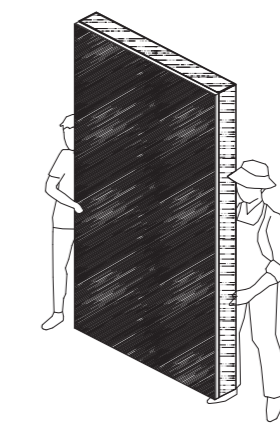


TY CLAUSSEN
2022

The **AdaptHaus** Project

TY CLAUSSEN | Texas A&M University



The **AdaptHaus** Project

TY CLAUSSEN | Texas A&M University

Thank you to my family
for every opportunity,
and for showing me that
the best life to live is the
one you build yourself.

1



Marcel Erminy
Studio Professor

2



Michael O'Brien
Committee Chair

3



James Tate
Committee Member

4



Shannon Van Zandt
Committee Member

1 Table of Contents

| | | |
|----------|---------------------------|-----------|
| A | Introduction..... | 5 |
| | Research..... | 6 |
| | Case Studies..... | 14 |
| | The Assembly..... | 22 |
| | The Townhomes..... | 30 |
| | The AdaptHaus..... | 44 |
| | House One..... | 48 |
| | House Two..... | 52 |
| | House Three..... | 58 |
| | References..... | 66 |

1 Introduction

2

Adaptability in architecture is vital in improving the longevity and broadening the use of a design beyond a single scope. Applicable in everything from healthcare to housing, and sports centers to commercial high-rises, an adaptable design creates a structure that can outlast its intended purpose to create opportunities for new uses. Focusing on housing, adaptability can mean the creation of a base floorplan that can be expanded or divided into a variety of uses that can meet the needs of families as time passes. Much like the ever-changing needs of a family, residential design must be able to continuously support change in order to stay relevant. This year, there has been an increase in families searching for a new home to fulfill their needs rather than stay confined to a non-applicable floor plan. Young Millennials were searching for their first homes; Gen Xers were the highest percentage of families who were moving because of a new child or searching for a multi-generational home; and retirees were searching for a universally-designed plan that fit the needs of the Silent Generation. I believe this points to a need for an adaptable home that creates a space where a young family can have a home that follows them through these stages of life, rather than only supporting them for a short time.

1 Research

2

Before beginning the design process, it was important to understand if a project that centralized around creating a home was valid for the modern family.

3

I looked towards sociological research on the desire of the average American family to have a long-term place to call home. According to researcher Jenny Schuetz, who works with the nonprofit public policy organization Brookings, the current housing trends show a great interest in long-term homeownership over short-term renting situations. A 2017 Freddie Mac survey on behalf of the United States Congress supported this statement, with 80% of the renters they surveyed saying they wanted to own their own home rather than rent.

Housing is a composite good of four factors

1

Shelter

Location

Wealth

Stability

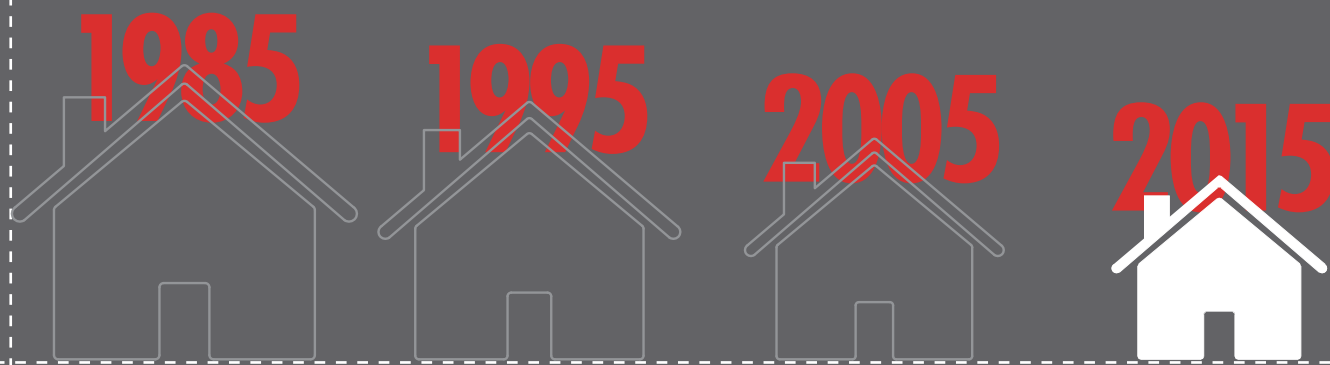
2

While a short-term housing solution will provide shelter, it may not satisfy location, wealth, or stability. For example a family's apartment may not be close to mom's work to sister's school. A long-term living solution creates a place where a family knows they will be for not just this month or this year, but for the next year or for the future.

3

Despite these factors being more present in long term housing, homeownership rates have been decreasing in the united states

A



B

Right now, this percentage is at it's lowest in **30 YEARS**

¹⁰
1 One might assume the reason could be the desire for an urban lifestyle and reverse migration back into the city. However, the understood reason for this is the result of rising housing costs and income that's not scaling with it. In fact, the earlier mentioned 2017 Freddie Mac survey found that 80% of the renters they surveyed wanted to own their own home rather than rent.

of that 80%

2

38%

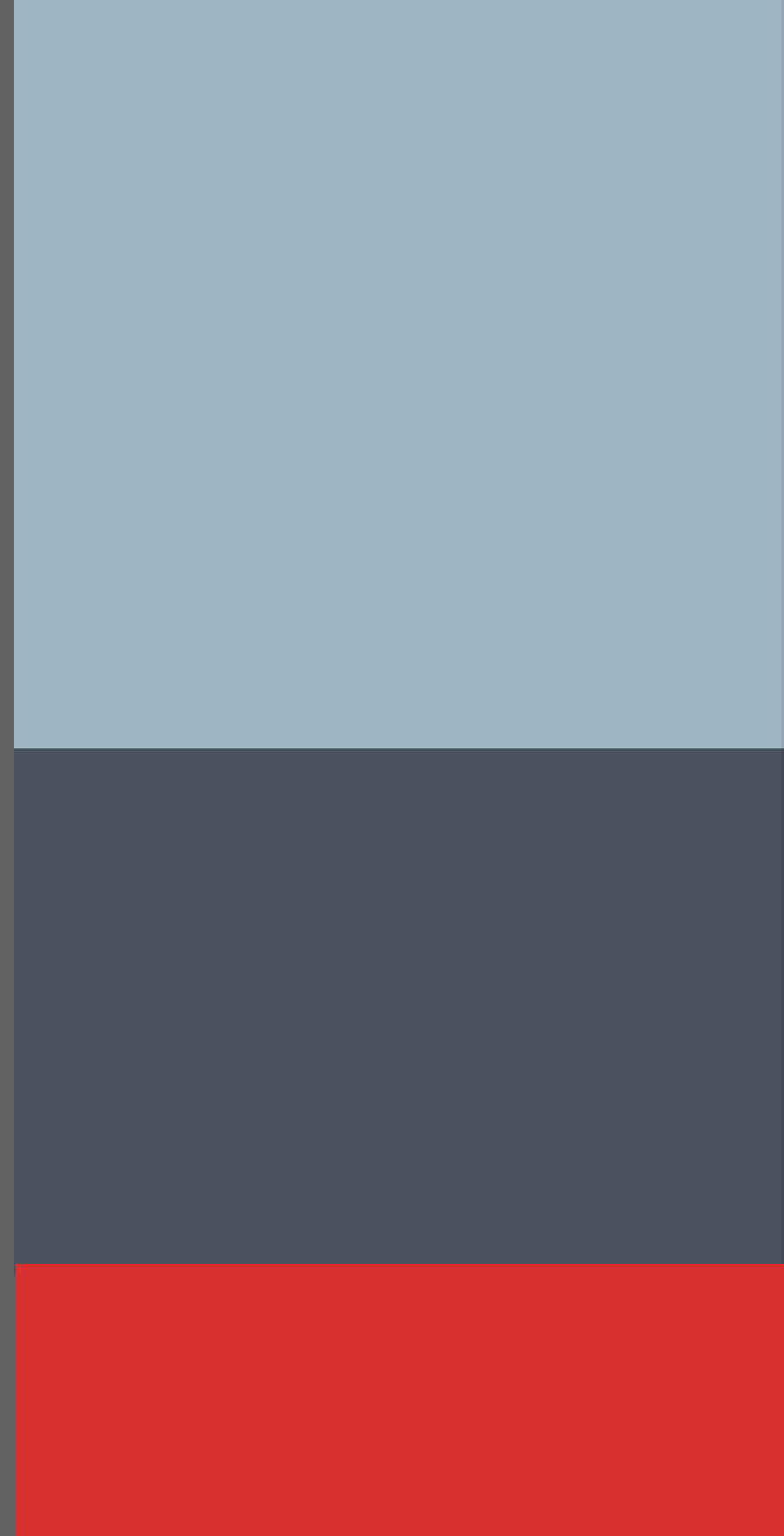
Can not afford
a home now

29%

Can afford a
home now

14%

May never
afford a home



3 In 1985, the rate of homeownership in the United States was on an upward trend at 63%. This continues in 1995 to 65%, and then peaks in 2005 at 69%. That forward progress was sharply halted and then regressed after the 2008 financial crisis. Credit, loss of jobs, higher student loan interest rates, fewer residential properties being available, and overall worse financial security contributed to a considerable loss in long-term rates (Goodman). This was especially apparent in the relationships of higher educated persons to homeownership. Along with the number of higher education graduates rising almost 20% from 1985 to 2015 (Goodman), homeownership rose as an example of easily affordable homes despite

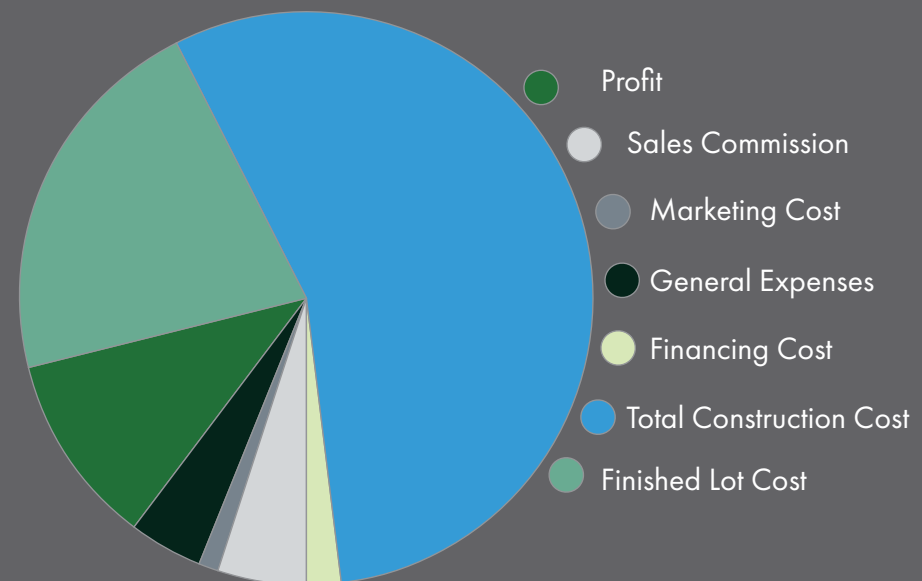
student loans, but the Second Great Recession flipped this trend. Despite the continued increase in college graduates entering the market, homeownership rates began to decline in 2005 and fell sharply after 2008. According to the Federal Reserve Bank of New York, student loan debt balances grew from \$378 billion to 1.19 trillion in 2015. This research shows that a more cash-strapped population struggled to make ends meet during the economic recession. Most of these point toward the impossibility of meeting the high price of housing due to a lack of available income, which has not kept pace with the increases in housing prices.

Simply put, what houses were left after the Second Great Recession were too expensive for families to buy.

Why is housing so expensive?

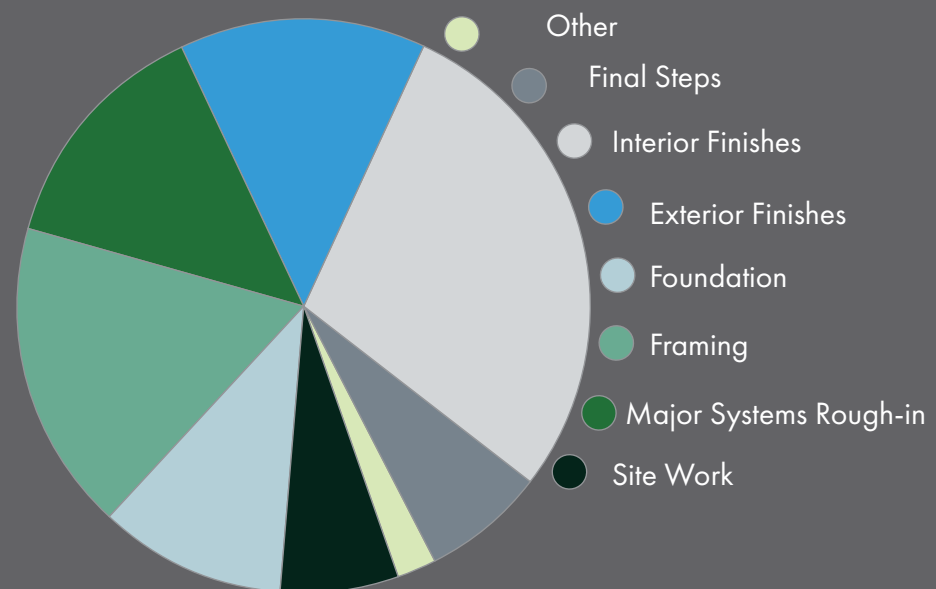
1

Beyond the market constraints of supply and demand, most of the cost of homes comes from their construction. According to a 2017 survey by the National Association of Home Builders, the average sales price of a home is broken into seven different costs. Of each of these, the cost of construction makes up the largest portion - around 56%.



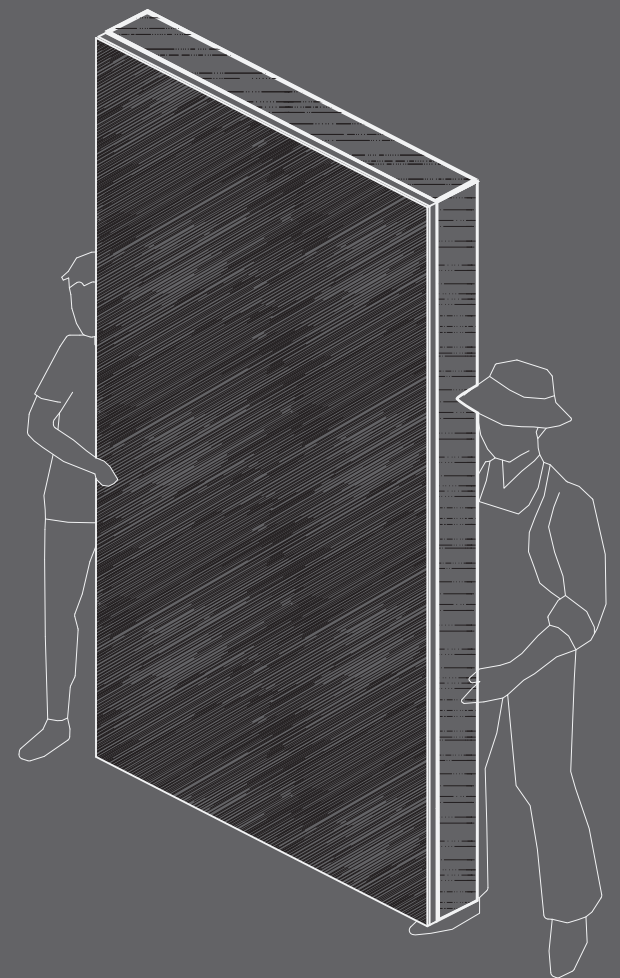
Of that total construction cost, 31% is just framing and major systems, like electrical and plumbing.

These systems are considered specialized and often require a professional to install, which many potential families are not. Internalizing these costs using a core module and fabricated panels enables the family to focus their attention and income on detailing the house.



2

Similar to social housing projects, this style of assembly provides families with the necessities and allows them to build-out the rest as needed. However, in this case that will be accomplished with a hybrid method.



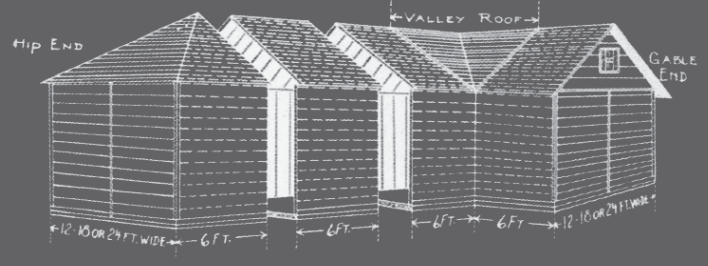
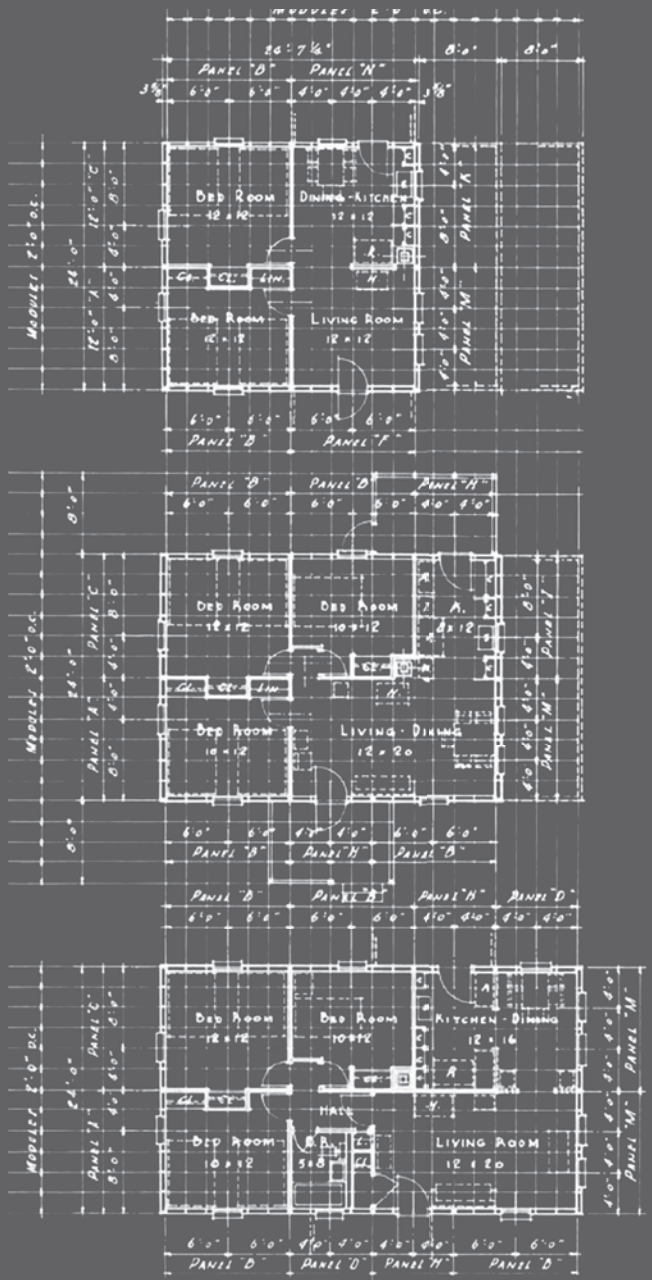
1 Case Studies

2

Prefabrication is not a modern idea. There are many examples of construction with prefabricated assemblies since before the Industrial Revolution, including examples of its successes and failures as a residential experiment as far back as the mid 1700s.

1 south east MISSOURI FARMS

2

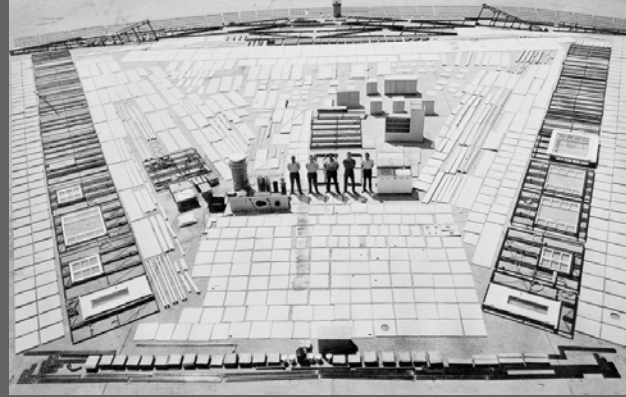


The Southeast Missouri Farms Project was a successful experiment in rapidly-built housing for displaced sharecroppers. Intended for an unskilled workforce with minimal literacy, the typical written instruction book was redrawn into something more like the IKEA instructions we see today. A family could build three different house plans, and they were intentionally simple in design and devoid of ornament. The houses were designed in 4-foot increments to provide the most versatility to a limited panel-type selection and the required workforce for assembly to a minimum.

While the homes were value-engineered to save on cost and construction time, the panels were constructed out of "first-grade materials" to extend these homes' longevity. They were also built on-site with jigs that the sharecroppers constructed also. These jigs were designed to be easily constructible and, once construction was completed, dissembled, and used to create a barn for the families to use.



THE LUSTRON CORPORATION



Carl Strandlund founded Lustron to utilize the supply of excess steel left from World War II and help solve the current housing crisis in the United States as soldiers returned home from war. As a system of architectural panels, the project was intended to be a fast-built, low-cost option to put as many families into homes as possible.

All models were made of porcelain-enameled steel, and four different floor plans were offered, all with two- or three-bedroom options. Intended to cost just \$7,000, Strandlund spoke of the Lustron Homes as the opportunity to create a home for your family at the price of "a loaded Cadillac." However, during the design of these assemblies, the cost and construction rapidly increased. When the first \$9,900 Lustron home shipped on the back of a truck, it consisted of 12 tons of steel made into over 3,300 parts that took a specialized team over 1,000 man-hours to assemble.

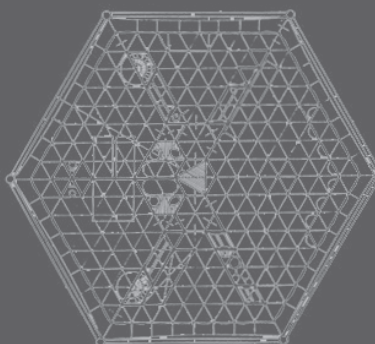
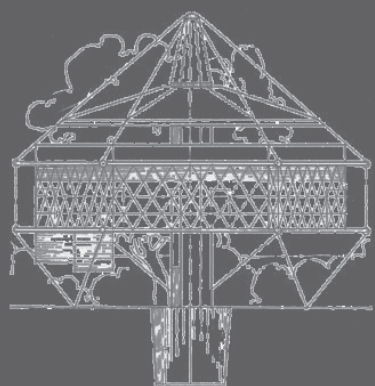
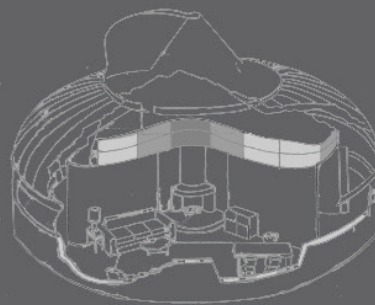
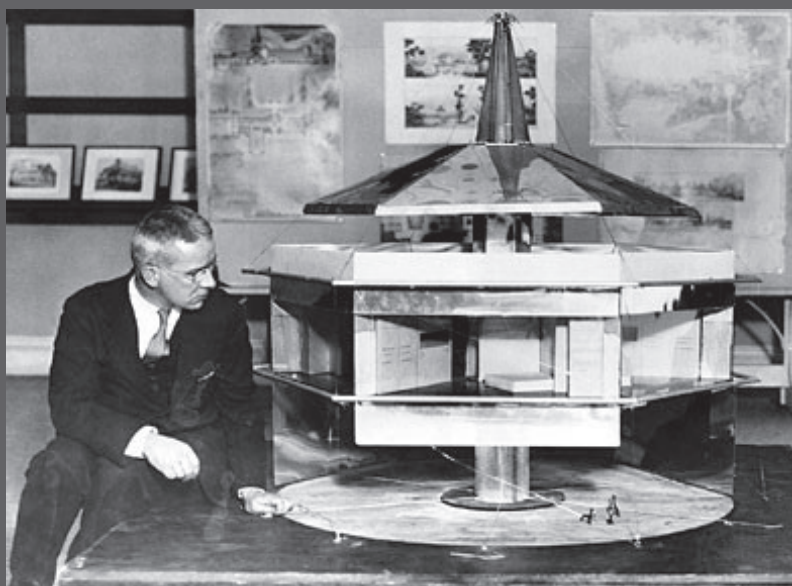
The homes had been priced out of the intended market, which resulted in only a little over one thousand homes being built in the first year with only a thousand following the second year, a far cry from the quoted 3,000 a month. Two years after the Lustron Corporation was founded, the federal government recalled the 32 million dollars in loans and forced Lustron into bankruptcy. Today only an estimated 1,500 homes are still standing.

Lustron Corp. provided an essential lesson in maintaining an eye on costs and ensuring that the families you're trying to help can afford the solution.

DYNAMIC MAXIMUM TENSION

1

2



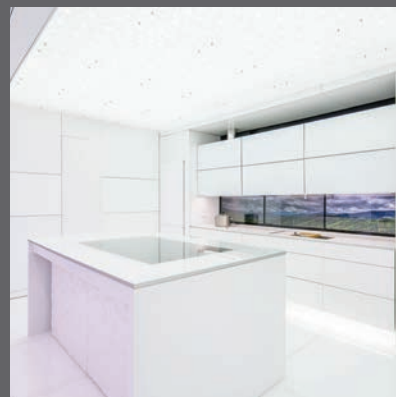
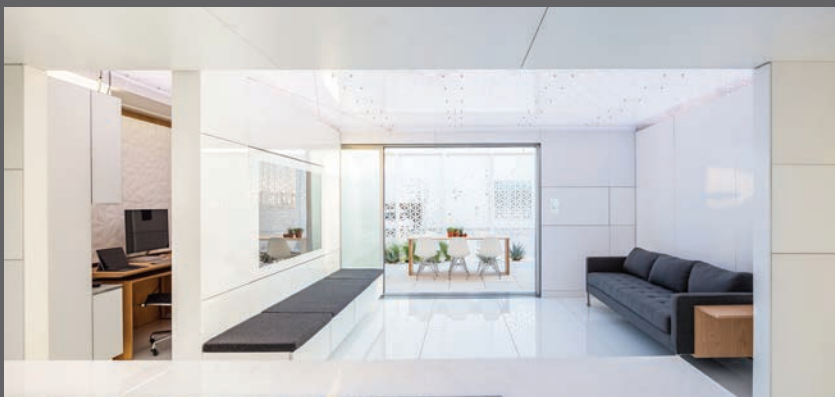
Originally designed in 1920 by Buckminster Fuller, the Dymaxion House was an aluminum structure built from a hexagonal footprint and suspended from a large central column (Baldwin). The residence combined futuristic design principles and an efficient floor plan to create a 100 square meter home that defied the construction norms of the time. The aluminum shell was suspended from the central pole by cables which allowed the outer walls to be non-bearing, giving the residents a 360 degree view with grand windows. By grouping all permanent utilities in the central pole and letting the rest of the interior space remain modular, Fuller created a flexible plan that would allow tenants to transform the space according to their needs. Another benefit of the aluminum structure was its light weight. Only weighing 3,000 pounds, the Dymaxion was able to be delivered on-site within its central column. Buckminster Fuller used this against his critics, often responding to comments with,

“how much does your house weigh?”

Over twenty years later, after World War 2 and the subsequent housing crisis, Fuller was presented an opportunity to make his dream a reality. Unfortunately, the subjective hexagonal design and unprecedented construction typology didn't sit well with investors and Buckminster Fuller refused to compromise, ultimately letting the project fail rather than be released before he felt it was ready.

After Fuller left the project, the potentially market-changing idea was left as a single prototype that an investor purchased and lived in until the 1970's, at which point the house was abandoned until it was donated to the Henry Ford Museum in 1990 where it's displayed today.

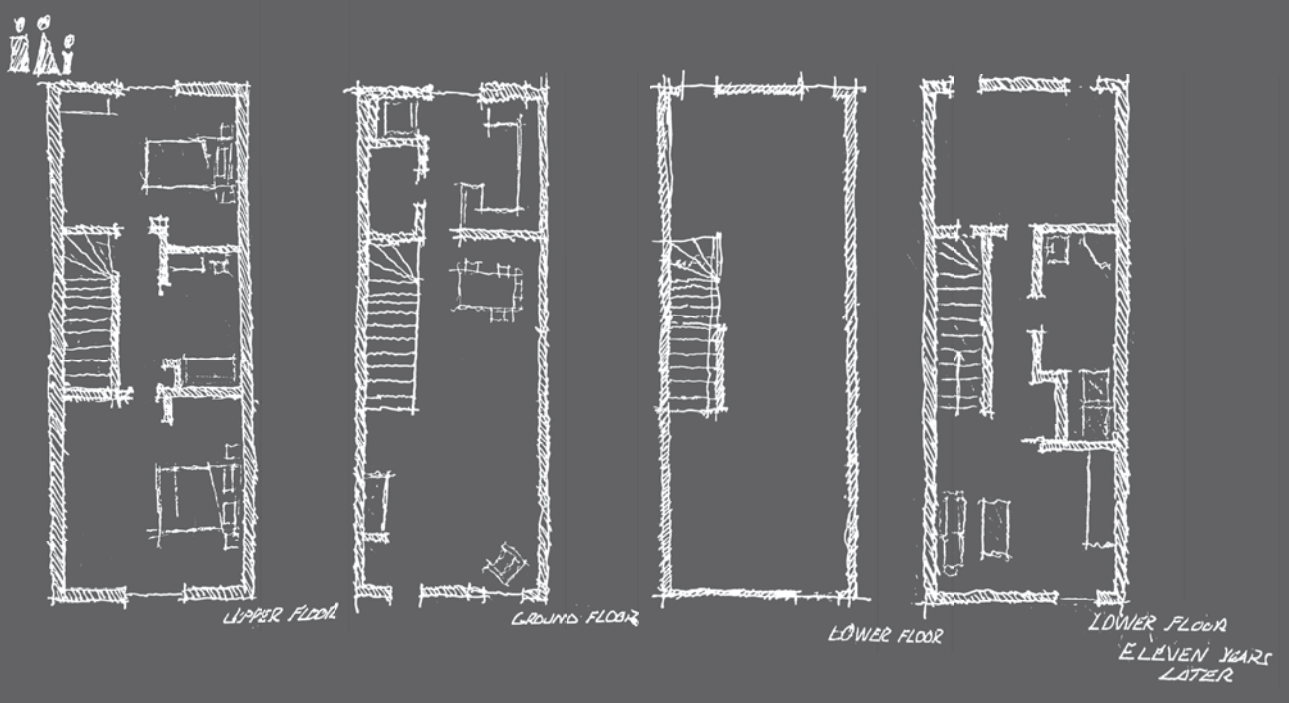
FUTURE 1 HAUS



FutureHAUS created a unique floor plan with a layout organized by systems rather than spaces as a cartridge-based assembly. Each module is constructed with structurally insulated panels (SIPs) and designed with universal application in mind. Each cabinet in the kitchen and bathroom cartridges are adjustable to raise or lower for wheelchair accessibility, there are sensors in the floors to measure weight and heart rate and to detect falls, there are food-monitoring smart appliances, and screens in the backsplash to project a particular vista or to facetime grandma for recipes.

The other cartridges were adjustable in a variety of different ways. The living area cartridge doubles as a flex space, with a rotating wall that doubles as entertainment with a TV and storage with cabinets. The dining area has foldable murphy beds and expandable storage. The service cartridge and spine are expandable to fit the family's needs, and the spine is placed over the central hallway to tie the mechanical systems in and can be resized to fit the designed floor plan. This revolutionary cartridge system is intended to create quick-manufacture, rapidly assembled homes, and the kitchen and bathroom cartridges can be used in emergencies for a quick deployment shelter. The consideration for the daily lives of the families living within FutureHAUS shows success in an iterative design process. The successful deployment of the SIP cartridge system illustrates the strengths of prefabricated residential architecture.

1 THE GROW HOME



Avi Friedman's Grow Home presents adaptability as the division of space. While working towards his graduate studies at McGill University, Friedman and his wife purchased their first home in Montreal, where housing was affordable and plentiful (Wong). However, that quickly began to change as housing prices rapidly rose across major cities in Canada in the 90s. As an architecture professor and founder of McGill's affordable housing program, Friedman decided upon a housing formula that could respond to inflating costs and create long-term solutions for families. He believed that, **"Without the roots of a home, people can't fully participate in society"**

He developed a simplified townhouse floor plan that placed the communal functions, like the kitchen and dining area, on the ground floor and regulated the more private functions to the upper and lower floors. Intended as a truly long-term solution, Friedman introduced one bedroom into the plan but created many opportunities for building within the open floor plan. Diagrams of his design show a changing floor plan as the years progress and the family dynamic changes, from a single bedroom and storage floor to a multi-bedroom living space accommodating a large and growing family. The private levels had fully finished areas but were left unpartitioned to promote expansion within the existing floor plan.

His plan was wildly successful, and in 1991 the first Grow Homes had been built and sold for half the price of a typical home in Montreal. By the end of the year, he had sold over 10,000 of them.

1 The Family Dynamic

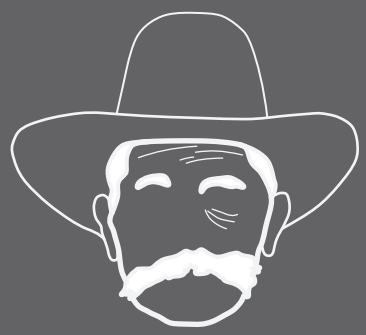
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To best determine the direction of this project, I researched the current trends of household types in the United States over the last five years. In the U.S., single-person households and empty-nest couples have become the fastest-growing household types.

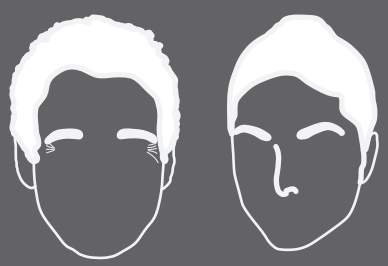
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The number of single-person households have increased by 2.2 million, accounting for 40% of all household growth.



However, households with an average age of 65 and older drove 80% of the increase in these single-person households.



Additionally, the number of married couples without children grew by 1.8 million, or another 32% of all household growth in America.

4

The aging Baby Boomer and Millennial population will direct housing trends in terms of size and layout. A high increase in single-person or empty-nest households may point towards a higher density, small floor plan living solution. However, with most of these being older homeowners, a universally designed single-floor layout would most likely be more conducive to the homeowner.

1 THE ASSEMBLY

2

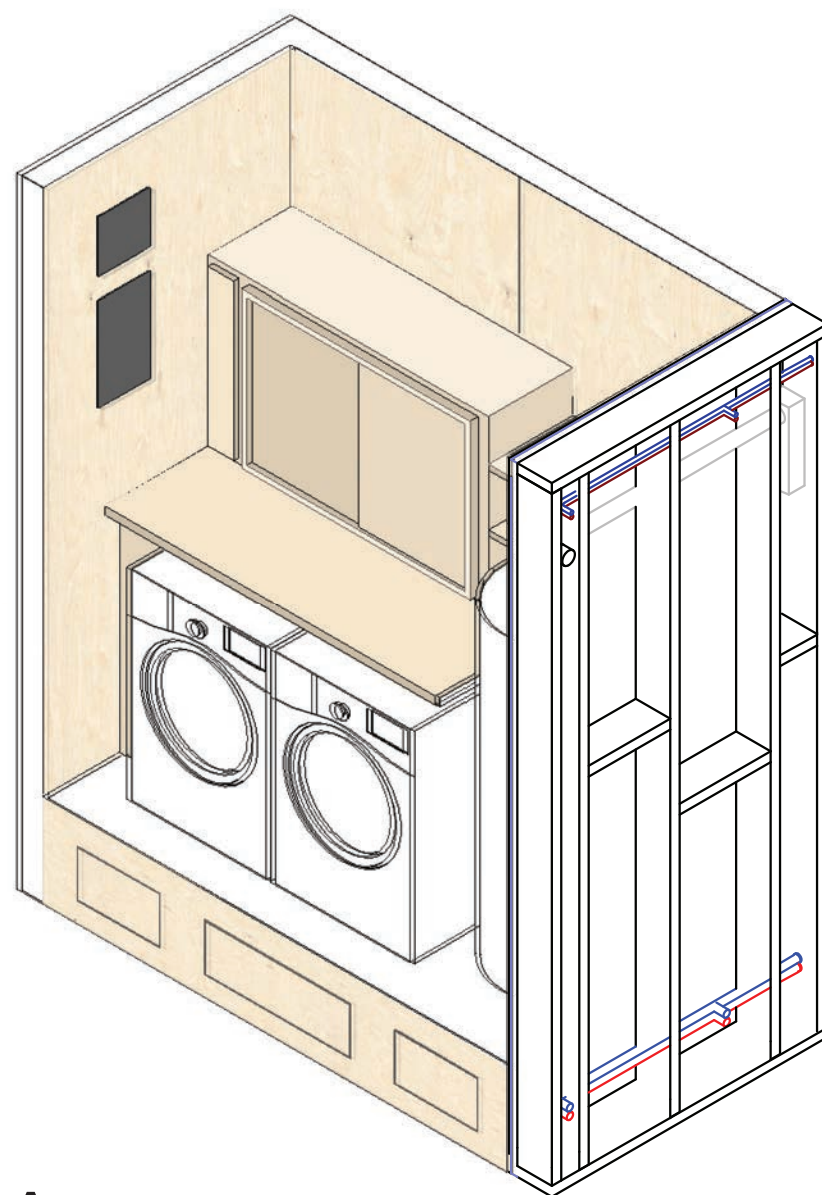
After reading about the different prefabrication methods concerning housing construction, I settled upon a hybridization of module-based and panel-based assemblies. This approach would combine the self-sufficiency of modularity with the ease of installing a panelized design, creating a layman-friendly workflow that will significantly shorten the time needed to go from assembly to home.

3

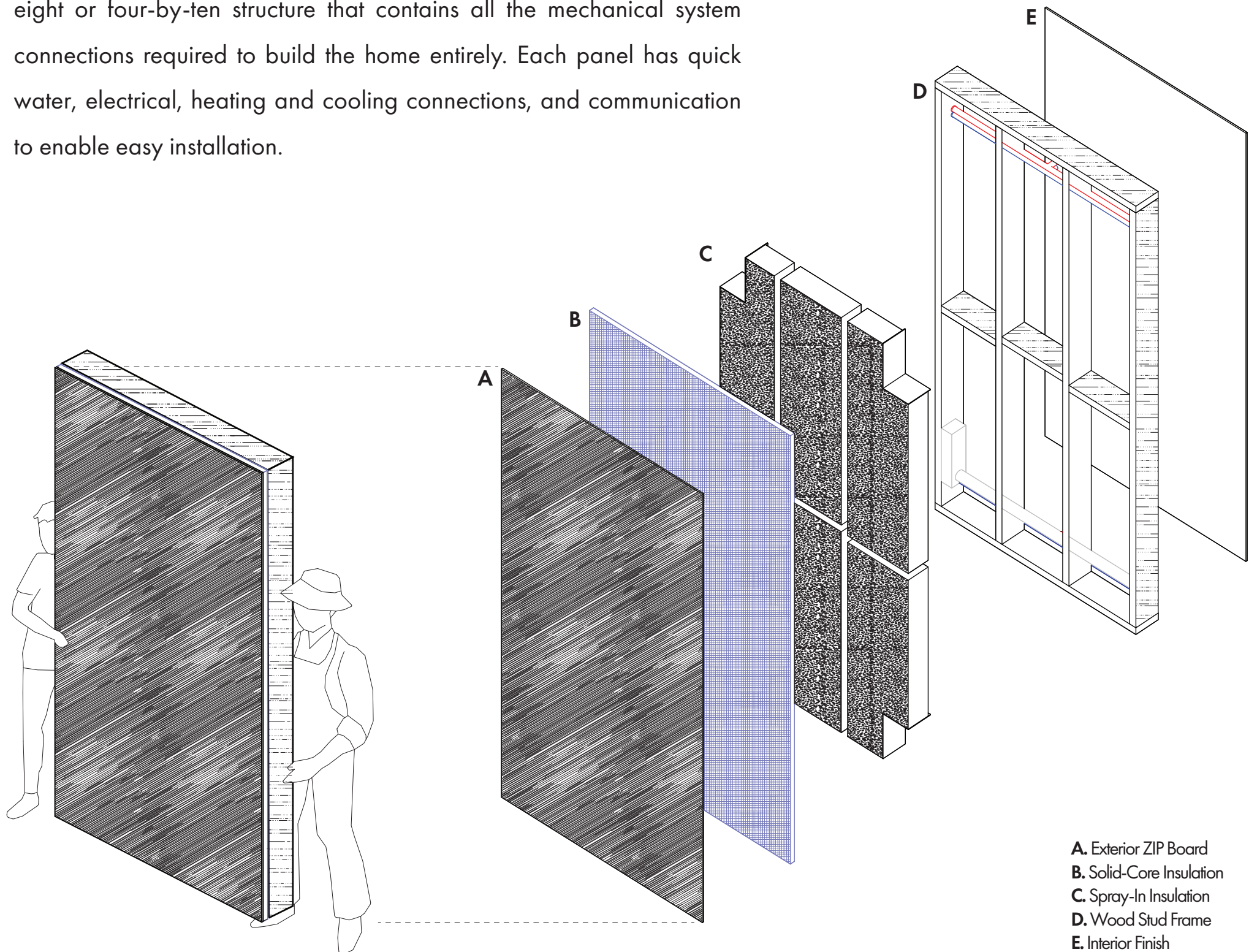
The composition would have a nexus of a single module that would contain the entry points for the home's wet and dry mechanical systems.

For electrical, this module would contain the main electrical distribution and breaker panel alongside an inverter to enable the attachment of solar panels for self-sufficient power.

The central water heater and laundry units would be placed on an isolated floor lifted above the ground plane for water. This enables the module to be delivered and installed as a complete unit, minimizing the amount of work needed to begin servicing the rest of the project and creating an inclusive process for inexperienced families.

**A**

1 From the central module is a network of panelized walls of a four-by-eight or four-by-ten structure that contains all the mechanical system connections required to build the home entirely. Each panel has quick water, electrical, heating and cooling connections, and communication to enable easy installation.



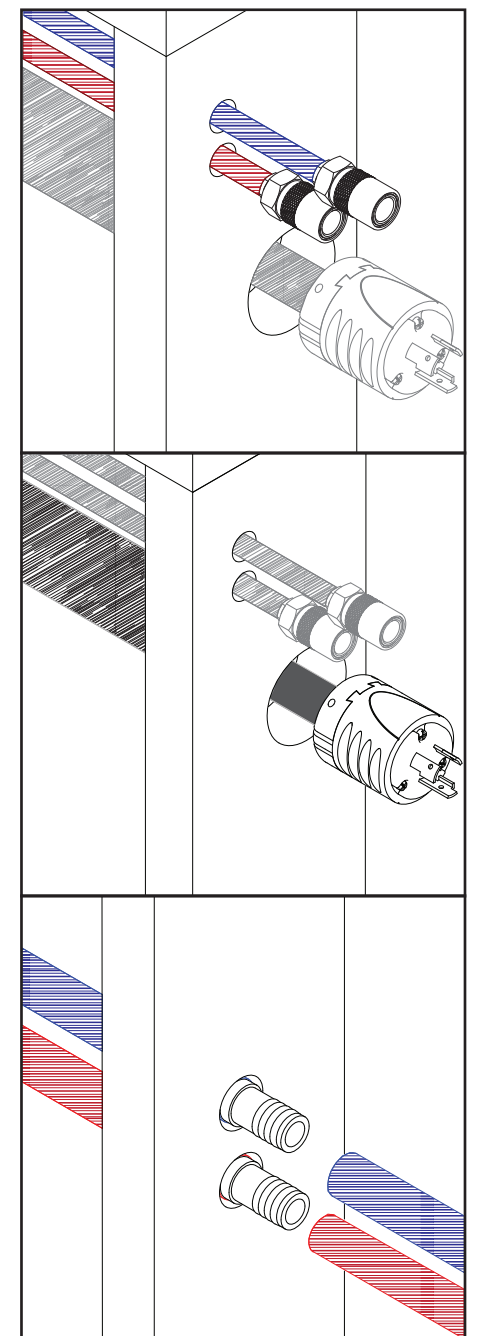
2 These systems feature quick connect and disconnect parts intended for maximum flexibility in the installation process and quick disassembly if a particular panel is needed elsewhere in the home. The panels are

connected together by all-thread connections that create an easily accessible connection type, where mom and dad or father and son can begin to build their home with only a wrench to tighten each connection.

3 The heating and cooling, which is done through the use of remote mini splits throughout the home, uses pre-charged copper tubing with a quick-latch system that creates a seal on installation and removal. This connection method prevents the need for a specialist to come onto site to charge the refrigerant lines and enables expansion of the mini split system throughout the house.

The electrical system features a power rail connected to a conduit that runs the length of the panel. A power rail acts similarly to a surge protector, in which it provides extended connection points (the outlets and switches on the panel) and as a primary safety before tripping the main breaker. The existing panel is connected to the next with a male-female locking connection on the conduit, allowing the family to plug in the wall panels as they're placed. Failures are limited to one panel because of the redundancy built into a power rail connection. The blown panel could be easily fixed and reconnected with a simple rail replacement.

The water lines make use of self-sealing screw connections on the pipes. Once the panels are attached, and the following water line has been placed in conjunction with the existing water line, the nut is tightened. The locker ring within the PVC nut creates a watertight seal that won't back off over time.

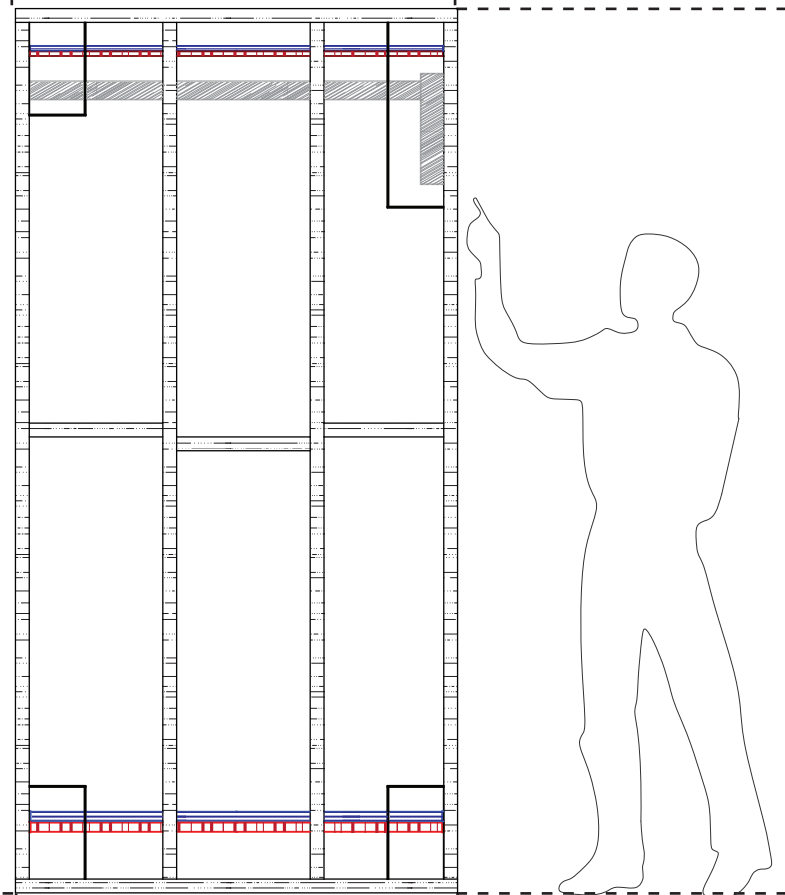


1 ABOUT THE PANELS

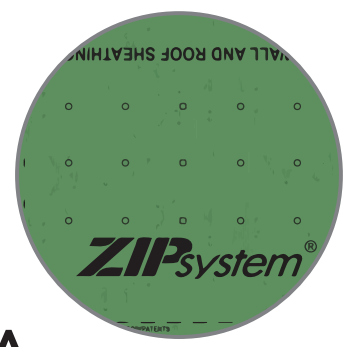
2 The solid core insulation provides extra strength to the structural panel while also providing sound-reducing benefits from the outside environment. The ZIP Board is utilized due to its high strength and includes a water membrane later.

On the exterior, these panels are joined together with ZIP tape before the exterior finish is added to create a waterproof seal. A variety of exterior finishes were explored in the project, with care taken to explore longevity and architectural appeal. For many of the designed housing examples, I chose a combination of vertical wood slats, standing seam, or brick for the solid panels and Corten steel or horizontal wood slats for panels that featured openings like windows or doors. The material change sought to accentuate the panelized nature of the home, and naturally aging materials like Corten “weeping” steel or wood would emphasize the passage of time much like a person or family dynamic.

The interior finishes explored ranged from drywall to wood; however, Research determined that the former may not be conducive to the design intent of the home focusing on longevity, so the material chosen was finish-grade plywood. Plywood is a durable material that is easily installed and removed if connections need to be serviced. The light touch of grain on many different plywood types creates an interesting wall pattern without being visually distracting and can be painted, stained, or left in a natural state, depending on personal preference.



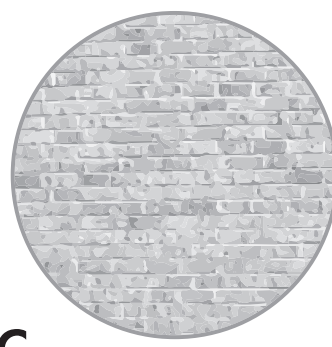
3 MATERIALS



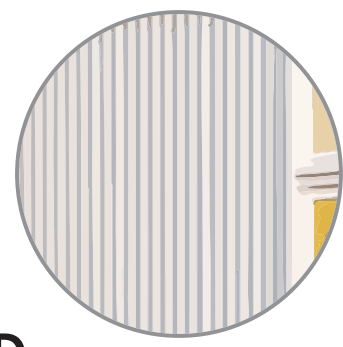
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B



C



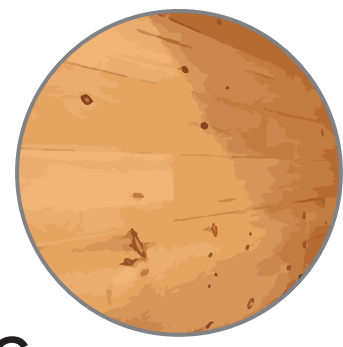
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E



F



G



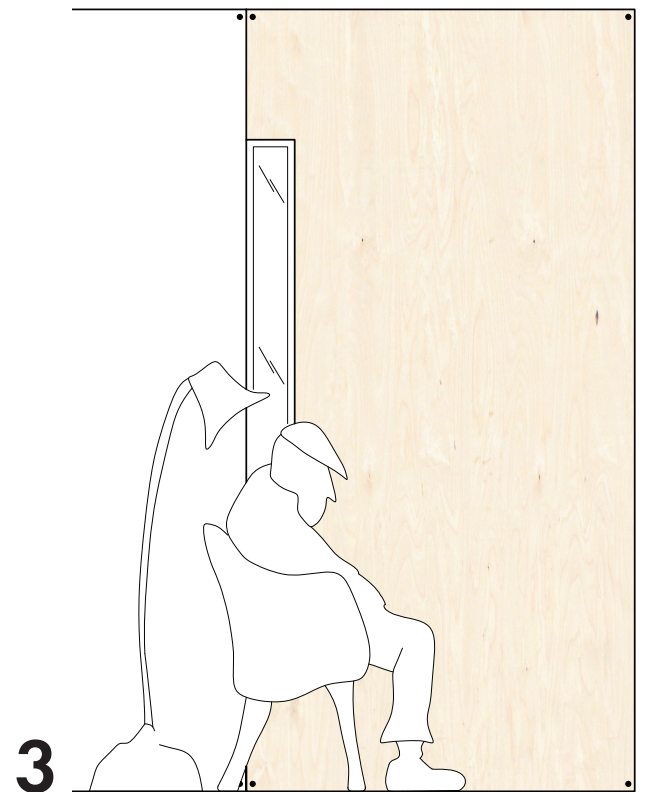
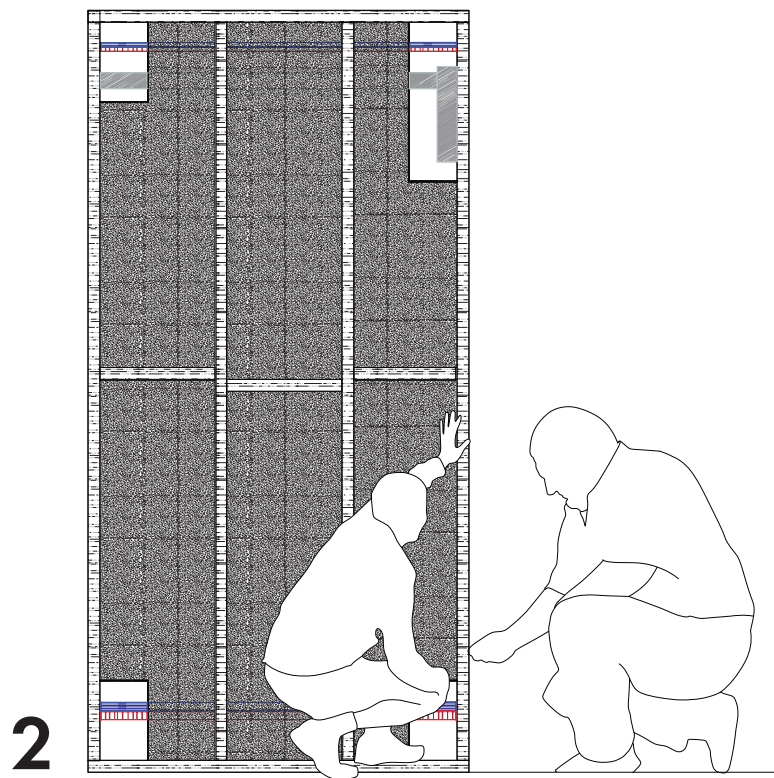
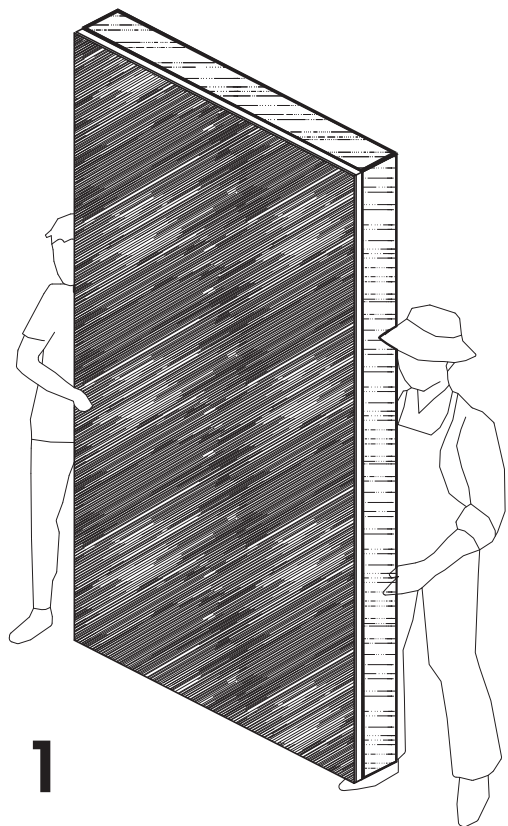
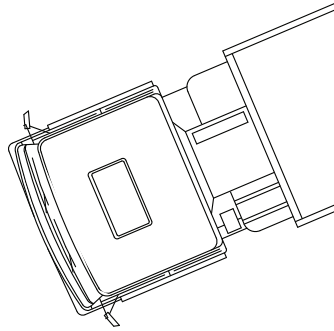
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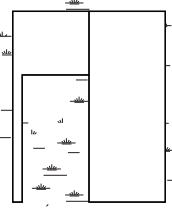
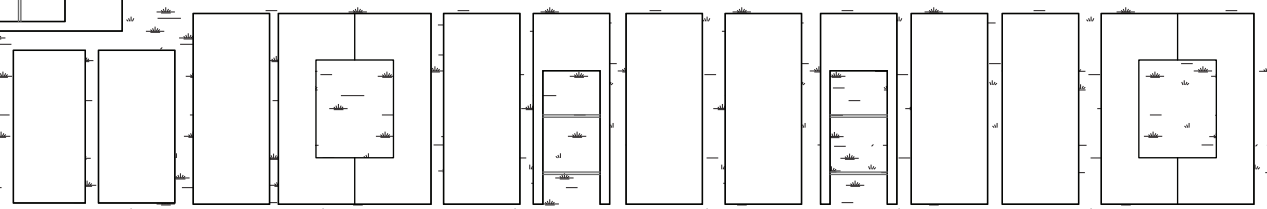
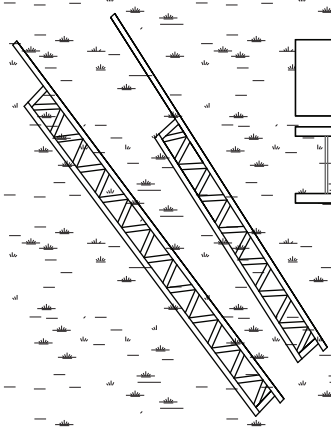
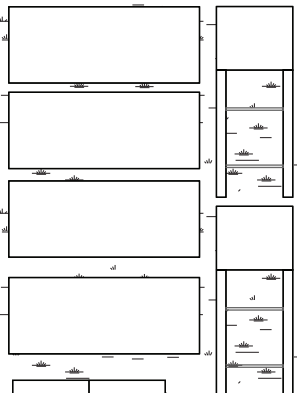
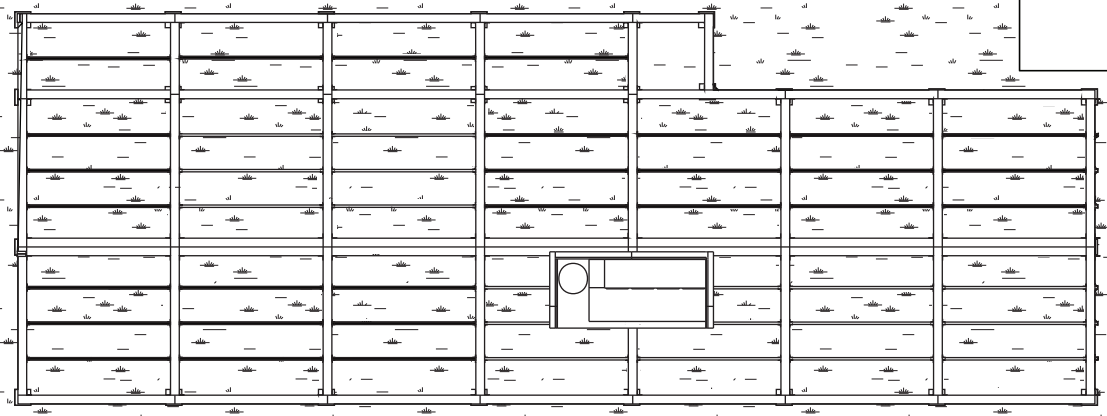
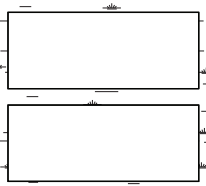
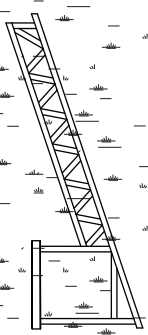
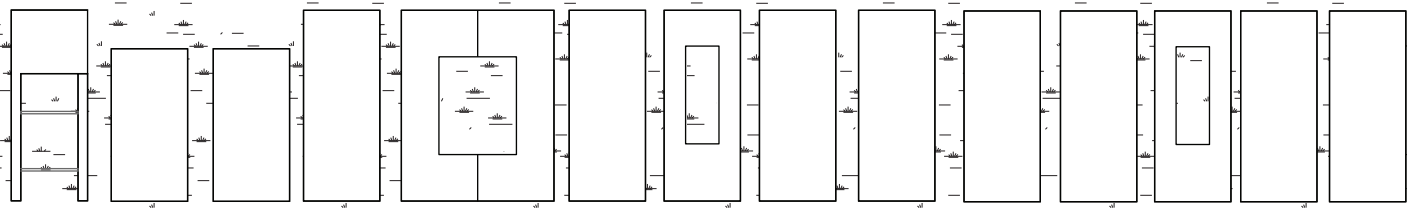
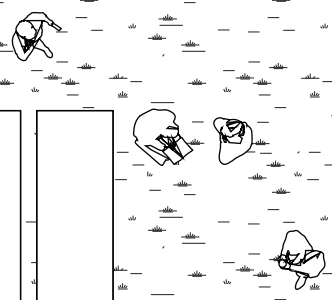
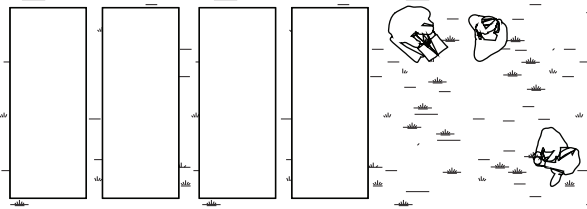
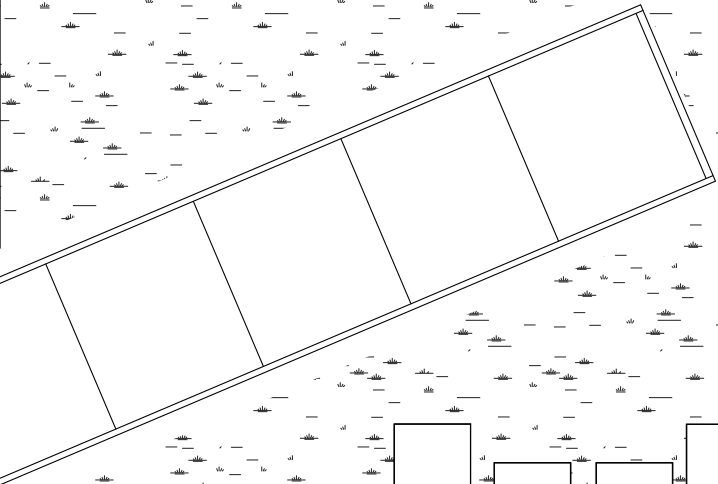


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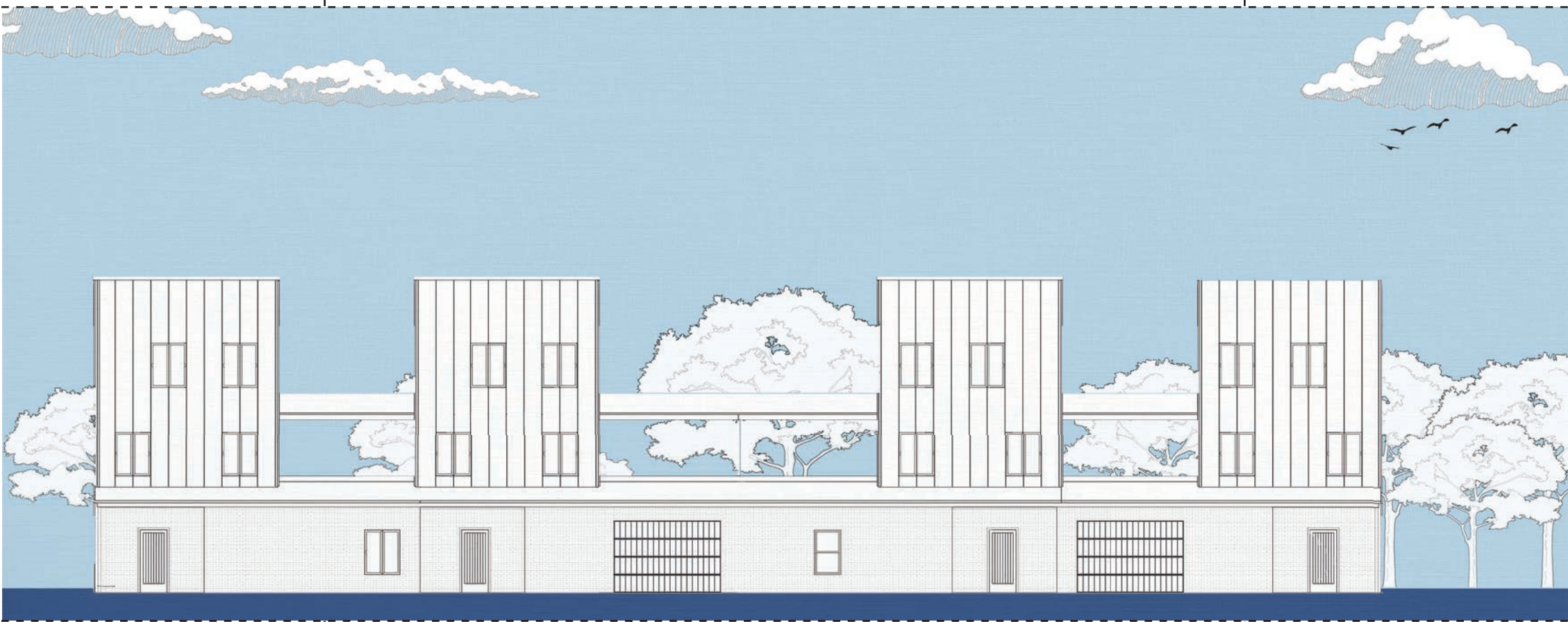
- A. Exterior ZIP Board
- B. Concrete Panel
- C. Brick
- D. Standing Seam Metal
- E. Horizontal Wood Siding
- F. Vertical Wood Siding
- G. Interior Wood Finish
- H. Interior Gypsum Finish
- I. Interior Plywood Finish

After it's brought onsite, the entire home can be assembled by a family, or alongside a few friends, with only a small number of tools in a short amount of time.





1 THE TOWNHOMES

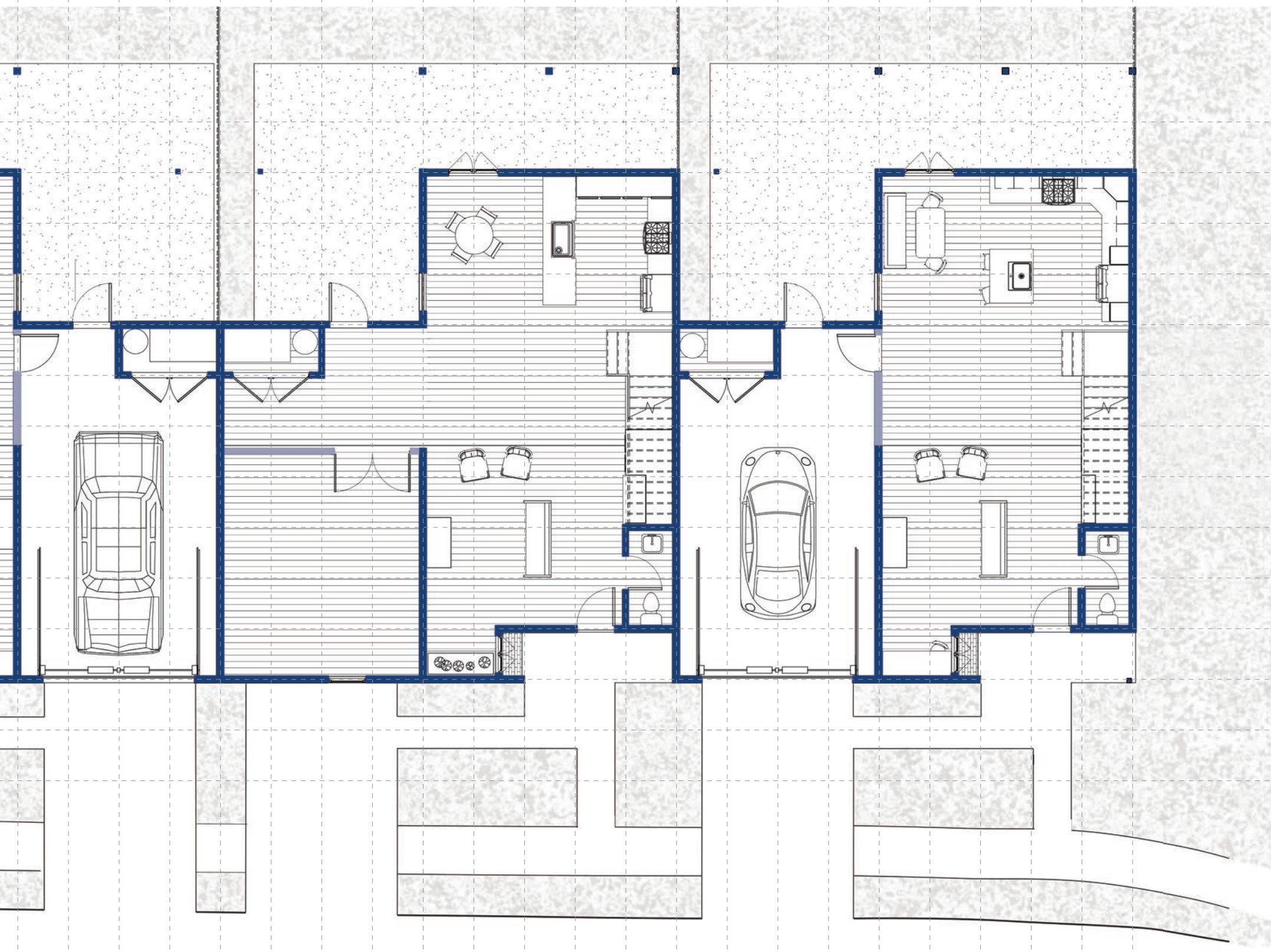




1 The townhome design is a three-floor design with shared walls within a ground footprint of approximately 1,000 square feet. The townhomes were designed with the living and kitchen areas as the ground floor and with an attached garage that can be filled in with the panelized assembly system to create a flexible space for the family to use or as another bedroom. The laundry module is placed within the garage footprint, which establishes the nexus for all the wet and dry mechanical systems in a centrally located area for the townhome.

This design created a unique balance between privacy and interaction and encouraged the development of a family through floor plan layout and interaction between themselves or their neighbors without sacrificing their desire for privacy.

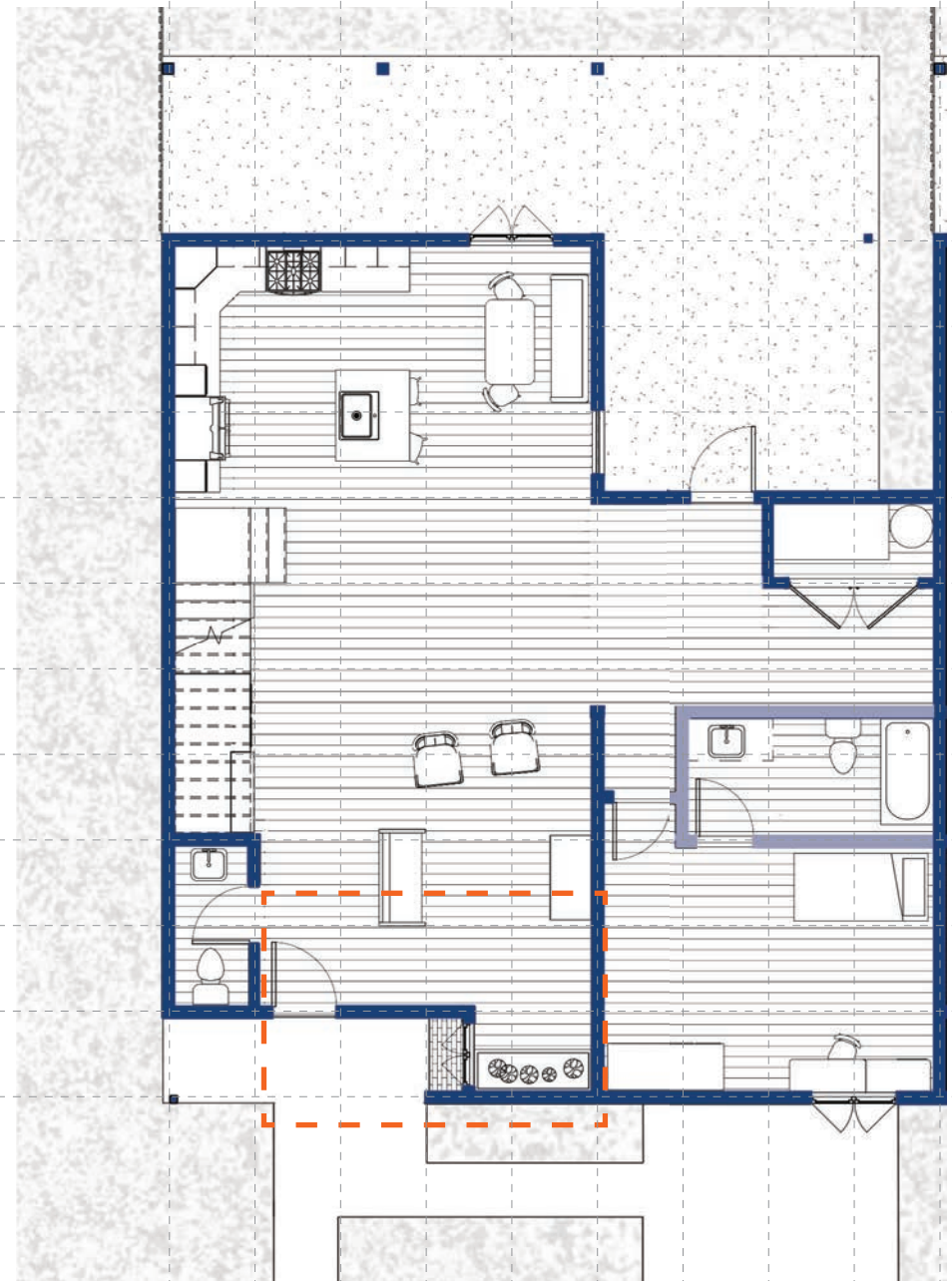




1 The overall design of the townhomes creates opportunities for family interaction on each floor. The ground floor was designed with privacy in mind as no windows face the street; however, there is an instance of a projection from the floor plan with a built-in planter system or desk. This extrusion has a window inset within a brick-clad ledge that looks out over the front door. This provides a private view of the outside, allowing those who are watering the plants or studying to connect with the outdoors without being observed from the street.

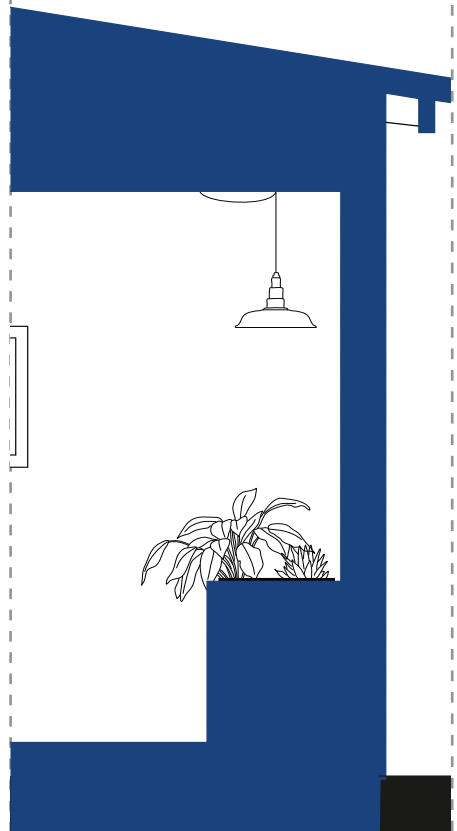
The brick ledge outside the window creates a space where flowers and ornamentation can be placed to help distinguish one's home.

A Floor Plan



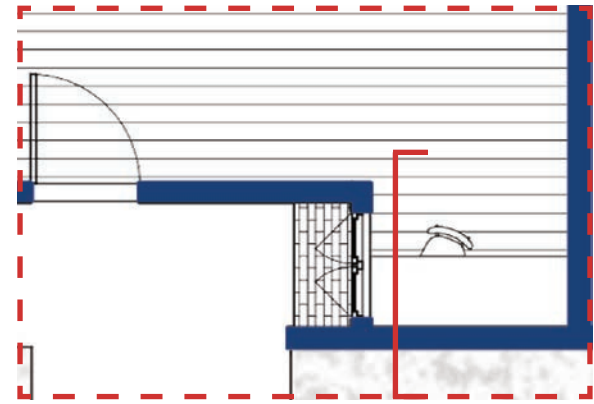
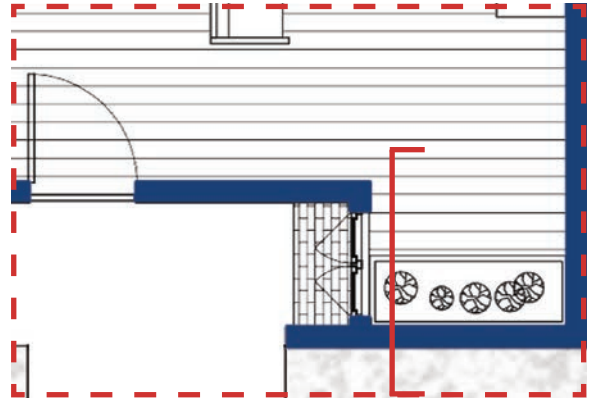
A-A

Planter Section



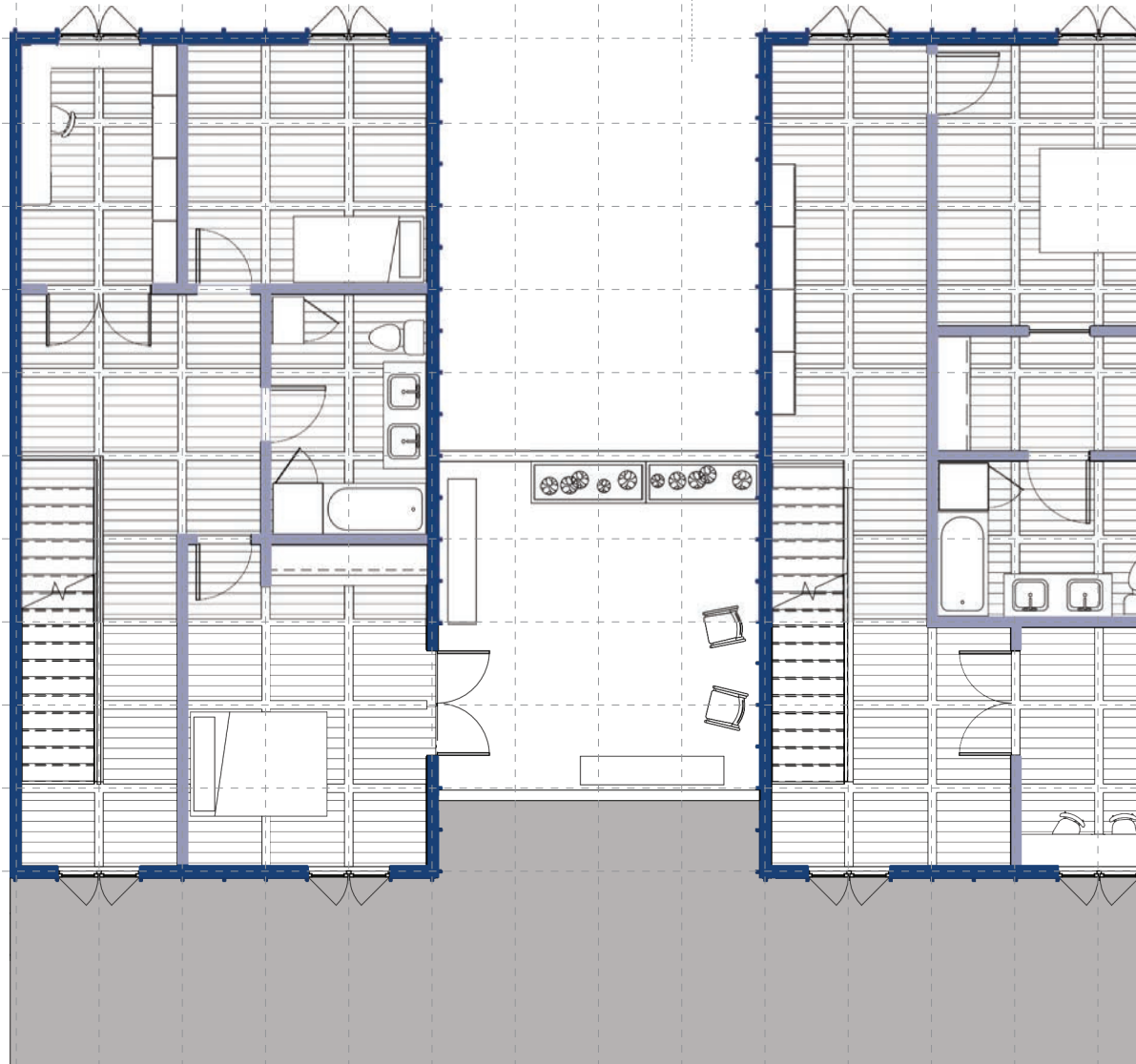
A-B

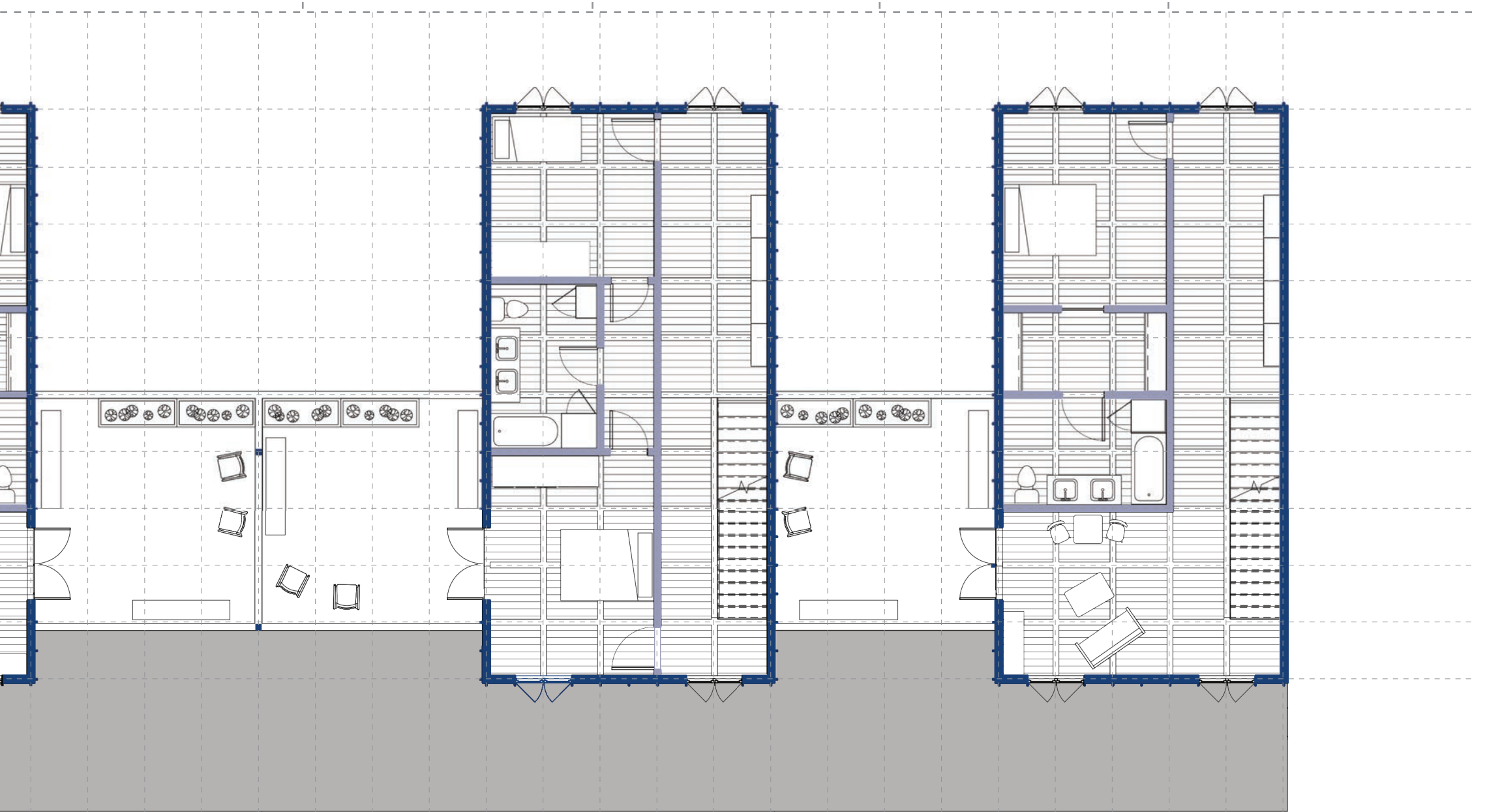
Desk Section



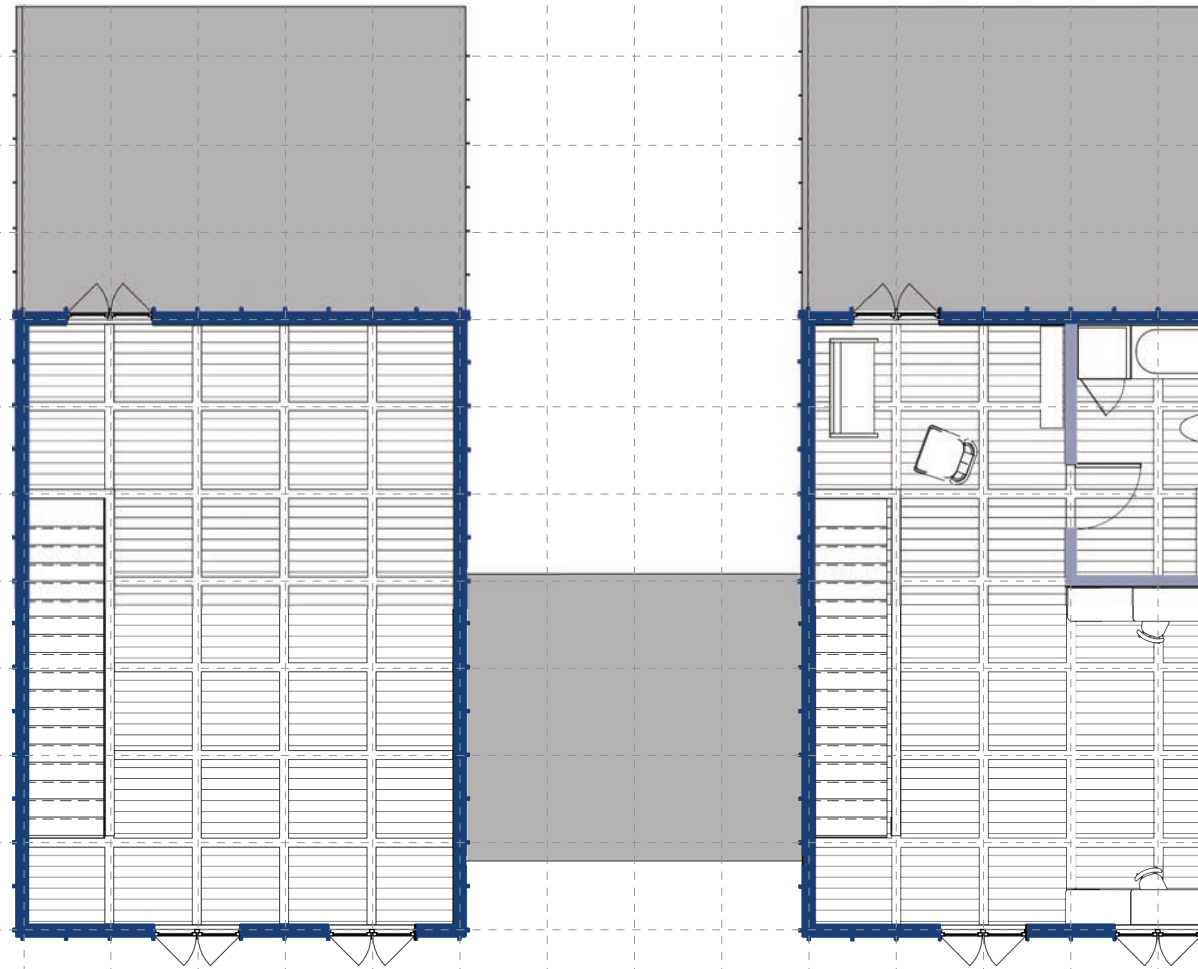
2 The second floor is finished with different examples in each designed floor plan. A single bedroom and large flex space for empty-nesters to utilize, two bedrooms and a usable space; two bedrooms and a shared bathroom for possibly when a young child joins the family; and two bedrooms with separate bathrooms for after the child ages and needs some privacy but still needs to be nearby.

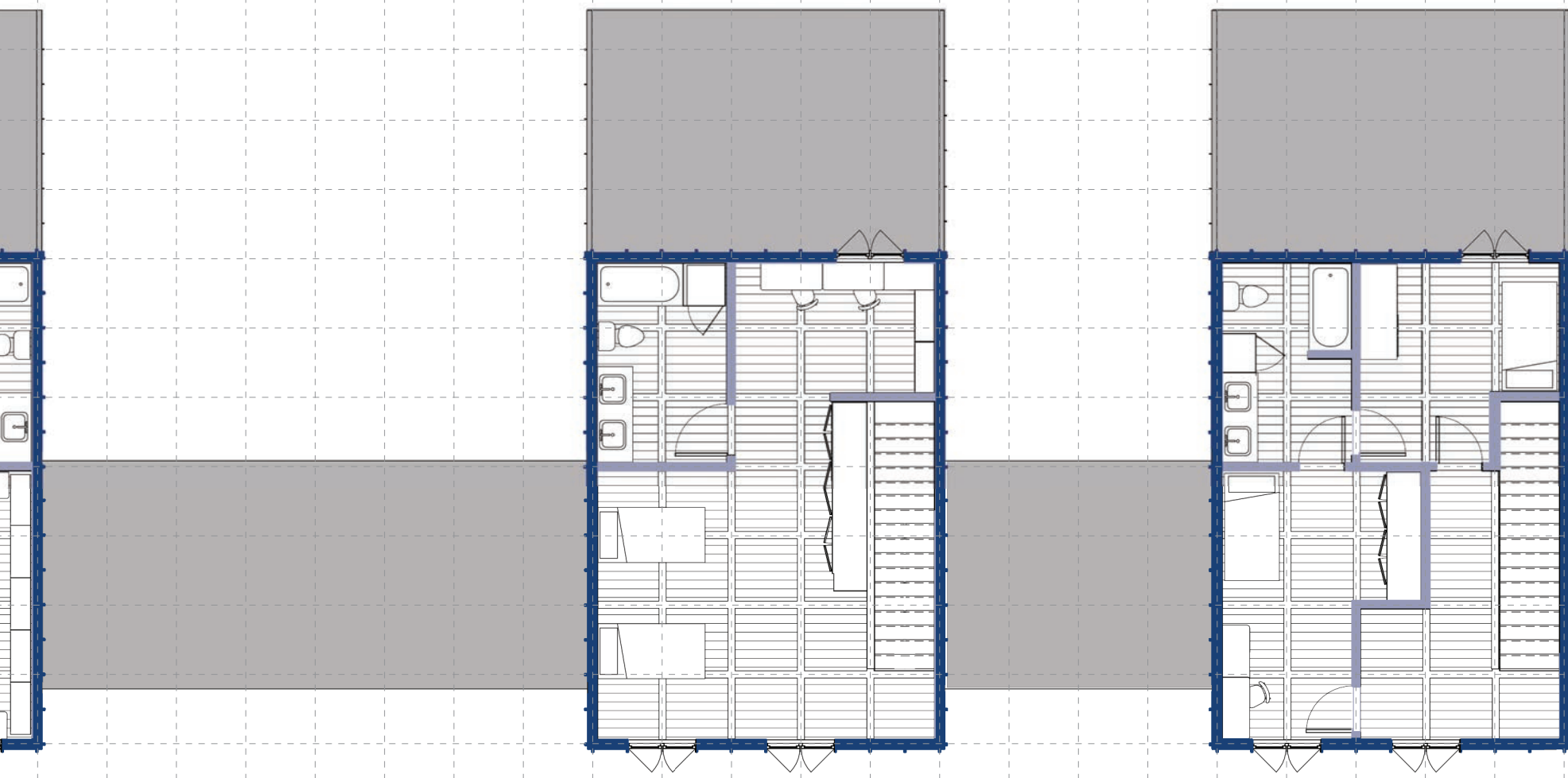
The second-floor balconies are lifted off the ground for privacy but create instances of inter-home interaction and can allow residents to visit with neighbors next to them or across the street. The roofs above slope downward towards the road, giving some privacy to each balcony while opening up the view to the forests onsite behind the townhomes.



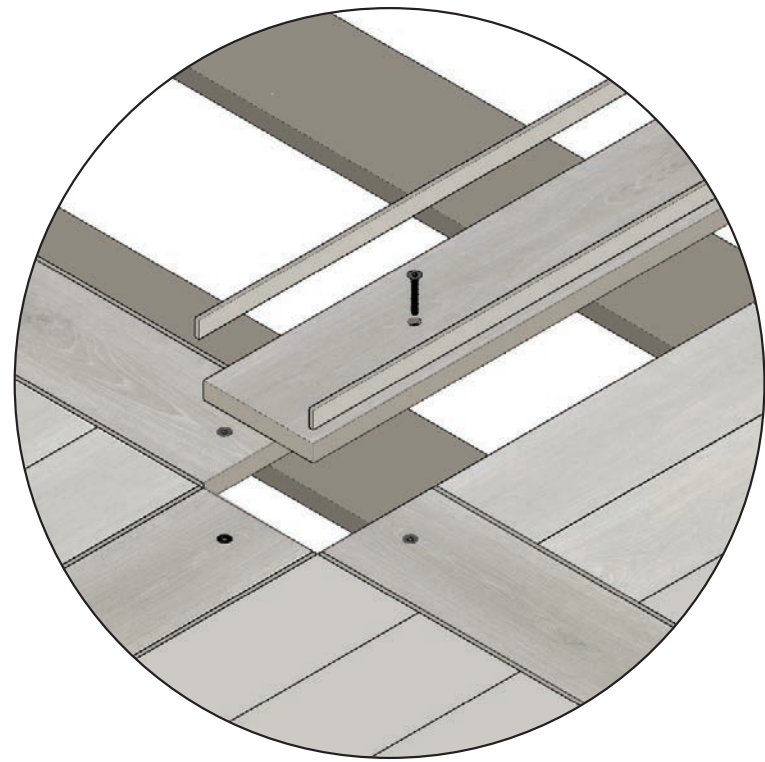


The third floor is fully finished but non-partitioned to act as storage, but I created **3** examples of a large office space for work-from-home events like these years of COVID, a shared bedroom space for siblings, and a shared bedroom space alongside a study space, or separate bedrooms joined by a bathroom. All these potential floor plans can be utilized at different points in a family's life, potentially expanding a townhome to contain up to five bedrooms in a ground footprint of only approximately 1,000 square feet.





1 To create an expansion process as minimally invasive as possible for daily life, I created a quickly removable floor system that runs in a four-by-four grid across the floors of each townhome level. This grid -- denoted by a slight change in floor material to delicately accent the grid system -- has an easily removable surface that allows the prefab panel system to slot easily into the finished floor; and all of the removed pieces can be stored for either rearranging walls or returning the townhome to its pre-divided state.



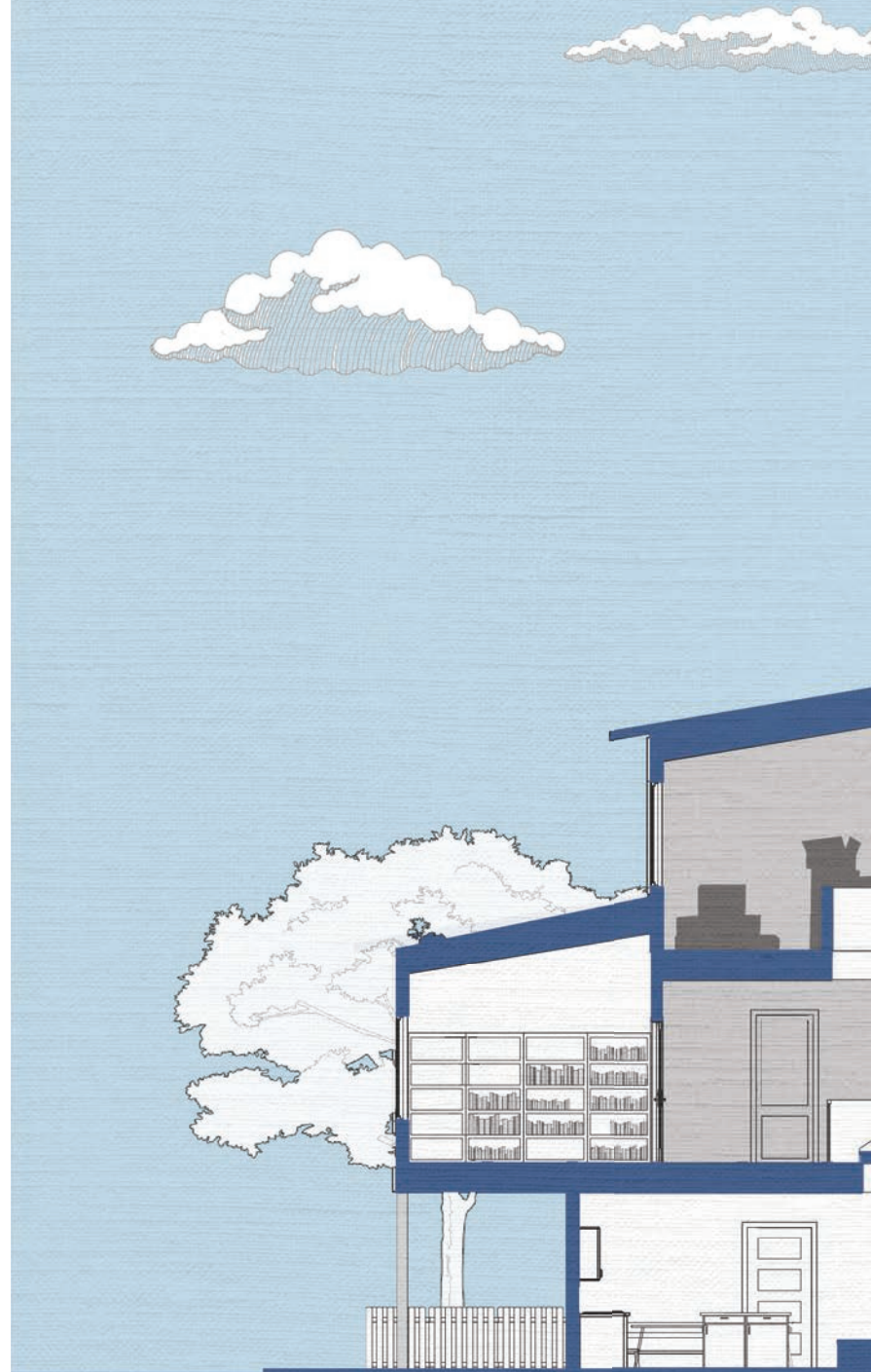
2

Considering the limited amount of floor space in such a narrow floor plan, I aimed to provide alternatives to traditional storage options. One of these was a staircase with a unique built-in, which offers opportunities for multiple types of storage and a place to sit down after work and take one's coat or shoes off. Storage underneath the coat rack provides a place for backpacks, school supplies, or anything that someone might need as they leave home for the day.

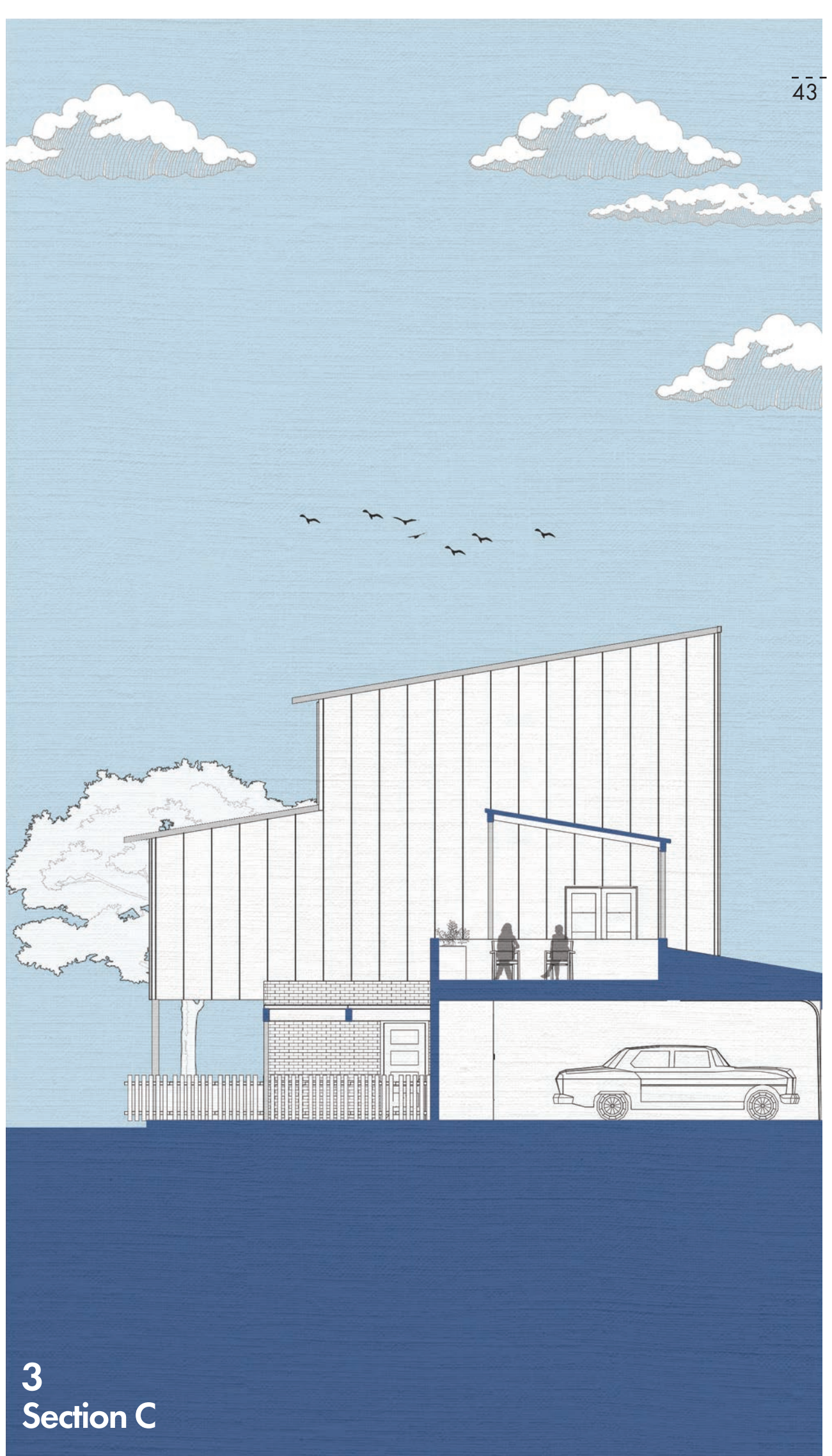
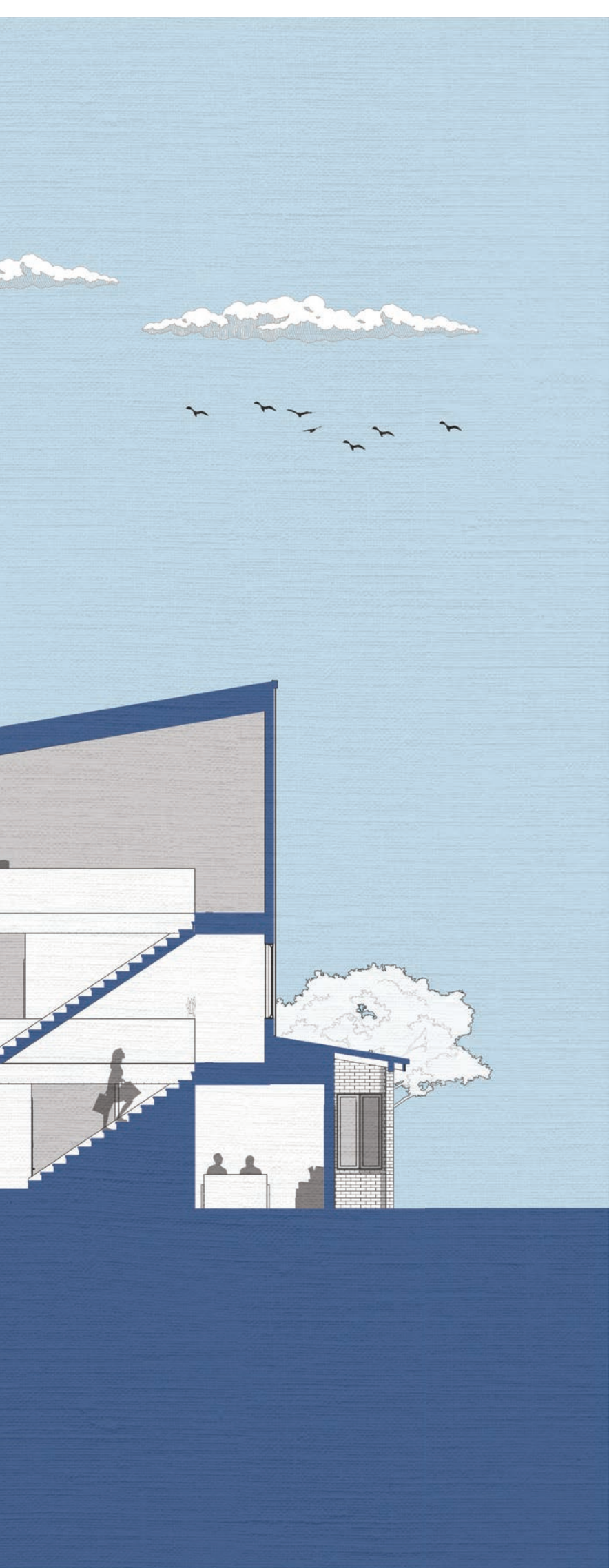




1
Section A

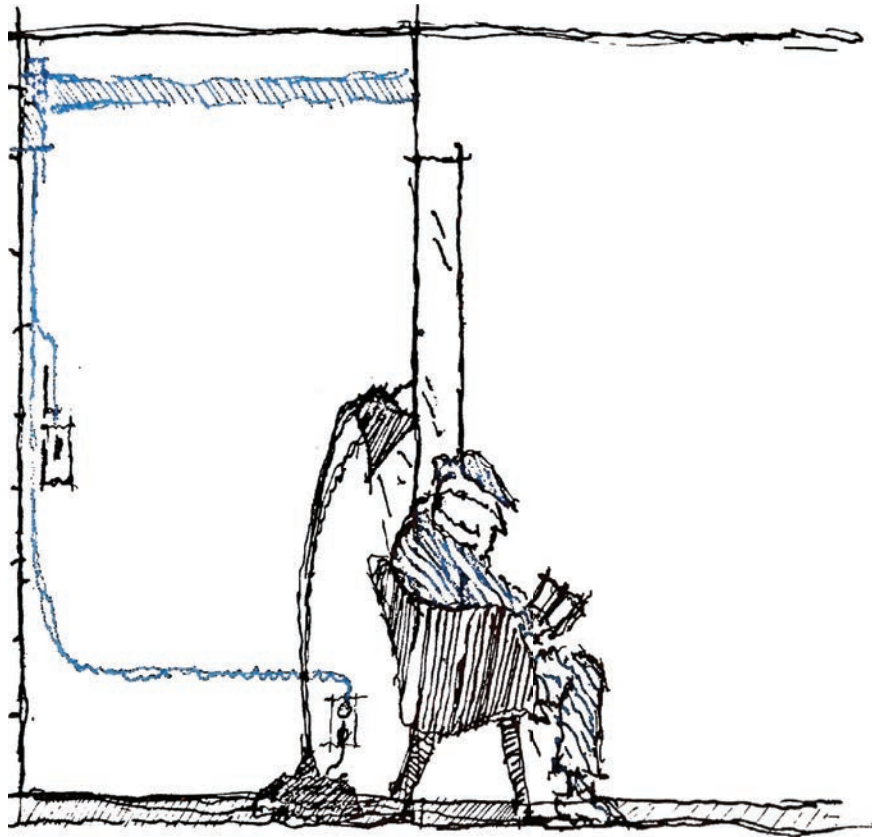


2
Section B



3
Section C

1 THE ADAPTHAUS





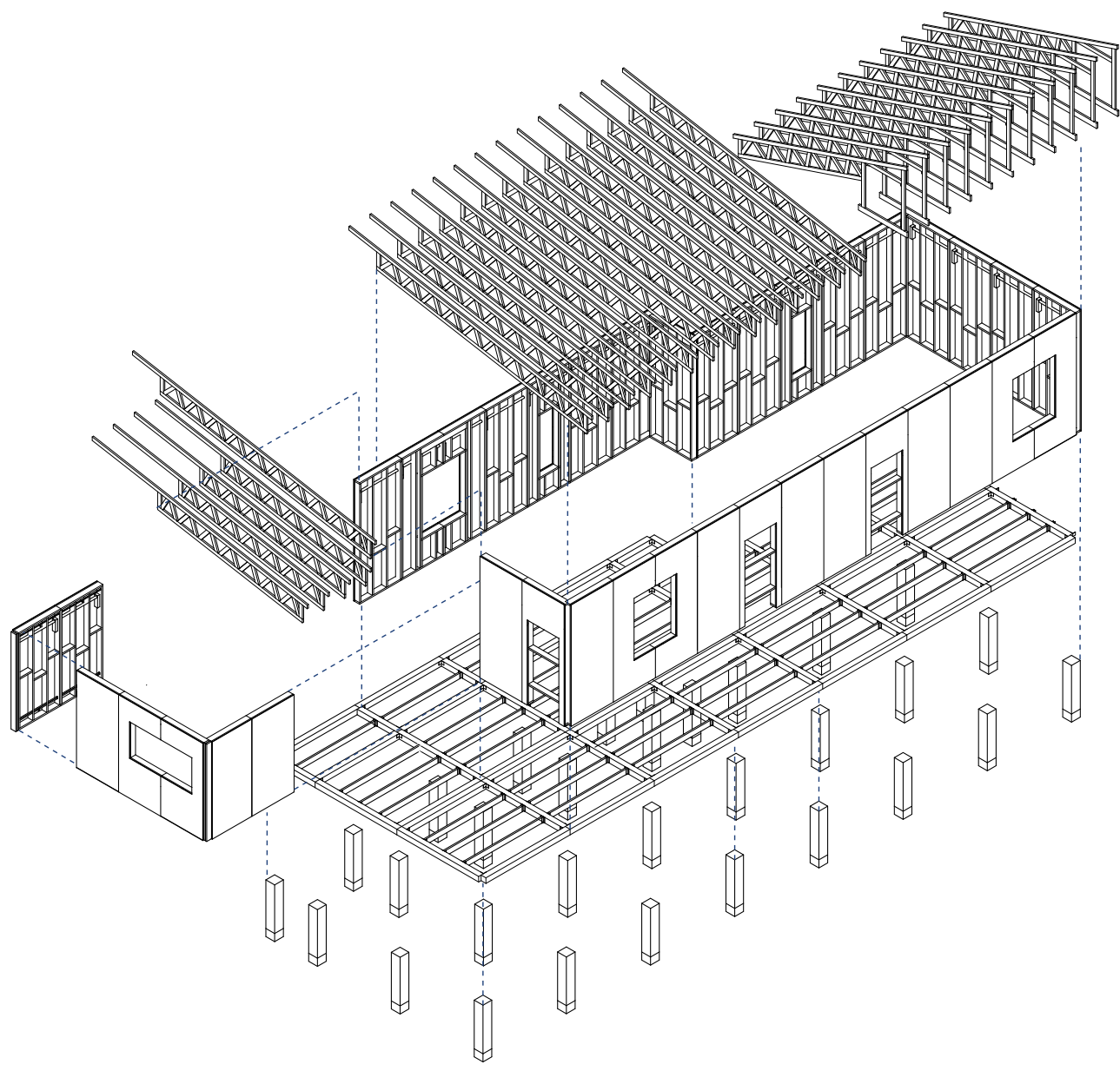
1

The development of the single-family home required deep thought over the assembly process. While the townhomes were an exercise in adaptability within a fixed perimeter, the house plan explored total adaptability. Complete adaptability required an understanding of inclusive layouts that benefited privacy while still encouraging interaction between the family or visitors who might have stopped by for the evening.

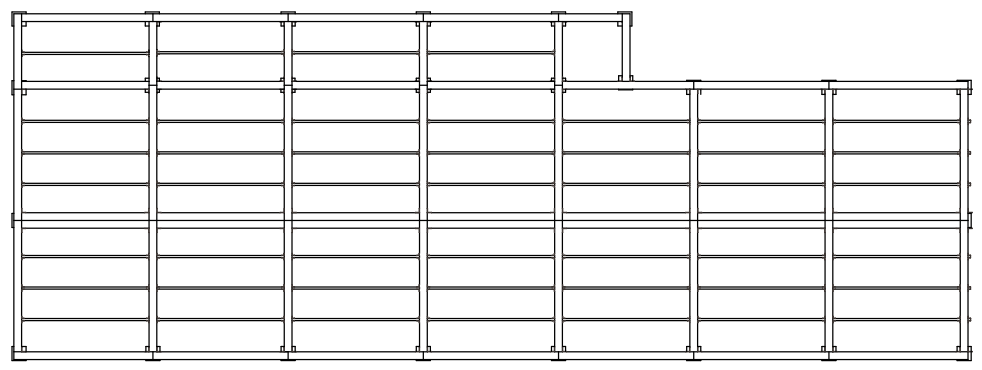
Designing a fully adaptable housing assembly also required considering a similarly capable foundation system. The solution became a pier and beam system, which had many positives compared to concrete construction. Pier and beam foundations create opportunities for constructing homes on many different topographical scopes with comparatively few materials. The foundation was designed on an eight-by-eight grid to follow the four-by-four panel system, fitting with almost any assembly configuration possible. By slightly inseting the main sills around the foundation, it creates an opportunity for expansion at each pier location allowing families to add to the structure whenever needed. The growth potential is supported by the repeated use of similar-sized structural members to create a simplified system that embraces expansion.

Piers are significantly more straightforward to dig and build than other foundation solutions, and the precut sill and joist system creates an easy-to-follow housing project component. The wet and dry mechanical systems are run through the home's walls, which lowers the 18-inch crawl space to a six-inch air gap. This design preserves the benefits of an air barrier under the house and protection from termites or other critters that may try and make this place home. A black mesh around the perimeter prevents animals from entering under the home and creates a shadow line that accents the chosen construction type.

A



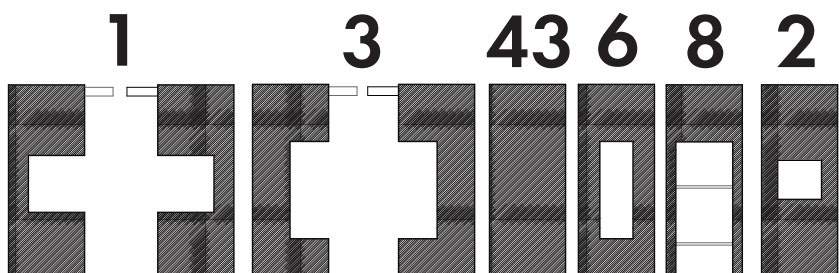
B



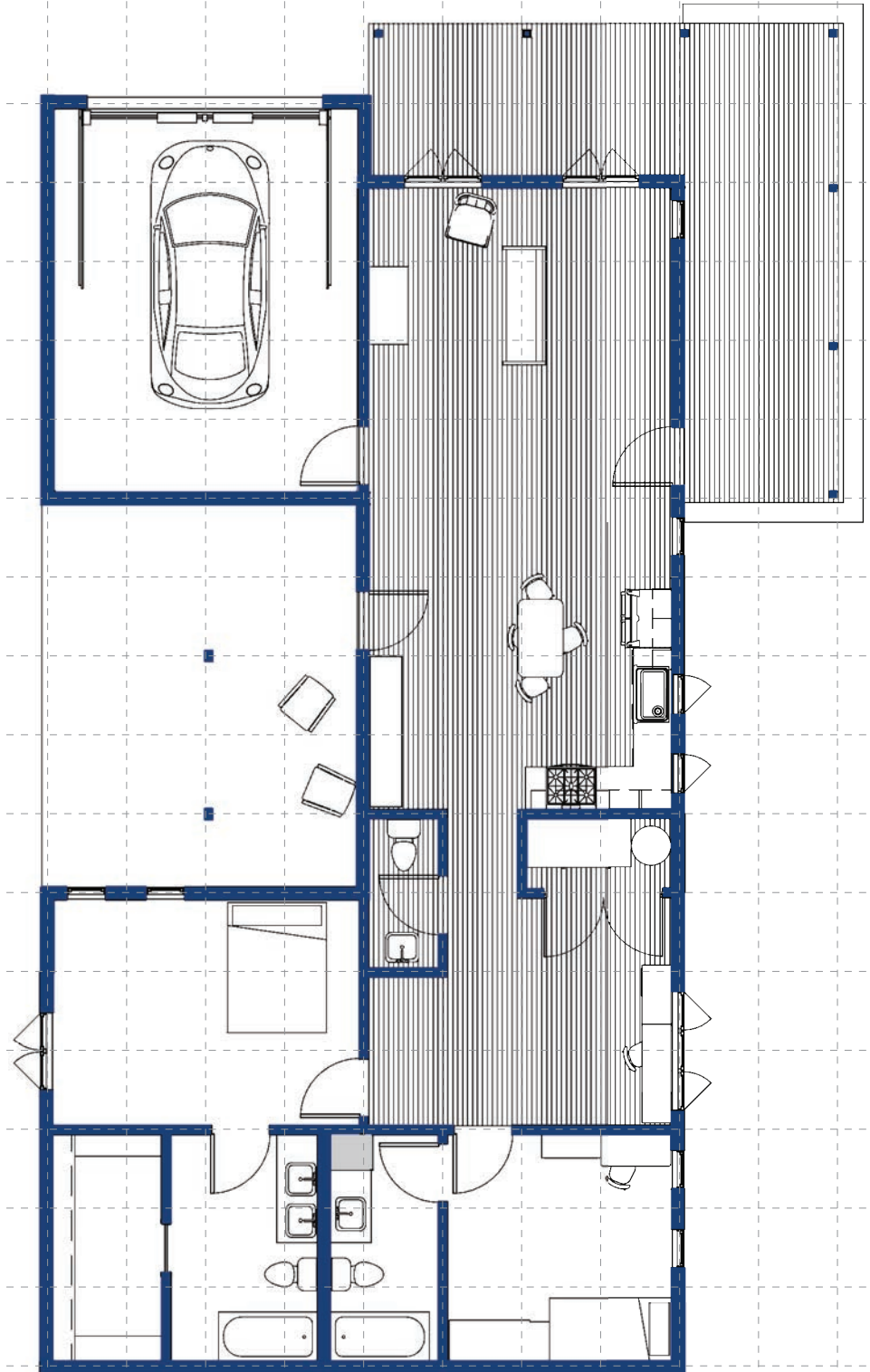
1 HOUSE ONE

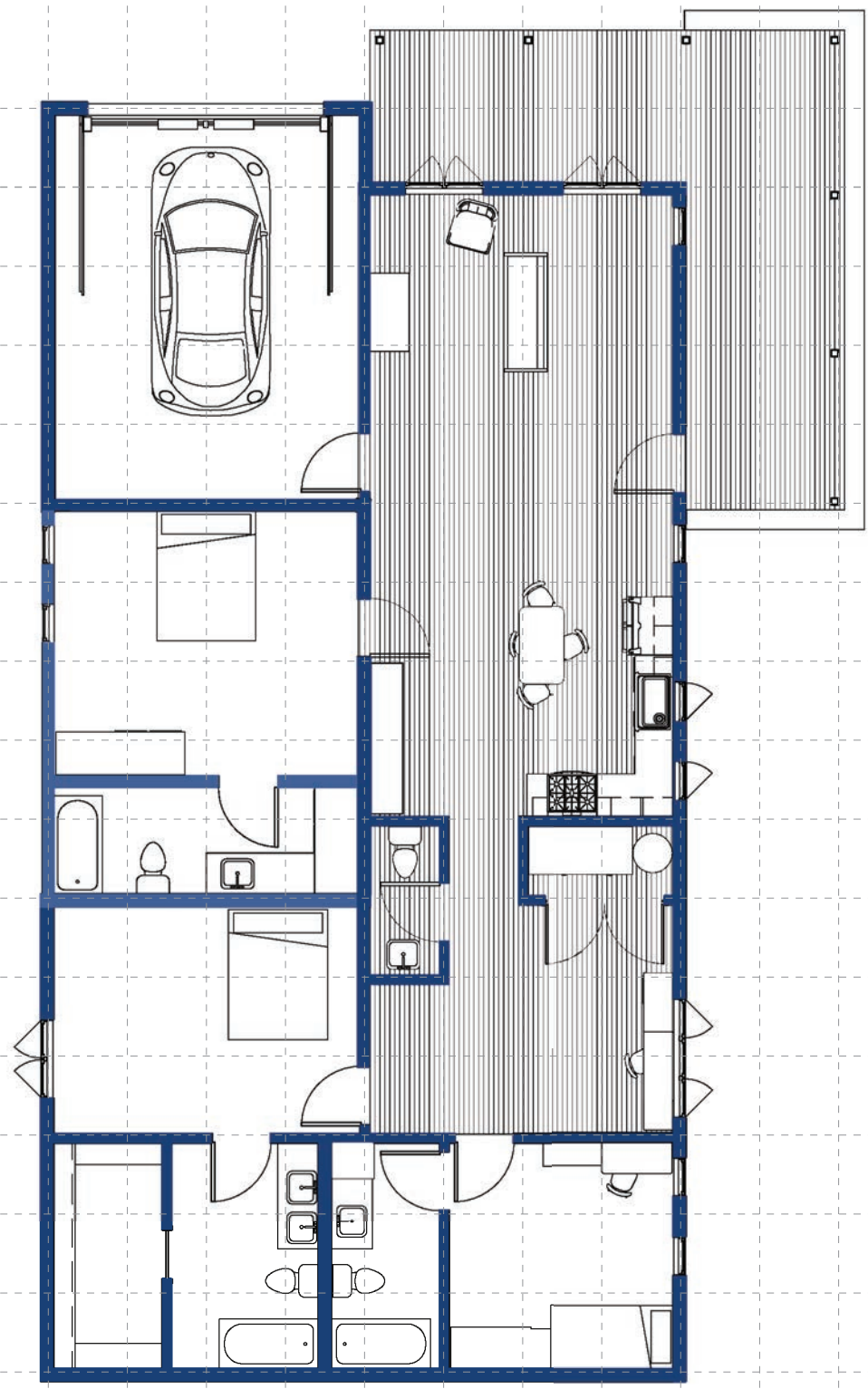
2 A longitudinal floor plan designed around a central public corridor that connects an enclosed porch that can be filled as an addition. This home can begin as a one-bedroom with an extended viewing porch that can be converted up to a three-bedroom without expanding the foundation. The home prioritizes a close family connection through the spatial consideration of the bedrooms.

It also includes a large front porch that wraps around to the front door to give the opportunity for outside gatherings.



3A





3B

50



1
Front Elevation



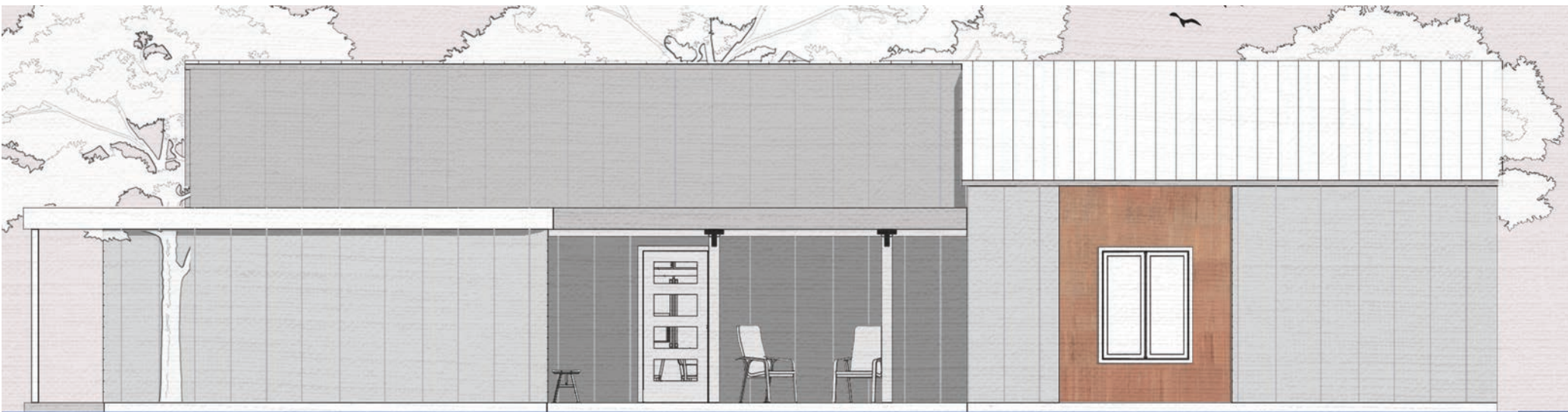
2A
Back Section



2
Back Elevation



1A
Side Section



1
Side Elevation - No Addition



2
Side Elevation - Addition One

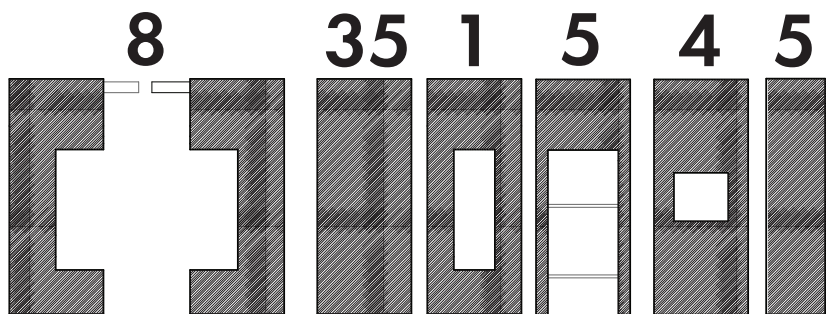
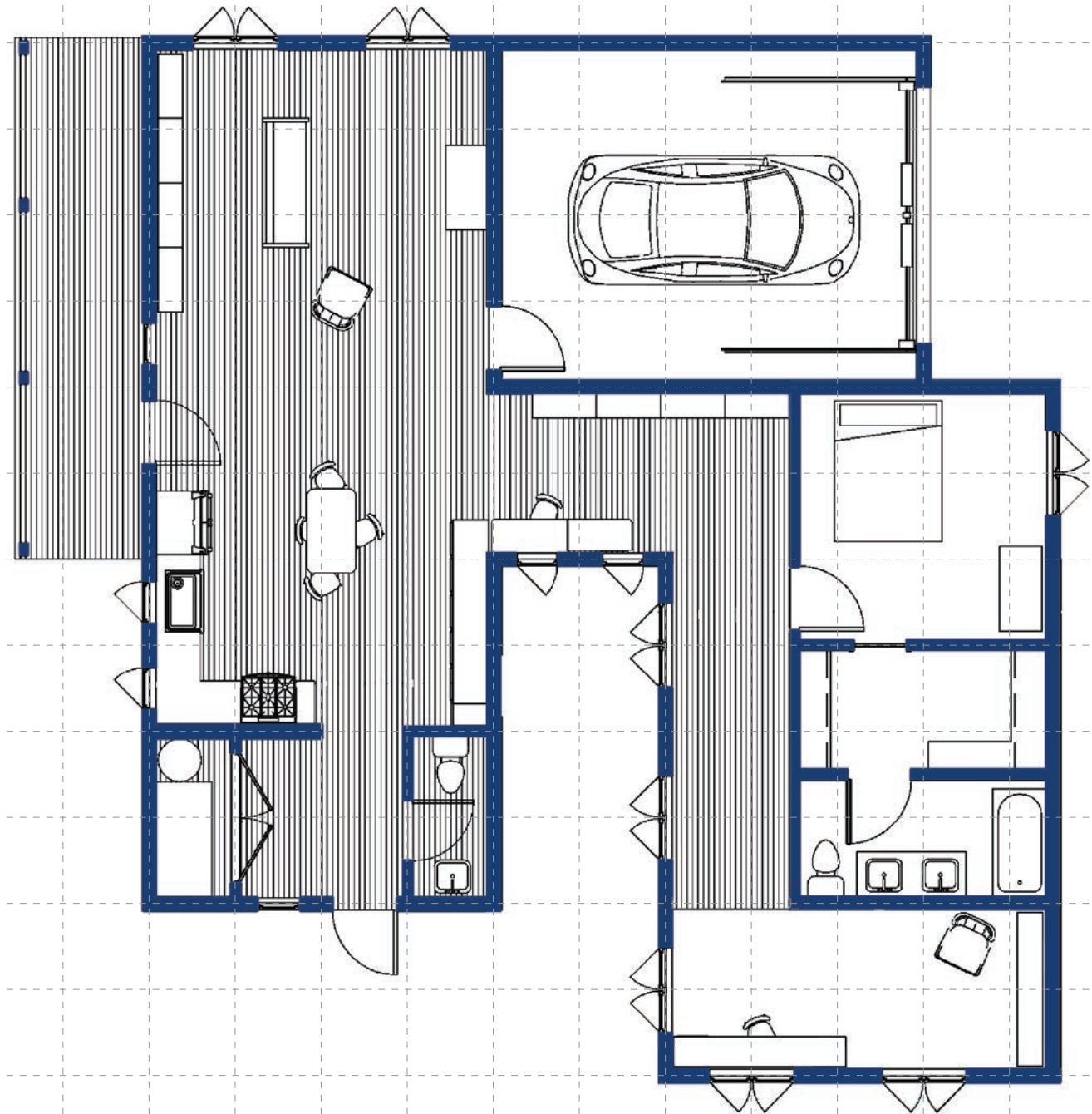
1 HOUSE TWO

A floor plan that wraps around an exterior green space that brings light into the interior spaces.

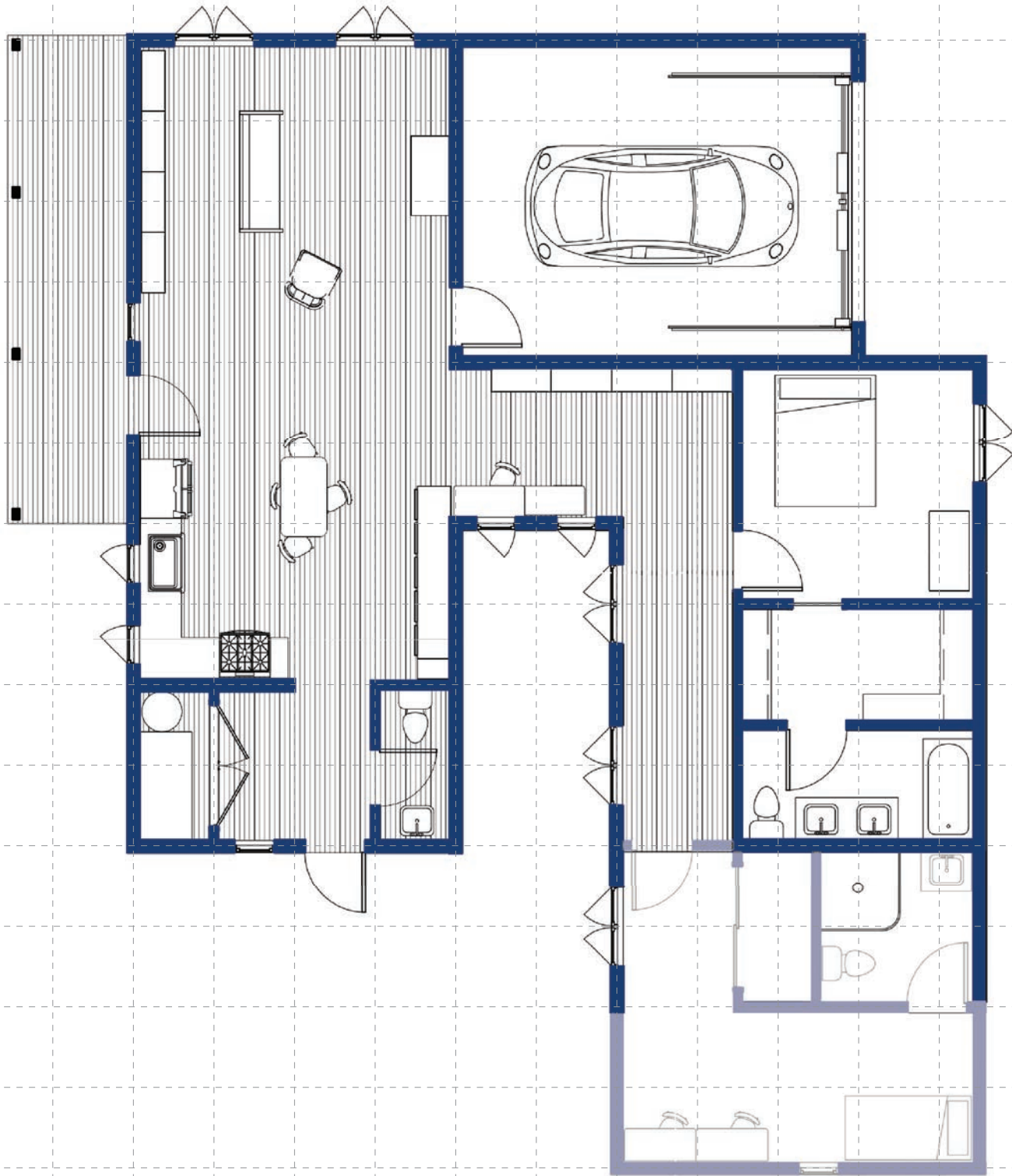
2

This home is spatially divided into public and private, with the lower ceiling of the transition space providing an evident spacial change. As a clear example of a transition between public and private, this home utilizes movement and spatial design to create this division, which would be great for a long game of cards on a school night.

This floor plan expands from a one-bedroom to a two-bedroom, providing lots of space for a growing family.



3A



3B



1A
Front Section



1
Front Elevation



2A
Back Section



2
Back Elevation



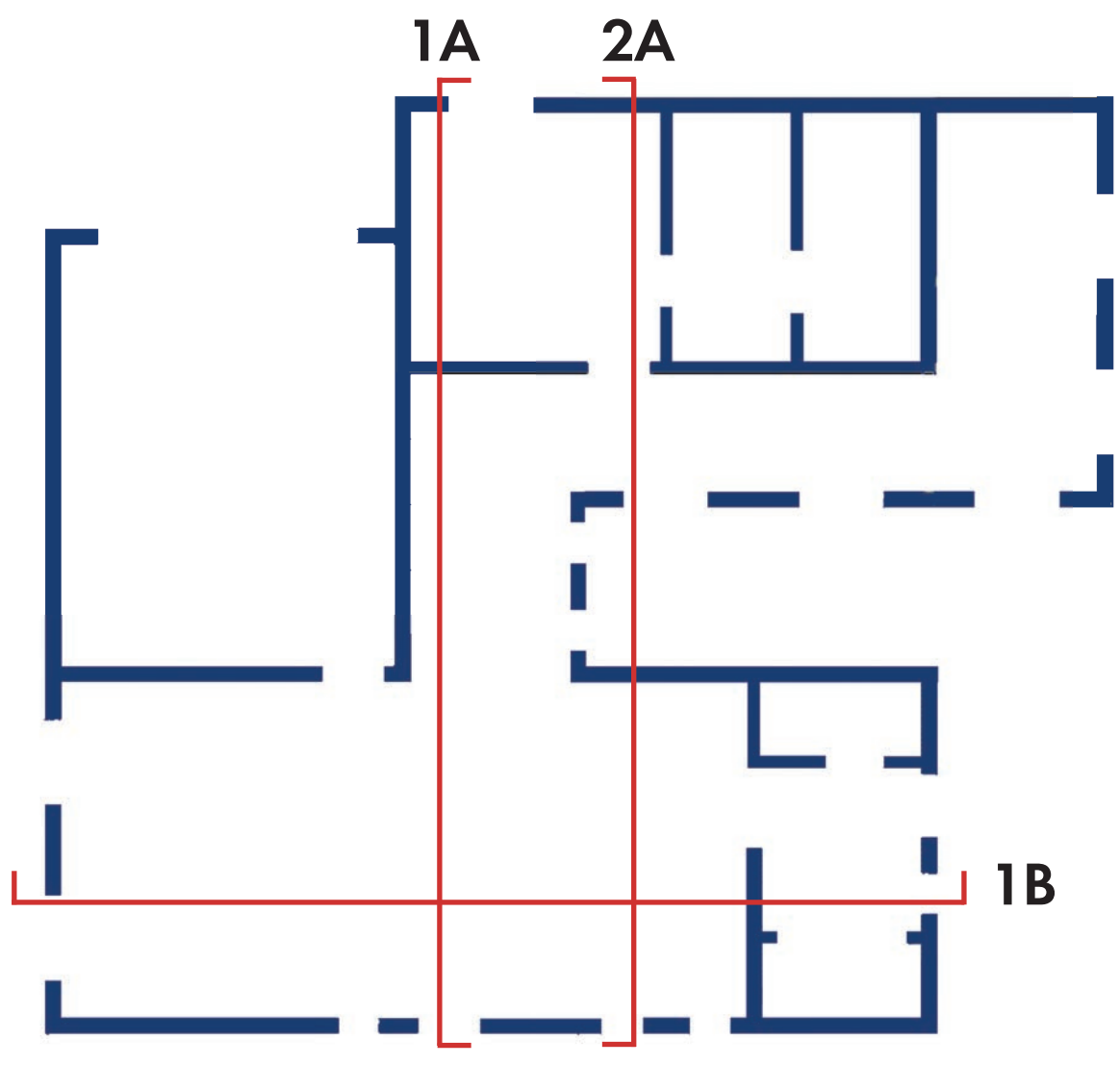
1
Side Elevation - No Addition



2
Side Elevation - Addition



1B
Side Section



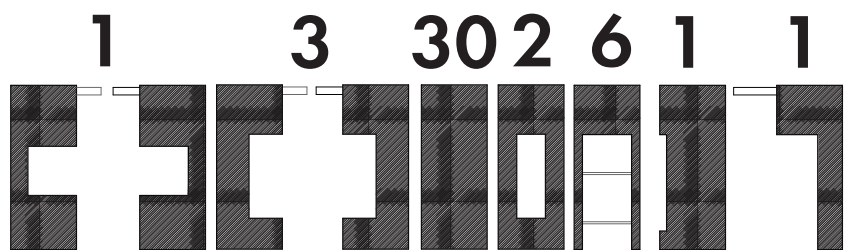
1B

1 HOUSE THREE

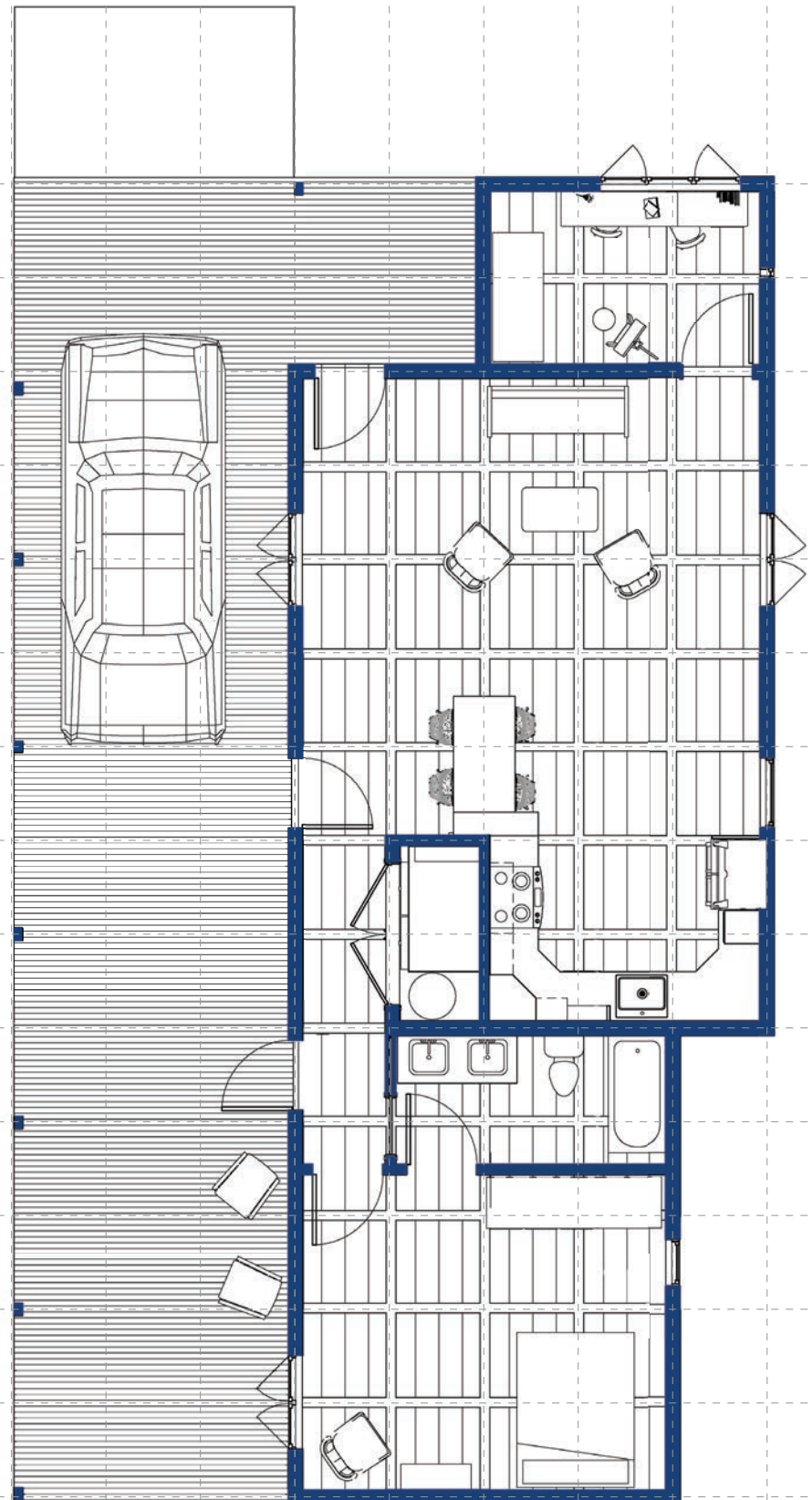
2

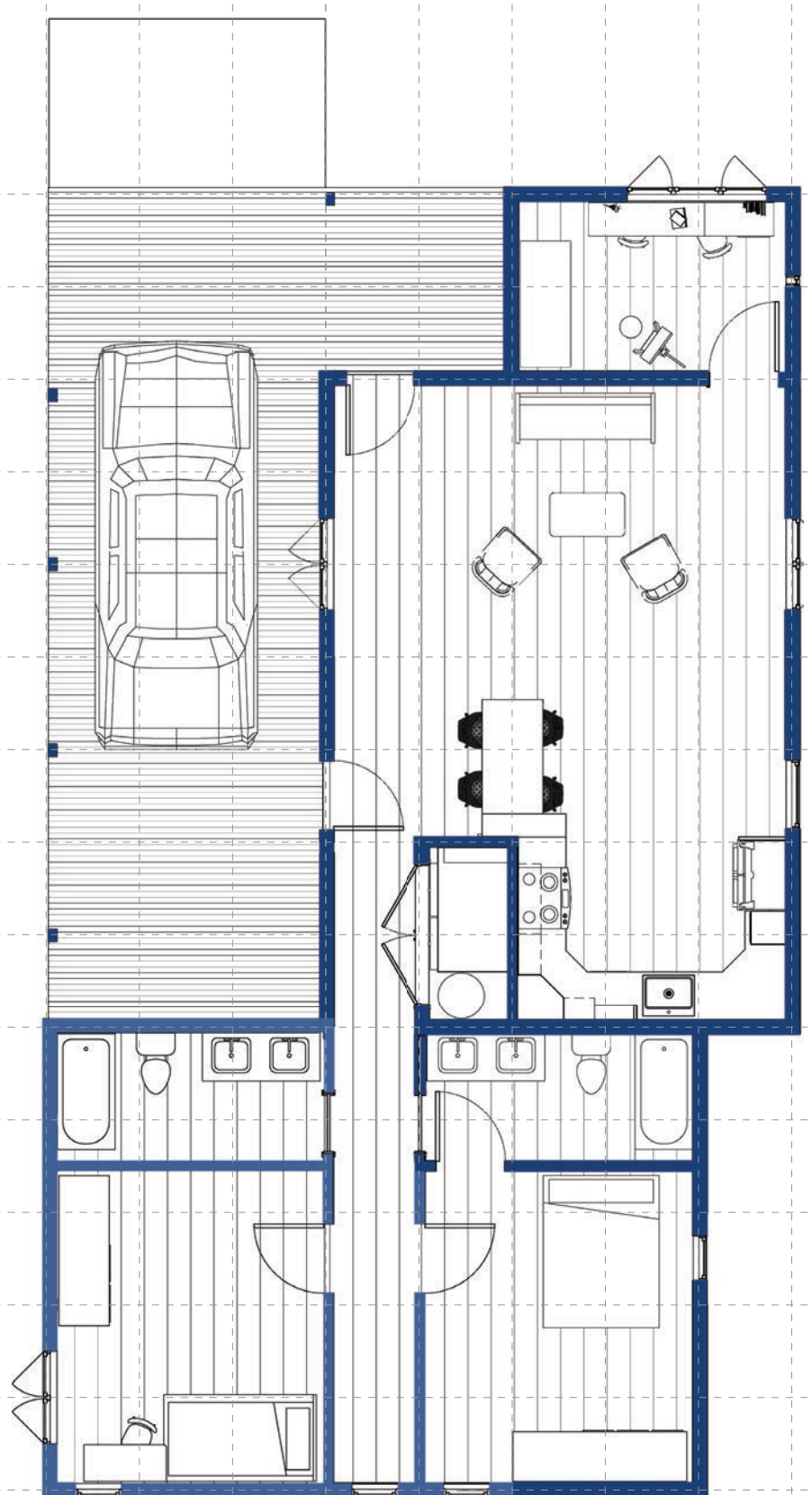
Walking into this home immediately places you in the central living space, which joins a sweeping outdoor porch for family gatherings. Mono-slope roofs offer dynamic ceilings throughout the home to give the room a larger feel, and the ceiling flattens out over the hallway for attic storage.

The connected movement corridor through the home also functions as the tie-in point for different types of additions, featuring a studio space that watches over the front of the house. This enables a family to significantly expand their habitable space without adding on to the foundation.

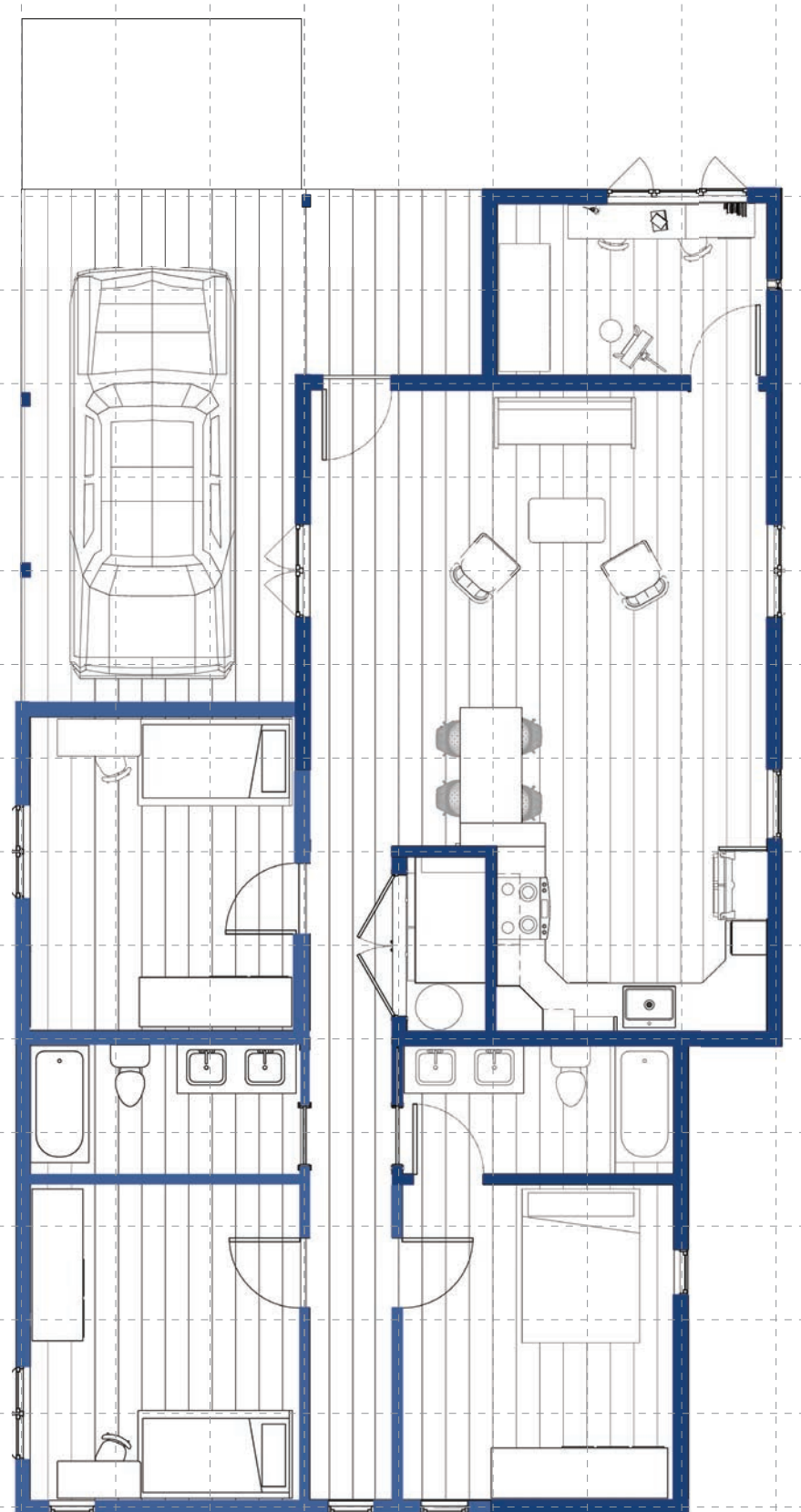


3A





3B



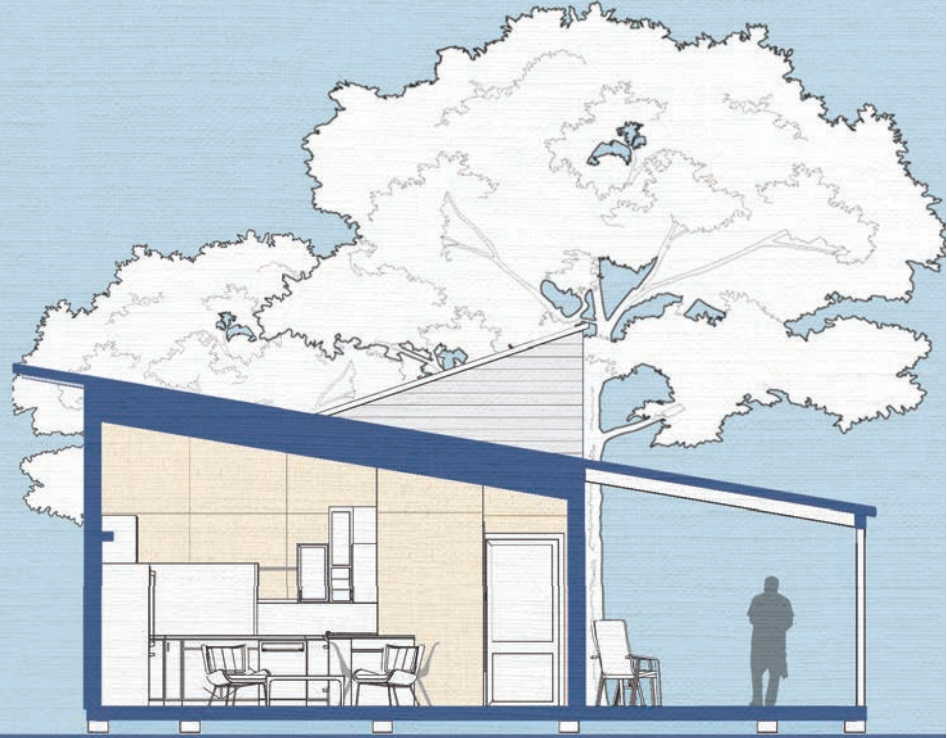
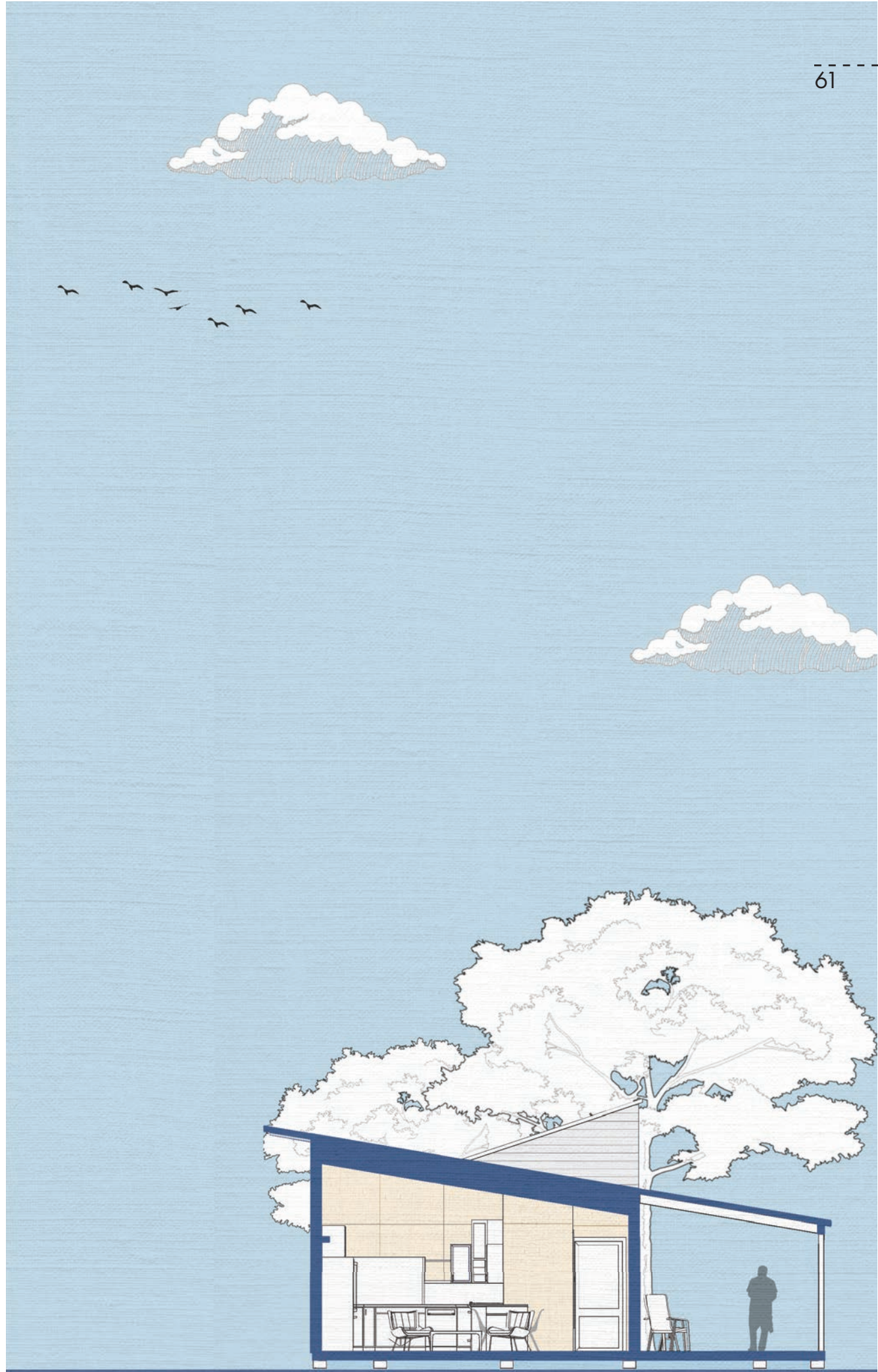
3C



1
Front Elevation



2
Interior Kitchen View



1A
Front Section



1
Side Elevation - No Additions



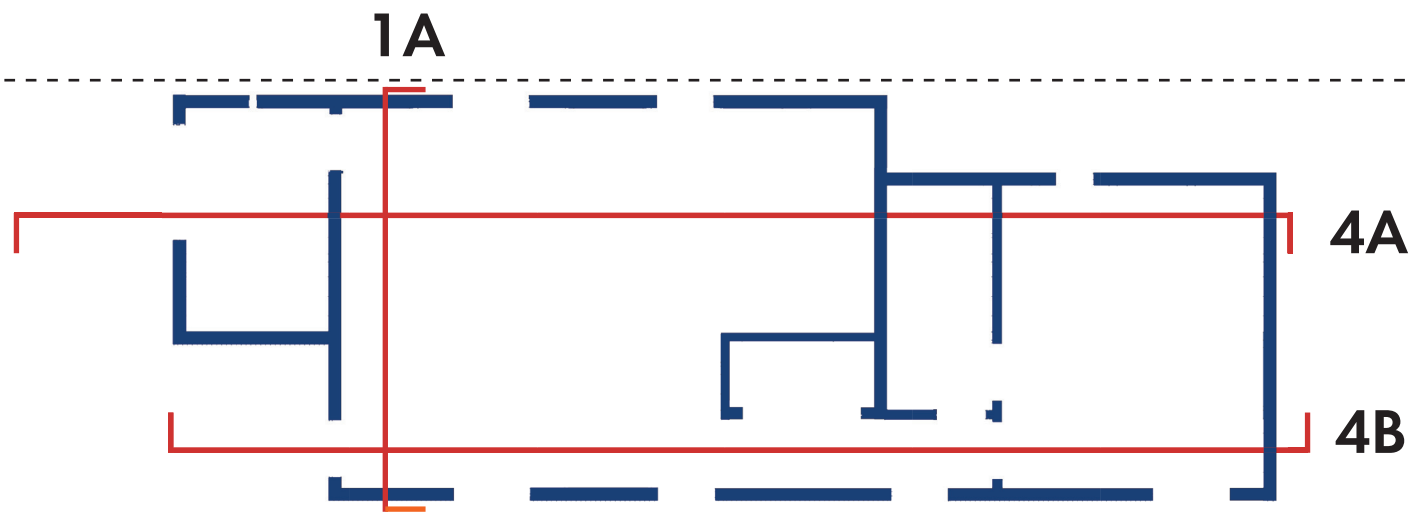
2
Side Elevation - Addition One



3
Side Elevation - Addition Two



4A
Side Section



4



4B
Side Section



1
Studio View

Thank You

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