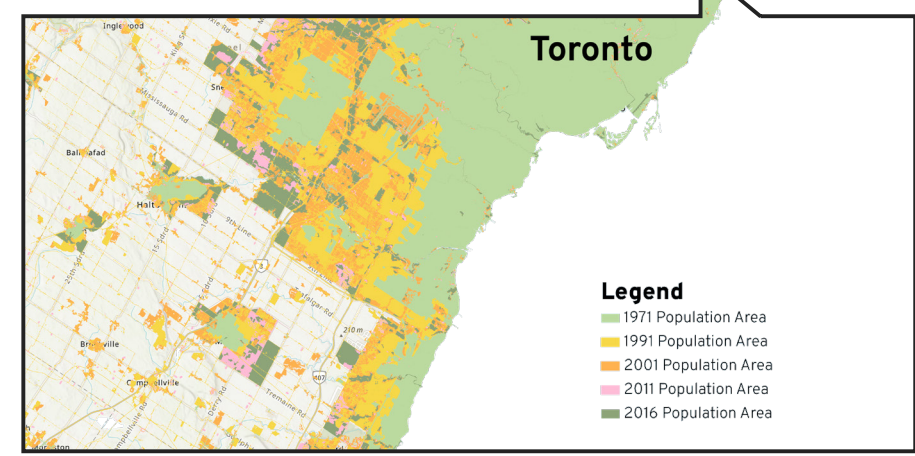


Global Food Supply

As cities continue to 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.** Cooperation between individual, producer, and greater community is essential to long term resiliency.

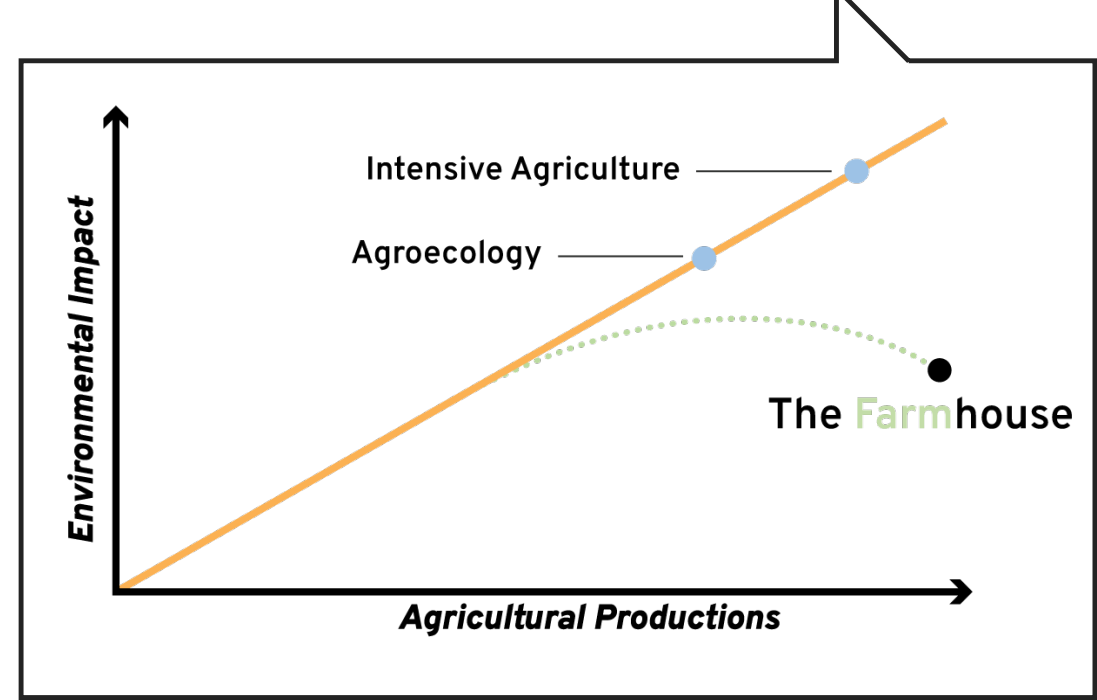
Urban Sprawl

Highway extensions, housing developments, and extreme weather events all contribute to the loss of prime farmland. The last 50 years have seen unprecedented wealth and the resulting housing boom. ***Rather than densify, the population has pushed itself further and further in-land.***



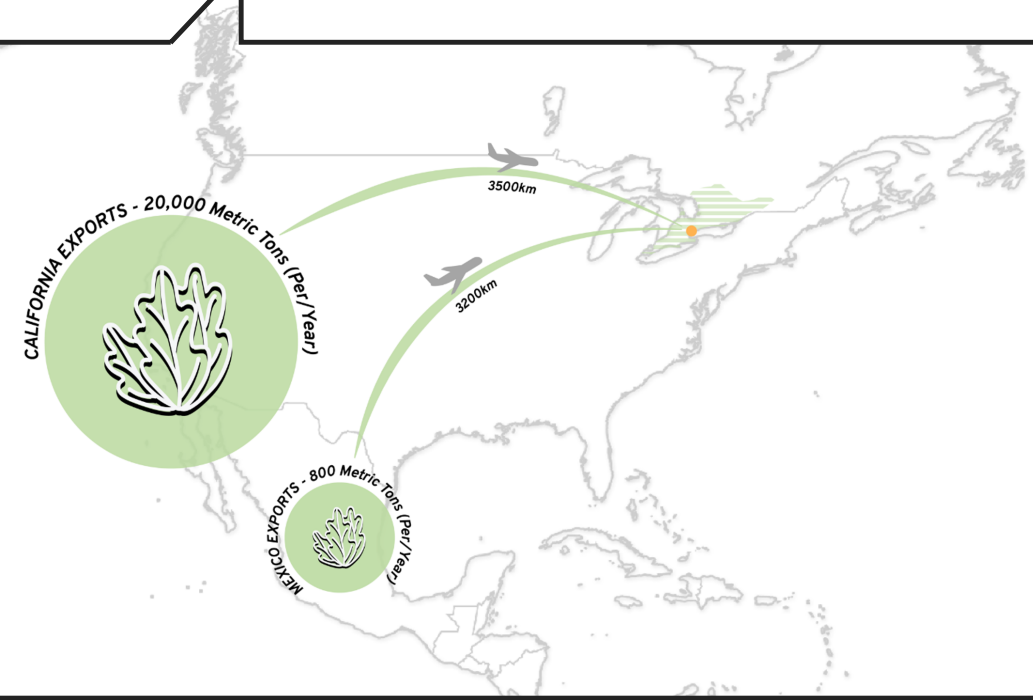
Agricultural Production

The failures of traditional agricultural practices could be summarized by their **inability to break the linear correlation between food production and negative ecological impact**. More ecologically-friendly farming methods suffer from a notable reduction in the volume of food production.

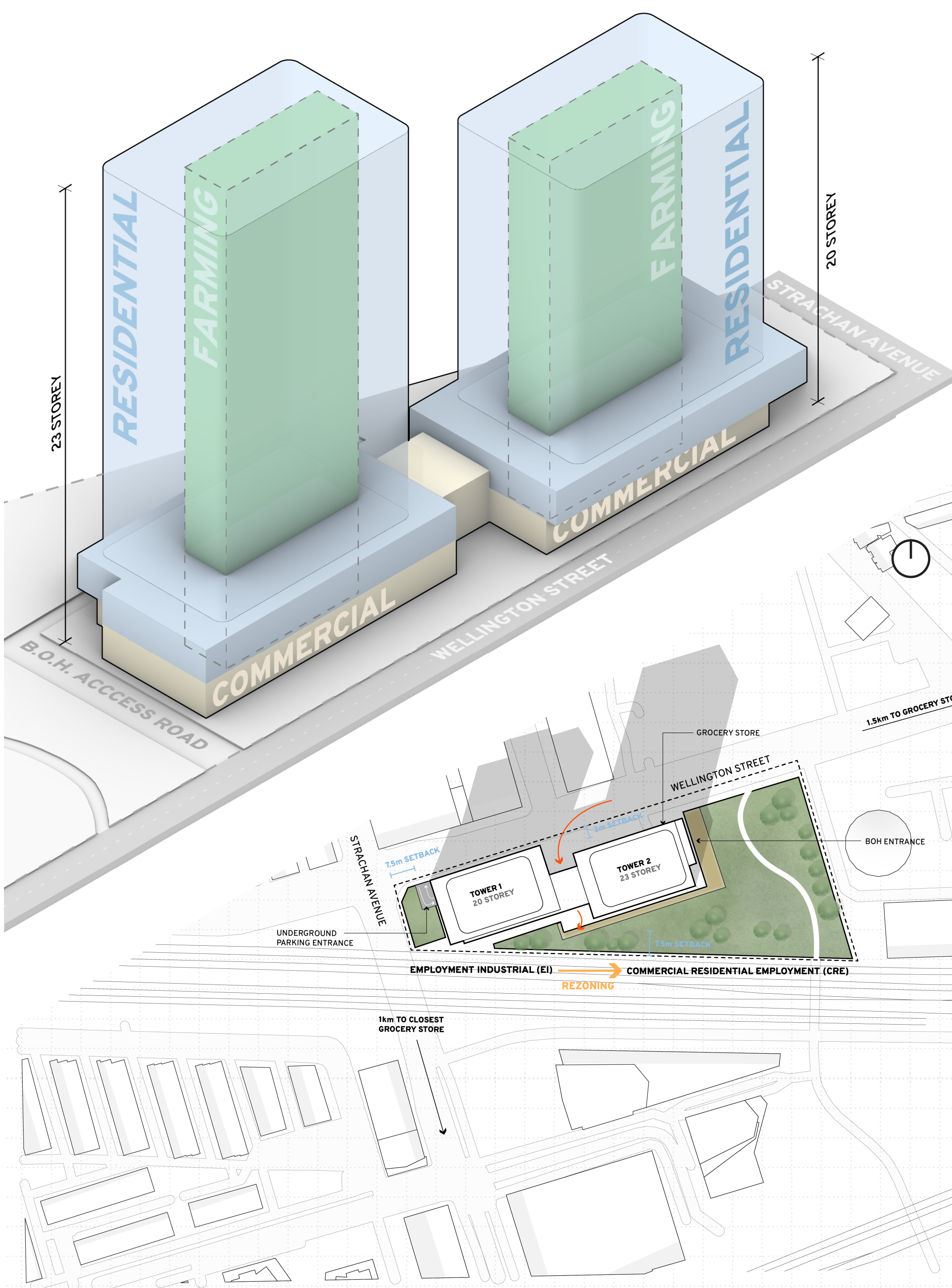


Embodied Carbon

Consumption patterns in many parts of the world **are not vernacular diets, they are not tailored to the seasons or local produce.** This results in the food consumed having high embodied carbon, especially considering the large distance to transport produce in an appropriate time span.

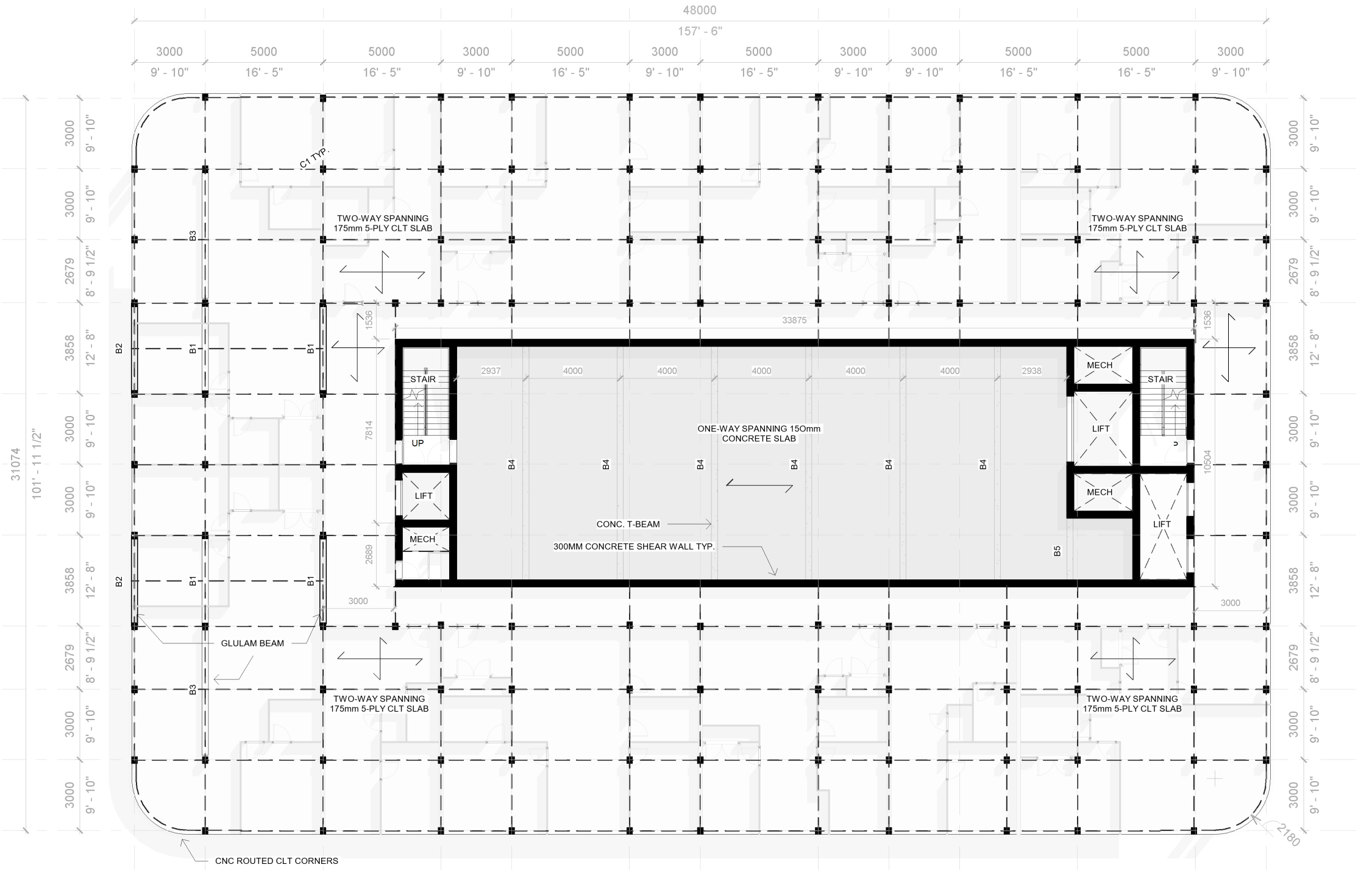


The Farmhouse is a mixed-use structure located west of downtown Toronto. The project **integrates housing and hydroponic vertical farming** in an urban area to address critical issues such as **urban sprawl, food insecurity, agricultural productivity** and the **embodied carbon** associated with the agricultural supply chain.

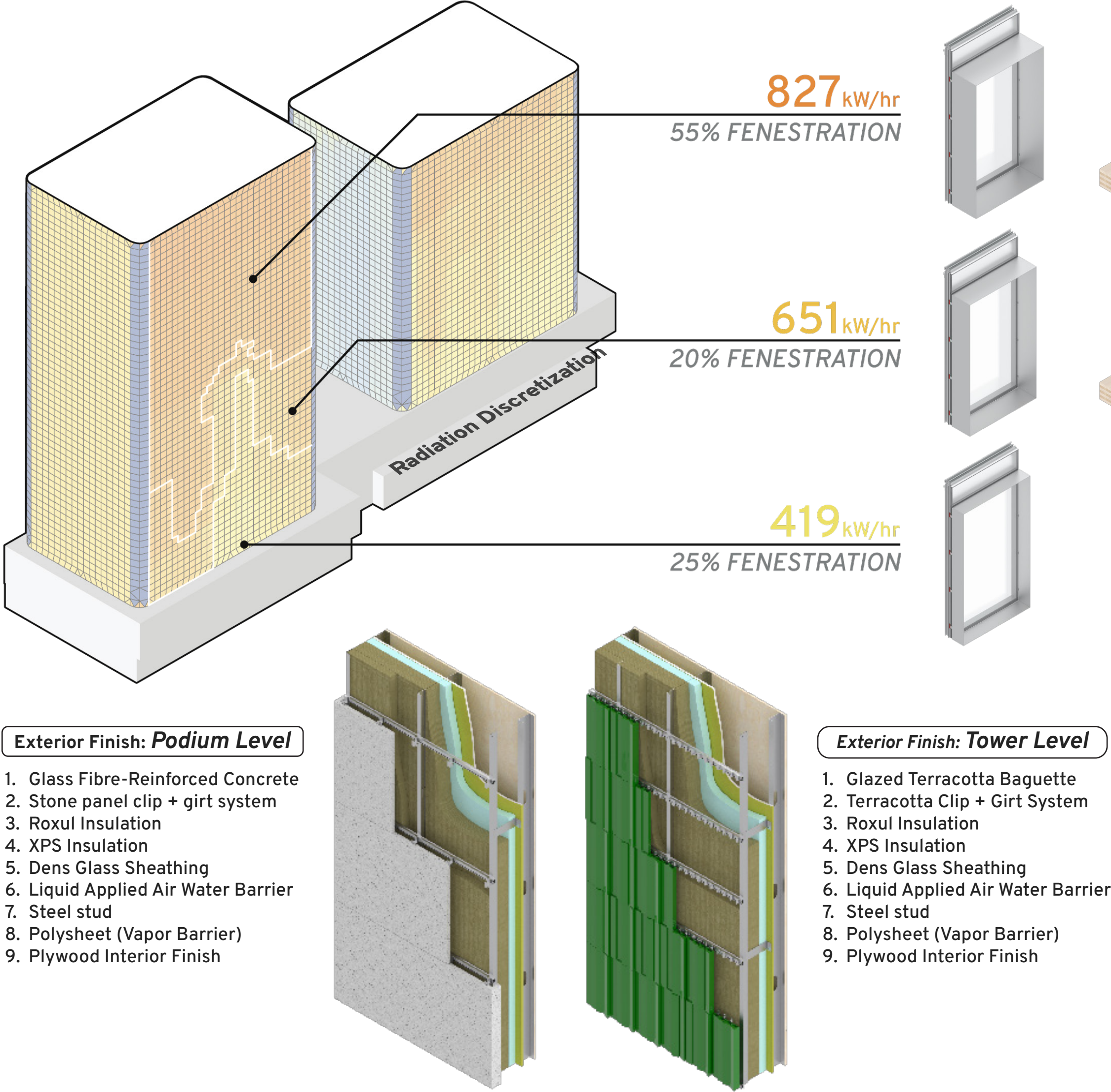
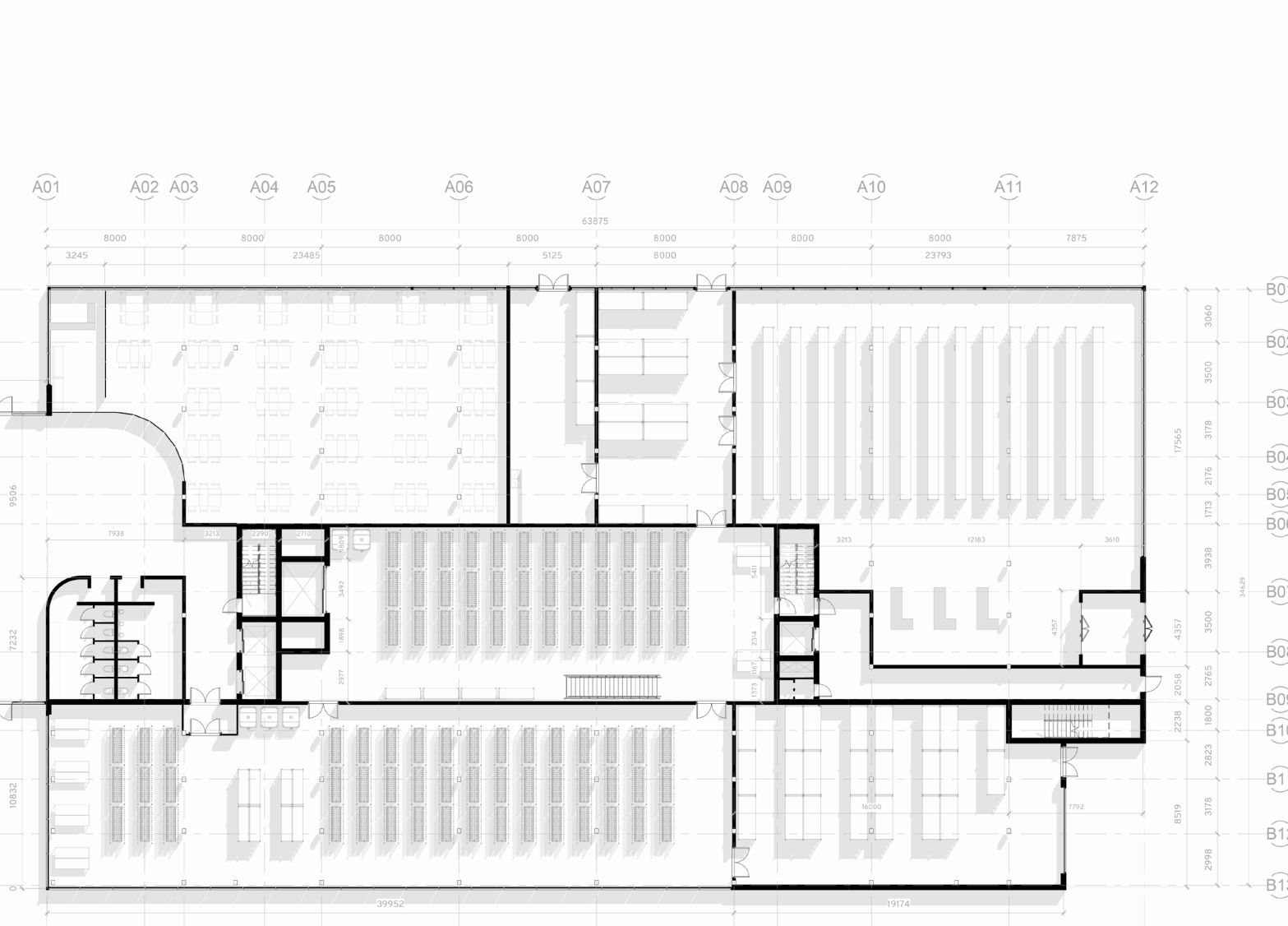


The site is positioned directly north of the historic site, Fort York. The location is just north of a rail line for GOtransit, in an area with a mixture of *high-rise residential to the south, commercial to the east and west, and single-family housing to the north*. This area provides an *ideal mixture of different zonings*.

In choosing a suitable location for the proposal of a vertical farm, it was essential to consider how the benefits of local food production would **address the needs of various communities throughout the city**. Due to the mixed-use nature of a structure integrating high-productivity farming and residential housing, this **building typology would integrate effectively in an area with a diverse surrounding context**.

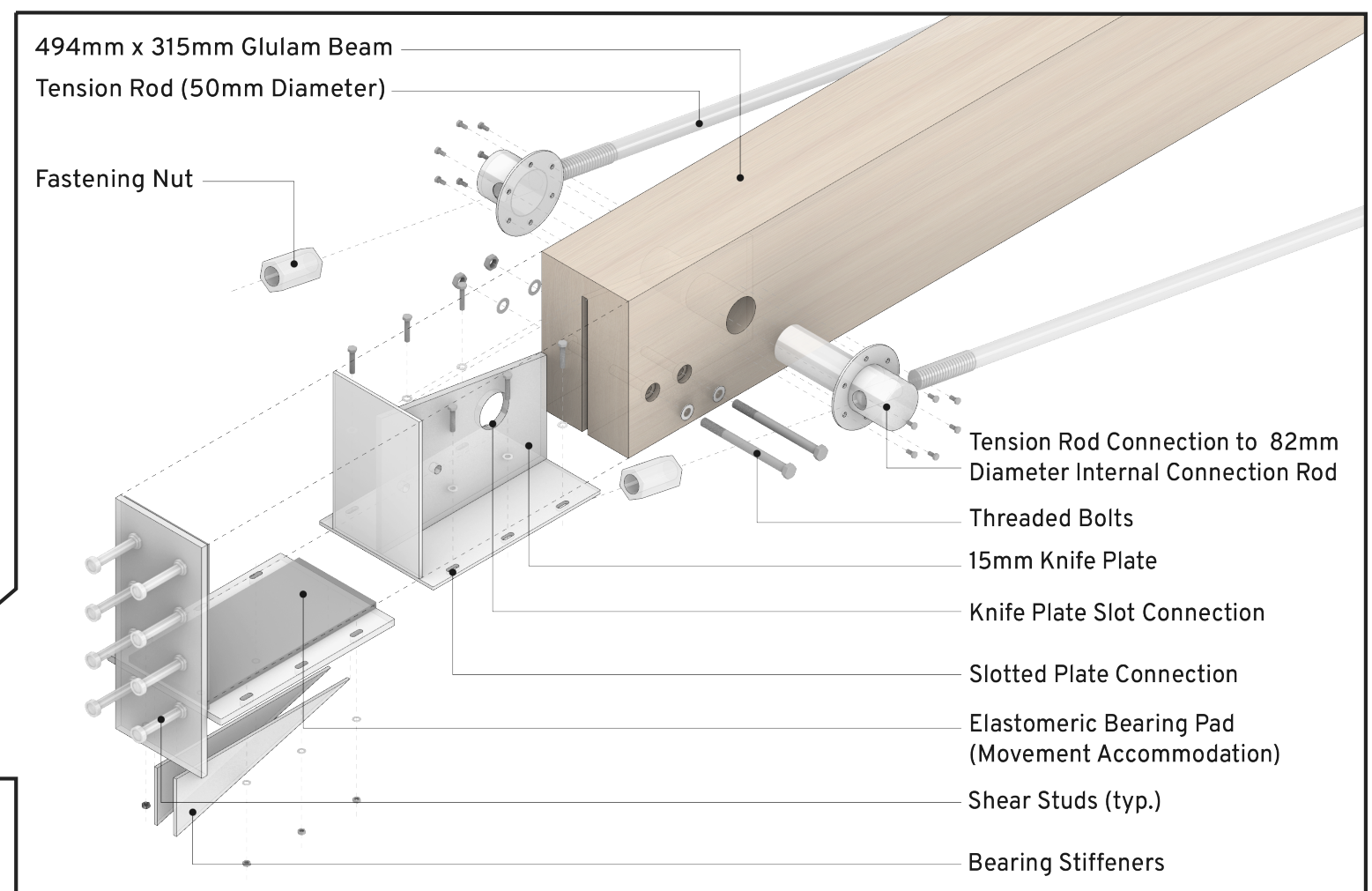
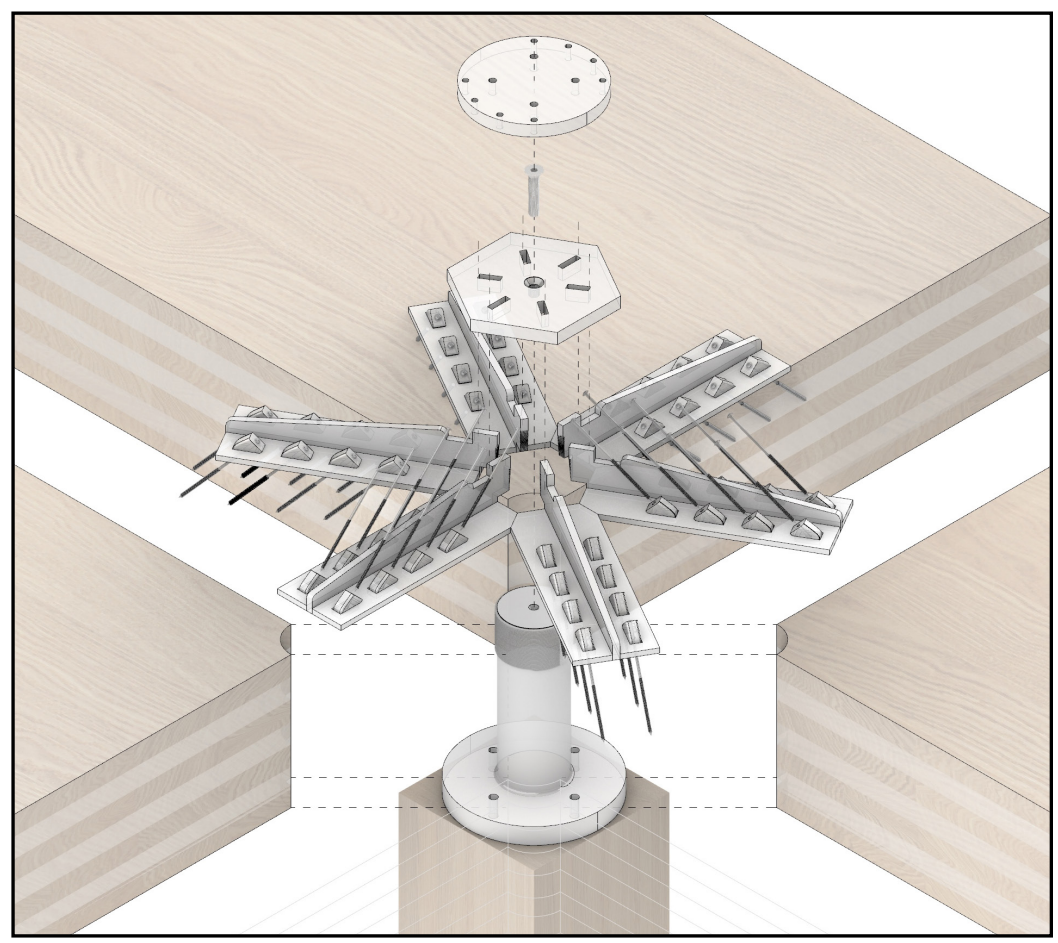
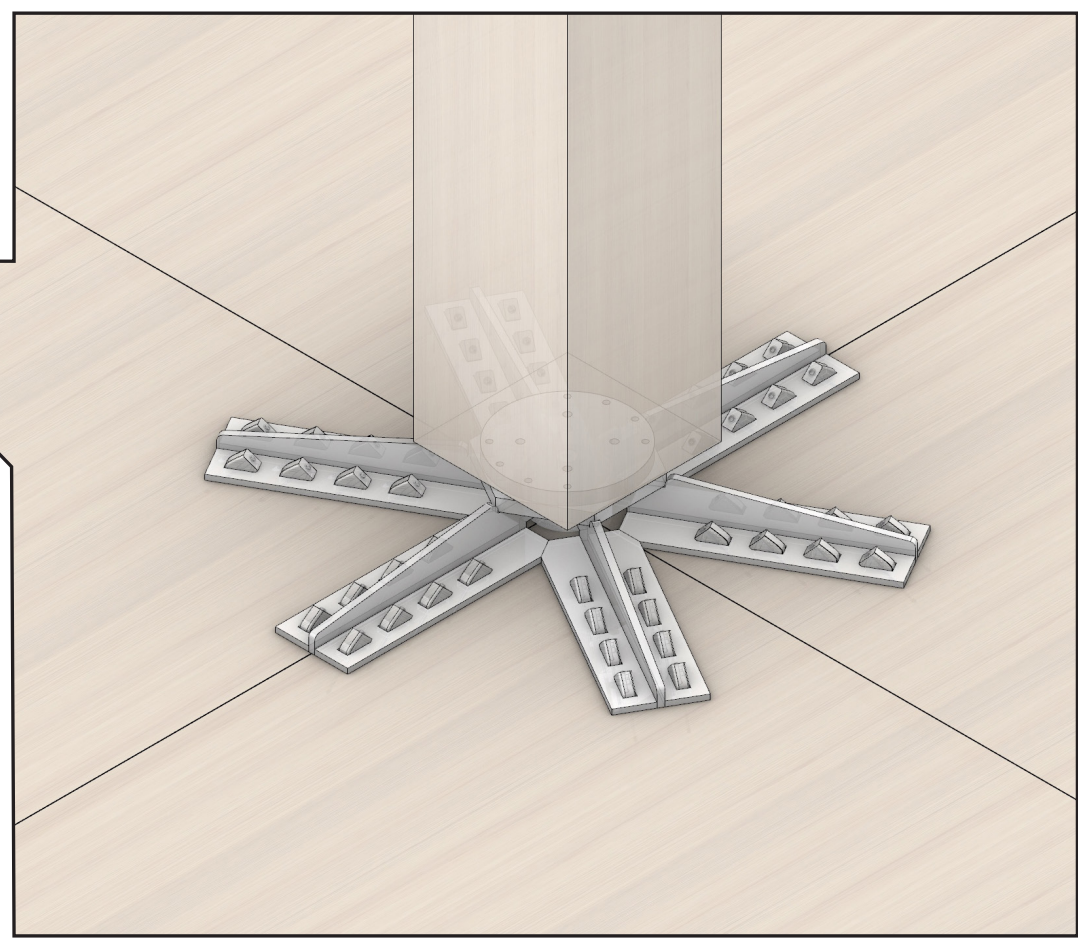
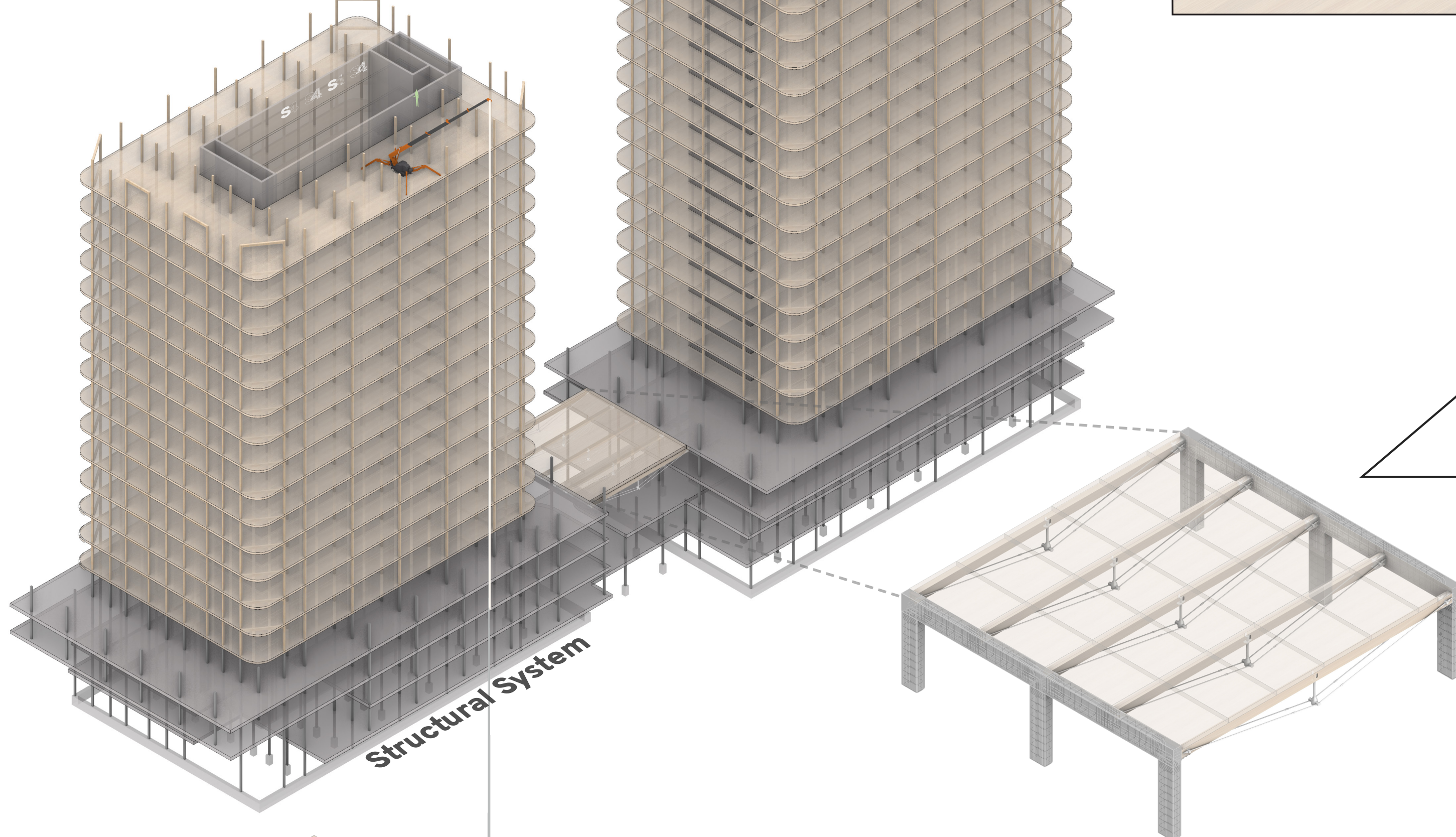


To reduce the building's solar gain, a variable depth solar shade system was implemented. A radiation analysis was performed and **the building was discretized into 3 distinct** radiation zones based on the curtain wall panel size.

[illegible]

The structural system consists of a **concrete core and podium** as well as **mass timber towers** that span a maximum of 21 stories. The towers were designed to be a two-way spanning flat slab system, with **5-ply CLT panels** transferring loads directly to glulam columns. The maximum panel dimensions are 3m x 5m by leveraging **Rothoblass spider connectors** to **reduce punching shear** and effects of serviceability limit states.

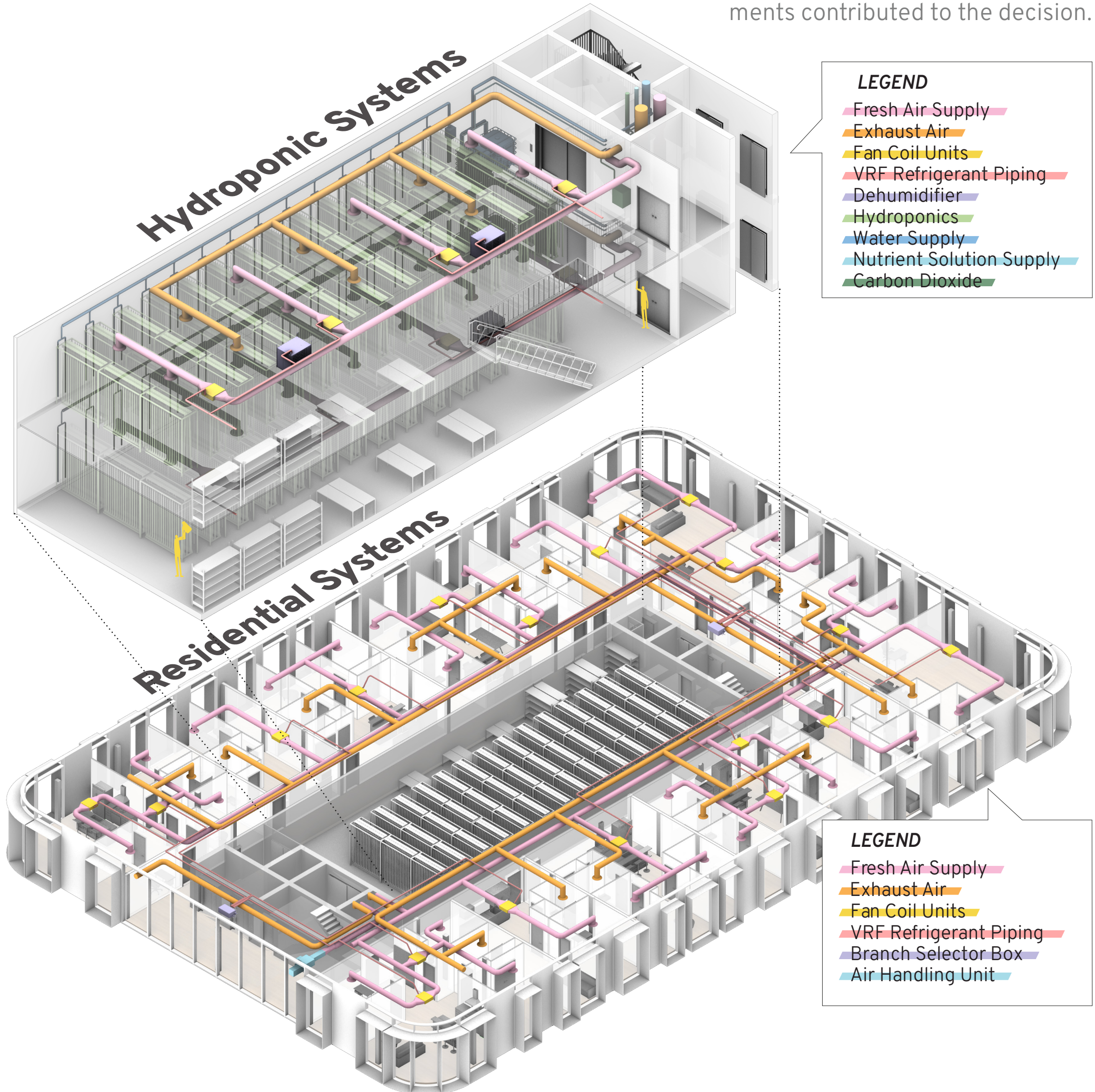
Incorporating CLT allows for exposed ceilings, a **reduction in embodied carbon, and a biophilic design** that promotes end-user well-being. The pre-manufactured nature of CLT allows for ease and speed of construction, minimizing mobilization and site manager costs.



The beams spanning the 16-meter roof of the building's atrium highlight the use of a king post system where **tension rods allow for smaller members to adequately support the load above.** A bearing connection accommodates movement at one side of the support from the differential movement of timber.

The tension rods are fastened to the beam by slotting through a knife plate, transferring the load into the steel backplate. The knife plate is fastened to the *elastomeric bearing plate with slotted connections, allowing the member to move along its long axis* while restricting vertical and out-of-plane movement.

Heating and cooling are personalized at the residential unit level, leveraging a **VRF integrated within the mechanical system**, while the growing area uses a centralized system running through the core. **Fresh air requirements are met through a DOAS**, to ensure high IAQ for each specific building zone.



For the top 13 most popular fruits and vegetables, the **average person in Toronto was found to consume 167 pounds over one year**. Based on the area of production and harvest season, the Farmhouse can supply almost **7 million pounds of produce per year**. This is enough produce for 41,424 people annually. With 1100 residents, there is enough produce to meet the needs of over 40,000 additional people in Toronto.

Vegetable/Fruit	Percentage
lettuce	33%
broccoli	9%
cabbage	15%
bok choy	3%
beans	3%
peppers	13%
tomatoes	24%
lettuce	33%

Unit	Produce (lbs/yr)
per ZipGrow tower	5.6 lbs/harvest 17.3 harvest/yr 97.1 lbs/yr
per ZipGrow rack	30 ZipGrow towers 2912 lbs/yr
per farmhouse	2382 ZipGrow racks 6,936,384 lbs/yr

The main entrance of the Farmhouse is located directly adjacent to the Wellington St. and Stafford St. intersection, creating a ***discernible connection between the two towers*** and will be used as the gateway for all public programming as well as providing access to ***residential, hydroponic and office areas.***

