Micro-home Ownership in a Mega-metropolis

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Submitted to the Department of Architecture in partial fulfillment of the requirements for the degree of Master of Architecture at the Massachusetts Institute of Technology, June 2005.

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abstract

As a means to keep pace with today’s globally networked society, the home is reconceived as a portable, transformable device that adapts and reconfigures itself to coexist within a range of changing terrains. Ownership will no longer act as a geographical constraint limiting world-wide, long-term travel. Mobile housing affords one the means to explore the landscape without sacrificing the sense of place and permanence provided by “home”. Analogous to the work of Archigram, “homes” of the future will have the ability to migrate according to the needs and desires of their populations. This thesis explores the possibilities of transformational, mobile architecture that delivers a diverse range of settlement options. As a means of demonstrating the flexibility of this concept, this micro-home will be incorporated into the social and technological framework of the modern metropolis and examined at both the urban scale of the city and at the micro-scale of the individual.

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Throughout most of human history, manufacture was a customized process. Artifacts were created in one-offs with little automation emphasizing specialized skills and hand-crafting. This involved great expenditure in time and energy both in production and training. Production, and by association fabrication, has always been governed by the laws of economy. For architecture, the revolutionary transition from the handcrafted to machine-produced was idealized by the modernists throughout the twentieth century. The goal was to create buildings, especially housing, as a commodity for mass production and consumption. Mass production in the historical sense, raised the standard of living for the majority but reduced their access to the unique. Industrialization brought us amenities from a cookie-cutter, driving an increasing desire for choice, expression, individuality and the ability to change our minds at the last minute.

Until recently, fabricating architecture in the same fashion that Henry Ford constructed automobiles necessarily reduced the quality and customization of our living spaces. Twenty-first century buildings will integrate new technologies that will transform the urban skyscraper from a linear process of field assembly methods to one which incorporates a process of collective intelligence and nonhierarchical production procedures implementing off-site fabrication of integrated component assemblies. By examining custom production-based industries such as aerospace, automotive, and internet commerce, this thesis demonstrates how modular architecture can achieve greater economic proficiency and a higher quality of production while simultaneously constructing interactive and dynamic living environments at both the scale of the singularity - the house, and that of a networked community - a multi-programmatic vertical hive that sustains an overall sense of neighborhood. Consumers will have the ability to modify their environments despite living in high-rise buildings or suburban neighborhoods that are otherwise notorious for their formal and spatial redundancies.

Another driving force of the current market is mobility. For the average urbanite, information, products, commerce, and people are moving constantly between the cities of the world. The ability to rapidly reorient oneself in this environment is a major economic advantage for corporations and individuals alike as opportunities are largely time and location dependent. Future homes, offices, and commercial spaces will be mobile. This thesis examines the possibilities of trans-mobile architecture by mapping a global network of host conditions that allow one a greater power of choice. Once uninstalled from the parent structure, smaller, transformable components designed to adapt to new local site conditions can be carried across the sea or lowered by air to their next destination.
sojourn, v.i. to dwell for a time; to dwell or live in a place as a stranger, not considering the place as a permanent habitation; as Abraham sojourned in Egypt.
sojourn, n. a temporary residence or visit, as that of a traveler in a foreign land; it soggiornare.
sojourner, n. a temporary resident, a stranger or traveler who dwells in or visits a place for a time.
Globalization defined here as the expansion, intensification, acceleration, and growing impact of world-wide interconnectedness. Contemporary patterns of globalization mark a new epoch in human civilization. Just as the industrial revolution and the expansion of the West in the nineteenth century defined a new age in world history so today the microchip and the satellite are icons of a new historical conjuncture.

In contrast with previous eras, globalization today combines a remarkable confluence of dense patterns of global interconnectedness, alongside their unprecedented institutionalization through new global and regional infrastructures of control and communication. Driven by interrelated political, economic and technological changes, globalization is transforming individuals, their societies, and the world order.

This world-wide interconnectedness is largely a function of the technologies that expanded and expedited information sharing. This coupled with a standardized transportation network enabled explosions in commerce for small and large businesses as they increased their efficiency by moving their production and distribution resources to the most effective locations globally.

The same evolutionary process has recently become possible in architecture. Technological advancements in manufacturing and materials make it possible to offer people the convenience, portability, and sense of home ownership without anchoring them to a singular location for their house. This global society demands mobility and speed; our lifestyles need to adapt to reflect the change. It is no longer necessary to sacrifice the dream of a white picket fence in order to live and compete in the modern metropolis.
In the mid-1960s, due primarily to the advent of information technology, the focus of architecture shifted from a conception of complexity viewed in terms of a biological model to one of information. This shift was registered not only in the work of Isozaki but in that of many of his contemporaries, including Archigram, Superstudio and Archizoom. They arrived at a concept of open or virtual architecture consistent with the conditions of informational network systems or cybernetic environments.

Archigram: Plug-in cities

The Plug-In City explored the notion of a motive urban environment where a flexible infrastructural framework would not only enable, but encourage the development of an ever-changing city matrix. Pods containing houses or parts of houses could be moved on-demand by cranes mounted at the top of the main structure. Movement and turnover was attributed to obsolescence or desire for relocation. The Plug-In City's energy derived from the various elements in motion and the ad-hoc way they react to each other.

Archigram managed to make architecture that dramatized consumer choice, an architecture which more than any other, captures the poetry inherent in an advanced industrial civilization. Starting with surreal images of mechanized cities, or what they called “hardware”, London’s Archigram Group moved towards a direction of “software” environments - control systems that aid personal choice and are responsive to individual whim and desire. In both the hardware and software that was developed by Archigram, one principal was consistently emphasized: plugging in. The idea that various systems are still semi-autonomous and change at different rates.
By taking advantage of in-place shipping networks, the mobile traveler can conveniently transport their dwelling from one continent to the next. The critical size that governs the shipment of high-tech factory, assembled buildings, or building modules, is set by the infrastructure needed to transport them. Sizes of mobile components need to adhere to a standardized shipping criteria. Houses (or at least parts of them) can be designed to fit within that critical size.

Rather than conceiving of the mobile house as a single, site specific project, this concept envisions any port city maintaining the infrastructure to handle importing and exporting standard cargo containers as a destination or node within the global system. The plug-in receptacles that reside within densely populated areas such as New York, London, Hong Kong, or Tokyo will tend to stack dwellings vertically as a means of conforming to the shortage of space.

In stark contrast to the hyper-activity of the mega-city, the micro-house can also exist as a self-sustaining singularity that lightly touches the ground in remote, water accessible, locations. Situated on or along accessible water ways - the micro-house can hover above rainforests of the Amazon, rest on the beaches of Madagascar or sit within the north american heartland via the Mississippi River.
South Seaport District, New York City

The site, chosen as test ground for representing the most extreme "urban" condition is on the island's edge between the Brooklyn Bridge and pier 17. Touching both water and ground it links the East River with New York's financial district. It was once a major seaport where millions of goods were imported daily into the city; possessing a thriving market and a major point at which goods from around the world entered the city.
Along the Manhattan shoreline, rows of sheared piles extend into the river recalling a once vibrant port city. In some instances they exist as carved markers or totems that give a sense that this place was once alive and its past memory still lingers in the present.
In the distance cargo loaders appear as giant nomadic beasts grazing along the river’s edge. The Brooklyn shore continues to operate as a major seaport importing and exporting goods across the world.
The verticality and horizontal coexist permeating the landscape at varying scales. The iconic stone caissons of the Brooklyn Bridge are seemingly in balance with the flatness of the river.
Once a busy seaport and one of the first melting pots of New York, portions of the South Seaport District have since become detached from the rest of the city.

Peck Slip was one of the last and most important of New York harbor's slips. The burgeoning population of European immigrants reclaimed new land along the East River in order to expand their thriving harbor community in the late 18th and 19th century. The shoreline was extended east from Pearl Street.

The Dutch were the first settlers in this waterfront district. Later, Irish, German, and English immigrants worked in the maritime industry that dominated this area—shipyards, ironworks, docks, and ferries. These industries were located along the shoreline and at the nearby slips and piers. More recently, many Italians and European Jews also settled on the "Lower East Side", creating one of the first "melting pot" communities in the city.
A view of the site from across the East River reveals its centrality within the landmark skyline.
This image was a study that aided in gauging an appropriate vertical presence for a building along the historical South Seaport which resides in the foreground (red). Within the immediate neighborhood surrounding the site, buildings range from 1-10 stories tall. As the skyline recedes in the distance the scale increases to 20-30 story mid-rise buildings (yellow) which occupy the middle ground while high rises of 40+ define the horizon (green).

As a mediating element with the intent of re-connecting the activity of the inner-city to it’s waterfront, the scale of the proposed tower falls within the range of a mid-rise building reaching approximately 350 feet tall. The height represents a compromise between the towers further inland and the horizontality of the waterfront.
The site sits with one foot resting on land and the other in water. What presently is experienced as a hard boundary, in which concrete and fill abruptly meets the riverfront, will be softened by a landscaped edge at the foot of the Brooklyn Bridge. The park breathes life into an underutilized and unsightly bikeway connecting New York with Boston and Washington D.C.
Site model
The tower emerges from the river with only the slightest, tenuous connection to land. The project seemingly dissolves into the water reinforcing the idea of a permeable edge.
Vectors of movement along the river and through the site
Along South Street, which runs parallel to the East River, are a series of overpasses that distribute traffic across the Brooklyn Bridge. An advantage of the elevated series of roadways is that it provides pedestrian access to the East River. In most cases the FDR Highway resides at ground level creating a physical barrier to accessing the waterfront. Siting the project in this location where the highway lifts away from the ground provides an opportunity to both visually and physically re-connect the inland to the waterfront.

The disadvantage to the presence of these overpasses is the way in which the ground beneath them is currently being utilized. Since the departure of the Fulton Fish Market, this South Seaport District has become an inactive and neglected place. Dark, unsightly littered parking lots discourage the pedestrian from moving along the water’s edge.

As a means of increasing the presence of visitors to the waters edge, several more lanes will accommodate activities that involve various rates (racing versus walking) or types of movement (biking, skating, running) along the East River Bikeway and Esplanade. Inserted along this new, dynamic riverfront corridor (which may over time connect with other systems like the Highline) will be elements programmed to energize activity into the system. Examples of a newly embedded program include water taxi terminals, bike rentals, and playgrounds. It’s proximity to public transit, and breathtaking views attract tourists and residence alike. On weekends or special events one can imagine the waterfront transforming into a vibrant outdoor market. The parking lots below the highway can be occupied by rows of concessionaires and the network of paths can be used for highly visible outdoor sporting events like the New York Marathon, Olympics, or X-Games as a way of promoting the outdoors and the rejuvenation of the rest of the city’s coastline.
The shipping container is a familiar image in today's industrial landscape. They can be found in ports, stacked in rows at freight terminals and on ships and on the back of 18-w wheelers. The MDU (Mobile Dwelling Unit) by LO-TEK, is a shipping container that is transformed into a dwelling that nevertheless remains shippable. The MDU is a discrete mobile element that can be relocated into a new infrastructure, the MDU Harbor, which is standardized around the globe.

The container is intended to follow its owner from place to place, carrying all their possessions, and is slotted into a transitory community for the length of their stay in a given part of the world. The MDU makes use of existing container production, handling, and transportation technology to make a potentially viable mobile house that alters the genre of the motor home or trailer house.
Concept models
Outer sleeve in-place. The diaphanous nature of the skin gives cues as to the life that happens within yet gives the composition a holistic form like that of a sculptural element walking on water.

Outer sleeve removed. The units housed between the two outer screens express the individuality of each inhabitant. The residual voids that remain shift over time and become volumes of communal space.

Core / vertical circulation. The crane is instrumental in the assembly of the superstructure and remains operational throughout the life of the building.
Suburban/remote condition
- Single unit

Rowhouse configuration
- Single core
- 3 - 4 stories (6-8 units)

Mid-rise configuration
- Dual core
- Four separate service shafts feed individual environmental control units.
- Staggered floor plan. Two units per half floor (10'-0") increases privacy, exclusivity and views.
- 10+ stories (20+ units)
View from South Street
Aerial view of roof deck and crane
The expression of the structure as it meets the water is inspired by the character of New York City's waterfront.
Individual units plug into the façade. Cantilevering out over the city, the cubes display the lives within. The building becomes an animated, never-ending story of people moving across the world. The screened elevations offer protection from the elements and partially conceal the cores.
There is one high-tech device that combines the various preoccupations with flexibility, demountability, renewability, and mass production—the plug-in unit. The beginnings of this idea reach back to several notable visionaries. Buckminster Fuller, the Japanese Metabolists, Archigram and the container revolution all have made their contributions.

The idea of the bathroom pod was conceived in 1937 when Buckminster Fuller designed the steel fabricated Dymaxion Bathroom. In 1959 a group of Japanese architects and city planners joined forces under the name ‘the Metabolists’. Their vision of a city of the future inhabited by a mass society was characterized by large scale, flexible and extendable structures that enable an organic growth process. It was a radical Japanese avant-garde movement pursuing the merging and recycling of architecture styles around an Asian philosophy. For Japanese Metabolists like Kisho Kurokawa the plug-in unit was not just a service module, it was a personal dwelling capsule. The Nagakin Capsule Tower built in 1972 is composed entirely of plug-in pods like Peter Cook’s Plug-in City project (1964).

It is perhaps the Lloyd’s building that gives the clearest expression of the modern plug-in system. Thirty-three stainless steel-clad cubes with circular windows are stacked in concrete-framed towers like shoe boxes on shelves. Visually, the idea (suggestion) is clearly that the pods can be removed and replaced when they reach technical or stylistic obsolescence.

Renewability is one factor for using the plug-in concept however the main advantage is that it enables complicated and highly finished parts of an assembly to be made under the controlled conditions of an assembly floor and shipped the site complete, fully out-fitted and tested. This offers two more advantages. First, it speeds up work on site, since the pods can proceed in parallel with construction of the superstructure of the building. Secondly, it improves the quality of the product, which is being made in clean, controlled working conditions, and not in the chaotic and dirty environment of the site.
In the automotive industry, engineers divide the production cycle into chunks, or modules. Each chunk is composed of many parts that are preassembled off the main assembly line, either in an adjacent facility, in a nearby plant or in a remote location. As a particular chunk moves through the assembly it passes through quality control checks requiring certification before it can proceed to the next stage of the process. The assembly process is highly automated through direct links among all participants and installed on the assembly line. For example, individual parts are bar-coded to enable instant tracking and to ensure that each is installed in the proper module or vehicle.

When assemblages like cars, or computers and buildings are constructed one part at a time, from the bottom up, then from inward outward, the art of joining was a craft developed to resolve the relations amongst a vast number of parts. Since the thermal expansion and contraction of materials generates movement, the main objective of the joint is to manage movement. Nearly all complex artifacts are made up of the assembly of multiple parts and require joints. The objective of modular joining is not to limit the total number of joints that are present in a given artifact.

Instead, the focus is on geography, on the location of the plant where the materials are actually joined. The least desirable place to join materials is the final point of assembly. The original idea behind a full site-assembly condition was that a command and control structure would assure quality and manage costs by keeping as much work under the final assembler's direct control as possible. In a more modern approach, the fabrication practice recognizes the essentially chaotic nature of assembling complex many complex, the focus is instead on distributing the process into smaller integrated component assemblies. These smaller chunks can then be designed and managed individually as separate completed artifacts, by a separate team focused solely on a piece of the overall product. Quality control can be managed incrementally one module at a time, with corrections made before final assembly. Furthermore, there is less product to clutter work spaces, enhanced efficiency and safety and less chance to install the wrong component during final assembly.
When conceiving of a design that takes specific consideration to the efficiently of construction, it was helpful to simulate this when building scaled models.

What would be prefabricated at full scale was also produced at the scale of the model by implementing rapid prototyping technology. Depending on whether a full-scale piece was to be cut from plate stock, cast or milled determined which machine was implemented into the process of making that particular part of the model.
Why shouldn’t consumers expect the same level of performance from architecture that he/she expects from other consumer objects? Performance, in this case being defined by the way a product is identified, researched, designed, produced, delivered, serviced, altered, and exchanged. By introducing the discipline of architecture into the world of consumer products, what might be the broader consequences regarding traditional questions of collective space, civility and urbanism?

This project tracked major advancements of the mobile phone as a means of comparing progress of wireless communication with modern construction. Wireless network systems, the hardware and the options has made the cell phone an icon of modern “pop” technology. Customers are able to customize their phone’s appearance, sounds, and service plan. By conceiving of an architectural typology that functions as a personalized device like the cell phone, one can begin to think of the home as mobile, customizable and state-of-the-art.
In this century, we desire choice, expression, individuality and the ability to change our minds at the last minute. To still be fabricating architecture in the same fashion that Henry Ford originally built automobiles equates to a limited amount of choice.

Twenty-first century sojourner will have the ability to affordably customize their environments despite living in high-rise buildings or suburban neighborhoods that are otherwise notorious for their formal and spatial redundancies. Each cube can be accessorized from a wide variety of after-market parts and systems.

The modern house buyer (or dwelling consumer) can be thought of as one who buys into brand in the same way that they purchase clothes, cars or jewelry — housing is an accessory-based product.

Mass customization meets the requirements of the increasingly heterogeneous markets by producing goods and services to match an individual customer’s needs with near mass production efficiency.

This means that personal goods can be provided without the high cost surpluses (and, thus, the premiums) usually connected with (craft) customization. To deliver mass customization, companies have new ways to interact with their customers during the process of co-designing and configuring a customer-specific solution.
Nike has designed an interface for their website where customers can (mass) customize the appearance of their shoes. Starting with a completely white shoe, everything from the color of the air-cushioned soles to the color of the shoe laces can be modified. Developments are underway to make it possible for a customer to have a 3-dimensional scan taken of their feet and a shoe constructed according to the individual shape.
Initial ideas for the unit’s design involved the expanding and collapsing of space. Component assemblies push and pull so that the unit can be reduced to an efficient packing density for international transport. The line defining the inside from the outside is ambiguous as spaces become animated-moving from inside out.
Integrated within the outer enclosure of the unit a liquid crystal display system coupled with a computer interface converts digital images into opacity maps for manipulating sunlight, view, temperature and mood. The images can be static or in motion. Darkest portions of the image that wrap the shell become visually opaque and the lighter colors appear transparent. This type of enclosure system, embedded with electronics, is an example of an object ideally suited for prefabrication.
In concept no two units are ever exactly the same. Market research shows that the average American wants to modify or make significant changes to their living environment every two years.

What if one’s house is an organic system of flexible parts? Today’s automotive industry covets the concept of the “AUTOnergy platform”, a single chassis design that can accept different body styles, interiors, engines and drivetrains.

Like with automobiles, airplanes or computers, every unit’s chassis is identical. By conforming to standardized dimensions and loading criteria, a perfect fit with the host structure is guaranteed every time.

The autonomous chassis can then be populated by any number of modular aftermarket products that again, are designed to fit within an established set of dimensional criteria. These modules can then be composed in such a way that meets the needs of each inhabitant’s particular personality. In the prototype, modular component assemblies are arranged together creating a structural platform for the level above. These components include kitchen and bathroom appliances, storage, a staircase and media center.
Each living unit is protected by a molded or formed poly-carbonate shell assembly. Within an air space of the shell, thin-film digital displays manipulate one's perception of the outer environment.
The standard international shipping container (8'6"h x 8'w x 20'1) represents one modular unit. The micro_house is equal to four units. The micro_house is spatially generous but can still be packed along with standardized freight containers.
Whether deployed in the open landscape or nestled into an urban space the cube accommodates a wide range of environments. In transit the unit compacts into half of its original volume. When settled it claims its place by expanding out.
cube

top

side 1

side 2

bottom

side 3

side 4
These heavier, utilitarian functions are concentrated towards the “inboard” side of the unit. In contrast, the transparent cube that expands from within the outer shell is lightweight, transparent and open. The 17’ ft. high space is designed to be user-defined or customized and accessorized to meet the needs of the inhabitant so that one’s home fits like a shoe. Environmental control systems are tucked in the underbelly of the chassis. Easily accessible from below, internal parts can be replaced as needed. A “plug-and-play” interface quickly and simply connects the unit to the host building’s utility supply shafts providing power, data, water, and sewage.

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