

At Home in the City:  
an exploration of the relationship  
between density, privacy, and  
flexibility in urban housing

a thesis by byron knowlson

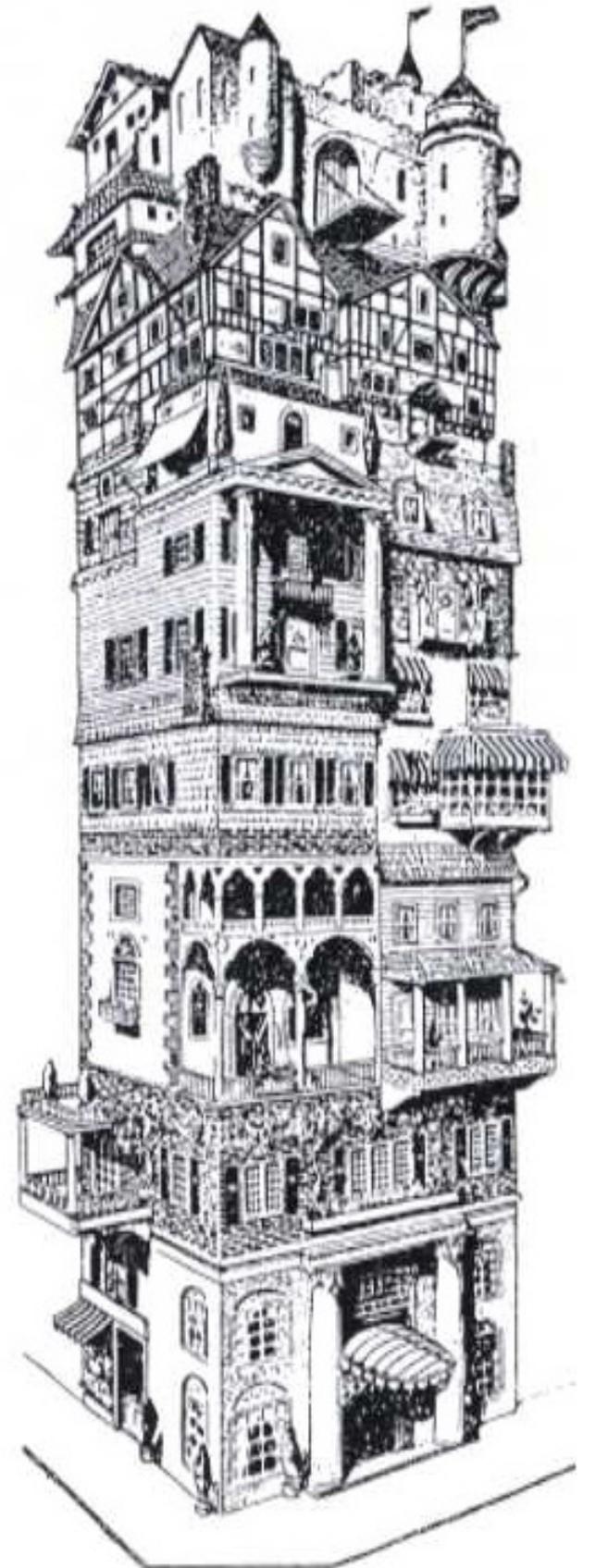


figure 1: Caricature of townhouse in the sky, circa 1920

At Home in the City: An Exploration of the Relationship between Density,  
Privacy, and Flexibility in Urban housing

byron j. knowlson

thesis submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of: Master of Architecture  
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Susan C. Piedmont-Palladino, Chair

Marcia Feuerstein

Jaan Holt

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The WAAC for providing a place that encourages exploration, and fosters learning.

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My parents, for your endless and unconditional love and support throughout my education and into the future.

Whitney, I could not have done it with your support and patience.



figure 2: housing project in denmark, Susanne Ussing/Carsten Hoff

*At Home in the City*: an exploration of the relationship, between density, privacy, and flexibility in urban housing

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“When the immediate vicinity is neither visible nor audible, the city apartment integrated into the urban fabric can be far more luxurious than the detached country home, provided both alternatives offer identical, house-like qualities of living: in the interior and at the transition to the appropriate exterior space - a small yard, a winter garden or a roof patio...

...the decision to opt for home ownership beyond the city boundaries, a voluntary choice it would seem, is in truth a flight from the insufficient housing options in the city, and less a rejection of the city as a place to live.”

Klaus-Dieter Weiss

“Living in the city offers irreplaceable advantages as soon as the variety of urban life is played out within reach right in front of one’s own doorstep.”

Klaus-Dieter Weiss

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figure 3: sketch for Lowengasse housing complex in Vienna



## *Presentation of Thesis*

Over 80 years ago Le Corbusier published “La Ville Radieuse” where he outlined a revolutionary idea of what living in one’s own home should be:

“Here are ‘artificial sites’, vertical garden cities. Everything has been gathered here: space, sun, view; means of immediate communication, both vertical and horizontal; (...). The architectural aspect is stunning! The most absolute diversity, within unity. The artificial lots are created first; highway + floorings of the substructure. And these sites are put up for sale as villas with garden and limitless view”.

Yet today people continue to flock to the suburbs, despite the fact that they often work in the city, and return for leisure activities. The move to a detached suburban home is inevitably a life of one dimensional living, “adhering to a purely linear order”. People wake up, sit in traffic on their way to school or work, return home in the evenings in traffic, and stay inside their homes, repeating the following day. The entire day is spent in a car, at a desk, and inside their home. As a result they are accepting a total loss of the social and cultural life that a city offers. One cannot underestimate the detriment this can cause on children who do not have the opportunity to live in the city and experience the social and cultural opportunities it offers.

After all, it is in fact young families who are so often leaving the city. As a single adult, or professional couple, sufficient housing options were available, and relatively abundant. However, once a family had a child or two, the housing varieties in the city were not acceptable. Often, the only outdoor space would be park that would require the parents to stop what they were doing, go down many floors in an elevator, cross busy streets, only to play in a park often crowded with all varieties of people. The appeal of the suburbs was allowing them to be able to run outside in the yard and watch them from inside the dwelling, knowing they were safe from cars, and other people, a luxury that is not possible in most city apartments or condos. Urban housing options often lack outdoor spaces at a variety of scales.

This move often places a financial strain on young families, as they are reaching beyond their means to find housing that meets their standards, when in reality living in a higher-density urban complex would result in them getting more for their dollar. Urban dwellings offer many things detached urban houses do not:

- a central location in the city, short distances to school and work, and as a result less time in the car and more time spent with the family.
- good communication with neighbors,
- apartments with views
- elaborate building systems technology, which is only economically viable when shared between many households
- amenities such as pools, guest apartments, gyms etc, things that many cannot afford to have on their own
- good protection against intruders
- decreased property costs as a result of cost sharing between units

Many of the characteristics that are enjoyed about suburban homes, are actually executed better, and made more enjoyable when incorporated within the city center. For example there is in fact, nothing private about detached homes, as they are set precisely in the middle of small open lots with little protection from neighbors, except for blinds to cover the windows. The desire for privacy is not satisfied by building methods of these homes. However things such as operable windows on all four facades, a distinguishable entry separate from neighbors and accessed directly from the outside, are valuable elements of these homes, and should be incorporated into denser urban projects.

This thesis aims to work towards a form that combines the best aspects of suburban and city dwellings and finding a solution that satisfies all of a families needs, while maintaining or increasing the density of the city. In the end, density is the most important factor in housing today. With the growth of the population at current rates, everyone will admit sprawling suburban neighborhoods just are not sustainable. Many people mistakenly view density as a reason urban housing feels crowded, dirty and cramped. This simply is not the case. “Crowding and monotony are the consequence of poor design, not the result of density.” We can easily provide housing that is denser than many current urban projects, but with thoughtful design, greatly out performs it’s counterparts.

The start of this thesis began with a question, how dense, is dense?

## Measuring Density

Density can be expressed in several ways, most frequently as housing units per acre, or persons per square mile. These numbers help to give us a general idea of how much activity is compressed into a given area of a city, but give little information about the physical form of a given area. Two areas with the same density can look completely different. They both have the same amount of units or people per acre, but the perceived density is different. What causes these differences in perception are how streets are laid out, the size and location of outdoor space, and the building arrangements. All of which are a function of design.

This thesis began with a look into the densities of similar neighborhoods as the chosen site, as well as comparing densities of various housing typologies on blocks of the same size as the chosen site. The Lincoln Institute of Land Policy considers any area with a density over 20 units per acre as a high density neighborhood. The following examples are high density neighborhoods in other Northeast cities on large bodies of water.

figures 4-7: Visualizing Density, Lincoln Institute



All four of these blocks have the same density but provide different types of living environments.

Washington DC  
Constitution and 11th

Region: Northeast  
Setting: Urban  
Density: 21.8 units / acre



figure 8: Aerial view, Washington DC



figure 9: Constitution and 11th block, Washington DC

Boston, MA  
Beacon Hill

Region: Northeast  
Setting: Urban  
Density: 52 units / acre



figure 10: Aerial view, Boston MA



figure 11: Beacon Hill Block, Boston MA

Baltimore, MD  
Fells Point

Region: Northeast  
Setting: Urban  
Density: 28.6 units / acre



figure 12: Aerial view, Baltimore, MD



figure13: Fells Point Block, Baltimore MD

Boston, MA  
Charlestown Shipyard

Region: Northeast  
Setting: Urban  
Density: 26.7 units / acre

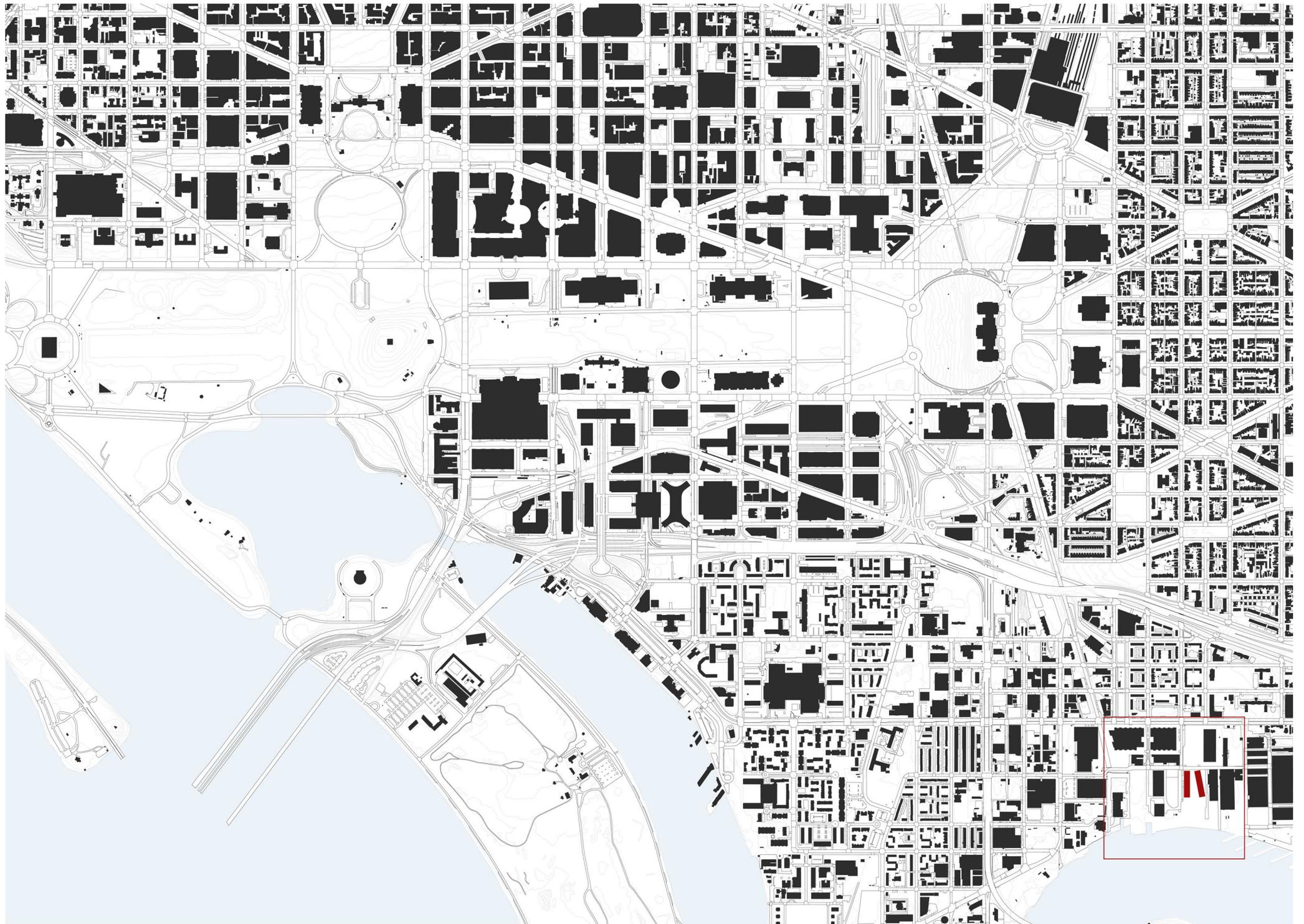


figure 14: Aerial view, Boston MA



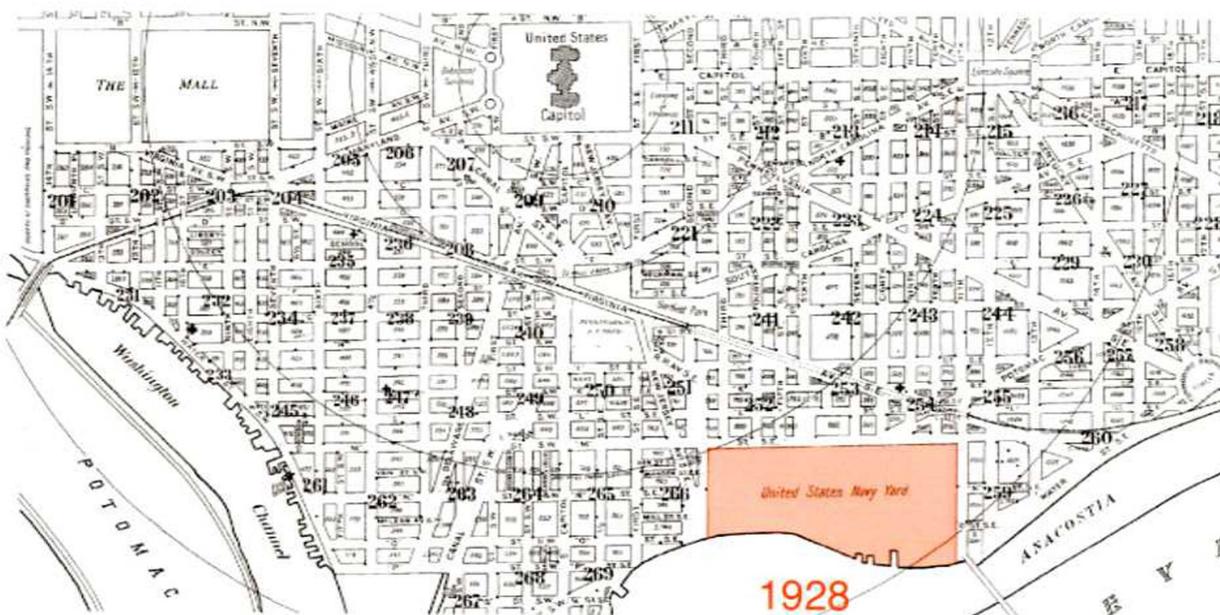
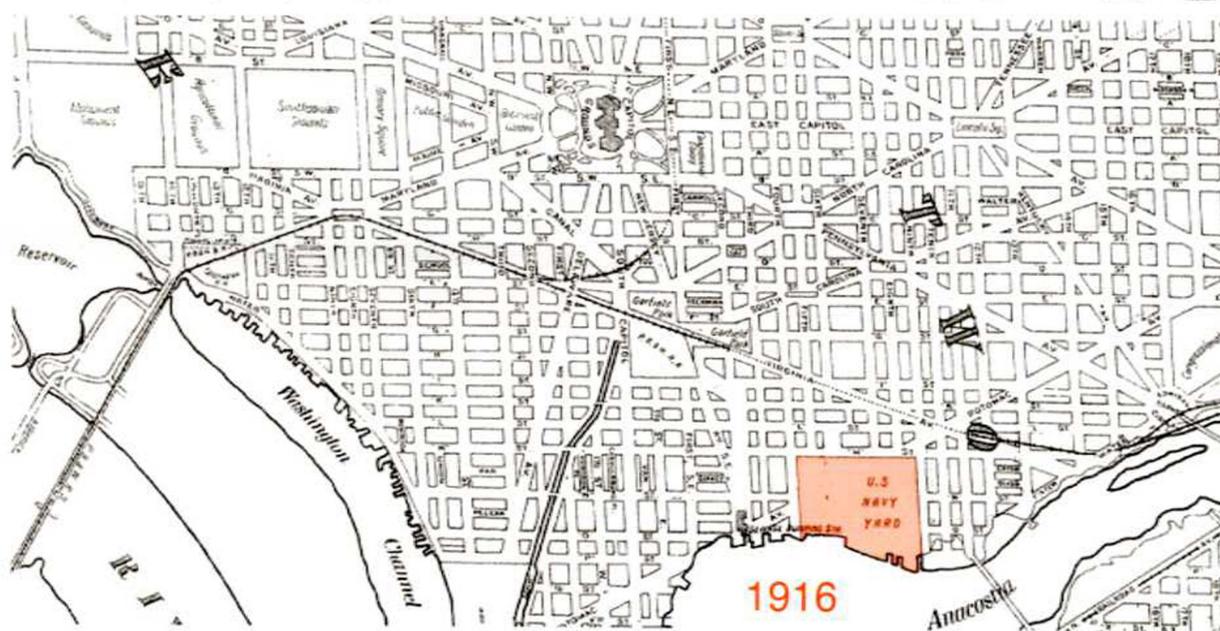
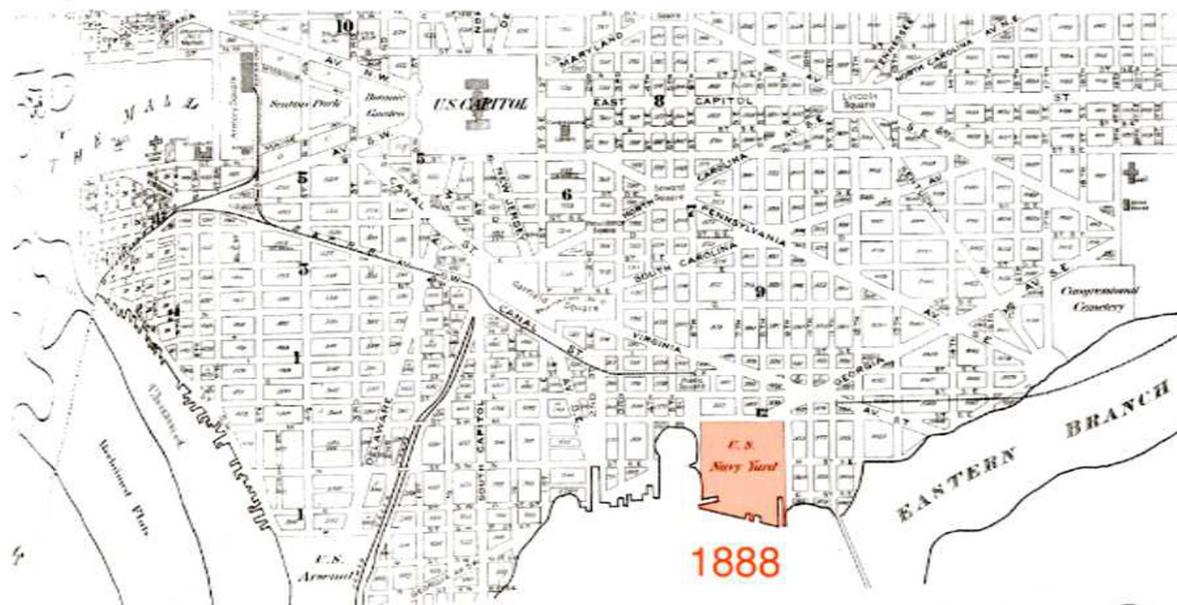
figure 15: Charlestown Shipyard, Boston MD

Site



The site for this thesis is located in the Washington DC Navy Yard in Southeast DC. This area provide a large site, in a neighborhood that is rapidly being revitalized after the construction of Nationals stadium and the headquarters of the US Dept. of Transportation. Many of the old Navy Yard buildings are being renovated into housing, retail and resturants, in addition the new Yards Park was recently opened, forming the beginning of what will eventually be a 14 mile river walk along the Anacostia River.

The site, situated directly on the water and river walk, lies in the midst of all these new projects, providing a great opportunity for a housing project within walking distance of all of these amenities.



Founded in 1719 as the original home port of the Navy, the Yard would continue to expand westward as the strength of the Navy increased and the demand for goods grew. By the 1870s the Navy Yard moved from shipbuilding to making ammunition and supplies, as the Anacostia quickly became too small for the large ships the Government was now building.

The yard would continue to grow rapidly until 1940 when it reached westward to 1st Street and had a population of 26,000 employees. However, with the development of the electronic missile in WWII, most of the Yard's manufacturing capabilities quickly became outdated as these missiles were developed by private companies. The Yard would begin shrinking, many of its buildings being abandoned, with the land west of 5th Street being given back to the city from which it had been acquired. From the 40s to present day, the Navy Yard serves mainly as an administrative and ceremonial center of the Navy.

“The Washington Navy Yard is representative of a contemporary urban situation in America. This situation concerns large tracts of land located in deteriorating inner-city areas, that have outlived their original usefulness.

These tracts of land, usually the site of industrial activities, were originally located near essential railroad connections and available housing for workers who would walk to work. As the population began to shift to the suburbs with the advent of the automobile, these formerly well located facilities became inconvenient to the interstate highway system and its vital truck access. Abandonment usually followed, causing a “ripple” effect by contributing to the decline of the surrounding neighborhood.”

figure 16: Sanborn Maps, Growth of the Navy Yard



figure 17: Navy Yard

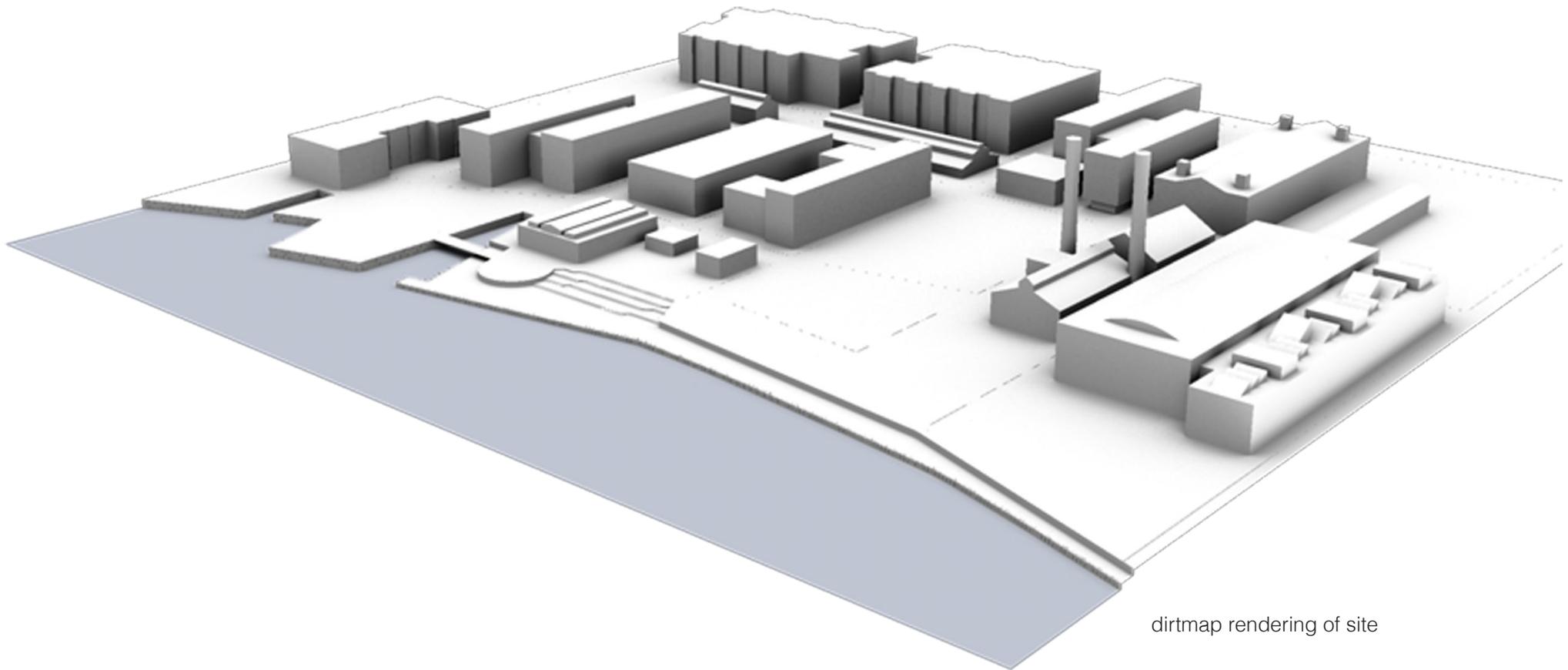


figure 18: Rendering of Yards Park development plan

#	Historic Use	Current/Future Use	Built
1	WASA Main Pumping Station	WASA Main Pumping Station	1905
2	-	US Dept. of Transportation HQ	2006
3	Navy Yard Building 170 Electrical Substation	Retail	1918
4	Navy Yard Building 167 Boilermaker Shop	Retail and Fine Dining	1918
5	Navy Yard Building 160 Pattern and Joiner Shop	The Foundry Lofts (residential)	1918
6	Navy Yard Building 173 Lumbershed	Dining/Retail	1918
7	Navy Yard Building 202 Broadside Mount Shop	Redevelopment as condos	1914
8	Navy Yard Building 74 Transportation Repair Shop	Redevelopment as residential	1889
9	Navy Yard Building 118 Power Plant	Power Plant	1905
10	Navy Yard Building 197 Gun Assembly Shop	Navy Yard Administrative Bldg	1939
11	Navy Yard Metro Station		
12	Nationals Park		
13	Yards Park/River Walk		

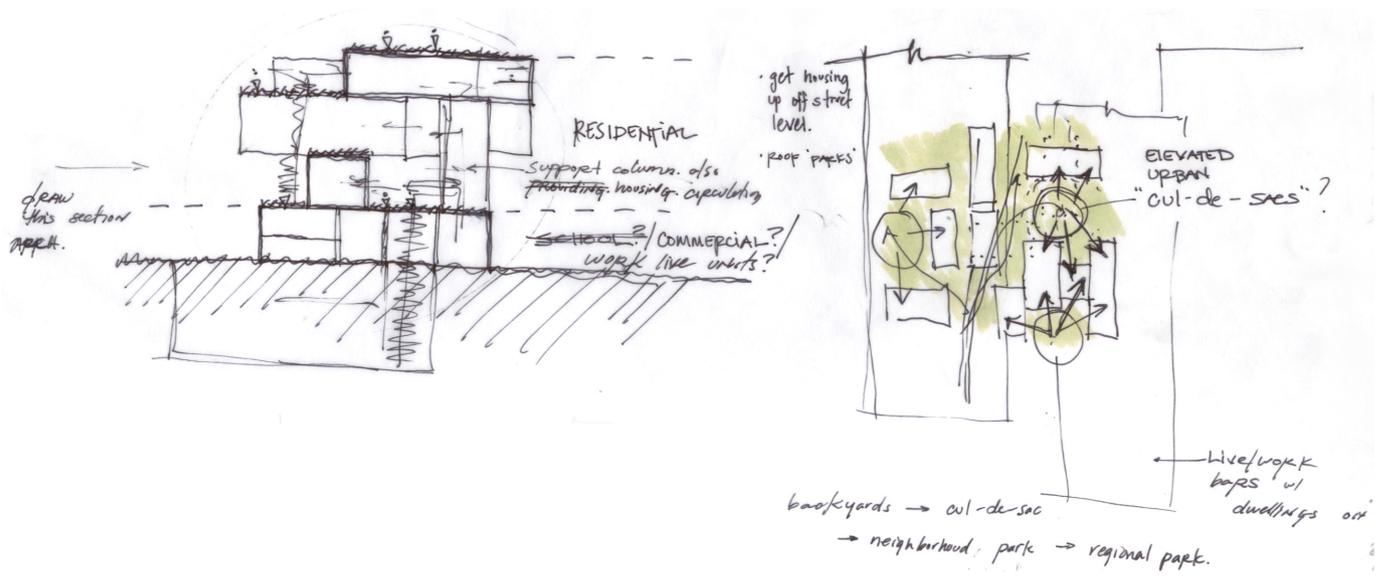


The Yards Park marks the beginning of the new river walk in DC. Along the walk are restaurants, shops, parks and new housing projects. Each portion of the proposed walk boarding different neighborhoods will have different identities, reflecting the history of that area. The site, and Yards Park, is dominated by large, linear warehouse buildings all running the full length of the blocks they are located.



dirtmap rendering of site

design process



## URBAN HOUSING REQUIREMENTS

### PRIVACY

Individual/designated entrances, many people are more concerned with privacy when entering a home than once they are in it. In suburban homes, nobody enters through their 'front' door, but instead through a rear door or from inside a garage where nobody can see them coming and going.

Avoid 'corridors' or rows of entrances which all line up, offering no privacy or no feeling of entering into an 'individual home'

Even if units are attached, if the entrances are separate, it gives the illusion of entering a detached home since you don't have other entering directly next to you.

Everyone should have a small private outdoor space, safe from the view of neighbors.

### GREENSPACE

Access to a large green space is necessary. Suburban homes are attractive for the space, but everyone does not need their own large space. The frequency with which people would use a large yard is actually quite minimal, it is unnecessary for everyone to have their own large lot. A large shared outdoor space will provide families with an outdoor area to play, plus encourage interacting with neighbors.

This large outdoor space must be easily seen and reachable from each unit for families to feel comfortable allowing children to use it. If you can't see it or reach it easily, it might as well not exist.

Avoid typical urban progression of walking down a hallway, traveling down an elevator and walking to a nearby (or not so nearby) greenspace which is out of view and often requires crossing streets.

### LIGHT AND VENTILATION

EVERYONE is entitled to natural light and ventilation.

Many urban housing options are unattractive because of a lack of light and no way to enjoy natural ventilation.

Avoid 'interior' units or units with only one exposure. Why shouldn't everyone one have an 'end' unit?

### FLEXIBILITY

Current urban housing is too spatially defined, there is no room to change as a family grows and changes.

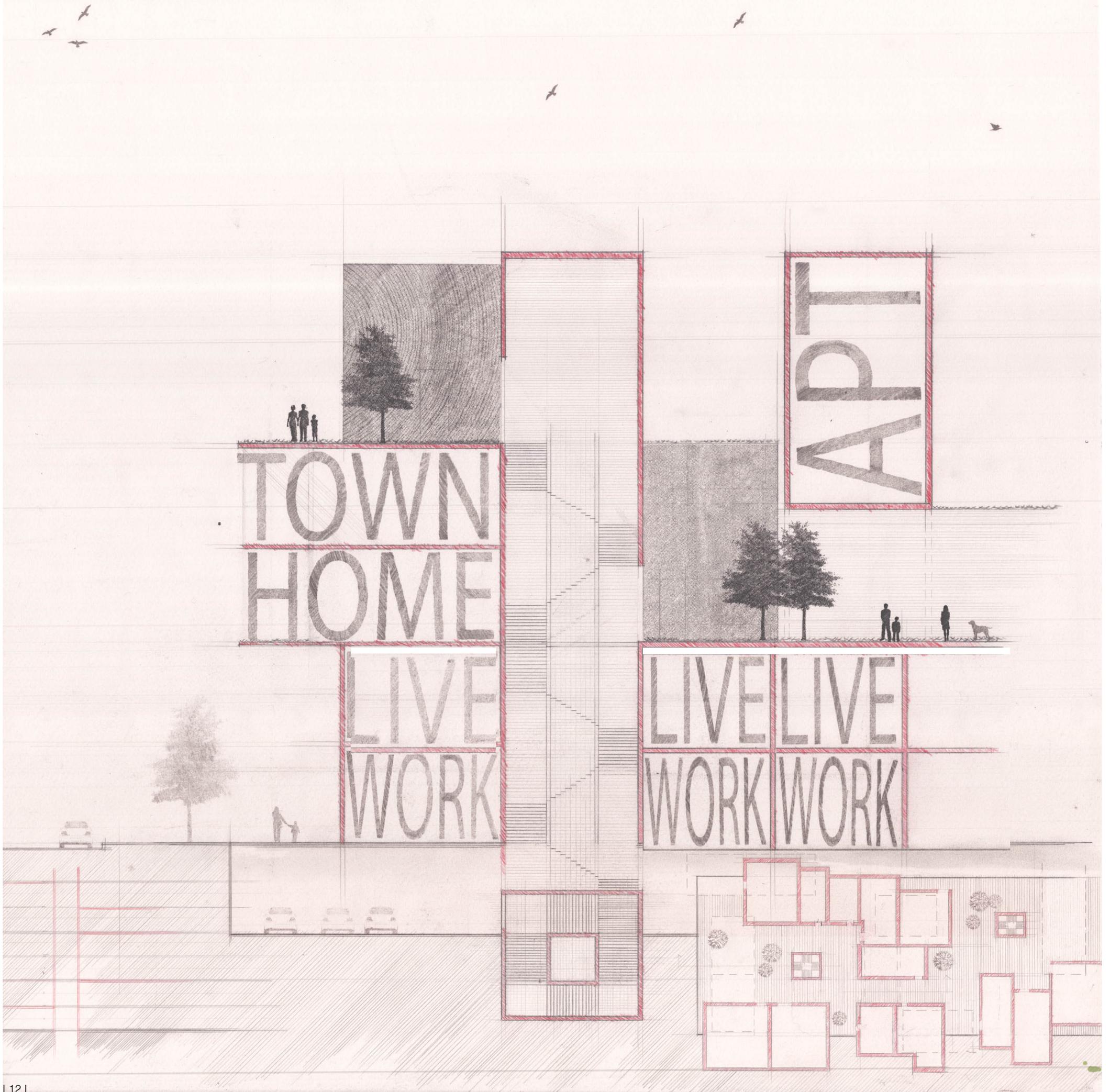
If housing cannot adapt, then people are forced move. Housing has a life cycle.

All people do not have the same hobbies, or use their homes in the same way, so rigidly defined rooms are not functional.

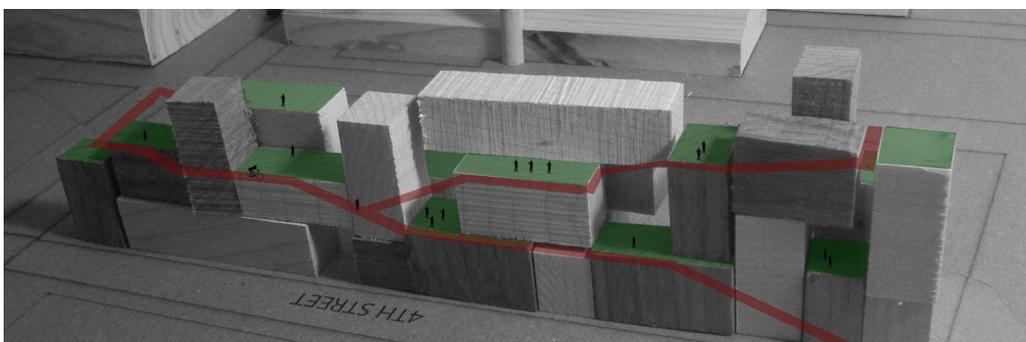
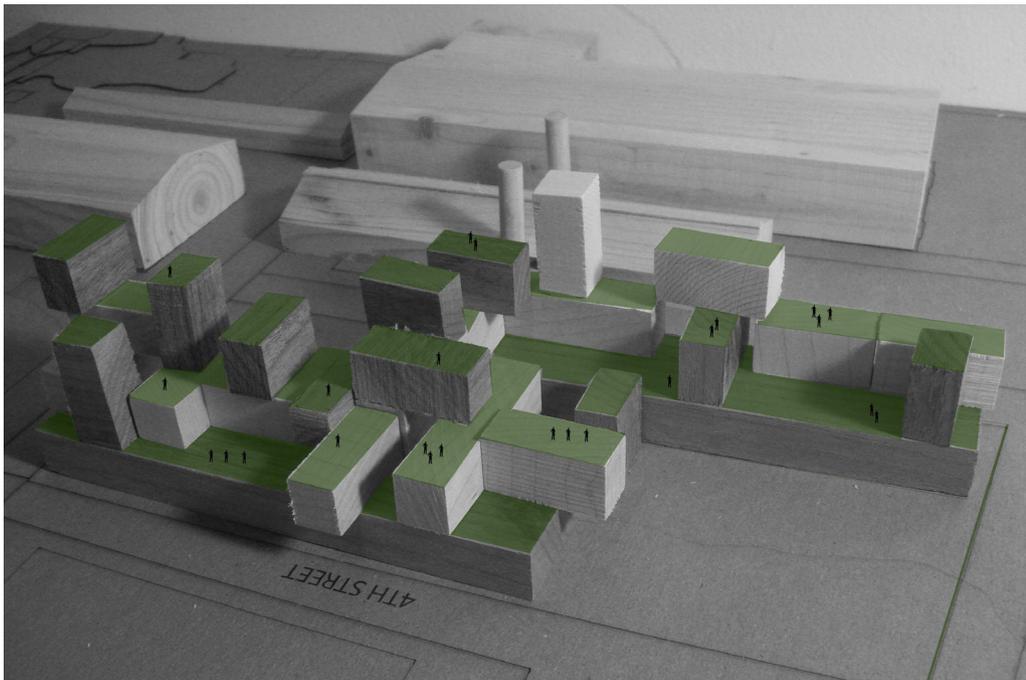
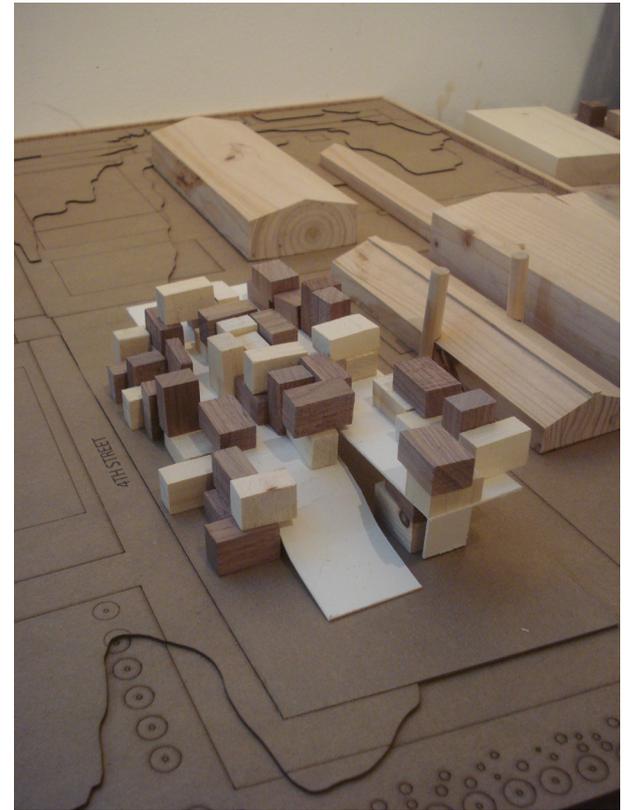
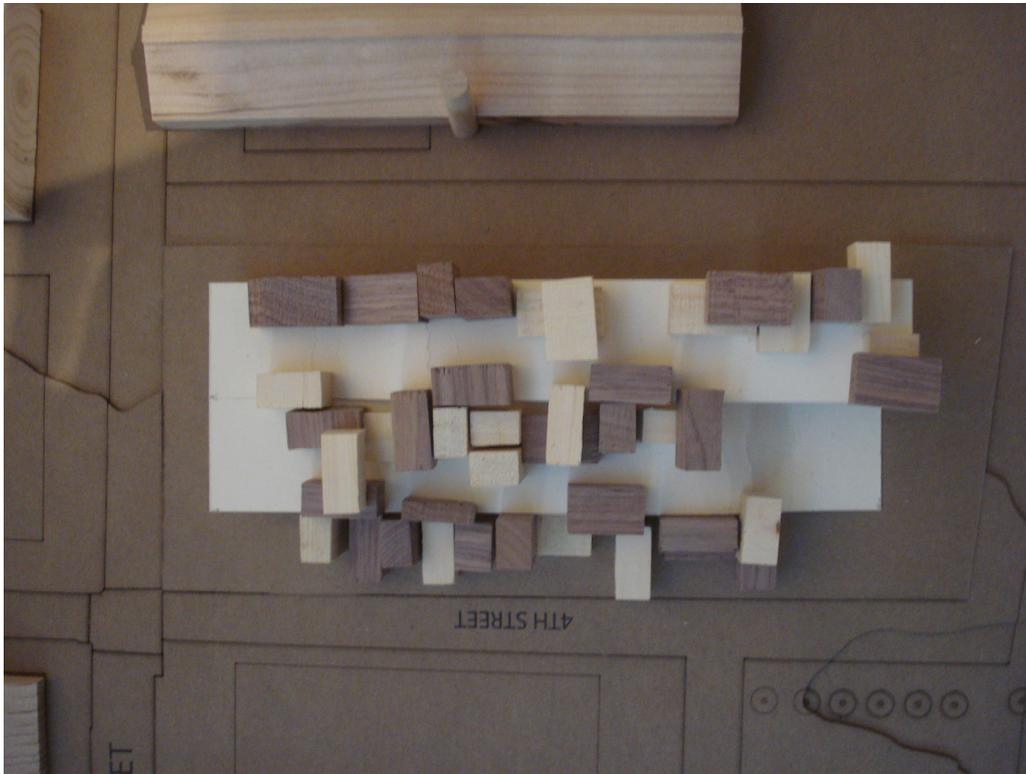
Aim for housing with adaptable rooms so new inhabitants can use it differently than previous ones.

Allow room for housing to grow/shrink as inhabitants do.

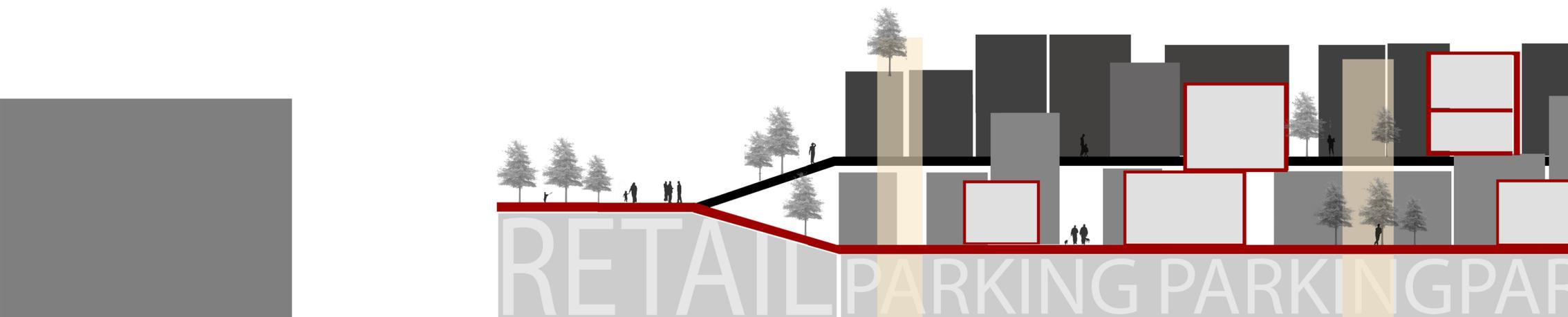
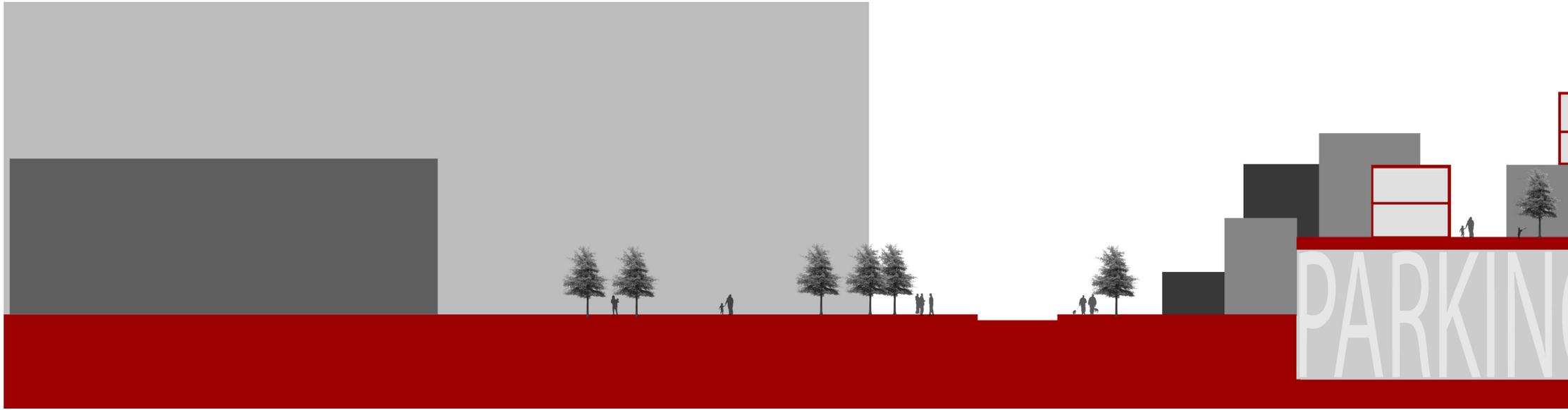
Initial drawing following creating list of housing requirements. The drawing aimed to capture as many of these requirements in one drawing as possible, and serve as a starting point for the form of the building.

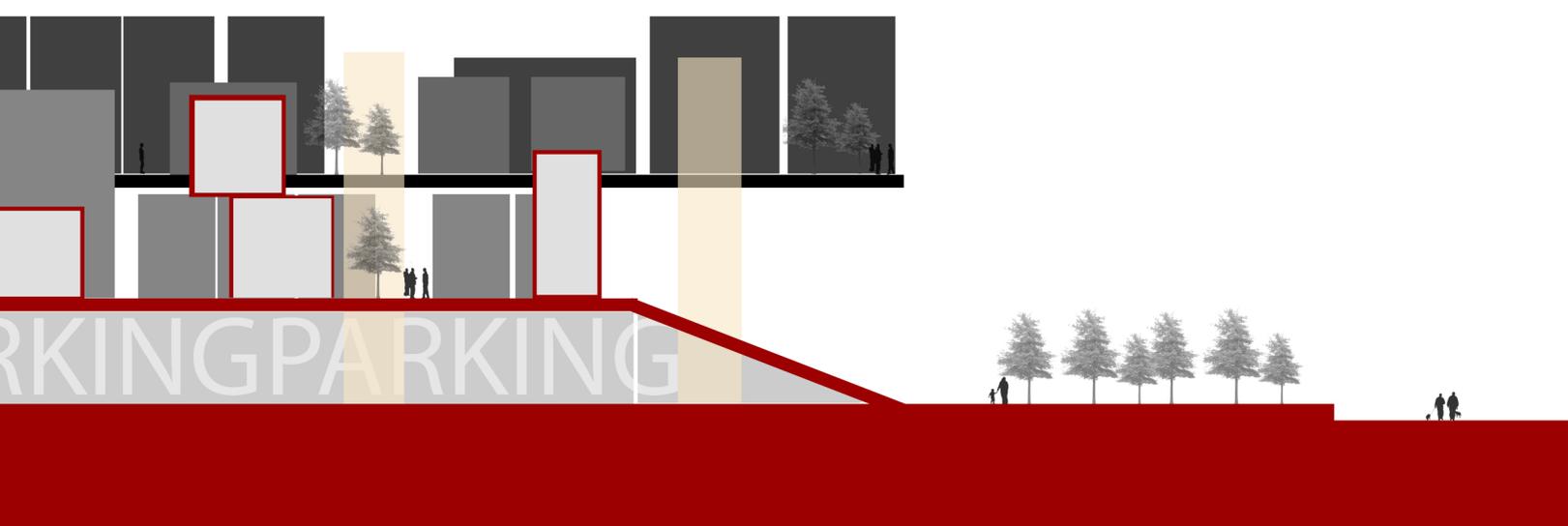
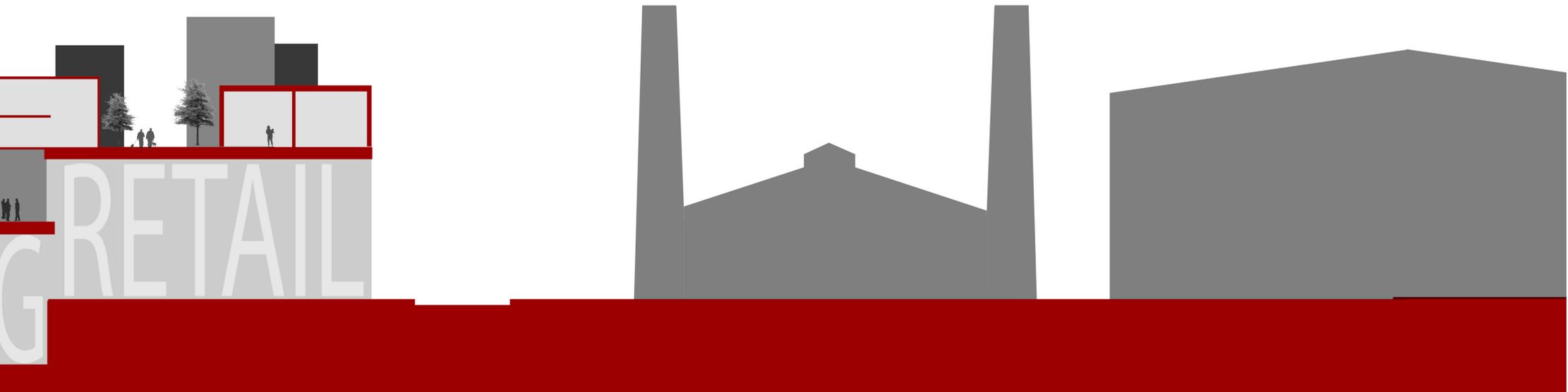


From the drawing a series of massing models were created to bring this drawing into a 3 dimensional example.



All of the early schemes were based on the housing being focused on a private plinth used as a large outdoor space for residents of the complex. This plinth would also serve as the central 'lobby' of the building as well as the main means of circulation. This would create opportunities for neighbors to meet other neighbors. No longer would you exit an elevator and walk down a long corridor void of natural light to your unit. This early design decision would remain throughout the entire life of the project. Off of the main path of the plinth would be small courtyards that small groups of units would be focused on. These would serve as smaller, less public, outdoor spaces for small groups of immediate neighbors to interact. Each unit would be entered from these courtyards, serving in a sense as the equivalent of a suburban cul-de-sac.





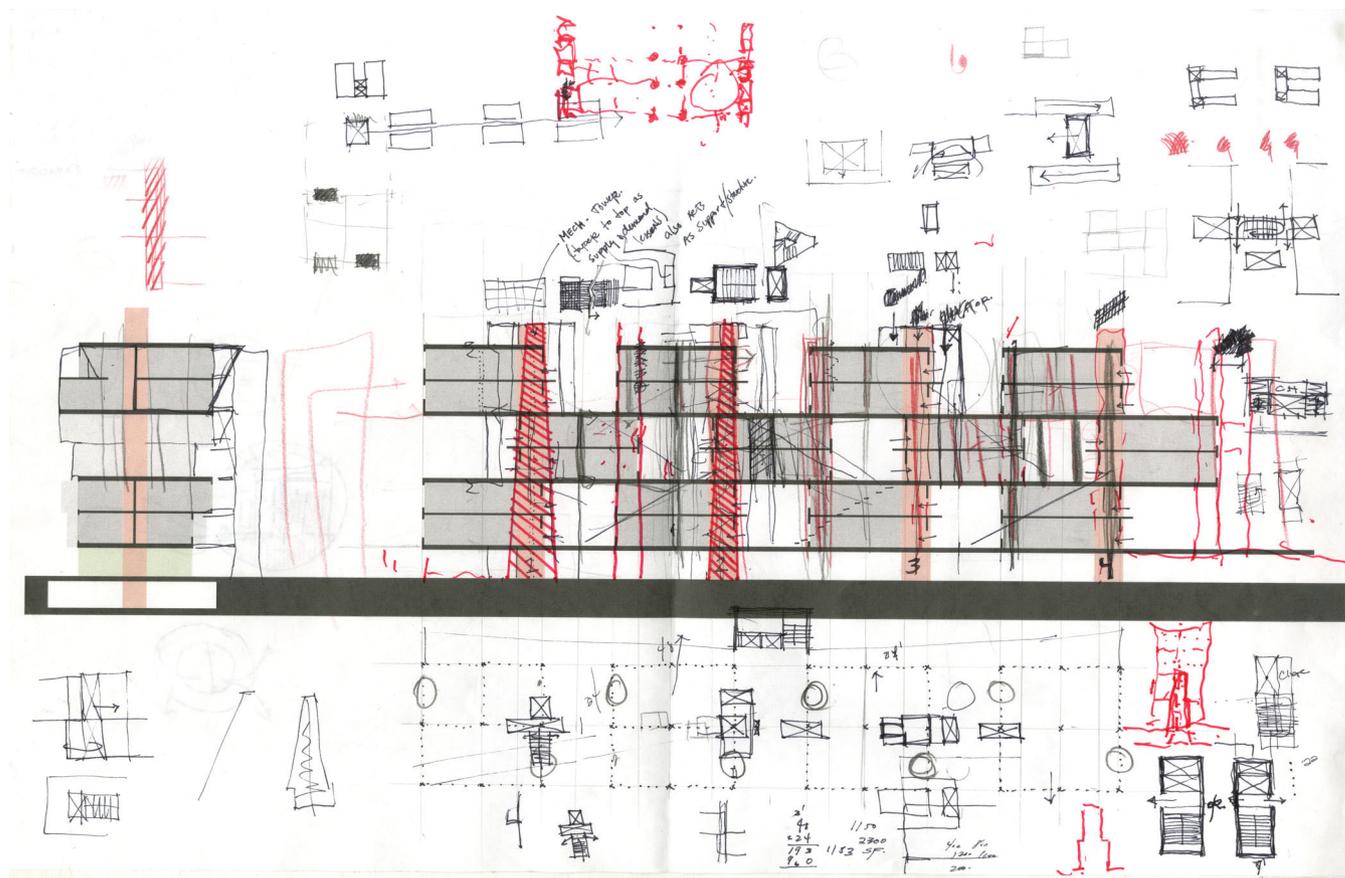
Early on it became evident that this sort of strategy would not be feasible. A housing block of this complexity would be very intricate in its design as nearly every unit would have to be designed individually. In addition, the cost to build something like this would be much higher than typical housing constructions. This two things combined, would drive the price of such units too high to make them affordable to young families, another problem that is typical with good urban housing options.

A new strategy was needed that would create similar characteristics, but keep the units similar in their designs. What if the interior became the element that was different and could be changed by the occupant easily? After all, that is where the home is used, the exterior really has little effect on how a person uses the space.

Looking back on the initial research, it became clear that rowhousing is a great compromise between density and space. This typology allows for homes to be close together, but provides each dwelling with a rear exterior space and often a small front exterior space. In addition everyone has a designated separate entrance, and the interiors are often slightly different.

The problems with rowhousing is just as evident as well. Dwellings often only have one or two facades with natural light, the interior is usually rigidly defined and modification options are limited due to load bearing walls, and narrow overall widths.

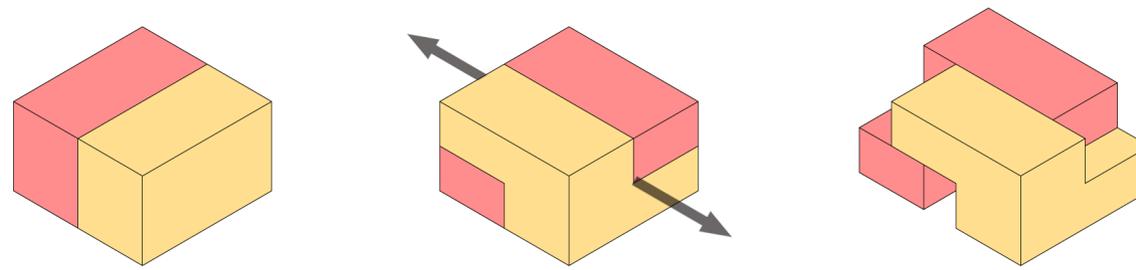
However, using rowhousing as a base, the thesis moved forward hoping to solve aforementioned problems, and increase the density by asking the question. What if rowhousing was extended vertically, rather than being limited to one row at ground level?



The next decision was the stack the units in a cellular manner, creating pods of units, separated by the smaller courtyards discussed previously. This minimizes the amount of shared walls, and insures everyone has access to a small outdoor space.

After working with the rowhouse typology for a while, a simple, yet incredibly valuable change to the typical rowhouse form was made.

First the upper levels of two adjacent units were rotated ninety degrees on top of the lower floor. Then each of the newly created “L” shaped units were pulled apart from one another.

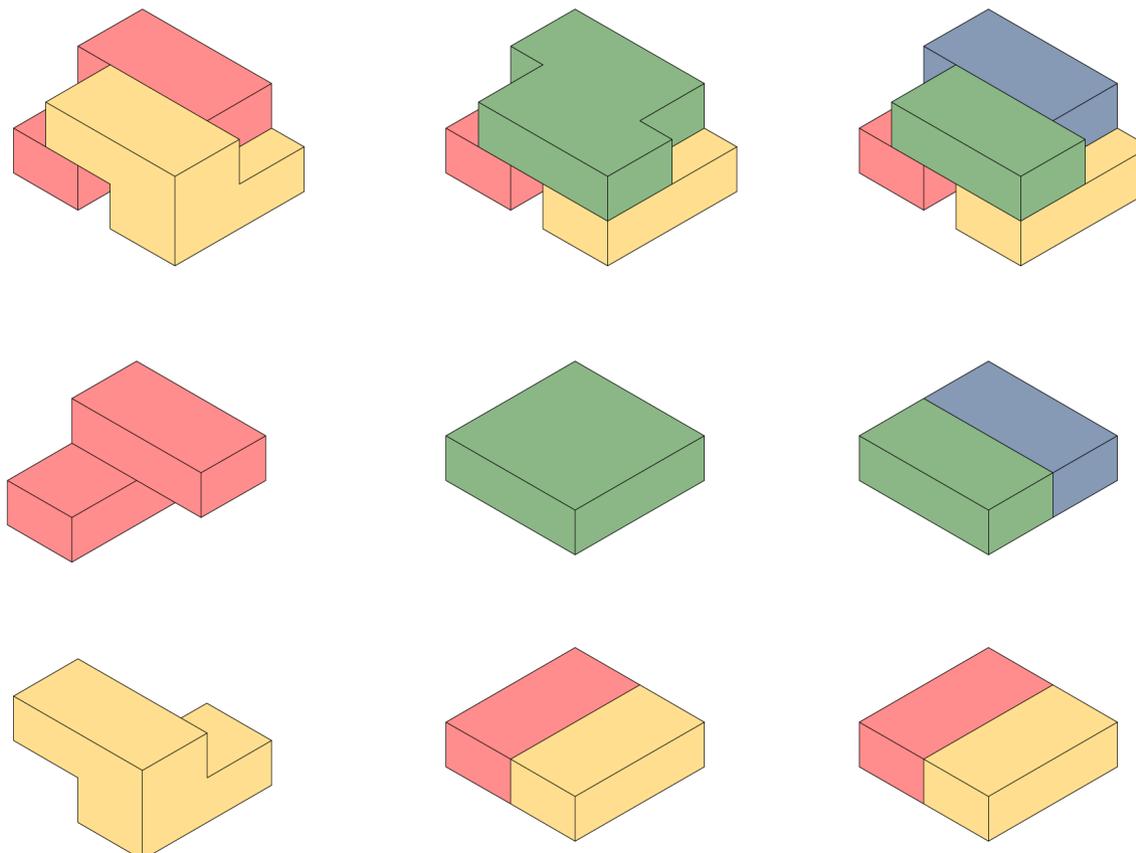


This move created a “pod” of units, in which each unit would have:

- all four facades available for windows, and views in all four directions.
- a small private outdoor space is created on the second level of each unit
- a corridor between the two units is opened, creating a exterior hallway that is covered between the two units.

In addition, each “pod” can vary in the style of units it houses:

- two large, two story units
- two small one story units, and one large one story unit on top
- two small one story units on the bottom and two small one story units on top.

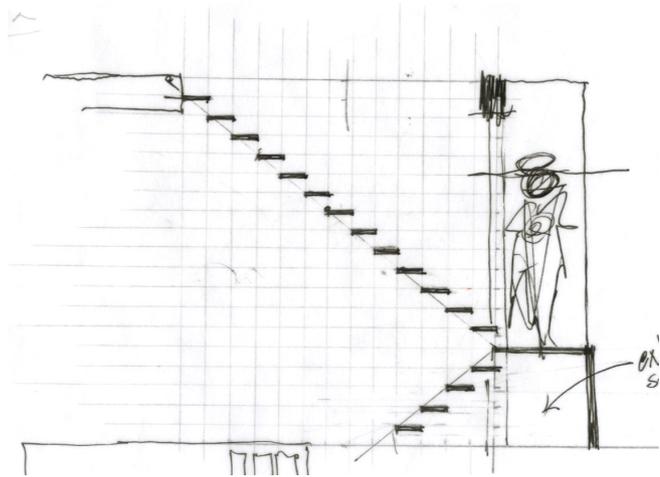
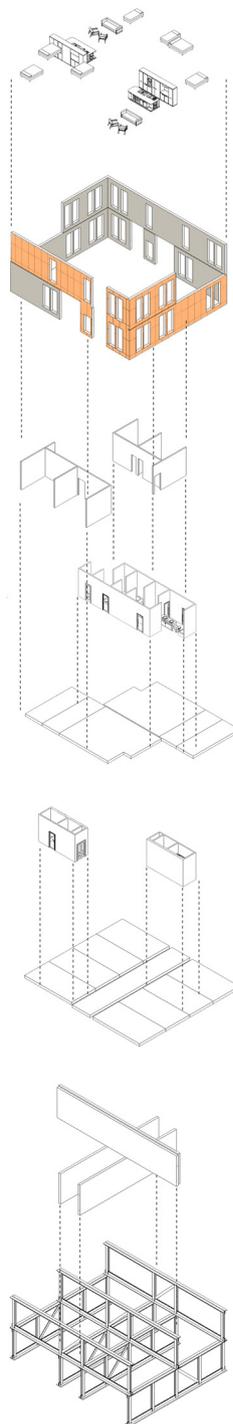


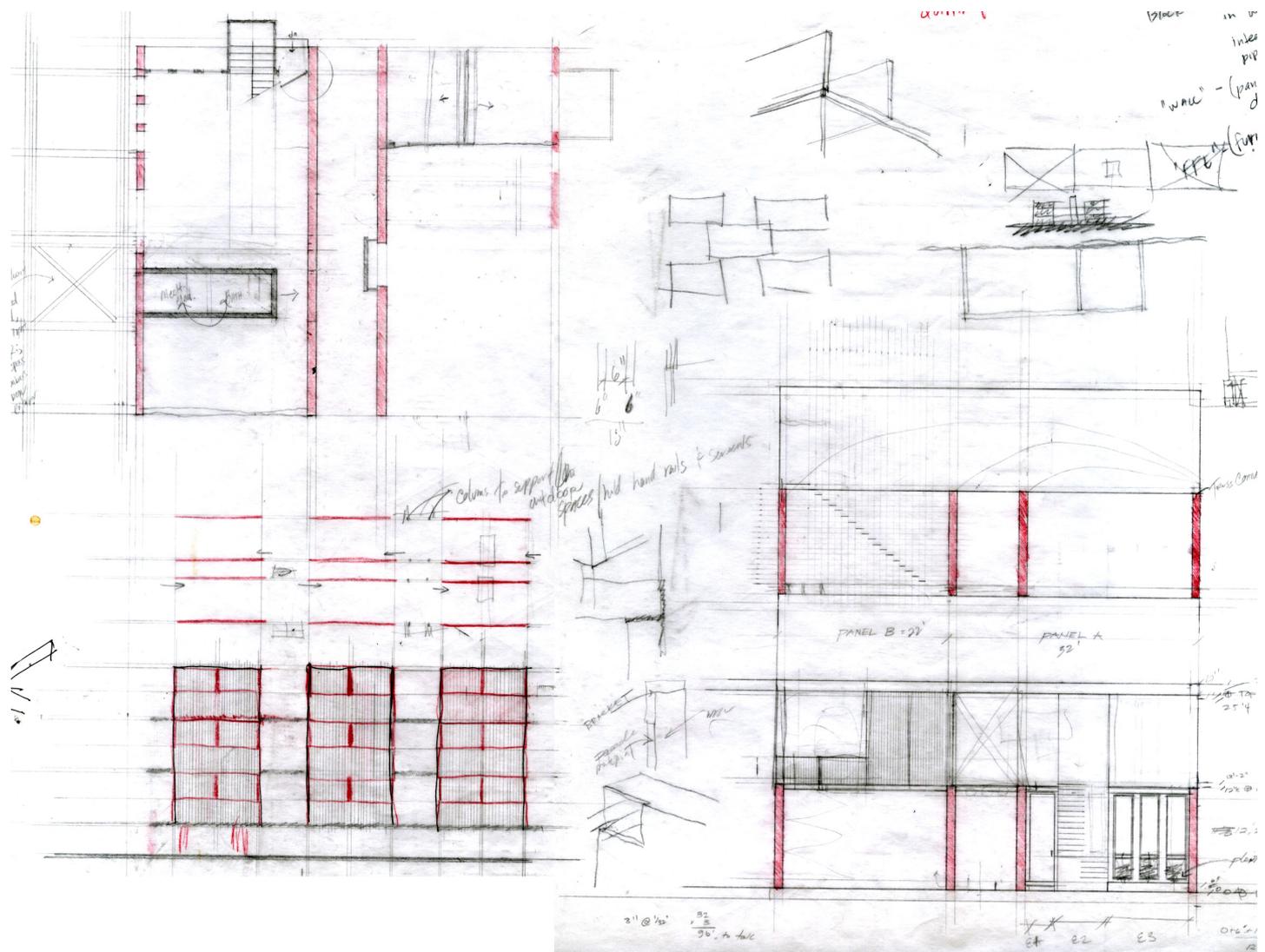
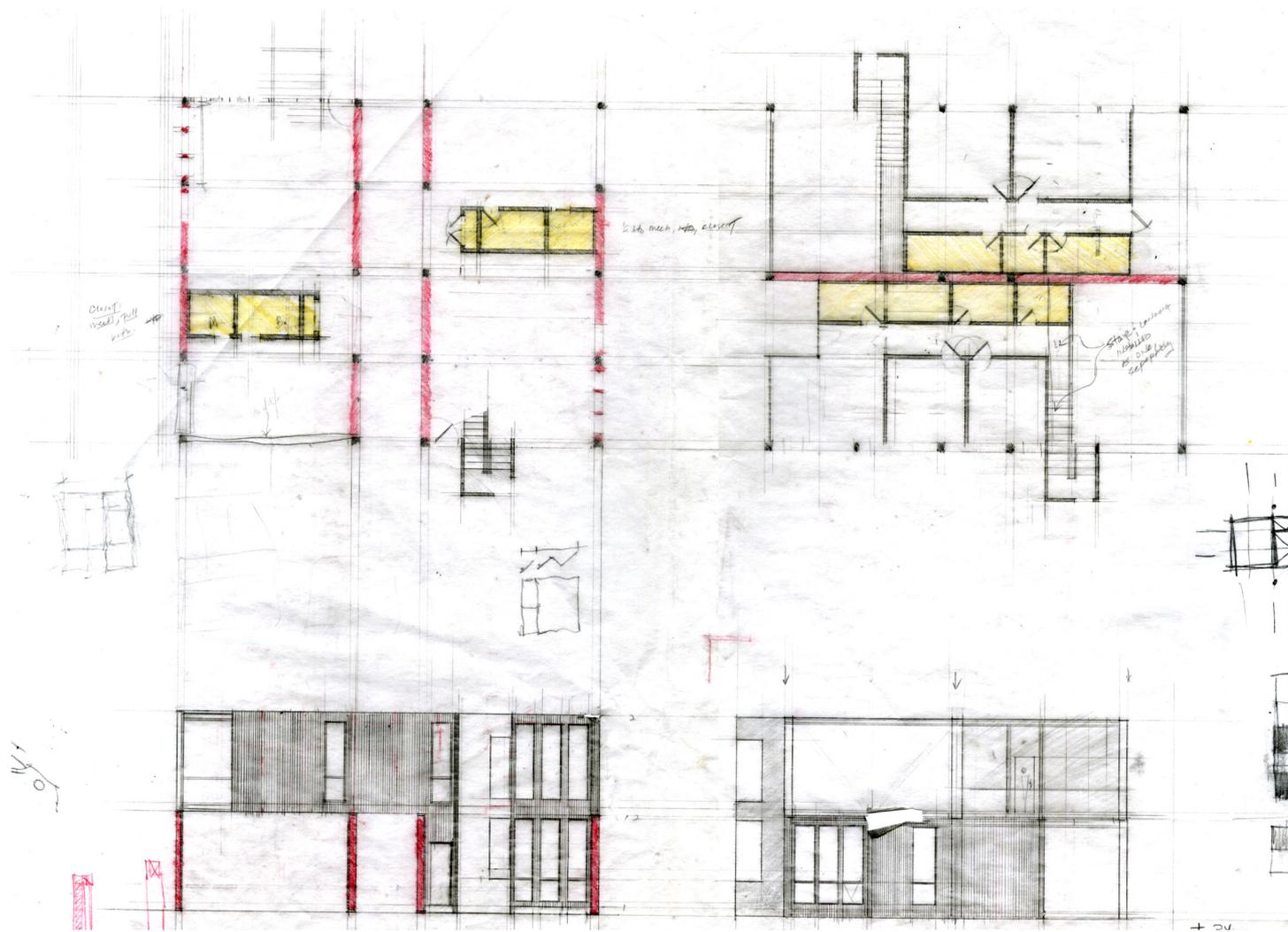
The structure of the building/units had to be such that it allowed for the interior to have as much flexibility as possible. Each “pod” of units consists of eight trusses which serve as the exterior walls of the units. This allows the interior to be free of columns and load bearing walls, creating interior spaces which can be easily modified with by moving partition walls as new tenants see fit.

The unit plans were designed around central cores which contained all of the service elements, such as water, sewage, laundry, storage, kitchen and bath facilities. This frees the rest of the space in the units to be used as necessary. With the exception of these service cores, and exterior truss walls, anything within the unit can be moved or modified to suit individual needs.

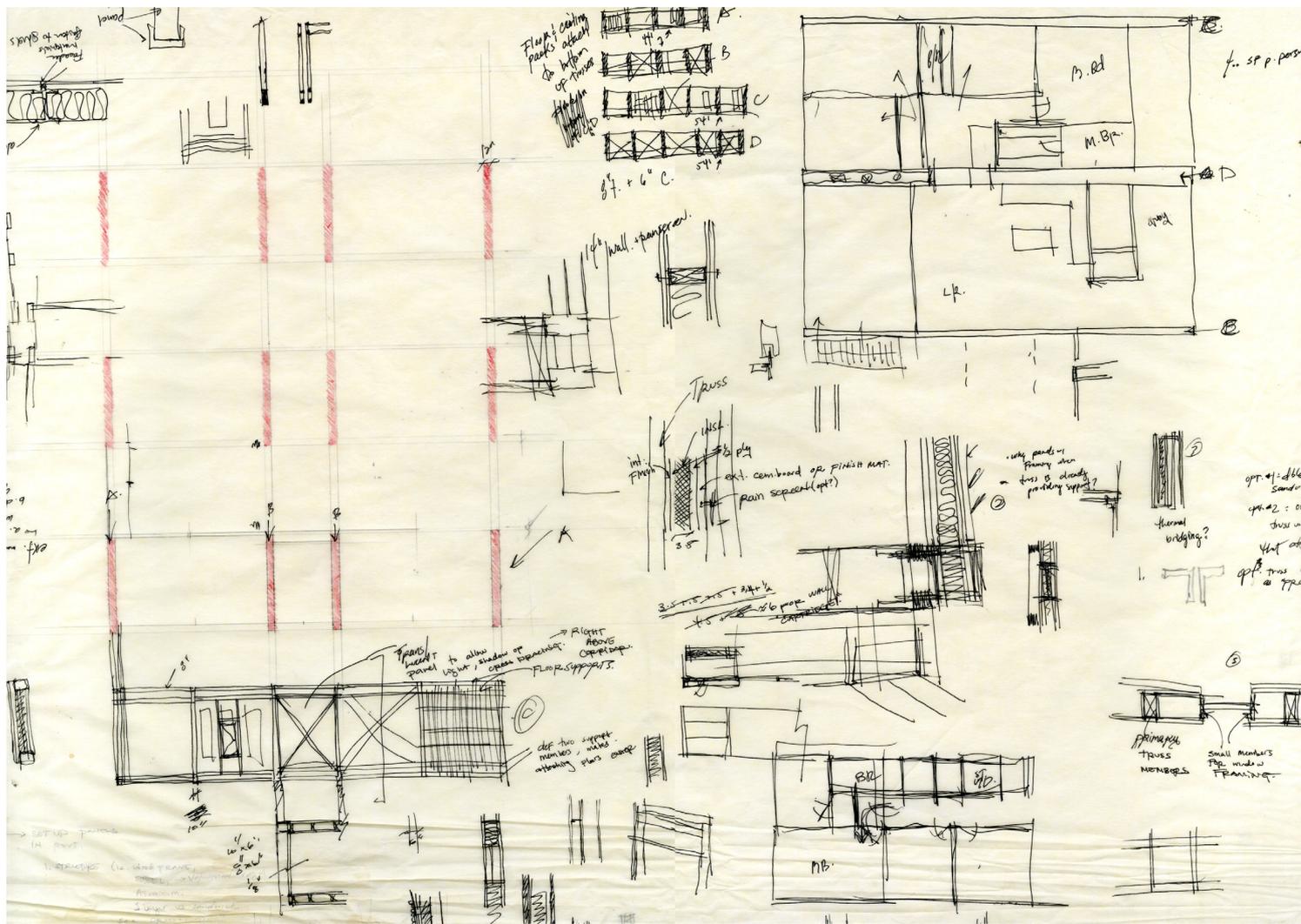
These trusses would be prefabricated offsite, and then stacked on top of one another, one floor at a time, being joined at the ten intersections at each steel connection. The cores would also be prefabricated offsite and raised as one solid unit, lowered in to each unit. Items such as stairs, for those units with two floors, were inserted on the ends of the units, outside of the main footprint, as to not impede upon the use of interior spaces.

Wall, ceiling and floor panels would be attached to the trusses, again all fabricated prior to construction. This allows for a quicker and more cost effective build, thus making these dwellings available to more than just extremely wealthy families. In honoring the heritage of the site, and its history as an technology research headquarters and wartime fabrication center for the Navy, it was important that the materials were used in a way outside of typical construction methods in multifamily housing.

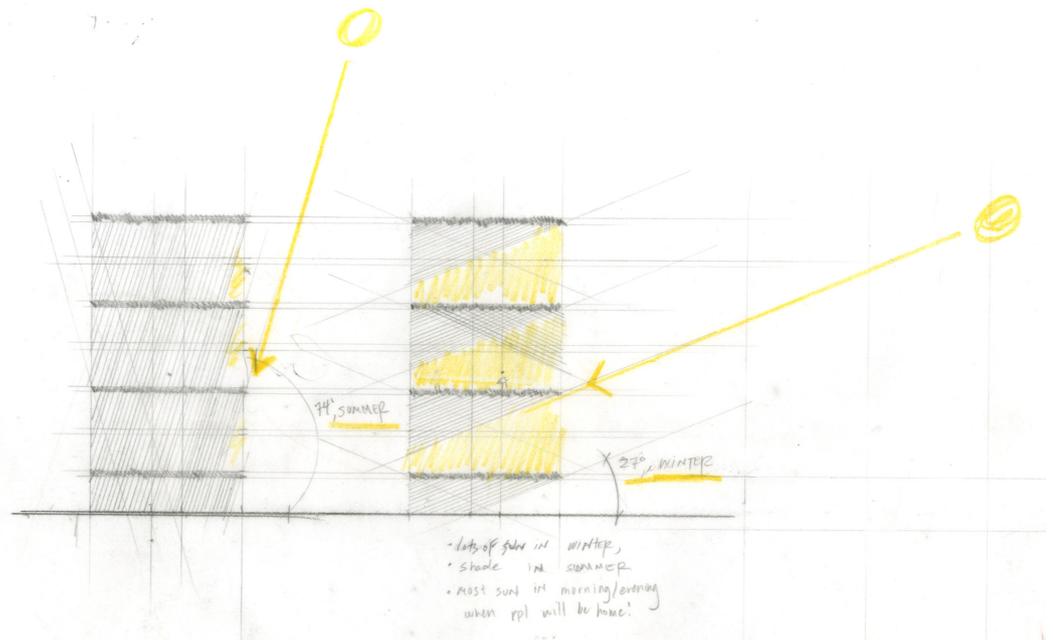
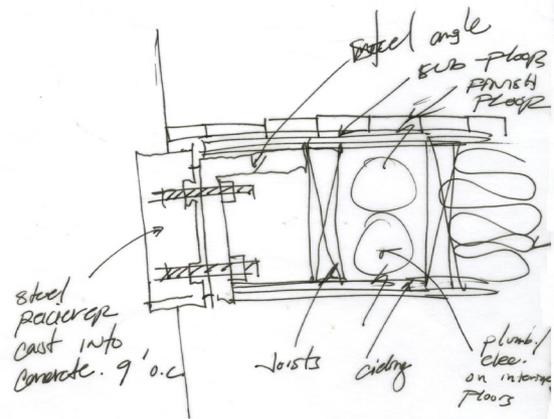




unit elevation, plan and section sketches working through relationship between cores, structural truss walls and interior spaces



structural sketches & sun studies

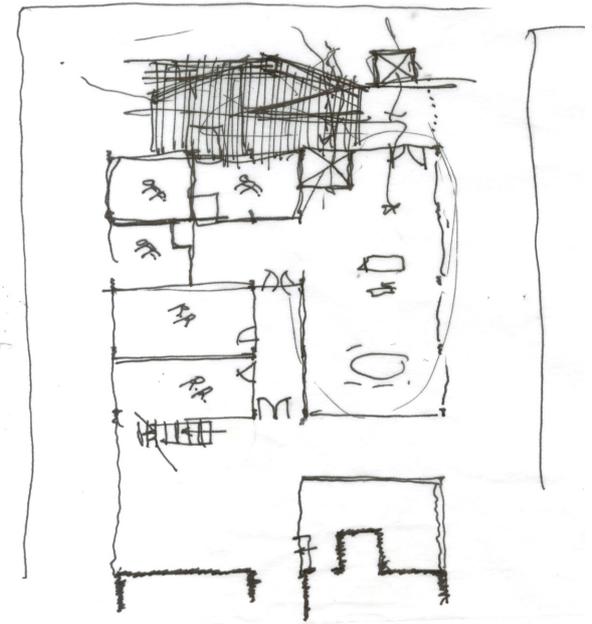
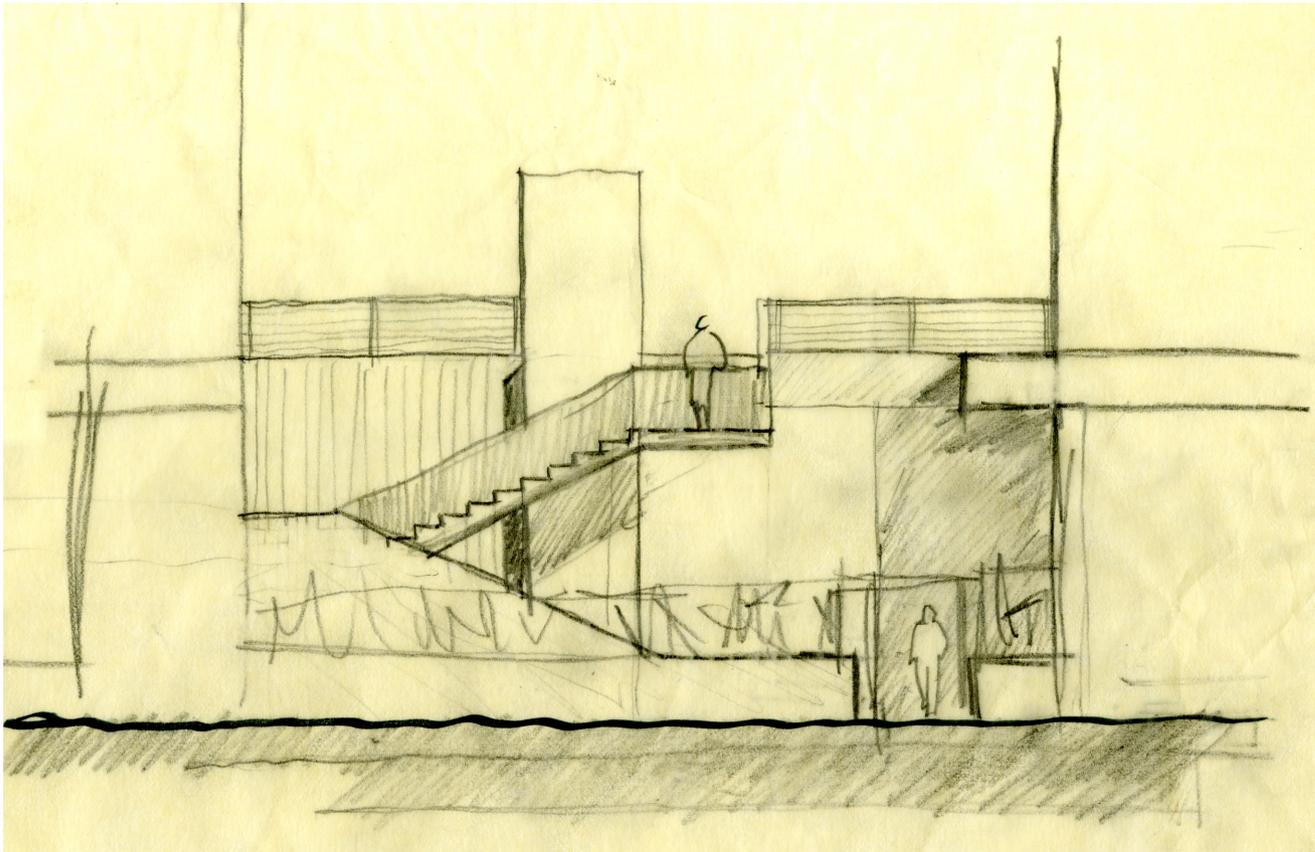
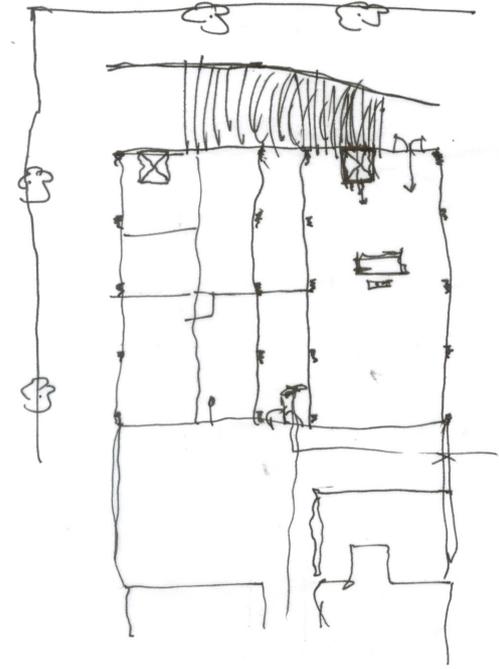
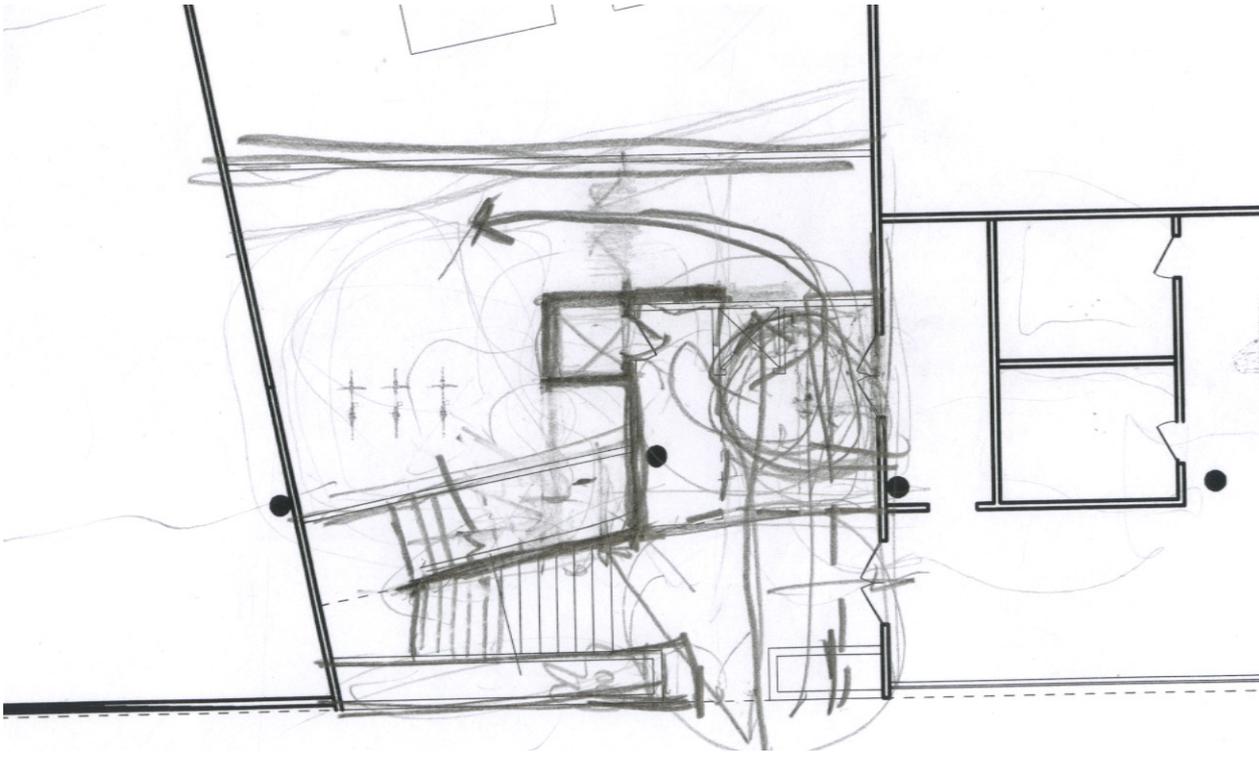


With the creation of the exterior corridor between the units, the natural arrangement for the pods was in a linear method, so that each of these corridors would align, forming one continuous circulation corridor, which terminated at both ends with natural light and an exterior space for everyone on the floor to enjoy.

Observing the nature of the other buildings in the area, a clear pattern of long, narrow buildings emerged. Due to the history of most of these buildings as fabrication and assembly line factories for ship parts, the most practical layout for them was in a line. Following in the same language, the pods were arranged, on three levels, in two linear arms.

With the majority of people arriving at the north-west corner of the site, due to its proximity to the Navy Yard metro station, the natural entry to the building is at this corner. As a result the two arms of the building are close to one another here, providing a gap between them as an entry to the plinth. From here, the arms spread apart opening up as they approach the river, widening the views for the units.



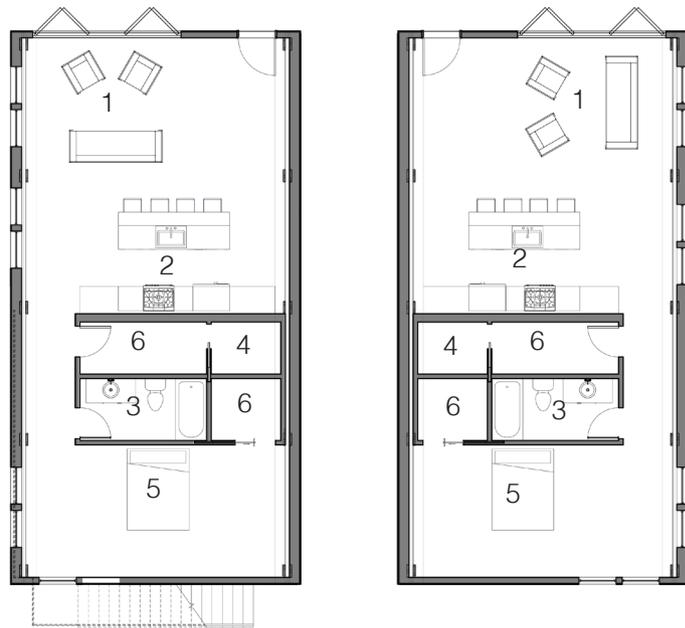






final drawings

base end units



base middle units

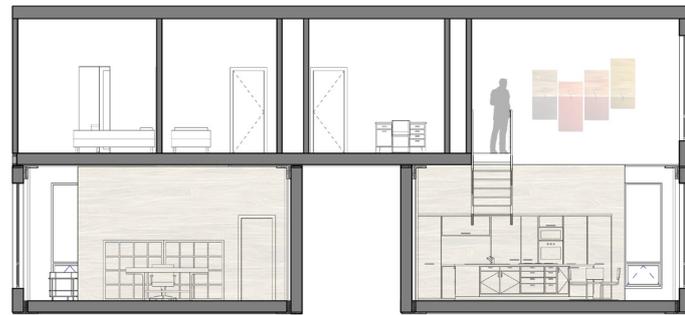
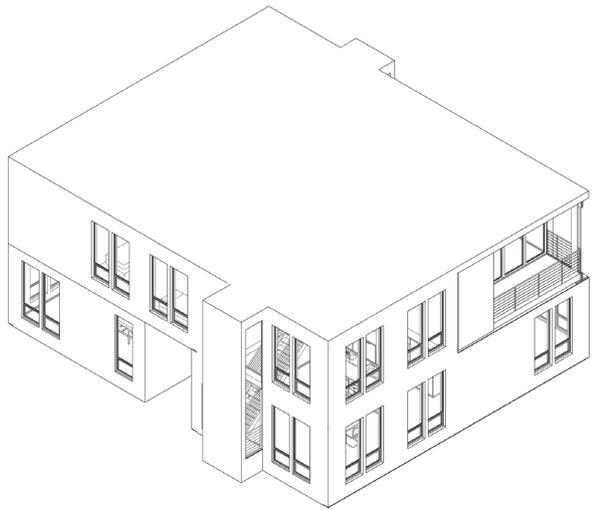
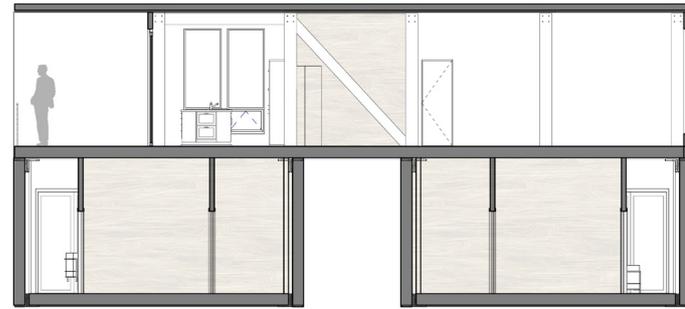
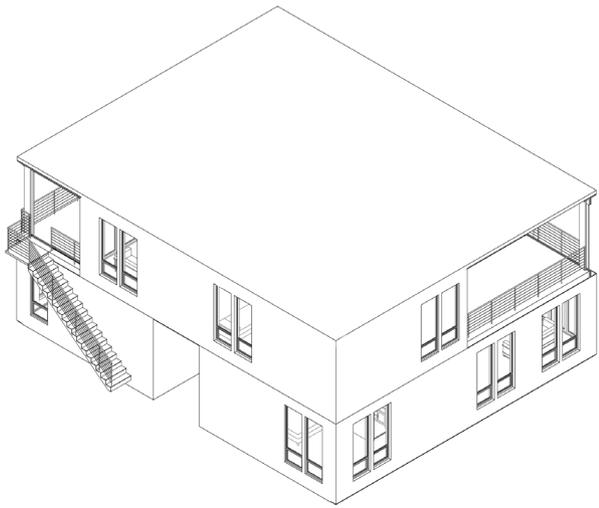


- 1 - living/dining
- 2 - kitchen
- 3 - bath
- 4 - storage/mech
- 5 - flex room
- 6 - closet
- 7 - bedroom

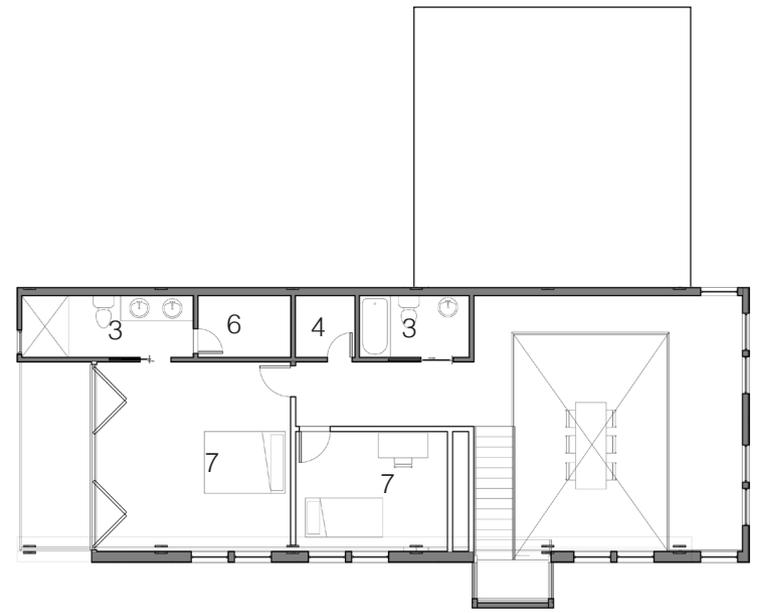
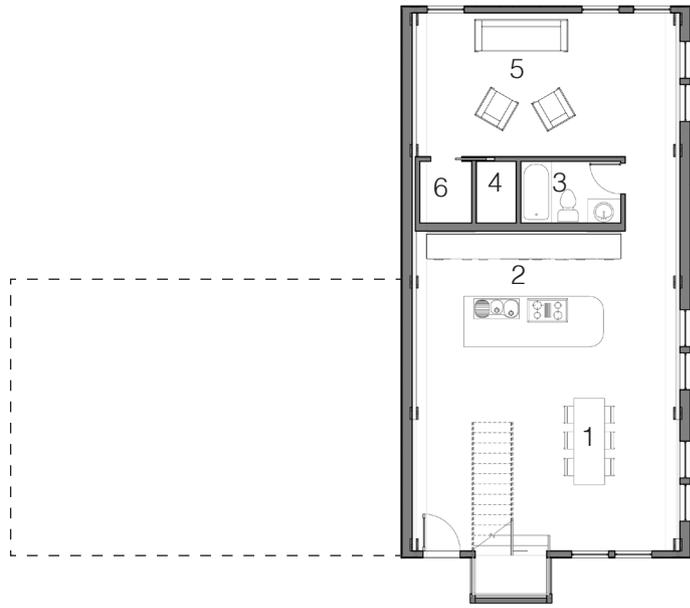
Units vary at either end based on the desire of the occupant for more interior or exterior space. One end can either be enclosed for another bedroom, or left open as an outdoor space directly off the master bedroom. The opposite end can be left solid, be extended with an interior projection used as additional living space, or as a balcony for more exterior space.

All services are left in cores which act as either room dividers, or hug interior walls, allowing the rest of the floor plan to be divided as needed by an occupant.

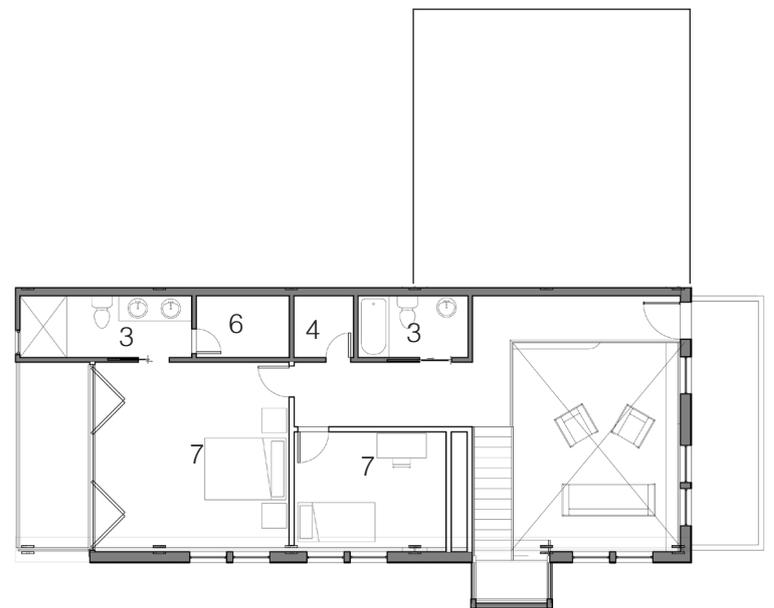
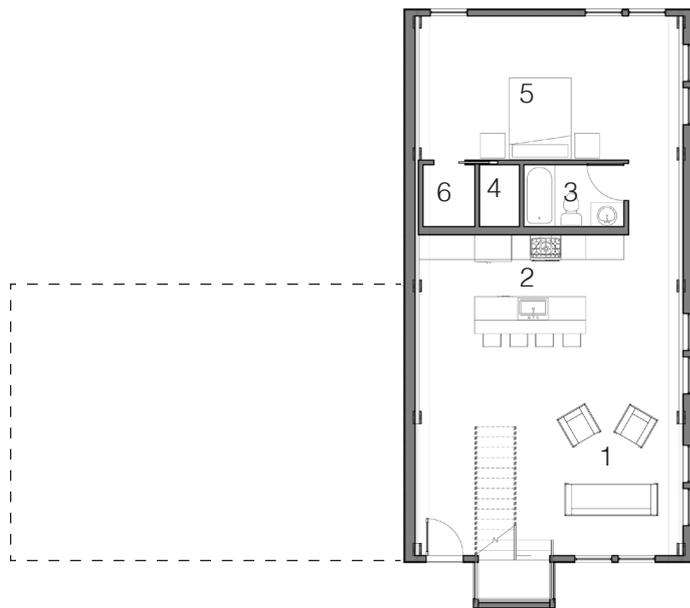
All non end units include a rear room on the first floor that can be used as living, dining, bedroom, or an office. This allows for maximum flexibility.



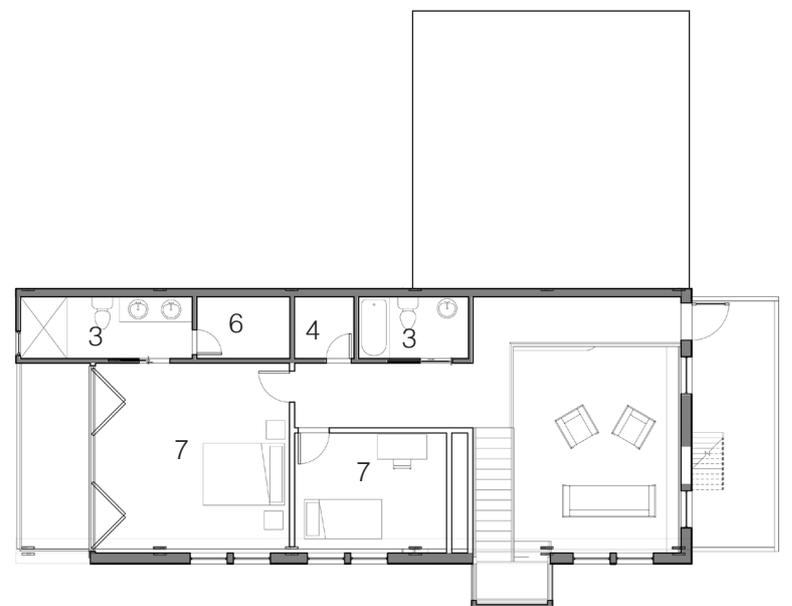
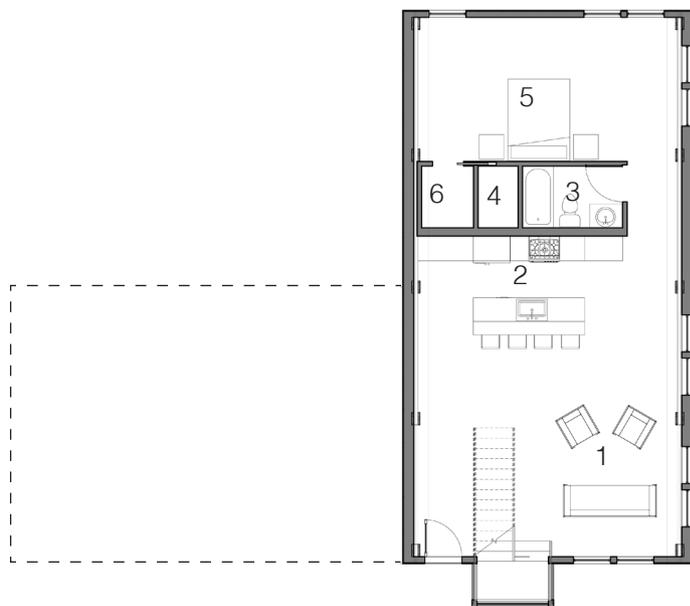
projection variation



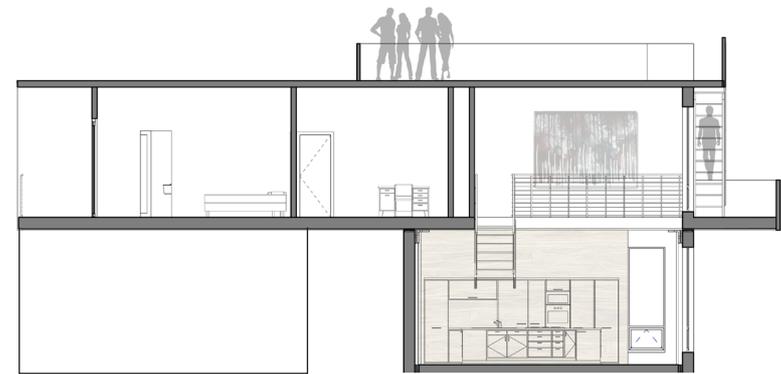
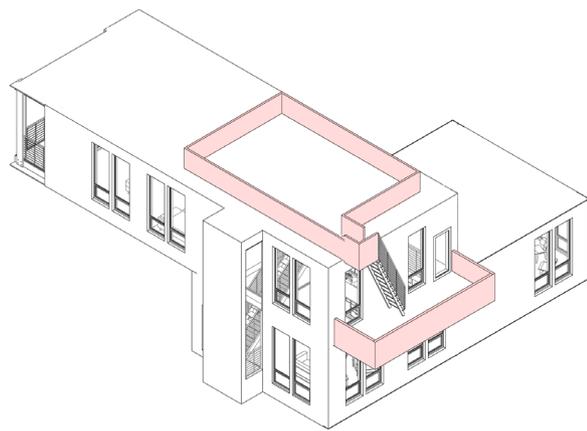
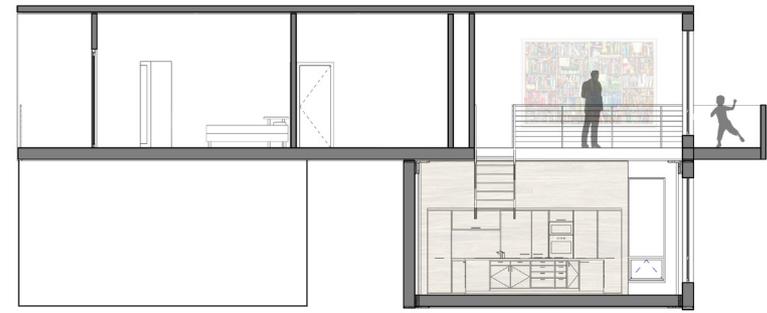
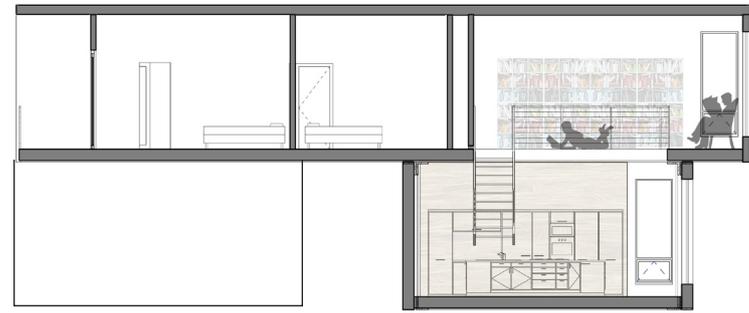
balcony variation



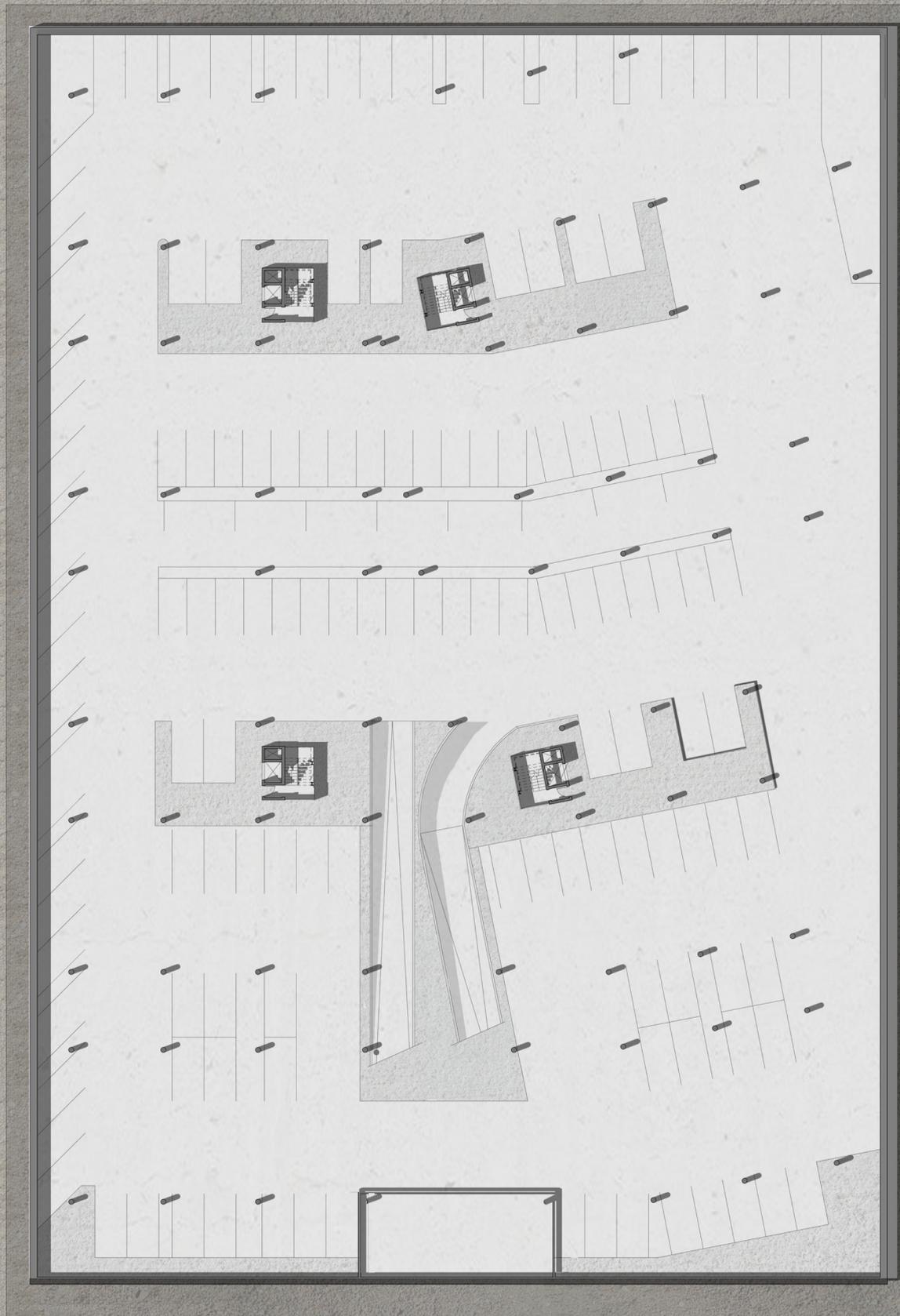
roof deck variation

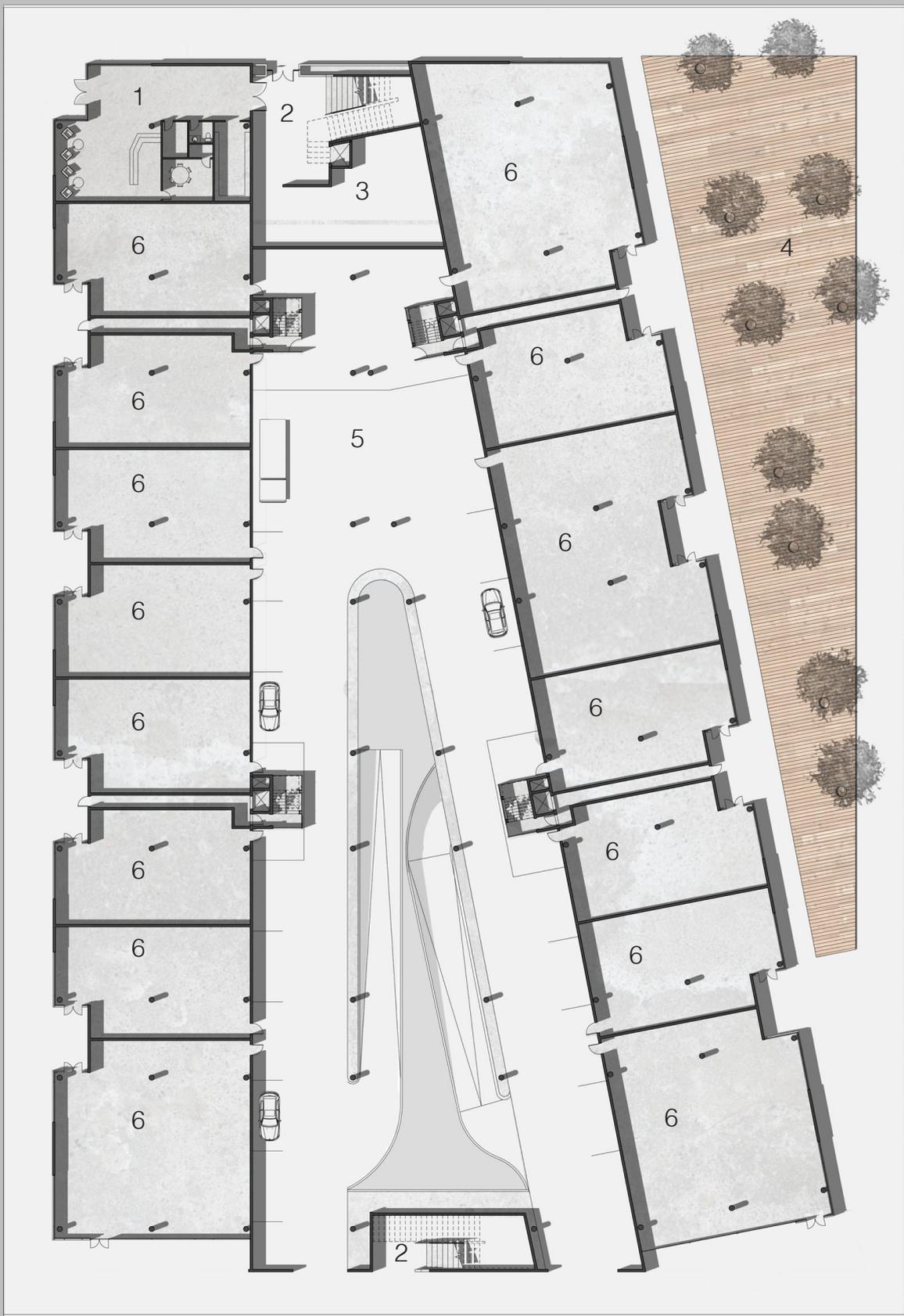


- 1 - living/dining
- 2 - kitchen
- 3 - bath
- 4 - storage/mech
- 5 - flex room
- 6 - closet
- 7 - bedroom



parking plan 





- 1 - residential lobby
- 2 - residences exterior entry
- 3 - bike storage
- 4 - retail/dining pavilion
- 5 - retail loading
- 6 - retail space

Ⓜ retail level plan

Residents arrive at the north side of the building from the metro, and move up to the plinth from street level.

Here they are presented with a view of the river, framed by two arms of units. This plinth level will be used by all residents as a large outdoor space to play, walk pets, and visit with neighbors.

Everyone arriving at the complex is immediately brought the plinth, and from there moves to one of the four circulation towers closest to their unit. In essence a large outdoor lobby is created, fostering interaction amongst neighbors.

The glass circulation towers encourage the use of stairs, rather than elevators. As residents move up the glass stairs, the DC skyline is revealed to them as they ascend. Views are available in all directions.

The one solid face of these stairwells are painted with murals that run the entire height of 6 levels. Each of these four murals provides a sense of identity to each corner of the building.



Ⓝ plinth plan



A central corridor running through the middle of the units brings each resident to their dwelling. Immediately off this path is an outdoor space for each unit, where residents can use it however they want. Each of these outdoor spaces are set down from the main corridor, suggesting that these are individual spaces, and not for public use.

Entrances to each unit are staggered as to provide some privacy when entering and leaving a unit, with the entries offset from the main corridor to provide ample room to take ones time entering their door, rather than traditional halls with numerous door opening on to one another.

⊕ typical plan for levels  
1.5, 2.5, 3.5



enlarged floor plan  
at circulation tower



typical living space rendering









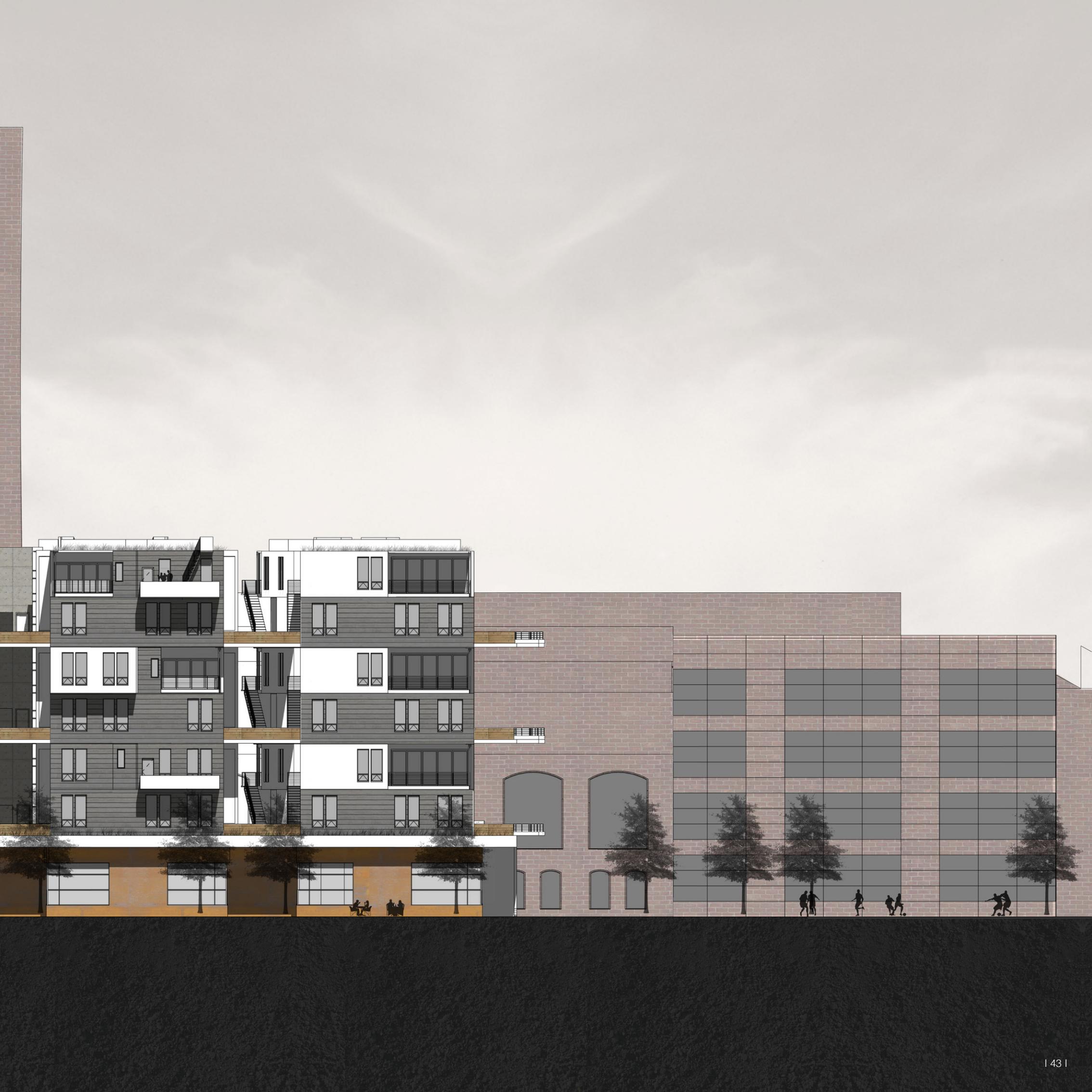


1401 north elevation





1421 east elevation





144 | transverse section a-a : through courtyards





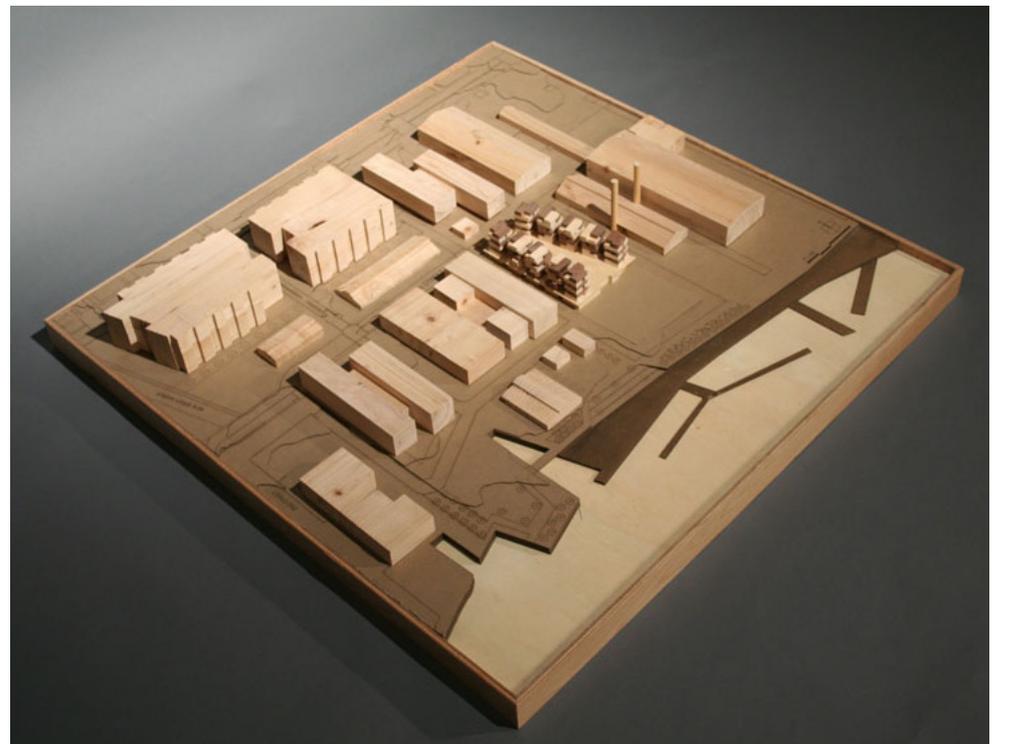
146 | transverse section b-b : through units







model images





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