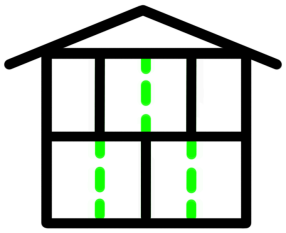


What Makes a Home?

The Vision for Tomorrow's Housing

Vivienne Evans (AREN, Sust. Eng)

Advised by Professor Nan Ma

Major Qualifying Project

Submitted to the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
in partial fulfillment of the requirements for
the Degree of Bachelor of Science in Architectural Engineering.

Capstone Design Statement

AREN graduates are expected to reach the design level in the structural or mechanical areas by completing a specific MQP that builds upon courses in which the application level is achieved. The content of the MQP and the way it is developed, in fact, present the attributes of the design level that is achieved in a context that:

(i) Considers the systems or processes from other architectural engineering curricular areas,

(ii) Works within the overall architectural design,

(iii) Includes communication and collaboration with other design or construction team members,

(iv) Includes computer-based technology and considers applicable codes and standards, and

(v) Considers fundamental attributes of building performance and sustainability.

Abstract

The essence of home transcends mere physicality, embodying a profound sense of comfort and belonging. However, many individuals find themselves residing in spaces that fail to evoke this essential feeling. This capstone project addresses this critical issue by investigating the fundamental elements that transform a dwelling into a genuine home. Through rigorous scientific research and analysis of surveys and interviews, three primary factors emerge: *security*, *predictability*, and *flexibility*. These elements form the cornerstone of a manifesto aimed at reimagining the traditional concept of housing and introducing a flexible living solution. The proposed solution envisions a dwelling with a permanent exterior but adaptable interior spaces. Lightweight panels, sliding into ceiling-mounted tracks, enable occupants to configure the layout according to their evolving needs and desires. Tailored specifically for the unique climate of Phoenix, Arizona, the design accommodates the average household size while allowing for future changes in family dynamics. Features such as adjustable louvers and roof overhangs optimize sunlight exposure and promote energy efficiency, emphasizing sustainability. In conclusion, this paper advocates for a holistic approach to redefining home—a concept that extends beyond physical construction to encompass spaces that nurture aspirations and support daily lives. The flexible living solution presented here offers a blueprint for the future of housing, fostering comfort, well-being, and sustainability in equal measure.

Acknowledgement

Thank you to Professor Ma for all of your guidance and support throughout the process of this project and my graduate school admissions.

Thank you also to the interviewees and participants of the survey for taking the time and effort to provide thoughtful and personal responses to each of the questions posed.

Table of Contents

List of Charts, Figures, and Tables

Chapter 1: Manifesto

The idea of a home seems so easy to imagine when you've experienced it. Warmth, relaxation, privacy, and comfort. However, ask someone to then identify the specific elements that create this feeling and it isn't so easy.

So what really transforms a dwelling into a home? You can't force the true feeling of a home onto any place. The dwelling has to earn your trust as much as another person does in order to become a home. It needs to be supportive and reliable. Home is where one is free from volatile variables that limit one's personal growth and expression. A place can become a home by addressing each of these variables in a specific order because each builds on the last. Each element is unachievable without the completion of the preceding one. Security, then predictability, and finally, flexibility. It's impossible to feel wholeheartedly comfortable and settled in a space that doesn't include all of these things.

IN ORDER

1. **Security** ⇒ Surviving

As the most immediate necessity for a dwelling, security protects us from the elements and physical harm from others. It is necessary to survive. By creating physical barriers and methods of defense, our vulnerability can be lessened and we can live without being constantly on guard for threats. Once we are able to survive, we have the opportunity to live, but not without predictability.

2. **Predictability** ⇒ Living

Predictability relies on consistency and reliability. With adequate systems in place, the question of whether resources will be available at a given time or day is minimized. By removing the obstacle of unforeseen variability, you can settle and plan for the future without hesitancy. If you have an understanding of the space, physically and emotionally, then unusual circumstances are more identifiable and manageable. Without the worry about constantly maintaining the functionality of the system, you can work on other improvements to your space or life. However, in order to host these improvements, the space must be flexible.

3. **Flexibility** ⇒ Thriving

Flexibility allows the inhabitants to adapt to changes, both personal and external. The dwelling should be a dynamic cradle for varying occupants and families. It should be generally

solid in terms of security and stable for predictability, but also have fluidity to account for the ever evolving and growing state of the people residing there.

Flexibility within a home is needed to allow for human imperfections. The concept of designing an ideal home for someone to move right into is impossible because every second they are living inside that home comes with changes. You can never design a perfect home for the present version of someone because they will be a different person from the moment you begin the process. To account for these constant changes, flexibility must be built into a home either architecturally or socially via the ability to change the physical space or leave the space altogether.

⌂⌂⌂

Ultimately, successful control over these aspects results in a space suited to and supportive of a person's needs and desires. Growth and expression thrive in such an environment.

⌂⌂⌂

But wait! That seems easier said than done… How can I possibly get all of these done, especially if I'm trying to make a dwelling into a home all alone?

Automation helps simplify the process of achieving control over safety, predictability, and flexibility and takes pressure off of the occupant. It can watch over the safety of the home and add an extra layer of defense. It can let you know as soon as your systems begin to malfunction so you aren't surprised by overwhelming, untimely failures. It holds your hand while you pass through each of the levels above, shielding you from excessive stress and effort. With the additional time and energy, you are able to expedite the process and quickly reach a state of comfort and eventually, growth.

1.1 Objectives Behind Manifesto

The goal of my manifesto is to determine the factors that contribute to or inhibit a living space's ability to foster a genuine sense of home. In the process of developing my manifesto, I researched a variety of sources including scientific and opinion-based works, along with analyzing the responses to a survey created about individuals' views on their own homes. While many of these responses have a more theoretical exploration on the meaning of "home,"this project goes beyond the theoretical and creates a practical guide to creating a physical environment that promotes the feeling and experience of home.

1. Mirriam-Webster defines a home as "one's place of residence"[1] , while the Oxford Dictionary defines it as "a dwelling place" or "a person's house or abode."[2] These definitions do not account for the emotional or psychological interpretation of the term "home." While the terms "house" and "home" are often used interchangeably in colloquial conversations, the term "house" does not hold the same personal emphasis as "home." Houses are a type of building, many of them exist within our lives. A home, however, is unique to the user.

2. "The effects of control and lack thereof cause subconscious association between locations and environments with satisfaction or dissatisfaction. An understanding of one's level of desire for control can shed light on the motivations for their behavior in many aspects of their lives"[3] (Burger 1992).

   The concept of control over one's space brings a level of security, predictability, and flexibility to a person's life. Burger finds that having limited or no control over their environment keeps a person from finding contentment in a place. Thus, control over one's environment is a vital part of creating a home.

3. "There is an often stated argument that the perception of control is a psychological and biological necessity, not merely a desire"[4] (Leotti, Iyengar, and Ochsner 2010).

   Leotti, Iyengar, and Ochsner push Burger's ideas further by insisting that control is not only a means for contentment, but also a necessity for living a satisfactory life.

---

[1] Merriam-Webster, "Home."
[2] Oxford English Dictionary, "Home."
[3] Burger, *Desire for Control*.
[4] Leotti, Iyengar, and Ochsner, "Born to Choose."

4. “Nonetheless, the meaning of housing, like the meaning of home varies from person to person between social groups and across cultures: houses are commonly attributed an economic value, an exchange value, an aesthetic value, and a use value, whereas, in addition to these, a home is usually attributed a sentimental and symbolic value”[5] (Lawrence 1991).

   In *The Meaning and Use of Home,* Roderick J. Lawrence points out that the meaning of both ‘housing’ and ‘home’ varies across individuals, social groups, and cultures. While houses are ascribed value based on economic factors, architectural aesthetics, and practical matters, a home has less concrete value. Its significance is based upon emotional and psychological factors.

5. “[T]here’s a big psychological difference between feeling at home and being home. Feeling at home on the Tiwi Islands or in Bangalore or Vancouver (if you are not native) is simply a way of saying that the not-home-ness of those places has diminished since you first arrived. Some people, as they move through their lives, rediscover home again and again. Some people never find another after once leaving home. And, of course, some people never leave the one home they’ve always known”[6] (Klinkenborg 2012).

   Verlyn Klinkenborg delves into the psychological aspect of home. He examines how people who move away from the place where they were raised, can nonetheless, find that emotional and psychological comfort that makes a new location feel more comfortable and safe, thus creating a sense of home. Others, on the other hand, either stay at their home all their lives, or go out and never connect to a new location in the way they’d connected to their original home.

6. “‘Home’ is the place where you feel in control and properly oriented in space and time; it is a predictable and secure place. In the words of poet Robert Frost, ‘Home is the place that, when you have to go there, they have to take you in.’ In short, ‘home’ is the primary connection between you and the rest of the world”[7] (McAndrew 2015).

   Frank T. McAndrew sheds light on the emotional and psychological aspects of home through the lens of control and perspective. It is the spot where a person can always go

[5] Lawrence, “The Meaning and Use of Home.”
[6] Klinkenborg, “The Definition of Home.”
[7] McAndrew, “Home Is Where the Heart Is, but Where Is ‘Home’?”

to become grounded and is also a place where they can judge the rest of the world around them.

7. “Home is where one starts from.”
   “Home is at the center.”
   “‘House’ means shelter, implies edges, walls, doors, and roofs…”
   “‘Home’ does not require any building, even if a house always does.”[8] (Rykwert 1991).

   Joseph Rykwert defines a “house” as a physical structure with attributes such as walls and roofs, while the idea of a "home" transcends any building. His article acknowledges the split between the physical aspects and the psychological aspects of a place to live.

8. “Home is the place where I go to feel safe and comfortable. If something negative happens, where do I retreat and regroup? It's not even my entire house, it is specifically my living room, kitchen, and bedroom; that is my 'home.' (The garage, bathrooms, den, and office don't feel like part of my home, they are just other places that happen to be adjacent to my home.) And if my house were to burn down, my home would be the next place in line that I go to in order to be safe: my bedroom in my childhood/parents' house”[9] (“What Is the Meaning of Home? Hint: It’s Not Just a Place.” 2020).

   Matthew Stonebraker further narrows the concept of home to specific spaces within a house, emphasizing the emotional connection tied to particular areas and how they provide a sense of safety and comfort. This presents a “home” as not merely a building, but a defined spot that provides comfort and safety.

9. “Home means a future. Once we had a stable home, we could think beyond where we were going to live from week to week, and we could begin to look ahead to where we wanted to go.”
   “Home is the base where everything begins”[10] (“What Does Home Mean to You,” n.d.).

   Kelly for Habitat for Humanity offers a forward-looking perspective on the idea of what a home encompasses. It is a place to dream of the future and plan for the achievement of those dreams. Her thoughts align with Habitat for Humanity’s push to make housing for people more than a physical shelter, but a place to add a sense of wellbeing to people.

[8] Rykwert, “House and Home.”
[9] Schlage, “What Is the Meaning of Home? Hint: It’s Not Just a Place.”
[10] Habitat for Humanity, “What Does Home Mean to You.”

Collectively, these passages offer a comprehensive, opinion-based view of the idea of a home. They highlight a home's multifaceted nature, encompassing emotional, psychological, and symbolic dimensions, transcending the physical structure of a house, and serving as a foundation for both personal identity and future aspirations. While the importance of having a place to support a person's emotional and psychological wellbeing is a necessity in making a home, there are practical things that an architect, an engineer, and/ or an interior designer can do to augment these things when designing houses.

1.2 Subjectives Behind Manifesto

I created a survey to analyze personal opinions about what constitutes a home and whether individuals' consider their living spaces to truly feel like "home". The survey was anonymous and sent to various groups of individuals to collect a wide variety of input. By analyzing the results and noting the trends, the information was used to influence the manifesto and final design. There were 33 respondents to the survey.

Survey Questions

1. How old are you?
    a. I provided specific age ranges due to their associations with typical life stages and housing changes.
2. What kind of dwelling do you live in?
    a. The permanence of housing can have an impact on one's perception of the space. Living in a space longer allows the individual to develop a deeper connection and plethora of memories. While owning a space does not always mean an individual has lived there longer than they would in a rented space, it often has that correlation.
3. Who do you live with?
    a. The amount and kind of people that individuals live with is important to their comfort within the space and need for privacy.
4. Do you have your own private bedroom?
    a. Similar to Question 3, if an individual shares a bedroom with another, they may not have another personal space for privacy.
5. In which zone of the following map do you live?

    a. A map of the continental United States, overlaid with the climate zones defined by the IECC, was provided. An individual's preference and opinion of thermal conditions may depend on their location within a specific climate zone.
6. How do you define "home"?
    a. I wanted to gather specific definitions of 'home' from individuals to find the personal factors of their lives that they associate with 'home'.
7. Does your residence feel like "home"?
    a. After having respondents describe their definition of 'home', I wanted to know if their residence achieved their personal description.
8. What makes your residence feel like "home", as you described above?
    a. This question is meant to collect the distinct reasons the respondents recognize their residences as 'home'.
9. What makes your residence NOT feel like "home"? What would you change?
    a. Similar to Question 8, but to collect the negatively associated reasoning.
10. What is your favorite room in your home? Why? Describe specific aspects (temperature, light, windows, walls).
    a. To determine which architectural features were important to the preference of certain spaces over others.

Survey Results

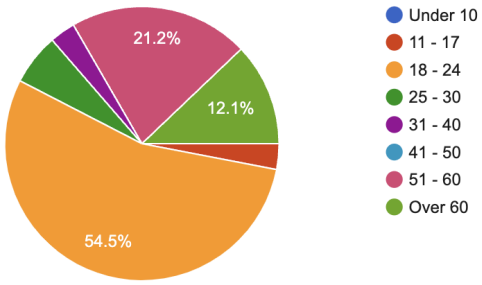


Chart 1: Responses to survey Question 1, "How old are you?"

Of the 33 respondents, 54.5% were between the ages of 18 and 24. The second greatest age group was 21.2% between the ages of 51 and 60. This result was likely due to the audience which received the survey primarily being college aged students and their parents.

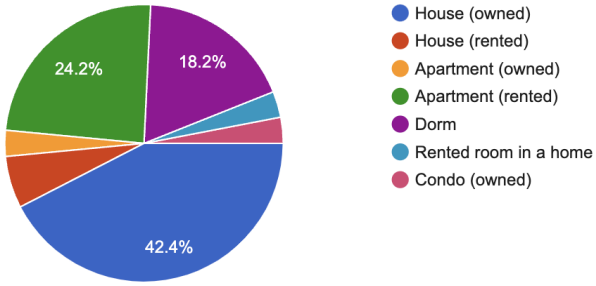


Chart 2: Responses to survey Question 2, "What kind of dwelling do you live in?"

Given the majority of the respondents were between the ages of 18 to 24 years old, it was not surprising that a large portion of the dwelling type was rented apartments and dormitories, as this is common for college aged students and recent post-graduates. In addition, I found that despite some of the respondents listing their dwelling as a rented apartment or dormitory, they responded to later questions in reference to their family's house.

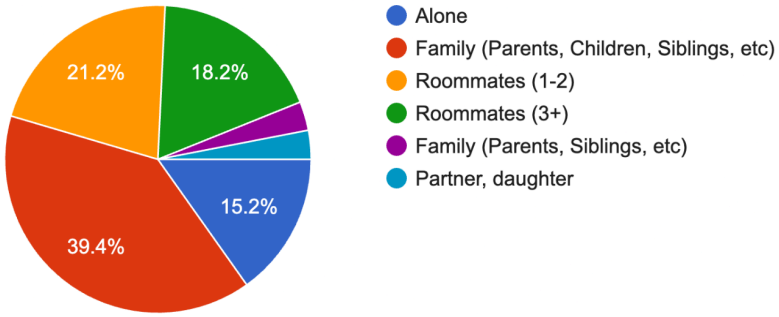


Chart 3: Responses to survey Question 3, "Who do you live with?"

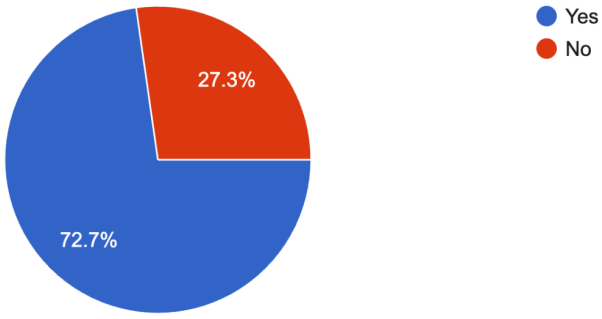


Chart 4: Responses to survey Question 4, "Do you have a private bedroom?"

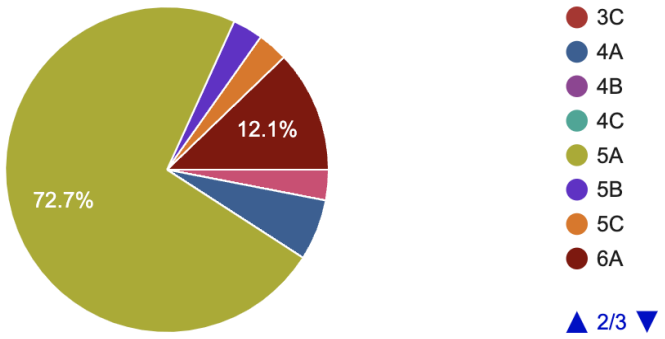


Chart 5: Responses to survey Question 5, "In which zone of the following map do you live?"

Of the responses to Question 6, "how do you define a 'home'?", the most frequently mentioned words were: *comfort/comfortable, relax/rest/retreat, safe, happy*, *family*, and *love*.

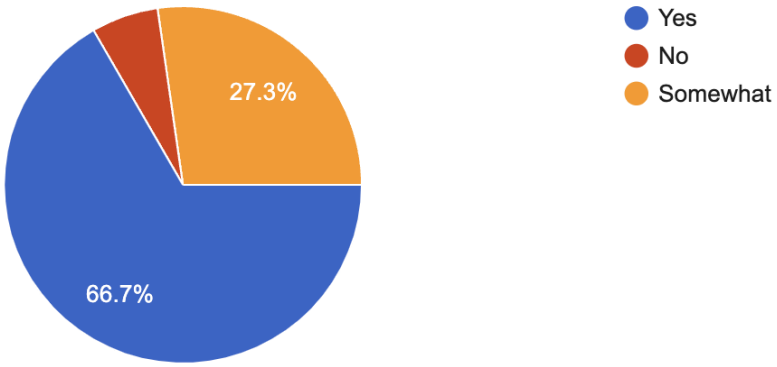


Chart 6: Responses to survey Question 7, "Does your residence feel like "home"?"

In response to Question 7, "does your residence feel like 'home'?", 6.1% said no and 27.3% said somewhat. All together, this results in 33.4% of the respondents feeling like their home does not completely feel like home.

Despite 66.7% of the respondents stating that their residence felt like home, only 12.12% of the responses to Question 9 said they would not change anything about their residence. Many of the answers were concerned with being unable to personalize their space or that they were otherwise in a temporary living situation. Several answers commented on both wanting to be alone or not wanting to be alone. The most common answer related to a lack of privacy and/or

personal space. This was due to the compact size of their dwelling or lack of interest in spending time outside of their bedroom because of unwelcoming or uncomfortable spaces.

Questions 10 garnered information about the respondents' favorite rooms within their homes and furthermore their favorite spot within those rooms. Undoubtedly, lighting was the most common element mentioned. Preferences of lighting varied between responses, most enjoying the brightness of their rooms, but some preferring darker, milder lighting. Responses that favored brighter lighting, also showed a preference for large windows with expansive views. The rooms most frequently named were family rooms and bedrooms, often associated with either community or solitude.

Survey Conclusion

Ultimately, the survey showed that there is a direct association between privacy, customization, and comfort with the feeling of home. The majority of the respondents, mainly 18 to 24 years of age, resided in dormitories or rented apartments. Notably, many of those respondents referred to their home as their parent's residences, not their temporary housing. This makes sense considering that key themes from the question of defining home included comfort, safety, and family. It also makes sense considering a majority of respondents felt discontent in their inability to personalize their personal spaces. The respondents continuously stated that they felt at home when they experienced relaxation, acceptance, and were surrounded by their own possessions.

Limitations to Survey

- The survey was primarily provided to college aged students and urged to be shared with their wider social and familial groups. College aged students often live in temporary housing and have non-familial roommates. This affects their perception of their living arrangements.

- The age ranges chosen for Question 1 were based on life stages typically associated with marriage and children. These assumptions were used to generalize the age range, since the final house design is designed for a single family household with children or other family members. However, due to the variability of individual's lives and life stages, additional questions were provided to get a clearer view of the respondents' living situations.

Chapter 2: Summary of Design Strategies

In order to respond to the factors described in the manifesto, I decided to create a house with a flexible interior layout inside a permanent exterior. This design allows the residents to customize their interior space while the exterior of the house maintains their safety and security. There are several precedents of flexible interiors that inspired my ultimate design.

2.1 Residential Precedents

While researching existing flexible residential spaces, a wide variety of designs were found. Most of these dwellings tend to be apartments with relatively small footprints which benefit from adaptability.

Ori Studios[11] has two main designs that each incorporate the concept of transformable furniture. One of the designs is a bed that lowers and rises from the ceiling, opening the otherwise limited floorplan. Their other design is a multipurpose piece of furniture that is capable of moving horizontally along a wall mounted track to alter the space. The base of the piece stores a bed which is revealed when the furniture moves away from its initial position.

Students Catalin Sandu and Adrian Iancu implemented a similar, yet expanded concept in their *Life Edited*[12] apartment in Soho, New York. Built in furniture, unique storage methods, and curtains help the space maintain its multipurpose capacity.

PKMN Architectures[13] created a dynamic apartment space using oriented strand board (OSB) to create a multilayered shelving design similar to that of rolling library shelves. By rolling the walls aside, the space between opens to introduce a new function, be it a kitchen, living room, or access to storage.

Each of these designs highlight the effectiveness of implementing dynamic furniture and storage in confined spaces. However, they do not align with the envisioned design direction for a larger residential space.

---

[11] Ori, “Expandable Studios.”
[12] Gheorghe, “Huge Multi-Functional Living Potential In A Tiny 420-Sq-Ft Apartment.”
[13] Mairs, “Sliding Chipboard Panels Utilise Space in Madrid Apartment.”

2.2 Non-Residential Precedents

Instead of drawing from the residential precedents, I found flexible wall usage in non-residential settings that would work better for a larger residence. These systems are not reliant on specifically designed spaces and are nearly universally applicable. They appear in banquet halls, temporary office spaces, warehouses, and healthcare locations. Depending on the application, the designs have to be soundproof, thermally resistant, and/or air tight.

Modernfold, Inc. offers an abundance of automated partitions which are highly rated for sound dampening. These designs most frequently appear in corporate, entertainment, and educational settings. Two of their products that were considered as inspiration were the Acousti-Seal® Continuously Hinged Automated Wall Systems[14] and the Modernfold Accordion Partition Walls[15]. Both of these systems feature fully automated electric operation and are stored folded on one wall at the end of the ceiling track when not in use. The Acousti-Seal® system is sealed to the ceiling and floor, preventing noise exposure. The Accordion system, however, acts similar to a structured curtain and does not seal to the ceiling and floor. While the automation of these systems is an appealing feature, the factor of the panels taking up space when not in use would be detrimental in a smaller, residential setting.

The SwiftWall® Pro system[16] by Instant Space Dividers is manually assembled by placing a track on the floor of the space and sliding wall panels down into it with additional connections between the panels. The system's lightweight components and ease of construction make it a good option for use inside a house. In addition, the opportunity to have wall and door panels as opposed to a single wall with no breaks is suitable for making individual rooms with designated entrances. However, this system is often applied in spaces with high ceilings or dropped ceilings where the ceiling tiles can be moved temporarily while the panels are dropped into the floor track. The walls created with the SwiftWall® Pro system tend not to sit flush with the ceiling as it requires some space above the wall for assembly. This would prevent the residents from having complete privacy within their flexible spaces.

The style that is most applicable for this project is the Floor-to-Ceiling Wall Partitions[17] by Portafab. The wall system uses a ceiling mounted c-channel track which the panels slide into horizontally while the bottom face remains on the ground. This design feature allows the panels to be added to spaces with fixed ceilings and still achieve a floor to ceiling division of the space.

---

[14] Modernfold, "Acousti-Seal® Continuously Hinged Automated Wall Systems."
[15] Modernfold, "Modernfold Accordion Doors and Partitions."
[16] Room Dividers Canada, "SwiftWall Solutions."
[17] PortaFab, "Floor-to-Ceiling Wall Partitions."

There are many panel options including a variety of wall materials, doors, and windows. The final flexible wall design is primarily based on the Portafab partitions with adjustments for the residential setting of the application.

Chapter 3: Flexible Wall Design

3.1 Materials

Due to the residential setting of the flexible walls, each panel is designed to have an appropriate weight and size for residents to move on their own. By removing the need for external help from contractors, the residents are able to independently change their space whenever they deem necessary. The flexible wall system consists of 3 foot wide, 9 foot high, and 3 inch deep panels which slide into an C-channel track fastened to the ceiling. Wall panels and door panels are the same dimensions and interchangeable which presents even more options for layouts.

Lightweight materials were used to create a product that is movable but solid enough to serve as a full wall as opposed to a partial divider. The frame of the panels are made of Timberwool™[18], a fibrous wood material typically used for sound absorption. In addition to acoustic control, Timberwool has an R-value of 2.35/inch which helps in compartmentalizing the rooms framed by the flexible walls. To further insulate the flexible rooms thermally and acoustically, the cavity of the panels is filled with unfaced fiberglass insulation. The fiberglass is lighter than mineral wool while providing a similar R-value.

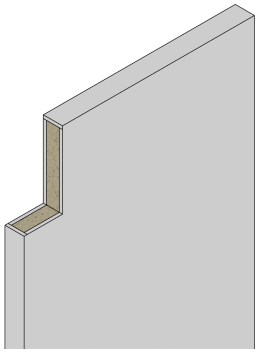


Figure 1: Wall Panel Construction

[18] Second Skin Audio, "Timberwool™ Wood Fiber Acoustic Panels."

Material	Manufacturer	Thickness	Weight	R-Value per Inch	Noise Reduction Coefficient (NRC)
Timberwool™ Wood Fiber Acoustic Panels	Second Skin Audio	½”	1 lb/ft^2	2.35	0.25/ ½ inch
Unfaced Fiberglass Insulation[19]	Owens Corning®	2”	.19 lbs/ft^2	3.35	0.95/2 inches
Melrose 30-in x 80-in Hollow Core Single Prehung Interior Door[20]	Masonite®	1.375”	35 lbs	2.17	N/A

Table 1: Properties of Panel Materials

Wall Panel Calculations

Total Panel Thickness = 2(½” Timberwool™) + 2” Fiberglass Insulation = 3”
Total square footage of ½” Timberwool™= 2(3’x9’) + 2(3”x9’) + 2(3’x3”) = 60 ft^2
Total square footage of 2” Fiberglass Insulation = 35”x107” = 3888 in^2 = 27 ft^2
Total weight per wall panel = (27 ft^2 x .19lbs/ft^2) + (60 ft^2 x 1lb/ft^2) = **65.08 lbs**
Total R-value = **9.05**

Door Panel Calculations

Total Panel Thickness = 2(½” Timberwool™) + 2” Fiberglass Insulation = 3”
Door Dimensions = 30”x80” = 2400 in^2 = 16.6 ft^2
Total square footage of ½” Timberwool™ = 2(3’x9’) + 2(3”x9’) + 2(3’x3”) - 2(16.6ft^2)= 33.2 ft^2
Total square footage of 2” Fiberglass Insulation = 35”x107” - (30”x80”) = 135 in^2 = .9375 ft^2
Total weight per door panel = 35lbs + (.9375 ft^2 x .19lbs/ft^2) + (33.2 ft^2 x 1lb/ft^2) = **68.38 lbs**
Total R-value = **5.33**

[19] Home Depot, "Owens Corning R-6.7 Multi-Purpose Small Project Unfaced Fiberglass Insulation Roll,"
[20] Lowes, "Melrose Primed Flush Hollow Core Molded Composite Pre-Hung Door."

3.2 Usage

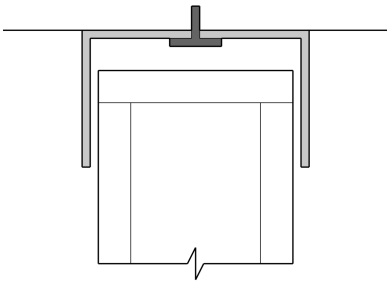


Figure 2: Ceiling C-Channel Track Diagram

To assemble the flexible walls, the panels are slid horizontally into pre-mounted ceiling tracks which hold the panels in place. Disassembly reverses the process until each of the desired panels is removed from the ceiling track.

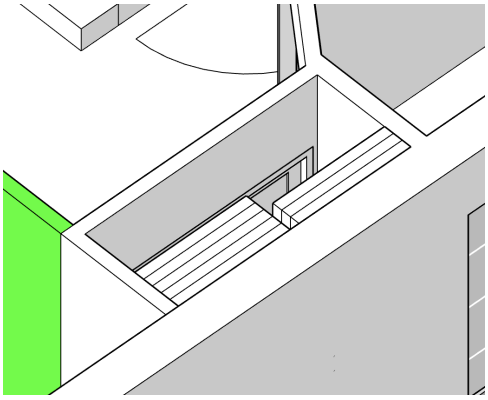


Figure 3: First Floor Panel Storage Closet

When not in use, the panels are able to be stored in one of the closets located on either of the floors. The closets are wide enough to accommodate two panels side-by-side and over five panels deep when laid face-to-face. By having a closet on both floors of the house, the residents do not need to carry panels up and down the stairs which could be strenuous and dangerous.

Chapter 4: Architectural Design Implementation in Phoenix

4.1 Why Phoenix?

Phoenix, Arizona, presents a unique climate for architectural design. The climate of the city makes the design of a house crucial in order to preserve the comfort and wellbeing of residents. To achieve the first factor of the manifesto, *security*, the design needs to ensure that the residents are protected from the elements.

The area experiences an average yearly high temperature of 96ºF and low temperature of 56ºF. In addition, there are between eight (winter) to twelve (summer) hours of sunlight per day with a solar radiation of 6.59 kWh/m^2/day, which is one of the highest levels in the country, tied with Nevada. Phoenix receives almost no precipitation, with a maximum of 1.5" per month, and an average total of 10.2" per year. Finally, the average humidity of the city is 36% RH, with a low of 15% RH in June and a high of 51% RH in December.[21] Ultimately, this results in the characteristically hot and dry climate of Zone 2B.

Given Phoenix's climate challenges, architectural designs must prioritize environmental adaptability to resident comfort and safety.

In order to create a desirable residence suitable for the lifestyle of Phoenix inhabitants, the size of the house was designed in accordance to the local demographics. Based on statistics from June 2020, Phoenix has an average household size of 2.79 people and an average family size of 3.39 people. Family households make up 66% of all households. In addition, 39.7% of all households had at least one individual under 18 years old.[22] Households with individuals under 18 years old will likely experience a change in the number of household members throughout time. These households may gain more family members, possibly children or parents, or have family members move out to college or for their careers.

Drawing from the data, I decided to design the house for a single family with space for one to five occupants. The constraints of the design are based on the average house and lot sizes in the Phoenix region. The average single-family home is 2,522 square feet[23], while the average lot size is 8,726 square feet or 0.2 acres[24].

[21] Climate Data, "Phoenix Climate."
[22] Infoplease, "Phoenix, AZ Demographic Statistics."
[23] Statista, "Size of New Single-Family Homes in the U.S. 2022."
[24] Visual Capitalist, "The Median Lot Size in Every American State."

4.2 Floor Plan

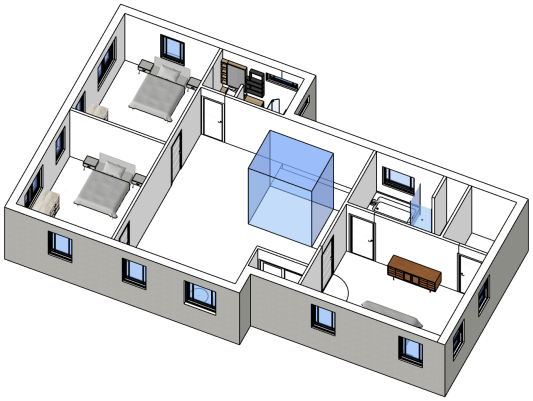


Figure 4: Pre-Flexibility Floor Plan - First Floor (Left)
Figure 5: Pre-Flexibility Floor Plan - Second Floor (Right)

Figures 4 and 5 represent the house design without the implementation of the flexible walls. This is a typical modern day house with strictly defined spaces. The house has permanent walls for all of the bedrooms and offices, limiting the ease of alternating the space. The first floor office space is open to the rest of the floor plan and the lack of privacy and sound dampening barriers prevents the space from being used for multiple work spaces. The second floor bathroom is only accessible from the hallway and there is no opportunity for an additional private space in the second floor hallway. Altogether, this house is nothing new when compared to the already constructed houses in the early 2020's. It may achieve the first and second factors of the manifesto, *security* and *predictability* by providing adequate protection from external harm, and reliable systems. However, it does not have the capability for changes to its form and layout and therefore does not achieve *flexibility*.

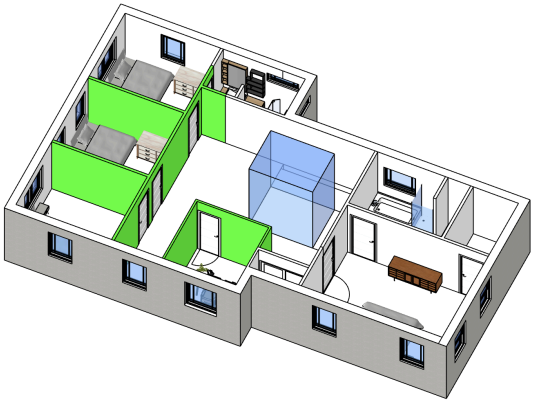


Figure 6: Post-Flexibility Floor Plan - First Floor - Two Office Configuration (Left)
Figure 7: Post-Flexibility Floor Plan - Second Floor - Three Bedroom and Multipurpose Room Configuration (Right)

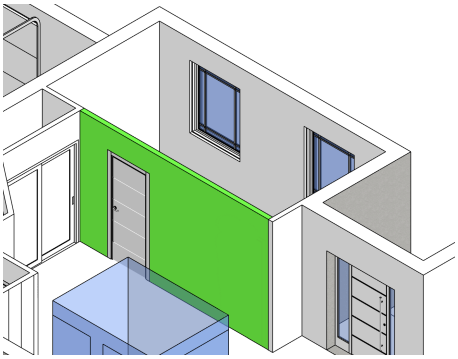
By implementing the flexible wall system in the house design, it was necessary to coordinate the dimensions of the house, particularly around the flexible wall areas, with the 3 foot width of the flexible wall panels. By doing so, the panels fit flush with the exterior walls they encounter.

The addition of flexible walls to the floor plan allows the residents to increase the number of bedrooms and office/multipurpose spaces. There can now be between one to four bedrooms and zero to three office/multipurpose spaces. This adaptability allows families to remain in the same house while their family dynamic changes, instead of upsizing or downsizing. The increase of work-from-home job situations in the wake of COVID-19 has presented families with a challenge of separating their home life from their work and school life while all under the same roof. The flexible interior enables the family to have individual work spaces that can be assembled only when necessary.

In addition, the flexible walls located on the corner of the upstairs bathroom allow residents to change the location of the bathroom door from the hallway to inside the bedroom. This small change results in a private bathroom for a family member or guest and can also allow sick individuals to isolate.

4.3 Window Solution

The multiple configurations of the flexible walls present a challenge in placing windows on the exterior walls of the house. In all of the potential layouts, each of the flexible spaces (office, bedroom, and multipurpose room) required at least one window for safety and to provide light to the room. Furthermore, if a window were to be divided by a flexible wall, the window frame would prevent the wall from sitting flush against the exterior wall and therefore prevent the adjacent rooms from being separated for adequate privacy and compartmentalization.



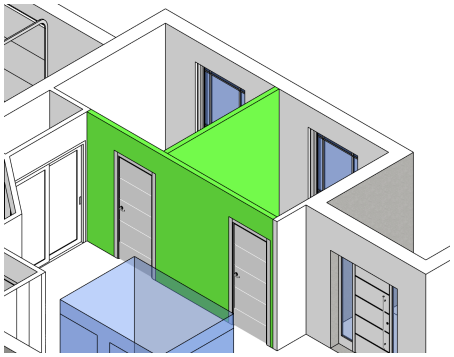
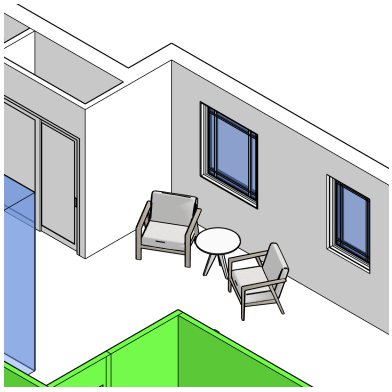


Figure 8: First Floor - Single Office Configuration (Left)
Figure 9: First Floor - Double Office Configuration (Right)



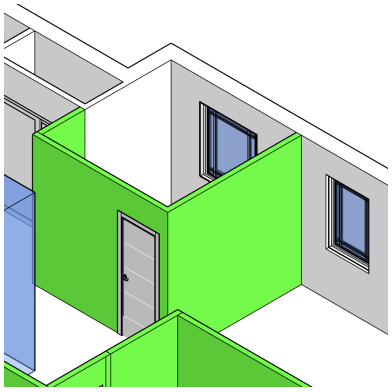


Figure 10: Second Floor - Open Hall Configuration (Left)
Figure 11: Second Floor - Multipurpose Room (Right)

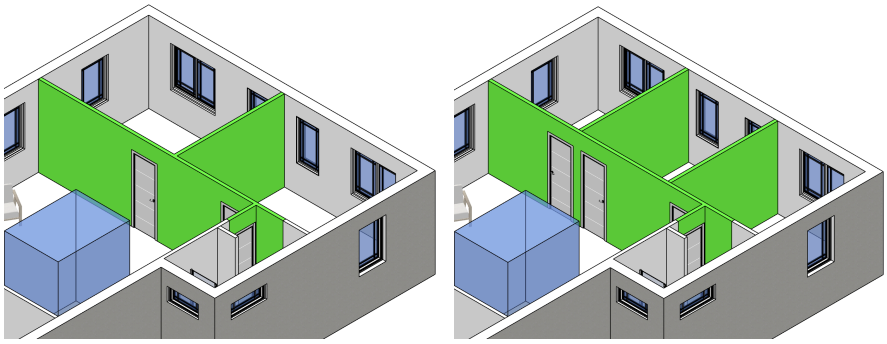


Figure 12: Second Floor - Two Bedroom Configuration (Left)
Figure 13: Second Floor - Three Bedroom Configuration (Right)

As seen in each of the figures above, the windows were placed such that each configuration allows at least one window for every office space and the multipurpose room and at least two windows for every bedroom. The windows provide passive ventilation and ensure that adequate natural light can enter the spaces.

4.4 Overhang Solution

Excessive sunlight and intense solar radiation can make the interior of the home increase in temperature rapidly and cause occupant discomfort, energy inefficiency for the cooling system, and mildew or mold within the building due to condensation from the humidity difference. To combat solar heat gain and its associated problems, large overhangs were added to the house exterior.

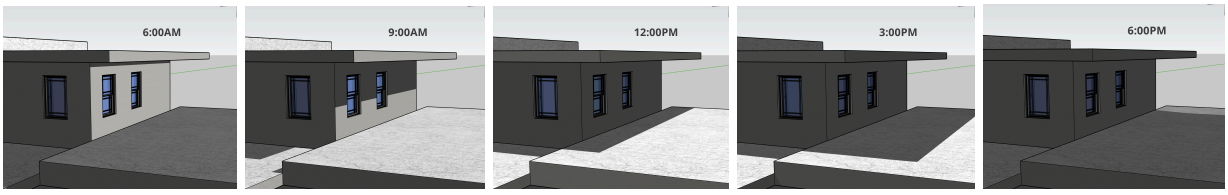


Figure 14: Sun Path on East Facade

Figure 15: Sun Path on West Facade

The five foot overhangs prevent the sunlight from directly intruding on the interior space during the hottest parts of the day. As seen in Figures 14 and 15, sunlight is able to enter in the morning and evening, when solar radiation levels are lower and can cause less harm to the interior of the building and the inhabitants.

If a longer overhang were to be used, the structure of the house would not support the weight. Alternatively, if the overhang had been shorter, it would not have protected the windows from as much of the midday heat gain.

4.5 Louver Solution

Louvers are often used as a method of shading exterior and interior spaces from direct sunlight without entirely preventing light from entering the space. Louvers can be fixed, manually adjustable, or, as applied in this house design, motorized and automated. Automated louvers can be connected to timers and a variety of sensors, such as light, wind, and precipitation detectors[25], to dictate when and how they should perform. Motors attached to the louver blades are then controlled to rotate the louvers into their designated position.

The 180 Weatherboard[26] louver blade design from Louvretec® Spiral Pivot Louvre Range served as direct inspiration for the shape of a louver utilized in the project. The blades are able to create a flush seal when the louvers are in the closed position, protecting the space below from the elements.

The house features a central atrium framed on two sides by the staircase. The atrium is enclosed with a skylight which allows light to enter into the core of the house, through the second floor and down to the first floor. While the skylight prevents exterior air from entering down into the house, the interior air can experience heat gain from the solar radiation. The addition of motorized louvers to the skylight allows the resident to personalize the amount and angle of sunlight that enters the space. The automation of the louver system also allows the louvers to adjust continuously depending on the level of sunlight and other elements, without the user needing to control them throughout the day. The same louvers are also featured above the front entryway and back patio.

[25] Global Blinds, “Sunbreaker Exterior Louvres.”
[26] Louvretec, “Louvretec Sun Louvres Brochures.”

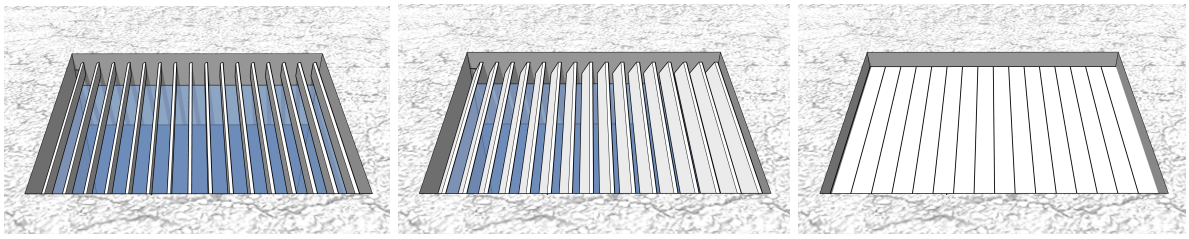


Figure 16: Exterior View of Fully Open (Left), 45º (Middle), and Fully Closed (Right) Positions of Atrium Louvers

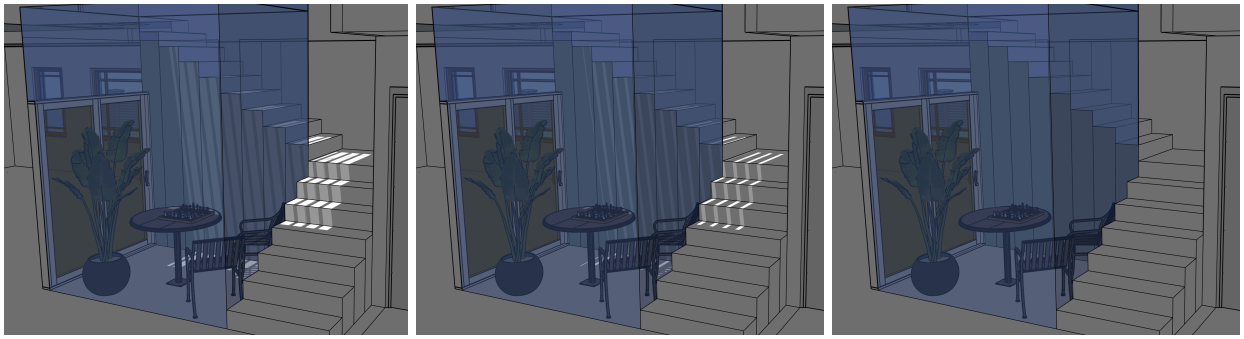


Figure 17: Interior View of Fully Open (Left), 45º (Middle), and Fully Closed (Right) Positions of Atrium Louvers

4.6 Building Enclosure

In order to counter the intense heat and preserve the humidity inside the house, the building enclosure design is crucial. I decided to use a wood-frame for the house due to the dry climate and light weight of the material. The wood-framing does not risk excess moisture from weather or condensation if properly installed. For Climate Zone 2B, the 2021 International Energy Conservation Code (IECC)[27] requires that wood-framed walls have an R-value of 13 cavity insulation or 0 cavity insulation + 10 continuous insulation. The IECC also requires an R-value of 49 for ceilings.

The local architecture already hosts a multitude of strategies for the hot and dry climate. I decided to draw inspiration from these methods combined with an emphasis on modern residential style. The exterior of the house as a whole is bright and reflective, redirecting the solar radiation away from the residence. The roofs are thick and flat, with multiple depths to add variety to the facade.

[27] "2021 International Energy Conservation Code."

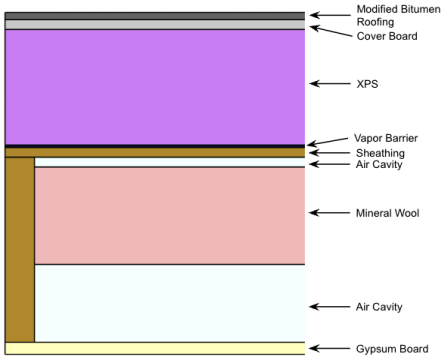


Figure 18: Roof Section Detail

The roof is a combination of "warm" and "cold" flat roof methods.[28] Due to the high R-value required and the interest in maintaining a low profile roof deck, insulation is installed above and below the sheathing. XPS is used above the roof deck, while mineral wool is used below. Air cavities are implemented to ensure the enclosure would not experience moisture build up. The roof surface is a reflective, light colored modified bitumen roofing.

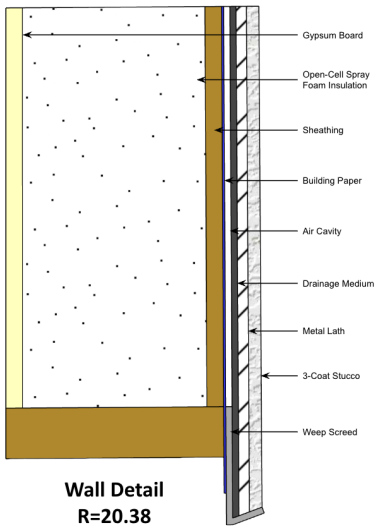


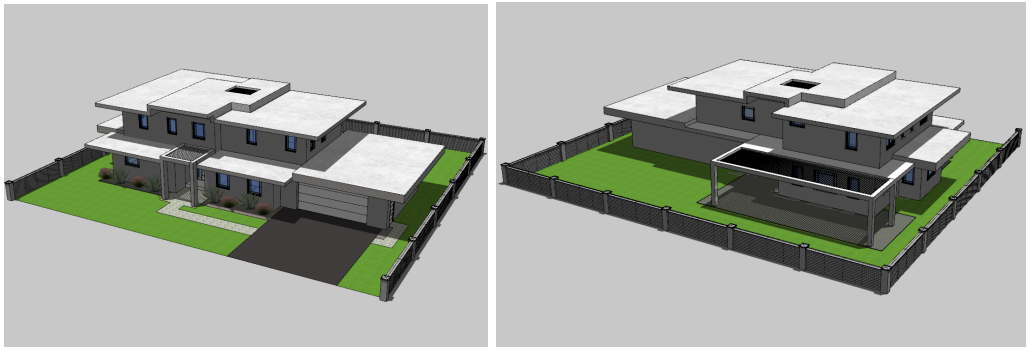
Figure 19: Wall Section Detail

The exterior walls are wood-framed with 2x6 studs and insulated with open-cell spray foam insulation. The wider wall profile, common in Phoenix, places a thicker barrier between the cool interior and the hot exterior. The wall finish is a white, 3-coat stucco which is frequently used in

[28] Franklin, "How to Design a Flat Roof That Won't Leak."

hot and dry climates. Standard practice[29] dictates the use of a drainage medium[30] and weep screed[31] when installing stucco walls. These components facilitate the escape of moisture or precipitation from the wall, preventing buildup and potential impact on the enclosure behind the building paper.

4.7 Summary of Architectural Design



Figures 20 and 21: Renderings of the Front (left) and Back (Right) of Final House Design

The architectural design implemented in Phoenix, Arizona, underscores the necessity of adaptive solutions tailored to the city's unique climate and demographics. With scorching summers, minimal precipitation, and fluctuating humidity, the design prioritizes environmental adaptability to ensure resident comfort and safety. By integrating flexible wall systems, strategically placed windows, and innovative shading solutions such as motorized louvers, the design optimizes natural light penetration and passive ventilation while mitigating solar heat gain. The use of a wood-frame structure, combined with reflective exterior finishes and effective insulation, further enhances energy efficiency and moisture management. This design exemplifies a forward-thinking approach to sustainable, comfortable, and resilient residential architecture in the challenging climate of Phoenix.

[29] Masonry Technology, Inc., “Stucco.”
[30] Masonry Technology, Inc., “Sure Cavity®.”
[31] Masonry Technology, Inc., “L & R Weep Screed™.”

Chapter 5: Conclusion

In conclusion, this manifesto and its accompanying research provide insights into the multifaceted dynamics that shape the concept of home. By delving into theoretical concepts and practical considerations, the goal was to offer a comprehensive guide for creating spaces that go beyond physicality to embody emotional, psychological, and symbolic significance.

An exploration of diverse definitions of "home" shows that a person's home is more than just a place of residence; it is a sanctuary that offers comfort, safety, and a sense of belonging. With a focus on security, predictability, and flexibility, any location or type of dwelling can become a home. Control over one's environment is also crucial, as individuals seek autonomy to cultivate contentment and satisfaction.

The survey reinforced the importance of privacy, customization, and comfort in shaping perceptions of home. Despite varying living situations, respondents shared a desire for spaces that reflect their personal identity and foster relaxation.

Drawing from residential and non-residential examples, the proposed design strategies create a flexible interior within a permanent exterior. The integration of flexible wall design in the Phoenix house addresses climate challenges with features like overhangs, louvers, and reflective surfaces, enhancing occupant comfort and energy efficiency.

There's no place like home.

⌂⌂⌂

References

Burger, Jerry M. *Desire for Control: Personality, Social, and Clinical Perspectives*. The Plenum Series in Social/Clinical Psychology. New York: Plenum Press, 1992.

Climate Data. “Phoenix Climate.” Accessed April 25, 2024. https://en.climate-data.org/north-america/united-states-of-america/arizona/phoenix-1468/.

Franklin, Sydney. “How to Design a Flat Roof That Won’t Leak.” Architizer Journal, July 20, 2017. https://architizer.com/blog/practice/details/detailing-a-flat-roof/.

Gheorghe, Stefan. “Huge Multi-Functional Living Potential In A Tiny 420-Sq-Ft Apartment.” Homedit, March 7, 2014. https://www.homedit.com/huge-multi-functional-living-potential-tiny-420-sq-ft-apartment/.

Global Blinds. “Sunbreaker Exterior Louvres.” Accessed April 25, 2024. https://globalblinds.com.au/sunbreaker-exterior-louvres/.

Habitat for Humanity. “What Does Home Mean to You.” Accessed April 25, 2024. https://www.habitat.org/stories/what-does-home-mean-to-you.

ICC Digital Codes. “2021 International Energy Conservation Code.” Accessed April 25, 2024. https://codes.iccsafe.org/content/IECC2021P1/chapter-3-ce-general-requirements.

Infoplease. “Phoenix, AZ Demographic Statistics,” June 5, 2020. https://www.infoplease.com/us/census/arizona/phoenix/demographic-statistics.

issuu. “Louvretec Sun Louvres Brochures.” Accessed April 25, 2024. https://issuu.com/louvretecworld/docs/2018_sun_louvres_brochure.

Klinkenborg, Verlyn. “The Definition of Home.” *Smithsonian Magazine*, May 2012. https://www.smithsonianmag.com/science-nature/the-definition-of-home-60692392/.

Lawrence, Roderick J. “The Meaning and Use of Home.” *Journal of Architectural and Planning Research* 8, no. 2 (1991): 91–95. https://www.jstor.org/stable/43029025.

Leotti, Lauren A., Sheena S. Iyengar, and Kevin N. Ochsner. “Born to Choose: The Origins and Value of the Need for Control.” *Trends in Cognitive Sciences* 14, no. 10 (2010): 457–63. https://doi.org/10.1016/j.tics.2010.08.001.

Mairs, Jessica. “Sliding Chipboard Panels Utilise Space in Madrid Apartment.” Dezeen, November 7, 2014. https://www.dezeen.com/2014/11/07/pkmn-architectures-all-i-own-house-modular-madrid-apartment-chipboard/.

Masonite. "Melrose Primed Flush Hollow Core Molded Composite Pre-Hung Door." Lowe's. Accessed April 25, 2024. https://www.lowes.com/pd/Masonite-Melrose-Primed-Flush-Hollow-Core-Molded-Composite-Pre-Hung-Door-Common-30-in-x-80-in-Actual-31-5-in-x-81-5-in/1001075534.

Masonry Technology, Inc. “L & R Weep Screed™.” Accessed April 25, 2024. https://www.mtidry.com/mti-product/l-r-weep-screed.

Masonry Technology, Inc. “Stucco.” Accessed April 25, 2024. https://www.mtidry.com/stucco.

Masonry Technology, Inc. “Sure Cavity®.” Accessed April 25, 2024. https://www.mtidry.com/mti-product/sure-cavity.

McAndrew, Frank T. “Home Is Where the Heart Is, but Where Is ‘Home’?” *Psychology Today* (blog), August 3, 2015. https://www.psychologytoday.com/us/blog/out-the-ooze/201508/home-is-where-the-heart-is-where-is-home.

Merriam-Webster.com Dictionary, s.v. “home,” accessed April 25, 2024, https://www.merriam-webster.com/dictionary/home.

Modernfold. “Acousti-Seal® Continuously Hinged Automated Wall Systems.” Accessed April 25, 2024. https://www.modernfold.com/en-US/products/operable-partitions/continuously-hinged-systems.

Modernfold. “Modernfold Accordion Doors and Partitions.” Accessed April 25, 2024. https://www.modernfold.com/en-US/products/accordion-doors/doors-and-partitions.

Ori. “Expandable Studios.” Accessed April 25, 2024. https://www.oriliving.com/ori-typologies/expandable-semi-furnished-studio-ii.

"Owens Corning R-6.7 Multi-Purpose Small Project Unfaced Fiberglass Insulation Roll." Home Depot, accessed April 25, 2024, https://www.homedepot.com/p/Owens-Corning-R-6-7-Multi-Purpose-Small-Project-Unfaced-Fiberglass-Insulation-Roll-16-in-x-4-ft-1-Pack-A85P/100320315.

Oxford English Dictionary, s.v. “home (n.1 & adj.),” March 2024, https://doi.org/10.1093/OED/9487569112.

PortaFab. “Floor-to-Ceiling Wall Partitions.” Accessed April 25, 2024. https://www.portafab.com/floor-to-ceiling-wall-partitions.html.

Room Dividers Canada. “SwiftWall Solutions.” Accessed April 25, 2024. https://www.instantspacedividers.com/temporary-walls.html.

Rykwert, Joseph. “House and Home.” *Social Research* 58, no. 1 (1991): 51–62. https://www.jstor.org/stable/40970630.

Schlage. “What Is the Meaning of Home? Hint: It’s Not Just a Place.,” November 17, 2020. https://www.schlage.com/blog/categories/2020/11/meaning-of-home.html.

Second Skin Audio. “Timberwool™ Wood Fiber Acoustic Panels.” Accessed April 25, 2024. https://www.secondskinaudio.com/acoustics/timberwool.

Statista. “Size of New Single-Family Homes in the U.S. 2022.” Accessed April 25, 2024. https://www.statista.com/statistics/529371/floor-area-size-new-single-family-homes-usa/.

Visual Capitalist. "The Median Lot Size in Every American State." Accessed April 25, 2024. https://www.visualcapitalist.com/cp/the-median-lot-size-in-every-american-state-2022/.