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DOWN TO EARTH

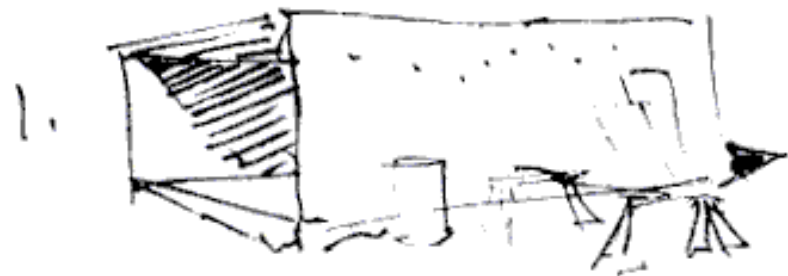
Underground architecture does not mean this:



Not does it mean this:



It means simply this: 2



BUILD A STRONG,
WATERPROOF
BUILDING.
INSULATE IT.
COVER IT WITH
EARTH.



AND PLANT IT WITH
NATIVE
PLANTS.

18.

Theoretical Premise

- Abstract
 - “Can subterranean architecture create a more sustainable design?”
 - Relationship between built structures and nature
 - Symbiotic Relationship



- Narrative
 - Typical built structures take and don't give
 - Subterranean structures replace earth with a building and places that earth on top and around the structure
 - "But now another type of building is emerging: one that actually heals the scars of its own construction. It conserves rainwater—and fuel—and it provides a habitat for creatures other than the human one. Maybe it will catch on, maybe it won't. We'll see."
- Malcolm Wells



"Most people move through the world in two dimensions. They have no idea what's beneath + them. When you see what's underground, you understand how the city works. But it's more than that. You see your place within history, how you fit in the world." (Hunt, 2020)



Historic Research

- Emergence Myths
- Red Ochre
- Dark Zone
- Lighting
- Ventilation

Basic Elements of a Radon-Resistant Home:

A. Gas Permeable Layer

Layer is placed beneath the slab or flooring system to allow the soil gas to move freely underneath the house. The material used is a four-inch layer of clean gravel.

B. Plastic Sheetting

Placed on top of the gas permeable layer and under the slab to help prevent the soil gas from entering the home. In crawlspaces, the sheetting is placed over the rawspace floor.

C. Sealing & Caulking

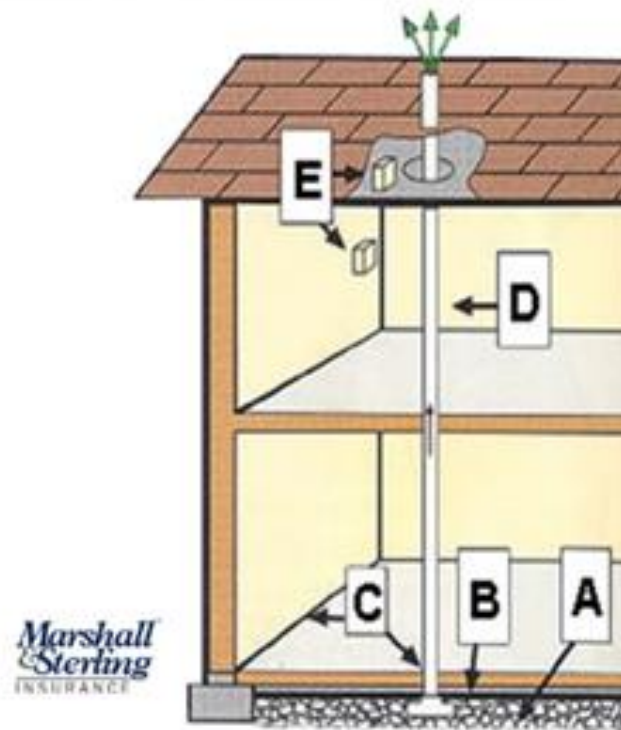
Openings in the concrete foundation are sealed to reduce soil gas entry into the home.

D. Vent Pipe

Three- or four-inch gas-tight or PVC pipe runs from the gas permeable layer through the house to the roof to safely vent radon and other soil gases above the house.

E. Junction Box

Electrical junction box is installed in case an electric venting fan is needed later on.



Mixed Research

- Radon
 - Second most cause of lung cancer
 - Tested radon at home
- Psychology
 - Noise reduction
 - Important for Senses
- Ground Source Heat Pumps
 - According to the EPA, GHPs “are 48 percent more efficient than the best gas furnace and 75 percent more efficient than the best oil furnace. They require 25 to 50 percent less energy than other HVAC systems and bring down operation and maintenance costs by as much as 40 percent.”

Type	System Cost	Operating Cost per year	Repair Cost	Zoning	Longevity	Efficiency Rank
Geothermal Heat Pump	\$18,250	\$375-\$600	\$-\$\$\$\$	Yes: \$-\$	20-25 yrs	#1
Mini Split Heat Pump	\$8,400	\$515-\$1,065	\$-\$\$\$	Yes: \$\$\$-\$\$\$\$	17-22 yrs	#2
Standard Heat Pump	\$7,100	\$750-\$1,200	\$-\$\$\$	Yes: \$-\$	15-20 yrs	#3
Split AC & Furnace	\$6,700	\$900-\$1,440	\$-\$\$\$	Yes: \$-\$	15-20 yrs	#4
Boiler & AC	\$9,750	\$1,150-\$1,500	\$-\$\$\$	Yes: \$\$-\$\$\$	20-30 yrs	#5
Electric Furnace & AC	\$6,100	\$1,225-\$1,750	\$-\$\$\$	Yes: \$-\$	15-25 yrs	#6

Notes:

- System Cost includes the cost of a system for an average 2,000 square foot home in a moderate climate.
- Operating Costs is an average if the unit is the main source of heating and/or air conditioning. The efficiency of the unit significantly affects operating cost.



Experimental Research

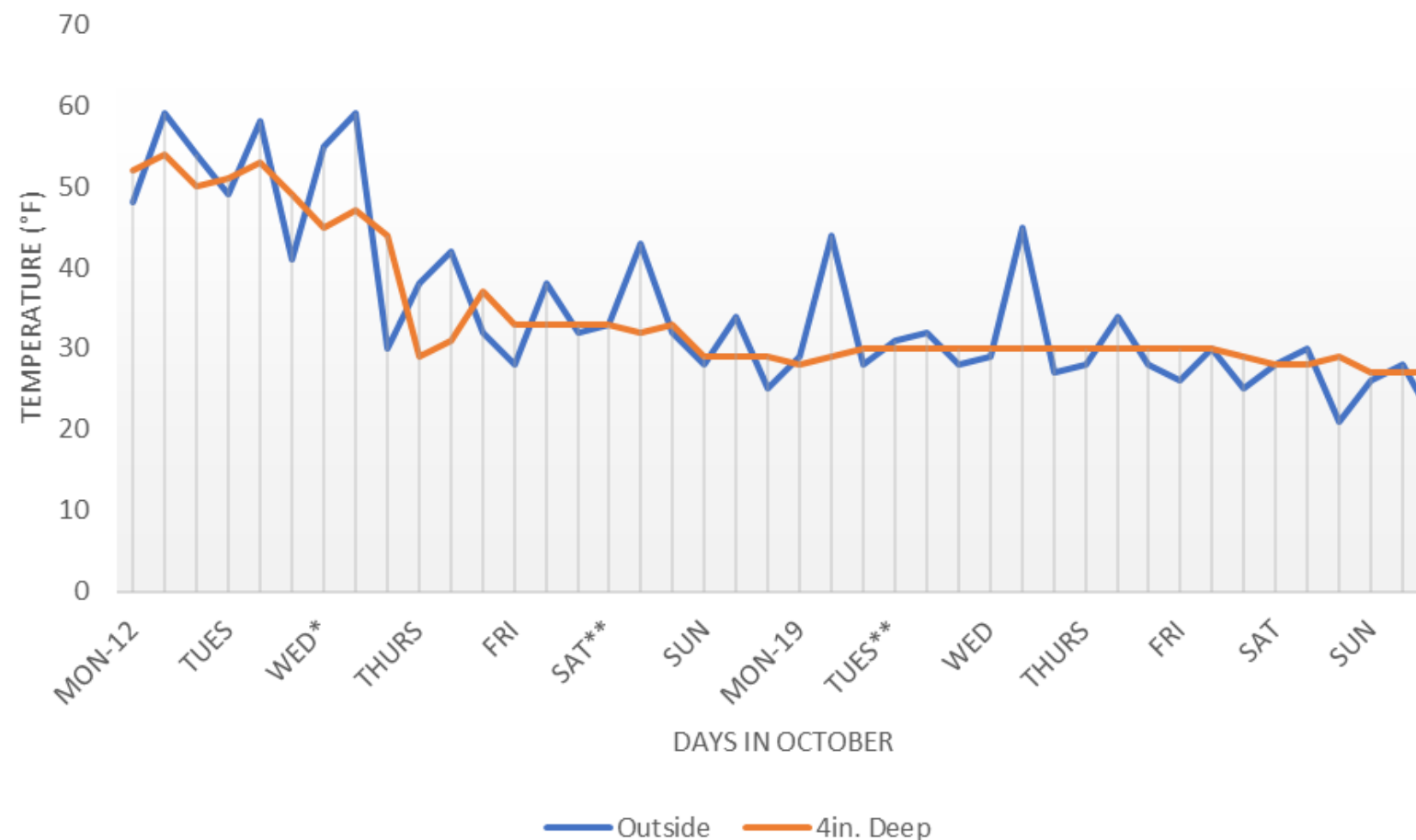
- “How well does earth provide natural protection from the climate with only 4 inches of soil?”

- 4 in deep green roof

- Results




- Earth gives stability in temperature at 4 inches
- Protects from other aspects of the climate

Temperature Data Collection



PROGRAM

Space Matrix	Residential Units	Circulation	Gym/Mail/Lobby	Parking (Multi-Level)	Mechanical Space	Garbage Rooms	Administration Space	Flexible Space	Food Service
Residential Units	Essential	Essential	Desirable	Not Needed	Not Needed	Desirable	Not Needed	Not Needed	Not Needed
Circulation	Essential	Essential	Essential	Not Needed	Essential	Essential	Not Needed	Essential	Not Needed
Gym/Mail/Lobby	Desirable	Essential	Essential	Essential	Not Needed	Not Needed	Essential	Not Needed	Not Needed
Parking (Multi-Level)	Not Needed	Not Needed	Essential	Essential	Desirable	Essential	Not Needed	Not Needed	Essential
Mechanical Space	Not Needed	Essential	Not Needed	Desirable	Essential	Desirable	Not Needed	Not Needed	Essential
Garbage Rooms	Desirable	Essential	Not Needed	Essential	Desirable	Essential	Not Needed	Not Needed	Not Needed
Administration Space	Not Needed	Not Needed	Essential	Not Needed	Not Needed	Not Needed	Essential	Desirable	Essential
Flexible Space	Not Needed	Essential	Not Needed	Not Needed	Not Needed	Not Needed	Desirable	Essential	Not Needed
Food Service	Not Needed	Not Needed	Not Needed	Essential	Essential	Not Needed	Essential	Not Needed	Essential

Essential 
 Desirable 
 Not Needed 

Space Interaction Net



DESIGN PROCESS



Hannah Arendt Underground School in Bolzano, Italy



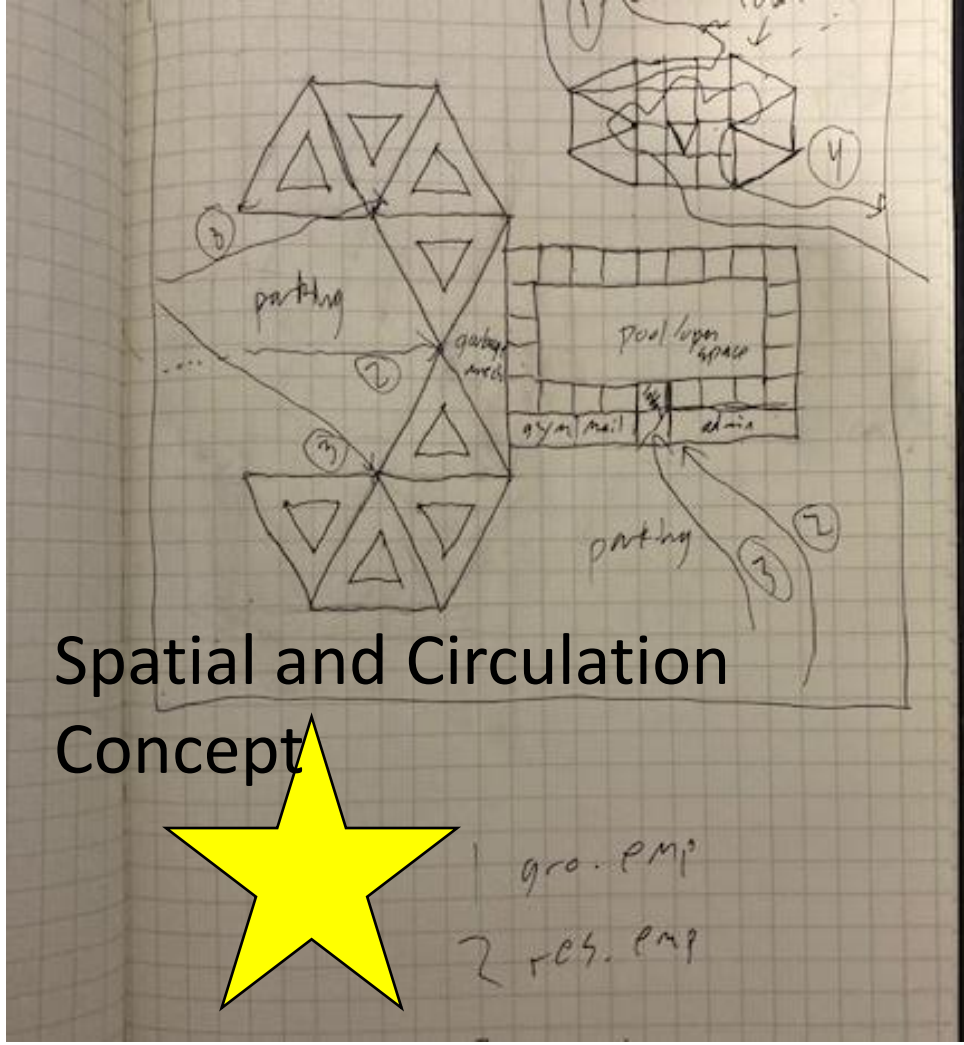
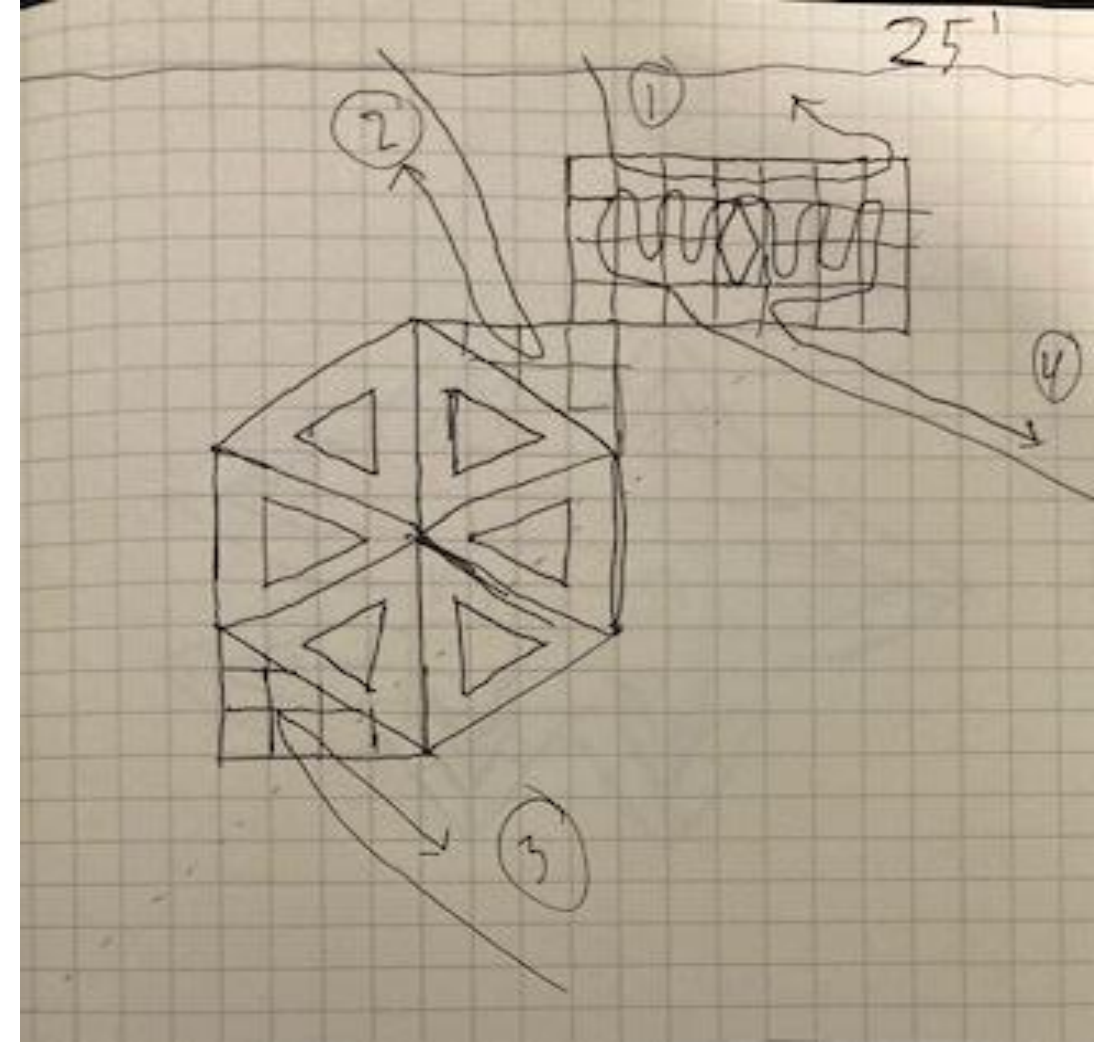
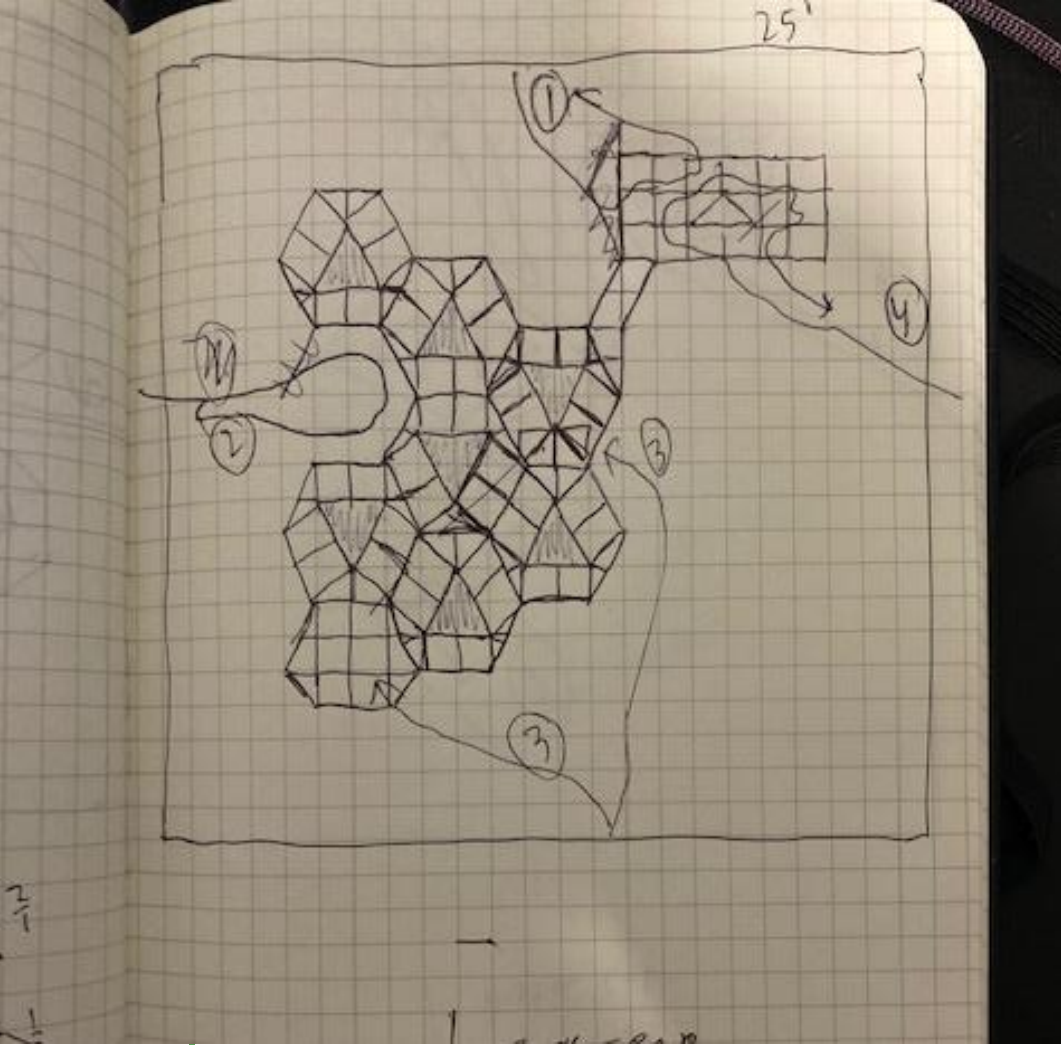
Stadel Museum in Frankfurt, Germany



Case Studies

Villa Vals in Vals, Switzerland

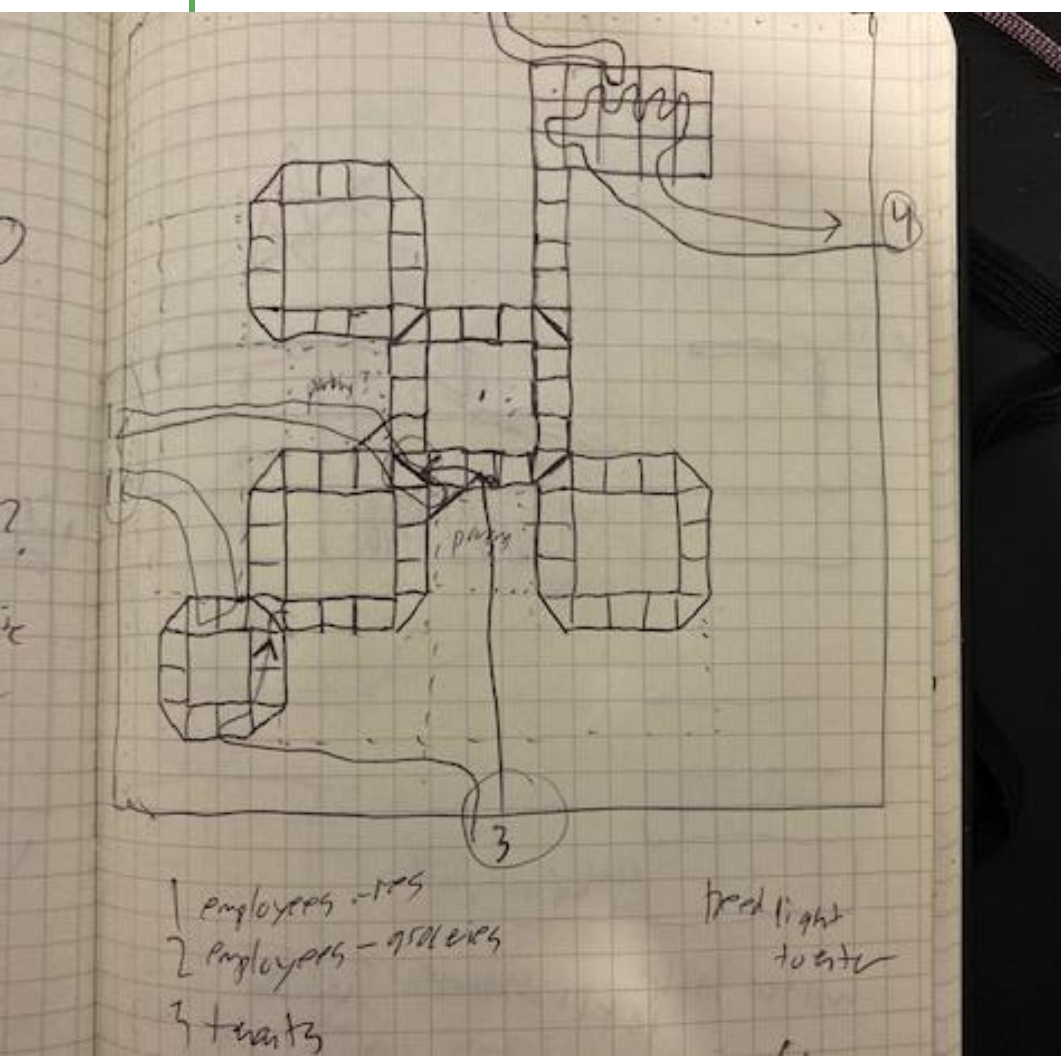




Spatial and Circulation Concept

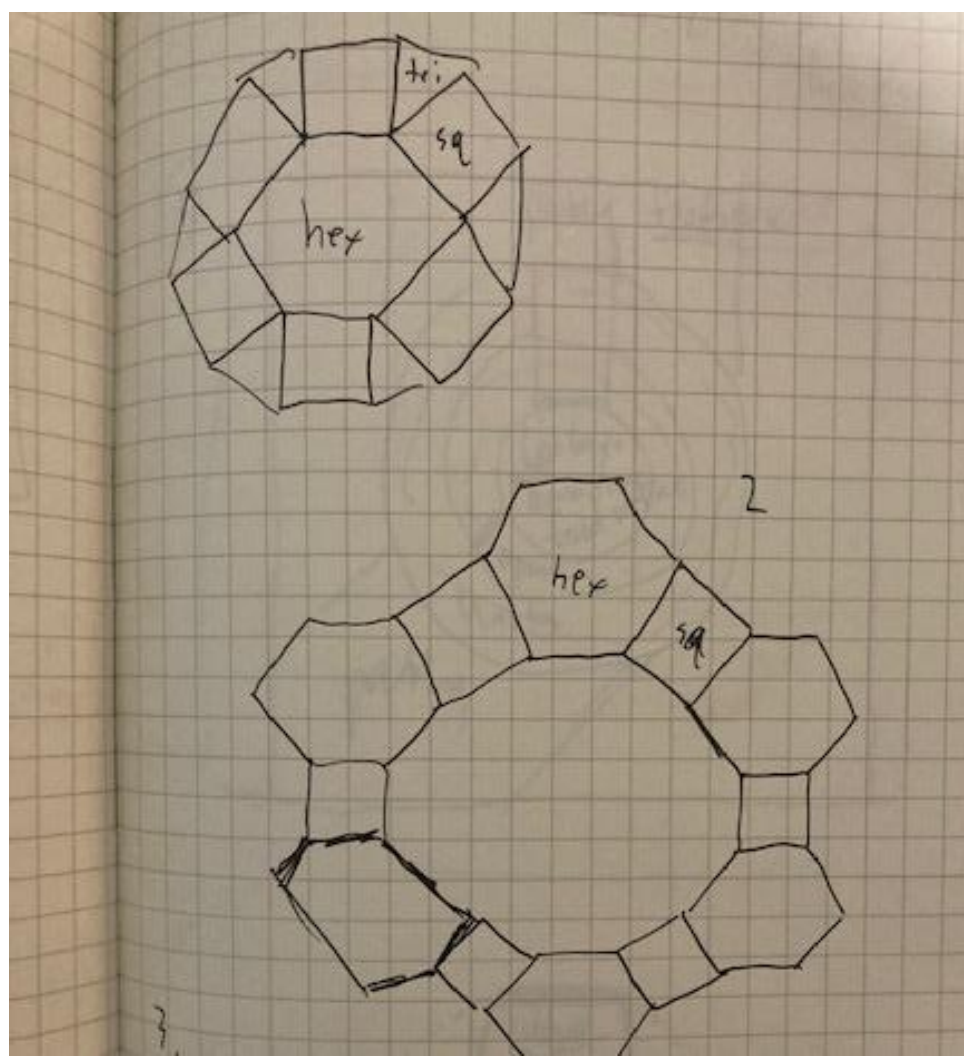


1 gro. emp
2 res. emp



Ordering System:
Courtyards = Datum,
Symmetrical

Proportioning System:
The deeper the building, the wider the
courtyards to allow light and air to
enter.

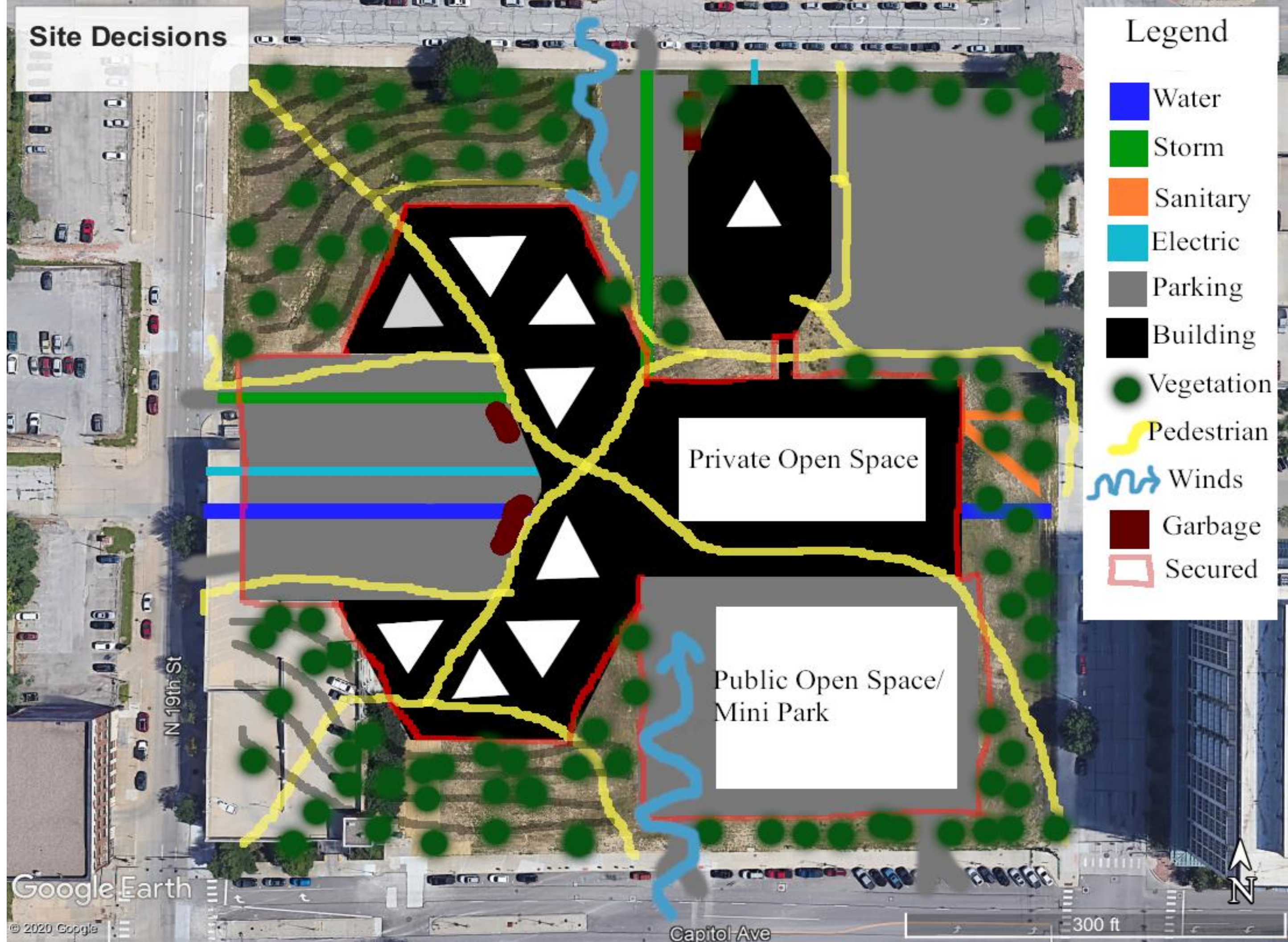


1 employees - res
2 employees - graders
3 tenants
fresh light to enter

Site Decisions

Legend

- Water
- Storm
- Sanitary
- Electric
- Parking
- Building
- Vegetation
- Pedestrian
- Winds
- Garbage
- Secured



Private Open Space

Public Open Space/
Mini Park

N 19th St

Capitol Ave

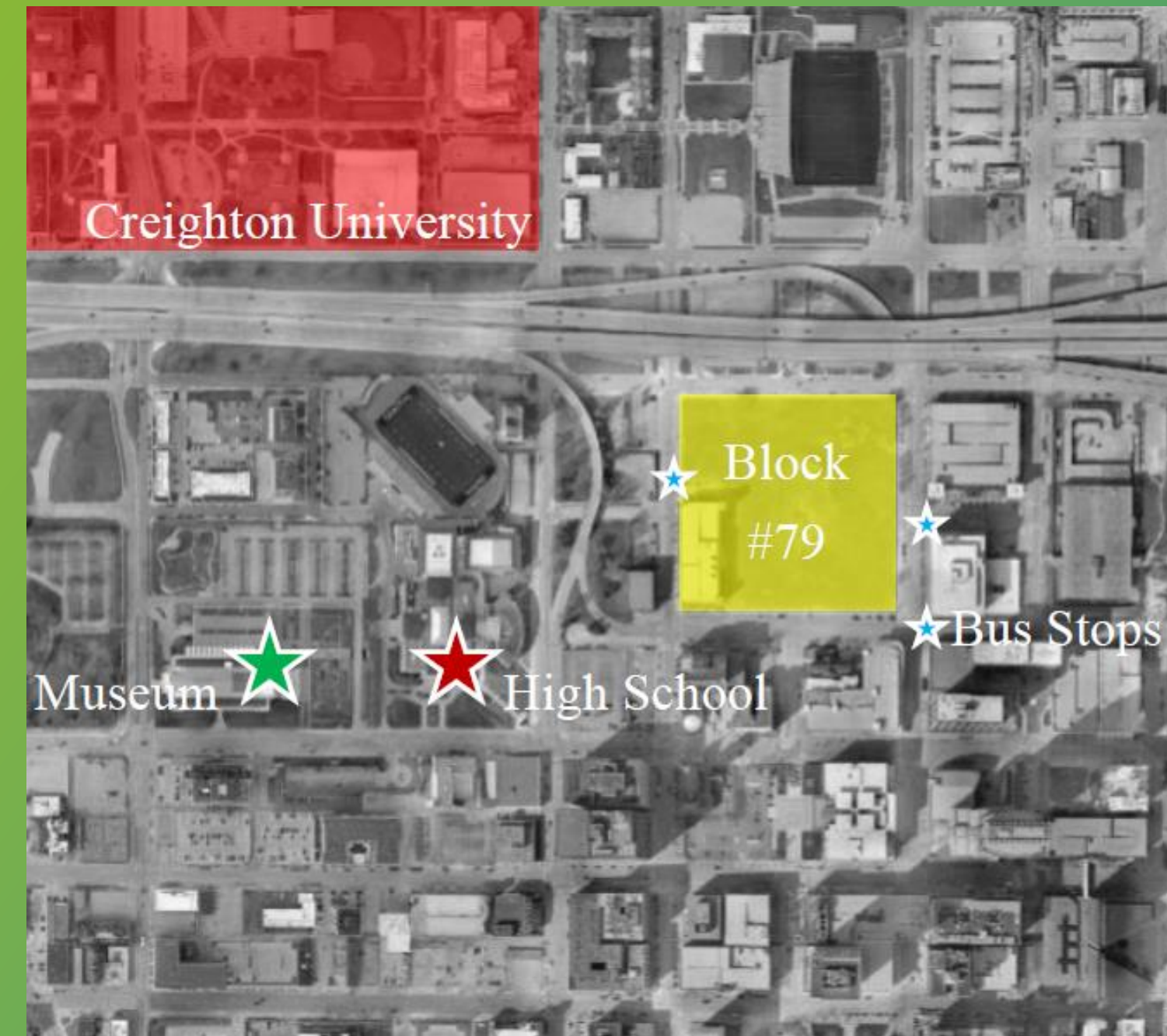
300 ft

Google Earth

© 2020 Google

Site Information

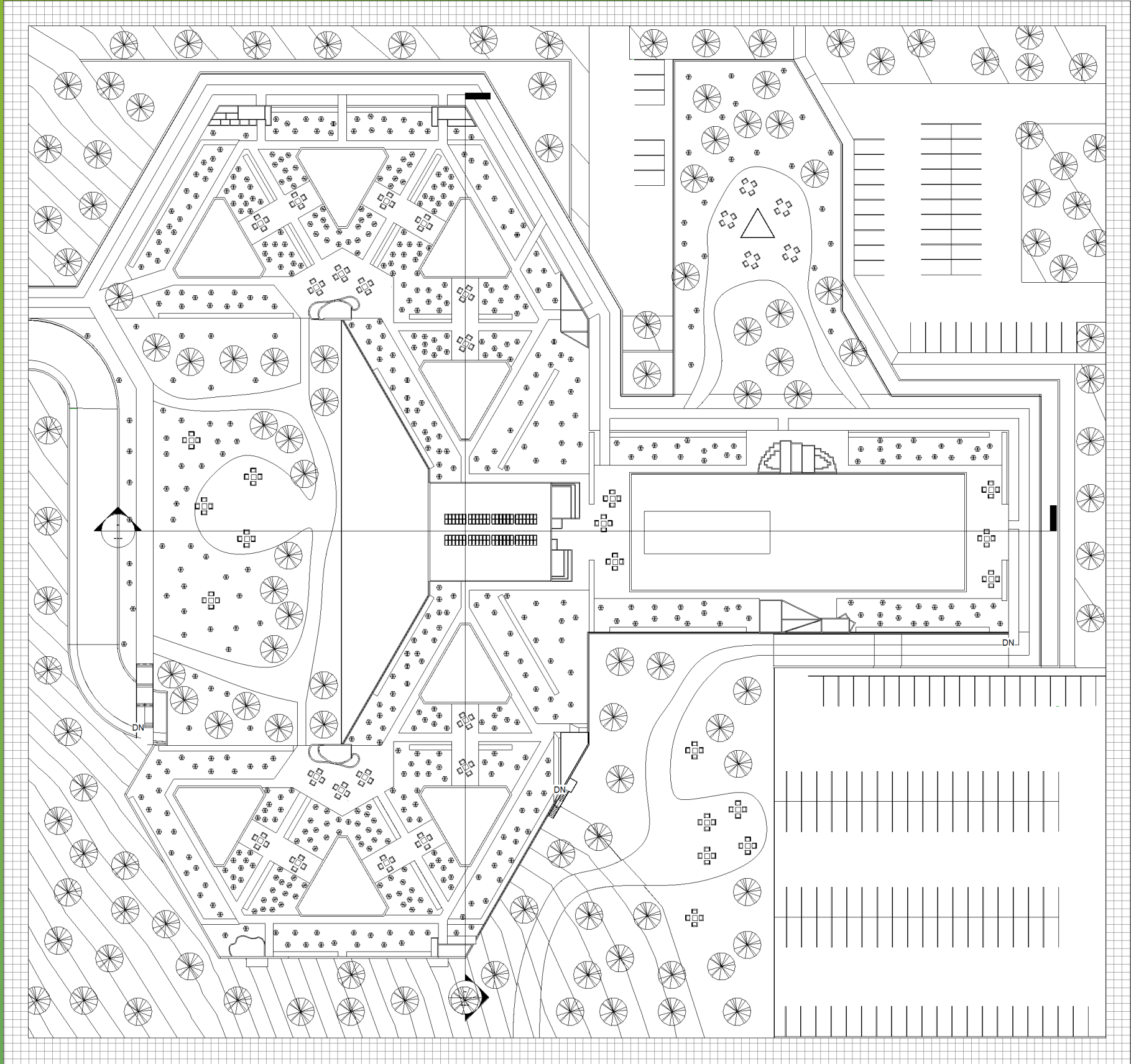
- Omaha, Nebraska, Block #79
- Personal Connection
- Omaha Metro System on site
- Outside flood zone
- Almost everything within walking distance
- College area



Site Information

- Infill
- Small amount of vegetation
- Parking garage on site
- Slope of Grade: 1% to 4%
- Southwest end high point
- 0-12in: silty clay loam
- 12-80in+: silt loam
- Water table: 10ft or more

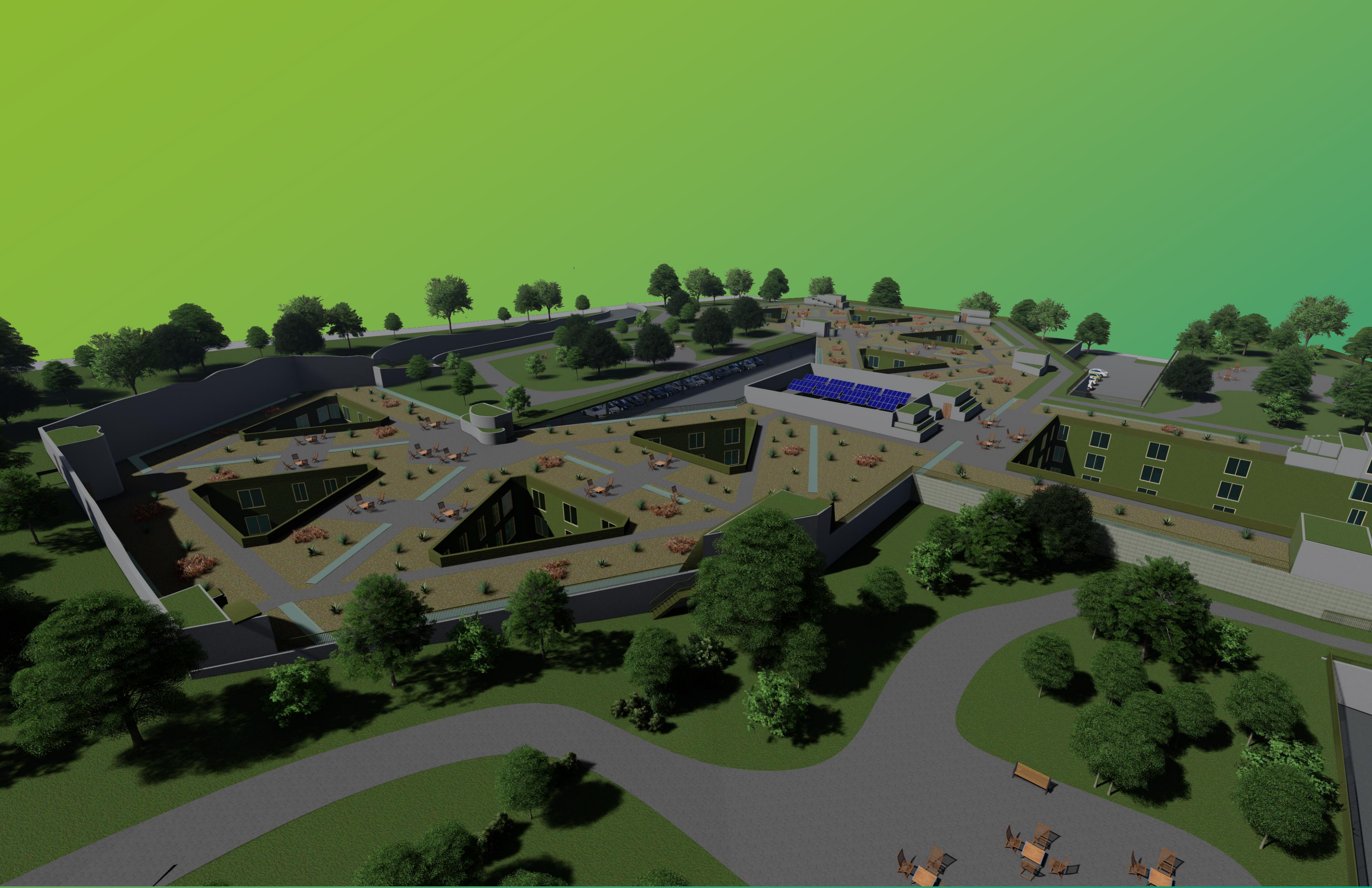




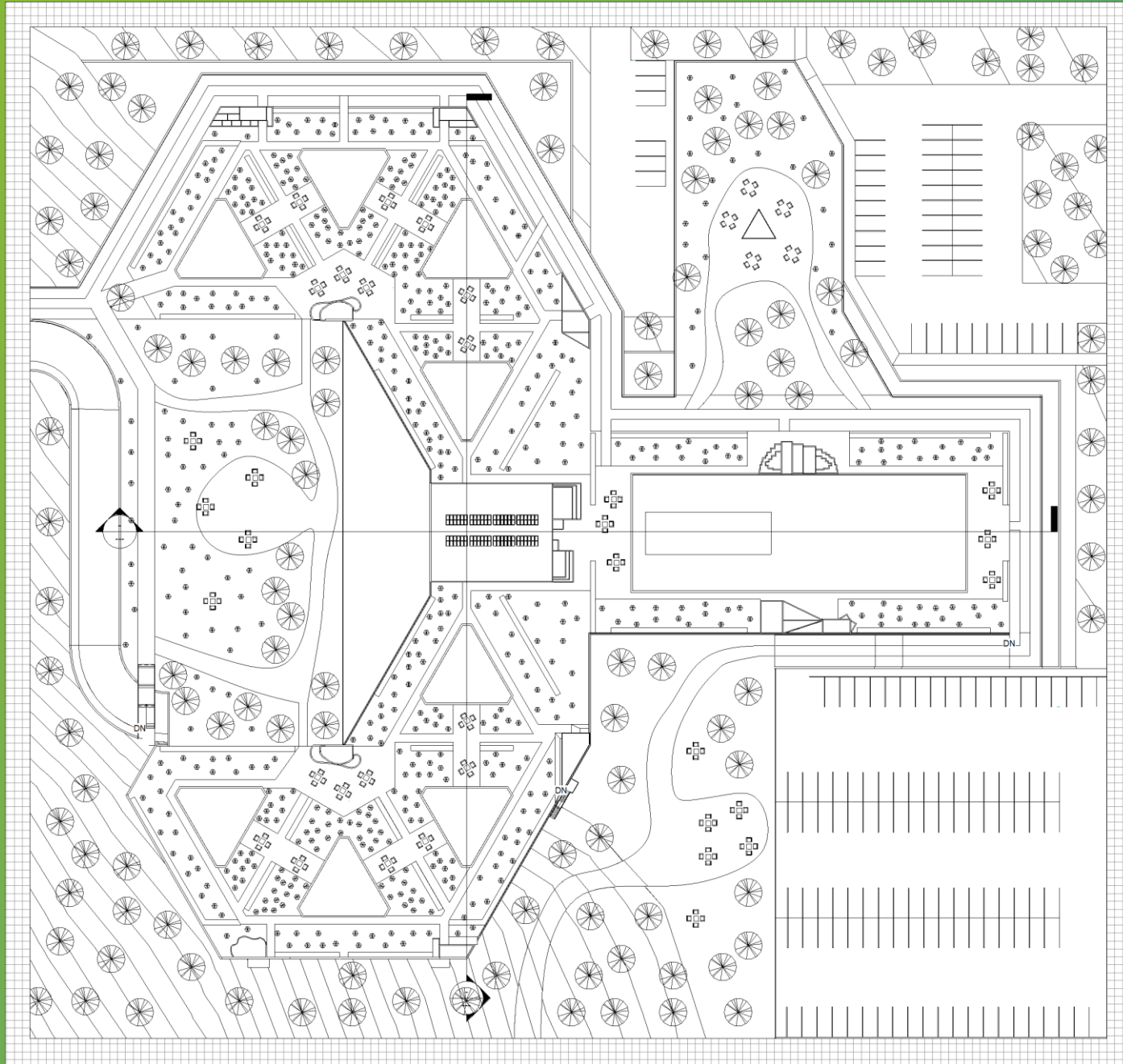
The Down To Earth Apartment Complex

Site/Roof Plan





Pros of Subterranean Architecture



- Earth is the most naturally made insulation that we can use
- Ground sourced heat pumps make the construction a more efficient investment
- Allows public spaces, parks, parking lots, and any building typology all within one site.
- Enhance nature and the built environment
- Reduces heat island effect
- Reduces noise penetration

Design Solutions to Cons of Subterranean Architecture



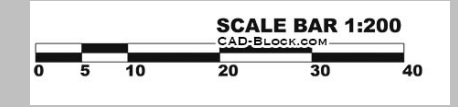
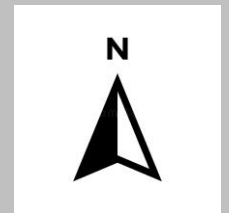
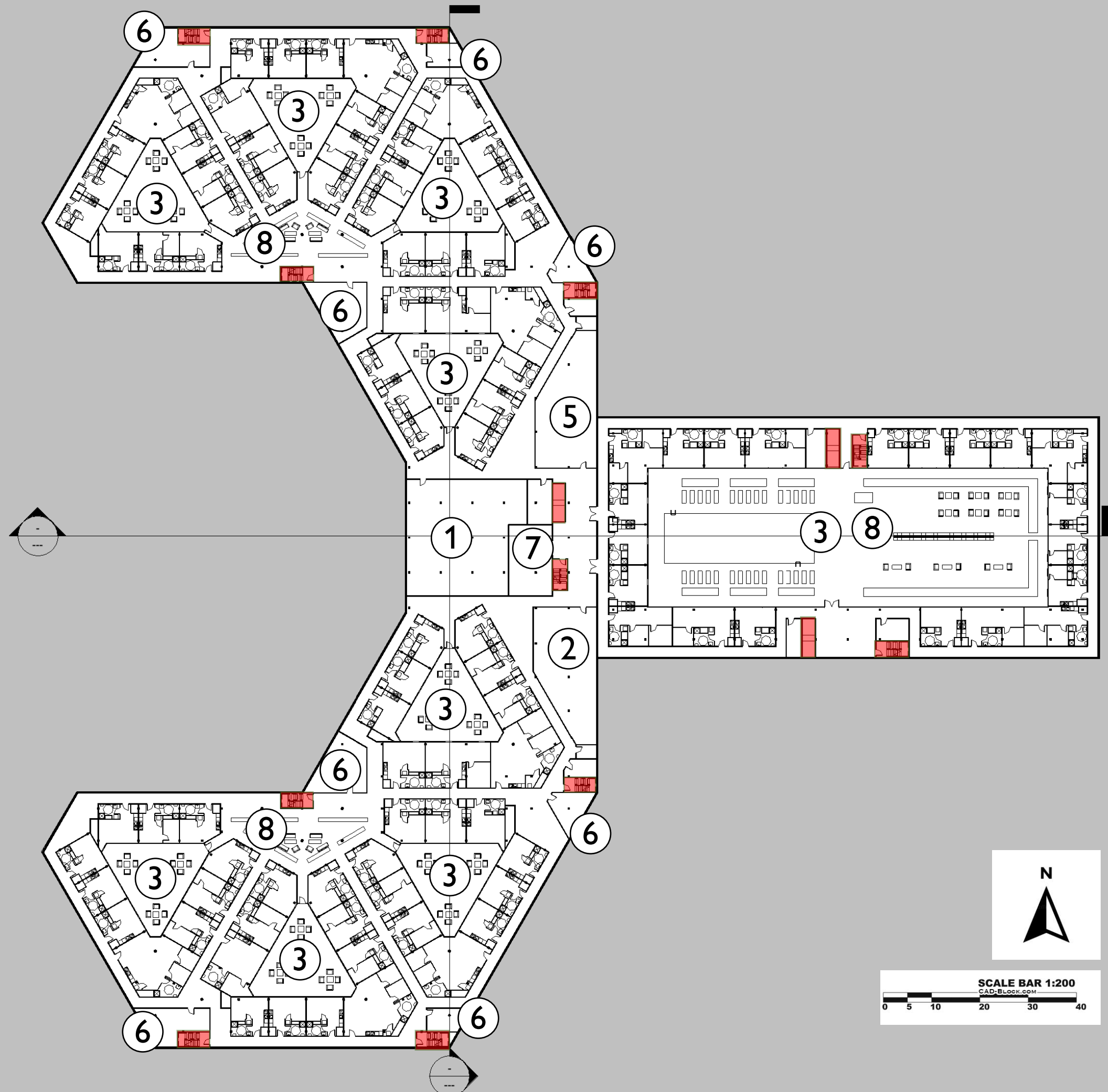
- Reduces natural light
 - Open courtyards to allow light to enter deeper floors
 - Skylights for circulation
- Water table depth
 - Limited depth of story based on local water table
 - Usage of concrete to be resistant to water and lateral force
 - Waterproof membranes surround entire building
 - Water pumps to be used for watering plants and other gray water uses
- Radon Buildup
 - Heated recovery ventilation
 - Gas Permeable Layers
 - Soil Suction Radon System



Exterior Perspective

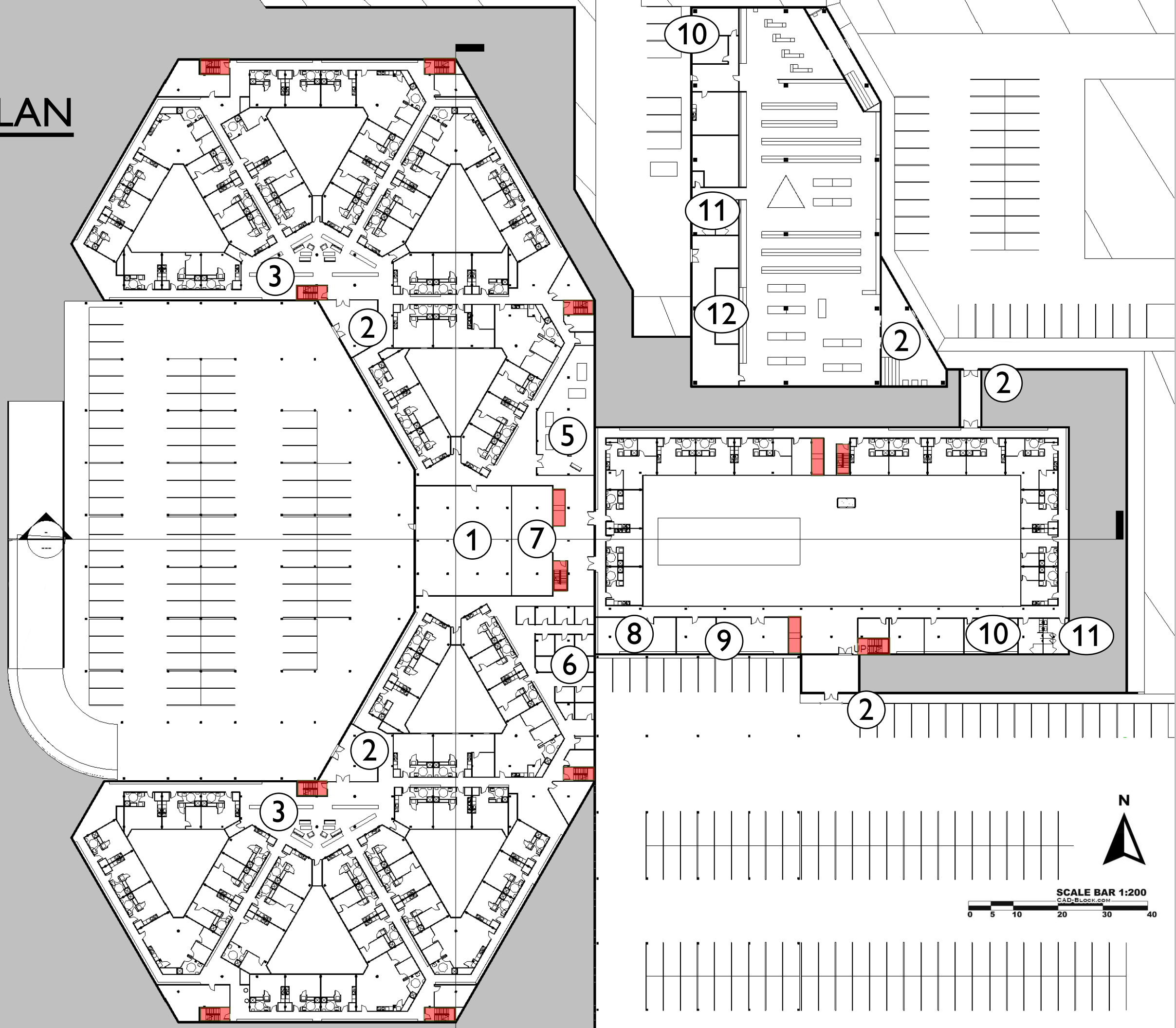
FIRST FLOOR PLAN

1. Mechanical Room
2. Pool Maintenance Room
3. Courtyards
4. Vertical Circulation
5. Storage Room
6. Rentable Space
7. Garbage Room
8. Community Spaces



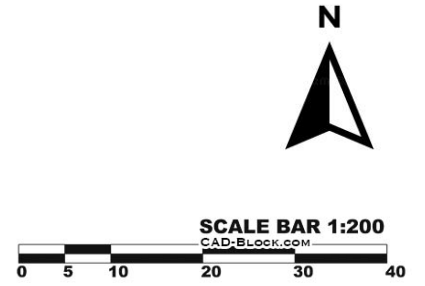
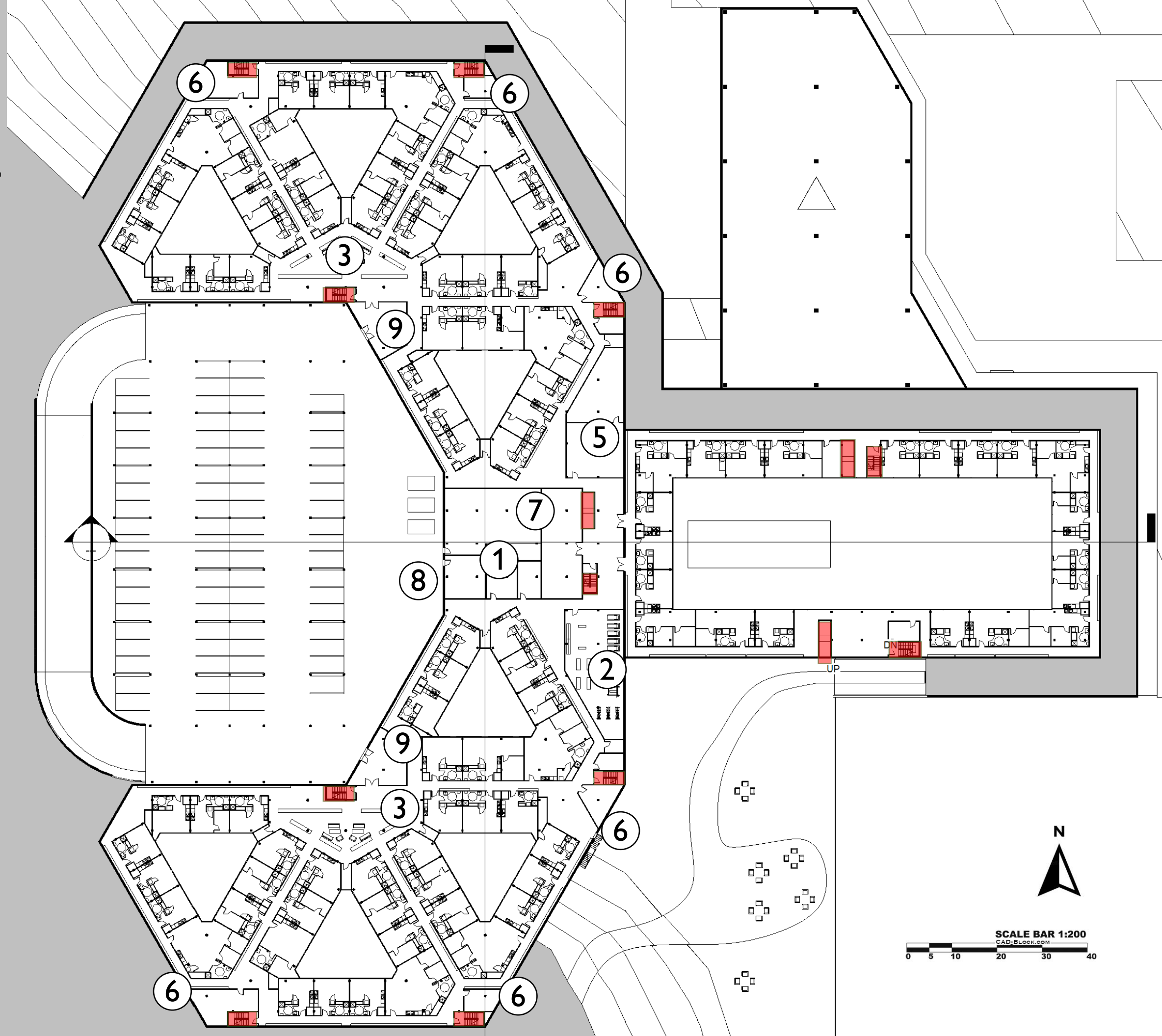
SECOND FLOOR PLAN

1. Mechanical Room
2. Main Entrances
3. Community Spaces
4. Vertical Circulation
5. Game Room
6. Rentable Storage Units
7. Garbage Room
8. Bike Room
9. Mail Room
10. Admin Offices
11. Public Restrooms
12. Unload/Prep Area



THIRD FLOOR PLAN

1. Mechanical Room
2. Gym
3. Community Spaces
4. Vertical Circulation
5. Handyman Workshop
6. Rentable Space
7. Garbage Room
8. Electrical Room
9. Main Entrances





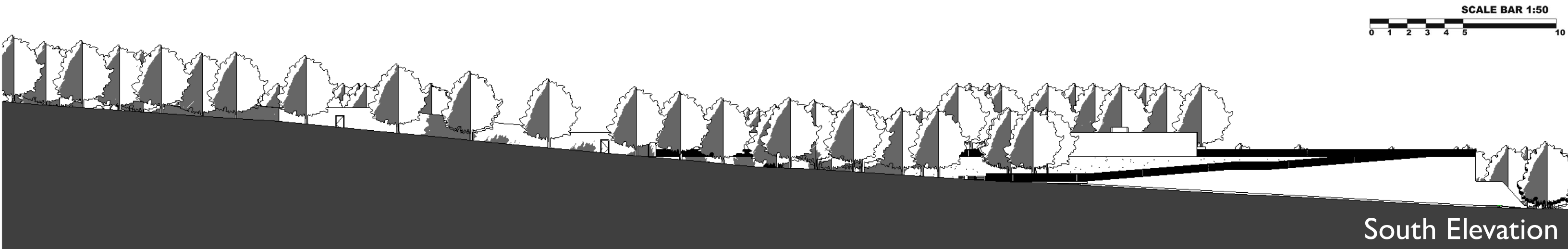
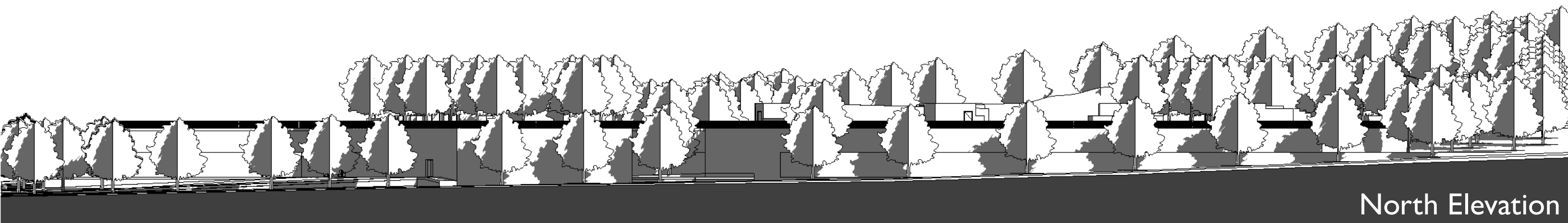
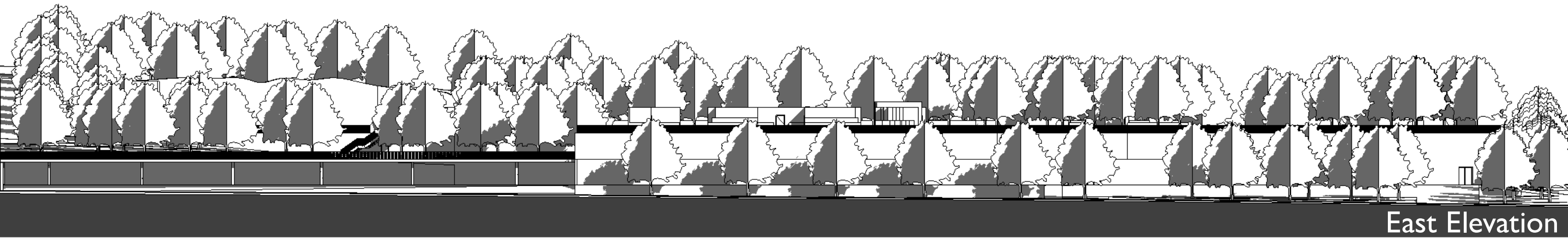
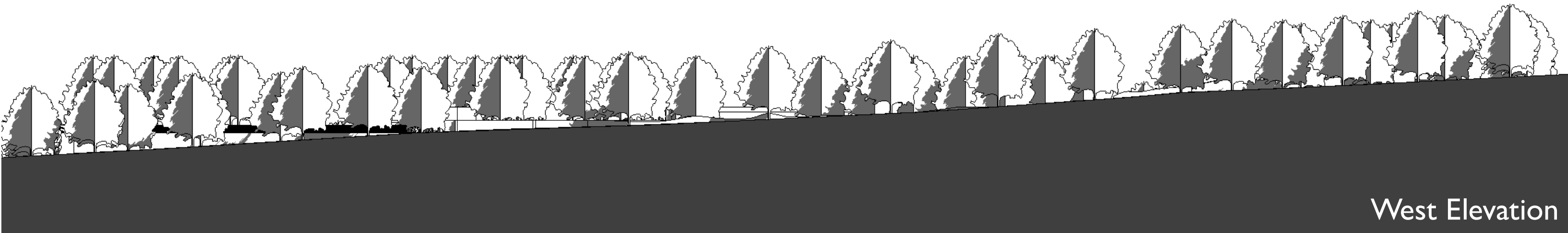
Interior Perspective



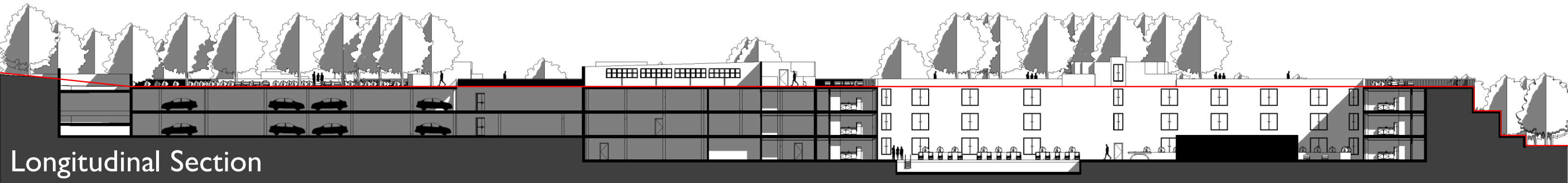
Exterior Perspective



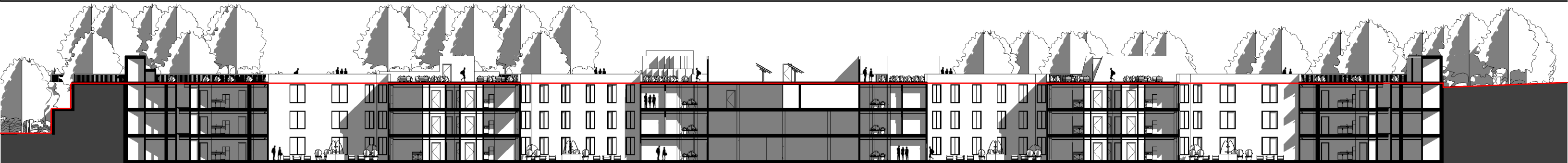
Exterior Perspective



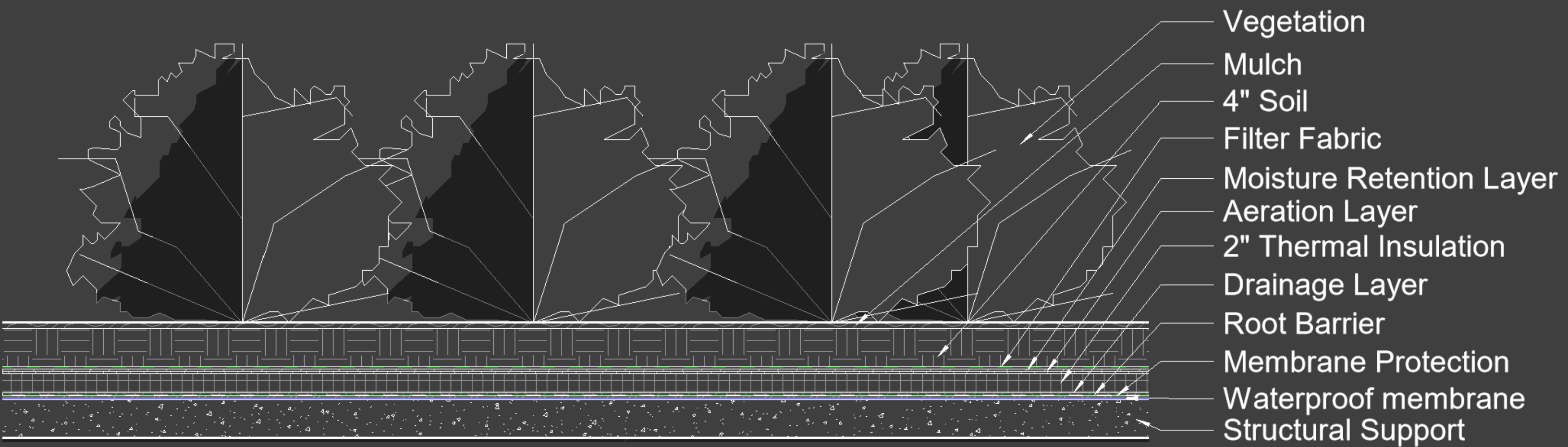
SCALE BAR 1:50
0 1 2 3 4 5 10



Longitudinal Section

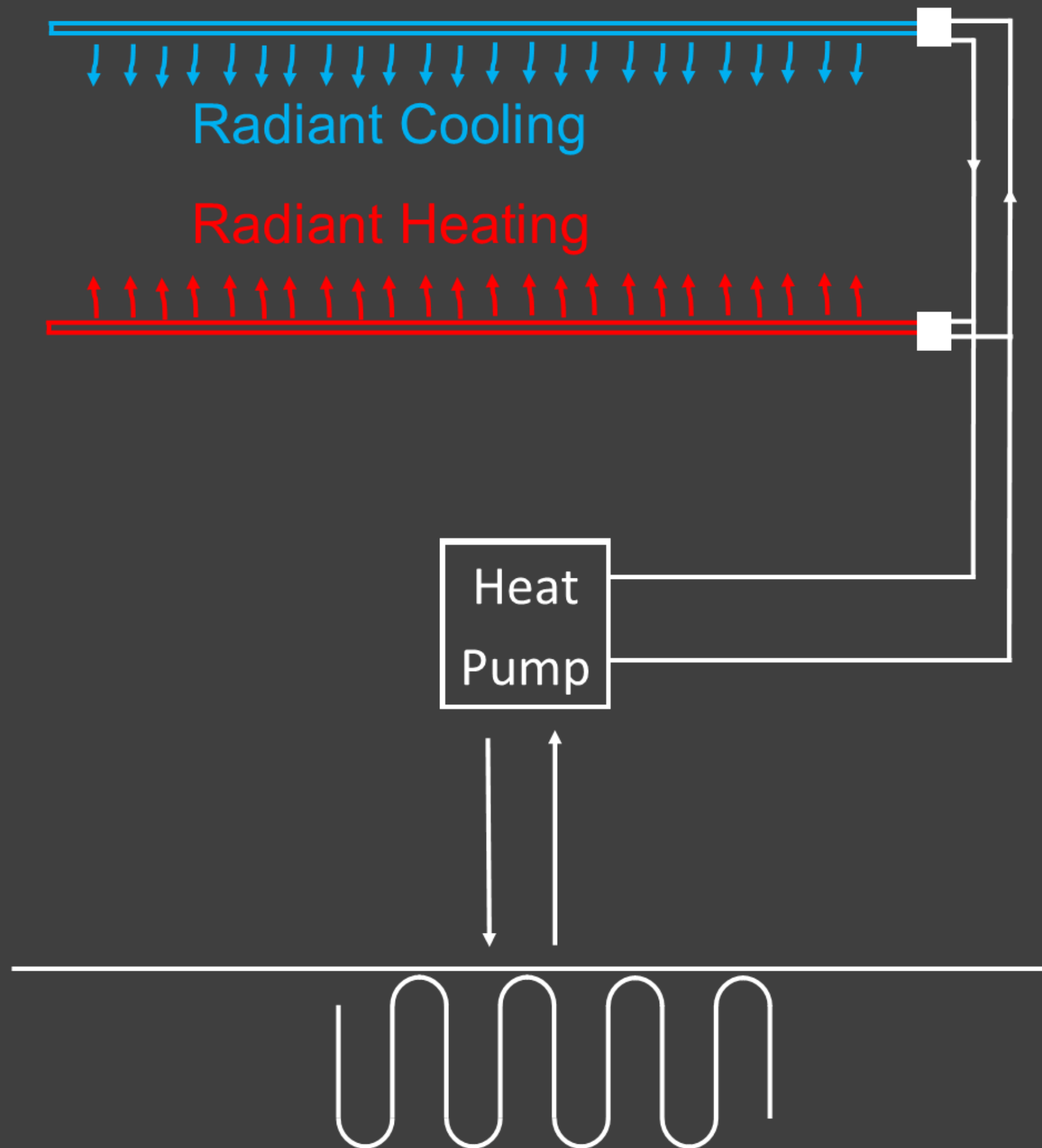


Latitudinal Section



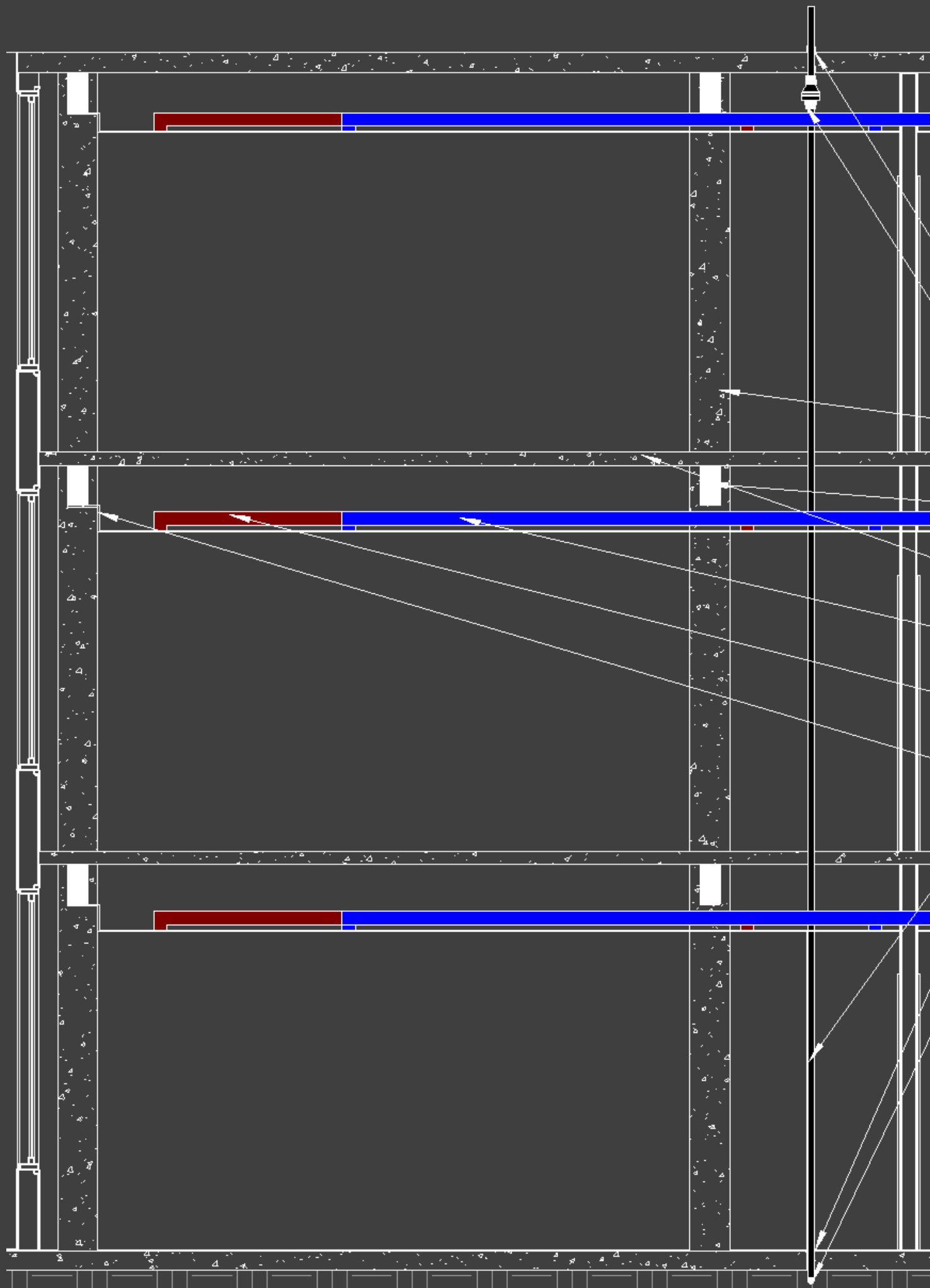
- Vegetation
- Mulch
- 4" Soil
- Filter Fabric
- Moisture Retention Layer
- Aeration Layer
- 2" Thermal Insulation
- Drainage Layer
- Root Barrier
- Membrane Protection
- Waterproof membrane
- Structural Support

Green Roof Detail



Ground Source Heat Exchanger

Heating/Cooling System



Roof Flashing

Fan Coupling to Pipe

12x12" Reinforced Concrete Column

6x12" Reinforced Concrete Beam

4" Reinforced Concrete Slab

4x6" Supply Ventilation Duct

4x6" Exhaust Ventilation Duct

Recessed Ceiling for Daylight Factor

2" Vent Pipe for Radon

Air Barrier Sealant

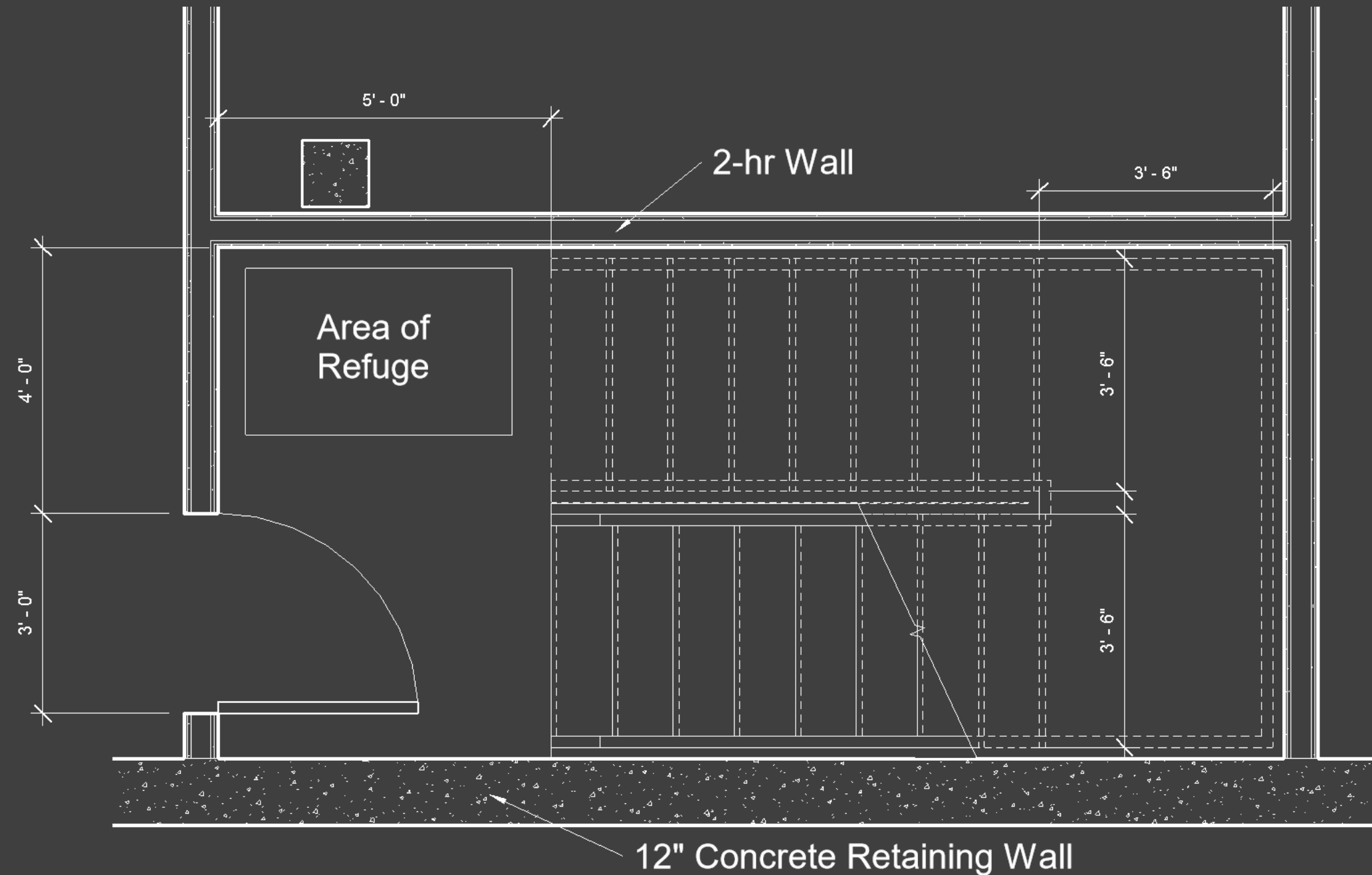
Performed Drain Pipe

Parking Requirements

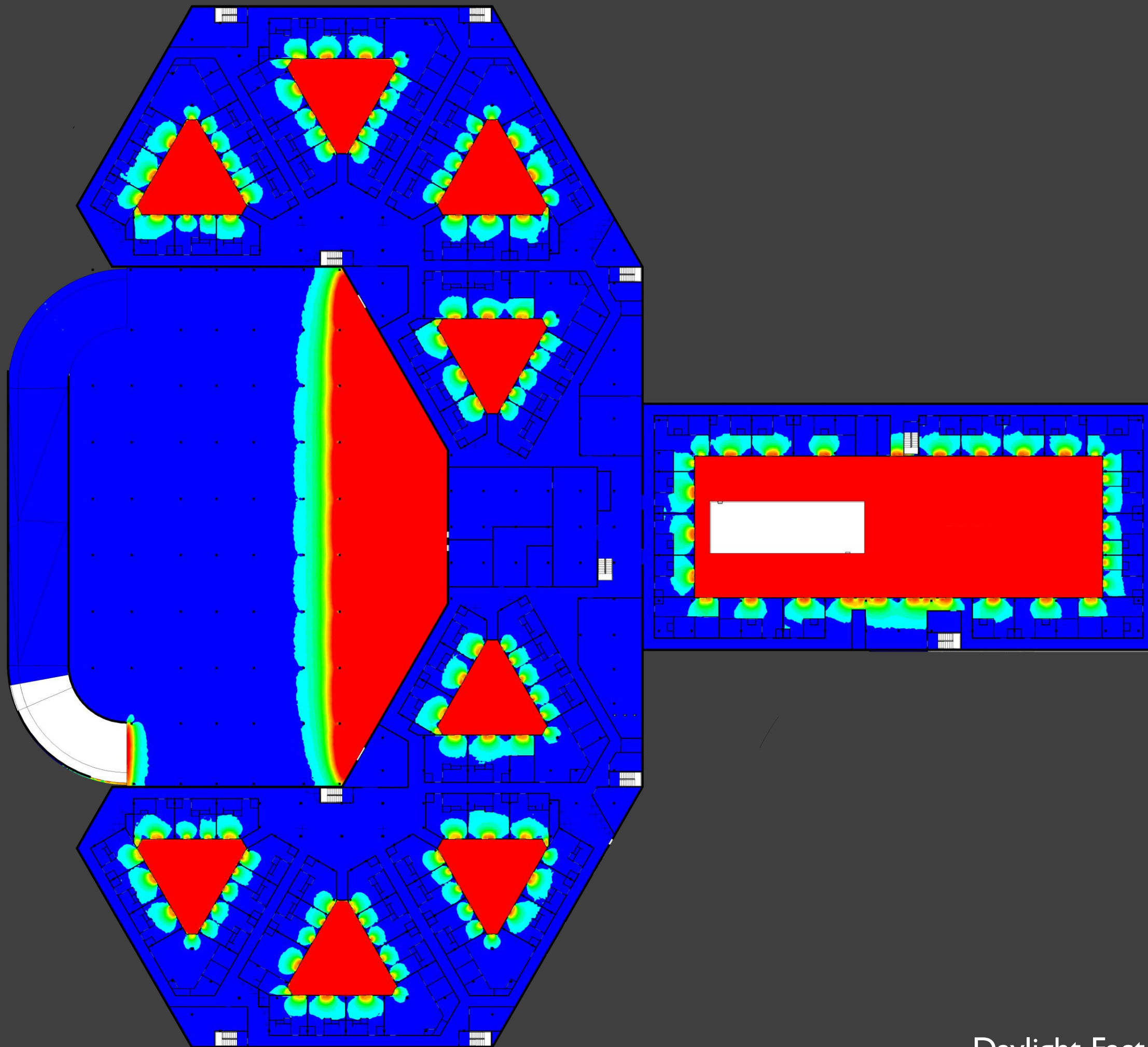
Typology	Required	On Site
Apartment	325 parking spots	339 parking spots
Grocery	37 parking spots	40 parking spots + 6 for employees

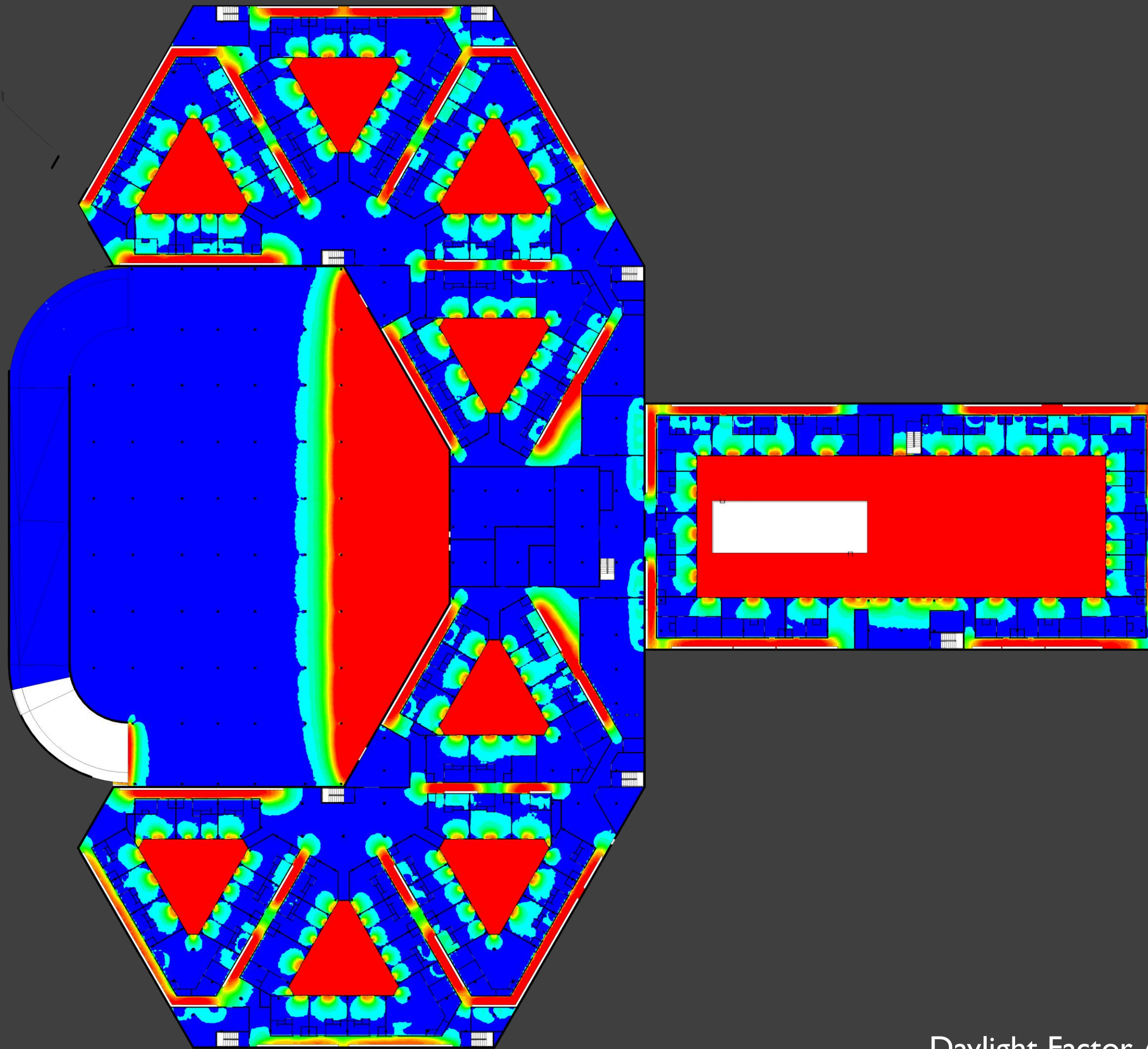
Bathroom Requirements

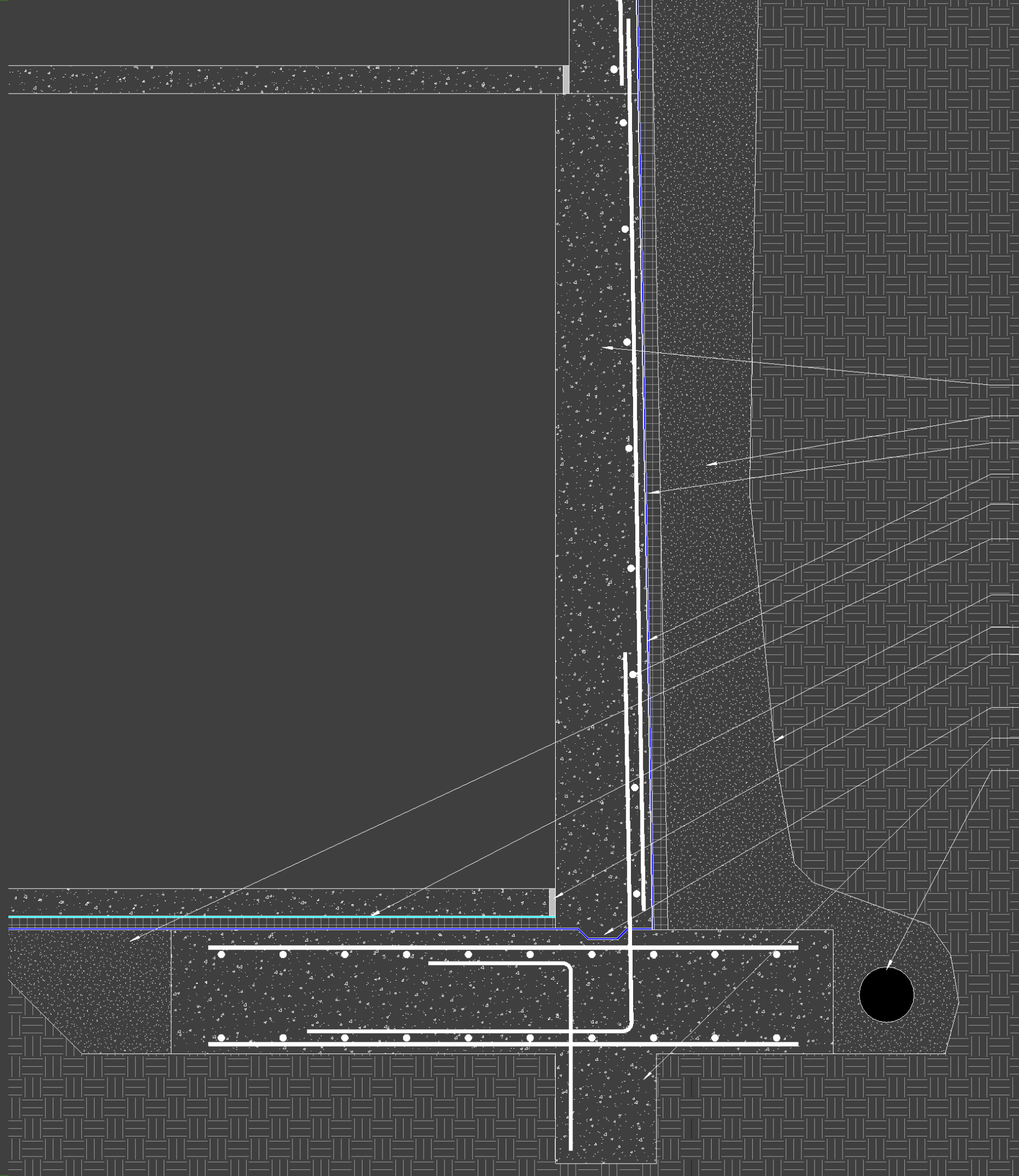
Typology	Required	On Site
Apartment	1 per unit	1 per unit + 6 for employees
Grocery	1 per sex	3 per sex for both customer and employee



Fire Code/ADA





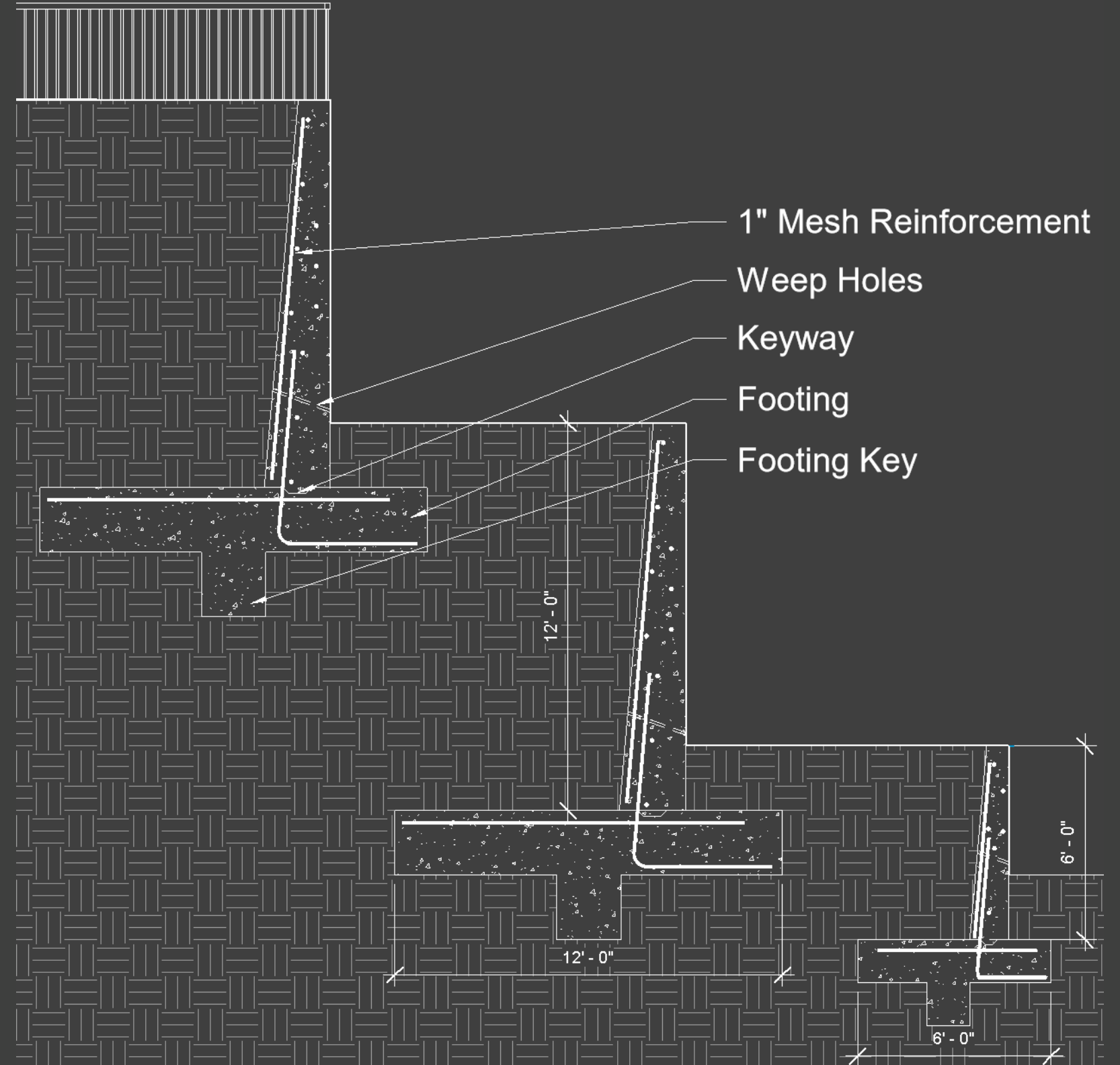


- Tapered Retaining Concrete Wall
- Gravel Backfill
- Rigid Insulation
- Waterproof Membrane
- 1" Mesh Reinforcement
- Gravel - Gas Permeable Layer for Radon/Foundation Support
- Vapor Retarder
- Filter Fabric
- Isolation Joint, Caulked and Sealed
- Keyway
- Footing Key
- Perimeter Drain System

Retaining Ext. Wall/Foundation Detail



Green Wall Detail



Retaining Walls Detail