

Spatial Flexibility:
Redefining Middle Class Urban Housing Communities
Through a Modular Solution for Seattle's Capitol Hill neighborhood.

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Committee
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Abstract

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Chair of the Supervisory Committee:
Associate Professor Brian McLaren
Department of Architecture

This thesis will first look at the basic case for flexible housing design, both for spatial efficiency and accommodating different family structures beyond the 20th-century nuclear definition. In addition, this thesis will explore how urban housing could benefit from accommodating different family structures and stages, by increasing social dependency and sharing resources and services. This approach would not only contribute to lowering long term housing costs, but also have tremendous effect on resident wellness. It has been linked that the cause of early onset dementia was due to lack of physical and social interaction with other people of varying ages. This thesis integrates concepts of spatial flexibility to promote healthy family communities with long term affordability to create a housing typology in Seattle's Capitol Hill neighborhood, providing additional dwelling options not currently available.



Spatial Flexibility: Redefining Middle Class Urban Housing Communities through a Modular Solution for Seattle's Capitol Hill neighborhood.

A Master of Architecture Thesis by
Raymond J. Sayers

A Special Thanks to:

Brian McLaren,
Nina Franey,
Sharon Sutton

+

My family and friends
& Aisha

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Part 1: The Problem and Investigation

“The United States has a housing crisis of disturbing complexity, a crisis that, in different ways, affects rich and poor, male and female, young and old, people of color and white Americans. We have not merely a housing shortage, but a broader set of unmet needs caused by the efforts of the entire society to fit itself into a housing pattern that reflects the dreams of the mid-nineteenth century better than the realities of the twenty-first century.” – Dolores Hayden ¹

¹ Hayden, 34

Chapter 1: Problem Statement

1.1 Introduction

1.2 Overview of the Thesis

1.1 Introduction

Seattle's current housing design strategies are at a constant risk of being obsolete, as demographics and family size trends change in a non-cyclic pattern. The vast majority of contemporary housing is built intentionally to be spatially inflexible to these changes forcing families to move to find new housing that fit their spatial needs. In doing so, people lose long term emotional connections to a place. As a result, coupled with middle class financial distress, more neighborhoods are becoming filled with people who are at the same family stage reducing age diversity in many neighborhoods (Figure 1.1). The inflexibility of housing is fueled primarily by economics, a paradigm consisting of the notion that housing is a commodity to be used for maximum of 30 years and torn down and redeveloped. ¹

¹ Schneider, 37

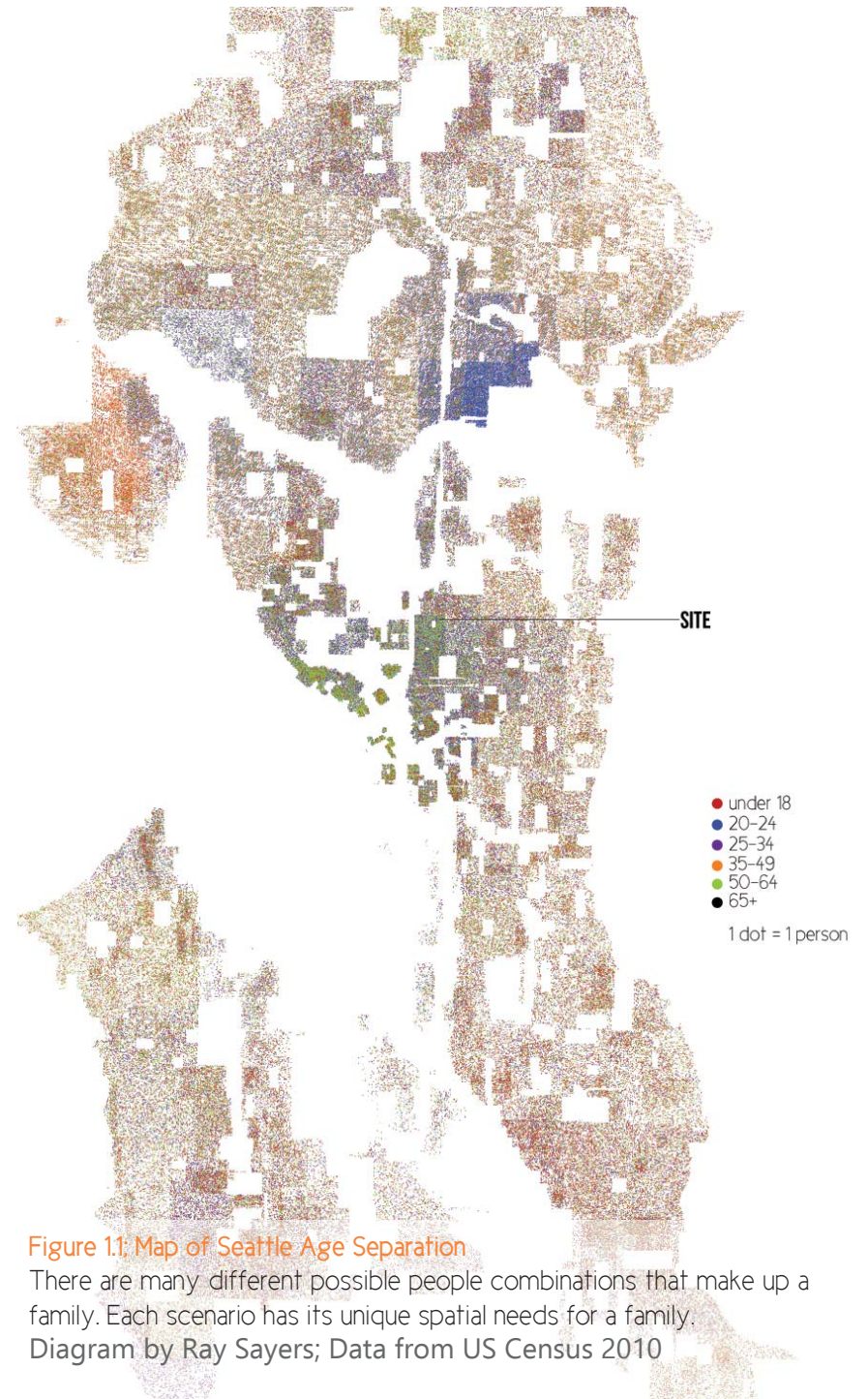


Figure 1.1: Map of Seattle Age Separation

There are many different possible people combinations that make up a family. Each scenario has its unique spatial needs for a family. Diagram by Ray Sayers; Data from US Census 2010

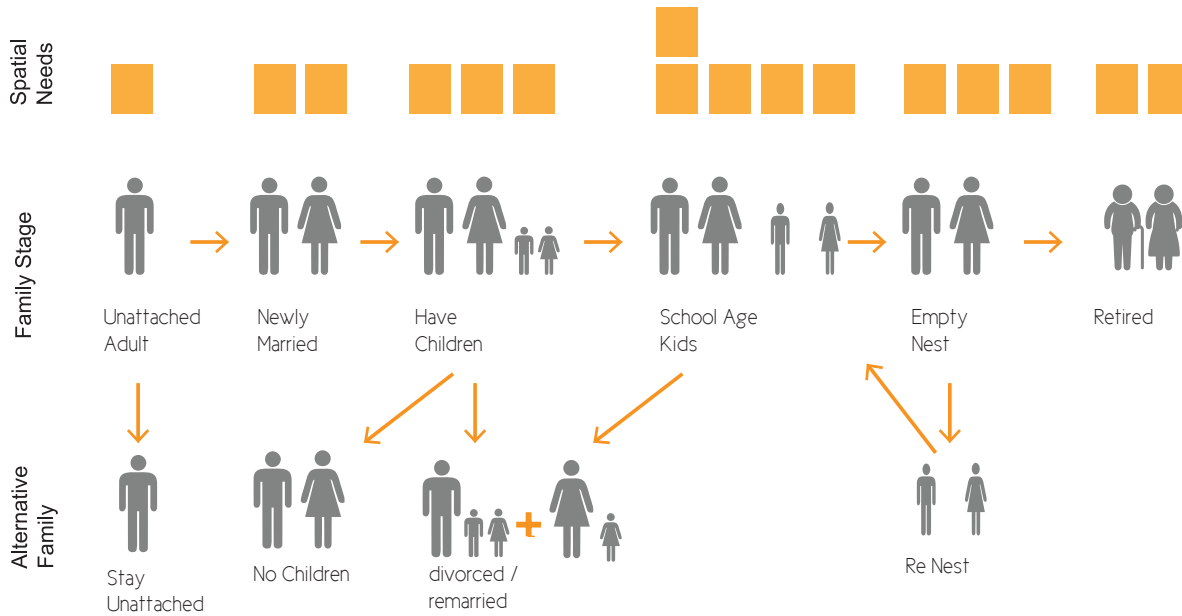


Figure 1.2; Family Life Stages & Spatial Needs

There are many different possible people combinations that make up a family. Each scenario has its unique spatial needs for a family. Diagram by Ray Sayers

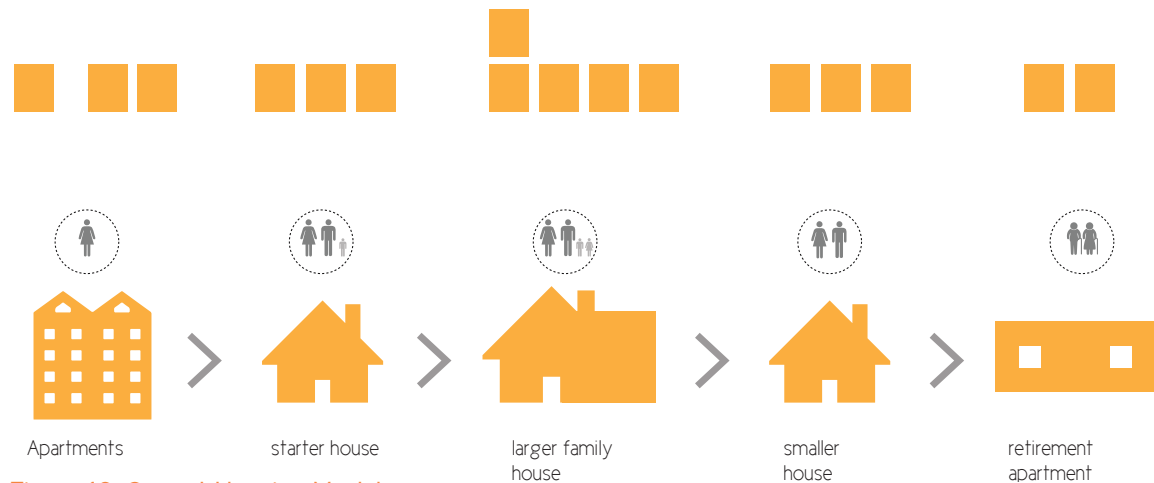


Figure 1.3; Current Housing Model

Due to the inflexible nature of current housing design, often times people move from house to house as their spatial needs change. Diagram by Ray Sayers

The housing industry tends to create specific housing design to support a specific stage or lifestyle and as a result, the typical approach to design and construction of residential spaces tends to be very fixed and static. This model of building often fails to adapt to changes in the community demographics and spatial changes, thus contributing to housing issues when the existing building stock cannot support the need of the population spatial changes (See Figure 1.2 & Figure 1.3). This leads the housing stock to become demolished and the land redeveloped into housing that supports current market and demographic trends.

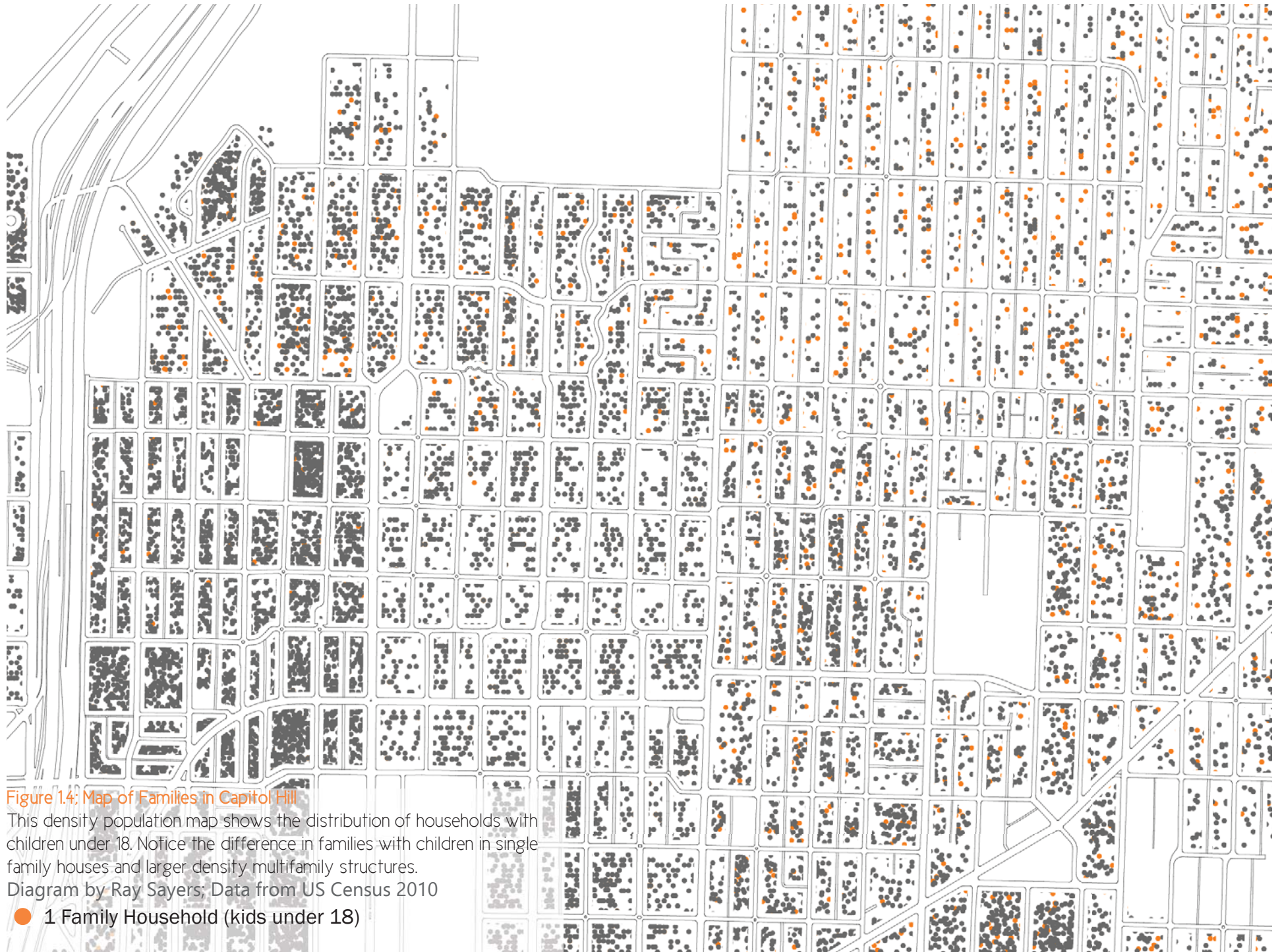


Figure 1.4: Map of Families in Capitol Hill

This density population map shows the distribution of households with children under 18. Notice the difference in families with children in single family houses and larger density multifamily structures.

Diagram by Ray Sayers; Data from US Census 2010

● 1 Family Household (kids under 18)

In most Seattle neighborhoods, family sized housing stock can be found in single detached homes, or multiunit structures of two or more bedrooms per unit. As of 2012, roughly 49 percent of Seattle’s overall housing stock was made up of detached single-family homes.² However, the detached building stock are being demolished, but often not replaced with family housing, but with smaller unit sizes that are not conducive to family living. Between 2010 and 2012 approximately 4,500 family sized housing units were demolished compared to 2,000 units built. During the same time, approximately 6,000 studios and 7,000 one bedrooms units were built.³ The market is primarily driven by the increase in single and couple population in Seattle, but does not take into consideration the future spatial requirement growth of these people. Developers and investors make more money on smaller unit sizes per land square feet, so it is incentivized by economics to build smaller units sizes to maximize profits on the property. As Seattle’s current population continues to grow, the city is in threat of losing adequate family sized housing stock.

As a result of this inflexibility of current housing, when a family’s spatial need change, that family is often forced to change homes that meet their new needs. In doing so, people lose their connection to their sense of place after constantly moving, in addition to the financial burden of moving.

² <http://www.seattle.gov/dpd/cityplanning/populationdemographics/aboutseattle/landuse/default.htm>

³ <http://www.seattle.gov/Documents/Departments/SeattlePlanningCommission/HousingSeattleReport/HousingSeattleweb.pdf>

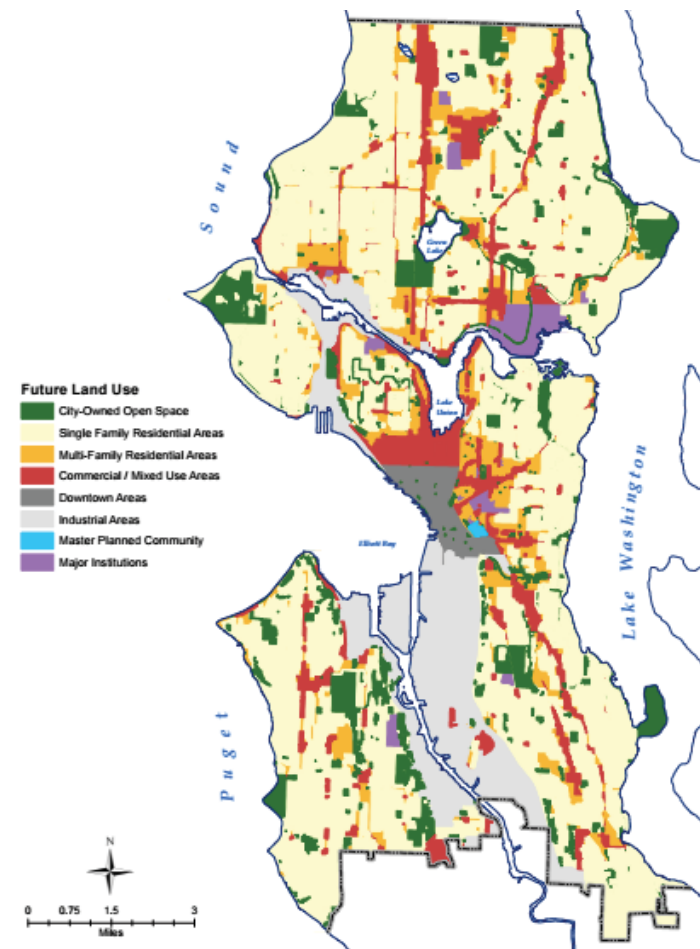


Figure 1.5; Residential Typology

Simplified map showing seattle zoning and uses. Diagram by 2011 Seattle Planning Commission Source: <http://www.seattle.gov/Documents/Departments/SeattlePlanningCommission/>

1.2: Overview of the Thesis

The thesis will discuss how both the traditional single family house and contemporary housing models fails the needs of middle class populations. This thesis redefines the typical inflexible housing typology and creates a spatially flexible housing prototype that can accommodate family's changing spatial needs without having to displace them. This thesis will first look at the basic case for flexible housing design, both for spatial efficiency and accommodating different family structures beyond the 20th-century nuclear definition. As Seattle population continues to grow, the threat of losing family sized urban housing becomes explicit. This approach aims to create a hybrid typology between detached single family housing and dense urban multifamily housing, to achieve a level of density that traditional single family housing alone can not accomplish. This thesis integrates concepts of spatial flexibility to promote healthy family communities with long term affordability to create a housing topology in Seattle's Capitol Hill neighborhood, providing additional dwelling options not currently available.

The scope of this thesis will start with Theoretical Framework where the investigation of proposed actions to redefine contemporary housing into spatially flexible housing that can both help alleviate middle income family housing costs, and explore design solutions that can create a wide range of age groups within a localized community. The next chapter will be devoted to case studies and lesson learned from other flexible design projects. Following, the discussion of the thesis that will explore and test a design strategy.

Chapter 2: Theoretical Framework

- 2.1 The 21st Century Family Structures & Spatial Needs: The Short Falls in Current Housing
- 2.2 Placemaking Strategies that Create Safe & Inclusive Communities
- 2.3 Space Efficiency & Longevity: Modular Flexible design
- 2.4 Conclusions

2.1 The 21st Century Family Structures & Spatial Needs: The Short Falls in Current Housing

2.a Section Overview

This thesis identifies two demographics, the millennial generation and baby boomers, who are the largest population moving to urban Seattle. Both demographics want to stay in the city for long periods of time and can benefit from spatial flexibility as a means of appropriate family sized housing, affordability and placemaking that can unify people of all ages and family life cycles. In addition, this section will address how these demographic needs do not fit into the current housing model.

2.b Middle Income Housing Burden & The Need for Change

Currently, young families are at a financial risk, out of reach of homeownership. The highest cost housing per square foot are now vibrant urban centers, rather than wealthy suburbs. This trend is expected to continue with urban growth of the millennial and baby boomer generations. According to the 2010 Census, over 80 percent of Americans now live in urban areas. However, with this new redefining of the American Dream comes major issues with affordability of urban middle income households. In 2013, rent in Seattle increased 10 percent from 2012, making it the steepest rent increase among all major U.S. cities.⁴ This makes it imperative for people to buy instead of rent.

With the large influx of people moving to Seattle comes a demand for more housing, which has resulted in property values and construction costs to increase. The middle class income earners in Seattle are extremely burdened with more educated working people slipping into financial distress due to minimal wage increases while housing costs rise.⁵

⁴ <http://www.seattletimes.com/business/real-estate/local-apartment-rents-up-almost-5-percent-in-3-months/>

⁵ <http://www.seattletimes.com/seattle-news/report-explores-why-rising-to-middle-class-or-staying-there-is-so-hard>

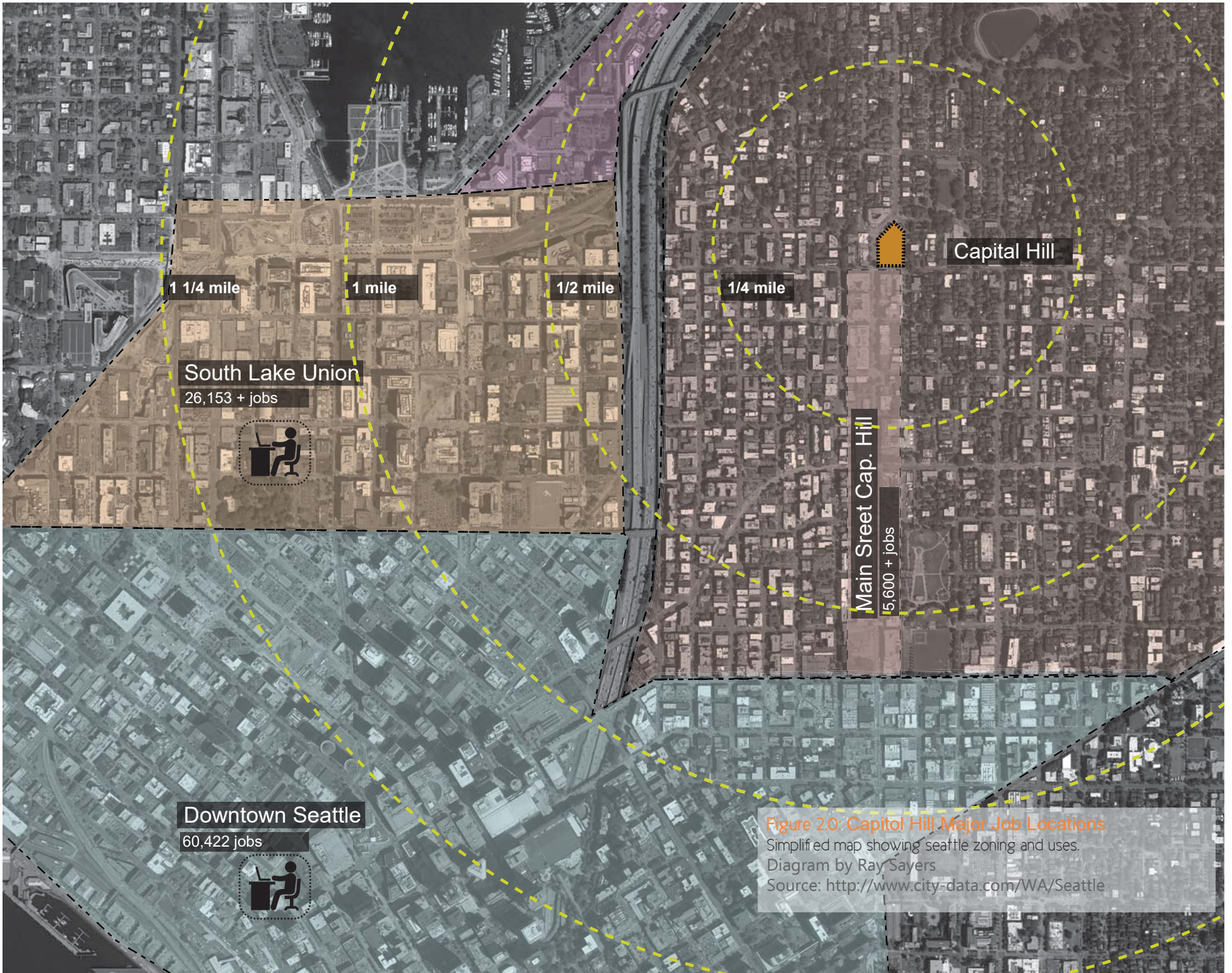


Figure 2.0: Capitol Hill Major Job Locations
Simplified map showing seattle zoning and uses.
Diagram by Ray Sayers
Source: <http://www.city-data.com/WA/Seattle>

A number of new technology industries are expanding within Seattle that are creating high paying jobs for a few, but are raising local housing costs for all. This has in part led to Seattle’s largest middle class job centers to also have the highest housing costs. The most striking example is in Seattle’s Capitol Hill neighborhood with its close proximity to middle income job centers of South Lake Union and downtown Seattle (See Figure 2.0: Capitol Hill Major Job Locations). These rising housing costs are combining with a trend toward smaller unit sizes to put the cost of living in Seattle, and more specifically Capitol Hill, out of reach for many middle income families, especially young and old families.

A recent Windermere real estate study found that middle income families only have financial access to 27 percent of the homes in Capitol Hill ⁶. As a result, many of these middle income people are faced with a choice: move further away from their jobs and social networks, or under current home prices spend much of their income on urban housing. This thesis takes the stance that middle income people should have access to quality location-efficient housing within close proximity to job opportunities and urban amenities.

Interestingly, Capitol Hill has a history of being exclusively for wealthy people. In fact, the original developer named the area “Capitol Hill” to give it the illusion of wealth and power so he could sell the property for a higher price. ⁷

2.c The Millennial Generation

Currently most of the millennial generation are individuals aged 20 to 34 that are typically finishing post-secondary education and getting established in the workforce. The millennial generation are responsible for a radical change in demographics. Between the years of 2005 and 2013 Seattle’s population in

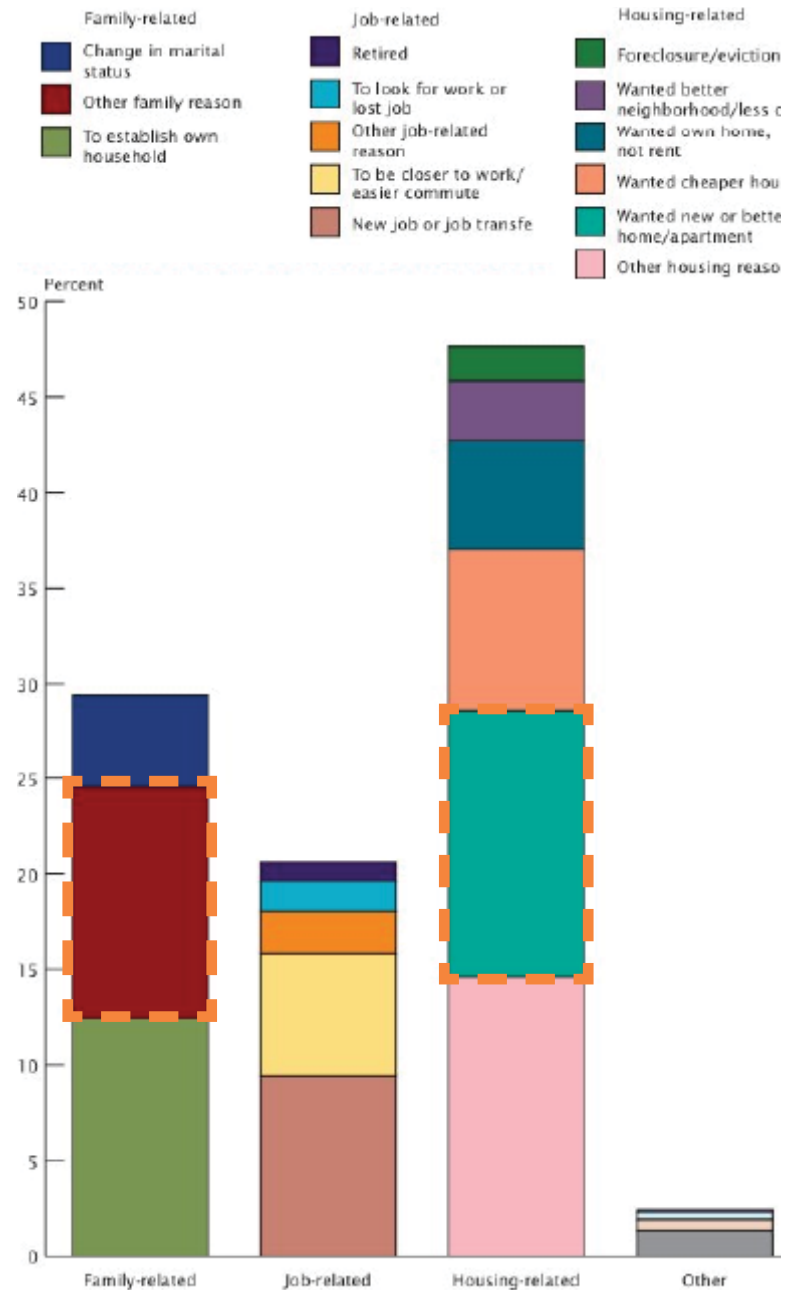


Figure 2.1: Reasons Families Move

US Census polling people across the United States on why they move.

Source: U.S Census Bureau

⁶ www.Capitolhillseattle.com/2013/10/neighborhood-housing-market-out-of-reach-for-majority-of-people-living-on-Capitol-hill

⁷ Atkins, 272

this age bracket increased by 32 percent⁸. They are typically prolonging marriage and having children at a later age, which is different from the generations before them. Only 9 percent of U.S. households fit the definition of the “traditional” family⁹. For the first time in US history, there are more women in higher education, earning 60 percent of the master’s degrees. In Seattle alone, 70 percent of women hold a post secondary degree as opposed to 50 percent of men. In a workforce where education is key, women are expected to have a dominant presence. Nationally, 81 percent of women in the childbearing years are employed. In addition, due to economic instability brought on by student debt loans and lack of affordable housing, the millennial generation is more likely to live with their parents until their late 20’s.¹⁰

The internet and social networking has largely influenced the millennial generation’s values. A value is set for instant information, sending and receiving, that allows for rapid physical and social gathering.¹¹ In addition, they value diversity and community, and generally do not perceive to anyone’s ethnic background as a negative issue. In fact, the millennial generation organize and pride themselves based on education levels and the fusion of cultural understandings.¹² Furthermore, they are also more committed to a healthy work and life balance, and are concerned with environmental issues more so than any other generation before them. All of these values help reinforce their desire to live in urban areas where they would have amenities, and social gathering within a larger community. However, many challenges face the millennial generation’s financial security. With large student loan debt, lack of confidence in social security, witnessing the housing financial collapse in 2008, and urban housing costs outpacing wage increases, this generation is reluctant

8 <http://www.seattle.gov/dPd/cityplanning/populationdemographics/aboutseattle/population/default.htm> & Us Census Bureau

9 Claster, 36-37

10 Arnett, 74

11 Claster, 36

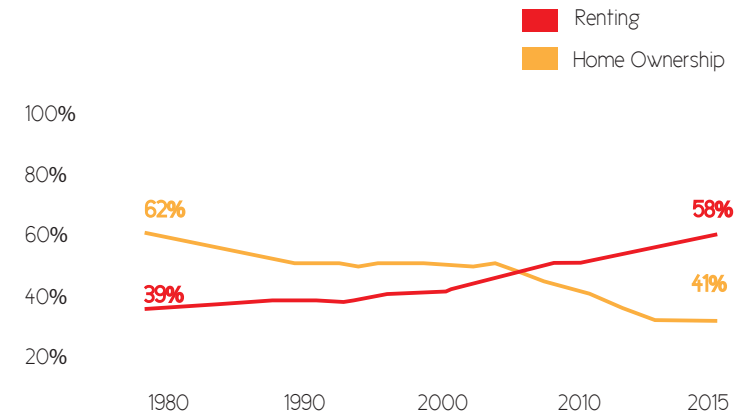
12 Arnett, 72

and largely unable to participate in homeownership. (See Figure 2.2: Owning vs Renting) For many, homeownership becomes less of a priority, while renting in an urban neighborhood becomes more desirable, which may become an issue when they start to have children. Due to affordability issues, many in this generation are either at dwelling with their parents, or more commonly, living with roommates.¹³ With this in mind, the millennial generation has more experience and willingness to live in semi-communal living situations.

2.d The Baby Boomers

Due to the great recession in 2008, and typically poor financial saving throughout their careers, the young baby boomer generation are expected to diverge from the traditional retirement cycle of their parents. They are identified as ages between 55 and 64, and have increased their population by 11 percent in Seattle since 2010.¹⁴ Many who are at traditional retirement age simply cannot afford to retire. Furthermore, with medical treatment advancement, and adopting healthier lifestyles, they will likely delay retirement or senior care communities by at least ten years to rebuild retirement funds.¹⁵

Many of the perceived benefits that they once saw living outside the city in the suburbs such as schools, green space and kids' programs, are no longer important now that their children are grown up. Much like younger generations, they want to live close to shops, and restaurants. According to a 2011 Community Preference Survey, baby boomers are choosing to live within close proximity to social activity in dense urban neighborhoods.¹⁶ This preference may be caused by years of social interaction with their children, and now that they are gone, there is a need to reconnect with people.



Home Ownership vs Renting
Figure 2.2; Rent Vs. Own
2008 marked the the shift where more people started renting vs homeownership.
Diagram by Ray Sayers
Source: <http://www.city-data.com/home-vs-renting->

¹³ Arnett, 83

¹⁴ <http://www.seattle.gov/dPd/cityplanning/populationdemographics/aboutseattle/population/default>

¹⁵ Claster, 43

¹⁶ <http://www.realtor.org/sites/default/files/smart-growth-comm-survey-results-2011.pdf>

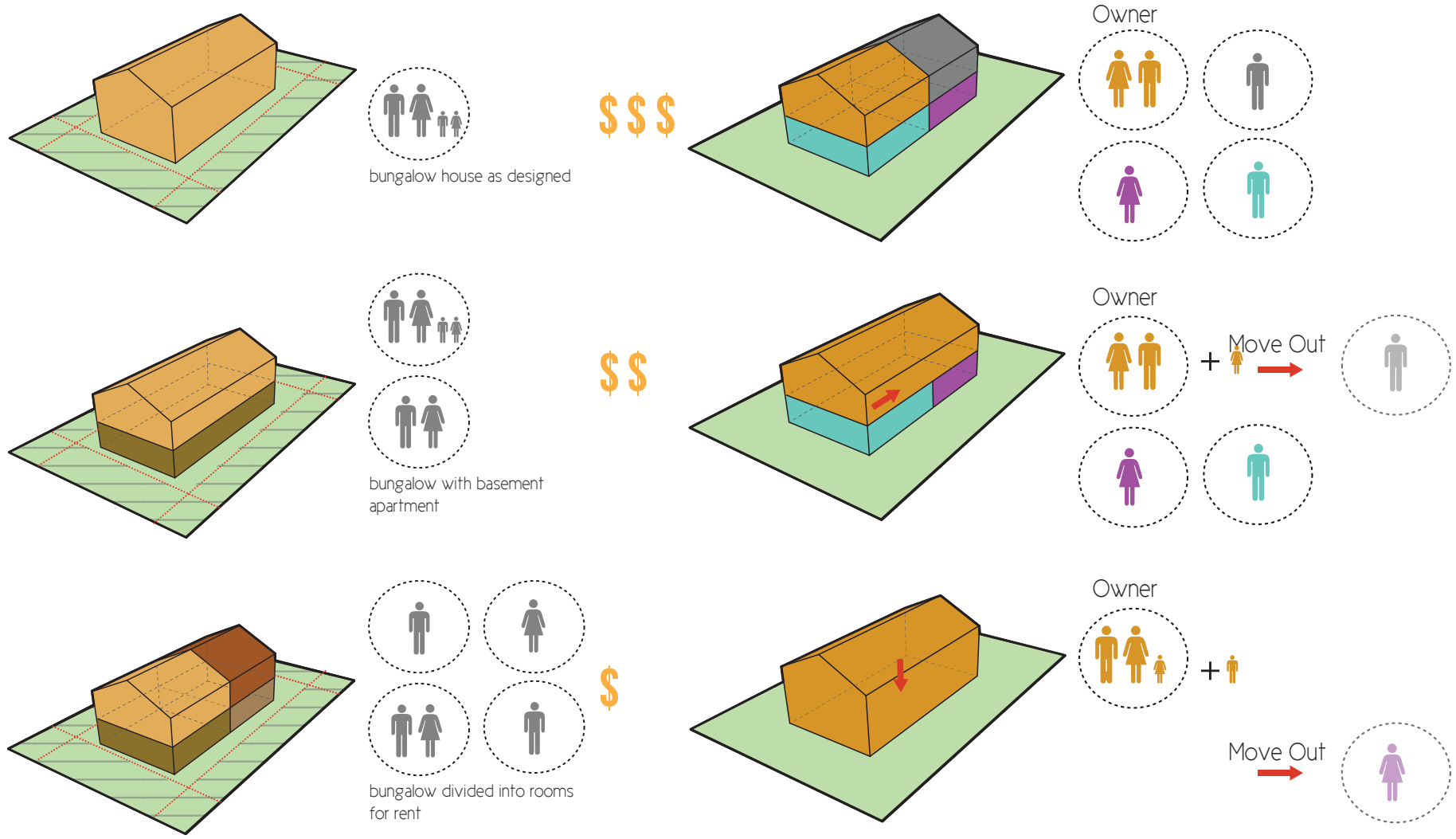


Figure 2.3; Current Flexibility issues with Urban SF housing

(Up) Dense Urban Single family housing offer some flexibility by splitting and spatially dividing the space.

(Upper Left) If a family decides to spatially expand and if they have another tenants living in their house, they must kick those people out to make room.

Diagram by Ray Sayers

2.e Current Housing model Fails the Users

Single family stock in many neighborhoods are inhabited by empty nester baby boomers that are taking otherwise useful family style house off the market. Many of these owners are dividing up their house to make an extra profit, or pay for mortgage costs. This takes away suitable family housing stock for families with children (See Figure 2.3 Current Flexibility issues with Urban SF housing). This is driving up demand for family housing thus making it more expensive for families to afford urban housing.

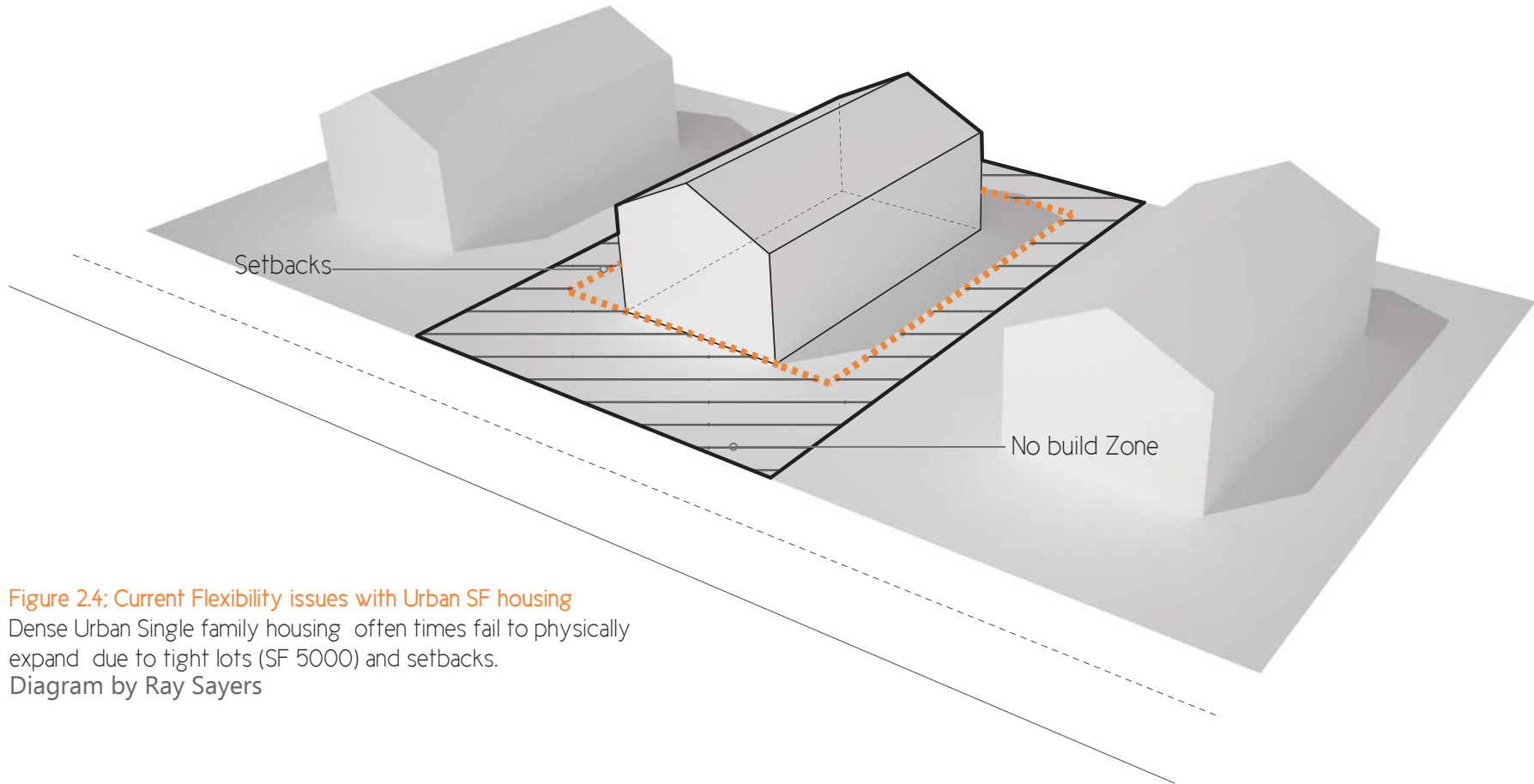


Figure 2.4; Current Flexibility issues with Urban SF housing

Dense Urban Single family housing often times fail to physically expand due to tight lots (SF 5000) and setbacks. Diagram by Ray Sayers

Due to tight lots and maximum build out from the setback in Single Family Zones, many of these detached houses are unable to expand. If a household outgrows its spatial needs often the residences must leave. The setbacks and no build zones are in place to preserve open space and character of the neighborhood. As a result these restrictions limit optimum density (See Figure 2.4 Current Flexibility issues with Urban SF housing).



Figure 2.5; Current Flexibility issues with Urban SF housing
Dense Urban Single family housing often times fail to physically expand due to tight lots (SF 5000) and setbacks.
Photographs by Ray Sayers

2.f Conclusions

These two groups make up the largest population growth in the past ten years, and are expected to continue. In addition to housing their needs, there is an opportunity to connect the demographics together to create a socially interdependent housing community that will both lower the cost of housing, and improve quality of life. With the rediscovery of urban living, people want to live and experience what the dense urban lifestyle has to offer. With traditional support systems like family, neighborhood community groups, and community churches weakening over the past few decades, many baby boomers are seeking new solutions that will strengthen and foster their sense of belonging. Working families can save money by seeking child support from older generations, while older generations can continue to contribute to younger generations

in a meaningful way. Older generations can see to improve mental health from social interactions with younger generations, while the younger generations will learn the value and importance of staying connected with people cross generationally. There are many varying combinations that make a family structure, some traditional and some not, and they rapidly change giving needs for spatial flexibility. By creating a housing environment that allows families to live in one home for a large part of their family life cycle, the housing complex is going to have a diverse number of families at different life stages (See Figure 2.6: Proposed Housing Model). This will create an age mix within the housing complex. This dynamic can result in shared public amenities that will create a strong sense of community and social dependence.

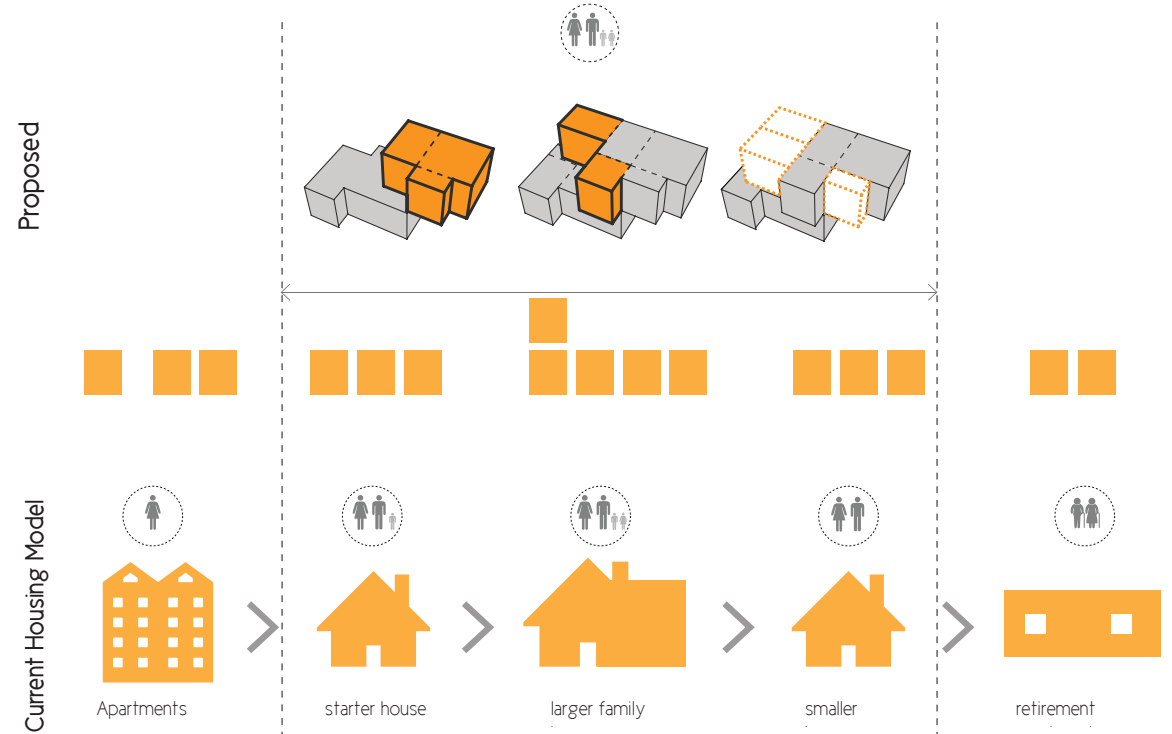


Figure 2.6; Proposed Housing Model

A flexible strategy allows for a family to stay in a place for longer when they spatial needs change .

Diagram by Ray Sayers

2.2 Density & Placemaking Strategies to Encourage Healthy Community and Resident Longevity

2.a Section Overview

An underlying goal for the thesis is to create a community that responds to concepts of what makes family-sized housing in Capitol Hill successful.

2.b Seattle Single Family House Density

Seattle averages 7,779 people per square mile which ranks 10th, while only being the twenty-second most populous city in the United States. Capitol Hill boasts the highest neighborhood outside of the downtown core at 12,323¹⁷. Current single family neighborhoods densities cannot support Seattle's population influx, due to lack of space. It can be concluded that many of these single family homes will eventually be demolished in favour of higher density, more compact inflexible housing. However, increasing density in single family zones does not necessarily translate into building large out of scale buildings such as the common "5 over 1" typology. To preserve the smaller scale character of North Capitol Hill neighborhood a hybrid approach to concepts of single family house and multifamily housing must be created (See Figure 2.7: Hybrid Typology).

Single Family House

Historically the single family house has been the choice for families. The typology allows for greater privacy and open space. The notion of ownership and sense of total privacy in an urban setting attracts many families. Back yards and front yards acts as buffers from the front street, while providing open spaces for activities and children's play. Side yards further the notion of privacy and open space, while creating a sense of rhythm from the separation from neighboring structures. However, the sense of privacy also leads to social isolation. With occupancy limits, unit limitations, and setback and FAR limits, proves to be constraining for modern day family needs. As a result these restrictions limit density potential.¹⁸

17 <http://www.city-data.com/neighborhood/Capitol-Hill-Seattle-WA.html>

18 <http://oldurbanist.blogspot.com/2015/12/single-family-zoning-in-seattle-and.html>

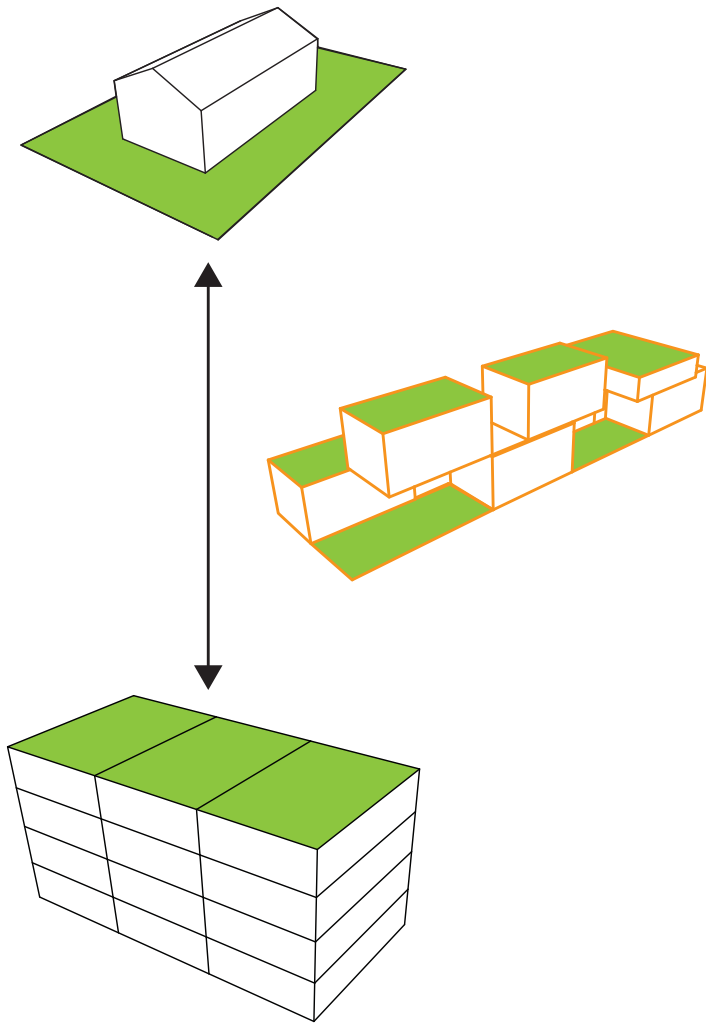


Figure 2.7: Hybrid Typology

This typology promotes open and private space, but allows for higher urban densities than the single family house. Similar to a townhouse approach.

Diagram by Ray Sayers

2.c Spatial Flexibility Cultivates Improved Wellness

Nationally, the National Health Organization estimates that over 14 percent of people over the age of 71 suffer from some form of dementia ¹⁹. This number increased by 6 percent since 1950. Although there are many factors that contribute to dementia, a recent study suggested the leading cause of early onset dementia was due to lack of physical and social interaction with other people. The same study suggested that close interaction with children and people of a younger age has dramatic decrease of cases of dementia, and can in fact prolong healthy brain function. Furthermore, research suggests that the majority of older adults want to “age in place,” remaining in their own home as long as possible before death. Often times people develop “place attachment,” to a specific location. People who remain living in an emotionally connected location for a long time have a suggested delayed risk of dementia as opposed to people who are physically forced to move into a new community. In the book *Healing Spaces* by Wilbert Gesler, he investigates how different aspects of environments affect physical, mental, spiritual, social, and emotional areas of healing. Gesler suggests a direct link with human perception of “place” and its effects on health. The research also suggests that not only does human interaction improve wellness, but also a direct connection to nature.²⁰ Figure 2.8 depicts the proposed model of mixed age community with public space for activity and connection to green space.

2.d Shared Realm: Community

Technological device advancements can be in part to blame for disconnecting and distracting people from their sense of place to a virtual world which has affected the integrity of the family cores sense of social interaction. New housing design is charged with reinstalling magnetized cores of social life into not only the family, but also into intermediate surroundings. An open courtyard provides a critical space to family living that should feature safe and visible places for children to play, while allowing people of all age groups to interact. In addition, the public space should

¹⁹ <http://www.nih.gov/news/pr/oct2007/nia-30.htm>

²⁰ Gesler, 56

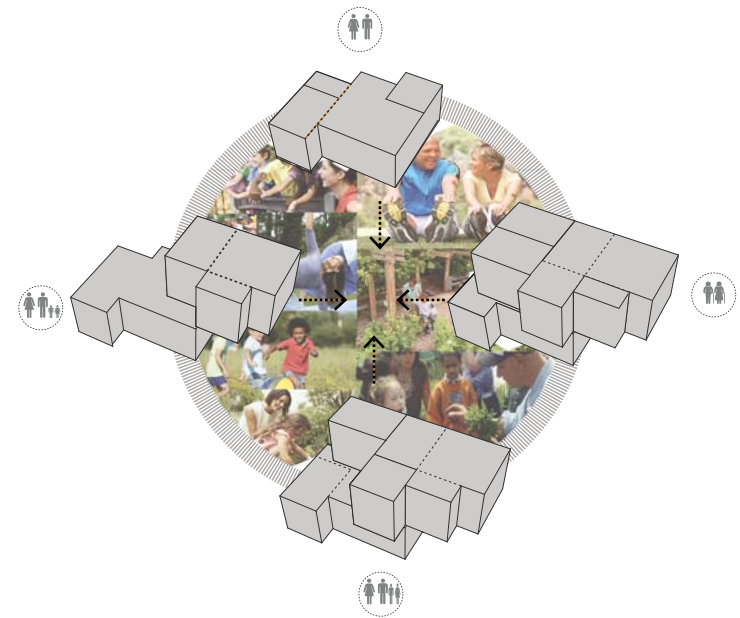


Figure 2.8; Public to Private

Threshold from private to public with vegetation screen
Diagram by Ray Sayers

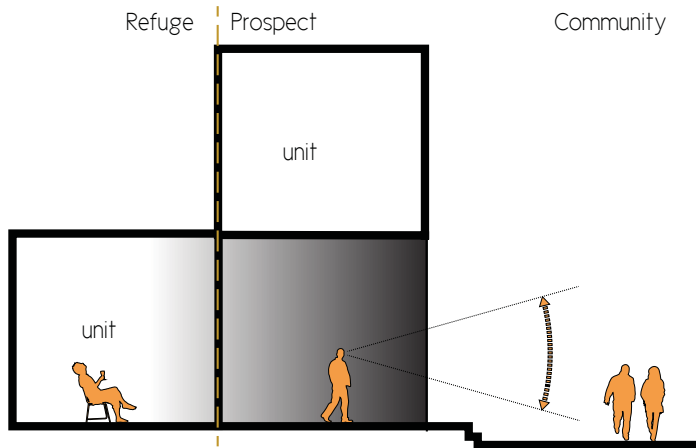


Figure 2.9; Prospect and Refuge Diagram

A flexible strategy allows for a family to stay in a place for longer when they spatial needs change .

Diagram by Ray Sayers

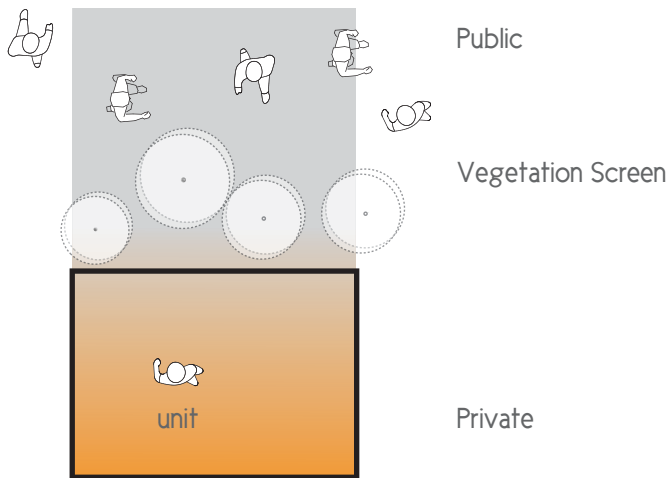


Figure 2.10; Public to Private

Threshold from private to public with vegetation screen

Diagram by Ray Sayers

work as a social mixing place. Activities such as playing, gardening, and informal gathering are essential for creating community connections. ²¹

Prospect and refuge describes the concept in which a person can watch and observe others without being seen. This is an essential concept of feeling security and privacy while still being part of the overall community. This is also critical for community members to watch children play and ensure safety in those spaces. Sight lines from units and circulation places play a key role in achieving this concept.²² (See Figure 2.9: Prospect and Refuge Diagram)

Private Realm

The private realm refers to living spaces and their respective thresholds. People’s definition of privacy often varies with cultural and environment experiences. Often private spaces are a “refuge” for people who want to reflect inside their home without being social with outside people. More private spaces such as bathrooms and bedrooms should be zoned to quiet areas in which outsiders cannot look in. People often refer to the bedroom or kitchen as a place of creativity and relaxation. The kitchen can act as catalyzing place of intermediate family social gathering, while for others it is simply a place to cook and the living room plays the role of family interaction. ²³ (See Figure 2.10: Private to Public)

In between Spaces

These spaces are seen as semi-private space much like what a front or backyard is to a single family house. The space provides additional places for children to play, green space to the associated dwelling and places for people to enjoy the outdoors. These spaces are seen as buffer spaces between private dwelling and the public.

21 Housing the family, 164-165.

22 Hertzberger, 202

23 Housing the family,12

2.2 Spatial Flexibility as a Means to an End

2.a Section Overview

Spatial flexibility, as an architectural theme, was among the inspirations for the ‘open building’ concept, where framework is created and a series of infill prefabricated modules can change depending on the needs of the occupants. Flexibility is the ability to achieve a change of conditions without changing the structural system, whereas variability is the ability to gain a change of conditions by changing the system. Flexibility has many definitions in architecture, in part because of the wide range of flexible options that allow for the concept of adaptability in response to a particular change or need. Whether that change be in family occupancy or room use, the ability to change provides flexibility for families to find housing solutions that meet their needs when their needs change. This thesis will focus on the idea that flexible housing can provide a response to change and demand depending on user spatial circumstances that will allow people to stay longer in their homes.

2.b Concepts of Flexibility

Soft Design Approach

In the book, *Flexible Housing*, the authors describe two different approaches that architects apply to housing, “soft and hard”. The soft approach allows for indeterminacy of spaces, in which the users are allowed to change the space to suit their needs, while the building architecture works in the background. This strategy embraces future change. The hard approach, in which many Seattle homes are designed, is where architect controls the design, creates spaces that may have predetermined uses and lack flexible options.²⁴

²⁴ Schneider, 131.

This thesis implements concepts of a “soft” flexible approach. Looking at this approach, a housing design not only allows for customization of space, but also can reduce spatial requirements needed in each unit.

Flexibility works in scales, from consideration of the furniture layout and design all the way up to the building. In all of these scales, the building would retain its original structural framework, while accommodating different uses from within.

Room Flexibility

Sliding and folding elements allow for partitioning a room for temporary change in room function, but has limitations of acoustic separation. Furthermore, folding walls allow for opportunity to change the character of a space and its relationship to other spaces. An area could be used multiple times for different functions. The idea was championed by the traditional Japanese dwelling with an open cubic structure that was subdivided into smaller spaces by means of sliding walls in a ratio of tatami mats (See Figure 2.11:Traditional Japanese Dwelling).

A more semi-permanent method of partitioning off rooms lies with the the divisible room strategy. By allowing 2 entrances into a 2:1 portion room, the room can be divided to allow for two different room uses. At a later date the room paration could be removed to make the room larger once no longer needed ²⁵.

Unit Flexibility

Unit flexibility will be the principal strategy in creating spatial flexibility in this thesis, by allowing the unit to grow and shrink depending on the family occupancy spatial needs. The strategy of “dividing up” or “unit expansion and contraction”, allows for such flexibility. In order to divide the unit, the units must be designed in zones, so it makes it easier for the division of the unit to expand and contract without occupancy disruption. ²⁶ With this strategy, circulation must carefully be thought through so that entrances can be into the divided zones.

²⁵ Schneider, 126

²⁶ Schneider, 188-189



Figure 2.11: Tradition Japanese Dwelling

As spatial needs change, people can stay in their home and the home will “grow” around them

Photograph by Ray Sayers



Figure 2.11: Typical Prefabricated Architecture Aesthetic

Image Source: Archdaily.com

With the concept of “unit expansion and contraction” the unit would physically grow within a preset structural framework, much like the concept of adding an addition to a single family house. Conversely, the added spaces would also be able to contract if the spatial requirements shrink. In short, the structure and exterior shell would be fixed and the structure would be designed to accommodate changeable infill systems based on the user’s needs and desire.

Aesthetic Flexibility

In creating a framework with series of infill modules controlled by the occupant, the facades have the capacity of altering form, creating a unique and progressing identity of the building throughout time. This approach differs from many other prefabricated architecture

projects from the rigidity in form and character. This lack of identity of with the repetitive architectural language was first raised as a protest against standardization and mass production in the 1960s.²⁷ (See Figure 2.11: Typical Prefabricated Architecture Aesthetic). Furthermore a dynamic and changeable facade allows for opportunity to characterize the building and provide an icon for the neighborhood.

²⁷ Sinclair, 36.

2.c Conclusions

The concept of flexibility would not only suit the ideal of the housing adapting to the family rather than the family adapting to the house, but it would also allow families with small spatial needs to buy into small, inexpensive homes and spatially grow when family spatial needs change (See Figure 2.12: Modular Growth). Furthermore, this strategy can also be used to implement higher density standards in single family or low rise zones in the city without compromising the fine grain aesthetic. This thesis specifically investigates flexible housing as an urban evolution of the single family home. A hybrid between detached single family housing and multi unit structures.

2.2 Summary of the Theoretical Framework

This thesis provides a solution to lack of middle class family-sized housing in Capitol Hill neighborhood. The thesis proposes a project that is an evolution of current single family house model in which allows households to expand and contract their spatial needs through a modular flexible system of spaces.

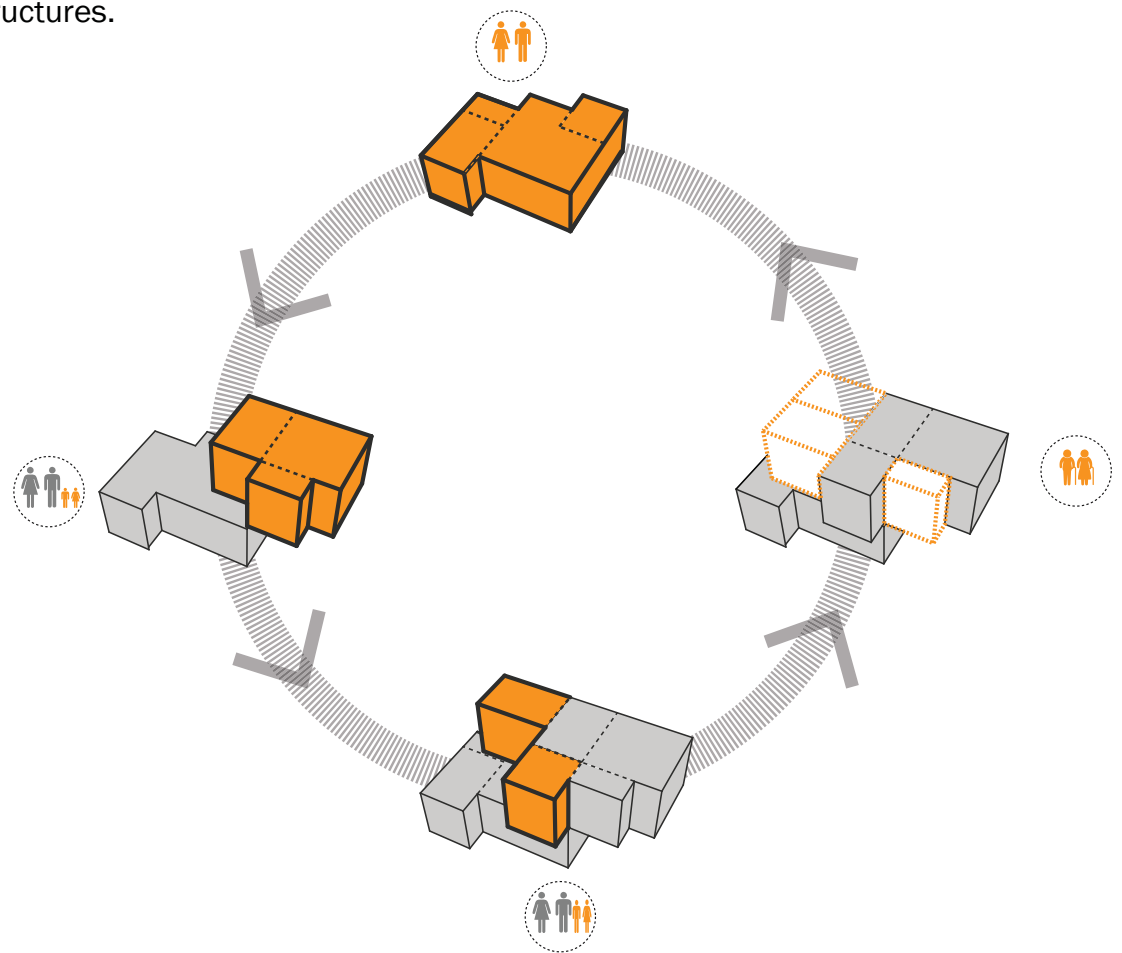


Figure 2.12; Modular Growth

A flexible strategy allows for a family to stay in a place for longer when they spatial needs change .

Diagram by Ray Sayers

Chapter 3: Precedent Analysis & Lessons Learned

3.1 Monterrey Housing

3.2 Dom-ino House

3.3 IbbN Flat-Packed Prefab Houses

3.1 Spatial Flexibility: Monterrey Housing, Architect ELEMENTAL

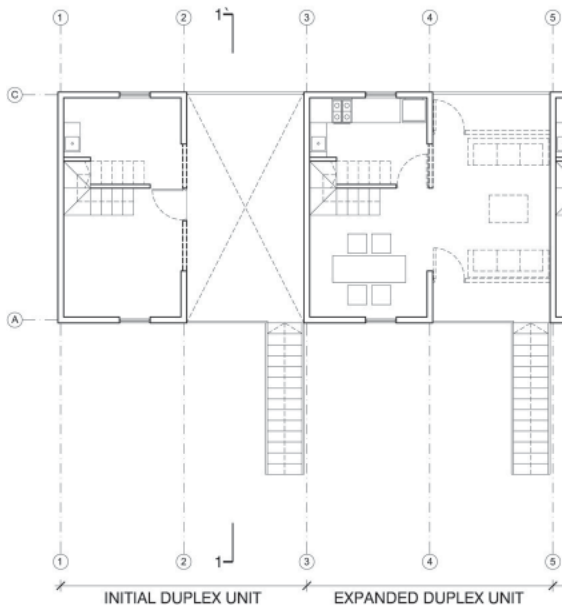


Figure 3.0; Monterrey Housing: Floor Plan

A flexible strategy allows for a family to stay in a place for longer when their spatial needs change.

Image Source: Archdaily.com



Figure 3.1; Monterrey Housing Expanded

Image Source: Archdaily.com

This project in northern Mexico takes advantage of creating a porous “in between” space inside the framework of the building that allows for the homeowners to spatially expand their home double the square footage of the “first unit” over time. (See Figure 3.0: Monterrey Housing: Floor Plan) The building frame allows for a predictable rhythm and control between units and in between spaces, but the spontaneous and unregulated aesthetic growth adds level on urban complexity and variation. A continuous roof bridges between the built solid unit and the void expansion zones from the weather, while creating a definitive profile of the building looking toward the public space²⁸ (See Figure 3.1: Monterrey Housing Expanded).

Key Lessons

Families are able to buy a home for relatively little expense, and while their spatial needs change, they can physically expand their home without having to move. The “in between” spaces prove to be a critical space for the success of the project. When not built out, the space acts as semi-private deck space looking towards the public space. Creating a solid buffer from each unit minimizes the risk of noise infiltration while construction on the expandable unit occurs. The technically challenging elements of the house such as bathrooms, kitchen, stairs, and dividing walls are already in built and ready to accept the eventual expanded scenario. The expanded scenario would most likely be an expansion of bedrooms or spaces that do not require water.

²⁸ <http://www.archdaily.com/52202/monterrey-housing-elemental>

3.2 Dom-ino House, Architect Le Corbusier

Le Corbusier's Dom-ino house paved the way for the open plan concept. The idea was to have load-bearing walls that had conventionally determined the spatial distribution on each level to be replaced with a column system. The once space defining load bearing walls become a frame that would allow for an open flexible plan so "Floors are no longer stacked on top of one another by compartmentalization."²⁹ As a result, the designer could divide the space by arranging the walls and rooms in function of the needs of the residents. Le Corbusier once wrote, "Each floor is constructed to suit its inhabitant, with open floor space, an open facade and five columns running from one facade to another."³⁰ (See Figure 3.2: Structure of the Dom-ino House).

Key Lessons

The Dom-ino house is a concept of a regular structure system that allowed for flexible use of a modular infill that would allow for varying uses of the same structure. However, the spatial uses were designed and built, therefore did not have designed provisions for modular expansion over time.

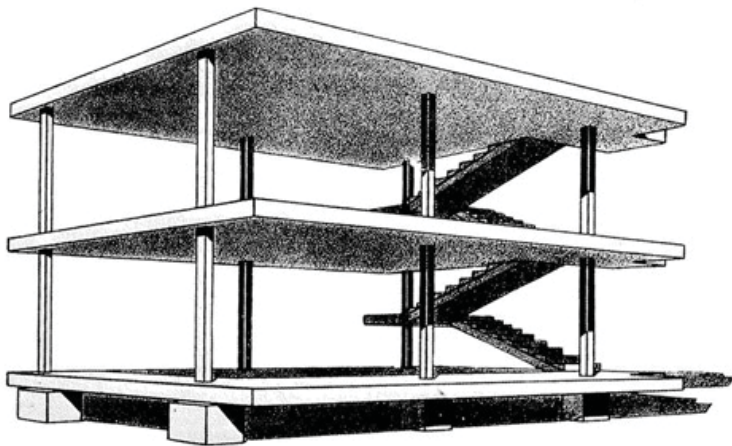


Figure 3.2: Dom-ino House

Le Corbusier concept for a flexible plan structure.

Image Source: Jeanneret, 17

²⁹ Jeanneret, 17

³⁰ Jeanneret, 88

Part 2: Design Response



Chapter 4: Site Analysis + Design Methodologies

4.1 Design Investigation Goals

4.2 Site Selection Criteria

4.3 Site Location, Context + Analysis

4.4 The Users

4.5 Program of Spaces

4.1 Design Investigation Goals

The general goal of this design investigation is to study how an architecture strategy can react to issues with current housing topologies to creating a vibrant and diverse community using the concept of spatial flexibility. As a result of the aforementioned research, the design project also has the following goals:

1. Create an infrastructure that allows for occupants to inexpensively add and subtract a prefabricated modules depending on their spatial needs, and in doing so;
2. Create a community that is age and family stage diverse;
3. Create public spaces for residents to share, building an internal community between age groups;
4. Recognize the need for small-scale social but intimate settings known as “in-between spaces that are similar to the single family “backyards”;
5. To promote increased density, small living space and dependence on natural day lighting encouraging a more sustainable lifestyle design.

4.2 Site Selection Criteria

To address the issue of housing affordability in desirable neighborhoods, the site must be with close proximity to schools, parks, retail, access to middle income jobs, and have access to a variety of transportation options. In addition, the site must be contingent on a few other categories: it must be underutilized, there must not be existing family sized housing on the site, it must be large enough for 30 units of flexible housing for all stages of the family cycle, it must be in a gentrified neighborhood where middle income families struggle to find housing, and have space for common shared indoor and outdoor spaces. Furthermore, the site must be within close proximity to detached single family homes that are at risk of being replaced with larger scale non family sized housing.



Figure 4.1: Surrounding Context

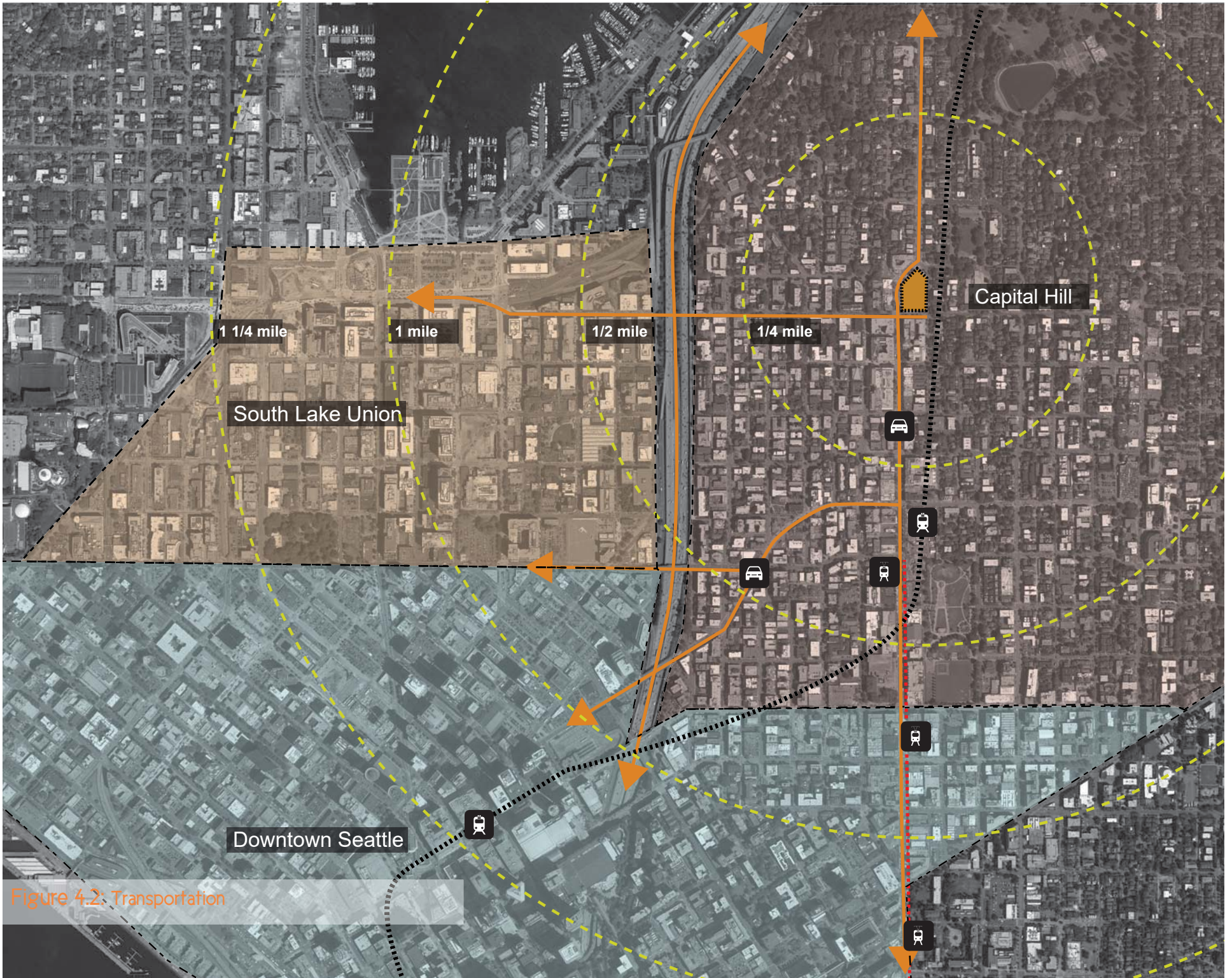


Figure 4.2: Transportation



4.3 Site Location, Context + Analysis

The site will be located in the Capitol Hill neighborhood, which has a historical precedent of expensive housing, bordered by East Roy Street and East Mercer Street. The neighborhood has been ranked as the second most expensive zip code in Seattle, because of its population increase demand and location-efficient desirability. The combined three parcel site is currently a surface parking lot and gas station. On the west edge sits a series of one story retail stores (See Figure 4.3: Current Site). Traveling southbound where Roy Street curves before turning into Broadway, the site provides a defining moment before entering the dense shops and restaurants that is characteristic of commercial Capitol Hill neighborhood. Building on this opportunity, the northern tip of the site has a potential to be a beacon for this housing type.

Figure 4.3: Site



Figure 4.4: Site Context

Capitol Hill is directly adjacent to South Lake Union on the East, and North of Downtown Seattle where most middle income jobs are found. Between them are 86,575 jobs within mile from project location (See Figure 2.0: Site, Transportation + Job Location).³²

The design project respects the existing street edge retail structures on the site, as these stores are home to popular bars and restaurants in the neighborhood. The existing buildings also create a buffer from Roy Street high traffic noise (See Figure 4.4: Site Context).

32 www.point2homes.com/us/neighborhoods/seattle/wa



Analyzing the figure ground and zoning map of the neighborhood, the site is in between urban fabric scales (See Figure 4.5: Site Figure Ground). The East edge of the site transitions in small scale single family neighborhood and the south west transitions into larger scale mixed used housing.

The design project will respond to the fine grain of the single family dwellings, while maintaining a higher level of density on the site. The maximum zoning height on the site 35 feet.

Figure 4.5: Figure Ground



Figure 4.6: Site

4.4 The Users

The defining characteristic of the building would be middle income families of all family stages and types that want to live in an urban neighborhood and have a desire to live in a community focused mixed family life stage living situation. By design, the residences would have access to an affordable homeownership model. The users potentially would want to stay in their home for long periods of time, through many family life cycles, and are willing to expand and contract their homes spatially when needed.

4.5 Program of Spaces

The program will address affordability by minimizing private spatial requirements for each unit through a flexible design strategy. The program will accommodate all six family stages, from singles and couples to retirement as presented in the preceding research.

The program is divided into three zones: the private flexible units, semi-public child play zones, which include open and closed spaces for children to play, and public zone, which will promote a diverse community. The “heart” of the project revolves around an exterior “Interaction Space” that promotes children’s play activities , gardening, and physical exercise. The space is reminiscent in concept of a “backyard” in a single family house.

Private Zone: Flexible Housing Units

The community will house between approximately 24 to 40 people depending on family size. The occupancy varies on the family stage of each of the families. By design, the spatial flexibility allows for families with varying stages to live within the community. Therefore the building will need program elements that can

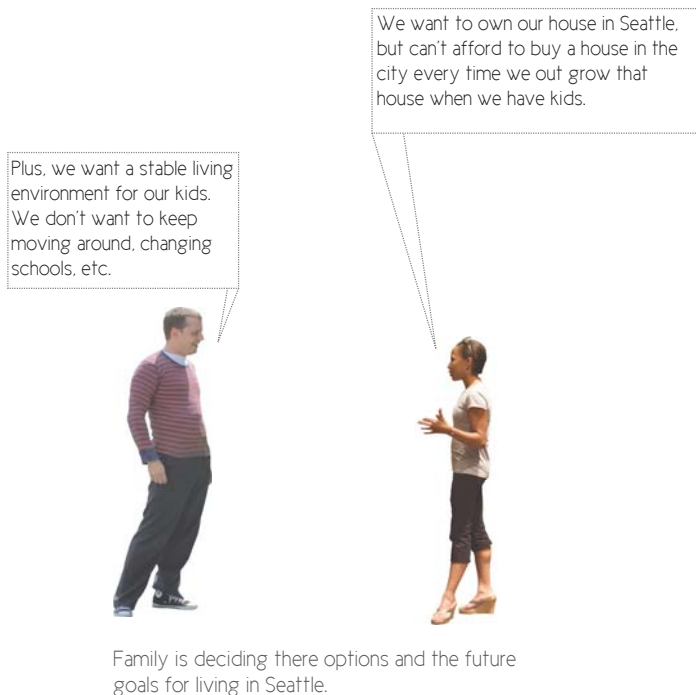


Figure 4.7: The Users







accommodate these varying family types and stages in the form of prefabricated modules that occupants can build into the porous “in between” spaces themselves. The individual modules are designed to be space efficient using “soft” flexible strategies.

4.a Semi-public Zone: The In between Space

In the porous spaces within the framework are the inbetween spaces between unit modules. This can allow for prefabricated green spaces and act as semi-private modules for either kids to play or for adult social interaction.

4.b Public Zone: Shared Community

Larger outdoor space for children and adults to interact. The goal for this space is to have a feeling of safety. All unit circulation and orientation will face toward the public space.

Module Program Space	Size (In Sq Ft)
 “Hub” Living Units	375, 425, 144, 48
 Kitchen	96, 128
 Bedroom	144, 192
 Recreation	144, 192
 Bathrooms	64, 48
 Landscape	64, 48

Exterior Shared Space	Size (In Sq Ft)
Public Courtyard P-patch Exterior Circulation Play Area	2,000

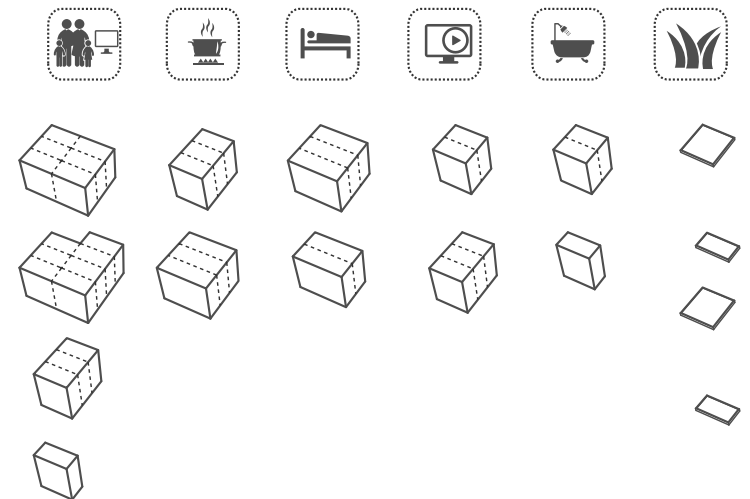


Figure 4.8: Program of Modules Spaces

Chapter 5: The Design & Findings

- 5.1 The Building Community Layout
- 5.2 Community Space
- 5.3 Infrastructure Framework and Infill Modules
- 5.4 Ownership
- 5.5 Aesthetic
- 5.6 Prospect and Refuge
- 5.7 Aesthetic

5.1 The Building Community Layout

The goal of the thesis was to create family-sized housing that resembled an evolution of the traditional concepts single family housing. By offsetting the 17 households, a fixed porous space is created. The porous spaces allow for each unit has maximum potential for sunlight and privacy. Furthermore, the porous spaces

create buffer zones in between units that can act as semi public space. (See Figure 5.0: Household Form).

Furthermore, the Porous space acts as gesture to intermediate single family house context. The feeling of openness and connectively makes the project more inclusive and integrated into the Community (See Figure 5.1).

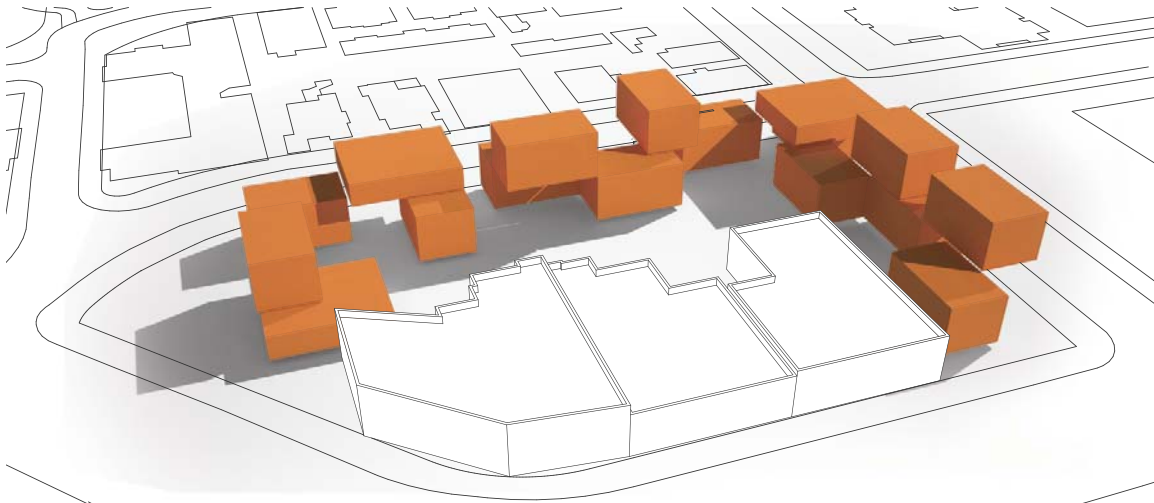


Figure 5.0: Household View

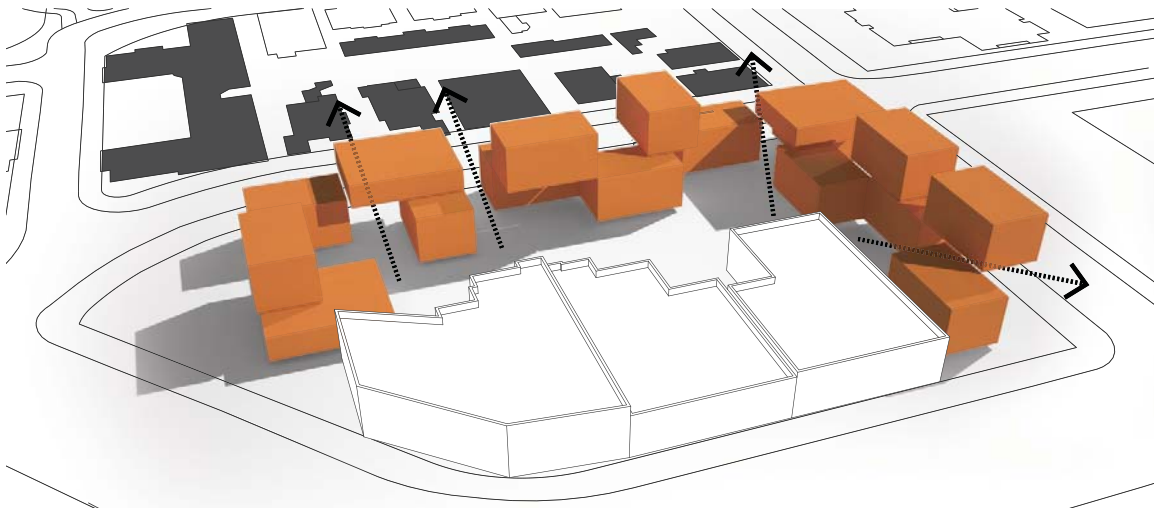


Figure 5.1: Community Connection

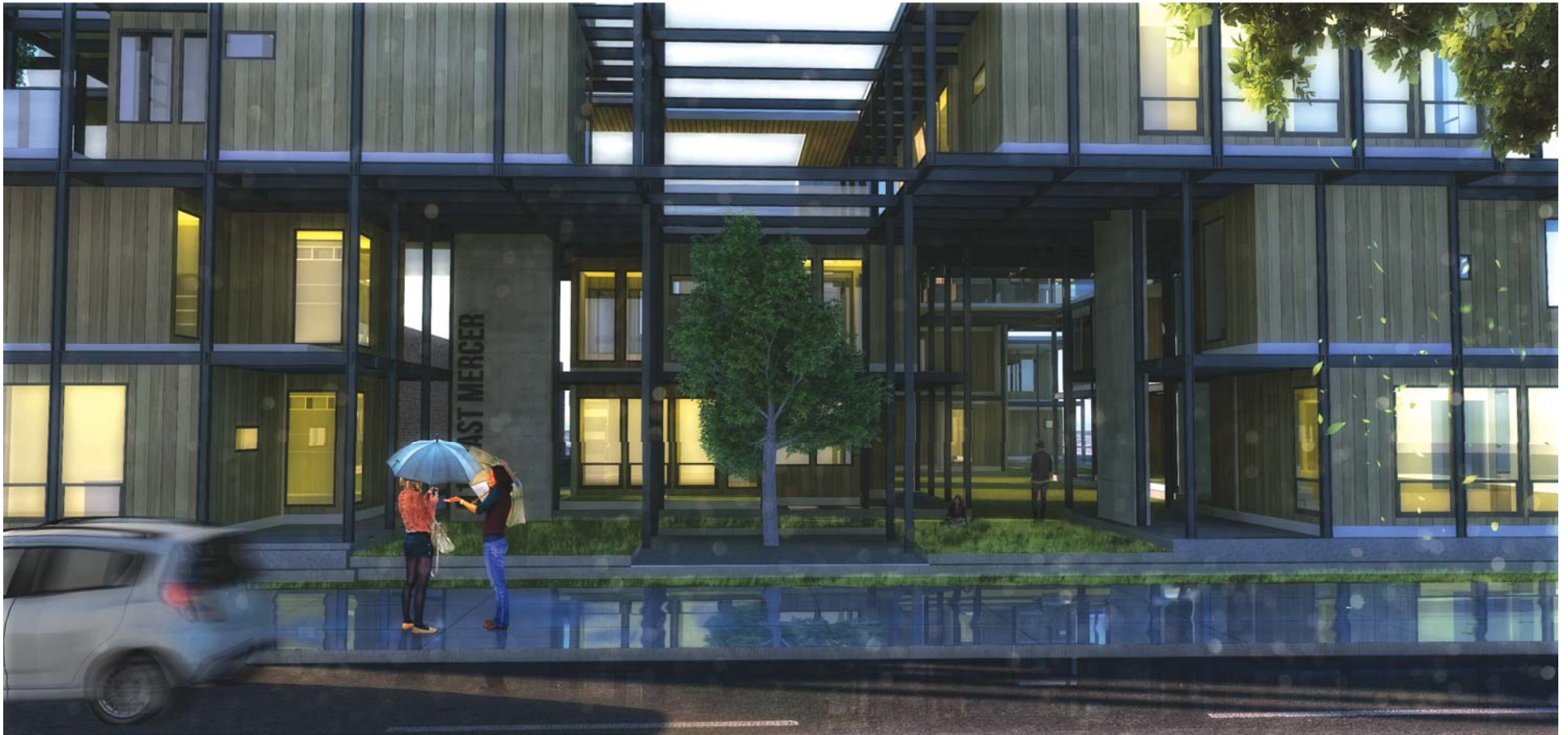


Figure 5.2: Porous Space Rendering

Rendering showing the semi-public space on E. Mercer Street. The space allows for previews into the main courtyard space.

5.2 Community Space

Community public spaces are programmed in the negative space between units (See figure 5.3). The center contains a large public courtyard that will allow for activities for both adults and Children. Looking at the site plan (See Figure 5.5) the design calls for several zones in the courtyard. The vegetable garden can become a teaching tool, and allows for mixing between older generations and children. Open green space allows for children to play. Last zone, is the rainwater retention gardens. These zones allow for discovery and teaching in sustainable systems.

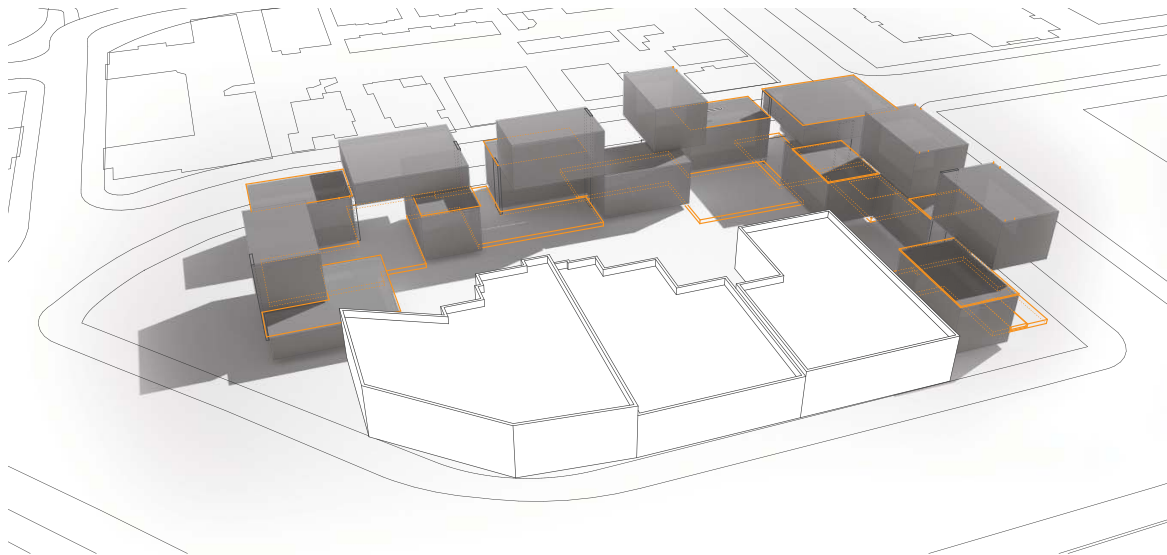


Figure 5.3 Community Areas



Figure 5.4: Rendering Community Courtyard
Rendering showing the active play space
and the teaching gardens.



Figure 5.5: Site Plan

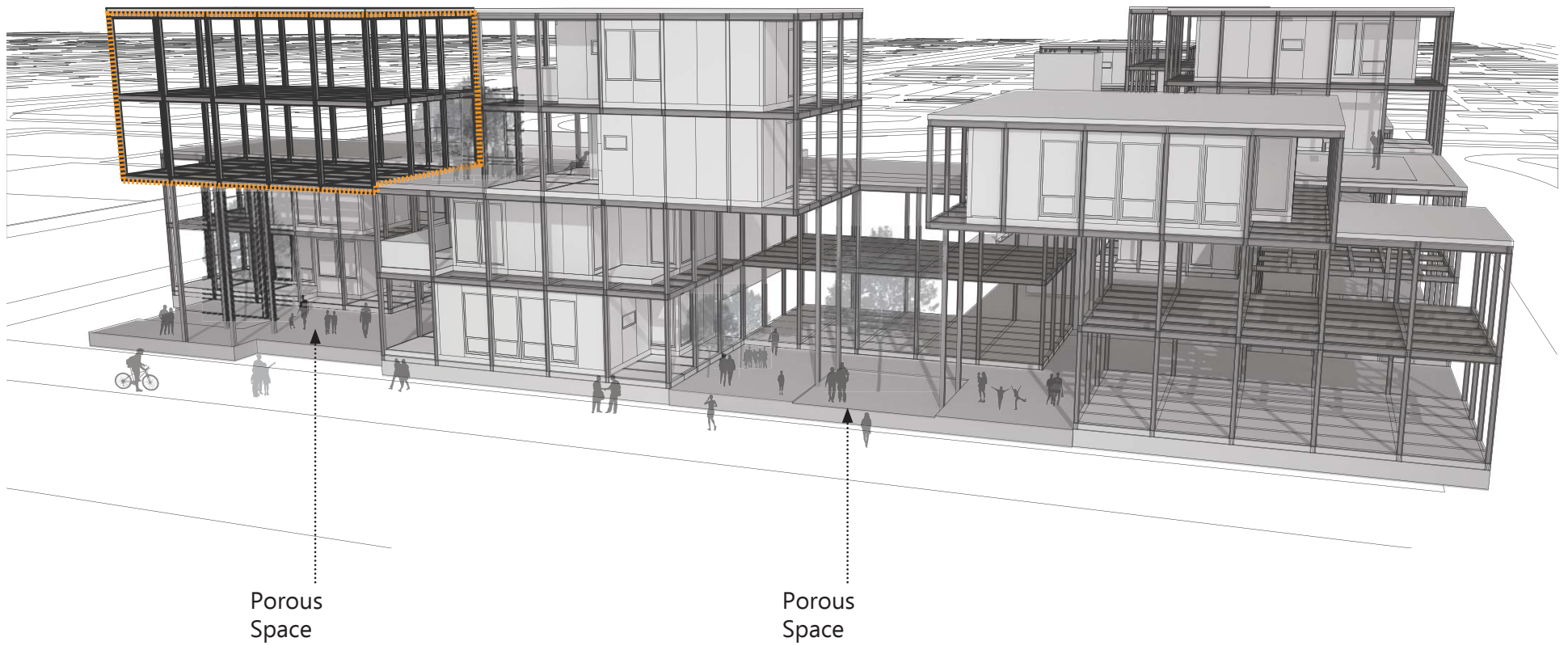


Figure 5.6: Infrastructure Framework

5.3 Infrastructure Framework and Infill Modules

5.a The Fixed Infrastructure Framework Logic

Based off household arrangement, the space will be surrounded by a infrastructure framework that allow for flexibility. The thesis will use the concept of a “soft” flexible strategy. The units implement a “expand and contract” flexible strategy depending on the family structure. A family can purchase a space within the structural framework and add prefabricated infill units. The creation of a 4'x 8' framework grid allows for direction orientation depending on the design's desired solar orientation on the site, while acting as structure for prefabricated modules to be placed within the increments on the framework.

The spaces in between the framework grid will be known as porous space where people can choose how to expand their home by using infill modules. The form is a simple cube to allow for the greatest flexibility, but has static circulation built in to suggest direction and orientation. (See Figure 5.6: Infrastructure Framework Logic). Each infrastructure unit allows for maximum build out of 1600 square feet.

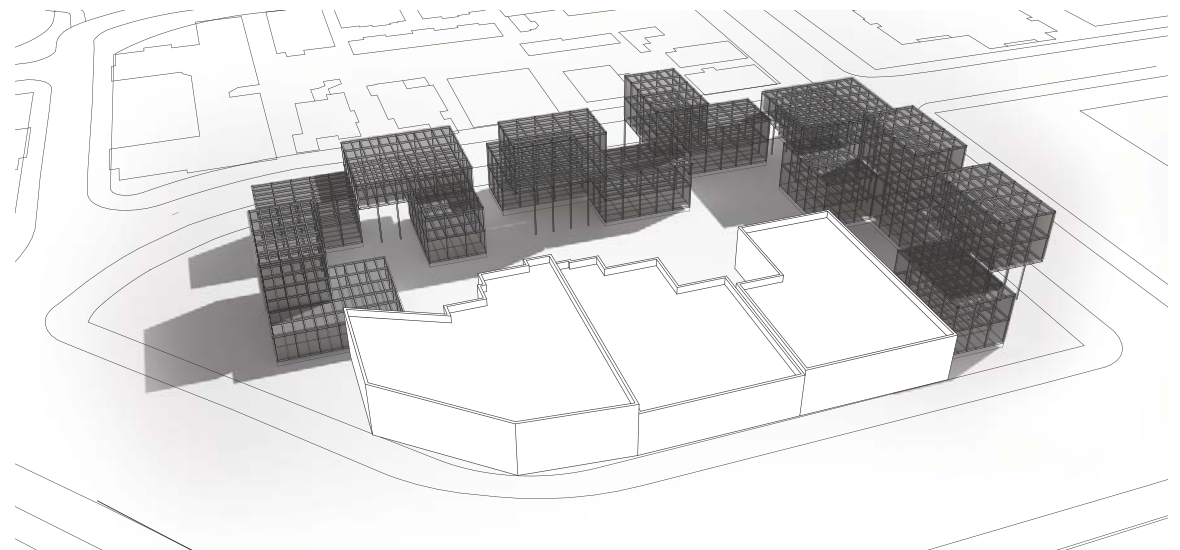


Figure 5.7: Infrastructure Framework Logic

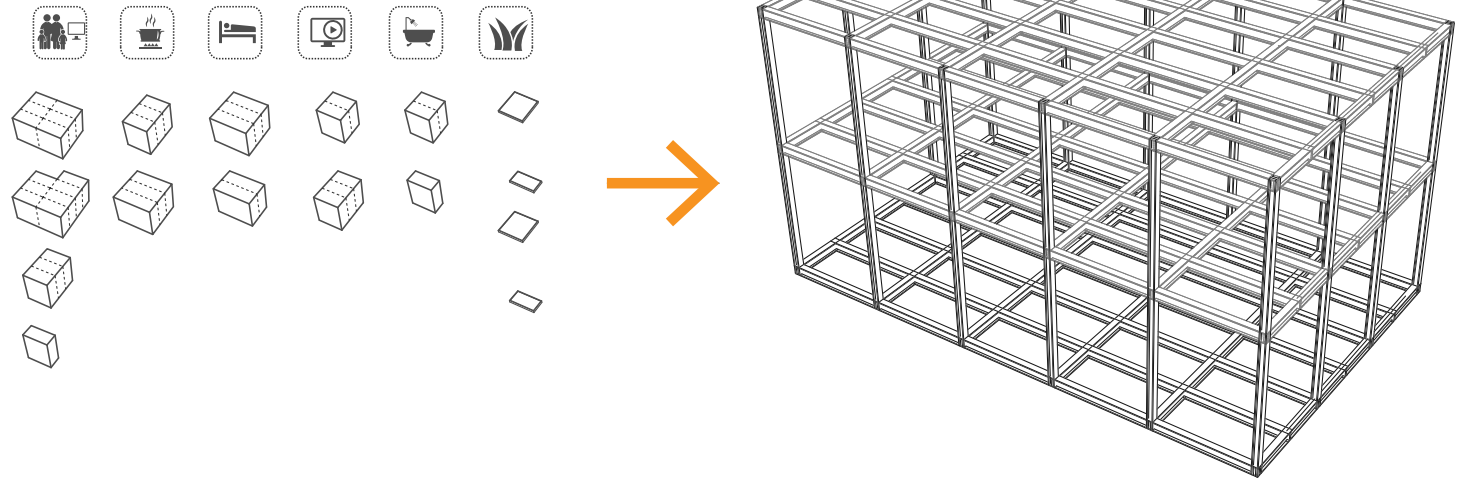


Figure 5.8: Modules placed in the Infrastructure

5.b The Infill modules Logic & Utilities

The central part of the overall housing unit will be referred as the “hub unit module”. The module can be placed anywhere within the framework. The household family have the preset amount of modules that they can choose from. When a household decides to expand their spatial needs, they order the kit of parts that will be shipped to their location (see figure 5.9).

Figure 5.9: Modules Shipped

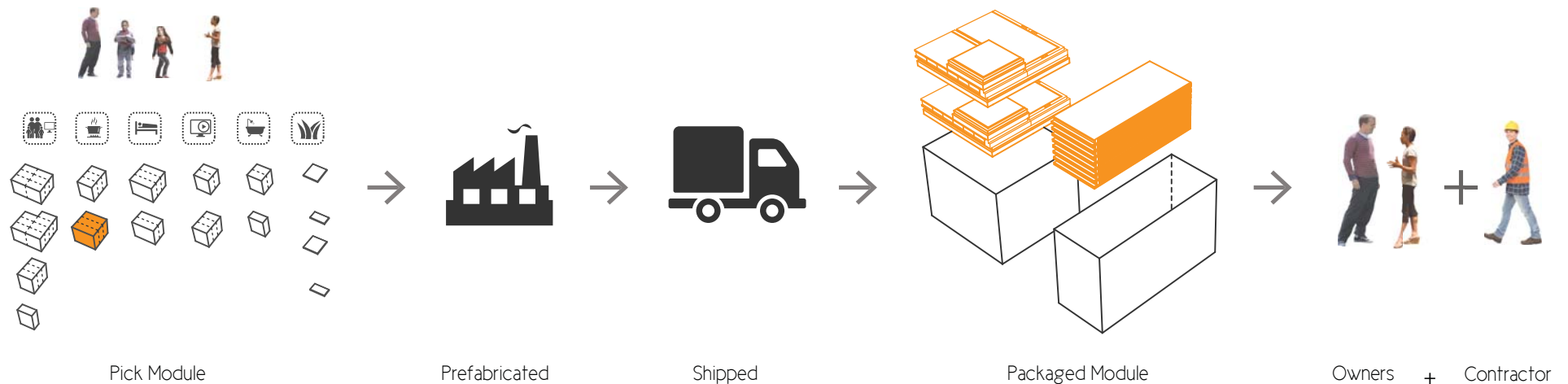
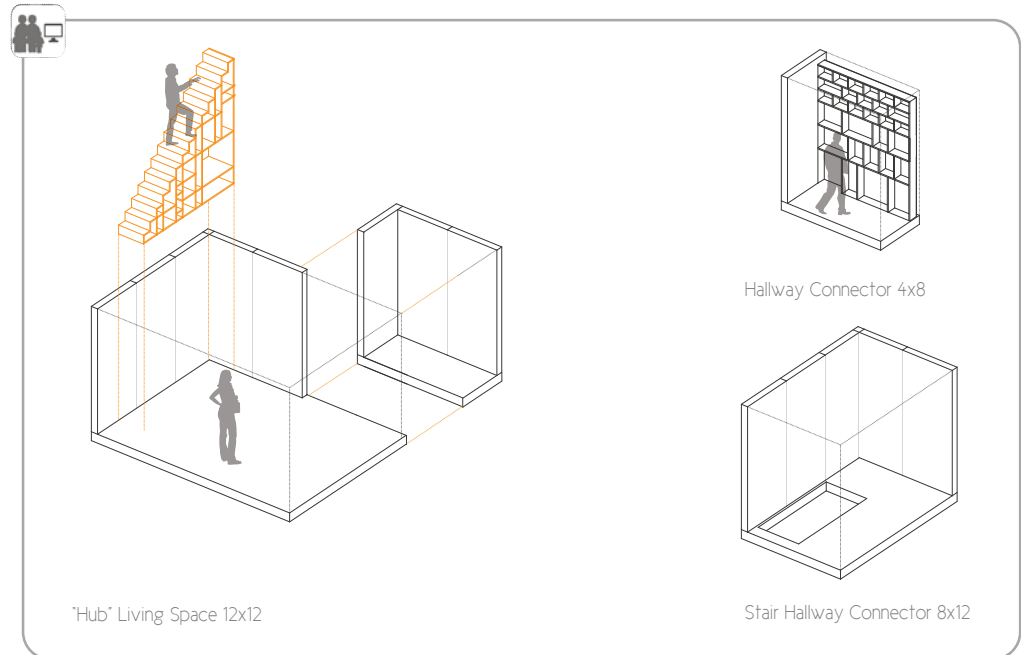
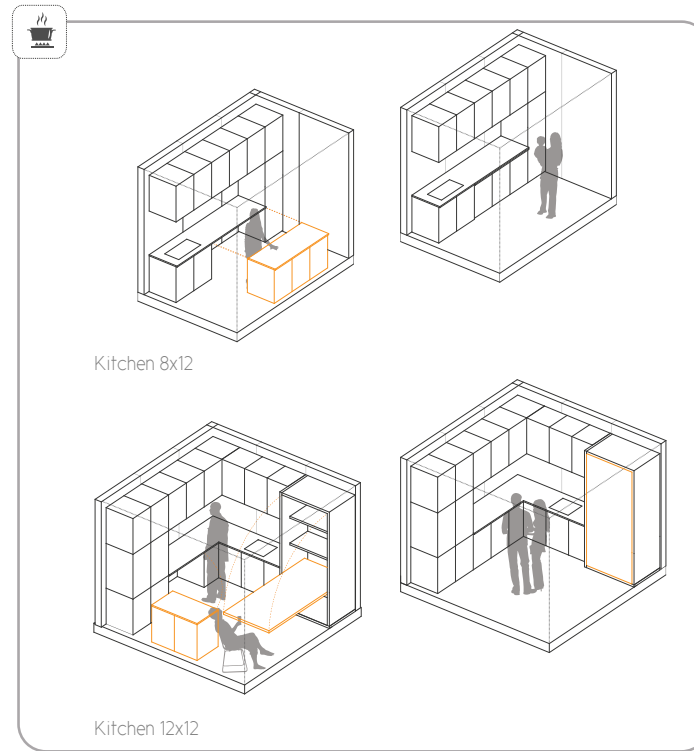


Figure 5.10: Infill Modules



Broken down by living, bathroom, kitchen, bedroom, recreation, and exterior landscape, each module corresponds to a spatial function in a home. Each infill module would be designed to maximize spatial efficiency in order to preserve affordability. This is done by flexible furniture, that allows multiple function in each space. The strategy gives complete flexibility and control to the homeowner on how they plan their dwelling and allows them to give hierarchy of importance to spaces (See Figure 5.9: Prefabricated Modules).

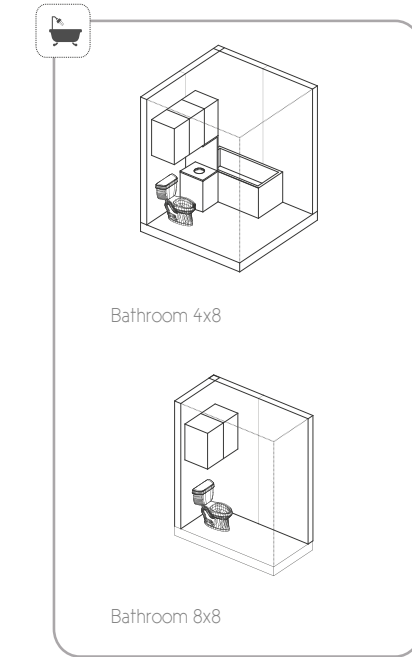
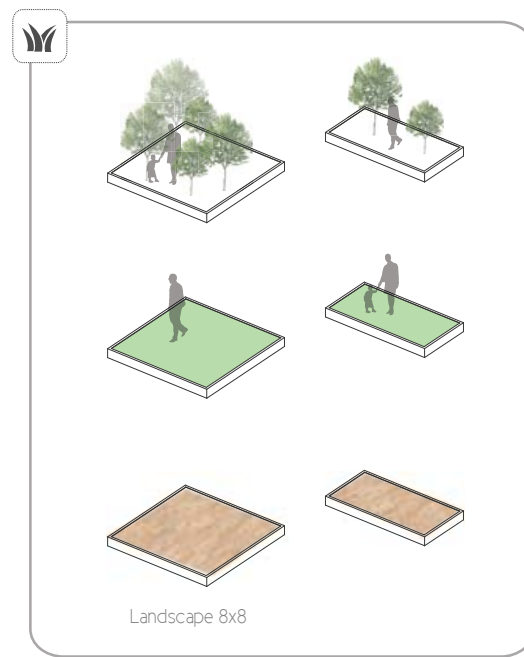
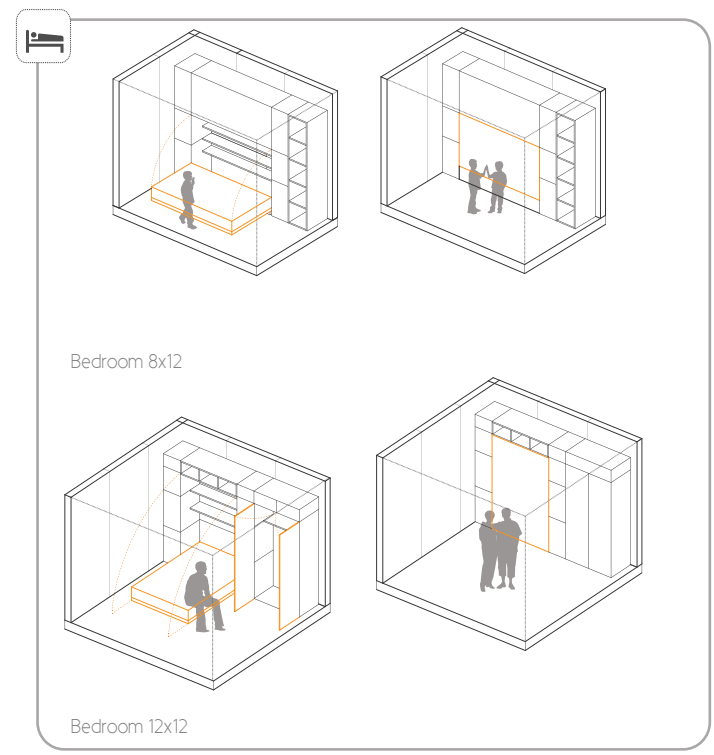
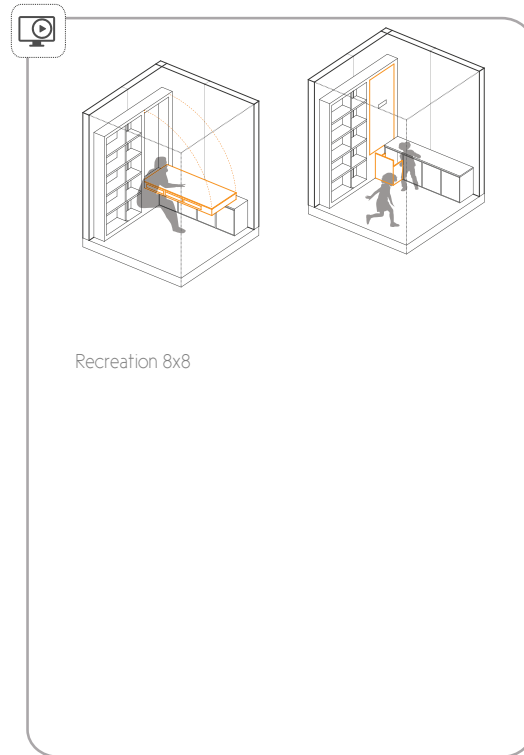


Figure 5.10: Inf II Modules (Continued)

Each module is specifically designed for ease of homeowner construction. Once the Family receives the shipped module package, they can begin with a local contractor to erect the module within the infrastructure framework. This concept was pioneered in the early 20th century with Sears Roebuck catalogue mail-order homes. The Sears Roebuck kit house cost about a third of the price of a traditionally constructed home during the time, making homeownership more accessible to many working class and middle class buyers. Each prefabricated module is built on site by the owner and a certified contractor from e shipped kit-of-parts (See Figure 5.10: Infill modules Construction Logic).

The thesis takes a cue from the Sears Roebuck catalogue concept, but with instead of ordering a full home, each module is bought at a time.

Figure 5.11: Infi II Module Construction Logic

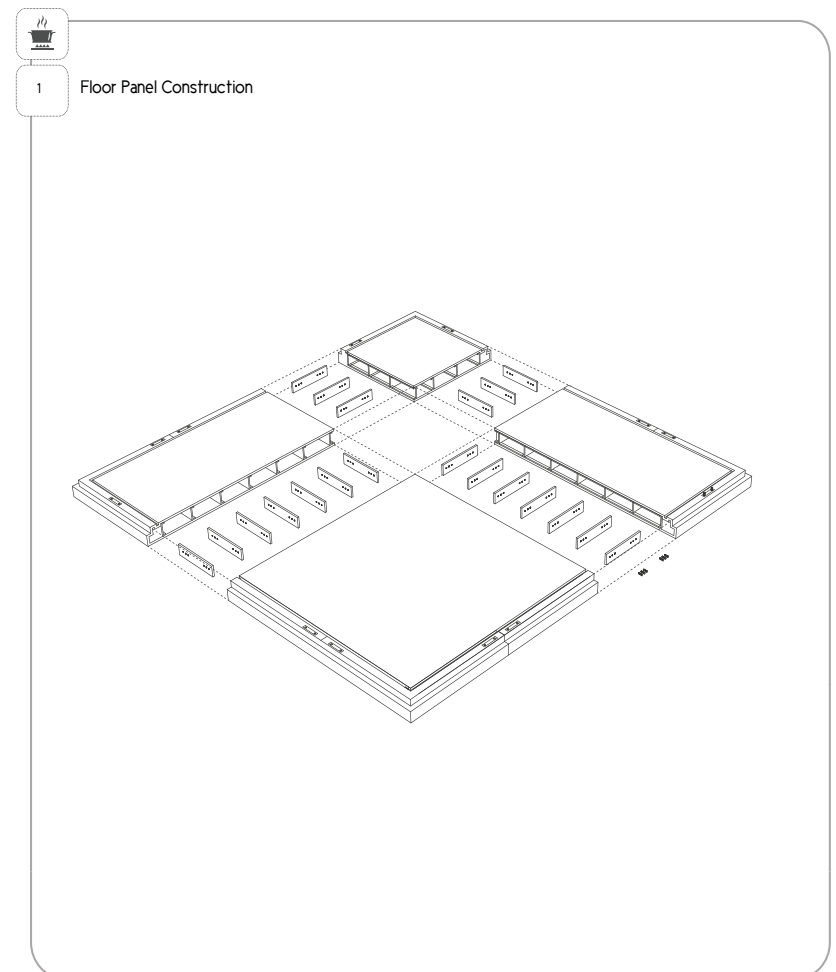
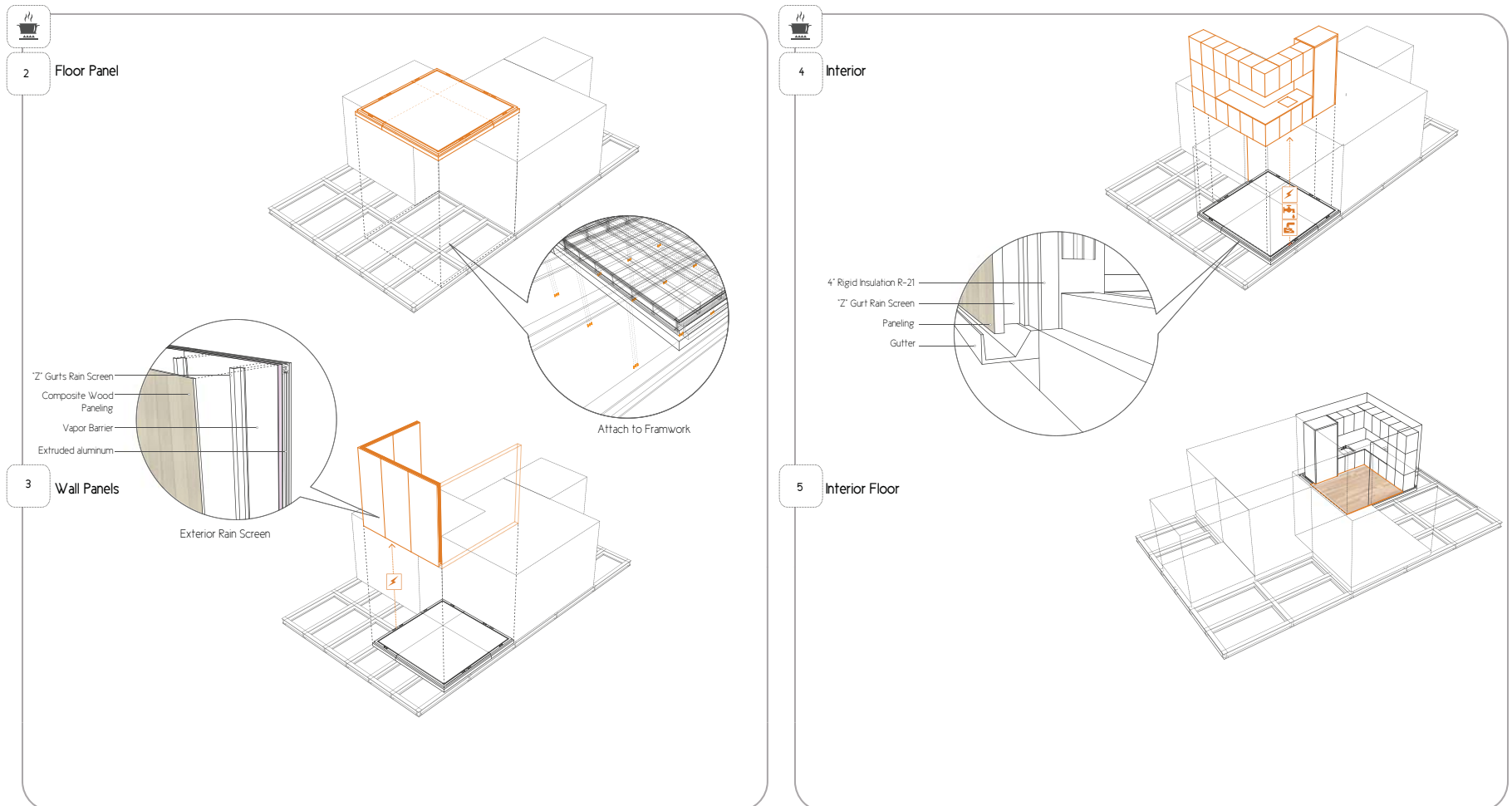


Figure 5.11: Infi II Module Construction Logic (Continued)



All other modules utilities are plugged directly into the hub unit (See Figure 5.12). Depending on the chosen orientation, the wall panel sections have a options between, opaque, transparency, or openings. Once placed, utilities such as water, sewer and electricity would be chased from the circulation core to the hub unit module from fixed utilities cores (See Figure 5.13: Infill Modules Utilities).

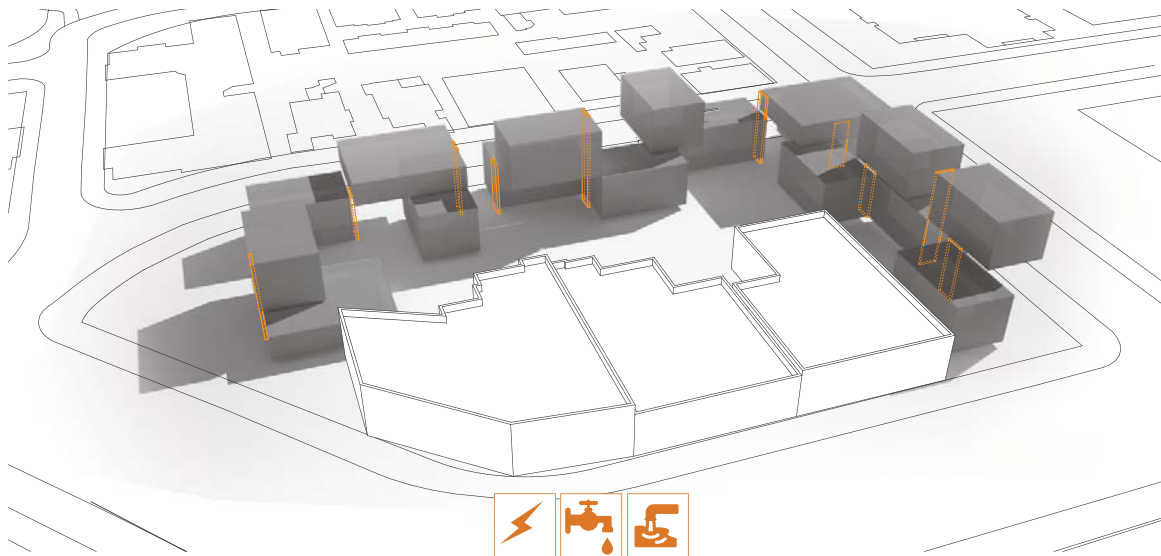
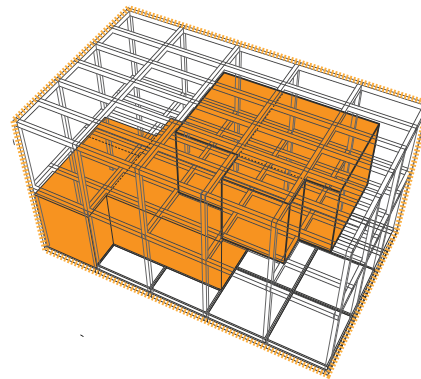


Figure 5.12: Fixed Cores

5.4 Ownership

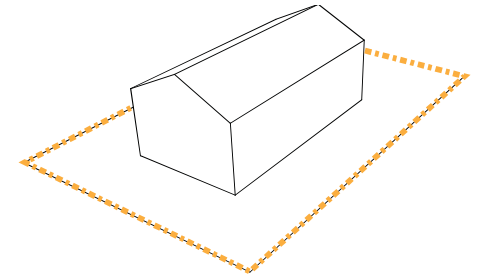
The thesis examines the notion on an evolution of a new ownership model. Instead of owning a single family house or multifamily structure that is already built to maximum capacity, the ownership of an open infrastructure would allow for a framework of inexpensive method of controlled expansion and contraction. This would allow families to purchase the infrastructure and expand based off spatial and financial needs as opposed to buying an expensive already built out homes (See figure 5.14).



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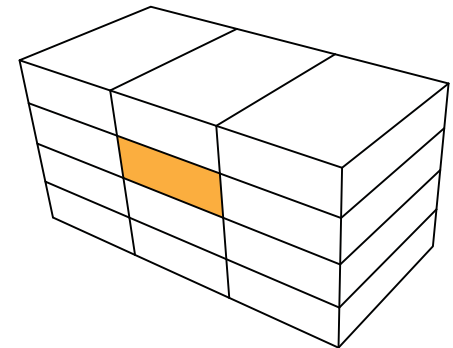
Proposed 'infrastructure'
ownership

VS.



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Single Family House
Ownership



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Condo Ownership

Figure 5.14: Ownership Models

Figure 5.15 Axon Perspective

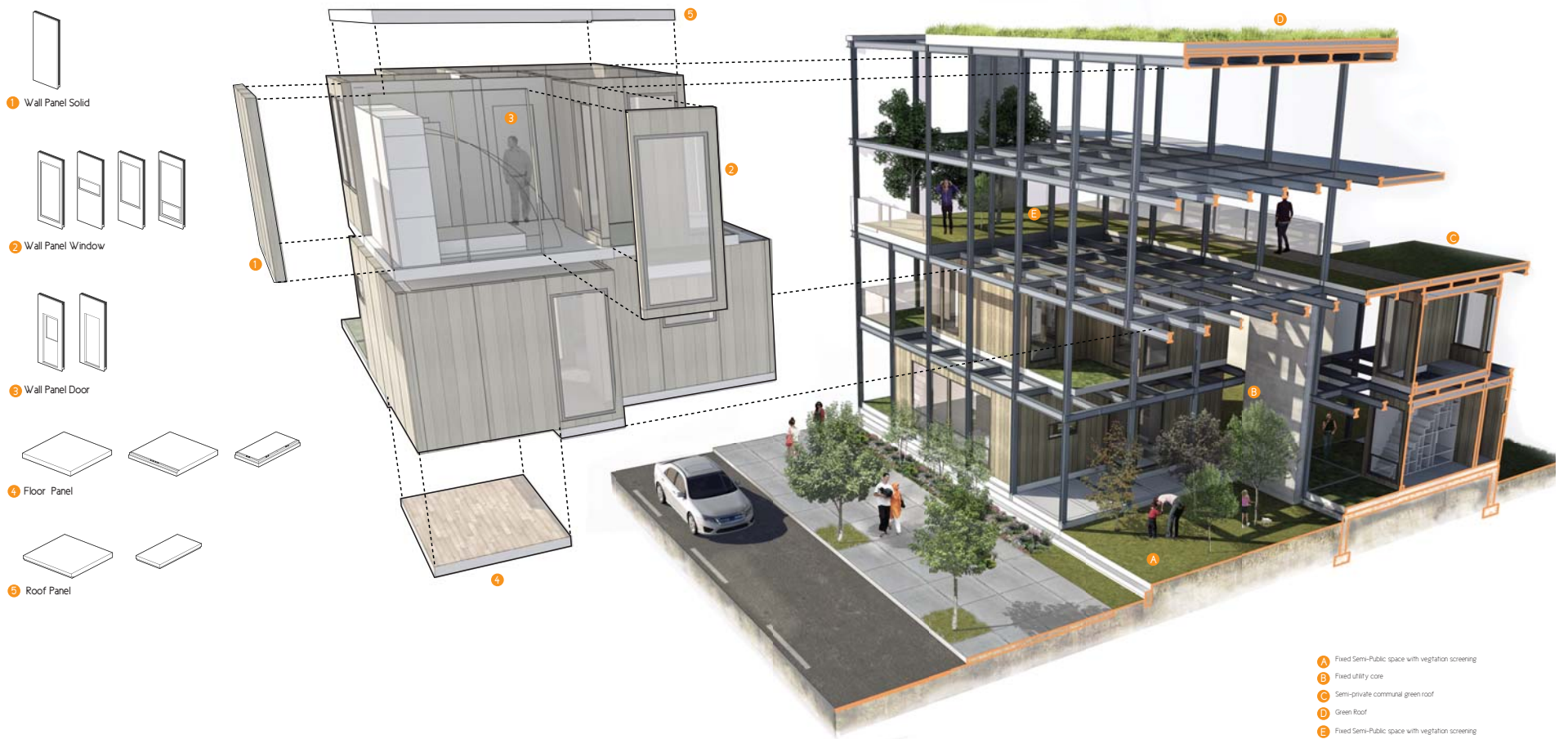




Figure 5.16: Rendering Interior

Rendering showing the inside of a typical unit looking outside from the hub spacing and the kitchen modules

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Figure 5.17: Section Looking West



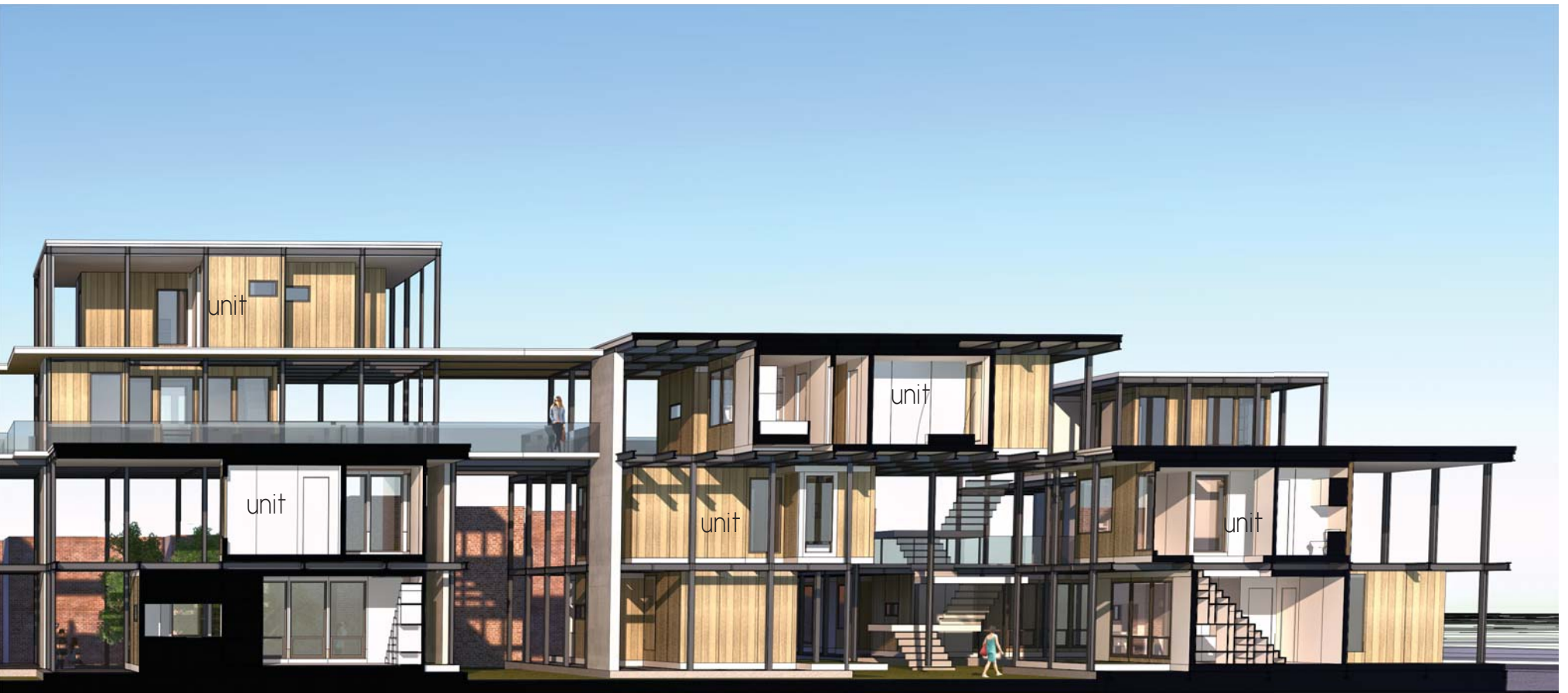




Figure 5.18: Section Prospect and Refuge

5.5 Prospect and Refuge

The building form was in part a response to the concept of creating family sized housing in a larger density context. Drawing concepts from the single family house, each unit is place strategically to encourage privacy and sense of prospect and refuge from their unit and semi-private space to the inner public courtyard (See Figure 5.18). There are always sight lines into the public spaces to promote sense of security for children playing.

5.6 Unit Privacy

Vegetation provides privacy screening to units from the semi-public green spaces. (See Figure 5.19).

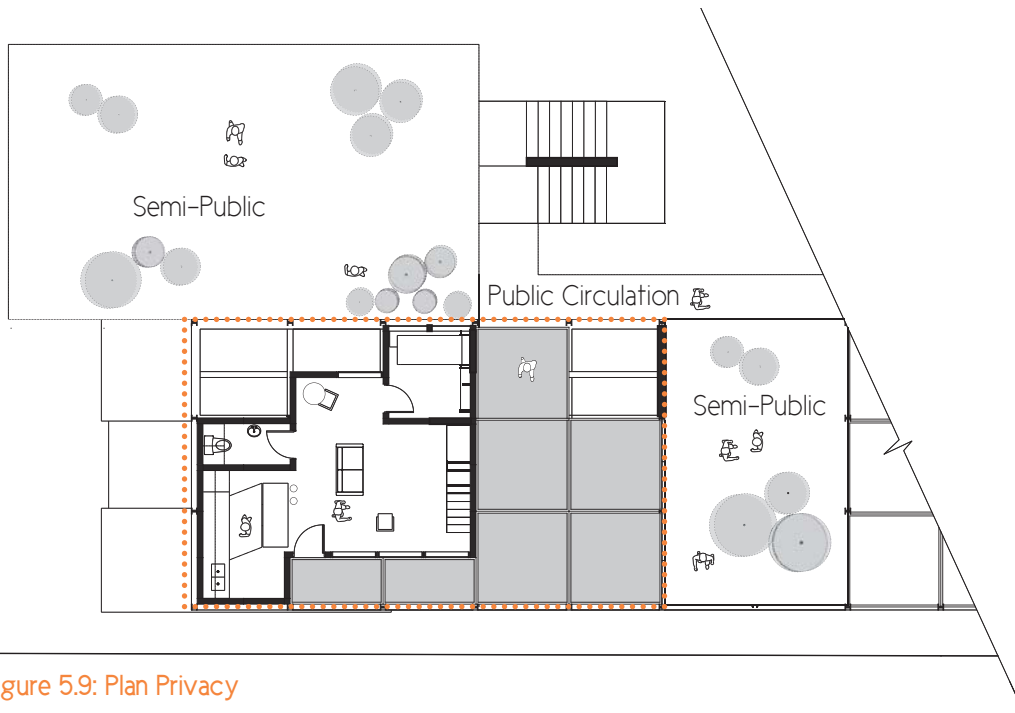
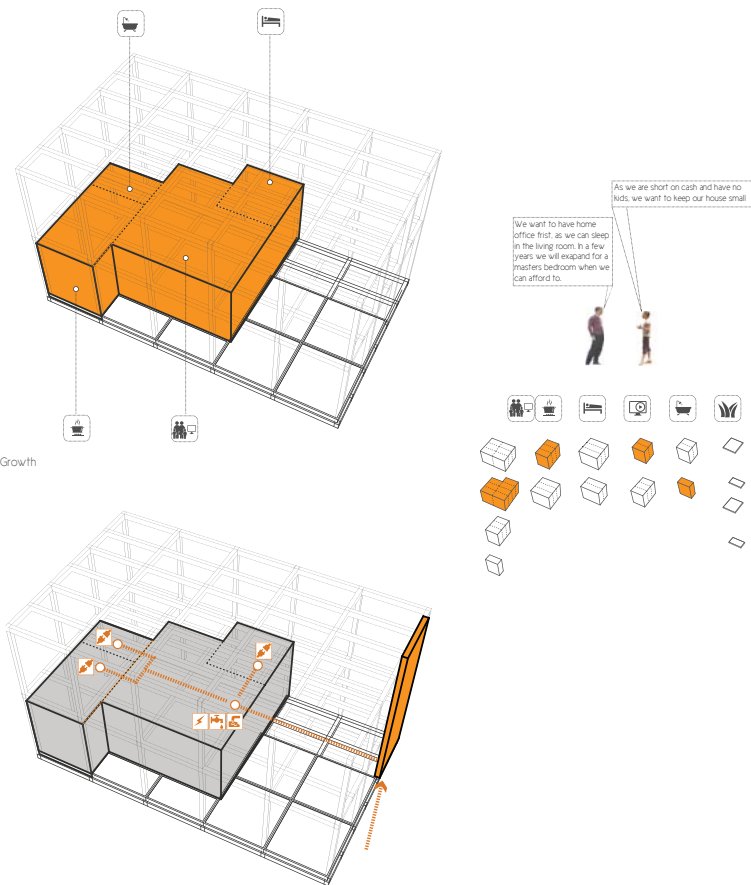


Figure 5.9: Plan Privacy

5.7 Aesthetic

Referring to Figure 5.20, the series of images depicts over time how the exterior form suddenly changes resulting from a family spatial needs change. To create a sense of visual unity between all the units, the infill modules exterior will all have a composite wood rainscreen system. The diagram series shows how a family can change their spatial needs over their life cycle.

Figure 5.20.A: Aesthetic Change Series
Year 1 of the Family



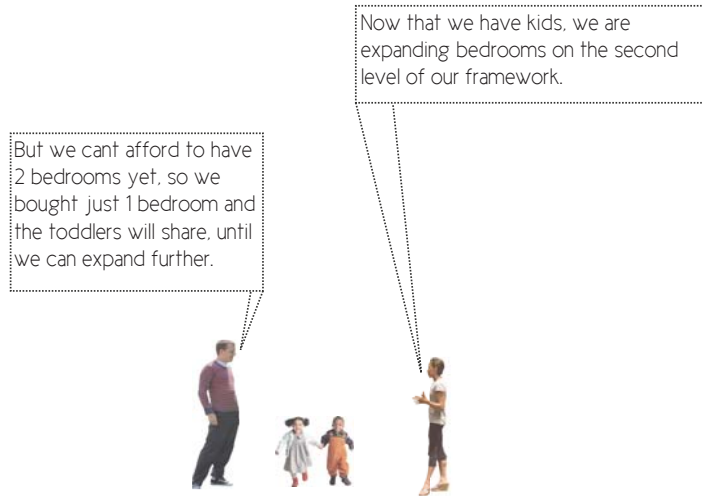
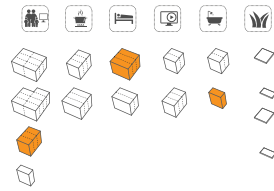
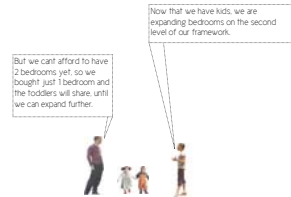
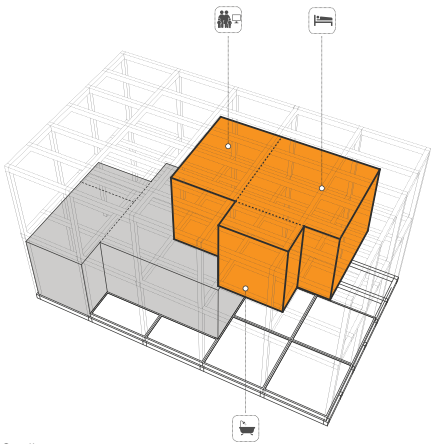
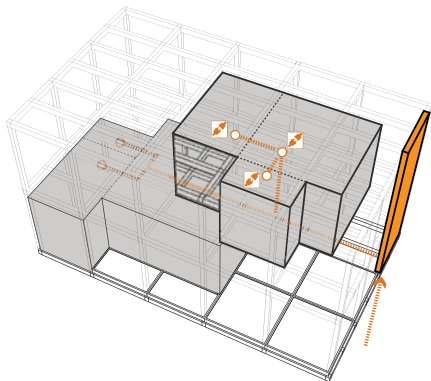


Figure 5.20.B: Aesthetic Change Series Year 5 of the Family



Spatial Growth



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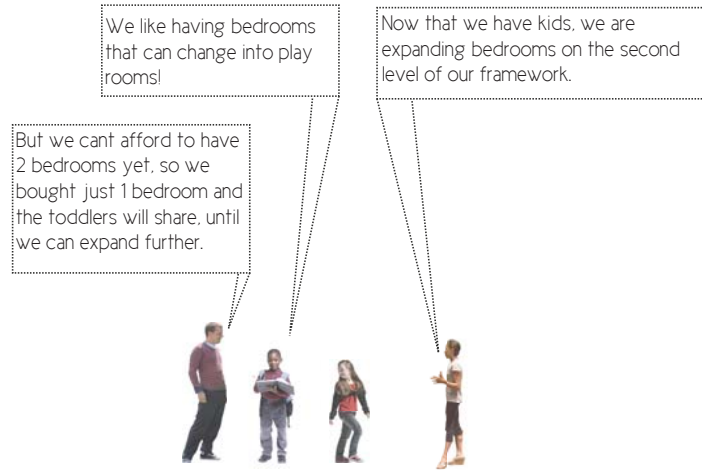
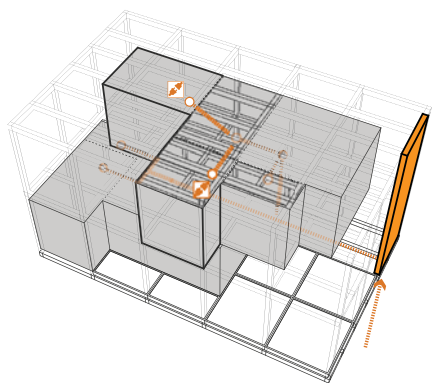
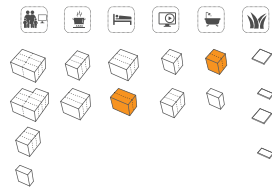
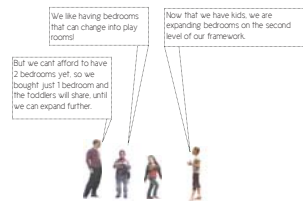
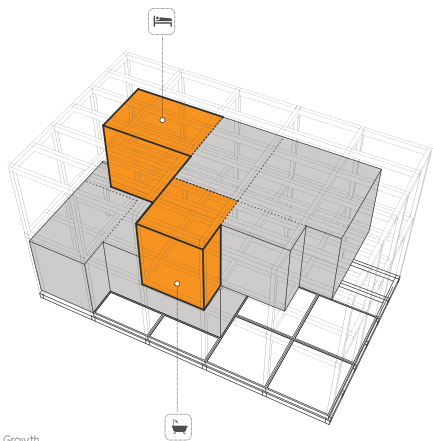


Figure 5.20C: Aesthetic Change Series Year 10 of the Family

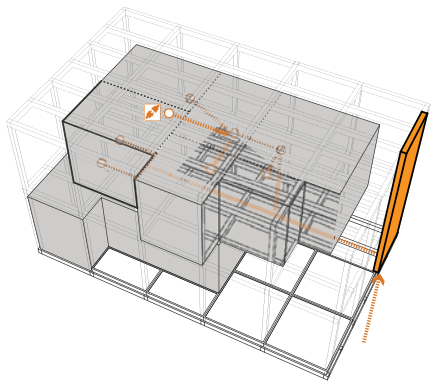
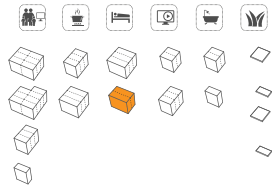
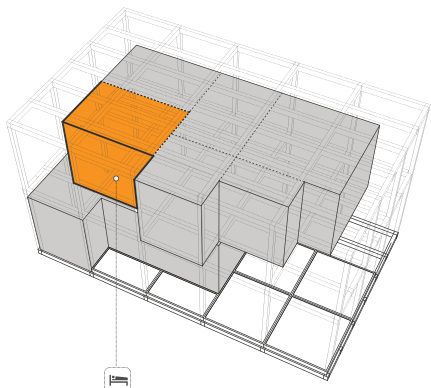


Spatial Growth

Utilities



Figure 5.20.D: Aesthetic Change Series
Year 14 of the Family



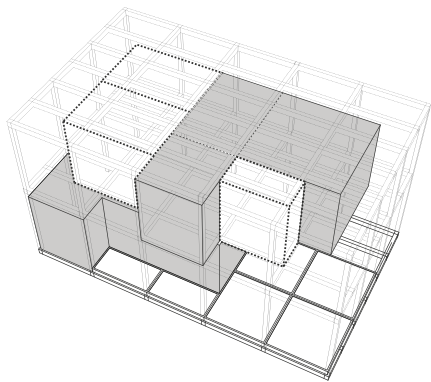
Spatial Growth

Utilities

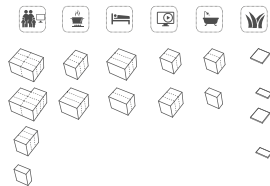
Our kids are gone, but they sometimes come back. But to save money, we don't need their bedrooms or extra bathroom.



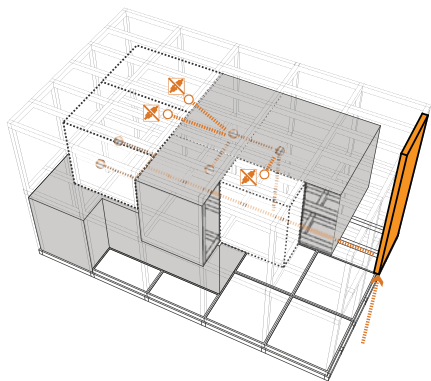
Figure 5.20.E: Aesthetic Change Series Year 23 of the Family



Our kids are gone, but they sometimes come back. But to save money, we don't need their bedrooms or extra bathroom.



Spatial Growth



Utilities

Chapter 6: Conclusion

6.1 Final Thoughts

6.1 Final Thoughts

This thesis began exploring the deaggregation of urban middle class family-sized housing in Capitol Hill. After researching further, it became apparent that middle class family sized housing is out of reach of many young and old families. Many factors arise from affordability to exponentially decreasing stock of family sized homes due to large block housing development. The thesis then began to focus on the notion of family life stages and how the current building stock does not fully address these needs, and a need for a new housing model. From that, spatial flexibility became the centerpiece of the thesis. Furthermore, the project evolved into a hybrid typology of a detached single family project with density closer to multifamily housing. The project turned an underutilized site with surface parking in north Capitol Hill into a thriving middle income, mixed family age community.

During the process of design, the site design proved to be the most challenging. Although the criteria of selecting the site was successful, the curved north end of the site proved to be difficult to design a modular structure. A site with the same selection criteria but with a more rectangular site located in North Capitol hill would have been better for the final design. The idea of spatial flexibility and the concept of the infrastructure preceded the site selection. The idea was to create a prototype, and the chosen site would have a test to the idea.

During the final review, the jurors were intrigued by the concept of spatial flexibility, but offered suggestions of what the infrastructure framework could be. It was noted maybe not an actual structural steel framework, but an invisible “framework” that could offer some constraints on how households spatially expand.

While few other aspects of the building was difficult to solve, such as circulation, the exact design of the infrastructure of the framework, the building test was an overall success, and the design offers hope for future development. The project

offers an alternative solution to middle income families that are interested in homeownership.

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