighting density			9/29/2013	
	DaySim model to be finished				
4	**Structural**			9/17/2013	
	Basic siesmic calcs				
5	**Construction**			9/9/2013	
	Researching site logistics				
	Begin constructing the Revit model				

Appendix B: References:

"2013 California Building Code." *International Code Council*. California Building Standards Commission, n.d. Web. Fall 2013.

"Budget Calculator For Access Floors." *Access Floor Systems, Inc.* N.p., n.d. Web. Spring 2014.

Leadership in Energy and Environmental Design (2008). LEED 2009 For Schools New Construction and

Major Renovations. Fall 2013. Web.<http://www.usgbc.org/ShowFile.aspx?DocumentID=5547>.

"My Solar Estimator." *Solor-Estimate.* N.p.,nd. Web. Spring 2014 <http://www.solar-estimate.org>

Reed Construction Data Inc. (2014). RSMeans Online Version 5.0.3. Spring 2014. Web. <http://www.rsmeansonline.com/SearchData>.

"Combined Heat and Power Partnership." *EPA.* United States Environmental Protection Agency, 7 November 2013. http://www.epa.gov/chp/.

"Renewable Energy Program." *California Energy Commission*. http://www.energy.ca.gov/renewables/renewable_links.html

"Delivering Low-Emission Energy." *Clean Energy Solutions.* PG&E http://www.pge.com/en/about/environment/pge/cleanenergy/index.page

"Combined Heat and Power (CHP) is it Rightyou're your Facility." *University of Illinois.*https://www1.eere.energy.gov/manufacturing /pdfs/webcast_2009-0514_chp_in_facilities.pdf

"Natural Gas and Environment." *Natural Gas.* http://www.naturalgas.org/environment/naturalgas.asp

"Capture and Storage of Carbon Dioxide From Earth's Atmosphere." *Mission 2013 Carbon Sequestration.* Massachusetts Institute of Technology http://igutek.scripts.mit.edu/terrascope/?page=Algae

ASHRAE, ANSI/ASHRAE Standard 62.1-2007.

ASHRAE, ANSI/ASHRAE Standard 55-2007

Appendix C: Detailed Estimate

Detailed Estimate			
Scope of Work	Cost	Scope of Work	Cost
General Conditions	$7,562,918	*Boilers*	$52,526
Sitework		*Mictoturbines*	$937,250
Excavation	$281,187	*Chillers*	$1,191,170
Dewatering	$940,295	*Raised Access Floor*	$10,666,586
Foundation		*Ductwork*	$2,414,135
Slurry Wall	$1,760,581	**Electrical**	
Mat Foundation	$1,111,231	*Switch Gear*	$106,490
Mat Foundation Rebar	$111,122	*Generator*	$90,942
Parking Garage	$8,363,950	*Transfer Switch*	$29,900
Structure		*Distribution Panel*	$152,490
Metal Decking	$1,252,359	*Transformer*	$102,258
Concrete	$4,344,157	*Panelboards*	$301,030
Reinforcement	$304,013	*Wiring*	$4,775,284
Formwork/Curing	$225,257	*Lighting Fixtures*	$8,693,575
Steel		*Receptacles*	$4,473,976
Beams	$7,612,926	*Photovoltaic*	$718,000
Columns	$7,351,078	**Services**	
Built Up Columns	$202,643	*Gas Sprinkler System*	$8,954,485
Brace Framing	$4,095,231	*Rain Water Collection*	$671,543
Shear Connections	$490,743	*Plumbing Fixtures and Fittings*	$1,233,944
Fireproofing	$260,837	*Elevator and Lifts*	$8,601,080
Double Façade	$15,566,226	*Stair Construction*	$691,840
Roof	$120,659	**Finishes**	
Interiors	$14,384,990	*Ceiling Finishes*	$1,369,580
Mechanical		*Floor Finishes*	$2,834,763
Cooling Tower	$102,810	*Wall Finishes*	$6,044,944
Air Handling Units	$3,604,618	**Total**	**$148,095,270**

General Conditions Estimate:

Staffing				
Personnel	*Qty.*	*Unit*	*$/Unit*	*Cost*
Project Manager	120	Week	$3,275.00	$393,000
Engineer	120	Week	$3,275.00	$393,000
Superintendent	120	Week	$2,050.00	$393,000
Safety Superintendent	120	Week	$1,638.00	$393,000
BIM Engineer	120	Week	$900.00	$393,000
			Total	**$1,336,560**

Temporary Facilities				
Description	*Qty.*	*Unit*	*$/Unit*	*Cost*
On Site Trailer	25	Months	$223.00	$5,575
Off Site Trailer	5	Months	$4,200.00	$21,000
Temporary Fencing	630	LF	$26.75.00	$16,853
Sanitary Facilities	30	Months	$200.00	$6,000
			Total	**$49,428**

Temporary Utilities					
Description	*Qty.*	*Unit*	*$/Unit*	*Cost/month*	*Total Cost*
Dewatering System	208	VLF	$3,931.00	-	$817,648
Temporary Power	160	CSF	$110.00	$17600	$809,600
Temporary Lighting	160	CSF	$3.63	$581	$26,717
Temporary Heating	160	CSF	$31.78	$5085	$233,901
Water	46	Months	$65.00	-	$2,990
				Total	**$1,890,856**

Bonds, Insurance and Tax			
Description	*Percentage*	*Project Cost*	*Cost*
Performance Bond	1%	$137,594,704	$1,375,947
General Liability Insurance	0.50%	$137,594,704	$687,974
Builder’s Risk Insurance	0.25%	$137,594,704	$343,987
Permits	0.50%	$137,594,704	$687,974
Contingences	3%	$137,594,704	$4,127,841
Tax	6%	$137,594,704	$8,255,682
		Total	**$15,479,404**

Appendix D: Life Cycle Cost Analysis

Life Cycle Cost Analysis						
System	Cost	Annual Energy Load Reduction	Annual Energy Cost Savings	Payback Period	Lifetime	Return on Investment
Photovoltaic System	$218,000	149,800 kWhr	$26,964	8.1 years	25 years	$456,100
Combined Heat-and-Power	$503,000	1,014,000 kWhr	$101,400	5.0 years	15 years	$1,018,000
UFAD/DFS	$2,390,882	1,111,144 kWhr	$200,006	12.0 years	100 years	$17,609,710
NOTES:	**The cost of the UFAD/DFS systems is the cost of upgrading from a traditional system, estimating that a traditional air distribution system would cost $10,228,260, and a single façade would cost $13,613,670**					

The life cycle cost analysis was a vital part of the decision making process for system design. We wanted to make sure that in designing a near net-zero energy building, we were still taking into consideration the economic feasibility for the owner. The photovoltaic and CHP systems both have a payback period of less than 10 years, making them a reasonable choice for a system.

Notably, the cost to upgrade from a tradition system to our designed underfloor air distribution system, and double façade is only $2.4 million (less than 1.5% of the project budget). These systems, however, are responsible for the majority of our cooling and heating load savings, and will save the owner a great deal of money in the long run.

Simple Cashflow Diagram				
Year	Notes	Cost/Maintenance	YTD Savings	Cashflow
1	All systems bought	$3,132,410	$328,370	-$2,804,040
2	-	$56,528	$328,370	-$2,532,198
3	-	$56,528	$328,370	-$2,260,356
4	-	$56,528	$328,370	-$1,988,514
5	-	$56,528	$328,370	-$1,716,672
6	-	$56,528	$328,370	-$1,444,830
7	-	$56,528	$328,370	-$1,172,988
8	-	$56,528	$328,370	-$901,146
9	-	$56,528	$328,370	-$629,304
10	-	$56,528	$328,370	-$357,462
11	-	$56,528	$328,370	-$85,620
12	-	$56,528	$328,370	$186,222
13	-	$56,528	$328,370	$458,064
14	-	$56,528	$328,370	$729,906
15	CHP system replaced	$559,528	$328,370	$498,748
16	-	$56,528	$328,370	$770,590
17	-	$56,528	$328,370	$1,042,432
18	-	$56,528	$328,370	$1,314,274
19	-	$56,528	$328,370	$1,586,116
20	-	$56,528	$328,370	$1,857,958
21	-	$56,528	$328,370	$2,129,800
22	-	$56,528	$328,370	$2,401,642
23	-	$56,528	$328,370	$2,673,484
24	-	$56,528	$328,370	$2,945,326
25	PV system replaced	$274,528	$328,370	$2,999,168
General Notes: Assuming a yearly maintenance cost of $12,168 for CHP, $4360 for PV, and $40,000 for DF/UFAD. Also assuming a lifetime of 15 years for CHP system (per Capstone spec sheet), and 25 years for PV system (per SunPower spec sheet)				

Appendix E: LEED

LEED 2009 for New Construction and Major Renovations

Project Checklist

350 Mission Street

January 27th, 2014

Y	?	N			
21			**Sustainable Sites**	Possible Points:	26
Y			Prereq 1	Construction Activity Pollution Prevention	
1		C	Credit 1	Site Selection	1
5		C	Credit 2	Development Density and Community Connectivity	5
		C	Credit 3	Brownfield Redevelopment	1
6		C	Credit 4.1	Alternative Transportation—Public Transportation Access	6
1		C	Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Roon	1
3		C	Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Ve	3
2		C	Credit 4.4	Alternative Transportation—Parking Capacity	2
		C	Credit 5.1	Site Development—Protect or Restore Habitat	1
		C	Credit 5.2	Site Development—Maximize Open Space	1
		C	Credit 6.1	Stormwater Design—Quantity Control	1
		C	Credit 6.2	Stormwater Design—Quality Control	1
1		C	Credit 7.1	Heat Island Effect—Non-roof	1
1		E	Credit 7.2	Heat Island Effect—Roof	1
1		E	Credit 8	Light Pollution Reduction	1
8			**Water Efficiency**	Possible Points:	10
Y			Prereq 1	Water Use Reduction—20% Reduction	
2		C	Credit 1	Water Efficient Landscaping	2 to 4
2		M	Credit 2	Innovative Wastewater Technologies	2
4		M	Credit 3	Water Use Reduction	2 to 4
30			**Energy and Atmosphere**	Possible Points:	35
Y			Prereq 1	Fundamental Commissioning of Building Energy Systems	
Y			Prereq 2	Minimum Energy Performance	
Y			Prereq 3	Fundamental Refrigerant Management	
19		M	Credit 1	Optimize Energy Performance	1 to 19
2		E	Credit 2	On-Site Renewable Energy	1 to 7
2		C	Credit 3	Enhanced Commissioning	2
2		M	Credit 4	Enhanced Refrigerant Management	2
3		E	Credit 5	Measurement and Verification	3
2		M	Credit 6	Green Power	2
8			**Materials and Resources**	Possible Points:	14
Y			Prereq 1	Storage and Collection of Recyclables	
		C	Credit 1.1	Building Reuse—Maintain Existing Walls, Floors, and Roof	1 to 3
		C	Credit 1.2	Building Reuse—Maintain 50% of Interior Non-Structural Element	1
2		C	Credit 2	Construction Waste Management	1 to 2
2		C	Credit 3	Materials Reuse	1 to 2

Y	?	N			
			Materials and Resources, Continued		
2		C	Credit 4	Recycled Content	1 to 2
2		C	Credit 5	Regional Materials	1 to 2
		C	Credit 6	Rapidly Renewable Materials	1
		C	Credit 7	Certified Wood	1
12			**Indoor Environmental Quality**	Possible Points:	15
Y			Prereq 1	Minimum Indoor Air Quality Performance	
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	
1		M	Credit 1	Outdoor Air Delivery Monitoring	1
			Credit 2	Increased Ventilation	1
1		C	Credit 3.1	Construction IAQ Management Plan—During Construction	1
1		C	Credit 3.2	Construction IAQ Management Plan—Before Occupancy	1
1			Credit 4.1	Low-Emitting Materials—Adhesives and Sealants	1
1			Credit 4.2	Low-Emitting Materials—Paints and Coatings	1
			Credit 4.3	Low-Emitting Materials—Flooring Systems	1
1			Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Product	1
			Credit 5	Indoor Chemical and Pollutant Source Control	1
1		E	Credit 6.1	Controllability of Systems—Lighting	1
1		M	Credit 6.2	Controllability of Systems—Thermal Comfort	1
1		M	Credit 7.1	Thermal Comfort—Design	1
1		M	Credit 7.2	Thermal Comfort—Verification	1
1		E	Credit 8.1	Daylight and Views—Daylight	1
1		E	Credit 8.2	Daylight and Views—Views	1
6			**Innovation and Design Process**	Possible Points:	6
1		M	Credit 1.1	Innovation in Design: Specific Title	1
1		M	Credit 1.2	Innovation in Design: Specific Title	1
1		M	Credit 1.3	Innovation in Design: Specific Title	1
1		M	Credit 1.4	Innovation in Design: Specific Title	1
1		M	Credit 1.5	Innovation in Design: Specific Title	1
1		C	Credit 2	LEED Accredited Professional	1
4			**Regional Priority Credits**	Possible Points:	4
1		C	Credit 1.1	Regional Priority: Specific Credit	1
1		C	Credit 1.2	Regional Priority: Specific Credit	1
1		C	Credit 1.3	Regional Priority: Specific Credit	1
1		C	Credit 1.4	Regional Priority: Specific Credit	1
89			**Total**	Possible Points:	110

Certified 40 to 49 points   Silver 50 to 59 points   Gold 60 to 79 points   Platinum 80 to 110

Sustainable Sites 21/26

Prerequisite 1: Construction Activity Pollution Prevention

Prevented sedimentation of storm sewers and dust from polluting of the air

Site Selection 1 Point

Site was previously developed land

SS Credit 1: Development Density and Community Connectivity 4 Points

Option 1: Development Density

SS Credit 4.1: Alternative Transportation – Public Transport 6 Points

Option 2: Bus Stop Proximity

SS Credit 4.2: Alternative Transportation – Bicycle Storage 1 Point

Case 1: Commercial Projects

SS Credit 4.3: Alternative Transportation – Low Emitting and 3 Points

Option 1: Provide preferred parking for low-emitting and fuel-efficient vehicles

SS Credit 4.4: Alternative Transportation – Parking Capacity 2 Points

Case 1: Option 1: Preferred/discounted parking for carpools

SS Credit 7.1: Heat Island Effect – Non roof 1 Point

Option 2: Underground parking garage

SS Credit 7.2: Heat Island Effect – Roof 1 Point

Option 1: Solar reluctant roofing material

SS Credit 8: Light Pollution Reduction 1 Point

Option 1: Reduce input power of nonemergency lights

Water Efficiency 6/10

Prerequisite 1: Water Use Reduction

Water demand reduced by 26% (see Appendix G)

WE Credit 1: Water Efficient Landscaping 2 Points

Option 1: Reduce by 50%

WE Credit 2: Innovative Wastewater Technologies 2 Points

Option 1: Water use reduced by 56% (Appendix G and Table 9 in the mechanical report) through rainwater collection and demand reduction

WE Credit 3: Water Use Reduction 4 Points

Water use reduced by 56% (Appendix G and Table 9 in the mechanical report)

Energy & Atmosphere 30/35

Prerequisite 1: Fundamental Commissioning of Building Energy Systems

Budgeted for a commissioning authority

Prerequisite 2: Minimum Energy Performance

Option 1: Whole Building Energy Simulation – Used IES to simulate and achieved a savings of 52% (see Table 7 in the mechanical report)

Prerequisite 3: Fundamental Refrigerant Management

Designed chilled water system

EA Credit 1: Optimize Energy Performances

Achieved an overall energy use savings of 52% (see Table 7 in the mechanical report)

EA Credit 2: On-Site Renewable Energy 2 Points

Photovoltaic array on the roof produces over 3% of total building energy use

EA Credit 3: Enhanced Commissioning 2 Points

Achieved an overall energy use savings of 52% (see Table 7 in the mechanical report)

EA Credit 4: Enhanced Refrigerant Management 2 Points

Option 1: Did not use refrigerants

EA Credit 5: Measurement and Verification 3 Points

Option 1: Budgeted for a measurement and verification plan

EA Credit 6: Green Power – 35% from renewable sources 2 Points

Option 1: Determine Baseline Electricity Use – We used IES to determine the annual electricity demand of the site

Materials and Resources 8/14

MR Prerequisite 1: Storage and Collection of Recyclables

Provided an area for the collection and storage of materials for recycling of the building.

MR Credit 2: Construction Waste Management 2 Points

Recycled or Salvaged Material by 75%

MR Credit 3: Materials Reuse 2 Points

Reused Materials by 10%

MR Credit 4: Recycled Content 2 Points

Used material with 20% recycled content

MR Credit 5: Regional Materials 2 Points

Used 20% of materials that were produced within 500 miles of the project site

Indoor Environmental Quality 4/15

IEQ Prerequisite 1: Minimum Indoor Air Quality Performance

Met both Case 1 and Case 2 because our building utilizes both natural and mechanical ventilation

IEQ Prerequisite 2: Environmental Tobacco Smoke (ETS) Control

Option 1: We are prohibiting smoking on the entire property, inside and outside

IEQ Credit 1: Outdoor Air Delivery Monitoring 1 Point

Case 1 and Case 2: We have provided for CO_2 for all spaces

IEQ Credit 3.1: Construction IAQ Management Plan – During… 1 Point

Developed and implemented an IAQ Management Plan

IEQ Credit 3.2: Construction IAQ Management Plan – Before… 1 Point

Option 1: Flush-Out, path 1

IEQ Credit 4.1: Low Emitting Materials – Adhesives and Sea… 1 Point

All adhesive and sealant complied with the requirements applicable

IEQ Credit 4.2: Low Emitting Materials – Paints and Coatings 1 Point

Paint and coatings complied with the criteria applicable

IEQ Credit 4.4: Low Emitting Materials – Composite Wood … 1 Point

Composite wood had no added urea-formaldehyde

IEQ Credit 6.1: Controllability of Systems – Lighting 1 Point

90% of the building occupants are able to adjust the lights

IEQ Credit 6.2: Controllability of Systems - Thermal Comfort 1 Point

Because of our underfloor system, the occupants have control over the vent closest to their desks

IEQ Credit 7.1: Thermal Comfort – Design 1 Point

Our HVAC system was designed using ASHRAE Standard 55-2004

IEQ Credit 7.2: Thermal Comfort – Verification 1 Point

We budgeted for a monitoring system

IEQ Credit 8.1: Daylight and Views - Daylight 1 Point

Option 1: Simulation

IEQ Credit 8.2: Daylight and Views - Views 1 Point

Achieved a direct line of sight to the outdoor environment via vision glazing

Innovation in Design 6/6

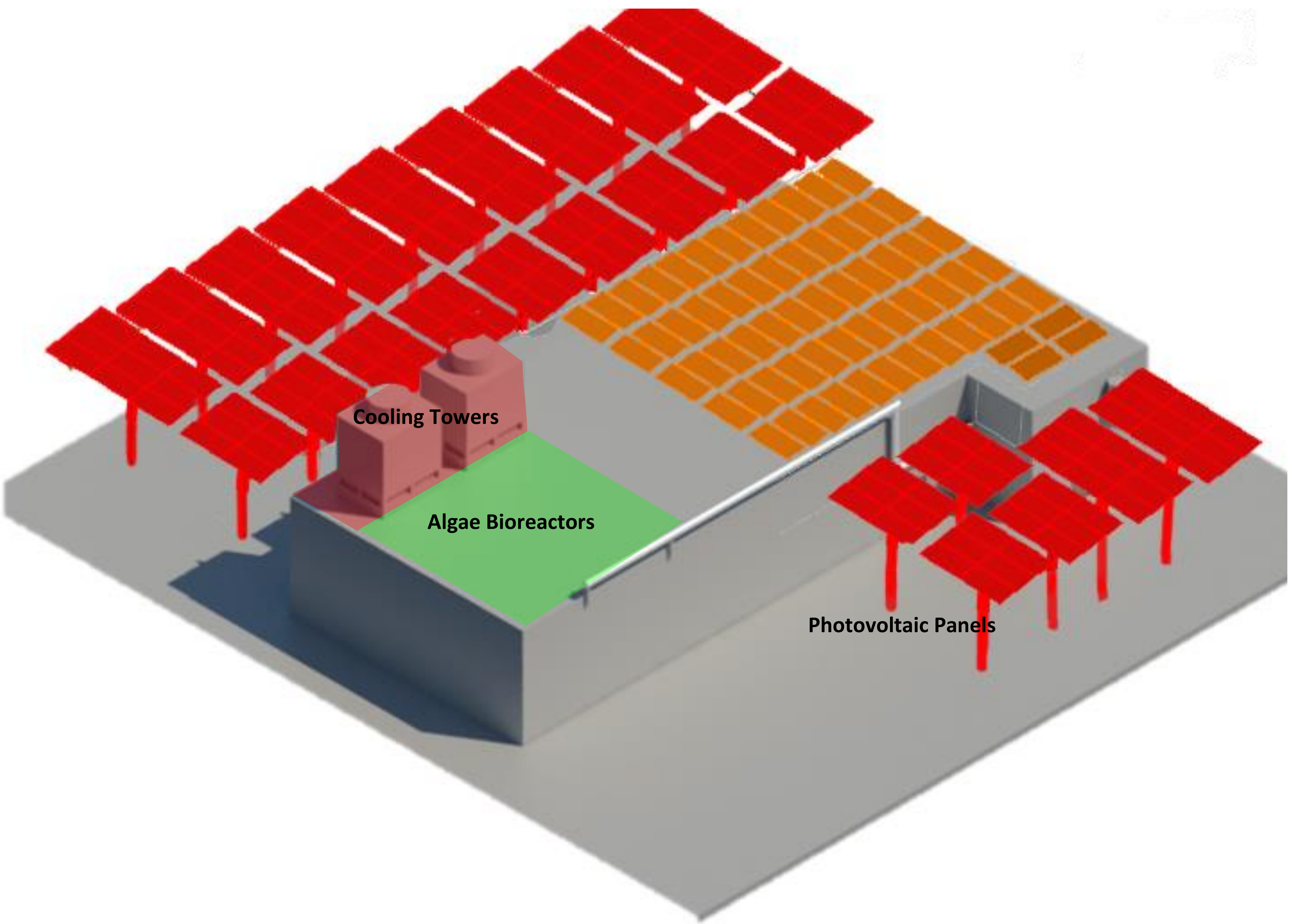
ID Credit 1: Innovation in Design 5 Points

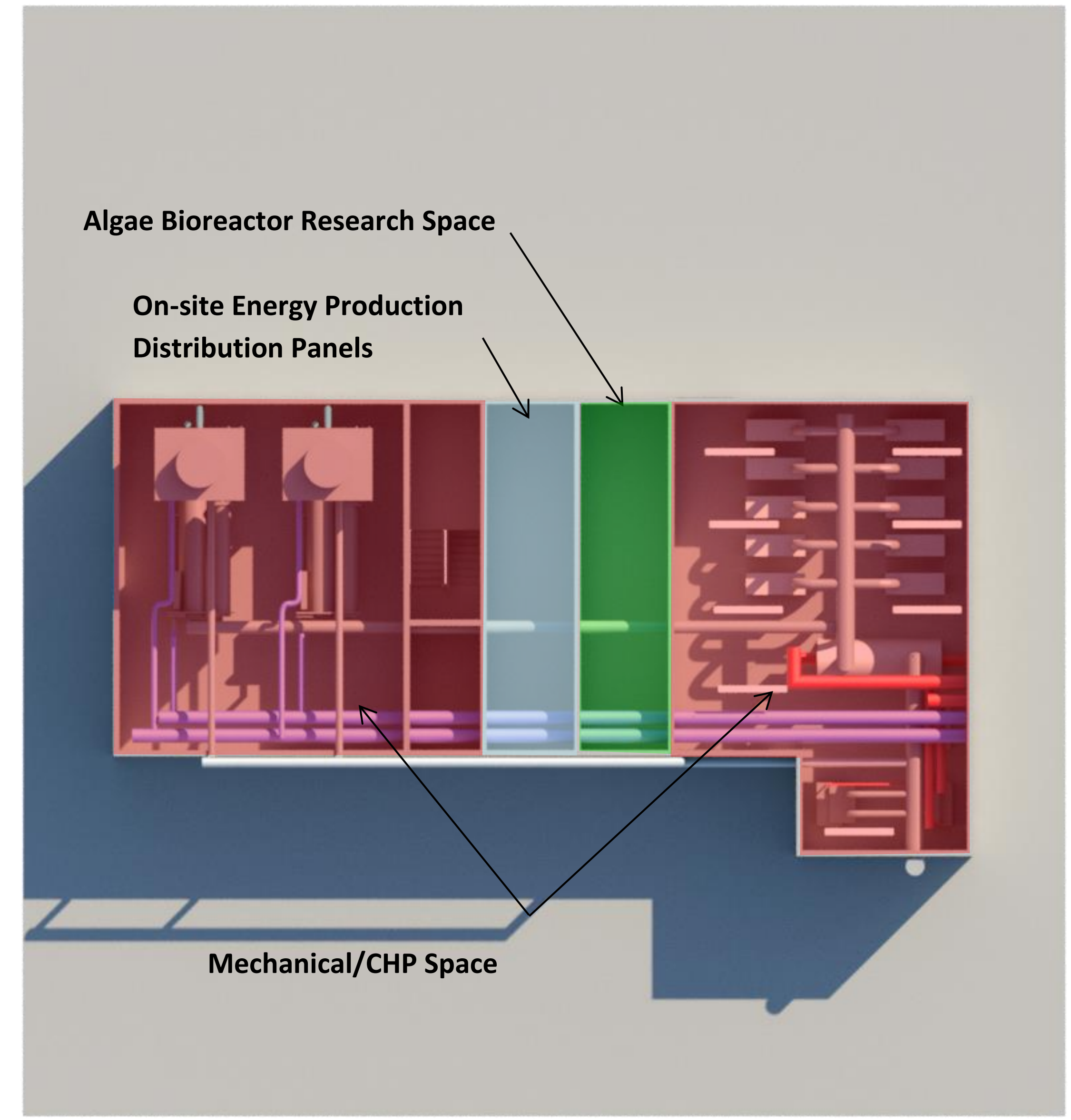
Path 1: Innovations in Design – Cogeneration, algae bioreactors

Path 2: Exemplary Performance – two incremental increases in EA Credit 1 (2 pts), three incremental increases in WE Credit 3 (1 pt)

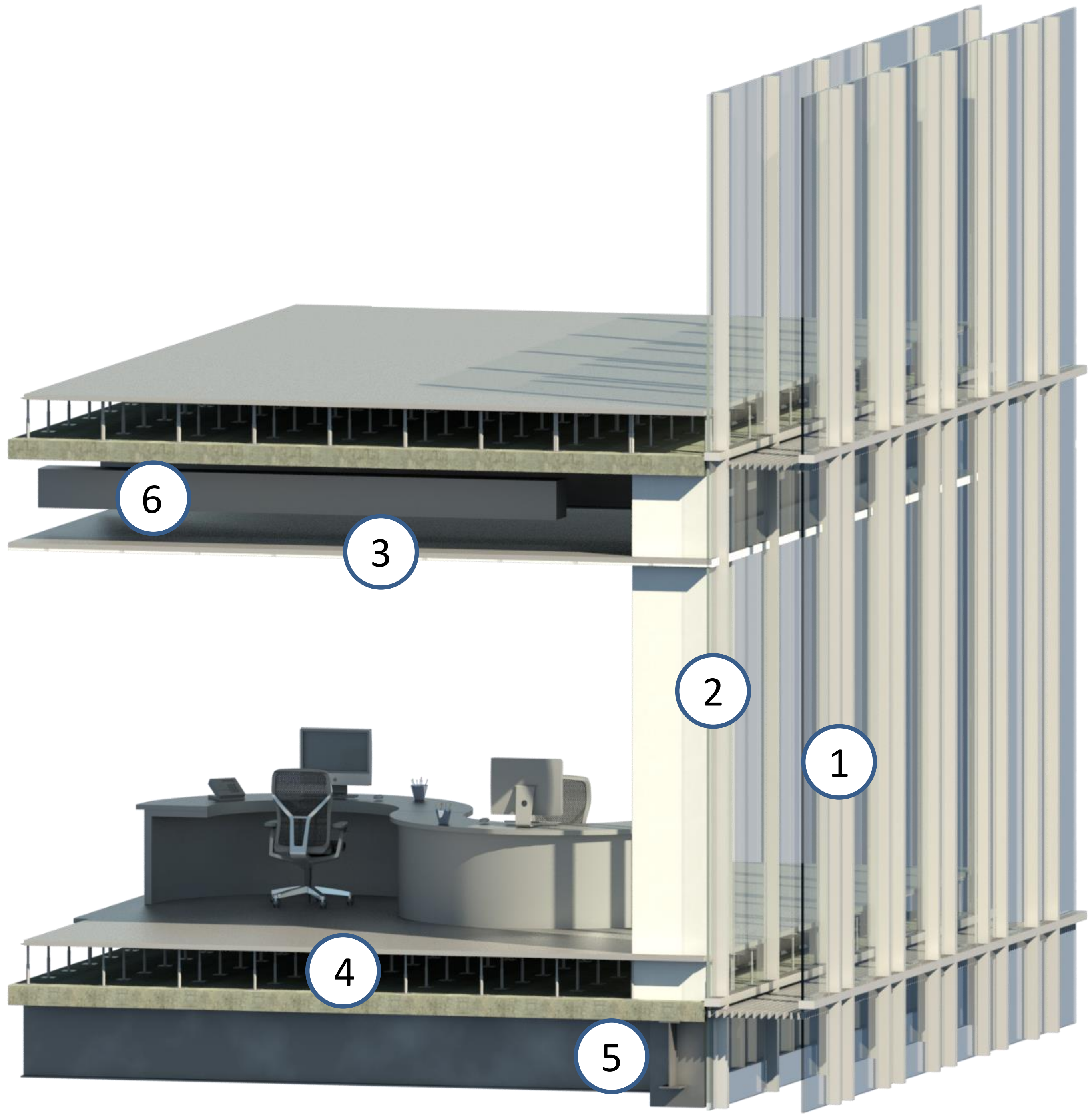
Total 89 Points

Appendix F: Roof System: System Space Coordination





Appendix G: Double Façade



1. Double Façade System (DFS)
2. Daylight Control Retractable Shading
3. Daylight Dimming
4. Underfloor Ducts and Data Cables
5. Structural System
6. Return Duct

Collaboration:

To ensure that all goals were satisfied, the disciplines had to confirm that all systems worked integrally with each other

- **DFS**

  Mechanical: Energy Savings
  Electrical: Light Control
  Structural: Additional Imposed Weight

- **Retractable Shading**

  Mechanical: Effects Space Loads
  Electrical: Effects Surface Lighting Levels

- **Daylight Dimming**

  Mechanical: Effects Space Loads
  Construction: Additional Sensor Costs

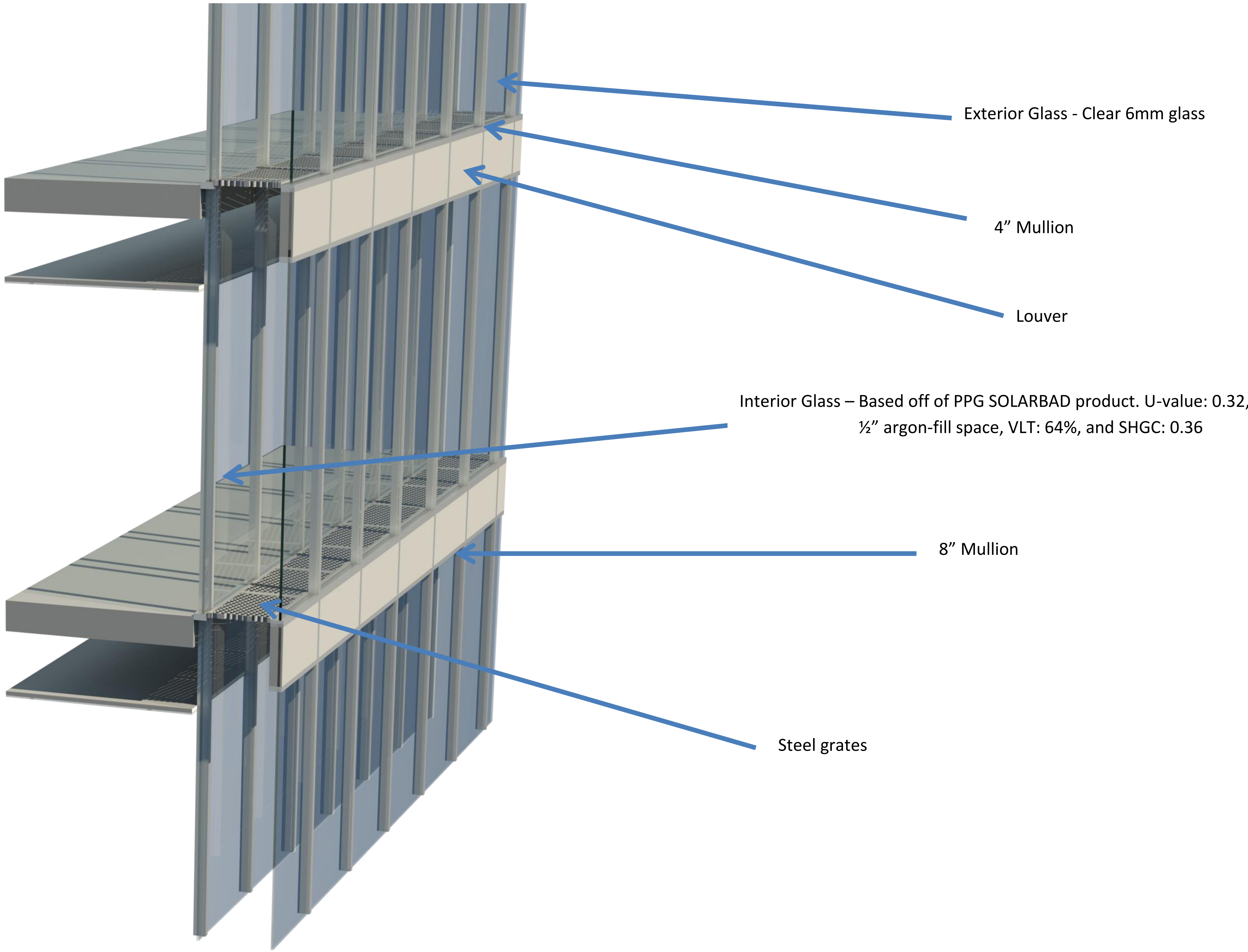
Raised Access Floor

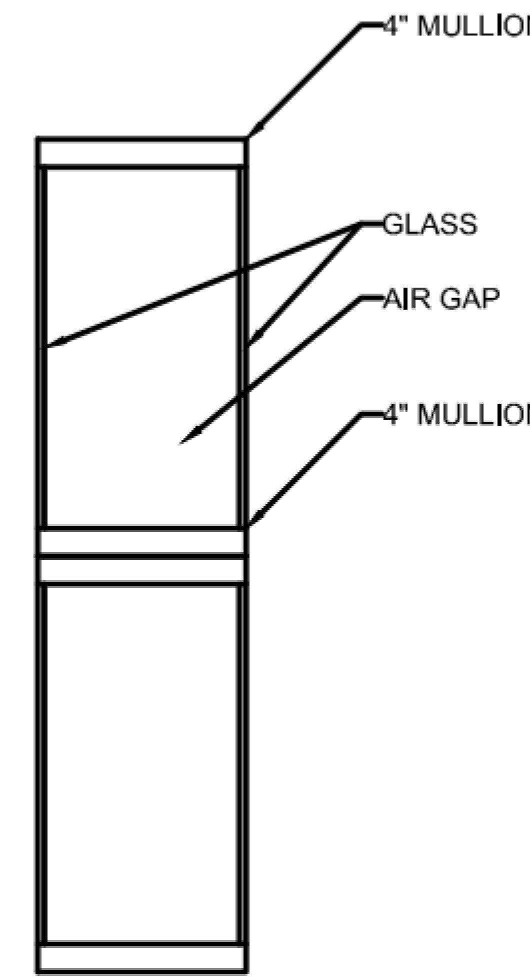
Mechanical: Coordinate with Electrical for Clash
Electrical: Coordinate with Mechanical for Clash

Structural System

Mechanical: Coordinate with Structural for Clash
Structural: Coordinate with all Disciplines for Loads
Structural: Coordinated with System Clash

Double Façade Detail



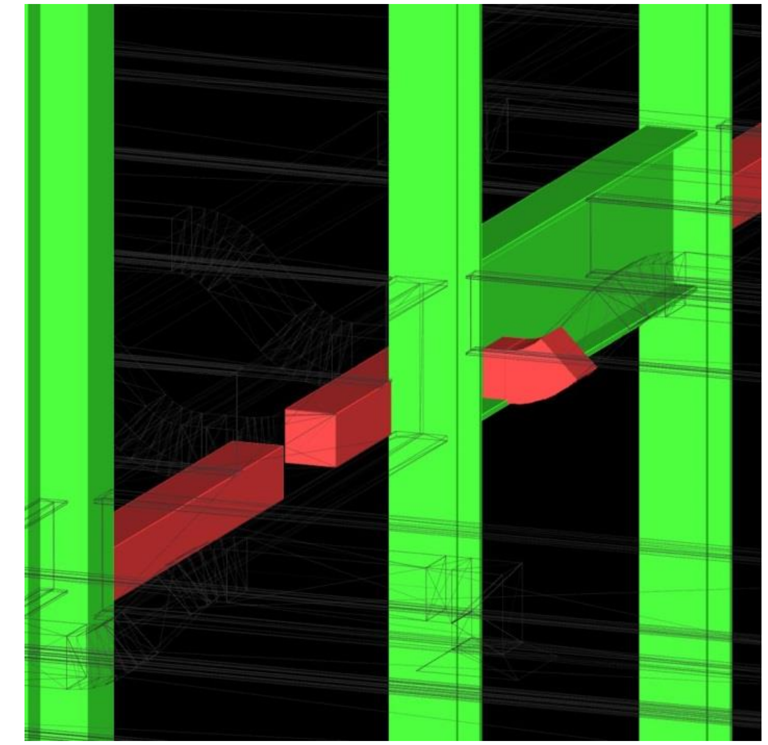


Horizontal Section Detail

Appendix H: Clash Detection

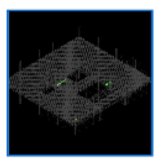
Stage 1:

Once the structural system and mechanical systems were placed into revit, clash detection was run. The results showed that in several places the mechanical ducts clashed with the raised access floor panel supports. In addition, we found that the return ducts from the elevator lobby were clashing with the beams over the opening into the space. Because the ceiling could not be dropped, the ducts had to be rerouted in an alternate direction. Finally, the main branch ducts were clashing with the columns around the core and had to be moved over a few inches.



Duct Vs UFD Clash

Tolerance	0.00m
Total	30
New	30
Active	0
Reviewed	0
Approved	0
Resolved	0
Type	Hard
Status	OK



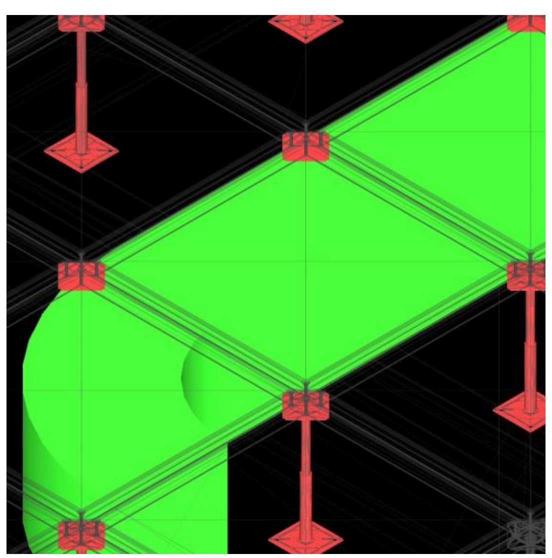
Name	Clash1
Distance	-0.00m
Description	Hard
Status	New
Clash Point	-3.44m, 1.27m, 0.00m
Date Created	2014/1/23 22:50:43

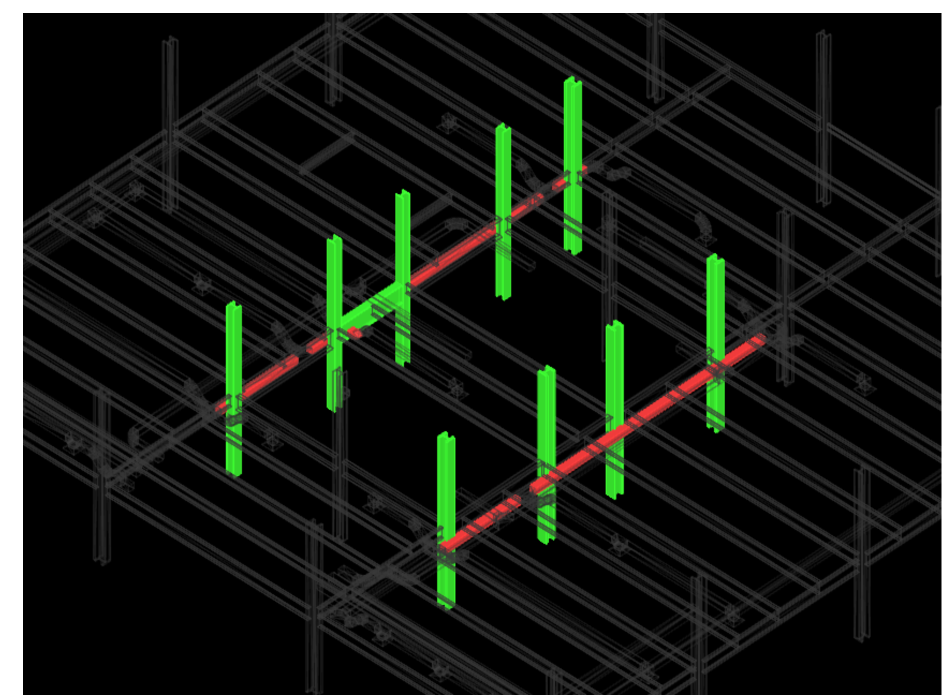
Item 1

GUID	9f5167e5-6fba-40b6-bea1-40df8fab96ce
Item Name	Raised_Floor_System_7475 [325474]
Item Type	Shell

Item 2

GUID	b395e624-86a5-41bd-a271-96b60f431494
Item Name	Rectangular Duct [327167]
Item Type	Shell



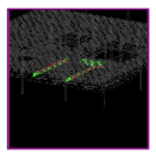


STAGE 2:

After the mechanical system was fixed, the electrical system was added. While there were no clashes with the electrical system, we did find that there were more mechanical clashes. At some point during the process some of the mechanical ducts were move over by several feet into the center of a beam. This is an error that was to be expected at some point because there were several systems being added by several different people. Clash detection allowed us to catch and fix the problem with relative ease.

Mech Vs Structure Clash

Tolerance	0.00m
Total	11
New	11
Active	0
Reviewed	0
Approved	0
Resolved	0
Type	Hard
Status	Old



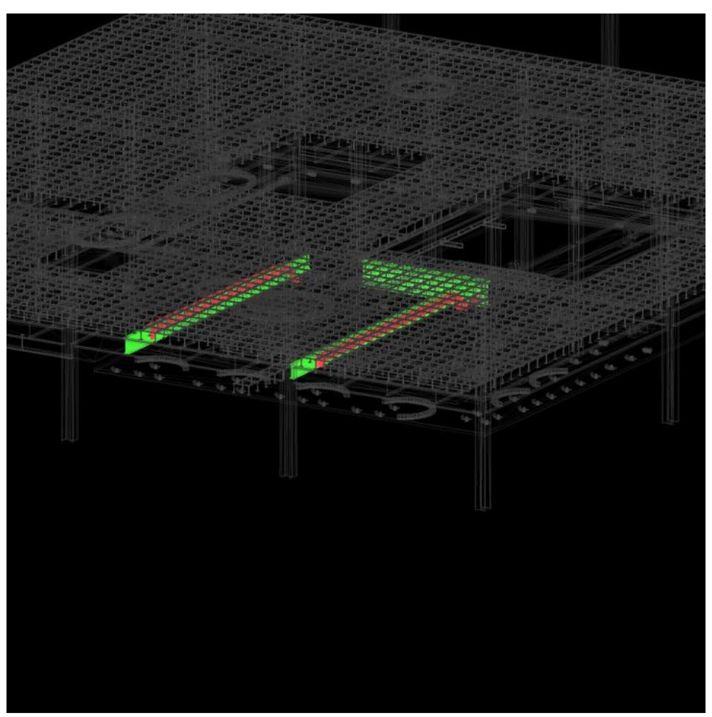
Name	Clash1
Distance	-0.25m
Description	Hard
Status	New
Clash Point	9.22m, 0.00085m, -0.93m
Date Created	2014/1/24 18:34:19

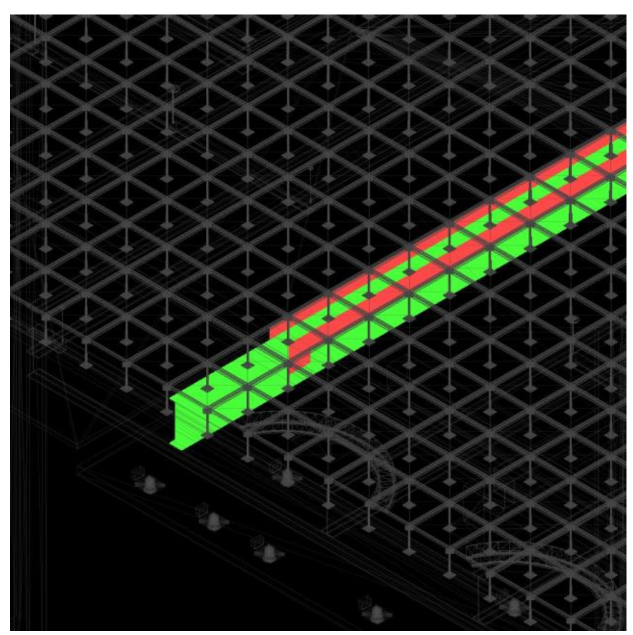
Item 1

GUID	7f346662-caf6-4fa9-83c6-220a1d79a833
Item Name	Rectangular Duct [336492]
Item Type	Shell

Item 2

GUID	ce3fabcd-06a6-4f00-81e7-9270e8e9c7e8
Item Name	W-Wide Flange [187349]
Item Type	Shell





STAGE 3:

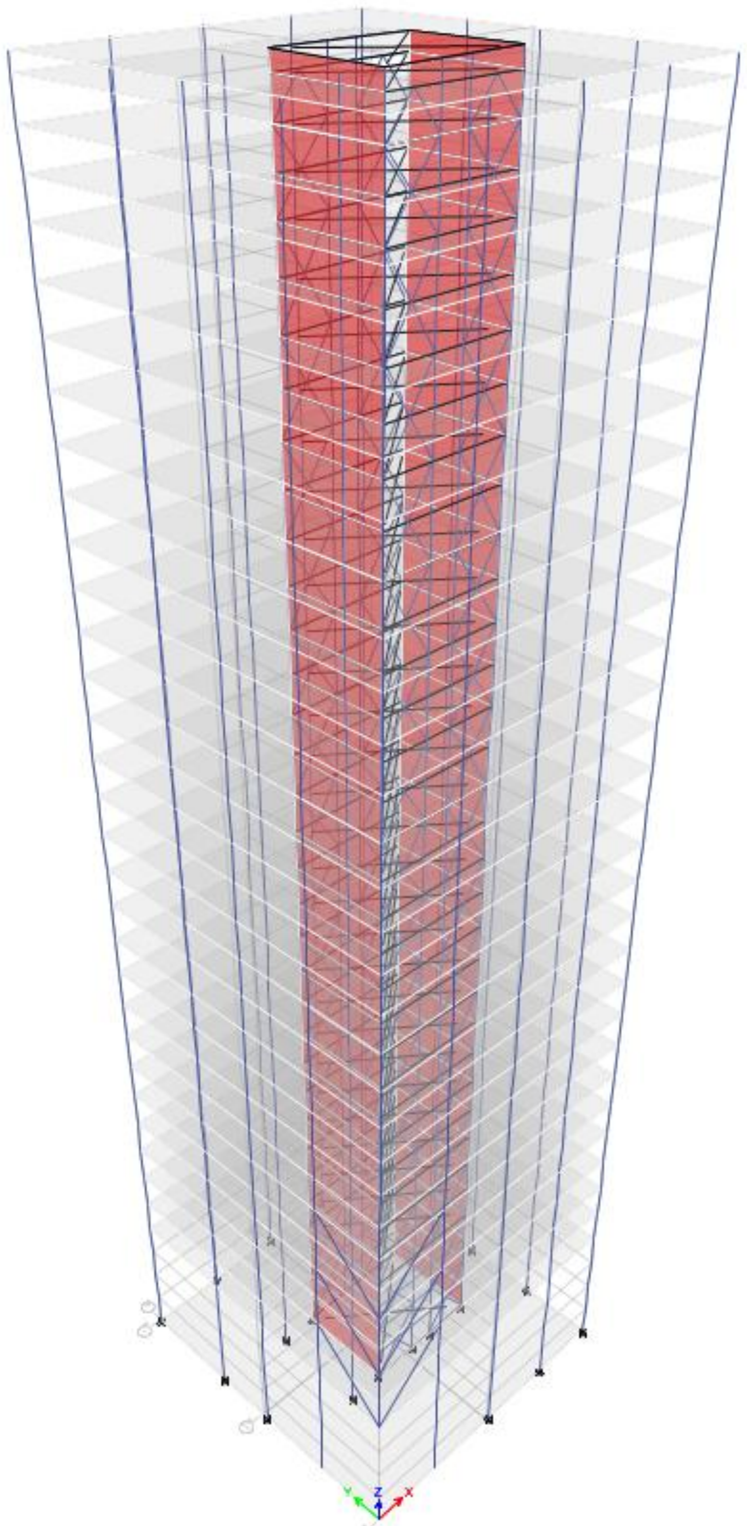
After the duct and beam clash was fixed, we ran a final clash detection to ensure that there were no clashes.

APPENDIX I: DUCT SIZING

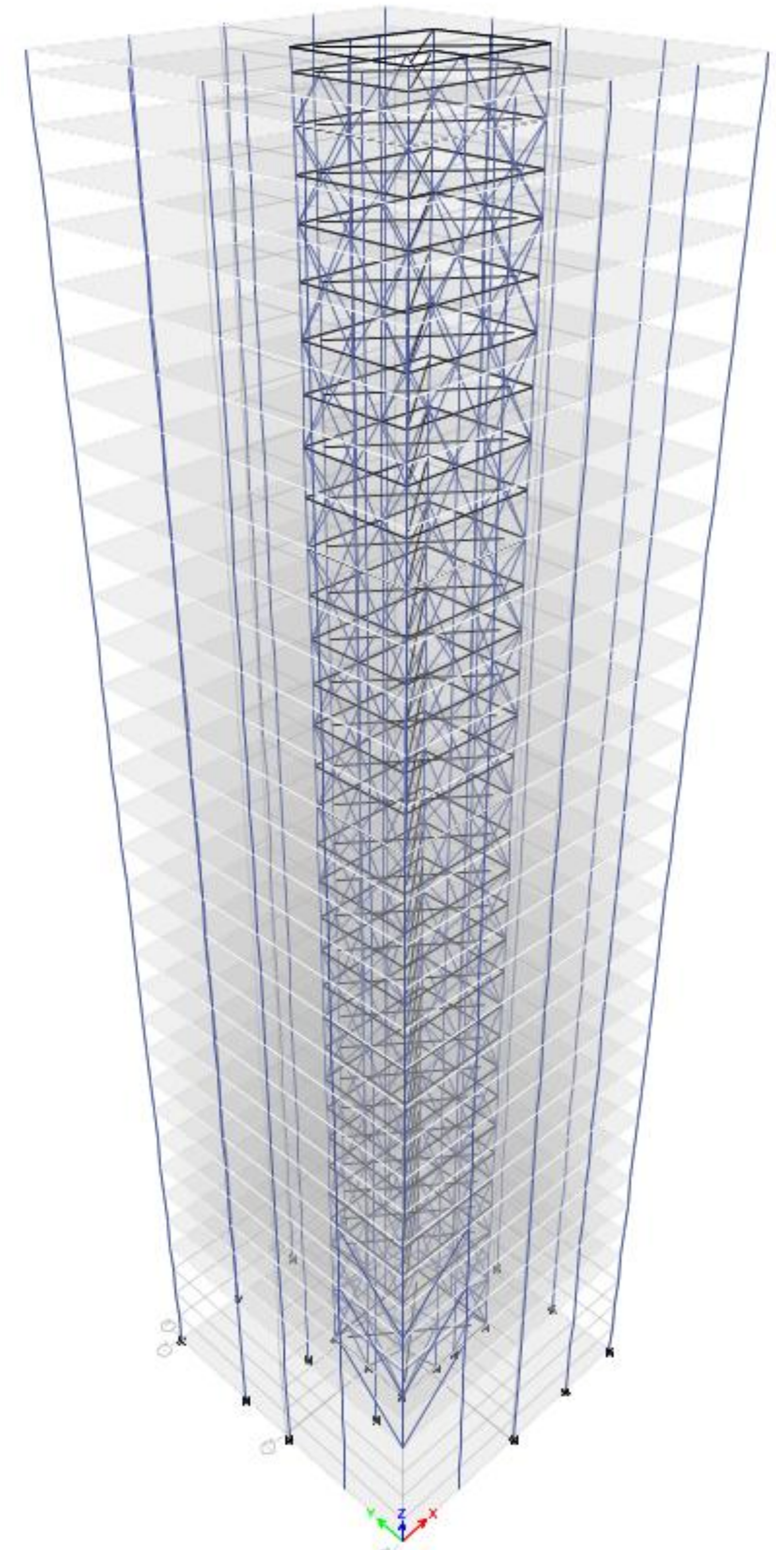
		Room Airflow (CFM)	Duct Airflow (CFM)	Duct Length (ft)	Friction Loss	Duct Velocity	Duct Size
Duct A			**1407.9**	**140.0**	**0.28**	**1300**	**13x12**
500	Perimeter Open Office	1,407.9					
Duct B			**1,398.2**	**70.0**	**0.15**	**1300**	**13x12**
508	Private Office	167.9					
509	Private Office	165.5					
510	Private Office	166.8					
511	Executive Office	336.6					
512	Copy Room	188.5					
513	Private Office	186.4					
514	Server Room	186.5					
Duct C			**1,407.9**	**140.0**	**0.3**	**1300**	**13x12**
500	Perimeter Open Office	1,407.9					
Duct D			**1,728.5**	**70.0**	**0.15**	**1300**	**13x12**
519	Private Office	262.8					
520	Private Office	257.4					
521	Private Office	246.7					
515	Copy Room	186.5					
516	Private Office	186.0					
517	Private Office	189.1					
518	Executive Office	400.0					
Duct E			**2,005.7**	**65.0**	**0.11**	**1300**	**17x12**
500	Open Office	500.0					
501	Elevator Lobby	1,294.6					
501A	Telecom	52.6					
501B	Electrical	50.4					
504	Stair 2	108.1					
Duct F			**1,302.5**	**110**	**0.25**	**1300**	**11x12**
500	Open Office	500.0					
502	Stair 1	94.5					
502A	Stair 1 Vestibule	82.7					
503	Service Lobby	31.7					
522	Conference	296.7					
523	Conference	296.9					

The duct sizing was vital to clash detection and integration. The supply ducts could not be any taller than 13 inches because the raised access flooring is only 14 inches off of the slab. Therefore, the ducts needed to be wider in many cases, but still had to fit within the 24 inches between panels.

APPENDIX J: LATERAL SYSTEM DESIGN

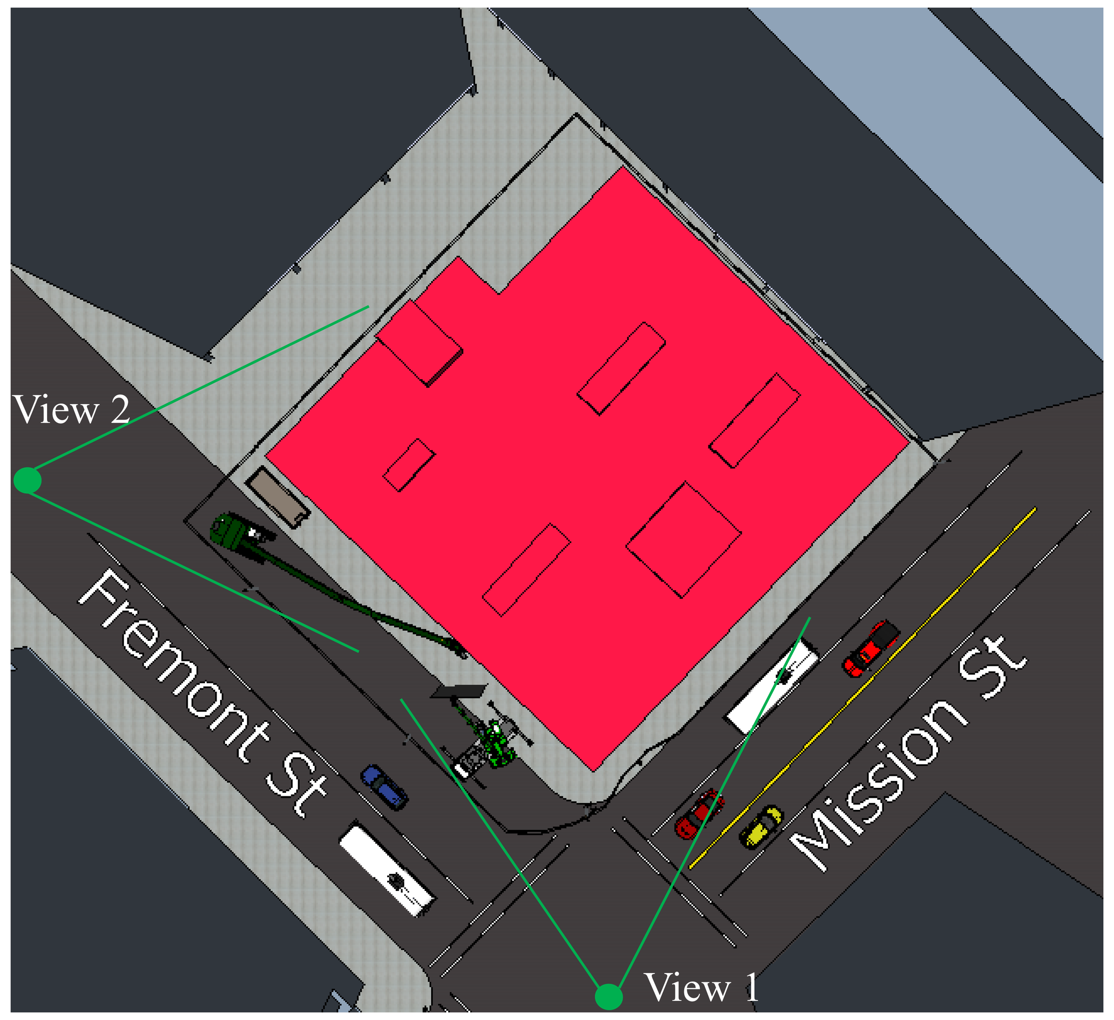


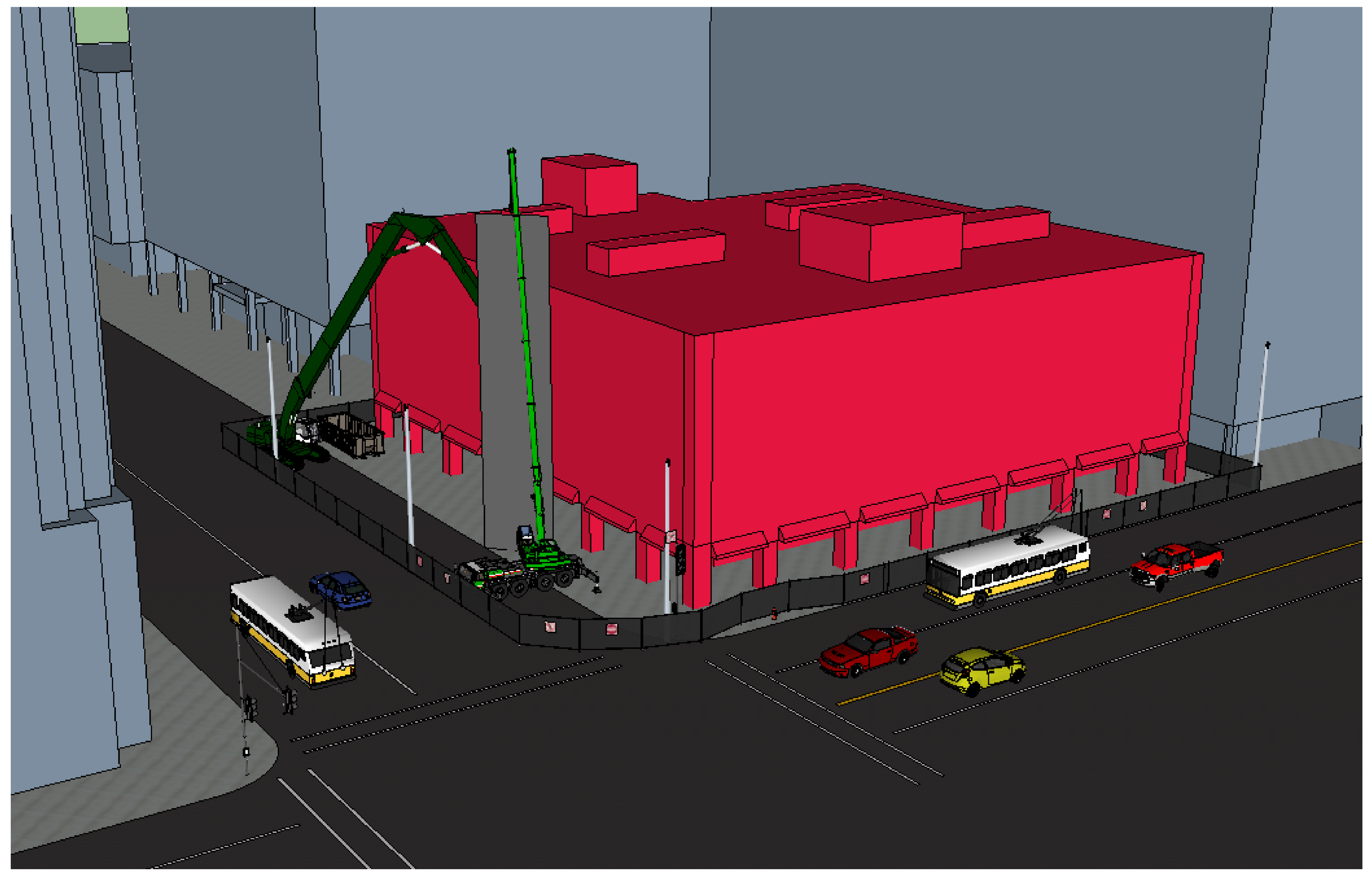
Shown left is the preliminary design of the lateral system of the building. The core, composed of a steel plate shear wall and braced frames, can be seen in the core in the center of the building.



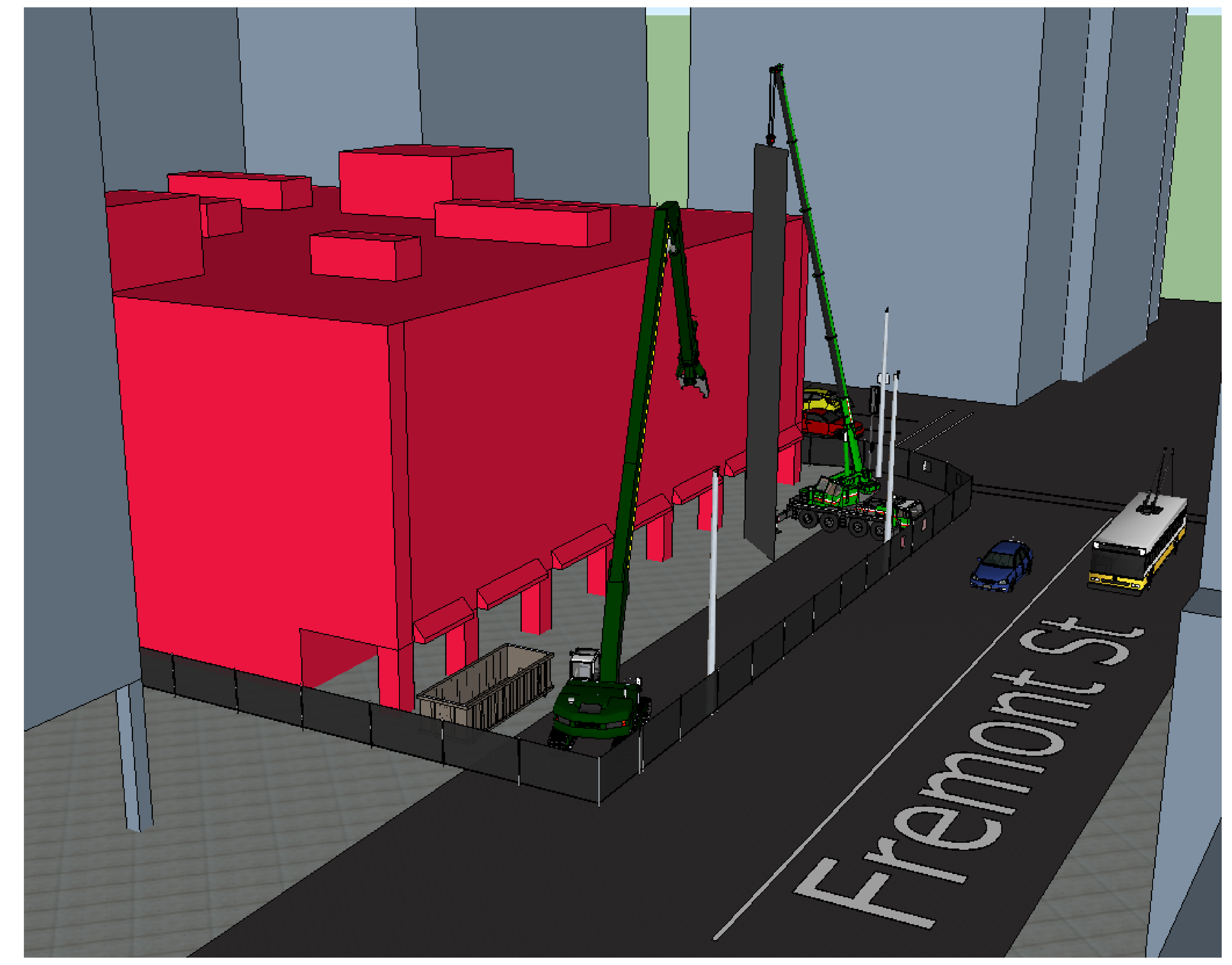
Shown left is the final design of the lateral system of the building. The core composed of two different configurations of braced frames can be seen in the core in the center of the building.

Demolition Site Plan



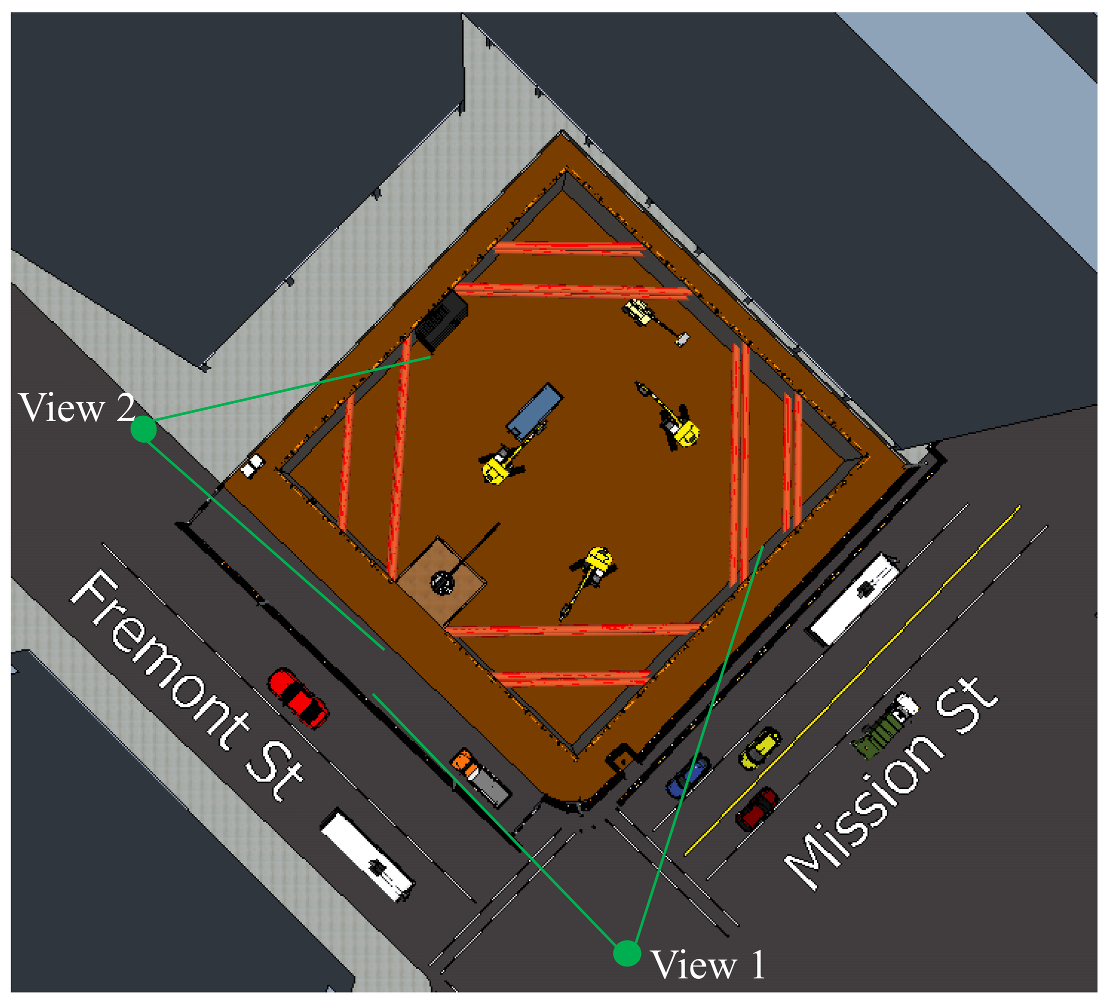


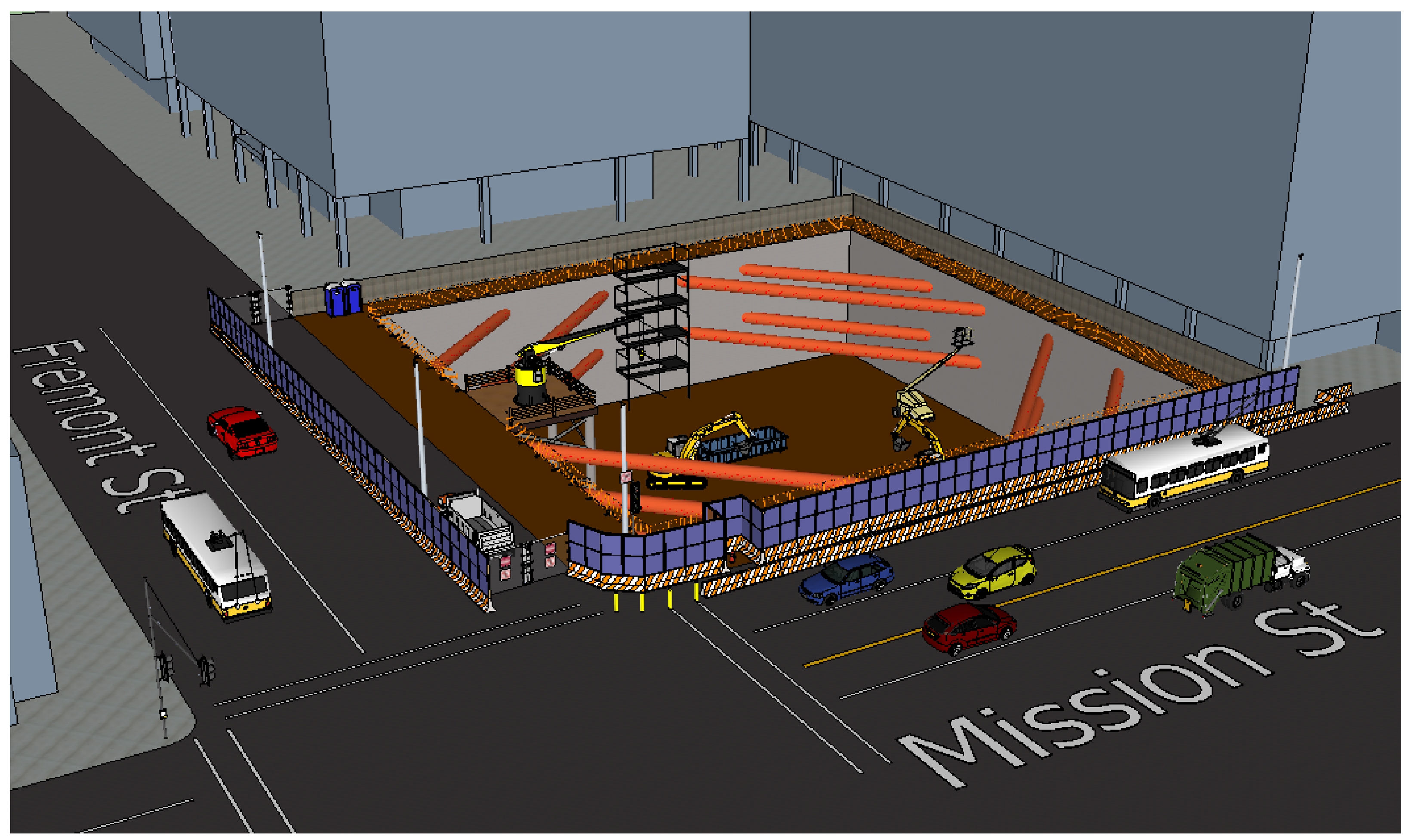
View 1: Demolition of Existing Building



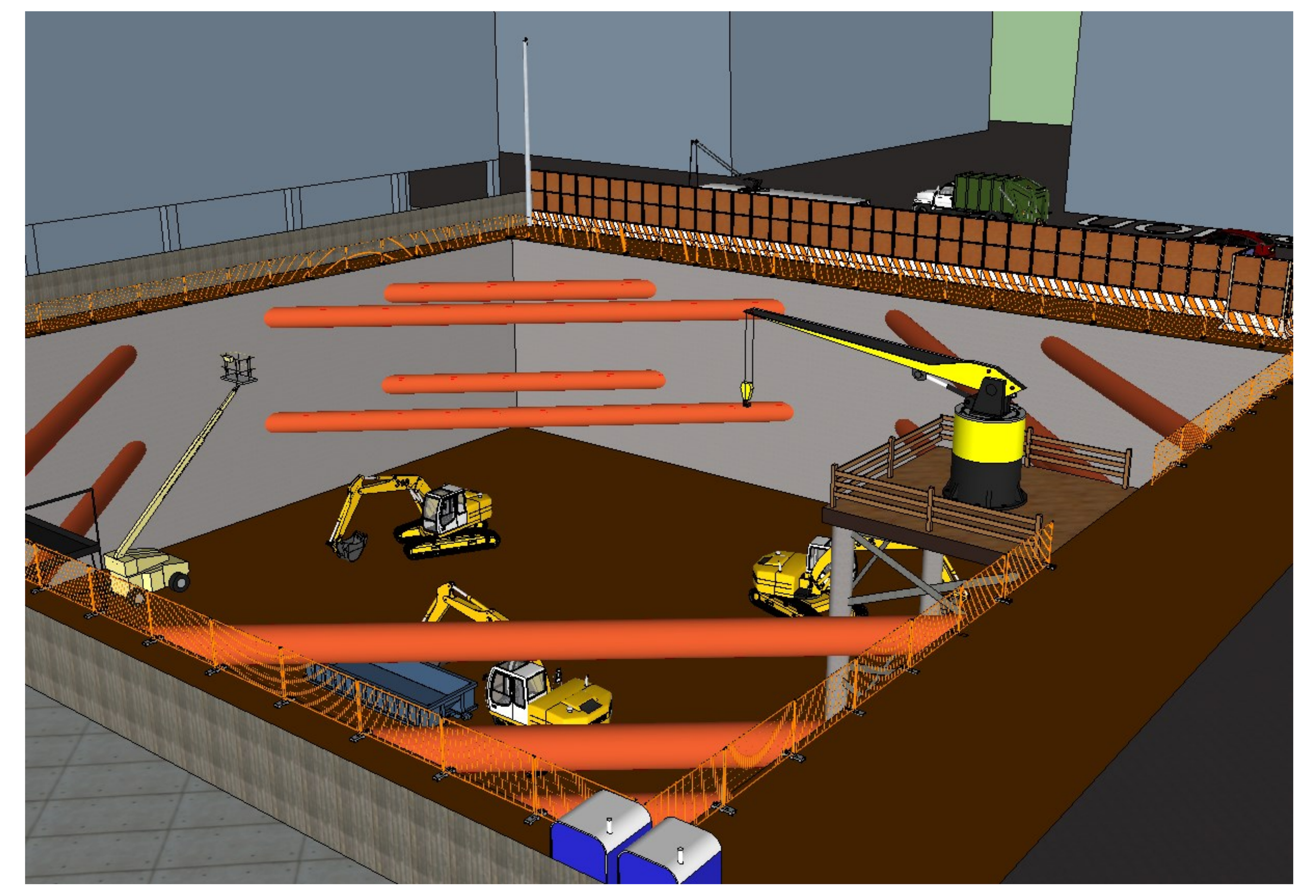
View 2: Demolition of Existing Building

Excavation Site Plan



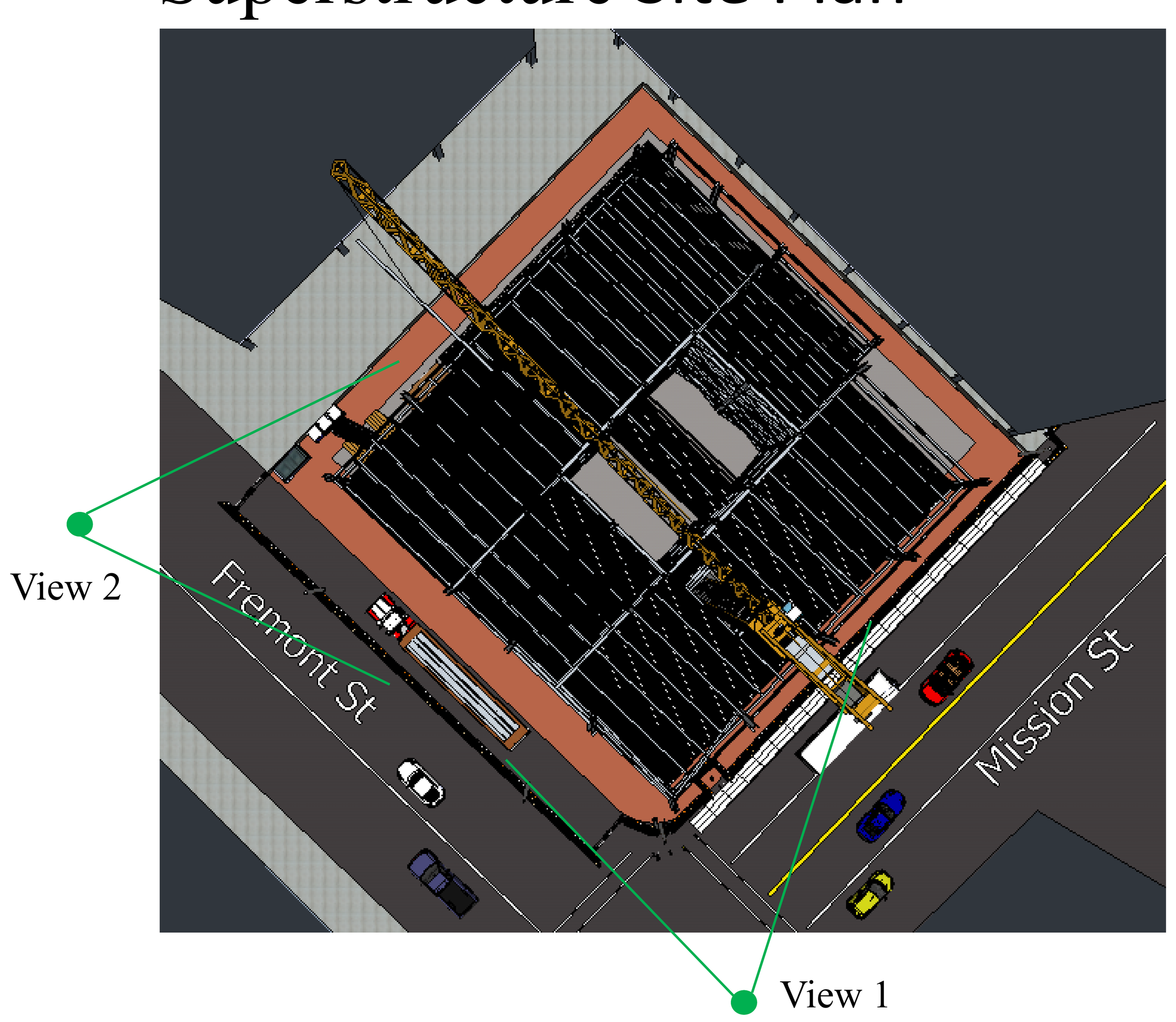


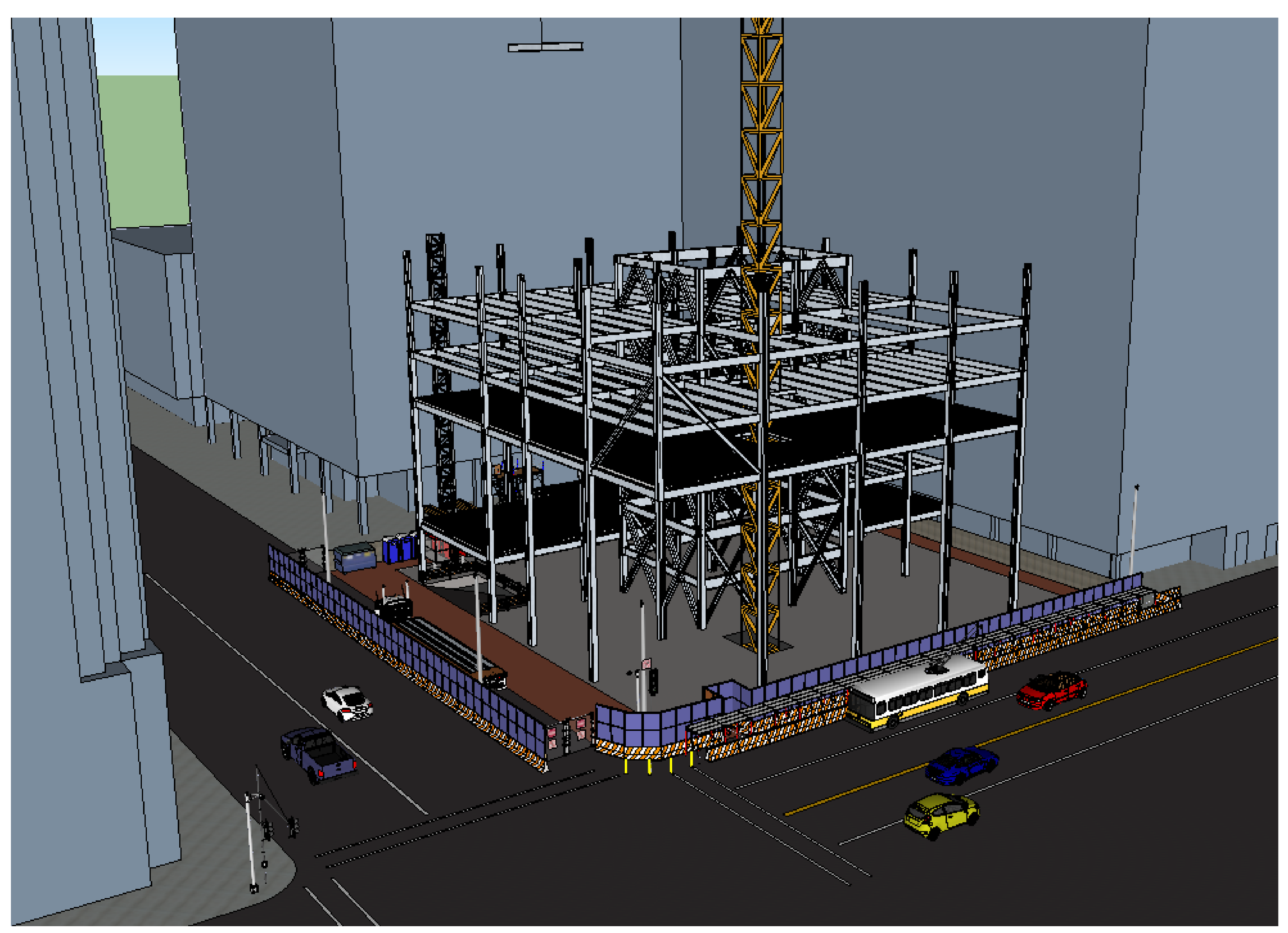
View 1: Excavation of Site



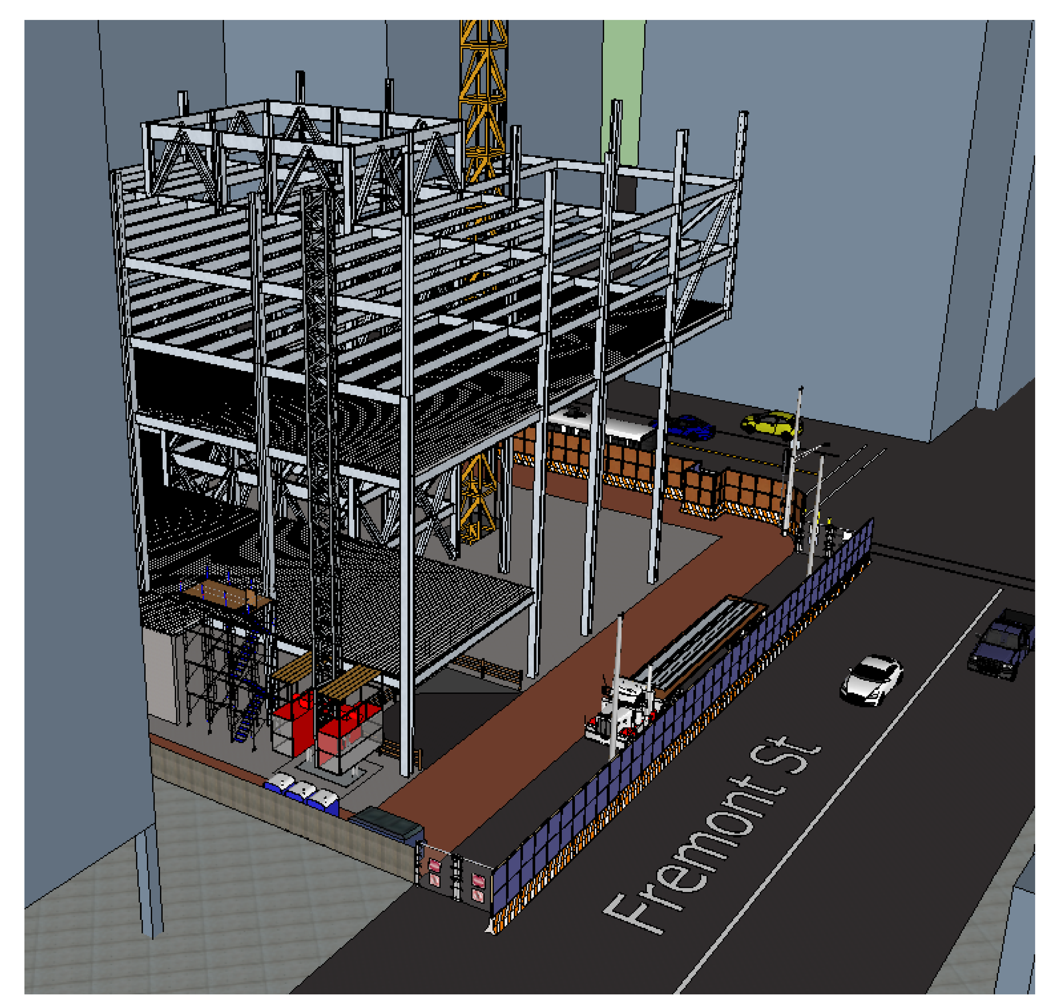
View 2: Excavation of Site

Superstructure Site Plan





View 1: Steel Erection



View 2: Steel Erection

AEI

ASCE

Integration

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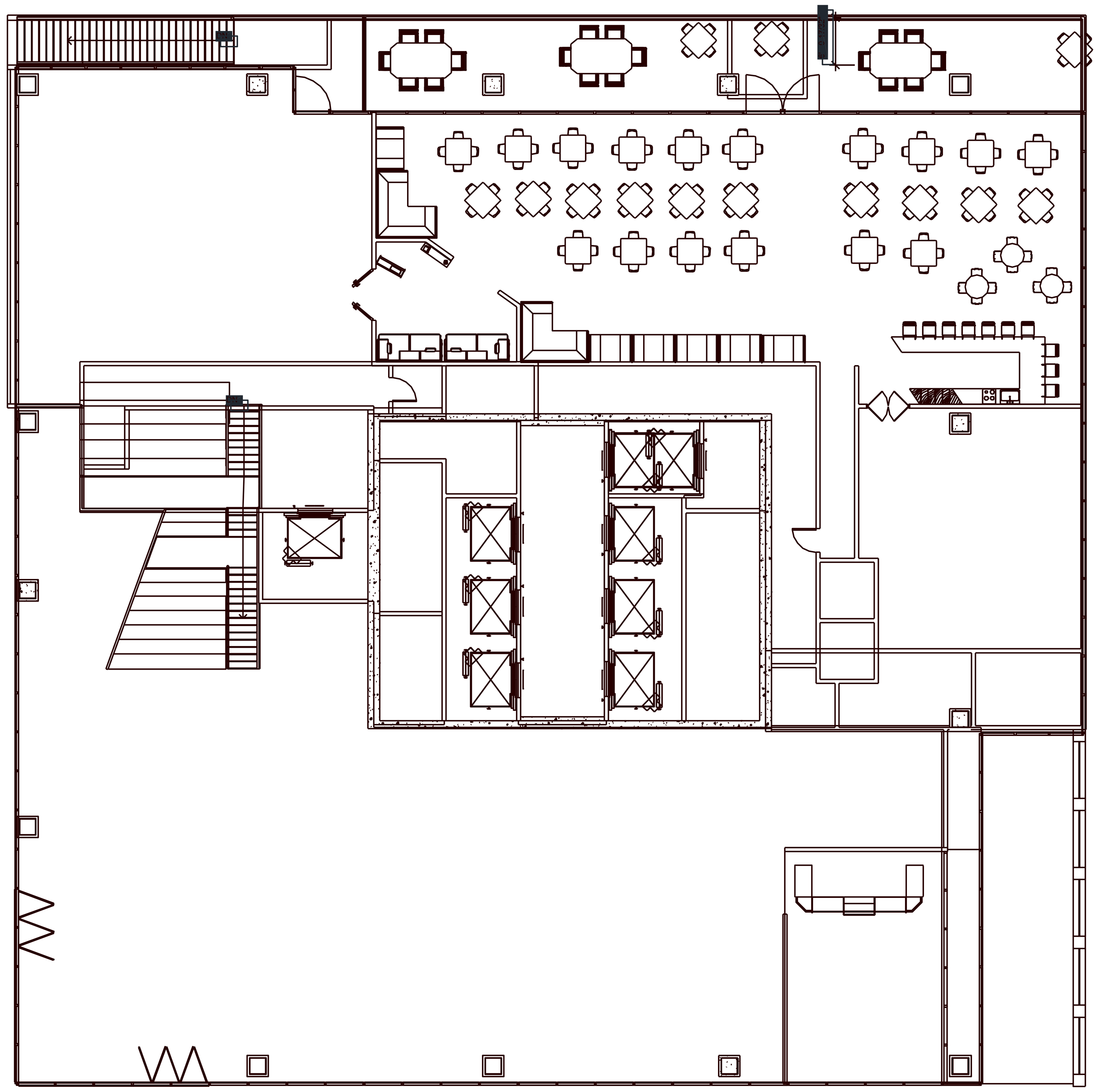
AEI Team Number

05-2014

Site Plan

I-100

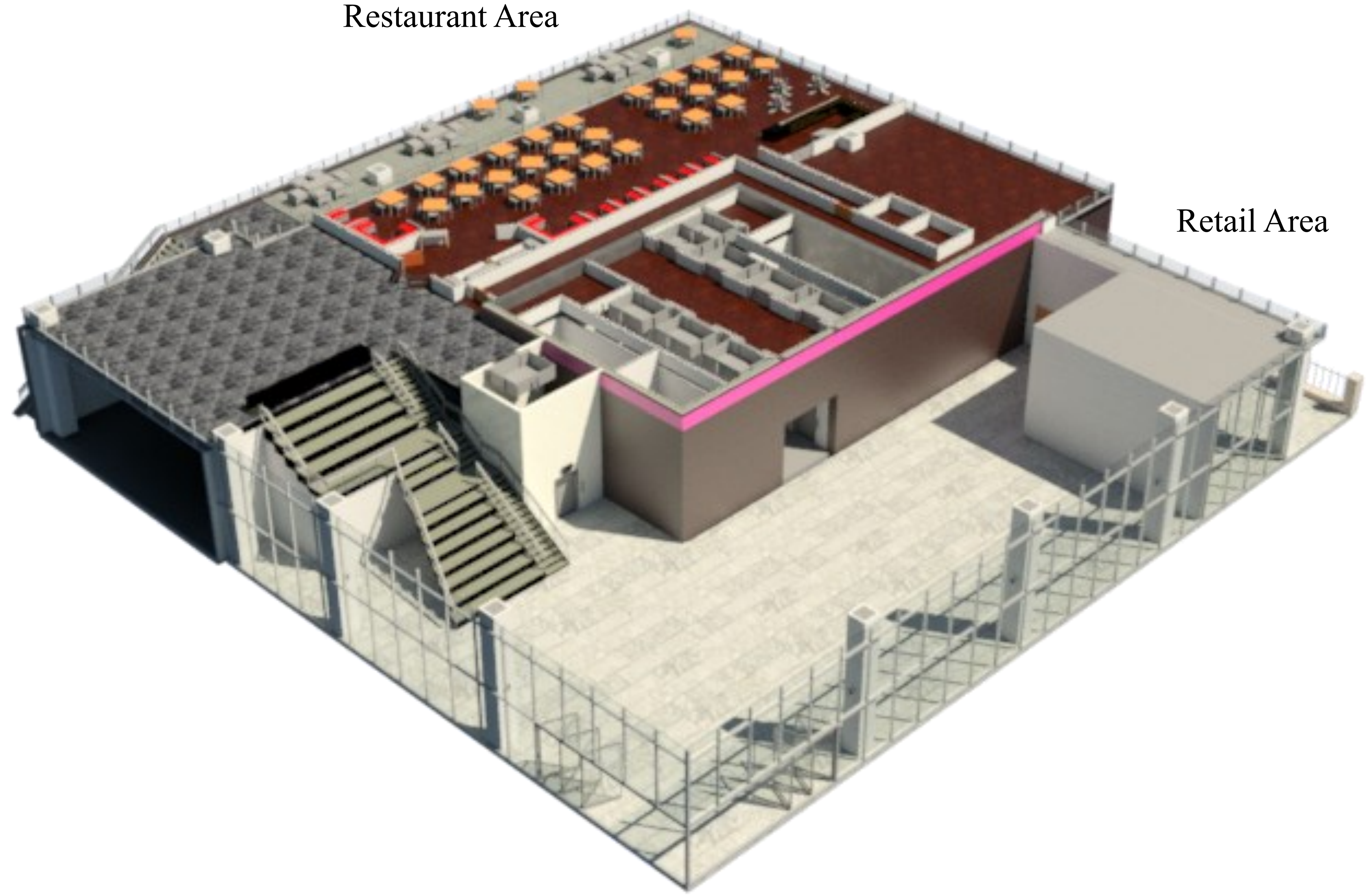


Lobby 2nd Level

Structrual Notes

A. Increased gravity loads were considered for the ground floor due to the open-air nature of the lobby

B. Column in the southwest corner of the building was removed for the open-air lobby in accordance with the original design of the building



Lobby Main Level

Mechanical

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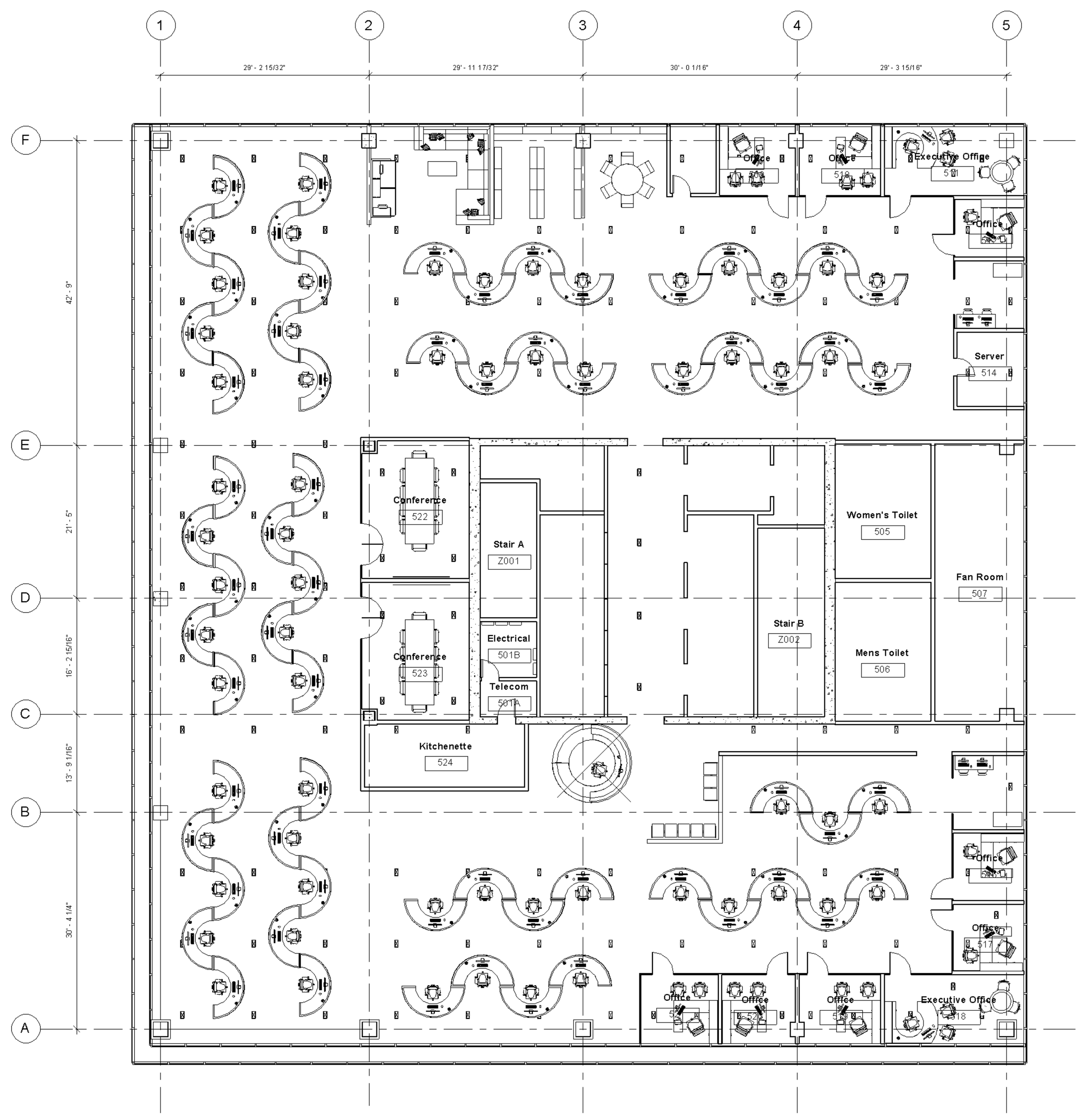
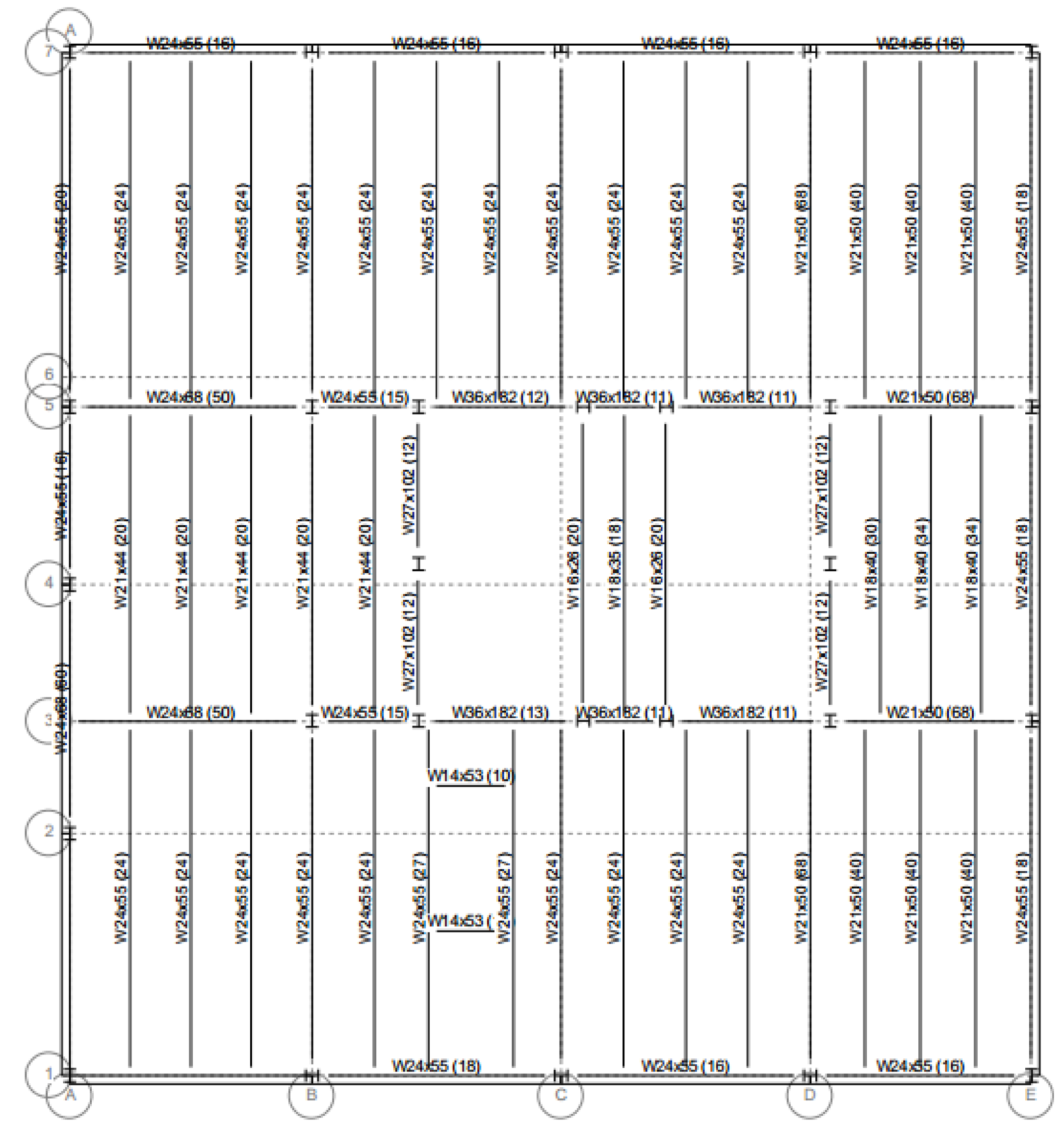
Lobby Plan

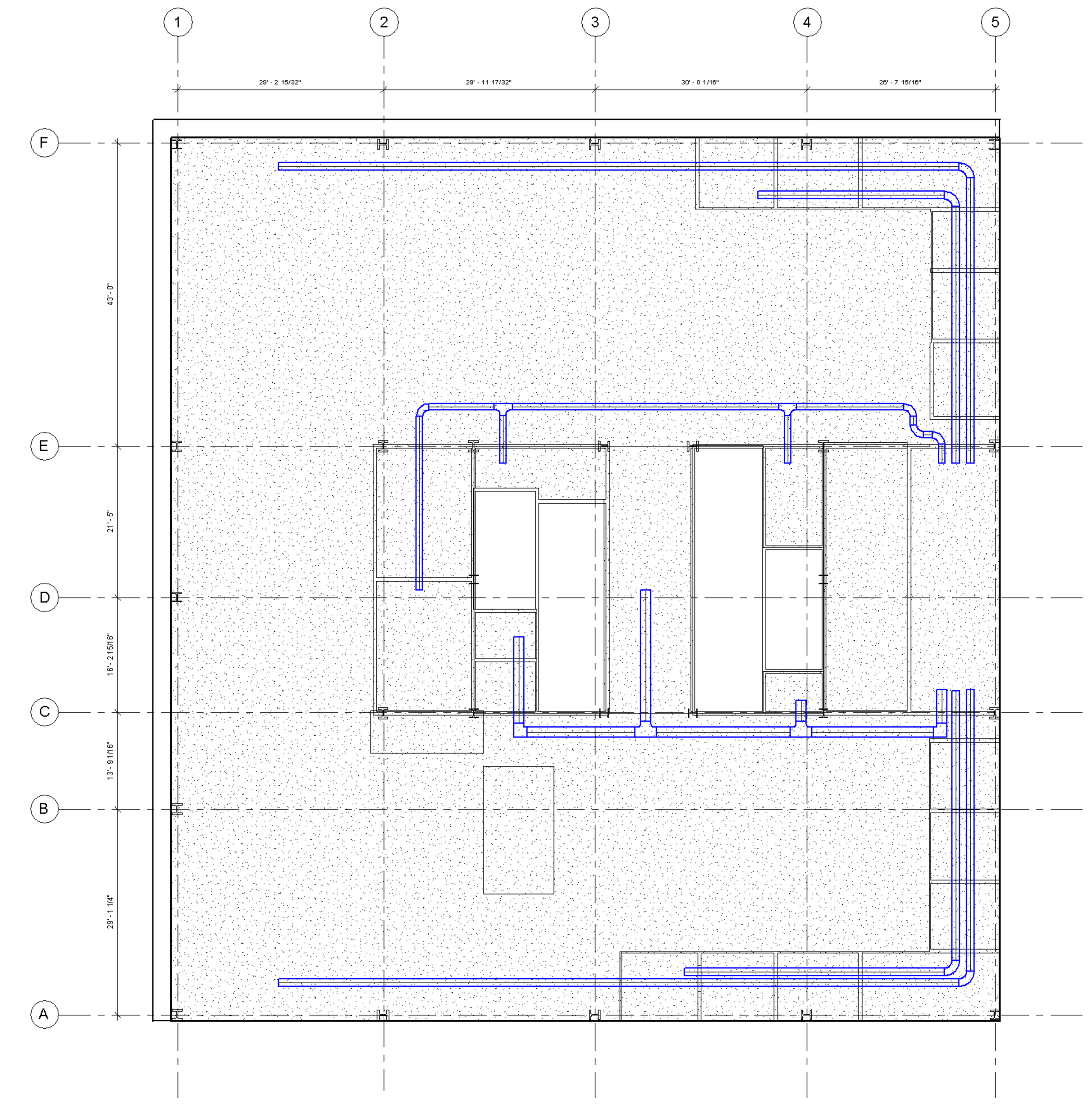
I-101



Typical Floor Plan

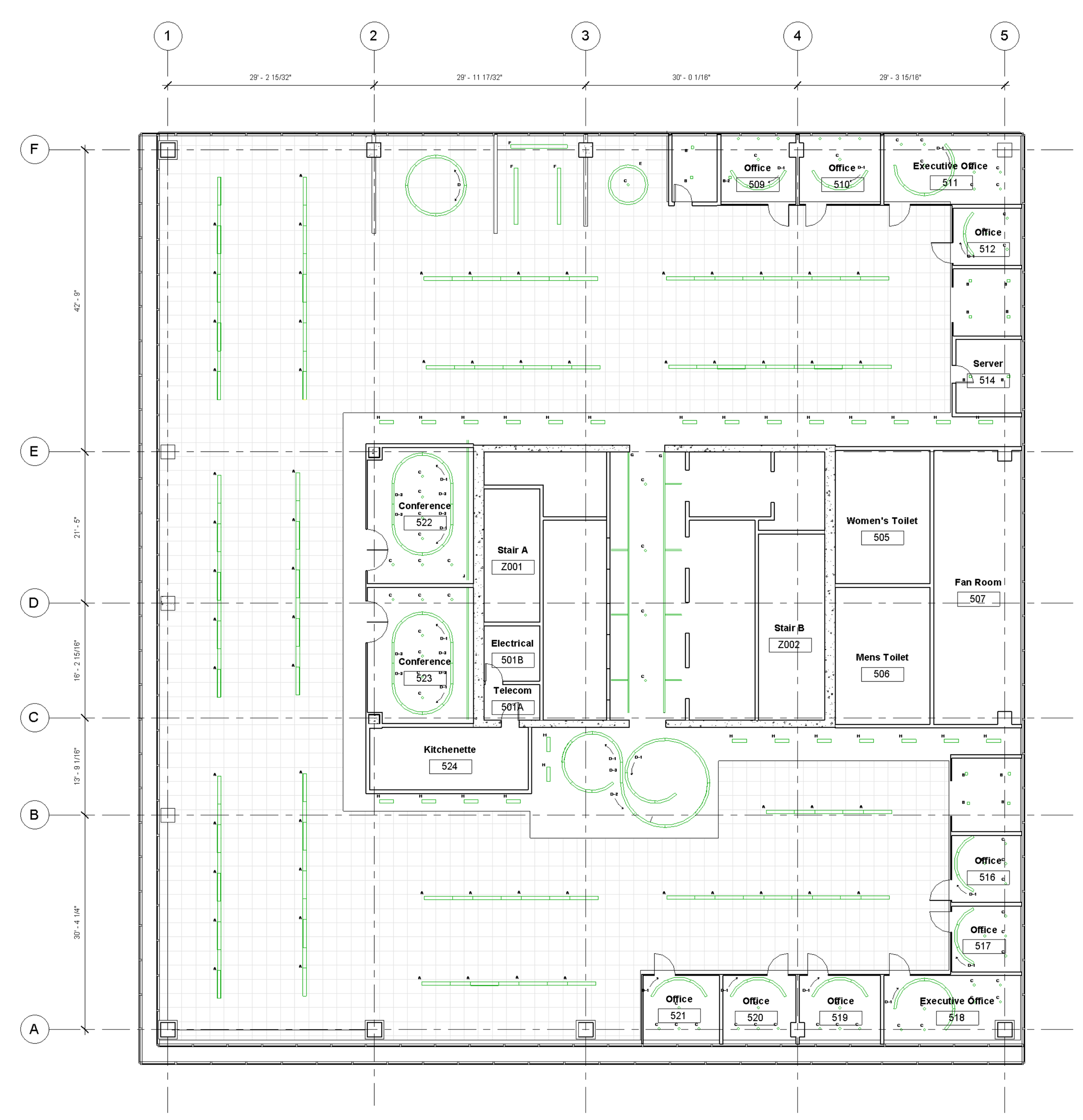


Structural Plan



Mechanical Plan

Sprinkler Plan



Lighting Plan

Electrical Plan

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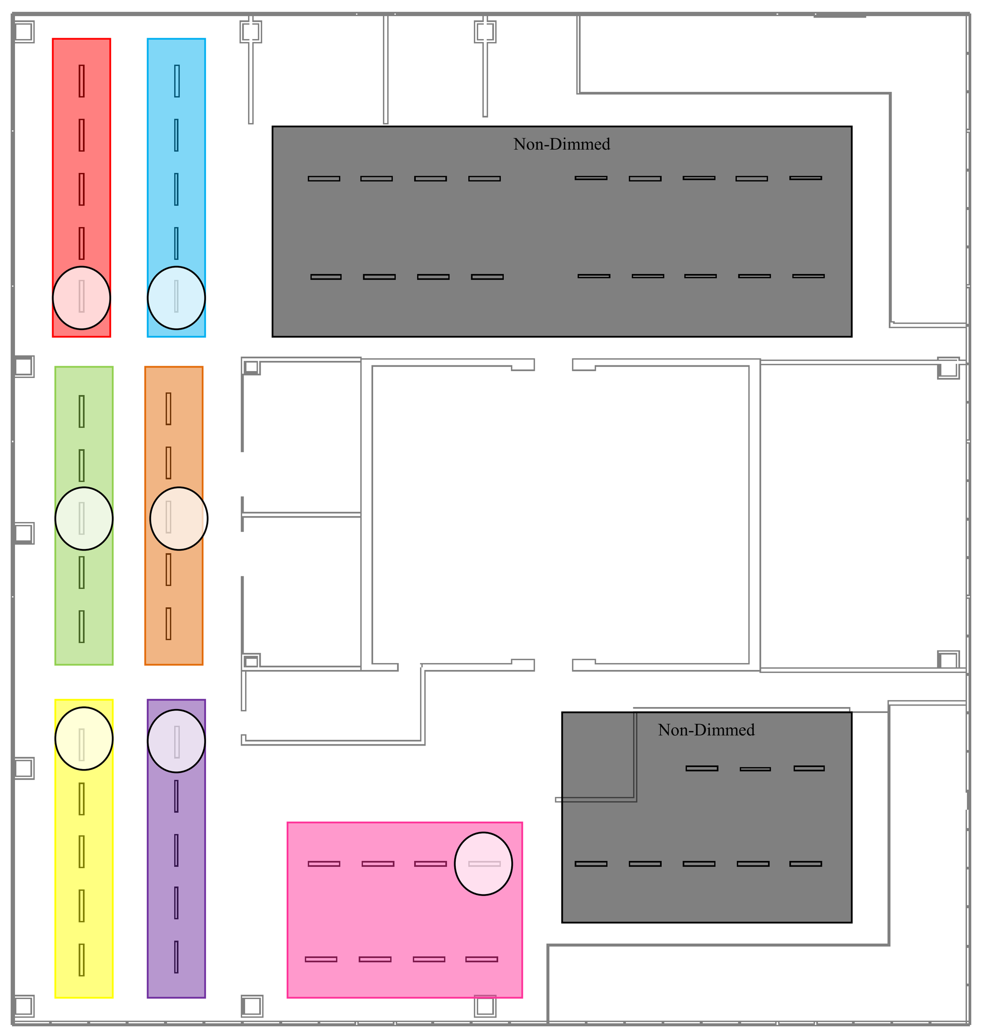
Office Plan
Levels 5-30

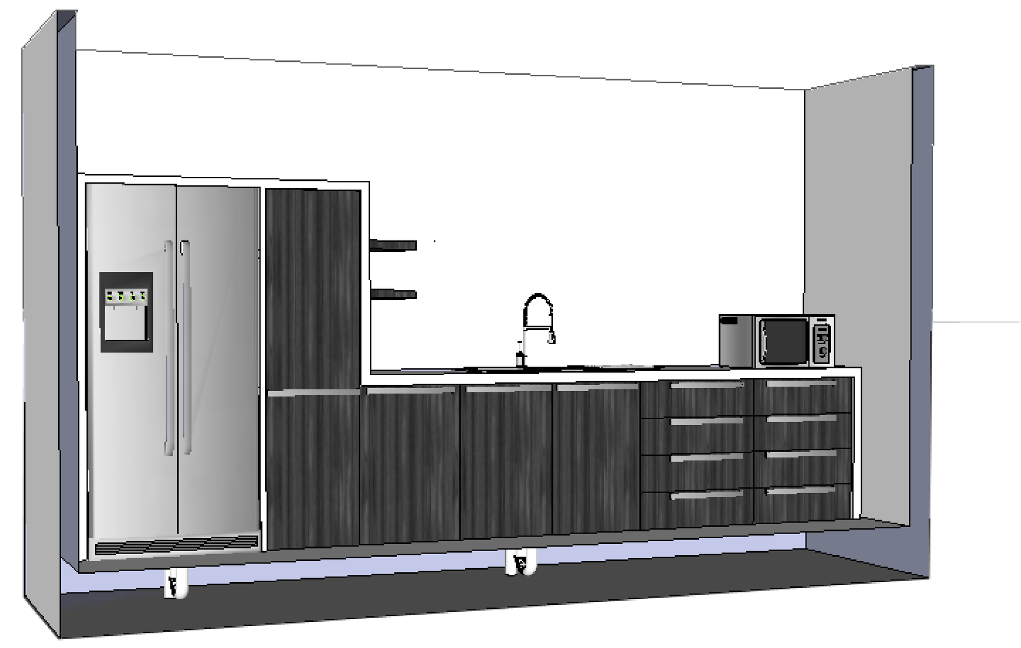
I-102

Lighting Controls

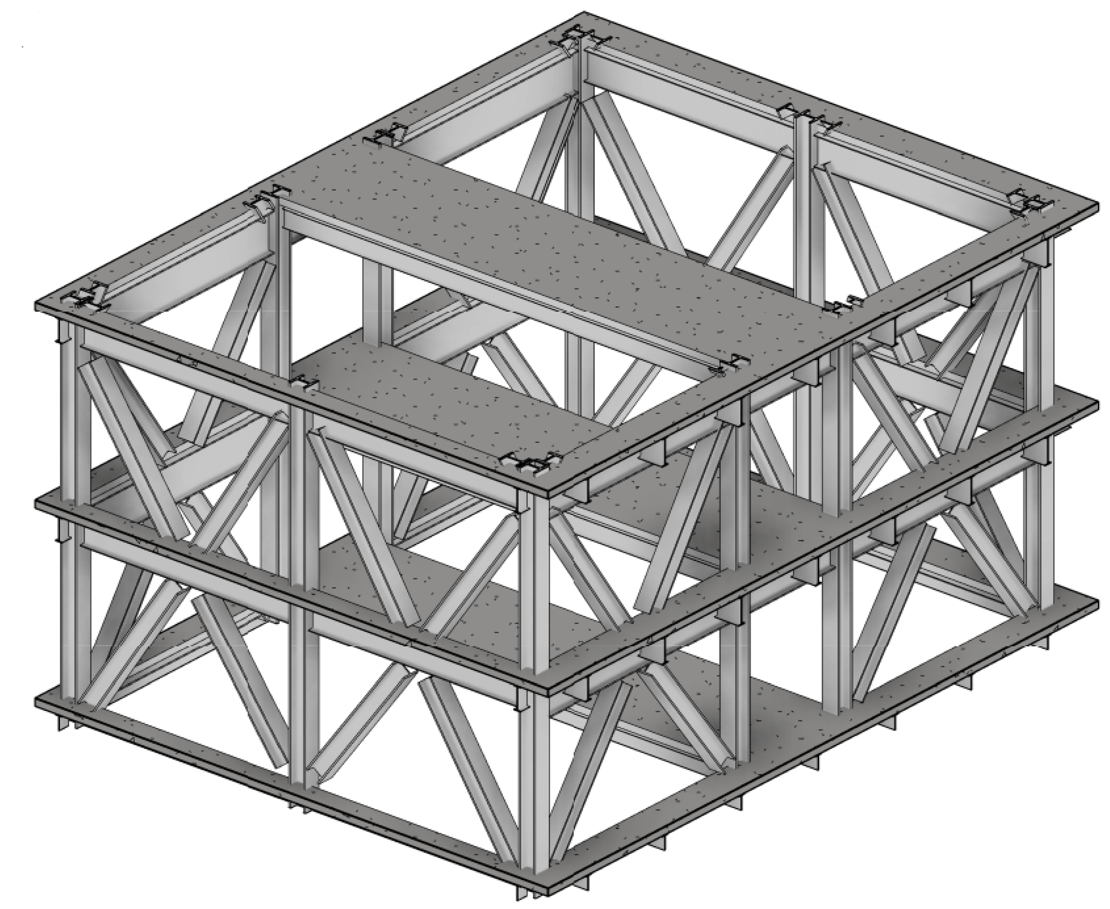


Open office area split into seven zones, which dim independently depending on the quantity and distribution of daylight entering the office.

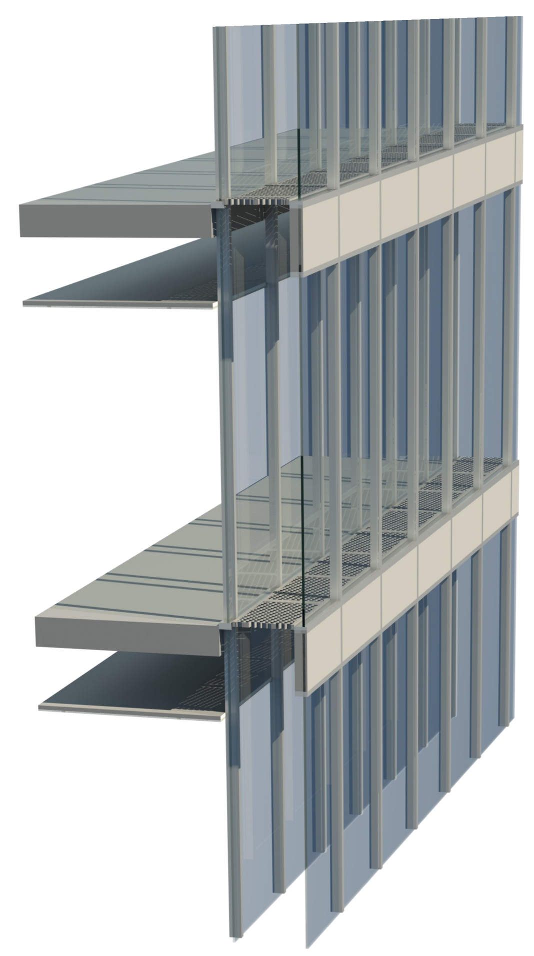
Prefabricated Pods



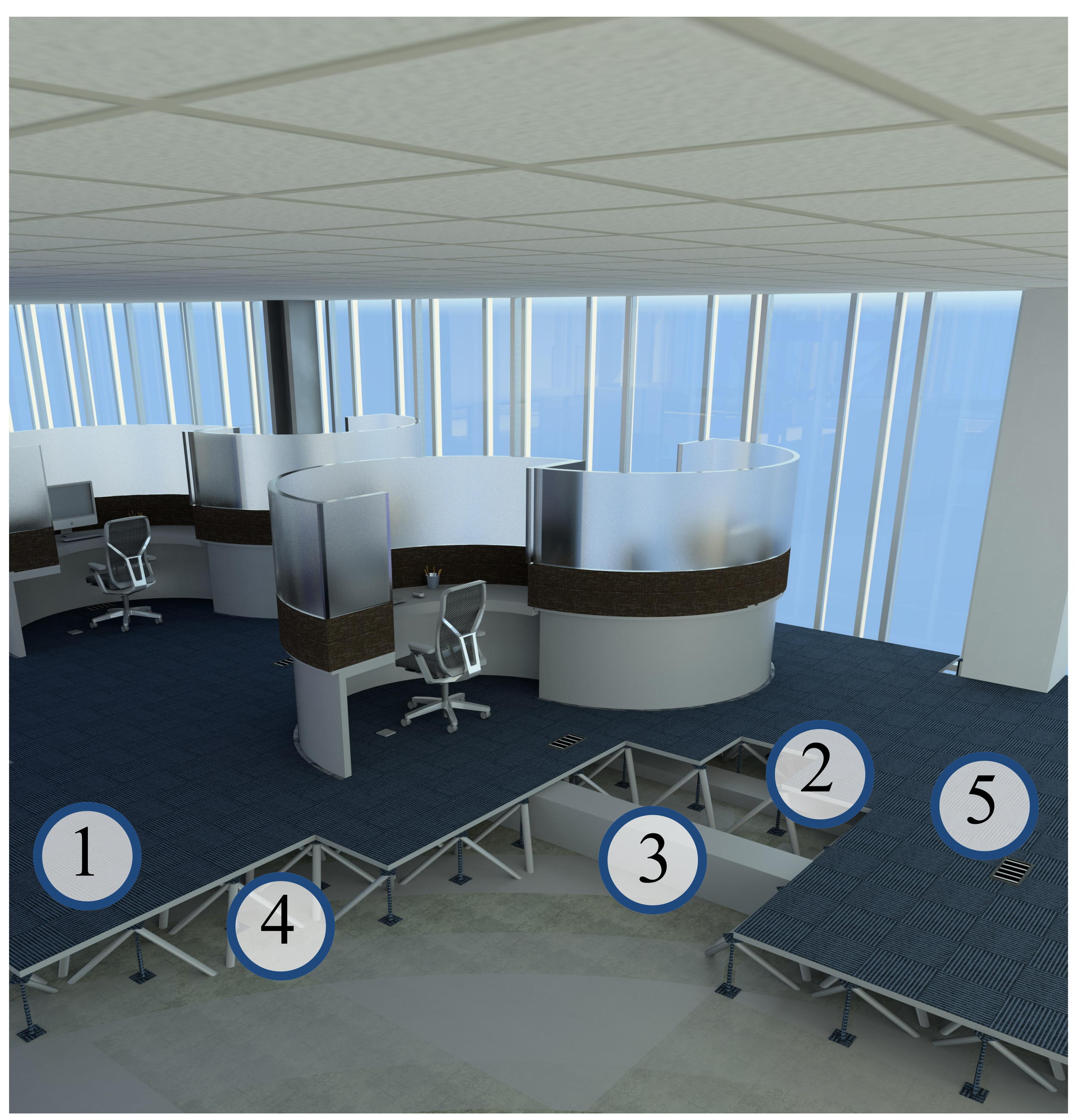
Lateral System



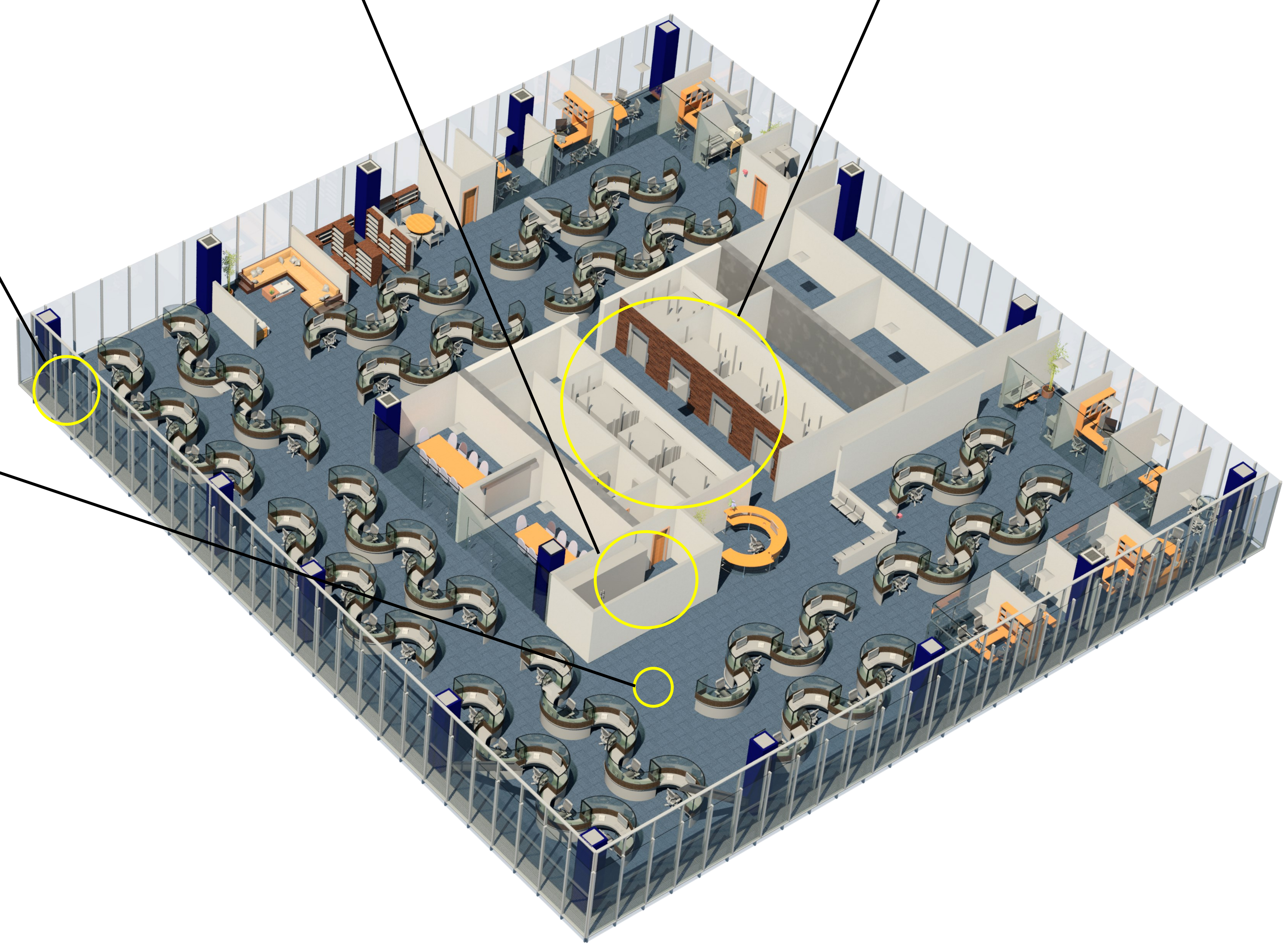
Double Façade System



Raised Access Floor



1. Raised Access Floor (RAF)
2. Data Cable Tray
3. Supply Air Duct
4. Seismic Bracing
5. Supply Diffuser



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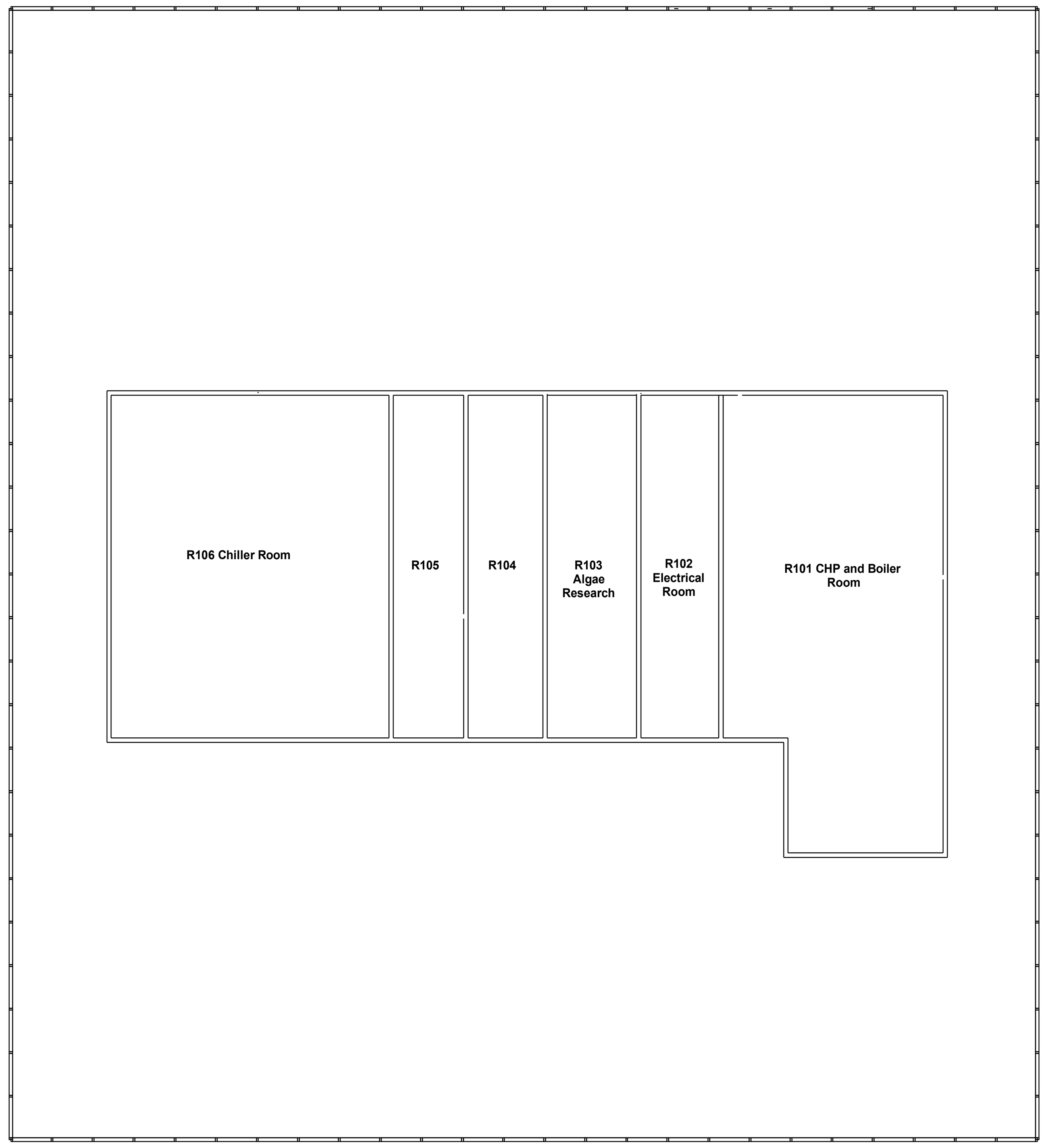
Office
Engineering Systems

I-103

Roof Plan



CHP System

Max Load Capacities		
Max Heating Capacity	2,100	kBtu/hr
Max Cooling Capacity	7,380	kBtu/hr

65 kW Capstone Microturbines		
Electrical Efficiency	29%	
Generation Capacity	627	kW
Quantity	10	
Actual Capacity	650	kW

Energy Production		
Generation Capacity	650	kW
Operating Hours	1,560	hrs/yr
Generated Power	1,014,000	kWh/yr
Power Consumption	3,815,944	kWh/yr
Electrical Capacity Met	33%	

Heat Recovery		
Heat Recovery Efficiency	45%	
Heat Recovery	1,842	Btu/hr
Capacity Met	88%	

PV System

PV Output Calculation

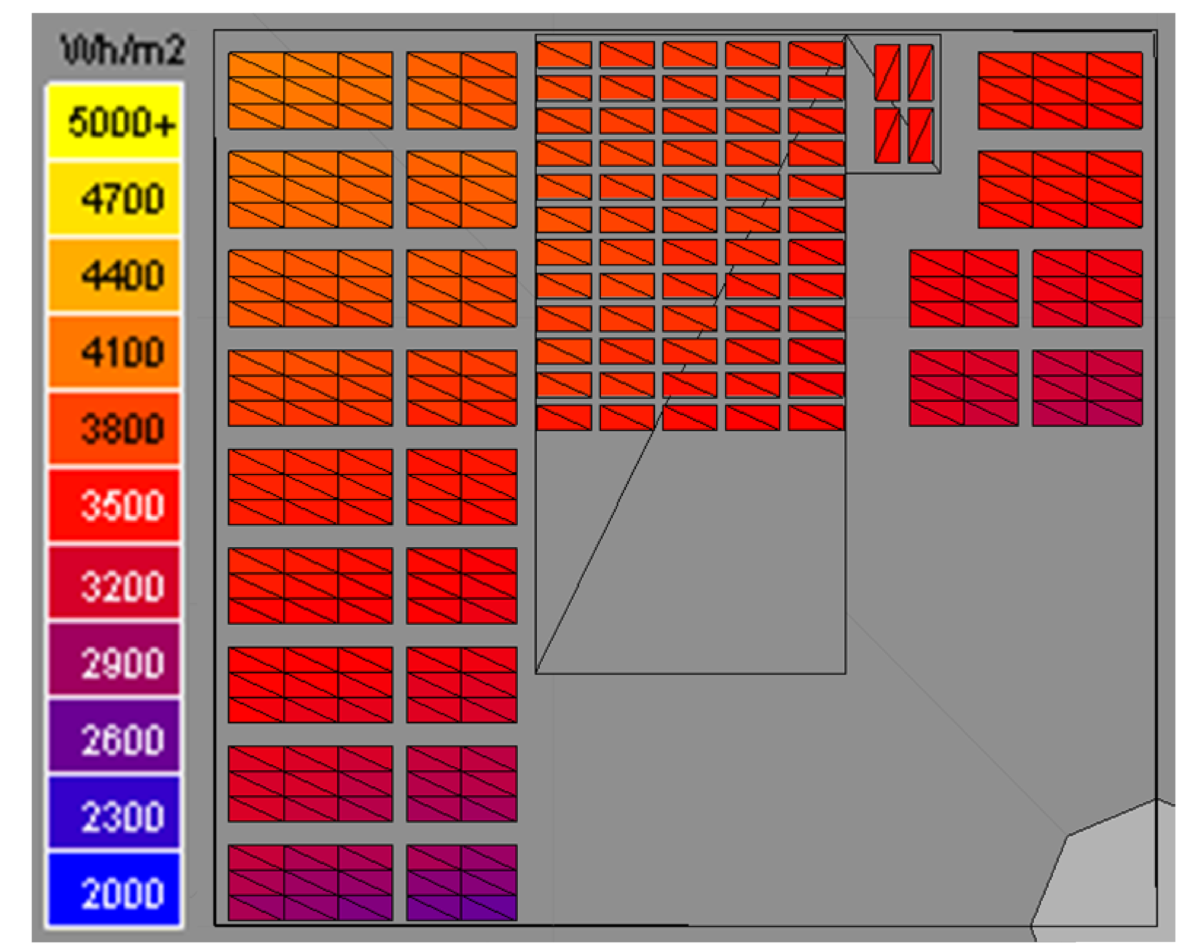
241	panels
2.44	m^2/panel
3,544.43	Whr/(m^2-day)

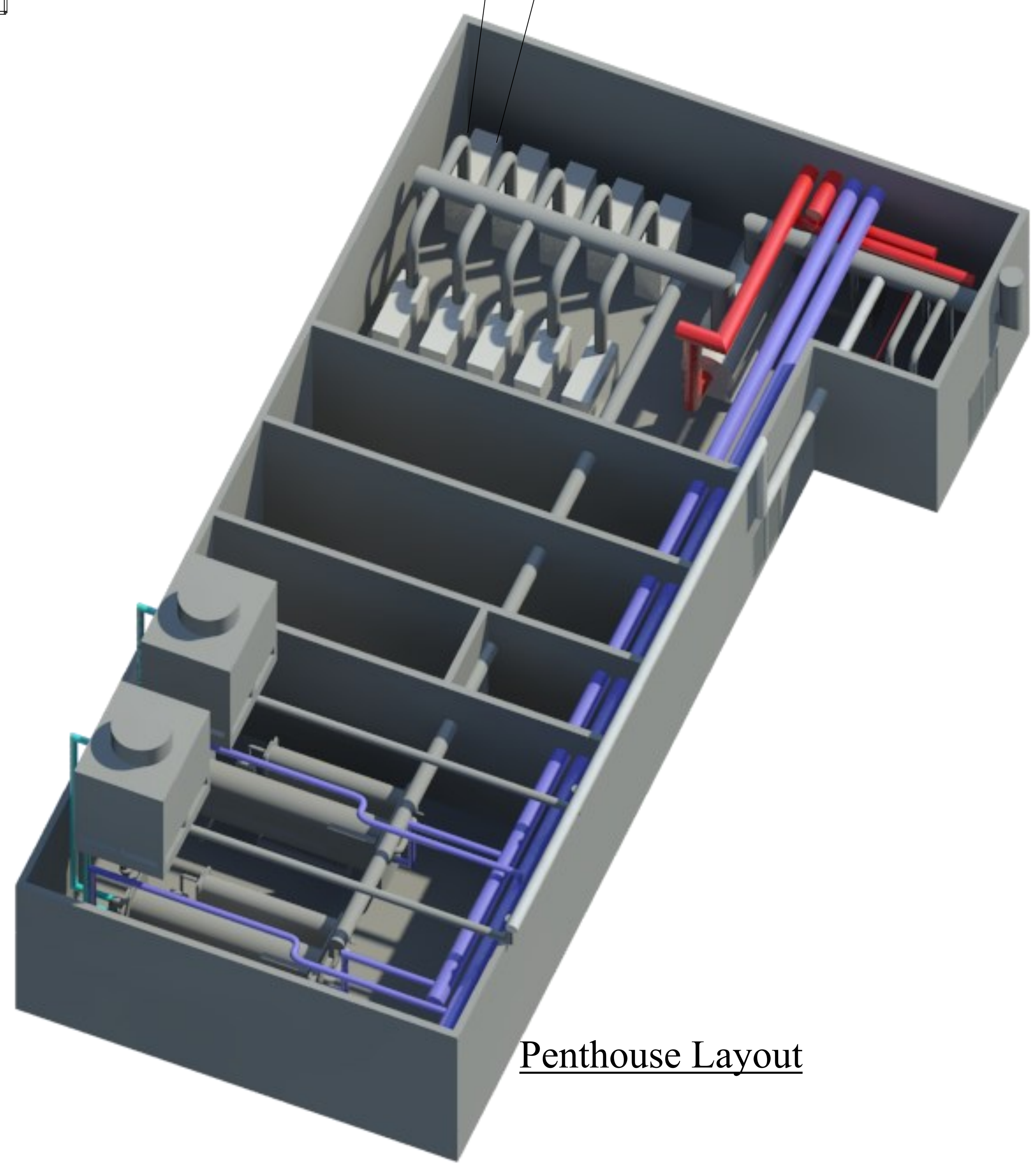
multiply the above to get:

2,083.41	kWhr/day
760,445.53	kWhr/year
19.7%	system efficiency

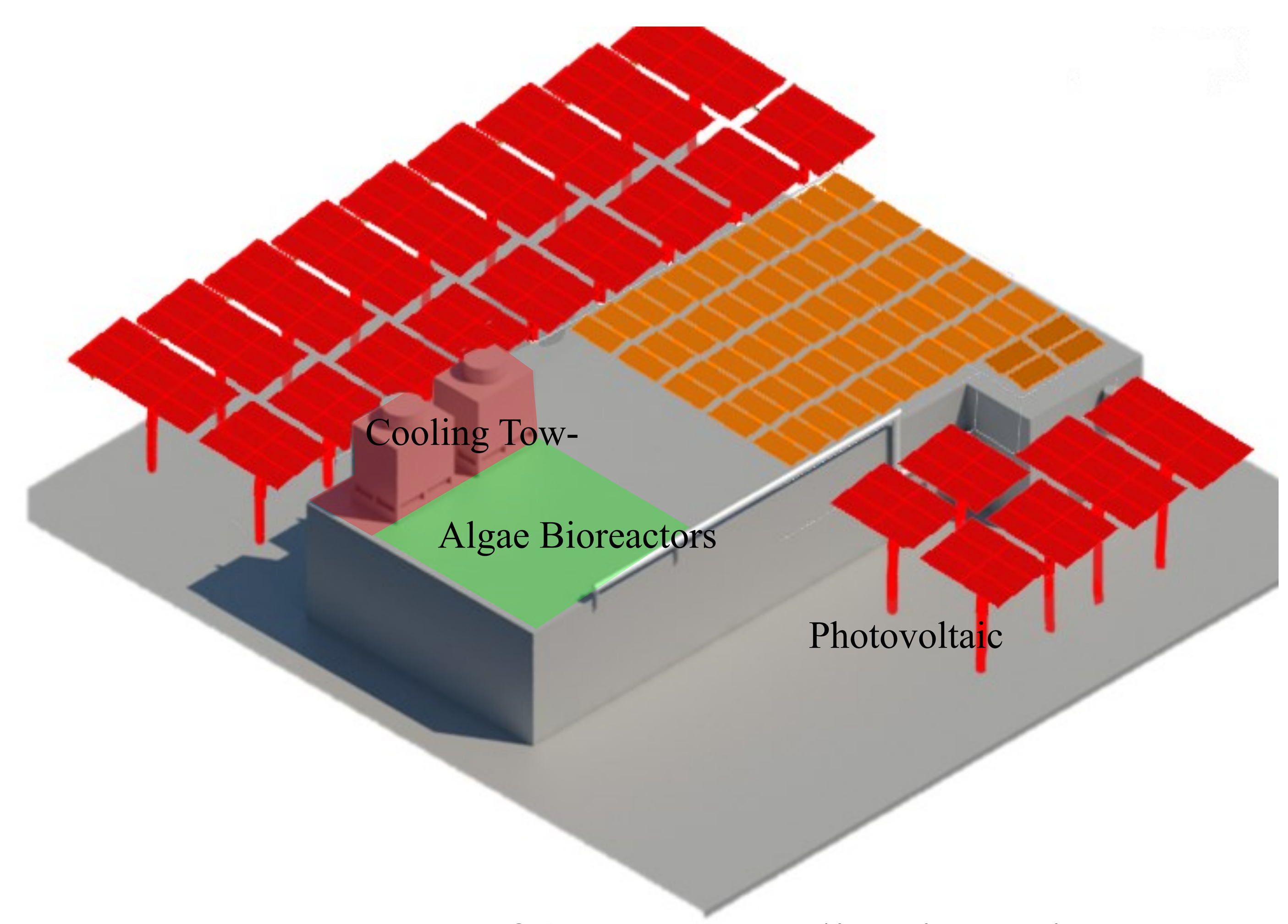
760,445.53 * 19.7% =

149,808 kWhr/year produced





Penthouse Layout



Roof Space Coordination Diagram

Structural Notes

A. Flooring comprised of larger beam depths to accommodate mechanical equipment

B. Consulted MEP members to determine weight of mechanical equipment to produce these sizes

Mechanical

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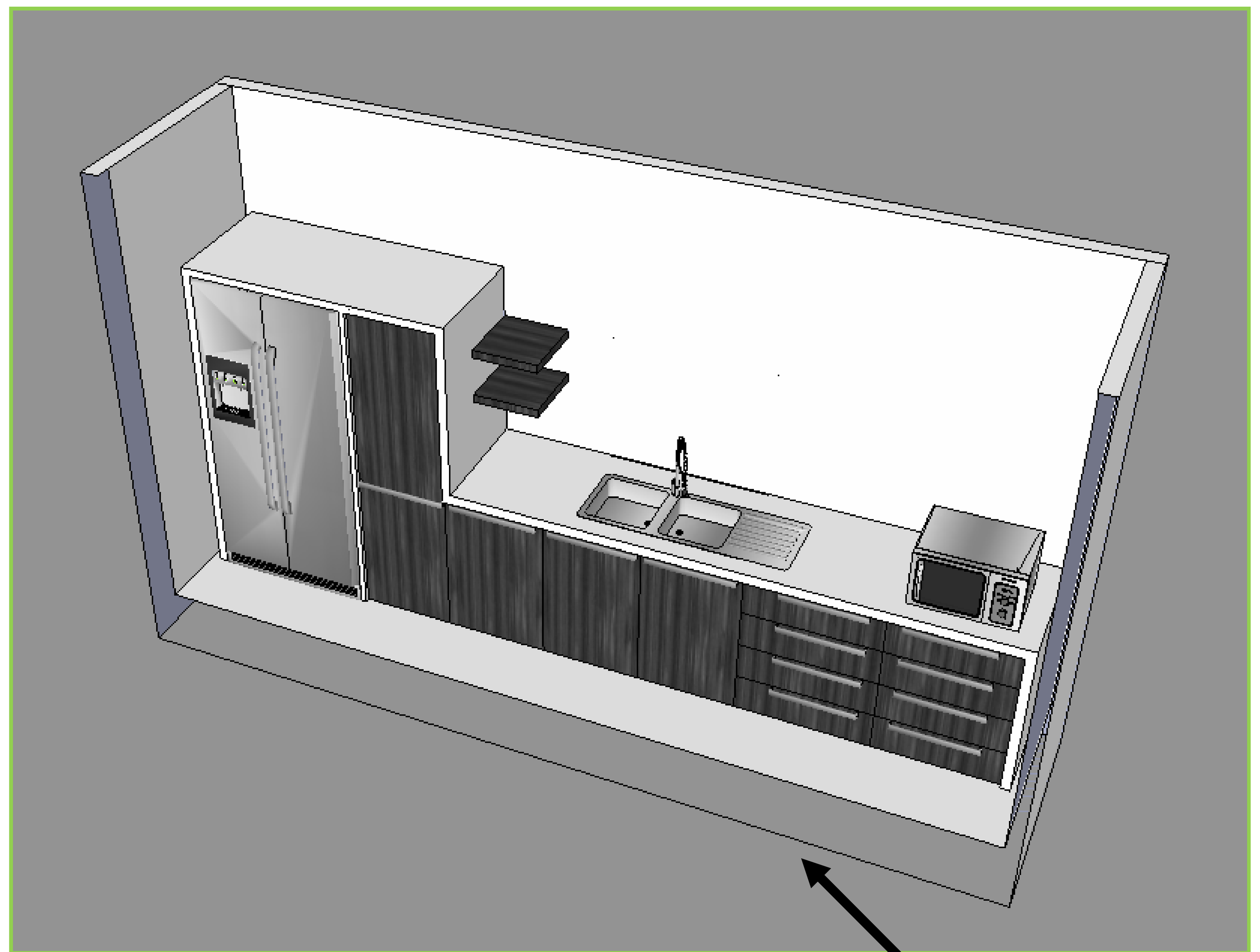
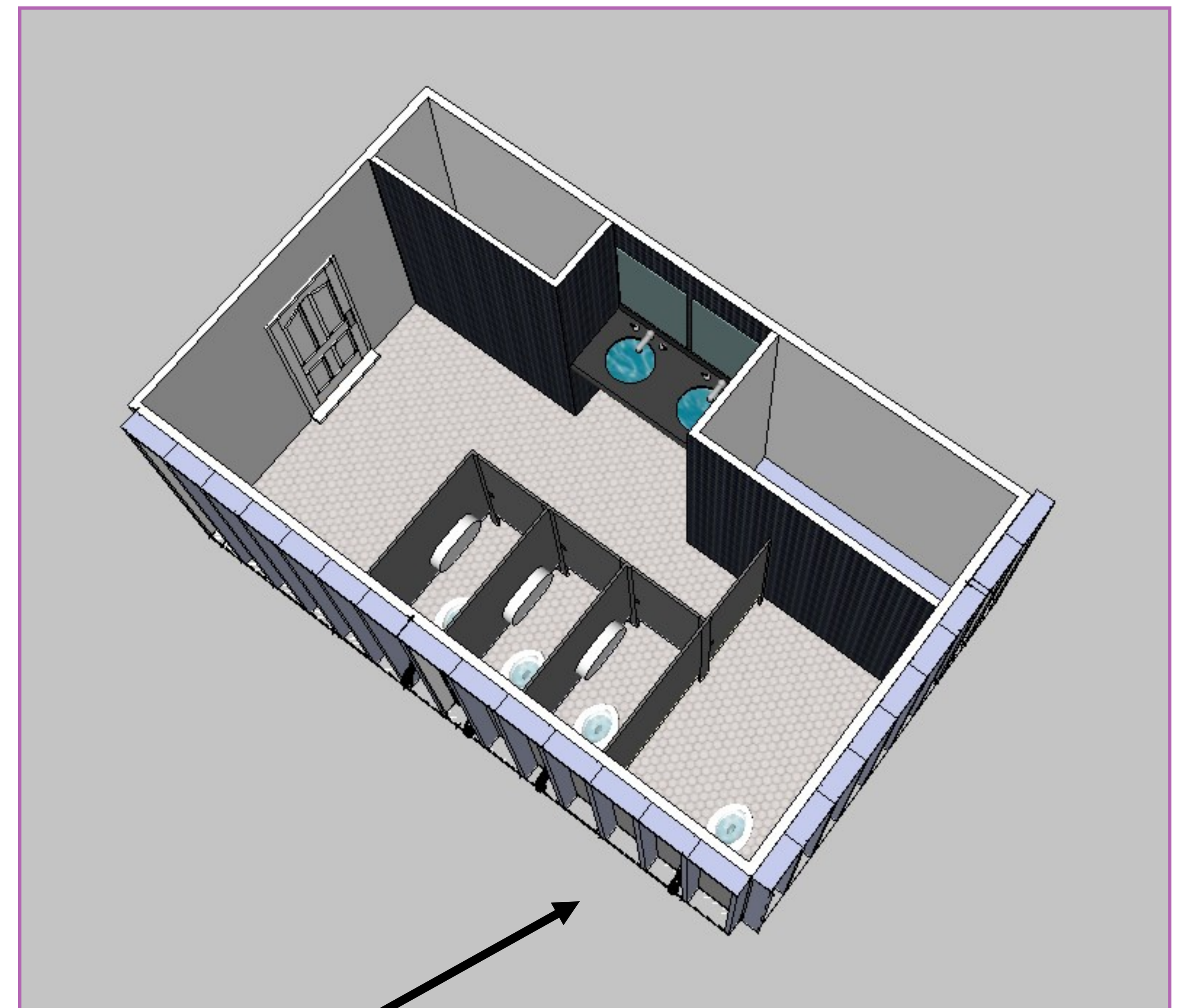
Roof Plan

I-104

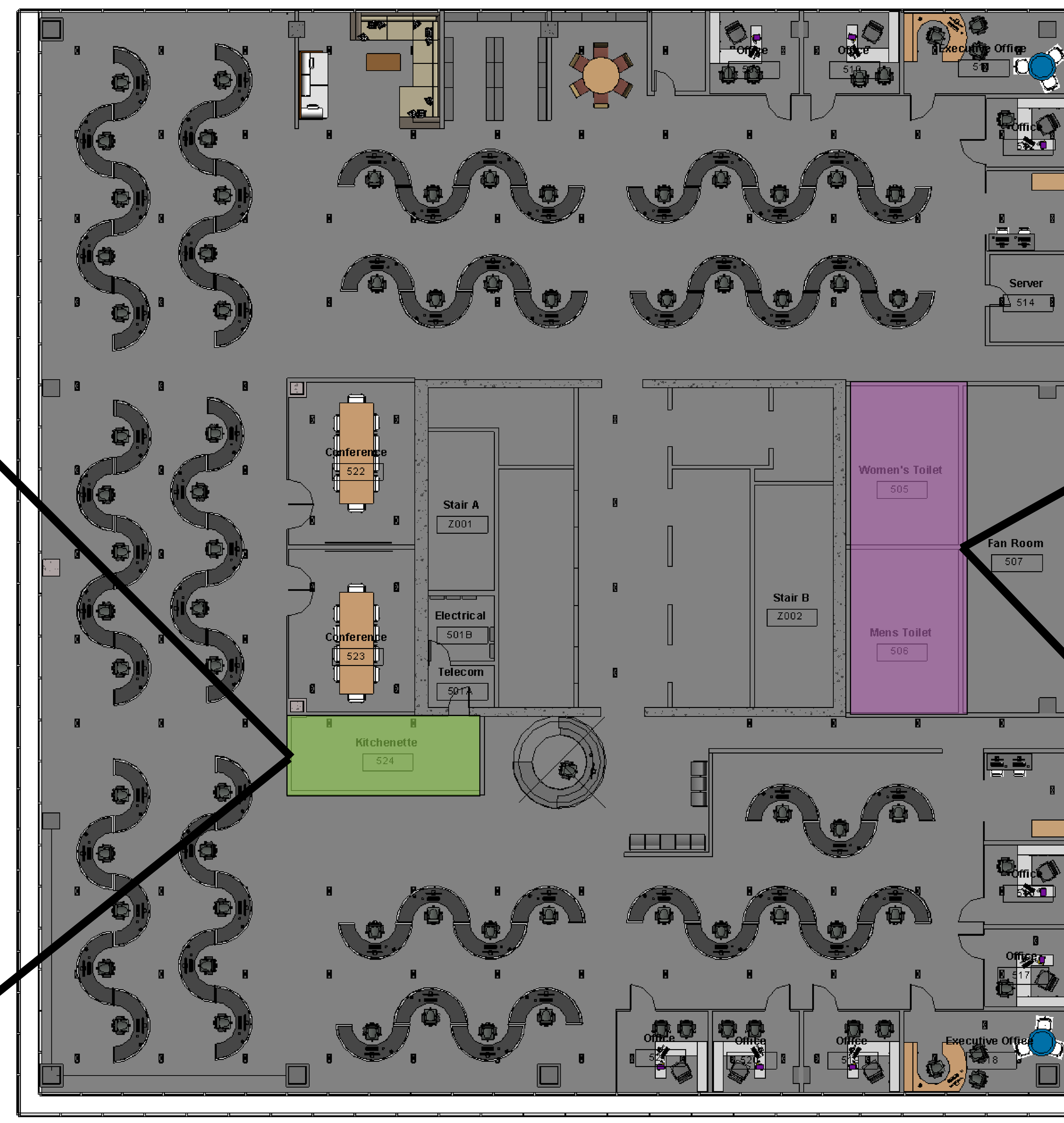
Kitchen Pods (Green)

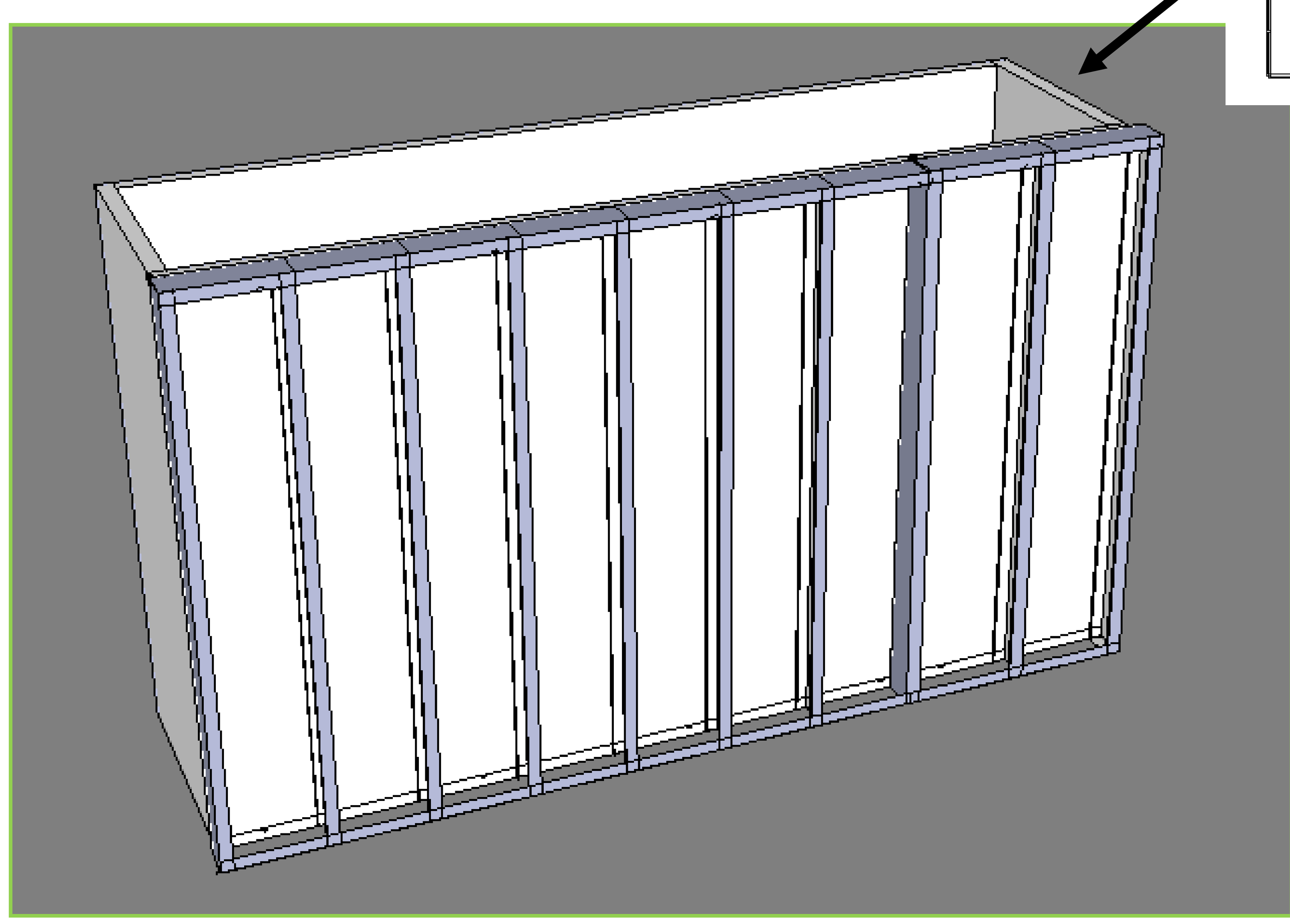


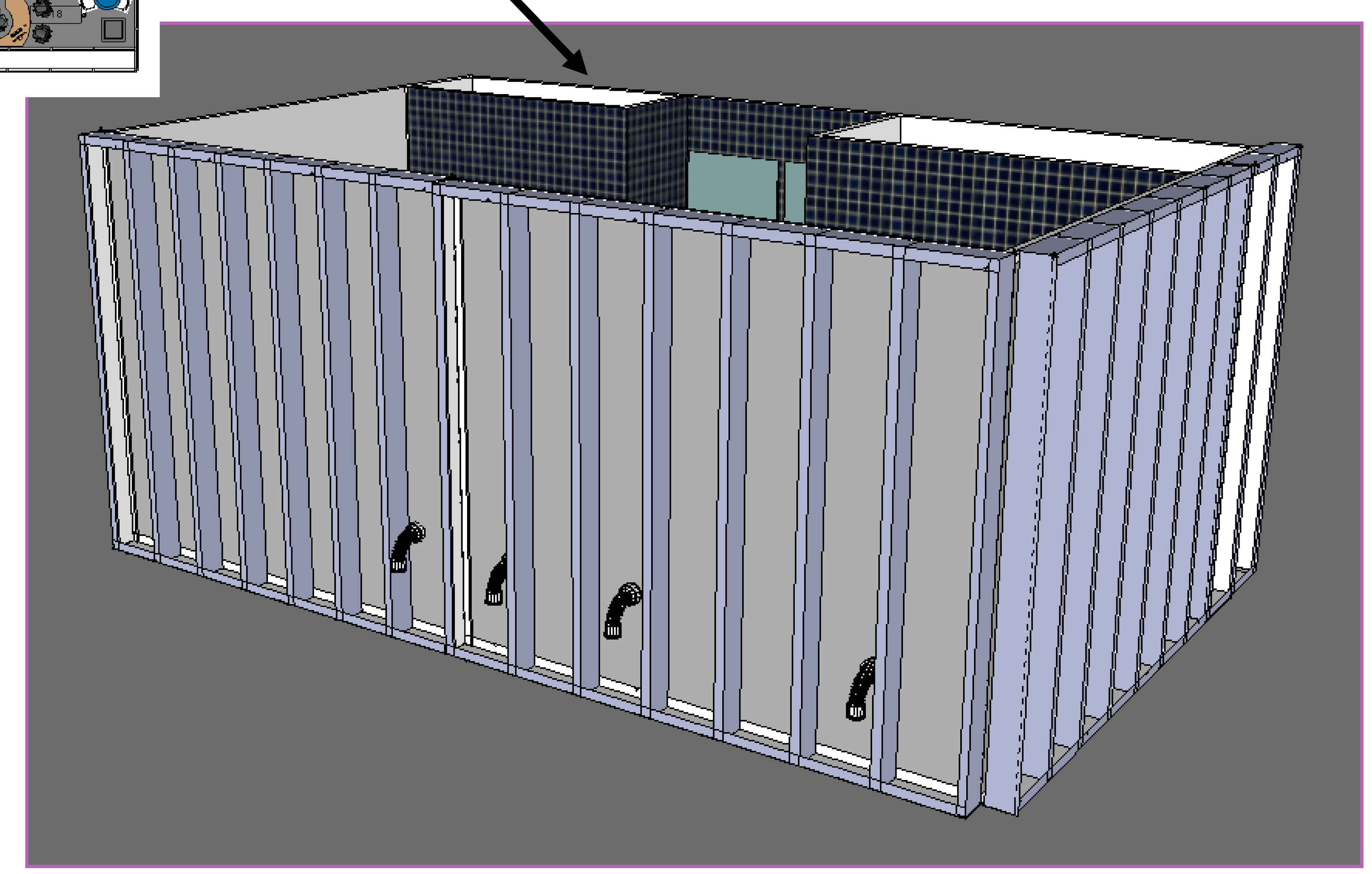
Bathroom Pods (Purple)



Location of PODs







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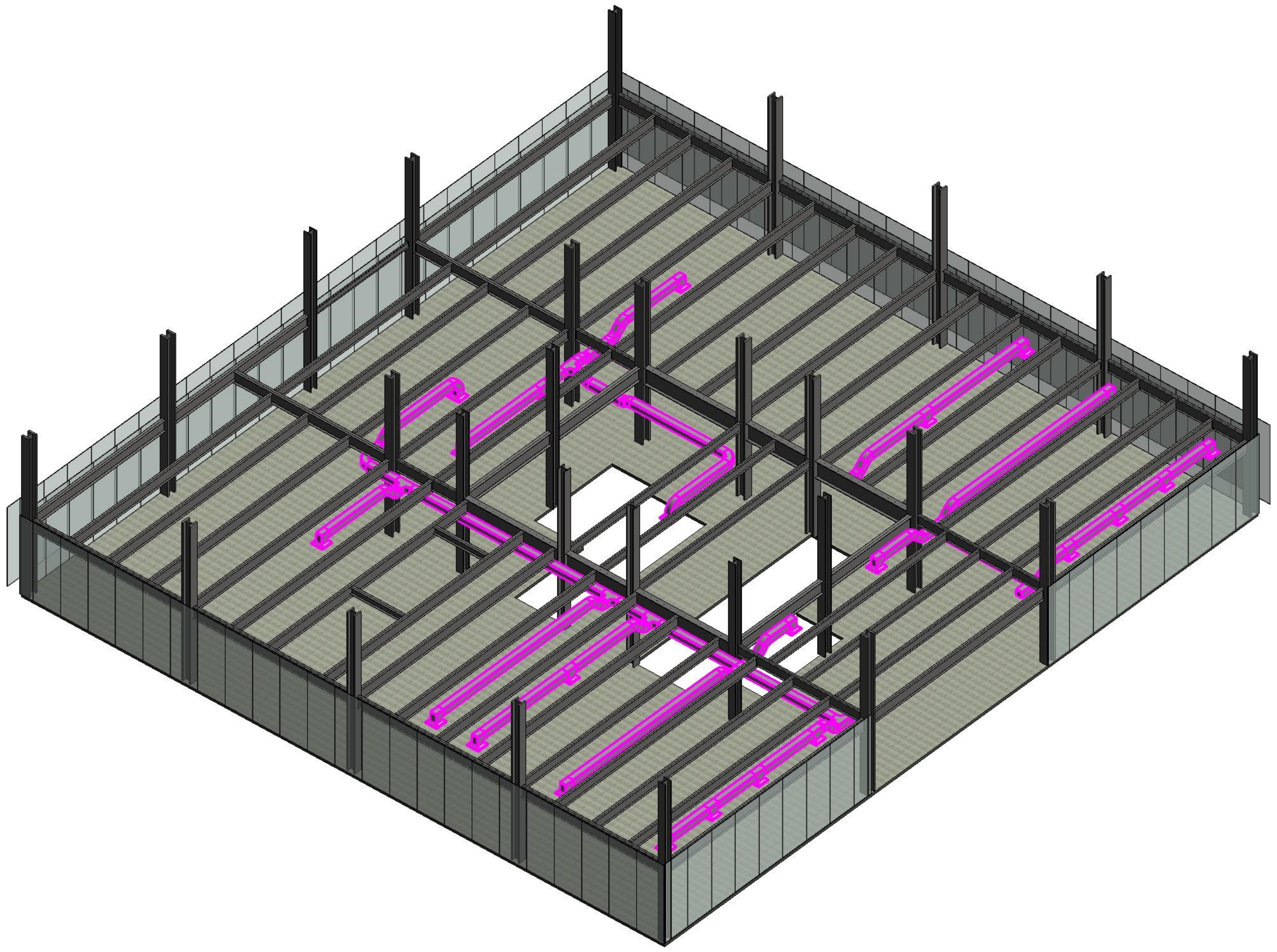
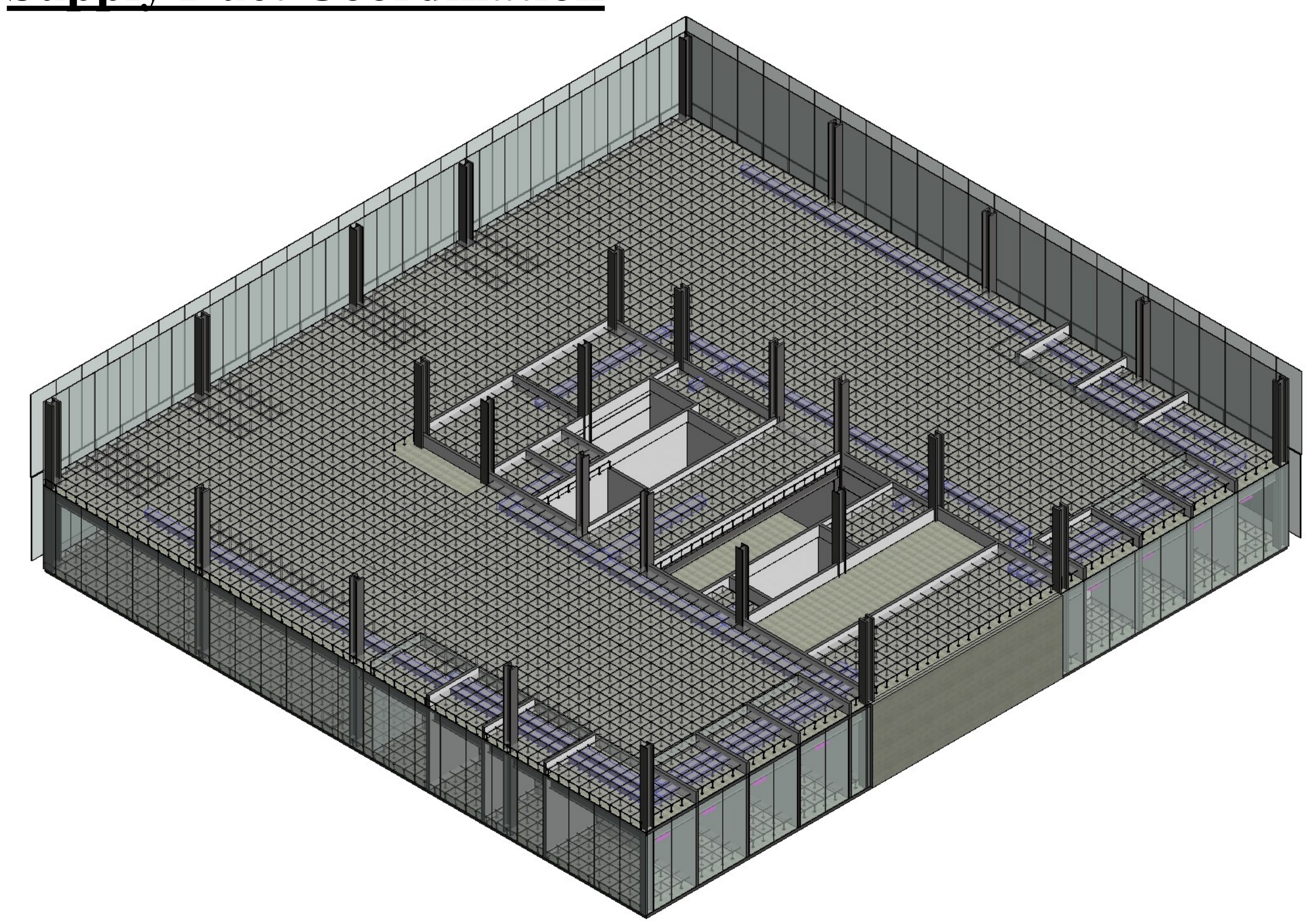
Pods

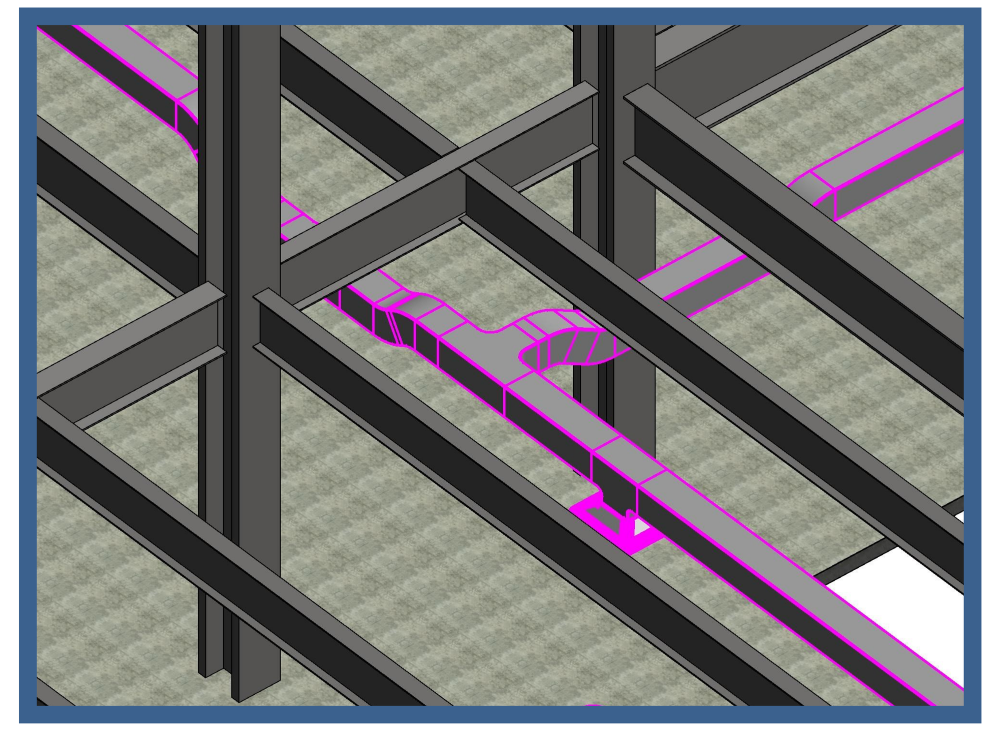
I-105

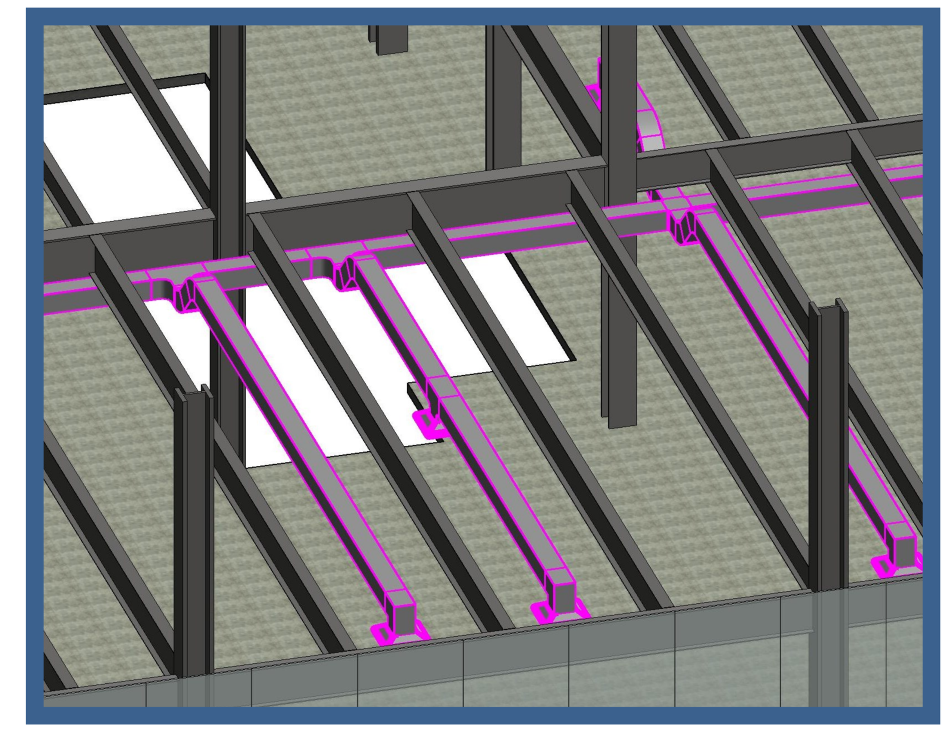
Return Duct Coordination



Supply Duct Coordination

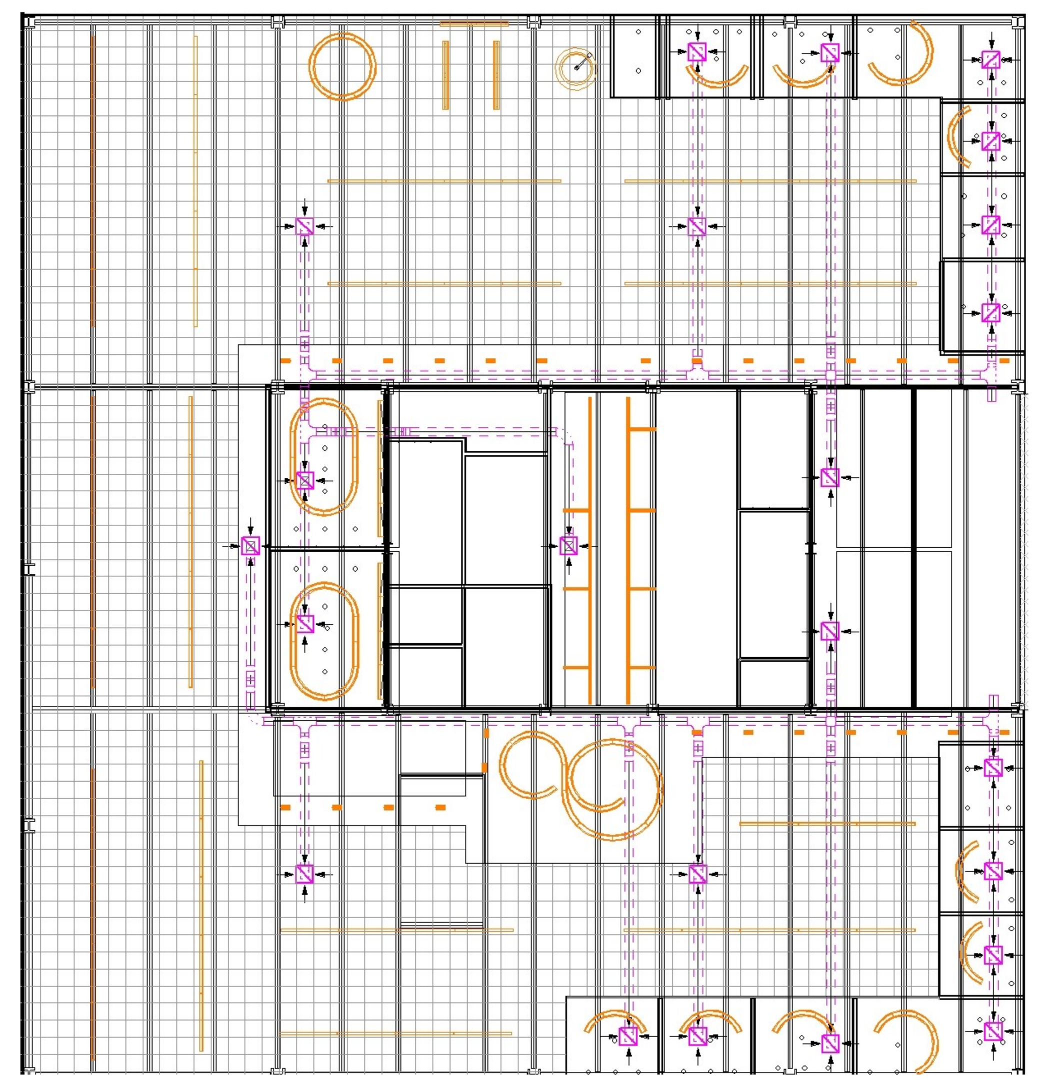






Structural Members

Because we do not have a drop ceiling in the majority of the space, most of the duct had to be run between beams as seen in the image to the left. This also meant that in some areas the duct did need to be dropped below the beams (and hidden with a bulkhead) so a great deal of time and consideration went into choosing the correct locations and coordinating transitions as can be seen above.

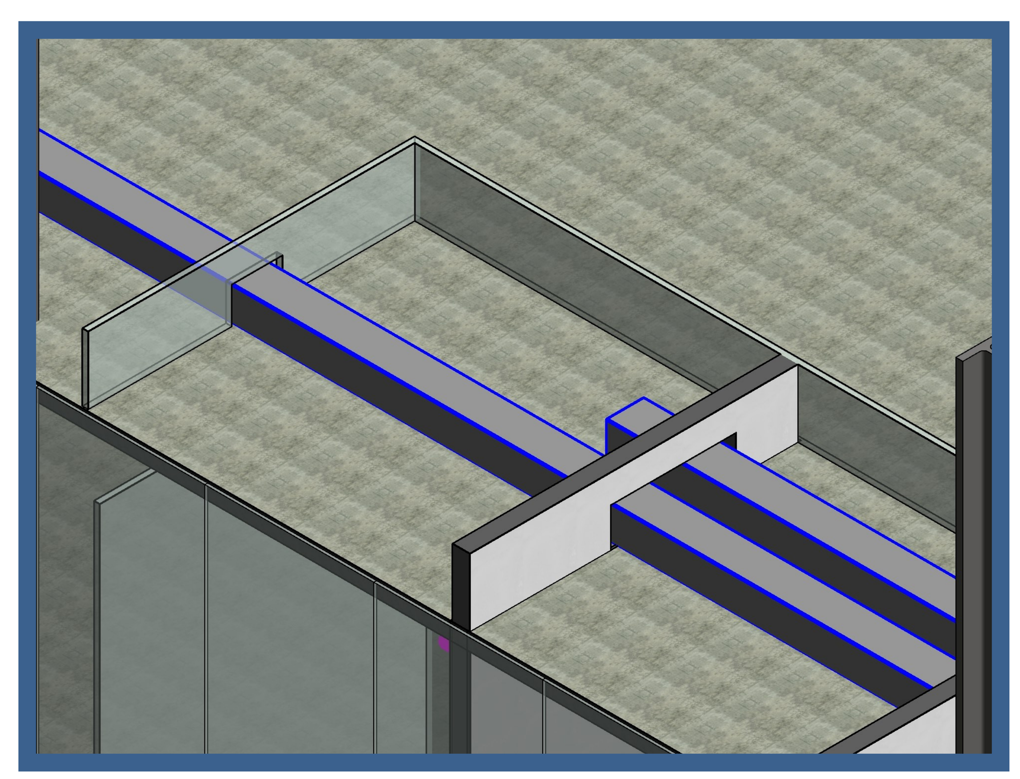


Return Diffuser Coordination

The diffusers needed to be placed in such a pattern that they did not clash with any of the lighting in the space. In addition, we placed the diffusers in the middle of acoustical tiles to ensure a consistent look across the space. The duct was not a concern because it was above the ceiling.

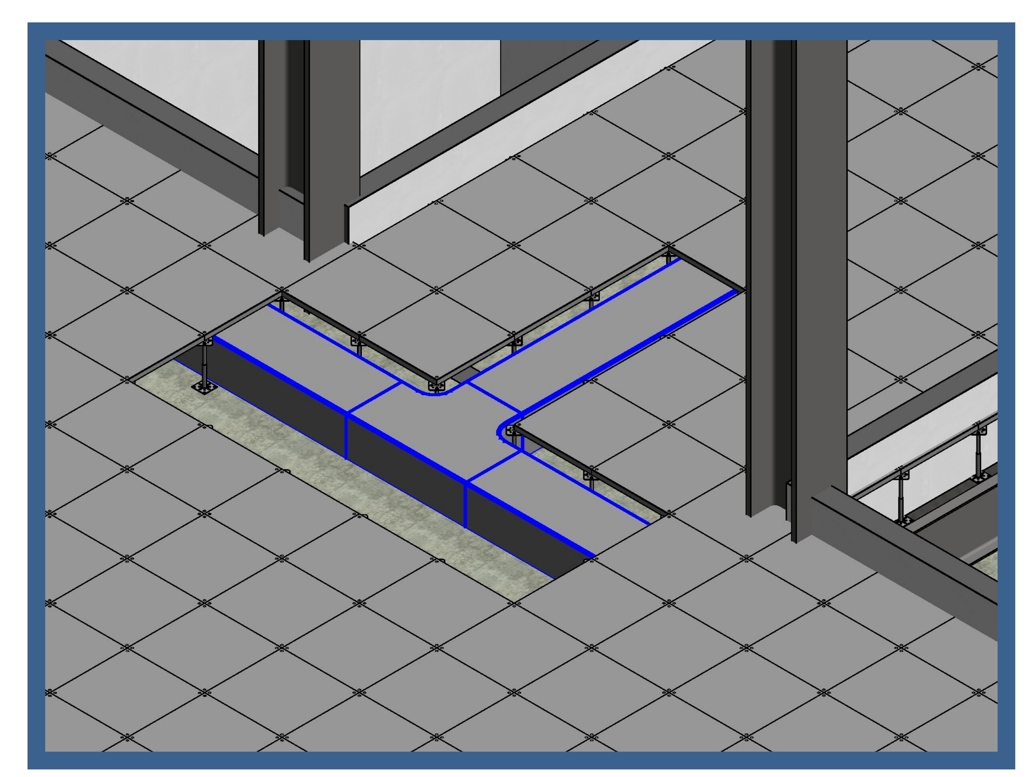
Lighting

Diffusers



Wall Cutouts

Because the duct needed to run from room to room and the walls extend down to the slab, cutouts were added to walls where needed to allow for the duct.



Raised Access Floor

When designing the duct system, we needed to make sure that all duct fit within the 24" x 24" x 14" space created by each panel of the raised access flooring.

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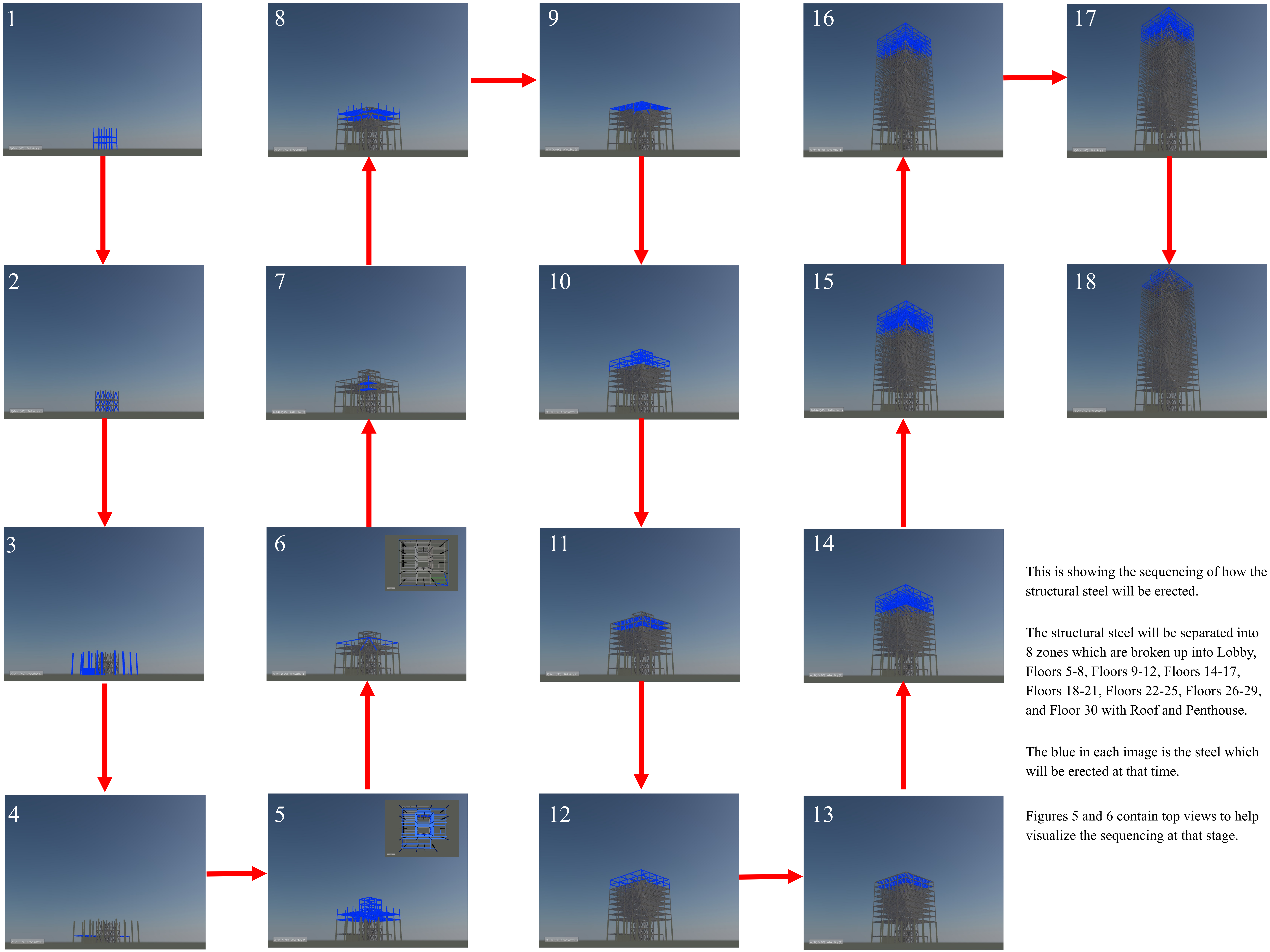
3D Duct Coordination

I-106



This is showing the sequencing of how the structural steel will be erected.

The structural steel will be separated into 8 zones which are broken up into Lobby, Floors 5-8, Floors 9-12, Floors 14-17, Floors 18-21, Floors 22-25, Floors 26-29, and Floor 30 with Roof and Penthouse.

The blue in each image is the steel which will be erected at that time.

Figures 5 and 6 contain top views to help visualize the sequencing at that stage.

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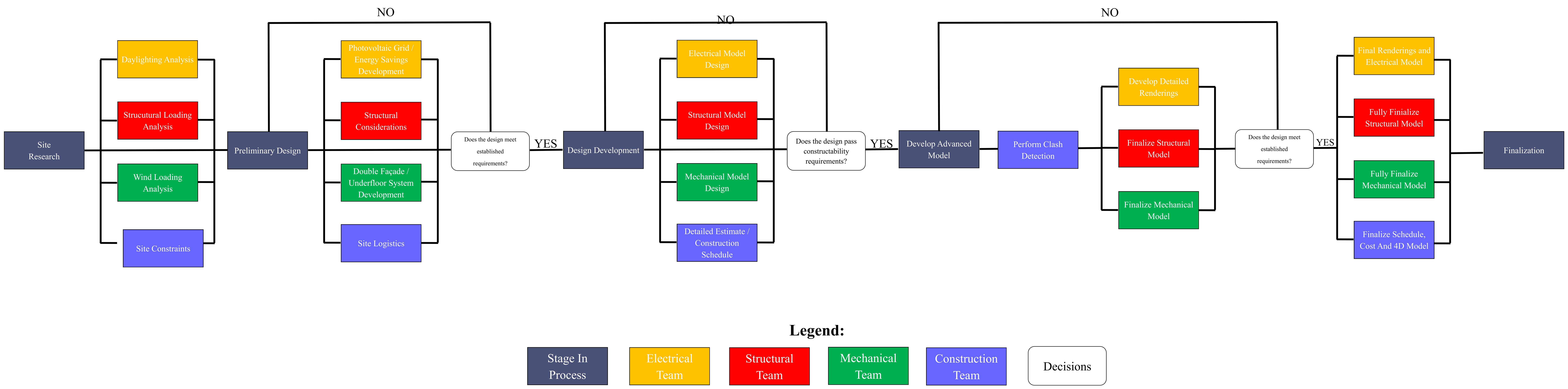
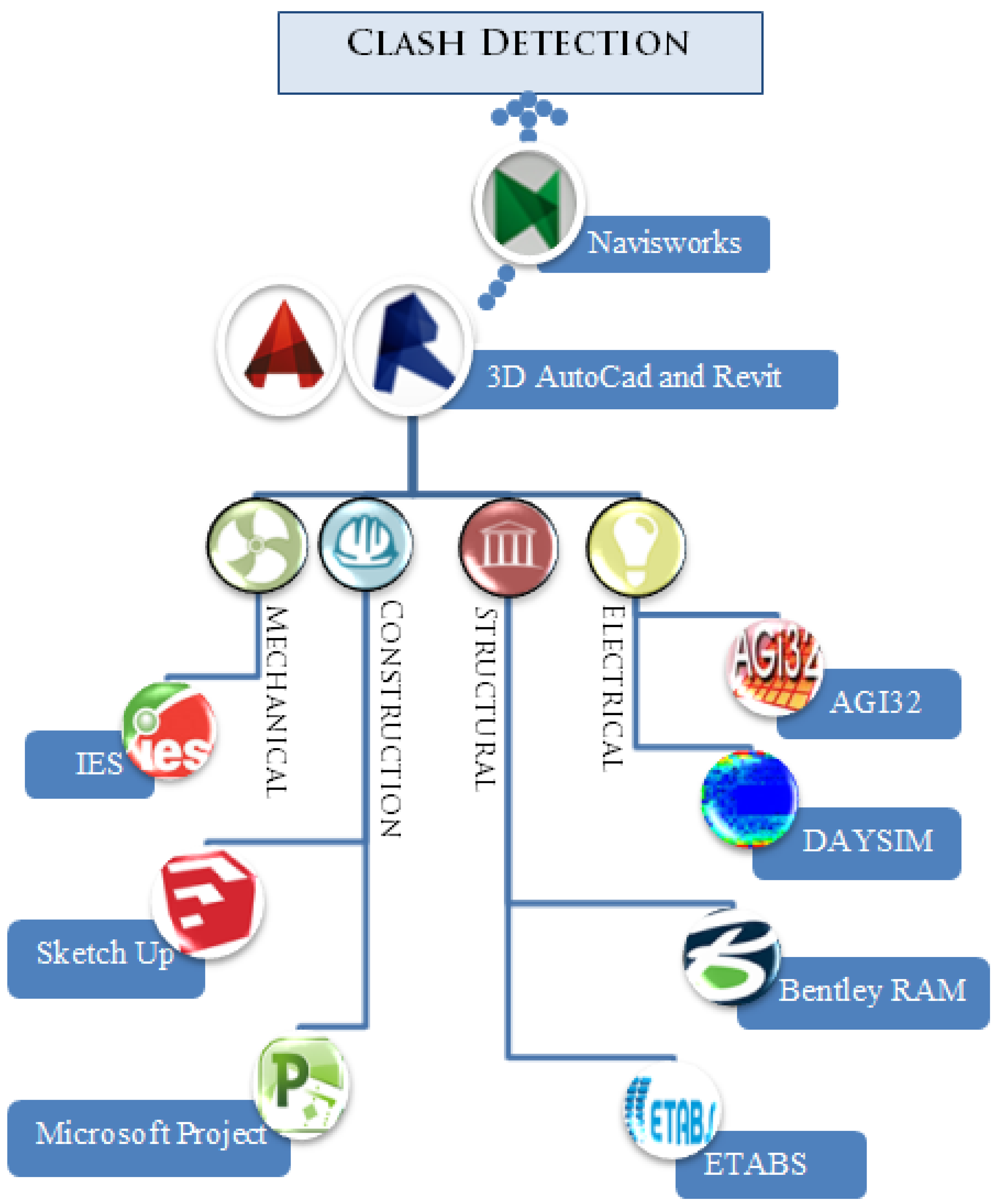
Structural Steel Sequencing

I-107





This chart above shows the software each of our team member used.

Project Milestone	Project Deliverable	Completion Dates	Project Involvement
Preliminary Research	Presentation 1	9/4/13	MEP, Struct, CM
Preliminary Design	Presentation 2	9/18/13	MEP, Struct, CM
Design Development	Presentation 3	10/9/13	MEP, Struct, CM
Discipline Draft Report	Proposal	11/12/13	MEP, Struct, CM
Integration Draft Report	Proposal	11/12/13	MEP, Struct, CM
Lutron Presentation	Walkthrough Presentation	12/9/13	Electrical
Advanced Design Development	Presentation 4	12/11/13	MEP, Struct, CM
95% Report	Proposal	1/27/14	MEP, Struct, CM
AEI Submission	Electronic Submission	2/17/14	MEP, Struct, CM
Finalist Presentation	Final Presentation	3/27/14	MEP, Struct, CM

This chart above shows the Project Milestones of our process.

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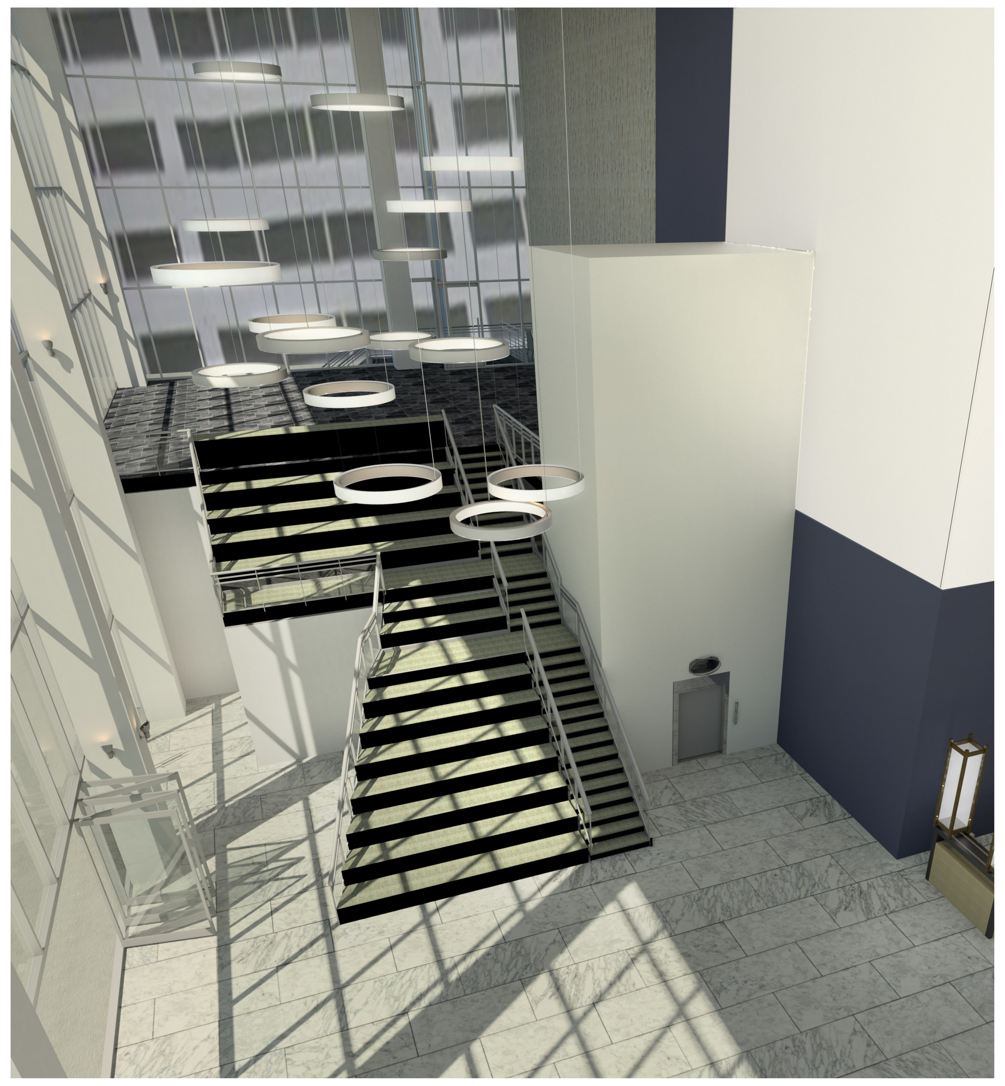
BIM Execution Plan

I-108



Lobby

Upper Lobby

Elevator Lobby

Office Room

Reception Desk

Office Desks

Break Room

Conference Room

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Renderings

I-109