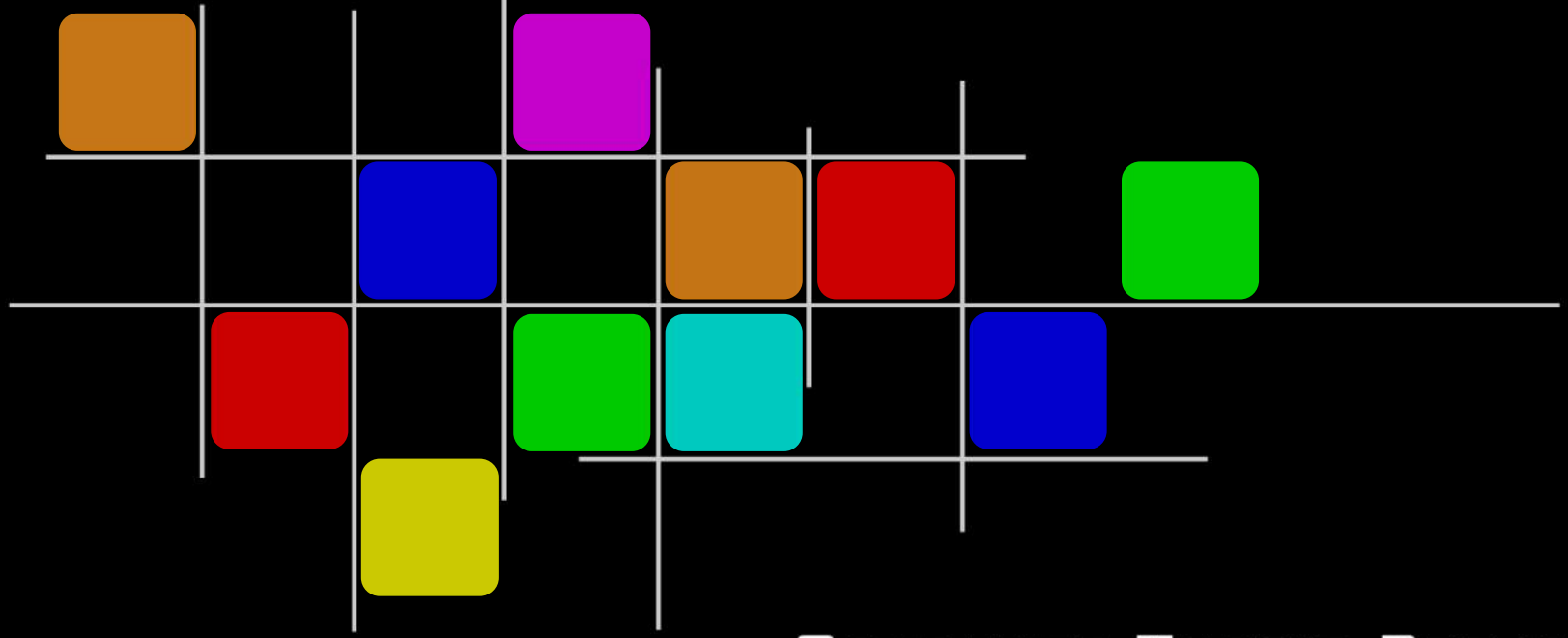
Housing Density for the Future Metropolis



Graduate Thesis Project

by Scott Philipp

"The key problem facing humanity in the coming century is how to bring a better quality of life -- for 8 billion or more people -- without wrecking the environment entirely in the attempt."

--Edward O. Wilson, scientist, Pulitzer prize winning author and father of biodiversity

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A Shrinking World...

The Current Situation

The human world population is already in excess of 6 billion people and the number is expected to climb towards *9 billion by 2050*.

In 1950 there were 86 cities in the world with populations over one million; in 2004 there were 386, and by 2015 there will be at least 550.

The global countryside will reach its maximum population (3.3 billion) in 2020 and thereafter will begin to decline. As a result, *cities will account for all future world population growth*, which is expected to peak at about 9 billion in 2050.

Ninety-five percent of this final build-out of humanity will occur in the urban areas of developing countries, whose populations will double to nearly 4 billion over the next generation.

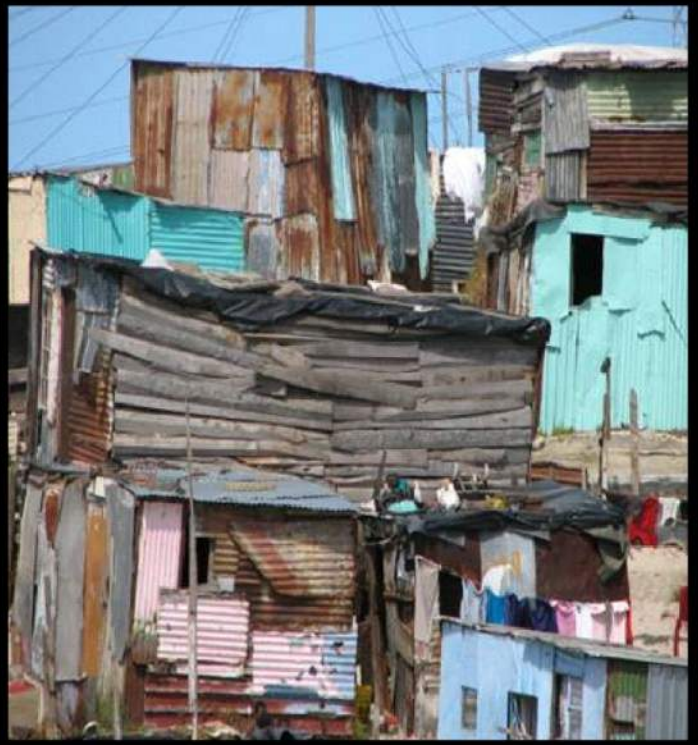
Addressing the Issue

A successful city should be capable of providing functioning and affordable housing to all its inhabitants.

Many migrants from the rural areas come seeking jobs and a better way of life in the city. This steady progression of people is known as the *Rural to Urban Migration.*

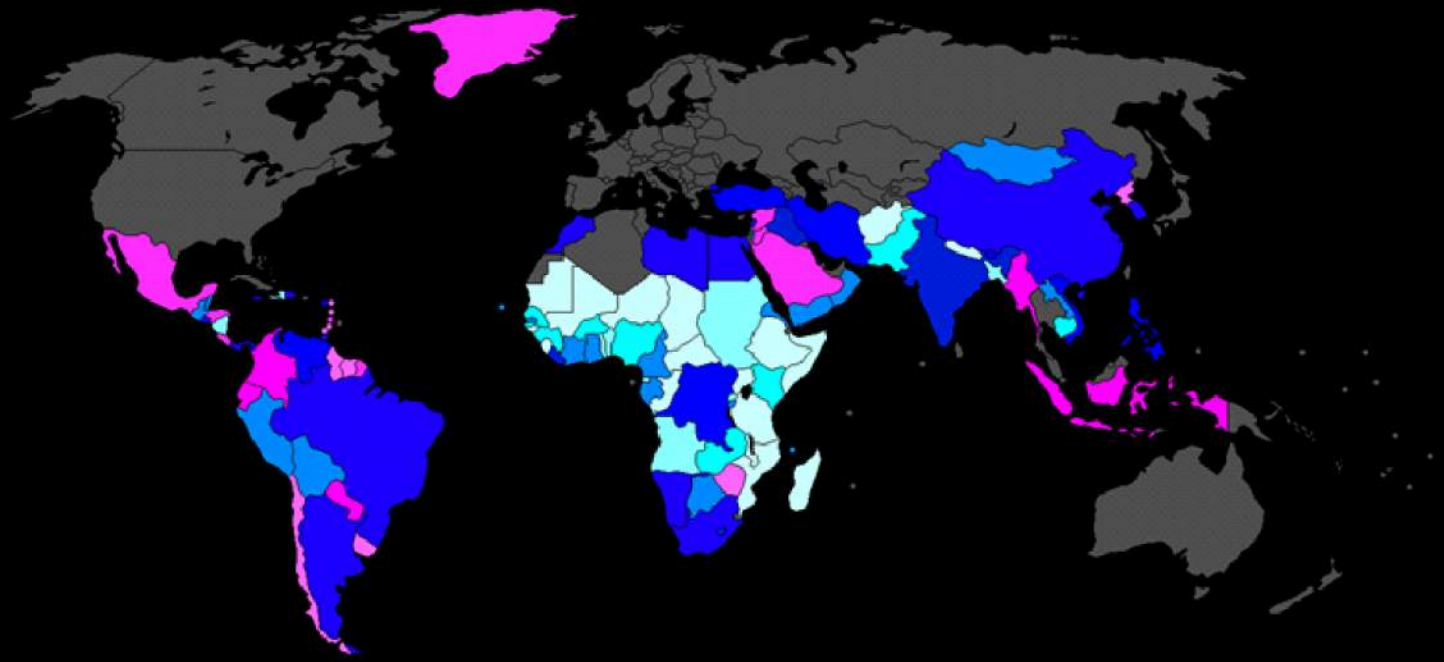
Unfortunately, the *lack of affordable housing* means that many become vagrants, or end up in shanty towns. They often feel defeated and find it difficult to improve their situation.

What's needed at present and will become increasingly crucial in the upcoming years is an *adequate supply of affordable housing* for those who have newly migrated to the city.



Site Selection and Analysis

Analyzing the Global Housing Crisis



Map showing the percentage of each country's urban population living in slums (according to UN-Habitat definition):
Magenta represents approximately 10-20% while White to Light Blue represents upwards of 80-90%.

Speculative Site Locations

Map representing the location of the 30 biggest "mega-slums" in the World, according to Mike Davis, the author of Planet of Slums. The circles' size and color indicate the number of inhabitants in millions.

Site Location: Mexico City

Ciudad de México, México, D.F.

The country of Mexico is currently going through a significant period of rural to urban migration. The capital city, *Ciudad de México*, has one of the largest shanty town communities on the planet.

Mexico City once acted as a magnet that attracted millions of migrants who hoped for a better life. But those who now leave the countryside for the capital usually find little improvement in its crowded slums.

The rapid growth of Mexico City has created several problems, including serious *air pollution, an increasingly inadequate water supply, and a general lack for a quality standard of living*.

An estimated *70% of Mexico City's inhabitants live within inadequate living conditions*.

A Great Metropolis

Mexico City, D.F. - Capital City of Mexico, has a population of over 8.7 million inhabitants in 2006 - The Greater Mexico City area had a population of 28.5 million, making it the *largest metropolitan area in the western hemisphere* and the second largest in the world.

The combination of large size, increasing population, and the lack of adequate housing for it's inhabitants makes Mexico City a prime choice for the development of a high density housing community.

The borders of Mexico City proper can be identified by the yellow area in the image.

The country of Mexico with Ciudad de México marked byt he red halo.

Site Analysis

Disecting the City's Components

This is a view of Mexico City. The blue represents the downtown and vibrant area of the city center where many of the hotels, shopping districts and other attractions are.

The yellow represents the inner city ring which is where many offices and industrial facilities are located. This is where the majority of the workers are employed.

The orange represents the suburban ring. This area is primarily houses and apartments and is where the majority of the Mexico City residents live and commute from.

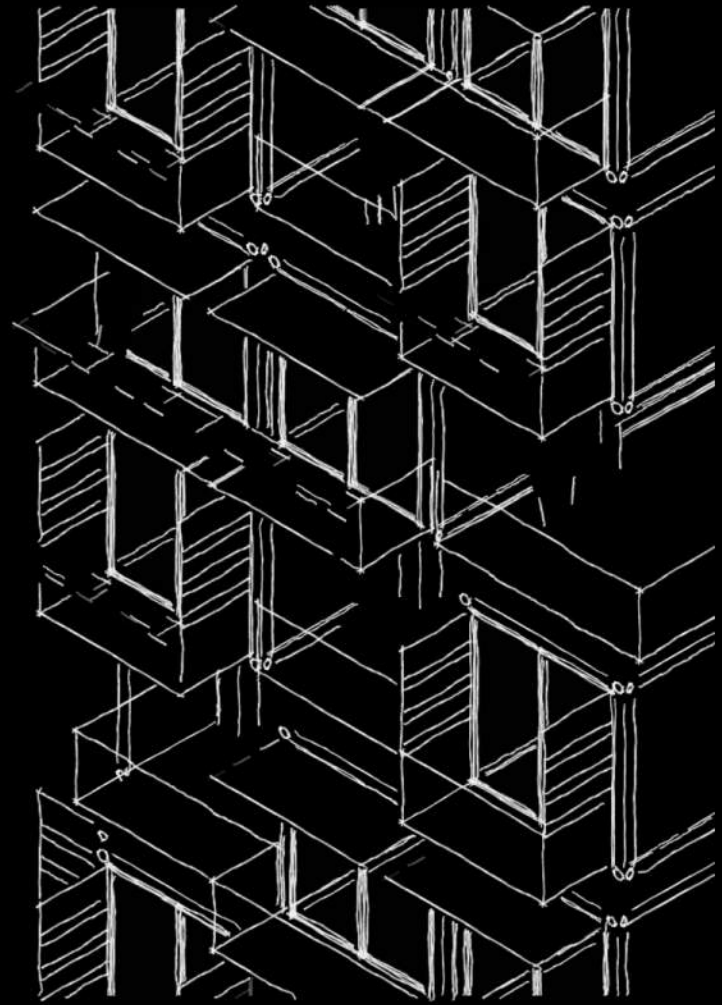
Purple represents the city's refuse area. The project site is located across the river from this zone and is adjacent to a main avenue.

Begining Design

Program Concept

The lack of affordable housing in the Mexico City area has quickly turned the city from a once thriving metropolis into one of the largest Mega-slums on the planet. To help this city regain it's place as a successful and inhabitable mega-city, I propose a prototype *housing project* that would be government sponsored. It would be similar in logistics to other projects currently underway in other areas of the country, but would be radically different in design and construction methods.

This project has been given the description of a *"housing incubator".* In this scenario, a resident who has recently arrived in the city can get a foothold by staying in these facilities for a price that is below market value. Over time, the rent will gradually increase and eventually exceed the market value. This will *passively urge residents to seek more long-term, permanent places to live*. This will allow new migrants to cycle through the housing program, repeating the process.



Design Guidelines

Density & Minimal Impact on Existing Infrastructure

If the estimated world population figures hold true, it is critical that future housing projects make density a priority in their design. By increasing density and concentrating people, less energy is needed and a city can better provide services and utilities to everyone with less infrastructure.

Building Economics & Ease of Construction

Many cities are already struggling to meet the demands of the present state of the city. More often than not there is little financing available for housing projects and other necessary programs. However, by reducing costs and maintenance through design, these projects can be implemented on a wider scale than ever seen previously.

Versatile Design & Expandability

A design must be versatile enough to be constructed repeatedly and at different locations without significant changes to design and without additional costs. The ability for a design to be expandable is also critical. A project may be given additional funds at a later point and the ability for expansion after initial construction has taken place would help to further reduce costs while also minimizing construction time.

Modularity & Pre-Fab

In an effort to design a structure that would meet these demands, we looked at many potential building components and methods of construction. Through investigation and conceptual design it was determined that the international standardized shipping container was capable of meeting all the requirements of the design guidelines listed above.

Shipping containers are constructed with a sturdy frame and can act as a cost-effective means for creating a pre-fabricated living unit.

A modified living unit could be manufactured, transported, and installed on-site with a minimum amount of time, equipment, and energy.

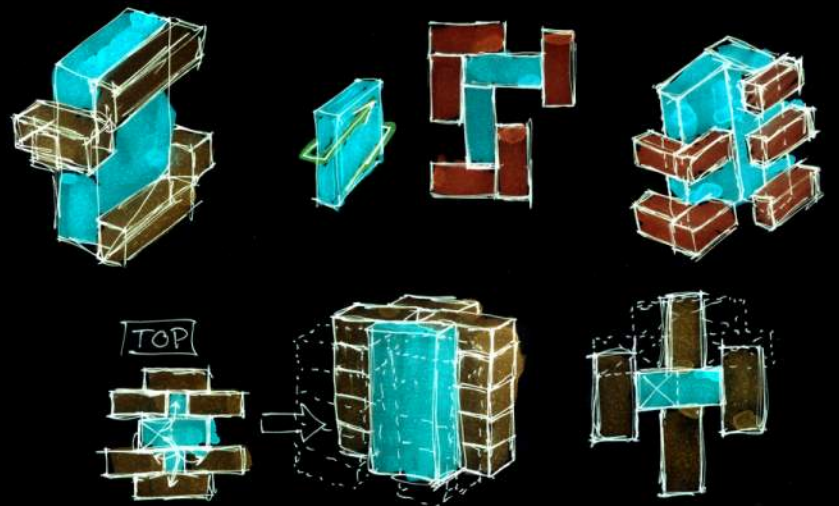
Shipping containers as dwellings are a proven concept that has been incorporated into architecture for decades.

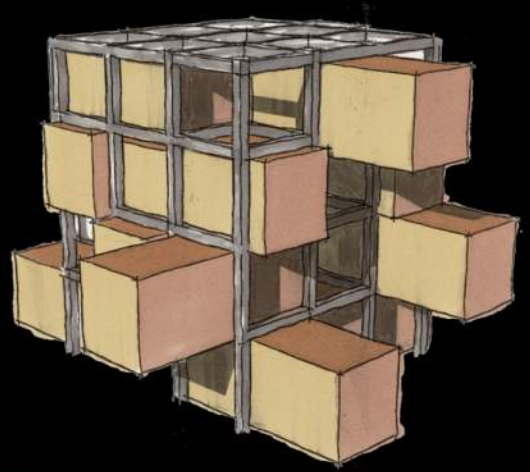
Conceptual Process

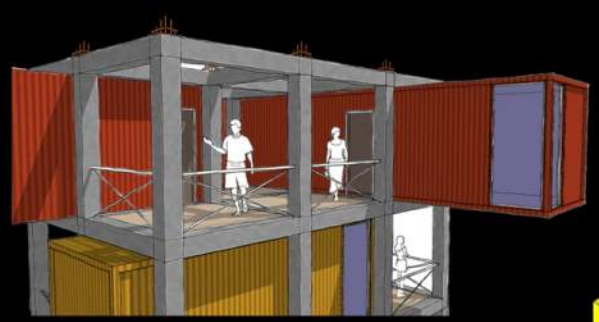
Modules and Matrix

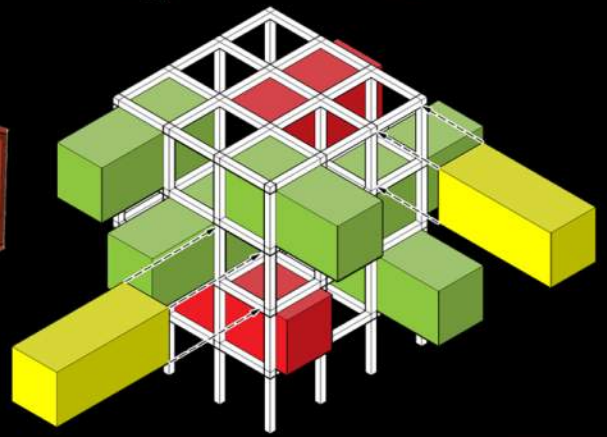
In the beginning design phases, the container units made up the entirety of the design. The containers would act as the core, the living units, and services.

The design soon became more modular and a grid matrix was added. This allow units to be placed in a variety of ways, creating a very versatile structure that could adapt to nearly any site or situation.



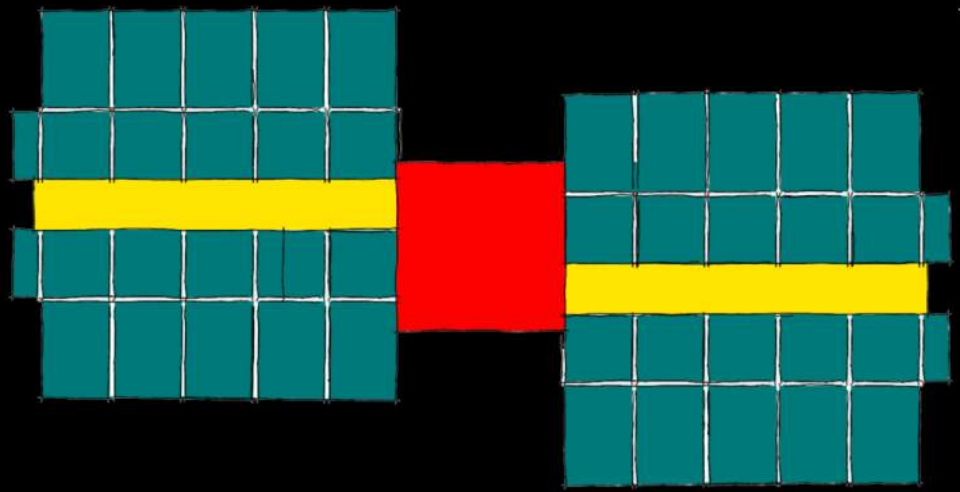


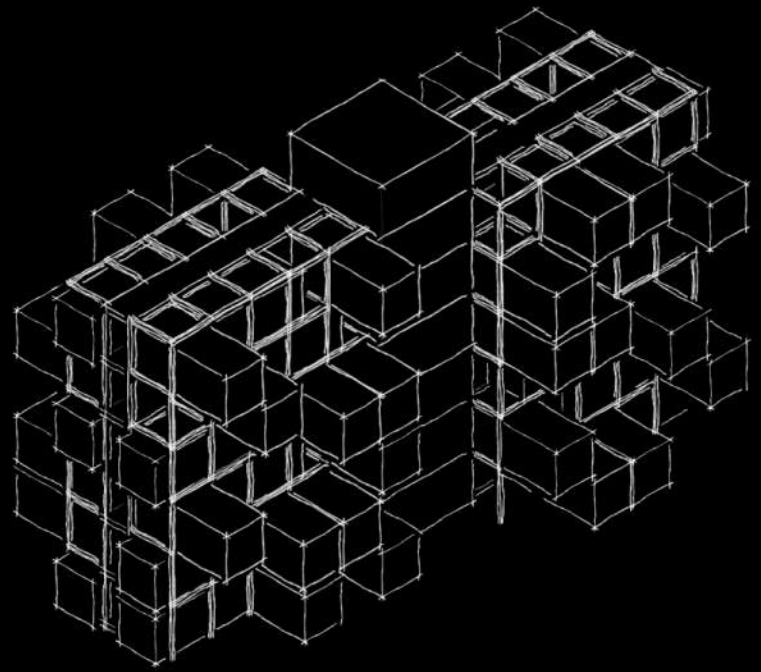




Cores and Mechanics

It soon became clear that not having a structural core, or even using containers for the core, would not be feasible and prove problematic on a large scale. Having an independent core which the units could be attached to proved to be a more efficient and practical design for the program.





The grid matrix remained in the design but became a supporting element for the living units. Because the units would be cantilevered from the arms of the building, the matrix was now used as a light frame to help minimize the cantilever loads.

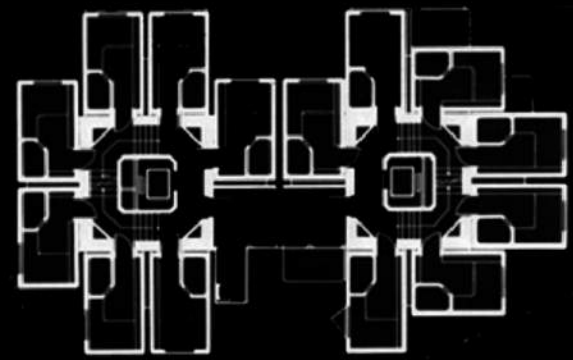
Inspiration & Precedents

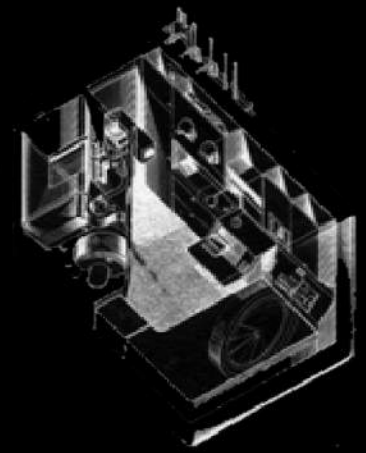
A Proven Concept

There were a variety of architects, structures, and building projects which assisted in the design development of this project. A few of the more influential projects are:

Container Home Kits
By Lot-EK

Nakagin Capsule Tower
By Kisho Kurokawa





Learning by Example

There were a variety of architects, structures, and building projects which assisted in the design development of this project. A few of the more influential projects are:

Container City
By Urban Space Management

Habitat '67
By Moshe Safdie

Design Synthesis

Evolved Construction

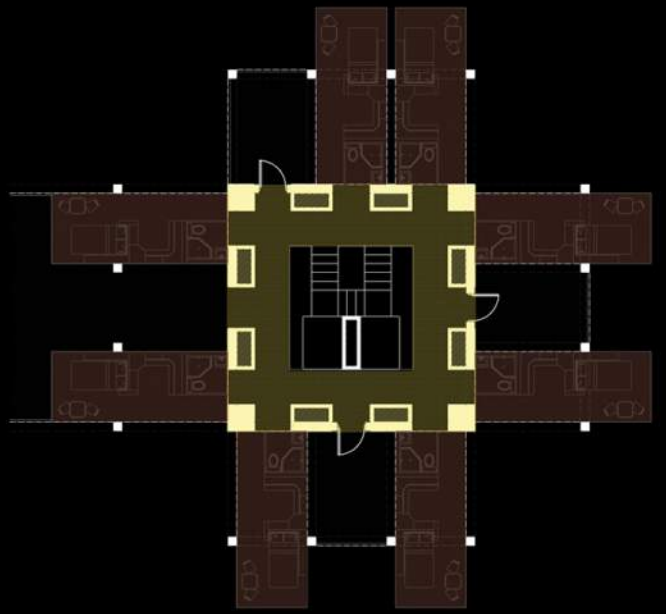
Through the pre-design process and investigations into past architectural precedents, a few key design elements came together to form the final design for the building structure. The following are some resolutions that were made.

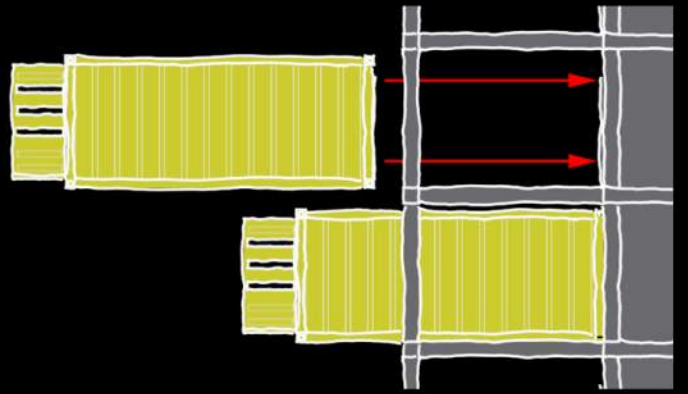
Pre-stressed concrete will be used as the primary structural material.

The concrete towers will server as the cores for the structure and contain all the building's services; electrical, plumbing, and waste.

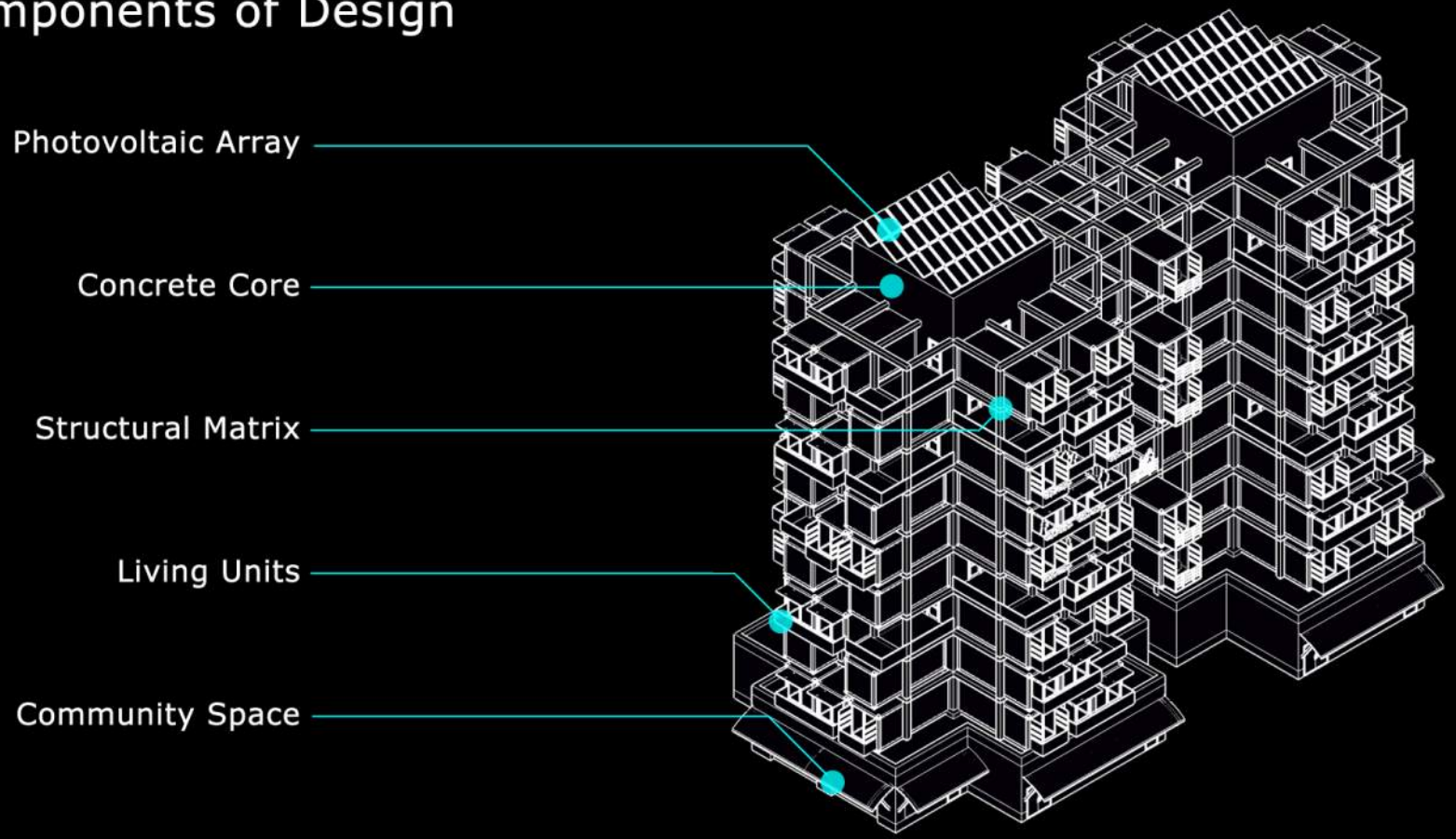
Living units are raised into position and connected to the core for services. The built-in locking mechanisms on the shipping containers will be used to secure them to the side of the tower.

A post and beam matrix will act as a support structure for the cantilevered living living units.





Components of Design



Construction
From the Ground Up

The towers would be built in binary pairs for the purpose of egress, maximizing density, and to meet international safety and code requirements.

The construction of the buildings would progress as follows:

-Concrete towers begin construction.

-Structural grid matrix would be installed on finished floors.

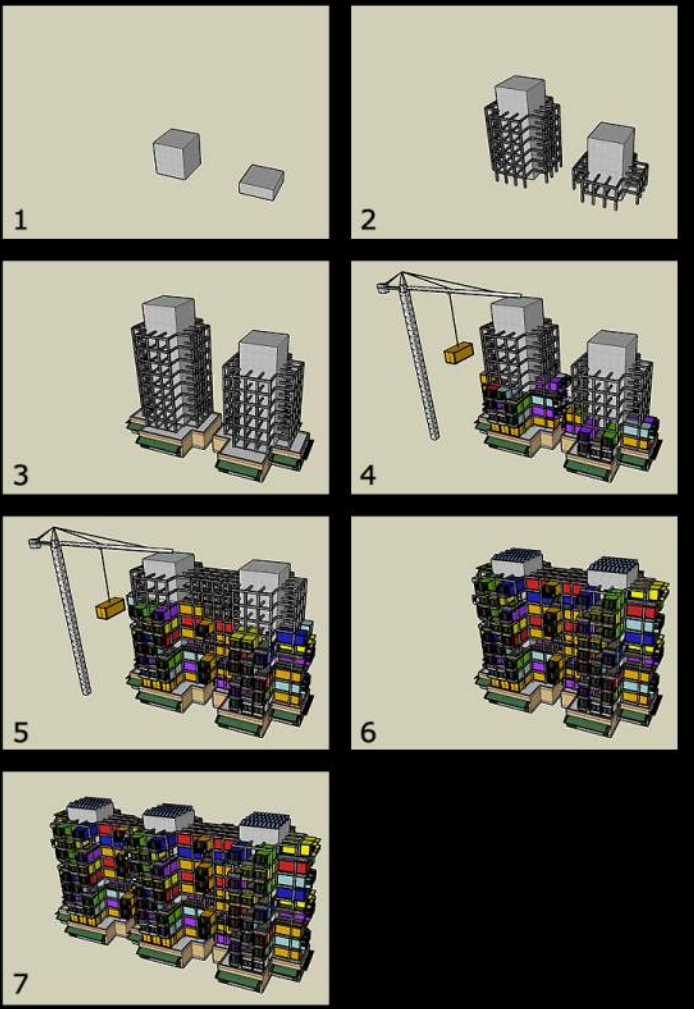
-As towers continued to grow, the ground floor spaces would be constructed.

-Living units would be installed while towers and grid matrix continue to expand.

-The structural matrix will connect the two towers like a bridge, making the two towers into a single building system.

-The remaining living units will be installed.

-Additional towers may be constructed and connected during a later phase.



Modular Living

Here are three examples of layouts that can be achieved using recycled standardized shipping containers. Each one offers a different living experience and is suitable to particular individuals.

These units are modular and can be combined in numerous ways to form different living experiences and conditions. Various models can be developed to suit various needs over time.

The modular nature also allows these units to be retrofitted easily in the future as systems need to be updated or new technologies need to be installed.

Living Unit 01

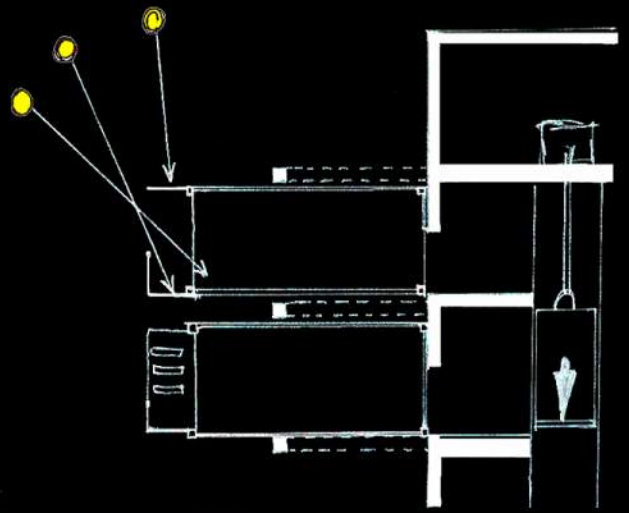
Living Unit 02

Living Unit 03

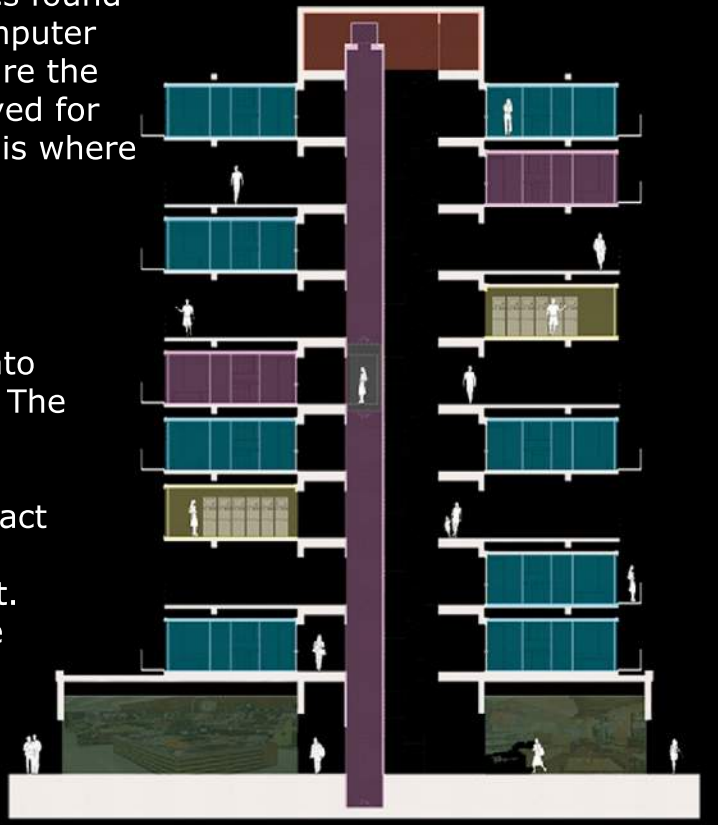
Design Considerations

Experiencing the Design

The different colors in the section represent the different uses found throughout a tower. Purple represents a leisure space or computer lab, yellow signifies a laundry or functional use space. Blue are the living units while red represents the mechanical space reserved for the elevator equipment, water pumps, etc. The ground floor is where the community space is and will consist of shops, markets, pharmacies, and other community needed services.

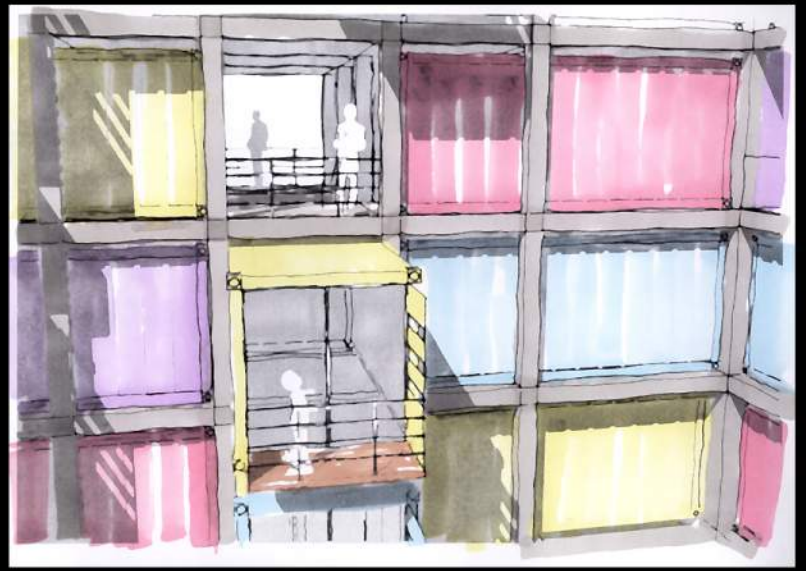


The sun's effect on the living units was taken into effect and designed for. The doors of the containers would be removed and oriented horizontally to act as a awning above the patio areas for each unit. This would minimize the amount of summer sun entering the units.



Personal Space

The privacy of the occupants was an important issue not to be overlooked. While achieving a high density living situation, this project also allows opportunities for families and residents to share and use as private space. Each floor will have openings and balconies created by the omission of a few living units. The following perspectives show these varied spaces in use.



Site Analysis

Taking a Closer Look

Site development coincided with the pre-design and final design processes for the building. Both the site and structure worked together to eventually produce a single harmonious community plan.

In the beginning some considerations were taken into account when developing the site.

Sun Angle and Intensity

Ratio of Buildings and Open Spaces

Pre-Existing Infrastructure

Environmental Site Conditions

Location Specifics

On the previous page you can see a diagram of the site in Mexico City showing different areas of interest.

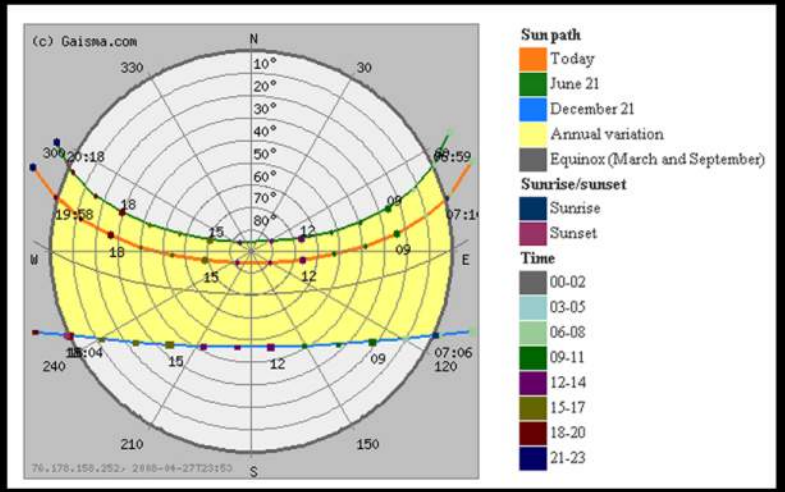
The orange zone represents a landfill area for Mexico City and is located across the river from my site.

The Magenta line running South the West is a rail line which heads to the center of Mexico City.

Surrounding the site are two main avenues in yellow. These avenues head directly to downtown and can take commuters to a transit hub that will allow them access to almost anywhere in the Greater Mexico City Area.

The blue arrows show the prevailing winds in the region. They are S-SE at 5 to 10 MPH.

The following information is climate and sun data gathered from NASA and gaisma.com. This data helped to create a more effective design by allowing the building and site to be developed with these conditions in mind.



Variable	J	F	M	A	M	J	J	A	S	O	N	D
Insolation, kWh/m²/day	4.47	5.09	5.82	5.90	5.94	5.24	5.30	5.21	4.64	4.77	4.61	4.35
Clearness, 0 - 1	0.59	0.60	0.60	0.56	0.55	0.48	0.49	0.49	0.47	0.53	0.59	0.60
Temperature, °F	54.27	57.31	62.04	66.24	67.69	66.13	64.89	64.96	63.79	60.78	57.74	54.59
Wind speed, mph	8.79	9.31	10.18	9.84	8.81	8.21	8.03	7.43	6.96	7.56	8.19	8.43
Precipitation, in	0.32	0.17	0.42	0.87	2.06	4.24	5.17	4.93	4.30	1.73	0.59	0.22
Wet days, d	1.8	1.3	2.5	6.0	10.4	15.5	19.8	18.8	16.2	8.1	3.6	2.3

MASTERPLAN
Taking a Closer Look

Key Design Elements

-Building Orientation
The towers were aligned so that the maximum number of living units could receive natural light throughout the majority of the day.

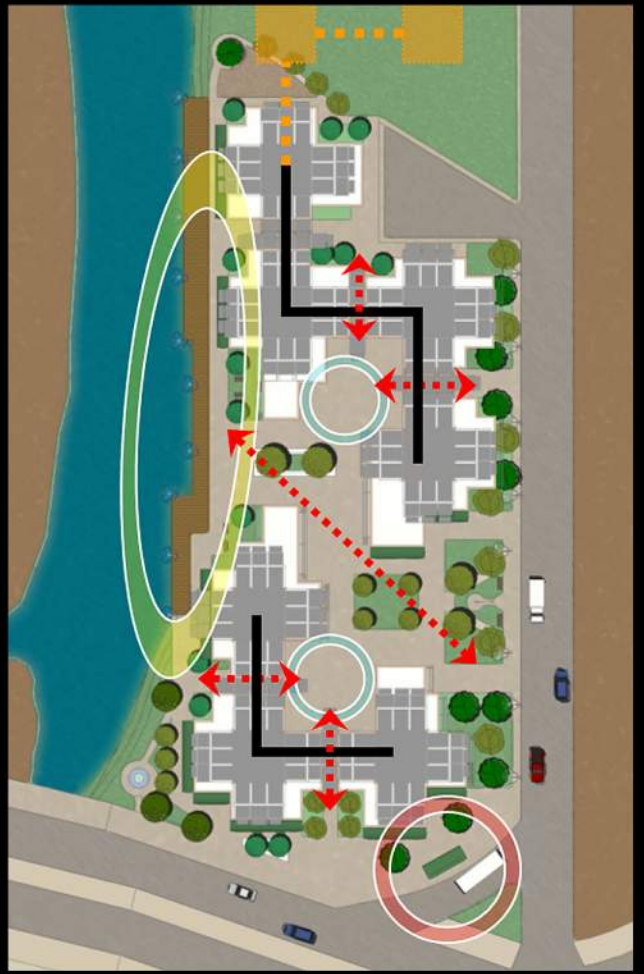
-Building Expansion
The decision to place a playfield at the north of the site was to allow the option for future towers to be built later.

-Open Space & Plazas
Mexican communities are usually oriented around plazas and courtyards. This design also accommodates this cultural preference by supplying plazas towards the site's interior.

-Pedestrian Access
It is critical to provide a permeable site. The spaces under the tower bridge sections and the openings across the plazas allows for maximum pedestrian access.

-Public Transit
The high density of this program demands the need for a bus stop that services all the residents of this complex.

-The Waterfront
Waterfronts are always desirable places for people to congregate. Providing a pedestrian friendly riverwalk will promote this activity.



Community Design

Key Elements

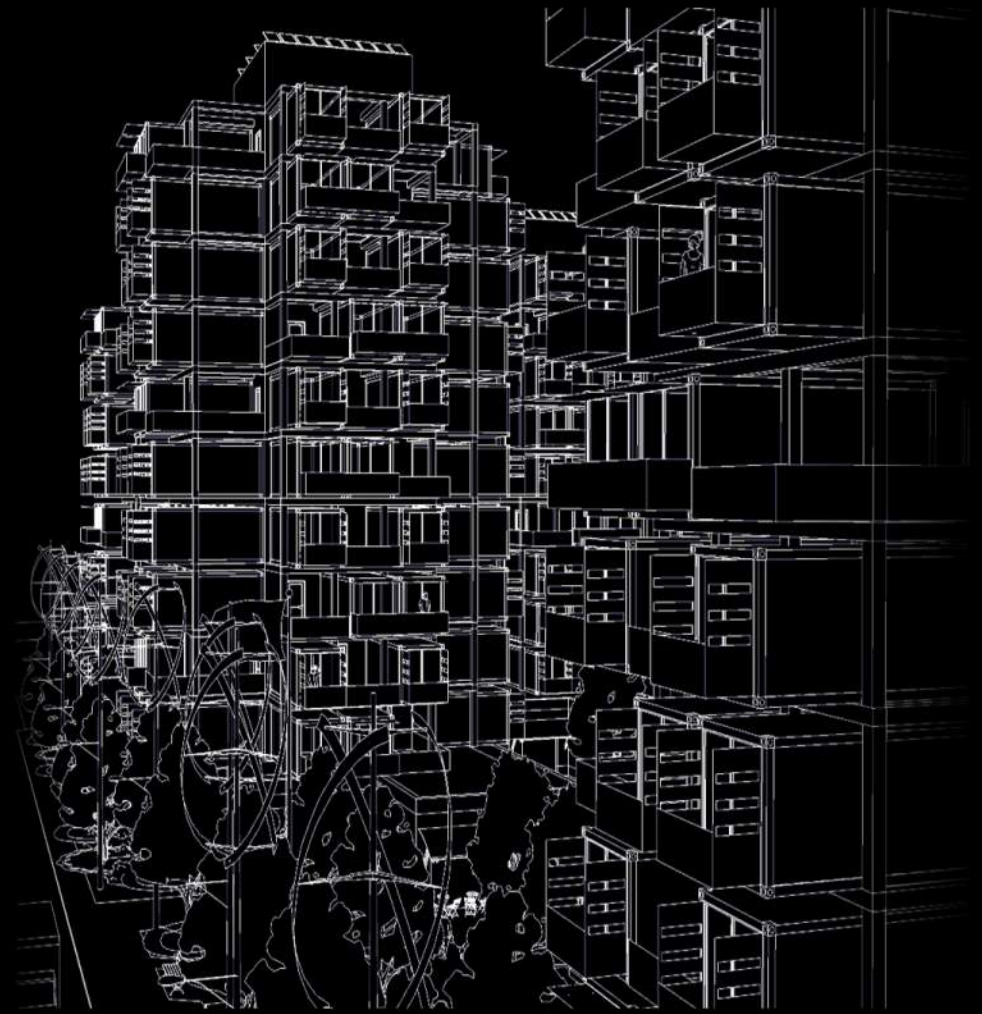
Some of the key elements that were discussed earlier are plazas, transportation, and the riverfront. All of these elements needed to come together to form a greater complete picture within the site.

Here are some renders to illustrate how this project will deliver on these necessities for a successful high density community.

Compilation
Project Review

This project set out with the goals to provide a feasible alternative to the housing crisis looming on the horizon. Many cities across the world are looking for solutions that will enable them to improve the lives of it's citizens. With the concepts and methods proven through this program, it will be possible to replicate this scenario across the world, wherever economic housing is needed.

The following pages are design documents relevant to this project. These include floor plans, sections, renders, perspectives, and various other information pieces which have not yet been covered in this book.



Elevations

North Elevation

South Elevation

Elevations depicting the elevations of the site.

In these renders you can see the wind generators along the east and west ends of the site.

You can also see the variation in tower heights and spacing, creating attractive public spaces.

West Elevation

Perspectives

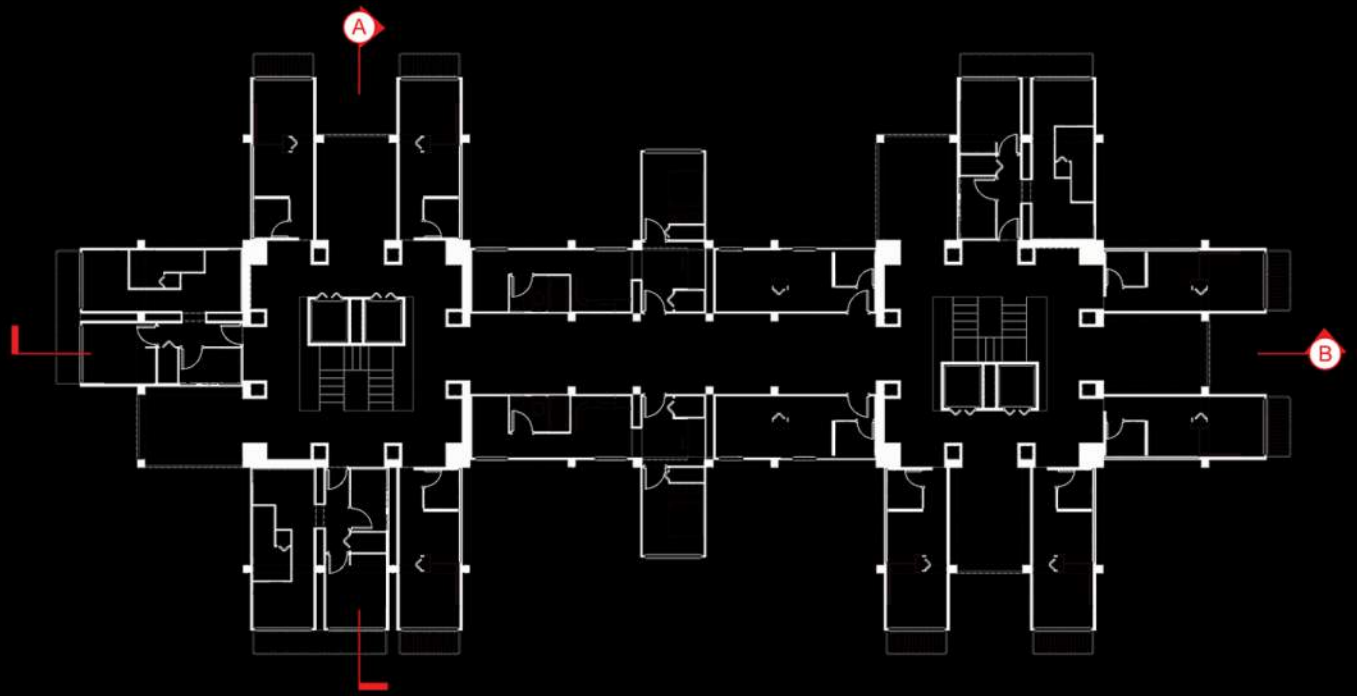
Interior Perspective

Image shows a view from the balcony of a living unit.

Site Perspective from River

Site Perspective from Avenue

Upper Floor Plan

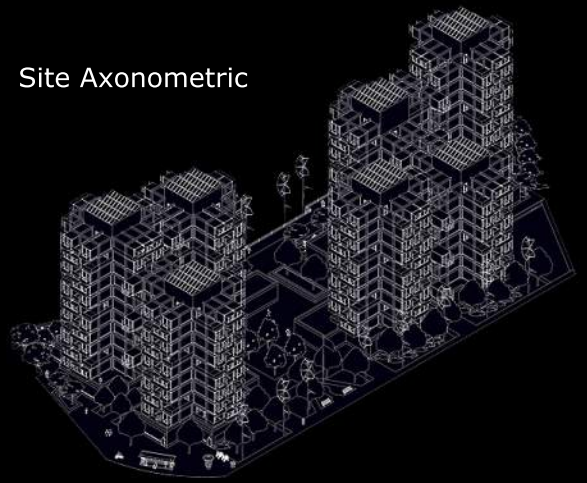


Ground Floor Plan

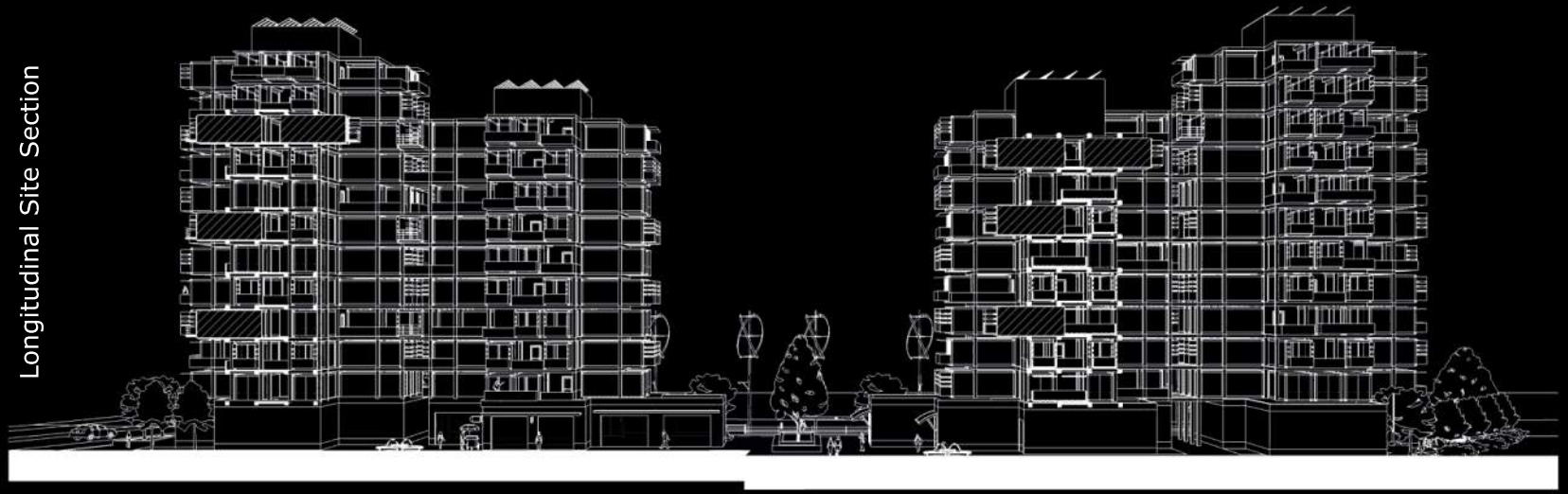
Site Section

Latitudinal Site Section

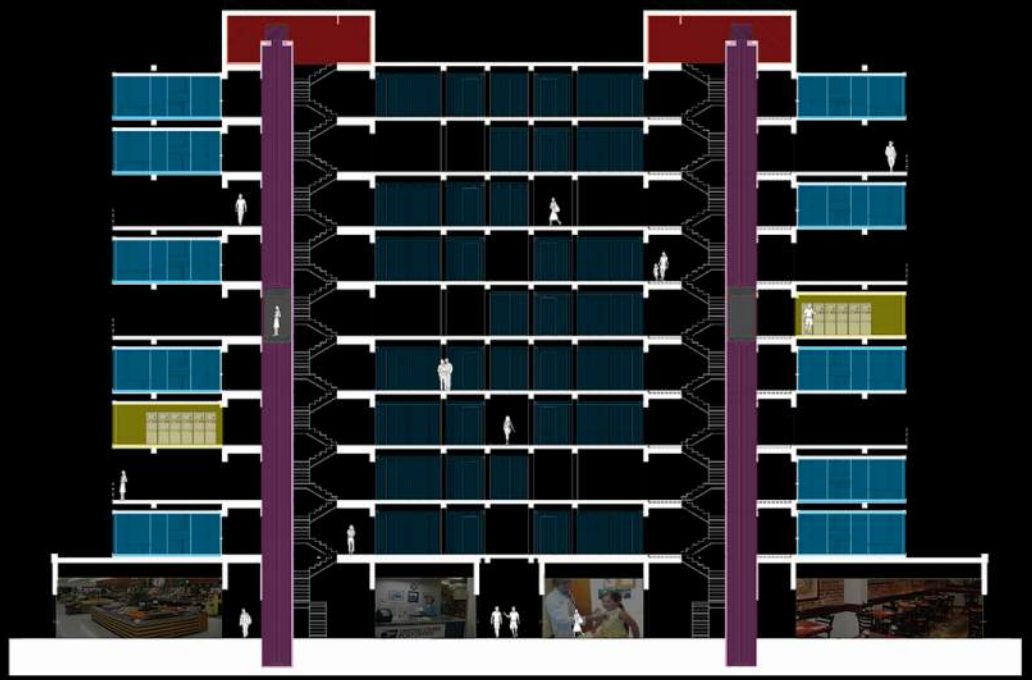
Site Axonometric



Longitudinal Site Section



Tower Section



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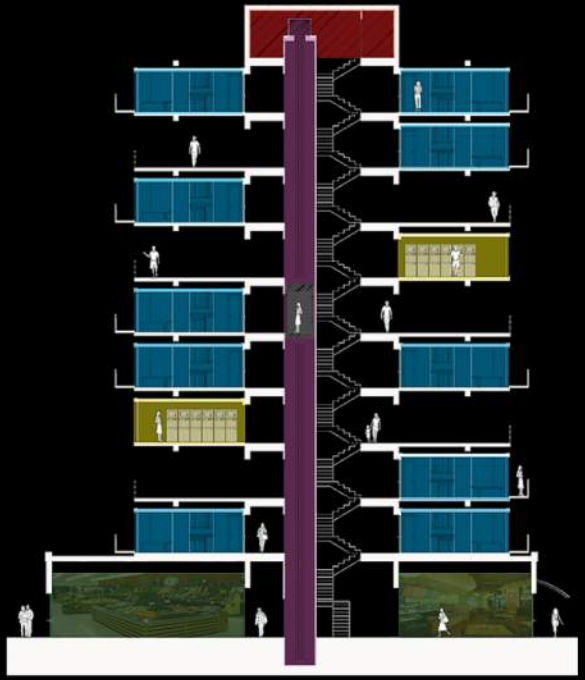

Section Cut A

MASTERPLAN

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