



# **MOVABLE POSSESSIONS**

Alternative Housing Through Adaptable Design

Master of Architecture, 2016

Lisa Marshall





MOVABLE POSSESSIONS:  
Alternative Housing Through Adaptable Design

by Lisa Marshall  
Master of Architecture, Ryerson University, 2016

A Design Thesis Project Presented to Ryerson  
University in Partial Fulfillment of the Requirements for  
the Degree of Master of Architecture Program.

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## **A B S T R A C T**

Poor communities around the world have developed architecture without architects. Subsidized low-income housing has been built as if to provide only a short-term solution. Poverty and lack of affordable housing is not a short-term problem but an ongoing issue that demands creative adaptable solutions for a changing world. Adaptable architecture is essential for the redesign of affordable housing that is environmentally, economically, and socially sustainable. In order to mend the broken bond between lower-incomes and the architectural quality of space, this design research strives to both defend and produce affordable architectural alternatives to housing through the use of adaptable design principles and strategies found within Barbados' Vernacular Architecture, the Chattel House.



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# INTRODUCTION

## [Re]envisioning the Way We Choose to Exist

In the years following the first World War, the design of the modern house was treated very much as a laboratory, a testing model for exploring new ideas about living patterns and the implementation of innovative technology. (Kronenburg, 2007) In an era of new political, social and economic theories and movements, the design of the home served as a 1:1 symbolic representation of a vast range of concepts, ideas, and experiments ranging from the practical to the incomprehensible. The conceptual relationships between housing and seeking to achieve individual happiness now possess a somewhat old-fashioned stamp, and it is at this crossroad that the question of supply and demand is intertwined with the cultural challenge of artistic creation. (Peripheriques, 1997) Architects, as well as the general public, have described these anonymous single-family entities as eyesores of negative social implications. (Peripheriques, 1997) Many architects recognize the mediocrity of their works. They blame their lack of design innovation on inappropriately limited resources and the resulting need to adopt the most economical solutions, no matter how inappropriate. The issue of resources should not be blamed for the tasteless designs of the home, but rather the ways in which the selected resources have been used, as well as the refusal to question existing solutions. (Peripheriques, 1997)

Physical design and architecture are offensive words to those battling against poverty. (Kronenburg, 1998) While the architectural press praises the fine design

of a number of housing projects as creating a better urban environment (usually for the upper-middle class), most social planners have seen “renewal” create only worse conditions for lower-income people. (Kronenburg, 1998) There is a disconnect between the architectural quality of space and a low budget, two elements that should be inextricably linked. (Peripheriques, 1997) The occupant, often referred to as the consumer, is deprived of choice. As seen in many social housing projects, the “house” has turned into a commodity of never-ending maintenance investments with a lack of uniqueness and variation in supply. As architects, conceptual, even unrealistic ideas of housing must be experimented with, with the aim to bring it back to a more realistic study for introducing new and innovative alternatives to the common place house of little identity. (Peripheriques, 1997)

Poverty, unemployment and homelessness have developed new attitudes to permanent residency. More and more people are no longer living in stable environments. Instead, these powerless people are moving from home to home, place to place, in search for a better life.

There is a need for a new type of low cost single-family house, whose limited construction budget challenges the designer to produce quality through innovative use of small spaces, strategic methods of deployment, growth over time, and the efficient

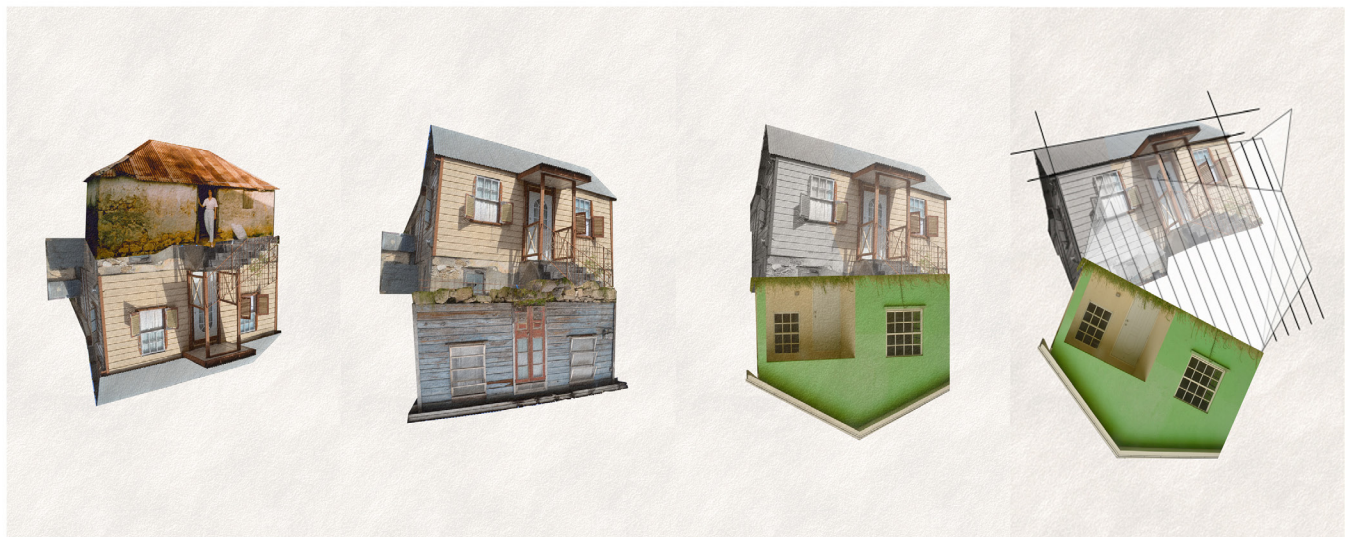


Figure 01: Houses in Perspective -  
A comparative study of  
Housing Typologies in  
Barbados

use of existing available resources. This thesis (re) introduces concepts of simplified living patterns, with smaller floor areas and by using locally sourced and novel construction materials.

Throughout this project, many challenges and contradictions with the concept of the innovative and still affordable small house come into play. Have we designed compact solutions for low-cost living or luxurious second homes? (Ruth Slavid, 2007) It is argued that once a building becomes very small, the level of interior variation decreases, often ending up with only a single way of living comfortably inside – All the furniture and fittings are preplanned and the level of personal possessions is limited to the bare minimum. (Ruth Slavid, 2007) If this is a personal choice, it can be viewed in a rather appealing light, but for others, who do not have choices due their economic limitations, a structured and minimal living environment may have a more negative result. However, the most intriguing part of this research and design is that it has opened the doors to new visions of tomorrow's affordable housing for both the architect, who must continue to focus their creative attention on this critical aspect of the built environment, as well as the general public who, through the presented design strategies and implementation schemes, will see that a low cost, small size (affordable) house does not necessarily translate into an impoverished space without the valuable influence of architectural expression. (Peripheriques, 1997)

"The physical design of our homes, neighborhoods, and communities shapes every aspect of our lives, yet too often Architects are desperately needed in places where they can least be afforded." (Abrams, 2012)

In relation to the number of people per hectare, Barbados is the 4<sup>th</sup> most densely populated country in the Americas and the 18<sup>th</sup> globally with a population in 2013 of 284,644 inhabitants and a growth rate set at 0.35%. (Barbados Today, 2014) Poverty has affected 13.9% (39,565 people) of the population and tends to be concentrated around the Urban areas such as Bridgetown, the island's capital city. (Barbados Today, 2014) The poverty line in Barbados was BDS \$5,503.00 per capita per year and approximately 7000 households existed on income below this threshold. (Barbados Today, 2014) By using Barbados, as the primary focus for this design proposal, this research will explore the concept of adaptable living by re-examining the type of built environment that can help those low-income persons live a more dignified lifestyle.

This thesis will primarily examine the genesis of adaptable design in traditional and historic building patterns such as the morphology of Barbados' vernacular chattel house, a housing typology that uses a 'kit of parts' approach to adaptability. (See Chapters One and Two) that came about through the emancipation of slavery, followed by more recent architectural influences on the island such as the borrowed patterns of Government Housing.(See Chapter Three) This thesis also examines several international examples of novel approaches to affordability in places such as Vietnam.

While environmental and economic sustainability have been the main driving factors in the movement towards a more resilient built environment in Barbados, social sustainability is a factor that has received significantly less attention over the years. (Adaptability, 2012) The

support for the historically proven self-help housing solution, explained in greater detail in Chapter One, has fallen drastically, which has resulted in a continuous decline in adequate, affordable homes. The intention for the design component of this design is to propose, through design schemes of strategies and limitations, the possible benefits of an alternative housing solution through the creation of a new adaptable housing modular system, heavily influenced by the chattel house's kit of parts approach for the low-income housing sector of the island; thus illustrating that architects can design innovative houses at a low cost. Ideally, this thesis will return the sense of purpose, pride and place that has arguably been ignored within these affordable design sectors of hidden gestures and under-designed solutions.

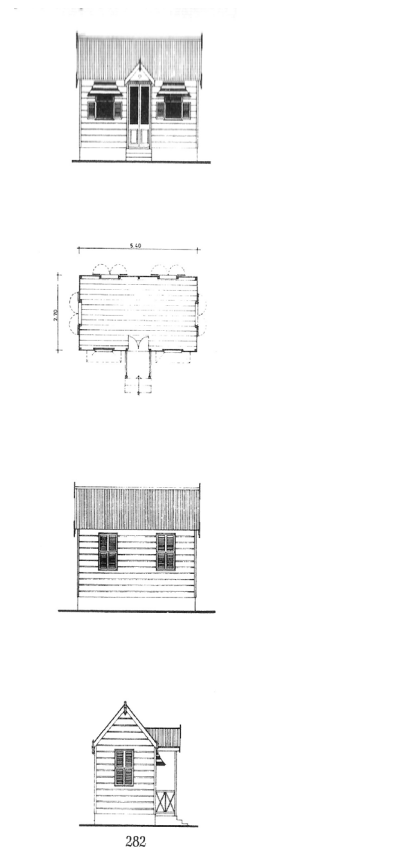


Figure 02: The Traditional Chattel House - Front Elevation, Floor Plan, Back Elevation and Side Elevation.









## THESIS STATEMENT

Adaptable Architecture consists of buildings designed to have the capacity to respond to economic, environmental, and/or social changes through physical transformation and is viewed by many as being less permanent and therefore less valuable than 'fixed' building typologies. This thesis will explore the opportunities for deploying Adaptable Architecture within the low-income sector of the built environment by challenging its perceived limitations and conventional responses in contemporary Barbadian society.











## CHAPTER ONE

### The Vernacular

# THE VERNACULAR

## Historic Houses of Barbados

*"The story of house is, indeed, the story of the people who build them (Acworth, 1949) It is also the story of people who, blind to the beauty of the familiar, tear them down, or abandon them to the forces of time and the elements. The values of the "throw-away" age threaten, literally, the fabric of our society – in particular our immediate built environment. We lose in two ways when a basically sound old house is left to rot or replaced in the current style – economically, aesthetically and culturally; and ironically, now that we are almost dependent on tourism for survival, we are destroying daily one of our most appealing attractions and valuable assets – a unique vernacular architecture." -Fraser, 2008*

Among the many historic buildings of Barbados, (colonized by Europeans in the early 17th Century) are quaint churches and stone cathedrals, hundreds of estate buildings, and civic buildings of power such as the Parliament building towers, numerous plantation houses between 100 and 350 years old, and with that, thousands of Chattel Houses and Suburban Homes, all characterizing the unique features of Barbados' vernacular architecture. (Fraser, 2008) Barbados' original Chattel House is an icon from the mid-19<sup>th</sup> through to the early 20<sup>th</sup> century. These clapboard clad wood framed homes, also known as movable possessions, are transportable, versatile and designed for coolness, privacy and pride by the owner, all within financial means.

Dr. Henry Fraser, a Barbadian Architectural Historian, stresses the cultural importance of the Chattel House in Barbados' architectural heritage and advocates the many reasons for preserving it. Today, due to the "house for slaves" stigma attached to these houses, as well as the high cost for importing and ongoing maintenance required for the structure's wood cladding and framework, these Chattel Houses are rapidly disappearing. Many have been demolished and replaced by pragmatic modern concrete structures, often of less aesthetic appeal and others left abandoned to decay. His many books, with a combination of photography and sketches, aim to represent Barbados' rich heritage in the hope of engaging the aesthetic and nostalgic senses of the people for what exists and to encourage reasons for and the need to save it.

When scoping the island for its historical gems of traditional Barbadian architecture, from the great plantation houses to the humble chattels that have been left to decay, and the unnerving number that have been demolished since Barbados' Independence in 1966, the island loses its capabilities of self advancement. (Fraser, 2008)

### Barbadian Influences: Material & Climate

Barbados has maintained a significant portion of its architectural legacy and is recognized for making the greatest effort amongst the Caribbean islands to preserve and adapt its existing buildings for reuse



Figure 05: The  
Vernacular Chattel  
House.



purposes, through the Natural Trust Foundation, established in 1961. (Fraser, 2008) These Barbadian entities of Late Georgian and Victorian styles, although highly influenced by European settlement from 1627, possesses their own Barbadian, or as locals call it, Bajan architectural style. Driving through the countryside or the narrow roads of the Island's capital Bridgetown, one can see the Georgian style populating the landscape with its principles of balance, symmetry and harmonic design of the 18<sup>th</sup> and 19<sup>th</sup> Century. This style has also been referred to as 'Caribbean Georgian'. (Fraser, 2008)

Other major influences in the growth of the island's vernacular architecture was of course, through the use of local materials in addition to materials imported from other colonies, its climate of tropical warmth 365 days of the year and its financial limitations.

The island Barbados of 166 square miles, lies mainly on coral limestone, making this a material that was historically relatively inexpensive to access through quarrying (initially slave, later cheap labour), making the distinctive coral limestone the most used building material for prominent buildings (public and private), especially once the forests were cleared for sugar cane plantations. (Fraser, 2008) Thus, the use of stone dominated the island's landscape compared to other neighboring islands whose lands were more of volcanic rock and/or were heavily forested.

The only places where wood was used extensively in Barbados was for the wooden Chattel Houses. In the 19<sup>th</sup> Century, the period after the abolition of slavery, cheap pine from North America became an increasingly important building material but was rarely

used for larger homes, as was the case in Jamaica. The use of wood was largely limited to the Chattel House, creating a social stigma of wooden houses being houses for the lower class only. (Fraser, 2008)

The hot climate of the island and its heavy rains between June and October resulted in innovative designs to counteract with its environment. The tropical climate resulted in the creation and adoption of several design features such as wide, covered verandahs for sheltered social activities protected from the blistering sun as well as the rain while giving access to cooling breezes; jalousied and Demerara windows (borrowed from Guyana) performed a similar function for interior spaces. (Fraser, 2008) High ventilated gable roofs and tray ceilings also came into use for the cooling down of the otherwise sweltering interior spaces. The risk of hurricanes hitting the island inspired more squat buildings, with a shortened depth than its horizontal face and height. These hurricanes inspired the creation of a unique 'Barbadian Parapet' made of coral stone to protect the gabled or hipped roofs overhangs from the high winds. (Fraser, 2008)

These design principles, the need for strength to resist high winds and the easily accessible coral limestone coral, highly influenced the design of many of the treasured old plantation houses of Barbados. The importance lay in its construction and rigidity, not in its decoration or grace. (Fraser, 2008)

Figure 06: Prior Park Plantation House.





## Caribbean Georgian

The Georgian architectural style reigns in the prominent buildings of the Caribbean islands, especially in Barbados, which was Governed by Great Britain and had significant growth in the 18th and 19th centuries. The Georgian lines of these Buildings, such as the Lancaster Plantation Great House, demonstrate the scale and proportion of this architectural style. (Fraser, 2008) This style of building had a strong influence on domestic architecture with their striking arcades, pediments and grand Palladian staircases. This style also influenced the architecture of the island, seen in the Chattel Houses with their simplified wooden versions of the pediment portico, locally carved.

*"..it inspires designs even today, with an increasing fondness for the vernacular, including this classic plantation style, with all the embellishments of pediment porches and bell pelmets (window hoods)." - Fraser, 2008*

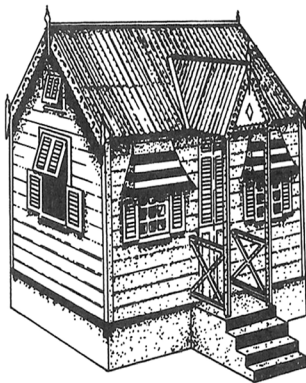


Figure 07: Lancaster Plantation House.

Figure 08: Decorated Chattel House - Georgian Influence



## Suburban Housing

In the 19<sup>th</sup> Century, the capital of the island, Bridgetown, expanded massively in every direction into the old suburbs. (Fraser, 2008) The architecture that populated these areas were suburban 'Bajan' homes, compact in size and vertical in length with a shop on the ground floor and accommodation above. In most homes of this type, the upstairs portion had attached to it a somewhat covered, if not completely sheltered, balcony overlooking the street for viewing below and conversing with neighbours. This suburban style, again highly Palladian with its central, sometimes pedimented entrance portico and extravagant double staircase guiding visitors to the first floor, introduced a new form of Caribbean architecture. (Fraser, 2008)



Figure 09: Barbados  
20th Century Suburbs

Figure 10: Typical Bar-  
badian Suburban Home  
- Sketch by Henry Fraser

## Slave Hut to Chattel House

The third house form of the island, the conceptual driver and personal cultural inspiration of this thesis topic, is that of the Chattel House, the Barbadian's movable possession.

Why the need for the movable Chattel House?

As mentioned by Walker and Trew (2011), these Chattel Houses came about through the emancipation from slavery in 1834. Although the slaves were freed, plantation owners still needed people to work their lands and the freed slaves themselves still required work to live for themselves. The freed slaves effectively became indentured servants. At the time of slavery they lived in slave huts, but now, with extremely modest means, sought a different mode of accommodation that allowed them to free themselves from the harsh memories of their chains; The Chattel House was owned by its occupant, which related to a new form of independence, and possessed the characteristic of being temporary (the house could be moved because the land was rented), relating to a new sense of freedom, hence the introduction of a new form of architecture, the vernacular Chattel House.

In order to better understand the Chattel House origins and evolution from the slave hut, one must first delve into the past of the housing of slaves during the slave period. With that said, it is important to note that, "as with so many areas of the social, cultural and material life of the enslaved people in Barbados, information in documentary sources is often very superficial, highly limited, fragmented and ethnocentric." (Handler & Bergman, 2009)

In Handler & Bergman's paper (2009), they describe the houses and household furnishings of the Barbadian slaves who worked on the sugar plantations, as well as the transformation of the architectural forms seen throughout the history of slavery on the island. The Barbadian slave huts, often constructed by the slaves themselves, were simple structures of wattle and daub with thatched roofs usually made from cane field 'rubbish' known as bagasse.

These slave huts were usually built in clusters of roughly 25-30 'homes', creating slave villages, also known as 'Negro Yards'. (Fraser, 2011) The villages were on an average of about five acres of land and were in close proximity to that of the planter's house and plantation yard, which contained the sugar mill and factory, the stables and various outbuildings. (Handler & Bergman, 2009) These villages varied in size from roughly 50 inhabitants (smaller plantations) to 100 to 200 people (medium and large plantations). In the 18<sup>th</sup> Century and until roughly 1820, these shelters were treated as "the slave's own problem..[and he] was left to build, repair, and furnish his hut with such materials as he could find himself." (Handler & Bergman, 2009) Most of these slaves were expected to find and/or construct housing for themselves with their own set of building materials – occasionally planters would help out with sourcing materials. Very little detail on the actual architectural quality of the spaces were found within the documented research. What is made clear however, is the most common formation of these slave huts, being rectangular, one level, wattle and daub structure with rammed earth floors and a pitched roof of varied thatch material and overhangs, all constructed by local materials of the area. These huts were highly influenced by the West African style





Figure 11: Old Slave Hut



1. Field Waste/Bagasse  
Roof

2. Found Timber Rafters

3. Wattle and Daub Walls

4. Dirt Floor

Figure 12: Slave Hut  
Axonometric Assembly.

of architecture. (Handler & Bergman, 2009) These slave huts of wattle and daub were originally formed with a framework of four wooden posts, which were secured into the ground. Interlaced amongst this framework were twigs or slim tree branches from the surrounding area, which acted as the formwork for the walls of the hut. (Handler & Bergman, 2009) This formwork was then plastered over with mud or clay daub on the interior and exterior faces of the wall. In later years, Handler and Bergman (2009) believe, these same walls may have received an extra layer of lime plaster. Large branches and/or boards were then set in place on top as roof rafters, which were then covered with thatch material, allowing shelter from the rain and the sun's heat. The research gathered does not indicate whether the huts were decorated and it appears unlikely that exterior conveniences such as porches or verandahs were used to add comfort to these shelters. It was noted that the door was typically so low that the building could only be entered by bending down, which again related back to the precedent African architectural forms. (Handler & Bergman, 2009)

*"Planters were sometimes advised to keep a portion of their land in 'wood for Negro-Houses', and some plantations advertised the sale of 'rafters and other sticks for building Negro-Houses.'" - Handler & Bergman, 2009*

The slave huts' interior were divided by rough wooden partitions, resulting in roughly one to three separate interior spaces for living. These partitioned spaces of little furnishings were documented as being six foot square. (Handler & Bergman, 2009) One room

was used by the adult[s] for sleeping, while the other was used for more general purposes such as cooking and/or sleeping quarters for the children. This room division, and with wooden partitions, found its way into the typical Chattel House layout and still informs Barbadian house design today.

### Amelioration

The amelioration period of the 18<sup>th</sup> century, a time when the movement for the abolition of slavery was intensifying, brought about a change in the level of care given to the living conditions of slaves by the planters. (Fraser, 2011) The planters were now more interested in the survival of their previously cheaply replicable slaves; Their physical health and procreation became important for maintaining the labour force. With that came an increased interest in their well-being and living conditions. Handler and Bergman (2009) made reference to a report from this period, which noted that slave huts were now being built of both stone, (a local material easily accessible with little expense but requiring increased labour) and wood, while others were built of strong reed or cane of the guinea corn. (Fraser, 2011) The stone houses were more durable and thus more likely to survive the regular violence of the hurricanes.

With the abolition of slavery in 1834, plantation owners were required to provide tenantry land at a modest rent to the freed slaves employed on the plantation to permit the construction of their individual homes. (Walker & Trew 2011) As a result, maintaining the slave hut was no longer required or desired, hence the need for a new form of Architecture, the Chattel House.

## Conclusion

The story of houses is indeed the story of the people who build them.

Barbados's vernacular architecture, ranging from its civic buildings, plantations, villas and suburban homes to the Chattel House, were all heavily influenced by the Georgian style and by each other.

As stated, these Chattel Houses initially came about through the emancipation from slavery in 1834. This new legislated reality meant that the freed slaves were given a means to access a significant degree of self determination (choosing who to work for, the ability to acquire and maintain material wealth) and the planters maintained some confidence of relatively secure access to a work force through a free market and working contracts. As a result of this new relationship, maintaining the slave hut was immediately undesirable and over time unnecessary, as plantation labourers found the means to build independent and superior accomodation in the form of the Chattel House.











## CHAPTER TWO

### Our Chattels

## OUR CHATTELS

### Principles of the Chattel House

It was necessary for the freed slaves to have mobility if they changed their choice of place to work or if dismissed by the plantation owner and forced to leave the rented lot of land. Their home was their movable possession, hence the term Chattel House. Their independence became their social strength.

With the Chattel House, the owner was able to move simply by dismantling their home into several components, (wall sections, roof, fixtures) load them onto an ox or mule cart - advancing today to the tray of a pick-up truck – and reassemble it the same day elsewhere. (Fraser, 2011) This mode of transport and versatility in design highly influenced the dimensioning of walls and choice in materials of the Chattel House.

*"A landless worker needed a house that could move."*  
Henry Fraser, 2011





Figure 14: Movable Possessions.



Figure 15: Moving the Chattel House on a mule cart.

Figure 16: Dismantling the Chattel House and loading it onto the back of a pick-up truck.





## Construction of the Chattel House

The walls were framed with 2"x4" lumber studs and wood plank cladding; the partitions were framed with planks, then boarded; the roof was framed of lumber rafters, then boarded and shingled (galvanized sheeting is more commonly used today); the floor was of joists and boards.

"They are as simple as a house a child draws on slate.. it is placed on a cart flat-wise, like a puzzle taken to pieces, the four walls laid one above the other.." (Fraser, 2011)

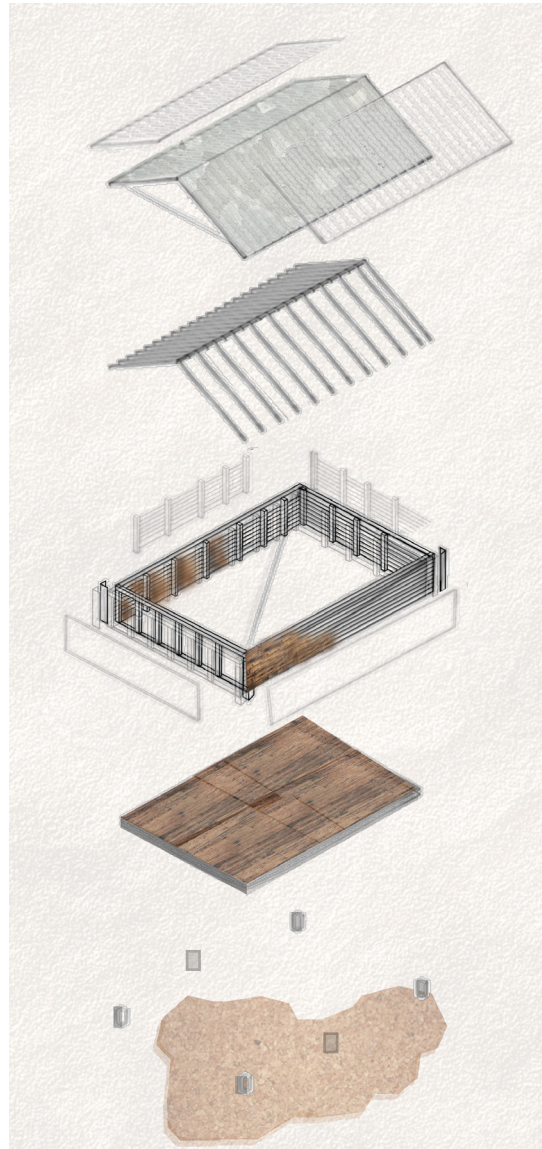
Although designed to allow such freedom of movement and relocation, the size of the island didn't provide many places for the freed slaves to venture to and although they were 'free', they still had no rights to own their own land and more often than not, held up to 12 year labour contracts. As a result, these freed slaves were often in debt to their plantation owner, which was viewed as this 'debt bondage', further limiting their freedom to move. Emancipation was said to produce a 'landless freedom', a legal system of entrapment. (Fraser, 2011)







Figure 17: Constructing  
a Chattel House Village.



1. Corrugated Metal Roof

2. Lumber Rafters

3. Wood Stud and Plank Clad Walls

4. Wood Joists and Plank Floor

5. Stone Footing Blocks

Figure 18: Chattel House Axonometric Assembly.

Figure 19: Owner involvement in the construction of the Chattel House.







With time, the freed slaves were able to purchase the land they had been renting for many years. Existing Chattel Houses were expanded with attention to detail, décor and with basic principles of unit by unit modular construction. The purchase of land meant that the foundations no longer had to be loose stones. As time passed, coral blocks were plastered over to allow a solid, static foundation compared to that of the loose, movable stones. This change in foundation allowed the owner of the Chattel House to communicate to their community the importance concepts of ownership and permanence of their residence.

"A unique building system – beginning small, solving problems of ventilation and space allocation, then adding rooms as time and money permitted." – Folk Architecture at its best.



Figure 20: Old Cozy Cottage-like Chattel House. Note - The staircase leads to nothing. The foundation of the Chattel House must have been for a previous house that was either demolished or relocated. This foundation has been reused as a base for this Chattel House.

Figure 21: Systematic Modular Growth of the Chattel House.







## Chattel House Principles

1. Versatility - ability to adapt to other functions and uses.
2. Mobility - ability to be dismantled on site and relocated elsewhere.
3. Ventilation - designed for coolness through the strategic placement of openings (Jalousie window) and high ceiling heights.
4. Privacy - designed for privacy through the strategic placement of openings (Jalousie window).
5. Modularity- a modular basis for its design and construction.
6. Simplicity - the condition of living minimally.
7. Framed Construction - the method of designing lightweight structures with lumber stud frames and wood plank cladding.
8. Systematic Deployment - designed to allow the built walls to be taken apart and relocated by sides.
9. Systematic Growth - designed to allow modular expansion laterally when time and money permitted.
10. Affordability - designed within the financial limitation of the owner.

The Chattel House, born of necessity in a difficult social circumstance, illustrated the ingenuity, the pragmatism and the skill of the Barbadian builder. With time, the desire to own the land on which Barbadians built their Chattel Houses, over-powered the benefits

of having a movable home, hence the diminishing need for a chattel house. (Totally Barbados Real Estate, 2009) Although many have been maintained with pride by their owners to serve their original purpose as a low cost cottage-like home, (some even treasured and valued by the Barbados National Trust), others have been transformed to adapt commercial uses, demolished and replaced by modern concrete and stone structures of less aesthetic appeal, or have been left to decay, slowly allowing the island's rich heritage to disappear through ignorance and neglect.

In order to better understand the structural system behind this 'kit of parts' notion for the movable chattel house, a photographic analysis of a derelict chattel house found on the south coast of the island was carried out.

Figure 22: An Abandoned Chattel House on the South Coast of the Island.



Figure 23: Interior Decay  
- standard spacing of  
timber studs was 2'-0".

Figure 24: Exposed  
Connections.







Figure 25: What's your story? Timber members spaced in accordance to the window and door openings.

Figure 26: Weathered Roofing. Exposed wood rafters below galvanized roof sheeting.





## Conclusion

These Chattel Houses are simple and compact in design and allow changes in the number of modular additions through systematic growth and methods of deployment. The interior partitions that allow room allocations and separations of public and private spaces are also fitted out with jalousied windows and lattice work for cross ventilation. The interior spaces are often more private. As observed, the socializing within these homes takes place on the verandah or through an opened window with the neighbor next door.

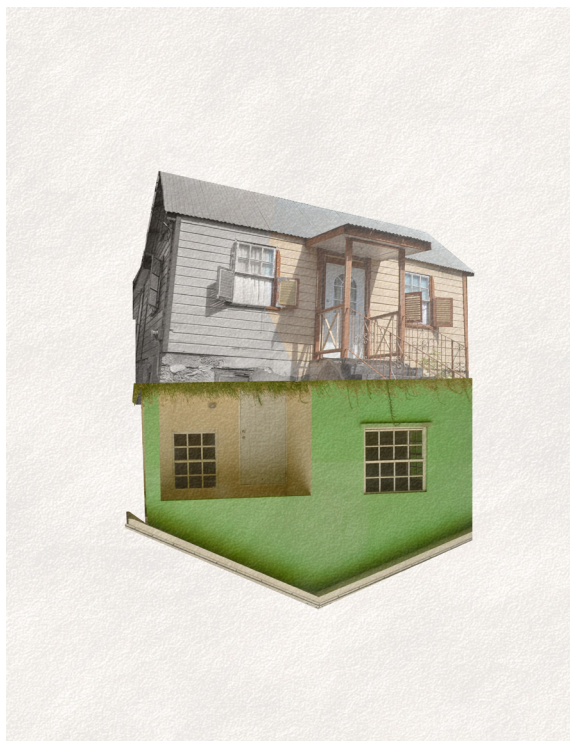
The genius of the Chattel House is the versatility and mobility in its most economical adaptation of space, combined with good craftsmanship and pride in appearance, all within the financial limitations of the owner.











## CHAPTER THREE

Affordable Housing

# AFFORDABLE HOUSING

## Barbados Government Housing

The value and potential of the Barbadian vernacular dwelling (the Chattel House) appears to have been recognized only in so far as low-income groups have historically been left to their own devices to provide homes for themselves. This they have achieved at a remarkably low expense, but the Government has not generally taken the process a stage further, and incorporated the popular dwelling into formal, proactive strategies for the general upgrading of housing within the region. (Watson & Potter, 2001)

The year 1973 marked the creation of the Government of Barbados' new housing executive body, the NHC. (Watson & Potter, 2001) All New units were to be of permanent wall construction. The initial project formulation included proposals for two expandable house types, both of which would afford the house owner the opportunity to occupy a basic, 'no frills' house and to complete the finishes and extensions in the future, as and when money was available. The housing types were called, 'National Housing Corporation (NHC) starter home' (Seen in Figure 28) and the 'twin core starter home'. (Watson & Potter, 2001) The construction of the NHC starter home type marked the beginning of a new phase for the state's involvement in low-income housing, and for the NHC in particular.

**NHC Vision:** To be the best provider of quality and affordable housing solutions for every Barbadian.

**NHC Mission:** To be the leading provider of affordable housing solutions through highly skilled, competent and customer focused employees, in collaboration with our stakeholders.

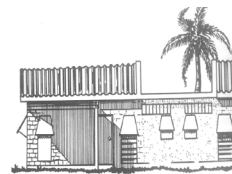
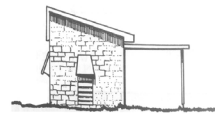


Figure 28: (Left) NHC Starter Home Unit Diagram.

Figure 29: Lancaster Government Housing Project.









# Current Direction of the Corporation

The focus of the National Housing Corporation has changed over the years in order to respond to the increasing demands by Barbadians for housing solutions at affordable prices. There was further diversification of its activities when in 1998 the Housing Act was amended to allow the engagement in non-housing commercial activities.

In keeping with the new direction, the Corporation re-branded the **H.E.A.R.T Programme** (Housing Everyone An Affordable Realistic Target) to the **H.E.L.P Programme** (Housing Every Last Person) so that the acronym reflects the more caring stance being taken. (NHC, 2011)

## (NHC) Starter Home

The proposed starter homes catered to those low-income citizens who dreamt of having their own home within their own level of affordability. Each starter home was designed to be expandable by the owner as much as their needs demanded and finances allowed.

These starter homes, which measured 800 square feet in dimension within a 3,000 square foot housing plot, consisted of two to three bedrooms. (Watson & Potter, 2001) Although all of these starter homes are of little aesthetic appeal, many stand today with new extensions to the original module such as additional spaces for patios, garages and even bedrooms, allowing the home itself to grow with the owners ability and need.

1. Corrugated Metal Roof

2. Lumber Rafters

3.CMU Walls with Reinforced Concrete Beams; Plaster or Vinyl Siding.

4. Reinforced Concrete Raised Slab.

5. Reinforced Concrete Footings and Beams

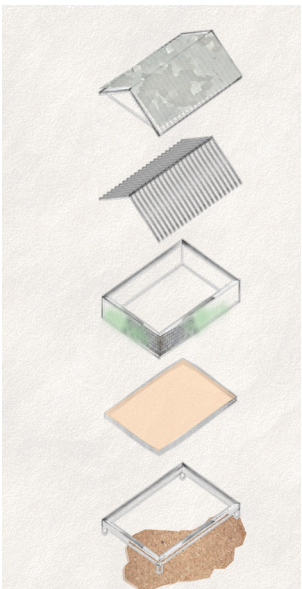


Figure 30: NHC Housing Additions.

Figure 31: NHC Axonometric Assembly

## (NHC) Starter Home Construction

The timeline given for the construction of many of these earlier Government housing projects was roughly two years. Some however, took over ten years to be completed, with many houses on site still left incomplete. Many problems were encountered such as the delay in materials arriving on site and their unnecessary importation, problems with the site itself, the construction equipment needed and the weather in general. (Watson & Potter, 2001) The structural walls supporting the wooden rafters and roof were of plastered concrete masonry units (CMU) and prefabricated beams and slabs supported the floors.

Throughout the world, the use of prefabricated systems of housing solutions has often proven to be futile, based on the continuously changing needs and conditions of the people, such as the climate for example. This need to continuously adapt to the changing world calls for a wider variety of solutions, which is something that one fixed system can't solely offer. (Watson & Potter, 2001)

In Barbados, the CMU walls produced, from their exterior appearance to method by which they are erected, are basically the opposite of those housing units provided by the island's vernacular housing system. As mentioned earlier, the vernacular Barbadian Chattel House is highly innovative, flexible, and appropriate, all within the financial limitations of its owner. These homes take the self-help housing and incremental construction approach, a strategy

that has proven to be of success. To ignore the suggestions by the public to incorporate the proven success of the vernacular housing system within main stream housing programmes at a national scale is nothing but detrimental to the future of the low-income sector of the island and the island's heritage as a whole.

Although many of those earlier Government housing projects are now complete, and others still only now beginning, the projects tend to fall short of their original intentions. (Watson & Potter, 2001) These starter homes, constructed from the cheapest local material resources (in order to minimize costs for the Government), soon after completion require a great deal of maintenance and constant repair; arguably because of the low quality of the chosen materials and/or the methods used to construct the house cheaply. Although the Government houses were made cheaply, they didn't benefit the owner. Instead, it placed the owners within a viscous cycle between paying for a cheaply made house to eventually having to apply to the same NHC department for funds to help with the predetermined repairs, which is in itself a time consuming process and a rather unnecessary burden for the poor citizen, which these homes are supposedly catering to. (Watson & Potter, 2001)

## The Tenant Versus The State

Although designed and built cheaply in order to be classified as 'affordable', upon completion, many of these homes remain unoccupied due to the low-



Figure 30: NHC  
Starter Home under  
Construction







income stigma and high cost of living; a politically charged issue in itself. (Watson & Potter, 2001)

For the public, these homes were, "built like cattle sheds" and were "aesthetically unpleasing." (Barbados Advocate, 1992)

As argued in the Barbados' Daily Nation Newspaper (1985), for many, the creation of these starter homes did nothing but create 'worse ghettos' by introducing more social problems than it resolved. (Watson & Potter, 2001) Common social problems found within these developments ranged from overcrowding issues, the lack of privacy, the absence of basic social amenities, inadequate recreational facilities, dislocation with its tenants and overall low community spirit amongst the residents.

If this existing attitude continues among planners and politicians, then the potential future of such developments can only be described as unpromising for those low-income earners who are expected to live in such areas.

In 1984, Peter Olsen suggested that in the case of Barbados, "Government programs should build on the longstanding tradition of self-help construction over time." (Watson & Potter, 2001)

Figure 32: NHC Housing.

## Conclusion

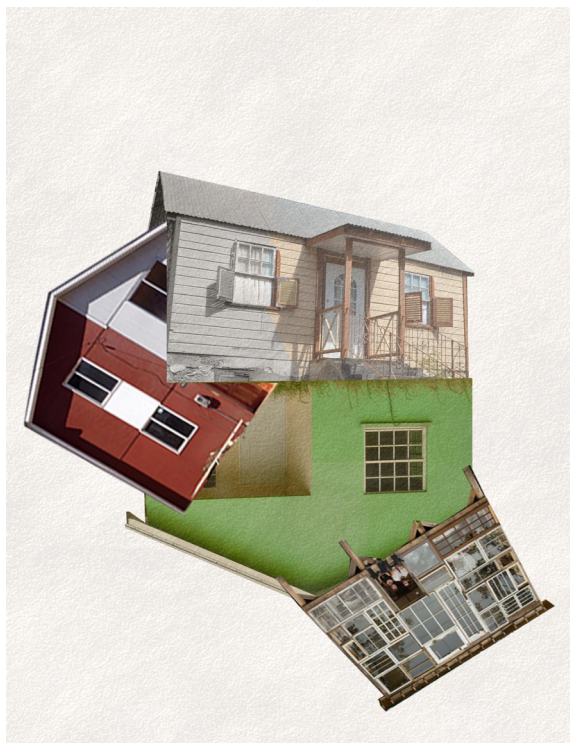
As this analysis of the NHC Plan for Barbados has shown, the richness of its design and means of execution of such shelters present both technical and political complications, hindering the view in many cases towards its success. Since the start of the NHC, town houses, apartments and freestanding dwellings for rent to eligible low-income families have been built. These Government funded houses however, are perceived by Barbadian Citizens as stigmatized housing alternatives that lack cultural identity, social engagement and are still too high in price. As a result, many of these undesirable spaces are left unoccupied.

It is evident that those in charge have overlooked the importance of Barbados's vernacular architectural system, seen in its chattel house, resulting in numerous situations of missed opportunities. The Government of Barbados should promote and strive to upgrade its vernacular architecture rather than waste time and energy on imported patterns of inadequate functional designs. (Watson & Potter, 2001) The introduction of the basic starter concrete home, which began in the 1980's, continues a rejecting trend to this day towards the vernacular chattel house system of parts and owner involvement.









## CHAPTER FOUR

You Live, You Learn

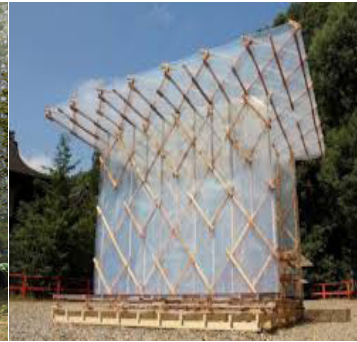
ONE



TWO



THREE



FOUR



FIVE



SIX

# YOU LIVE, YOU LEARN

## Living Simply, Living Small

Specific opportunities of impact seen through the selected innovative projects from around the world, demonstrate the power of design to improve lives through alternative means of housing. Although ranging from humanitarian, refugee designs to more contemporary versions of an adaptable hut, these projects hold similar riches of architecture - for the people, by the people (DIY).

These selected case study projects highlight global political, economic and social issues in housing as well as possible solutions, with their unique interventions of what they consider to be the most appropriate answer to the problems they are faced with, ranging from choices in: materials and construction; size and spatial quality; temporal relationship to context; natural ventilation and light throughout the day; future growth; and affordability.

Overall, these case studies demonstrate the ability for Architecture to overcome the original general assumption that low budget construction is disconnected from architectural quality of space.

Figure 35: Worldy Examples of Affordable Housing.





# ONE

Name: Ekhaya: An Affordable Informal Housing Solution  
Designer: Johnny Aderton  
Place: Cape Town, South Africa  
When: 2013

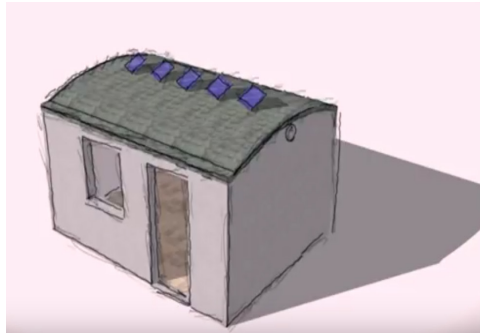
A Doctor from Cape Town, South Africa by the name of Johnny Aderton lived comfortably just a few kilometers from one of the many South African Slums. Aderton and his family, his wife and two kids, spent a lot of their time exploring the world by living on a sailboat. Aderton realized two things from this experience, the first being how to live comfortably in small spaces and secondly, what it means to live practically. (Ekhaya, 2013)

After returning home to Cape Town from life at sea, he was surprised to see the same neighboring slums in the same condition, if not worse. This bothered him greatly; Aderton felt that the whole approach to low cost housing in Cape Town was completely wrong. Like many, when he first viewed the slums he saw cramped dark spaces where everyone was basically living uncomfortable lives on top of one another. But after his journey at sea, this view changed for Aderton, he no longer saw cramped living but instead, places of opportunity, resources, acres and acres of space made by the roofs. (Ekhaya, 2013) This realization led him to leave his medical career and to focus his time and energy on developing the Ekhaya, which in Afrikaans meant 'home living in small spaces'. (Ekhaya, 2013)

Houses were built by first erecting a temporary wooden frame to support the stacking of locally-filled sand bags, which were then tied together. Once

the sand bags were in place, the wooden frame was removed and reused to act as a supporting structure for the construction of another neighboring Ekhaya. The sand bags were insulated, bullet proof, fire proof and flood proof. The polystyrene foam roof was then added. This roof was arched, (inspired by a simple arched bridge he'd seen in Venice), self-supporting, extremely simple and cost effective. (Ekhaya, 2013) This simple arch allowed for the placement of solar panels and thus transformed the simple home into an electric box with light and technology. The roof could also be leveled if future extensions were needed or desired. The ability for the small house to grow created different opportunities for the owner from places for gardening, added space to raise chickens, or rentable space, thus transforming the simple small home into an owner financed income generator.

Figure 36: The Ekhaya House - Cape Town.



"The most exciting thing was the tangible amount of energy and excitement when the community realized they can actually build a house."  
- Aderton (Ekhaya, 2013)



Figure 37: Ekhaya  
- Growth and Construction.



Roof Occupation  
Changes Over Time:  
Solar Panels, Levelled  
out for Extension  
Above for Work  
Space/Rentable  
Accommodation.

Figure 38: Ekhaya  
- Community  
involvement in its  
construction.









## TWO

Name: Low Cost Vietnamese Housing

Designer: HP Architects

Place: Vietnam

When: 2015

These are homes made of wild grass called bamboo. Bamboo is one of the most durable materials in the world, with a growing rate up to one meter a day. Although it can be cut young to be woven into mats and panels, if used for construction purposes it is fully grown in just three years (up to eighteen metres of usable length, tensile strength of steel, and compressive strength of concrete) (Hardy, 2015) Due to its hollow make up, this material is also lightweight, easily handled and transported.

One of the biggest issues in terms of housing in South East Asia is flooding. Not only is it prone to severe temperatures year round, it also takes on a lot of water.

How do you design an affordable home in a hot, humid, and flood-stricken country?

With the basic understanding of the residential needs and desires found within a dwelling, HP Architects designed a lightweight housing module that can float in times of flooding. (Floating Bamboo House, 2013) The key designed components of this house were its means of assembly, the sizing of the bamboo module, and the use of local materials, making the design not only resourceful and practical but also affordable. In terms of construction, the bamboo modules were secured with local building techniques such as anchors, ties and solid connections.

Traditional architectural characteristics were explored further with the access to local building materials such as bamboo, leaves and recycled oil containers. Access to local materials and mass production techniques implemented by the local community, allowed the homes to be built for the people, by the people (DIY) - producing a stronger social network within a community. (Floating Bamboo House, 2013)

Figure 39: Vietnamese Affordable Housing by HP Architects.

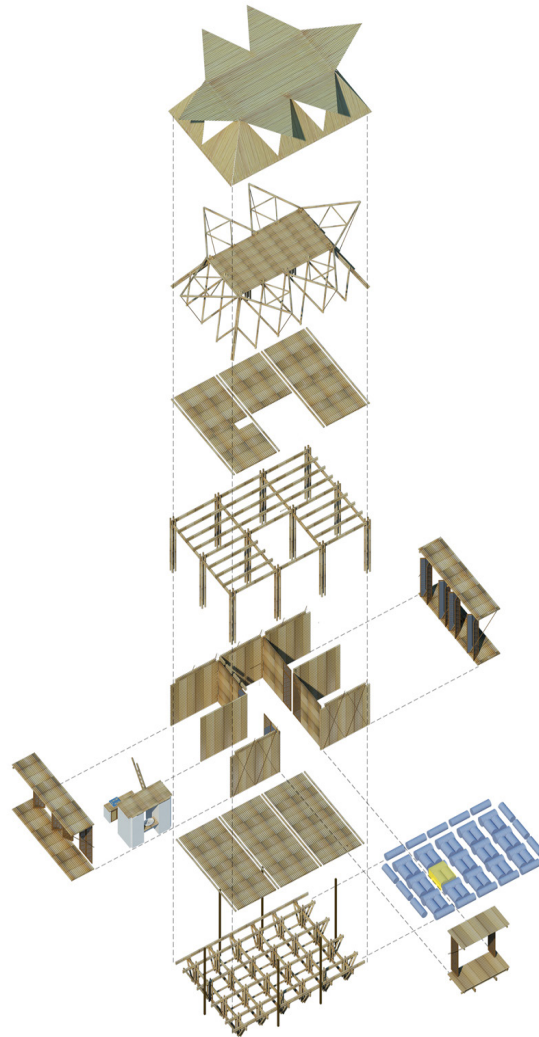


Figure 40: Vietnamese Affordable Housing Axonometric Assembly.

Figure 41: Vietnamese Affordable Housing by HP Architects - Night Shot.







## THREE

Name: Shimogamo Jinja Hojoan  
Designer: Kengo Kuma and Associates  
Place: Kyoto  
When: 2013

800 years ago, a Japanese author by the name Kamono Chomei wrote a book titled, 'An Account of My Hut'. In this book, Chomei gave a detailed account of his life experiences living alone in a three meter by three meter hut. (Shimogamo Jinja Hojoan, 2013) To pay tribute to this fact, Kengo Kuma and Associates built a temporary hut using Cedar, ETFE, plastic and magnets on the same site where Chomei's humble dwelling was originally built.

To emphasize the transportation, assembly, disassembly and lightweight qualities of Chomei's hut, the designers made a combination of ETFE sheets that could be rolled up and transported. The magnets, which were fixed onto the lattice framework of cedar posts, held the portable ETFE plastic sheets in place in a sandwiched fashion. (Shimogamo Jinja Hojoan, 2013) Although this project doesn't target low income housing, it stood as an example of a contemporary interpretation of one's past, bringing the principles of their cultural history into the present through the use of contemporary building materials and construction techniques.

Figure 42: Kengo Kuma's Contemporary Hut in Kyoto.



Figure 43:  
Contemporary Methods  
of Construction - wood,  
plastic and magnets.

Figure 44: Interior  
View showing the  
architectural quality of  
space.









## FOUR

Name: Glass Cabin

Designer: Nick Olson and Lilah Horwitz

Place: West Virginia

When: 2012-2013

Designed and built by two young artists, Nick Olson and Lilah Horwitz, this glass home started as a simple idea discussed in one of their first conversations as a couple, to a realized dream a year later. These two artists imaged a space whose walls would be fully exposed to the different natural light experiences throughout the day. The designed wall would never hide the natural light. (Jobson, 2013)

The realization of their dream house began in the Summer of 2012 when the two artists agreed to leave their jobs and relocate to the open road in search for new, old and abandoned windows. They collected dozens from garage sales, antique dealers and bought a few new ones, but not many. (Jobson, 2013) Each window told its own unique story.

With regards to construction, the two artists built the house entirely by themselves. The front wall was 16 feet in height with a base 4 feet off of the ground. (Jobson, 2013) The estimated costs of the project as a whole was \$500 US. They had to be resourceful in order to complete the project cheaply.

"It was just the two of us trying to put up these gigantic posts. It was scary and hard. Looking at it now, it is just totally insane. It is huge. I realize now that's what makes it so amazing. – Horwitz (Jobson, 2013)

Although there wasn't any plumbing or electricity, the two artists enjoy the space as a means of an escape from their daily lives. Horwitz's favourite time of day in the Glass Cabin is dusk, when everything inside is on fire. (Jobson, 2013) For Olson, his fascination was with the fireflies at night that started at the ground and ascended into the open sky amalgamating with the stars above. (Jobson, 2013)

Not only was it an inexpensive project that made use of recyclable materials and methods of construction, it was also built by the artists themselves and focused on the overall expression and spatial quality of the interior space; thus allowing the designed space to be both innovative and affordable.

Figure 45: Glass Cabin Designed and Constructed by two Artists.



"Light is so different in the morning, at noon and at dusk. We wanted to somehow build a house so that change happened in our living space. It was about being closer to living with the elements." – Olson (Jobson, 2013)

Figure 46: Owner involvement in construction and design.

Figure 47: View showing the architectural quality of space at Night.







## FIVE

Name: Tiny House

Designer: Tiny House Movement (Self Built)

Place: Anywhere

The Tiny House Movement is a group of people creating housing solutions to issues ranging from environmental and financial concerns, and the desire for more time and freedom. (The Tiny Life, 2015) The aim is to downsize the space, which they live in.

The typical American home is around 2,600 square feet. The tiny house on the other hand, ranges between 100 and 400 square feet. (The Tiny Life, 2015) With a variation in form and size, these tiny homes encourage simple living in small spaces, anywhere.

Although living in such spaces may not be the answer for everyone, they function today as 1:1 successful examples of a different means of living. It encourages house dwellers, builders and designers to rethink the meaning of self-sufficiency, simple living and permanence.

Figure 48: The Tiny House Movement  
- simple living -  
anywhere.



Figure 49: Owner involvement in construction and design.

Figure 50: Interior View showing the architectural quality of space.



## SIX

Name: Villa Verde Housing

Designer: 2016 Pritzker Prize Winner, Alejandro Aravena

Place: Chile

When: 2013|2016

Alejandro Aravena's designs are well known for their socially engaging architectural qualities. The goal as an architect is to improve the world through designed space, an attribute Aravena possesses in his works. This design characteristic enabled him to win the 2016 Pritzker Prize. His pioneering work is a continuous dialogue of how architecture can improve people's lives, whether through the creation of economic opportunities to the less privileged, mitigating the effects of natural disasters, reducing energy consumption or providing welcoming public space. (Pritzker Prize, 2016) With regards to this thesis, the project, 'Villa Verde Housing', was investigated further.

Villa Verde Housing was a social housing project that aimed to give access to home ownership through this idea of a starter home. This concept created a partially completed house within a framework, allowing the owner the freedom for future growth within a given scenario. (Villa Verde Housing, 2013)

Aravena referred to this idea as 'incremental housing'. Instead of providing a completely finished home at a greater cost, Aravena applied this 'incremental housing' strategy to his design where the owner would basically receive half of a house with allocated space for future growth within provided boundaries and limitations. (Villa Verde Housing, 2013) These houses

began with a 57 square meter floor plan, and grew up to 85 square meters. (Villa Verde Housing, 2013) These homes could have been given to the owners as completed entities with the provided void that families were expected to use for future growth, already filled. However, Aravena believed in the principles of owner involvement, incremental construction and prioritization, allowing the creation of a higher standard social housing network for both the initial and final scenarios. (Villa Verde Housing, 2013)

Figure 51: Villa Verde Housing by Alejandro Aravena.







Figure 52: Owner involvement and incremental construction.

Figure 53: View showing the architectural quality of space.





## Conclusion

The common denominators throughout this exploration of the selected case studies were the following:

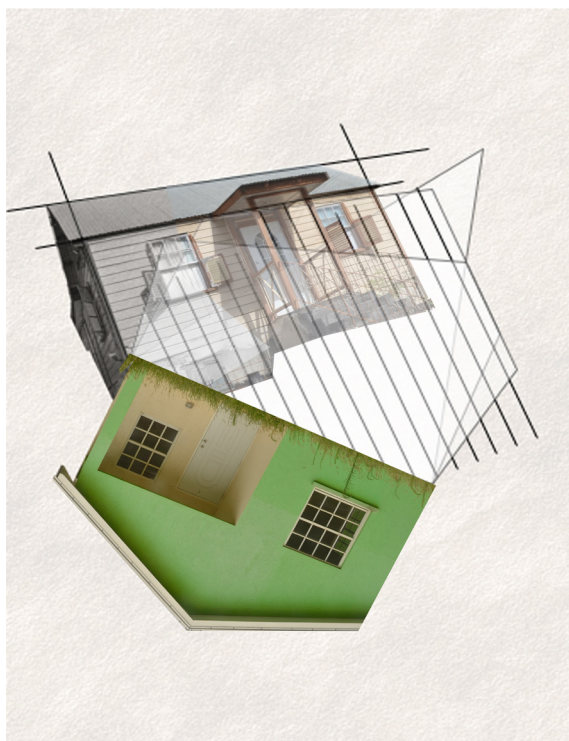
1. Modularity: simple, systematic compact living.
2. The notion of a DIY strategy in terms of the various methods of deployment.
3. A DIY strategy supporting various systematized methods of growth in size over time.
4. Resourceful use of materials whether from the immediate surrounding context or recycled materials collected elsewhere.
5. And finally, the transformable qualities of these spaces at different times throughout the day.

These innovative projects, specifically chosen from different locations around the world, show the power and ability design has to enhance people's lives. They are examples of socially conscious architecture through the use of socially conscious contemporary solutions.









## CHAPTER FIVE

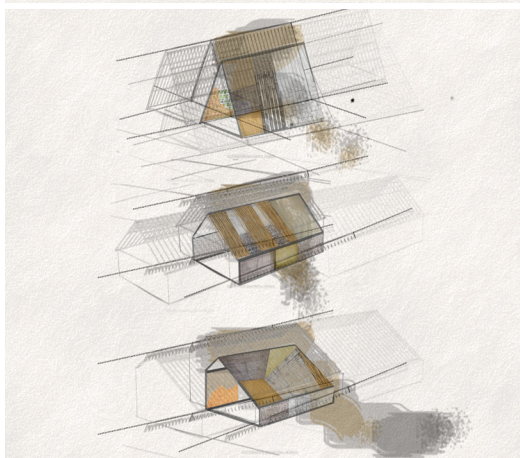
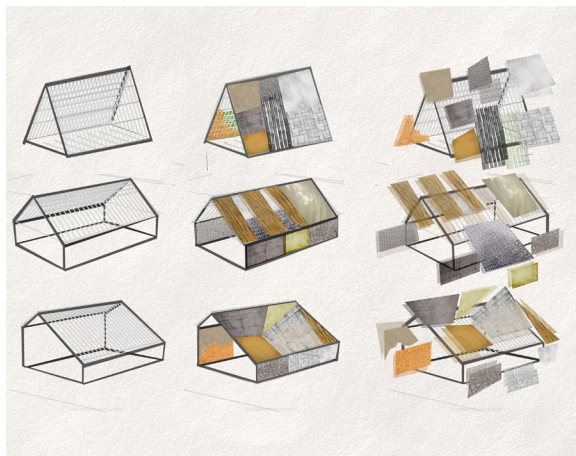
Strategies & Limitations



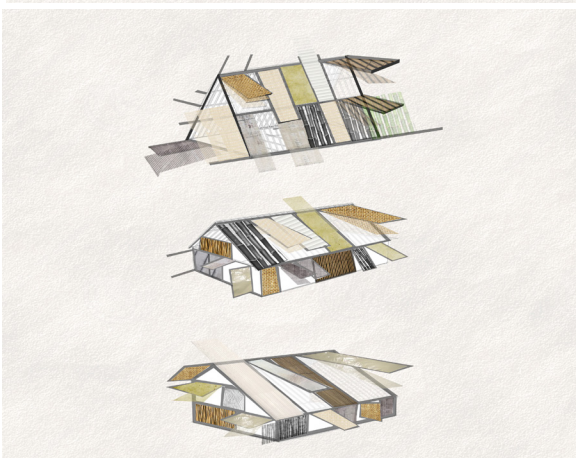
ONE



TWO



THREE



FOUR



# STRATEGIES AND LIMITATIONS

## How to be Adaptable

Following the principles taken from the island's vernacular Chattel House (See Chapter Two) and the chosen case studies from around the World (See Chapter Four), such as: the innovative designs of the modules in terms of their sizing and function; the methods by which the modules were deployed on site; the careful selection and implementation of local resources; accommodating for the future growth of the modules and their spatial qualities, this thesis investigated the following adaptable design strategies:

ONE. Adaptable Use of Local Material Resources

TWO. Adaptable Construction Methods of Deployment: The Module and Site

THREE. Adaptable Spatial Volumes: The Grow Home

FOUR. Adaptable Through Transformability: Environmental Factors

Figure 55: Design Strategies and Limitations.



# ONE

## Adaptable Use of Local Material Resources

Barbados, the small mass of land floating further East on the chain of the Caribbean islands, is divided into eleven parishes. Each parish has their own unique qualities and characteristics.

In order to get a better understanding of the island's context and accessibility to local resources, the unique qualities of these parishes have been further explained. (See Figure 57)

The Parish of Saint James, the West Coast parish of the island, or referred to by some as the 'Platinum Coast', is known for its expensive hotels and mansions, the majority of which are holiday homes owned by internationals. (Barbados Tourism, 2016) However, when driving down this coast one will still find these elegant homes neighbouring small lots of land occupied with Chattel Houses and rum shops. In this Parish, away from the coastline, one will also find the Portvale Sugar Factory.

Saint George, Saint Thomas, Saint Peter and Saint Lucy are known for their valleys and relatively flat fields of agriculture with a variety of crops ranging from the coconut tree, the cultivated Sugar Cane to the ignored bamboo. (Barbados Tourism, 2016) In these parishes one will find the local Arawak Cement Plant, Barbados' Recycling Centre and the Black Bess Quarry.

Saint Andrew, known as the 'Scotland District' with its mountainous hills of clay, shares the East Coast of

the island with Saint Joseph and Saint John. In these parishes, one will find Saint Andrew's Sugar Cane Factory and similar gullies and fields of agriculture to those found in Saint Thomas.

Saint Phillip on the south-east houses the island's airport, beautiful coves, hotels, and the Coral Quarry, which has helped supply the cut coral stone used in constructing Barbadian Civic buildings and expensive homes in the past. (Telling, 2015) The use of coral limestone on the island is seen as an indication of wealth.

To the west of Saint Phillip is Christ Church, the parish known as the area of 'Rich Diversity' and offers a varying coastline with hotels and restaurants. This parish neighbours Saint Michael, the parish referred to as the parish 'For Everyone'. Here one will find the Island's Capital City, Bridgetown where Barbados makes its trades in exports and imports. (Barbados Tourism, 2016)



Figure 56: Barbados in the Caribbean.

Figure 57: The Eleven Parishes of Barbados.



East Coast - St. Joseph, St.  
John, St. Andrew



The North Coast - St. Lucy



South Coast - St. Phillip,  
Christ Church



The Middle - St. George

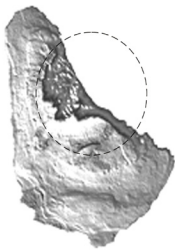


South Coast - St. Michael,  
Christ Church

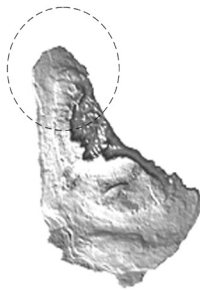


West Coast - St. James, St.  
Peter

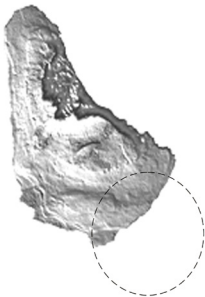




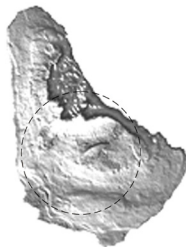
East Coast - St. Joseph, St. John, St. Andrew



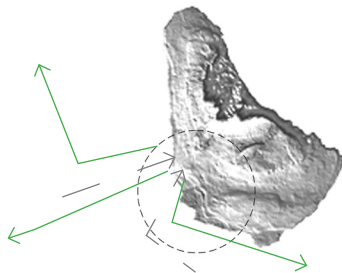
The North Coast - St. Lucy



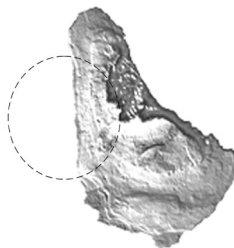
South Coast - St. Phillip, Christ Church



The Middle - St. George



South Coast - St. Michael, Christ Church



West Coast - St. James, St. Peter

(From Top Left to Bottom Right)

Figure 58: East Coast - St. Joseph, St. John, St. Andrew

Figure 59: North Coast - St. Lucy

Figure 60: South East - St. Phillip, Christ Church

Figure 61: The Centre - St. George, Saint Thomas

Figure 62: The City - St. Michael

Figure 63: West Coast - St. James, St. Peter

Figure 64: Barbados - Contour map.

## Imports and Exports

The island of Barbados is heavily dependant on imported goods and services. Almost everything is imported. In 2013, Barbados exported \$577M and imported \$1.98B, resulting in a negative trade balance of \$1.41B. (OEC Barbados, 2013) The top export destinations of Barbados are the United States (\$82.5M), Jamaica (\$53.8M), Trinidad and Tobago (\$53.7M) and Guyana (\$46.2M). (OEC Barbados, 2013) These main exports include locally produced crude oil from the Barbados National Oil Company Limited, (this crude oil is then refined elsewhere under a processing agreement and re-imported) Hard-Liquor, packaged medicaments, (such as medicine and antibiotics) passenger and cargo ships, (also known as boats, cruise ships, excursion boats, ferry-boats, barges, tankers) and cement. (OEC Barbados, 2013)

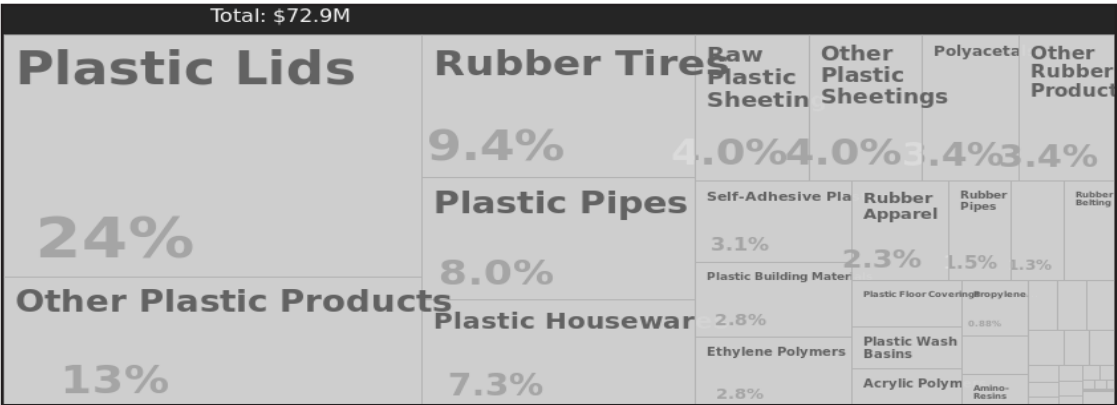
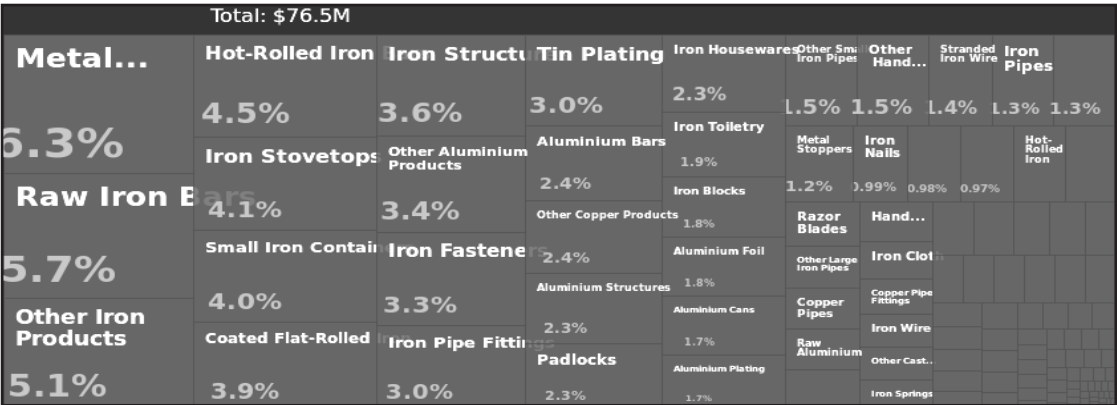
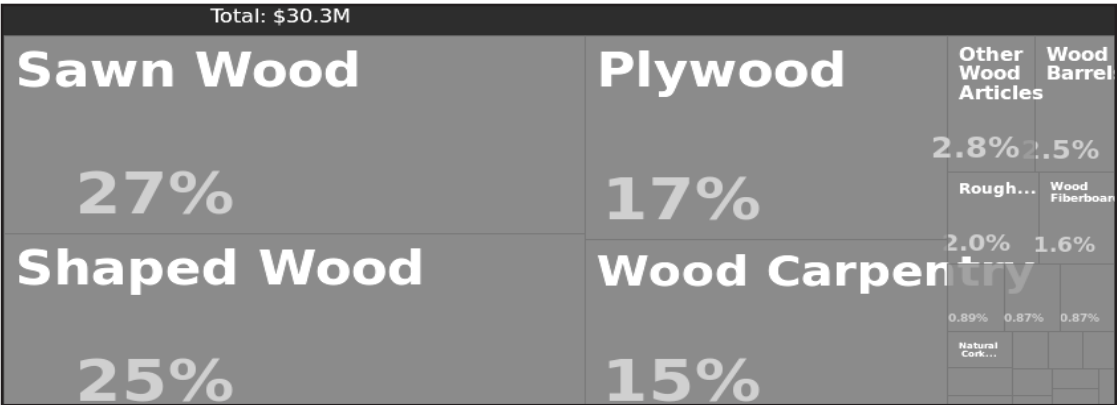
The top import origins are the United States (\$568M), Trinidad and Tobago (\$447M), Russia (\$121M), Suriname (\$83.5M) and Canada (\$80M). (OEC Barbados, 2013) The main imports include refined petroleum and packaged medicaments. (OEC Barbados, 2013) The importation of materials has accounted for as much as 50 to 60 percent of the total cost of a house. (Watson & Potter, 2001) As seen in Figure 65, the total cost for the various wood imports in 2014 was \$30.3M, the total cost of metals was \$76.5M and the total cost of plastic imports was \$72.9M. In relation to this thesis research, wood, the “poor man’s material” used in the island’s traditional Chattel House, was either imported from South America, Canada and the US or cut down from plantations. To build a chattel house today would be more expensive than building a concrete block

home with the local CMU because of the importation and maintenance costs of wood.

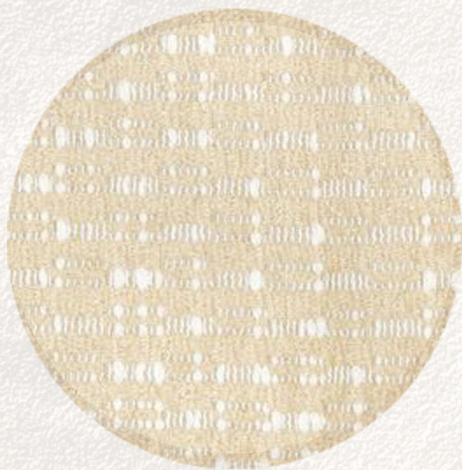
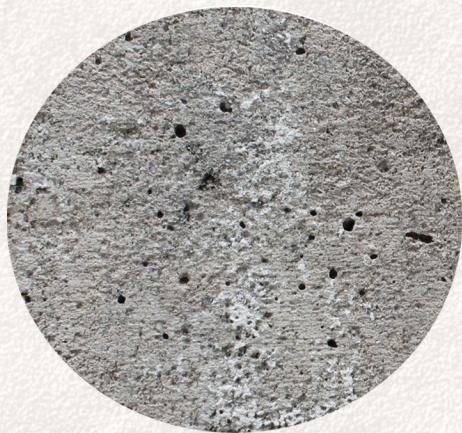
Explained in greater detail in Chapter Six, the local, available and affordable materials on the island that this thesis will investigate incorporating into house construction are the following:

1. **Concrete** - the most common material currently used in constructing houses. As discussed in Chapter Two and Three, this material for many, unlike the previous use of imported wood, (the “poor man’s material”) is an indication of permanence, independence and wealth.
2. **Bamboo** - the potential of which has not yet been realized by local builders and designers perhaps because very little is currently grown commercially.
3. **Sugar Cane Rubbish (Bagasse)** - the potential currently limited to altering landscapes but, with significant industrial investment, could supply construction materials to the island and region.
4. **Recycled Plastics** - the potential of which has already been used for other windows in affordable housing but still provides significant opportunity for exploration and further development.

Figure 65: Wood, Metal and Plastic Imports.







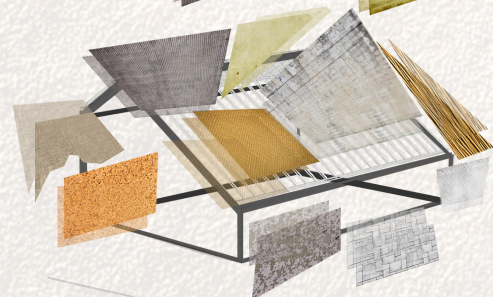
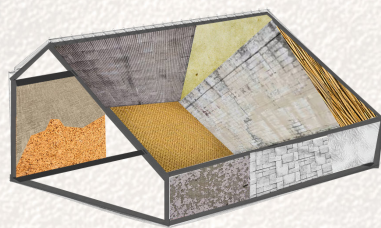
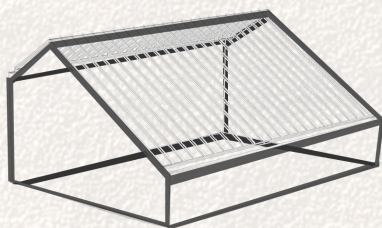
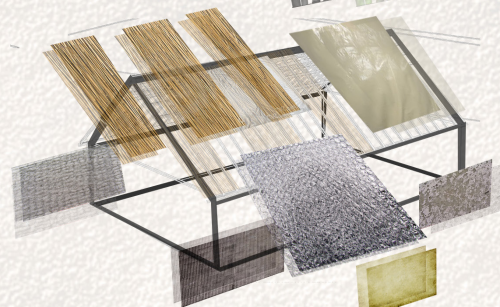
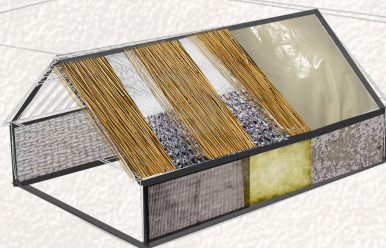
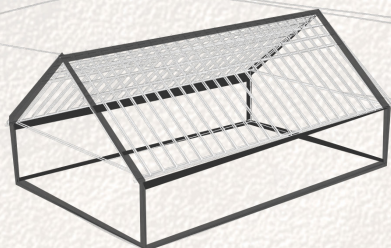
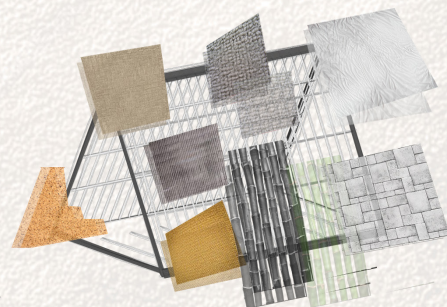
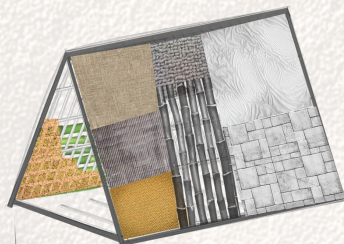
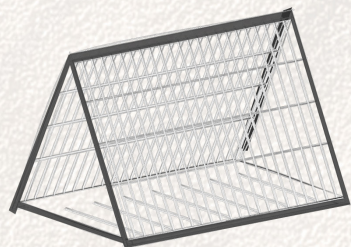


With the provided research on the available resources on the island, (explained in greater detail in Chapter Six), how does one design and build an affordable house that reconnects the disconnected link between architecture and a low budget (primarily) with the locally available materials? As seen in the comparison of material pallets between the adaptable wooden chattel house in Chapter Two and the rather static but durable concrete block Government funded homes in Chapter Three, this strategy aims to identify the potential use of a new locally sourced material pallet that combines the adaptable wooden Chattel House construction principles of versatility and lightness with the concrete starter homes construction principles of locality and durability.

Proposed Material Palette (See Chapter Six):

1. Concrete
2. Bamboo
3. Bagasse
4. Recycled Plastic

Figure 66: Proposed material Pallet.



## TWO

### Adaptable Construction Methods of Deployment

In Chapter Two, the principles of the Chattel House, its transportable qualities through its modular “kit of parts” and loose stone foundations, were explained in detail in relation to adaptable construction, methods of deployment, and community involvement. This rich potential found within the adaptable means of construction, also seen in many of the chosen case studies discussed in Chapter Four, was ignored when designing the borrowed patterns of the Government-funded starter homes (CMU and precast concrete) that were built for occupants without any involvement of the owner or community in its design and construction.

Although the words “movable possession” today often conjures up memories of slavery and housing the poor, these compact modular homes on loose stone foundations were, in fact, part of a social revolution that evolved into a low-cost, portable alternative to the traditional harsh memories of the slave huts.

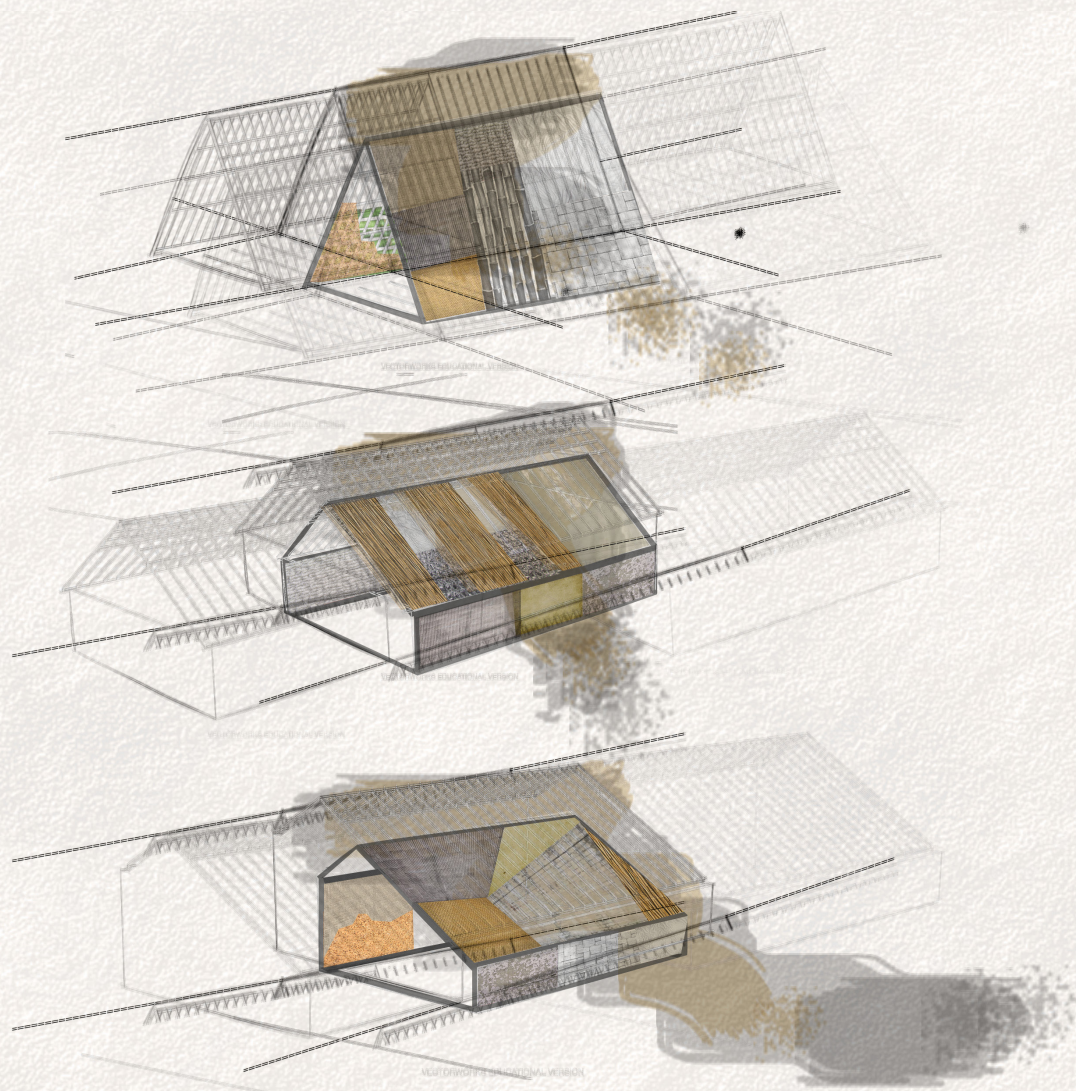
The idea of building modular components is nothing new. (Modular Construction History, 2013) This method of designing and building captured its popularity globally between World War I and World War II before really taking off in the 1950's. (Modular Construction History, 2013) The Barbadian Chattel House, brought about, as discussed in Chapter One, through the abolition of slavery in the early 19th Century, understood the importance of the module itself in terms of its proportions for functional space,

its modular dismantling of whole wall sections with the installed window and doors for transportation and relocation, as well as the potential for future modular growth.

This strategy therefore strives to positively represent and in turn, reintroduce the potential use of the modular principles and adaptable construction methods of deployment seen in the vernacular architecture of the island's Chattel House with a new locally sourced material pallet for the adaptability in its construction and permanence.

Figure 67: A  
Conceptual Diagram  
Illustrating Adaptable  
Construction Methods  
of Deployment with  
a Chosen Variety of  
Materials.







## THREE

### Adaptable Spatial Volumes

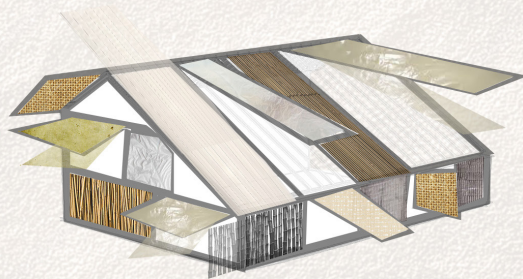
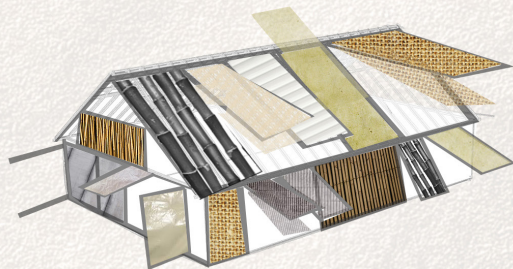
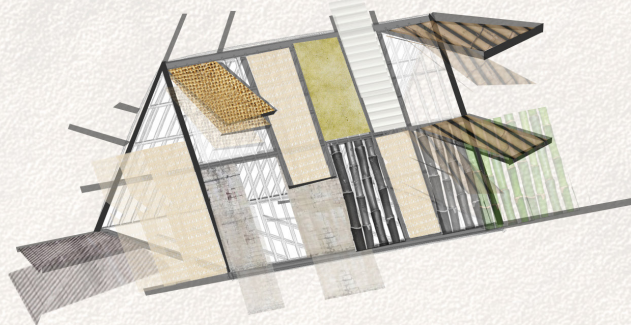
Following the concept of Chattel Houses' modular make up, further discussed in Chapter Two, the choice in material and method of construction permitted the removal and addition of walls with ease to allow further extensions and thus, changes in spatial volumes.

The owners of the Chattel Houses, who were also the builders, developed systems for adding modules towards the back of the structure for additional rooms and space. This allowed the home to continuously grow in scale both horizontally and vertically. This concept was also seen in the Affordable Housing project made of bamboo in Vietnam, as well as the Ekhaya hut in Cape Town, Case Studies which were provided in Chapter Four.

The current Government Housing system, further explained in Chapter Three, was designed to allow future expansion by the owner as time and money permitted. However, the provided designs of these starter homes do not facilitate this change easily. The level of construction and demolition required is far more complex compared to the simple lightweight removal of whole wall section panels for future additions made to the Chattel House.

As a result, this strategy aims to make use of the adaptable spatial volume principle, arguably found within both the chattel and Government housing projects, but with the focus being that of a simple, systematic, more modular approach in growth both horizontally and vertically - a characteristic only seen in the Chattel House.

Figure 68: A  
Conceptual Diagram  
Illustrating Adaptable  
Spatial Volumes  
Expanding Laterally.



## FOUR

### Adaptable Through Transformability

As mentioned in Chapter Two, the cleverness of the Chattel House design is seen not only in its methods of deployment, its versatility and mobility, but also in its design for coolness and privacy. This has been done through the transformable use and placement of openings. The Chattel House today makes use of several window types ranging from the sash windows with window hoods (awnings), louvered shutters, and demerrara windows, but the most common and original is the jalousie window. This window mitigates and protects the interior space from the natural elements as well as separates the public from the private spaces and is located on both the internal and external walls of the home. The jalousie window in Barbados is traditionally made of wooden louvres set within a frame. Today, these louvres can be made out of plastic, glass, wood and aluminium. Joined on a track and manually operated with a crank, these wooden louvres can be tilted open and shut in unison to control the flow of ventilation entering and escaping the space. (Oran Ltd., 1964) Whether a sun shower or heavy rainfall, jalousie windows have the ability to be left partway open, allowing the desirable ventilation to still flow through the space. Its flexibility makes it a popular product. (Oran Ltd., 1964)

The Government Housing system referred to in Chapter Three, made use of a more restricting sash window system. Completely exposed to the heat from the sun without the help of curtains or window hoods, this sash window is slid open and closed on a vertical axes. This method of opening and closing on a vertical plane removes the flexibility aspect seen in the tilting jalousie window. As a result, during times of heavy rainfall and sun showers, this choice in window hinders

the desirable air flow and level of shade obtained, making the house itself uncomfortable to be in without the additional use of electrical appliances such as ceiling fans and HVAC units.

The choice in materiality, like that of the wooden Chattel House versus the concrete starter home, plays a huge role in the thermal dynamics accumulated within these spaces. Methods to minimize this accumulated heat within these concrete starter homes is currently underway.

More Mass = More Heat

6" Concrete walls - 3" Concrete walls

3" Concrete walls = cooler, dissipates heat

This strategy aims to further develop the impact of the adaptable module through the use of transformable openings influenced by that of the tilting jalousie window design for coolness and privacy found within the island's vernacular Chattel House for different situations throughout the day.



Figure 69:  
Adaptable Through  
Transformability

Figure 70: Jalousie  
Window.

## Conclusion

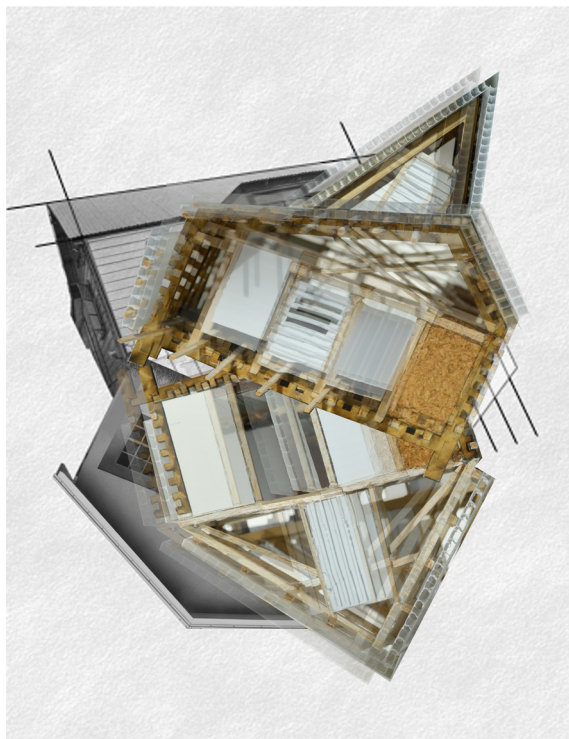
The production of innovative new projects that are specifically tailored to meet the affordability requirements of low-income families is of utmost importance. (Potter, 1992) The experience gained through the history of the Chattel House strongly suggests that the Government of Barbados should make use of the desire and ability low-income families have to build homes for themselves. This can be done through the self-help (DIY) tactics seen in the adaptable design strategies provided.

These adaptable design strategies, heavily influenced by the island's vernacular Chattel House, not only allow but also act as a guide to help those low-income families who wish to build for themselves, to do so. As expressed throughout each individual strategy, all of which work together to create a whole, the benefits of the Chattel House design have been discredited and cast aside into a corner of missed opportunities. These adaptable design strategies aim to create new and innovative affordable housing solutions that will advocate for the benefits of the island's historical Chattel House system of parts.







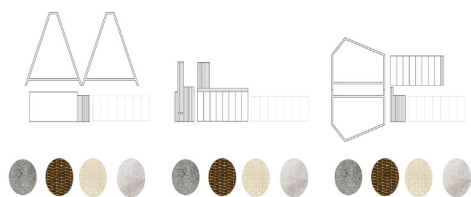


## CHAPTER SIX

Design Proposal



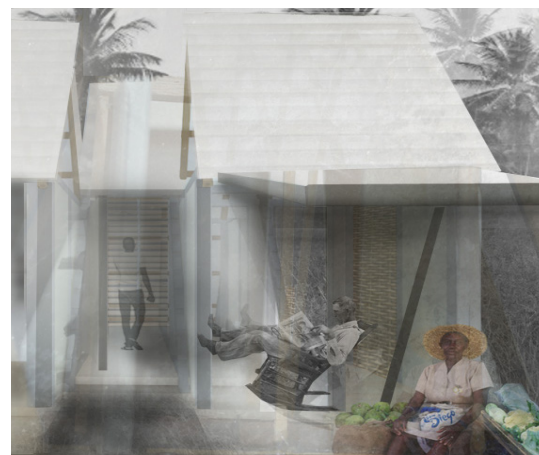
ONE



TWO



THREE



FOUR



# DESIGN PROPOSAL

## The Contemporary Vernacular

### Design Program

The design component of this thesis focused on the design of a modest home for the Barbadian low-income earner. With the concept of the Barbadian vernacular Chattel House, this thesis aims to produce a housing alternative that is both affordable and architecturally innovative, through the means of the adaptable design strategies discussed in Chapter Five.

Location: Barbados

Building Type: Low-income House

User: Low-income earners

ONE: Adapting to the Island's Material Resources

TWO: Adaptable Construction Methods of Deployment

THREE: Adaptable Spatial Volumes

FOUR: Adaptable Through Transformability

Figure 72: Adaptable Design Strategies.

## ONE

### Adapting to the Island's Material Resources

This component of the design aims to identify, as well as make use of a locally sourced material pallet that combines the adaptable Chattel House principles with the durable properties of the existing Government house.

Location: Barbados

Local: Affordable and Available Materials

Structure: Concrete, Bamboo

Skin: Recycled Plastics, Woven Bamboo, Bagasse

Floor: Concrete, Bamboo, Bagasse

#### Light Weight Concrete (Cellular Concrete)

The Local Arawak Cement Plant is known for producing a consistently high quality of Portland cement using 98% of Barbadian raw materials and is used in the production of the island's concrete along with the local sand, crushed limestone and water. (Arawak Cement Ltd, 2010)

#### Design Limitations

Influenced by the movable wooden "kit of parts" design seen in the Barbadian Chattel House and the more permanent properties of the Concrete Government houses, how does one design kit of parts components with the local concrete that is light enough to be transported and assembled without the use of heavy equipment?

Barbados Concrete: Cement + Water (Paste) with the

Sand + Crushed Limestone (lighter Aggregate)

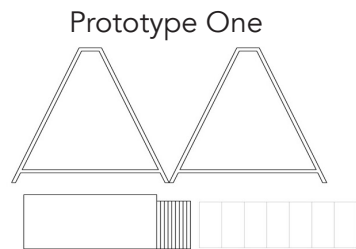
Avg. weight of a concrete block: 8"x 8"x 16" =28 LB

#### Limitations or Areas of Opportunity?

Typically, concrete is known for being very dense and heavy, characteristics, which are suitable and preferred for most applications such as footings, walls and floor slabs. (True Level Concrete, 2016) However, Cellular Concrete, also known as foam concrete, performs as a versatile lightweight concrete material. The mixture of water, cement and foaming agent produces this lightweight concrete. (Foamed Concrete, 1975) Water and cement are mixed together in such a way as to allow a high degree of hydration of the cement particles. When this is achieved, a foam like substance is produced under pressure from the mixture of water, air, foaming agent and chloride accelerator. (Foamed Concrete, 1975) The foam and cement mixture are blended into a uniform, foamed cement swirl. The aggregate typically used in the production of standard, heavier concrete is replaced by the air bubbles produced during the process of mixing the foam with the cement and water mix. (True Level Concrete, 2016) This mixture is then cast in a form and cured to form a lightweight cellular concrete structure.

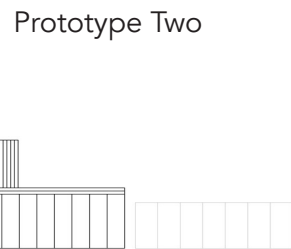
#### Advantages and Disadvantages

Light-weight foamed concrete (LWC) has gained its popularity in construction over the recent years due to its lightness, versatility and cost reduction potential. (Kun Guan, 2010) One of the unique qualities of LWC is the absence of an added aggregate. With the



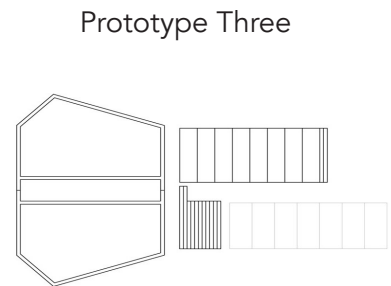
Structure:

.Concrete  
.Bamboo



Skin:

.Bamboo  
.Bagasse  
.Plastic



Floor:

.Concrete  
.Bamboo  
.Bagasse

Figure 73: Proposed Material Palette.  
Three prototypes of different forms were explored, all with the same set of parts.

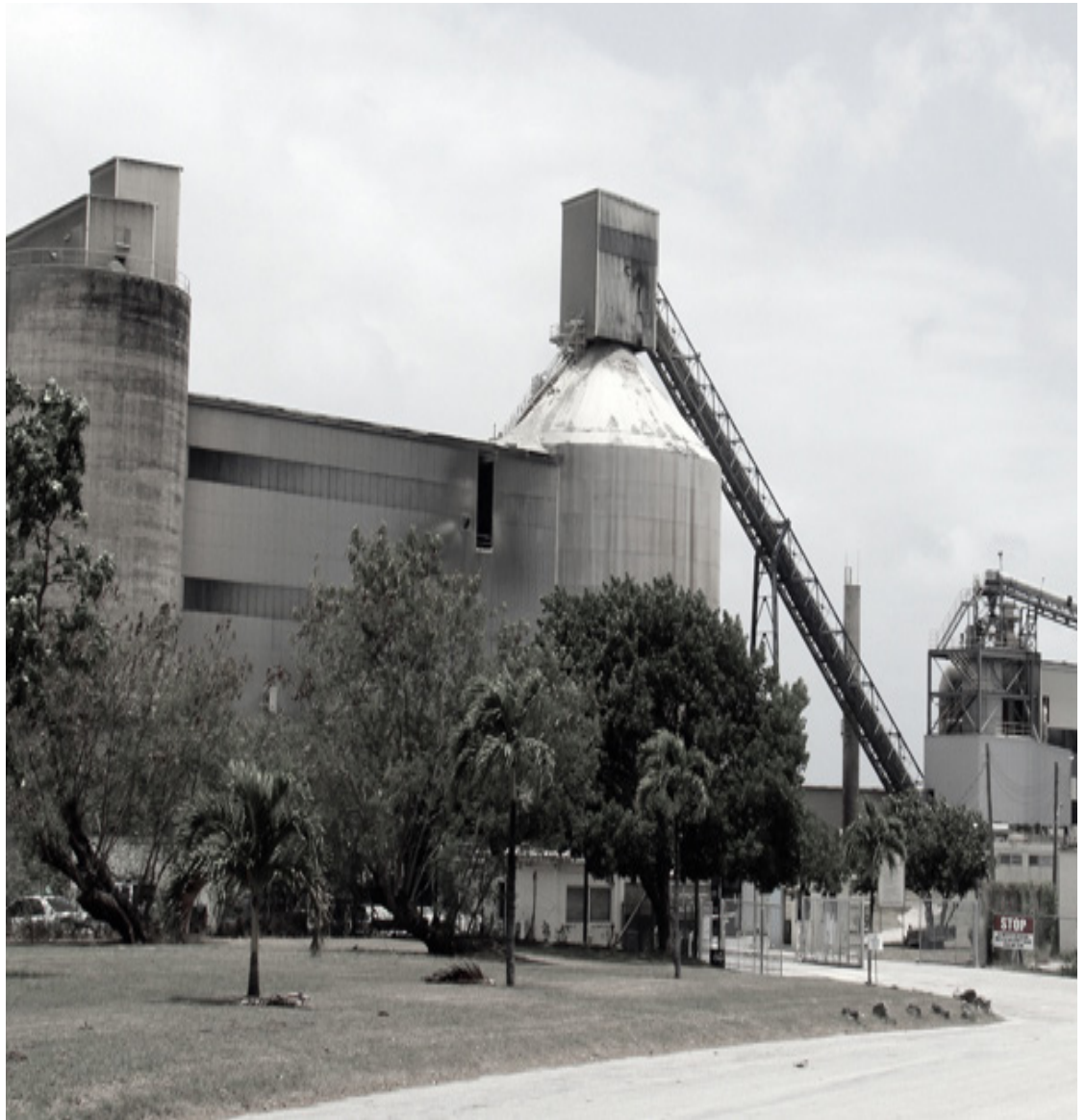


Figure 74: Barbados  
Local Cement Plant.

Figure 75: Concrete  
Texture.



help of the existing cement plant on the island, the production of LWC can be a positive alternative along with the standard concrete production already taking place, allowing the Cement Plant to further benefit the island. LWC can be produced rather rapidly both on and off site. (Kun Guan, 2010) It is also seen as a more economical method of construction in terms of the ease in its transportation as well as the reduction in manpower required. (Kun Guan, 2010) There is also a reduction in the overall weight of the structure, resulting in the decreasing use and need of structural frames, footing and piles. (Kun Guan, 2010) Although the production of LWC, and concrete in general, is still unnatural with its chemical reaction properties during its production, it arguably opens the doors to different ways by which the local resources can be used.

#### Design Intent

Inspired by a video found on YouTube, (titled 'Concrete Foam House in 8 Hours' - See Video Reference), where a group of young men built a LWC house in their own backyard in just eight hours with simple hand held equipment and personalised molds, the design intent for this thesis is to make use of the durable properties of the local cement available in order to allow the production of LWC posts and slabs either in a factory or on site by the owners themselves, acting as one of the two options for a structural element in the low-income, Chattel inspired house.



## Recycled Plastic Panels

The Sustainable Barbados Recycling Centre, Inc. (SBRC) was formed in early 2008. (SBRC, 2015) The waste stream entering the facility is generally comprised of Municipal Solid Waste (MSW) and Construction and Demolition (C&D) Waste, which each make up about 50% of this waste stream by weight.

### Design Limitations

What would the impacts be of making use of the traditional wall construction framing seen in the chattel house, but instead of imported wooden panels acting the structures skin, one uses engineered lightweight panels made out of locally recycled plastics collected at the Barbados' recycling centre? These versatile panels could be modular in size, acting as door, window and walls, depending on its placement, and light enough to be operated, transported or relocated within the structure itself without the use of heavy equipment.

### Limitations or Areas of Opportunity?

Conventional wall construction has utilized studding and framing, with sheathing and finish materials of one type or another placed on one side to complete the wall. The conventional wood frame of the Chattel House is clad with dimensional lumber in time-consuming construction and added expense through the importation of wood as well as its costly maintenance for termites and rot. The expense of obtaining and maintaining the imported wood seen in the traditional Chattel House construction, deny adequate housing, hence the introduction of the more durable concrete Government homes that make use of

the local concrete resources. What would the impacts be of making use of the traditional wall construction framing seen in the Chattel House, but instead of imported wooden panels for the structures skin, one uses engineered lightweight panels made out of locally manufactured recycled plastics collected from the Barbados Recycling Centre?

### Advantages and Disadvantages

Approximately 1,000 tons of waste, 500 truckloads, is delivered to the Sustainable Barbados Recycling Centre (SBRC) everyday. (Blenman, 2016) The recovery of recyclable materials from this mass reduces the amount of waste normally taken to the local landfill by 70%. (Blenman, 2016) Preconco, a Barbadian Engineering Firm, already implements the use of recycled PVC windows frames in their designs. In 2010, after months of research and improving technologies, they also started recycling PET bottle waste into roof shingles as a modern manufactured roofing alternative. (Preconco, 2016)

The practice of recycling in the home is a rather new concept on the island. Implementing this conversion of plastic waste into recyclable plastic panels for low-income housing would not only encourage but also educate locals on the means of recycling, as well as continue, if not increase the diversion of waste taken to the actual landfills. These recycled plastic panels would be designed to avoid swelling, rotting or absorbing moisture; they would be easy to work with in terms of cutting and fixing with standard tools and easily maintained. Similar to the production of concrete, manufacturing these plastic panels from recycled waste is also a chemical process however; it



makes use of the already existing SBRC and acts as an educational tool in the means of recycling.

#### Design Intent

Inspired by Kengo Kuma's Contemporary Hut installation discussed in Chapter Four, as well as by the works of Preconco, a Barbadian Engineering Firm who already implements the use of recycled PVC windows frames and roof shingle alternatives made from recycled PET bottle waste in their designs, the design intent of this thesis aims to make use of the high quantity of plastic collected at the local Recycling Centre on the island for the production of lightweight, modular sized recyclable plastic panels for the building and roof skin. These versatile panels would be modular in size, acting as both door and window openings depending on its placement, and light enough to be operated, transported off site or relocated within the structure itself by man. The transformable quality of these versatile recycled panels would allow the openings to have a variation in degree to which they open, thus allowing the desirable airflow and shade whether it be a day of sun showers or heavy rain.

Figure 76: Plastic  
Texture

## Sugar Cane Rubbish (Bagasse)

The sugar produced from Sugar Cane, also known as the white gold of the island, has been an ideal crop for Barbados due to its production of great wealth and admirable reputation. (Barbados Tourism Encyclopaedia, 2016) This crop is harvested between the Months of January to May. When sugar cane is crushed to extract the juice, the remaining pulp, also referred to as sugar cane rubbish, is called bagasse. It has a low fabrication costs and produces a high-end green quality material that is biodegradable and reusable. (Bagasse Fibre, 2014)

**Bagasse Production:** Harvested Sugar Cane – milled = Sugar + Juice + Sugar Cane Pulp/Bagasse.

### Design Limitations

This bagasse material, the potential of which is currently ignored in Barbados other than its deposition on fields as a fertilizer or for burning fuel at the local mills, one of which is active, is currently under investigation by Material Scientists around the world whose goal is to confirm the potential use of bagasse's natural fibres in the area of construction. (Bagasse Fibre, 2014) Influenced by the Barbadian Chattel House, how can the locally harvested bagasse pulp be used in this lightweight design and construction process of the modest low-income house and what would the effects of this be on the island's agriculture?

### Limitations or Areas of Opportunity?

The production of sugar cane as an agriculturally

economical system, stands today as an inefficient system. (Barbados Tourism Encyclopaedia, 2016) Inappropriate use of mechanization and dry seasons has been the cause of this. (Thompson, 2013) The continued survival of this industry has been through the support of additional funds from the Government, a continuous exchange that in turn would also run out of fuel. Why would the Government of Barbados continue to indefinitely support an unprofitable industry? (Holder, 2007) The sugar cane industry itself needs to be restructured.

"Most of the 30,000 acres being used for sugar farming in Barbados are relatively small farms of 200 acres on average. To properly benefit from mechanization a farm should be not less than 700 acres." (Barbados Tourism Encyclopaedia, 2016)

The restructuring proposal proposed by the chairman of the agricultural sector of Barbados, Lindsay Holder suggests the shift from a 'sugar' industry to a 'sugar cane' industry, a multi-purpose system where the traditional sugar and molasses would still be produced, with the addition of ethanol and electricity from its bagasse pulp and harvesting practice improvements. (Holder, 2007) Although the potential of bagasse has evidently been taken into consideration, the research in its use for construction purposes on the island is still viewed by locals as impractical due to the structural qualities that the material is believed to lack. This area of research needs further investigation.

"It is important to recognize that the restructuring of the industry is not driven primarily by the desire to reduce the dependence on fossil fuels





Figure 77: Bagasse  
Texture



Figure 78: Sugar  
Cane Production

for energy needs, but by the desire to preserve the agricultural sector.” (Holder, 2007)

#### Advantages and Disadvantages

The use of bagasse in construction as a building product itself is still under siege in terms of the success in its use. (Bagasse Fibre, 2015) The natural fibers themselves, local to the island, are easily available for currently six months of the year and low in cost. The suggestion for this multi-purpose sugar cane factory would allow the traditional sugar and molasses to be harvested and milled for five months of the year, and the harvesting of the high fibre sugar cane crop for its bagasse properties for the following six months of the year. (Holder, 2007) Still under investigation are the following issues in relation to the service life of the bagasse product for its use in construction:

1. Moisture absorption
2. In some cases, inadequate toughness
3. Reduced long-term stability for outdoor applications
4. Weather conditions of the material such as temperature, humidity, UV radiation

The tests performed by material scientists, who are exploring these properties around the world, have confirmed that when appropriate manufacturing procedures are applied, bagasse displays mechanical properties such as tensile strength, flexural strength, and impact strength. (Bagasse Fibre, 2015)

“The sustainable tomorrow for future generations lies with the present industrial development towards eco efficiency of industrial products and their process of manufacturing.” – (Bagasse Fibre, 2015)

#### Design Intent

Influenced by the contemporary use of materials in Kengo Kuma’s Contemporary hut as well as the resourceful use of materials in the immediate context of the Ekhaya house in Cape Town, both discussed further in Chapter Four, the intention of this design is to suggest the idea of using compressed bagasse OSB oriented “strand boards” as 2”x8” roof rafters, in place of the imported lumber, as well as modular size lightweight compressed bagasse OSB panels to contribute to the building envelope of recycled plastic panels.

OSB: Oriented Strand Board - A structural panel suitable for a wide range of construction and industrial purposes. (Floor, Roof and Wall Sheathing)

OSB Panels: 4’x8’ Sheets - or cut to size. 8’x24’ (Industrial) Or larger (Special Order)

OSB Thickness: (Most Common) 1/4”, 3/8”, 7/16”, 15/32”, 19/32” and 23/32”

Weight: Ranges from 1.25 psf to 2.5 psf

Dimensional Lumber: 2”x4”, 2”x6”, 2”x8”

It is believed that the aesthetic design itself, and the desire to continue with the experiments for a possible alternative in existing material resources, will be the driving force to help transform the depended island today into a more self-sufficient tomorrow.

## Bamboo

The durable properties of Bamboo, a plant grown in Barbados but in little quantity and thus, hardly documented, is a popular building material known in areas such as East Asia and South America.

### Design Limitations

Using bamboo, the potential of which is perhaps unfamiliar and therefore overlooked in Barbados, is currently one of the most sustainable means of construction in the world. (Sustainable Building, 2012) Influenced by the Barbadian Chattel House, whose imported wooden skin and structure is light enough for man-handled manipulation, how can the locally harvested bamboo, increased in quantity by which it is currently grown, be used in this lightweight design and construction process of the modest low-income house?

### Limitations or Areas of Opportunity?

The biggest issues for this choice of material in relation to Barbados is the small quantity currently grown, as well as the lack of skills possessed by the locals to build with it due to the existing unfamiliarity. Can we grow more bamboo? Will it be a cost effective building material? How can this be seen as an opportunity of change, a means of education and jobs while maintaining the influence of the rich vernacular for a more self-sufficient tomorrow?

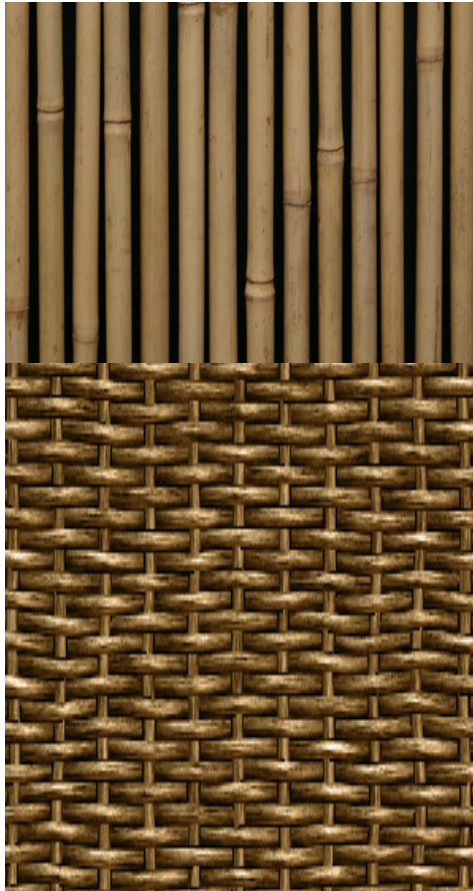
### Advantages and Disadvantages

The structural component of the imported wood for the Chattel House can be replaced by the use of locally harvested bamboo. Depending on the species, Bamboo can grow up to one meter a day and be cut down at three years old, a period of growth which allows the bamboo to reach its full potential. (Hardy, 2015) Again, depending on the species grown, it may be hollow and therefore lightweight and transportable. Along with the structural properties of these rods, the potential of weaving the itsy splits to contribute to the building envelope and internal partitions is also of interest in combination of the newly taught, improved and existing skills of the local artisan and builder. The use of bamboo allows the luxury of being connected to nature while still being affordable. (Hardy, 2015)

The building quality, cost and long lasting properties of such low-income homes is heavily dependent on the species grown and harvested as well as the level of maintenance required. For many, low-cost housing and bamboo construction do not work together, but it is believed to be an option still worth investigating. The cost of a house built with bamboo is dependent on the following:

1. **Bamboo Supply:** Locally grown and harvested in comparison to the greater cost of importing wood. There is no manufacturing component required for its supply.
2. **Location and Availability of Craftsmen:** The existing conditions of the chosen land for the house and roads access. Who knows how to build with bamboo? How can this practice be taught and implemented? How can the already existing building traditions be incorporated with this material?





3. The overall budget and standards: low-income housing.

4. Design Shape and level of Difficulty: This is dependent on the sizing of the bamboo, what needs to be cut and how many times, as well as how these various sized pieces join together. (Keep in mind all these homes need to be easily assembled, perhaps disassembled in some cases, transported and reassembled.)

#### Design Intent

Influenced by the contemporary use of bamboo in the low-income housing project by HP Architects in Vietnam, discussed further in Chapter Four, the intention of this design is to suggest the idea of making use of the existing bamboo grown on the island as another option for both, the supporting structure of the house, as well as modular sized lightweight locally woven panels to contribute to the building skin of recycled plastic panels and bagasse boards. This material, as the research suggests, is easily grown and harvested, making it one of the most cost effective as well as natural materials available, a contrast to the factory built recycled plastic panels, compressed strandboards and chemically altered lightweight concrete.

Figure 79: Rod and Woven Bamboo Texture.

## TWO

### Adaptable Construction Methods of Deployment

This component of the design strives to positively represent and in turn, reintroduce the potential use of the module and its adaptable construction methods of deployment seen in the vernacular architecture of the island's Chattel House.

Influenced by the historical Chattel House and the contemporary affordable projects discussed Chapter Four, such as the Tiny House Movement and the kit of parts Low-Income Housing project by HP Architects in Vietnam, this thesis highly focused on the overall structural system of such a kit of parts, and thus the pros and cons of the chosen local materials and how they can be assembled easily. The intention is to design a structure that can be deployed on site with ease by the owner for permanent or temporary use. The prototype would be brought to site as a kit of parts, like that of the vernacular chattel house, ready for assembly.

Three prototypes of different forms were explored, all with the same set of parts, the recycled plastic and compressed bagasse manufactured panels, the bagasse OSB "strand boards" as roof rafters, and the precast cellular concrete and bamboo supporting systems, which varied in form and connections to the other elements. Through the use of model making (See Appendix D), the advantageous and disadvantageous properties of each form was further investigated in order to produce the most suitable system that allowed the selected local materials to work at its optimum level independently as well as in unison.

#### Creating the Movable Module

In order to begin investigating modular sizes of the structural elements and other building envelope components, the overall size of the module had to first be worked out. The vernacular Chattel House, one of the first examples of prefabricated housing on the island, used this idea of modular construction with rational sizing of components, elements and spaces. (Crocker, 1971) This idea of modularity resulted in rational solutions of affordable and efficient subdivision construction of the module. (Modular Construction History, 2013) The only limitation to the size of each individual movable module was the width of the roads on the island and the structural relocating systems, such as the tray of a truck that would allow the transportation of the kit of parts or house as whole from one site to the next. The amount of fuel required to deliver these kits of parts that make up one module, would be reduced when they are tightly packaged on one truck, rather than in dozens of small deliveries. (Modular Construction History, 2013) Many modular buildings today consist of 3-6 different modules. For this design, the limitation is one module to one truck. The size of the module itself is at the maximum width of a structural relocation system. With these dimensions, the owner's movable possession can be relocated either as a complete entity, one module per truck, or taken apart by sides and stacked in the tray to then be relocated. The number of modules deployed in relationship to the lot of land provided is further discussed in the following strategy.

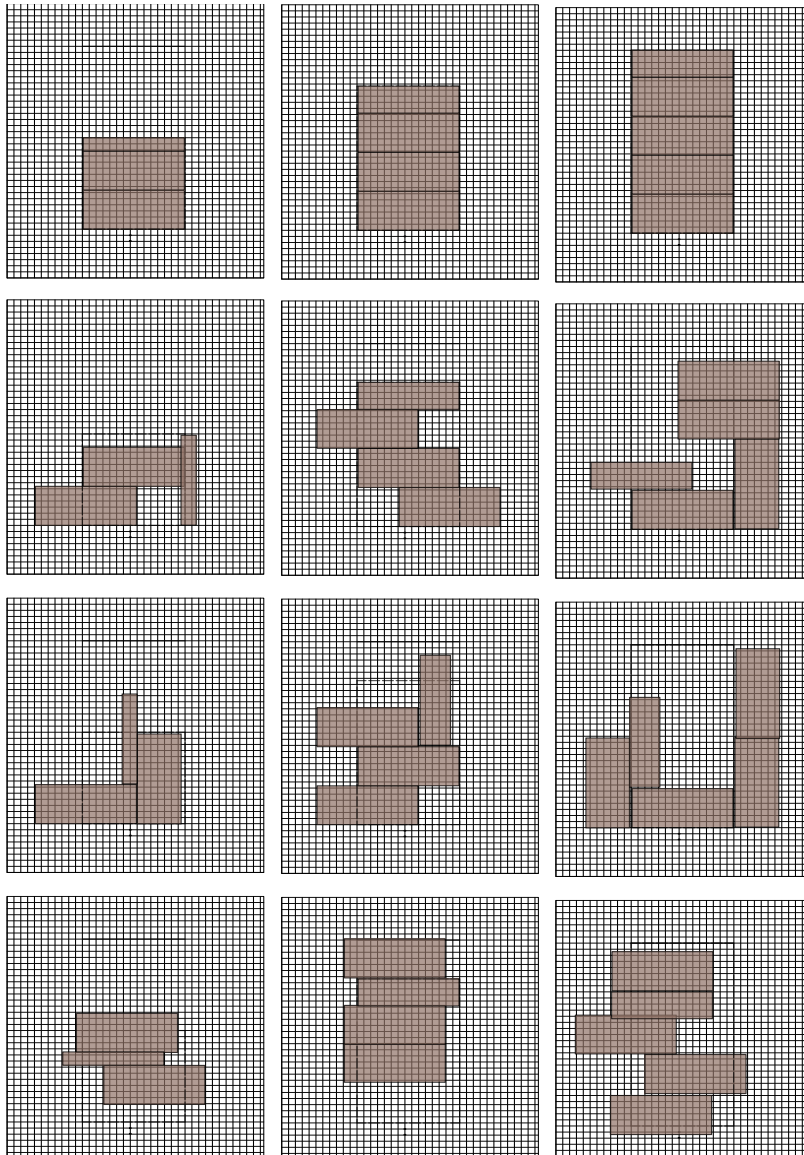


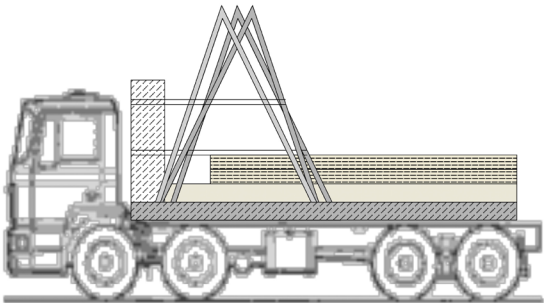
Figure 80: Creating the Module. Within a 3,000 sqft site, the modules were rearranged in different configurations to explore the different qualities of space.

Prototype One: Two Modules = 400 sq ft.  
 Prototype Two: Three Modules = 600 sq ft.  
 Prototype Three: Four Modules = 800 sq ft.

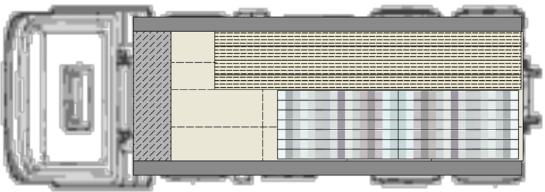
# EQUIPMENT

## Cellular Concrete

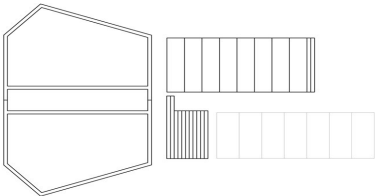
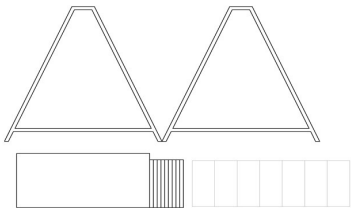
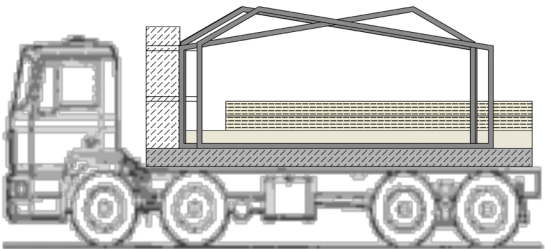
1. Siel Foam Concrete Plant - (On or Off Site)
2. Slab Formwork
3. Frame Formwork
4. Mini Crane



1. Siel Foam Concrete Plant - (On or Off Site)
2. Post Formwork
3. Slab Formwork



1. Siel Foam Concrete Plant - (On or Off Site)
2. Frame Formwork
3. Slab Formwork
4. Mini Crane



Prototype One



Prototype Two



Prototype Three



Structure Relocation: Transportation as a whole entity  
or as a Kit of Parts

Typical Flat Bed Truck: W 2.6m (8'-4") x L 6m (20'-0")

Road Limits: W 2.6m (8'-4") x H 3.6m (11'-9") x Length  
Varies

Size of Module: W 2.6m x L 6m x Height Varies

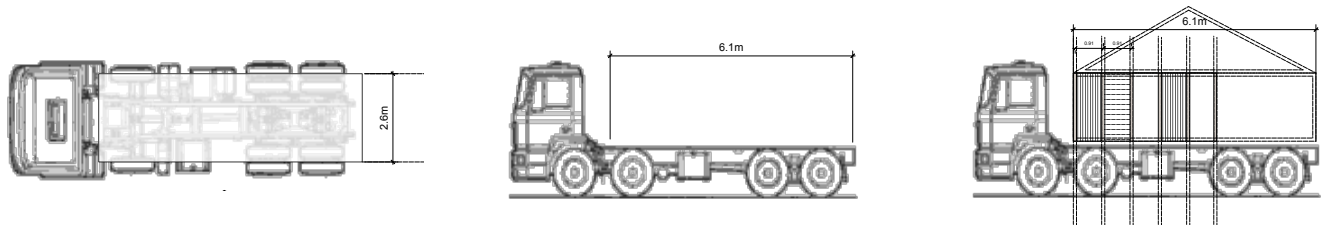
#### Adaptable Methods of Deployment

Once the size of the module was determined,  
adaptable construction methods of deployment were  
further investigated through the use of model making:

1. PROTOTYPE ONE: Structural frames + Components
2. PROTOTYPE TWO: Structural posts + Components
3. PROTOTYPE THREE: Structural frames +  
Components

Figure 81: Bringing  
Prototypes to site  
as a kit of parts - to  
be assembled with  
out the use of heavy  
equipment. Built for the  
People, by the People.

Figure 82: Sizing the  
Module and Relocation  
System.



A kit of parts is a system of designed components that join together to create a desirable whole. With this kit of parts, the DIY owner/builder would be able to produce an enclosure or series of enclosures of functional, economic and aesthetically pleasing spaces through a logical and repetitive structural grid. (Crocker, 1971) This would enable the owner/builder to build rapidly with ease and reduce construction waste. It is important to note the practical requirements needed for the successful functionality of this module such as the supporting walls, floors, roof and location and space required for services. (Crocker, 1971)

There are two structural system options proposed: The first structural system is based on a single modular sized framing unit of precast cellular concrete (LWC) and/or bamboo, which is repeated three times per module. The second structural system is that of modular sized precast LWC and/or bamboo posts with roughly 6 posts per module. The precast LWC frames and posts can be made on or off site with rentable/shared equipment (from local departments /neighbors) and adjustable formwork to suit the form desired. The harvested bamboo, the more natural material, can also be cut and joined together on site to support the chosen form. Although described as separate materials, the bamboo and the LWC can also work together structurally rather than as separate entities. The main supporting structural system was on a distinctly defined structural grid and the secondary structure of roof rafters, was a subdivision of the frame and posts spacing, and following that was the final component of the structure, the panels. (Crocker, 1971)

When these structural frames and posts are made (on or off site) and secured into place within the structural

grid of one module, followed by the addition of roof rafters, the bagasse, the woven bamboo and recycled plastic panels are then slid into place to create the mixed material palette of the structure's building envelope. The floors are constructed of joists and floor panels, which would again be made on or off site. These floor panels also slide into place within the structural frame. The detailing of these components would be based on a logical, dimensionally coordinated, structural design. (Crocker, 1971)

One of the main purposes of making use of the adaptable modular construction methods of deployment was to allow the creation of this affordable home without hindering the sense of freedom in the design and the need to resort to system building of limitations and wasted space. (Crocker, 1971) The whole system is to be viewed as a trouble-free construction kit that allows the community, the owner and builder to once again have involvement with the construction of their house, as well as the freedom to move with it, adjust and expand as needed over time, like that of the vernacular Chattel House, hence movable possessions.

The dimensioning of the components in relation to the transportation and accessibility is as follows:

The structural systems: Posts + Frames

Height: Do not exceed 3.6m in height (Road Transportation Requirement) This does not limit the overall building height to 3.6m but may require an additional relocation system (flat bed truck) For this design the standard height has been kept at 2.6m

Width: Do not exceed 2.6m in width (Maximum width of Relocation System)

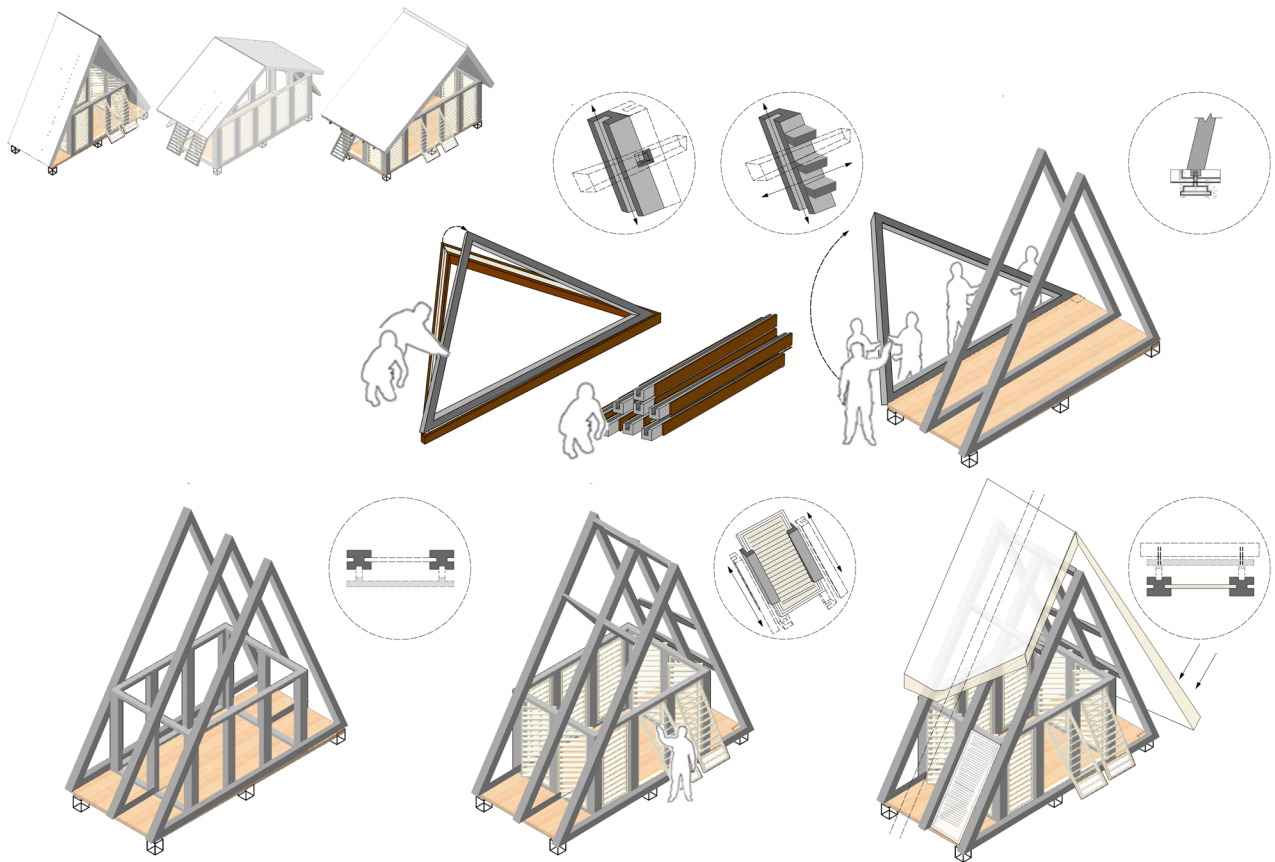
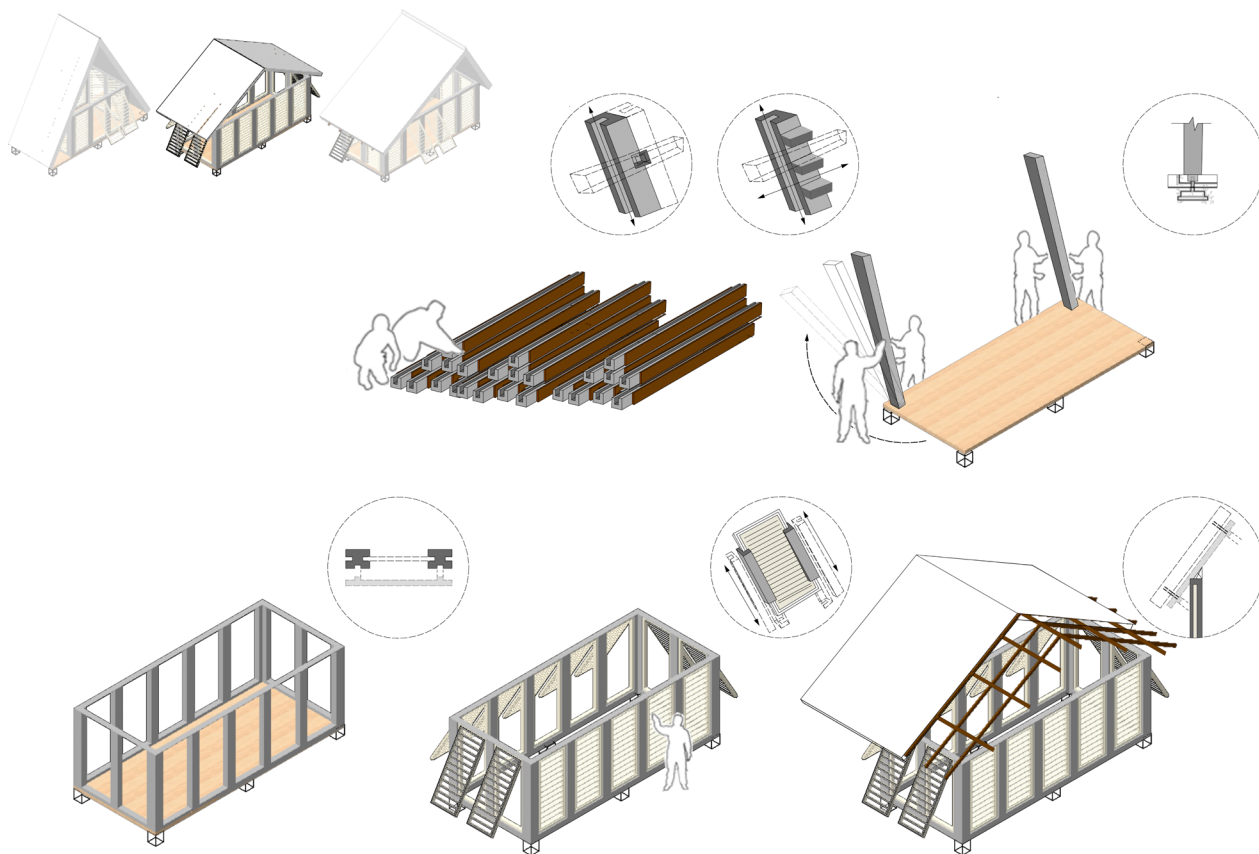


Figure 83: Prototype One and Three:  
Structural System One:  
Precast Frames





**Length:** Do not exceed 6m in length. (Standard Length of a flat bed truck) However this length may vary.

**Depth:** Varies depending on the height, length, width and material of post/frame.

**Secondary Structure: Rafters**

**Width:** Do not exceed 2.6m in width (Maximum width of Relocation System)

**Length:** Do not exceed 3m in length. (Within the Standard 6m Length of a flat bed truck and capacity of material).

**Depth:** Varies depending on the height, length, width and material of post/frame. Understand the limitation of the materials chosen to act as rafters – in this case it is the choice between bamboo rafters and purlins.

**Tertiary Structure: Panels (Windows + Doors)**

**Width:** Do not exceed 0.9m (3'-0") in width. (Barrier Free Design)

**Length:** Do not Exceed 2.6m (8'-5") in height. Minimum 2m (6'-8") in Height.

**Depth:** Depth Varies depending on Material Choice.

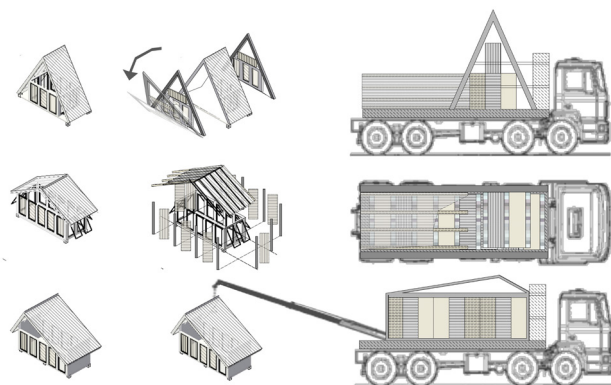
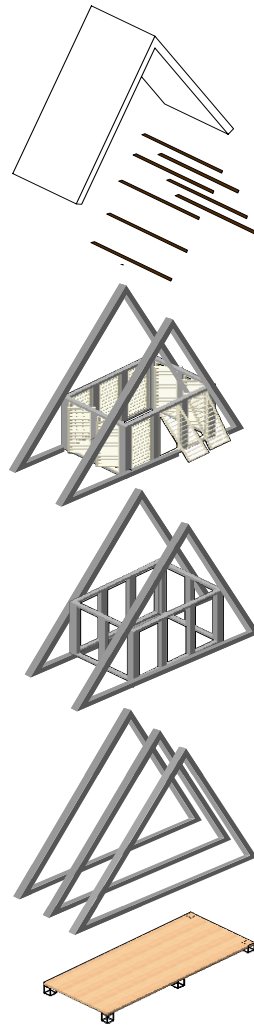


Figure 84: Prototype Two - Structural System  
Two: Precast Posts.

Figure 85: Removing  
Prototypes from Site.



1. Recycled Plastic  
Panel Roof Skin

2. Bamboo Rafters/  
Bagasse OSB

3. Recycled Plastic,  
Bagasse OSB and  
Woven Bamboo Panels

4. Precast Cellular  
Concrete Frames and  
Post

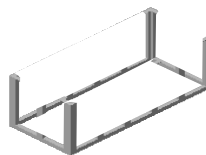
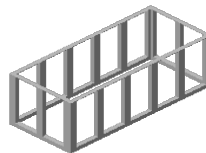
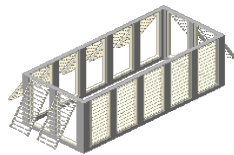
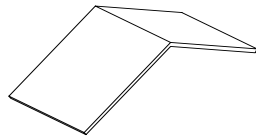
5. Precast Cellular  
Concrete Frames

6. Joists and Floor  
Panels

Figure 86: Prototype  
One Axonometric  
Assembly.

Figure 87: Prototype  
One on Site.





1. Recycled Plastic  
Panel Roof Skin

2. Bamboo Rafters/  
Bagasse OSB

3. Recycled Plastic,  
Bagasse OSB and  
Woven Bamboo Panels

4. Precast Cellular  
Concrete Post and  
Beams

5. Precast Cellular  
Concrete Posts

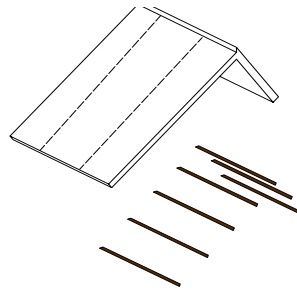
6. Joists and Floor  
Panels

Figure 88: Prototype  
Two Axonometric  
Assembly.

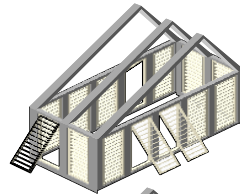
Figure 89: Prototype  
Two on Site.





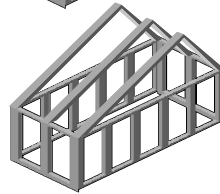


1. Recycled Plastic  
Panel Roof Skin



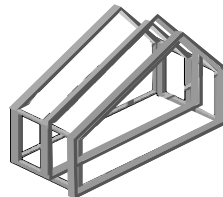
2. Bamboo Rafters/  
Bagasse OSB

3. Recycled Plastic,  
Bagasse OSB and  
Woven Bamboo Panels



4. Precast Cellular  
Concrete Frames and  
Post

5. Precast Cellular  
Concrete Frames



6. Joists and Floor  
Panels

Figure 90: Prototype  
Three Axonometric  
Assembly.



Figure 91: Prototype  
Three on Site.











Figure 92: All Prototype  
Assembled on Site.

THREE  
Adaptable Spatial Arrangements

This strategy aims to make use of the adaptable spatial volume principle, found within both the Chattel and Government housing projects, but with the focus being that of a simple, systematic, more proportional approach in growth, a characteristic only seen in the Chattel House.

The structure of the module would be conceived as to allow lateral combinations, thus enlarging or restructuring the house lengthwise and widthwise, allowing the occupant to manipulate the space as time and money permitted.

Reasons for Adaptable Spatial Arrangements:

- . Increase/Decrease in family size.
- . Increase in salary – can purchase more space.
- . Change in use of space.

The floor area of the low-income Government houses in Barbados, range roughly from 400 sq ft., as the smallest, to 800 sq ft., all within a 3,000 to 3,500 sq ft. site. Although this project isn't site specific due to the movable possession concept, it is still very much grounded to Barbados and its cultural roots. With the heavy influence of the new low-income Government houses of repeated form and fixed floor areas, it seemed suitable to work within the parameters of the existing floor areas to investigate the different spatial configurations that could be obtained from the derived module. Within this 3,500 sqft lot, the modules were rearranged in different spatial configurations, testing out the limiting size of the module itself and the qualitative

spaces the additional floor plans variations could create. Inspired by the modular growth of the Chattel House as well as the expansion of the Ekhaya and Villa Verde housing projects discussed further in Chapter Four, this strategy allows these innovative homes to increase in size in a systematic but unconstrained manner with ease by the owner.

Floor Area of one module: 2.6m x 6m = 15.6 sqm

- 1. 37 sqm (400 sq ft.) = 2 modules
- 2. 56 sqm (600 sq ft.) = 3 modules
- 3. 74 sqm (800 sq ft.) = 4 modules

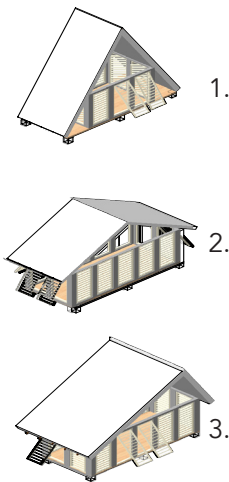
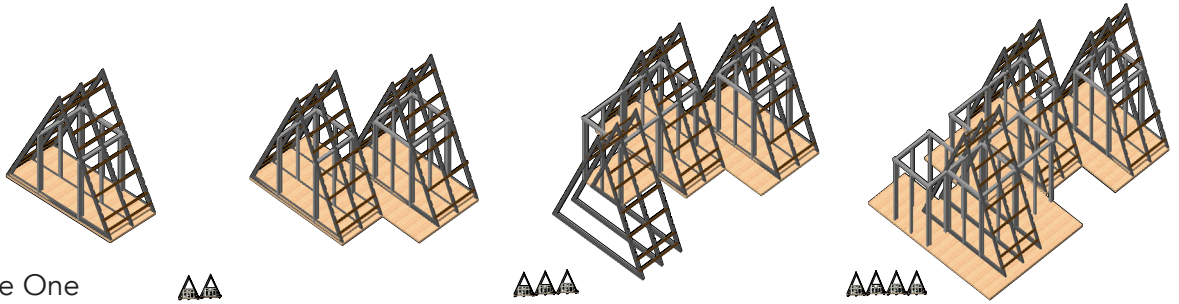


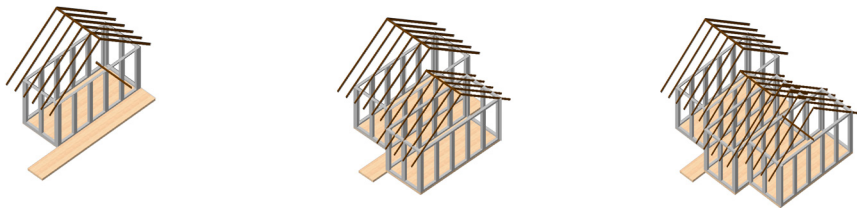
Figure 93: Prototypes 1-3 - Right Isonometric.

Figure 94: Prototype Systematic Modular Growth.

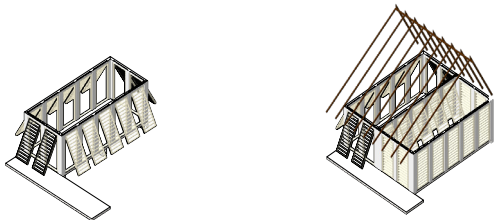
Prototype one	-	4 Modules
Prototype two	-	3 Modules
Prototype three	-	2 Modules



△ Prototype One



▤ Prototype Two



▥ Prototype Three





Figure 95:  
Prototype One  
- Modular Growth  
on Site- Front  
Elevation.

Figure 96:  
Prototype One  
Modular Growth -  
Side Elevation.

Medium: Island  
Photography and  
Physical Models  
Collaged.









Figure 97:  
Prototype Two  
Modular Growth -  
Side Elevation.

Figure 98:  
Prototype Three  
Modular Growth -  
Side Elevation.

Medium: Island  
Photography and  
Physical Models  
Collaged.









FOUR  
Adaptable Through Transformability

This strategy aims to further develop the impact of the adaptable module through the use of a transformable building skin influenced by that of the versatile design for coolness and privacy found within the island's vernacular Chattel House.

The structure of the modules would be conceived as to allow experiential and physical spatial changes within an adjustable building envelope of manually moved lightweight panels. These panels, the window, door and walls, were designed to allow such transformations of space and thus had the same modular height and width of 3'-0" by 6'-8". This allowed the adjustment of room volumes with the opened concept of public activity during the day and closing for security and privacy reasons at night, while still feeling connected to the outdoors. These modular sized panels also responded to environmental factors such as sun, wind and rain.

Based on the lightweight material, these panels can be manually adjusted to allow different shading environments throughout the day as well as a natural flow of ventilation while still being sheltered from the rain.

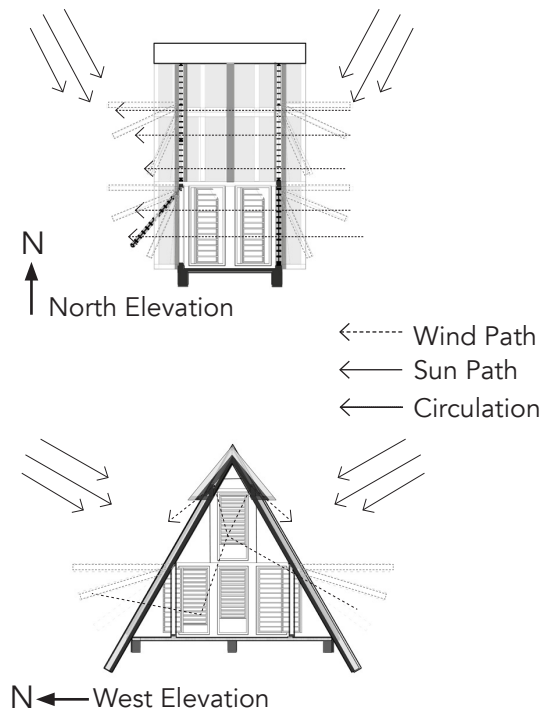


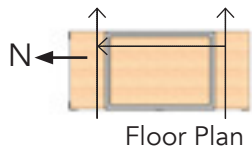
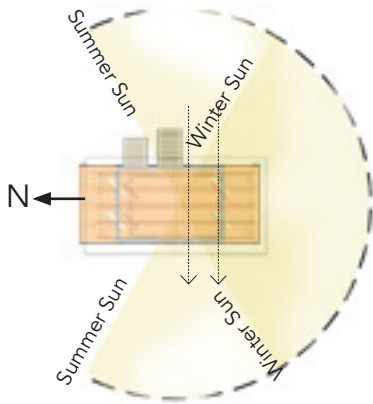
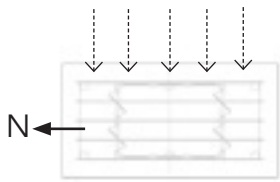
Figure 100:  
Section A-A

Figure 101:  
Section B-B

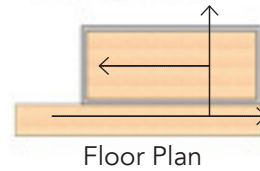
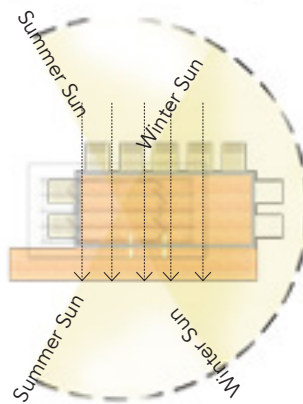
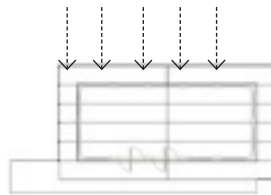
Figure 102:  
Sun and Wind  
Path Diagrams.



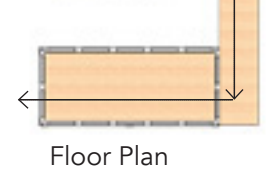
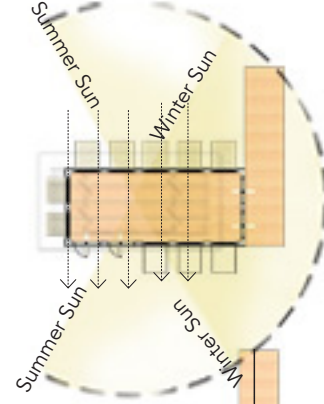
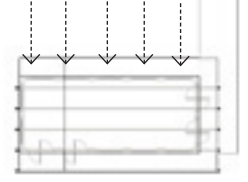
Prototype One



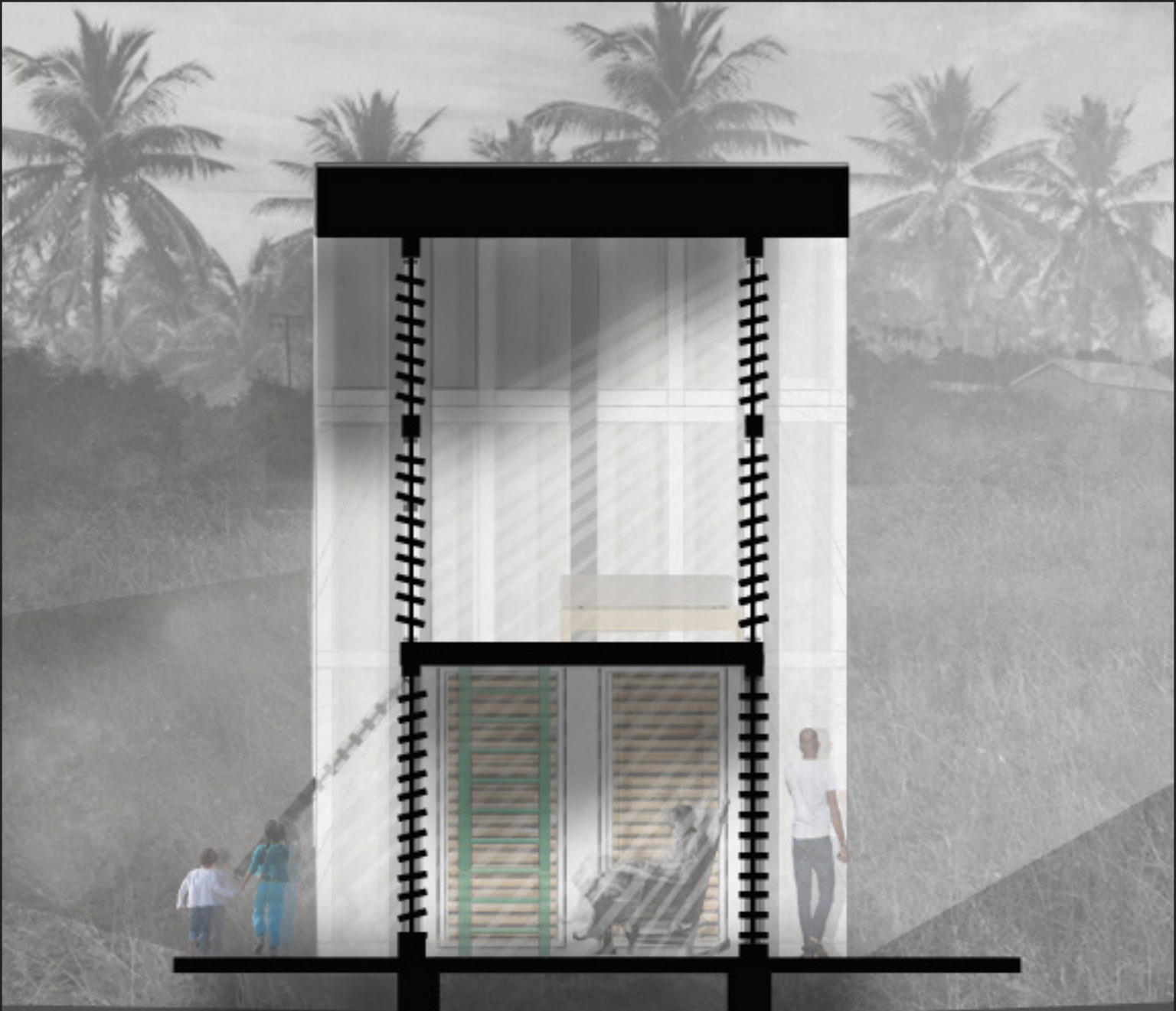
Prototype Two



Prototype Three









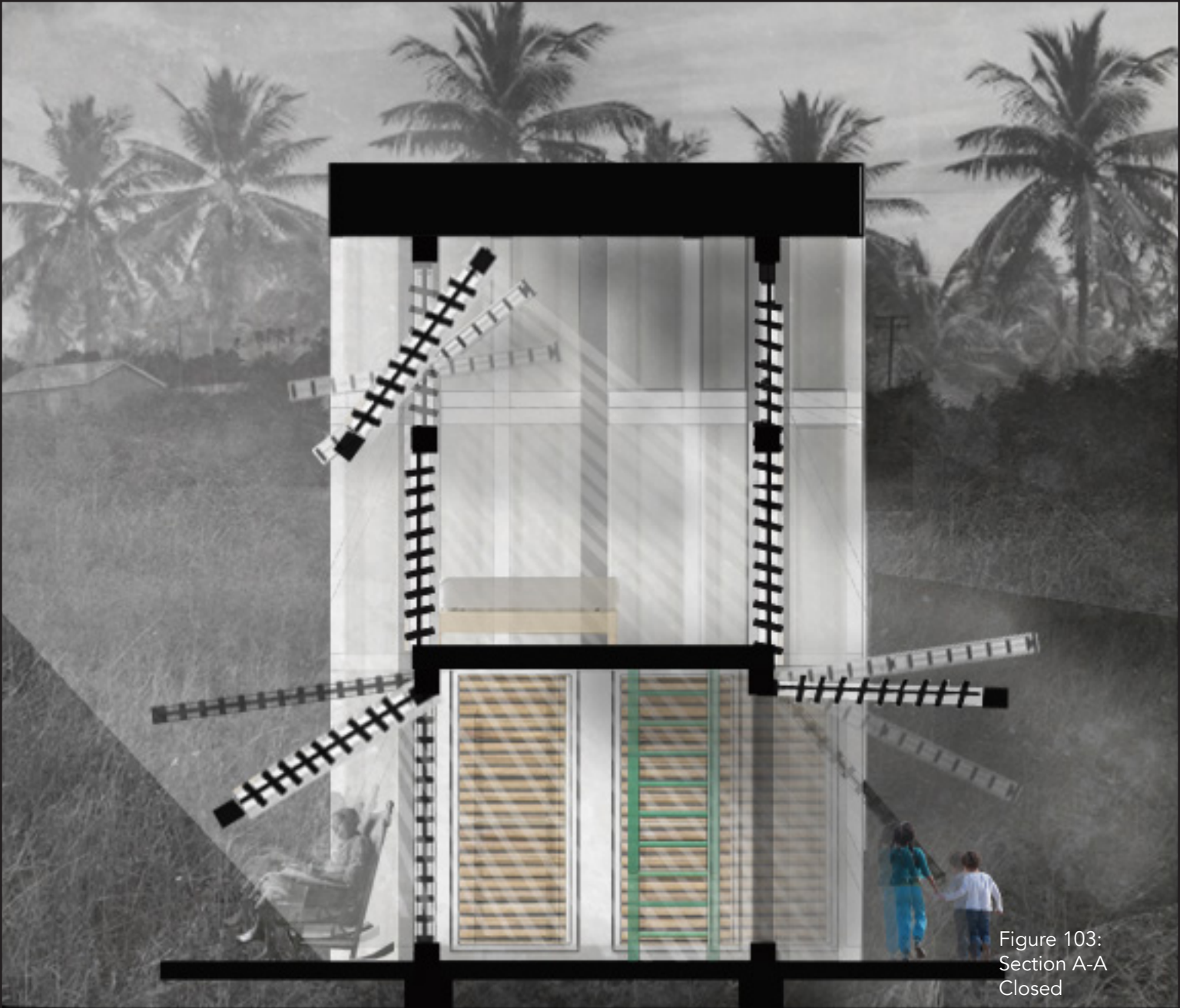


Figure 103:  
Section A-A  
Closed

Figure 104:  
Section A-A  
Open



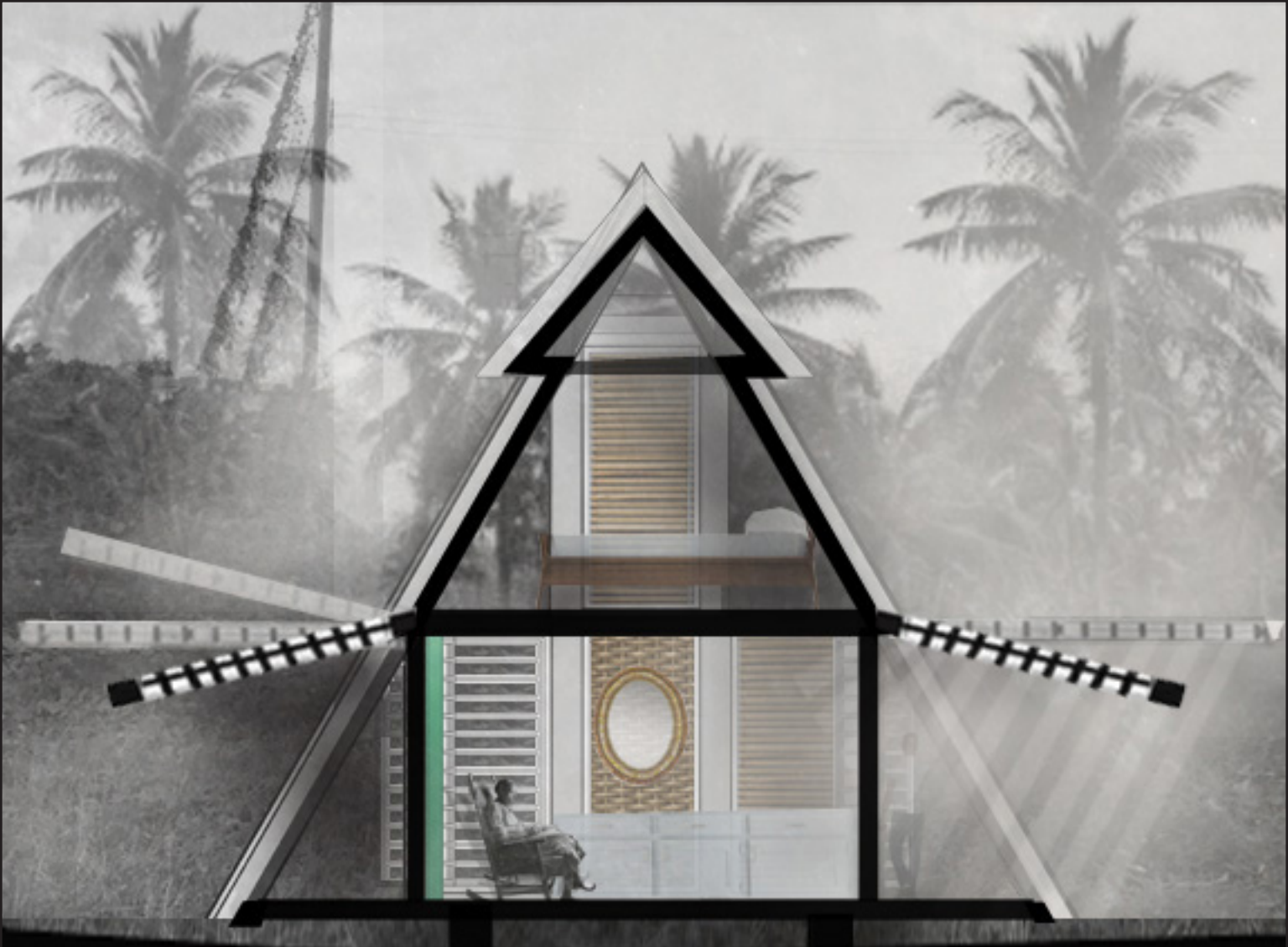


Figure 105:  
Section B-B  
Closed

Figure 106:  
Section B-B  
Open



Figure 107: The Importance of the Verandah

Figure 108: The Mixed Material Palette - Building Skin.



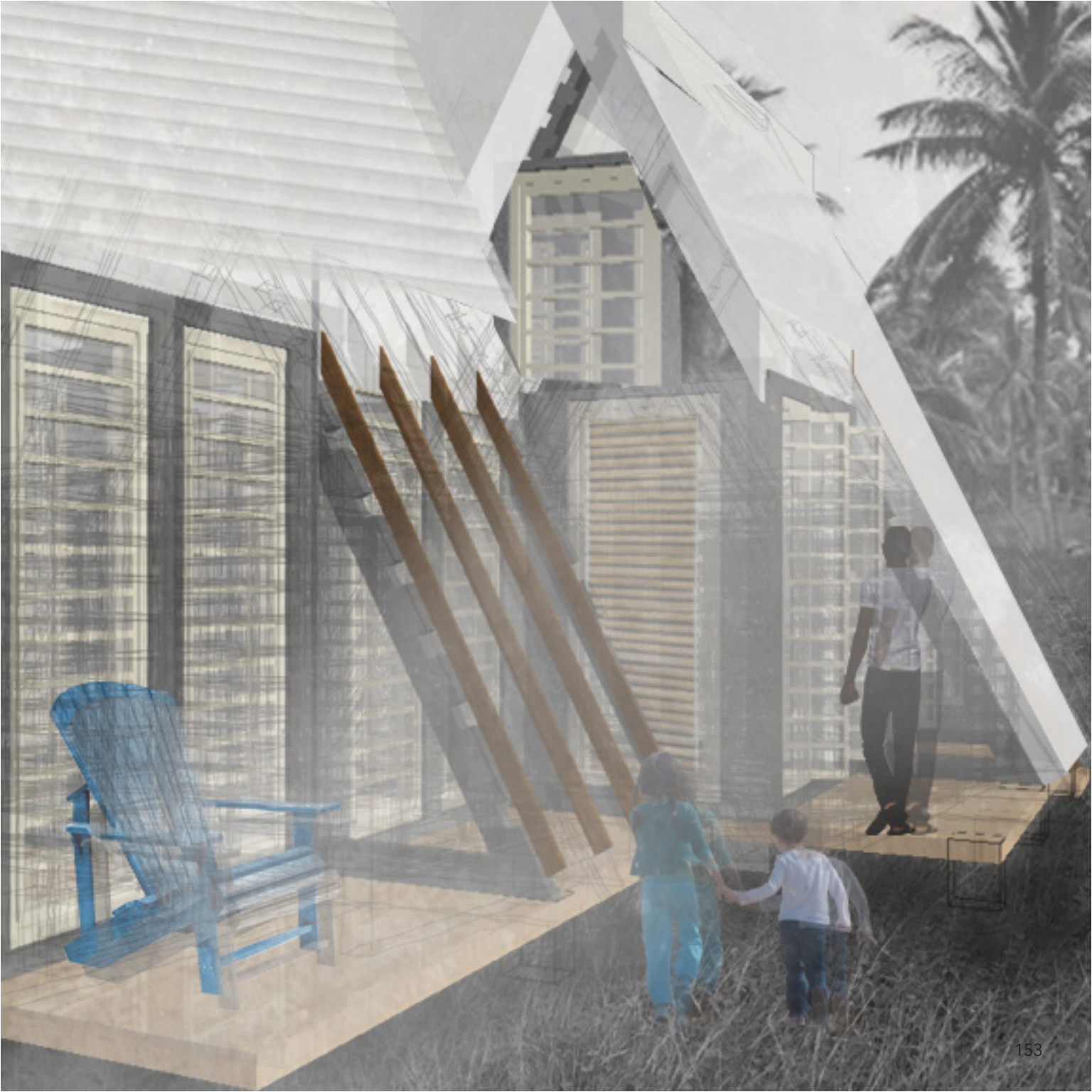






Figure 109: Inside  
Outside

Figure 110:  
Engaging with the  
Surroundings.





Figure 111: The Quality of Light - Open.

Figure 112: The Quality of Diffused Light - Closed.





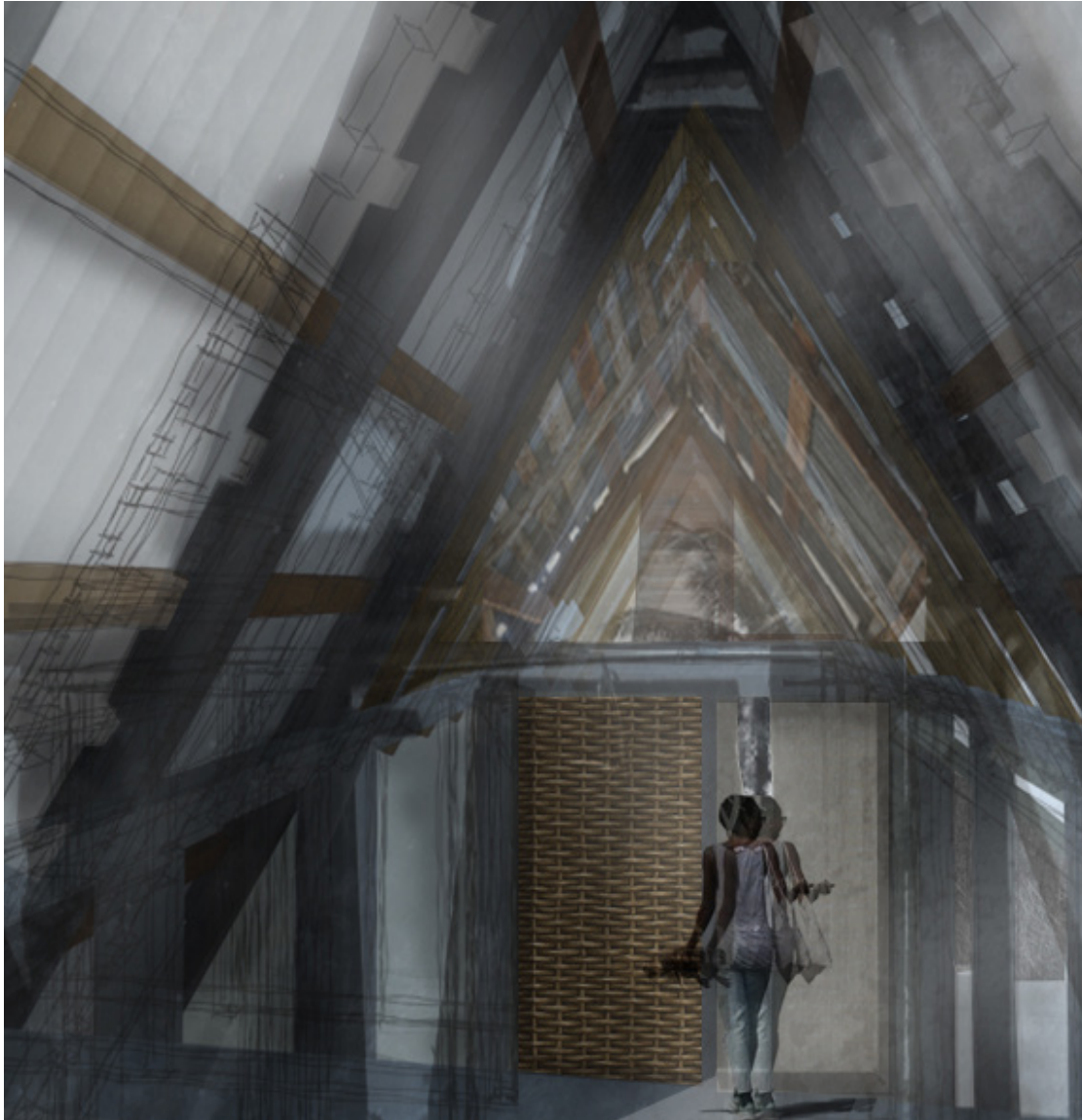
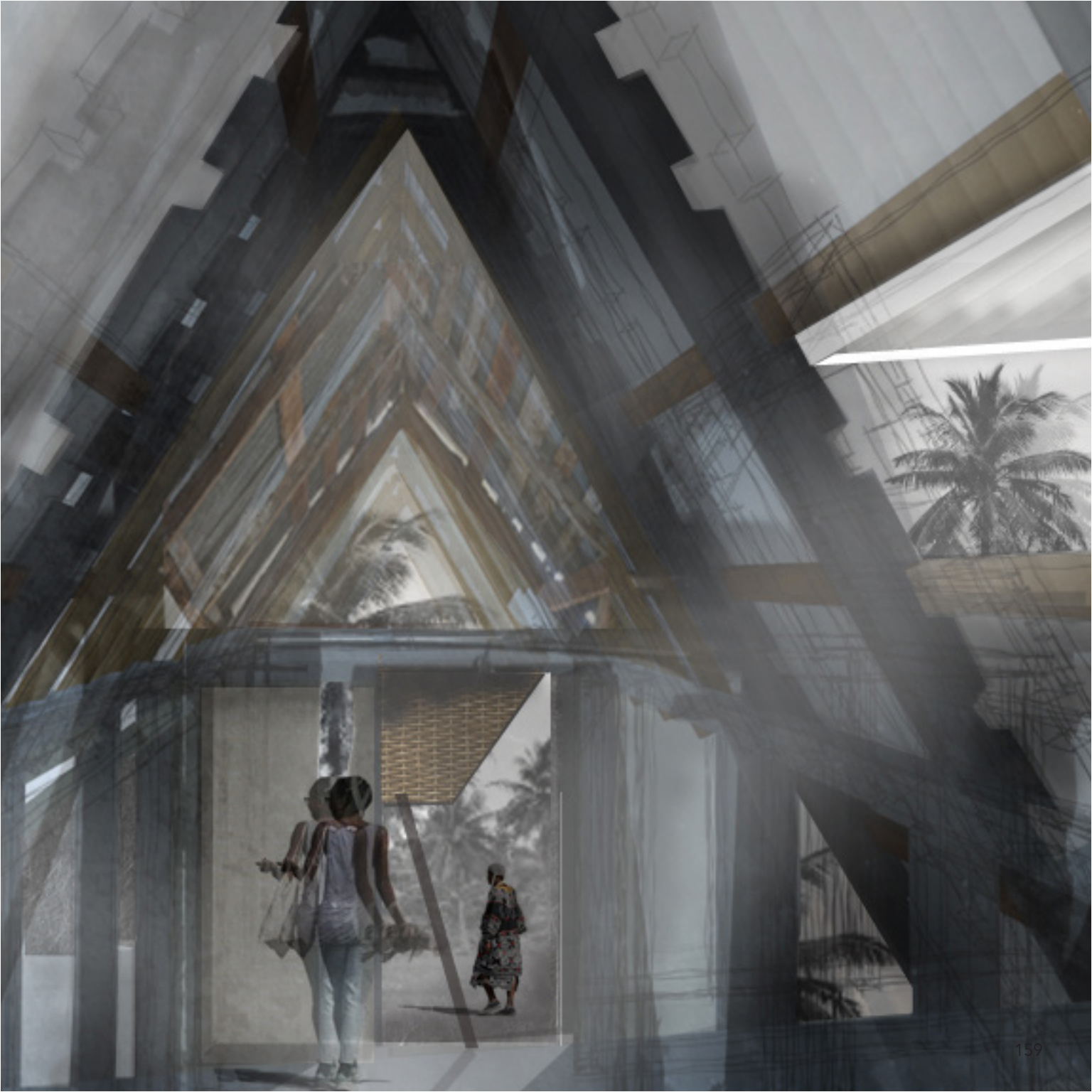


Figure 113: View  
from above -  
Closed

Figure 114: View  
from below - Open





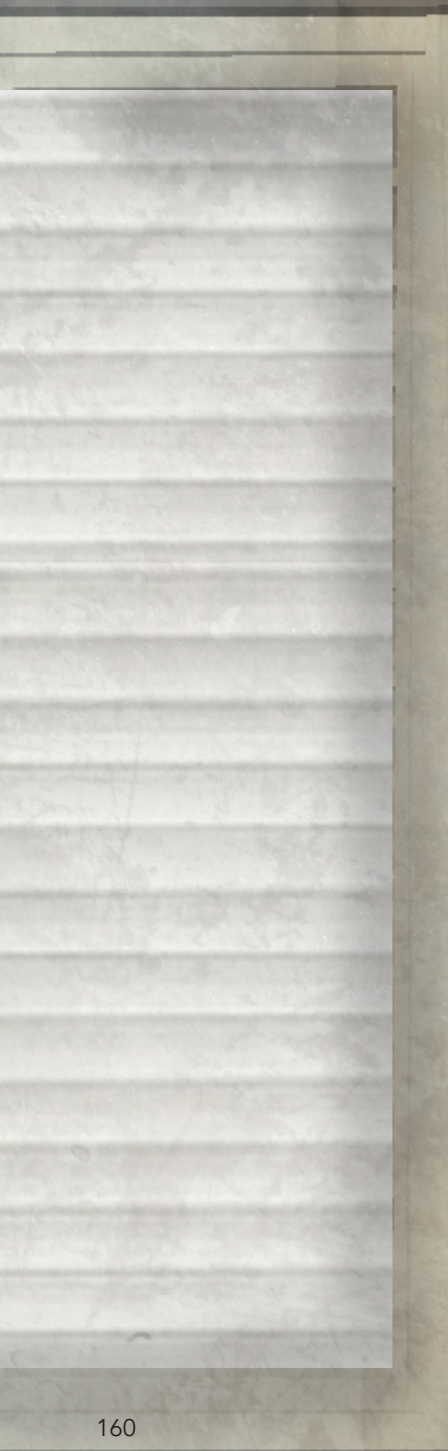






Figure 115:  
Allowing privacy  
and ventilation -  
Closed

Figure 116:  
Engaging with the  
public - Open

## CONCLUSION

Design does matter. Today, more people are growing concerned with how they choose to live. Different pressures – financial and otherwise – have made adaptable architecture a more viable option. What needs exploring are the methods used by designers to respond to personal, societal, and even environmental priorities. It is not only about saving money – it is also a system for producing innovative, personalized homes while still providing predictability and confidence in a process often accompanied by risk. The proposed affordable housing should promote progressive development through adequate design.

“The physical design of our homes, neighborhoods, and communities shapes every aspect of our lives, yet too often Architecture are desperately needed in places where they can least be afforded.” (Design like you give a damn, 2006)

Affordable housing in Barbados has a somewhat unknown future. With the research provided throughout this thesis, there is evidently room for growth in the ways the rich vernacular Chattel House is utilized by policy makers and those designers involved, a structural system that has proven to be both technically and politically difficult to achieve. The highly appropriate, but very much ignored, vernacular housing system of the island remains ignored and undervalued by the vast majority of the population and even denounced by some. The architectural design of the unique chattel house is a true example of innovation with its capabilities of easily adapting to local climatic, social and economic conditions. In meeting the housing needs of the poor, the Government of Barbados “should promote and upgrade vernacular architecture.. dwelling design should respond to

climatic and cultural characteristics of the country.” (Potter, 1992) The borrowed designs should give way to the vernacular architecture. (Bonhomme, 1978) The proposed affordable housing designs should build on the long-standing tradition of self-help construction seen in the island’s indigenous vernacular system.

Architects who are seeking to make their services and designs accessible to the many versus the few, have turned to an alternative housing industry. These architects hope to make a better tomorrow through space; architecturally designed homes that can be built efficiently and sustainably, on-time and on-budget. They strive to mend the broken bond between the architectural quality of space and a low budget, an area where creativity and care is needed most.

It is, “architecture for the people, by the people.” (Parvin, 2013)

The most intriguing part of this research and design – I hope – is that it has opened the doors to new visions of tomorrow’s affordable housing for both designers, as well as the general public, who will now be able to understand with the presented schemes of strategies and limitations that a low cost-affordable house does not necessarily translate into a space without the positive influence of architecture.









Appendix A: The Chattel House  
Orthographic Drawings  
Photographic Analysis

The site plan illustrates the layout of various buildings and proposed developments at the Chattahoochee National Monument. Key features include:

- Buildings:** Buildings #1 through #13 are shown with their respective footprints and dimensions. Building #13 is noted to be at a 45-degree angle to buildings #3 and 5. Buildings #2 and #3 are to be parallel to the adjacent boundary to the southwest.
- Proposed Developments:** Areas for "FUTURE DEVELOPMENT" and "Construction of Road Ends Here" are indicated.
- Infrastructure:** The plan shows "Paving Stones", "Construction of Path End Here", and a "4'-0\"

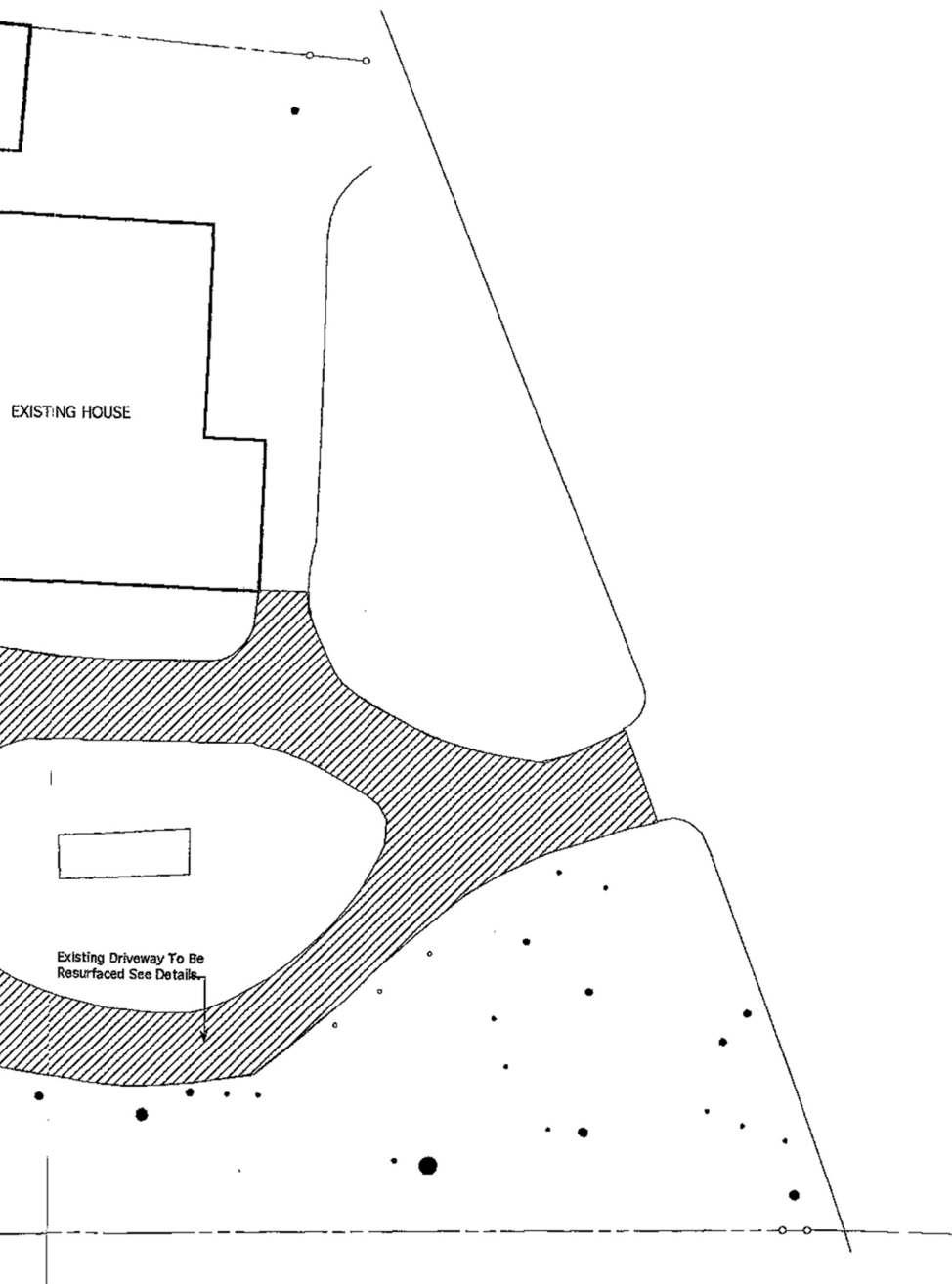


Figure 117:  
Site Plan of a  
traditional Chattel  
House Village  
scene built in the  
grounds of one  
of Barbados' Old  
Prime Minister's  
Home. - Tyrol Cot's  
Chattel Village  
Museum and  
Heritage Site.

These designed  
homes are replicas  
of the 1920 and  
1930's Chattel  
houses and  
are specifically  
positioned on  
site around a  
central social core  
to demonstrate  
the home life of  
Barbadians of that  
era.

Drawings by:  
Gillespie & Steel  
Associates Ltd.

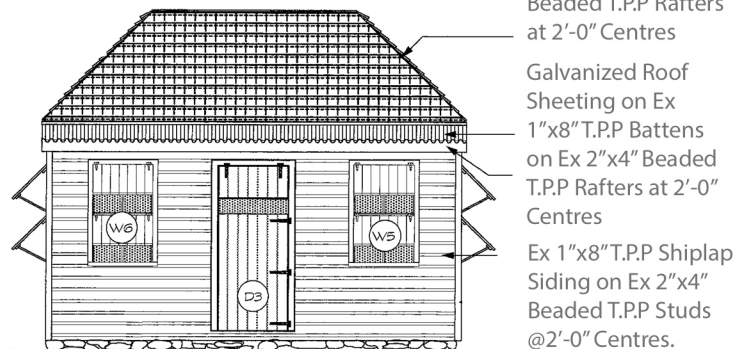
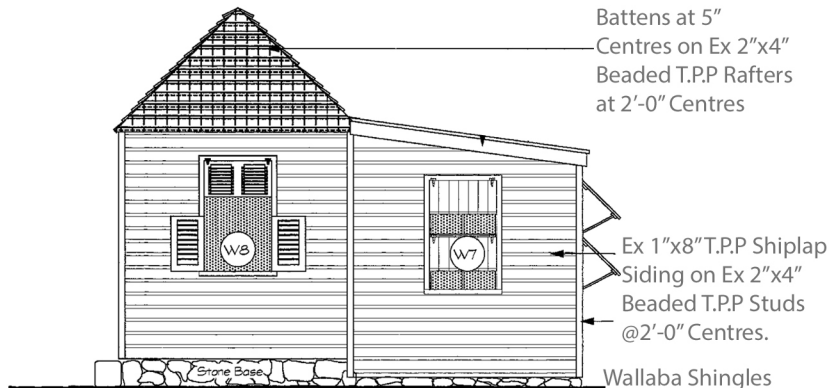
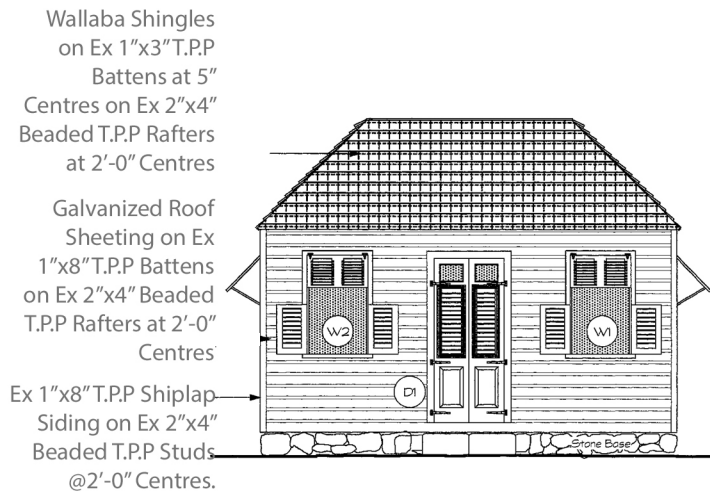


Figure 118:  
Original  
Chattel House  
- Orthographic  
Drawings -  
Elevations.

Phase One House  
- with gabled roof.

Phase Two House -  
Lean to roof.

Figure 119:  
Original  
Chattel House  
- Orthographic  
Drawings - Plan.

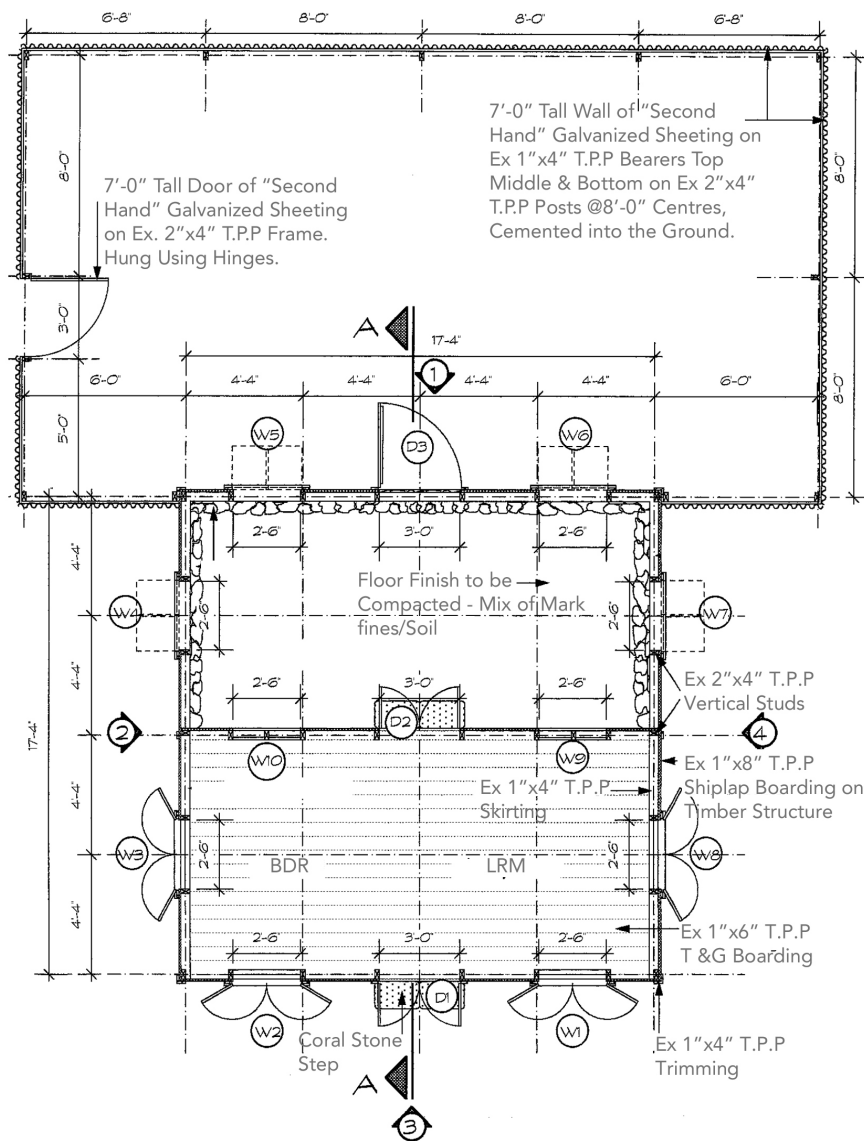
Scale: 1/4" = 1'-0"



Legend:  
 BDR: Bedroom  
 LRM: Living Room  
 KTCH: Kitchen  
 BY Backyard

Note:  
 1st Phase House  
 - framed floor  
 seperated into  
 a Bedroom and  
 Living Space.

2nd Phase House  
 - Lean to Kitchen,  
 earth floor,  
 enclosed yard with  
 an out house for  
 washroom utilities






Figure 120:  
Original Chattel  
House in poor  
condition.

Note: The  
galvanized  
sheeting for the  
roof material and  
jalousie windows  
as well as the  
deteriorating  
condition of the  
wood cladding  
due to high  
maintenance  
costs.





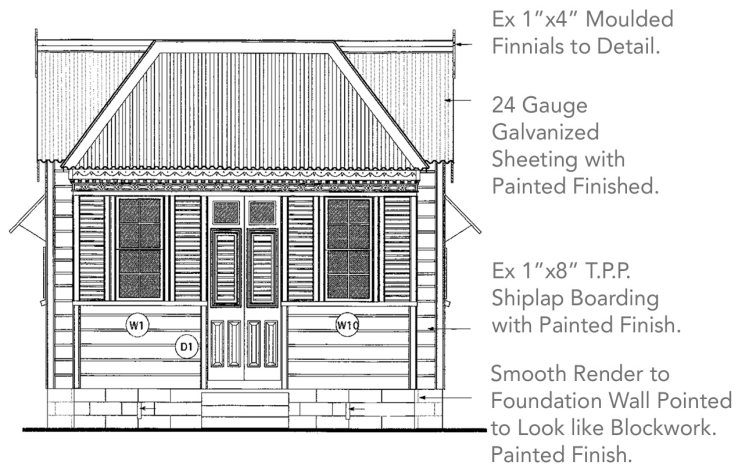


Figure 121:  
Chattel House  
with covered  
front Porch-  
Orthographic  
Drawings - Plan

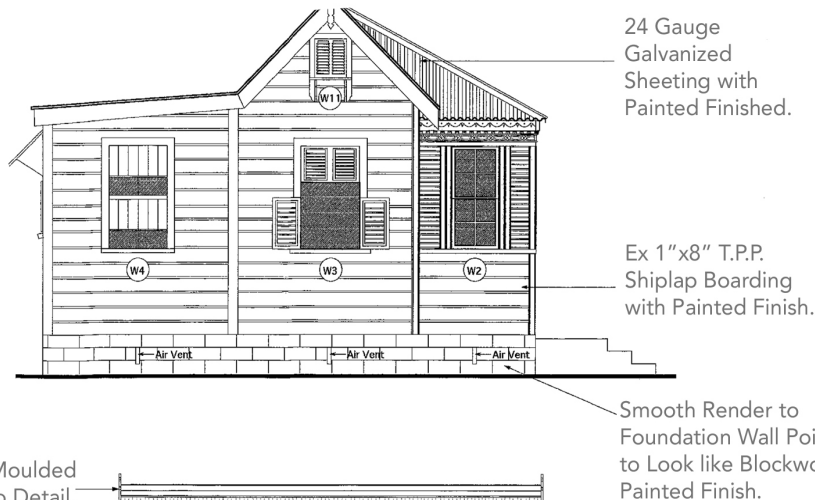


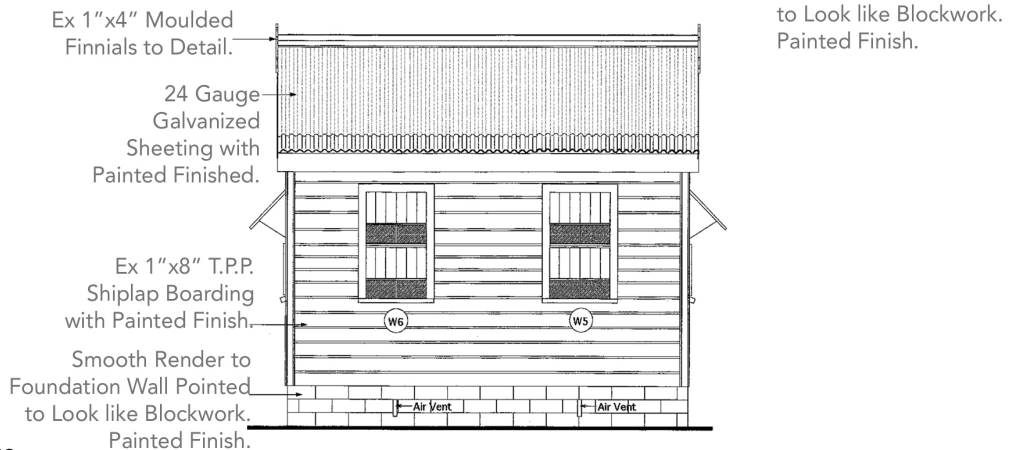
Figure 122:  
Chattel House  
-Elevations.

Note:  
1st Phase House -  
in the middle.

2nd Phase House  
- towards the  
back with a lean  
to Kitchen with  
wooden floor.

3rd Phase House -  
towards the front  
with a hipped  
roof covering the  
Porch.

Scale: 1/4"=1'-0"



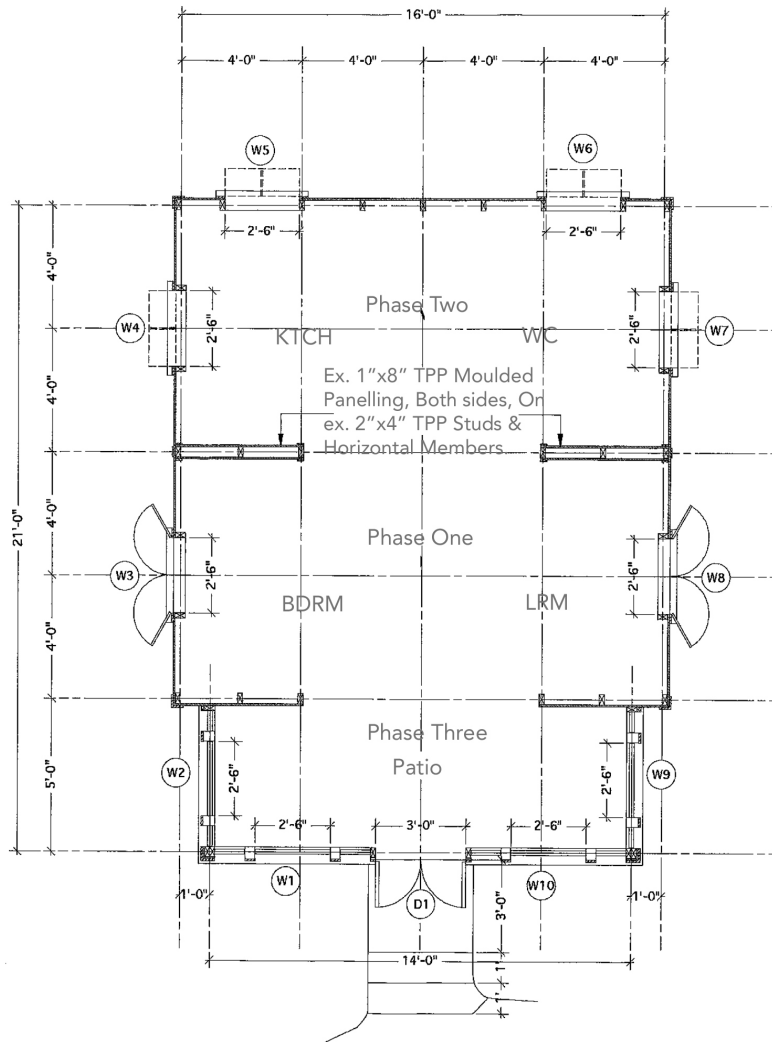


Legend:  
 BDR: Bedroom  
 LRM: Living Room  
 KTCH: Kitchen  
 BY Backyard

Note:  
 1st Phase House  
 - framed floor  
 seperated into  
 a Bedroom and  
 Living Space.

2nd Phase House  
 - Lean to Kitchen,  
 wooden and/or  
 ceramic tiled floor  
 on concrete slab.

3rd Phase House -  
 Hipped roof Patio  
 for added living  
 space.






Figure 123: One of the many Chattel House variations with a covered Porch at the front of the House.

Note: The placement of jalousie windows for ventilation and cooling purposes and the solid foundation that would have originally been loose stone before.



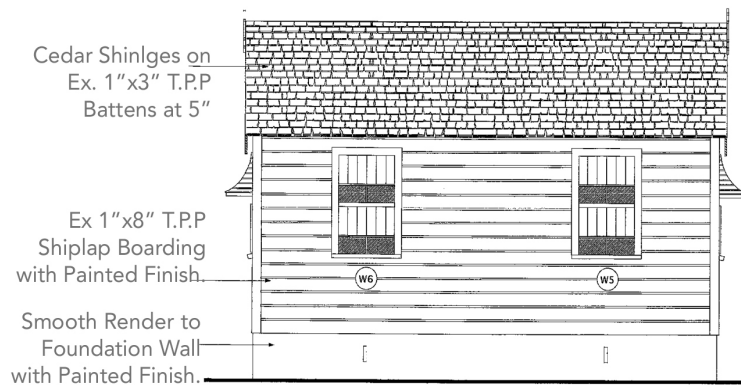
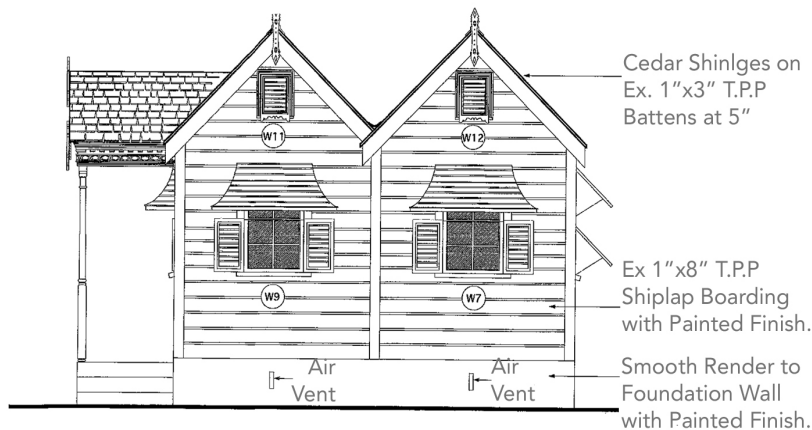
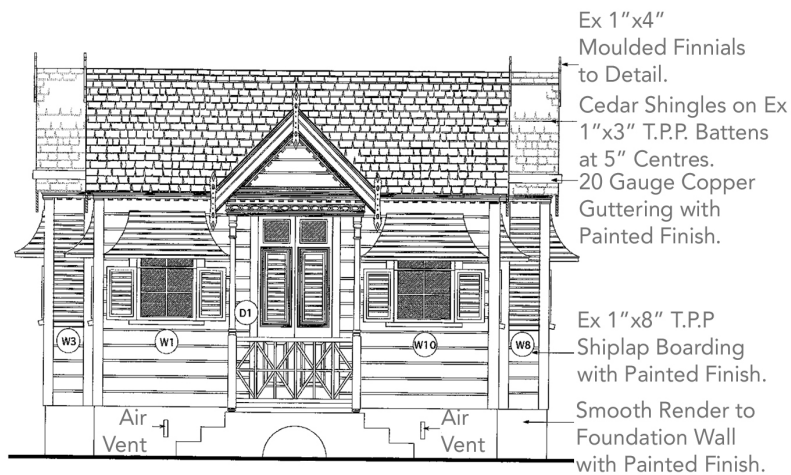


Figure 124:  
(Decorated)  
Chattel House with  
front Verandah  
Entrance -  
Orthographic  
Drawings - Plan

Figure 125:  
Chattel House -  
Elevations.

Note:  
1st Phase House

2nd Phase House  
towards the back.  
(Gabled Roof  
Addition)

3rd Phase  
Verandah with a  
pediment roof.

Scale: 1/4"=1'-0"








Figure 126: One of the many Chattel House variations with a Pediment Covered Verandah over the entrance of the House.

Note: The placement Window hoods for shading and cooling purposes and the Georgian Influence in style with the Pediment Portico and lines of symmetry.









Appendix B: The NHC Starter Home  
Orthographic Drawings  
Photographic Analysis

One of the seventeen NHC  
Starter Home Site Plans showing  
the subdivisions of land into lots  
for the erection of residential low-  
income housing.

- Housing Options:
- . Rent to Own
  - . Rentals
  - . Land Only
  - . Buy House and Land



Subdivision of Land into Lots and Erection of Houses for Residential Purposes  
at Lower Greys, Christ Church



Figure 127: NHC Starter Homes Site Plan.

Survey Information  
provided by Preconco  
- Engineering firm in  
Barbados - by W.A.G  
Scott, Land Surveyor  
dated 16 June 2010  
showing:

## Lot Boundaries and Areas

### Minor House Details in Plan

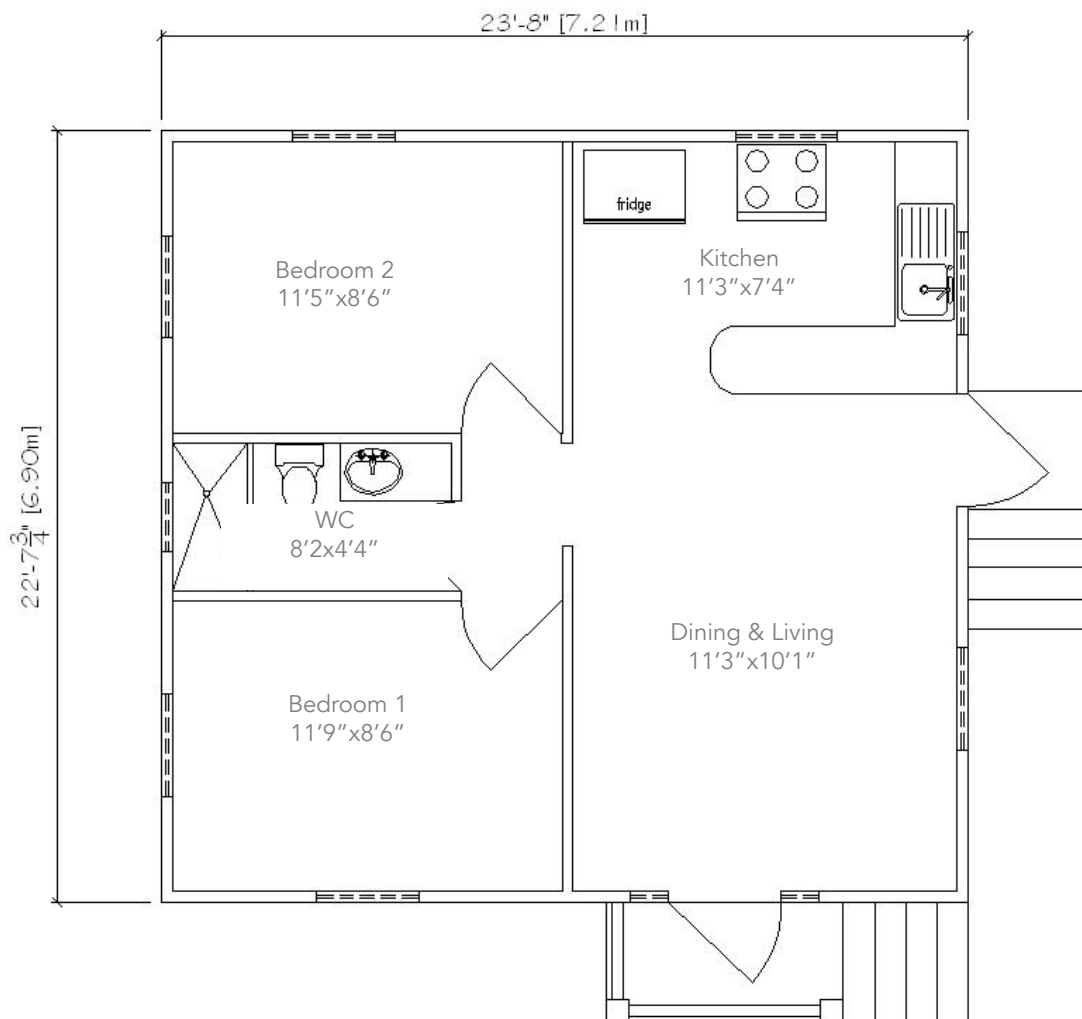


Figure 128: NHC Starter Home - Contessa - Floor Plan.

Note: Drawings taken from the NHCO Website.

One half is an open plan concept for the kitchen and living space, the other half is divided into bedrooms and washroom area.

Floor Area: 536 sq ft.

Figure 129: NHC Starter Home - Contessa 3d Render taken from the NHC Website.





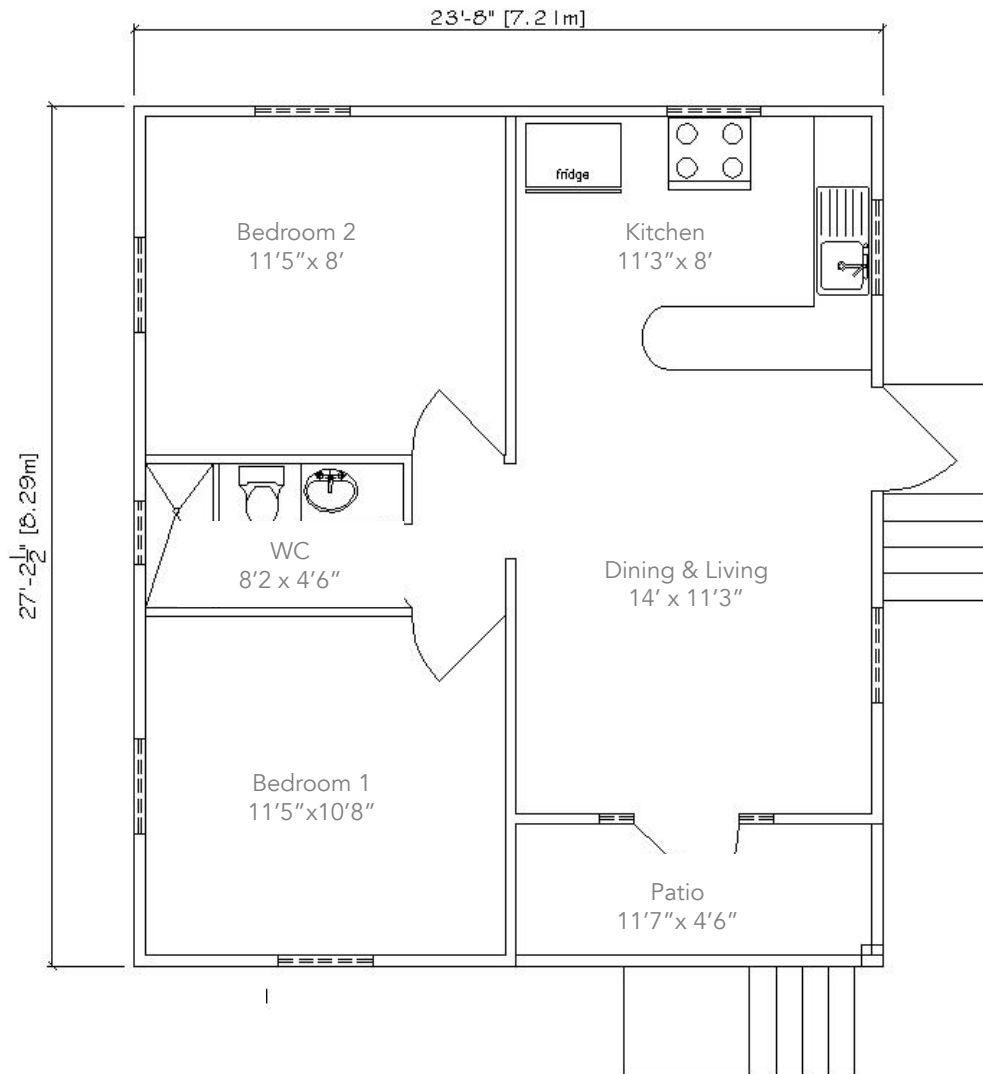


Figure 130: NHC Starter Home - Orchid - Floor Plan.

Note: Drawings taken from the NHCO Website.

One half is an open plan concept for the kitchen and living space with a small patio at the front, the other half is divided into bedrooms and washroom area.

Floor Area: 644 sq ft.

Figure 131: NHC Starter Home - Orchid 3d Render taken from the NHC Website.



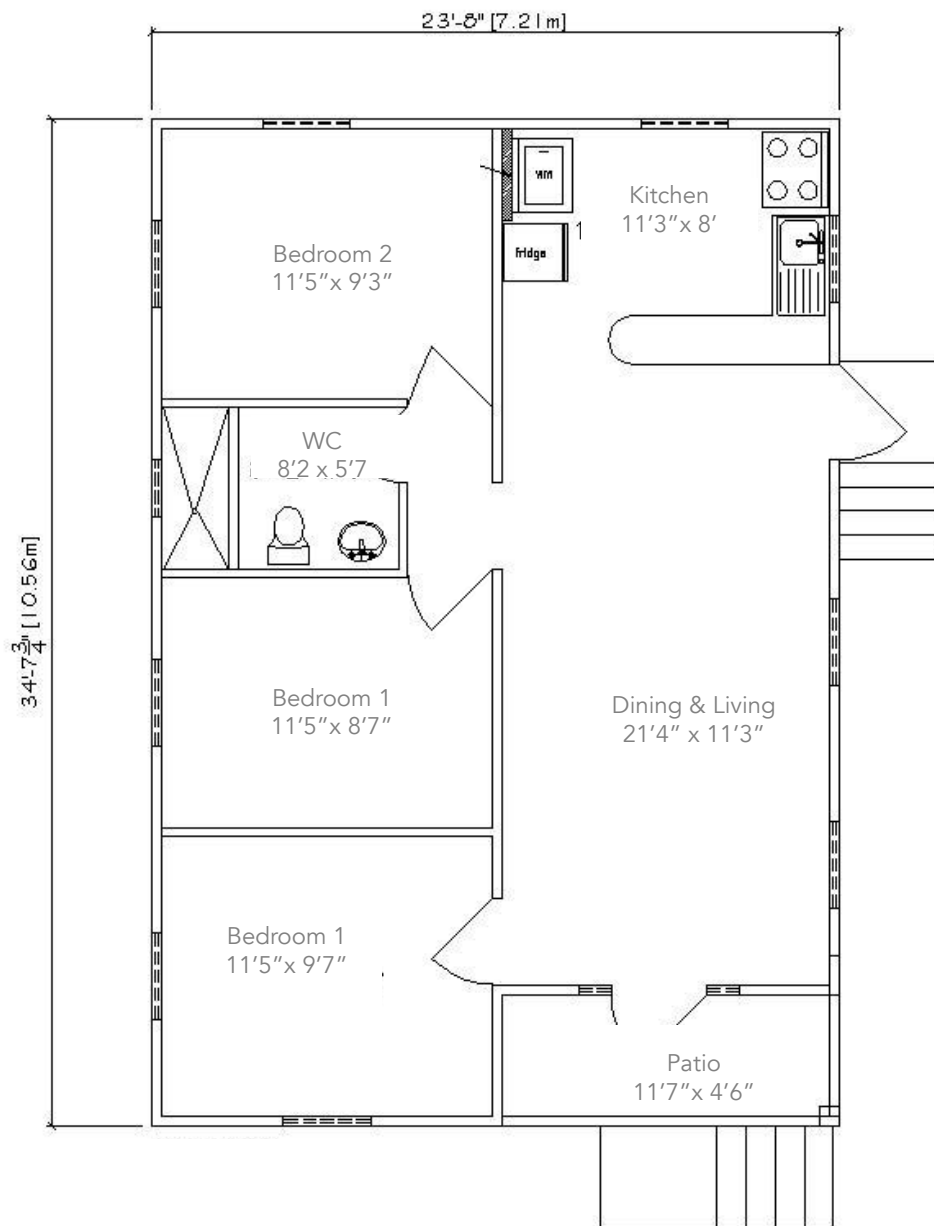


Figure 132: NHC Starter Home - Pearl - Floor Plan.

Note: Drawings taken from the NHCO Website.

One half is an open plan concept for the kitchen and living space with a small Patio at the front, the other half is divided into bedrooms and washroom area.

Floor Area: 820 sq ft.

Figure 133: NHC Starter Home - Pearl 3d Render taken from the NHC Website.







## Appendix C: Design Proposal

### Conceptual Renders



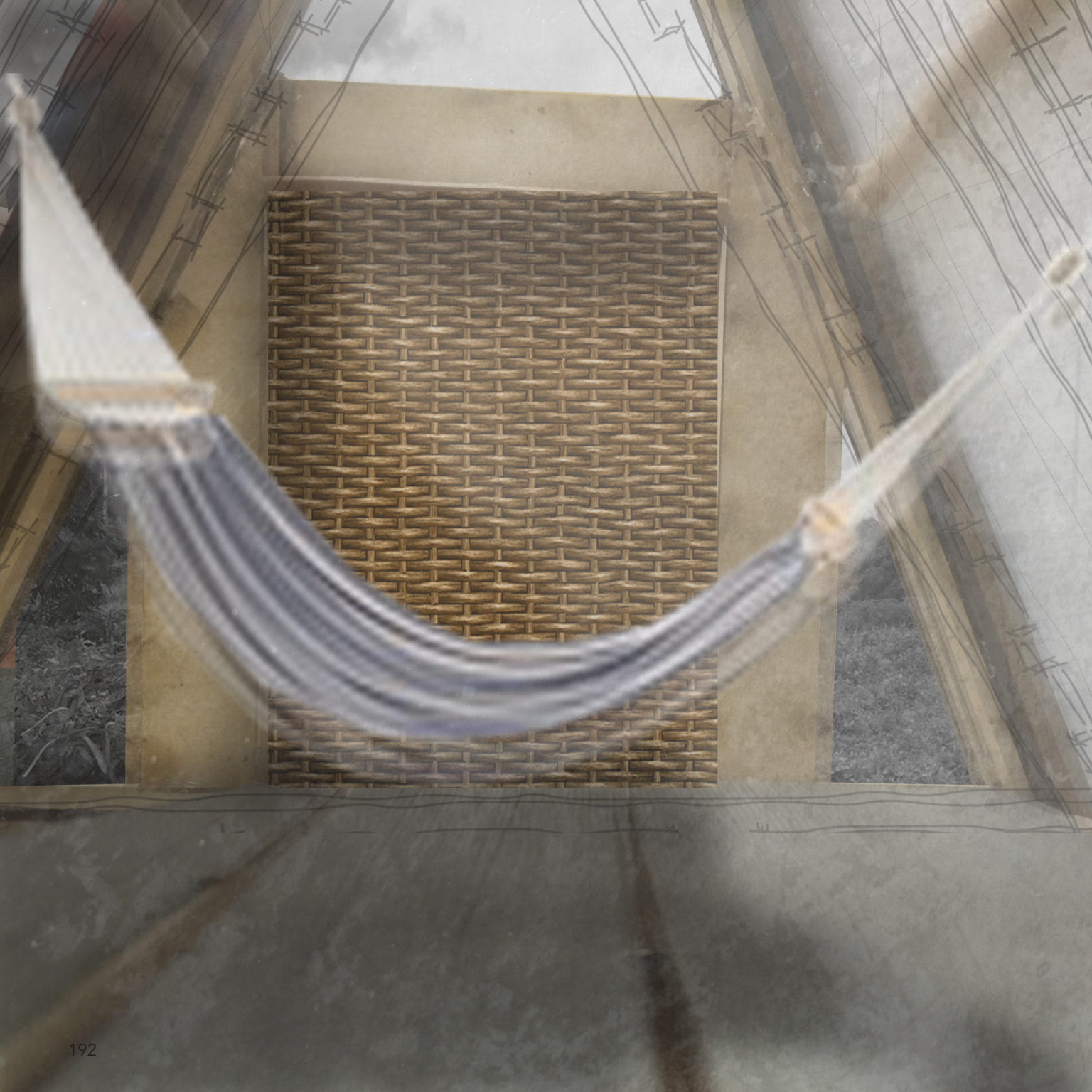






Figure 134:  
Sleeping Quarters  
In the Loft. -  
Closed

Figure 135:  
Afternoon Nap -  
Open





Figure 136:  
Socializing in the  
Patio. - Open

Figure 137:  
Preparing food in  
the Patio - Closed.











Figure 138: The Backyard.

Figure 139:  
Prepping for  
Laundry in the  
Backyard.



Appendix D: Modelling Process  
Model Massing - Stage One  
Model Massing - Stage Two  
Model Massing - Stage Three

## STAGE ONE

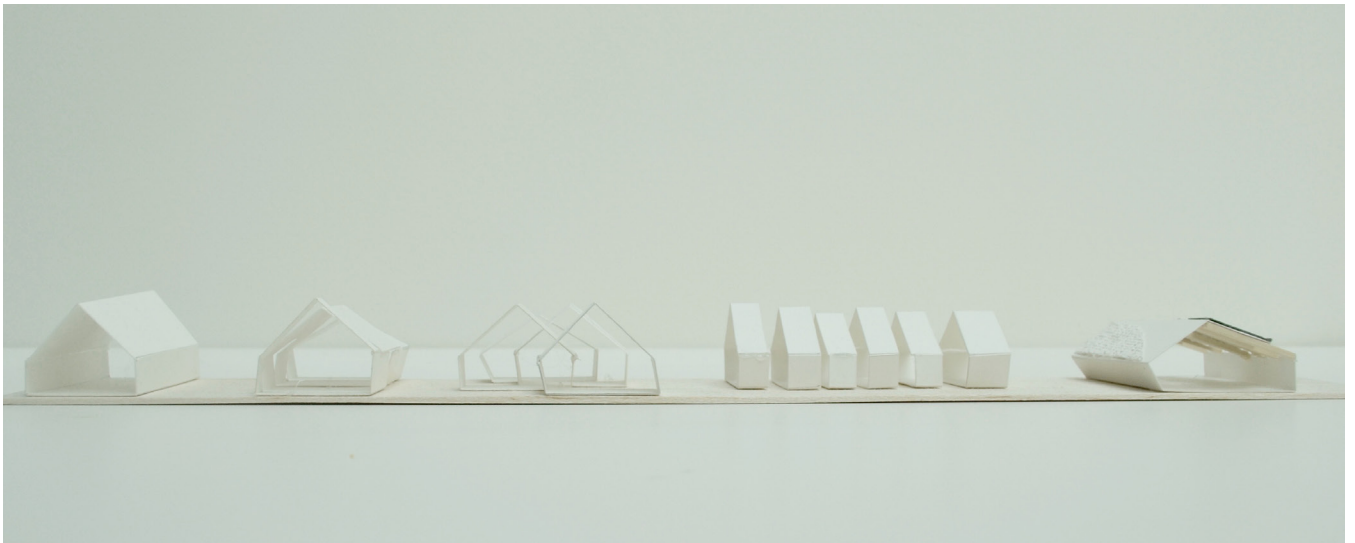
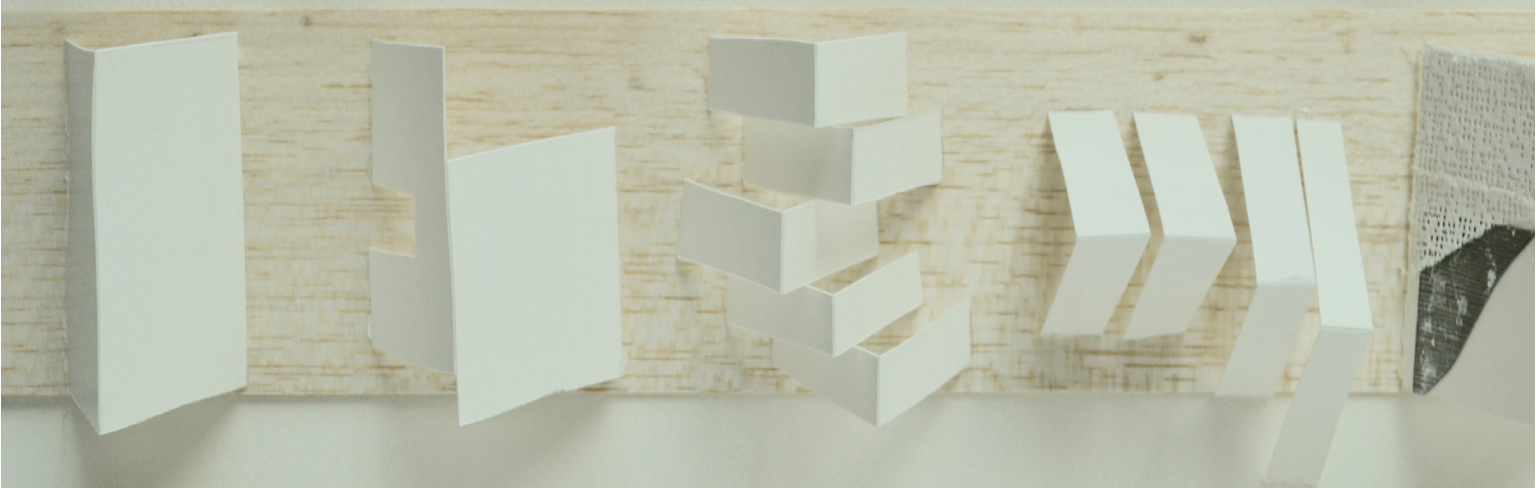
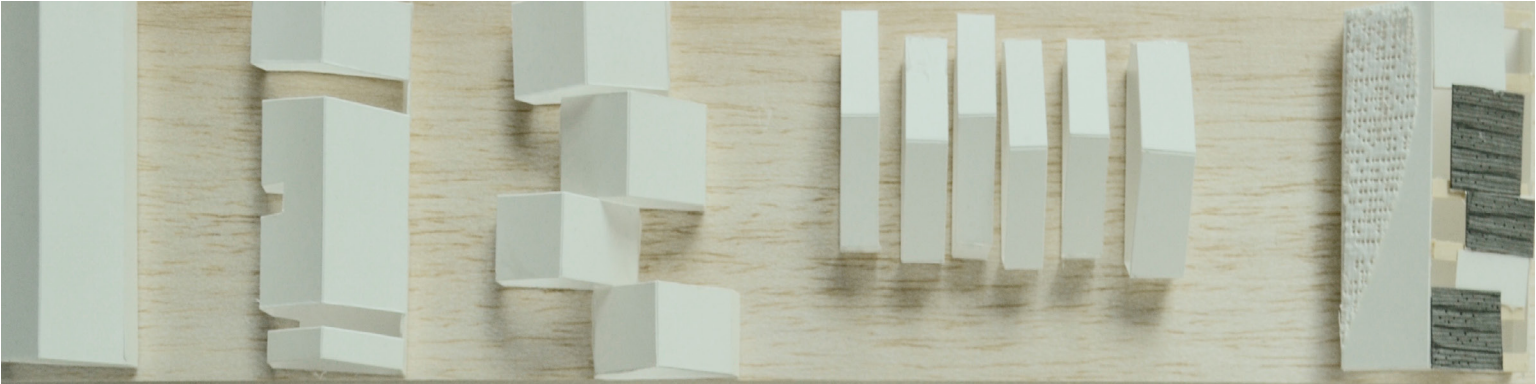


Figure 140 & 141:  
Model Massing  
- Experimenting  
with different  
forms inspired  
by the vernacular  
Chattel House





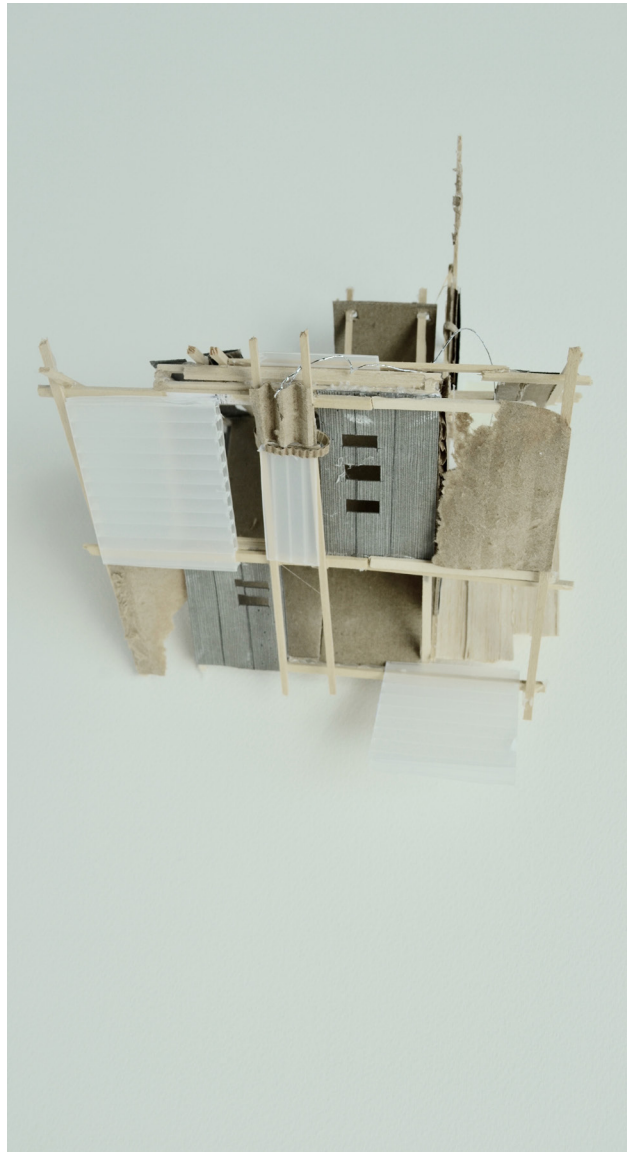


Figure 142:  
Prototype One  
Model.

Figure 143:  
Prototype One  
Model showing  
the transformable  
building skin  
components and  
modular growth.

Medium:  
Photographic  
Collaging of  
physical models.



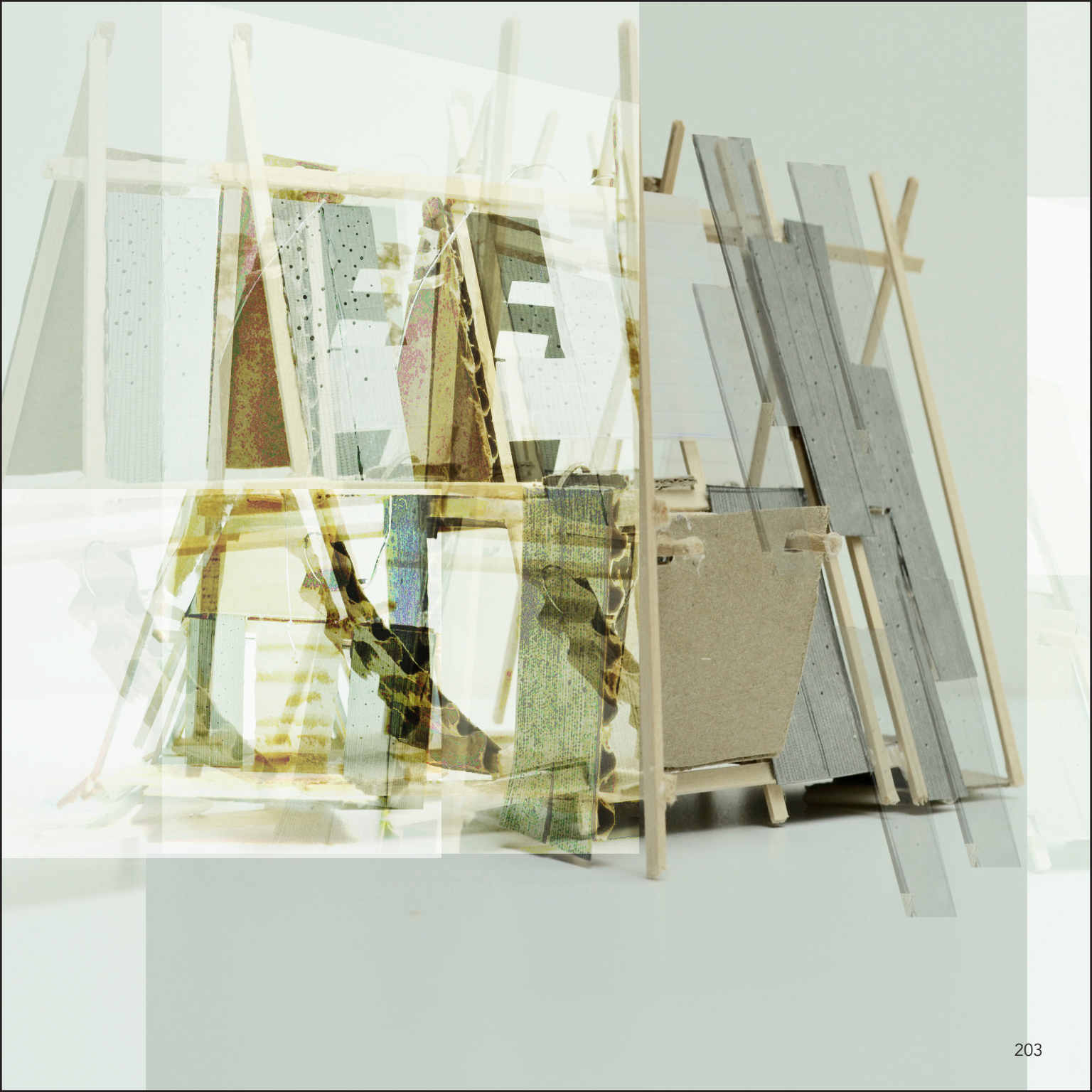




Figure 144:  
Prototype Two.

Figure 145:  
Prototype Two  
Model showing  
the transformable  
building skin  
components and  
modular growth.

Medium:  
Photographic  
Collaging of  
physical models.



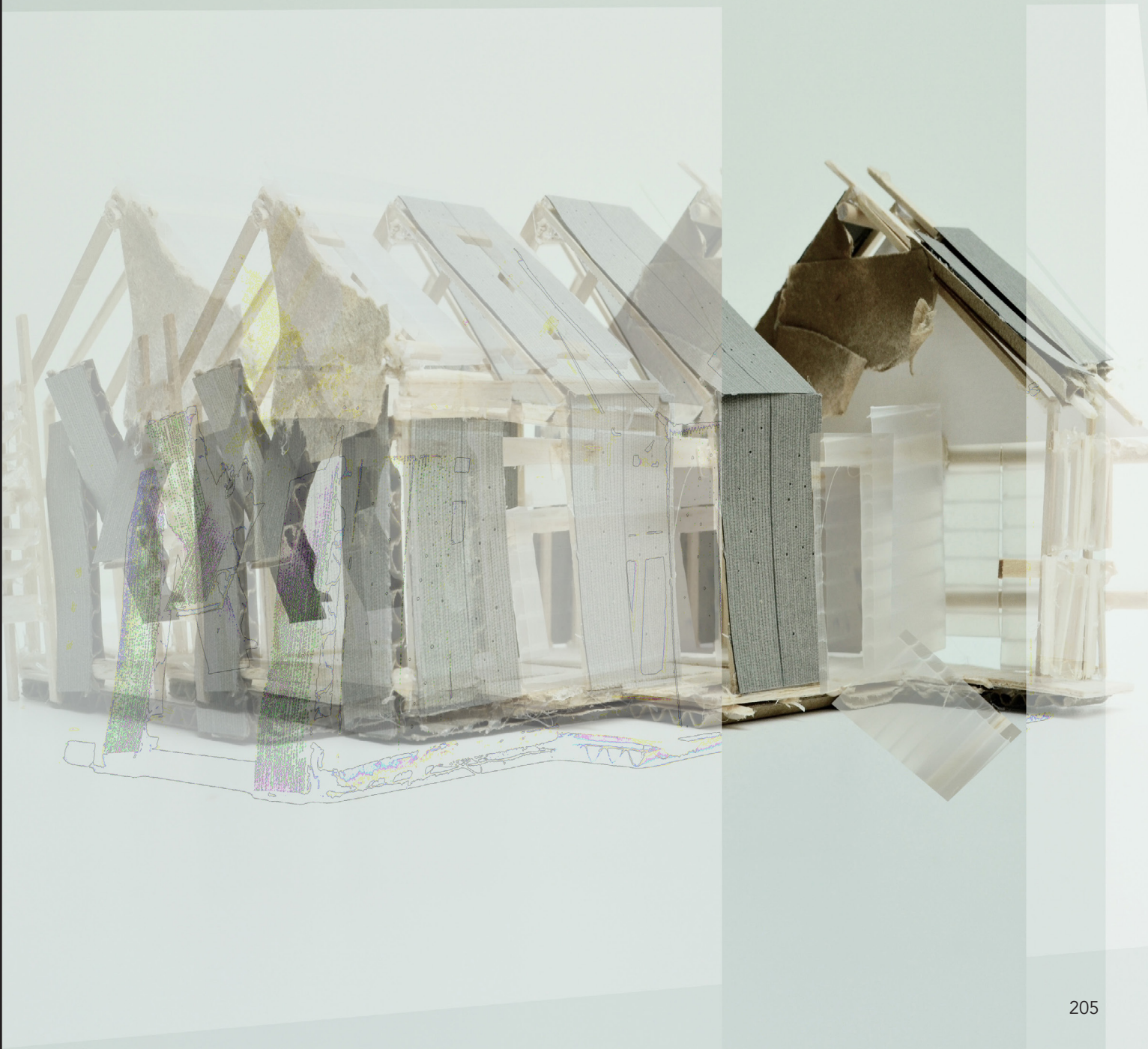


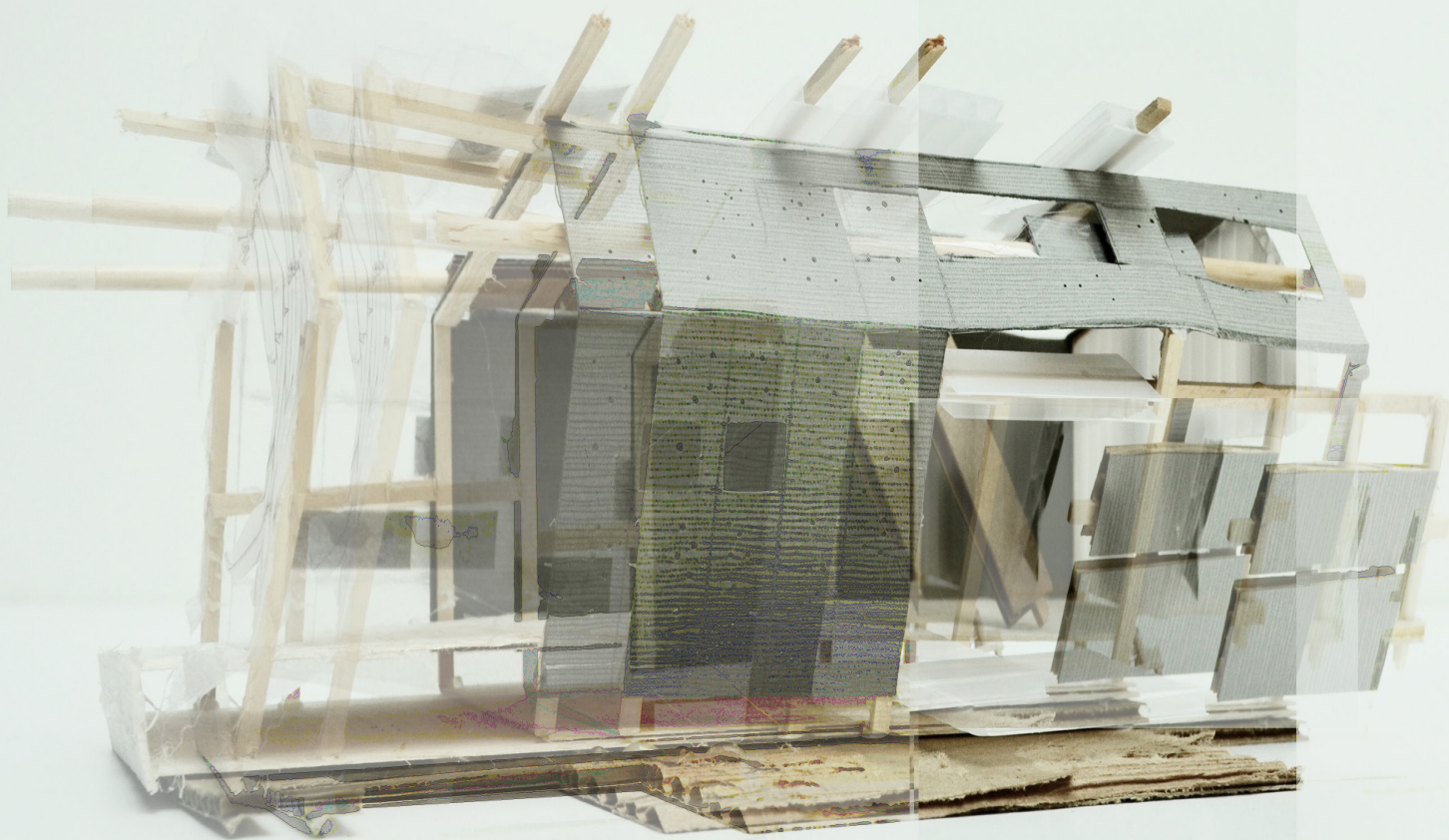


Figure 146:  
Prototype Three

Figure 147:  
Prototype Three  
Model showing  
the transformable  
building skin  
components and  
modular growth.

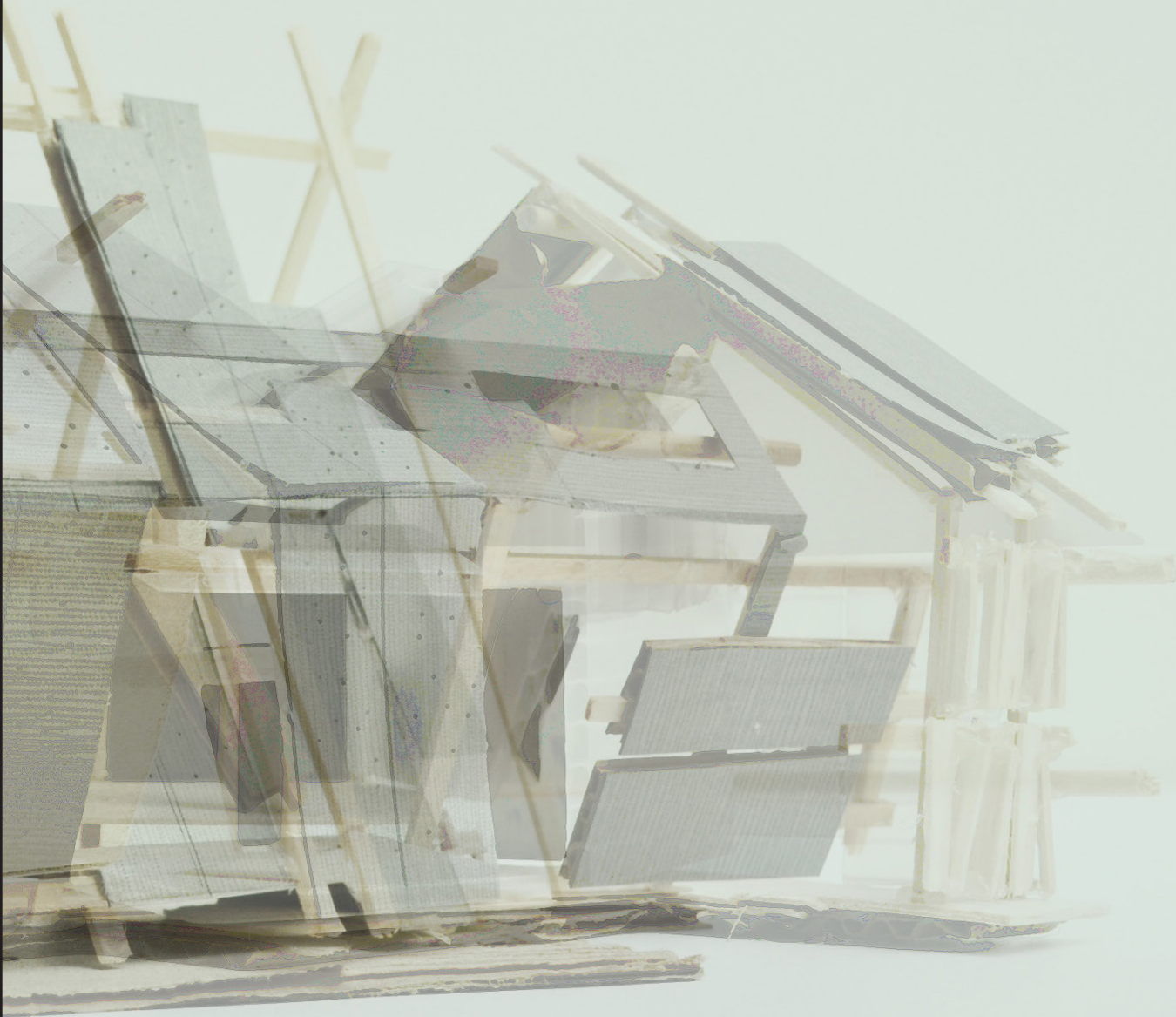
Medium:  
Photographic  
Collaging of  
physical models.











## STAGE TWO



Figure 149:  
Prototype One.

Figure 150:  
Prototype One -  
Modular Growth.

Medium:  
Photographic  
Collage of Physical  
Models.



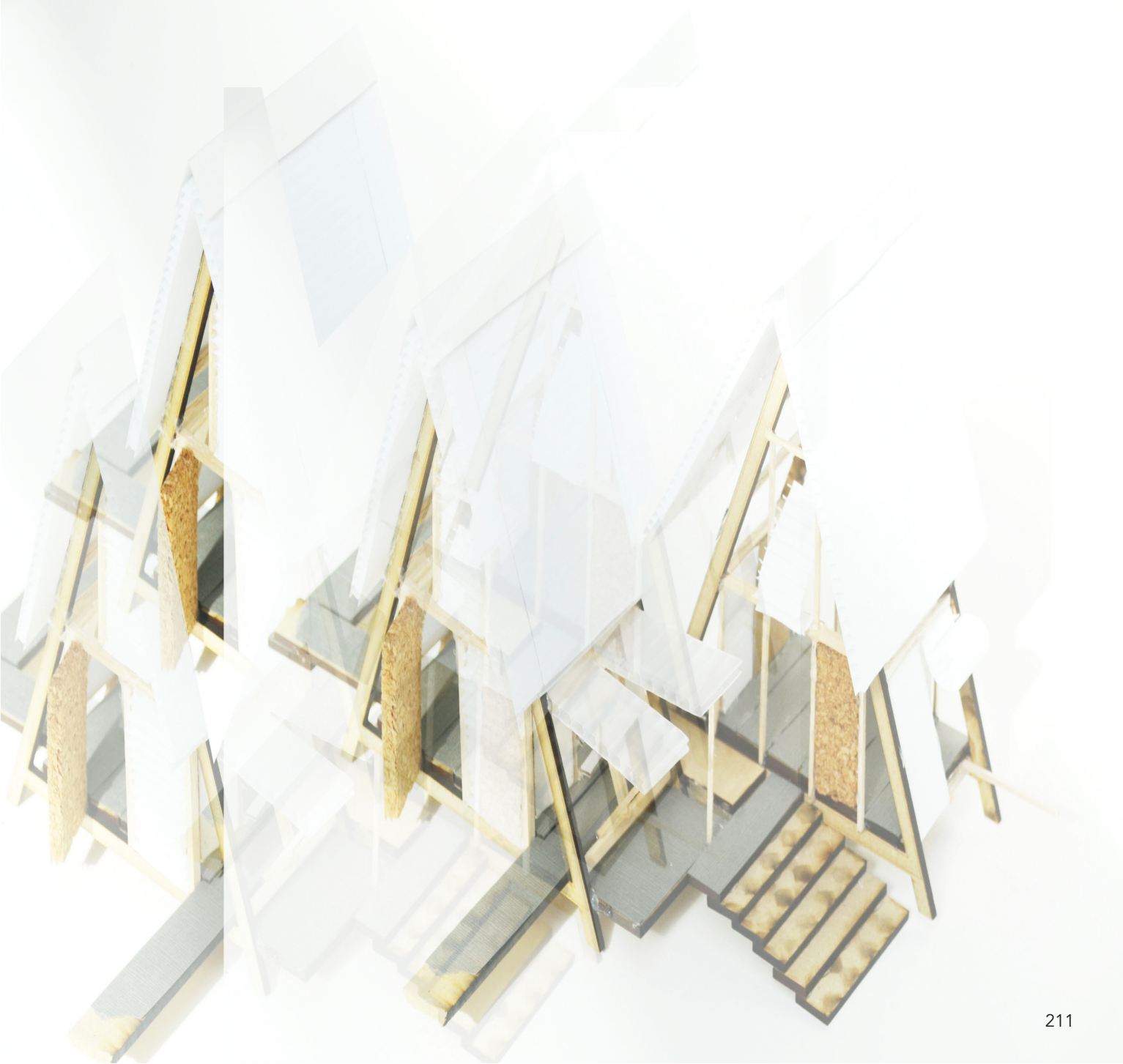




Figure 151:  
Prototype Two

Figure 152:  
Prototype Two -  
Modular Growth.

Medium:  
Photographic  
Collage of Physical  
Models.

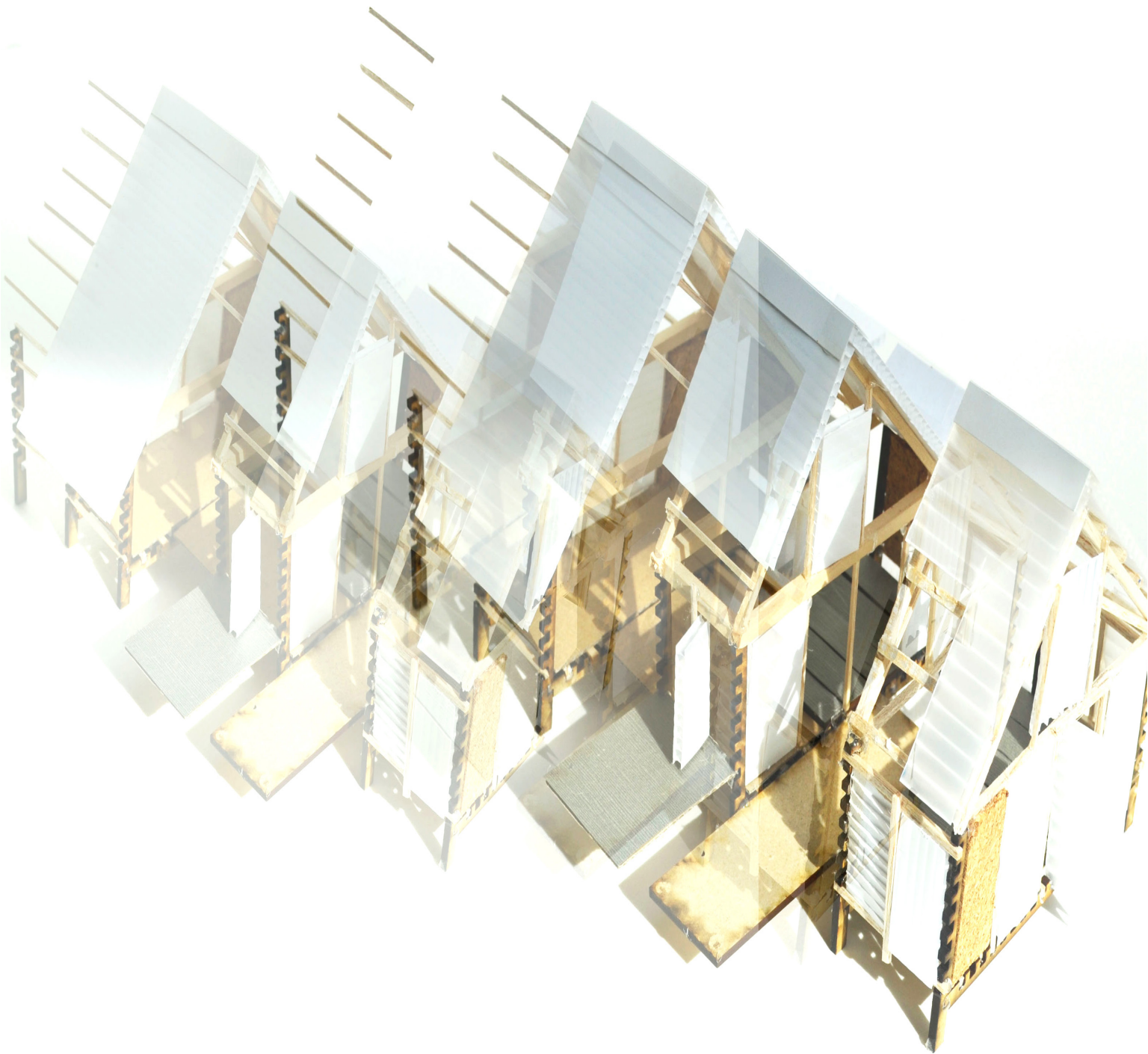


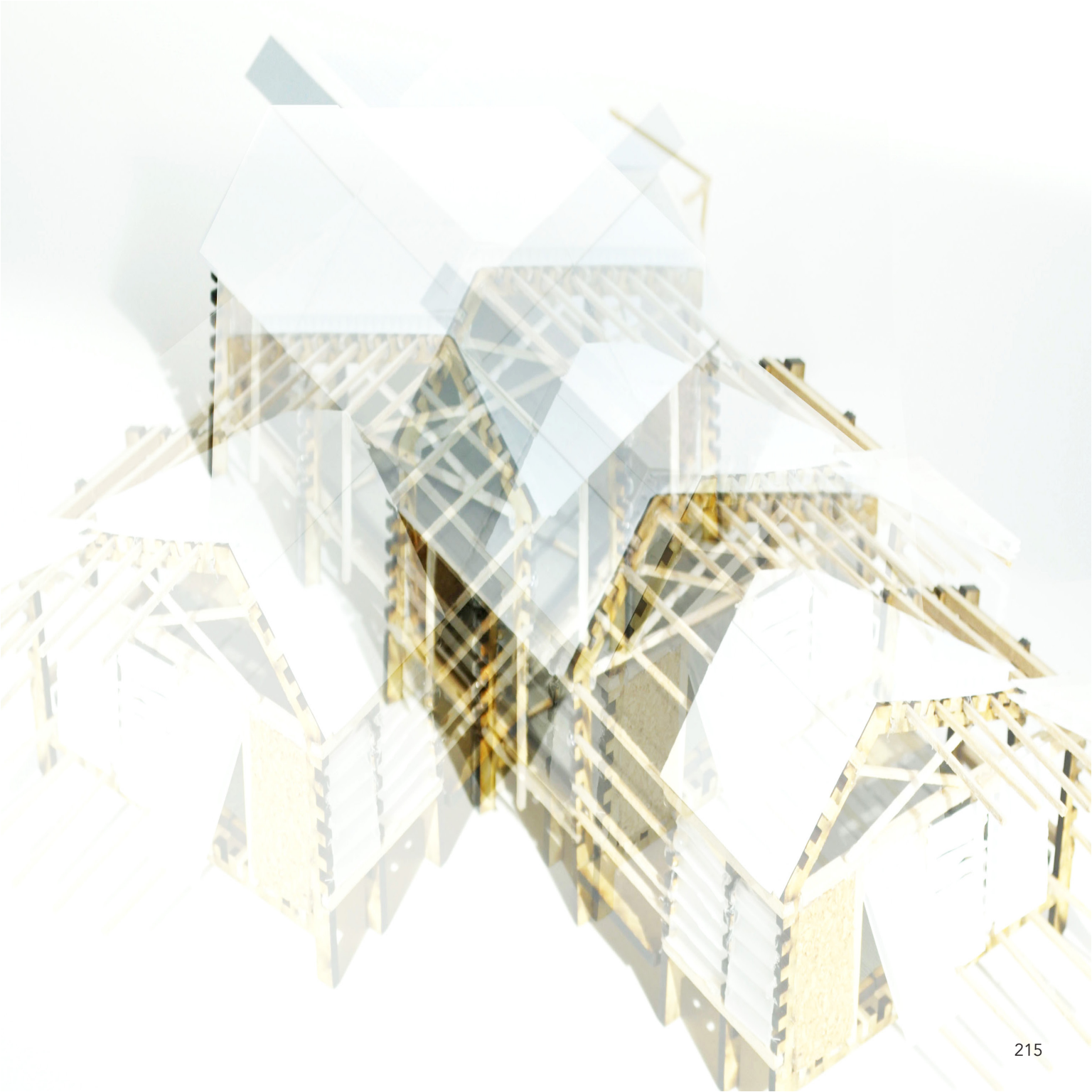




Figure 153:  
Prototype Three

Figure 154:  
Prototype One -  
Modular Growth.

Medium:  
Photographic  
Collage of Physical  
Models.



STAGE THREE







Figure 155:  
Prototype One.



Figure 156:  
Prototype Two

Figure 157:  
Prototype Three

Medium: MDF  
Laser cut model  
with Veneer and  
Plastic panel  
cladding.



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