

The Farmhouse

*Studio 4.

*s_4. Design Team



*Susannah Coons
Project Manager

Susannah has key work experience in all aspects of building design. Susannah is well suited to oversee the project to completion, giving a guiding hand.



*Max Daviau
Façade Lead

Working at WSP in the facades and new development team, Max has developed parametric analysis tools and worked closely with industry to design resilient buildings



*Stefan Rankovic
Structure Lead

Stefan has extensive structural design experience through Warrior Home & collaboration with the Structural Timber and Advanced Research Team



*Ethan Paquette
Architecture Lead

Ethan possesses a broad range of architectural design experience from working on a unique selection of projects at Hossack and Associates Architects.

Introduction

Objectives

Site & Program

Design Updates

Spatial Design

Facade

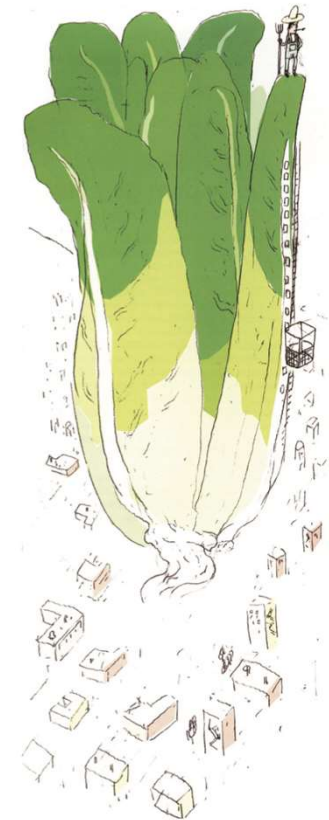
Structure

Farming

Systems

*Introduction

1. As cities continue to grow and sprawl, traditional farming methods are becoming unsustainable. At the current rate of growth, **1 billion hectares will need to be converted to farmland to sustain the global population.** In Canada, only **7.3% of land is prime farmland**, much of it located in Ontario. This is diametrically opposed to the urban development that is destroying said land. The sprawl further fuels the already rapid climate change experienced in the 21st century.
2. The disconnect between producer, conscious producer, consumer and conscious consumer are widening everyday. Food agency, regardless of security is becoming more obscure, while prices skyrocket. **Access to healthy produce is a right, not a privilege. Cooperation between** into those that can afford it. Hyper individualistic western societies lend themselves to “productivity” without regard to those outputting said productivity **individual, producer, and greater community is essential** to long term resiliency.

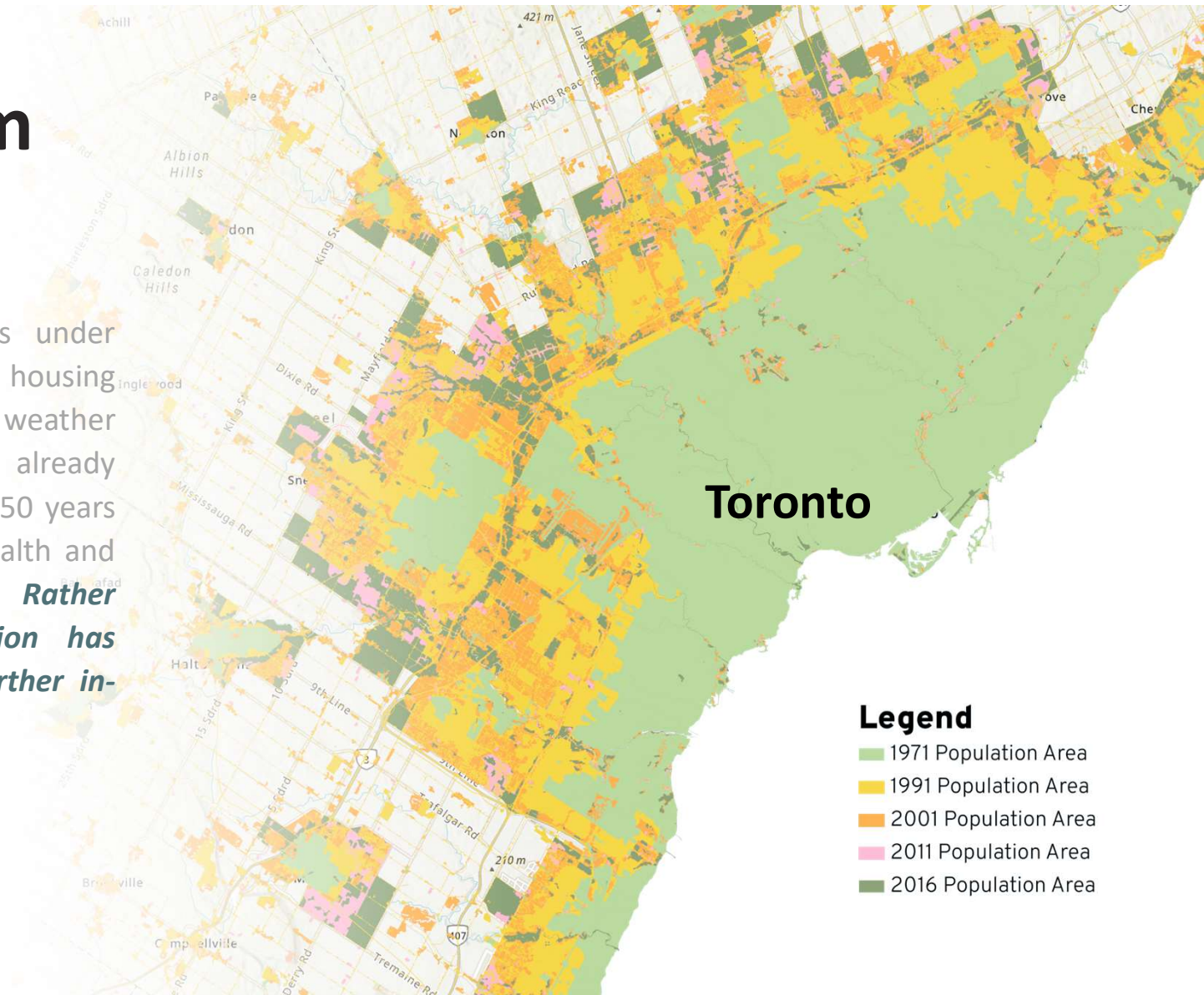


"Vertical Farm" illustration by Peter Mitchell, THIS Magazine 2009

*The Problem

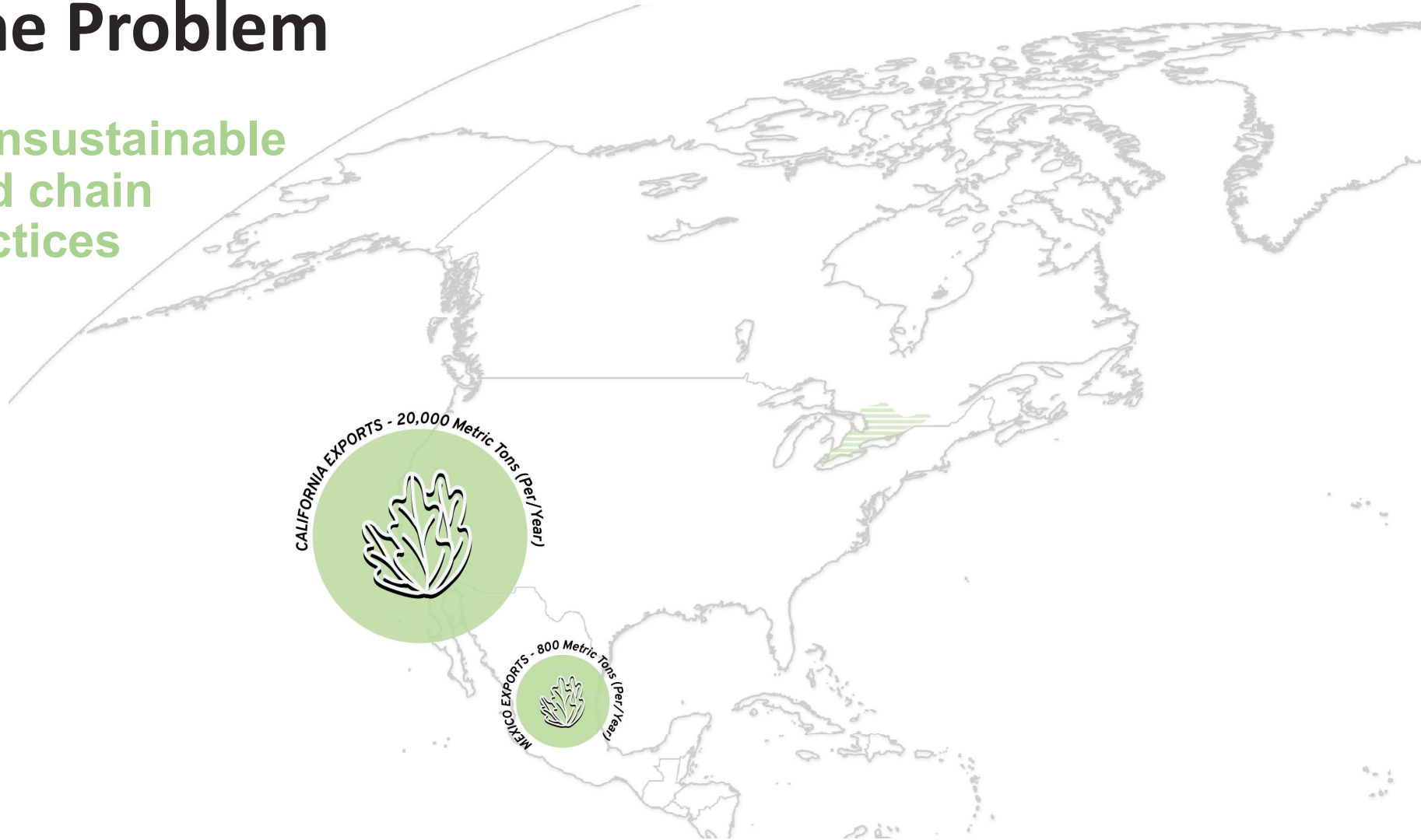
1. urban sprawl

Near daily, the greenbelt is under attack. Highway extensions, housing developments, and extreme weather events all contribute to the already precarious situation. The last 50 years have seen unprecedented wealth and the resulting housing boom. ***Rather than densify, the population has pushed itself further and further inland.***



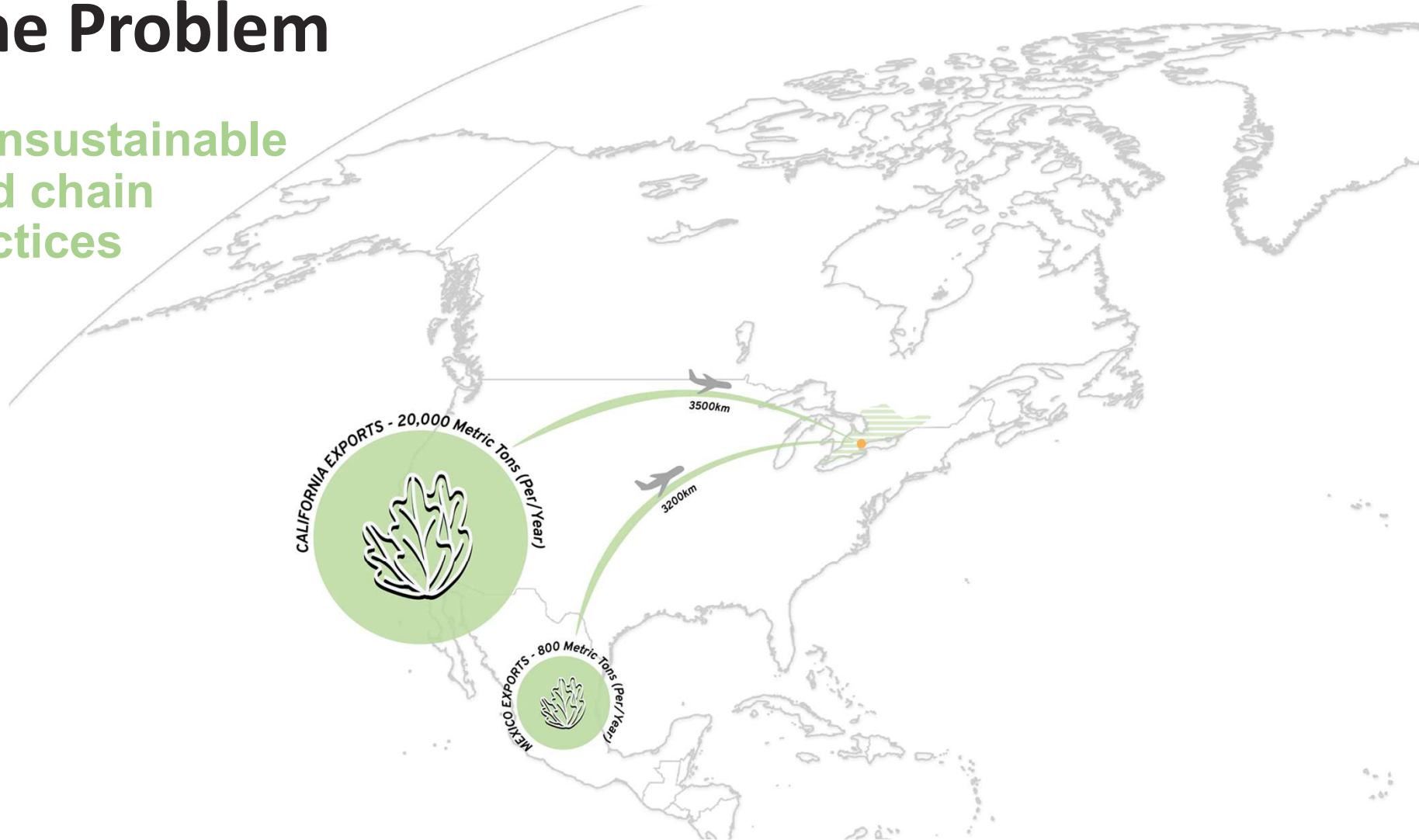
*The Problem

2. unsustainable food chain practices



*The Problem

2. unsustainable food chain practices



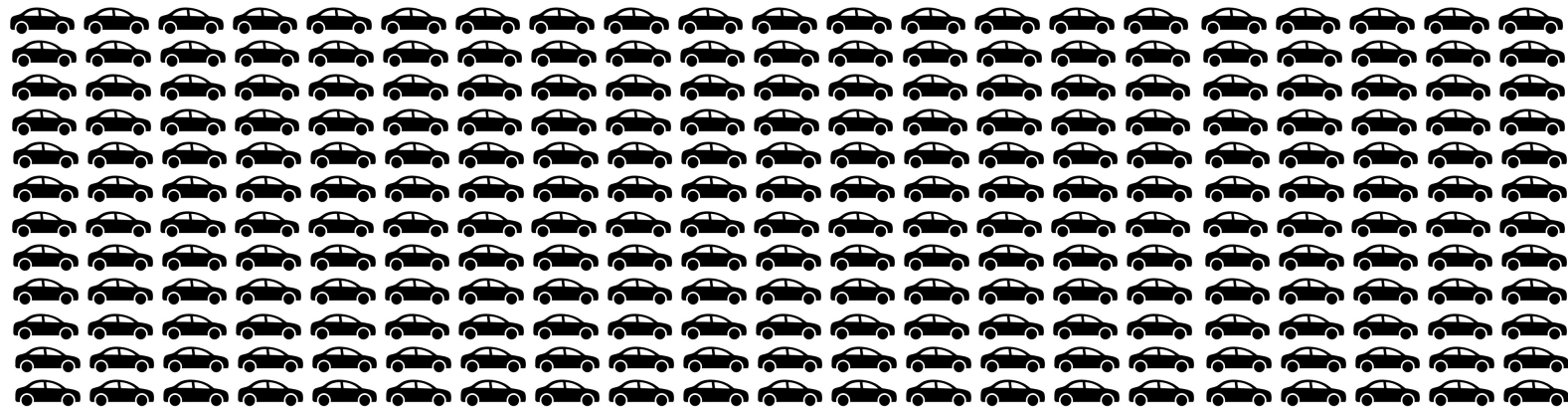
*The Problem

Ton-Km of Imported Lettuce For Toronto Per Year = $70 \cdot 10^6$ ton-km

Emissions Factor = $600 \text{ g} \cdot \text{CO}_2 / \text{ton-km}$

Total Carbon Emissions Per Year = $40 \cdot 10^6 \text{ kg}$

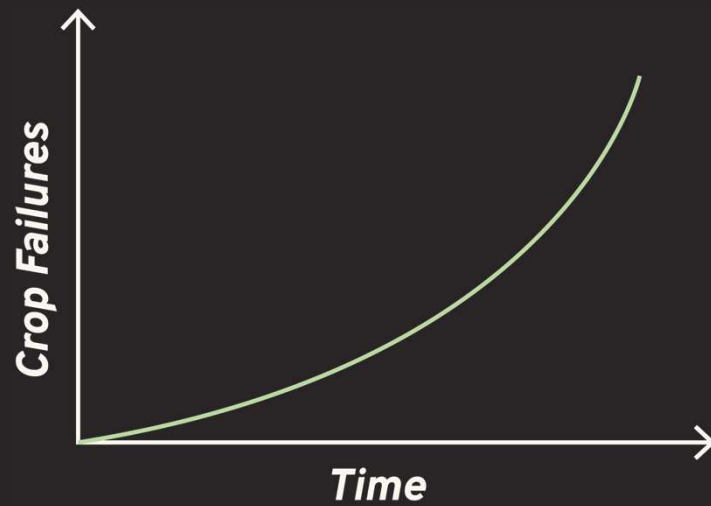
Equivalent to **1million cars on the road!**



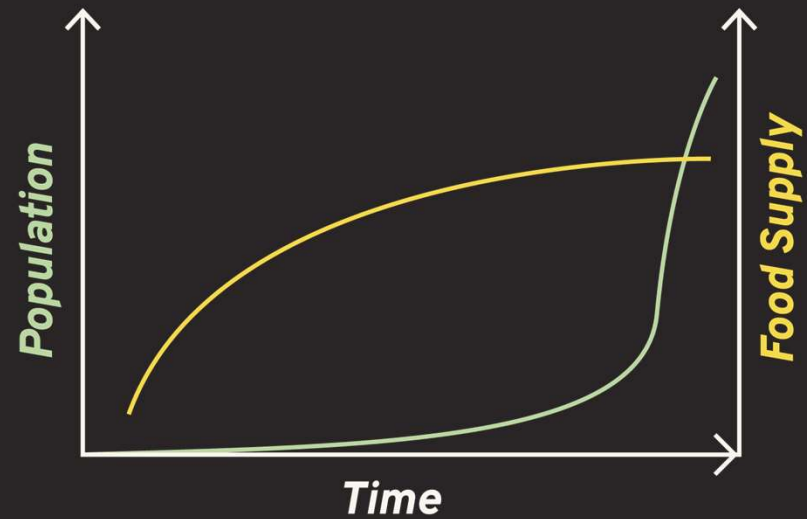
+ a lot more...

*Why Do We Care?

“By 2030, crop failures will be 4.5 times higher and by 2050, 25 times higher”



“As populations increase, the problem only becomes more severe as we run out of land altogether”





Amazon deforestation hits new record in Brazil

Area cleared in the first six months this year is five times the size of New York City

By Gabriela Sá Pessoa and Kaasha Patel
July 8, 2022 at 4:00 p.m. EDT



California's Oak Fire destroys at least 42 structures as it burns more than 18,000 acres near Yosemite National Park

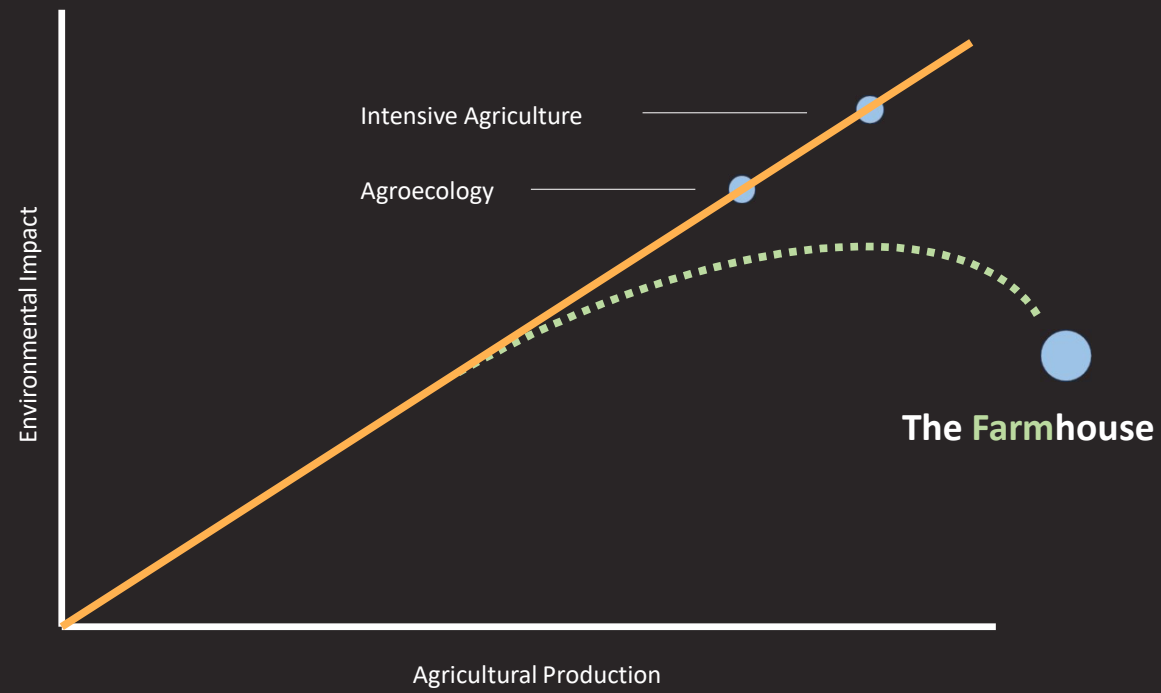
By Elizabeth Wolfe and Steve Almasy, CNN
🕒 Updated 11:28 PM ET, Tue July 26, 2022



Sardinian farmers suffer worst locust invasion in over 30 years



Reuters
Federico Maccioni



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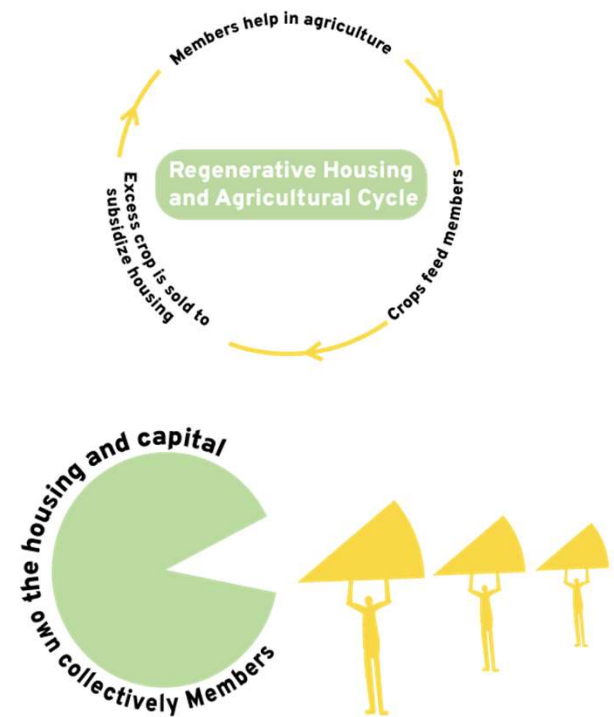
Systems

*Objectives

Key objectives of the farmhouse was to *provide a system of living whereby residents have an ownership closer to that of a house instead of a condominium.* Long-term and stable living through a system of responsible ownership are key objectives we hope to foster.

Food security for our residents and the surrounding community is a pillar of the development; providing healthy and affordable produce in the food desert that currently exists remain a key driver in the design process.

Climate change will only exacerbate the food crisis
*Studio 4.



*Why Integrate?

The planet isn't creating more land—it's doing the exact opposite. Collectively we must find ways to incorporate growing abilities within the existing urban landscape.

Typical Condominium: **345 \$/sqft**

Commercial Growing: **8.02 \$/sqft**



Commercial Space: **90 \$/sqft**

443.02 \$/sqft

Typical Farming Profit : **30 \$/(sqft x yr)**

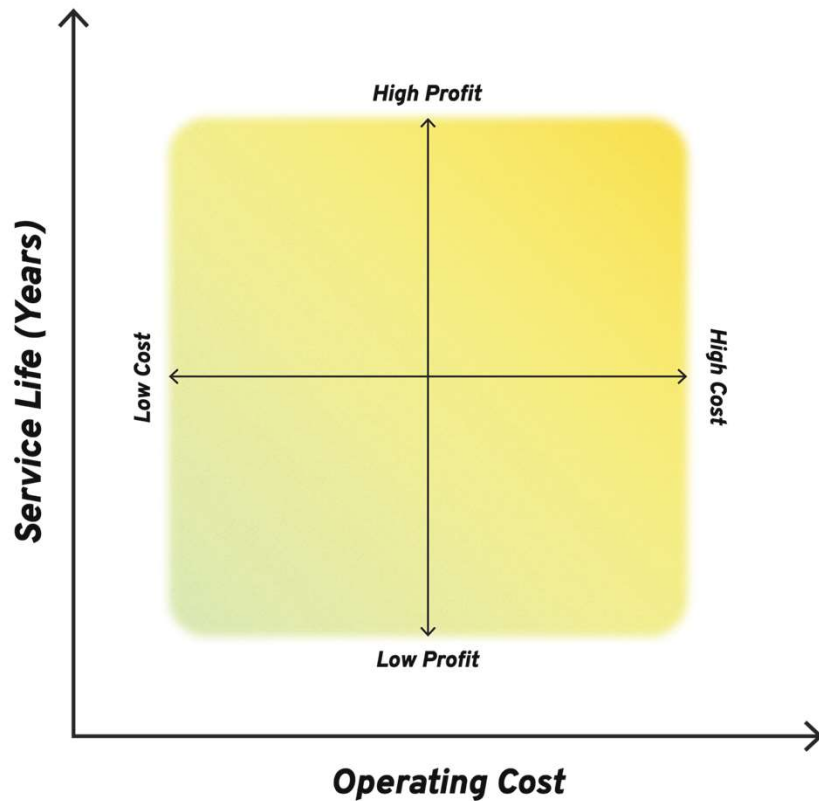


*Why Combine Farming and Housing?

Population growth of cities, reduce transportation, food desert.

*Humans are more important than Profit - *Studio 4.*

*Precedent



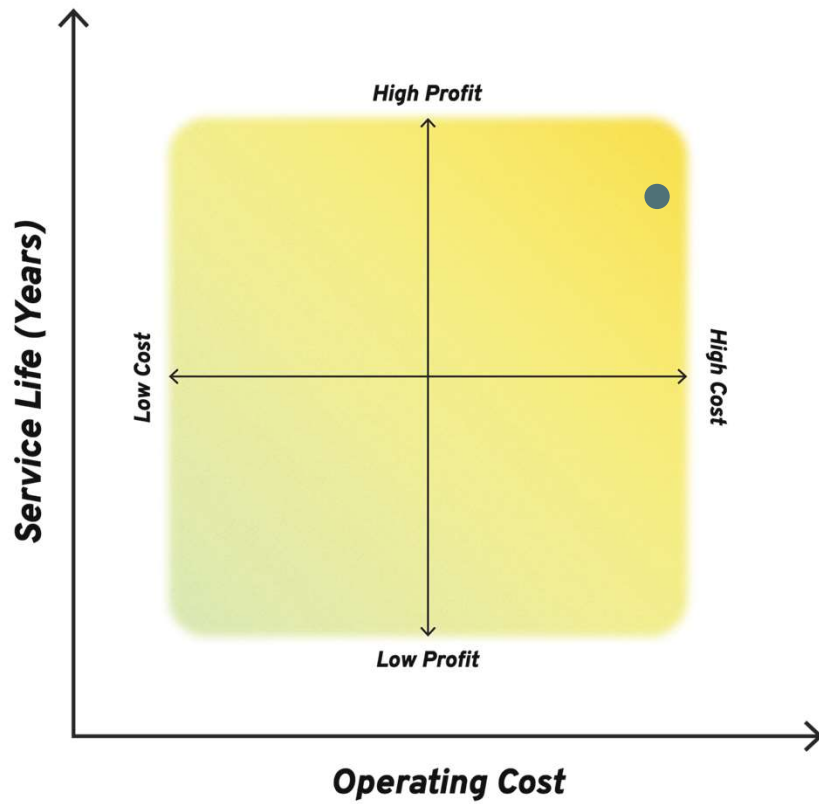
Design Matrix

The *ideal building finds itself in the top left* of the design matrix. High profit to the investor, low cost to build and buy, and low operating costs over the service life.

Sadly, typical developments typically fall far from ideal conditions and tend to choose one group to *prioritize, the residents or the investor—but never both.*

Research into existing and future high-rise vernacular we identified interesting trends.

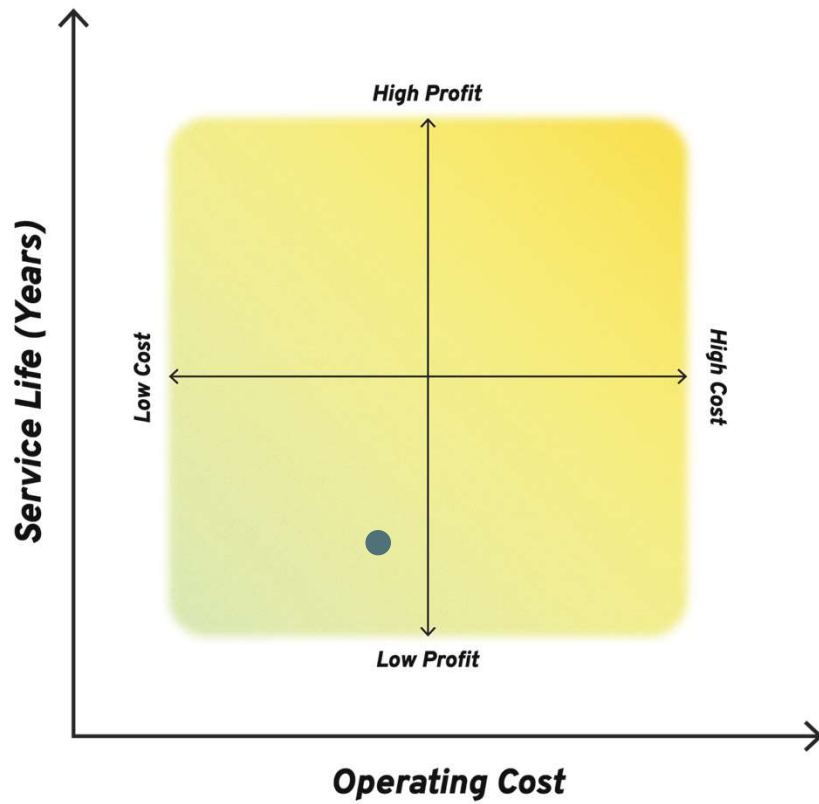
*Precedent



Profit Driven



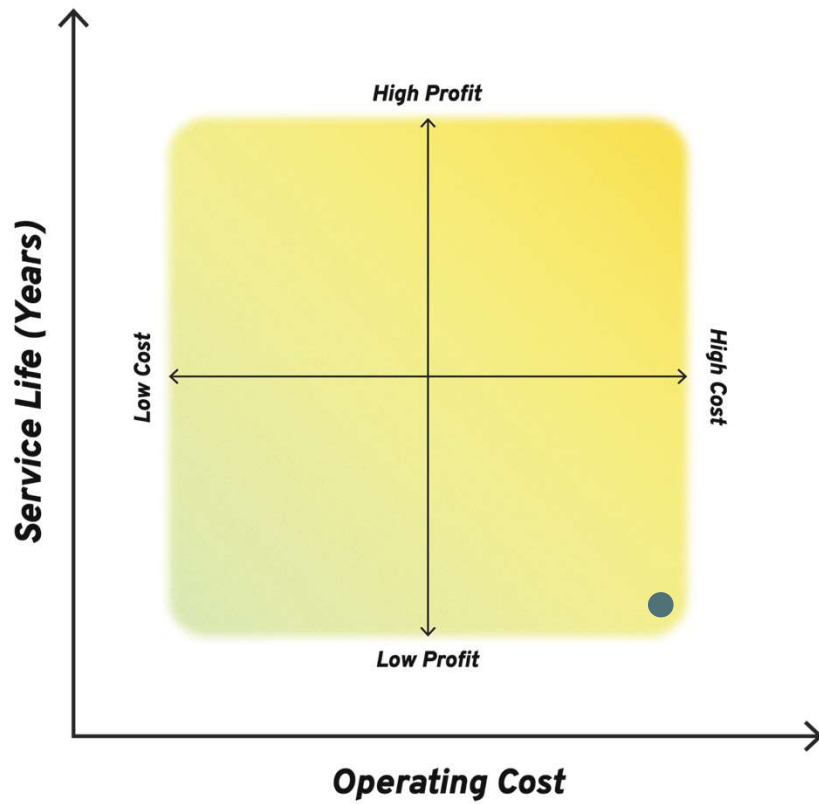
*Precedent



Cost Driven



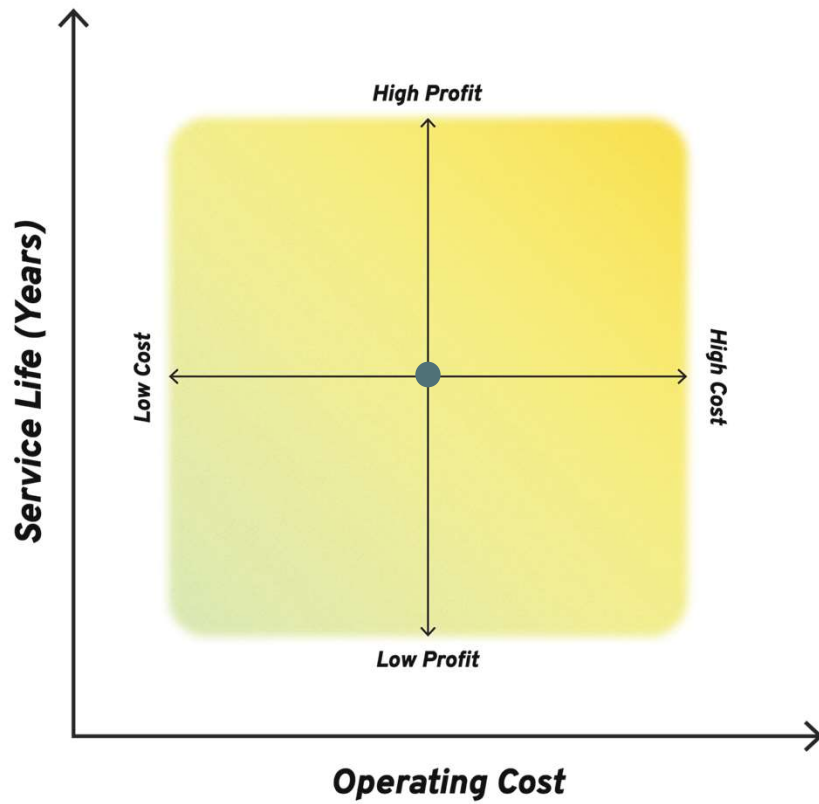
*Precedent



Dream Driven



*Precedent



Driven



*Constraints

Main constraints of the farmhouse is the site location. *zoning constraints limited the size and form* of the farmhouse.

Housing and construction *costs are subsidized by the scale of production*. Rapid farming cycles ensure higher crop turnover, *which are sold to the community*.

The Torontonians diet was analyzed and the most *popular produce identified*. This informed the diversity of crop and the required quantities.



Site



Budget



Diversity of Vegetation

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1000m

Trinity Bellwoods Park

1km

Rogers Centre

Port York

© 2021 Google

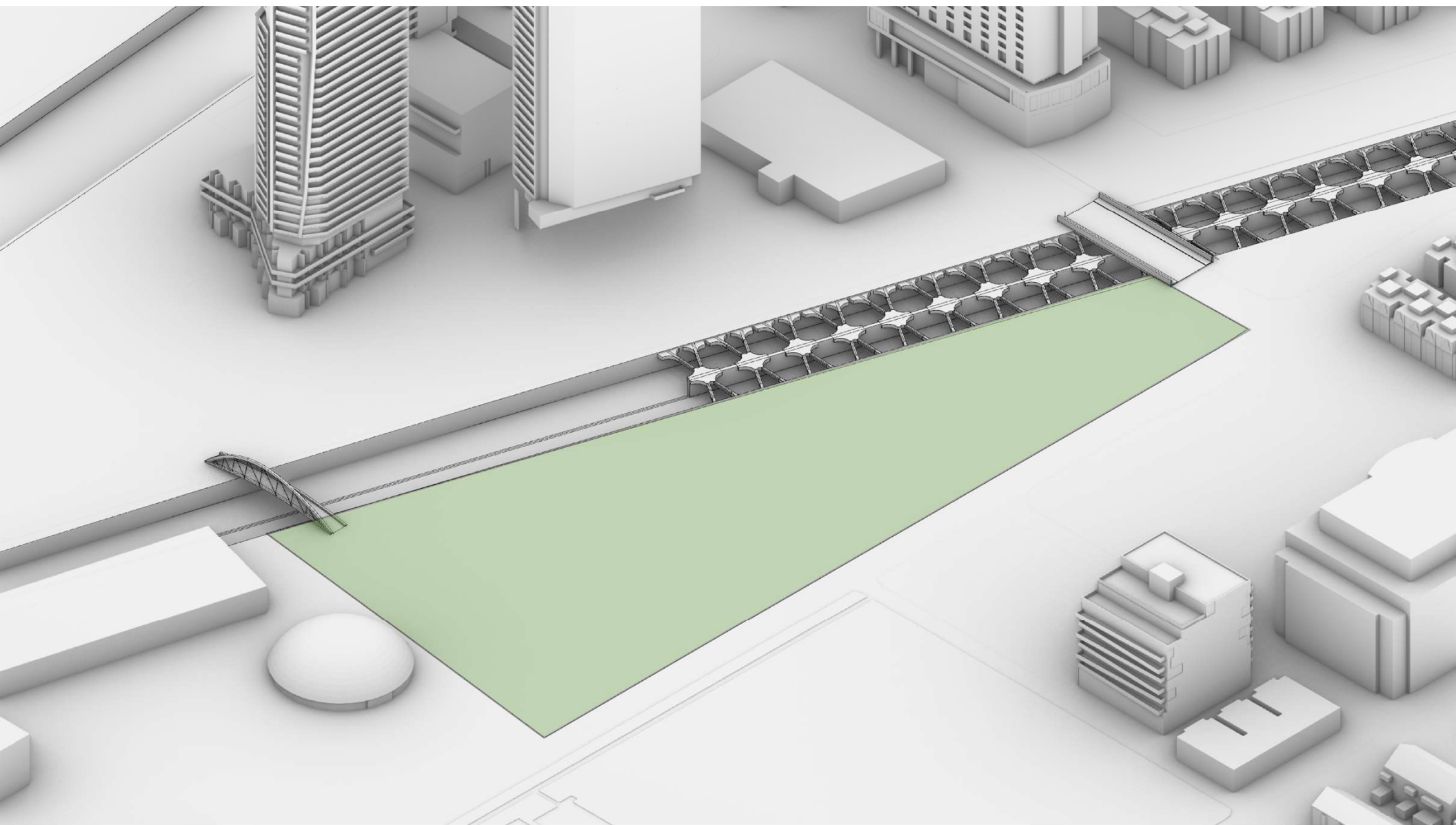


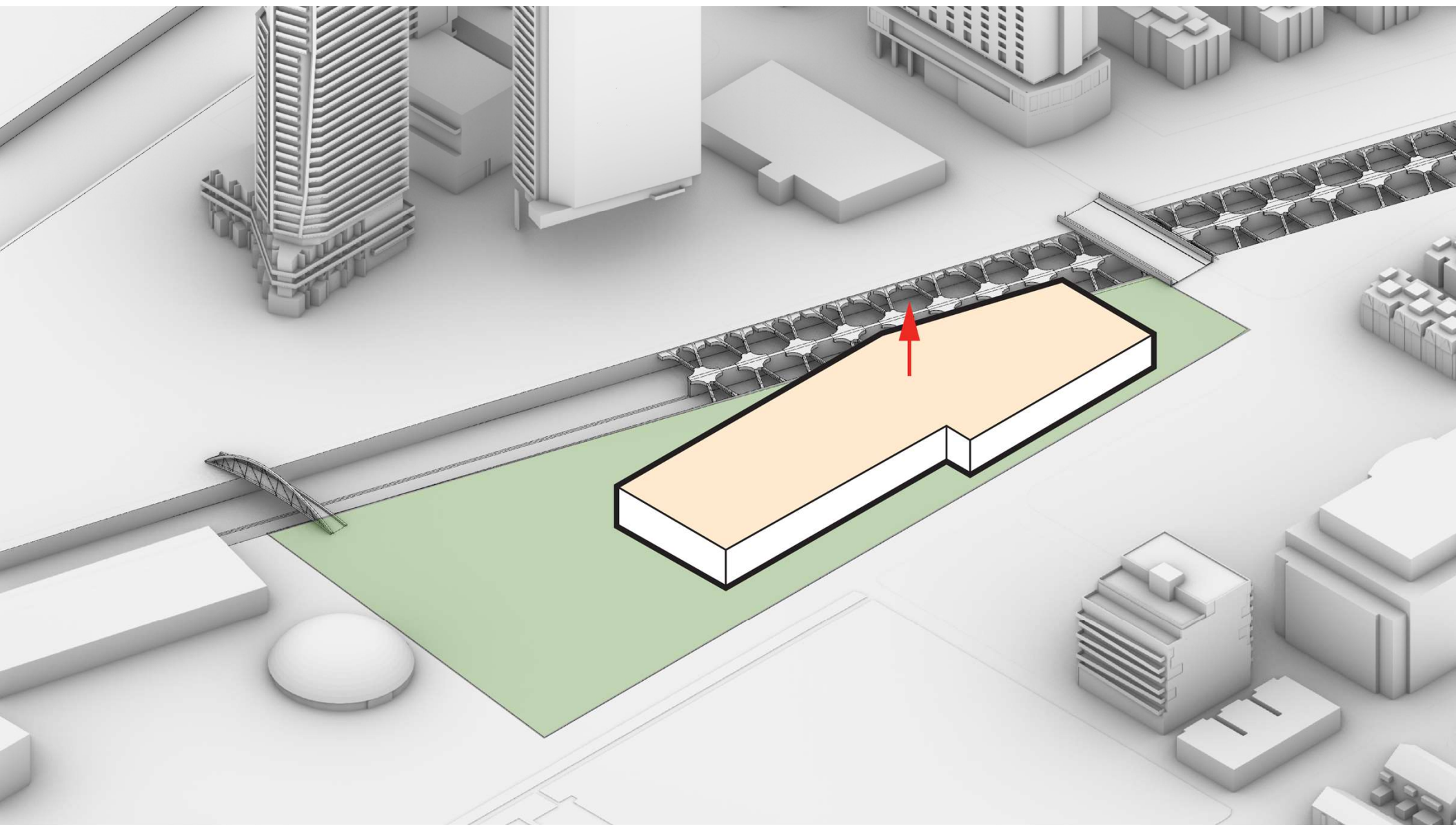
*Original Parti

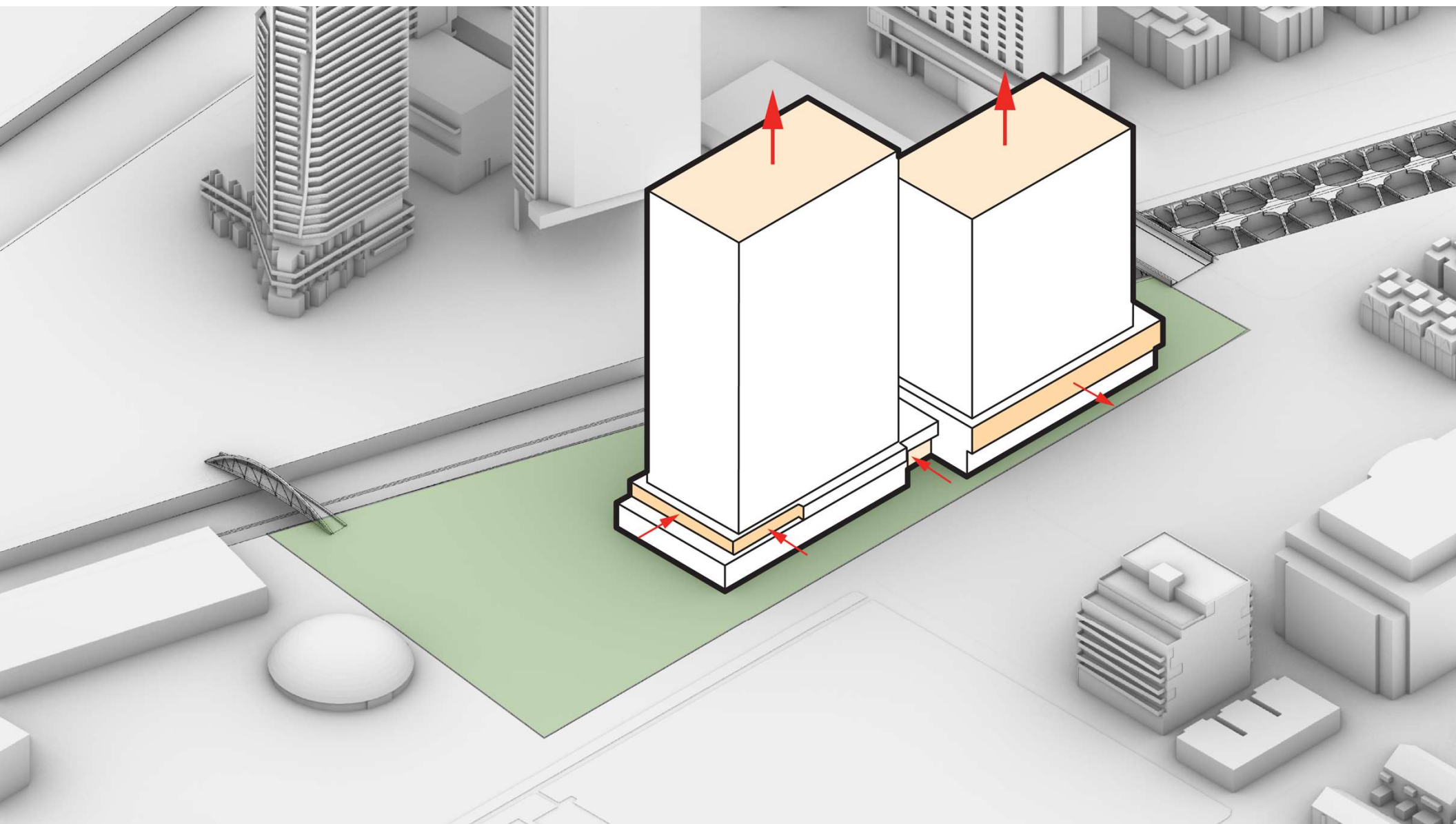
Initial spatial adjacencies were optimistic.

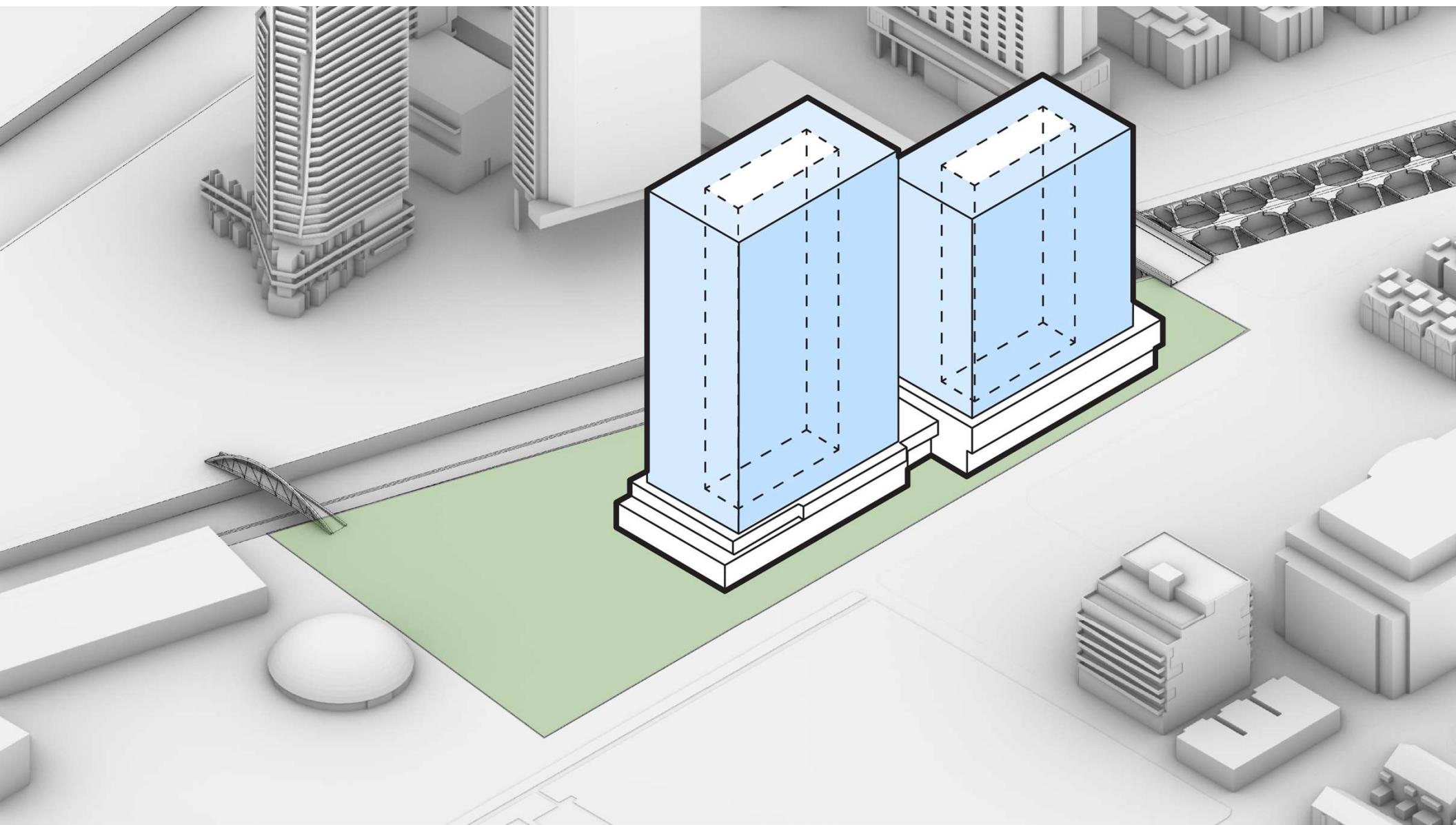
This framework provided a strong background to push our design forward.

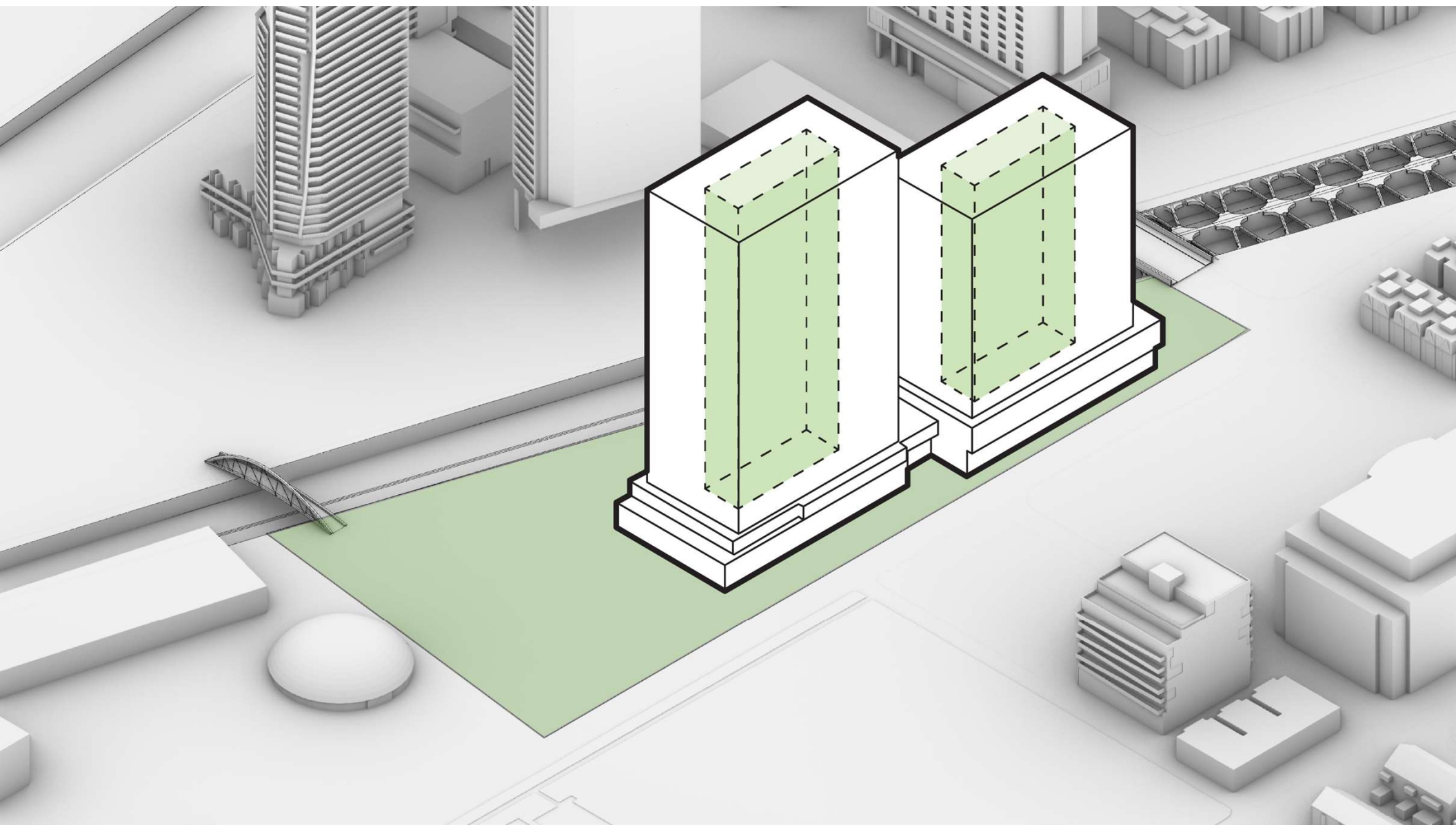


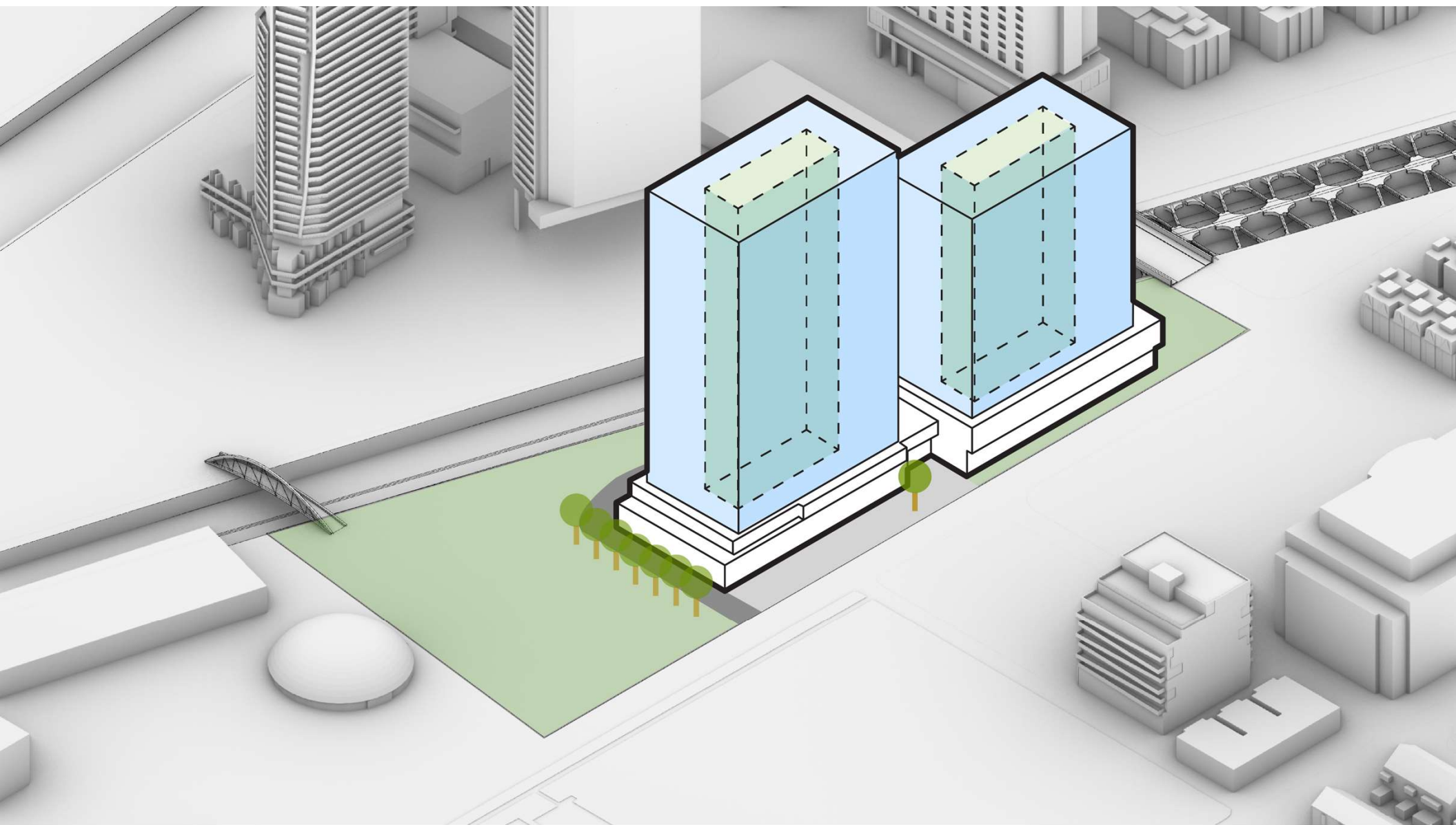


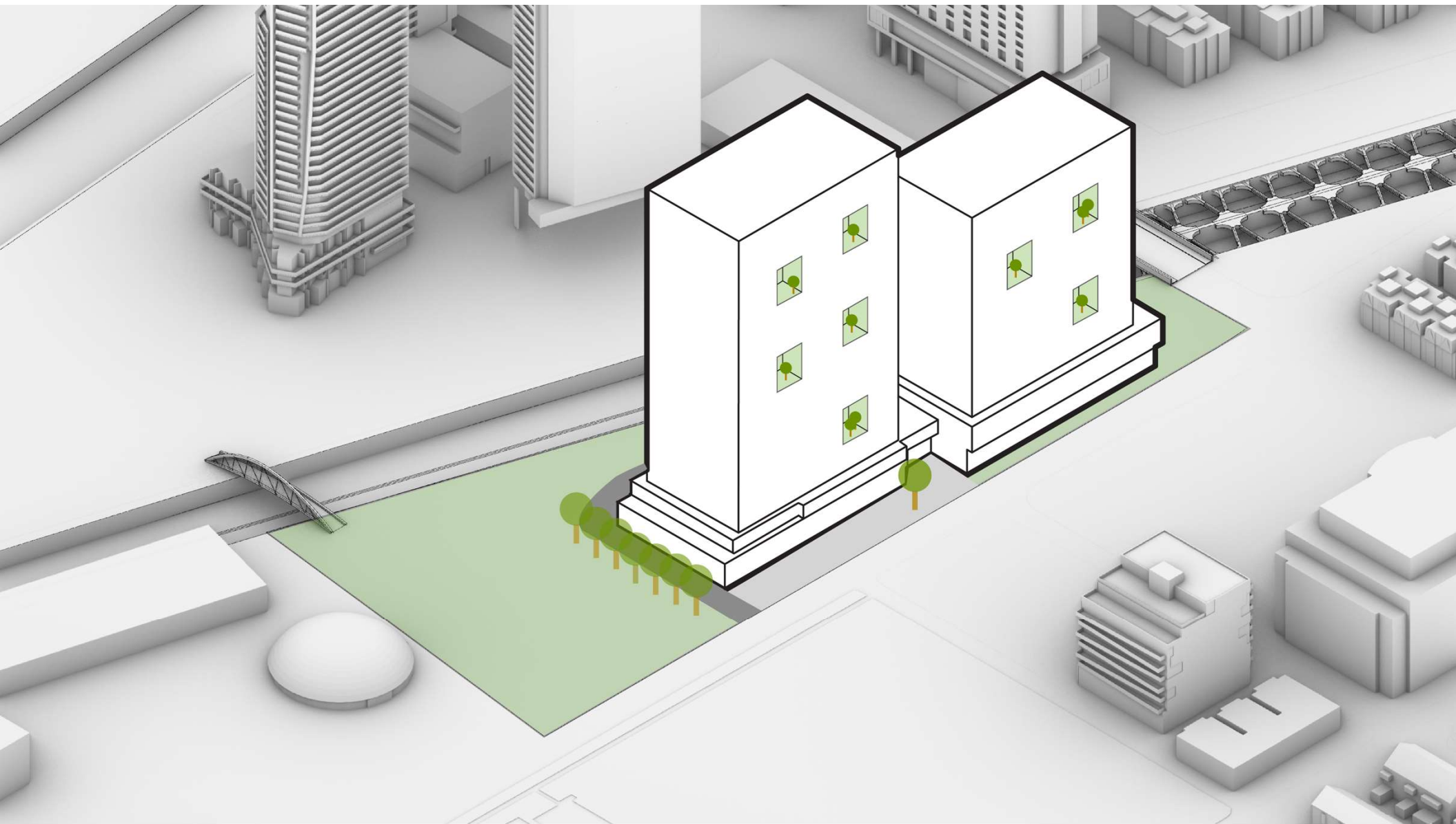








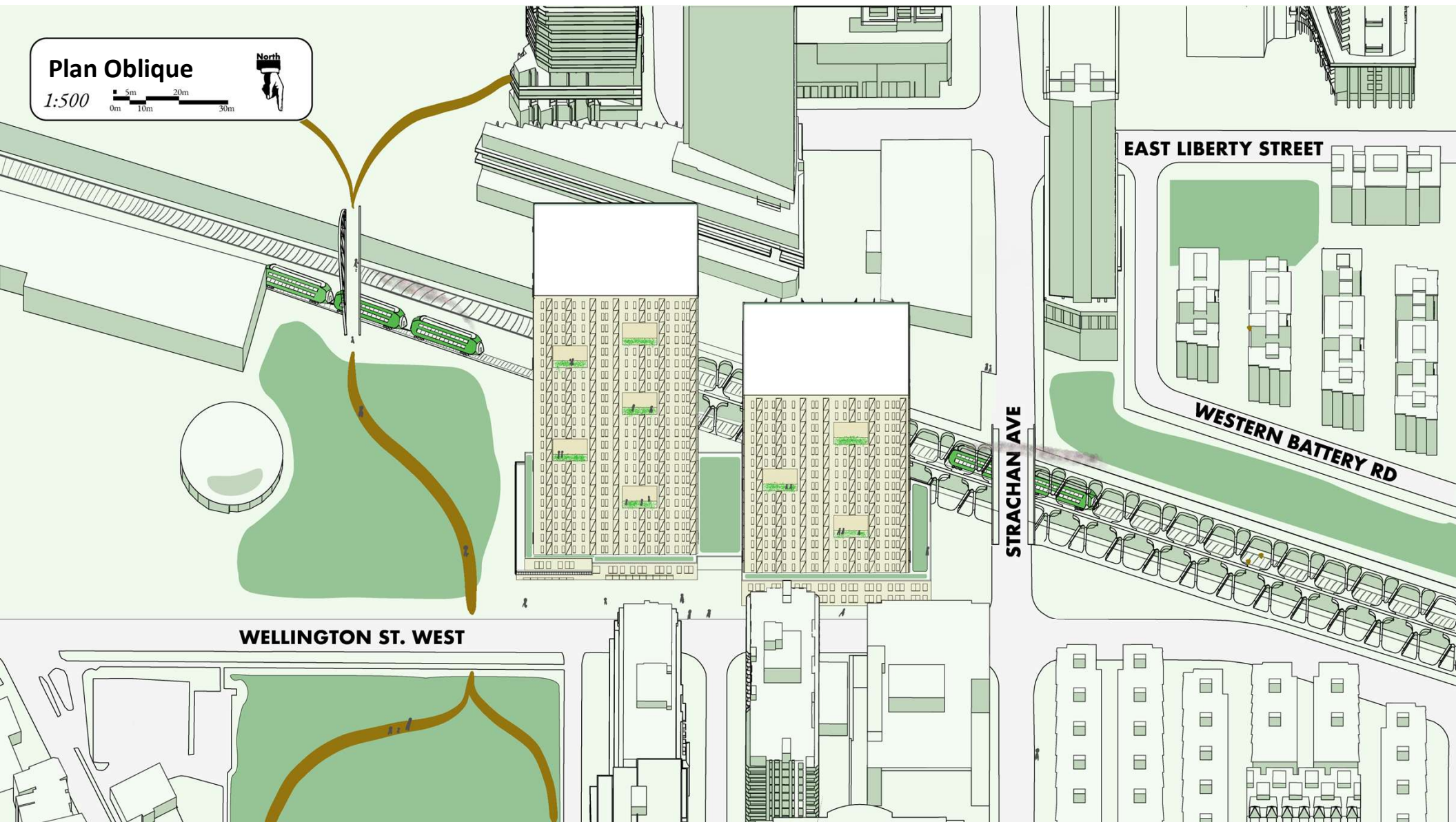




Plan Oblique

1:500

0m 5m 10m 20m 30m



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*Design Updates: Phase 1

- ✕ Site Analysis
- ✕ Farming Method Research
- ✕ Masterplan Development
- ✕ Enclosure Concept
- ✕ Structural Grid and Materiality
- ✕ Schematic Systems Design
- ✕ Farming Production Evaluation
- ✕ Exterior and Interior Renderings

*Design Works: Phase 2

Systems Integration

Enclosure Analysis and Details

Structural Connections and Load Analysis

Full Building Sections

Exterior and Interior Visualizations

Presentation Boards

Comprehensive Diagram Set

Small Scale Physical Model

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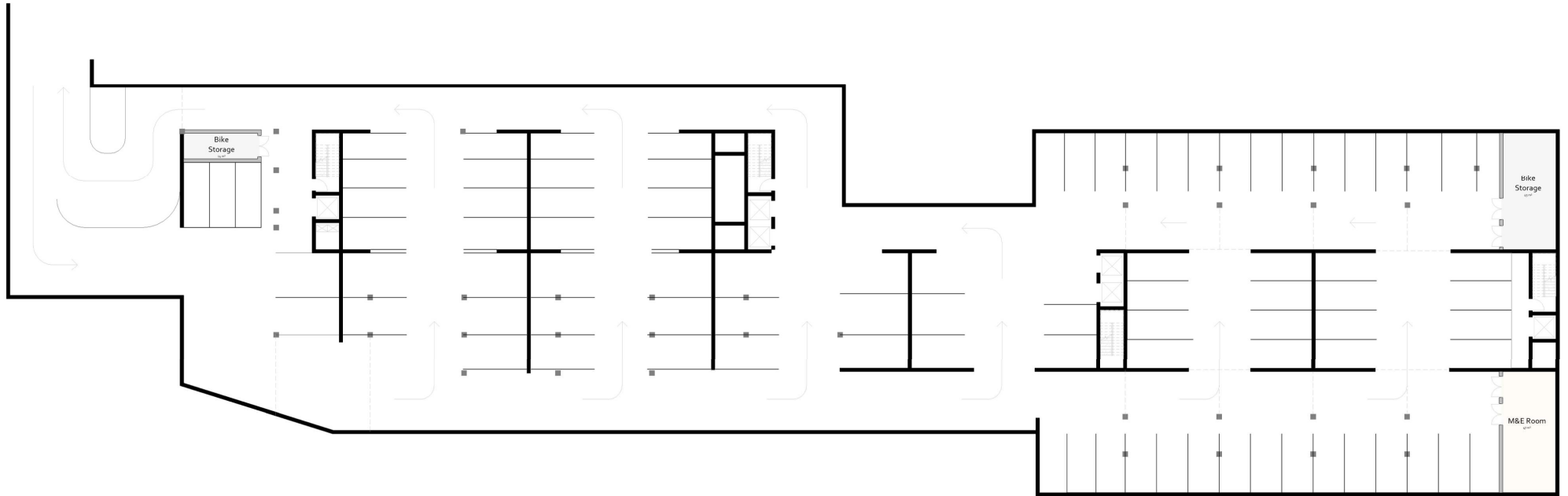
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L1

L2

L3

L7



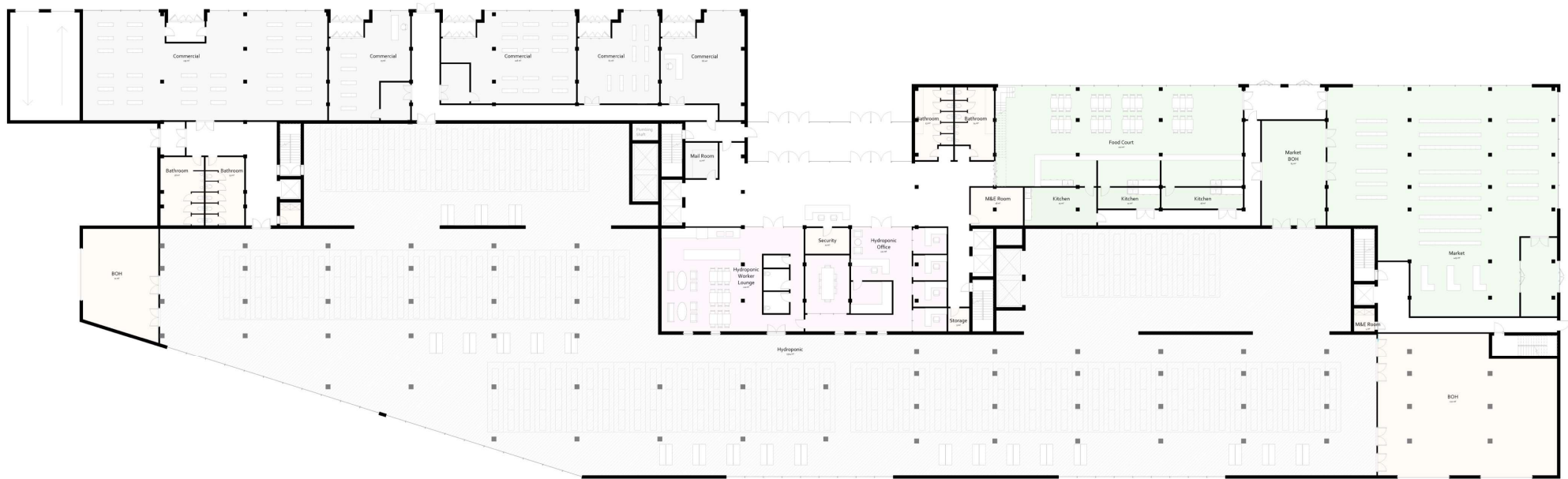
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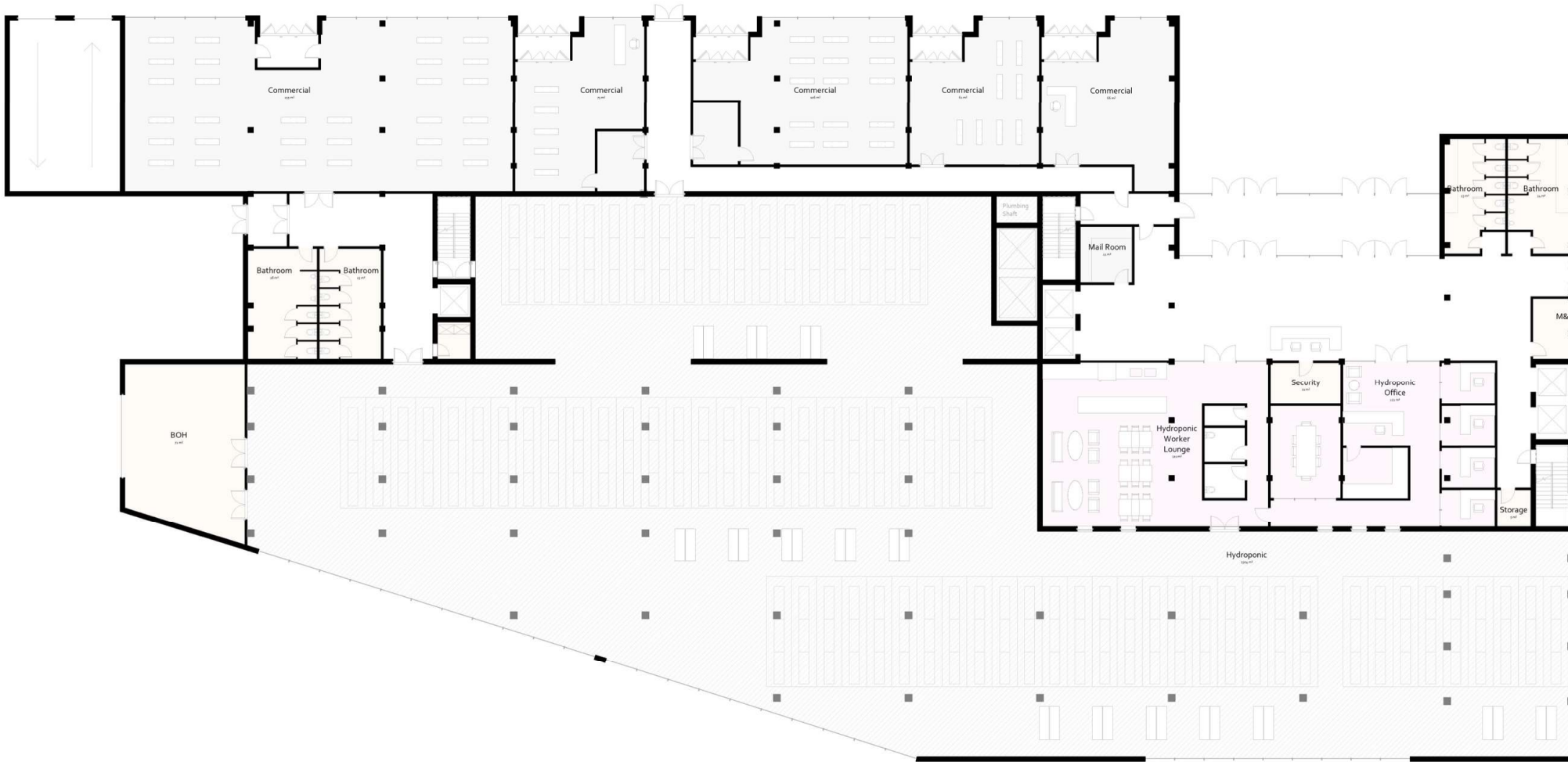
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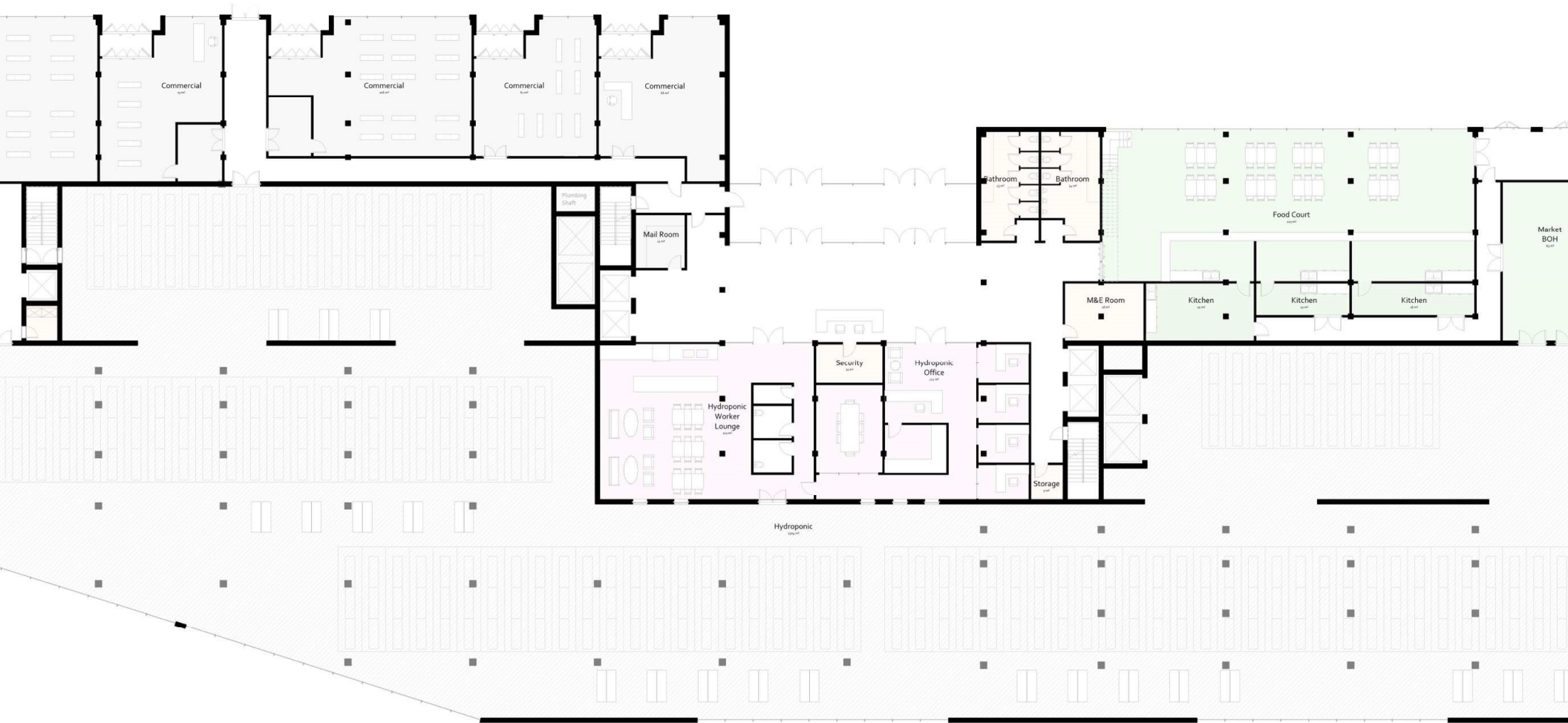
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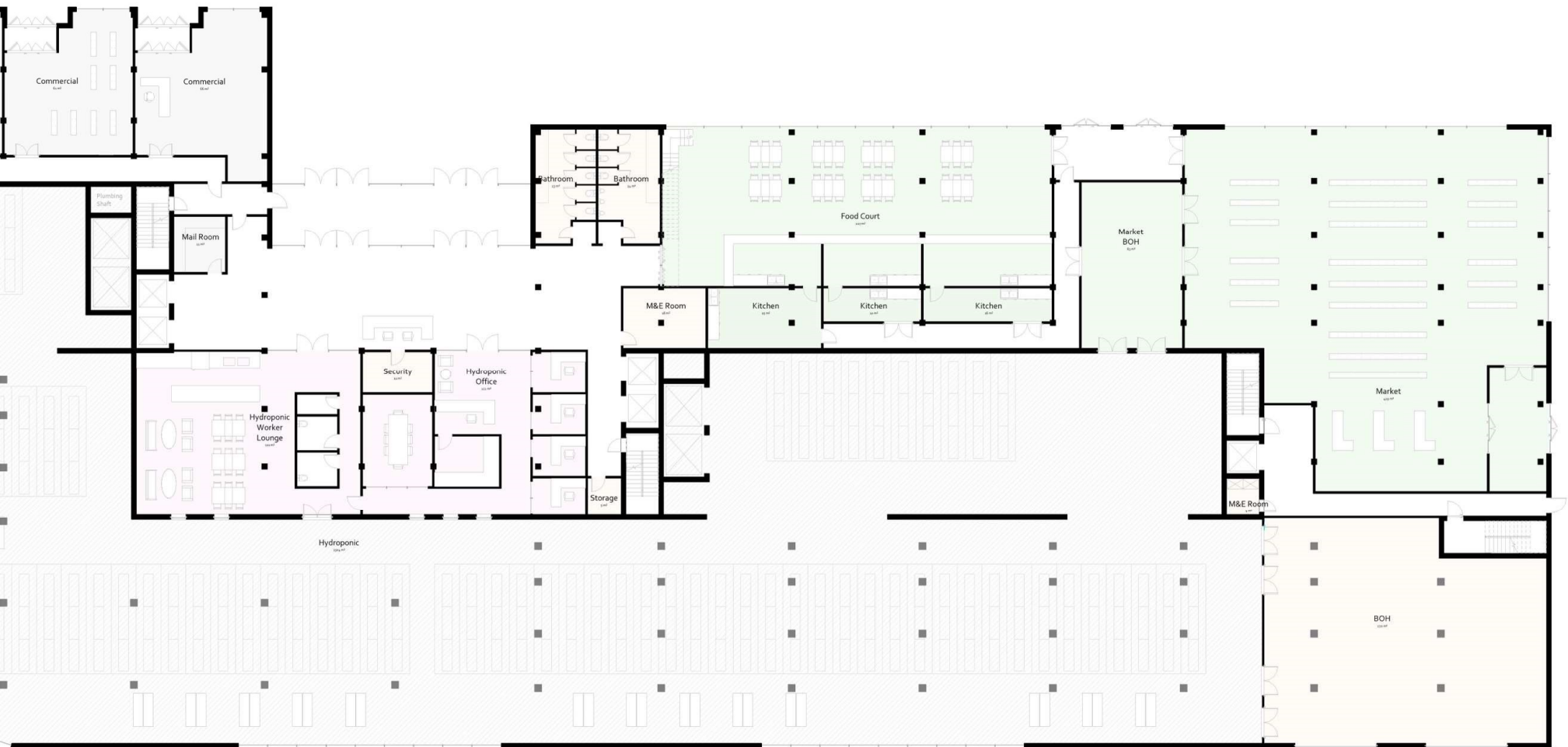
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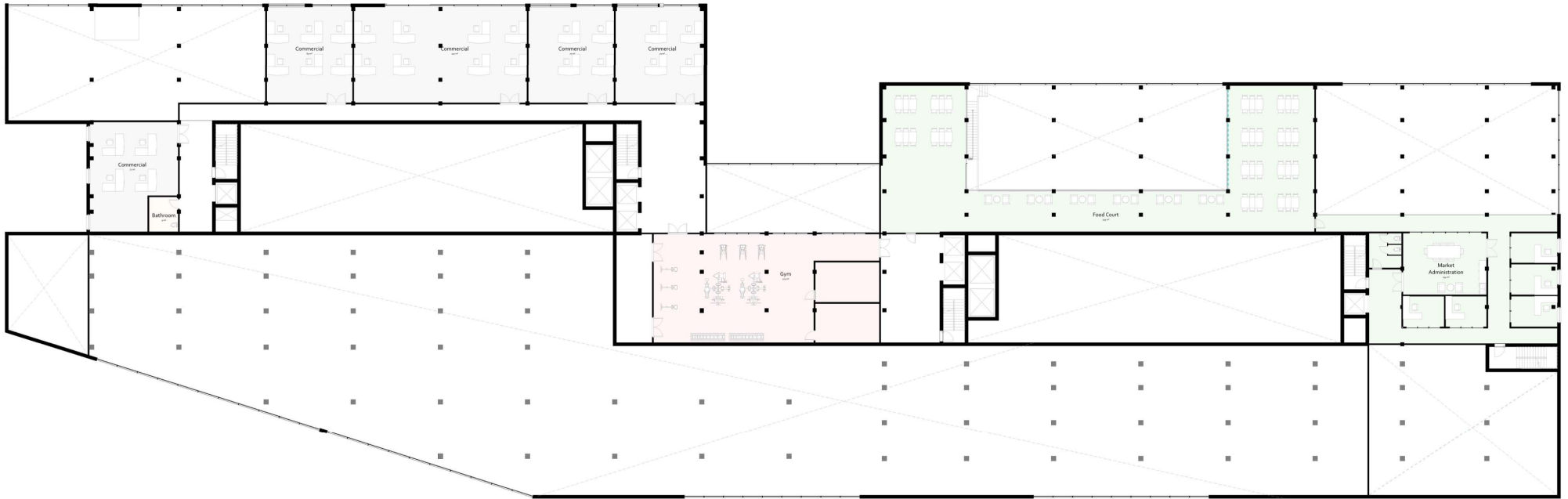
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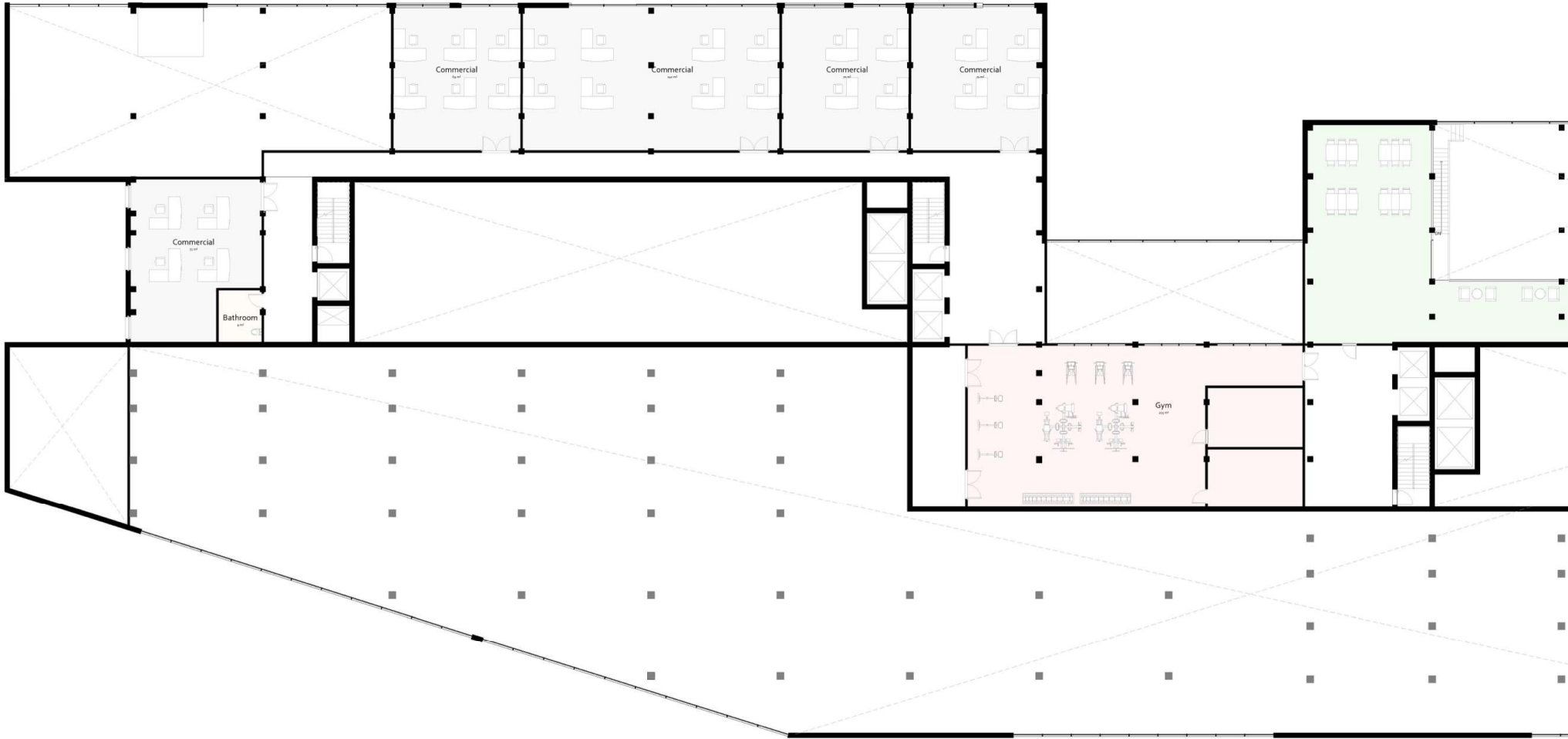
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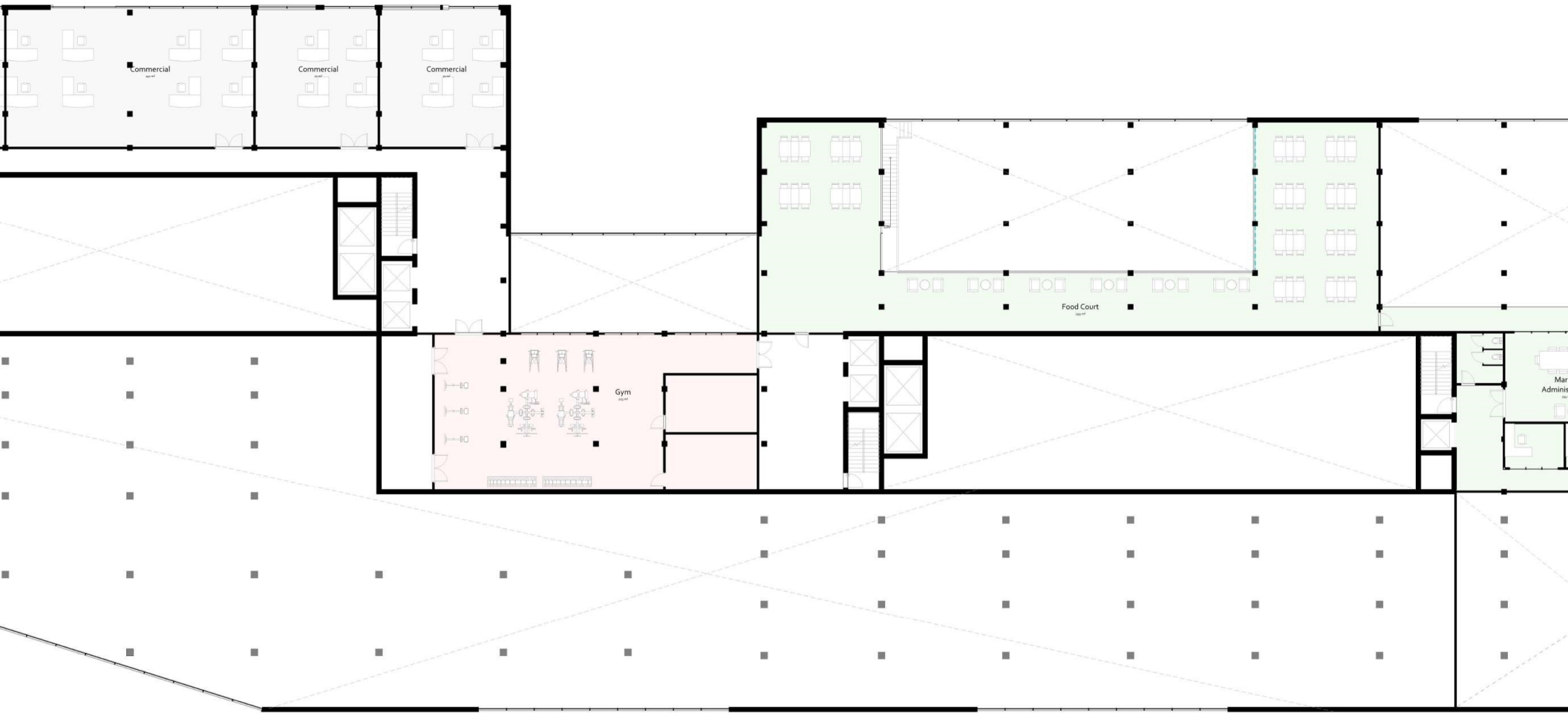
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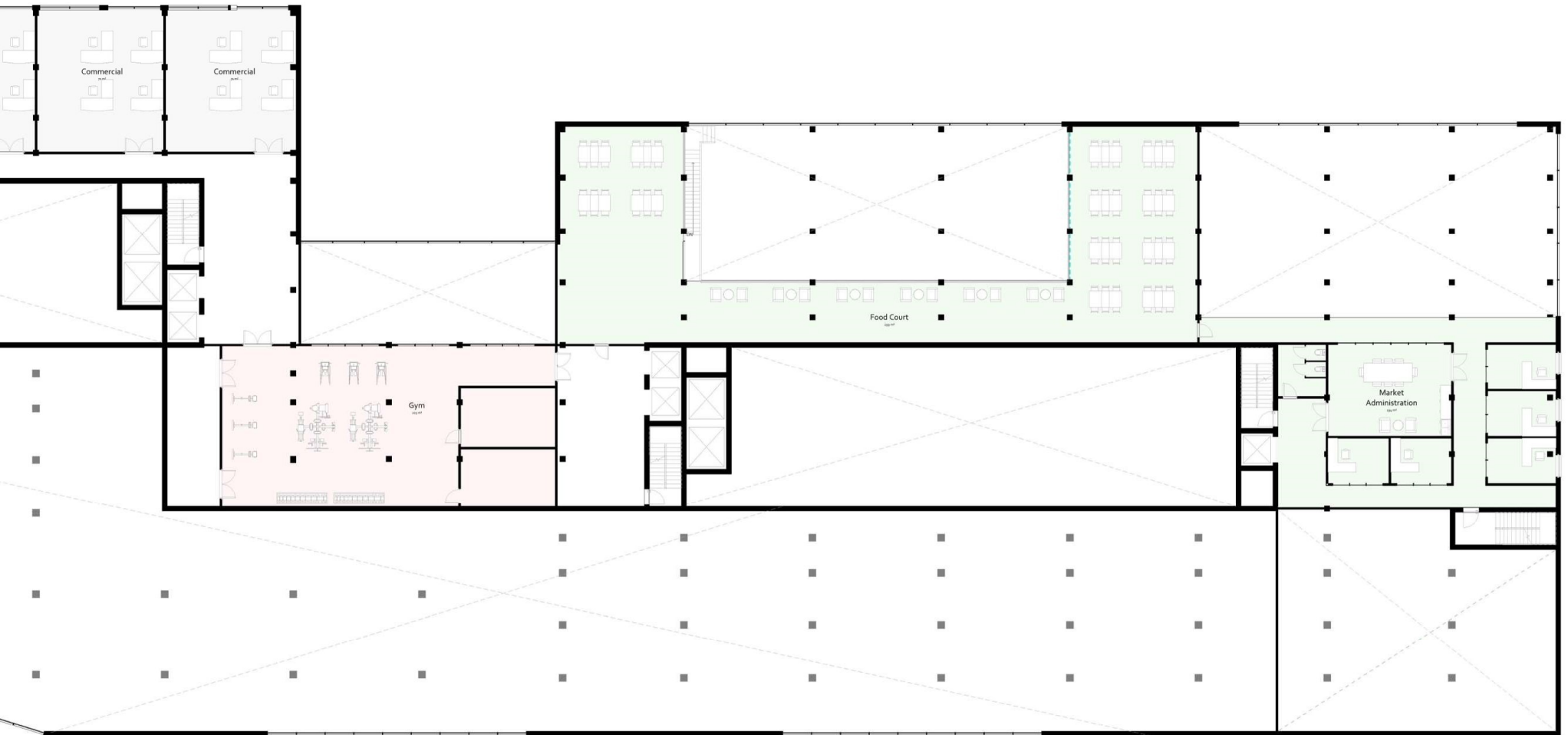
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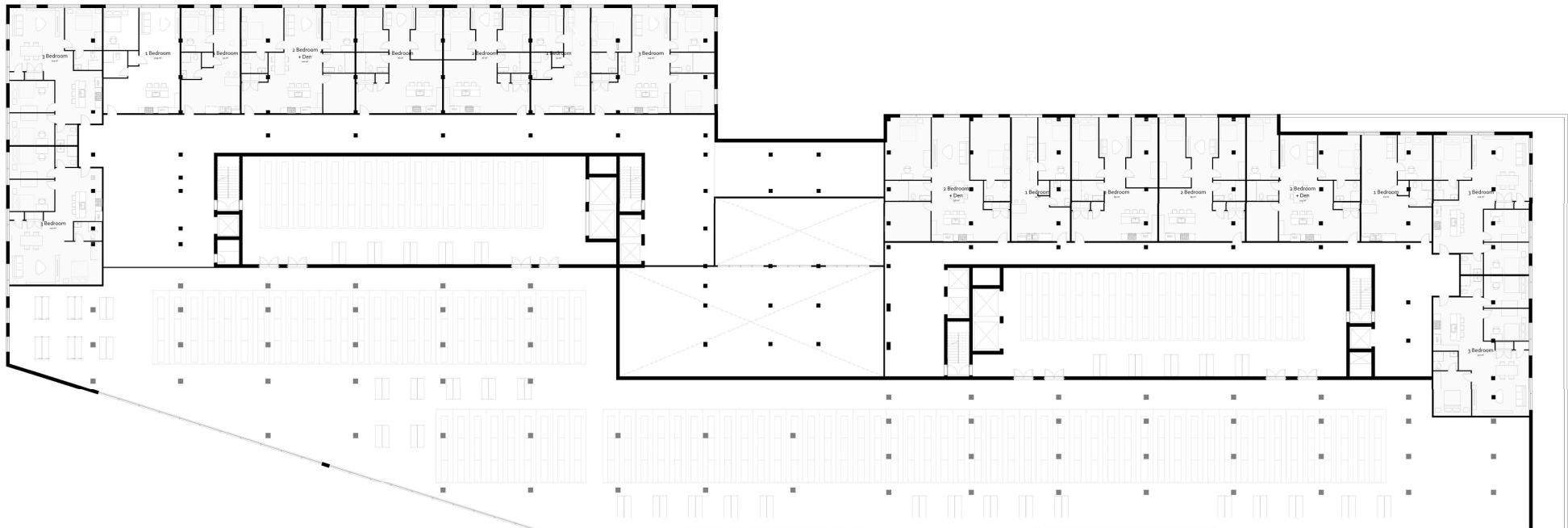
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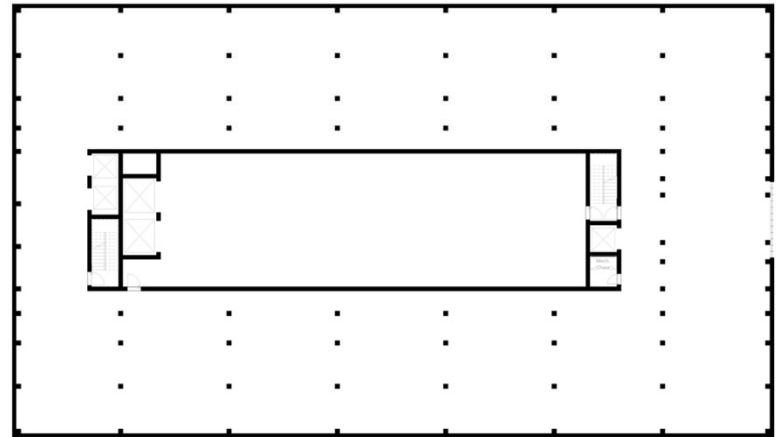
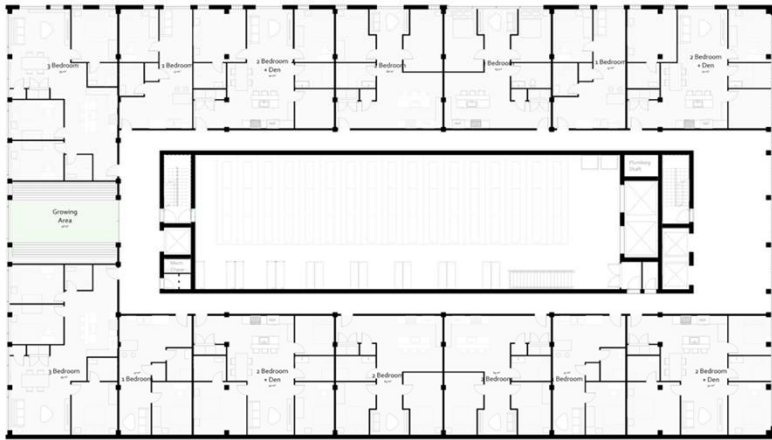
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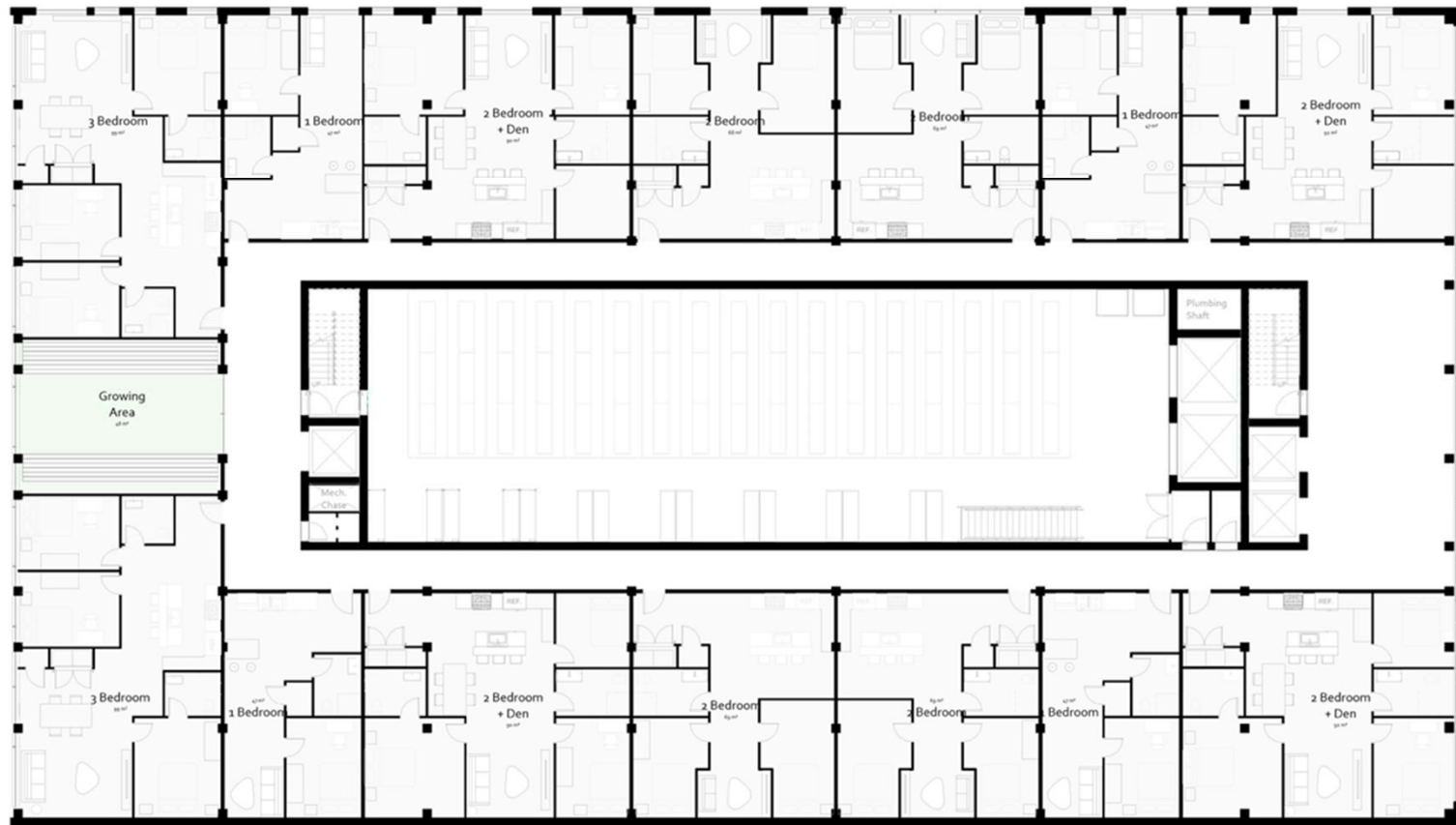
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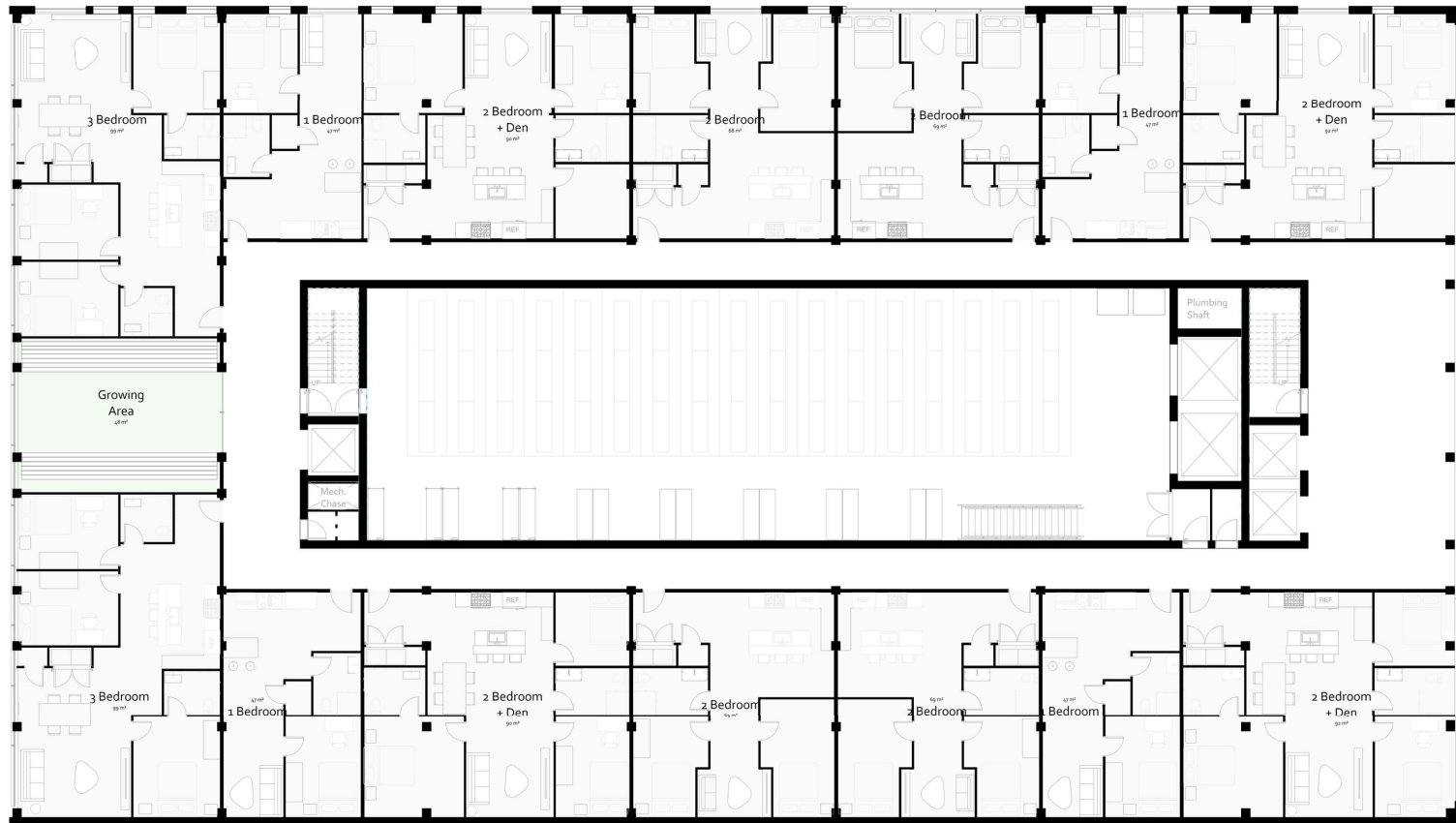
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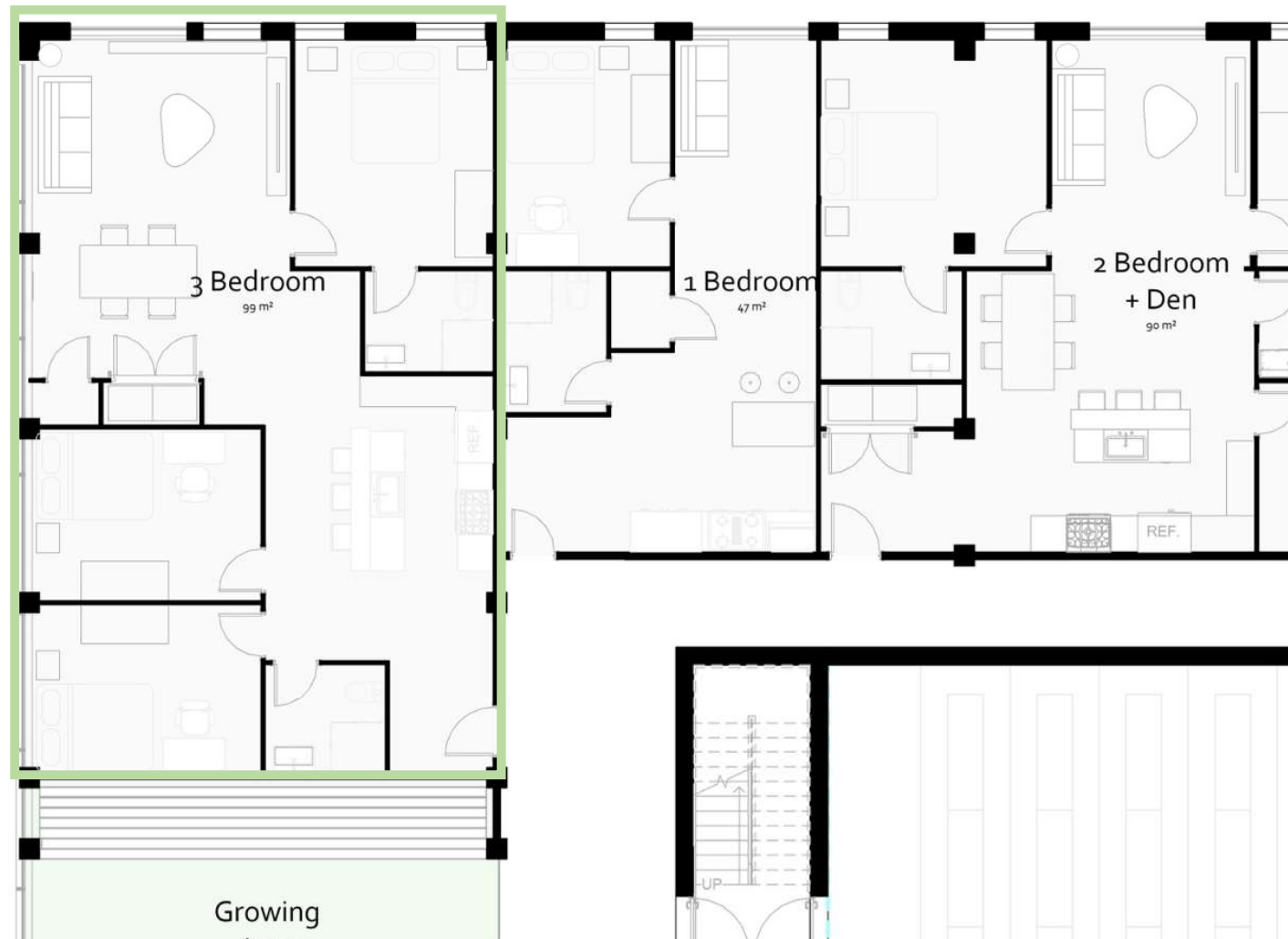
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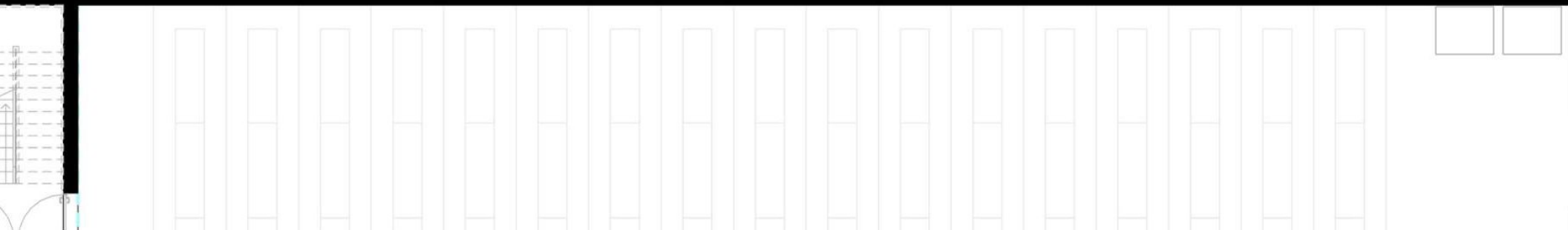
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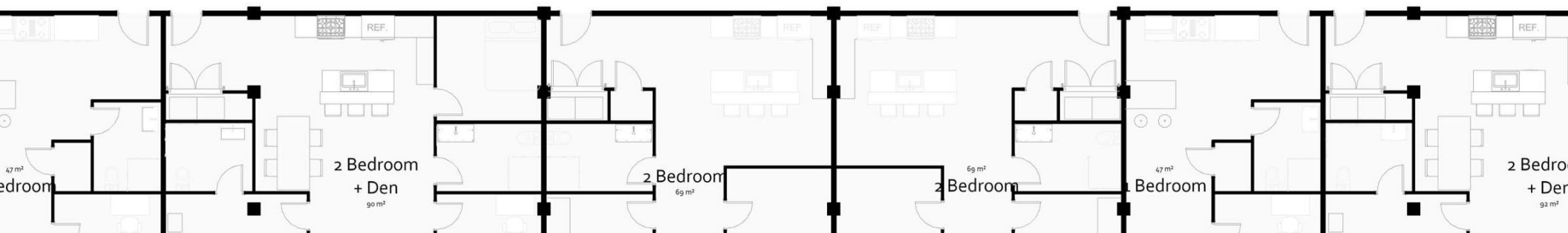
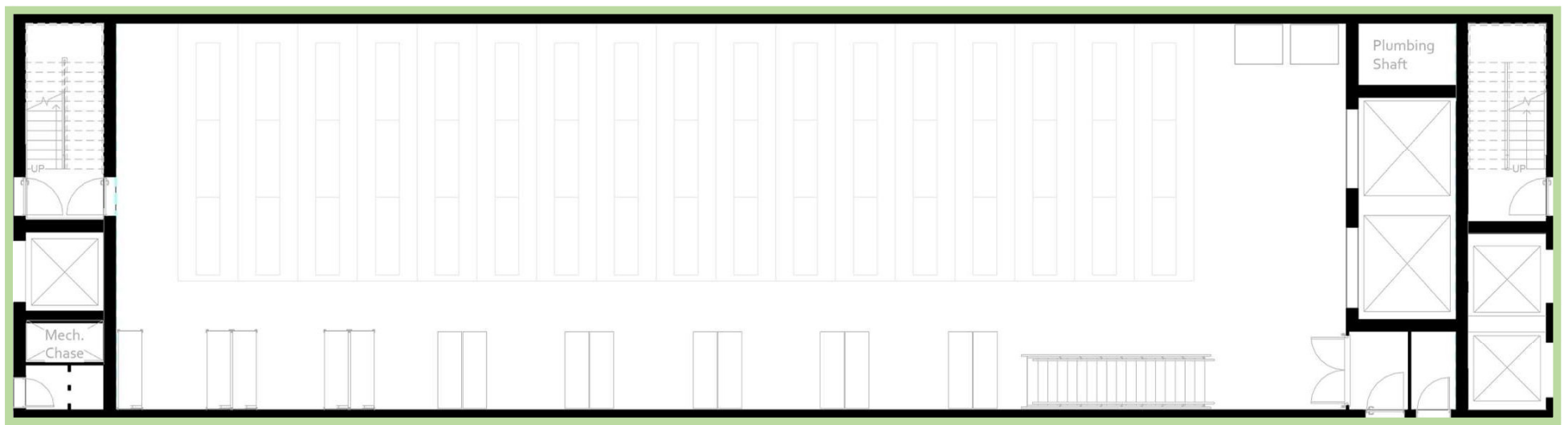
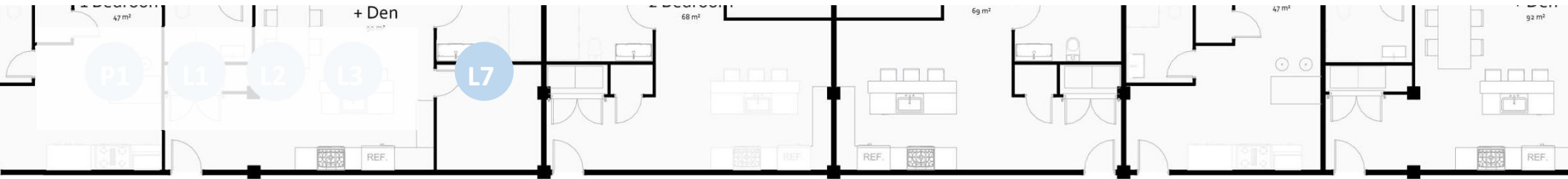
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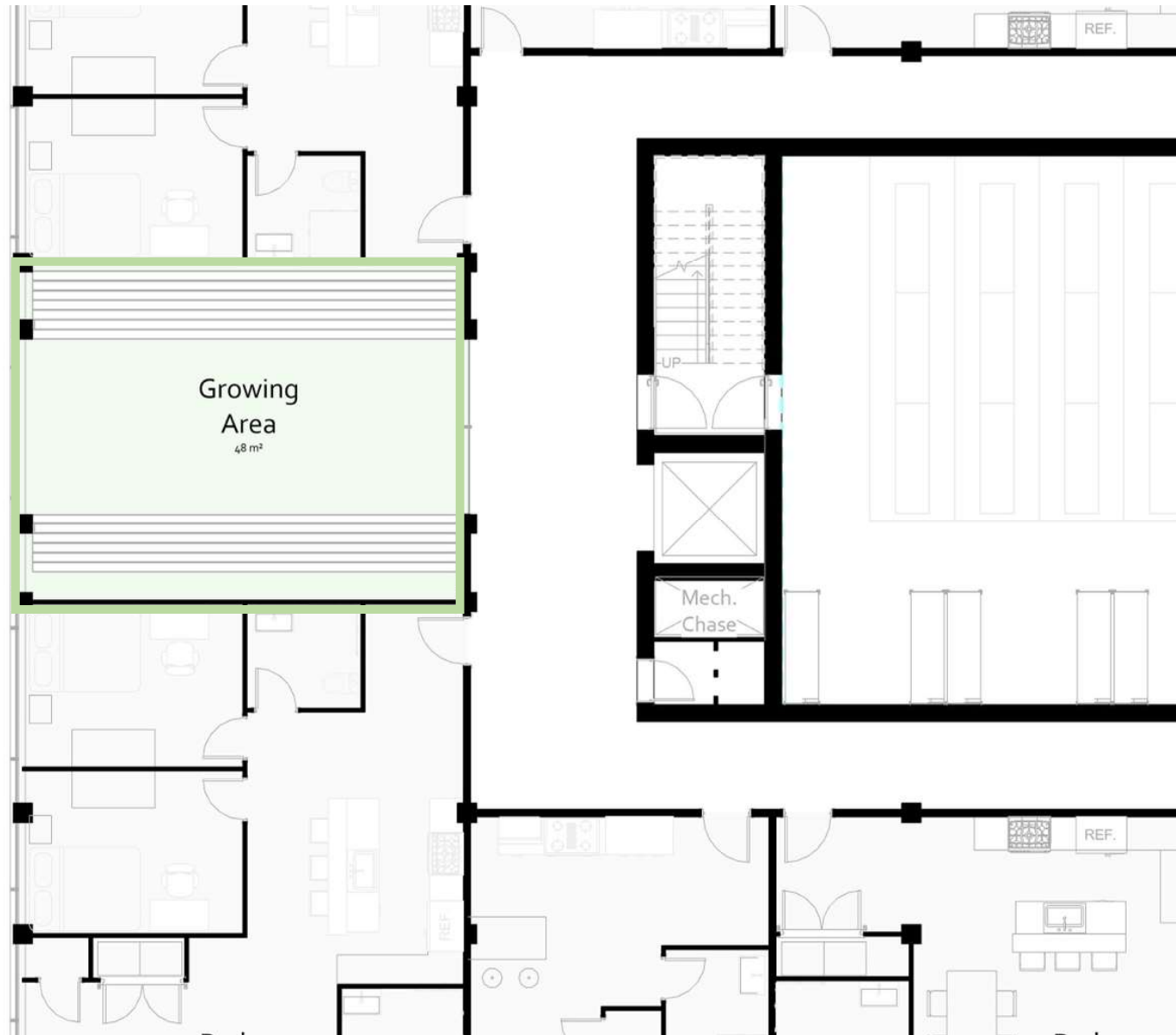
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L2

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L7





***5 second break**

Introduction

Spatial Design

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Facade

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*Facade

Type: *Curtain wall*

Challenge: *High incident radiation*

Solution: *Solar shades*

Incident Radiation: $126,419.7 \frac{kWh}{m^2}$



*Facade

Type: *Curtain wall + Curtain wall*

Challenge: *Moderate incident radiation*

Solution: *Diversified geometry*

Incident Radiation: $119,173 \frac{kWh}{m^2}$

Improvement : -6%



Type: *Curtain wall + Solar Shade*

Challenge: *Moderate incident radiation*

Solution: *Diversified geometry*

Incident Radiation: $119,173 \frac{kWh}{m^2}$

Improvement : -6%



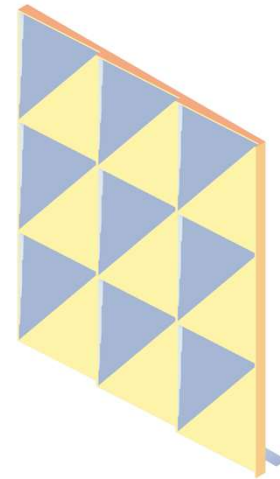
Type: *Closed-cell wall + Solar Shade + Geometry*

Challenge: *Construction*

Solution: *Incorporate repetitive design*

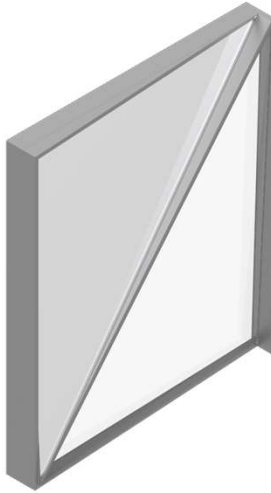
Incident Radiation: $86,408.1 \frac{kWh}{m^2}$

Improvement : -27.5%



*Facade

Closed-Cell Façade?



*Facade

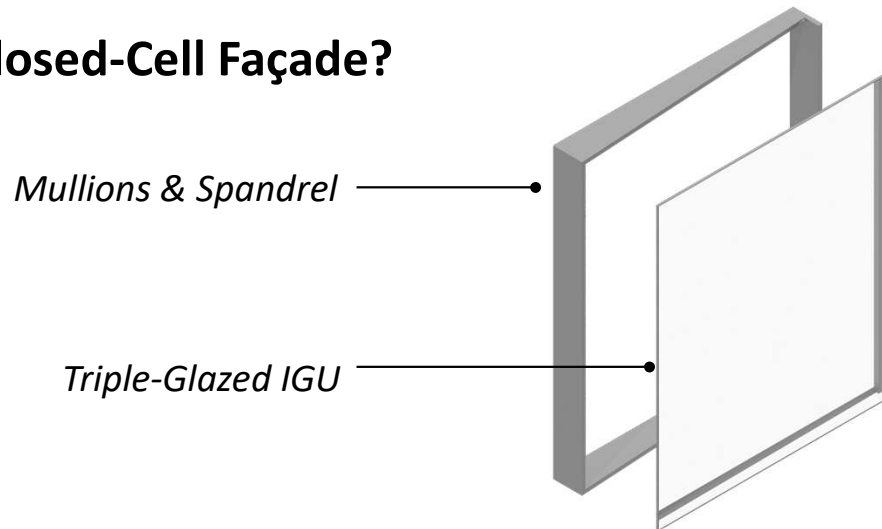
Closed-Cell Façade?

Mullions & Spandrel



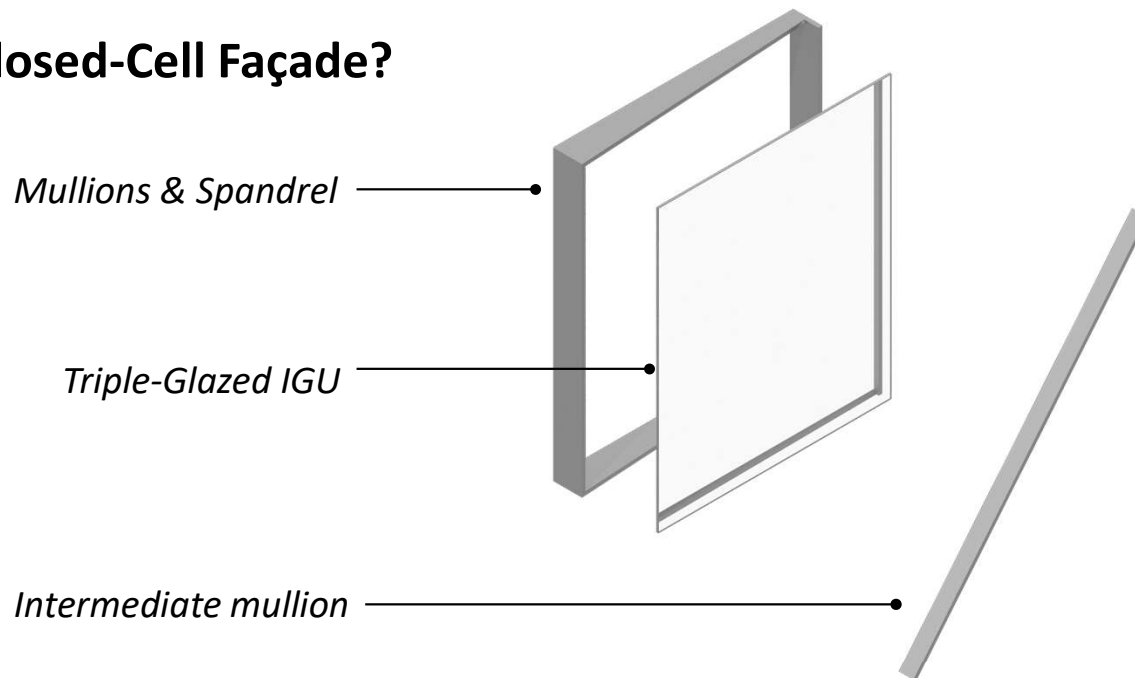
*Facade

Closed-Cell Façade?



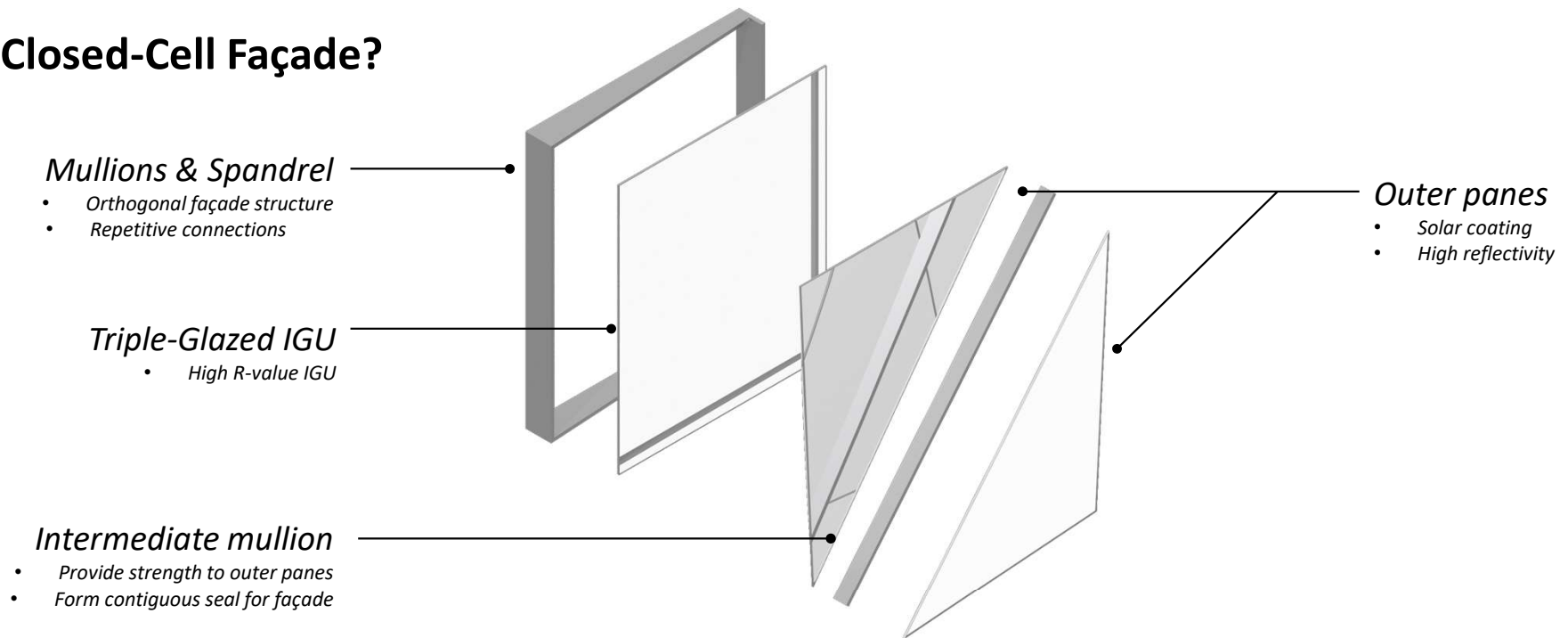
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Closed-Cell Façade?

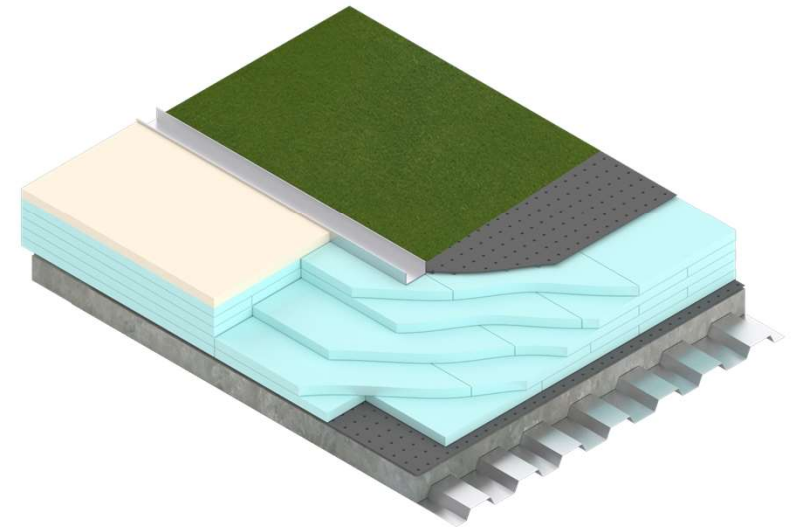
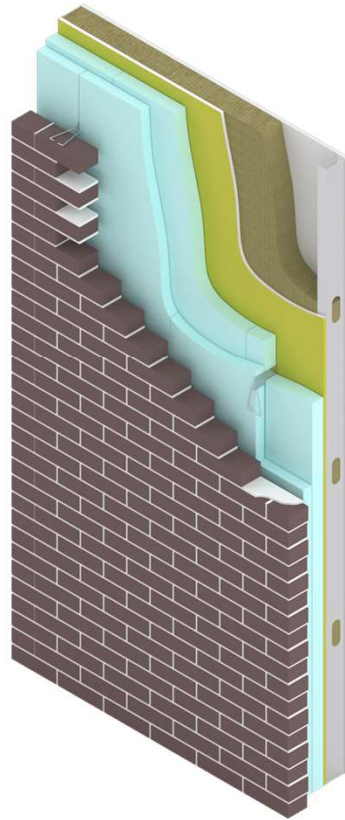
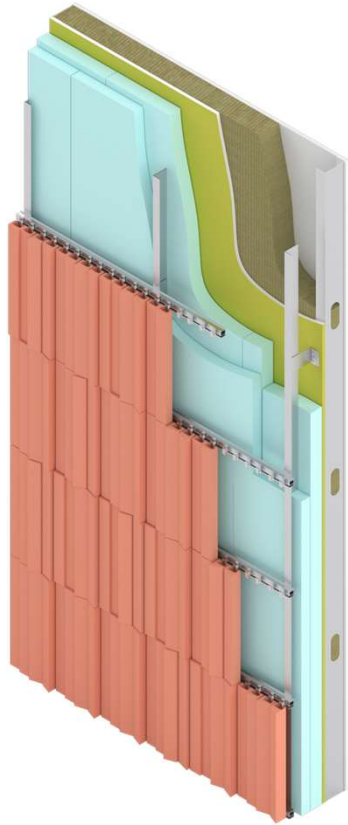


* Facade

Closed-Cell Façade?



* Facade





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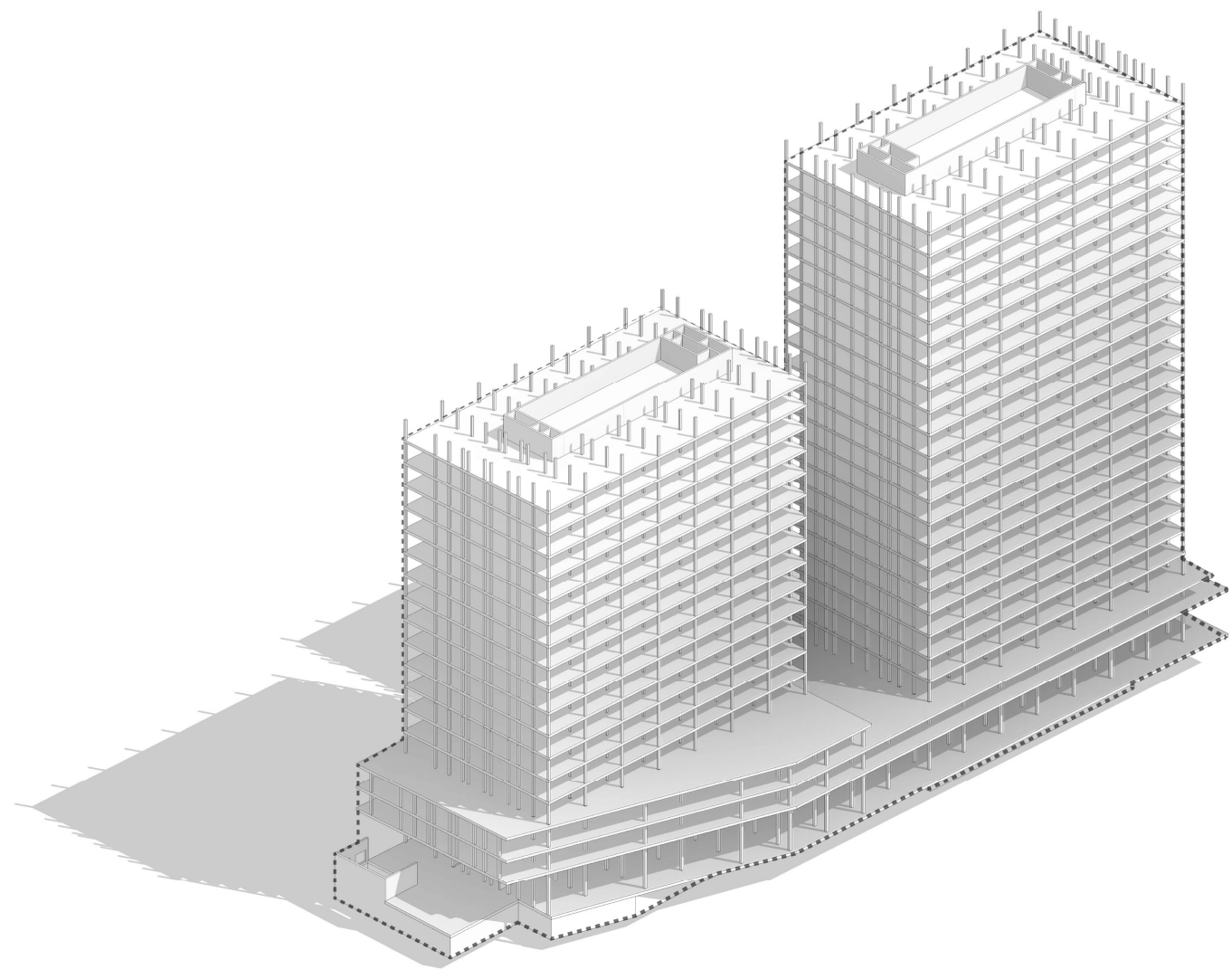
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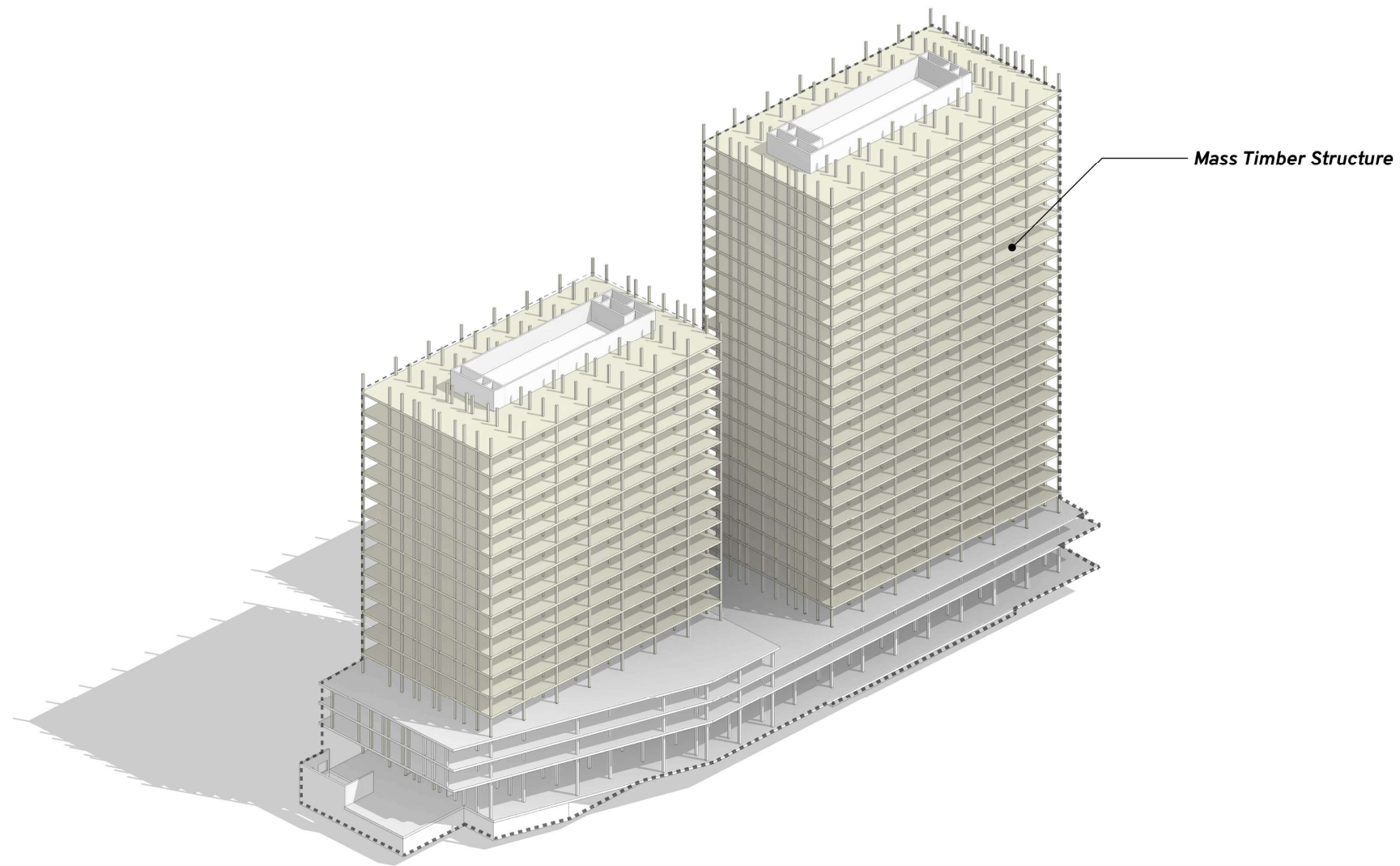
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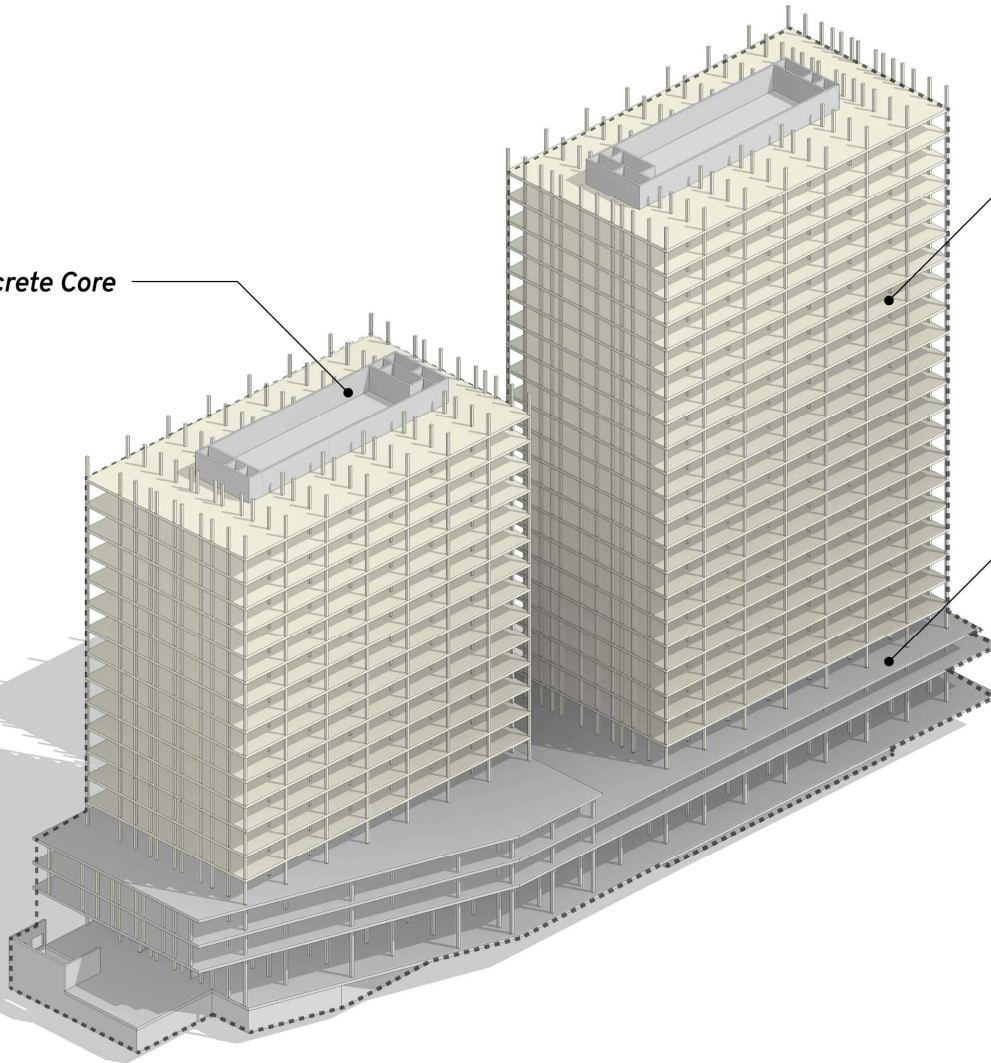


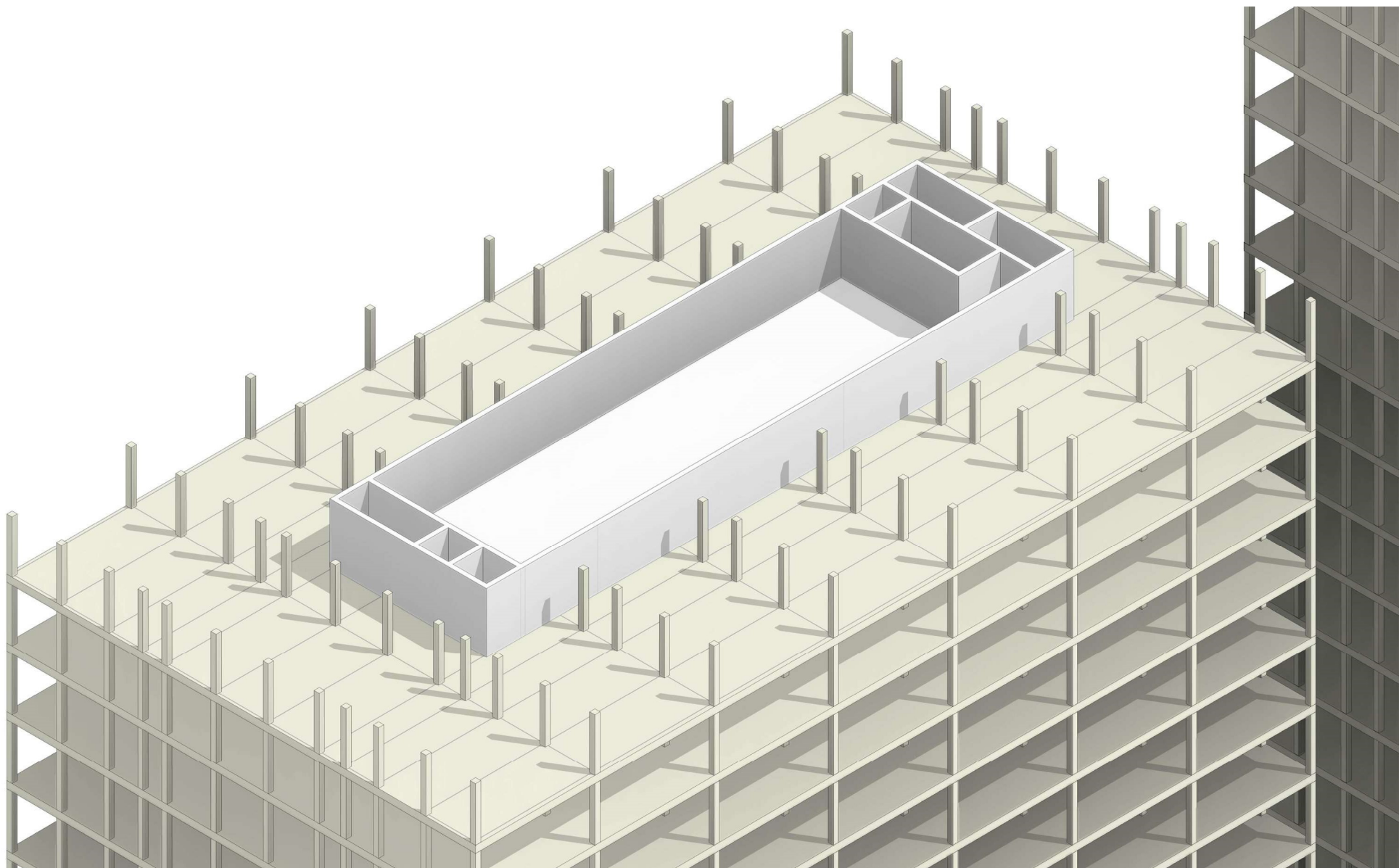


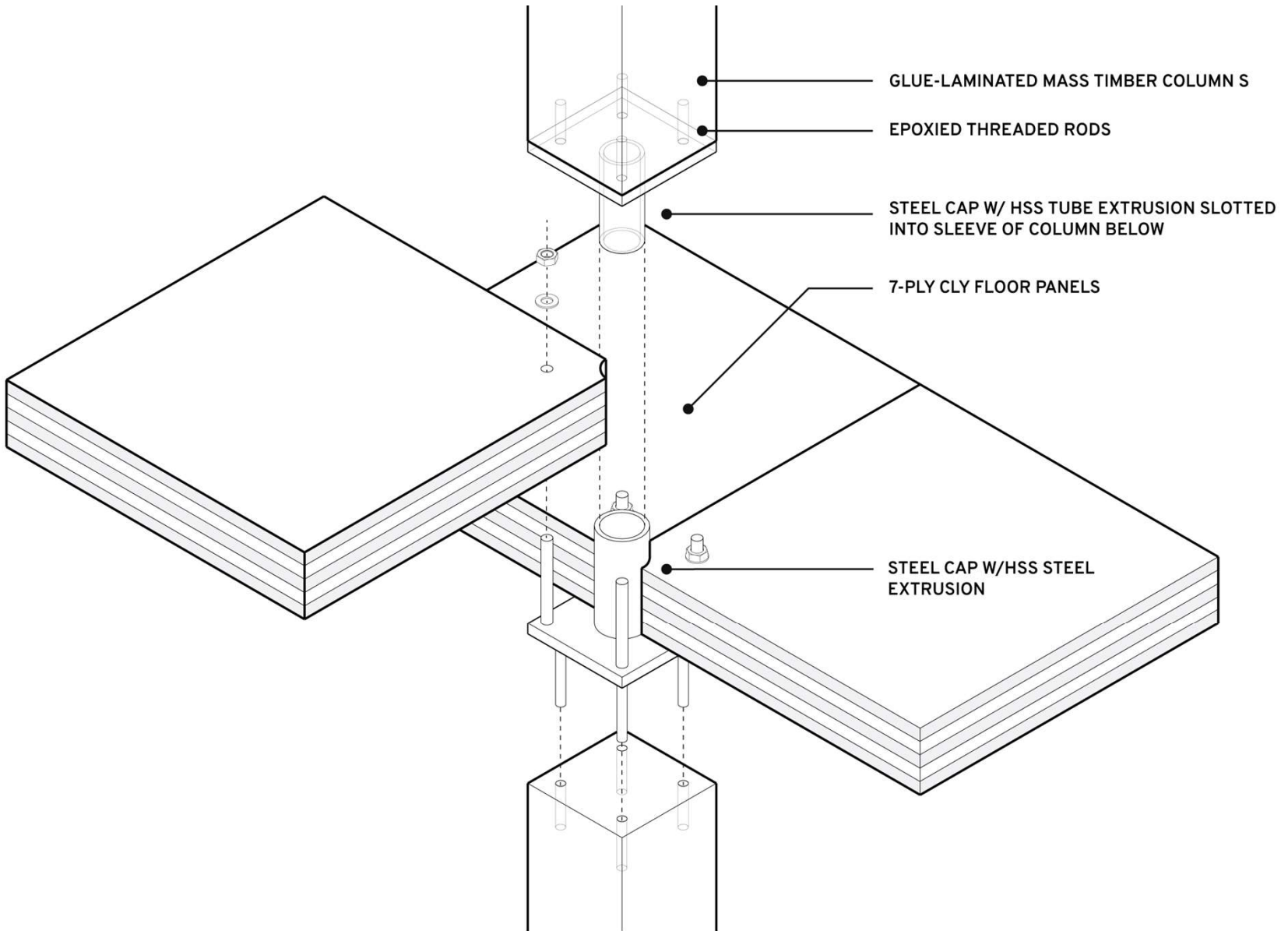
Concrete Core

Mass Timber Structure

Concrete Podium - Flat Slab System







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*Crop Production

For the top 13 most popular vegetables and fruits, the *average person was found to consume 167 pounds over one year.*

Based on the area of production and harvest season:

Pounds of lettuce per grow tower per harvest: **5.6 lbs /tower**

Harvests per year (harvested every 3 weeks): **17.3**

Number of pounds of produce per year per tower: **$17.3 * 5.6 = 97.1$ lbs/year**

Total number of growing towers: **63240**

Total pounds of produce per year: **$97.1 * 63240 = 6,138,495$ lbs/year**

With factoring in the pounds consumed by the average person over a year, the hydroponics area can grow enough produce to feed *36,650 people per year.*



Building Footprint : 400m²

Total Floor Area : 400m² * 10 Levels = 4,000m²

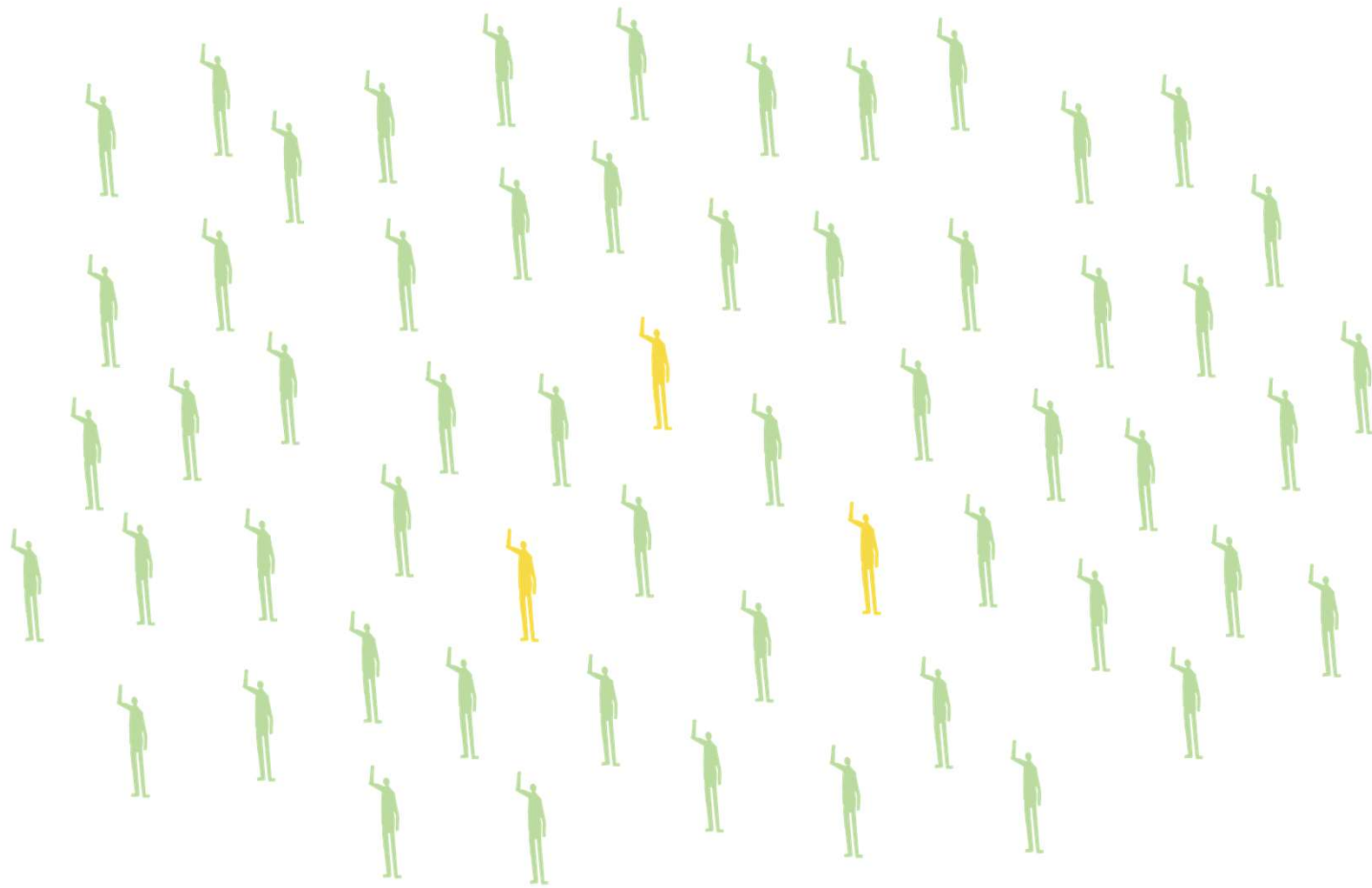
Growing Area : 4,000m² * 5 = 20,000m²

Productivity Factor : 20,000m² * 11 = 220,000m²

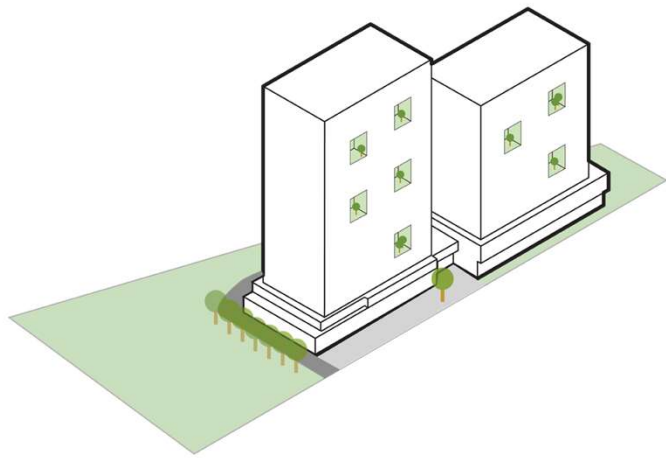
Farmland Equivalent = 220,000m²



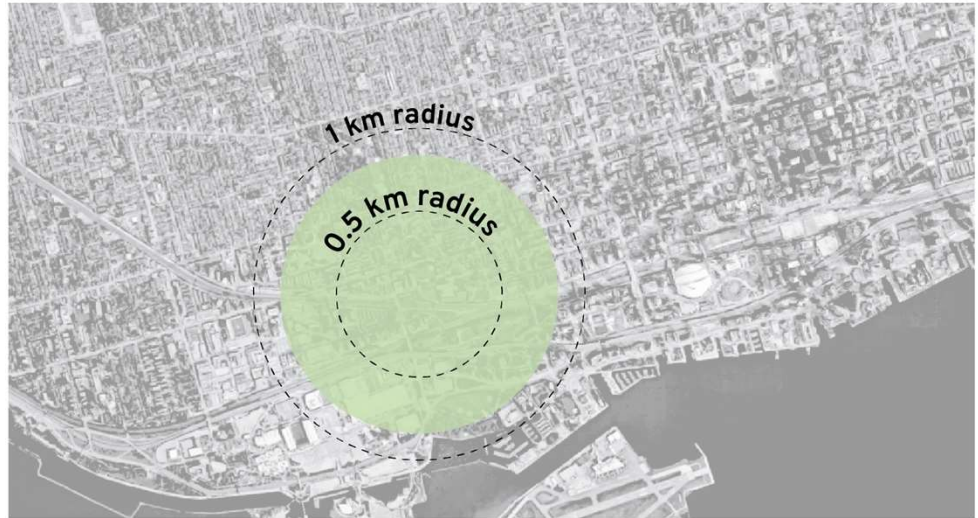
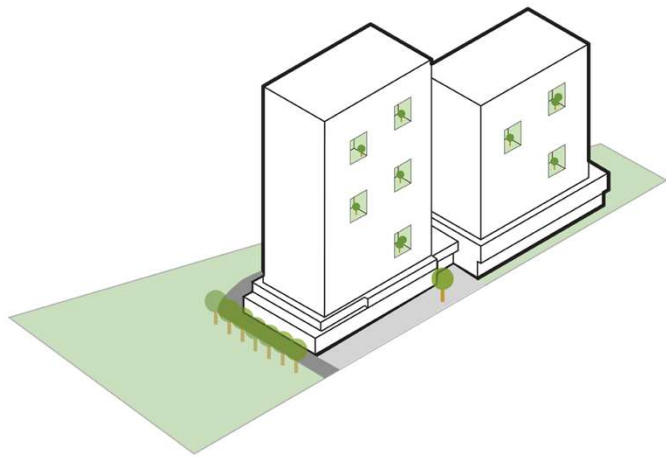
1,400 People



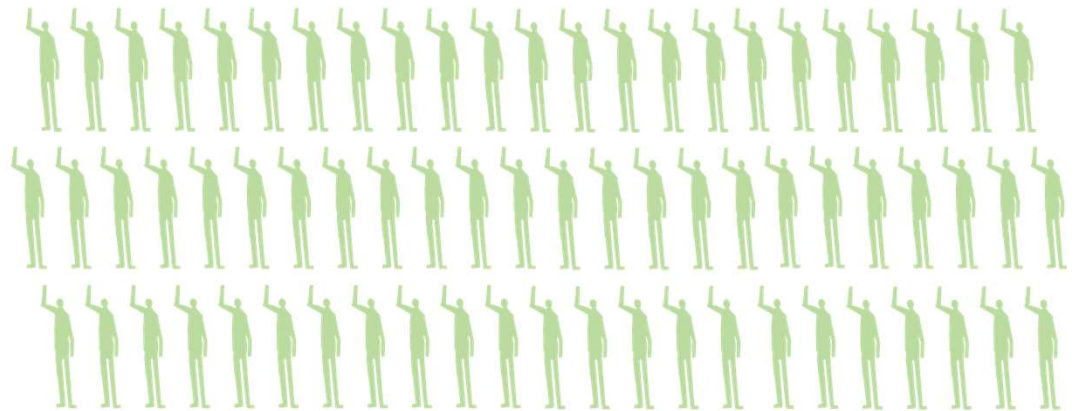
36,650 People



1,400 People

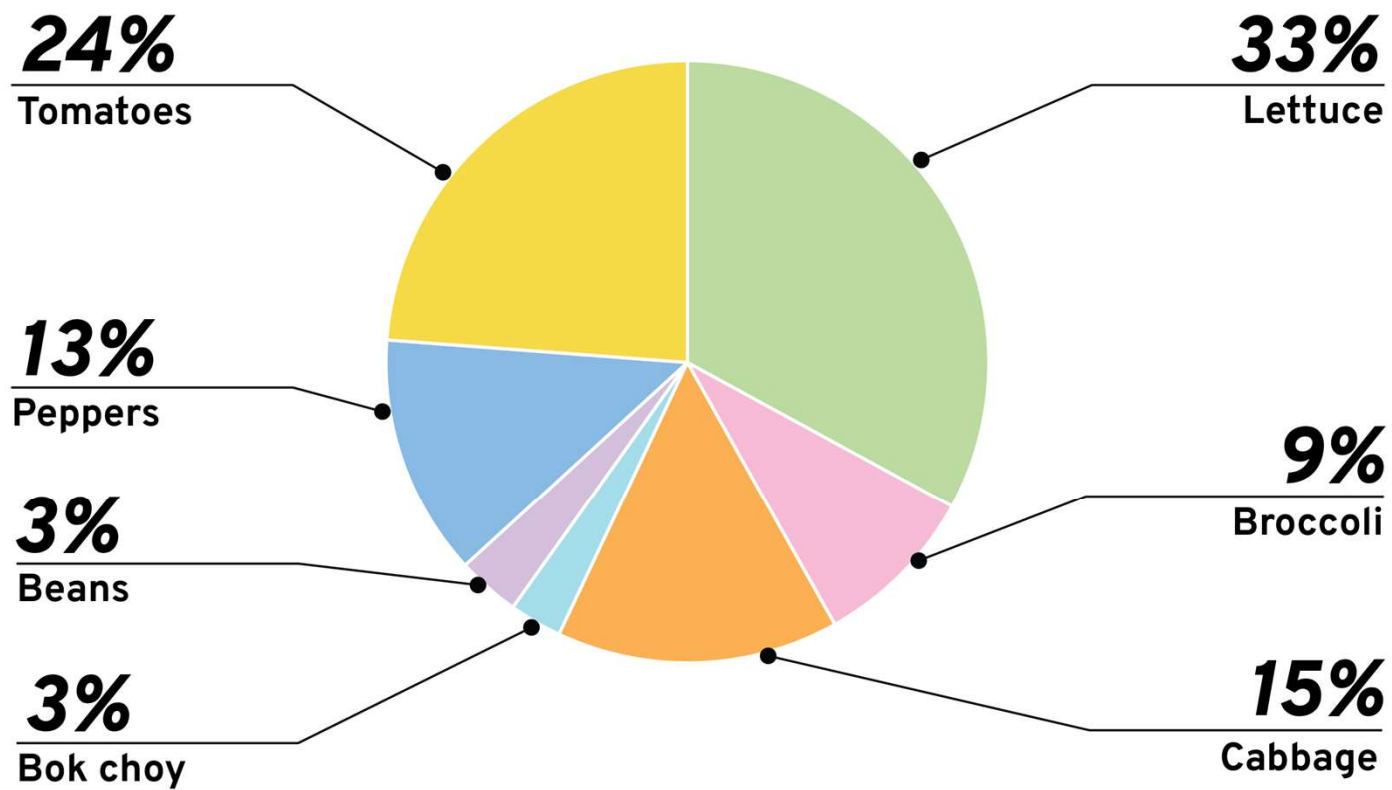


1,400 People

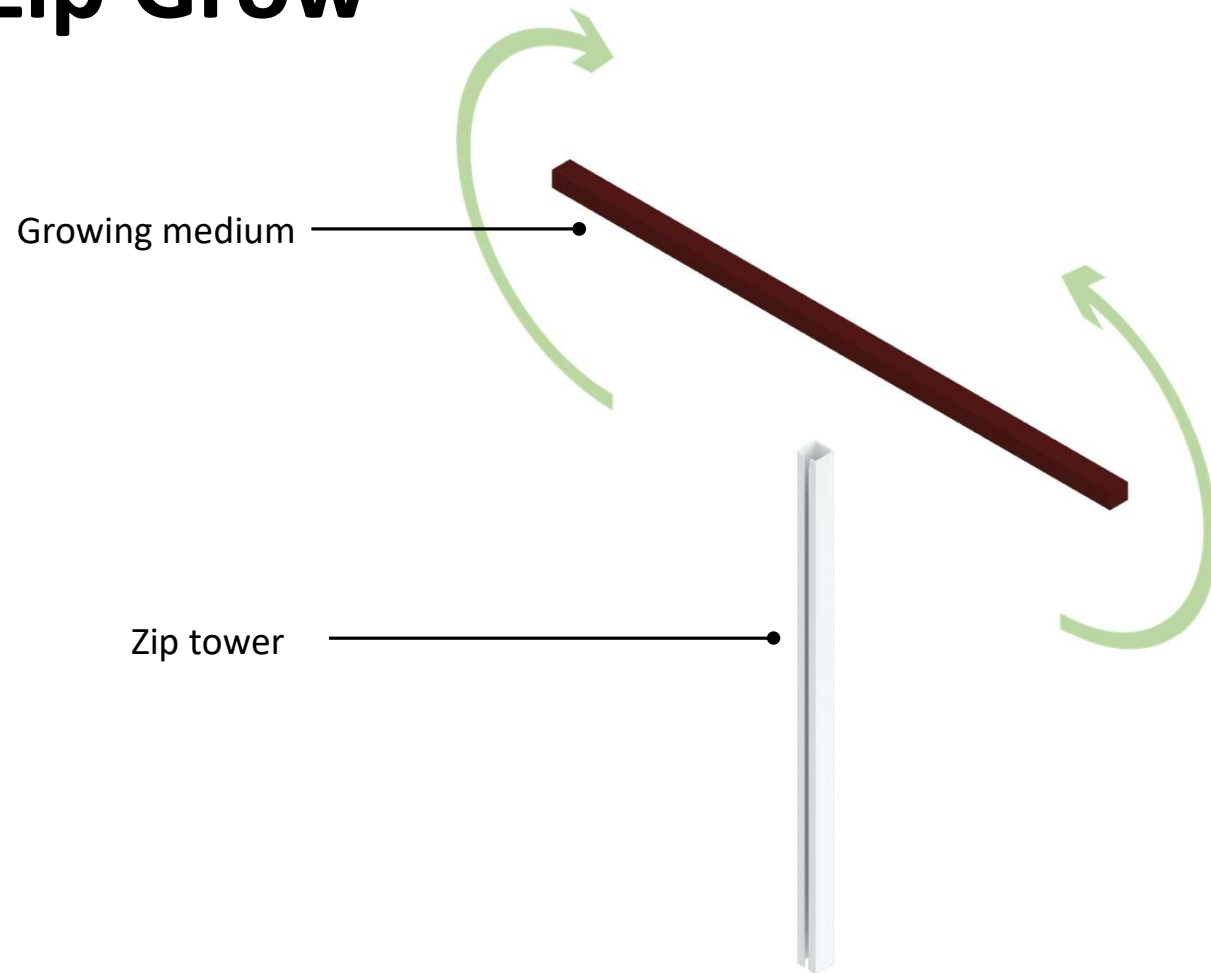


35,250 People

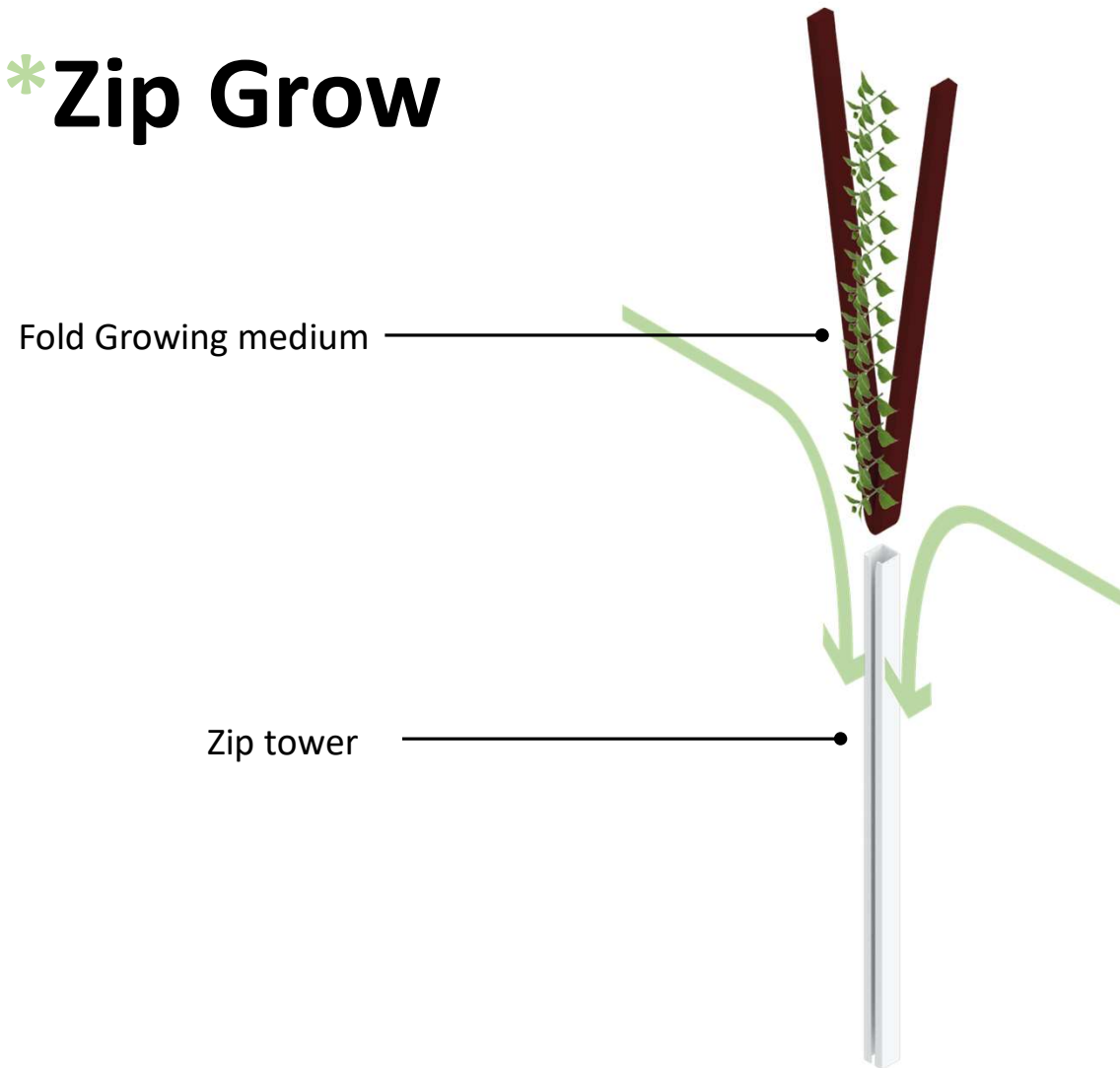
*Crop Production



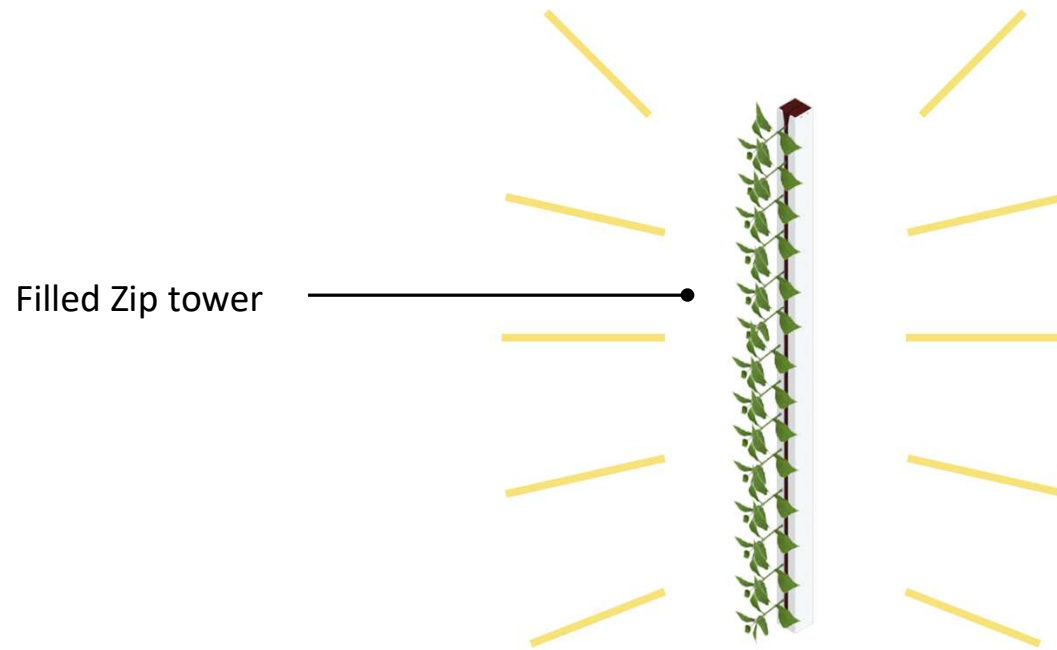
*Zip Grow



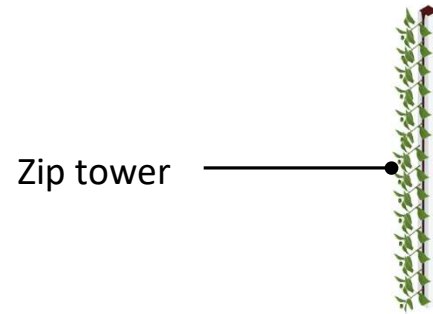
*Zip Grow



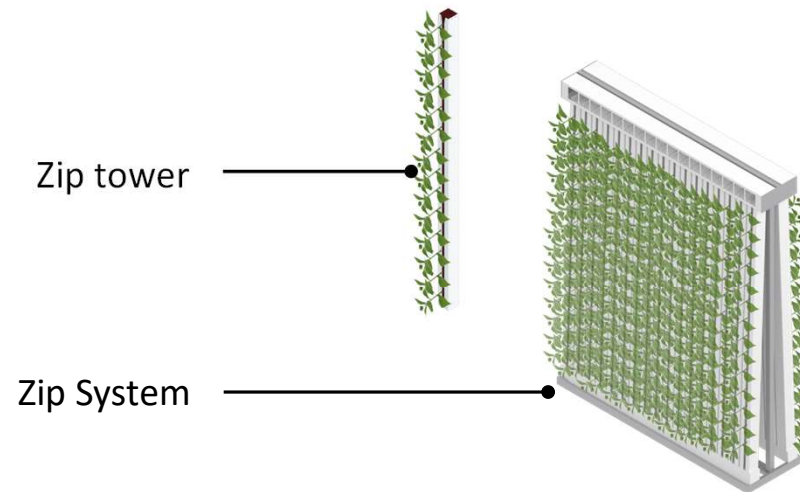
*Zip Grow



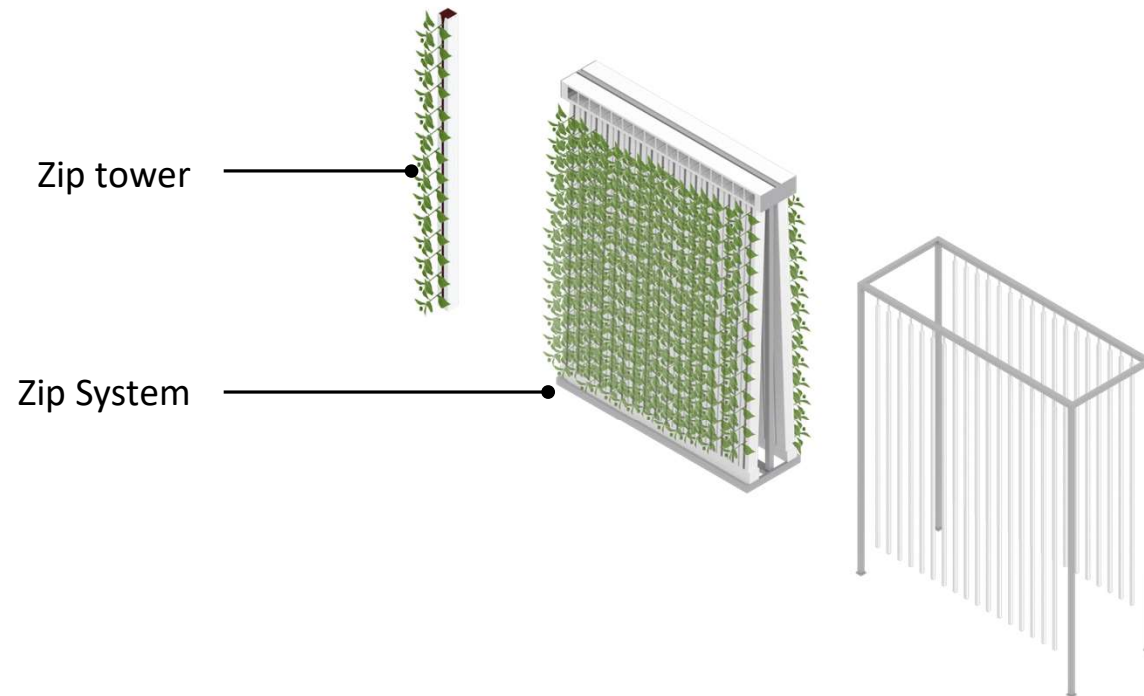
*Zip Grow



*Zip Grow



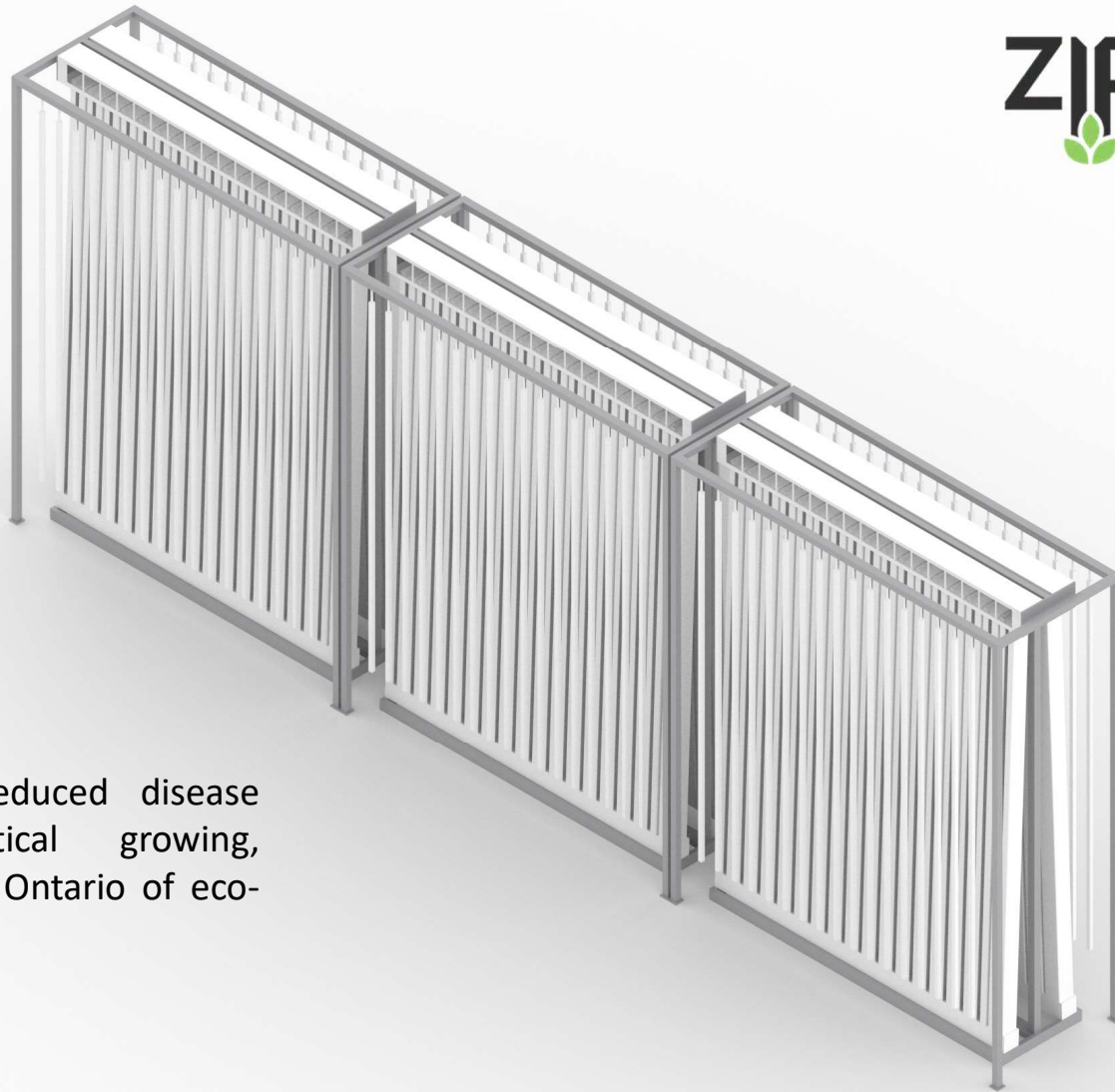
*Zip Grow





Why?

A small footprint, reduced disease spread, truly vertical growing, fabricated in Cornwall Ontario of eco-conscious materials



Introduction

Spatial Design

Objectives

Facade

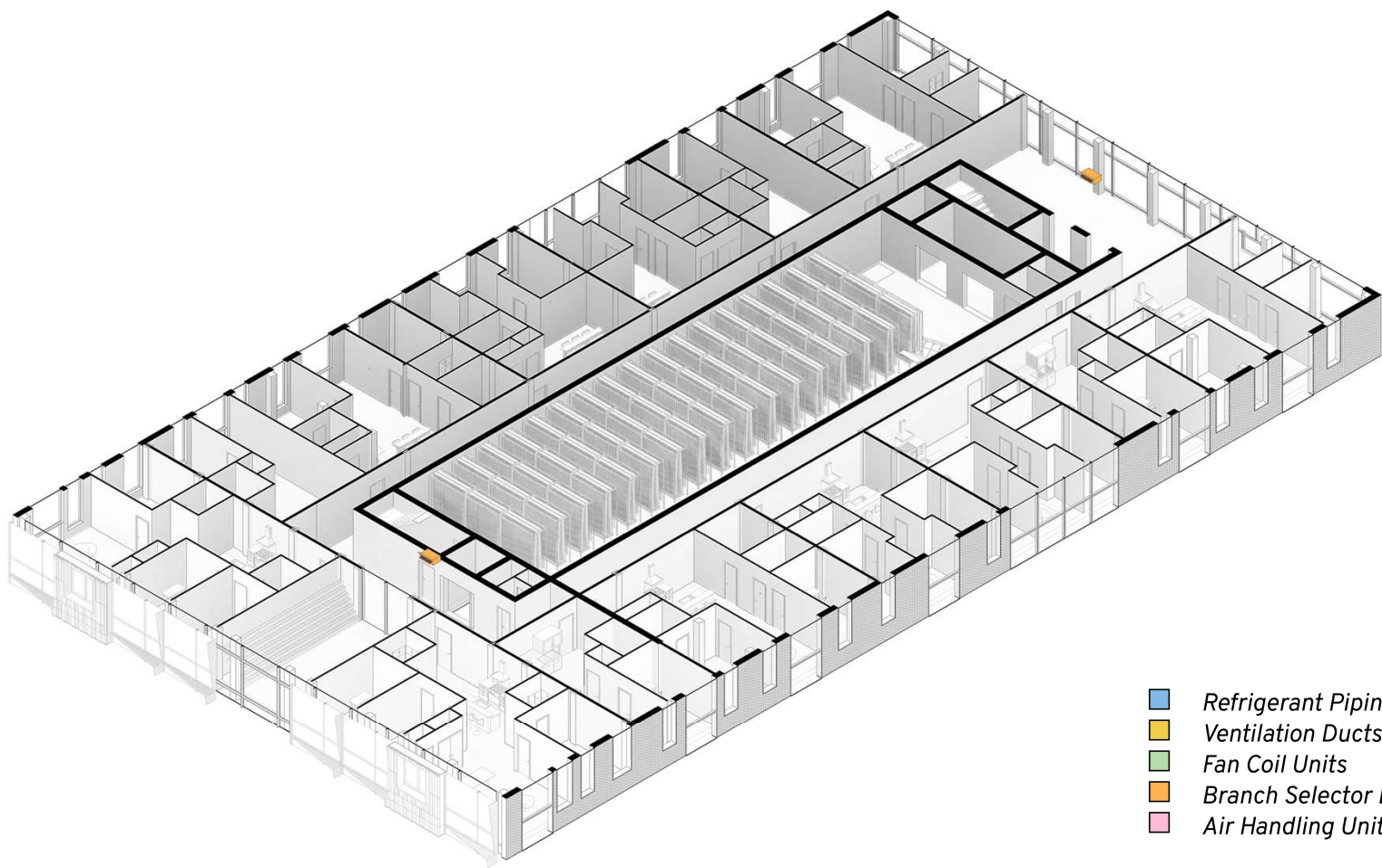
Site & Program

Structure

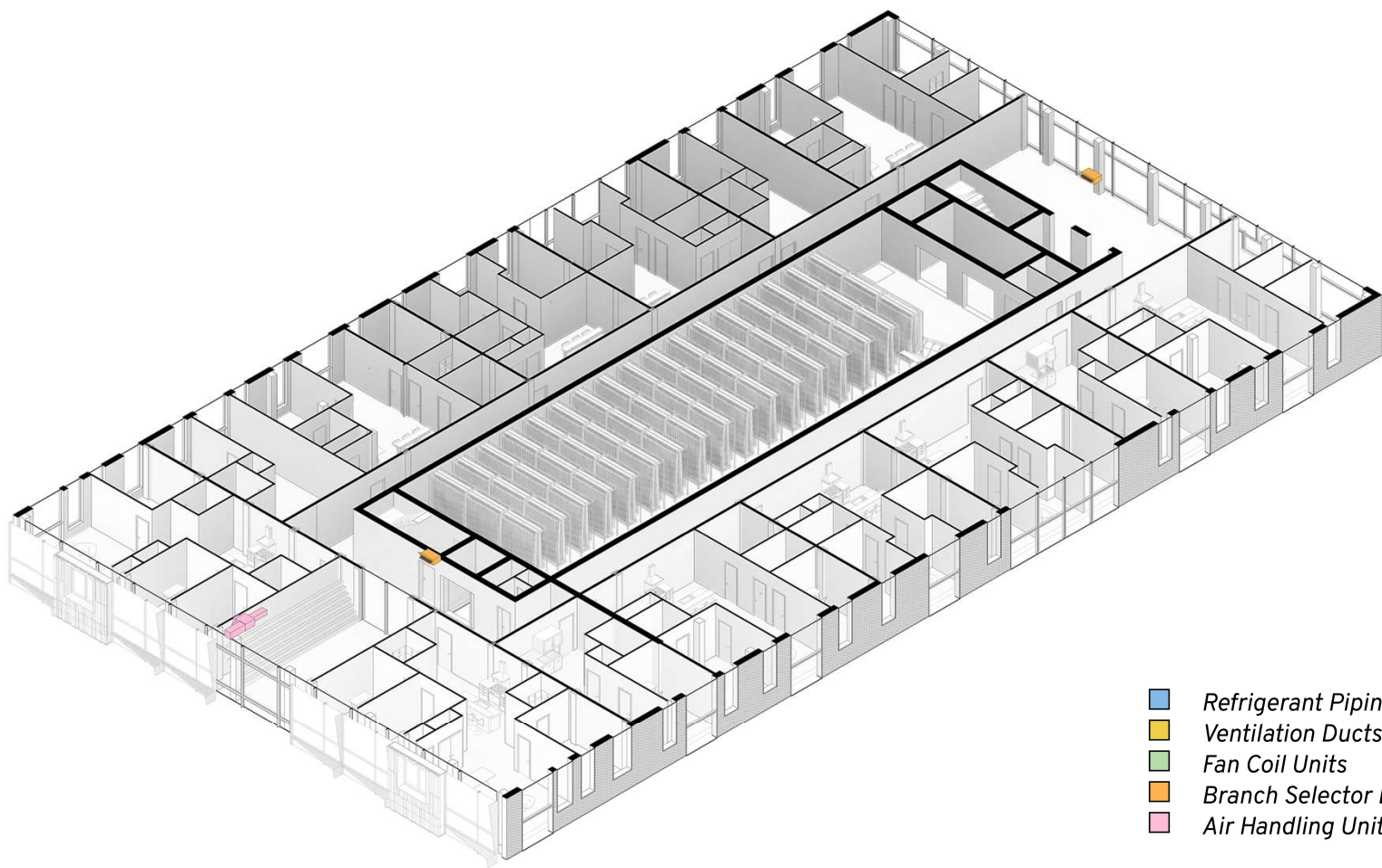
Farming

Design Updates

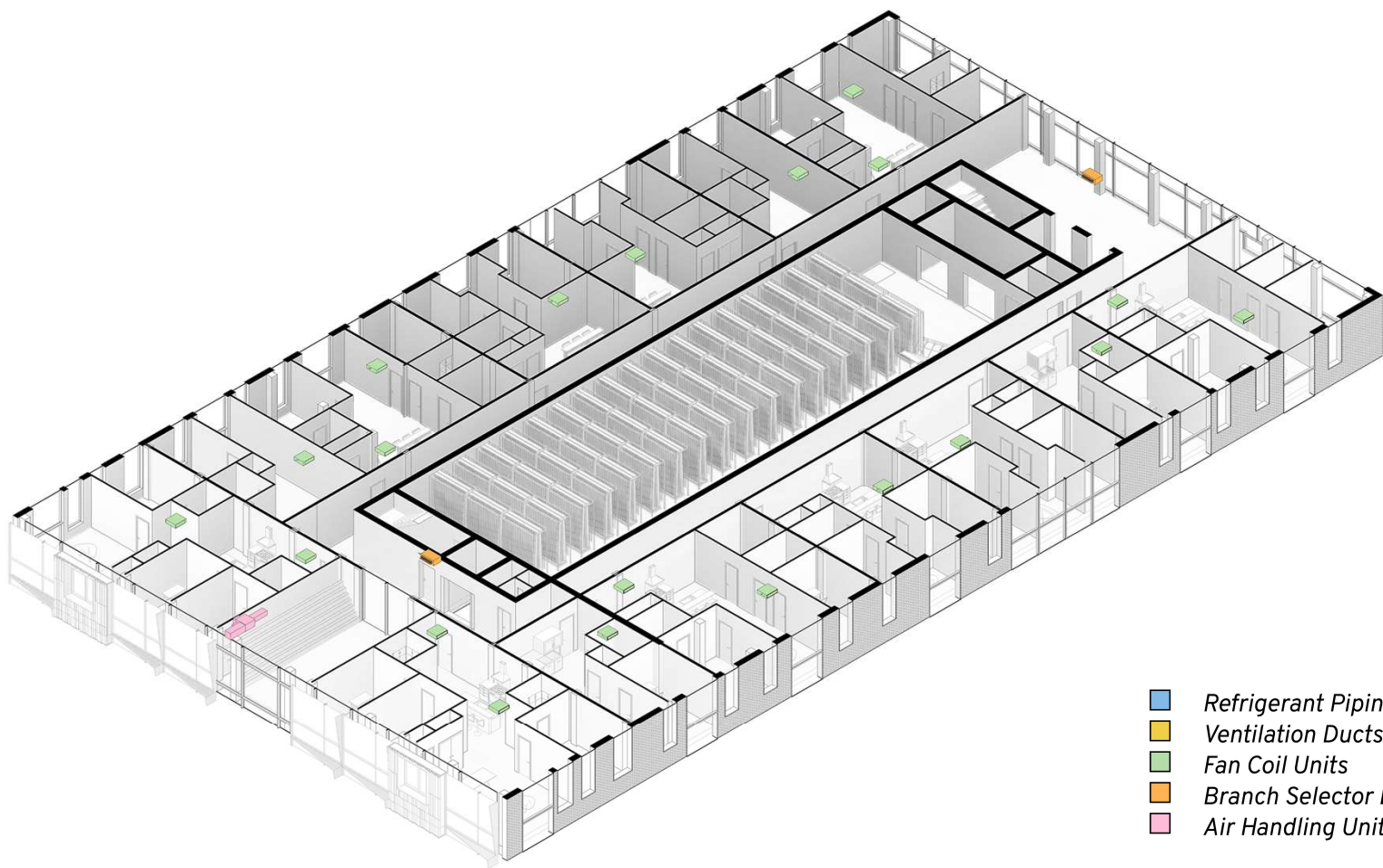
Systems



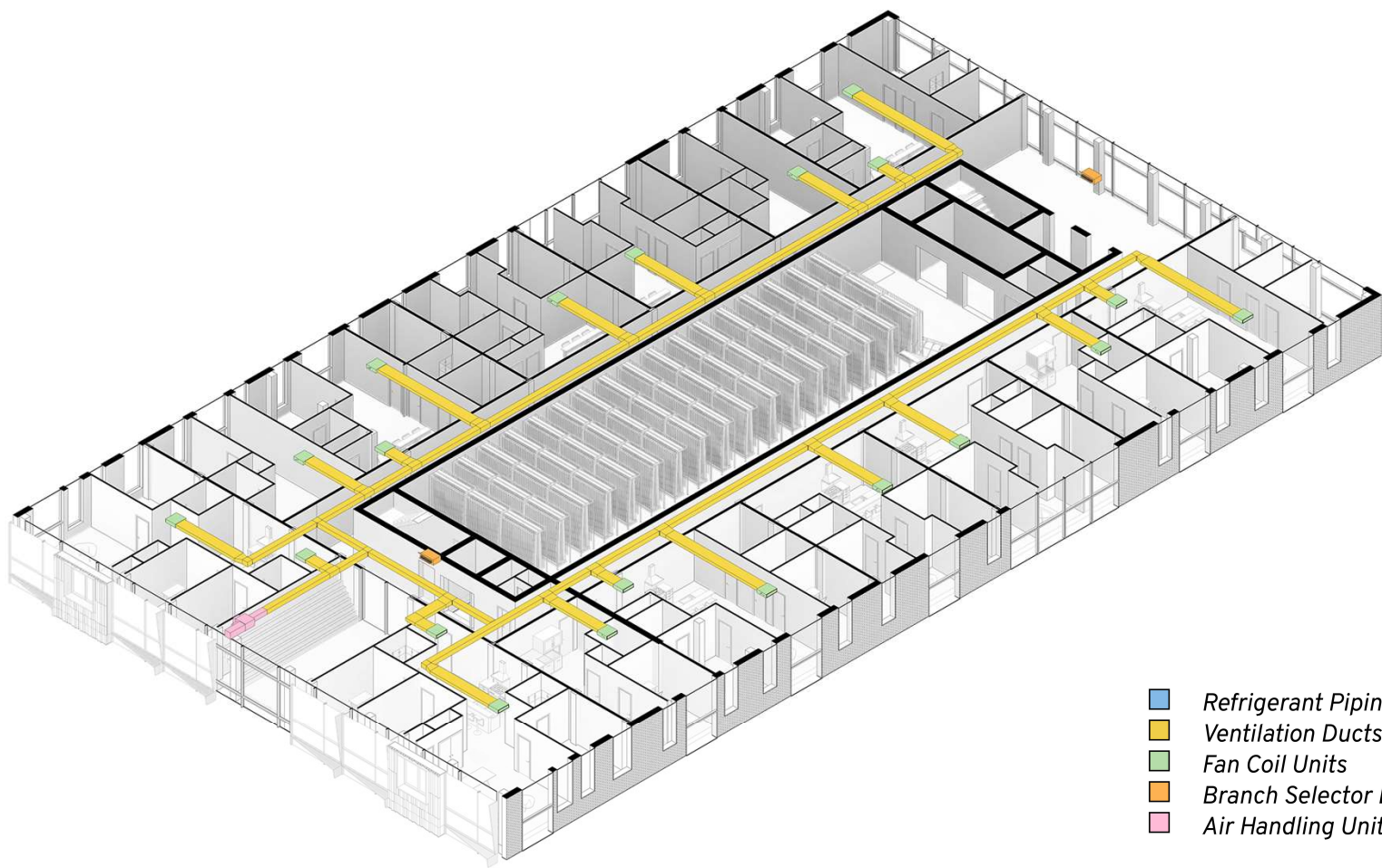
- Refrigerant Piping
- Ventilation Ducts
- Fan Coil Units
- Branch Selector Box
- Air Handling Unit



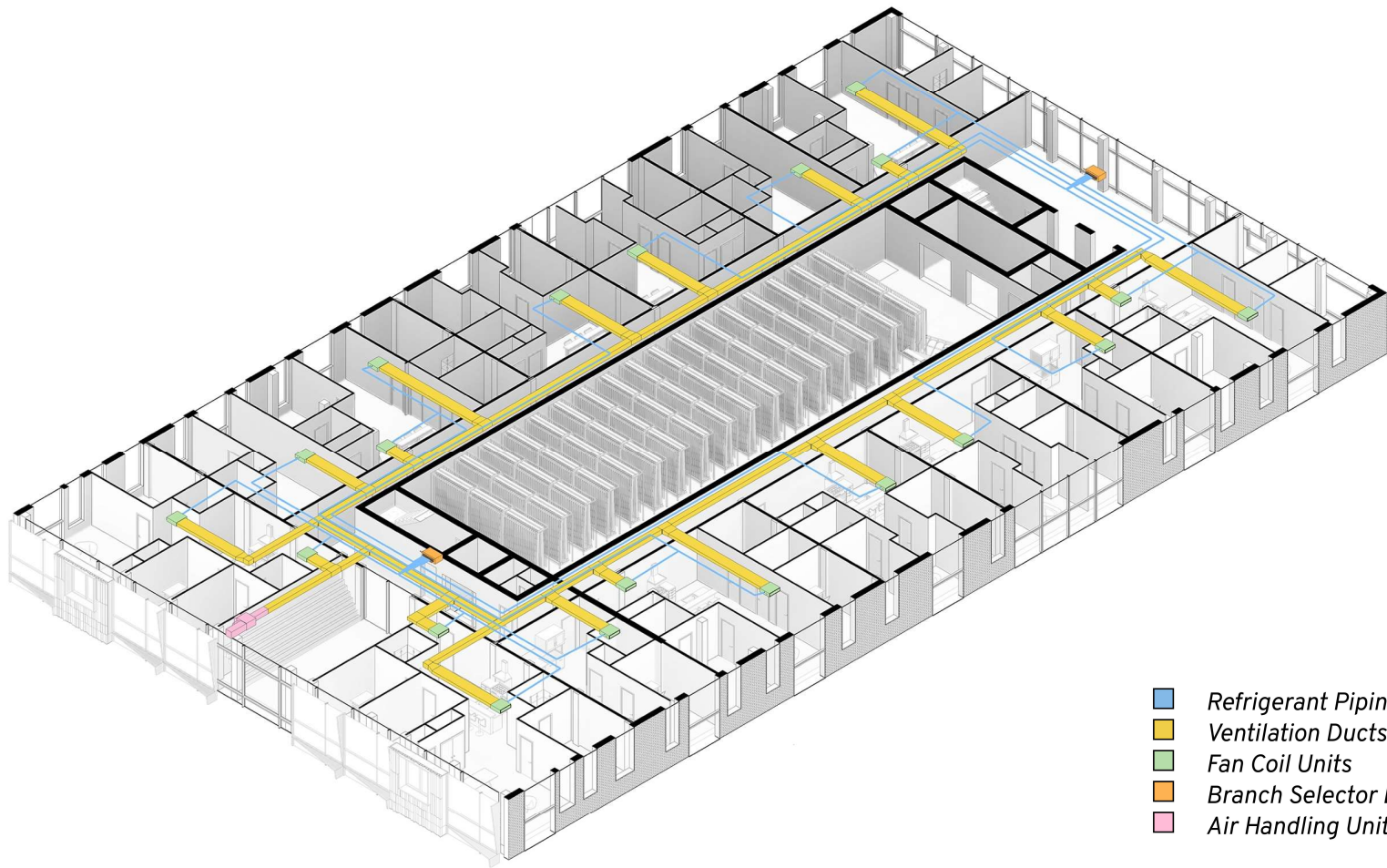
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The Farmhouse

*Studio 4.