re-imagining the middle landscape
An Exploration of the Inhabited Envelope and an Industrialized Framework for Dwelling

Joshua S. R. Batman

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Howard S. Gartner, Chairman

Robert J. Dunay

Timothy M. Frank

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abstract

This thesis seeks to tie into the underlying ideology of the middle landscape that has shaped housing development in the United States up to this point, and re-imagine its physical manifestation. An incremental approach is taken in imagining what housing might be in America, considering our myths surrounding the single family house, micro and macro community creation, density, sustainability (regarding the economics of the home and country, as well as our place in an ecosystem), emerging timber construction of tall buildings, and industrialized methods of building.

A mix of passive and active green building strategies are employed in making an expanded or “inhabited envelope”, which surrounds a 22-story mass timber modular mid-rise residential tower in Red Hook Brooklyn. The base of the tower and development of the city block include a cooperative factory for wood based production, innovative bike storage, bike repair shop, shared use digital fabrication lab, shared use shops (wood, metal, and upholstery), loading dock, laundry, gym, shared use office space, and café.

Fig. 1 Site Model Roof Plan Photo

Fig. 2 CLT Photo (Green & Karsh pg. 37)
Thanks to all of my family and friends whose support and prayers have made all the difference. To all of my professors who believed in me and encouraged me when I doubted myself. To my Committee Chair, H. Scott Gartner, for his support, insight and his seminar “Architecture & Urbanism”, which forever opened my eyes to the ideology underlying the beginnings of architecture in America. Thanks to those I have had the pleasure of working with in the Center for Design Research at Virginia Tech and the base research in the future of housing and steel modules that I built off of in the creation of a mass timber module.
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In the current proliferation of ideas regarding the making dwelling in North America many have missed a crucial part of our history, which informs every part of our current society; the not so distant beginning of things in what we now know as the United States. The essay that follows was written in a formative graduate seminar “Architecture & Urbanism”, in my first year pursuing my Masters of Architecture at Virginia Tech’s School of Architecture + Design, it speaks to the confluence of forces again at work in our society and forms the theoretical basis of my thesis work.

“Re-imagining the Middle Landscape”

The middle class exodus to the suburb of the last century was the realization of utopian principles seated in the idealization of nature and the moral obligation of women in the home. Though it has stratified the city and created dissonant sectors of development, the suburb still holds sway as the desirable location for the most prosperous members of our society. This leaves inner cities vulnerable to social degradation, blighted forgotten neighborhoods and creates sprawl outside of the city. Even still we must acknowledge the enormously successful creation of a “middle landscape” and an architecture befitting its purpose if we are to begin addresses the ills of sprawl and urban blight. The utopian ideals of the house set in nature are indelibly written on our social conscience and must not be railed against as an enemy but redeemed in the re-imagining of the “middle landscape”. Thomas Jefferson, Alexander Jackson Davis, Andrew Jackson Downing, Ralph Waldo Emerson, Frederick Law Olmstead, Catherine Beecher, and Harriet Beecher Stowe are of paramount importance in understanding the flourishing of the suburb in America and perhaps give clues to the re-imagining of our way settlement.

“We hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness.”
-Declaration of Independence

Each man would be given opportunity to claim his part of the returned Eden many believed America was destined to become. The ideal of the honest farmer is personified in our heroes such as George Washington, shown in illustrations as hardworking, honest, man who tills his own soil, someone who takes authority only for the protection of his people and when danger subsides relinquishes the same. Again with Honest “Abe” Lincoln, a common man of hardy stock who plowed his own fields and read by candlelight at night, a self educated cultivator exemplifying the best life to produce moral fortitude. John Locke summed up the early mythology of America when he said, “In the beginning all the world was America”. With the laying of the gridiron across the west America forever broke the standard mode of European settlement and began its own unique utopian settlement pattern.

During and after this time English picturesque landscapes and landscape paintings had a profound effect on the arts and architecture in America. We see after its initial copying the development of a uniquely American expression and fascination with dynamic composition and the idealization nature. Some the most notable American to produce original work were artists from the “Hudson River School” Thomas Cole, Frederich Church, Thomas Moran and poets and scholars such as Walt Whitman, Ralph Waldo Emerson, Henry David Thoreau, and Margaret Fuller. Emerson in his essay Self Reliance wrote in challenge to the prevalent euro centrist.

“Our houses are built with foreign taste; our shelves are garnished with foreign ornaments; our opinions, our tastes, our whole minds lean, and follow the Past and Distant... The soul created the arts wherever they have flourished. It was in his own mind that the artist sought his model. It was an application of his own thought to the thing to be done and the conditions to be observed. And why need we copy the Doric or Gothic model... If the American artist will study the precise thing to be done by him, considering the climate, the soil, the length of day, the wants of the people, the habit and form of the government, he will create a house in which all these will find themselves fitted.” -Emerson

In the realm of architecture two men who took up the challenge and succeeded where Alexander Jackson Davis and Andrew Jackson Downing. A. J. Davis was a prolific and inventive architect of the time and deftly designed both houses and public edifices, giving life to his ideas in exquisite picturesque drawings. He helped give rise to the American braided style in his design for the Gatehouse at Blythewood Estate, and popularized the now ubiquitous board and batten siding. He used the dynamic composition of the picturesque aesthetic and local materials to root his houses to the landscape and create a sense of place in a vast country.

Andrew Jackson Downing, a very talented landscape architect, worked with A. J. Davis on the publishing of some of the most influential designs and ideas of a domestic architecture suitable to America. He published The Architecture of County Houses in 1850, and voices the ideal of he and Davis’s, ground breaking architecture for the common man,

“...the condition of the family home — in a country where every man may have a home —should be raised, till it shall symbolize the best character and pursuits, and the dearest affections and enjoyments of social life.”
-Dowling, The Architecture of Country Houses

Fig. 3  Lyndhurst for George Merrit, Tarry Town, NY, 1865(www.metmuseum.org)

Fig. 4  Blythewood Estate Gatehouse, Ammandale 1841 (www.newburghdc.org)
"...the first suburb to embody the vision of a middle landscape for all and gave visible form to the idealization of the home of each citizen set dynamically in nature."

"...further immortalized the single family dwelling in the American psyche."

"The advent of the railroad, rotary saw mill, the wire nail, and the balloon frame made house construction fast and affordable."

"...mass industrialization...

"...Because of their simplicity they offered the arcadian ideal Jefferson so greatly hoped for, in that their simplicity actually afforded to the everyman self-reliance and the chance to create your own utopian 'middle landscape'."

Quotes are taken from the highlighted red text from the essay at right.

The design for the Small Bracketed Cottage, from the same book, was a truly American one; its basic lines give shape too much of our current vernacular and perhaps best realizes Emerson's call to an uniquely American house. Many of the cottage designs are in the Gothic and Italianate styles, stemming from a sentiment of an order of association rather than the higher order of classical harmonic proportions being more appropriate to the architecture of the cottage; the designs were primarily constructed of wood and gave rise to carpenters gothic and some ownership of the style.

With the help of builder and friend of A.J. Downing, Llewellyn S. Hasbrou, Downing began designing the first picturesque suburb. Although not the first suburb, Llewellyn Park, in West Orange, NJ was the first suburb to embody the vision of a middle landscape for all and gave visible form to the idealization of the home of each citizen set dynamically in nature. Sadly Downing died during this time and A. J. Davis had to take over design, however, many of the houses of A. J. Downing are thought to have already been of Davis's conception. To this day it still provides a true middle landscape for its homes and is a cherished place to live.

With the popularization of empiricism through the writings of John Locke, his ideas of the mind as a blank slate to be written on with the pen of experience and the liberal philosophy of John Stuart Mill and Jeremy Bentham propounding the voluntary self governance of individuals in society, came the rise of the woman as the priestess of the home. The woman was the sacred teacher and molder of children in their formative years in which they developed the moral character that would carry them the rest of their life for the betterment of society or to its destruction. Catherine Beecher and Harriet Beecher Stowe gave clarion voice to these sentiments and helped widely popularize the absolute importance of the domestic economy in the home with the publishing of their books in 1869, American Woman's Home: or, Principles of Domestic Science; Being a Guide to the Formation and Maintenance of Economical, Healthful, Beautiful, and Christian Homes. Beecher was the first of the functionalist and designed a model house the kitchen in the center and by de facto the duties of the woman, touted sunlight, nature, and fresh air as the necessities of healthful wholesome living. Her house had ducted air and a central heating and cooking stove through which air was ducted, water was heated, and the bread was baked. Through Beecher's and others work the preeminent role of the woman in the home became a part of Christian theology and further immortalized the single family dwelling in the American psyche.

Concurrent with ideological and architectural development in housing was the industrialization of its building process. The advent of the railroad, rotary saw mill, the wire nail, and the balloon frame made house construction fast and affordable. In the 1830's building and loan associations started forming to finance home building. The picturesque suburb with its winding streets and rural connotation, analogous to the winding paths of the English picturesque garden, started to pop up all over the country. Some of the finest examples are Frederic Law Olmstead and Calvert Vaux’s Riverside, Illinois and Richard Morris Copland’s Oak Bluffs, Martha’s Vineyard, Massachusetts.

The next major event in the evolution of the suburb was the post World War II mass industrialization of the housing industry and William Levitt’s vision of a home for the everyman. The formation of the Federal Housing Authority, Federal Savings and Loan Insurance Agency, and the 30 yr. mortgage enabled young couples returning from the war to buy the affordable houses of Levitt and others. This fostered upward mobility and by the creation of home equity and thus personal wealth. Though the houses were quite simple little boxes they took on character with the picturesque landscaping very popular even today and the addition of sometimes whimsical ornament. Because of their simplicity they offered the arcadian ideal Jefferson so greatly hoped for, in that their simplicity afforded to the everyman self-reliance and the chance to create your own utopian "middle landscape".

“Rural Architecture is, indeed, so much more a sentiment, and so much less a science, than Civil Architecture, that the majority of persons will always build for themselves, and unconsciously throw something of their own character into their dwellings. To do this well and gracefully, and not awkwardly and clumsily, is always found more difficult than supposed.” ~ Downing, The Architecture of Country Houses

Indeed the sentiment of the suburb and by extension its search for the “middle landscape” have been thus far a rural sentiment. Though the suburb has all to often been designed “awkwardly and clumsily” the realization of its utopian ideals has fostered the American Dream and so it is certainly tied to many of our triumphs as a nation and our coming to the forefront of the World as well as to some of our failures. Our suburbs have now been over scaled and overpriced, filled with houses both to complex and much to simple all at once. We have priced many of our people out of the housing market and by extension the chance to realize their own utopia. An architectural as well as societal mal-lange has developed and is evidenced both in sprawl and urban blight. In speaking of societal betterment A. J. Downing writes:

“And, as the first incentive towards this change is awakened in the minds of most men by the perception of beauty and superiority in external objects, it must follow that the intent manifested in the Rural Architecture of a country like this, has much to do with the progress of its civilization.” ~ Downing, The Architecture of Country Houses

Perhaps the suburb is not the villain but the loss of vision as to the idealistic triumph it was and is in the best cases and, what its root intentions are in the worst. If we again look at the champions of the “middle landscape” in the suburb (A. J. Downing & A. J. Davis) and its champions in the city, Frederic Law Olmstead & Calvert Vaux; if we can remember the fulfillment of Utopian intentions in the picturesque landscape in Central Park and the same underlying ideals in Levitt town, we may then be able to re-imagine a true “middle landscape” in both our suburban sprawl and our urban blight, perhaps we too can appeal to the underlying sensibilities of our countrymen and “awaken in the minds of most men” a sense of what our desolate places might become, what our houses might look like, and what our lives might be.
hand and vice-versa. In my design process I have struggled to find the balance of the same, trying always to shift from the computer to the mind and imprint on our buildings is still very important in combatting a sterile soulless built environment. The idea of “some exploration of a wood module with some assembly required. In this wave of technological advances, the human touch structure for existence more conducive to a life of hope and happiness.

We are on the cusp of another industrial revolution in construction, one using digital prototyping, CNC processes, high performance standards, and many other changes in our methods of construction. This plays strongly into my exploration of a wood module with some assembly required. In this wave of technological advances, the human touch and imprint on our buildings is still very important in combating a sterile soulless built environment. The idea of "some assembly required" strives to maximize the strengths of the hand and the machine/robot, hoping to find place for both. In my design process I have struggled to find the balance of the same, trying always to shift from the computer to the hand and vice-versa.

In the face of a decreasing middle class and a population increasingly demanding urban living (a rental dominated housing demographic) the issues of urban housing cost and ownership are of great importance. Home equity has traditionally been the primary source of wealth building in this sector of society and has offered stability for the citizens as well as the country. The recent collapse has called this into question. While there are many reasons, questionable banking among them, the residences built were too large, inefficient and not sustainable in purchase price or upkeep (energy and maintenance costs).

In light of these concerns, exploring the use of industrialized housing solutions becomes a necessity. At present industrialized modular construction competes with standard methods on the basis of a shorter time necessary for construction, which creates savings enough to make it viable and lowers inconvenience. By using an exposed mass timber structure and eliminating the typical secondary layer of finishes, the cost to the consumer may drop. Mid-rise housing is the most amenable typology for this study, as an industrialized process needs economies of scale to be effective.

The thesis is set in Red Hook, Brooklyn and the program consists of a mid-rise residential tower, factory for wood based production, innovative bike storage, bike repair shop, shared use digital fabrication lab, shared use shops (wood, metal, and upholstery), loading dock, laundry, shared use office space, and café. I based the program on the “Timber in the City” Competition held by the ACSA, and submitted an entry. Wood was specified as the primary material for the structure which seemed right in two ways. First, wood has been the dominate residential building material in North America for centuries and engenders a certain connotation of “home”, and second, emerging timber technology offers a renewable alternative to standard concrete and steel construction of tall building and has a much lower embodied energy. The competition program brought together the issues set forth in the beginning essay as well as previous research and work I had done, and provided a framework to study the issues of housing in North America.

After participating in a research intensive at Stedmore, Owings and Merrill, the summer before my thesis year and struggling with issues of steel modular construction, I became intrigued with the idea of a wood module. I started researching emerging timber technology and was struck by its ability to take on the characteristics of a heavy timber building. This eliminates the necessity of drywall or intumescent paint for fireproofing the steel modules require due to large wood members ability to form a char layer that meets a two hour fire rating. This allows freer design, material honesty and a dust free assembly line (components are sanded and finished before assembly). The module structure becomes the interior finish of the base housing units lowering initial cost and allowing individualization by the owner. The exposed structure allows different finishes and cabinetwork to be easily attached and re-configured over time. Another benefit offered by mass timber construction is the transferability of our current construction workforce’s skills in its making.

The expanded envelope surrounding the modules plays a vital part in the life of the building providing: a climatic buffer from the natural and man-made (buffers city noise and visibility) elements, an urban lawn equivalent, a place for operable vertical gardens giving place for individual expression and supplemental food production, air purification (from vegetation), and a scaffold for construction, maintenance and systems updating. This buffer space or inhabited envelope is not heated and cooled but stays temperate by passive and active strategies and becomes part of the living space at most times of the year, acting as a green house in winter (capturing the sun’s warmth and that lost at the units perimeter) and allowing cross breezes and shading in the summer. These attributes accelerate construction time and increase safety (built in scaffolding), and lower life cycle costs by decreased grid dependence and maintenance difficulty (easy access).

In conclusion, I have employed all of these means in an effort to compete with or even beat the cost of more traditional and less energy efficient constructions to make available housing that operates on a fraction of the typical energy costs, interacts more peacefully with our environment, and does so without completely sacrificing the ideology that has sustained housing as “home” in America. I have set the dwelling in a performative middle landscape (a kind of tamed nature that has a filtered relationship with the city and the “wilderness”), hoping it may connect our past with a bright future, creating a vertical grid of opportunity, a manifest destiny toward the stars.
This diagram was a guide to cycle through the concerns of my thesis and check each facet was considered adequately. While the layout of the book may seem partially sequential there was a very cyclical approach and each part of the research and design was revisited many times. Not specifically mentioned in the method of study diagram was a great deal of research regarding precedents, mass timber technology, industrialized housing, and current steel module construction. These are however, fleshed out in the rest of the book.

**program–Use**

- sketch
- diagrams
- sensory
- plan

/experience
/use mapping
/kinetic living space
/ffe–activity
/vegetation–Implications of a buffer zone

**site/context**

drawings
/demographics

/urban fabric and massing
/scale city, street, building
/community connection & catalyzation
/transit, ingress, egress
/urban visualization
/climate

/model
/diagrams
/sketch
/section

(small)

**performance**

/simulation
/physical model
/cad model
/sensory drawing

(climate)
/light
/scale city, street, building
/thermal
/sound
/view

**tectonics**

/sketch
/diagrams
/model
/section

/assembly
/material
/composition (wall–floor–ceiling)–exterior|interior
/tactile nature

Fig. 10 Initial tower section sketch over 3D model export.
Fig. 11 Tower sketch model.
Fig. 12 Process plan on 14’ grid to insure shipping req. were met.
Adolf Loos’ thinking on worker housing complemented my own thoughts on housing and was an inspiration. Below is a translated quote from a biographical work on Loos.

“According to the first World War engaged L. to 1924 in mass housing, 1923/24, he was the chief architect of the settlement office of the City of Vienna. He designed spacious terrace houses for workers’ housing, which should enable the children in the city a safe stay in the fresh air. Its terraced apartment building represented a compromise between a barracks housing with apartments and a garden complex with single-family homes, which he regarded as the only correct and socially appropriate solution to the workers’ housing problem. In this sense, he created several versions of small village houses. An especially economical type of house he patented in 1921.”


Below are some of the findings from surveying many previous mid-rise housing examples. Represented are some of the more relevant precedents that had an influence on my work and the beginnings of their expression in my thesis work.

- Importance of sectional variation in making dynamic living environs.
- Finding a means of making each unit somehow unique to the inhabitant.
- Providing a yard equivalent for each unit as a space of individualization.
- Giving place for individualization of each unit.
- A vibrant mix of ages and stages life from the young, to the married with kids to the old.
- Tying the tower housing into a vibrant podium.
- The possibilities of a courtyard like space in a modern dwelling.

(Adolf Loos’s thinking on worker housing complemented my own thoughts on housing and was an inspiration. Below is a translated quote from a biographical work on Loos.)

Preface (precedents & findings)

Fig. 13 Process sketch over rough 3D and photoshop rendering 2 & 3 bedroom units.

Fig. 14 Sketch explaining implications of an infill structure around the modules.

Fig. 16 Section from a project in done in conjunction with SOM exploring a Unite’ concept in steel modules and the finding of section as a huge benefit to the units.

Fig. 17 Beginning ideas for the malleable wood structure becoming framework for individualization.

Fig. 15 Beginning diagram of the mid-rise tower and its cross section of unit sizes and prices.

Fig. 18 Plan of the De Menil house by Philip Johnson (http://s873.photobucket.com/user/berginarchitects/slideshow/Philip%20Johnson/deMenil%20House/?albumview=slideshow).

Fig. 19 Photograph of the De Menil house by Philip Johnson looking into the courtyard (http://s873.photobucket.com/user/berginarchitects/slideshow/Philip%20Johnson/deMenil%20House/?albumview=slideshow).

Fig. 20 Big Architects’ Mountain Dwellings (http://www.archdaily.com/15022/mountain-dwellings-big/).

Fig. 21 Ludwig Mies van der Rohe’s Lafayette Park Chicago, IL, a very successful mixed income housing development (www.lynnbecker.com).

Fig. 22 Le Corbusier’s Unite’ de Habitation in Marseille left (agingmodernism.wordpress.com/), right (greatbuildings.com).

Fig. 23 Bertrand Goldberg, American (1913-1997): Marina City, Chicago, IL, 1965: Marker on trace. The Art Institute of Chicago, Archive of Bertrand Goldberg, gifted by his children through his estate, 2013.64/75.57. (http://artattler.com).
the american dwelling

Beginning sketches in the exploration of the inhabited envelope and its relationship to the residences and the mid-rise towers place in the context of Red Hook, Brooklyn.

Fig. 24 Progress Sketch Plan.

Fig. 25 Initial Urban Perspective Sketch Over 3D Model Print Out, NE Corner.
In re-imagining the American dwelling, I sought to understand the elements that make home ownership desirable. The diagram below represents my thinking regarding physical conditions that make up the realization of ideological aims. I tried to incorporated these elements in the mid-rise tower. Though the car and the unit do not have the same proximity (there is a parking garage and rotary bike storage in the podium) and the inhabited envelope is not the size of a suburban yard, the units do function similarly to that of a single family dwelling.

It became apparent the sectional change of 24" at the perimeter of the units was not sufficient in the courtyard like spaces to provide an urban yard equivalent. Staggered 2-story spaces in the inhabited envelope of the 2 & 3 bedroom units solved this problem and allowed for more sunlight, a tree, vertical neighbor creation and more. It is hoped that this will allow a greater sense of ownership similar to that of the single family home and form a possibly less transitory more accountable urban social fabric.

notes:
1. Urban attic helps alleviate storage concerns and the removable storage units allow access to the utilities for construction and maintenence.
2. The inhabited envelope gives a yard equivalent, the vertical garden give place for individualization and their ability to rotate allows the creation variable ancillary spaces to the domicile, and many other benefits (See pages 8&9).
3. The thickness of the mass timber structure combined with the built in cabinetwork gives a strong sense of threshold and there would be some individualization of entry to each unit.
4. The double height interlocking spaces give the sectional quality similar to walking outside of a house and allows the development of vertical neighbors.
5. The adjacent studios allow for mix of incomes and the possibility of multi-generational living on a floor.
the american dwelling

This is a possible scenario of the lives of some of the residence living in the tower, and how they interact with one another in the framework provided. It demonstrates the cross generational life the unit mix enables; encouraging families to support their old and befriending those without family in close proximity. There are many benefits for everyone involved; the old don't get lonely, the young get advice, and the families get help with the kids, etc.

**Father: John**

Works at the new wood building systems factory located at the base of the tower built with the wood modules he helps make everyday. He is a cabinet fabricator and has a share in the cooperative factory. He works hard to make the coop a profit to get his dividend for the garden he takes great pride in. He and Molly (his wife) have made a little paradise inside their tower dwelling and love raising their two kids in Red Hook new waterfront development.

**Mother: Molly**

Runs a small consulting firm using their home office and the shared use office space in the base of the tower. She loves having her mom close by to baby sit while she works. She also loves her mother having her own studio close by to keep some separation and make caring for her mother in old age a viable option.

**Son: Billy**

Loves to go play with his friends on the playground located on the factory's green roof while his parents workout in the gym located on floor adjacent. More than that though he loves to play with his friend Maggie who lives in the unit below he often goes to the spot where the railing is lower and yells through the tree to see if he can come down and play.

**Grandmother: Lillian**

Lives on the same floor of the tower in a studio apartment. She comes and helps with kids often, but if she or her daughter's family needs space she can escape back to own little place where she loves tending her vertical kitchen garden. She helps run the Red Hook Community Garden outreach program and supervises the kids enrolled in replanting the garden walls of those less inclined to garden living within the tower.

**Neighbor: Ron**

Lives in one of the studios in another studio on the same floor. He works at a local architecture firm and is collaborating with John on a furniture line. They are prototyping the pieces in the shared use digital fabrication lab. They have become friends and Ron comes over often with some of the produce from his garden walls to contribute for dinner.

Fig. 31 Section perspective rendering looking at the kitchen and living room spaces in the 3 br. units.

Fig. 32 Typical tower floor plan.
The inhabited envelope is principally the enlargement of a double layered skin. The perimeter of the unit is the insulated skin and the glass greenhouse like enclosure forms the perimeter of the climatic buffer. This provides a framework for living which makes it a choice to expend energy to maintain a controlled environment and keeps at least a relatively comfortable state with minimal energy input into space conditioning. As architects it is our responsibility to design structures that set up a poetic and performative dialectic with the local climatic forces instead of a hermetic separation. While this space functions on many levels this section will focus on its performative possibilities and the details of its components.
the inhabited envelope

Below is the manifestation of the ideas laid out in the previous discussion of the possibilities offered by an inhabited envelope. The building envelope is a set of discreet units with relatively simple operation that amplify passive environmental strategies. The inhabited envelope floor is composed of precast concrete with radiant lines to take full advantage of its thermal mass in buffering the climate surrounding the units.

notes:
1. Gear and chain assembly opens the operable top section of the vertical glass louvres.
2. Ball bearing aluminium puck locked in place with set screws.
3. Steel gerberet under wood shroud.
4. Motor and track operating the vertical garden wall.
5. Wood shroud (3" thick wood forms fireproofing).
6. Vertical garden wall.
7. Aluminium fixed ring and bar assembly for glass attachment to vertical stainless rod.
8. Aluminium ring and bar assembly with ball bearing center allows bottom section of glass rail assembly to remain stationary and the operation rod to rotate.
9. Compression bearing puck slides in rail and is fixed in place with set screws.
10. Aluminium rail.
11. Radiant lines.
12. Bottom guide rail for vertical gardens forms the of the precast inhabited envelope floor and protects and insulates the radiant line joints.
13. 1/2" glass of the vertical louvre assembly.
14. Siding, batters, and vapor barrier are installed as much as possible in the factory. The remaining trim etc. is installed from the inhabited envelope floor after structure is attached. Closed cell foam insulation used between batters.

Fig. 45 Sketch of vertical garden operation and its motor and track.

Fig. 46 Sketch of vertical glass louvres.

Fig. 47 Sketch of vertical glass louvres aluminium track.

Fig. 48 Detail section of inhabited envelope.

Fig. 49 Detail plan of inhabited envelope.
the module & the tower
(mass timber research)

My principle reference for the mass timber tower structure was THE CASE FOR Tall Wood BUILDINGS by Michael C. Green (mgb ARCHITECTURE + DESIGN) and J. Eric Karsh (Equilibrium Consulting). This was a ‘Case Study’ project funded by the Canadian Wood Council (CWC), the Wood Enterprise Coalition (WEC), and Forestry Innovation Investment and was published February 2012 as sharable resource for non commercial endeavours. In the Report they propose the use of emerging timber products, Cross Laminated Timbers (CLT), Laminated Veneer Lumber (LVL), and Laminated Strand Lumber (LSL), and steel sections to form a timber panel and steel frame. The wood products have a similar material property strength of concrete and need the steel to provide enough ductility to the structure to withstand the forces on tall buildings. Due to the mass of the timbers proposed (7-10.5” thick) the wood acts like a heavy timber and forms a fire rated char layer in the event of a fire. They propose designing a sacrificial layer of wood that would char during a fire and then be replaced. The sacrificial layer is deducted from the member for structural calculations. They developed four tower options, option 1 (12-story), options 2&3 (20-story), and option 4 (30-story). I referred to the 20-story options for the development of a 22-story modular wood residential tower. Wood tower construction is not allowable by code in the United States at this time, however the United Kingdom, Norway and New Zealand have no limits if sufficient research is presented. As more research is done and mass timber buildings built this will become a standard mode of building the world wide.
There are two basic types of wood modules. The first type is one which the whole living arrangement fits within the confines of a singular module. The second is a composition of living modules adjacent to a singular smart module containing all of the appliances and major services, (i.e. plumbing, hvac, av, etc.). Every module has a certain amount of "urban attic" or loft storage. The void waiting for the storage units allows access for utility hook up module to module and module to core. These excellent storage units slide in after hook up and slide out when maintenance is necessary. The module dimensions are 11’x14’ in section and never more than 42’ long adhering to standard shipping dimensions and removing the need for a low bodied trailer.

The module is not completely finished, it comes partially finished with all of the remaining parts stored within, excepting the pre-cast concrete panels that form the floor of the inhabited envelope. As the tower rises the remaining parts are installed easily from the scaffolding formed by the enlarged envelope, in addition any future maintenance is made easy by the steel, wood and concrete enclosure. All exposed steel outriggers and gerberets are encased with pre-made wood components shipped within the unit during transport. Wood components fireproof the steel and provide the tracking system for the vertical gardens. The bottom track of the vertical garden unit forms the joint in the pre-cast concrete floor of the inhabited envelope.

**Notes:**
1. Removable storage units in the urban attic.
2. Vertical garden walls.
3. Glass and aluminium curtain wall assemblies.
4. Aluminium rail for the curtain wall.
5. All other necessary siding, trim, all exterior fixtures, and any other parts necessary to complete the module are stored in the module during shipping and tower erection, and installed from the inhabited envelope floor.

**Fig. 61** Mass timber modules stack similarly to steel with the use of a halo (image from a steel module research at SOM).

**Fig. 62** Cross section of steel module.

**Fig. 63** Mass timber module detail cross section.

**Fig. 64** Cross section of steel module.
the module & the tower
(tower structure)

Rounded shear keys enable easy stacking and cnc router fabrication.

Pre-cast concrete inhabited envelope floors.

Multi module glue-lam connector columns.

3 ply 18"x48" clt columns steel bolted connections with glue lamination.

Fig. 64 Isometric drawing of the tower structure.

CLT and steel housing module 14’x28’x11’.

Envelope gerberets.

Multi module clt connector splines.

CLT and steel housing module 14’x28’x11’.

Steel spline connector.

Buffer floor in conjunction with operable glass facade elements acts as a scaffolding during construction for the assembly of remaining siding, vertical gardens, and facade; later it functions as a maintenance scaffold. In conjunction with operable glass facade elements the buffer floor functions psychologically and climactically.

CLT grided beam structure.

Steel spline connector.

Buffer floor in conjunction with operable glass facade elements acts as a scaffolding during construction for the assembly of remaining siding, vertical gardens, and facade; later it functions as a maintenance scaffold. In conjunction with operable glass facade elements the buffer floor functions psychologically and climactically.

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CLT grided beam structure.
the module & the tower
(model)

Fig. 70 Sketch model, view of corner studio.

Fig. 71 Sketch model, view of corner studio interior.

Fig. 72 Exploring what the top floor might be.

Fig. 73 Sketch model, view of the inhabited envelope.

Fig. 74 Sketch model, exploring openings onto the inhabited envelope.

Fig. 75 Model examining the structure of the tower base and the modules, downward view of the SW corner.

Fig. 76 Upward view of the SW corner.
Red Hook Brooklyn is a vibrant old industrial neighborhood. The site is located across the street of a very large Ikea. The storied Red Hook ball fields, the new coastal walking and biking path (along the docks behind Ikea and out the iconic “hook”), and the community garden located in block adjacent to the site were three important parts of the urban fabric surrounding the site. I identified these as priority elements to tie into my site proposal. The nearest subway stop is located at the Carroll street (F & G lines) station 1.4 miles away, there is a B61 bus stop in front of Ikea. The distance to the nearest subway station was a driving factor in providing an innovative bike storage solution in the competitions program. Super markets, schools, and health facilities are all located within .5 miles of the site and include the Fairway Market and the Brooklyn Health Center.

![Figure ground mapping of the larger context of the site](image)
As mentioned in preface, the program consists of a mid-rise residential tower, factory for wood based production, innovative bike storage, bike repair shop, shared use digital fabrication lab, shared use shops (wood, metal, and upholstery), loading dock, laundry, shared use office space, and café. I based the program on the "Timber in the City" Competition. Employing a cooperative businesses model will give employees part ownership, helping engender a sense of pride and ownership in the neighborhood. The shared use shops will provide an avenue for entrepreneurship by decreasing the amount of start up capital necessary to start a small business. The project follows fairly closely the program of the competition seen at left.

### competition program

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1. Bike storage is based on revolving book stacks in the libraries of the 19th century. It has two large axles with multiple 12’ dia. gears and connectors for bike attachment. An RFID key would be given upon entering one’s bike. A similar system would be employed at the Carroll Street subway station to enable quick travel to anywhere in the city.

2. Bike repair facility on both floors of this part of the podium connecting to the bike storage for easy drop off and repair.

3. Shared use digital fabrication lab, with flexible space on two industrial floors for shared use wood shops, metal shops, upholstery shops, and any other shared use industrial space there was adequate demand for in the Red Hook community.

4. Show room for goods produced in the shared use shops

5. Loading docks serve all industrial activities

6. Storage and material lift for the two story shared use shops

7. Industrial storage the wood module and other wood component manufacturing facility.

8. CNC Router and robot component fabrication area.

8.1 Small component fabrication and storage.

9. Robotic assisted module assembly line.

10. Finished module loading bay.

11. Dedicated and shared use office space two floors in tower base.

12. Cafe

13. Wood module showroom.

14. Red Hook community garden couples with the greenhouse on the roof of the tower to raise plants for the vertical gardens and residents participate as much or as little as they want, paying for the plants if they do not use raise them. This creates excellent safe first jobs for youngsters.

15. New farmer’s market plot from an enlarged sidewalk gives place for the sale of all manner of goods.

- The input and output of material to module in the cooperative factory.

- Urban stair and bridging leading to new farmers market connect and make visible the existing community garden and scenic coastal walls.

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Fig. 85 Site plan of the tower base, factory, and shops.
notes:
1. Playground located off the gym and laundry floor of the tower.
2. Cooperatively owned factory.
3. Parking garage with small storage units and U Share car
4. Foundations need only 3-steps of depth because the wood structure is significantly lighter than standard concrete and steel tower construction.
5. Piles have geo-thermal loops, taking advantage of the deep hole already being drilled.
6. All foundations have a 42” stem above grade, 2022 hurricane Sandy’s high water mark. All curtain wall assemblies have rotary flood water dampers at ground level. To relieve water pressure and let water pass through the base in the event of a flood.
7. Entry lobby.
8. Urban stair leading to roof garden over the shops and showroom ending in foot and bike bridge landing at the new farmers market.
9. Rotary bike storage.
10. Taking advantage of the greenhouse-like outer envelope of the building, the roof level is a greenhouse with glue lam beam structure. The plants to replenish the vertical gardens are potentially grown here.

Fig. 86 Site section through tower entry, parking entry, and factory.
the urban context

Fig. 87 View of SW corner.
the urban context

Fig. 88 View of SE corner with the foot and bike bridge coming down to the proposed farmers market at the community garden.

Fig. 89 Close up view of SW corner.
the urban context

Fig. 90 View of NW corner of the factory.

Fig. 91 View of the front elevation.
the units
(3 bedroom)

notes:
1. Entrance off core.
2. Magnetic lock fire doors open during a fire and allow access to both cores typ.
3. Urban attic storage typical.
4. Dining table slides in over built in seating when extra seating is not needed.
5. Murphy bed with desk or shelving when folded for day use.
6. Utility chase for all services with easy access from inhabited envelope.
7. HVAC unit fed with geo thermal loops in tower foundation via utility chase.
8. Stackable washer and dryer.
9. Translucent insulated walls, changes to glass doors in units with tree on right.
10. Utility closet for motors operating the glass louvre system.
12. Vertical gardens offer transformable space, shading and many other benefits (see pg. 9-10).
Fig. 93 View looking into the staggered 2-story inhabited envelope of the 3-bedroom units; 2-bedroom units are similar w/ only one bay of 2-story space.

Fig. 94 Typical kitchen and living area of two and three bedroom units.
the units
(2 bedroom)

notes:
1. Entrance off core.
2. Magnetic lock fire doors open during a fire and allow access to both cores typ.
3. Urban attic storage typical.
4. Dining table slides in over built in seating when extra seating is not needed.
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10. Utility closet for motors operating the glass louvre system.
12. Vertical gardens offer transformable space, shading and many other benefits (see pg. 9-10).

Fig. 95  1/4”=1’ plan of two bedroom unit.
the units

Fig. 96 Rendering considering the tower in another part of NYC and cities in general.

Fig. 97 View of the inhabited envelope of the three bedroom unit, two bedroom is similar with only one deep bay.
the units
(studios)

notes:
1. Entrance off core.
2. Furniture nested.
3. Urban attic storage typical.
4. Nested dining and coffee table deployed.
5. Murphy bed with couch when folded for day use.
6. Vertical gardens offer transformable space, shading and many other benefits (see pg. 9-10).
7. HVAC unit fed with geo thermal loops in tower foundation via utility chase in core.
8. Utility closet for motors operating the glass louvre system.
10. Audio visual wall.
11. Laundry on the third floor of the tower opening onto the roof gardens.
12. Entry shoe cubby with coat rack and hat and glove storage above.

day
(configuration)

night
(configuration)

Fig. 98 1/4" Plan of typical studios.
the units

Fig. 99 View of corner studio with an optional structural configuration.