

11-20-2009

Dyna-Mod Constructing the Modern Adaptable Home

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Dyna-Mod
Constructing the Modern Adaptable Home

by

Sarah Deardorff

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Architecture
School of Architecture and Community Design
College of The Arts
University of South Florida

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Date of Approval:
November 20, 2009

Keywords: modular, housing, transportable, urban, alterable

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Dedication

This thesis is dedicated to those that have inspired and guided me. Your lessons will always be kept.

Acknowledgements

I would like to thank my family, without them and their unwavering support I wouldn't have made it here. To my parents, they bought me the copious amounts of blocks and Lego's that first sparked my imagination in the built world, even if it was in plastic form at the start. To my brother for playing Godzilla with my wooden block creations, it was because of you that made me build it better the next time. To my friends in studio, my second family, as I saw you and spent more time with you than my actual family, I thank you for the memories and late night laughs. To my thesis chair, Shannon Bassett, I thank you for quickly stepping up to fill the need of my chair when I was left without one. I still can't thank you enough for filling this position. To my committee members Trent and Chaddy, thank you for your continual support and feedback in furthering my project. Thank you for all your help these past semesters.

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Dyna-Mod: Constructing the Modern Adaptable Home

Sarah Deardorff

ABSTRACT

The modern home has become a static fixture in society that is not reflected in the growing populous that is becoming an ever increasing mobile society. Many are not able to stay to the same place that they call home for long periods of time. Changing jobs, markets and neighborhoods force those to continue their movement around leaving what it is that they call their home to try and reproduce it within another location. The home finds itself lost in this transition and must now function on a greater adaptability than ever before and reflect the growing demand placed upon these structures. It must be able to easily and quickly change with the inhabitants growing needs and become a reflection of the currently growing mobile society. It must find itself able to move and adapt to new sites and surrounding whether suburban or urban. I intend to design a different type of residential environment that allows the ease of alterability and portability that proposes the home as a module that is easily added and removed from a larger structure and that holds the ability to expand and multiply to meet the needs of the owners. The tower must take a strong leap forward in construction and

structural technology to allow the continuous altering of form and program through its own morphing. Related to this, the adaptability of the home modules are also envisioned. This new building would not only benefit the inhabitants, but also the owner. The quick and easy customization of space allows continuous occupation and an ease when providing for a variety of tenants whether residential or commercial minded. Where property is at a premium in urban centers, construction can be quick and continuous while allowing inhabitants to take their home while construction continues above them. It allows a greater adaptability to growing needs and demands of an increasing population but allows the owner to meet their own needs as well.

"Unlike the architecture of the past, contemporary architecture must be changeable, moveable and capable of meeting the changing requirements of the contemporary age. In order to reflect dynamic reality, what is needed is not a fixed, static function, but rather one which is capable of undergoing metabolic changes."

- Kiyonori Kikutake

"The increasing automatization of production and the associated liberation from the necessity of alienated labor created a new type of urban nomad, who was scarcely bound to any specific place, aloof from his or her native land, and in search of diversion"

-Jan Maruhn

Why is it that most homes are not easily able to be moved or adapt to the ever changing needs of the owner and reflect a currently mobile society? Homes have become reflective of a sedentary lifestyle that many have fallen into. They promote a sense of place and security. But why is it that the home cannot move with the family or adapt to the changing space needs of a family? With today's lifestyle many families and homeowners have to leave their home in pursuit of a new city or new life leaving what it is that they call home and that reflects them. With the growing advances in construction and portability in prefab and modular architecture, why is it that the home is still not able to easily move yet unlike the rest of our society. A family grows and must leave the home it has come to know. It becomes too large to inhabit comfortably because the home cannot adapt to the changing needs

of the family. Instead they are to leave their home in search of another that is able to accommodate their needs. A home should be able to be adapted and altered easily by the family or owner to meet the growing needs and demands that face it. It should also be able to be portable to follow along with a family that has taken to the home meeting its personal needs. A home should start to reflect a mobility that allows it to thrive in a suburban setting as well as an urban without much altering.

With a newly growing mobile society, the home is in need of an adaptation that reflects this changing lifestyle and change of movement. A home should be able to find itself able to move but still retain what it simply is as just a home. A growing trend is that of modular or prefabricated architecture, largely on the domestic scale. This is the needed component that permits the further exploration of allowing a home to be altered in various locales whether grounded or inserted within a tower.

The concept of "plug-in" is a concept that had found paths to urban cores since the mid 60's developed and promoted strongly by Archigram. A plug-in city represents possibilities to allow civilized culture to the return of a nomadic population with the capabilities to

move and construct in short periods of time returning to groups able to follow jobs and resources as predominant in human history. The new nomadic society would be part of a megastructure that locates itself around resources. The hurdles of relocation are reduced and allow jobs, houses and lives to become a semi-permanent and worldly alternative to living. The adaptability of small details would allow a changing society to be revisable and workable reducing mass reconstruction. By using ever changing elements in design, it allows a possibility of stability even in a continuously altering world. A new form of connectivity of resources and locations make a permanent home for these impermanent objects.

It allows for unique chances to play with recycled materials or the ability of cutting construction wastes through factory driven design parts making the homes a viable green alternative to the rapidly produced neighborhoods of today's suburbia. Changes of space both vertically and horizontally are allowed a freedom in ground design as well as within a tower application. Ongoing research has been issues of prefab home issues and design. However looking further towards the tower and how that has become a prefab or modular entity in today's building and how the two truly can work together and separately at the same time. Continuing further studies into prefab and tower architecture, taking cues from the works of the Japanese Metabolists, historic and current trends in modular design as a necessary step of being able to bridge the gap between prefab home and prefab tower to unify them.



FIGURE 2.1. ARCHIGRAM'S Plug-In City

Following on the heels of the Japanese architects and city planners that joined their pursuits under the name of 'the Metabolists,' the study will follow with the vision of the city and future inhabitations that are characterized by large scale, flexible and extensible structures that allow for an organic growth process. Architecture is adaptive as is the human body. The buildings become mechanized in a near biological way. Many of their forms allowed for interchangeability of the pieces that can be added on or removed allowing a biological method of changeability. Traditional laws no longer fit within form and function and laws of space must be held to transform the future for society and culture. Their work was largely concerned with housing issues even if most could never be built as they were of insane scales that pushed engineering beyond its capabilities. Further breaking down their thoughts and designs of adaptable plug in mega structures and how their designs and advances can further my own research and design. Kisho Kurokawa's Capsule Tower (Figure 2.2) came at the end of the Japanese Metabolist movement but remains as the movement's iconic work. Following with other Metabolist works, the tower is a simple core superstructure with prefabricated units able to plug in. Conceived as an infinitely alterable helicoidal infrastructure that allows qualities of adaptability and flexibility. Hyper-dense capsules provide the flexibility and freedom minimizing domestic choices and maximizing the flexibility of the larger organism to allow future version of itself (Bergdoll, 144).



FIGURE 2.2. Kisho Kurokawa's Capsule Tower

A modular home that has the capability to move from ground to tower and back again or vice versa is the goal. Multifunctional design is becoming a necessity and home design should follow suit. The home is to be able to adapt from urban to suburban fitting the needs of the moving family allowing them to design through a selected modular process. It is to allow flexible design on a flexible grid to meet the demands of an ever changing and unstable market of need. Flexibility can become a new sustainable adaptation allowing reuse and relocation to become a lower cost than what it is currently for people to relocate themselves. Already it has the implications of lowering construction wastes as modular and prefab design already has this inept ability designed within its scopes. Design is to be broken into two sectors, the modular home units and the tower.

History

At the turn of the 20th century, the American middle class numbers grew pushing them from the cities to the suburbs. With housing scarce and new housing costs on the rise, the prefabricated home offered an inexpensive option. Sears, Roebuck and Co. is the best known for their catalogue homes. Between 1908 and 1940, over 100,000 mail order homes were sold. Homes arrived in 30,000 pieces and a 75 page instruction manual for assembly. Entire homes arrived by rail from the lumber to the staircases, from nails to the paint. However Sears wasn't the innovator of home design. Instead, they were able to follow popular design with the advantage of modifying homes and hardware to suit



FIGURE 2.3. Sears, Roebuck and Co. Home Catalogue

buyer tastes. Individuals were able to design their own homes and submit the plans to Sears which would then send the appropriate parts and materials for construction. It gave the owner full creative control over their home (Sears Archives 2007).

After World War II, faced with housing shortages, the U.S. government supported prefab housing to house troops during the war and then after the war (Herbers 2004). As a building typology, prefab design promises an affordable alternative to traditional building practices. It provides an option for individuals to build homes that are not just within their economic means but also easily customized to their lifestyle. Since only five percent of Americans can afford to hire an architect and construction costs in the major metropolitan areas, such as New York, run \$400 a square foot, the use of prefabrication becomes an increasingly affordable option in an expensive housing market (daab 2007).

Modularity

Modular homes are sectional prefabricated buildings that consist of modules that are manufactured off site and then delivered to the final site after completion. Because these units are factory constructed it allows them to be a very cost effective alternative when compared to conventional construction. They also have the capability to be constructed in less time than it would take to finish the construction on site. The homes can be built in major distribution hubs and then shipped out to various sites with different conditions. It allows the

ease of transportation as pieces can be moved rather than an entire building. Low construction waste is also contributed to this form of construction as the same plans are constantly being built. It allows the manufacturer to know the exact quantity of materials that are needed while site waste is greatly reduced (Conbere and Foss 2006).

Usually, the modular homes are built to the state codes so that each dwelling built will have different construction standards depending on where the final destination is. They are capable of being moved after the unit has been installed on the initial site. However they do need to be checked for the environmental issues that will change from site to site such as wind, thermal and roof load requirements that may be present.

Rules of Play

In 1968, Ralph Wilcoxon was made to define his stance on the continually shaping phenomenology of megastructure architecture. He used four major characteristics to define this stance and it is these four characteristics that this thesis will begin to form itself around as the rules that will govern the decisions of this design (van der Ley and Richter, 28).

- It is to be constructed of modular units.
- The structure should be capable of great extension.
- It should consist of a structural framework that allows smaller units to either be plugged-in or

clipped-on after prefabrication at another location.

- There is to be a structural framework that is expected to have a useful life long after that of the smaller units.

The Modern Nomad

Urban nomad

A new generation of worker/travelers, they transplant themselves to new cities across the globe following the next big opportunity.

-Urban Dictionary

What is a nomad? It is defined as "1. A member of a group of people who have no fixed home and move according to the seasons from place to place in search of food, water, and grazing land; 2. A person with no fixed residence who roams about; a wanderer" (nomad).

In a world where more and more live in multiple locations, where identity is becoming increasingly rooted to an intellectual identity and social standing rather than a physical form, the populous has begun to detach itself from the traditional dwellings and have shifted lives to become 'modern nomads.' Unlike nomads of the traditional understanding, the modern nomad is not governed by nature as there isn't a search for food, or following of traveling herds that had once occupied the lives of the traditional nomad. The modern nomad has a job, earns a living through any means. They can be artists, influencers of modern technology, even politicians. They are no longer tied to the traditional pursuits of the herd. The modern nomad does reflect

their national origins, but however tend to associate themselves more with a cultural class, a citizen of the world (Wu 2009).

The Home

What is a home? Defined, it is "a place where one lives; a residence" (home). The obvious assets of a home are the ability for it to offer the physical of shelter, protection, hygiene, and a place of protection from hot and cold, storms and snow. A home fulfills the physical needs but it must also provide for psychological and sociological needs as well. Home is where one belongs, where one interacts with people. It is the ownership of a home where one sets the rules, where one is truly themselves. Ownership, the desire to own land and a home has been conditioned through decades of social interaction and instinct. The home has become a mark of success and part of social systems of recognition and interaction that can mark the social and economic status of a person. It is a facilitator; it allows interactions at various levels that allow the meetings because of the private and familiar environment (Wu 2009).

The modular home units will be designed to morph with the ever changing and increasing needs of the families and owners. A set of rules to govern the design must be implemented and followed to assure the governance of forms that are to work both in a tower application as well as on the ground. However it is understood that certain changes will happen on the ground level that changes how the modular units are to be inhabited and those must be recognized and designed for with their own rules and implications. Most families

will require the needs of garages or covered car ports for the protection of vehicles unlike they would in an urban context. Garden spaces are now located around them rather than to their roof creating new groundscapes that can influence the changing modular designs. A changing program and interaction will enter the project when the home is placed on the ground but still must be able to function when removed from the suburban context to the urban.

It is the design of a box unit that can be connected and replicated easily with programmatic changeability that allows it to easily change its function to what is called for for this project. Much like the future Rodovre Sky Village by MVRDV, based on the pixel, allows a system of individual units that can be stacked in various configurations that allow the form of the tower to maximize the available space and structural changes that may come with shifting market demands. Dimensionality will become increasingly important in this option but it allows the greatest flexibility for the owner to configure the spaces to suit them rather than trying to make themselves comfortable in spaces that are already predesigned. Flexibility for adaptation is one of the strongest characteristics of this option. It gives the owner greater sense of their home allowing them to have a say in the configuration of these units to develop what it is that they are to call home. Construction and portability is a strong viability in this option as the boxes would be easy to transport and connect with very simple alterations to make them inhabitable whether a bedroom, office or even a kitchen. This would create

increasing variation of design and function within these units that are fitted to solve the needs of the inhabitant.

Each option will have and utilize a service core. This unit will house all the mandatory living functions such as the electricity, mechanical, plumbing, and vertical circulation within the home unit when stacked. Programmatic functions will be the kitchen, bath, and storage when a lack of a stair is needed. The service box will be the core to the project placing the necessary and wanted living spaces around (eg: bedrooms, offices, etc.). Electricity and mechanical while housed within this core will provide extensions and plugs that can easily be connected at the addition of living space around this unit. A quick and easy application of connection must be used to provide the ease of moving these pieces around or complete relocation of them.

The Tower

The tower of this project is to be a core. It is to contain what is needed for the home (eg: plumbing, mechanical, electrical, circulation, etc.) and allow the homes to be able to easily access and tap into the needed necessities to make the units habitable. The core must provide a major portion of the structural stability to hold these homes in their locked positions while allowing the ability to add more atop, below, against, and above, much like the core of the towers designed by the Metabolists. The core has the ability to reproduce itself just as the modular homes. A tower can be comprised of more than one core to support the needs of the domestic community that is growing around it. It allows the flexibility of design much in the same way that the

domestic units will allow. It lets those that inhabit it develop the way it looks through their homes. Given the towers urban context, its lower floors must have some programmatic function allowing commercial space even if it is simple modular units designed out allowing companies to purchase each unit to accurately receive the amount of space that is required for their operations. However this aspect of the tower is not a major player within the thesis and is more a reflection of the urban environment that the tower is to be inserted in.

Case Study 1: Rodovre Sky Village: MVRDV & Adept Architects

A housing project design by the cooperative minds of MVRDV and Adept Architects to answer one main question; "What kind of tower should be added to the skyline of the capital?" (MVRDV)

The Basics

Situated in the city of Rodovre, just outside of the Danish capital of Copenhagen, is an answer to the slowing real estate markets through flexibility. With the recent slowing of residential demand, office space has hit a premium in new construction and by creating a flexible building it can accommodate whatever is required of it. Offices can easily be transformed into houses and vice-versa; small can turn to big or big down to small.

The Pixel

The basic unit is designed around what the architects are terming a "pixel." Each pixel is two stories in height and measures $25\frac{1}{2}$ " by $25\frac{1}{2}$ ". The dimension was arrived at for the flexibility that it offered for both a housing and office typology. This pixel size gives the building its thirty-six pixel gridded base. By varying the number and placement of the pixels on each level, more facades allow more light



FIGURE 3.1. MVRDV Rodovre Sky Village with context

and air creating a composition of terraces and balconies.

Analysis

Copenhagen, like many cities around the world, is faced with the low market for residential. However, MVRDV and Adept Architects were able to create a building that has the ability to continually alter itself to fit the needs of the users and inhabitants by creating a vertical village, a sky village (MVRDV).

The pixel, easily repeatable and alterable provides the best framework for the continuous altering of the building to meet the needs of the owner and inhabitants. Using the grid that is created, if one varies the placement of the pixel, a unique building form is possible that allows a maximum of light and freedom in planning and uses for balconies and public spaces. Even in the interior, opening the pixels allows for covered terraces for public or office functions. By building the mass upwards and leaving a small footprint, it creates a plaza at the base of the structure that is for use of those that do not live or work within the building. With the freedom of planning within the pixels, commercial uses are able to be positioned at the base of the tower.

The central core, housing the necessary elevators and stairs comprises of three individual cores that sever the residences, offices, hotel and restaurant. A corridor surrounds these cores to allow

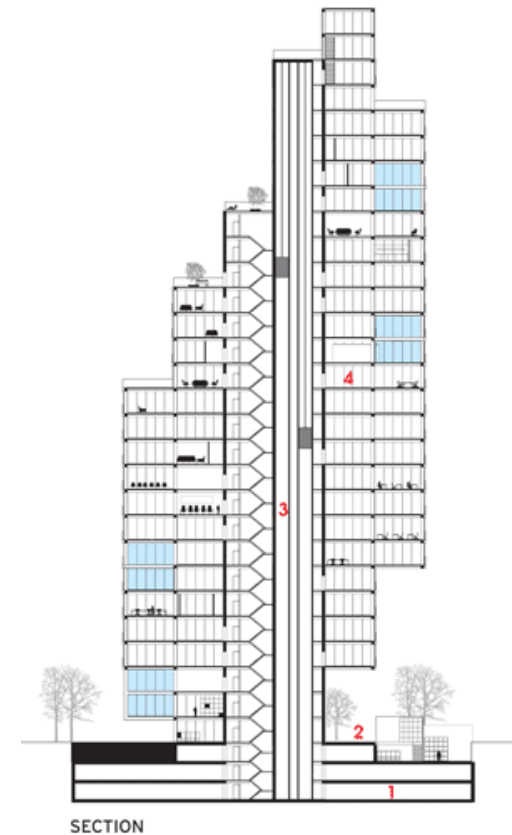


FIGURE 3.2. Section Elevation

easy access to all to the varied program placed throughout the floors of the building. The core is a cast in place concrete core with a base beneath of two levels of underground parking providing the main structure likening it to the trunk of a tree. Each pixel hangs from the core by steel trusses rather than cantilevering connected through columns at each of the corners of the pixel that will connect to the main truss with diagonal bracing for added strength and stability of the hanging unit. By hanging the pixels in this manner it creates a lot of compression within the central core, so even in the high wind loads that are prevalent to the site, there is very little tension which allows the steel to be used more efficiently (Minutillo, 119). The structure is taken down through the pixel as well to be able to maximize the floor space in a set condition.

The Verdict

By exploiting the stacking of the pixel on the frame, the tower has the ability to constantly vary itself and the experiences of those within the tower even down to the site itself. The two story design allows a larger square footage on a minimal footprint making it easily able to house a number of residents within one pixel making them multifamily rather than just space for one or two. However the pixel size was determined not just for the residential but also for the ability of it to fit into the larger mixed-use plan as it was the size that could accommodate all the needs including the grid that would allow a parking structure that was

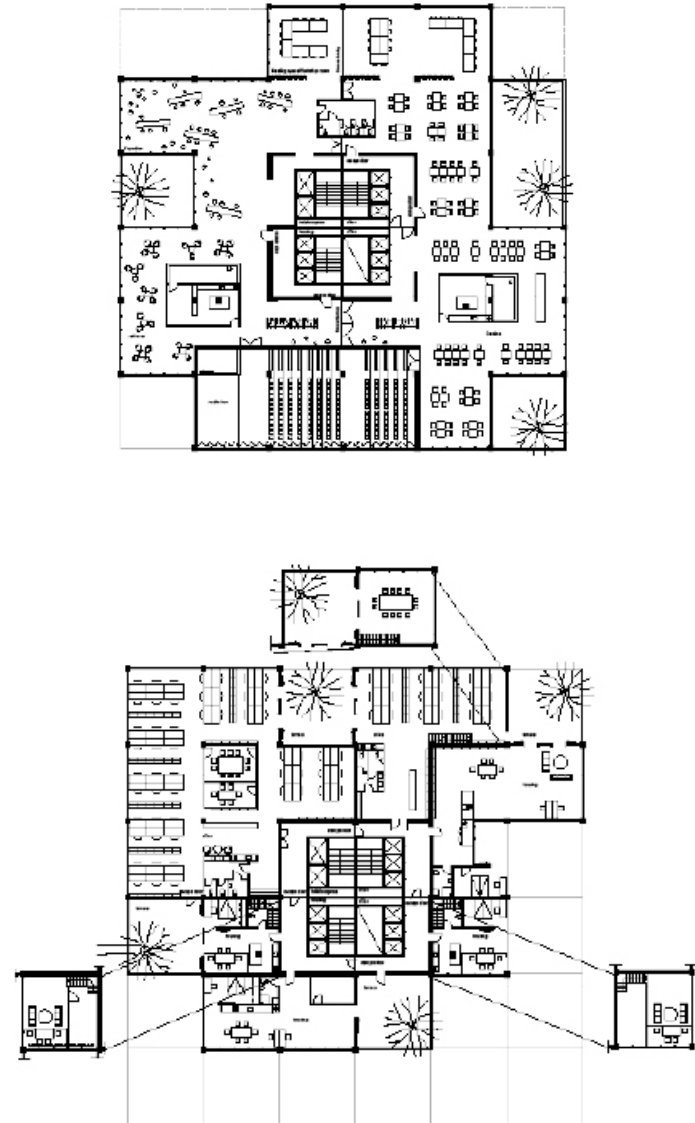


FIGURE 3.3. Sample Floor plans showing exchangeability

reflective of the desired size. This raises the question of the home itself and the ability for it to fit the needs of one who is to inhabit it as it could have previously been an office that was converted. Can one live in a converted office space if you simply put a bedroom in it and call it a home?

What of the adaptability of the building? A modular pixel does allow the varied shapes and floor plans that this building is able to give but is it as easily alterable on the exterior as well as the interior? The shape seems decided, but what if tenants wish to add further to their space and are unable as the grid is the grid and a corner unit can't be expanded further. The exterior and interior terraces allow public gathering space and private gardens that are a premium in a vertical home to allow a further freedom of space and movement that is needed in vertical living.

The current plans give 10,500 sf of retail, 170,000 sf of offices, 39,300 sf housing and 21, 500 sf as hotel. With such a heavy amount of office space designated within the tower, what is to keep it from becoming completely office spacing? Since the stress is on the adaptability of the building to shift to meet market demands, easily the home can be pushed from this tower completely.

Case Study 2: System 3: Kaufmann & Ruf

Easily portable, the units can be fitted inside the standard shipping container to allow the entire house to be shipped anywhere in the world.

The Basics

System 3, designed by Kaufmann and Ruf, was developed as a building system to meet future demands concerning mobility, flexibility and sustainability. Each home is moveable, expandable and suited for lifelong use.

The “Serving Space” & the “Naked Space”

The design of the home module is a twist on Louis Kahn’s “servant” and “served” space. System 3’s serving space is a completely fabricated unit that provides all the necessary functions such as the kitchen, bath, electricity, internet, laundry, heating and cooling, and vertical circulation in the event of stacking. The naked space is formed by planar elements, the floor slab, walls, windows, roof, and the optional skins that allow customization of the exterior of the home module. The naked and serving space are the same size rectangular volumes that are connected with each other. Each space is 19 by 38 feet when together (Bergdoll, 214).



FIGURE 4.1. System 3 Service Module and Connection Module

Analysis

The serving unit, containing the needed functions of the home, are designed and built in factory allowing the designated workers, such as the plumbers and electricians, to conduct the needed work not at the site. The flat elements employ CNC technology to cut the openings of the walls providing the building skin in one flat shipment. By employing this technology, the producer is able to supply a wide array of different skins for the home units making each a completely customizable and unique.

By designing the unit with flat floors and roofs, they are easily able to be stacked vertically and accommodate pivoting and vertical loads that would come with the larger structure of stacking these units (Bergdoll, 216). By locating the vertical circulation in the center, stacking is allowed easier and higher even if vertical circulation was seen in an office schematic of stacking these units rather than a housing unit. The housing unit was only designed to go three floors and no higher but could easily be designed to reach a greater height, much like the office design of this unit, if the vertical circulation remains in the same location but is redesigned to allow entrances to the individual units.

The Verdict

The home takes the basis of what a modular home is and uses it with modern technology to create something completely unique. It allows the owner to



FIGURE 4.2. System 3 Vertical Stacking Conceptual Model

have a hand in the design process by choosing the skins that are to cover the sides of their homes and continually alter as the skins are easily replaceable for another. The ease of shipping provides a great viability for this design as it can easily be shipped anywhere through any means to reach its final destination giving the home an ease of portability.

The home stacked, only at a max of a 3 unit by 3 unit, still holds the base ideal that it could be stacked to fit a multifamily typology within. However, it was only designed to ten stories with an office programming removing many of the functional domestic needs from the boxes. Redesigned, it could hold a multifamily within the ten stories replacing the originally planned office space into that of purely residential. It does, however, speak of the easy alterability that this unit is able to have and easily changed from one typology to another.

Case Study 3: Micro Compact Home: Horden Cherry Lee Architects

A home unit designed by Horden Cherry Lee Architects with Haack Hopfner Architects that promotes "Smart living for a short stay" (Bergdoll, 190).

The Basics

The MCH is designed towards a person with a mobile work or leisure-oriented lifestyle rather than for permanence. Mobility instead of permanence and with streamlining shape instead of acquisitiveness is the core of the prosperity of home.

The Cube

Compact living at only seventy-six square feet, the home is designed as a "machine for living" (Bergdoll, 190). Within the small cube, two compact double beds, a sitting area, a table for work, dining space for five people, complete HVAC, a bathroom, two flat screen televisions, internet, storage for clothing and two mirrors are included within the small adaptable space. It can very easily be taken off the grid with passive energy equipment, solar cell and turbine energy (Bergdoll, 192).



FIGURE 5.1. Cube Spaces Conceptual Model

Analysis

The Micro Compact Home has the benefit of quick delivery and installation. The only site prep that is needed is the installation of its support frame at the site and the home is simply delivered by a truck or trailer and then inserted with a crane in minutes. Because of its size it has the ability to be delivered in remote locations using helicopter delivery. With its small size, it has the ability to make very little impact on the site as it can be placed around existing trees and other site conditions.

The exterior cladding of the cube has the ability to be changed and fitted to meet whatever aesthetic the owner wishes. Graphic adhesive films can be applied along with a range of colors. However, the cladding of the home is completely recyclable providing a longer life after life in the home has moved on.

The units can be designed into a larger village form using some of the precedents created by the Metabolists and Archigram. Two units could have the possibility to be connected together with a door creating a larger living environment. Another configuration, a "tree village" (Bergdoll, 192), takes the cubes and stacks them vertically. Using steel columns that would be giving brackets for the cubes to connect to, it would support the individual units in a number of possible configurations. A central elevator core surrounded by a stairwell would be in the center of the massing to provide the needed

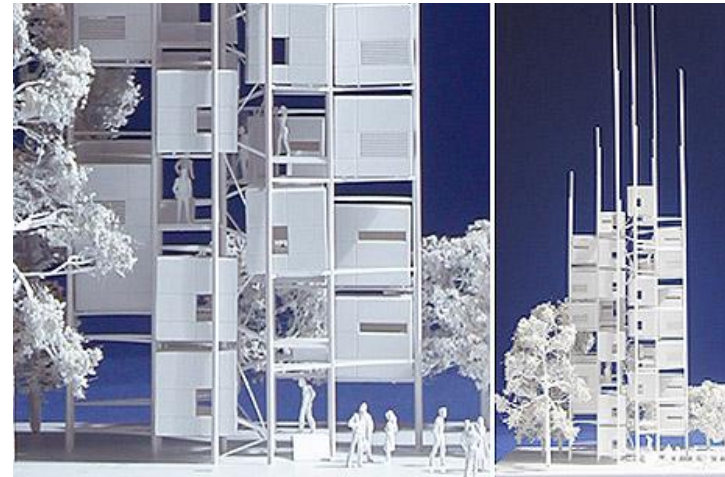


FIGURE 5.2. Tree Village



FIGURE 5.3. Micro Compact Home on site

vertical circulation. Units would have the ability to be removed without disturbing the structure and surrounding cubes.

The Verdict

The cube is a study in the minimization of space that is allowed to still make a comfortable habitable unit. It takes a strong stance on what it is that is essential to life within a compact unit. However the maximum amount of people that the cube was designed to house was only two, keeping the availability to a larger spectrum of tenants to a minimum. Even if the cube was designed for short stays, it shows the ability that it could be used for lasting living space. Because of its size, it is easily portable from place to place making it the most transportable unit of the other precedents studied as well as the most sustainably designed. With the ability to produce its own power, it is able to further reduce the footprint it takes on the site.

The vertical configuration is limited in the total height that it is able to achieve but it does offer another option of configuration rather than a cluster of cubes located on the ground. It does however offer the ability for the cubes to be arranged in varying forms vertically through being clipped to the structural steel columns creating a number of options for location but also programmatic additions to the vertical configuration.

Case Study 4: Plug-In-City: Archigram

Plug-in-city was a megastructure scheme that was designed to continual circulation, varying functions and a new form of collective living on an urban setting.

The Basics

Archigram turned to the works of Le Corbusier and Karl Ehn's work, combining their elements of collectivity, interchangeable living units and the connection to transportation links. The proposal of this city was to keep urban areas viable when rapid change was happening everywhere (Sadler, 15).

Analysis

The planning was promoted as an event that could only be realized by the involvement of the inhabitants that were to call this home. Peter Cook used a tubular system to create a diamond shaped lattice that acted as the structural support for the plug-in units and the other elements termed as the inflatables (McIntyre, 38). The lattice was set at a 45 degree angle creating a continuous structural grid. The tubular system was to be a link into the surrounding city as were several other links that could provide travel between the separate "cities". By setting up a large scaled network of structure, access

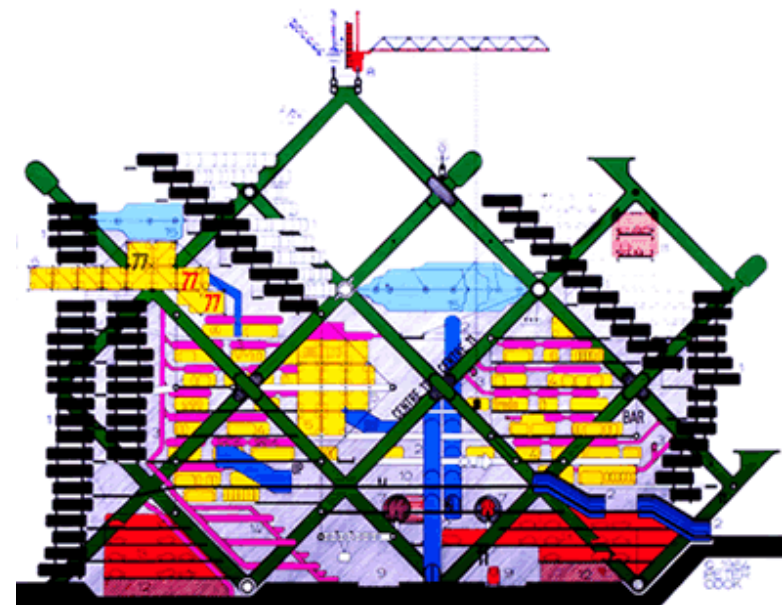


FIGURE 6.1. Section of Plug in City

ways and essential services can run easily no matter the terrain. The tubes were nine foot in diameter that intersected at 144 foot intervals meeting in an eight way joint. One in four would contain a high speed lift while another would hold a slower moving local lift and the others were to be tubes for goods and services (van Schaik and Macel, 84).

Pylons would be used as central cores that would contain the lifts and necessary services that would hold a tray to each side that allowed the connecting parts to be completely interchangeable. This allowed the functions to change as needed around each pylon if it was to be residential or commercial (van Schaik and Macel, 78). Craneways and mechanized slipways were installed throughout the configuration to handle the movements of the changing units. The locations of the cranes were multiplied along the main feeder routes. The main access roads and service routes were had feeder roads and services that ran to either side of the major arteries. The pedestrian walks ran at right angles to these routes.

The Verdict

The systemization of the modular units and the necessary functions offer a freedom in form and the location of units. Keeping the necessary functions located within selected tubes making linking the units to them easy for insertion and removal purposes. It also allows a freedom in flexibility. The appearance of

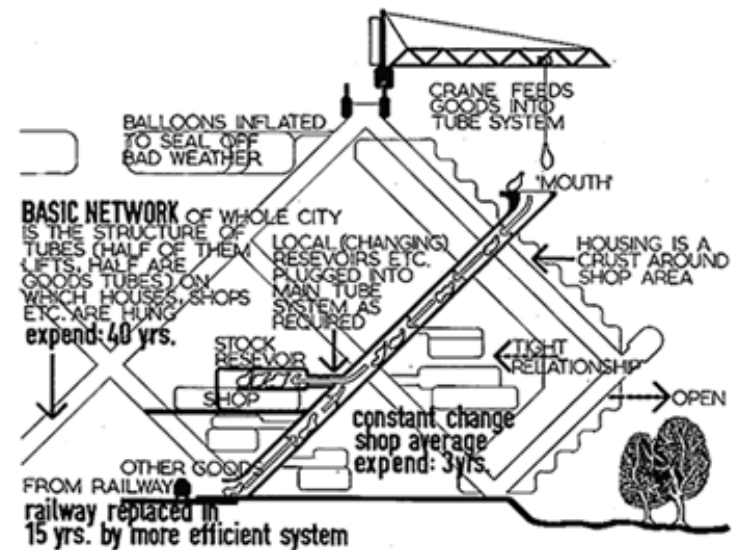


FIGURE 6.2. Diagram of Service Access

construction apparatuses with a continued purpose and use for work with the units and the delivery of units from the circulation tubes helps to believe that continuous construction of a building is possible.

If the system would work it is not known as it was never building and was a theoretical project to answer the urban areas that were under rapid change. However, it is still strong as a precedent for the ability of continuous construction and movement of a building that can completely rebuild itself several times and continually alter its form and functions.

Case Study 5: L'Architecture Mobile: Yona Friedman

A study that started in 1956, Yona Friedman's L'Architecture Mobile, became architecture that is capable of understanding the constant changes that characterize a social mobility based on an infrastructure that provides housing.

The Basics

The underlying principle defined by Friedman's L'Architecture Mobile is that the design activity should be left to the occupants. The occupant needs to be instructed on the consequences of the decisions that they make during the design process. Architects are unable to cater to every personal need of each individual occupant. The sheer number makes it impossible to do.

The Objectives

The first object is to ensure that the preferences of all the occupants were compatible. The second being the insurance that once the occupant has chosen and implemented a design, it can be altered and modified at a later stage if ever wanted or needed by the occupant. Both objectives aim to give the occupants an initiative in architecture. Outlined further by Friedman was his "Ten Principles of a New Architecture" and why both human behavior and rapid

population growth necessitate the needed flexibility that is the base of his mobile architecture.

- The fifth principle states "The structures, which together form the physical fabric of the city, should reflect the extent of advancements in modern technology" (Sabine Lebesque, 21).
- The eighth principle states "The structures that form the city must be skeletons, to be filled in as desired. Additions to the skeletons are dependent on the initiative of every inhabitant" (Sabine Lebesque, 22).

Analysis

1957/1958 :: SPAN-OVER BLOCKS

The first technical proposal of L'Architecture Mobile is the span-over blocks. It is a hollow supporting structure or skeleton that contains all services such as the electrical and plumbing needs. The occupants have the ability to make any spatial arrangement of the blocks within the skeleton framework through the use of mobile partitions, walls, even floors. The building is supported by a small number of columns making the ground impact at a minimum. The main circulation is housed within these columns (Sabine Lebesque, 28).

1958/1962 :: LA VILLE SPATIALE (Figure)

Using the advantages of the span-over buildings such as the flexible spatial arrangements and minimal impact on the ground, La Ville Spatiale was developed. The skeleton of the building extends horizontally making the constraints in the span-over blocks easily avoidable. This increases the configuration the future occupants can ultimately have. A “spatial infrastructure” (Sabine Lebesque, 29), a multileveled space-frame grid that is ten meters above the ground level, is the essential component. Small volumes, like the homes, give minimal structural loading, are easily supported by this grid whereas the larger public function spaces are located at ground level because of the structural load.

The Verdict

The modularity of Yona Friedman’s work offers better living conditions through the flexibility that is given in layout as well as the freedom of design by the occupant. The structure does allow a varied program to respond to the needs of not just the occupant but that of the site it is to be placed upon allowing space for public function around the base of these structures.

The homes, easily alterable, as the bathroom and the kitchen were movable as was the entire position of the apartment within the larger structure. Complete freedom of design makes each home independent of the other making it uniquely one’s own. It is not the typical repetition of units that are only different



FIGURE 7.1. Conceptual Sketch

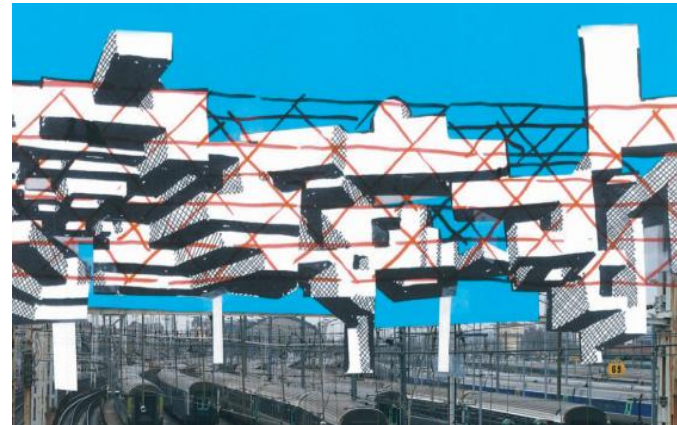


FIGURE 7.2. Drawing in context

through the furnishing of the occupant, but each can be significantly different than its neighbor. This allows a design freedom and decision on the part of the inhabitant that makes them an active participant in what it is that they wish to call their home. For a home to meet our society, it must find itself able to alter and transform continuously.

Construction Systems

Typical construction systems were explored for this thesis but the final conclusion came that the current systems in use proved too space consuming to be used for the needed applications. Alternative methods were explored looking to the future of construction methods and trends that have started to be explored and used in the recent past. Specialized robots in the construction industry have the potential to raise productivity through repetitive task efficiency while improving hazardous working conditions taking the worker out of harm's way.

There are currently few industrial robots in use that are for the construction sector. However with the advances in robotics and computer control, automation has been able to turn robots into construction workers. They have the ability to be self-regulating and correcting. In the case of construction, the use of a systemized approach in construction using prefabricated components has the ability to advance the ability of the automation uses at a construction site.

R.O.B.: Robotic Fabrication Unit

The R-O-B goes beyond the traditions prefabrication processes of construction. The robot leaves the enclosed environment of the production building and ventures out to the building site. Housed in a freight container that has been modified, it can be deployed anywhere in the world. The unit combines the precision and consistency of prefabrication but also has the advantages of short transport routes and use on a construction site. It is not restricted to a predefined manufacturing process or one building material. By using the computer, design and fabrication allow for a greater variety in the manufacturing of building elements with very specific forms that can't be built manually. (Kohler, 57)

The Robot

The robot used for the R-O-B, is the KR150 L110 from KUKA Robotics. It is an industrial robotic arm that is equipped with 6 axes, each that are controlled by an electromechanical drive system with brushless AC servomotors (Kohler, 49). It is classified by the International Federation of Robotics as an "articulated robot" (Kohler, 49), the KR150 L110 can lift up to 110 kg and perform nearly any automated task it is given. It has the ability to work upside down, mounted on the ceiling if needed.



FIGURE 8.1. KUKA Robot with Site Context of R.O.B.

Serpentine Climbing Robot

The Virginia Tech College of Engineering Robotics and Mechanisms Laboratory developed a set of pole-climbing serpentine shaped robots called the HyDRAS-Ascent, the HyDRAS-Arm, and the CIRCA. These robots are designed to climb scaffolding and building simply by wrapping themselves around a pole or beam and rolling upwards by an oscillating joint. Moving through sensors and cameras, the robots can inspect structures or handle other dangerous tasks.

Dr. Hong, faculty advisor of the project stated "Unlike inchworm type gaits often being developed for serpentine robot locomotion; this novel climbing gait requires the serpentine robot to wrap around the structure in a helical shape, and twist its whole body to climb or descend by rolling up or down the structure" (Duncan 2009). The HyDRAS and CIRCA were designed to take the place of construction workers that work in dangerous climbing situations or jobs that are performed up on scaffolding.

The motion created by these robots offers distinct advantages. When moving up a pole and faced with an obstacle like a T or X- Junction, the robot can unwrap its head and let the controller use a camera to guide it to where it needs to go to next. Changes in pole diameter or shape would not slow the movement or functions of the robot (Duncan 2009).



FIGURE 9.1. Test Robot Climbing Pole

The Service Core

A service core is defined as the parts of a building that consist of the elevators, elevator shafts and lobby, staircases, toilets, mechanical and electrical service, and riser ducts. The structure of the core can also contribute to the structural stability of the building as well (Yeang, 10). The position of the service core in relation to the usable functions and floor space within the building determine the vertical circulation and how most of the building services are distributed.

The Function

The sizing and location of the core is dependent on the requirements needed to meet the general egress regulations while creating an efficient layout that can maximize the requirements of vertical transportation and egress routes. In many tall buildings the core can provide the principal structural element for both gravity and lateral loads. The configuration of the service core is to be finalized early within the design development stage because of the layout and configuration impact on the building (Yeang, 13).

Types and Placement

The service core has four typical types, the central core, the split core, the end core, and the atrium core. The selection will depend upon many factors to find the best solution that will meet the buildings needs. The placement and internal arrangement of the core depends on the type of building, the people using it and the needs of the building codes. Certain needs of the service core will not change much in any application. Elevators, stairs, and service ducts will be required regardless of tenant type.

At the conceptual stage of design, the service core should consider the implications of all core placement options available to the project. The aspects that must be considered are the architectural design, functionality of the spaces, fire escape regulations, the overall structural stability, the mechanical and electrical needs and service, the building typology and the overall cost of the project (Yeang, 12).

Structure

For towers, the weight of the materials for the floor are usually the same no matter where the floor slab is located since they carry near the same loads. However the columns of the service core carry the

load of all the floors above. The load being placed on the columns increases with the number of floors and the load bearing capacity will vary. A lighter frame can be achieved by using two separate structural systems. Creating a flexible exterior frame and a stiff inner service core that is used for wind bracing but also which holds the vertical circulation within. In addition to using beams and columns, the core can use a frame with diagonal bars creating an X that give the core an increased stiffness. However, only three of the four frames that surround the core can be X-ed because of access (Yeang, 23).

Vertical Circulation

One of the first elements to be determined during the internal configuration of the core must be which vertical circulation will be used.

Elevators

High-rise buildings require a certain number of elevators and arrangement that allows the best use. A bank of elevators is the main element that is in service core design with the other needs being designed around the bank. Once location within the core is established, the size of the elevators must be calculated. The sizes are configured by the number of cars and the car shapes and sizes that have been selected for the project. A general rule to the sizing of the lobby is that it must be twice the depth of the elevator car it is servicing (Yeang, 45).

Staircases, Exits, Fire

The locations of stairs, as a means of egress are often decisive form givers in a building. In high rise buildings, elevators are not considered as fire emergency exits as they may fail operate and the shaft of the elevator can connect the fire to the rest of the building. The use of the building, whether it is office, commercial, or living, can have a major impact on the floor configuration with the design of the service core. The local building code will further determine the detail about the exit requirements necessary for the type of construction being performed and building type requirements. There should be at least two escape stairs within a building in case one should become unusable. The stairwells must be fire protected to create safe havens (Yeang, 47-48).

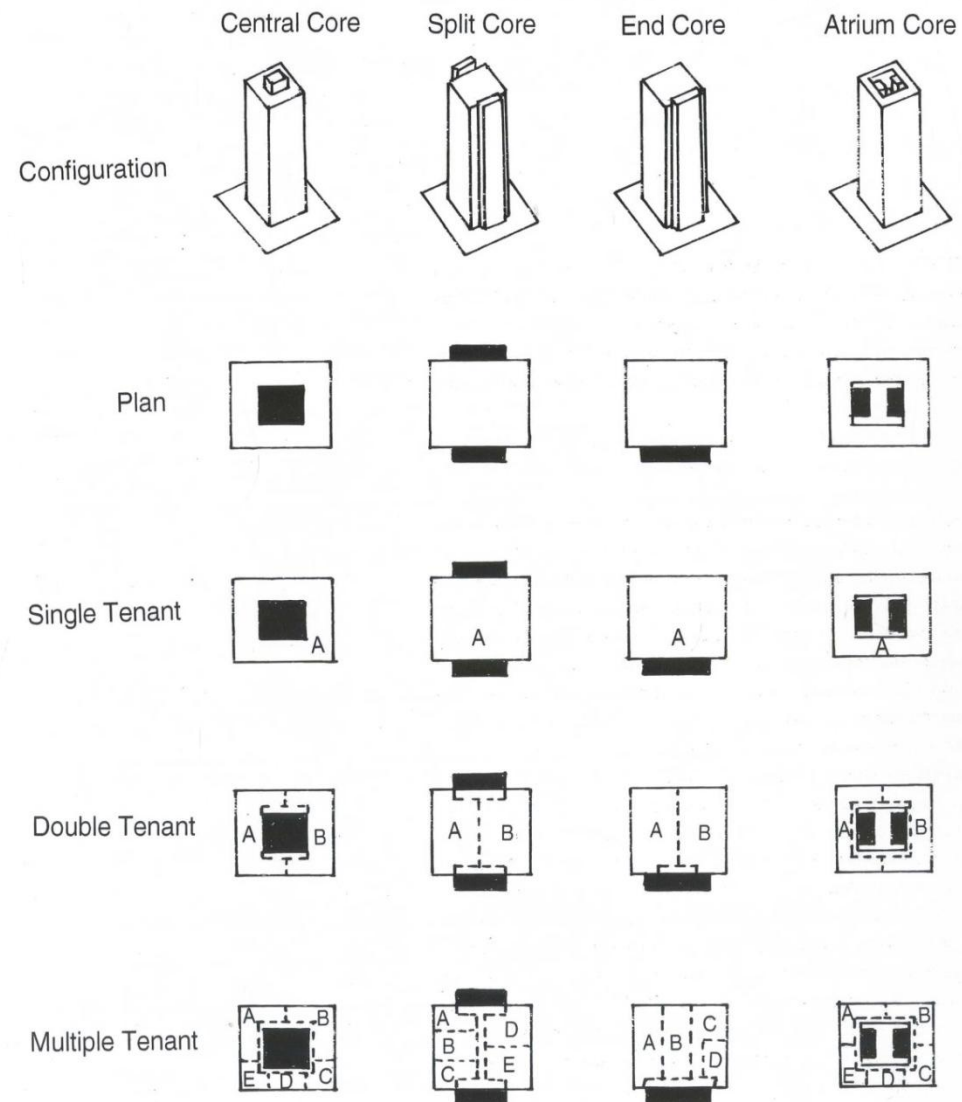


FIGURE 10.1. Core Diagram

Dwelling Unit Modules

A module is defined as a separable component, frequently one that is interchangeable with others, for assembly into units of differing size, complexity, or function (Dictionary.com 2009). The key is the design of modular homes that can be clipped or connected together to provide continuous customization. Construction technology allows for the insertion of complete units that can be trucked in and craned into a desired location.

The Grid

The grid, for the purposes of this project, is used for geometrical base that will determine the position and dimensions of the modular dwelling units. The module itself is 15' x 30' and will be reflected in the sizing of the service core needs to make the modules easily adaptable within the frame of the tower. The aperture itself will be reflected through the sizing of the homes that will allow the ease of placement and removal at a continual basis while providing the necessary structure of the building form.

The Micro Flat

These were first effectively developed by the Metabolists in Japan to answer the need for quick, affordable

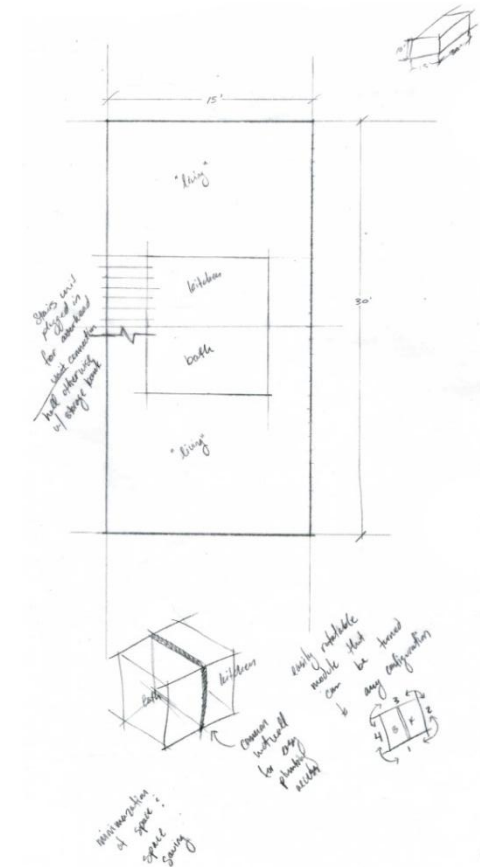


FIGURE 11.1. Module Conceptual Drawing

housing for rising populations. Most famously is the Nakagin Capsule Tower by Kisho Kurokawa. The main idea of the size and compact, pod form was that the homes could be added to an almost indefinite space that could provide affordable housing where land is at a high premium. Using yacht design and technology, everything is designed to be easily stacked away and every bit of space is put to use, however each basic module will be able to accommodate a bedroom with space for a double bed, a living/working space, bath and kitchen. Each module is to be factory built and delivered to the site for easy insertion into the armature of the tower into whatever quantity and design that is required.

Built-in Design

Part of what is currently making prefabricated homes work is molded or built-in design that can allow the inhabitant to save space within the modules. Pieces of the functional home can be compartmentalized and combined to allow use of same resources and saving of space for already small living conditions. Much like the Hidden Kitchen by June He (11.2), the traditional kitchen has become hidden behind a wall allowing easy clearing of the kitchen and saving space that was the kitchen to be used for other functions. Options like this allow for the quick customization of any living module to a variety of wants and needs.

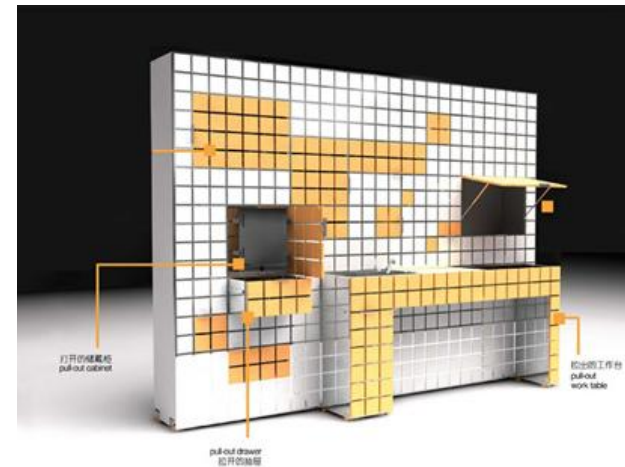


FIGURE 11.2. Hidden Kitchen by June He

Portability

"The significance of place is that which is determined by the builders of that architecture, not by the permanence of the artifacts which express that significance" (Kronenburg, 127). It is averaged that every American family will move homes at an average once every three years (Kronenburg, 129). Using a structural armature, the module finds itself easily inserted and removed allowing it to keep what many homes in dense urban cores do not have, portability. It allows one to retain their home and at the want of another location can easily be removed from the armature, put to a truck bed and delivered to a new location, much like its delivery. Using the common shipping and portability options that are available, the home will be able to easily and importantly, move through cost effective and commonly accepted shipping methods. Truck beds for relocation between state to state, a cargo ship for shipment half way around the world if needed with simple unload and loading applications for efficiency and speed.

Site Selection & Zoning

The intent of the thesis is to provide a new system of housing that has the ability to continually adapt to the needs of the inhabitants and the commercial conditions put forth by the site. The ideal location is within a dense urban fabric that is in need of a residential application. When choosing sites, the ultimate decision was the density of the city chosen that would welcome this typology and allow alterations to the existing city skyline. After study of several dense urban cities around the globe, New York City, mainly Manhattan, was chosen as the city to further investigate this typology.

Any city could have been chosen, but New York City is one that will always have to address housing in every form. The continuous rebuilding of the city and altering of the skyline pushed Manhattan to the forefront of the list. With further research when concluded on the island of Manhattan, the Flat Iron District became the area that would further be studied for locations. It has long been the void of major residential works the past years but recently has begun a large push to add residential space to the largely commercial and industrial area and once again make it a neighborhood that people are once again making their home.

"The Flatiron district is once again a place that many people are calling home".

-The Flatiron/23rd Street Partnership

The Flatiron District

The Flatiron District is a small neighborhood in the New York City borough of Manhattan that is the area bounded by 14th Street and Greenwich Village to the south; Sixth Avenue and Chelsea bind it to the west; 28th Street and the area of Midtown South are to the north with Gramercy Park and Lexington Avenue on the east.

While it is not certain when the neighborhood began to change, the addition of thousands of new apartments and residences has begun a transformation in the neighborhood taking it from mainly commercial to mixed-use. Since 2000, around 6,500 new units became available with 3,600 within the past three years (The Flatiron/23rd Street Partnership, 8). This new rebirth is a reflection of what this neighborhood once was. In the 19th century, the area around Madison Square was home to many of the top of New York society and commerce. With its recent residential rebirth, the Flatiron district has seen the arrival of many home oriented businesses such as Gracious Home, Home Depot, BedBath &

Beyond, the Container Store, HuffmanKoos, Best Buy and P.C. Richards. Along with these businesses, child-friendly services have quickly found space within this area. New day camp facilities, play spaces and stores advertising to families by carrying necessary items such as kids clothing and furniture have started operation.

Across the street, Madison Square Park recently went through a redesign to update the neglected park turning it into an urban oasis. The Madison Square Park Conservancy maintains and operates the park hosting many free events that create a public draw to the area. The improved park was the start to a renewed economic interest to the area.

Selection

Each site was located within the island of Manhattan and located further within the Flatiron District. With the dense urban core, a further density was required for choosing the site. Each needed to be located within an area that would support a mixed use tower condition, but also the ability to be able to support an ever changing tower. Location of public transportation and major arteries proved an important necessity to allow easy delivery of the home unit and building materials. The sites had to consider the conditions that would comprise of construction of this building by street blocking and delivery allowances.

Would the site hold a tower? An important question with each site selection was the ability to hold a tower and not inhibit or hinder the surrounding

buildings and context that had to be answered. A site was chosen in relation to the dense areas with verticality already introduced or on the fringes. To introduce a tower within a predominantly low lying area wouldn't suit the neighborhood or the ultimate goal of the tower's position within the neighborhood and its surrounding context.

Site Option 1

Located at the eastern edge of Gramercy Park, the surrounding area is mixed use residential. The tallest building is a 20 story residential at the western end of the park. The nearest major road artery is Broadway, two blocks to the west. The park on site, allows easy access to green space within the dense urban condition allowing an option of integration within design. A large addition of commercial space may not work within this configuration if it was to reach higher than three floors as majority of commercial in this area is the main level of surrounding buildings. There is a stronger possibility of the tower standing out much further than its final height as the neighborhood is not holding any other buildings reaching higher than 20 stories. The park itself is privatized to the residents of the neighborhood limiting outside visitors from access to the space even if the tower formed itself on its edge.



FIGURE 12.1. Site Option 1

Site Option 2

Located within the middle of the block bound by 22nd St and 21st St and the buildings located at the end of the block, it takes four buildings within the middle for this construction. Broadway and Park Avenue flank the block for major artery access to the site. The flanking streets, smaller than the larger arteries to the east and west could post a problem in hindering of truck deliveries if one lane was to be shut down for the duration of the home module delivery. A mixed use condition, residential tower at the edge of block and commercial at the main floors are typical of this location. Addition of major commercial may work in this spot but limited to the amount. Park access is to the north and east, both a block away however Gramercy Park is for residents only. This formation does greatly limit access to all sides of the tower hindering the desired construction formations and availability.



FIGURE 12.2. Site Option 2

Site Option 3

Located at the convergence of Broadway and 5th Avenue, the area is largely commercial based with little residential surrounding. There is strong commercial already within the base of the building with residential towers being built along 23rd St park edge. The highest of the towers in the neighborhood, of which is still currently under construction, is to be topped at 60 stories. At the fringe of the skyscraper height towers with 40 story Met Life Tower and a similarly sized residential tower adjacent. It is at the convergence point of two main arteries allowing ease of delivery and access to site. Madison Square Park provides easy access green space across the street with public availability and programs with given playground space for children and a dog play area. Locating it on the eastern edge of the park allows uninhibited views of Manhattan.

*Site 3 was ultimately chosen as the site in which this project would find itself.



FIGURE 12.3. Site Option 3

Site Selection & Zoning

The site is currently zoned as a C5 Commercial District with allowable residential on site to the tolerance of an R10 Zoning.

Commercial District: C5

C5 is a central commercial district that is intended for offices and high end retail that serve the metropolitan region and for streets where continuous retail frontage is desired. These districts are usually developed with department stores, large office buildings, and mixed use buildings with residential located above the commercial floors. This district is mapped in Mid and Lower Manhattan, Downtown Brooklyn and in Long Island City in Queens. All of the commercial uses in these high dense locations are exempt from parking requirements because of the easy access to public transportation (Planning 2006).

- The maximum commercial floor area ratio (FAR) in C5 districts ranges from 4.0 to 15.0 with the maximum residential FAR is 10.0.

Residential District: R10

R10 permits the highest residential density allowed in the city. In Manhattan, much of midtown and downtown permit an R10 density. This classification can be also allowed in commercial districts that permit an R10. Height factor regulations do not apply when an R10 is located in a commercial or other R10 districts. Height factor regulations do not apply. However developers of residential buildings may choose between Quality Housing regulations or tower rules, which allow the building to penetrate the sky exposure plane. Depending on location, the building may be required to have a contextual building base. Parking is generally not required of the buildings in these districts (Planning 2006).

- Most of the districts that permit R10 allow a residential FAR of 10.0 that can increase to 12.0.

R-10 Tower-on-a-Base

Tower regulations require a tower-on-a-base building for most residential developments in R-10 districts and in C1 through 9 which permit residential density of R10. A residential building fronting on a wide street must have a contextual base between 60 to 85 feet high which is to extend continuously along the street line. The tower is permitted a lot coverage of 40% maximum. 55% of the floor area on the zoning lot is to be located below a height of 150 feet (Planning 2006).

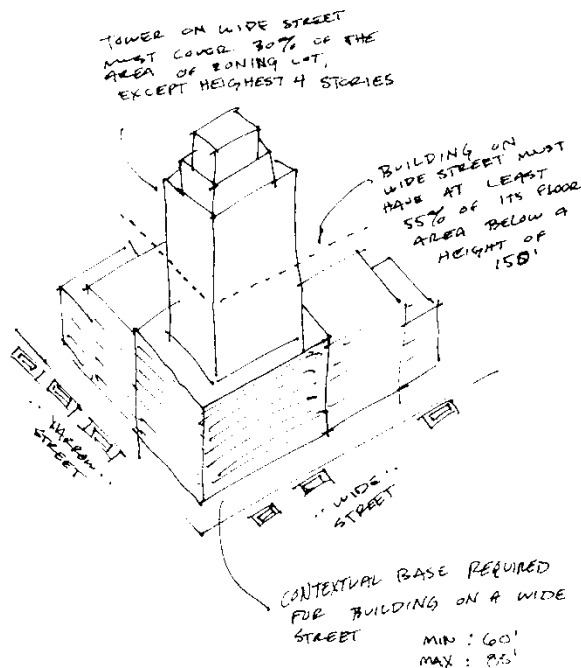


FIGURE 13.1. Tower-on-a-Base Zoning Diagram

R-10 Towers in Primarily Commercial Districts

In primarily commercial districts that allow residential development at an R-10 density, the tower is not required to have a contextual base. The footprint may cover no more than 40% of the area of the zoning lot or up to 50% of lots smaller than 20,000 ft². The tower must be set back at least 10 feet on a wide street and 15 on a narrow. A floor area bonus can be achieved by providing a public plaza (Planning 2006).

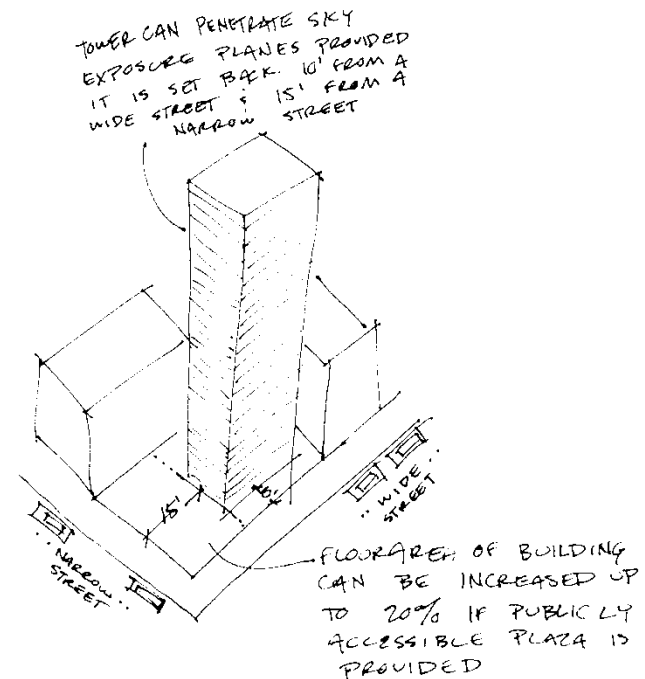


FIGURE 13.2. Tower in Commercial District Zoning Diagram

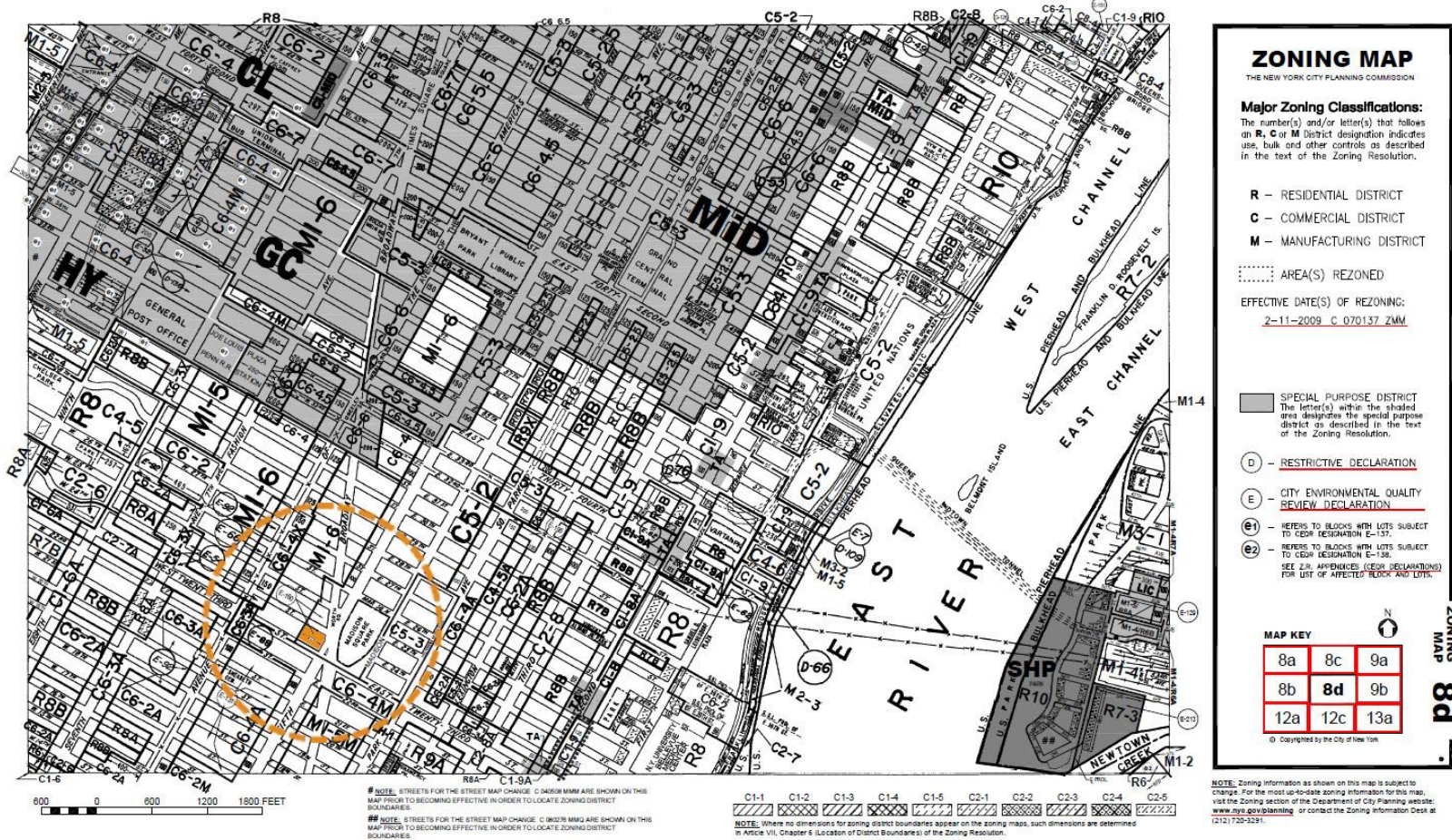


FIGURE 13.3. Zoning Map of site

Programming

The base of the design, the home module, is the main unit of design. The ability for the home modules to be easily located and moved between a suburban and urban context is the core concept. Insertion into a tower (second half of design) is the home location in a dense urban setting. The home must be able to function simply as it is (out of a tower configuration and into a suburban setting). It must meet the requirements needed for comfortable living spaces and be able to be altered to meet the programmatic needs of the inhabitant.

The high density design, the tower, is the urban half to this project. The ability for the home modules to be easily located and moved between a suburban and urban context is the core concept. The tower is to reflect the urban placement by offering some commercial space on the street edge and possibly throughout the tower. The tower is to show the multiple configurations and plans that the home units are able to take in this vertical form. The necessary operating spaces, besides the homes, will be fitted in with a determined grid of design, along with the home modules.

Home Module

Goals:

- Should be easily moved
- The form is able to be added to and subtracted from to meet the owners needs
- Module size based on a grid reflective of tower and vice versa
- Easily adaptable to increasing number of inhabitants in one unit (adaptability)
- Easy connection into site utilities (water, electricity, etc.)
- Meet the needs of the inhabitants
- Provide core needs of a home
- Provide quick and easy construction on site and off
- Portability
- Basic 15' x 30' module able to accommodate:
 - (1) kitchen
 - (1) bathroom
 - (1) bedroom
 - (1) multifunction space (ex: living room)
 - Base 15' x 30' is 450 sq ft.

Programmatic Spaces:

KITCHEN	~ 100 sq ft
<ul style="list-style-type: none">- refridgerator- stove- oven- sink- storage	
BATHROOM	~ 40 sq ft
<ul style="list-style-type: none">- toilet- sink- shower/tub	
BEDROOM	~ 80 sq ft
(number to be determined on occupancy and needs of resident)	
<ul style="list-style-type: none">- full bed (minimum)- storage- 2 separate bedrooms able to occupy (1) 15' x 30' module as a bedroom addition module	
LIVINGROOM	~ 100 sq ft
STORAGE CLOSET	~ 10 sq ft

The Tower

Goals:

- Minimum 25 stories
- Form based on grid adaptable with the home modules
- Minimum 1 main circulation core to allow flexibility of form
- Home modules easily removed and inserted into form
- Formwork for cranes (robots) to easily access exterior of building for construction, insertion and removal of home modules
- Communal spaces to meet needs of inhabitants
- Ease of connection into tower utilities (water, electricity, etc.)
- Possibility of parking integration
- Possibility of retail/commercial at base to meet urban criteria
- Allow variety of home module configurations (one story, two story, multiple story)
- Able to be replicated

Programmatic Spaces:

RESIDENCES

~450 sq ft

- Minimum of 50 residences (variable sized)
- 15' x 30' modular block
- base size with allowances to be added to to create larger square footages and program to fit tenant needs

DELIVERY BAY

size as required

- *dependant on urban requirements
- drop off/pick up space
- trash

STORAGE/EQUIPMENT

- mechanical rooms (main/each floor)
- crane/robot bay
- maintenance office ~ 100 sq ft
- building storage ~ 300 sq ft
- receiving room ~ 400 sq ft

RESIDENCE LOBBY

~ 800 – 1200 sq ft

- office ~ 150 sq ft
- elevator lobby
- reception area ~ 120 sq ft
- mail/package ~ 120 sq ft
- security ~ 120 sq ft

VERTICAL CIRCULATION

- elevators ~ 4
- fire stairs ~ 2

COMMERCIAL SPACE

- Space to be set on grid created throughout building with ease of adaptability to allow various commercial spaces (ex: offices, shops, restaurants, etc.)

*PARKING

- resident
- commercial (lower levels)

*Not mandatory programming

Concept

This project is presented as a typology that could exist in multiple dense urban conditions as well as suburban and any variation of density in between. The final built structures should be designed in relation to its site however this thesis is providing the framework for more of this type of structure to be built and used in ever changing configurations of tower, horizontal and home modules. It is to provide a set of rules that will govern the further production of buildings of this typology.

The first conceptual point is that of the importance of the main core and the wrapping that will happen of the inhabitable units in a vertical massing. The units will find themselves positioned around the central core using it for access and structural support. The attached home units find their way upwards along the core both metaphorically and physically. A continuous movement of the building in form is to relate to the continuous moving of the units and the ever changing appearance that the building can take. Incorporating construction units (ex: cranes, lifts, etc) within the design to allow quick customization and continuous construction and deconstruction of the tower. The alterability offers something that many conventional constructions cannot give to its tenants, the ability to construct and design their own habitat.

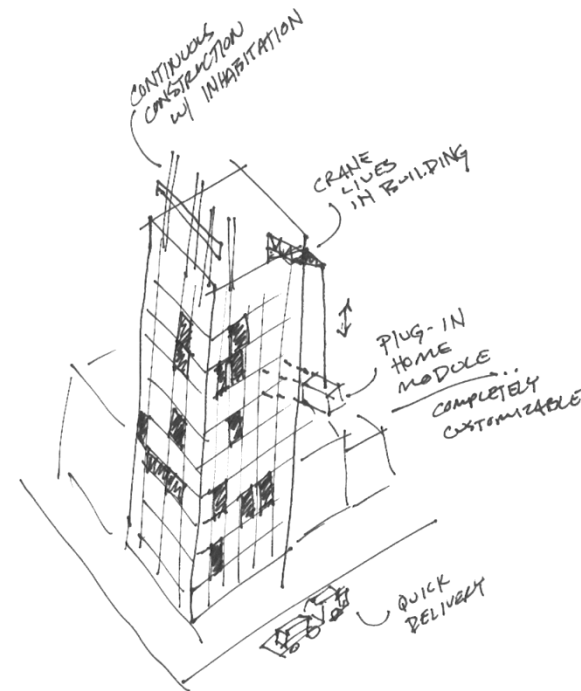


FIGURE 14.1. CONCEPTUAL SKETCH

Schematics & Early Decisions

How to build something that will be able to rebuild itself time and time again? It is a question that followed through since the early processes of discovering this forgotten and left behind building concepts of the 1960's. If it was to build itself up in one configuration, how long would it stay to this configuration? How could it be possible to provide a sense of stability not only for the residents but also for the building if the building itself was not to be the same every passing year or every passing day. Construction currently, is modular, to a certain point but a building is not reconfigured a few years later. It is a modular item that finds itself transformed to a permanent structure. If this building is to change, then everything that is placed within it must be capable of change or altering itself to fit to the changing requirements of the owners or residents.

Early Decisions

A framework is needed. The simplicity of the grid quickly became appealing as it is already frequently used in construction practices making it easily built and understood within different methods of erection that will still allow an easy translation despite the advanced building the structure is to Voids created when two grids are placed parallel to

each other allow for a 'plug-in' condition or even a 'clip-on' giving a variety of connection approaches of a home module.

The home module, the base of design was studied using conventional high rise residential units and what is the given square footage needed to sustain occupants of varying numbers and needs. Also looking to micro housing and learning how compact living can still provide comfortable living. This is not to say that the home is just to be in a high rise application, it has to be considered also as it is simply, just a home. It must function as such and be able to provide the comforts that are expected. But the home must change. It must be able to add to itself to house growing inhabitants but then also allow quick alterability to suit the owner's needs. It should be able to be transported through a variety of methods such as truck, train, or cargo ship. The home and grid of the surrounding structure must be reflective of each other to allow the quick insertion and connection into the larger structure.

The selection of the site provided another design challenge, an existing structure. It was decided to keep a majority of the existing building to show that this typology has the ability to adapt to an

existing condition as well as work on a blank site. The building would have to interact with the existing building and fabric that is already intact. How would the structure of the tower find its way down through the existing without disturbing the structure already intact? How would this new building inhabitants interact with the already existing inhabitants of the base building?

How would the grid form itself into a functioning tower? How would it be able to build itself up and down without disturbing life within? Quickly the form started to build itself as two grids that created a space between. The space would become the interior circulation that allows the residents to move from the service core to their individual units. A double loaded corridor that is typical within high rise residential but poses the problem of how to change the corridor so it is not like the other halls within high rise residential and make it something special within this new configured way of living.

The service core became centrally located for ease of access and to make the building code compliant. Two elevators and a fire stair are located to each half making a total of four elevators and two fire stairs that run the entire height of the building. It also provides the access and run space for all the required services that would have to be accessed by each of the home modules to make comfortable living possible. Access space at each level would have to be provided to allow for service access to the electricity,

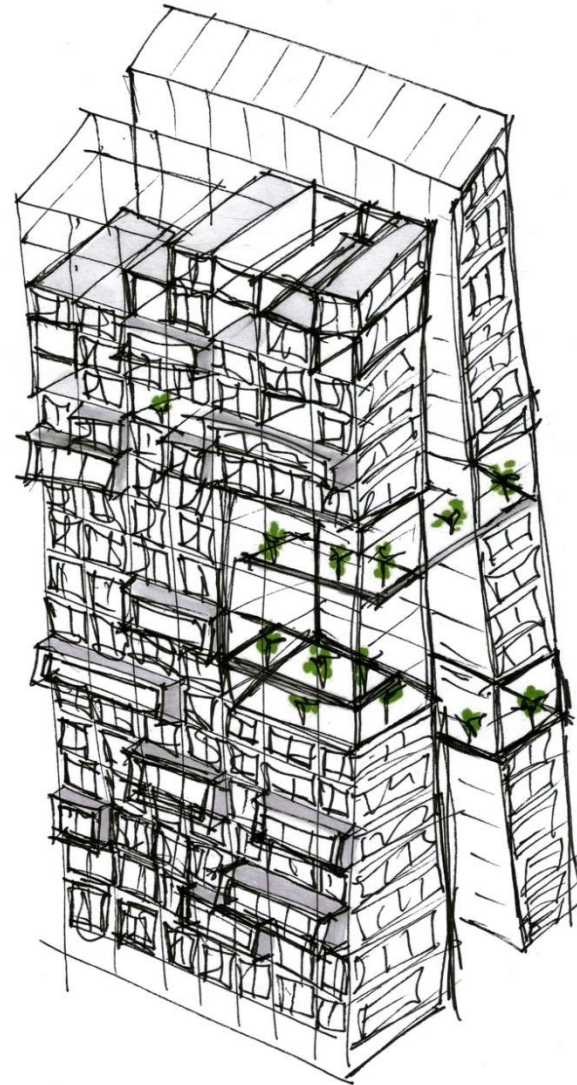


FIGURE 15.1. Early Tower Sketch

plumbing, mechanical and what else would be required. Much like a tree with its branches the branches would reach out and link with the home modules to provide the needed services.

What of green space? Homes already have a yard and within a vertical configuration the units wouldn't have this option. How could green space be introduced within a high rise configuration but still allow customization by the owners? Could they be open air if even located on the 40th floor or would they have to be completely enclosed losing what value open green space allows. How could one green space differ from the next allowing a customization of needs to happen?

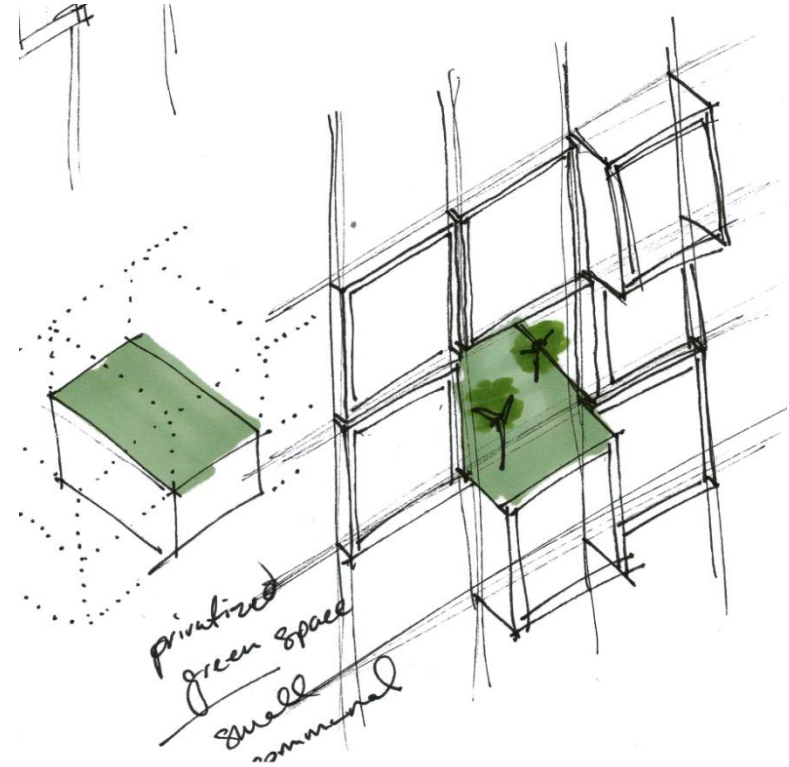


FIGURE 15.2. Garden/Green Space



FIGURE 15.3. Form Sketch Models

Final Design

The Home

The base home module is 15' x 30'. This was arrived at by researching various home designs both in modular design as well as in high rise applications. Ultimately, the criteria for shipping quickly came to the forefront and forced certain decisions to allow the home modules to be able to be shipped through a variety of forms including truck, train and cargo ships. The home module is able to split into two creating two halves that are 8'6" x 30' for shipping and are quickly put together once on site.

Each home module is provided with its own service core. These cores provide the needed services for comfortable living within the home. It is here that the link of the services that run within the service core of the building will be connected into the home providing the necessary needs. Each core contains a full bath equipped with shower, sink and toilet and a full kitchen. Each space shares a common wet wall that also is the link to the main building services. The kitchen was designed as a hidden kitchen so that the necessary cook tops can be pushed back into the wall creating more living space when not in use. Much like June He's Hidden Kitchen, everything is disguised and only when needed does the actual function of the wall show itself. By compacting these two spaces

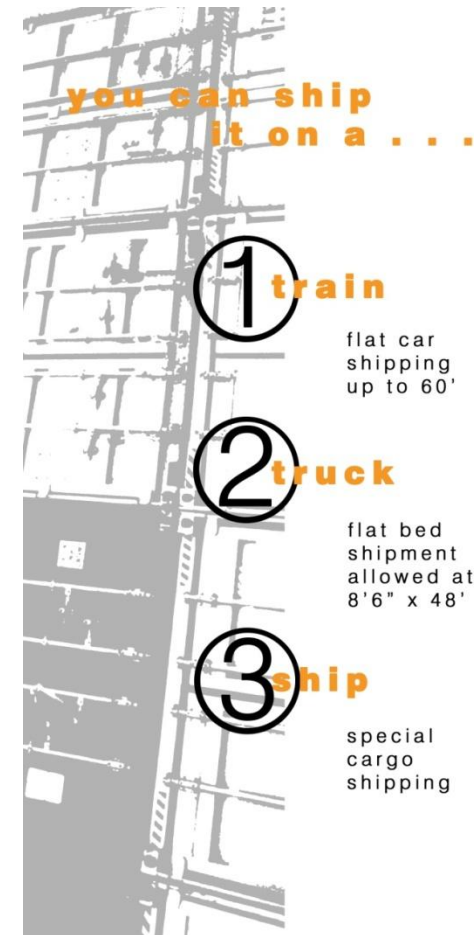


FIGURE 16.1. Home Module Shipping Allowances

above each other providing easy access even in a stacked configuration. However in a second story configuration the kitchen space is no longer needed and easily converted into a closet for storage.

The modules are easily customizable letting the owners expand or lessen the amount of space that is required. If a family of four occupies a three room module configuration and the children go on to college, the excess space of their room modules can be removed easily altering what it is that is the needed space for the new family way of living. This goes the same for an expanding family. Bedrooms can be added on as well as configured spaces for what the needs are by the addition of another module or the addition of multiple modules to fill the new need of the inhabitants.

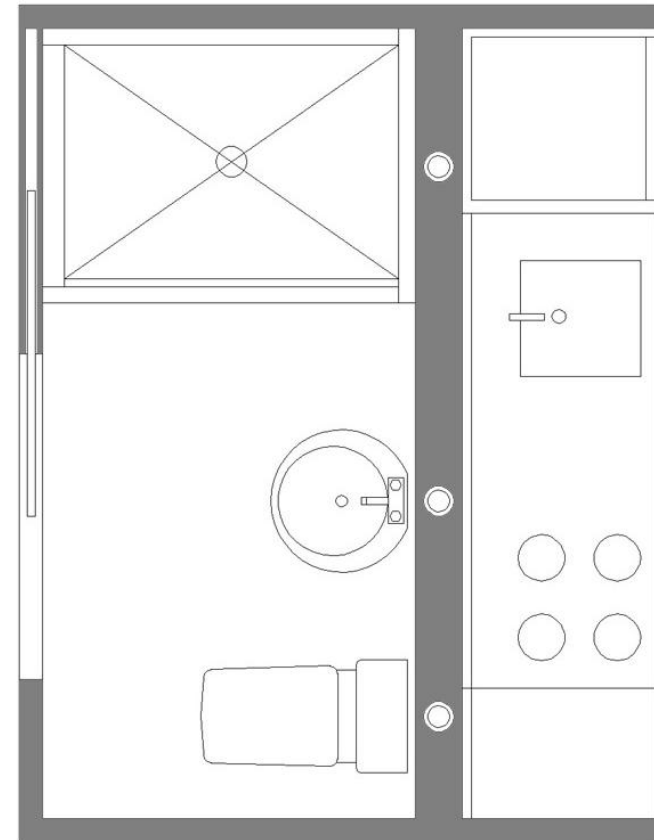


FIGURE 16.2. Service Module for the Home

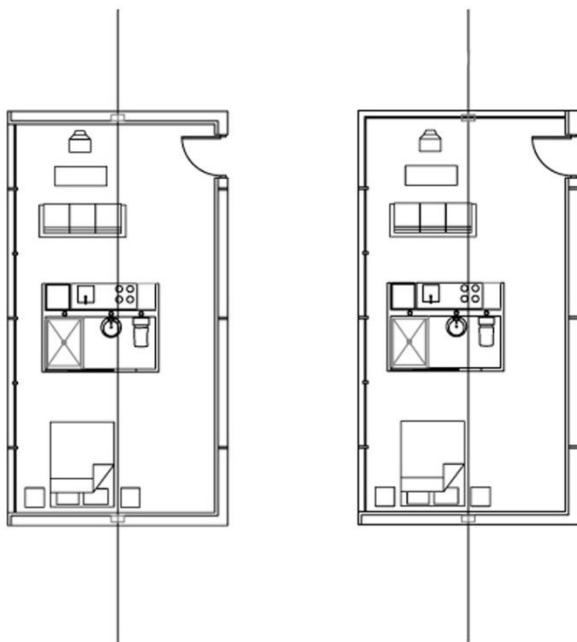


FIGURE 16.3. Single Unit

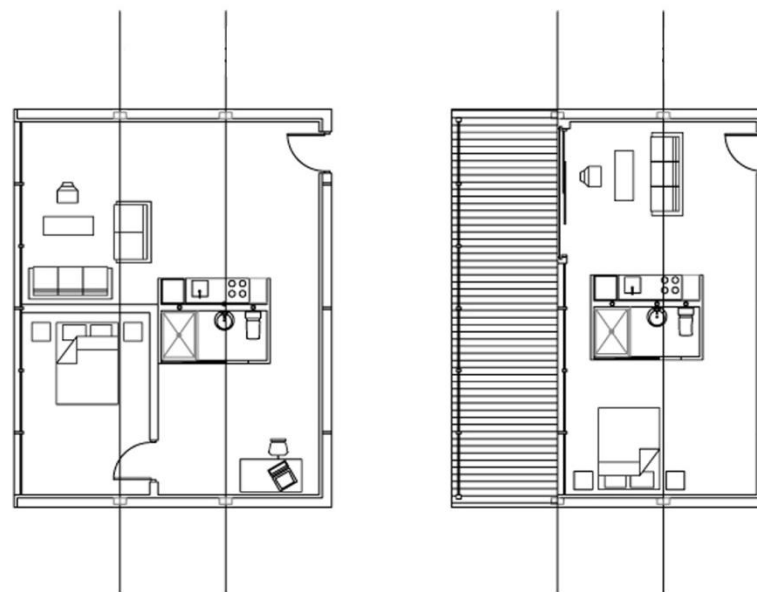


FIGURE 16.4. Single Unit + Half Unit

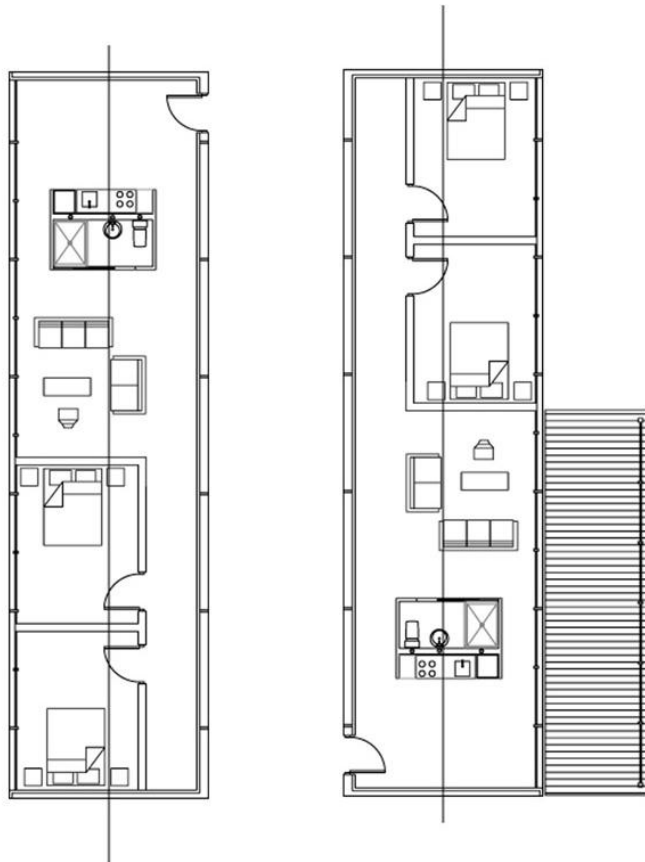


FIGURE 16.5. Double Unit

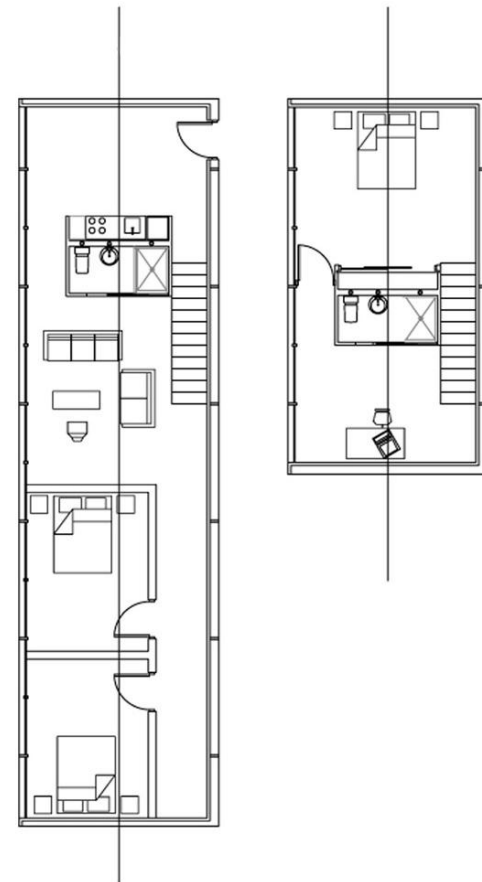


FIGURE 16.6. Triple Unit

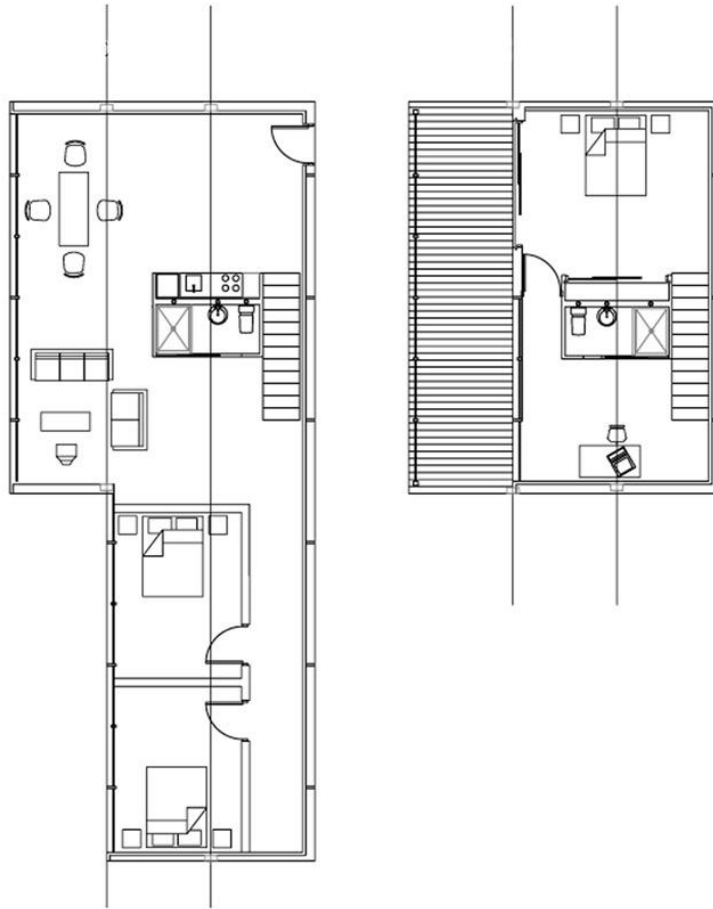


FIGURE 16.7. Triple Unit + Half Units

Existing Building Integration

With a building already existing on the site, it was decided to keep a majority of the building as not to completely remove the existing condition of the neighborhood. It was important to show that this type of building has the capability of integrating into existing contexts without completely removing what makes it familiar. Leaving the existing circulation core intact, the tower found itself built to half of the structure keeping intact the main core and existing condition of half of the building. While the half that the structure of the tower came through, the shell of the building was kept allowing the new circulation core of the tower to insert itself within the existing building. The remaining half of the space was repurposed for tower usage that includes offices, laundry, needed stores and spaces that would be needed or requested.

The tower inserted itself, removing the existing southern corner of the building and latching this new system on to what is already there. But what of the inhabitants already living there? This building was assumed to be residential on the upper floors with mixed use at the base as is typical of this location. Residential was kept to the north wing, leaving it undisturbed and to function as it always has. However the southern wing was completely changed. The tower as stated latched to the southern corner creating green links that tied the old with the new allowing the existing residents to use the services that are offered in the new extension. It no longer isolates the two halves as separate buildings but brings them both together to work as one.

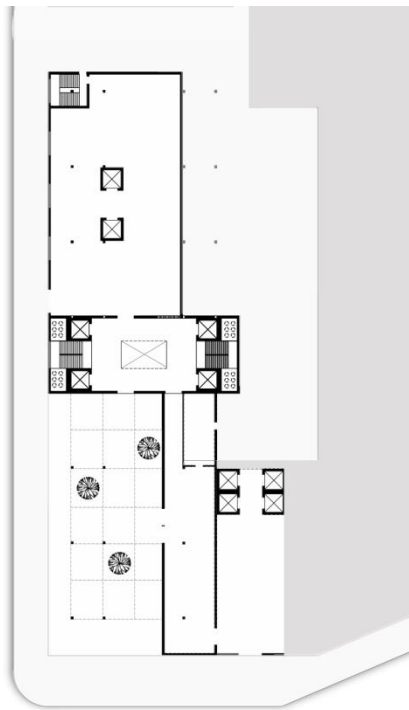


FIGURE 16.8. Current Building Corner View

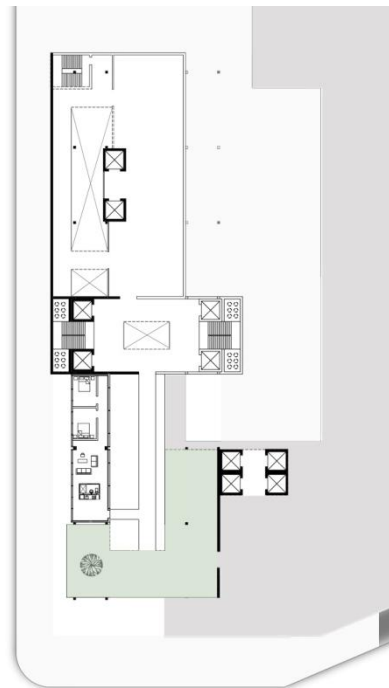
Space was provided for commercial pursuits needed by the occupants and even the surrounding neighborhood. Ground floor space is given to commercial or retail and the public access. At the ground floor, an extended plaza was introduced to connect the new urban beaches that exist on the medians on 5th and Broadway and further into Madison Square Park. It gives the public a limit amount of access but ultimately the decision is to the owners of the building as to the complete access that would be allowed. Typical of New York, security would be located within the elevator lobby of the service core to allow a control of resident access that is desired of the neighborhood the tower is inserted within.



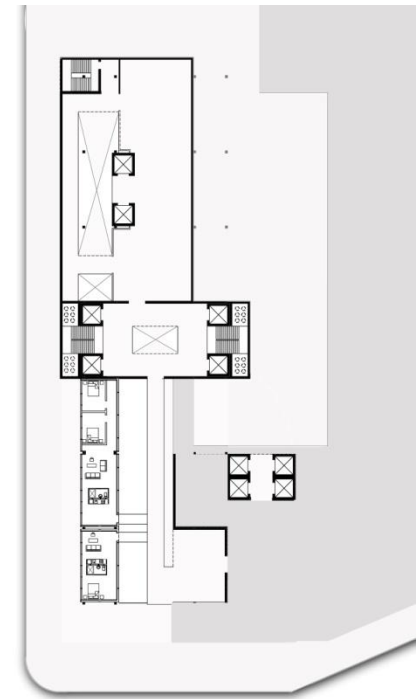
FIGURE 16.9. Existing Building Connection



ground
floor



fifth
floor



sixth
floor

FIGURE 16.10. Existing Building Plans

The Atrium

The atrium quickly took form through the decided placement of the home modules in a linear fashion flanking this space. It could have simply been a space reflected in much highrise residential architecture making it a simply hallway condition that the elevators open onto and everyone disappears behind their own door. However the size of the space allowed for something different to happen. It allowed for a chance to change the way interactions happen between the floors by exposing them to one another no longer leaving each level as an isolated condition. Instead it opens and introduces every level to the viewer creating a dialogue between levels and neighbors that usually wouldn't happen in the traditional fashion of highrise residential architecture.

Each level shifts from the one below and above, exposing itself to the floors around it and creating a dialogue with those that live on different levels. It could have simply been left as level planes through this interior space but the decision was made to create connection ramps that would connect the levels together no longer making one floor isolated from the one above and below. They now function together, allowing residents an interior promenade to stroll rather than disappear behind a closed door. Each ramp joins five levels together always bringing the path back to the core of the building to link the traditional forms of circulation through the elevators located here. With the shifting of the circulation paths and the connecting ramps, spaces between began to form that

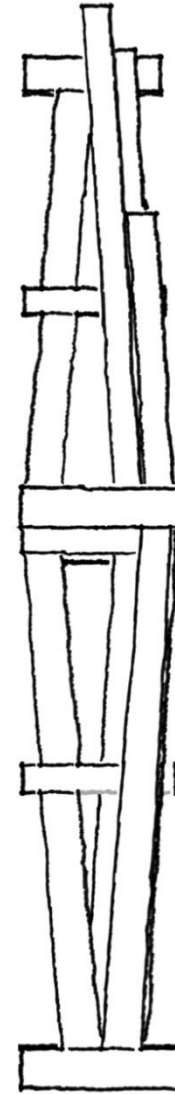


FIGURE 16.11. Atrium Drawing

allowed for an opportunity to introduce communal space within the atrium to allow the circulation to now be inhabited. It gives an opportunity to stay within the halls and now inhabit an area that isn't traditionally used in such a way.

Bridges connect the modules to the main circulation path. The atrium had to be configured to allow the building to continuously change, therefore the paths to the home modules would change continuously as well. The concept of bridges quickly took hold that would allow connections between the entrances of the home modules and the circulation paths. These also have the capability for removal and insertion to the needed paths to allow the home modules that are changing and entrances that were positioned in one location that are now in another to still be accessible. They also allow a changing of the interior circulation to continually happen when looking above and below from a floor, a bridge that was once there may no longer be there continually changing the interior design and pathways.

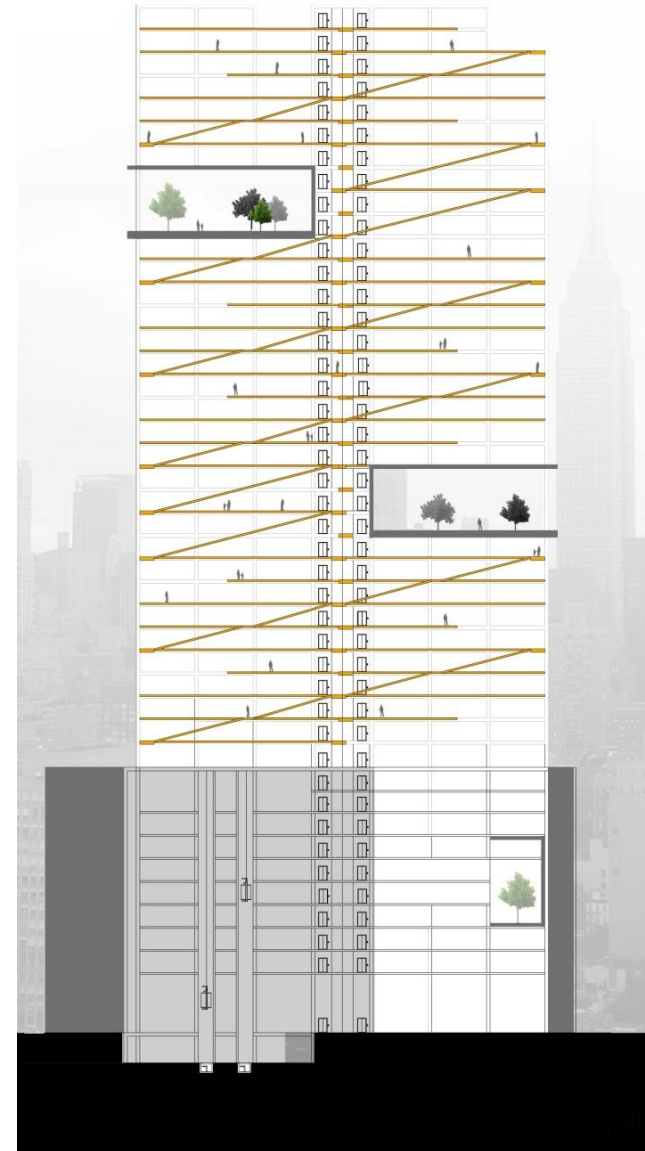


FIGURE 16.12. Atrium Section

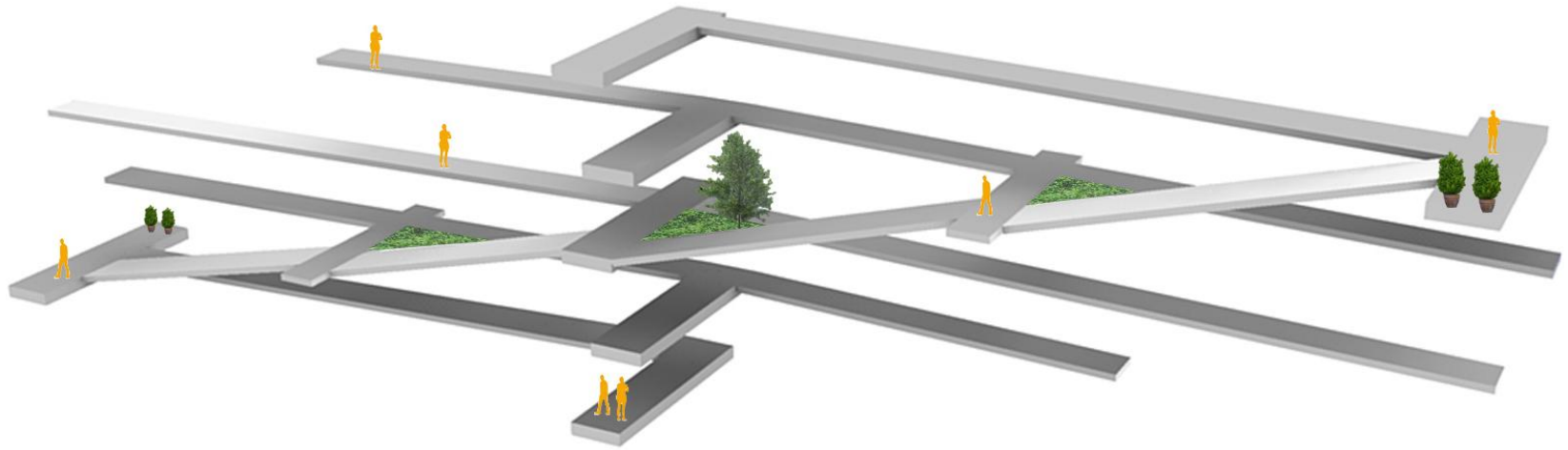


FIGURE 16.13. Atrium Module

Green Space

Since the green spaces in the building are able to form themselves in varying sizes, it was important that they as well had the ability to change themselves as needed. The solution for these spaces was a system developed by 1:1 Architects for their proposal for Green Roofs of Melbourne. These green spaces are able to be easily inserted, modified or dismantled quickly and without much effort. The spaces can quickly be configured for a wide variety of needs whether the groundspace needed is grass or a hard surface such as paver stones. It allows not only the large public green spaces to be configured for the residents as whether they need a running track, garden space or any other configuration but on the smaller scale it allows for private gardens for the residents whether small scale gardens or even playgrounds for the children that inhabit this tower. These spaces are to be gridded out turning each patch of grass to a pallet condition that promotes user interaction to shape their own space through the ease of portability of these pallets to be changed and reconfigured without much effort.

Because of the size of the large green spaces that take up 50% of the total floor area for the level they are located on, they are to be located every ten floors to allow an easily accessible open space to the residents without much travel on their parts to interact at these spaces. Each large green space can be configured differently than the prior one but the access will still remain the same despite the designated use.

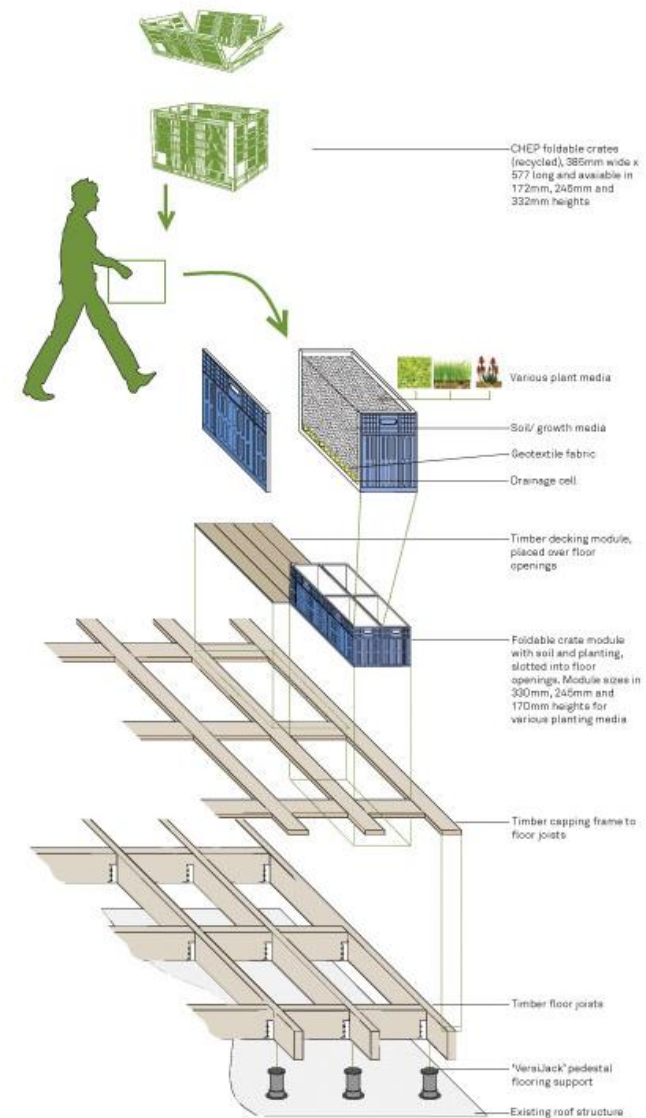


FIGURE 16.14. Modular Green Space Developed by 1:1 Architects



FIGURE 16.15. Large Green Space

The Skin

A skin that is able to shed, the concept behind the exterior cladding of the tower. For a system that could be placed anywhere in the world, an exterior cladding system became difficult to design. However one that has the ability to shed itself seemed the perfect solution. It should be able to close itself in the winter but then open in the warmer summer months to use the benefits of the environment that it is placed within. But then it should also be at the choice of the inhabitant of how it is to act or if it is to be placed before their modules at all. It was Jean Nouvel's Torre Agbar that gave the solution.

The exterior skin is chosen by the occupants who own the modules behind it. It is not necessary for it to be located over the entire tower but rather given to the residents as a choice. Each of the glass louvered façade is able to react to the environs it is placed within and even controlled by the owner itself if wanting to regulate the amount of sun that is able to reach the interior or even as to the condition of whether green spaces or private patios will be exposed to fresh air. While not in the residents control, environmental sensors placed along the façade can take over allowing the building to decide whether it is to open or not, especially if placed in an environment with freezing winters. The glass louvers themselves can hold varying opacities making the skin an ever changing element.



FIGURE 16.16. Jean Nouvel's Torre Agbar Exterior Skin

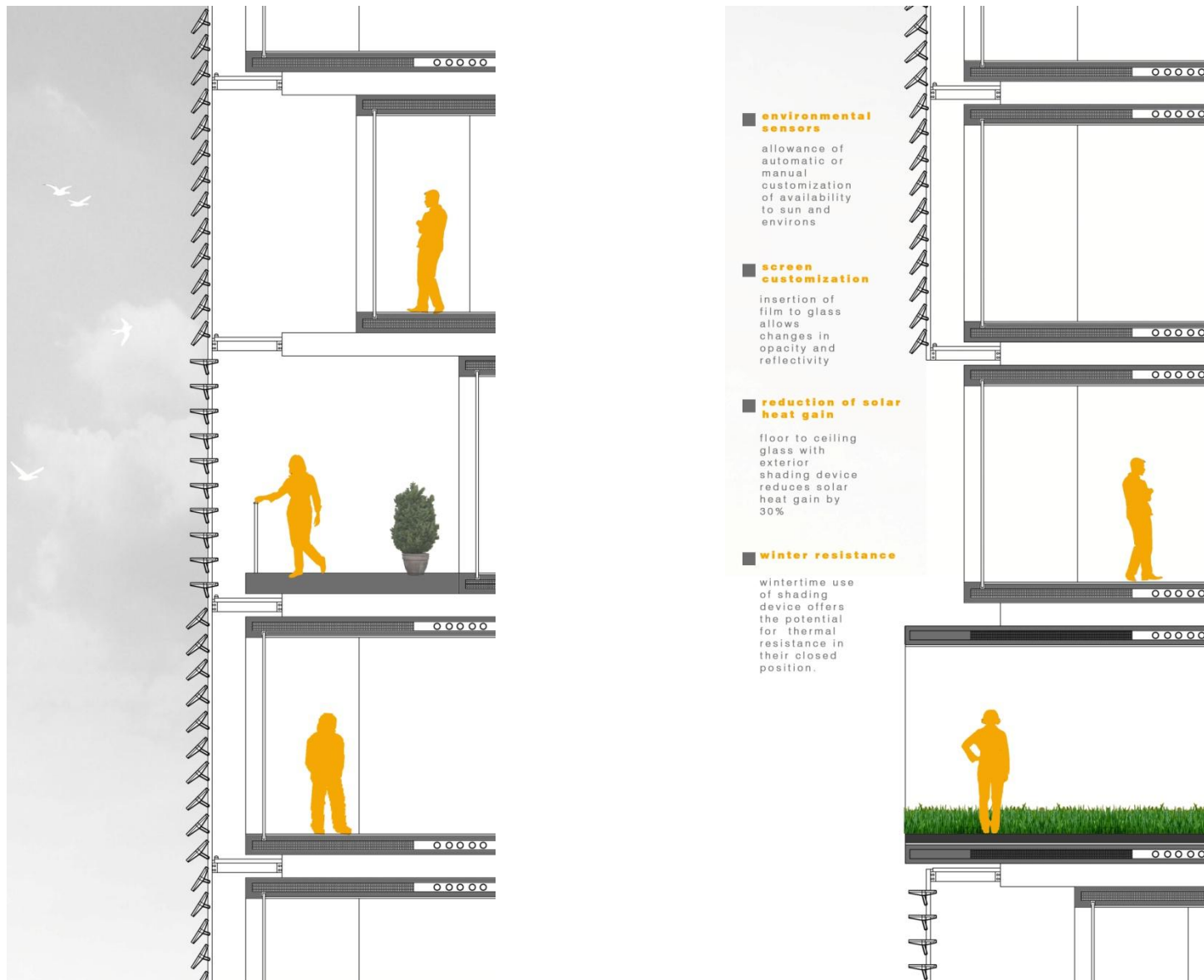


FIGURE 16.17. Exterior Skin Drawing

Final Images and Drawings



FIGURE 16.18. Plans 1



FIGURE 16.19. Plans 2



FIGURE 16.20. Service Section

With this type of system, the tower finds itself able to keep growing past the current design if needed. Although capped right now at 48 stories, it has the possibility to grow higher if needed or build itself down. It can reflect the current design of the neighborhood but if in the future more towers come into the area as has already started, it can grow with the heights to reflect the new height lines of the neighborhood continually altering itself to fit with its location. It is even able to alter its form as it builds up altering its own shape making it a continually changing fixture in the skyline of New York City and any other city this typology will find itself inserted.

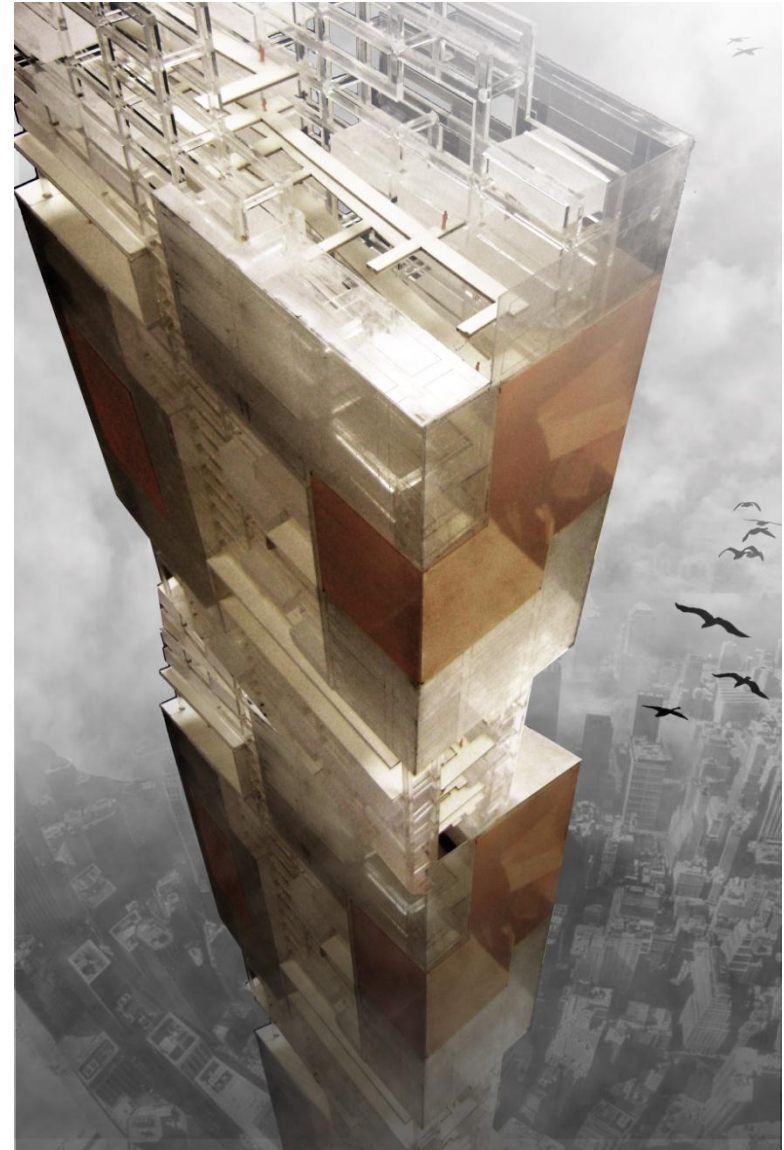


FIGURE 16.21. Expanded Tower

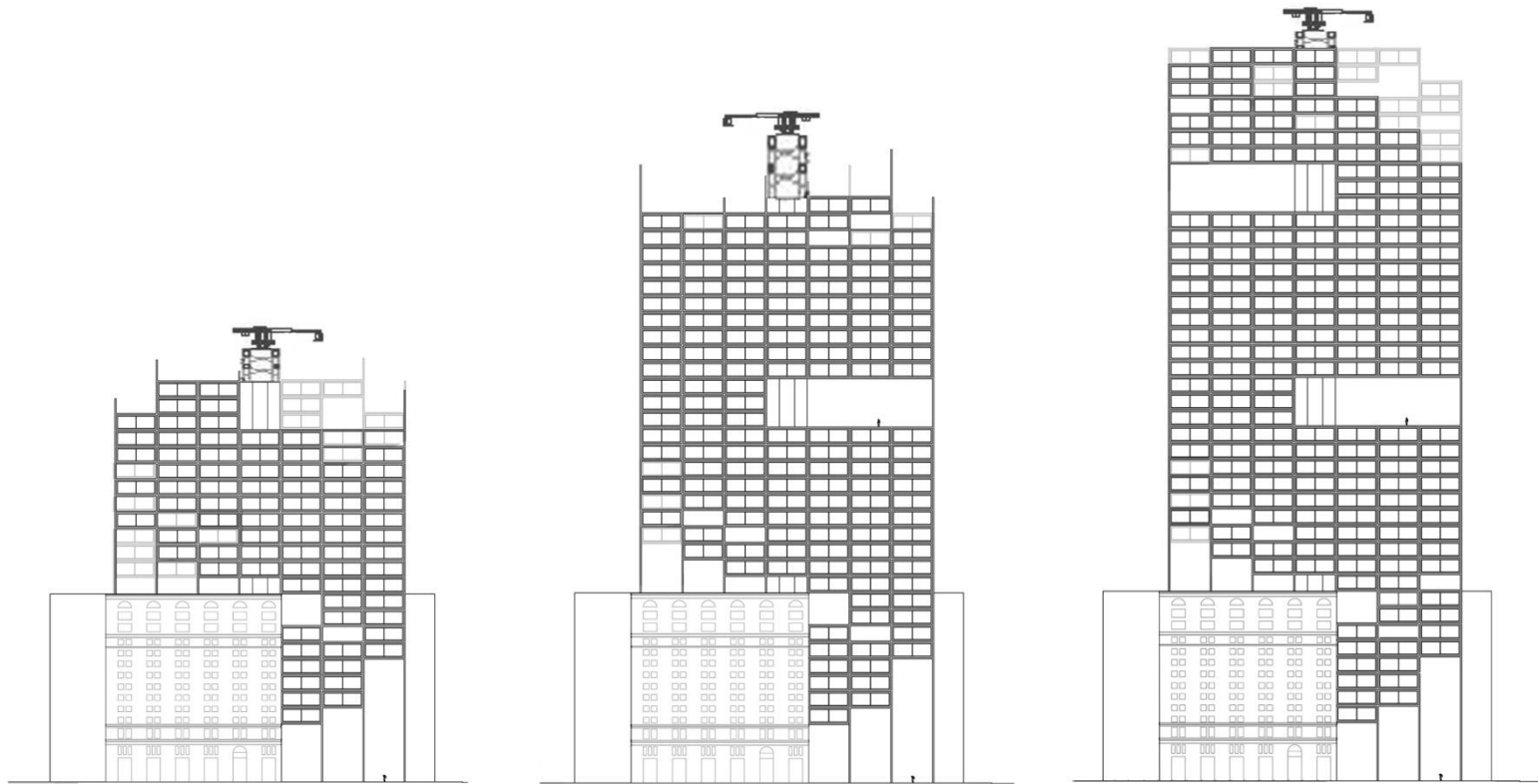


FIGURE 16.22. Building in Construction

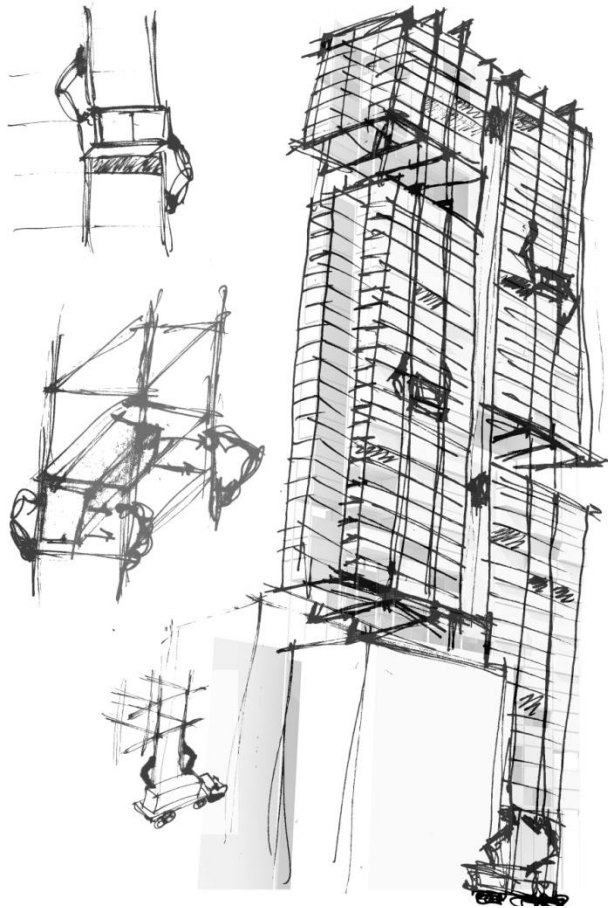


FIGURE 16.23. Module Insertion Drawing

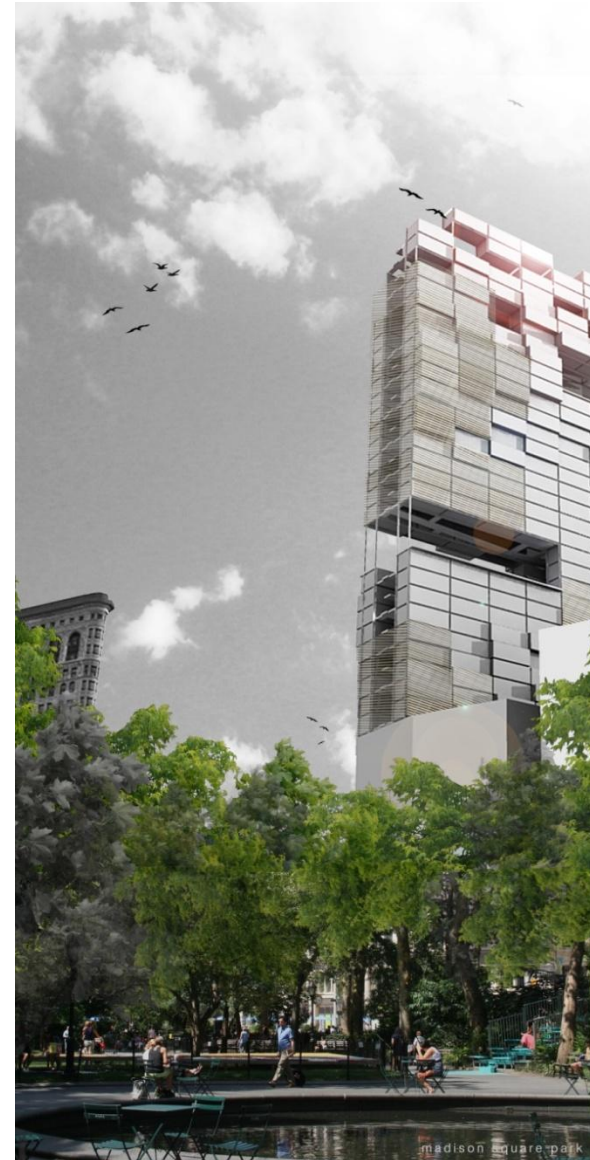


FIGURE 16.24. Madison Park View



FIGURE 16.25. Schematic Model Placed in Context

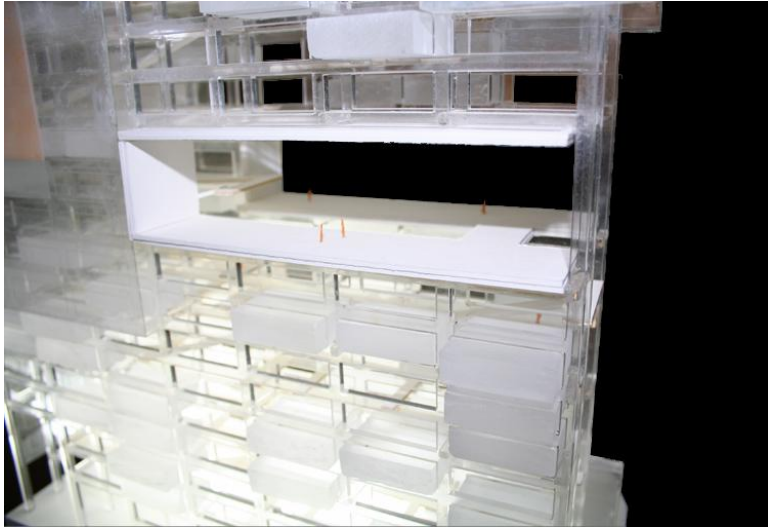


FIGURE 16.26. Model Looking at Large Green Space

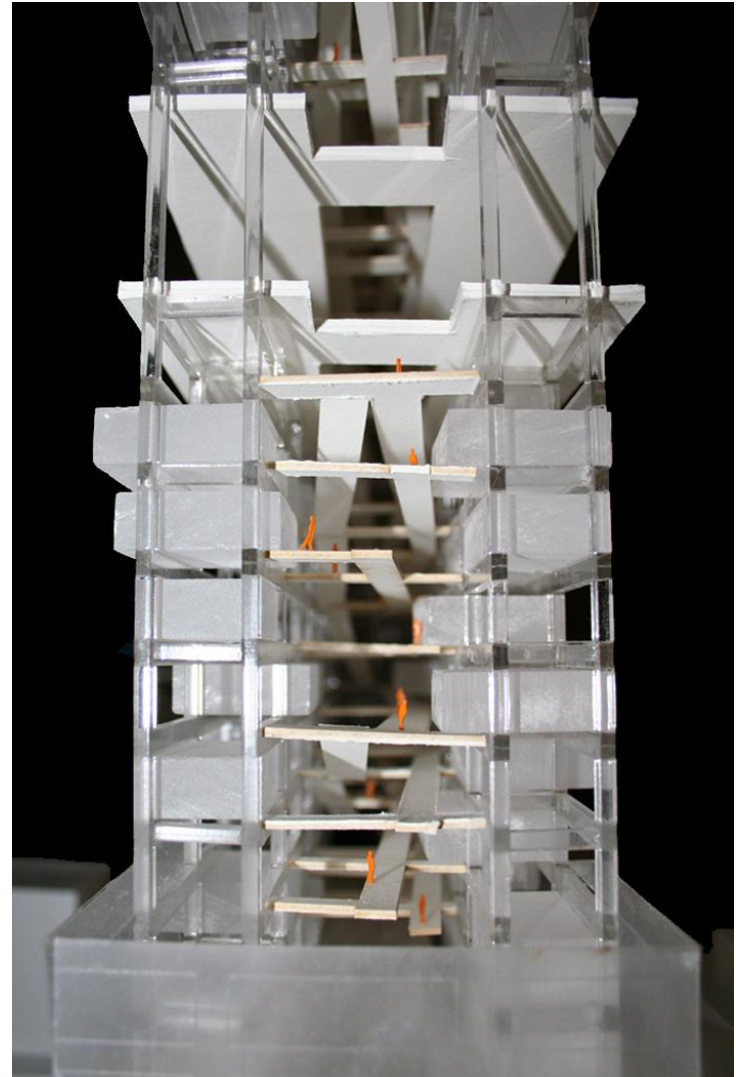


FIGURE 16.27. Model Elevation Looking Into Atrium



FIGURE 16.28. Final Model

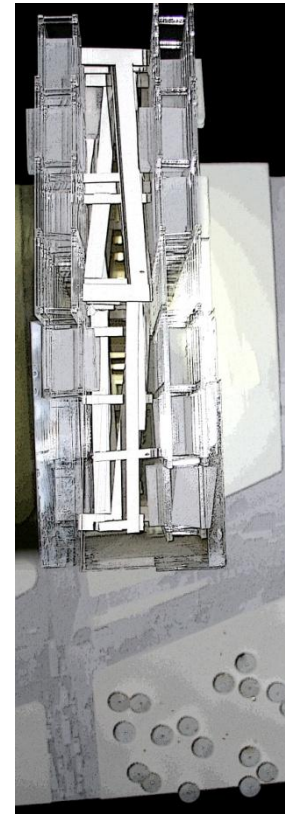


FIGURE 16.29. Model Aerial

Conclusion

This thesis began with the investigation of the home and its relation to the growing mobile society that is quickly coming to the forefront. The home is lost in this transition and ultimately it was a goal of this thesis to design a home that had the ability to follow the owners as well as alter itself to fit the ever changing needs so that they never lose what a home is to them. It was important to prove that the home has the ability to travel, alter and morph to what is required of it but never losing its core.

The site became important in the relation of this typology of building as it had to find itself housed where residential would always be in need and could give home to a society that is always in flux. Ultimately, Manhattan was chosen for its ideal conditions. However I do see the wide appeal a typology like this could give to many cities throughout the world and it shouldn't just be limited to just this one place and site. It should be explored further for the potential that other cities would give to this system and the relation that several could have with each other and the residents. The building has the ability to alter itself to local needs and relationships to make each one an icon of its own location and further let the residents experience what is customary of one location in comparison with another. No building will be the same and this typology was developed this way. Personal customization is a

large part of this thesis making one home module different from the next and one tower different from another. It allows the residents to answer and fulfill their own needs by making their environments what they need of them. Not only can the home alter itself to the inhabitants needs for space but also the public spaces are allowed to alter and change in reflection of what is needed.

It was the Metabolists and Megastructuralists of the 1960's that first gave birth to the idea that a building has the ability to become more than just a static function and form. Unfortunately many of their lessons have been forgotten or overlooked and should be reintroduced and explored for their value into our ever changing society that could benefit from this typology. A building of this typology should be explored for the potential it can give to the future form our buildings take in an ever increasing mobile society that will come to expect more of what their homes and spaces are able to be and become.

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