



Integrative Design Studio
Liam Vennerholm
EMMTH



Schematic Design

In Schematic Design, we made all the big design decisions. First, we decided on a conceptual direction and then we nailed down the overall shape of our building, avoiding getting involved with some of the smaller details. We wanted to save those for later, so we didn't have to change too much as inevitable larger changes happened.

The conceptual aspect of the design was derived from the initial site visit to Edmond. While there, we were inspired by the shapes of the agrarian buildings across the train tracks from where our building was to be designed. We were mainly inspired by how those shapes could be read as large, flat, logo-like shapes. They were very simple and solid. We wanted our building to engage with that idea as well. We were also inspired by some of the buildings in Edmond's downtown area and all of the various "appendages" they use to draw people in: things like awnings, alcoves, and on-street dining structures. These additive elements felt very much like the appendages of a creature. We wanted our building to also engage with this idea.

This led us to design a building that has what we like to call a "figural profile and creaturely appendages." The main body of the building (the "figural profile") is a large, flat, logo-like shape. It is relatively simple and unadorned. The building then has smaller scale "creaturely appendages" added onto its sides and roof.

These are all more large-scale decisions that paved the way for our explorations in the following phases.



Madison Harper
Architecture



Jacob Jones
Architectural Engineering



Liam Vennerholm
Architecture

Concept

- Unique Color
- Figural Profiles
- Creaturely Appendages

3

Drawings

- Plans
- Elevations
- Sections

7

3D Views

- Front
- Back
- Terrace
- Exploded Axonometric

11

Structural Framing Options

16

Design Narrative

- Planning Efficiency
- Carbon Footprint
- Acoustic Performance
- Thermal Resistance
- Lighting & Daylighting
- Thermal Comfort

19

Table of Contents



Concept—Unique Color, Figural Profiles, & Creaturely Appendages

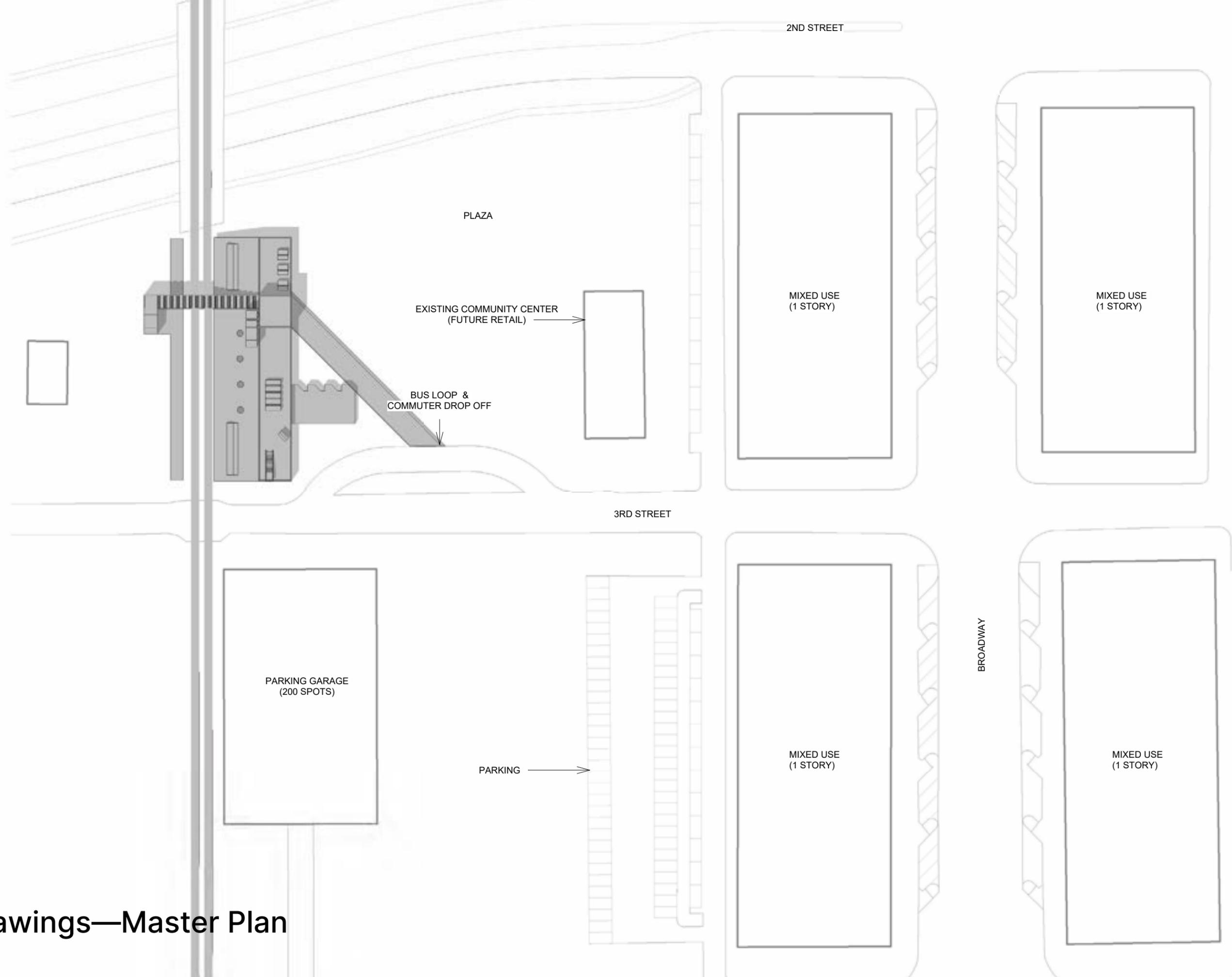


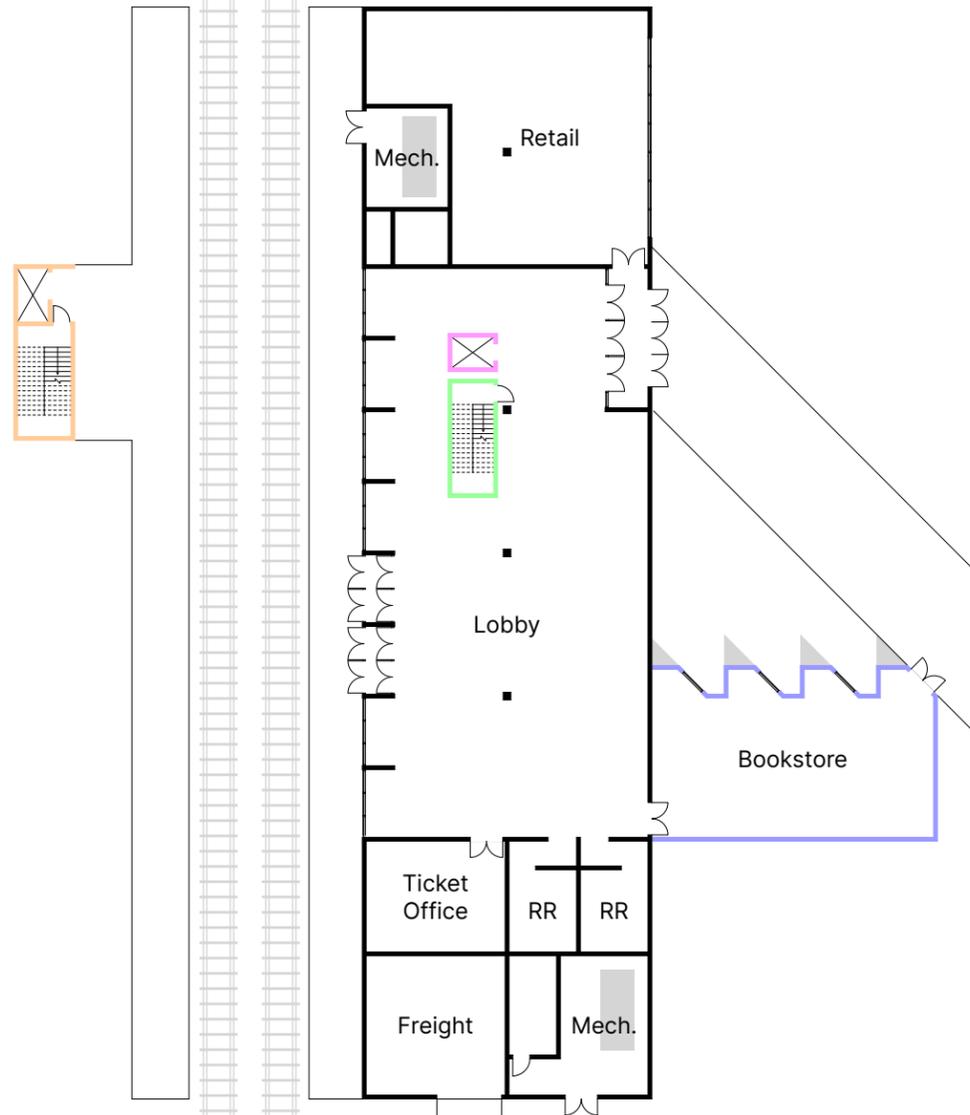


Concept—Creaturally Appendages

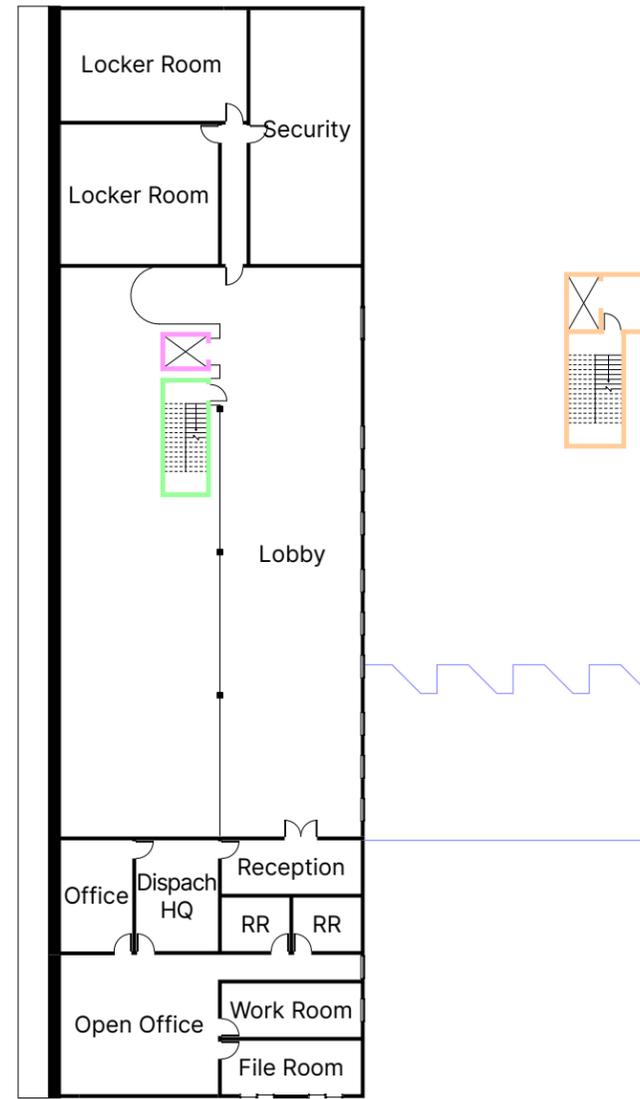


Concept—Unique Color

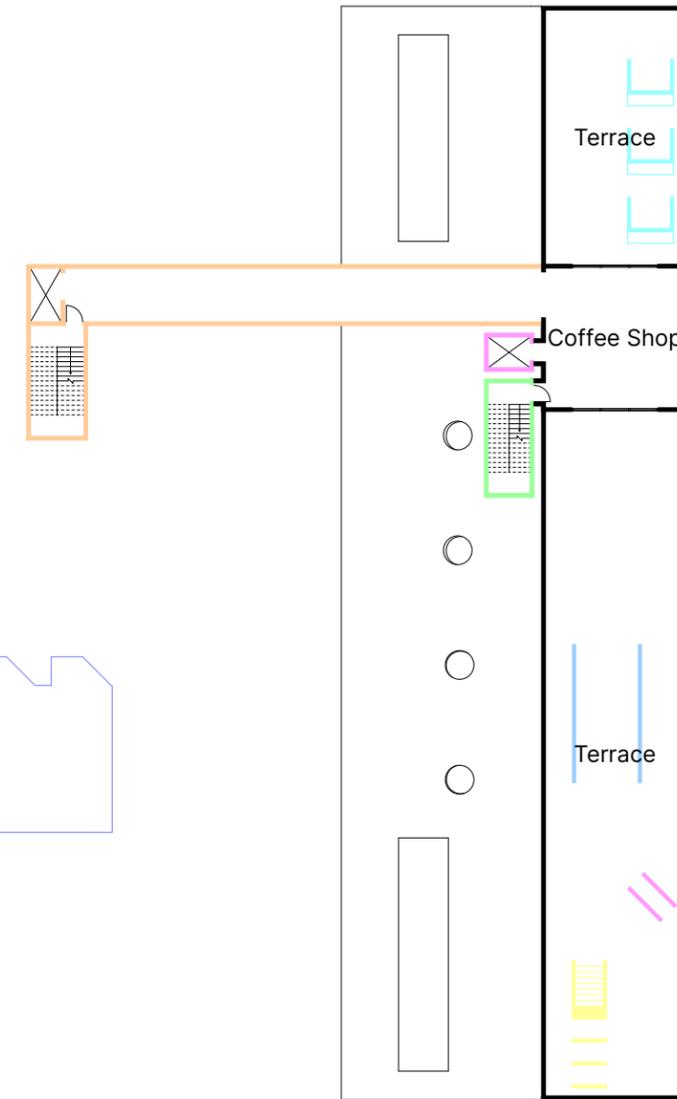




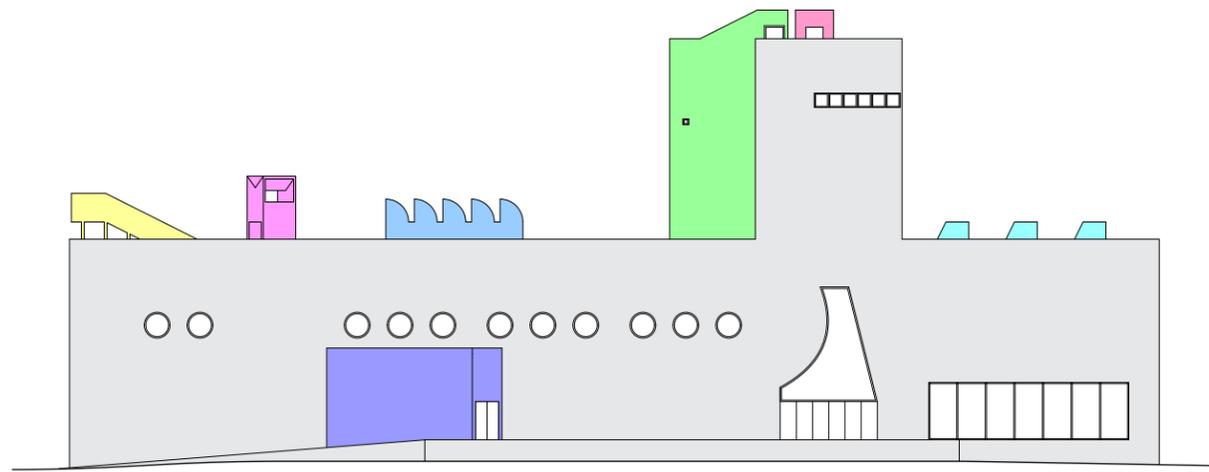
Plan 1 N↑



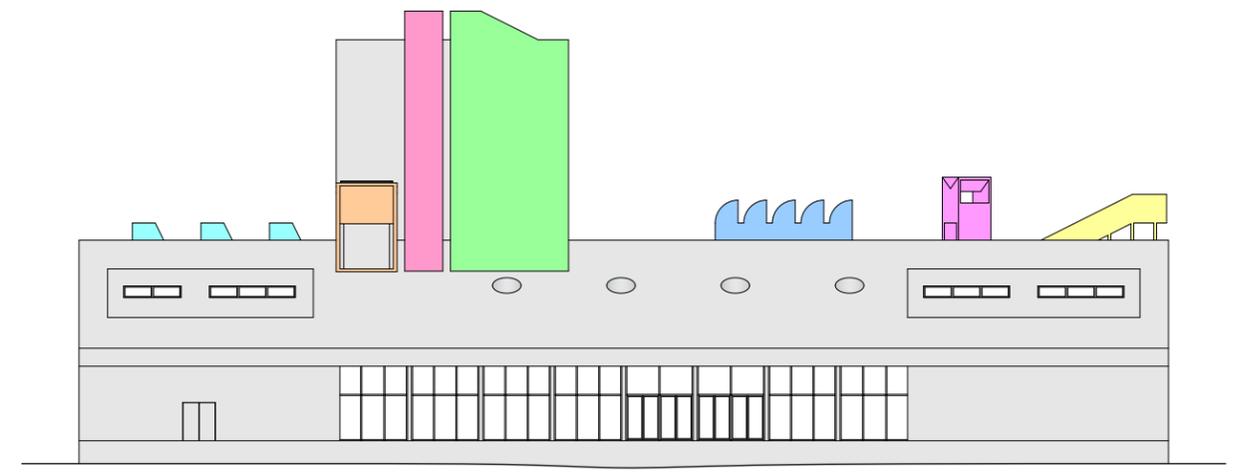
Plan 2 N↑



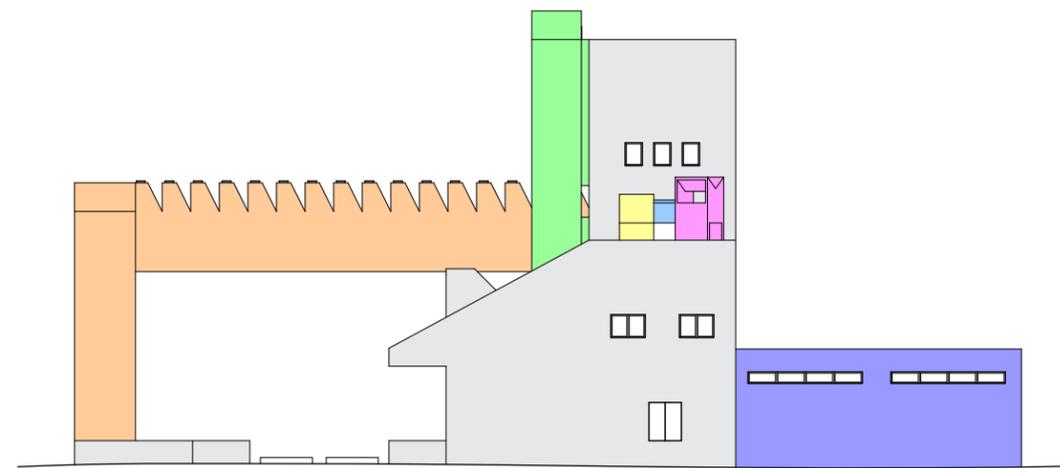
Plan 3 N↑



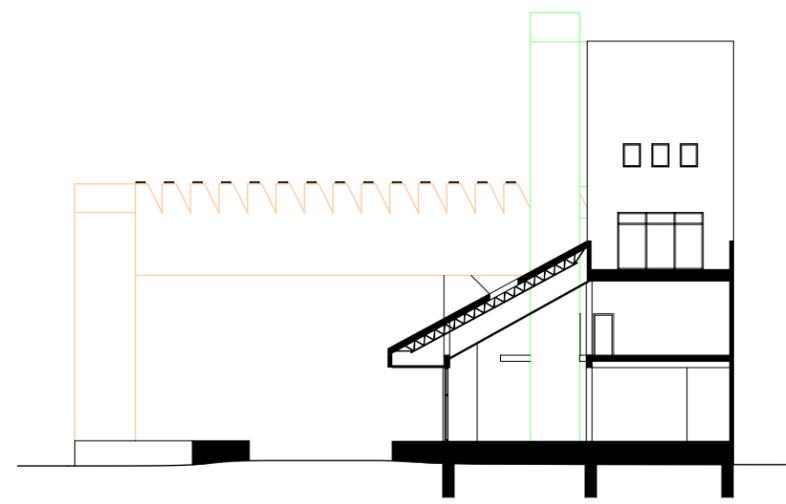
East Elevation



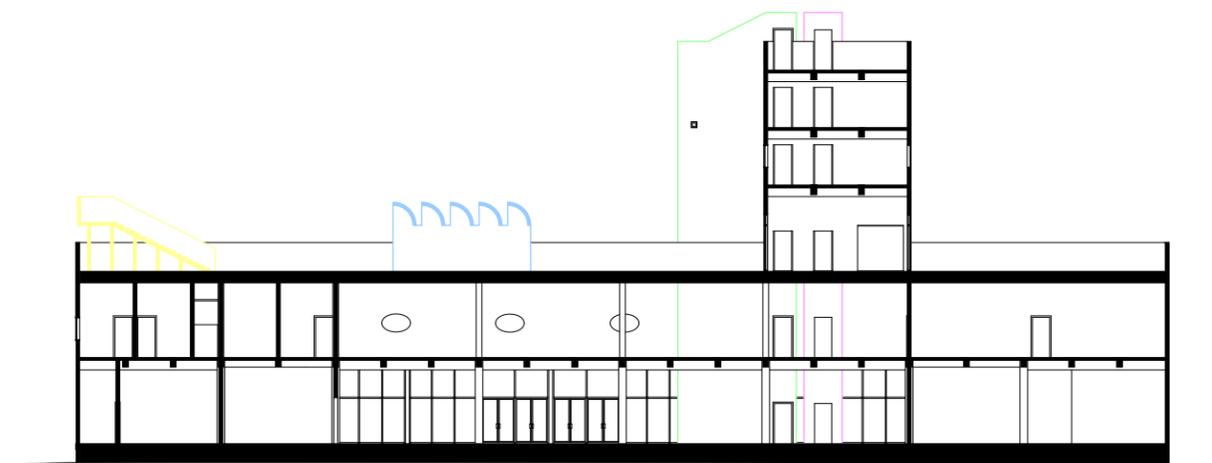
West Elevation



South Elevation



Short Section



Long Section



3D View—Front Perspective



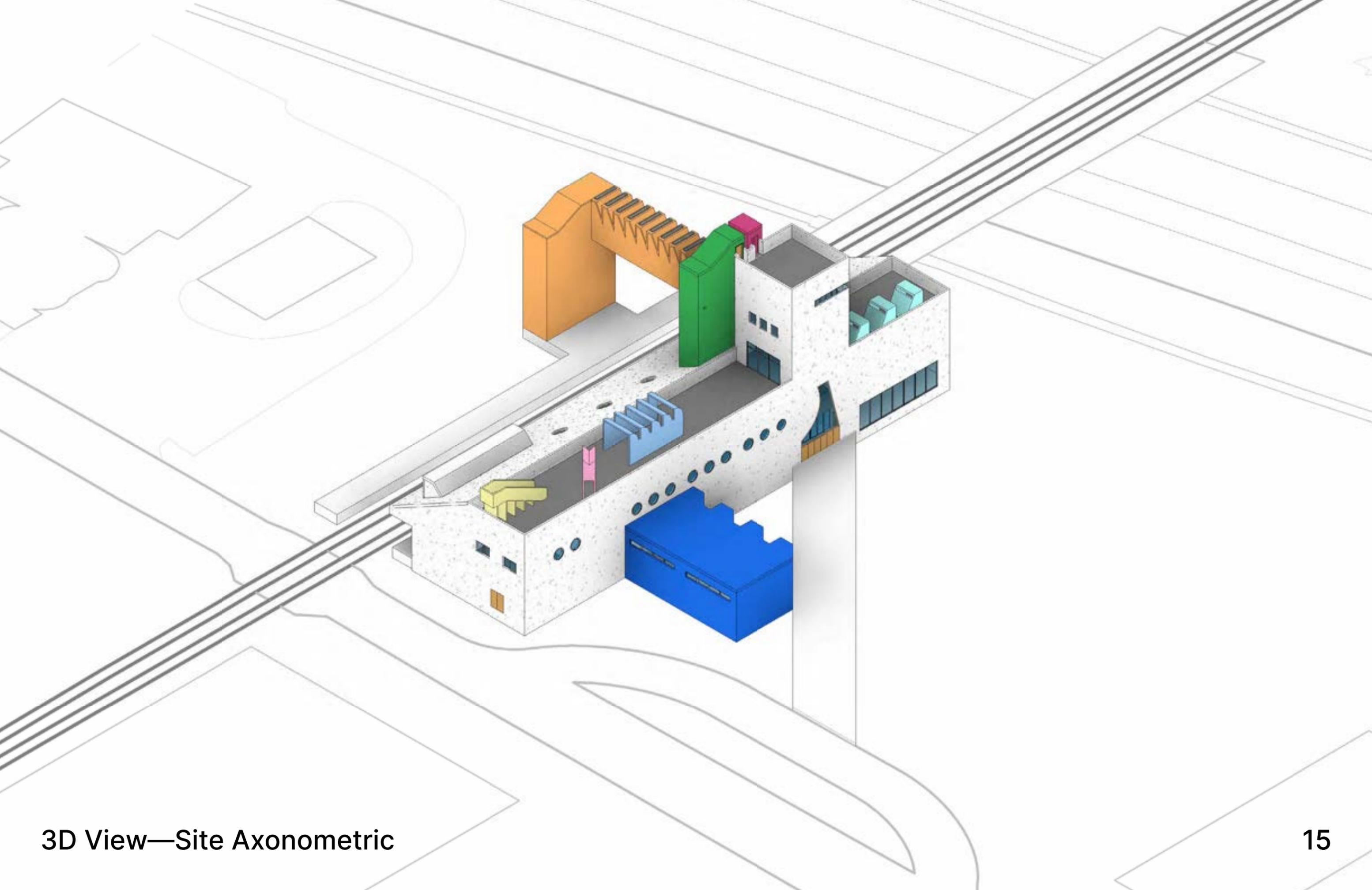
3D View—Back Perspective



3D View—Terrace Perspective



3D View—Lobby Perspective



3D View—Site Axonometric

Narrative

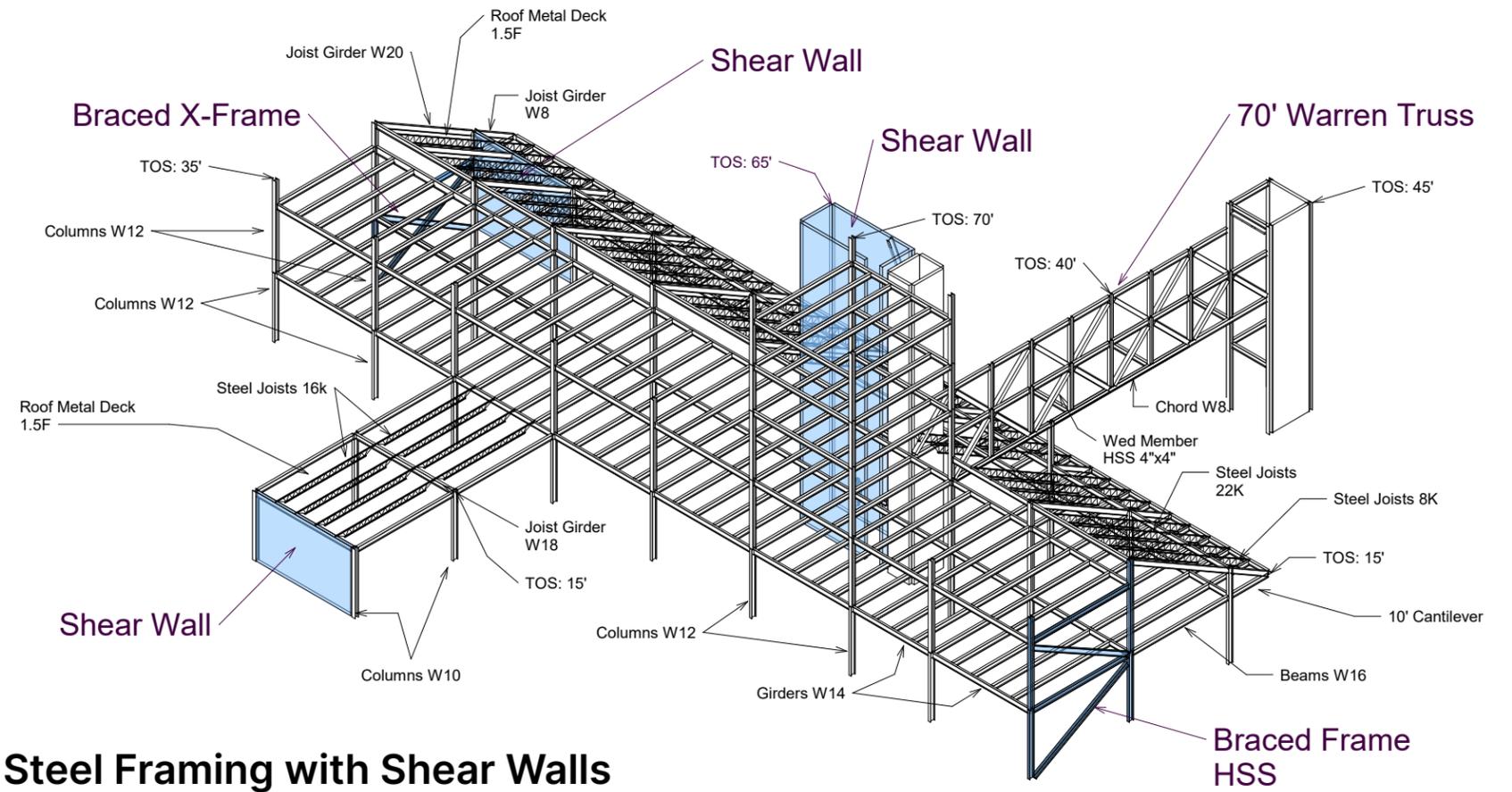
The first structural system explored was a total steel framing option. The lateral force resisting systems included an X Brace frame, with shears walls. Steel Joists were the economical option for the steep gabled roof as it wouldn't experience a lot of load. Designed with a composite slab that would act as a rigid diaphragm to carry horizontal forces to the lateral systems.

Pros

- Consistent Materials
- Easier Connections
- Lightweight
- Great for Cantilevers

Cons

- Steel Lateral Bracing can reduce openings in walls
- Needed Fire Proofing
- Composite Slab construction



Steel Framing with Shear Walls

Narrative

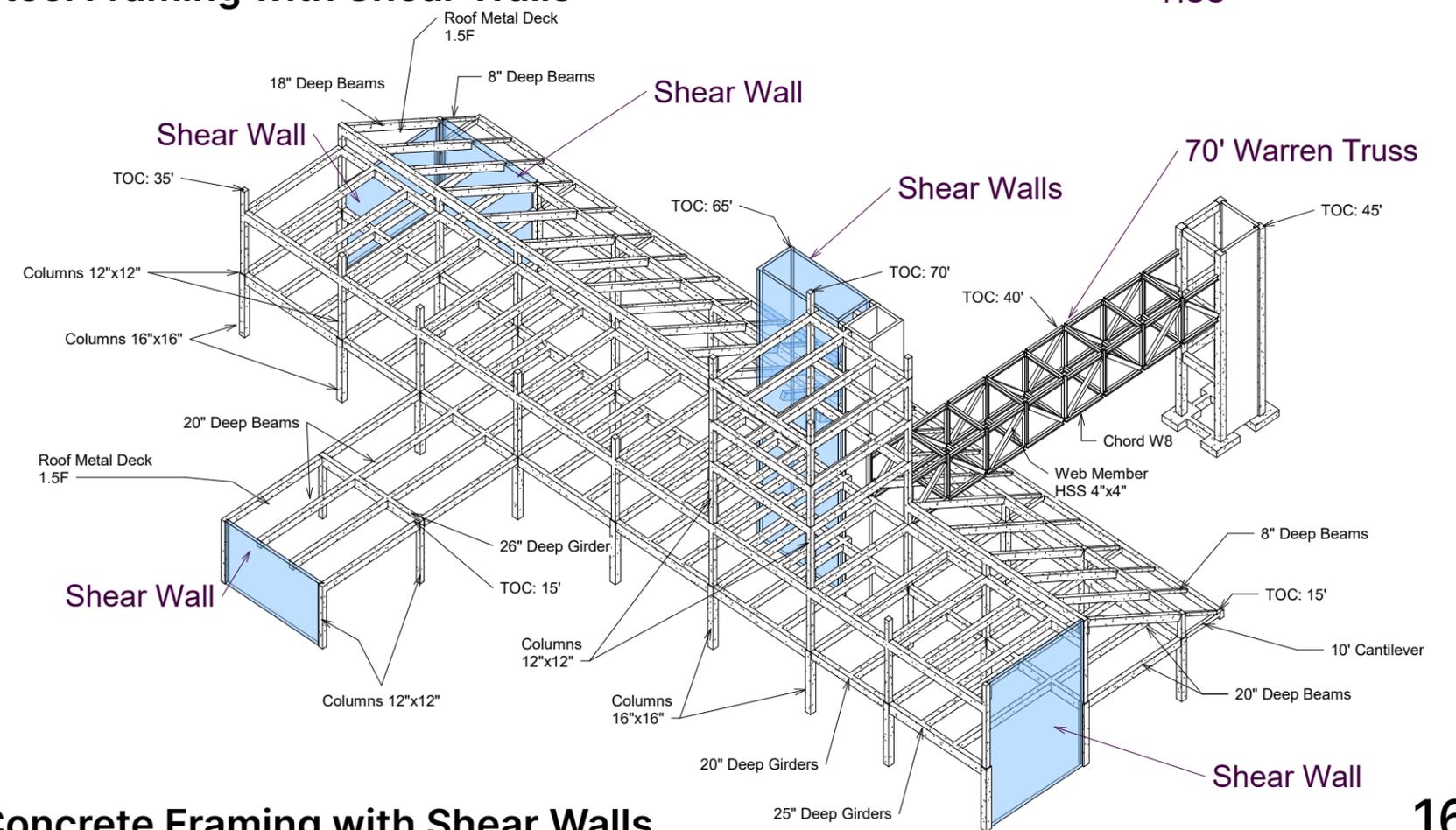
The second structural system was a complete concrete option with shear walls. Concrete beams would require a low slump to cast but would allow for wider spacing for possible skylight options in the gabled roof. The use of concrete shear walls was used as the only Lateral Force Resisting System

Pros

- Consistent Materials
- Cast on Site
- Monolithic
- Fire Resistant

Cons

- More Labor Required
- Expensive
- No Openings at Shear Walls



Concrete Framing with Shear Walls

Narrative

Similar to option 2, this concrete framing option was designed with a steel roof, using wide flanges and joists for the gabled roof. The concrete option was chosen to establish a more monolithic feeling on the site and for the city of Edmond. The single gabled roof, inspired by the original Edmond train station comes to a 10'-0" cantilever towards the tracks to hold MEP. Concrete shear walls act to resist lateral forces placed around the exterior of the building and surrounding the central staircase to help support the 70'-0" tower. The bridge spanning across is designed as a steel warren truss that will frame into shear walls on each side of the truss.

Pros

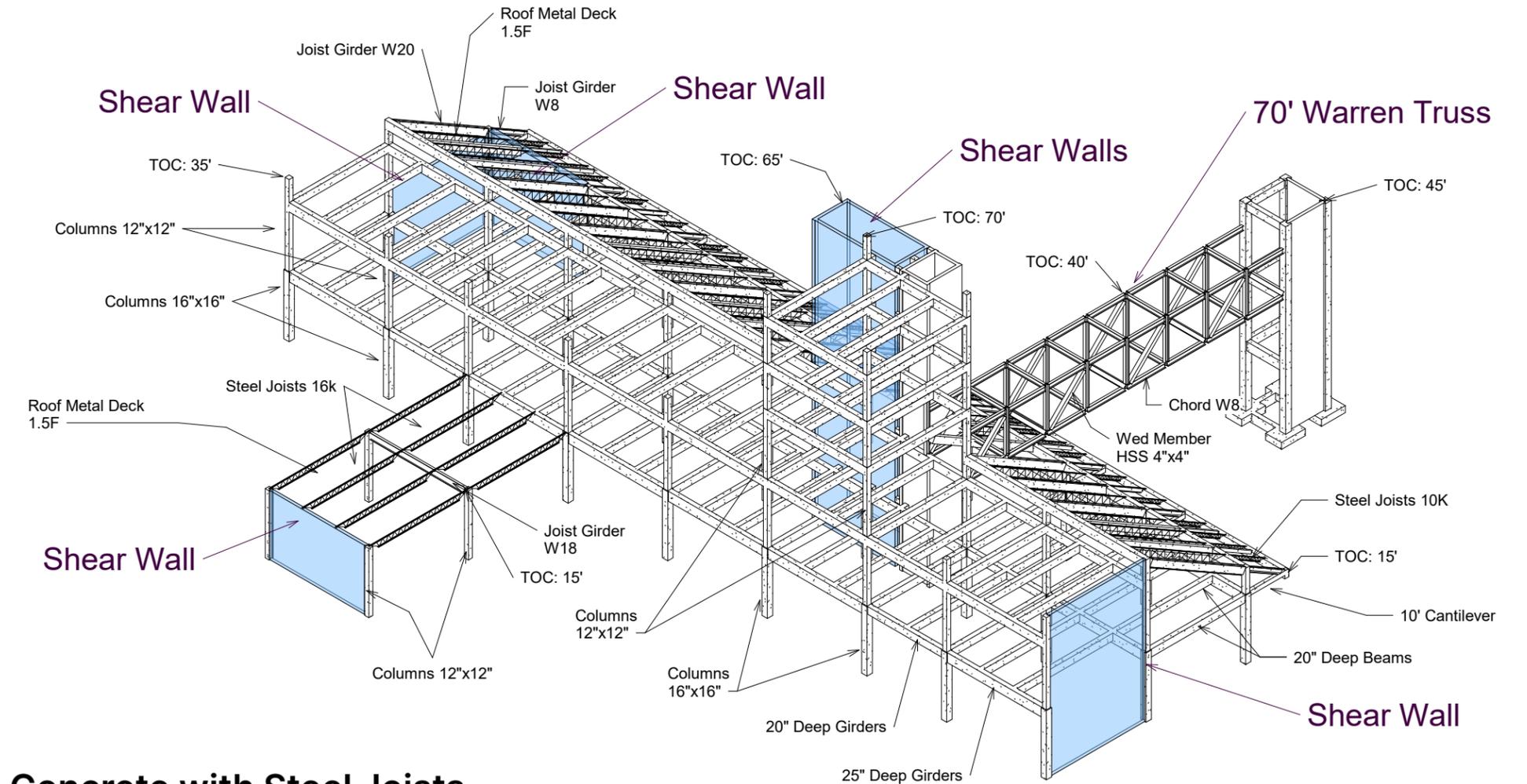
- Cast on Site
- Monolithic
- Fire Resistant
- Economical and Practical Roof System
- Lateral Systems Hidden in Structure

Cons

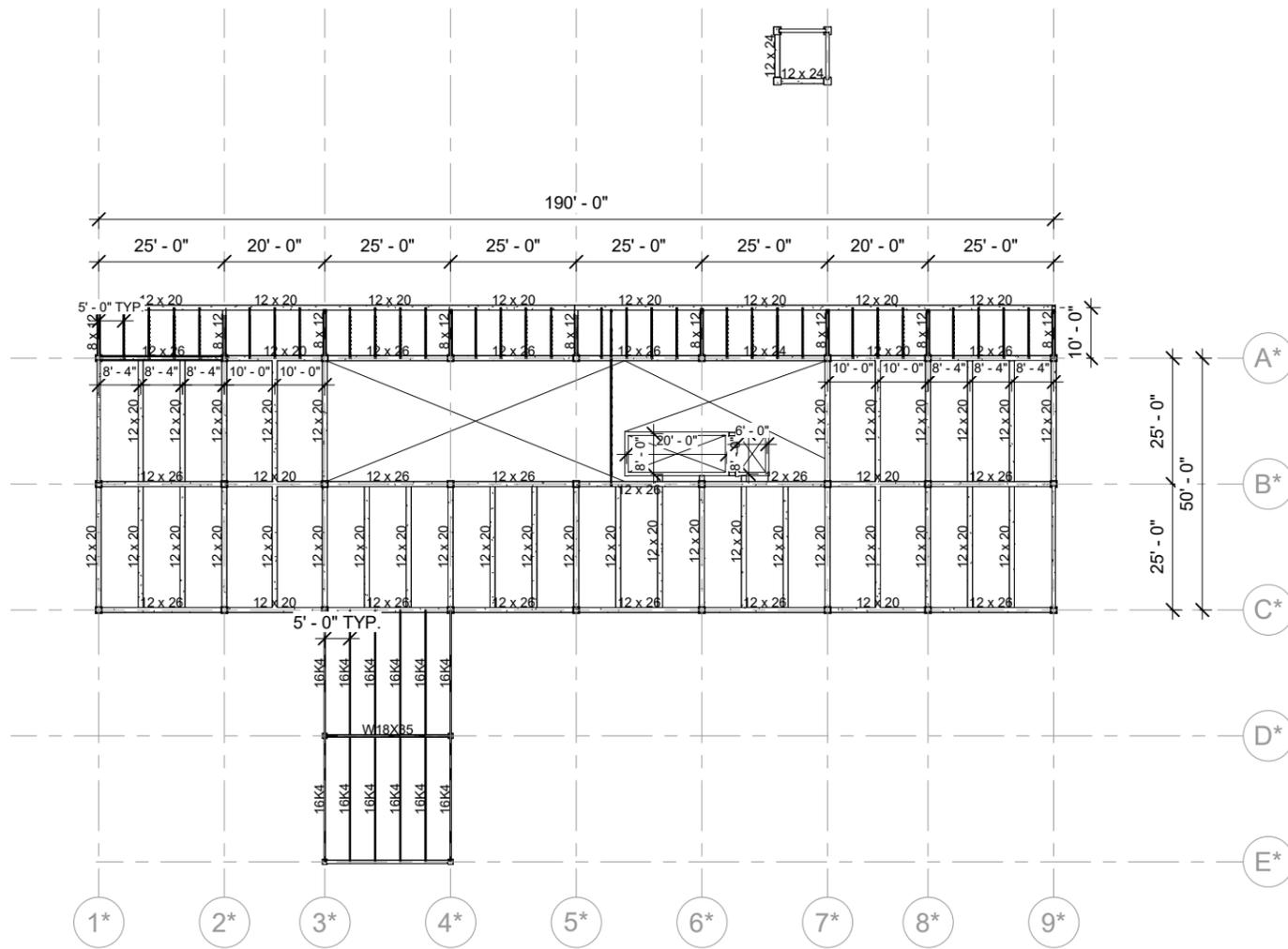
- More Labor Required
- Expensive (More Economical than Concrete Roof System)
- No Openings at Shear Walls

Pier and Grade Beam Foundation System

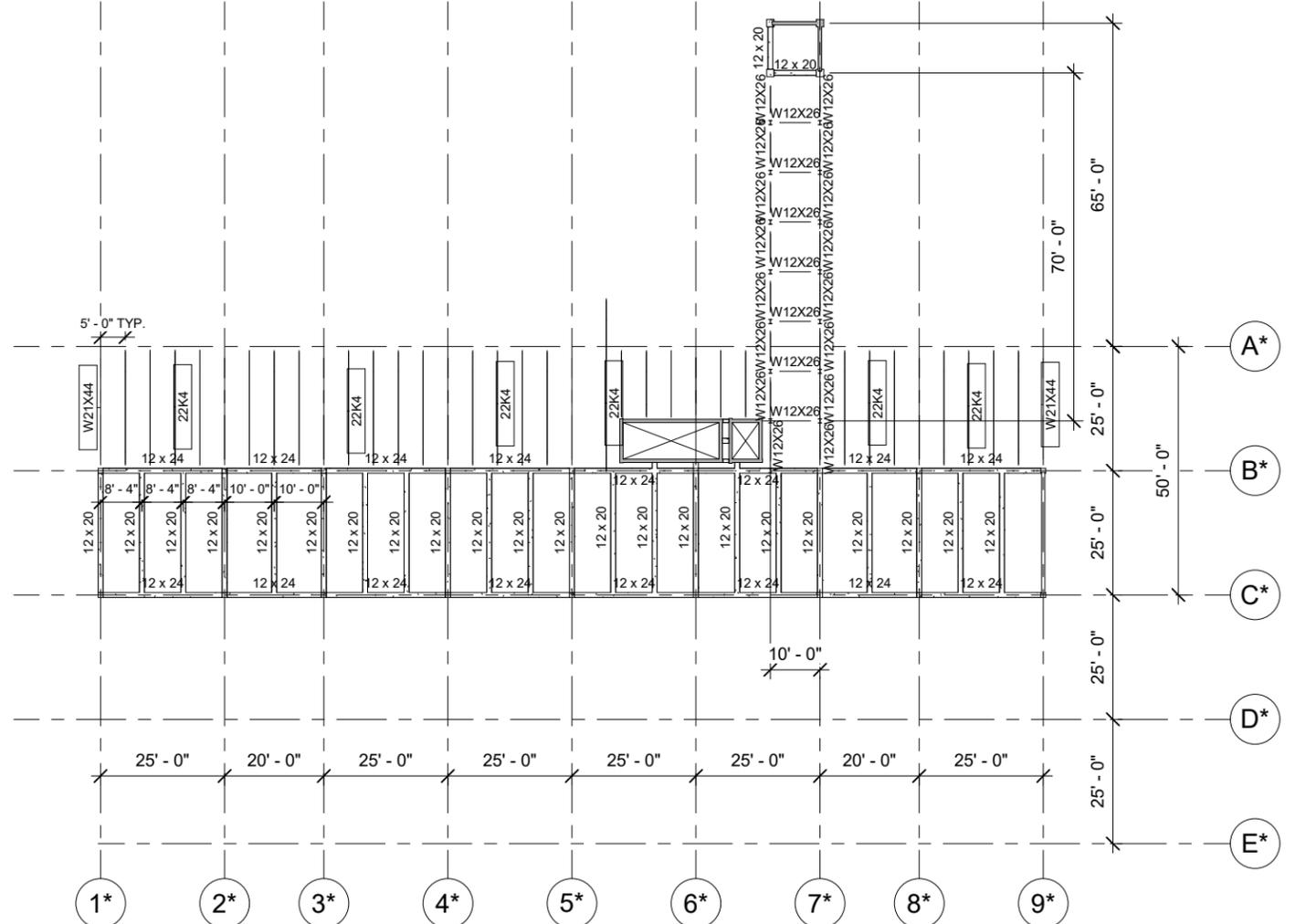
For the design of the building, drilled cast-in-place concrete piers that go down into rock at 18'-0" for a total 3'-0" to 5'-0" embedment. This foundation system will support each column on a single drilled pier with grade beams that will span from each pier to support building walls. The column layout will allow for easy layout of piers, and is the more efficient system for upholding the most weight for the three-story concrete building. This will eliminate some of the demand on the subgrade to transfer loads and will provide stability and will reduce the chance of cracking in the slab on grade due to poor subgrade compaction or suitable fill under the slab.



Concrete with Steel Joists



Structural Plan 2



Structural Plan 3



Design Development

In the Design Development phase, the group was split, and we worked individually from there on out. During this phase I looked more toward the smaller scale details and worked them out. I focused on one part of the building, the lobby. By placing my focus on the lobby, I was able to dedicate more time to one space and develop it as much as possible (as much as one can in one semester that is). I also designed the cross section of the exterior wall, deciding what the different layers are and the different materials for the interior finishes and the exterior cladding.

In the lobby space, I wanted to bring the “creaturely” feel of the outside to the inside. One way I did this was by creating what I called freckles. These freckles are different conditions in the building where a regular pattern is established, but then a singular element is different, creating an asymmetry akin to that seen in biotic creatures. For example, in the roof above the lobby there are large circular skylights. They all follow a line and are all the same size except for one which is much smaller. There is also a mezzanine in the lobby where all the air conditioning ducts run through and deposit air into the whole space. These ducts come out the side of the mezzanine through holes, but one of the holes is empty allowing the visitor to look up into the space between the ceiling and the next floor.

All intense design work set the groundwork for the next phase, where I documented all of it in Construction Documents.

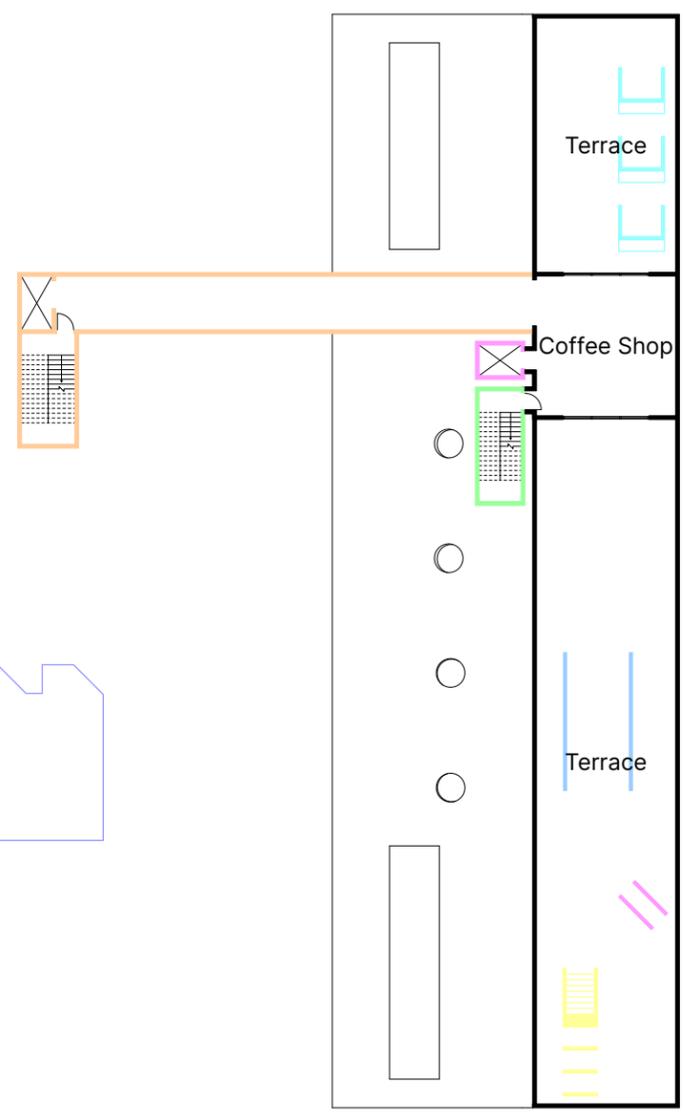
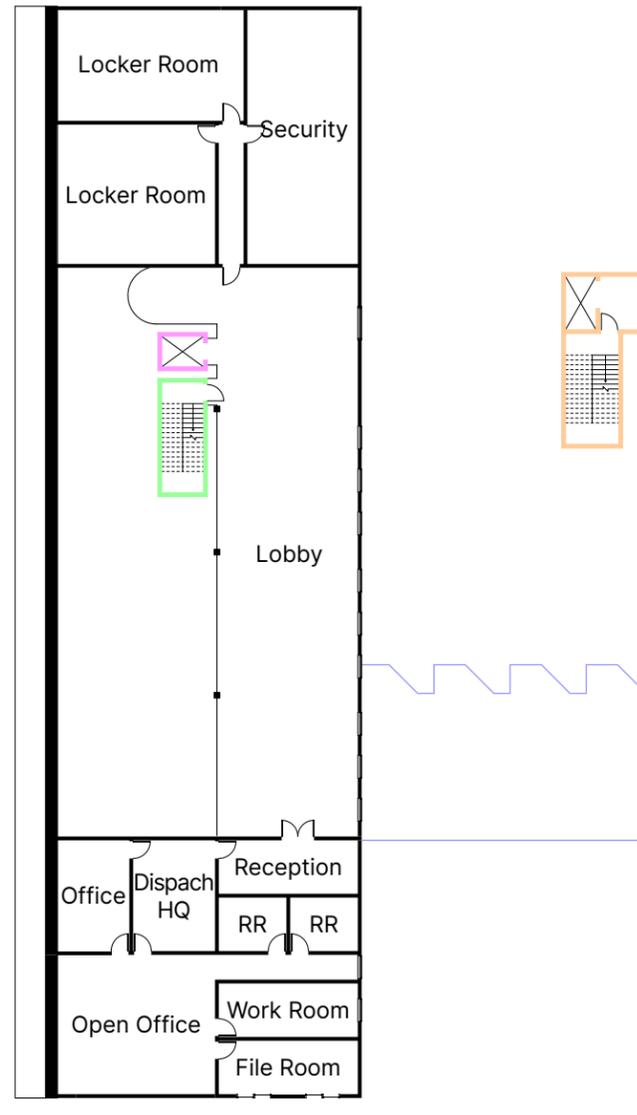
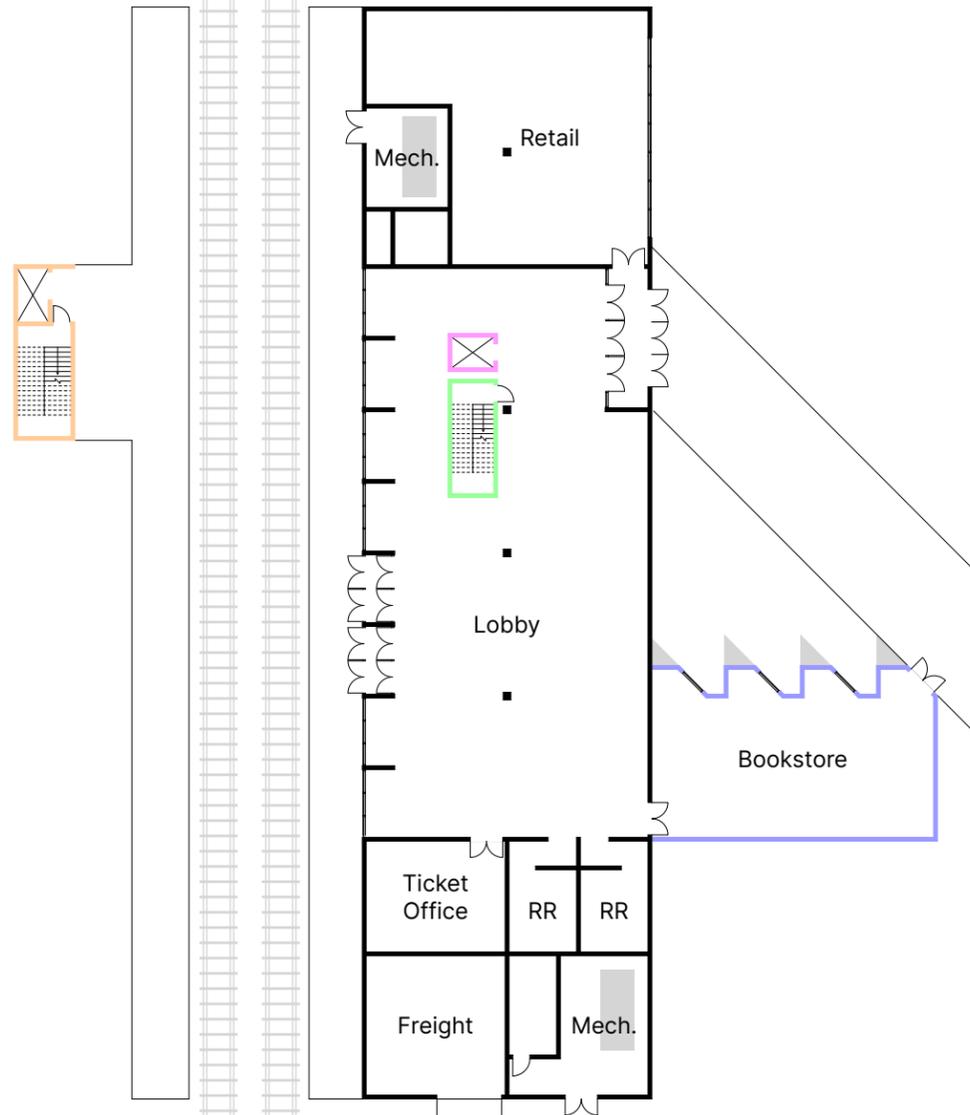


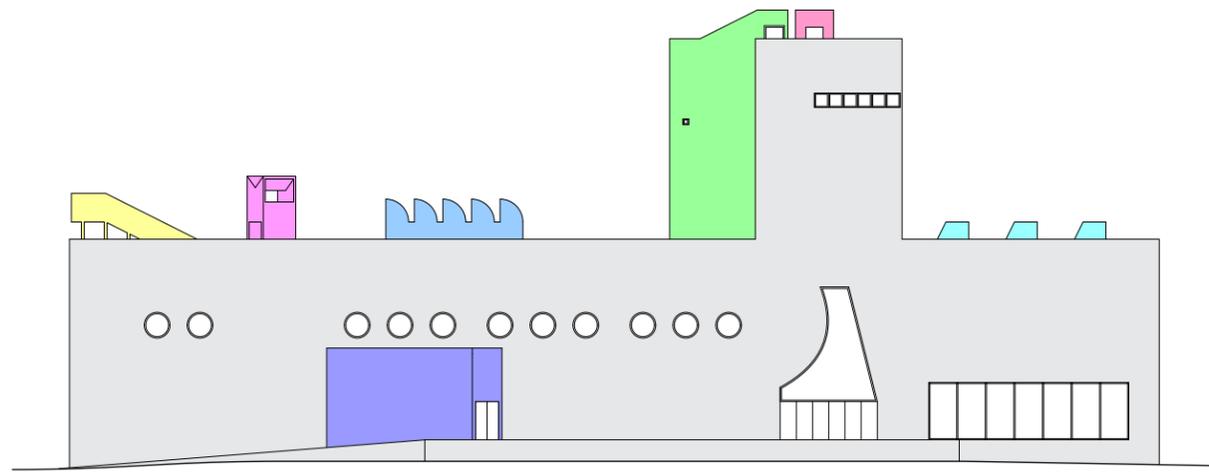
The site of the Edmond Multi-Modal Transport Hub exists between two differing parts of the city: to the west stand monolithic grain elevators with a herd of various agricultural buildings—an agrarian skyline, though not all of them retain their original function, e.g. a grain elevator that is now used as a car dealership; to the east there is a bustling downtown with local businesses and merchants reaching for your attention with various awnings, alcoves, and on-street dining options.

On the site sits a building in dialogue with both the **figural profiles** of its agricultural neighbors and the **creaturely appendages** of the nearby Broadway Avenue. From the front, it engages the viewer on a monumental scale. While its profile against the sky is meant to be in dialogue with those of the agrarian skyline behind it, it is not meant to directly resemble them, still engaging with the typological conventions of a train station. From the back, it interacts on a more intimate scale with a low overhang and architectonic creatures partying on the roof.

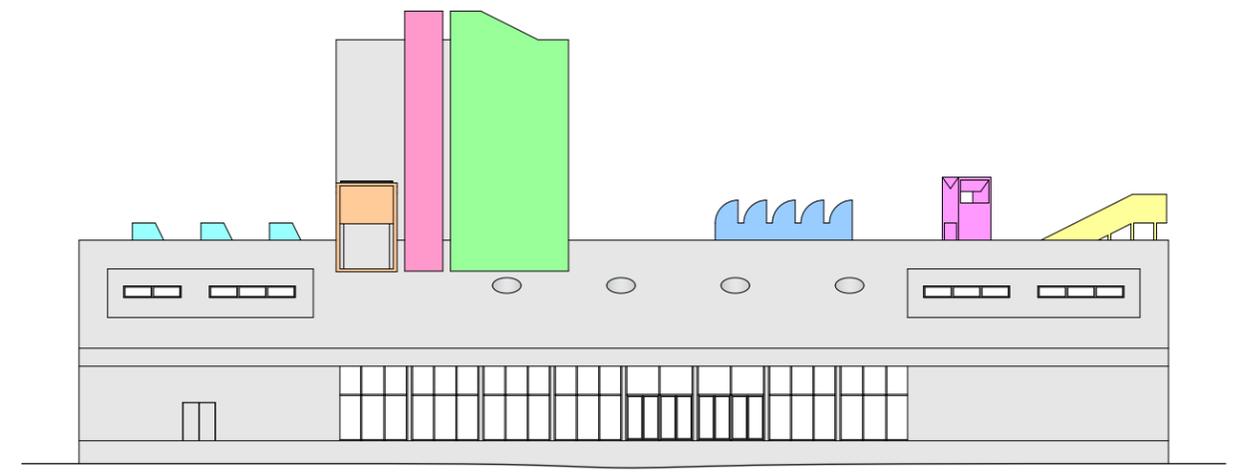
The project draws from the work of architects who have engaged with the ordinary and vernacular mainly through form-making. Similarly, this multi-modal transport hub engages with its context and becomes an icon in Edmond.



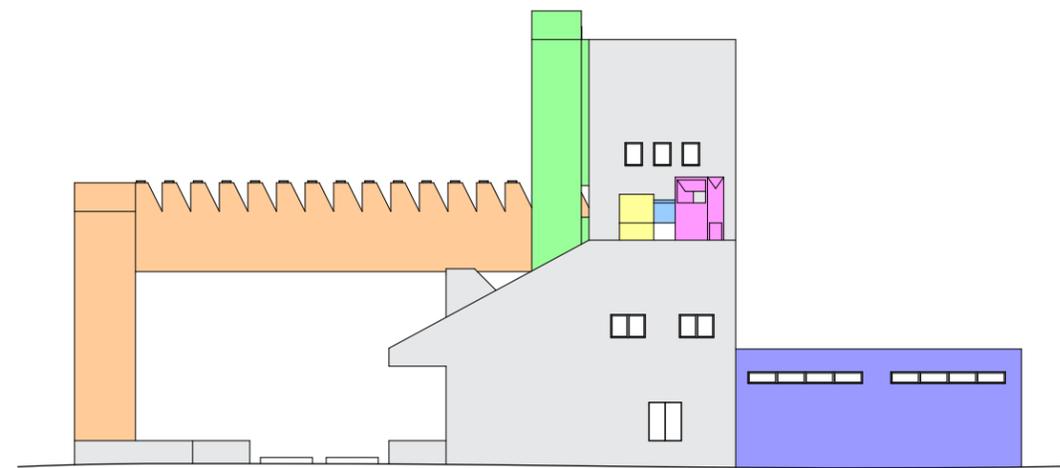




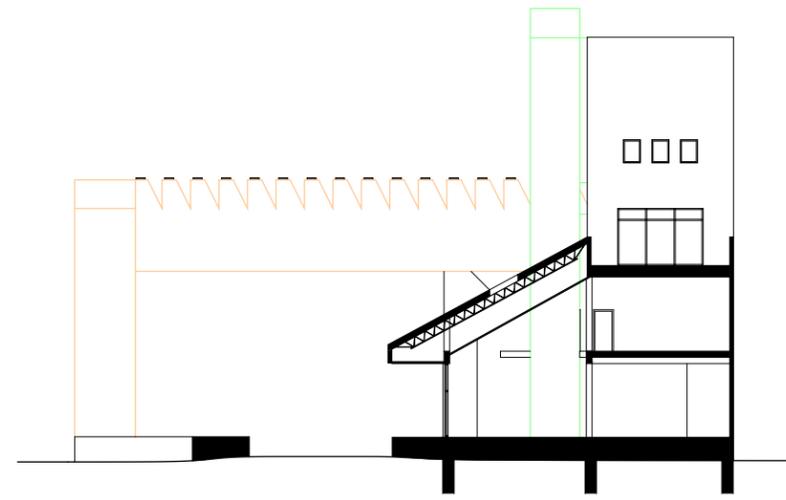
East Elevation



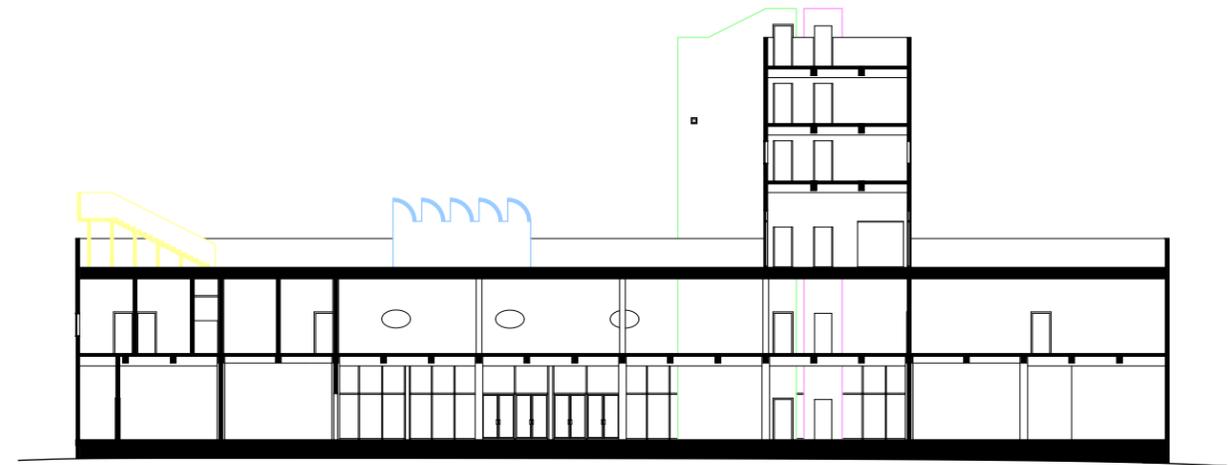
West Elevation



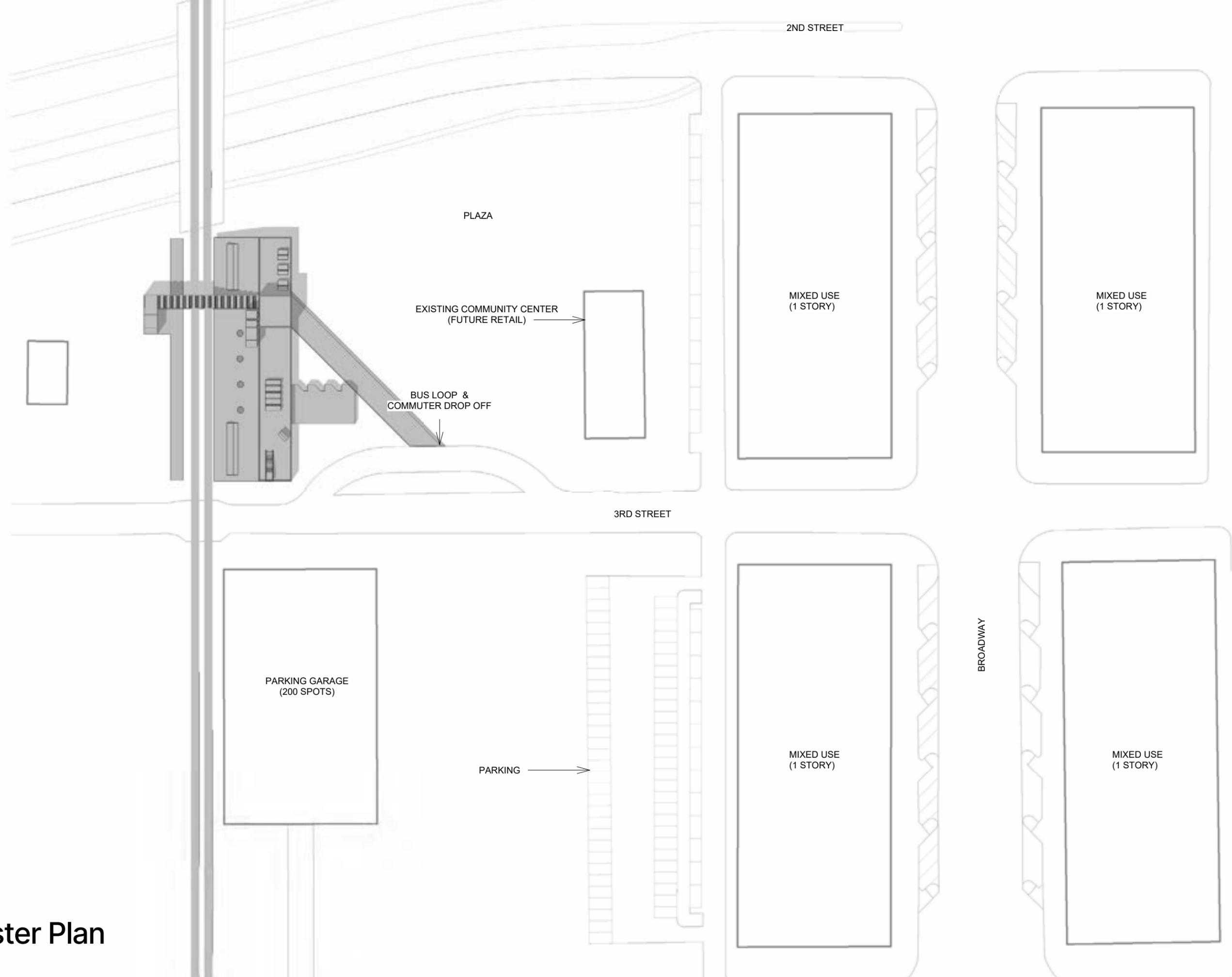
South Elevation



Short Section



Long Section



2ND STREET

PLAZA

EXISTING COMMUNITY CENTER
(FUTURE RETAIL)

BUS LOOP &
COMMUTER DROP OFF

MIXED USE
(1 STORY)

MIXED USE
(1 STORY)

3RD STREET

PARKING GARAGE
(200 SPOTS)

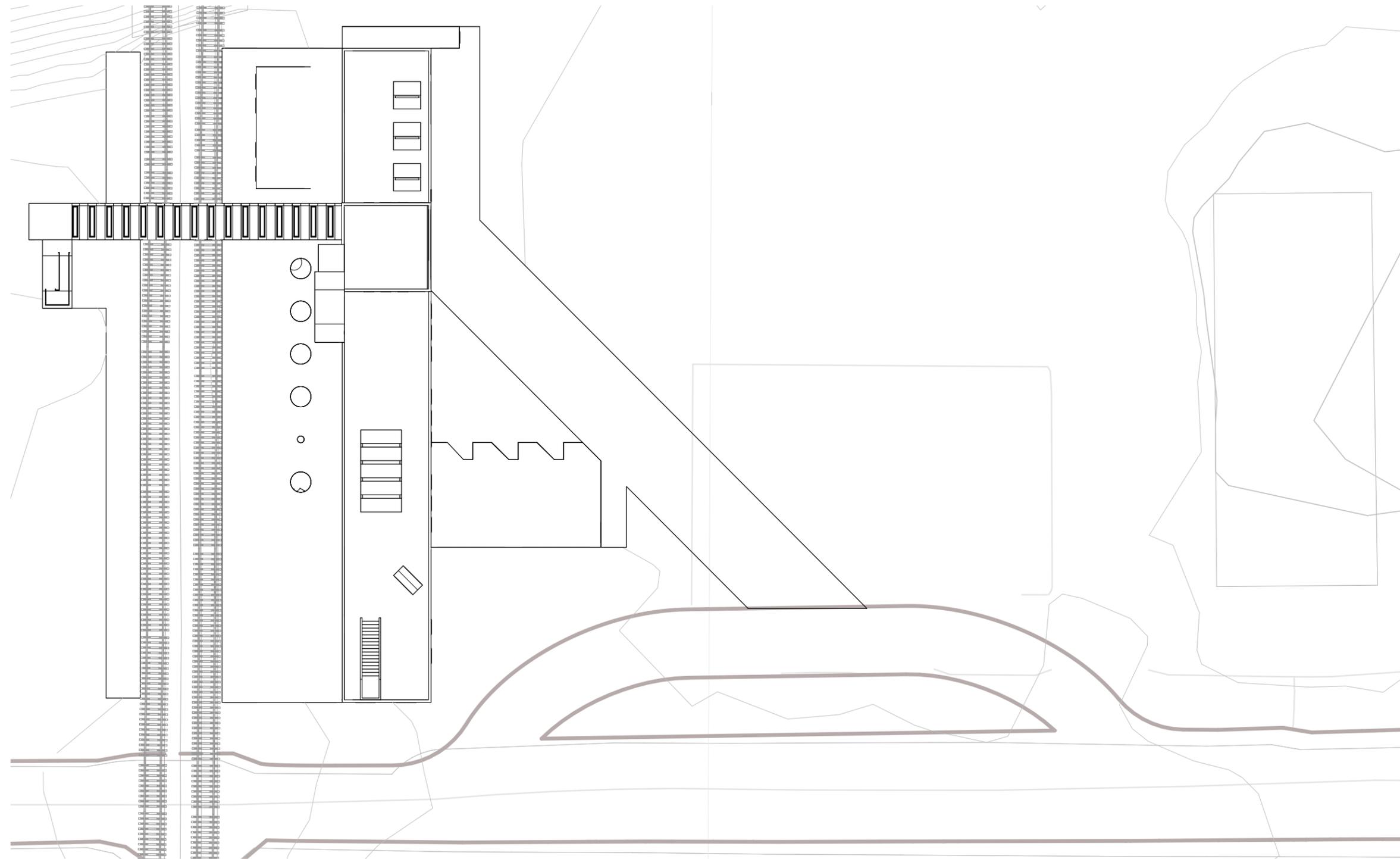
PARKING

MIXED USE
(1 STORY)

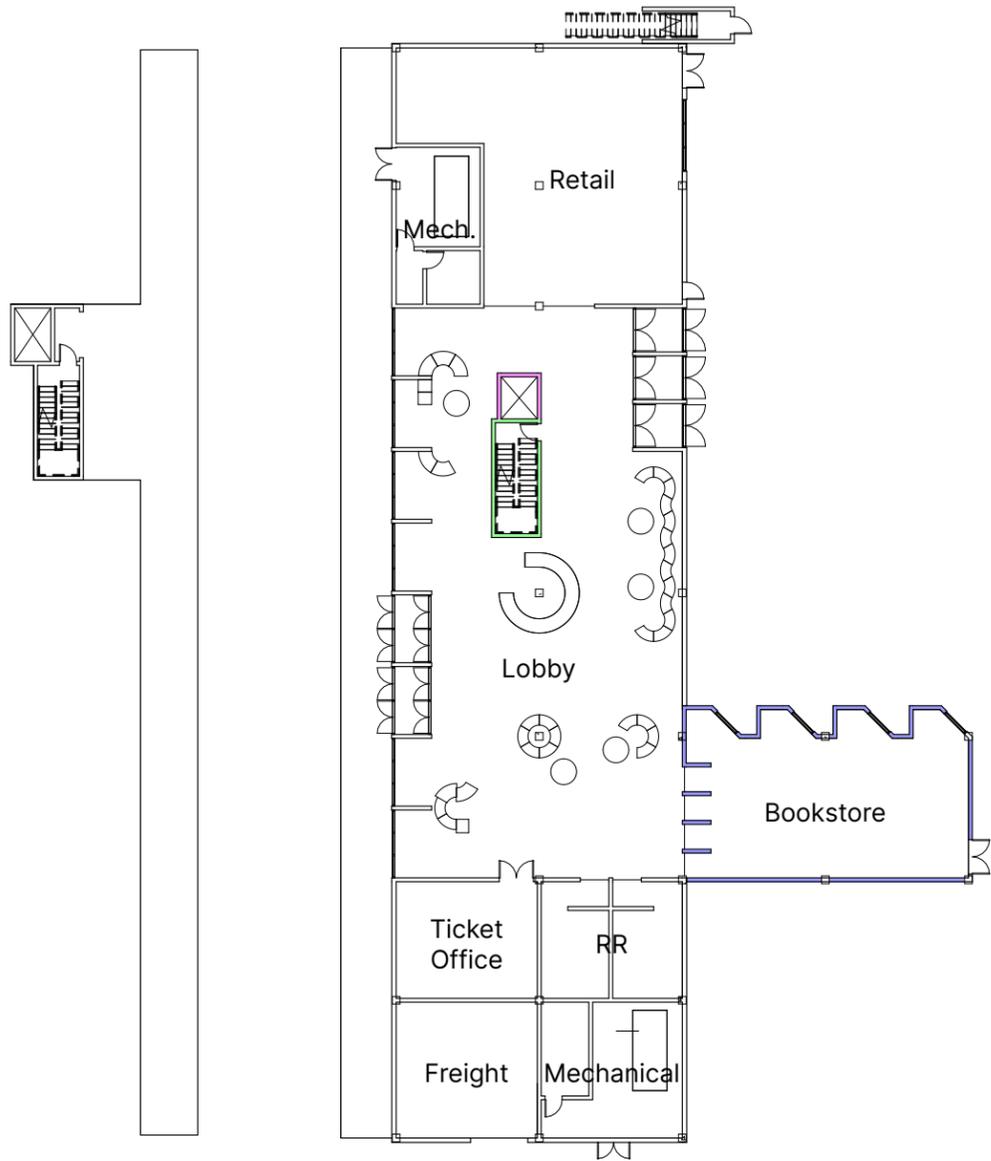
BROADWAY

MIXED USE
(1 STORY)

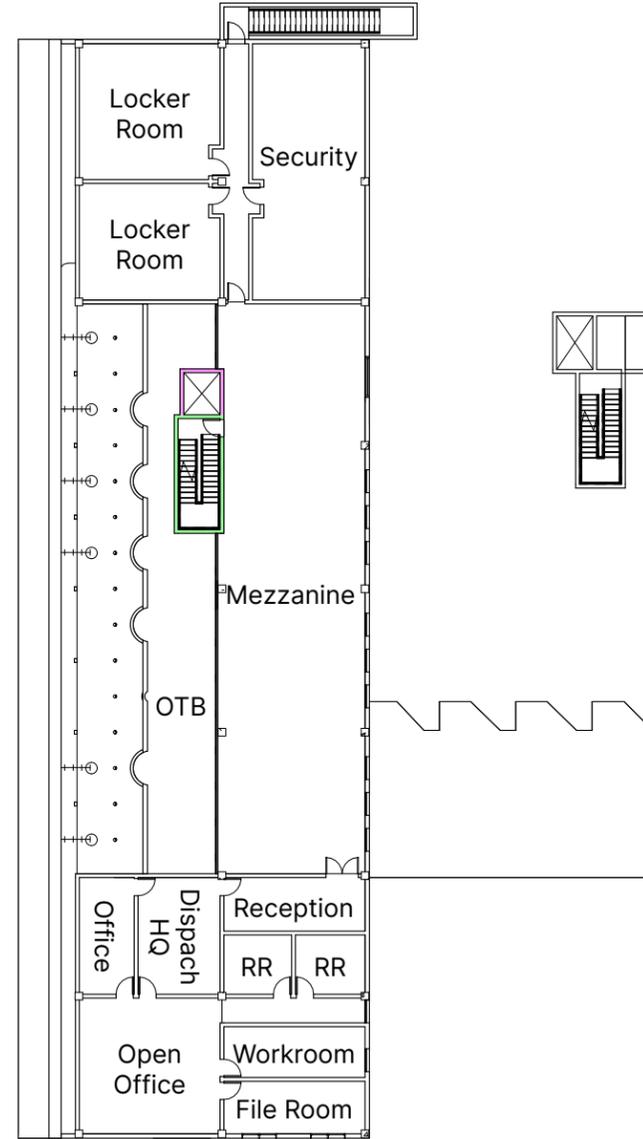
Master Plan



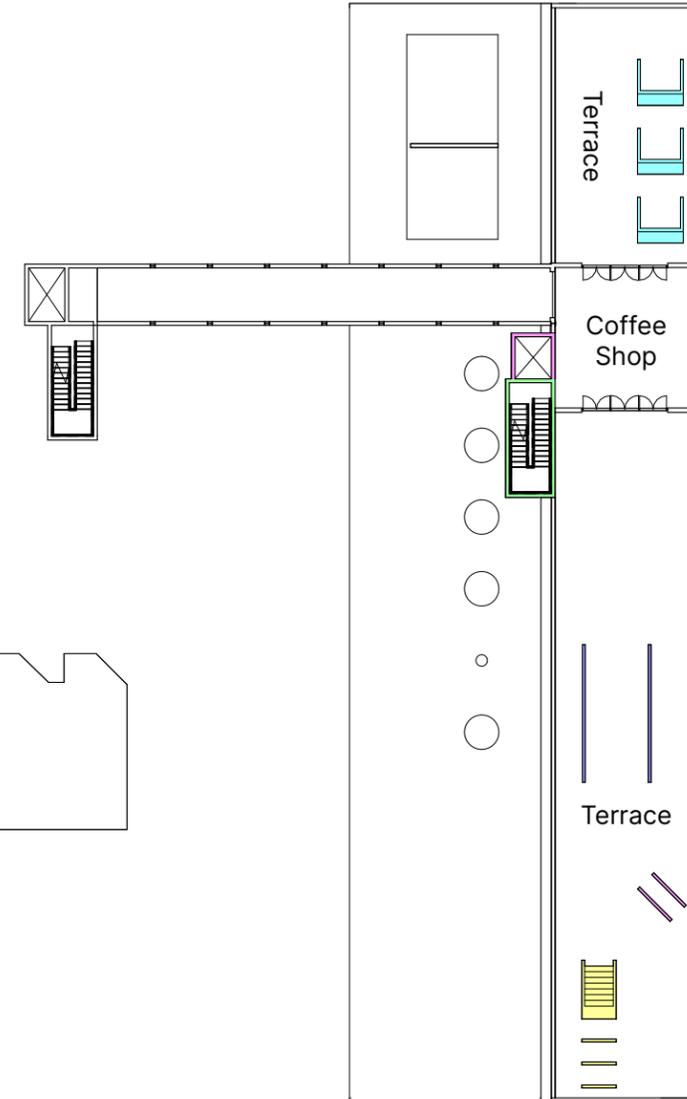
Site Plan N ↑ $\frac{1}{32}'' = 1'$



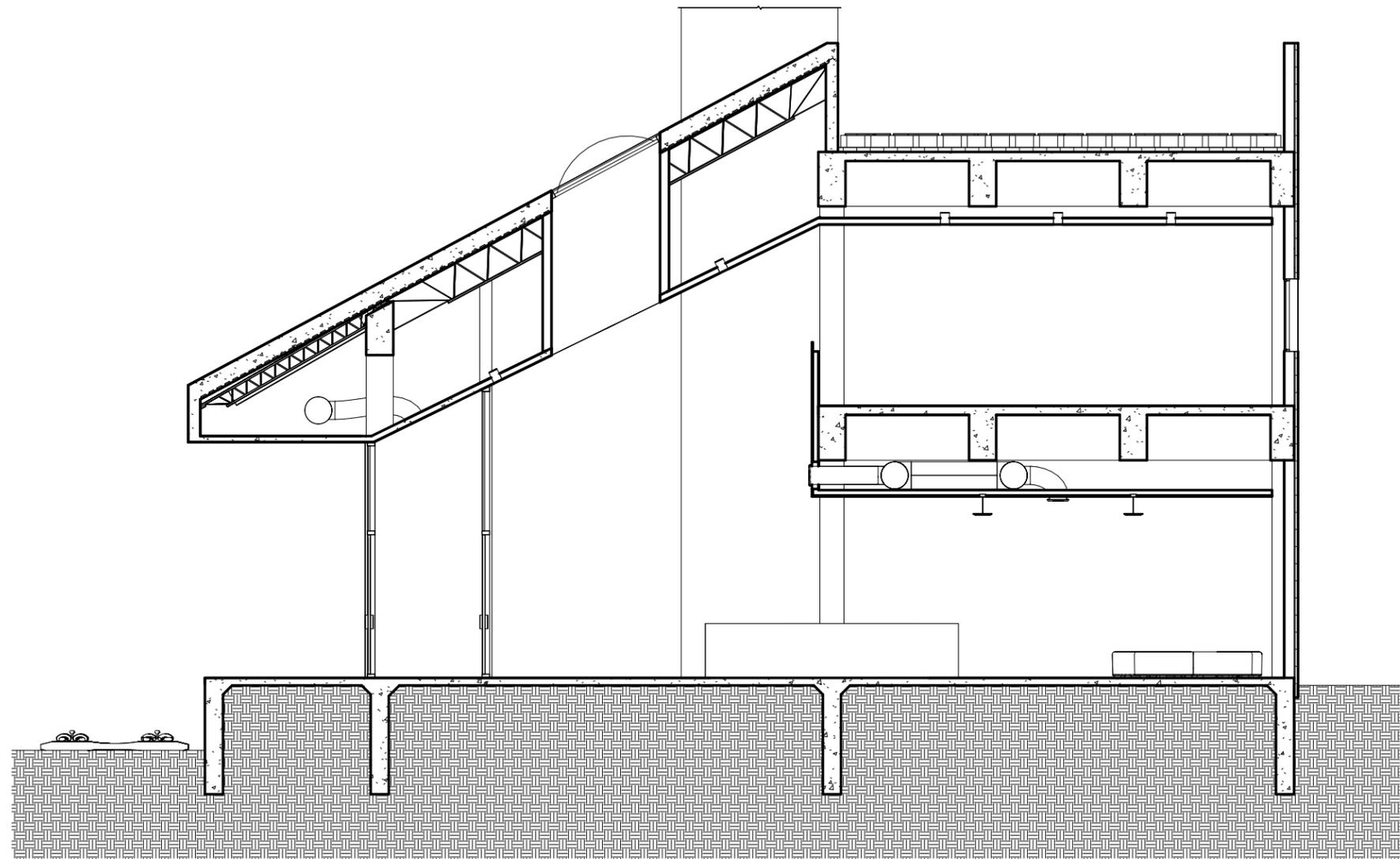
Plan 1 N↑ 1/32" = 1'



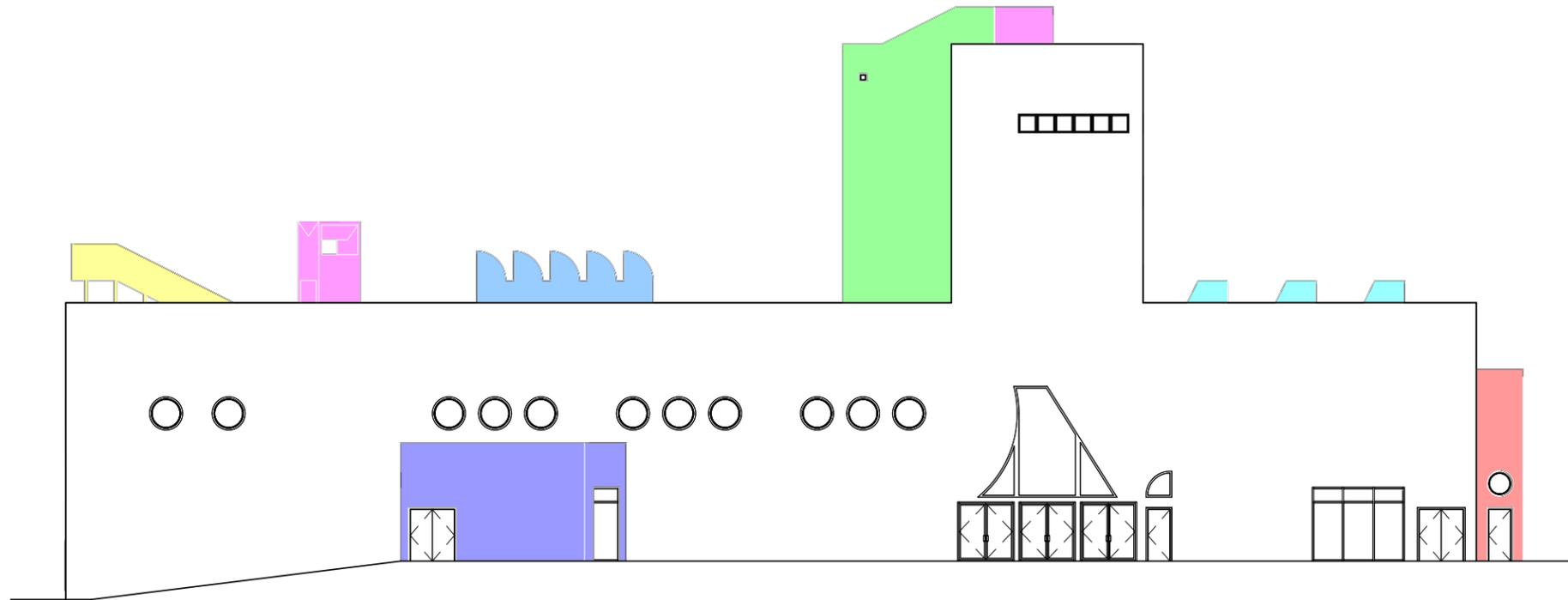
Plan 2 N↑ 1/32" = 1'



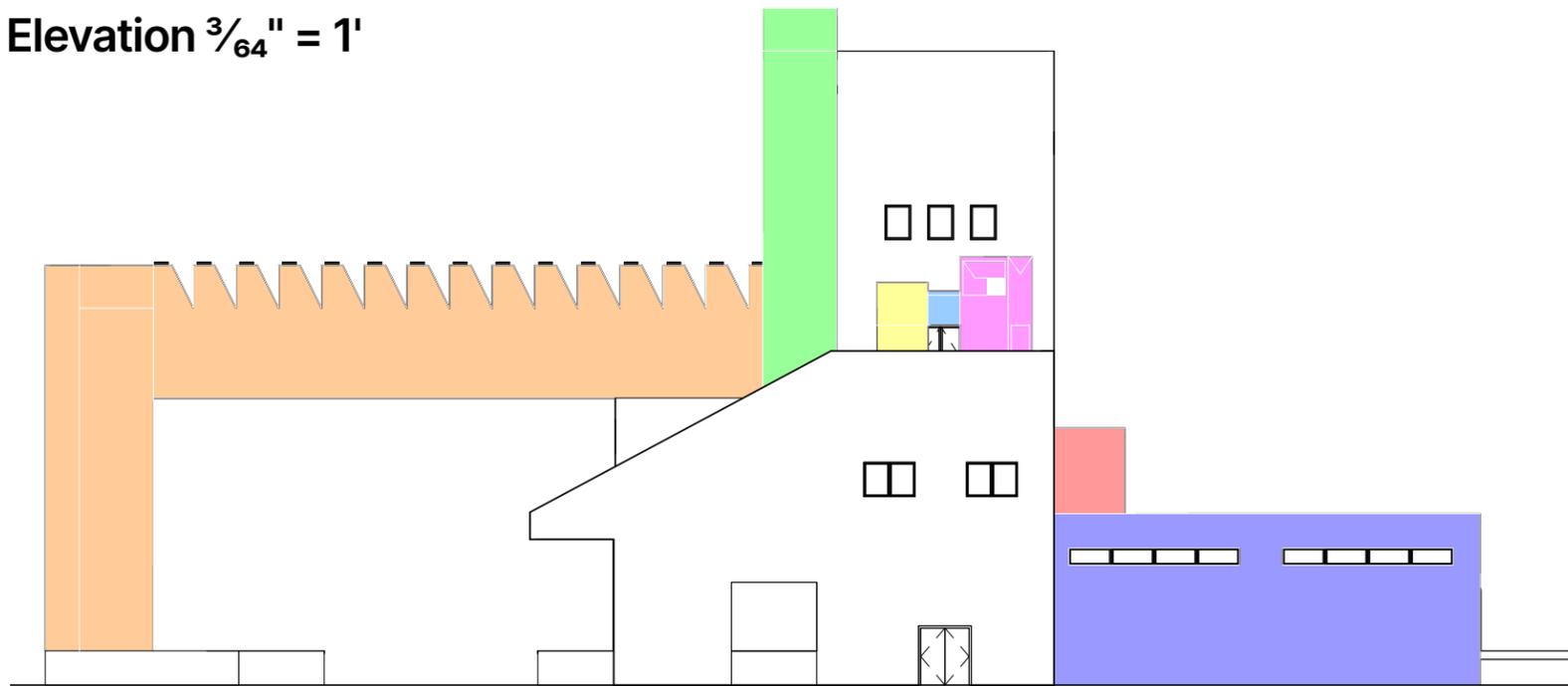
Plan 3 N↑ 1/32" = 1'



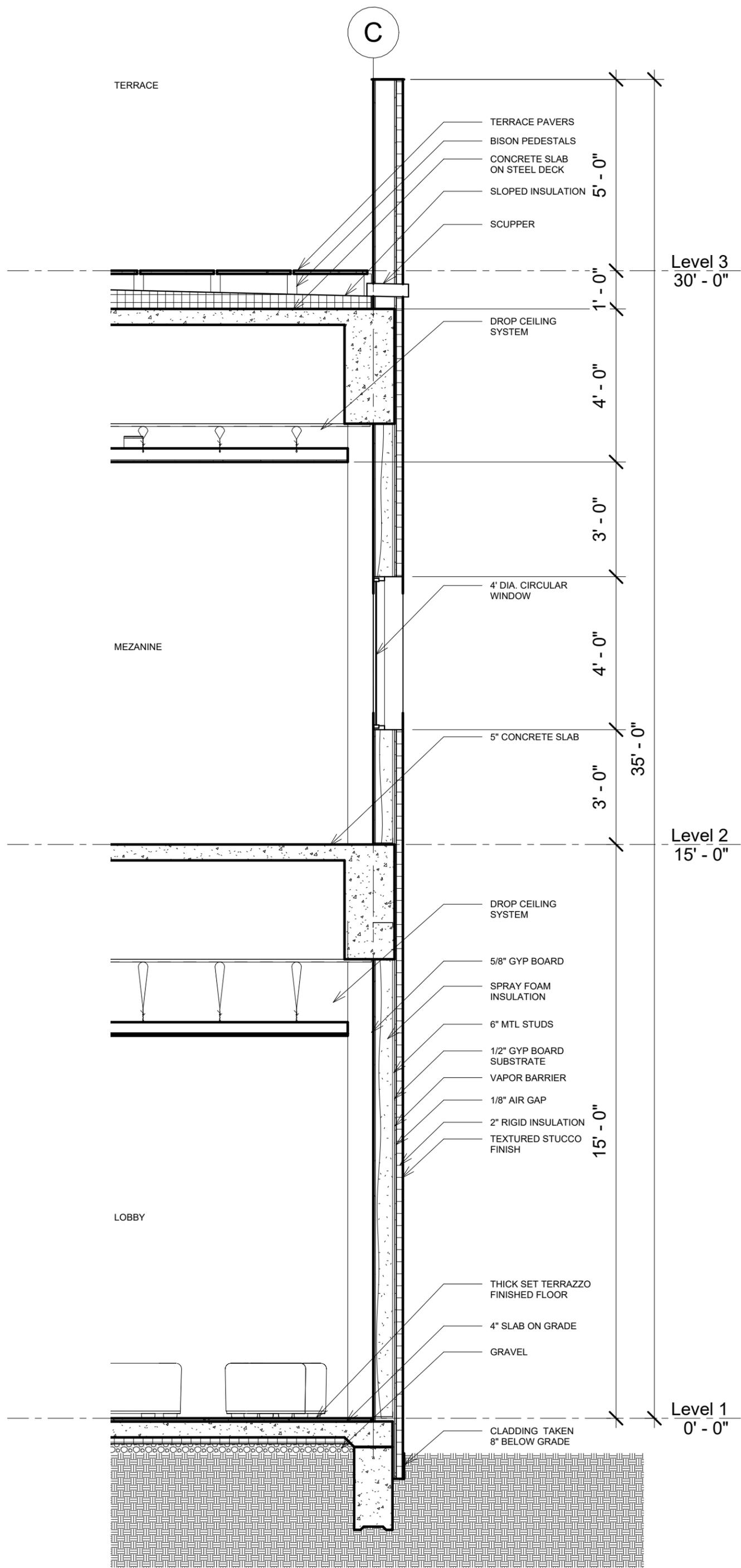
Focus Space Section $\frac{1}{8}'' = 1'$



East Elevation $\frac{3}{64}'' = 1'$



South Elevation $\frac{3}{64}'' = 1'$



Wall Section $\frac{3}{8}'' = 1'$

Wall Section

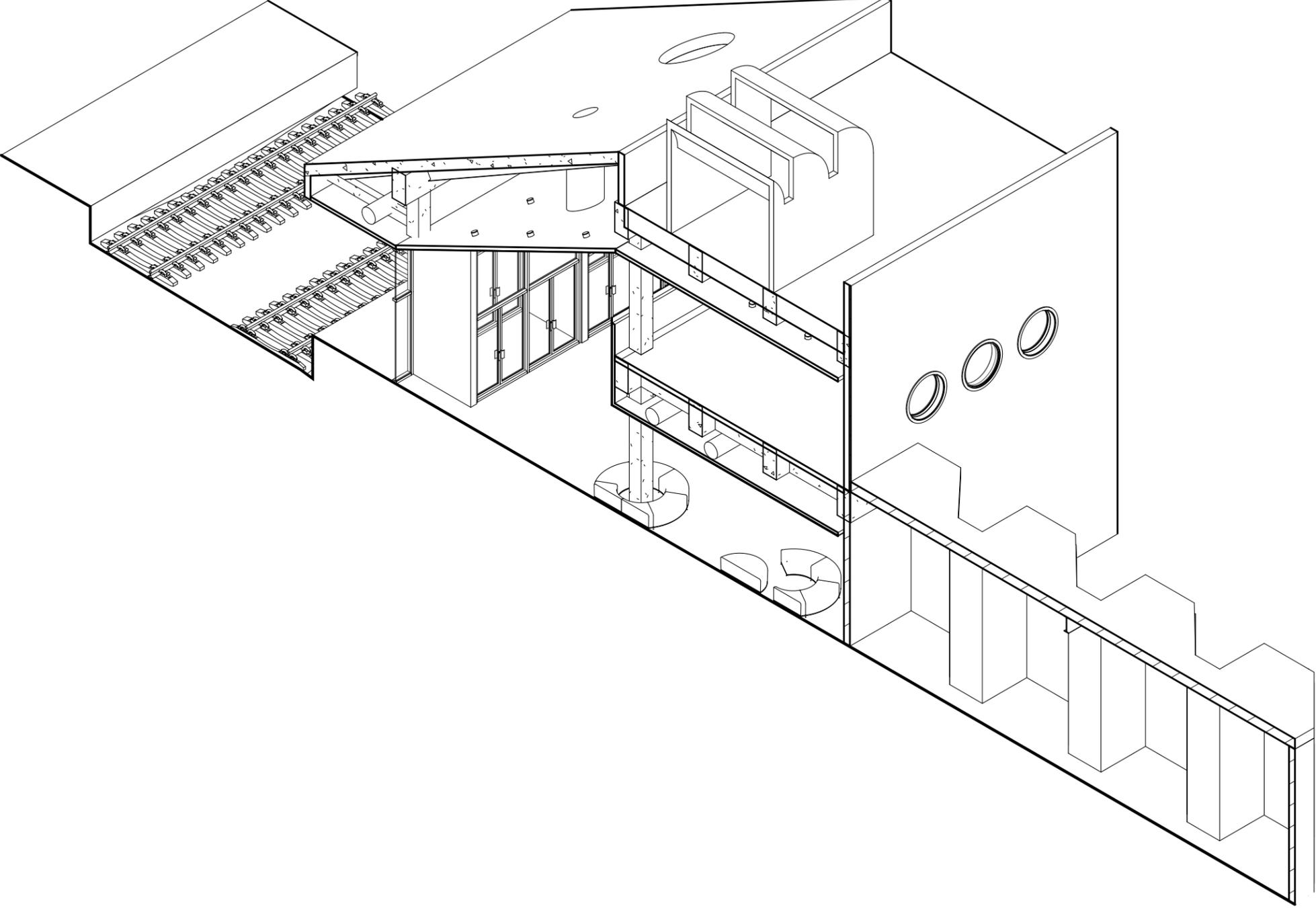


Enlarged Elevation $\frac{3}{8}'' = 1'$

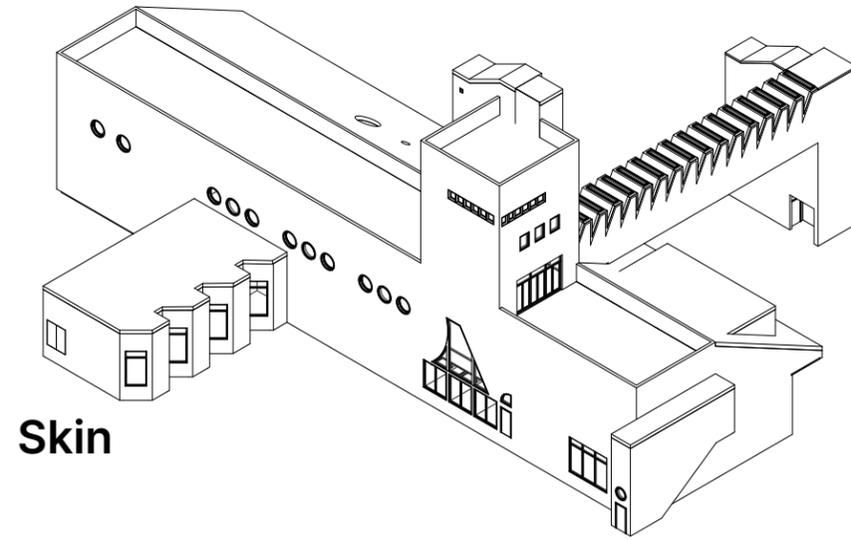
Enlarged Elevation



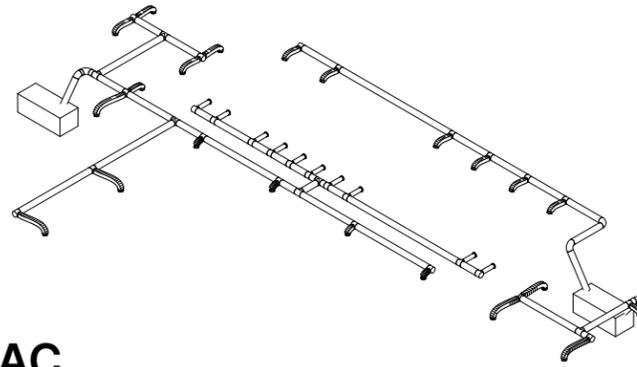
Interior Perspective



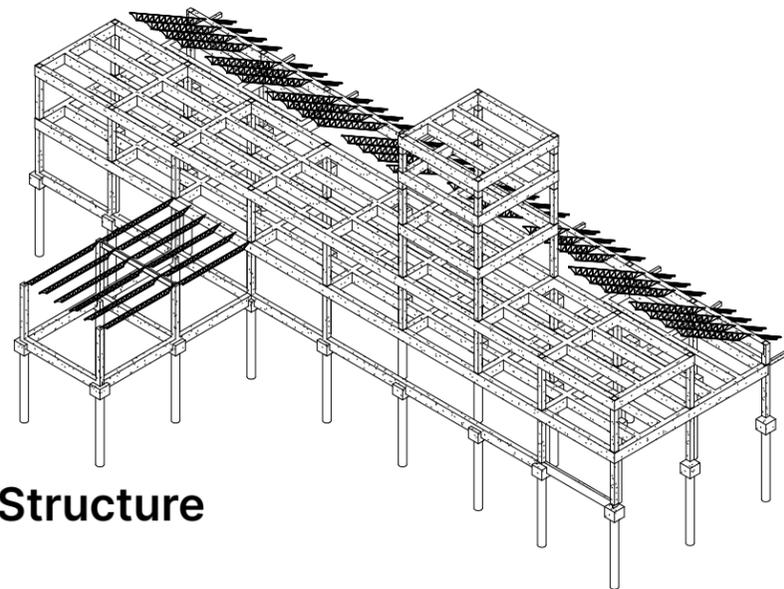
Bay Model



Skin



HVAC



Structure

Exploded Aonometric

Textured Stucco



Painted Drywall



Thick Set Terrazzo

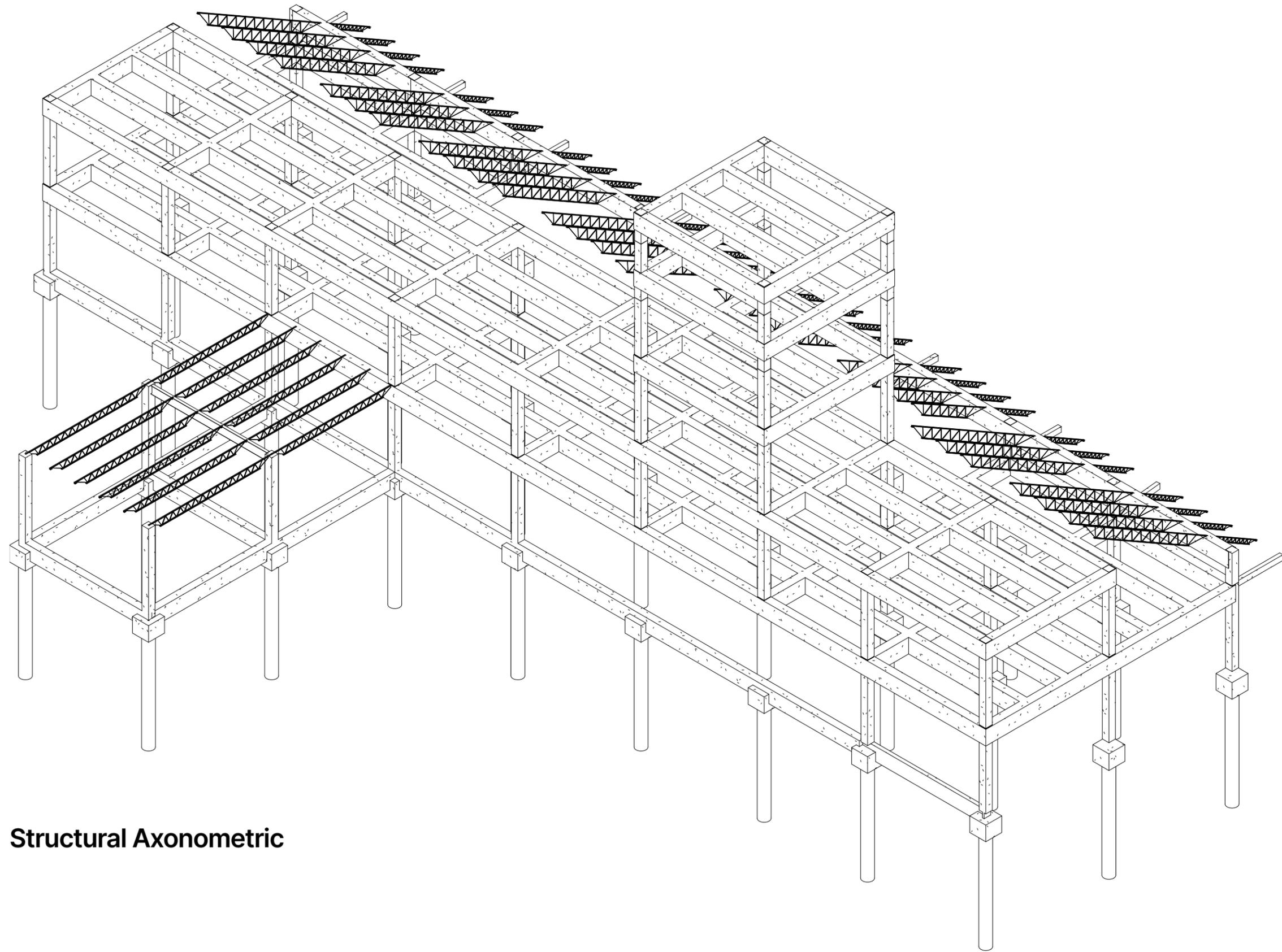


Dyed Concrete

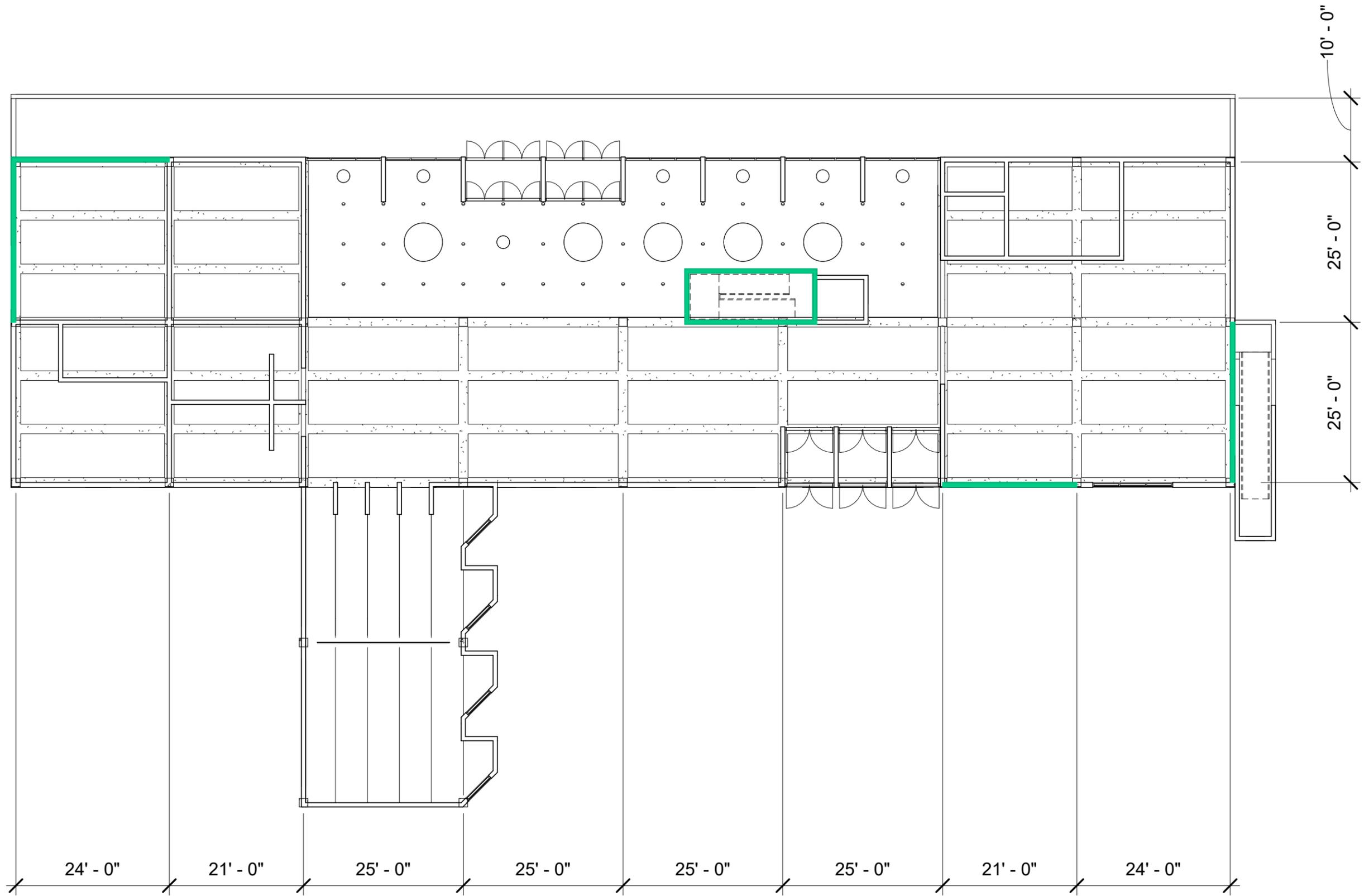


Dyed Concrete

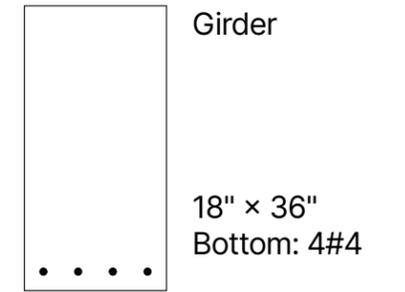
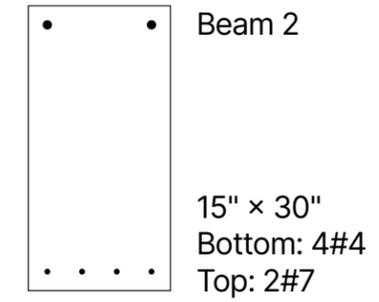
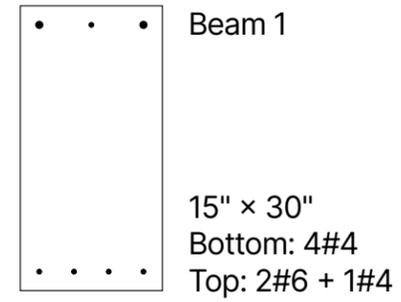
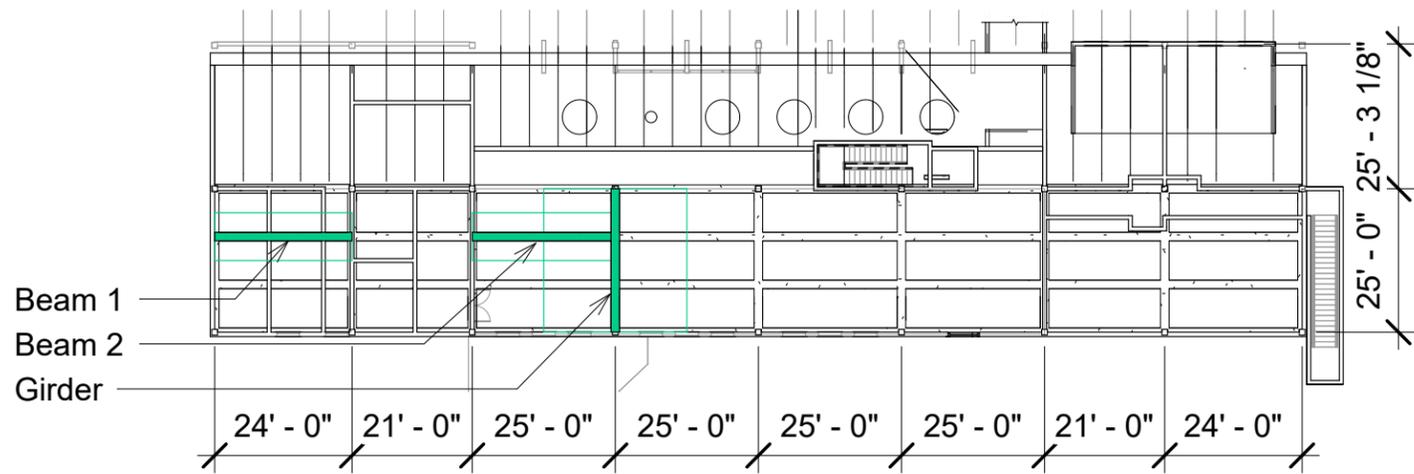
Material Palette



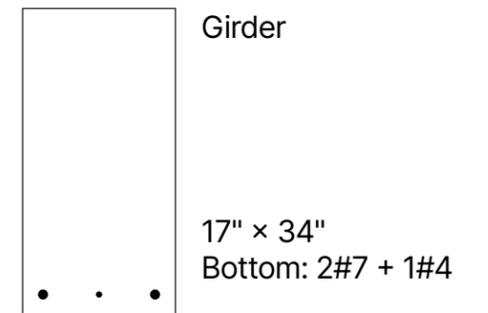
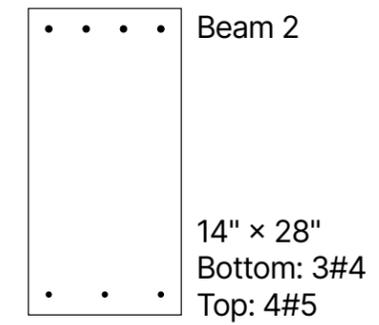
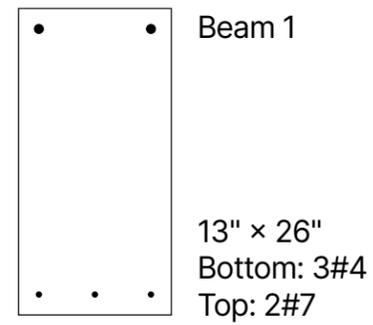
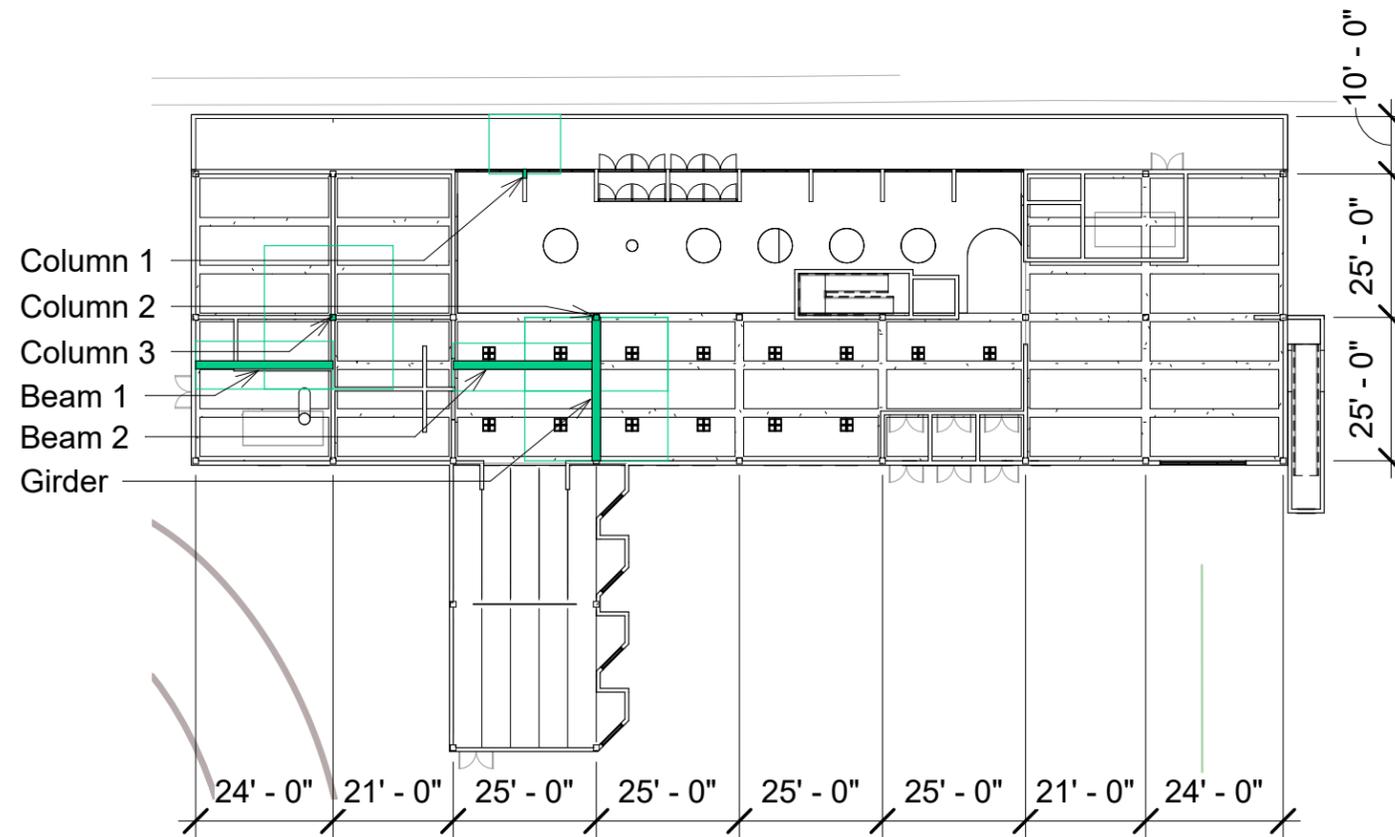
Structural Axonometric



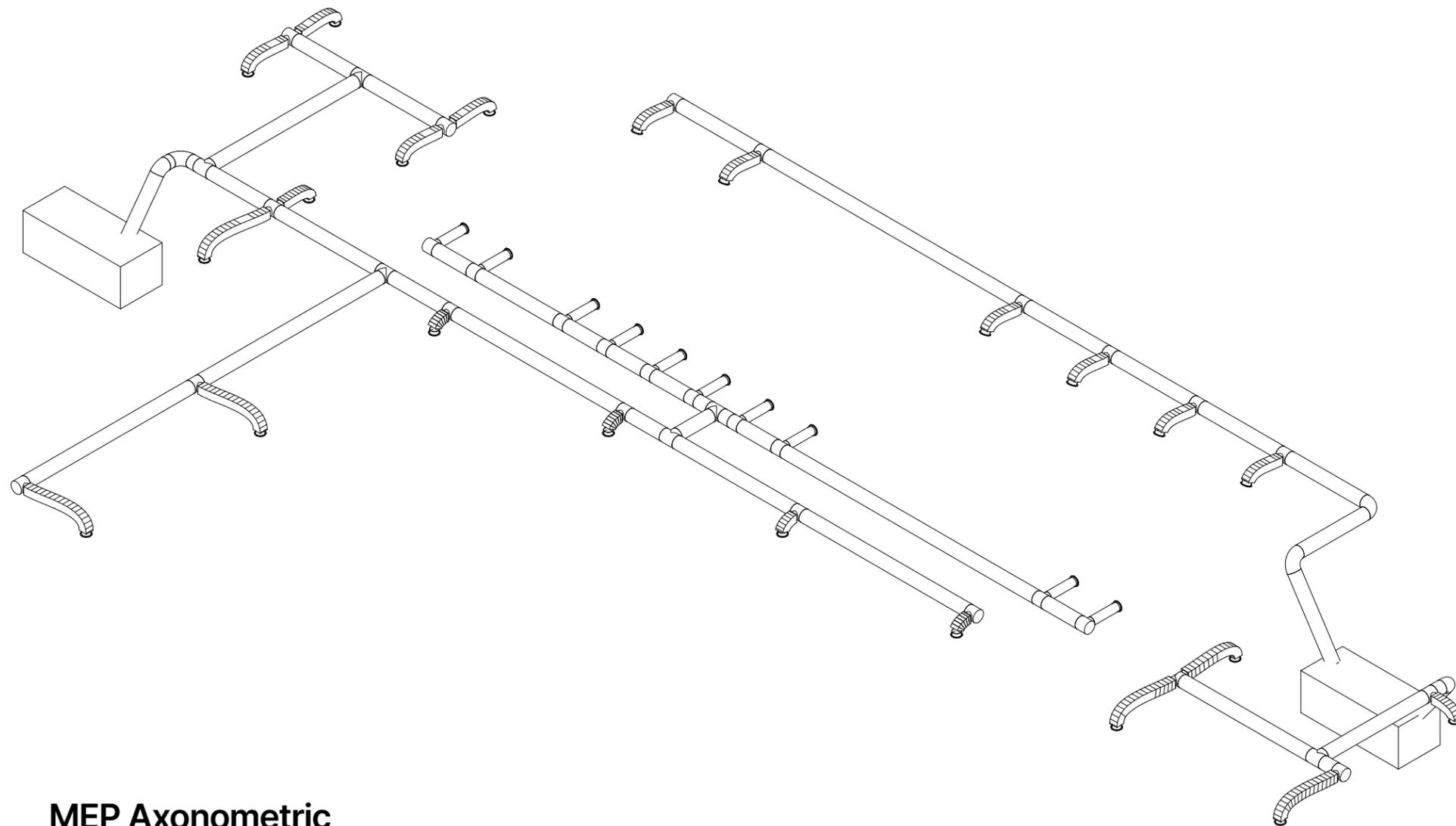
Lateral Systems Plan N → 1/16" = 1'



Framing Plan 1 N → 1/32" = 1'



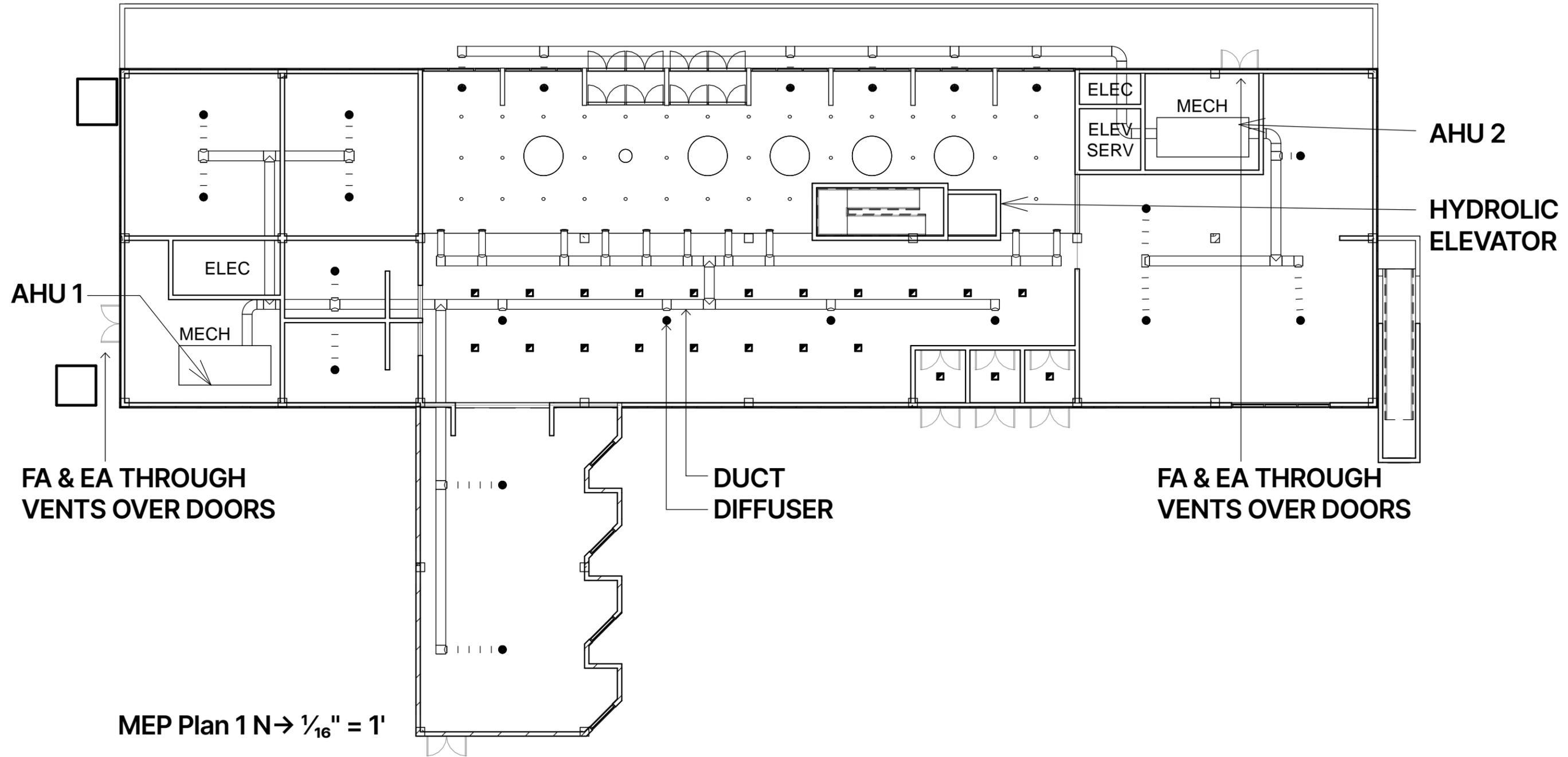
Framing Plan 2 N → 1/16" = 1'

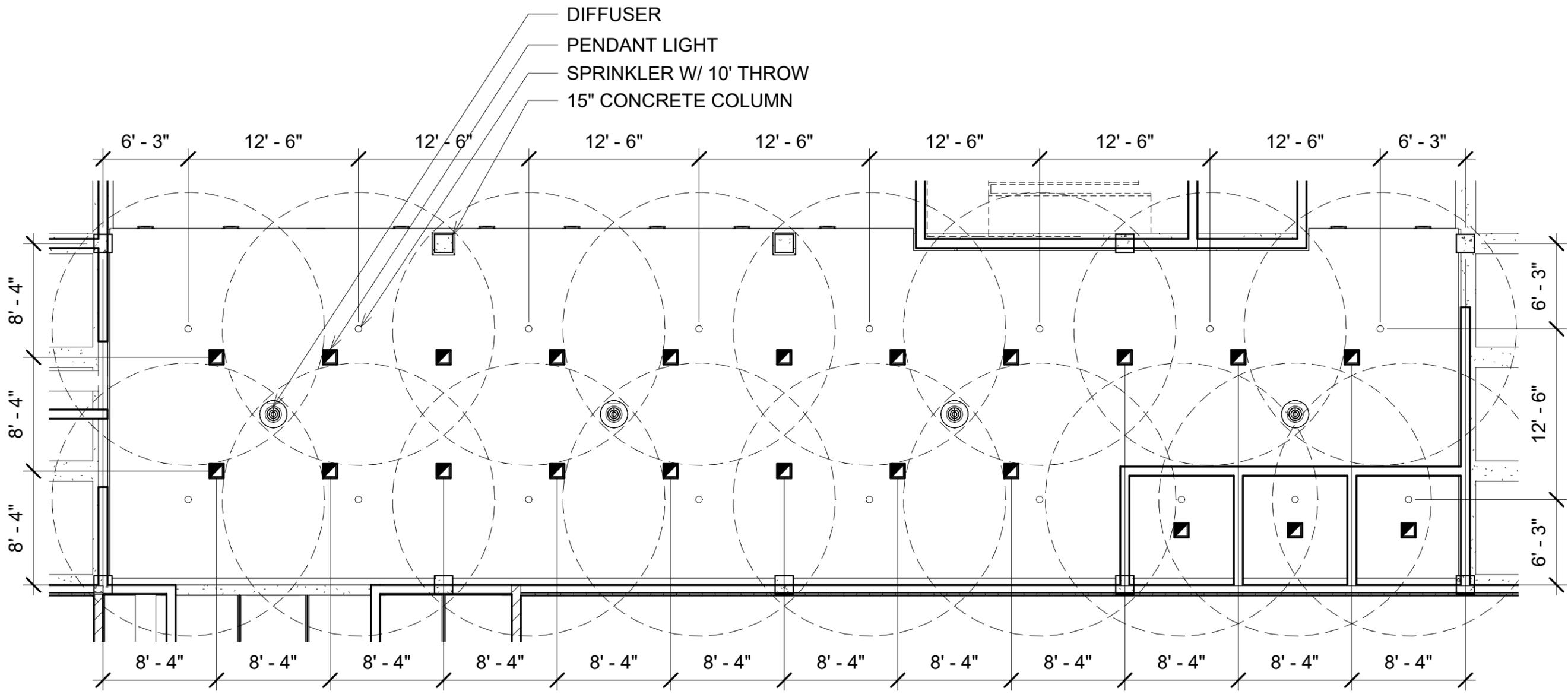


MEP Axonometric

***All ducts are in the space between levels 1 & 2, resulting in just 1 level of ducts. Air is provided to level 1 from above and level 2 from below**

MEP Design





Reflected Ceiling Plan 1 N → 1/8" = 1'



HIGHLIGHTS

- Total System Integration features 5-year limited warranty by Acuity Brands covering all components and construction
- Up to 109 lm/W
- Softshine®-engineered comfort optics
- Flicker-free dimming to dark (0.1%) powered by eldoLED® driver
- Integrated nLight® control module for system networking (optional)
- White, black, painted aluminum or custom color
- Three distributions available: (see page 2)



eldoLED



Shape	Square
Light Source	LED - Static
Lumens	6900 LM
CCT / LED Color	3000 K, 3500 K, 4000 K
CRI	80, 90
Product Type	Pendant
Environmental Listing	Damp Location
Regulatory Listing	CSA
Dimming Protocol	0-10V, DALI
Mounting Type	Suspended

LUMEN PACKAGES Based on 3500K. Additional color temperatures available.

Indirect / Direct LED Output	ID2000LM
Delivered Lumens	2001
Input Watts	20
Lumens Per Watt	102

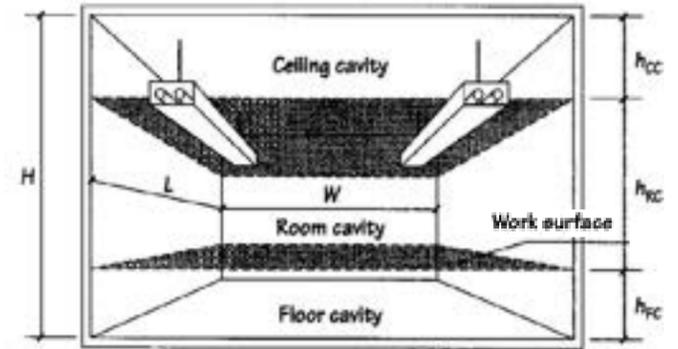
Coefficients Of Utilization - Zonal Cavity Method

Effective Floor Cavity Reflectance: 20%

RCC %:	80				70				50				30				10				0
RW %:	70	50	30	0	70	50	30	0	50	30	20	50	30	20	50	30	20	50	30	20	0
RCR: 0	1.18	1.18	1.18	1.18	1.15	1.15	1.15	.97	1.10	1.10	1.10	1.04	1.04	1.04	1.00	1.00	1.00	1.00	1.00	1.00	.97
1	1.08	1.03	.99	.95	1.05	1.00	.96	.82	.96	.92	.89	.91	.89	.86	.87	.85	.83	.87	.85	.83	.81
2	.98	.89	.82	.76	.95	.87	.81	.68	.83	.78	.73	.80	.75	.71	.76	.72	.69	.76	.72	.69	.67
3	.89	.78	.70	.63	.86	.76	.69	.58	.73	.66	.61	.70	.64	.60	.67	.62	.58	.67	.62	.58	.56
4	.81	.69	.60	.53	.79	.67	.59	.49	.65	.57	.52	.62	.56	.51	.60	.54	.50	.60	.54	.50	.47
5	.75	.61	.52	.46	.72	.60	.52	.43	.58	.50	.44	.56	.49	.44	.53	.48	.43	.53	.48	.43	.41
6	.69	.55	.46	.40	.67	.54	.46	.37	.52	.44	.39	.50	.43	.38	.48	.42	.38	.48	.42	.38	.36
7	.64	.50	.41	.35	.62	.49	.41	.33	.47	.40	.34	.46	.39	.34	.44	.38	.33	.44	.38	.33	.31
8	.59	.46	.37	.31	.58	.45	.37	.30	.43	.36	.31	.42	.35	.30	.40	.34	.30	.40	.34	.30	.28
9	.55	.42	.33	.28	.54	.41	.33	.27	.40	.33	.27	.38	.32	.27	.37	.31	.27	.37	.31	.27	.25
10	.52	.39	.31	.25	.50	.38	.30	.24	.37	.30	.25	.36	.29	.25	.35	.29	.24	.35	.29	.24	.23

Designer: Liam Vennerholm Space type: Lobby

PHOTOMETRIC DATA
 IESNA Illuminance category: P
 IESNA Recommended illuminance (average): 15 (fc)
 [Refer to IESNA tables]
 Lamp type: LED
 Recommended spacing ratio 1.0
 Lumen output from one lamp (initial): 2001 (lumens)
 Number of lamps per luminaire: 1 (lamps)
 Fixture efficiency: 100 (%)
 Lumen output from one luminaire: 2001 (lumens)



ROOM DESIGN
 L = 100' - 0" (ft)
 W = 25' - 0" (ft)
 H = 15' - 0" (ft)
 Ceiling cavity reflectance = CCR = 80 (%)
 Room cavity reflectance (walls) = RCR = 50 (%)
 Assumed floor cavity reflectance = FCR = 20 (%)

h_{CC} = 5' - 0" (ft)
 h_{RC} = 7' - 0" (ft)
 h_{FC} = 3' - 0" (ft)

SIZING OF THE SYSTEM

a. Effect of room geometry: Determine equivalent-square room length (W_{sq}), and the Room Cavity Ratio (RCR).

$$W_{sq} = W + [(L-W) / 3] = \dots\dots\dots 50$$

$$RCR = (10 \times h_{RC}) / W_{sq} = \dots\dots\dots 1.4$$

From manufacturer's data, obtain the Coefficient of Utilization (CU) of this luminaire in this space.

$$CU = \dots\dots\dots 0.96$$

b. Effect of maintenance conditions of the space and the system (includes ballast factor): Estimate LLF.

Light Loss Factor = LLF = 0.85 Good conditions = 0.65 (Circle one)
 Average conditions = 0.55
 Poor conditions = 0.45

c. Calculate useful lumens from one luminaire (on the workplane):

Useful lumens from one luminaire = Lumen output from one luminaire x CU x LLF
 = 1632.8 lm

d. Determine total lumens needed on the workplane:

Total lumens needed on the workplane = Recommended illuminance x area
 = 37500 lm

e. Determine needed number of luminaires:

Number of luminaires = Total lumens needed on the workplane/useful lumens from one luminaire

$$\text{Number of luminaires} = \dots\dots\dots 22.966 \rightarrow 23$$

Actual illumination level provided = $15fc \times (23 \text{ luminaires} \div 22.966 \text{ luminaires}) \rightarrow 15.022 fc$

Light load = $(23 \text{ luminaires} \times 20w) \div (100' \times 25') \rightarrow .184 w/sqft$

Light load index = $15.022fc \div .184w/sqft \rightarrow .0122 w/ftc$

Covered area per luminaire = $(100' \times 25') \div 23 \text{ luminaires} \rightarrow 108.7 sqft$

System's overall efficiency = $1.0 \times 0.96 \times 0.85 \rightarrow 81.6\%$

Products
9/16" (14MM) LAMINATED WITH ROOMSIDE LOW-E VE33-48

VIRACON
GLASS IS EVERYTHING

Transmittance		Shading Coefficient	
Visible Light	38%	Shading Coefficient	0.40
Solar Energy	22%	Relative Heat Gain	87Btu/(hr x sqft)
UV	<1%	Solar Heat Gain Coefficient (SHGC)	0.35

Reflectance		LSG	
Visible Light-Exterior	11%	LSG	1.09
Visible Light-Interior	6%		
Solar Energy	13%		

NRFC U-Value	
Winter	0.61 (hr x sqft x °F)
Summer	0.47 (hr x sqft x °F)

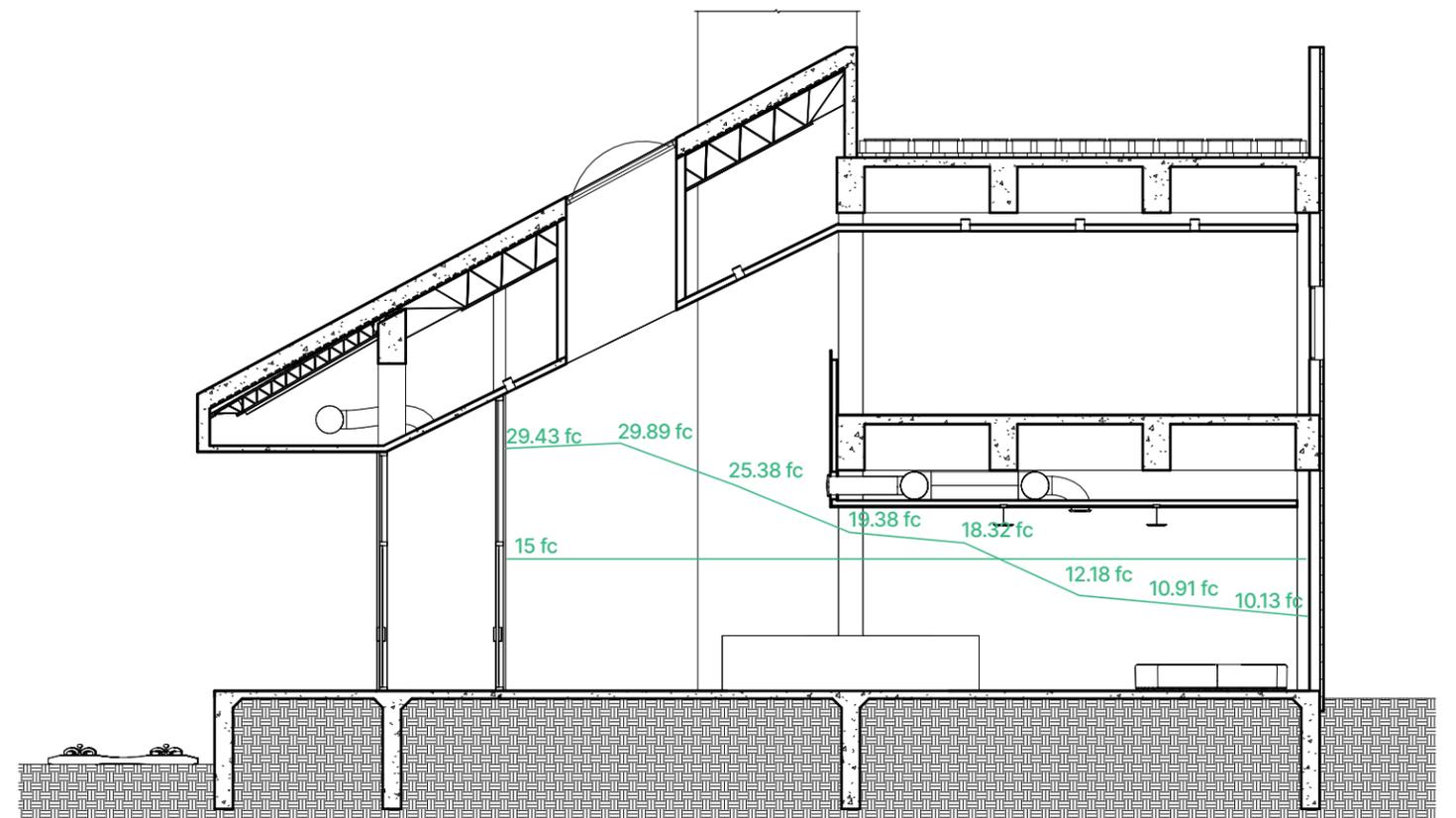
Daylighting lab test results Sky Condition: Standard CIE Overcast Sky

Light Sensor #	Multiplier	Meter's Reading	Illumination level under artificial sky dome		Sensor's Serial number
			lux	fc	
1	2.9210	21.1	62 lux	5.7 fc	PH 8355
2	2.8313	22.1	63 lux	5.8 fc	PH 8356
3	2.8248	18.8	53 lux	4.9 fc	PH 8357
4	2.9378	13.8	41 lux	3.8 fc	PH 8358
5	2.9792	10.4	31 lux	2.9 fc	PH 8359
6	2.7992	9.1	25 lux	2.4 fc	PH 8360
7	2.9673	7.7	23 lux	2.1 fc	PH 8361
8	2.9431	7.2	21 lux	2.0 fc	PH 8362
(single sensor) 9	2.7651	267.3	739 lux	68.7 fc	PH 8363
Outside (under dome)	2.7390	269.8	739 lux	68.7 fc	PH 8364

Measured outside illuminance = **68.7 fc** [NOTE]: This is the outside horizontal illuminance under the artificial sky dome in the lab, and not the standard illuminance at the location of your building.

Daylight Factor for VT= 1.00		Daylight Factor	
For models tested with glass or trace paper		excluding effect of glass VT	
1	8.34%	8.34%	Average sens # 1 to 8 5.38%
2	8.47%	8.47%	
3	7.19%	7.19%	
4	5.49%	5.49%	
5	4.19%	4.19%	
6	3.45%	3.45%	
7	3.09%	3.09%	
8	2.87%	2.87%	
(single sensor) # 9			Ratio of Max. to Min. 2.95

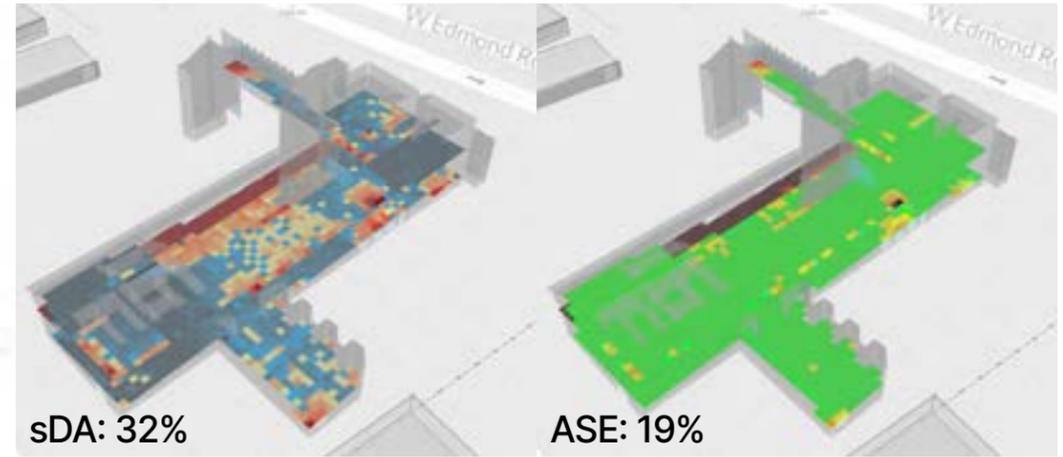
Point	IL Standard (fc)	DF	VT	M	IL Predicted (fc)
1	1597	8.34%	26%	85%	29.43
2	1597	8.47%	26%	85%	29.89
3	1597	7.19%	26%	85%	25.38
4	1597	5.49%	26%	85%	19.38
5	1597	5.19%	26%	85%	18.32
6	1597	3.45%	26%	85%	12.18
7	1597	3.09%	26%	85%	10.91
8	1597	2.87%	26%	85%	10.13
Average	1597	5.51%	26%	85%	19.45



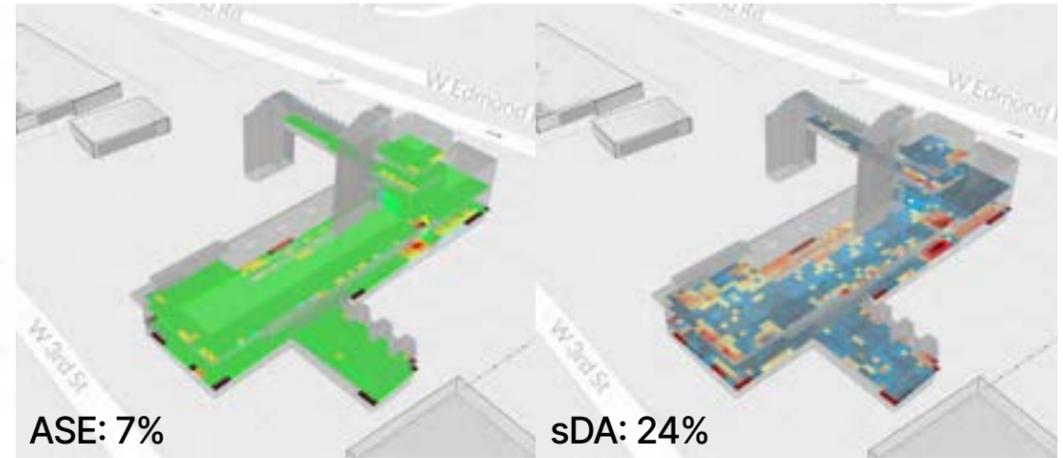
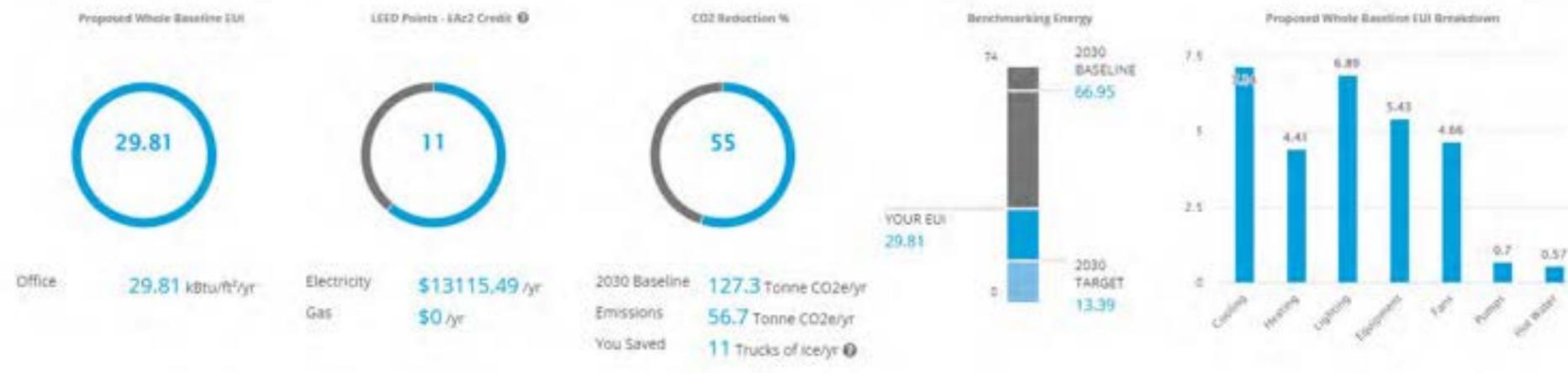
Daylighting Design

Footcandles in Lobby

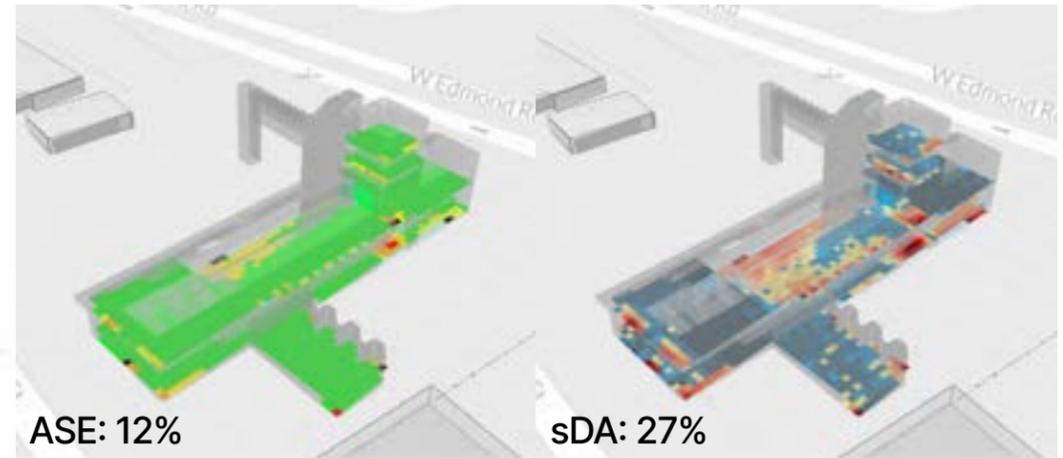
Model A



Model B



Model C



Cove.Tool Comparison



Construction Documents

In the Construction Document phase, most of the designing was finished aside from a few loose ends. The main focus of this phase is to document everything so that someone can construct what I've designed. The goal is to create a set of very detailed and very specific documents that describe the way the building goes together so that a construction company who has never seen it before and perhaps is not familiar with my design process can build it. Of course, since I focused on the lobby space in the previous phase, that is the most detailed portion of the building. Additionally, once again I completed this to the best of my ability in the allotted time which was only a few weeks. In reality, an architecture firm would spend one or two years if not longer in this phase of a project.

My main challenge in this phase was to document all the aspects of the building. I had become intimately familiar with the design, so I had to make sure I didn't accidentally assume something. Everything was to be labeled, dimensioned, and put on a sheet so that someone could read it and reproduce it in three dimensions.

This phase also required me to focus in a lot closer on the conditions of the building that I hadn't fully resolved earlier in the project. I reconciled all of the small-scale junctions of materials and other building elements. I also executed the vision I had established in Schematic Design and Design Development.

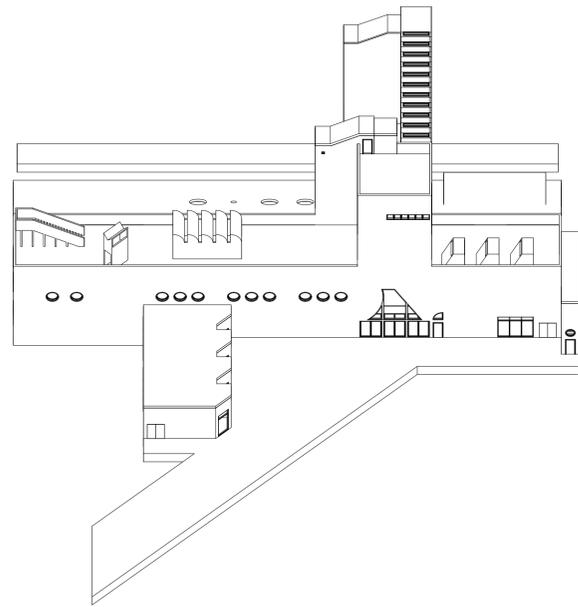
Overall, I was able to produce a building that I am quite happy with. I got to spend all semester with it and get more detailed than I ever have before.



EMMTH
Edmond, OK

Project No. 001

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Designed by Liam Vennerholm
Checked by Keith Peiffer



② Project Image



EMMTH
Edmond, OK

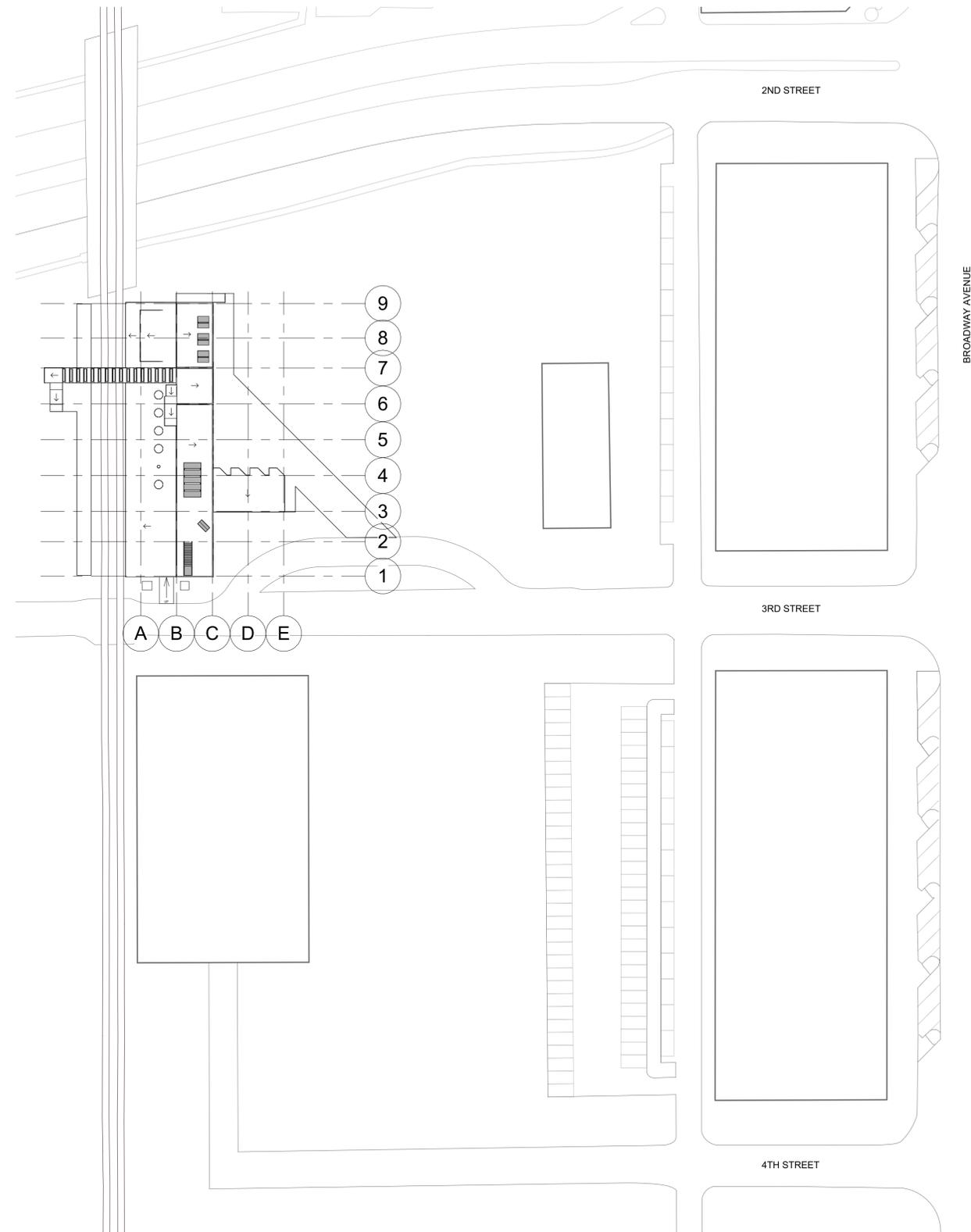
Liam Vennerholm
liam.vennerholm@okstate.edu

Owner
City of Edmond, Oklahoma

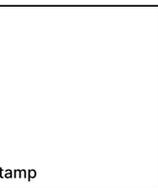
Structural
Jacob Jones

MEP
Khaled Mansy

- Sheet List
- A000 Title Sheet
 - A101 First Floor Plan
 - A200 East Elevation
 - A201 South Elevation
 - A300 Building Sections
 - A350 Wall Section
 - A400 Detail Drawings
 - A401 Detail Drawings
 - A700 Focus Space Drawings



① SITE PLAN
1" = 50'-0"



Stamp

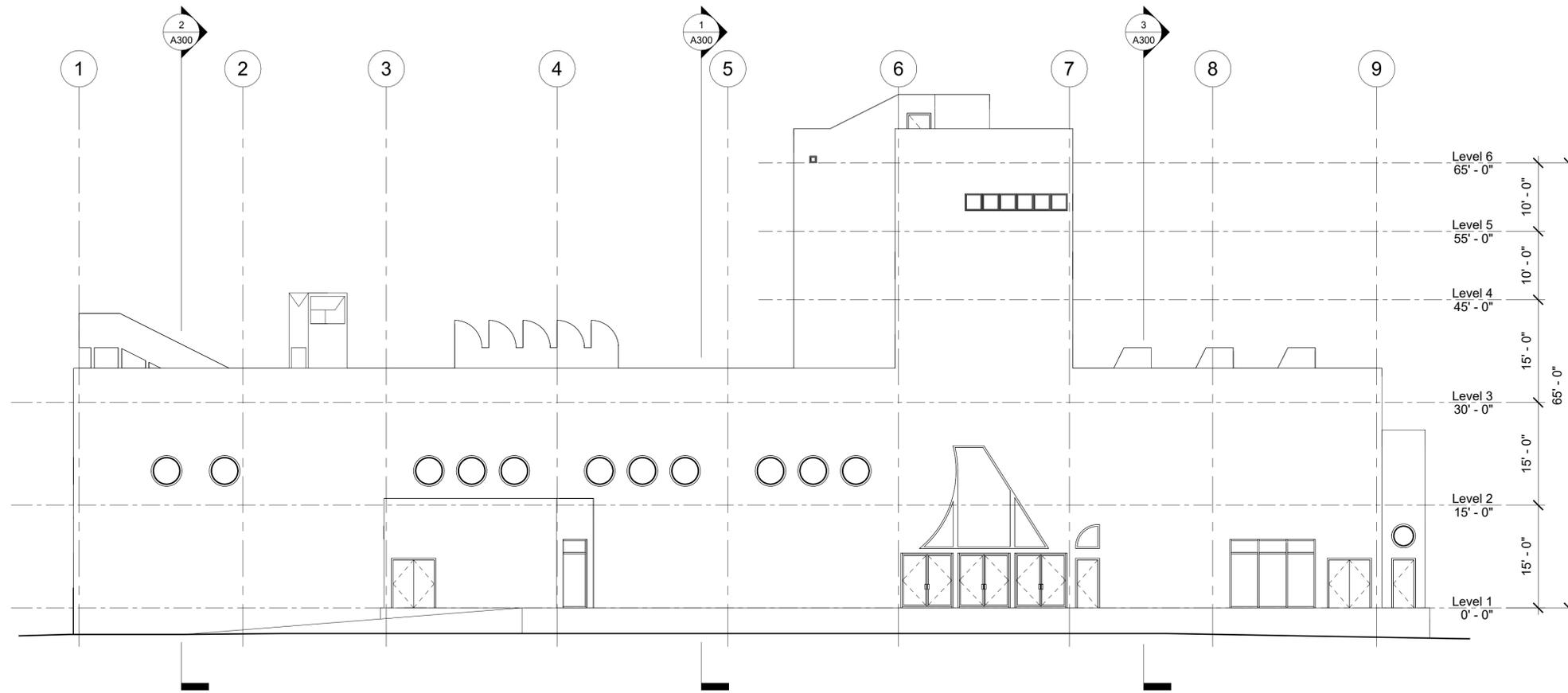
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① EAST ELEVATION
3/32" = 1'-0"

Stamp

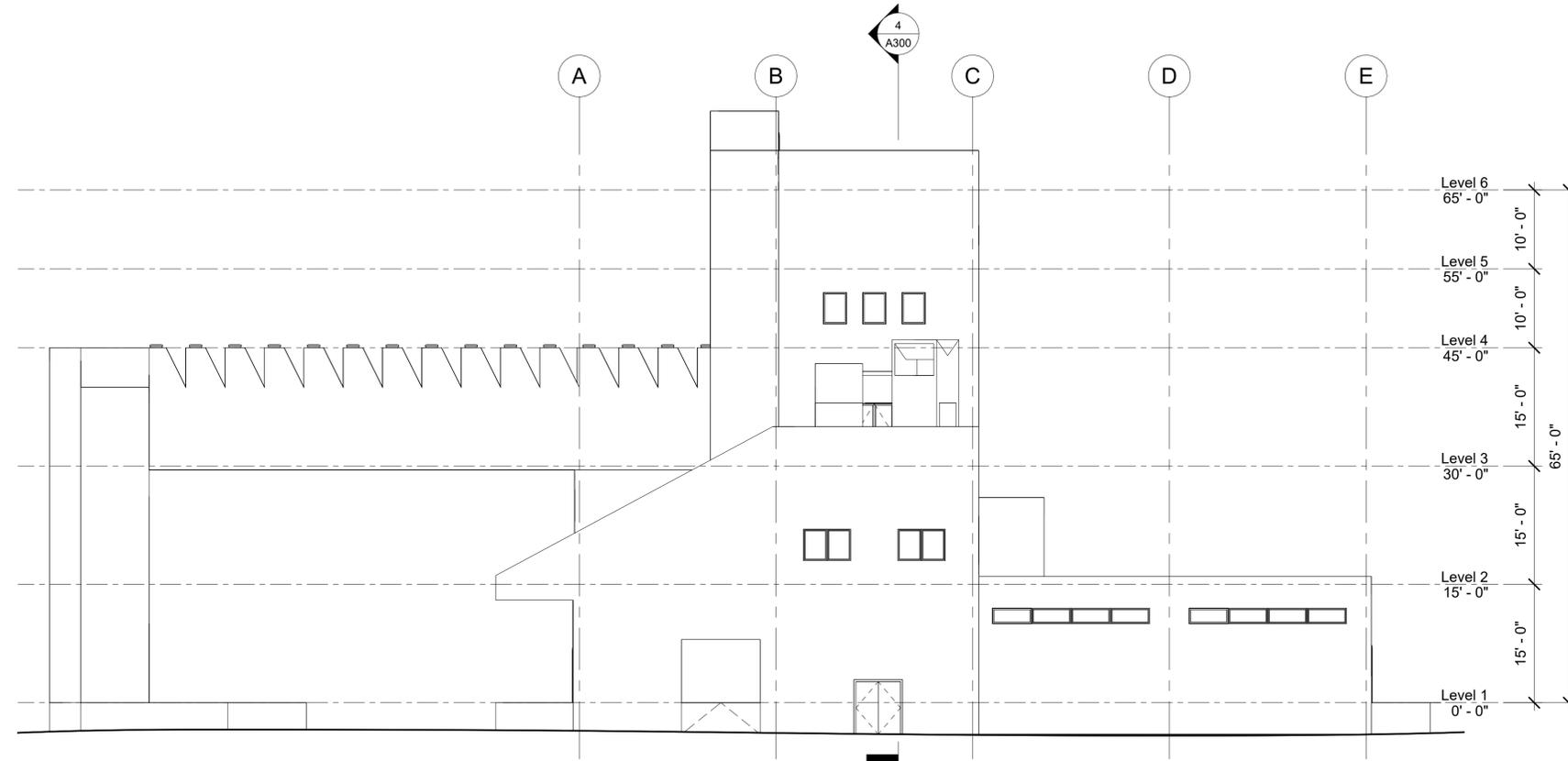
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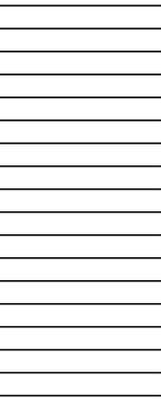
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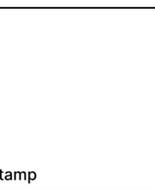
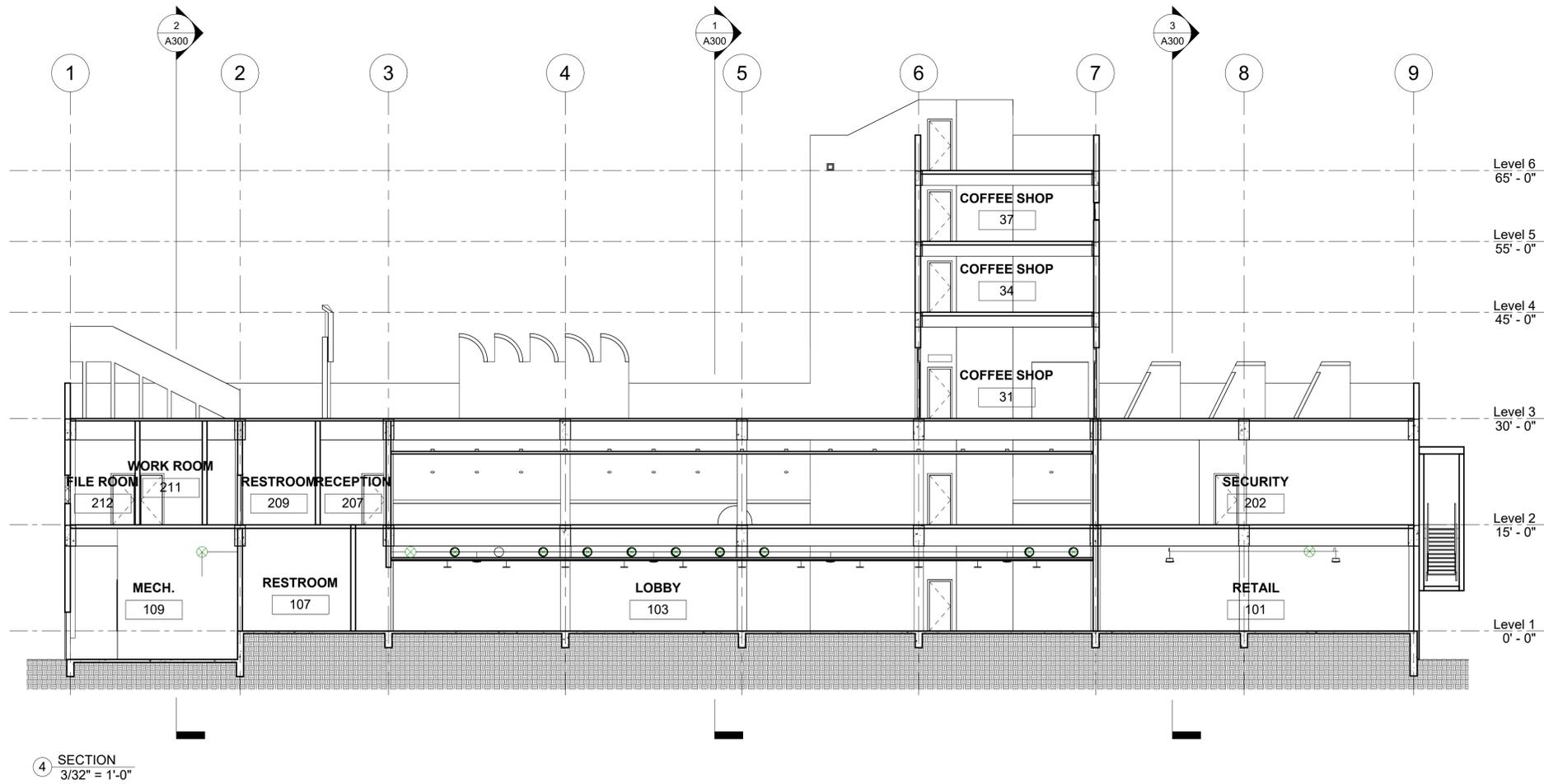
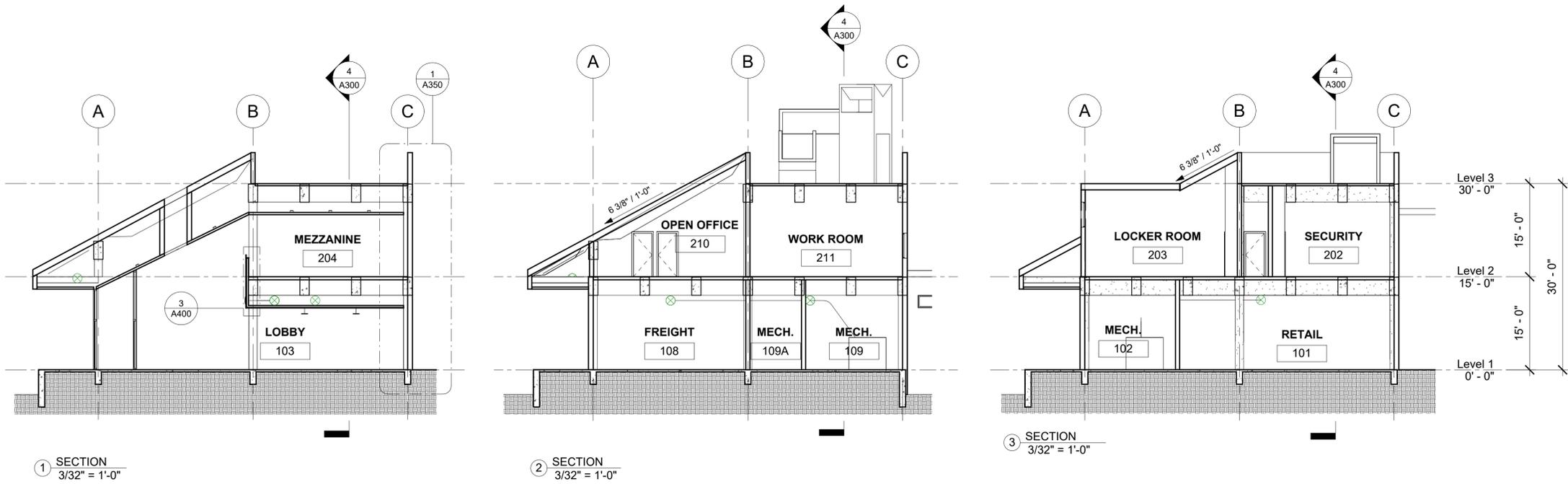


① SOUTH ELEVATION
3/32" = 1'-0"

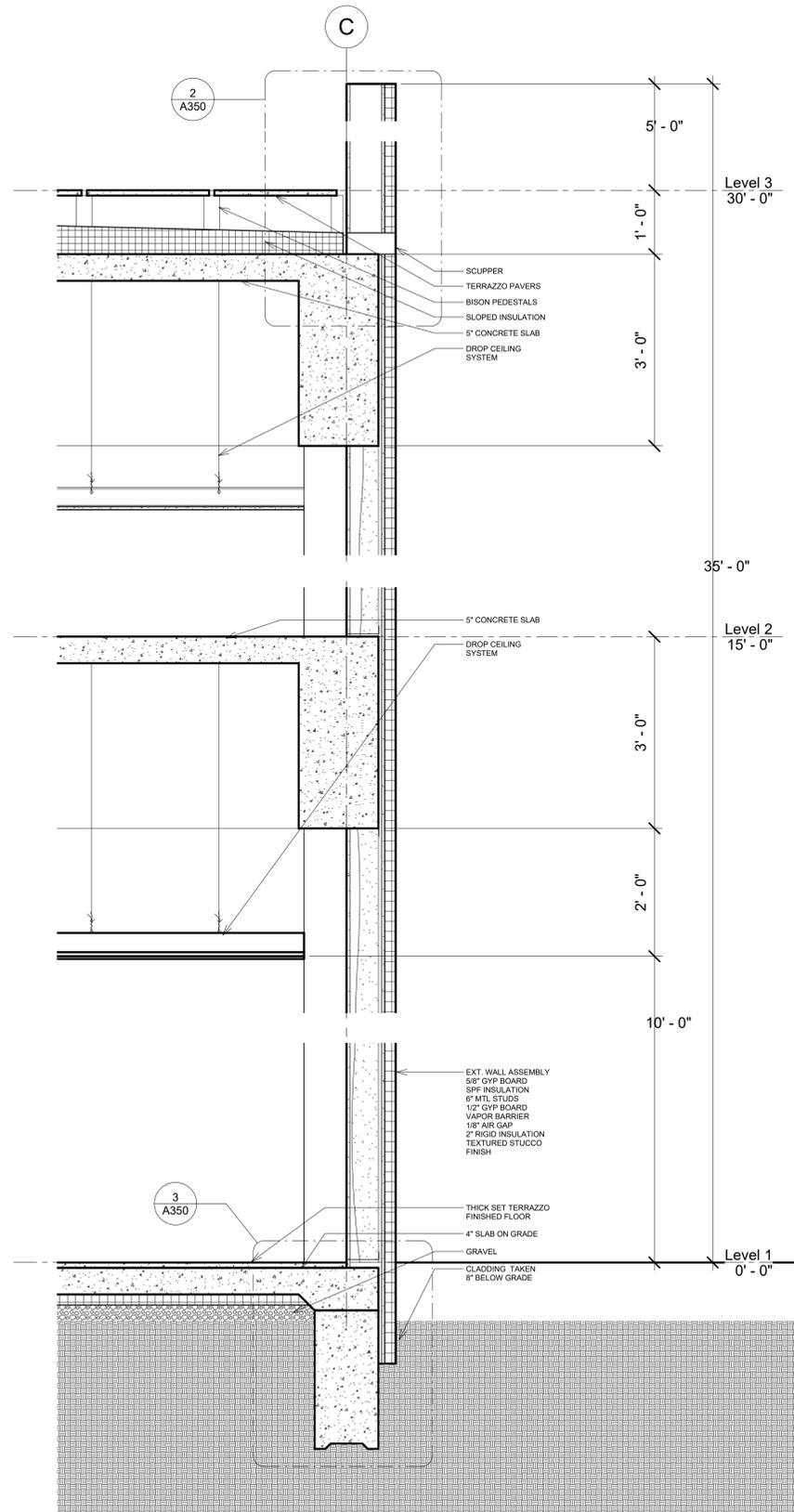


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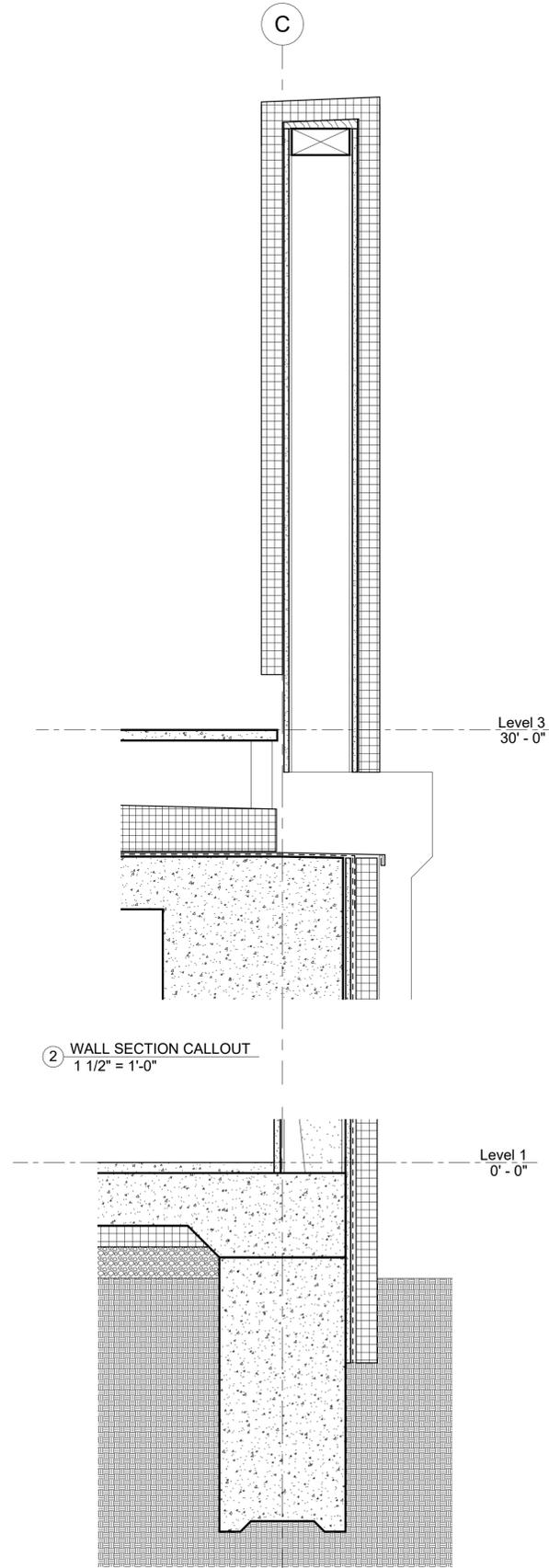




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1 WALL SECTION
3/4" = 1'-0"



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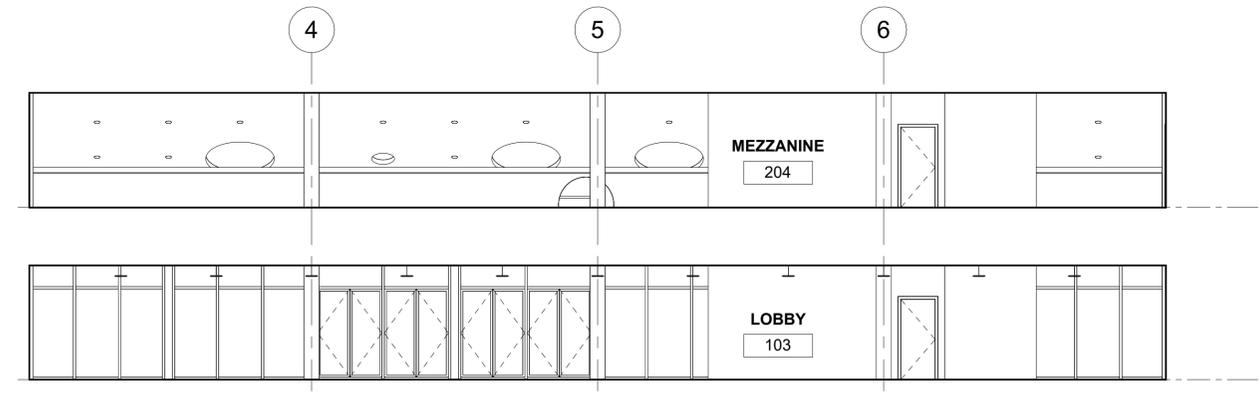
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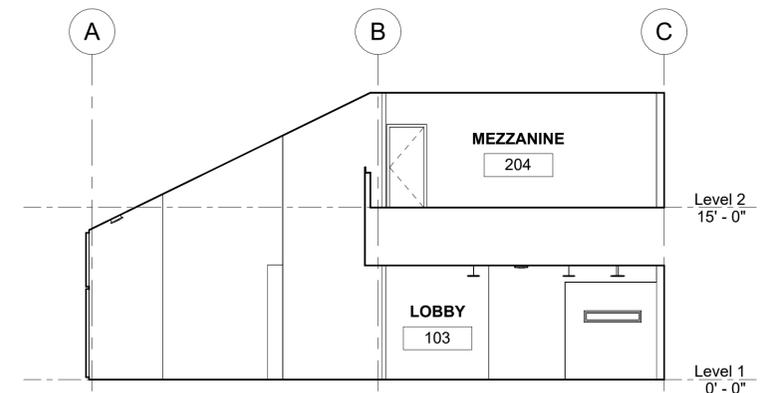
EMMTH
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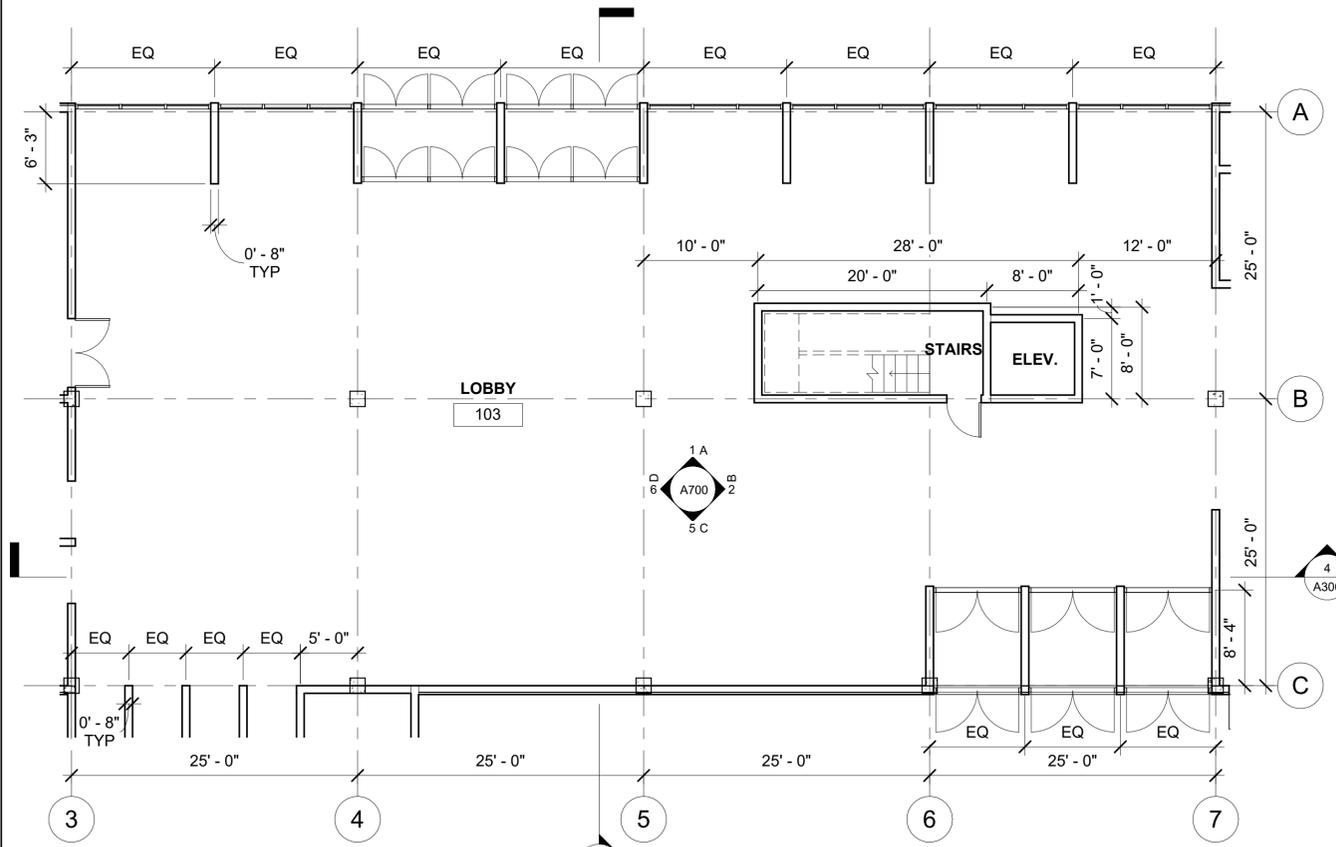
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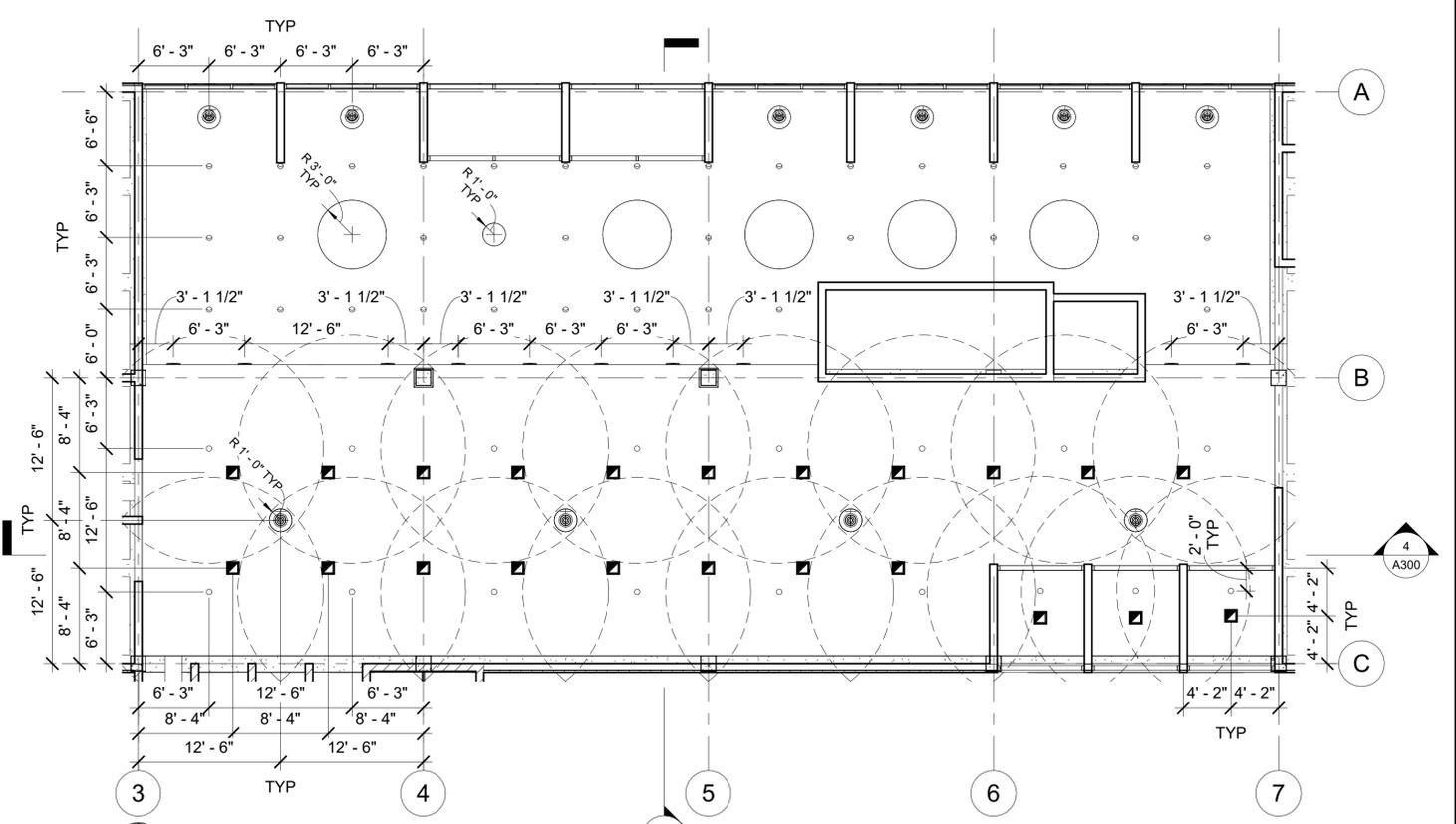
1 INTERIOR ELEVATION
1/8" = 1'-0"



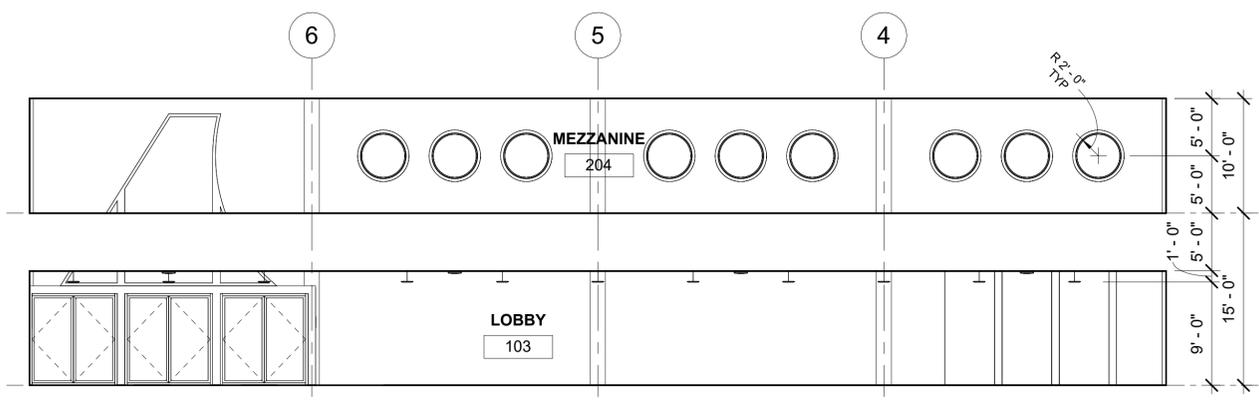
2 INTERIOR ELEVATION
1/8" = 1'-0"



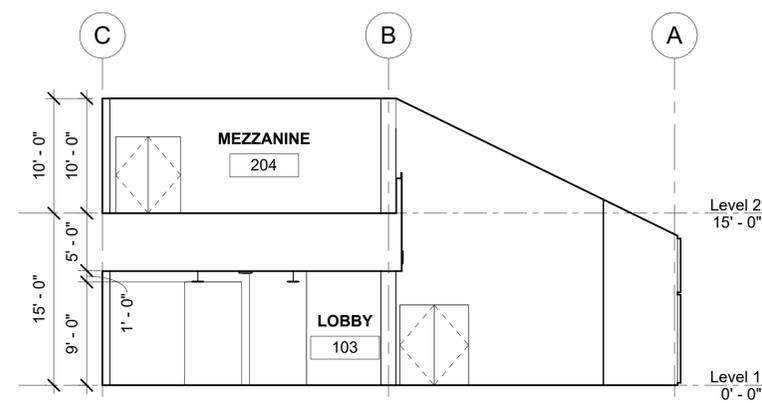
3 ENLARGED PLAN
1/8" = 1'-0"



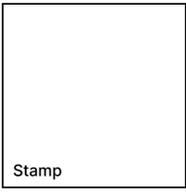
4 REFLECTED CEILING PLAN
1/8" = 1'-0"



5 INTERIOR ELEVATION
1/8" = 1'-0"



6 INTERIOR ELEVATION
1/8" = 1'-0"



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