Spring 5-4-2018

Hurricane Communities

Katie Masters

Hurricane Communities:
An Analysis of Florida Housing

Request for Approval of Thesis Research
Project Book Presented to:

Professor Bronne Dytoc

and to the
Faculty of the Department of Architecture
College of Architecture and Construction Management

by

Katie Masters

In partial fulfillment of the requirements for the Degree

Bachelor of Architecture

Kennesaw State University
Marietta, Georgia

Spring 2018

Kennesaw State University

Department of Architecture
Collage of Architecture and Construction Management

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Hurricane Communities

Katie Masters ______________________________ Date___________

Approved By:

Primary Advisor: Bronne Dytoc ______________________________ Date___________

Thesis Coordinator: Liz Martin ______________________________ Date___________

Department Cahir: Tony Rizzuto ______________________________ Date___________

The Author Would Like to Acknowledge

Bronne Dytoc

Josh Blount

The Authors Parents

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OVERVIEW

CHAPTER 01

Top 10 U.S. states with most natural disasters:

1. Texas: (Hurricane, tornadoes, floods, wildfires)
2. California: Earthquakes (wildfires, landslides, flooding, winter storms, severe freeze and even tsunami waves)
3. Oklahoma: Tornado (winter storms, wildfires, floods)
4. New York (Blizzards and Tropical Storms)
5. Florida(Hurricanes/ Tropical Storms)
6. Louisiana (Hurricane)
7. Alabama (Hurricanes and tornadoes)
8. Kentucky (Hurricane, landslides, mudslides, rock-slides, flooding and tornadoes)
9. Arkansas (Storms/Tornadoes and heavy rain, snow, ice, tornadoes and flooding, tropical storm)
10. Missouri: Tornadoes (flooding, snow, ice storms)

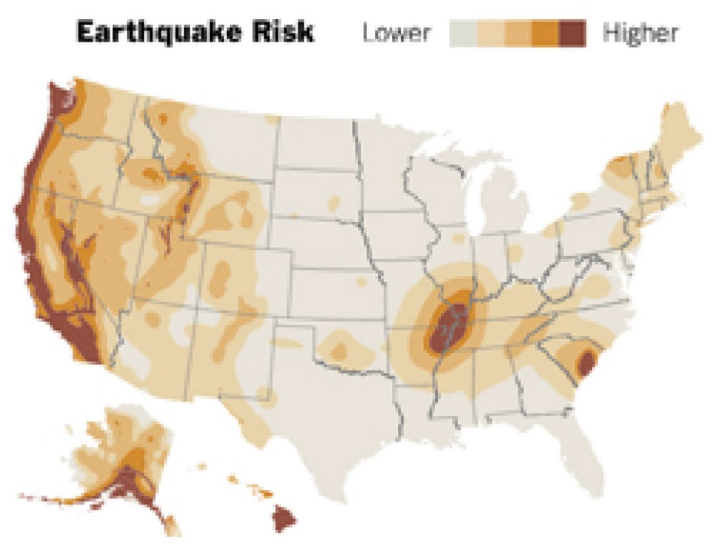
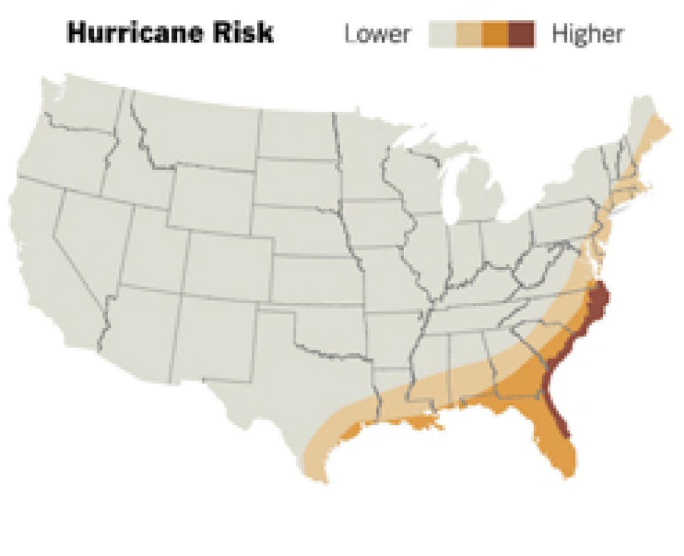


Figure 1.1



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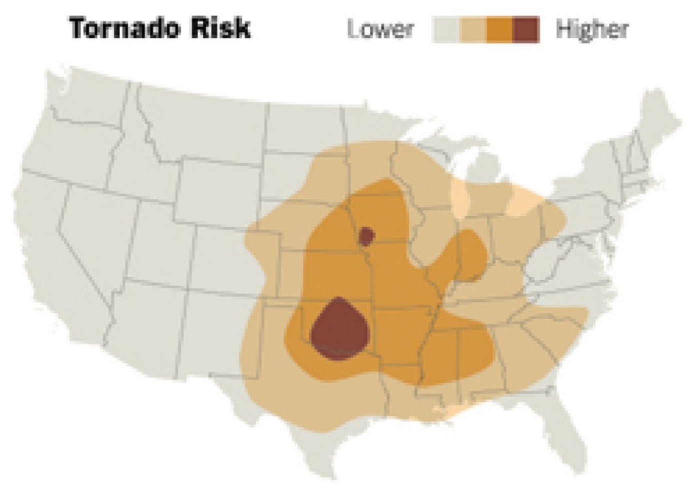


Figure 1.2

Types and Rankings of Deadliest Disasters

(1st)Flooding
(2nd)Earthquakes
(2nd)Tsunami
(3rd) Hurricane
(3rd)Severe Storm
(4th)Volcanic Eruption
(5th)Tornado
(5th)Landslide
(6th)Avalanche
(7th)wildfires

1.1 HYPOTHESIS

Parts of the United States deal with natural disasters every year. One of the most devastating of these natural disasters and one that is very costly to recover from is the hurricane. These storms leave paths of destruction and heartache. The aftermath and repairs are long and tedious often lasting years or decades. These storms may foster migration to less hurricane prone areas.

We have recently experienced these disasters when hurricanes Irma and Marie struck the state of Florida in 2017. We know that the population of the areas hit by these storms is still working through the repair of homes, loss of utilities and challenges of rebuilding their lives. The strain of this recovery takes an enormous emotional toll, especially on the working class. It is hard to measure the destruction in human terms, but one can quantify the damage to housing. Losing a home that cannot be fully replaced within their available resources is the closest measure available to assess the human emotional impact.

What should we do, knowing that these hurricanes are certain to recur, to typical houses that were not constructed to survive these storms? Can we design better forms and use better construction that harmonizes with the forces of the hurricane rather than trying to resist them? In many coastal regions, not all the housing is destroyed and replaced following a disaster, so the homes now in these neighborhoods is a mixture of older non-storm and

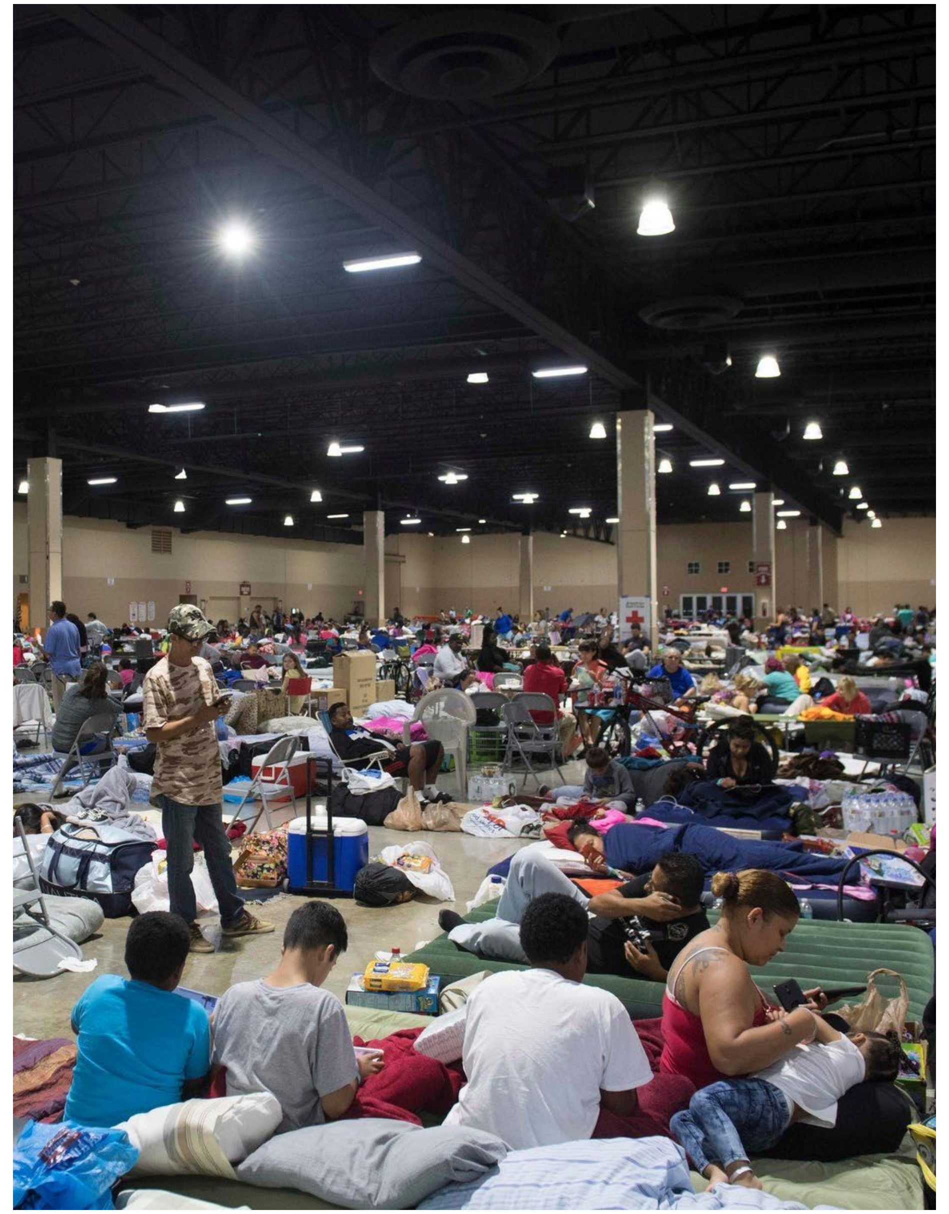


Figure 1.4

Figure 1.5

Figure 1.6

Figure 1.7

resistant and upgraded more hurricane resistant structures. While many upgrades were made to the building codes, particularly after Hurricane Andrew in 1992, even the newer houses are not fully hurricane resistant. There has not been a holistic design solution to develop neighborhoods capable of weathering a storm. At best, the solutions have been individual house modifications that have tried to lessen the debris generated when whole houses come apart in the driving wind. What is needed is a well-designed coastal architecture that harmonizes with hurricanes through better form and structure.

This thesis aims to reexamine how we can as architects can design more effectively at the residential scale through investigation of site, lateral forces, form and structure. The intent is to minimize the physical and emotional damage that is left behind by hurricanes so that the next time an area is struck, we can be better prepared through more thoughtful design.

From: https://www.nbcnews.com/business/10-states-most-natural-disasters-6C10088195

NUMBER OF STRIKES, CATEGORY, AND PLACE OF HURRICANES

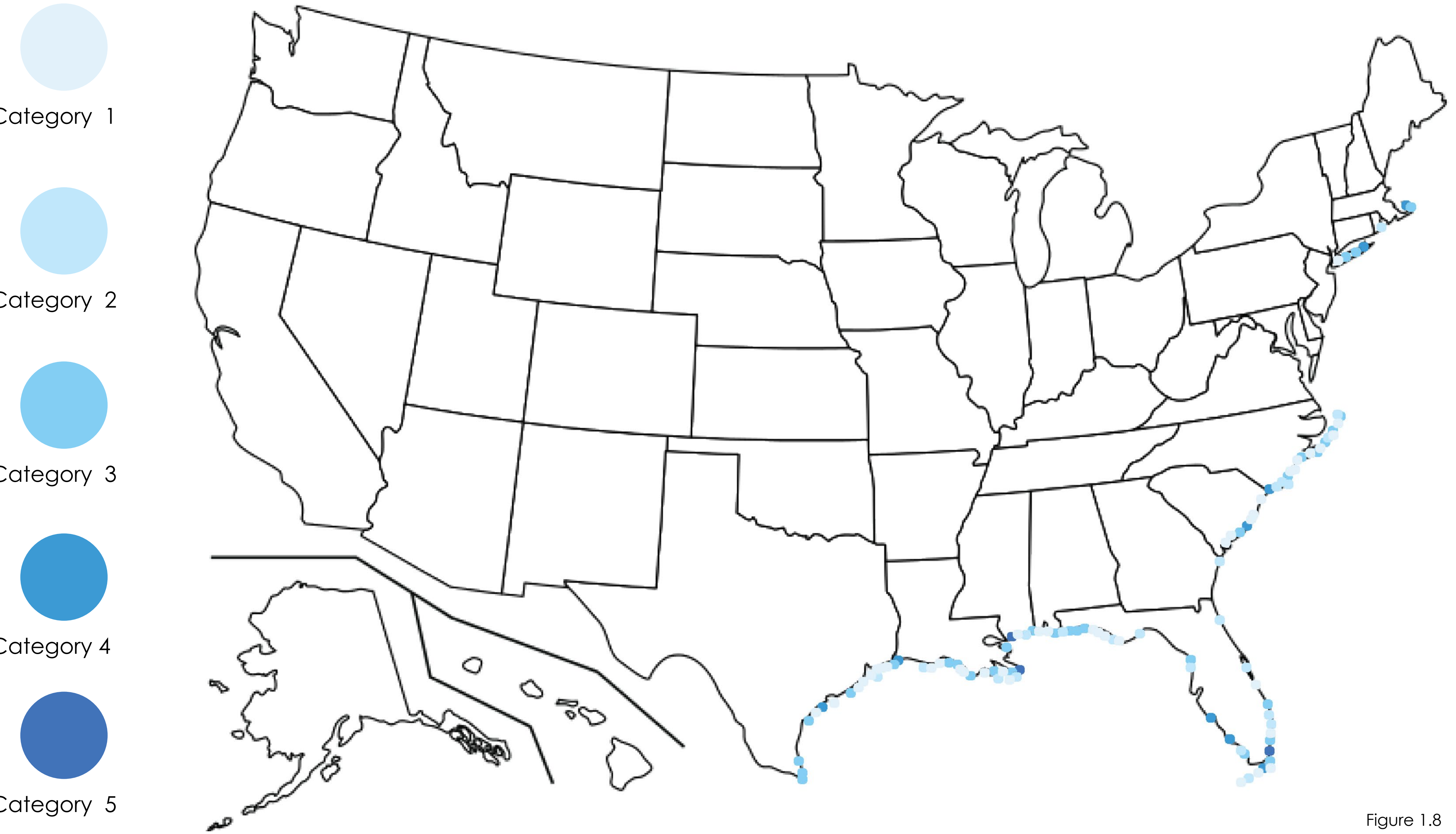


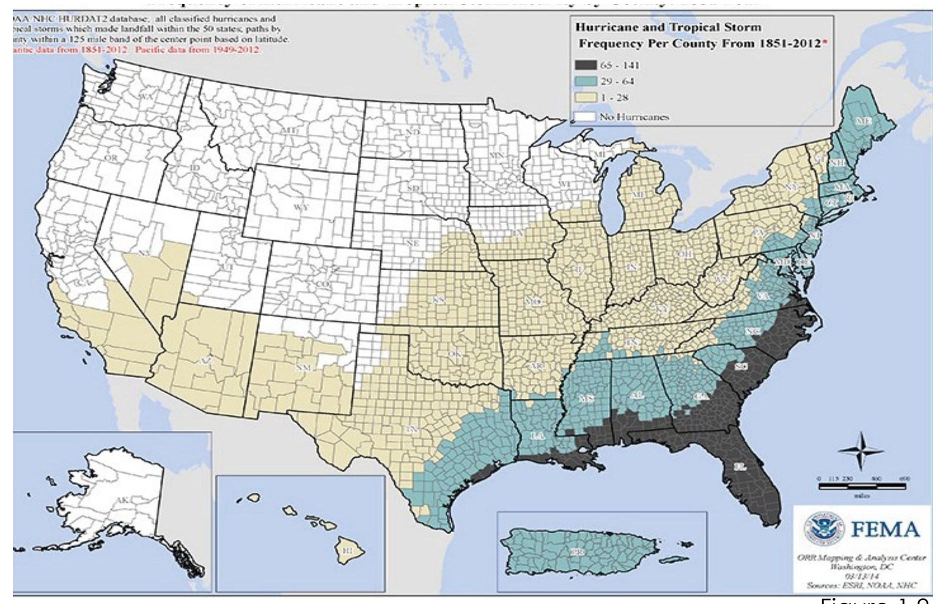
Figure 1.8

1.2 THE PROBLEM

Hurricanes are tropical cyclones, which are rapidly rotating storms characterized by a low-pressure center, a closed low-level atmospheric circulation, strong winds, and a spiral arrangement of thunderstorms that produce heavy rains. The hurricanes range from category one to category five, the most devastating. Category one storms have winds speeds between 74 and 95 miles per hour. Category five winds are in excess of 155 miles per hour. The storms cause damage due to the high winds followed by flooding. Storms category three and above can result in major structural damage, particularly from flying debris and the resultant roof damage exposing the interior of the house to flooding.

Examining data from the parts of the United States with the most frequent hurricanes, the state of Florida is a frequently affected area and the only state with a risk area that covers the entire state. It is a rare year that Florida is not hit by at least one major hurricane as can be seen in figure 1.8. Florida is a high risk area that extends into the ocean with no barrier protection, a flat topography and high working class population density near the coast that tends to live in single family home neighborhoods. The flat topography results in a high flood risk associate with the storms as shown in figure 1.10.

Data for the state of Florida as seen in figures 1.8 shows that the major population centers of Miami and Dade County are historically in the path of many hurricanes (including a category five, Andrew), have a high population with many neighborhoods including homes built under the old building standards.



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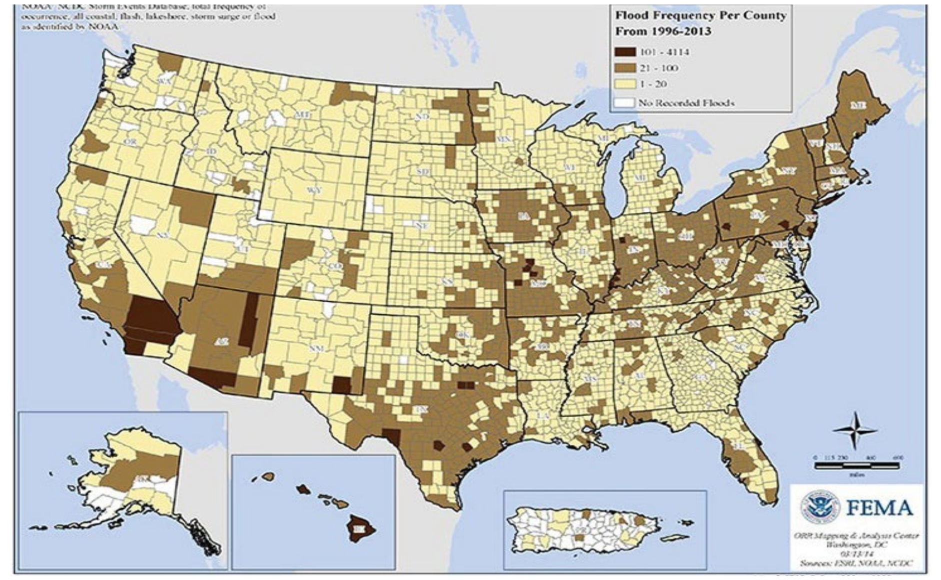

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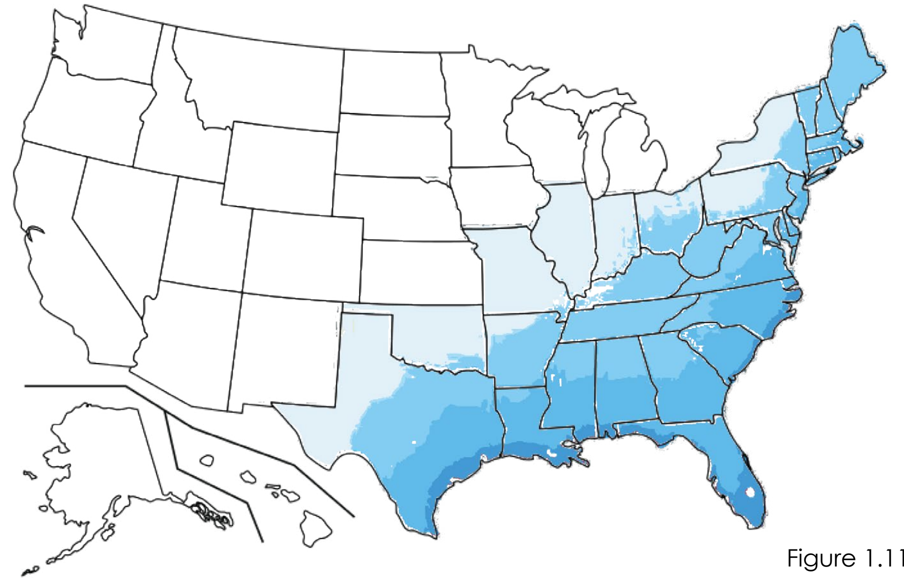


Figure 1.11

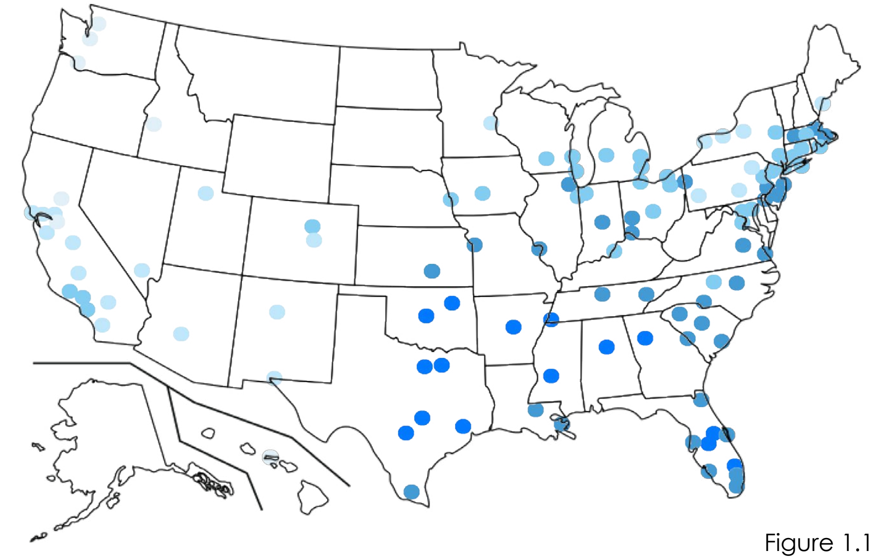


Figure 1.12

The figures (1.9, 1.10, 1.11, 1.12) are useful in this thesis because they show that Florida is the state most affected by the devastation hurricanes bring to the USA. Figure 1.9 shows the hurricane and tropical storm risk and how frequent they are in each county. Figure 1.10 shows the reoccurring flood risk in the US according to county. Figure 1.11 shows how much the hurricanes have cost each state on the south-east coast. Figure 1.12 shows which places in the USA are most at risk for natural disasters. Collectively the diagrams provide solid evidence that Florida is the most appropriate site to study for this thesis over any other state.

LOSS COST

HIGH • • • • • • • • • • • • • • • • LOW

SCALE OF HAZARD

HIGH • • • • • • • • • • • • • • • • LOW

The process of the study as a whole is depicted on the next page going in order of the study.

https://patch.com/florida/miami/4-worst-threats-south-florida-hurricane-irma / Google images

CHAPTER

02

REASONING AND RESEARCH

2.1 RELEVANCE OF HYPOTHESIS: CASE STUDIES OF HOUSE DAMAGES

Readings

The readings that I looked for were based on five things: Housing damage, emotional damage, cost in repairs, what was missed and potential improvements. The readings looked at Hurricane Andrew, which caused the most damage to Miami-Dade county and to the rest of Florida.

I reviewed two articals and two books on hurricanes and what was learned and observed from each one. The articals were: *Building Performance: Hurricane Andrew in Florida: Observations* and *Lasting Effects of Hurricane Andrew on a Working Class Community*. The two books that I read were: *Building Performance Assessment Report: Hurricane Georges In Puerto Rico* and *Building After Katrina: Visions for the Gulf Coast*.

References

1) Lasting Effects of Hurricane Andrew on a Working-Class Community: Nicole Dash; Betty Hearn Morrow; Juanita Mainster; and Lilia Cunningham; Natural Hazards Review: American Society of Civil Engineers (ASCE) February 2007
2) Building Performance Assessment Report: Hurricane Georges In Puerto Rico: Observations, Recommendations, and Technical Guidance: FEMA/March 1999 Federal Emergency Management Agency,
3) Building Performance: Hurricane Andrew in Florida: Observations, Recommendations, and Technical Guidance: FEMA/December 1992 Federal Emergency Management Agency, https://www.fema.gov/media-library-data/20130726-1611-20490-4516/fia_22.txt

HOUSING DAMAGES

For the working class communities that are the focus of this thesis, the housing damage from a major hurricane can be massive. From a 1993 survey of the South Miami Heights, Florida neighborhood following Hurricane Andrew, "The community has been largely destroyed, with 70% of the homes reporting severe damage, and a median estimated repair cost of $40,000-$50,000 (median value home value in 1990 was $66,500)." (Ref 1)

The conclusions of the FEMA Building Performance Assessment Team (BPAT) following Category 5 Hurricane Andrew in 1992 effectively summarize the damage. "The breaching of the building envelope by failure of openings (e.g., doors and windows) due to debris impact was a significant factor in the damage to many buildings. This allowed an uncontrolled buildup of internal air pressure that result in further deterioration of the building's integrity. Failure of manufactured homes and other metal [clad buildings penetrated significant debris. Numerous accessory structures such as light metal porch and poll enclosures, carports, and sheds, were destroyed by the wind and further added to the debris.

The loss of roof material and roof sheathing and the failure of windows and doors exposed interiors of buildings to further damage from the wind and rain. The result was significant damage to building interiors and contents that rendered many buildings uninhabitable.

Field observations concluded that the loss of roof cladding was the most pervasive type of damage to buildings in southern Dade County. To varying degrees, all of the different roof types observed suffered damage due to the failure of the method of attachment and/or material, inadequate design, inadequate workmanship, and missile (debris) impact.

Much of the damage to residential structures also resulted from inadequate design, substandard workmanship, and/or misapplication of various building materials. Inadequate design for load transfer was found to be a major cause of the observed structural failure of buildings. In adequately designed buildings, the load transfer path is clearly defined. Proper connections between critical components allow for the safe transfer of loads that is required for structural stability. "(ref 3, p 2) Additionally: "The wood-frame gable ends of roof structures were found to be especially failure-prone. Wood-frame gable ends are effectively a vertical continuation of windward/leeward wall systems and require bracing from within the roof structure for lateral force resistance. A lack of adequately defined load transfer path for the gable ends was evident." (Ref 3, p 17)

The BPAT for the Category 3 Hurricane Georges in Puerto Rico in 1998 described much of the same damage modes, noting: "A large number of residential buildings in Puerto Rico experienced structural damage from the high winds of Hurricane Georges. This can be attributed to a lack of a continuous load path from the roof structure to the foundation."(Ref 1, p1-1)

EMOTIONAL DAMAGES

For the working class neighborhoods, the predominant feelings after a hurricane are abandonment and hopelessness. From a long-term study of the effects of Hurricane Andrew on a working-class community, residents of the South Miami Heights, Florida neighborhood following Hurricane Andrew reported, "it was two weeks before the military "discovered" their situation, and longer than that before the received any local or state assistance. Even the usual nongovernmental agencies were absent." (Ref 1, p 14) This is reflective of the more recent experiences of Hurricane Katrina in New Orleans and Hurricanes Irma and Maria in Puerto Rico.

"Overall the findings one year after Andrew indicated that recovery had been a slow, difficult, and uneven process with many families, particularly minorities still living in damaged homes… Many small insurance companies were unable to handle the losses, resulting in homeowners receiving inadequate compensation. Further, this community appeared to be a magnet for fraudulent contractors and repair services...Many felt they were in a hopeless situation and things would never get back to normal." (Ref 1 p 14) The long-term (10 years later) follow-up survey conducted with the same respondents as the initial one-year survey tells an even more emotionally devastating story. "About two-thirds had lived in damaged homes for an average of 25 months before repairs were completed. Even more significantly, one-quarter reported that their homes were still not completely restored. Interviewers saw evidence of leaking roofs, open rafters and walls, bare electrical wires and unfinished construction.. ..About 55% reported problems related to their homeowners insurance… Nearly three-fourths of these homeowners reported problems getting repairs complete...Many of the homeowners attempted to do some or all of the work themselves…In many cases, this took a significant physical and economical toll. (Ref 1 p17)

As could be expected, the strain took an emotional toll on individuals and families. In the 10 year after survey, "90% reported major or moderate long-term effects on their families. About 36% indicated that Hurricane Andrew had a lasting effect on their relationship with their partner, and nearly 40% experienced problems with their children's behavior… Husbands and fathers were more likely to be upset by their perceived failure to protect and take care of their families… Mothers had to continue taking care of their families in partially destroyed houses… Getting anything accomplished in a largely destroyed community with many businesses and other institutions gone was time consuming and frustrating...children spent much of their childhood fruitlessly waiting for their lives to return to normal." (Ref 1 p18)

"One interesting phenomenon was that most people divided their lives as before or after Andrew. As a respondent noted: "Nothing was the same after that. We mark time as before or after Andrew." (Ref 1, p14)

RESOURCES TO REPAIR

The long-term (10 years later) follow-up survey after Hurricane Andrew showed , the majority of those affected lived in damaged homes for over two years, some homes were not fully repaired, even after 10 years and over half had problems related to their homeowners insurance. Repairs were incomplete or poorly done due to fraudulent contractors and many resorted to completing the repairs themselves even when not physically able to do so. (Ref 1 p17)

Why was this the case? Where were the resources need to repair the devastation? "Homeowners with insurance do not qualify for most government aid. Yet it is clear that many homes, particularly the less expensive ones are not insured adequately" (Ref 1, p 20) Following Andrew, there were slow/inadequate insurance payouts, particularly among minority residents who were less likely to have been insured by major companies. Many of the smaller companies were overwhelmed by the losses and could not provide adequate payouts to their customers. (Ref 1 p14) Fraud was also a major contributor, particularly among less educated residents who were dealing with large government bureaucracies or insurance companies for the first time. (Ref 1, p 17)

WHAT WAS MISSED

Repairs were done under older or no building codes, either by contractors who were in some cases fraudulent or by the residents themselves. (Ref 1, p While Florida building codes have been extensively upgraded, they apply to new structures. This leaves large numbers of existing structures with potentially fatal structural deficiencies standing in existing neighborhoods. As the 10 year follow-up survey after Andrew noted, in the reference South Miami Heights neighborhood, only 45% of the home owners have bought shutters for their homes (ref 1, p 20)

Based on the housing failure modes and the conclusions of FEMA Building Performance Assessment Teams after severe hurricanes (ref 2&3) the following elements are missing:

- Adequate building codes
- Adequate building code enforcement
- Adequate fraud deterrence mechanisms following disasters
- Sufficient capitalization for insurance companies in areas subject to periodic natural disasters
- Method to assess and mitigate the risk to older structures ahead of natural disasters
- Adequate contractor licensing and building inspection

POTENTIAL IMPROVEMENTS

The South and East Coasts of the United States will continue to experience Hurricanes, with a high potential that category 4-5 storms will increase in frequency. Based on the inadequacies in construction and building code compliance noted by the BPAT for both Hurricanes Georges and Andrew (Ref 2&3), the governmental infrastructure to prepare for and respond to these storms needs improvement. Potential improvements could include items called out in the BPAT report for Hurricane Andrew (Ref 3, p 41-), including:

- Improvements in construction quality and standards
- Improved Inspect standards
- Improved training and qualifications for building Inspectors

Additional potential improvements:

- Inventory of standing residential structures and their hurricane readiness (hurricane strapping on rafters, storm shutters etc.)
- Incentives to retrofit hurricane survival improvements on existing structures
- Better disaster response and recovery readiness could include county-by-county civil defense teams able to rapidly assess local damage and population needs.
- County by county long term recovery teams that can pursue local fraud cases and provide recovery counseling to residents
- Improved insurance standards to mitigate under insurance and insolvency
- Neighborhood based rebuilding planning services

1940's-50's

Hurricanes led to the South Florida Building Code in Dade and Broward Counties.

1960's

Hurricanes and 1970's booming growth led to the state mandate for local adoption and enforcement of the State Minimum Building Code.

1970's-80's

Hurricanes and coastal environmental concerns led to the hurricane protection specific "Coastal Building Code".

1990's

Hurricane Andrew (1992) led to first statewide wind engineering code and the consensus exercise that authorized the Florida Building Code, the first State controlled code.

2000-2017

The State developed Florida Building Code pre-empted local codes.

2.2 HISTORICAL ANALYSIS OF THE FLORIDA BUILDING CODES

In 1940-50's there were not that many building codes present thus there is very little information on them.

In 1960 building codes were a local option and many didn't make specific building codes. However we could start to see more counties adopting the building code since 1940-50's were they were almost non-exisitaint.

Building codes in 1970-80's became more popular. In 1974 Florida law required local adoption, amendment and enforcement of State selected model codes (State Minimum Building Code). Two main codes were adopted and enforced locally, the South Florida Codes (Dade and Broward counties) and Standard Codes (everywhere else)

- Coastal beach and dune systems were damaged by construction practices
- Rapid development of coastal land increased risks to the public and local, state and federal governments
- The first engineering design based codes were applied to the coastal rim requiring elevated and wind resistant buildings
- The State began development of a "deemed to comply" prescriptive standard based on the engineering standard

Codes such as the South Florida Building Code were developed empirically and were appropriate to the construction practices they were based on. However, they are reactive and only adjusted for new construction methods after hurricanes revealed failures.

In 1992 Hurricane Andrew hit and it was the first major test of the locally managed building code system and non-indigenous construction of th 1970'-80's boom. But what happened was the code failed. The sate of Florida responded to Andrew by a move to Take Over Building Codes from Local Control. Miami-Dade's and Florida's Response to Andrew was to:

- Improved Roof System Requirements 1993
- Major structural and building component upgrades 1994
- Engineered design using ASCE 7-1988 requirements, which made new building product to wind testing standards. Creating the First Wind Engineering Based Design requirements in Florida building codes outside Dade and Broward.
- New law requiring Licensing/Certification of Local Government Building Code Enforcement Officials
- Florida Board of Building Codes and Standards Adopts the "Deemed to Comply" Standard initiated in 1986.

Impact of Post-1993 Florida Codes (what was resolved)

- Overall –Most Catastrophic Structural Failures of Buildings Due to Wind Pressure Were Resolved
- Gable end failures were resolved with bracing criteria
- Wood frame wall racking failures were resolved by bracing with a complete layer of plywood sub-sheathing
- Pulling apart at roof-to-wall, wall-to-wall and wall-to-foundation intersections were resolved by metal connector requirements for wood walls and reinforced concrete column and beam requirements for concrete block walls to create a "continuous load path".
- Roof deck detachment failures were resolved by enhanced nailing requirements. Lessons for Post 1993 and Pre-Florida Building Code Houses

(What still was failing)

- Building components and claddings continued(vinyl siding) to fail
- Roof coverings – Asphalt Shingle and Roof Tiles
- Exterior Insulation and Finish Systems – EIFS
- Windows, Entry Doors and Garage Doors
- Aluminum screen enclosures and structures continued to fail

Lessons for 2001 Florida Building Code Houses

- No Catastrophic Structural Failures
- Windows and Doors Resisted Wind Pressures Better
- Garage Doors Resisted Wind Pressures Better
- Window Protection Reduced Wind-Borne Debris Damage
- Shingle Roof Covering Performed Better
- Metal Roof Coverings Performed Well
- Overall, the Building Structure Performed Well in High Winds and
- Components and Cladding Wind Resistance Were Improved

HOWEVER (Lessons for 2001 Florida Building Code Houses)

- Roof Tile Detachment at Hips, Ridges and Eaves
- Extensive Soffit Damage
- Better Aluminum Screen but Still Failures
- Wind-Borne Debris & Water Intrusion still an issue:

  At the interface of first story masonry and second story wood walls, attic vents, interface of windows and doors to walls

2002, Florida Building Code Improvements:

- Higher wind designed buildings in South Florida and most coastal areas
- Wind-borne debris protection of windows in all coastal areas
- Improved roof covering systems requirements
- Product approval system ensuring products comply with codes
- Improved window performance labeling requirements to improve enforcement

Florida Building Code Improvements 2004-2007

- Improved requirements for wood to masonry wall interfaces
- Allow unvented attics under certain conditions
- Improved requirements for roof tile attachment
- Adopt standard that rates asphalt shingles based on wind speed
- Require improving roof deck nailing when reroofing
- Adopt wind pressure criteria for soffits
- Labeling of windows, garage doors and shutters for wind pressure are required
- Eliminate partially enclosed design option
- Amend panhandle wind-borne debris requirement

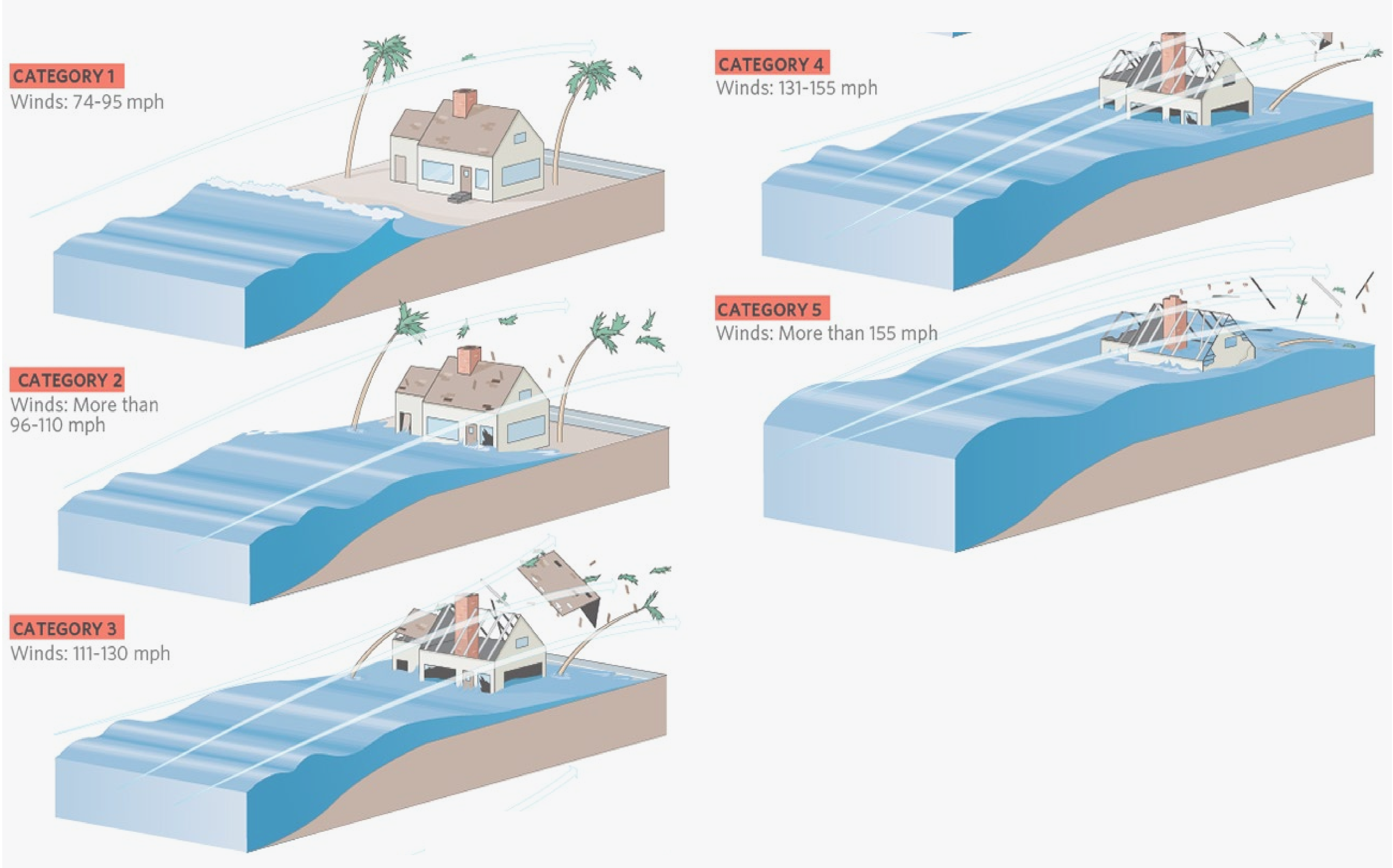


Figure 2.1

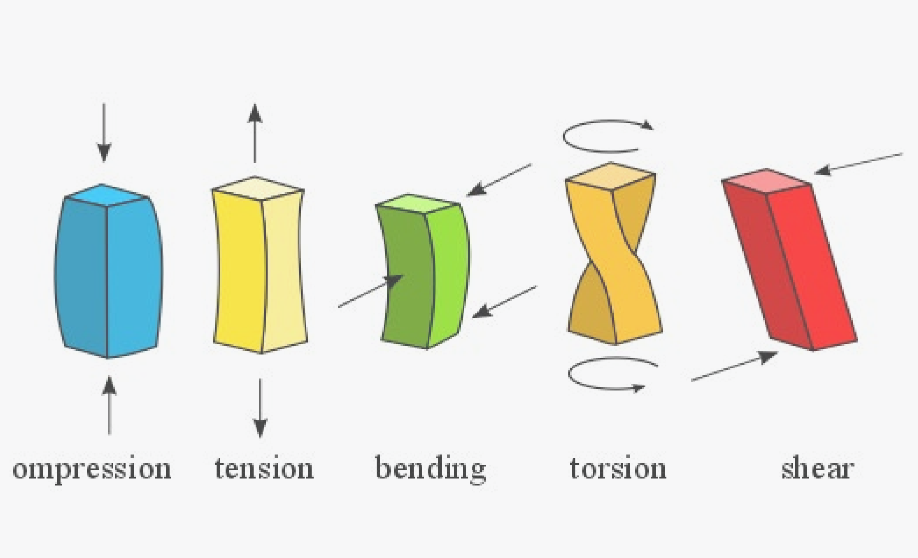
2.3 PRINCIPLES OF THE HOUSE AND HURRICANE'S EFFECTS ON THE HOUSE

Figure 2.1 above shows typical failure modes of a house as the severity of the hurricane increases from one to five. In category one, the roof and openings remain intact and flooding does not enter the home. Some damage is visible in category 2 and in category 3, the integrity of the roof and openings is lost, allowing water inside the structure. Rain soaks the interior from above and once the flood waters have entered the structure, the damage proceeds upward floor by floor until the destruction is complete. Any technique to improve survivability must be focused on these failure modes. If the openings and roof remain intact, the structure has a reasonable chance of survival.

From the codes discussed above we can identify certain techniques that help houses be more hurricane resistant. There are five main factors that can be defined to help protect or improve already existing houses. The forces acting on the structure determine what techniques are most affective. The techniques include but are not limited to: conservation, shape, material and joints.

From: Dictionary.com

2.3.1 FORCES



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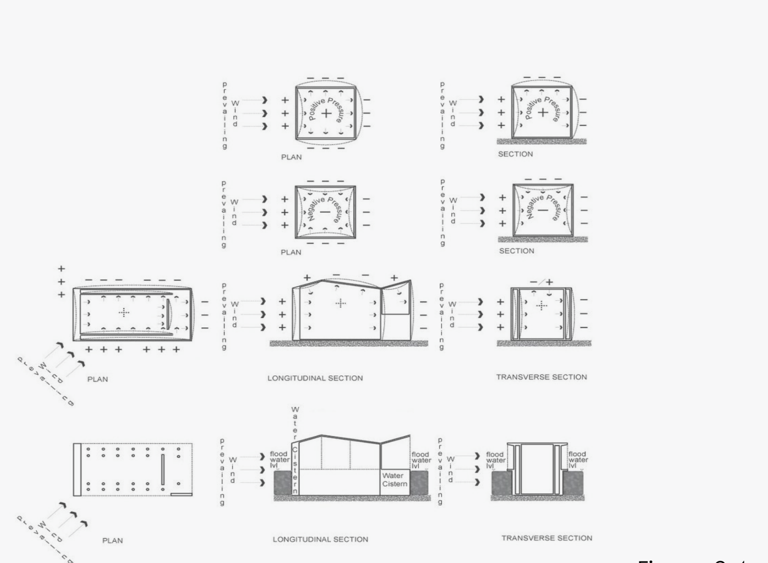
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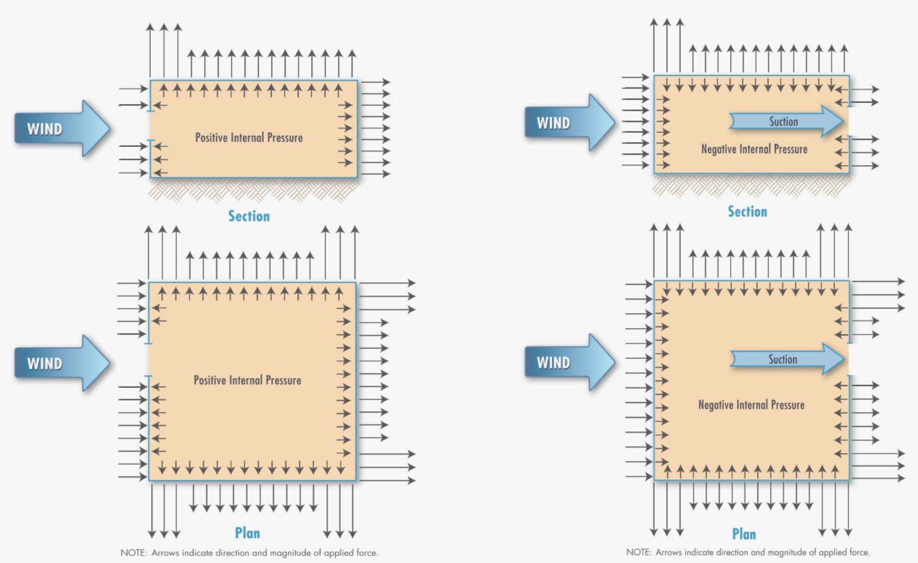

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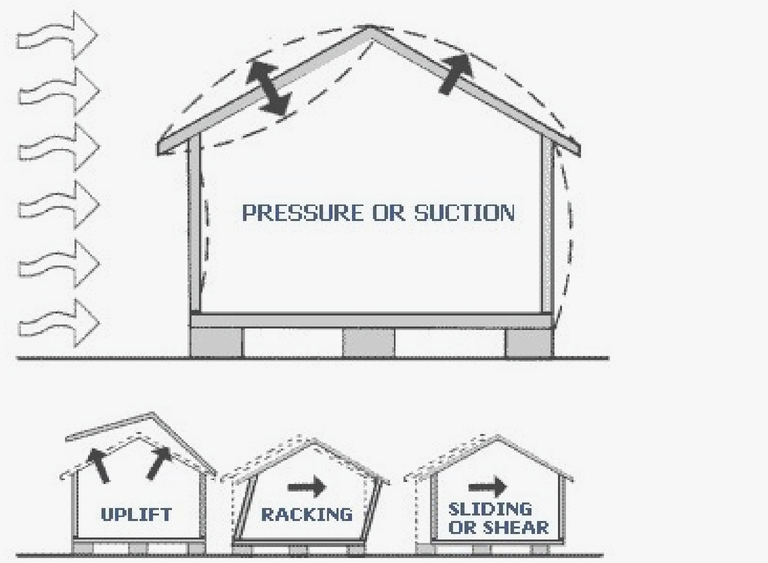


Figure 2.5

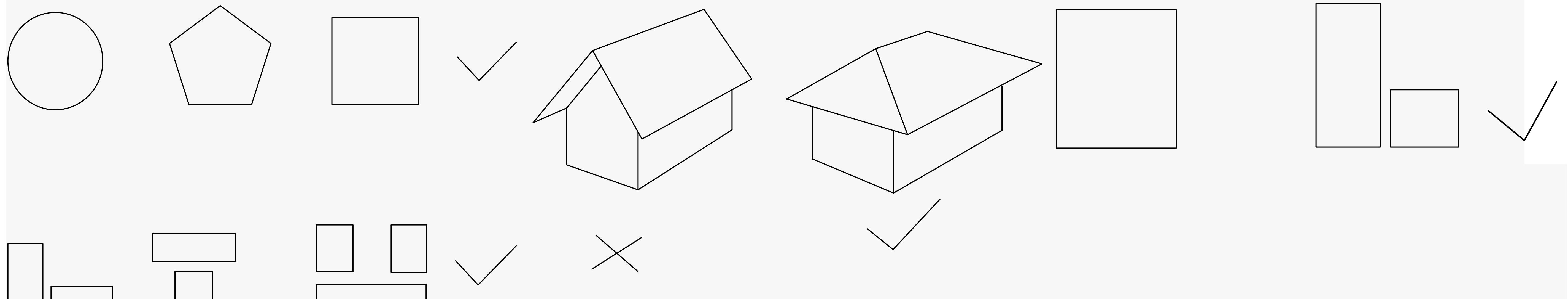
Forces are a strength or energy as an attribute of physical action or movement. The main forces that are seen in hurricanes as shown in Figure 2.2 are:

- Compression
- Tension
- Bending
- Torsion
- Shearing

The other figures 2.3-2.5 show how each force reacts with the structure in both elevation and plan. As shown above, the movement of wind against, across or through the structure is the primary agent for inducing forces against the structure. Bending, shearing, compressive and tensile forces are generated by wind blowing against the structure of flowing over it creating low pressure zones on the leeward sides.

This is important to note so that we know that we are developing techniques to counter the forces that can lead to structural failure.

https://www.sbafla.com/method/portals/methodology/windstormmitigation-committee/2009/20090917_dixonflbldgcode.pdf
-http://www.floridabuilding.org/fbc/information/building_commission.htm
-https://www.businessinsurance.com/article/20120819/NEWS06/308199985
-http://www.floridahousing.org/docs/default-source/aboutflorida/august2017/august2017/tab4.pdf



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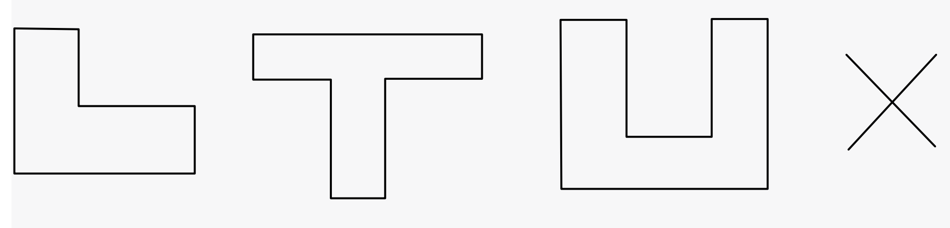


Figure2.6

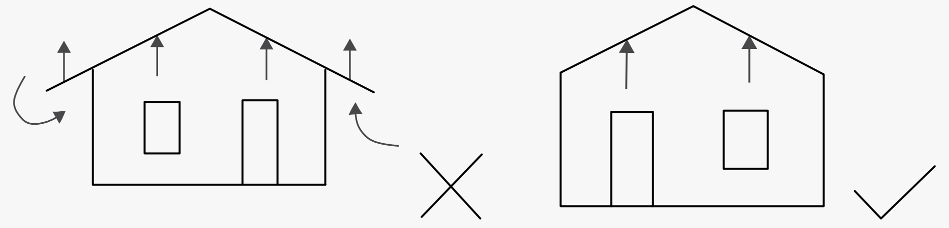


Figure 2.8

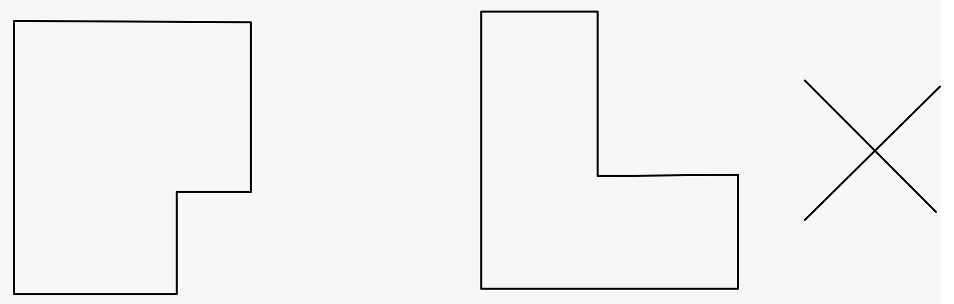


Figure 2.9

2.3.2 SHAPE

Shapes are the external form or appearance characteristic of a house. The source material allowed me to examine the roof shape, the over all building shape which led to the diagrams above describing what is and what is not a good design for the shape of a residential house to withstand the hurricane winds. In general, minimizing the surface area that is normal to the wind flow this minimizes the forces the wind can apply in the structure.

Examining Figure 2.6, at the top, the circle presents the smallest area normal to the wind-flow regardless of the direction of the wind, making it the best design, the pentagon approximates the circle, but still presents substantial flat surfaces in five directions and the square presents large flat face, making it the worst choice. The figures at the bottom in Figure 2.6 have closed corners that do not allow an outlet for wind or water thus it gets "trapped in the corner" allowing forces to build up causing damage to the house.

In Figure 2.7, the wind pushes against the gable, forcing it inward, while wind flows freely over the hip roof.

In Figure 2.8 the overhangs apply lift forces that take the roof off which allows water in the home causing issues.

Figure 2.9 illustrates the important principle of continuous connection between roof and foundation. The top images lines don't extend all the way up making for a poor design while the bottom image have the continual lines.

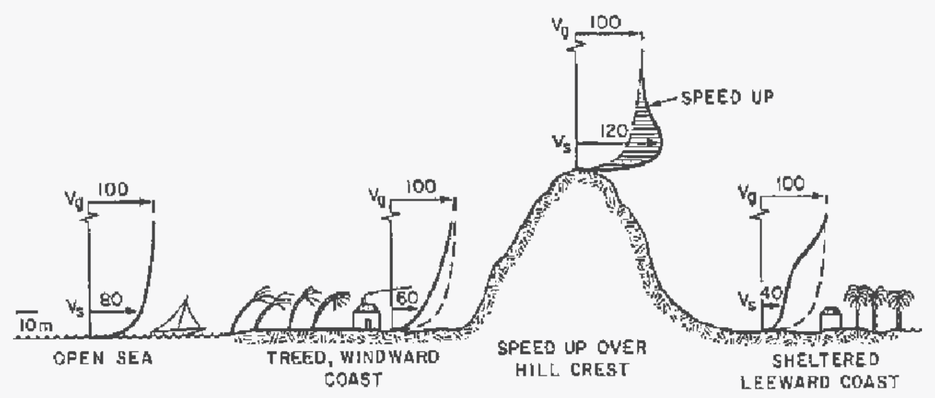


Figure 2.10

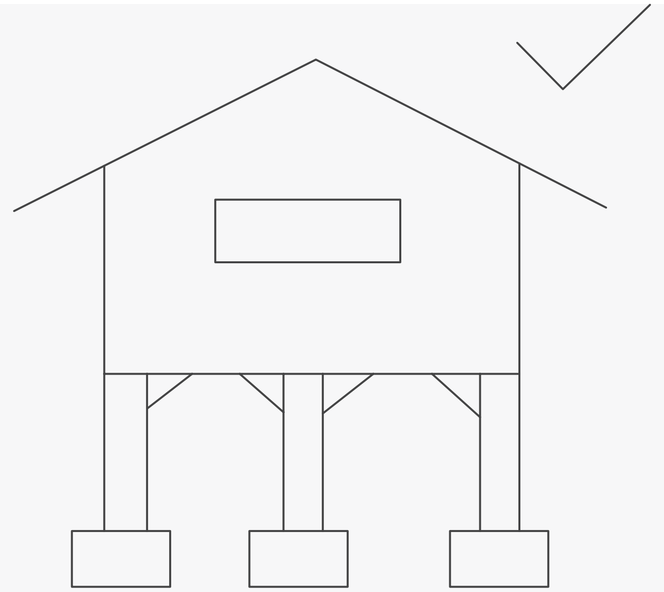


Figure 2.12

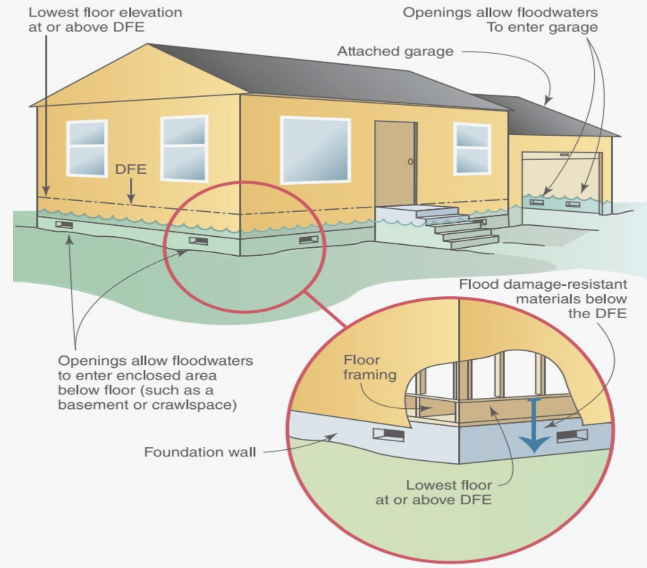


Figure 2.14

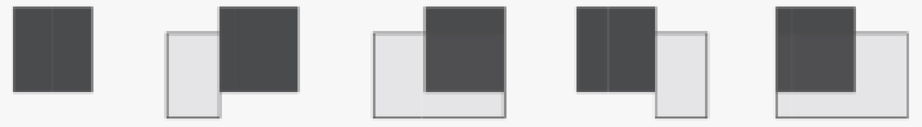


Figure 2.11

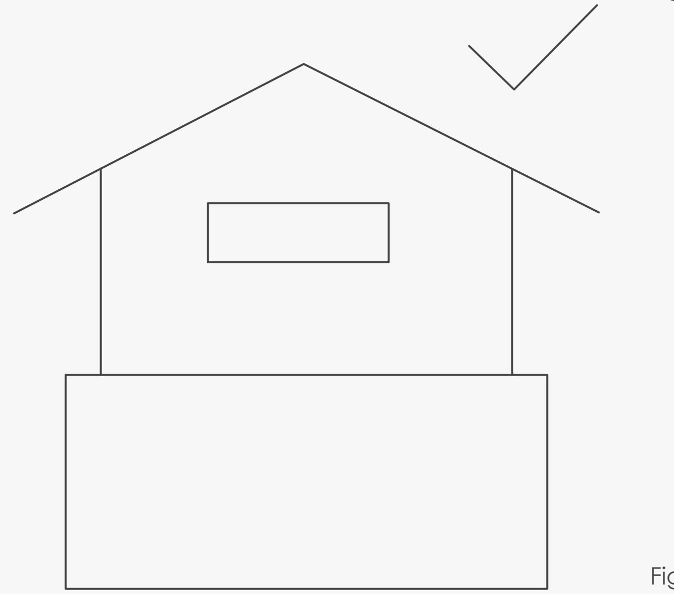


Figure 2.13

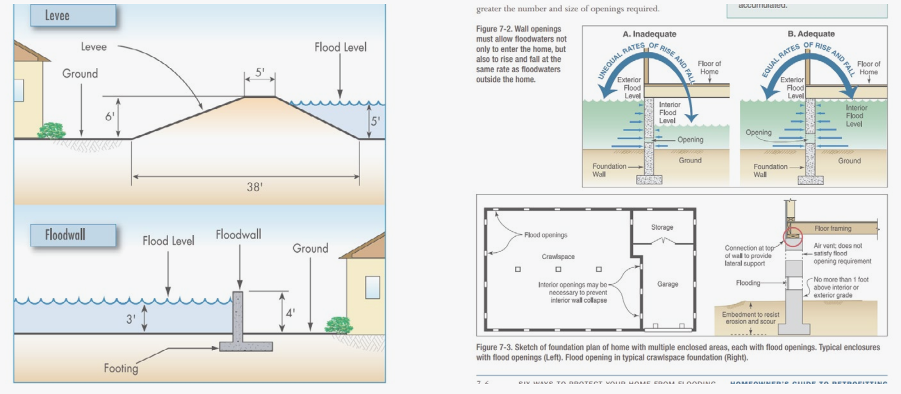


Figure 2.15

2.3.3 CONSERVATION

Conservation is defined as the action of preserving something, in this case the house. The main conservations that are used in Florida are:

- Lifting the house to move it above the flood (figure 2.13)
- Puncturing the foundation of the house to allow water to flow under the house.(figure 2.14)
- Making barricades to hold the water back from the house this could be done in a small way with a wall or on a bigger scale by using hills or mountains by redesigning the lay of the land. (figures 2.15 &2.10)
- Lastly, a break away method could be used where the main part of the house is built with concrete and the rest is allowed to break away and be easily replaced (figure 2.11)

All of these conservation techniques limit the extent of flooding, even after the failure of the openings or roof. This limits submersion of the house interior, but does not limit the damage from the intense hurricane rain soaking the interior. Recovery of the structure would be easier than without the conservation if the structure could be left attached to its foundation by the use of conservation.

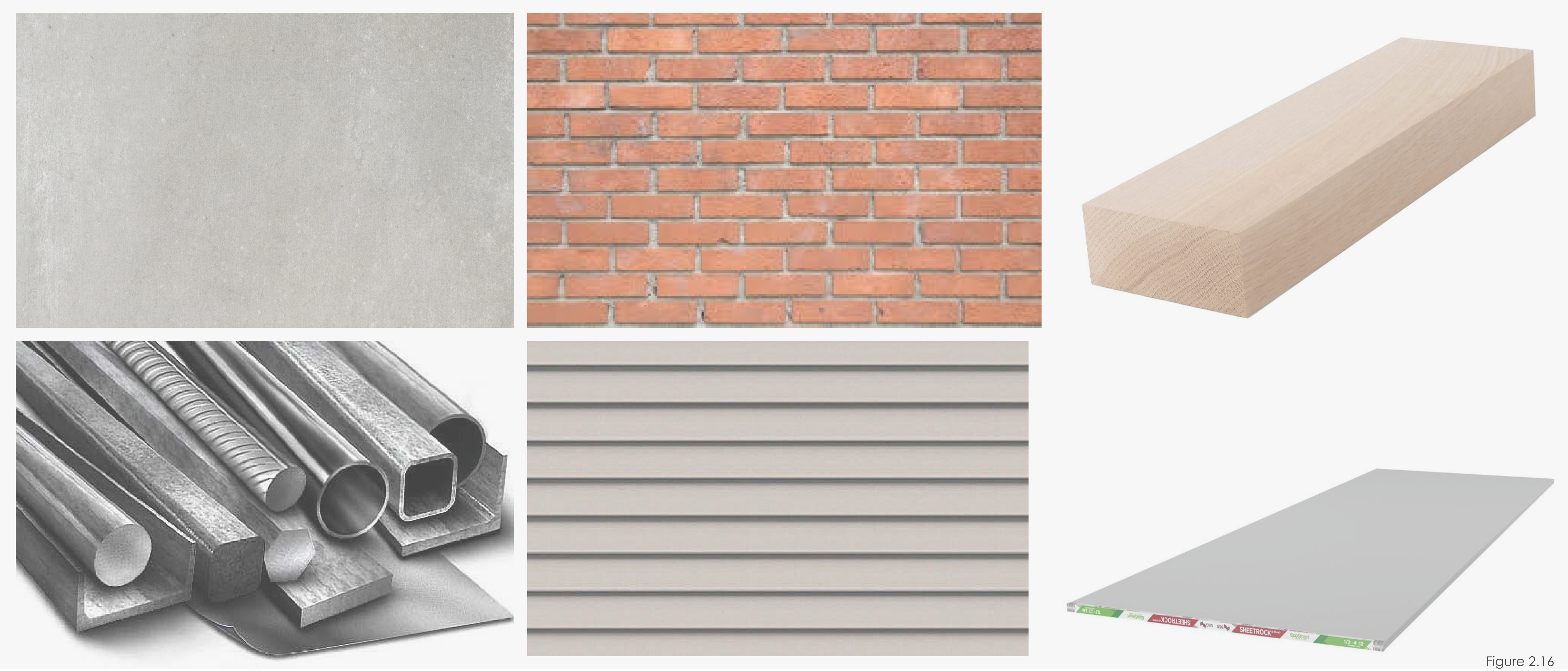


Figure 2.16

2.3.4 MATERIALS

Materials are the matter from which a thing is or can be made. All materials have characteristic bending, compressive and tensile strengths.

In figure 2.16, each material makes up part of the houses in Florida. The concrete and metal on the far left are the most resistant to wind and water, followed by the brick. The lap siding exterior below the brick is the least resistant exterior covering and the wood and gypsum wall board on the bottom are generally the least resistant interior materials. Gypsum dry wall is generally destroyed in even minor flooding. This is why it is important to maintain the out side materials so it will protect the weaker interior material.

By mixing certain stronger materials with the weaker materials, such as bracing the wood with metal strapping, the structural integrity from the lateral forces being applied to the house during a hurricane can be resisted or allowed to bend more freely. Florida has started to adopt this technique since 2000 and on however they have failed to try mixing other materials together to see if any other combination could be useful to the effort of strengthening the house.

2.3.5 JOINTS

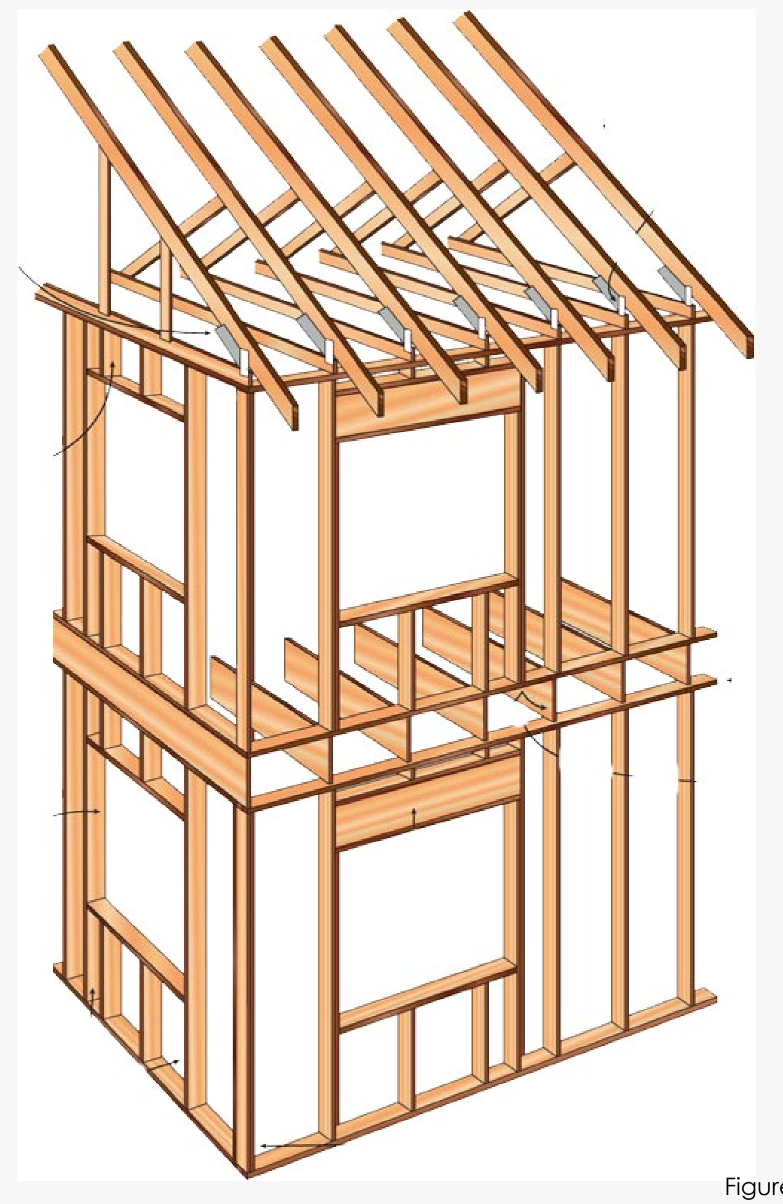


Figure 2.17

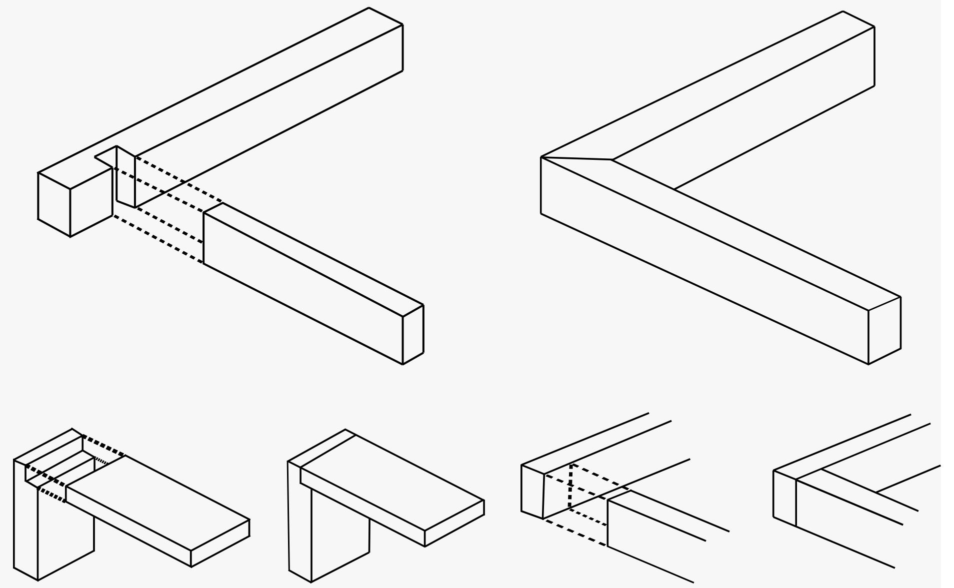


Figure 2.18

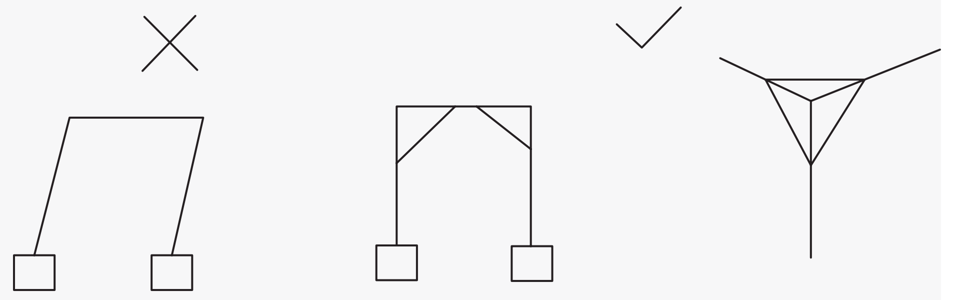


Figure 2.19

Joints are the point at which parts of an artificial structure are joined. The strength of these joints determines the amount of compression, bending, tension, torsion and shear forces a structure can withstand without joint failure.

As can be seen, in Figure 2.17, roof detachment would require joint failures at the roof attachment points that can be countered by metal strapping or plates reinforcing the joints. Corner and floor to wall joints also present opportunities for failure.

Figure 2.18 shows the variations in corner joints from simple butt joints to stronger notched joints. Butt joints tend to be weak because the peaces are only reallying on nails and metal strapping to hold the two pieces in place.

Where as the lap joint is more secure because its the actual material holding each other together then the extra support such as the nails and strapping are put on. The idea of the lap joint as show latter in the book in the Pagoda precedents demonstrates how strong and useful the lap joint can be in keeping houses stable against high winds/lateral forces.

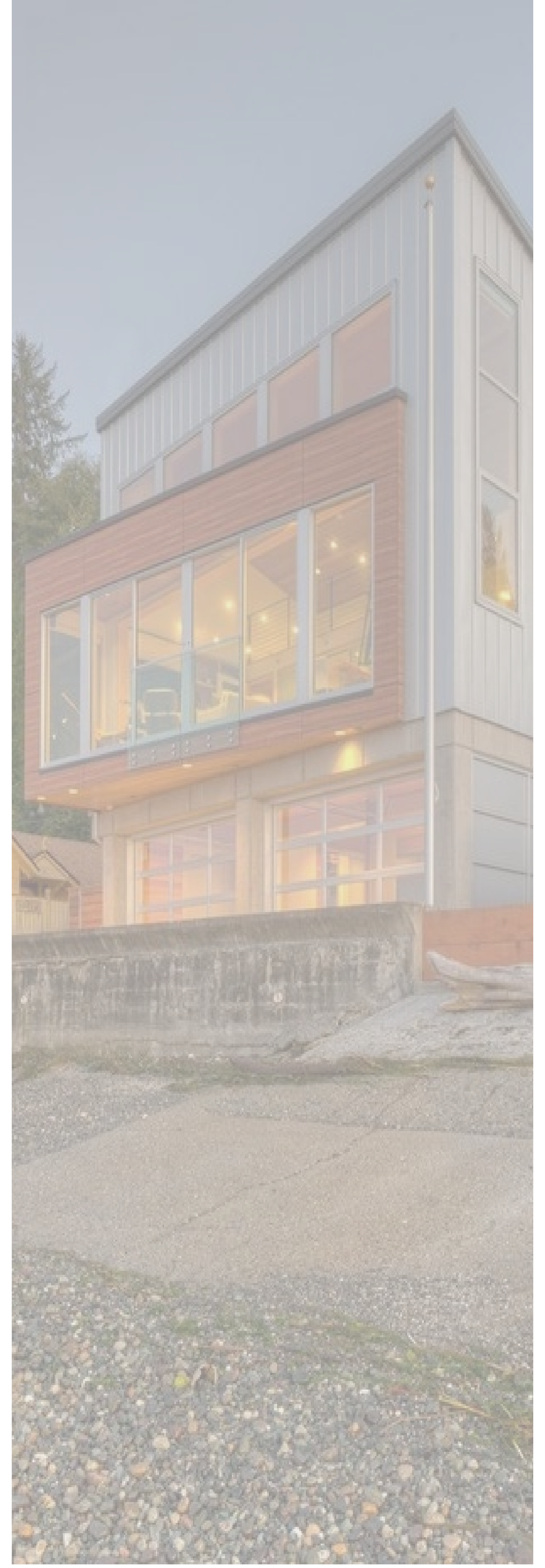
Figure 2.19 shows the use of diagonal bracing to counter the lateral racking forces due to wind.

CHAPTER

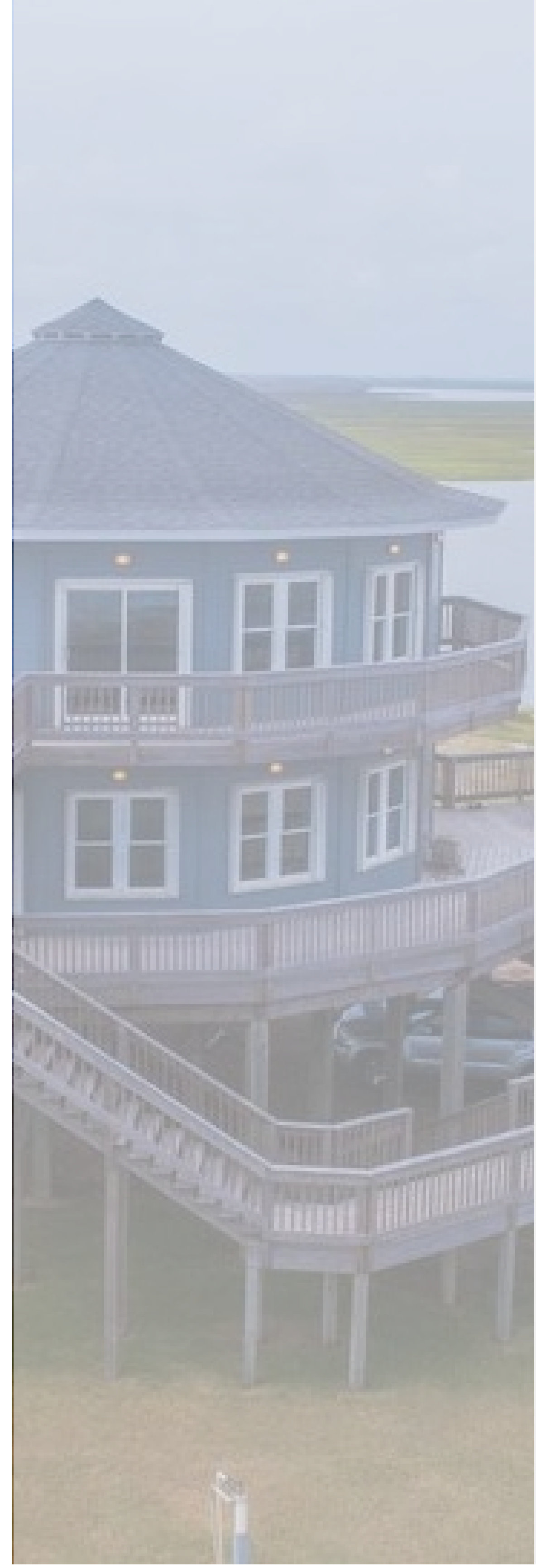
03

PRECEDENT

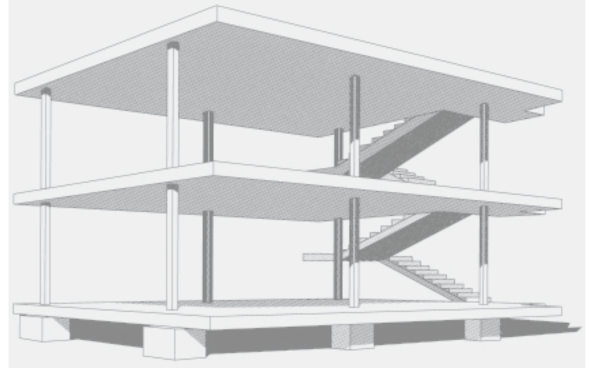
TSUNAMI



DELTEC

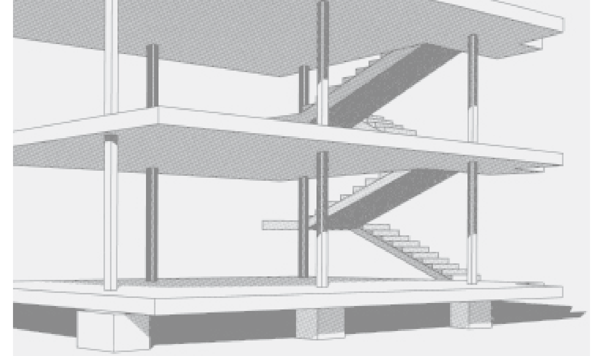


D O M I N O STRUCUTRE



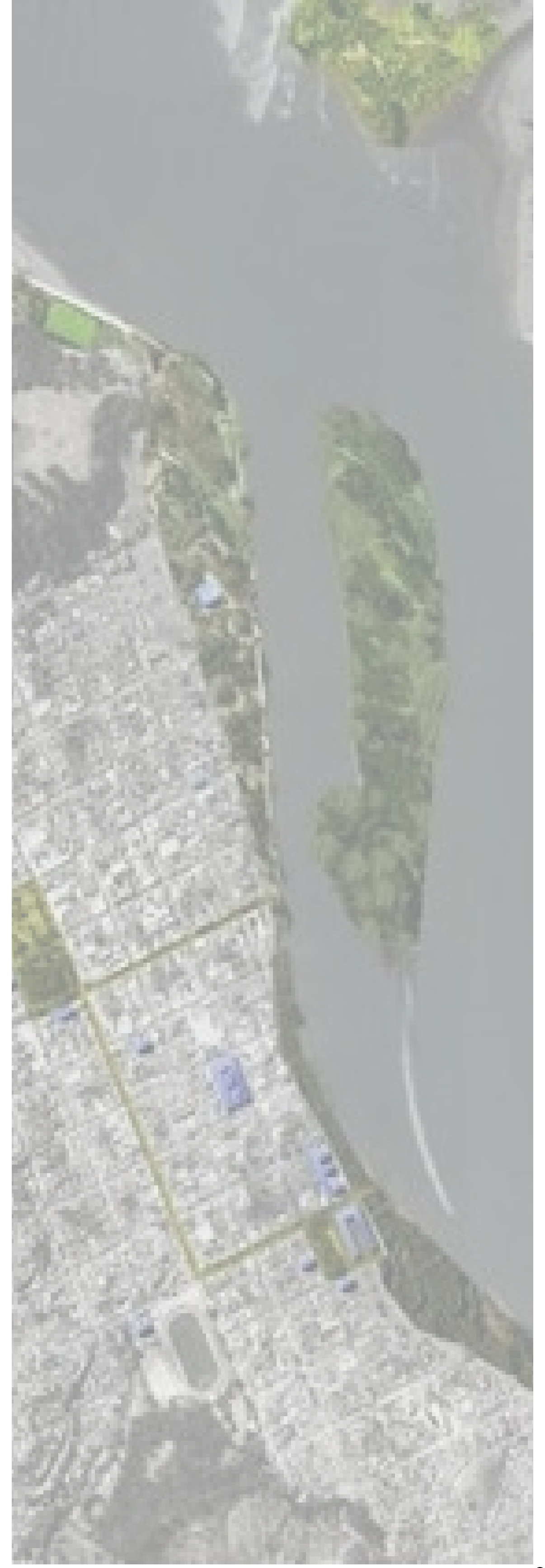
U M B R E L L A HOUSE

DELTA HOUSE



SEA SIDE

ELEMENTS



3.8 PRECEDENTS ANALYSIS

3.1 CALEARTH HOUSES

Figure 3.1

Figure 3.2

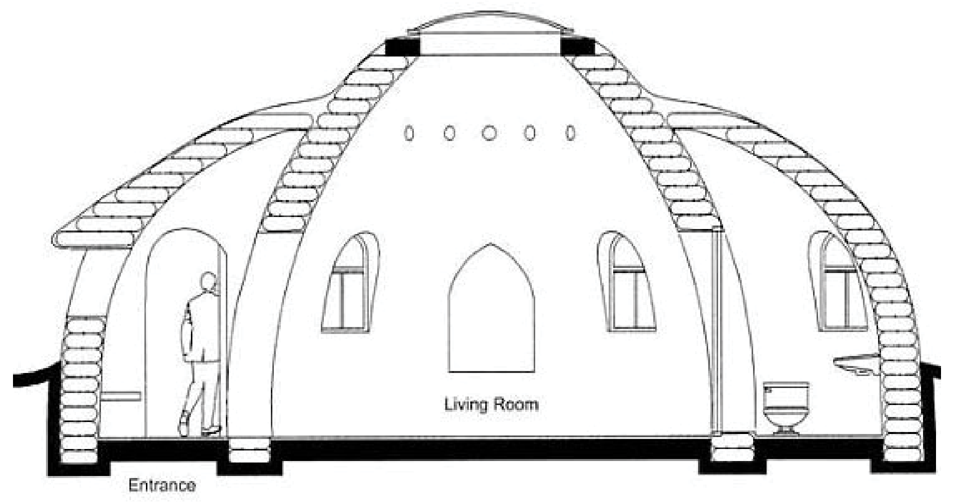


Figure 3.3

The Calearth houses were developed by Nader Khiill. The houses have been erected in various different sites. The house's structure is not meant to be a permanent structure, but the structure can be converted into one if desired. The materials used to built this house were localy found as well as inexpensive ones.

The form of the house is a rounded dome that employs the timeless forms of arches, domes and vaults to create single and double-curvature shell structures that are both strong and aesthetically pleasing. The form of the structure is aerodynamic because of its round shape which makes the house resistant against hurricane winds up to 180 mph winds.

The materials that are used are: sand bags, PVC pipe, clay/concrete, barbed wire and earth. The houses structure has additions of barbed wire in the walls. The wire helps the compression of the structure which allows the house to be earthquake resistance. While these load-bearing or compression forms refer to the ancient mud-brick architecture of the Middle East, the use of barbed wire as a tensile element alludes to the portable tensile structures of nomadic cultures. The result is an extremely safe structure.

Sand bags are used in the walls as well to aid in resisting flood waters from penetrating the house. The earth is then placed over the wire and sand bags to provide insulation and fireproofing to the house.

From:http://www.earthbagbuilding.com/projects/sandbagshelters.htm

3.1 CALEARTH HOUSE ANALYSIS

FORM

The rounded form of the CalEarth house provides few corners o flat surfaces for wind to apply force to the structure. The four exterior semi-circles provide protection for the central dome.

CONSERVATION

The principle conservation feature of the CalEarth house is the soil berm around the bottom of the structure. This drains water away and anchors the structure more firmly to the ground.

FORCES

The principle forces on the structure are the downward compression due to the weight of the structure, firmly fixing it in place. Wind flows over and around the domed shape without a significant flat surface to apply force against. The only vulnerability to forces due to wind and water are the openings for the entrance way which exposes a section of the inner dome wall.

MATERIAL

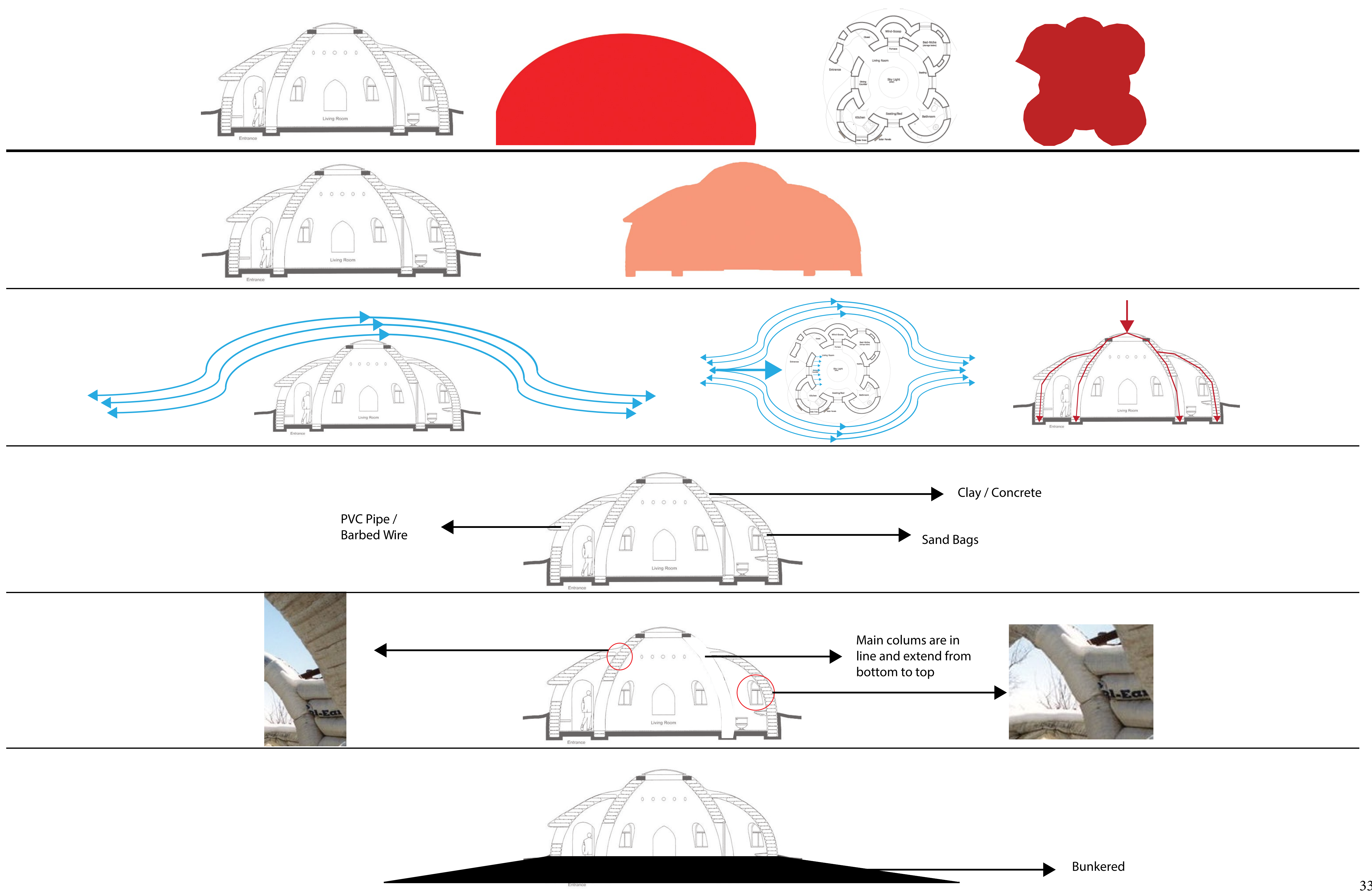
The sand or soil bags are the same basic material as used in the sand bags used to build temporary levees to combat flooding. Combined with the connecting barb wire and PVC piping, the materials are simple and not subject to generating debris or collapsing due to the wind or flooding. This makes the structure very survivable.

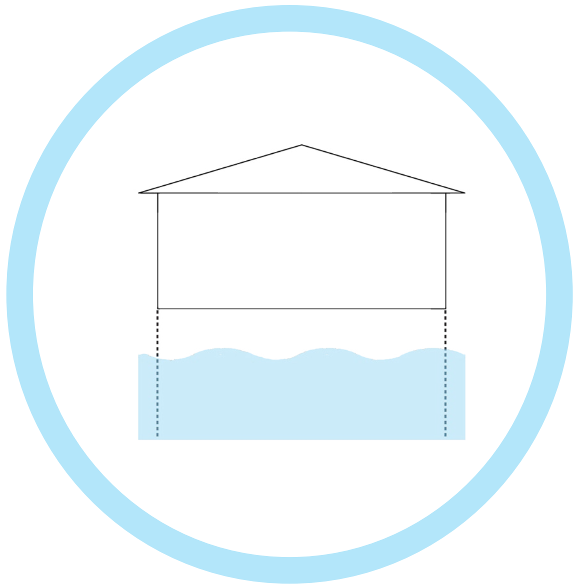
JOINTS

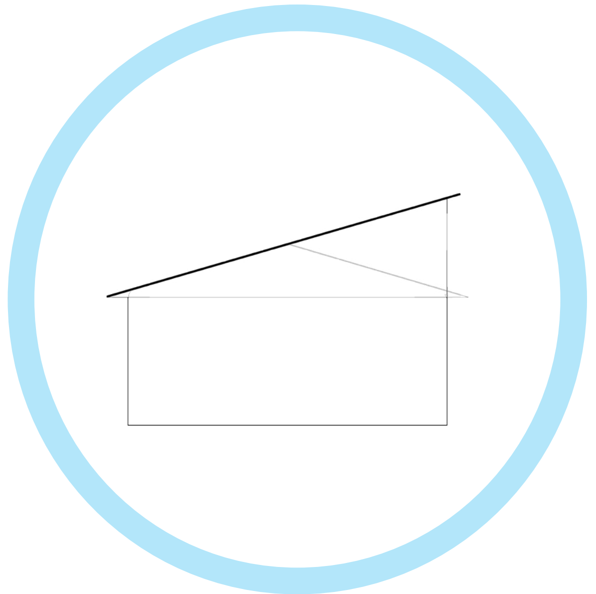
The sand or soil bags are overlapped and anchored together with barbwire to create a joint system between the bags that will not slide. Separation is unlikely due to the shear weight of the bags. Additionally, the bags are used to form main columns that are incline and extend from the top to the bottom of the structure, providing lateral stability.

SITE

The site is used to bunker the house. This provides direction of water falling on the domes away from the house. In addition, the lower areas between houses provide a means of channeling the water away from the community.







3.3 TSUNAMI HOUSES

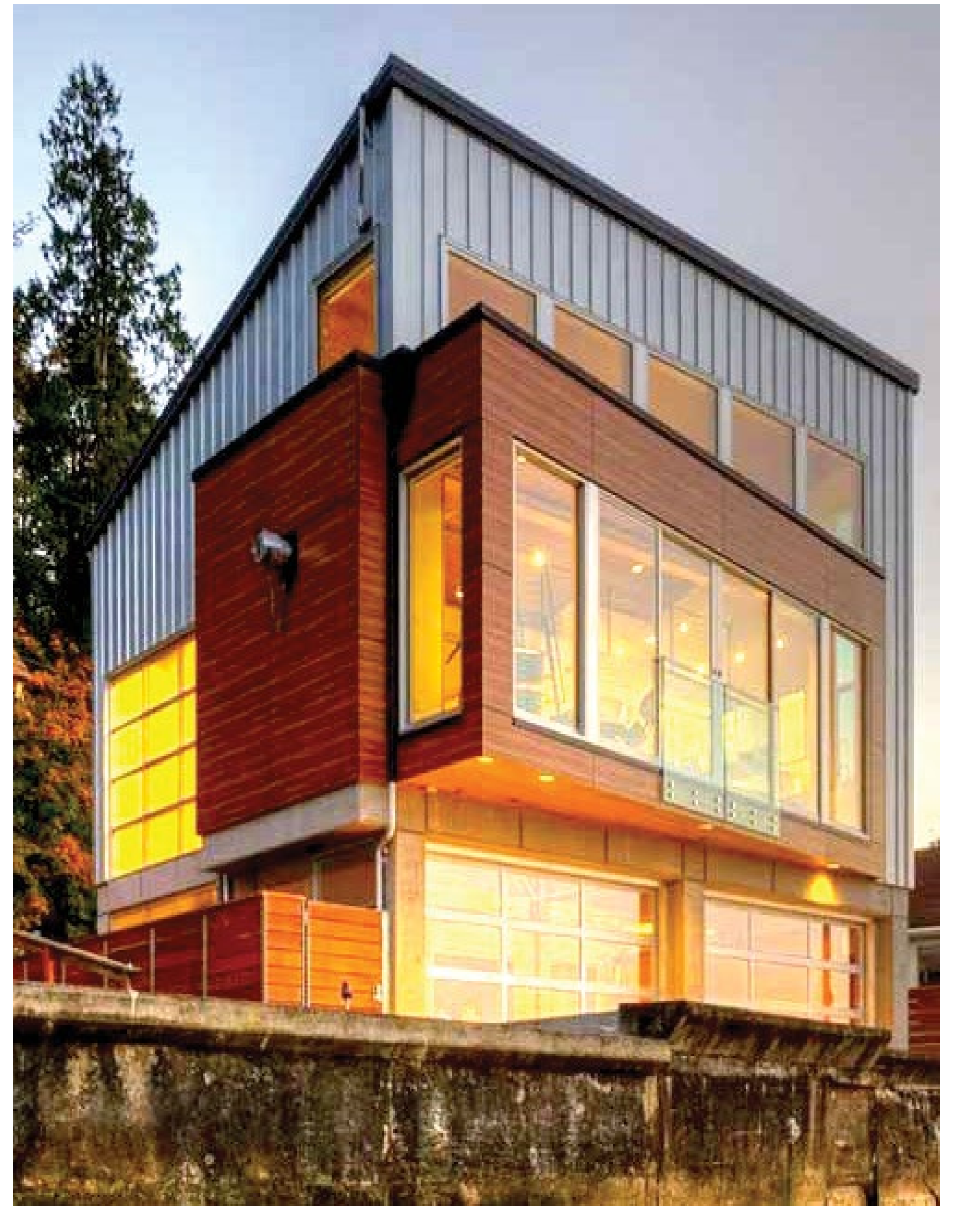
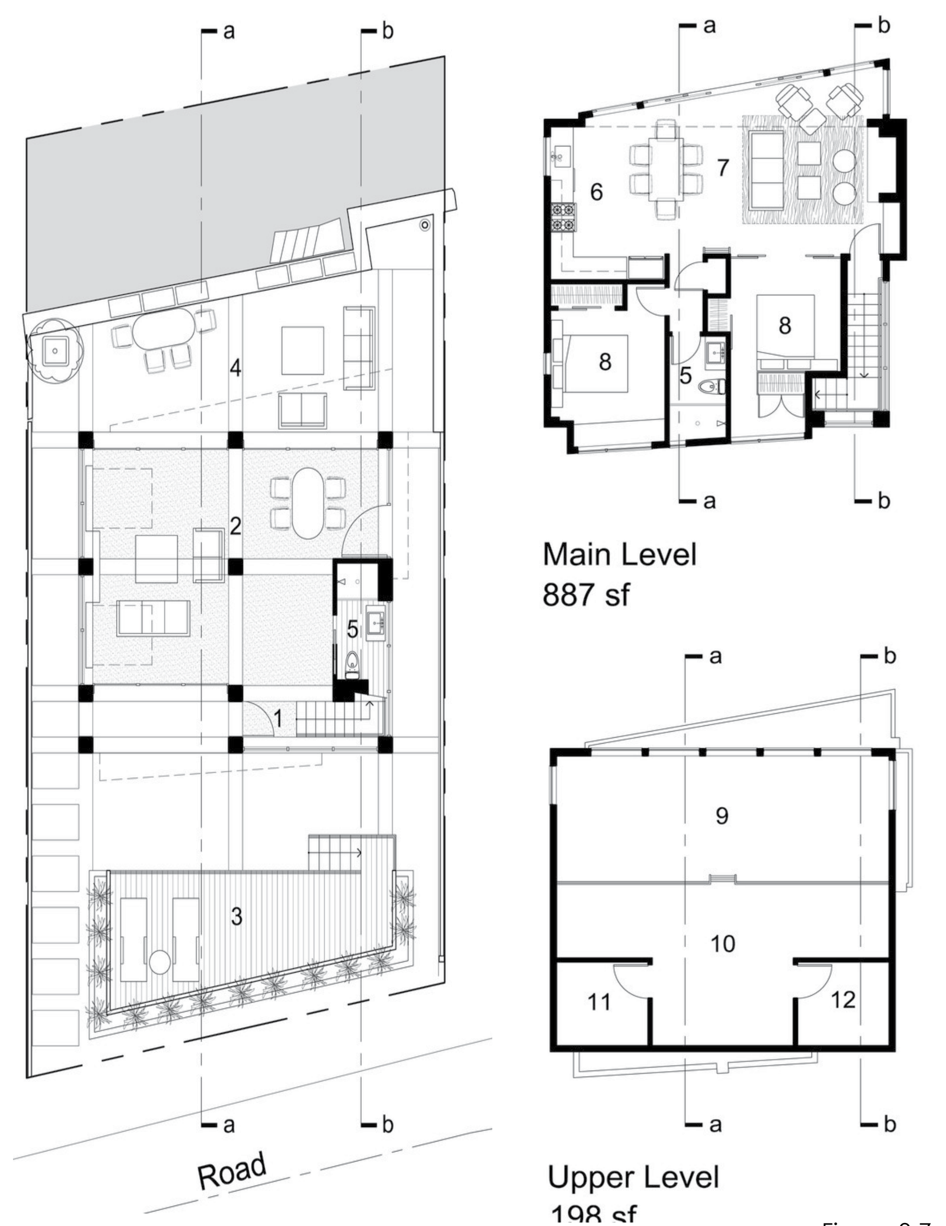


Figure 3.4

Figure 3.5

Figure 3.6



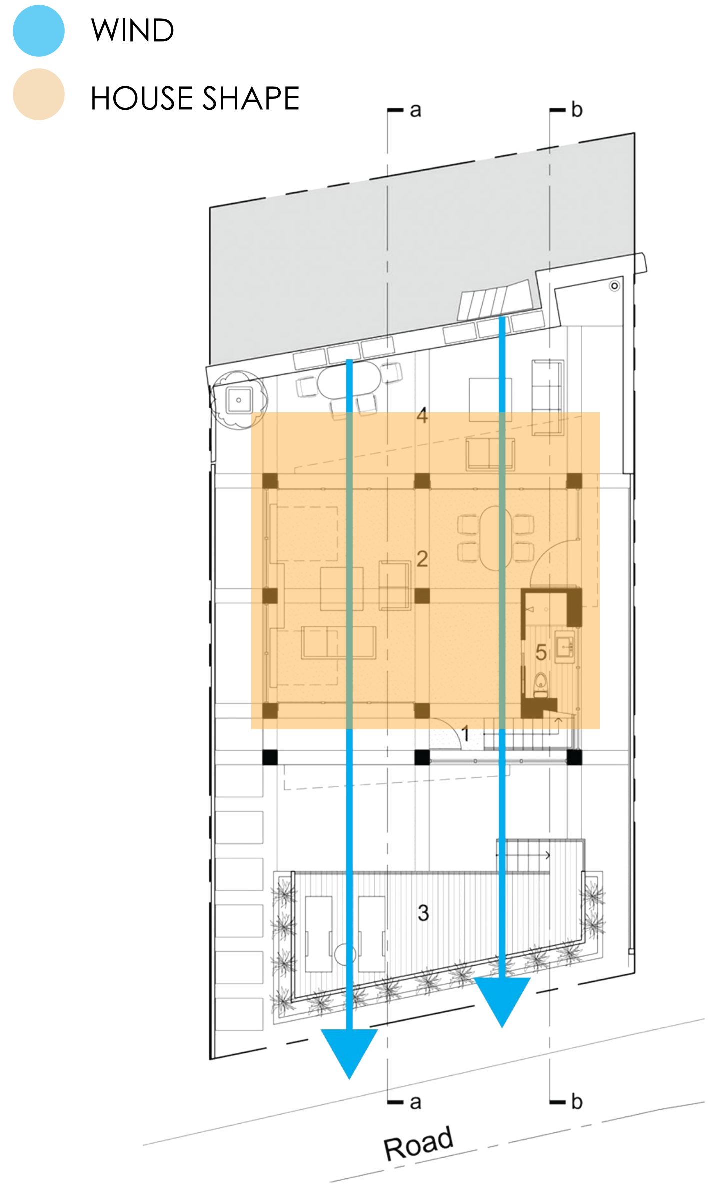


Figure 3.7

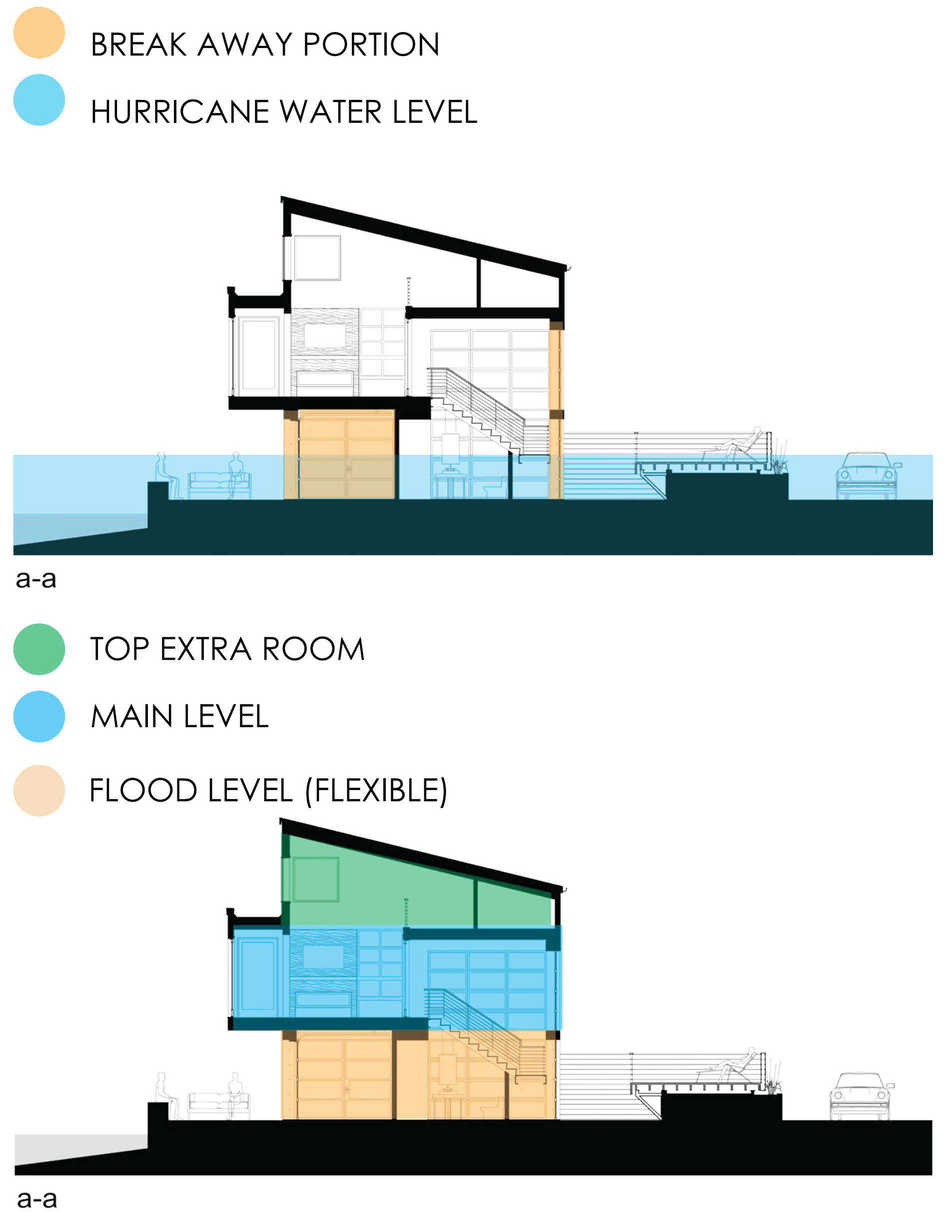


Figure 3.8

The Tsunami house was built by Designs Northwest Architects, with the head designer Dan Nelson and Tom Rochon. The house is located in the United States. The house is layed out and uses materials that allow water to pass through the house.

The main level had to be located 5' above grade so it was able to withstands high velocity wave action. Above ground sand filters help with erosion control. The foundations had to be designed on pilings capable to withstanding high velocity tsunamis. Concrete columns and steel frame are left exposed becuase they can with-stand the water and lateral forces. Lower level walls made of glass and wood are designs to break away in a strong storm surge. Overhead doors on the lower level open to allow water flow through the building. The exterior siding is a mixture of composite and galvanized standing seam panels and aluminum windows. The lower level is meant to be a flood room which is why it is built to the standards as previously discussed.

The main level is located 9 ft. above grade. This level houses the main amenities of the house such as kitchen, living room, bedroom and bathroom. This design allows water to come up 9 ft. with minimal damage to the house but keeps the main components and belongings safe on the second level.

http://www.archdaily.com/464506/tsunami-house-designs-northwest-architect

3.2.3 TSUNAMI HOUSES ANALYSIS

FORM

The form of Tsunami Houses is specifically designed to survive a wave. There is little or no consideration for the effects of wind in the shape of the house.

CONSERVATION

The principle conservation feature of the Tsunami house is elevation of the structure above grade. The addition of offshore break waters also are installed to mitigate the wave.

FORCES

If the storm surge or wave passes beneath the house and the first level flood room functions as designed, the principle forces acting on it are winds blowing directly in from the ocean. The house is narrow facing the ocean, but presents a large flat area of glazed openings. In response to higher category hurricane force winds, roof failure is very probable.

MATERIAL

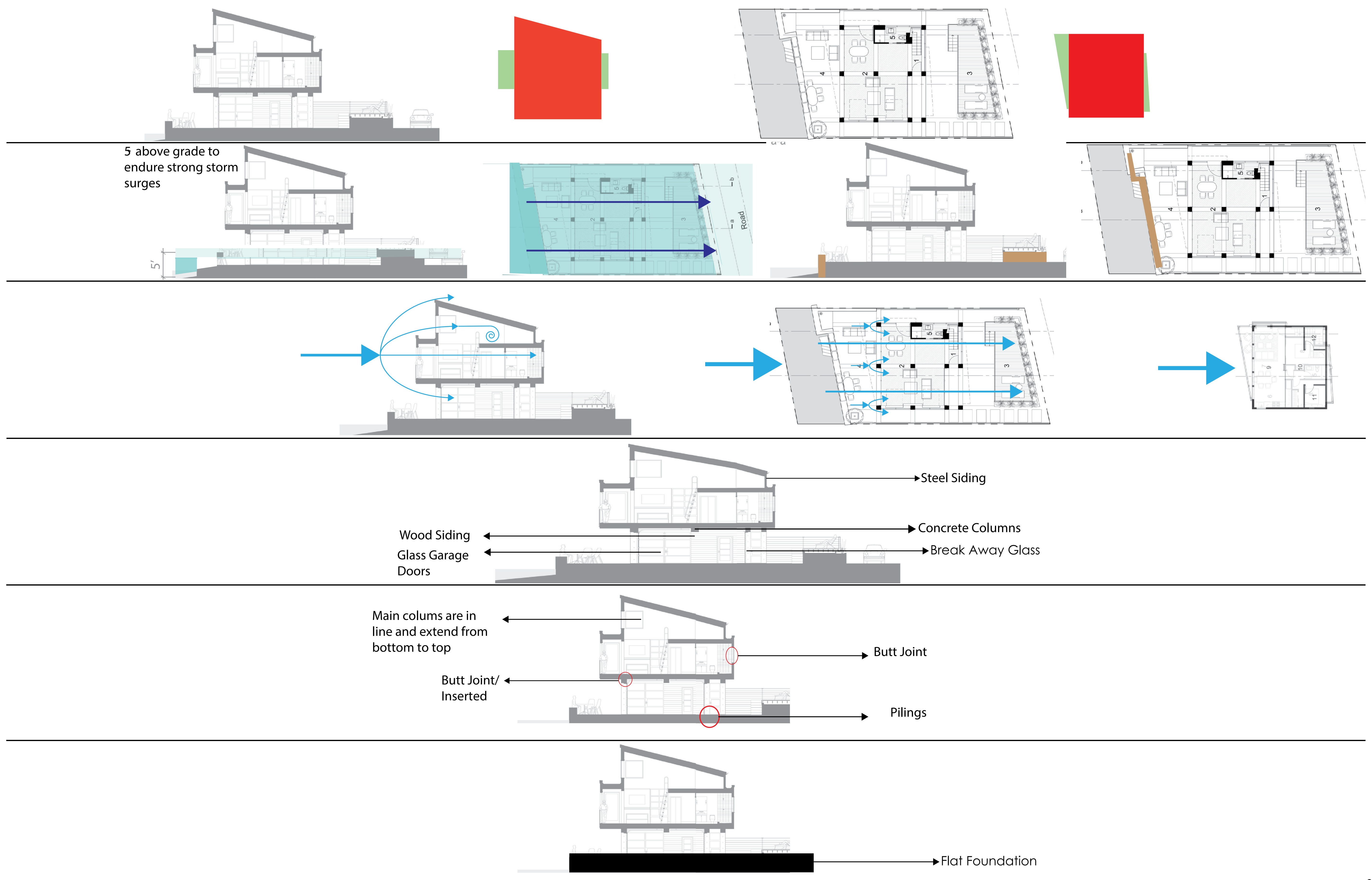
The concrete pylons and steel frame will ensure the basic structure survives after the breakaway siding and other materials are washed away.

JOINTS

The alignment and continuity of the main columns added to the insertion of the steel frame should provide sufficient strength against flooding or wind for the structure

SITE

The site is meant to be ocean front with only the elevation to protect the building. Site provides little to the survivability in a hurricane, but should provide some protection from flooding in a smaller tsunami.



3.3 DELTEC HOUSES

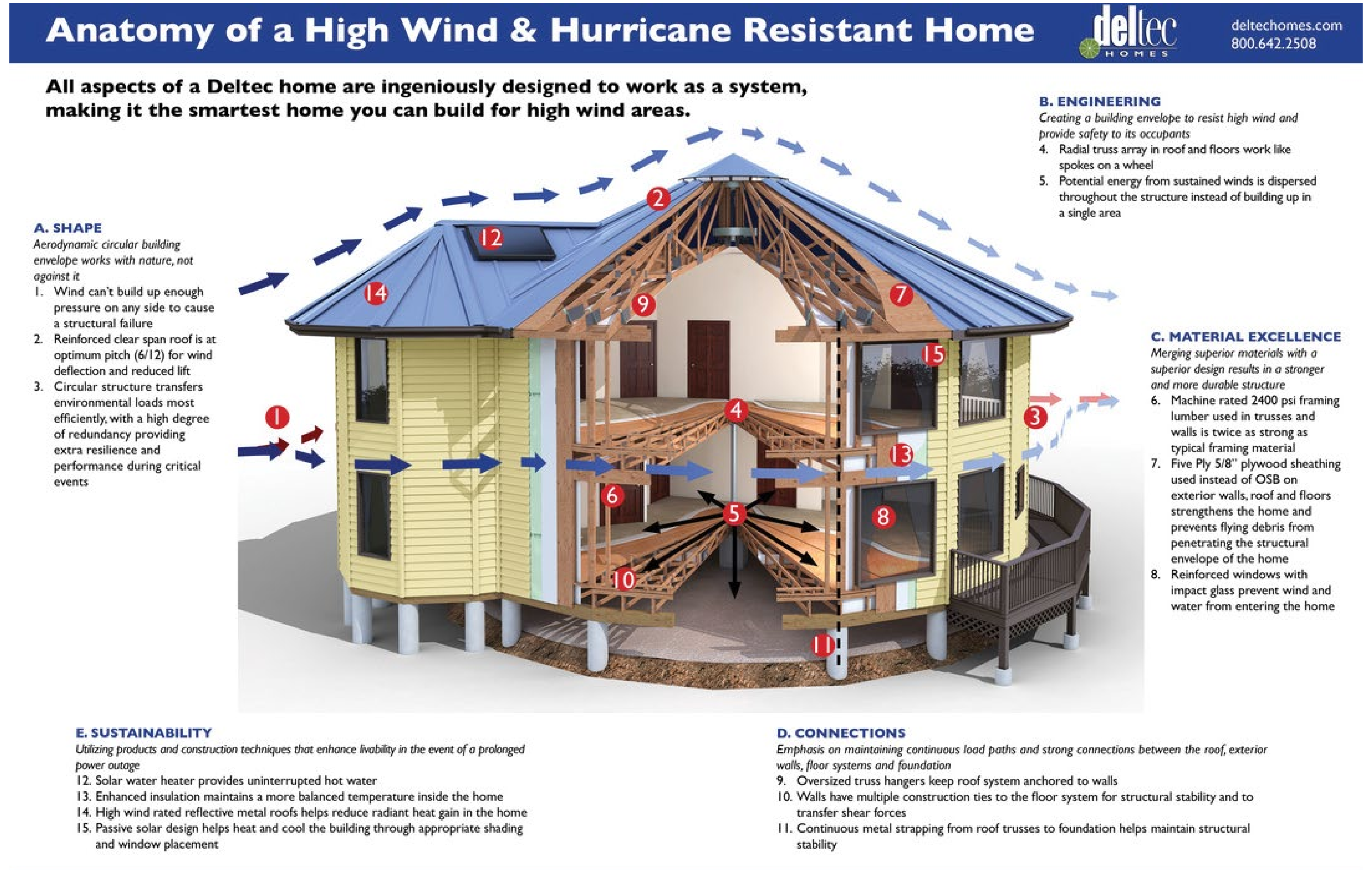


Figure 3.9

Figure 3.10

Figure 3.11

Deltec homes are located in various places but all of them have the same characteristics. The structure is round thus wind can't build up enough pressure on any side to cause a structural failure. Energy from the wind is dispersed instead of building up in a single area and trying to push through. Its optimum roof pitch is 6/12 for wind deflection and to reduced lift. Radial floor & roof trusses work like spokes of a wheel to hold the house in place.

The materials that are used to construct the house include: machine rated 2400 psi framing lumber that is used in trusses and walls are twice as strong as typical framing material. Five Ply 5/8" plywood sheathing is used instead of OSB on exterior walls. The roof and floor strengthen the home and prevents flying debris from penetrating the structure, in combination with its pinwheel design. Reinforced windows with impact glass prevent wind and water from entering the home causing water damage.

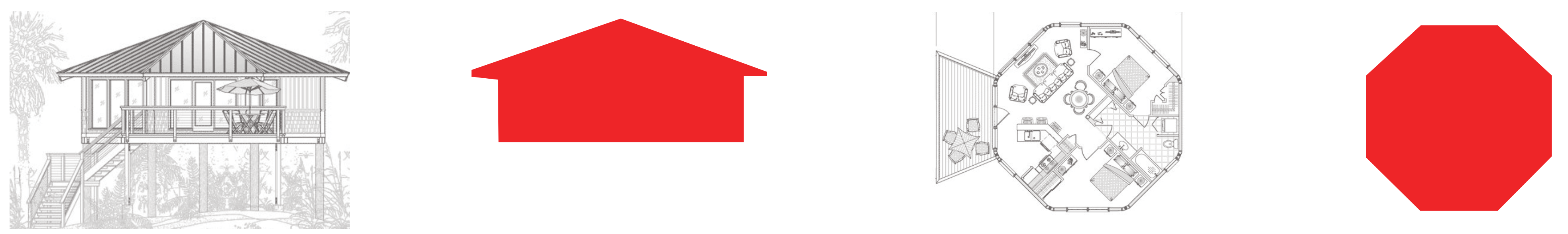
The type of connections used through out the house are oversized truss hangers that keep roof system anchored to the walls. Walls also have multiple construction ties to the floor system for structural stability and to transfer shear forces. There are continuous metal strapping go from roof trusses to the foundation to help maintain structural stability.

From: http://www.ecobuildingpulse.com/projects/deltics-hurricane-proof-homes

3.2.3 DELTEC HOUSESANALYSIS

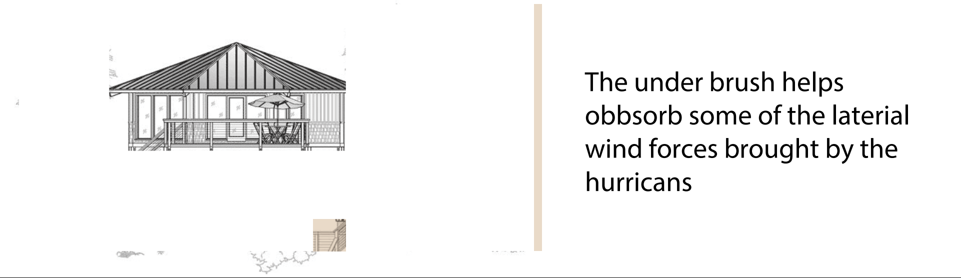
FORM

The form of Deltec Houses is geared to surviving high winds. As discussed in section .2.3.3, the house is octagonal, approximating a circle presenting small areas normal to the wind flow. In addition, it's hip roof allows wind to flow easily over the top. Reducing the size of the overhangs would help roof survivability.



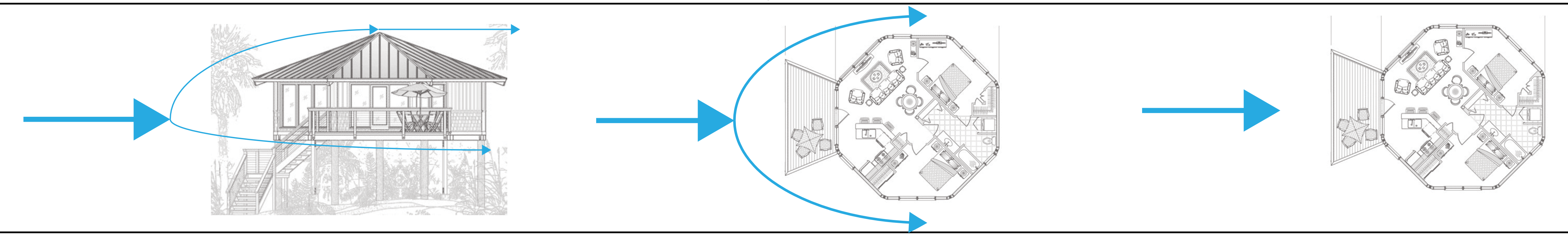
CONSERVATION

The principle conservation features of the house is elevation of the structure allowing water to pass beneath and the use of under brush to dampen wind forces.



FORCES

The overall shape channels wind around the structure minimizing the lateral forces. However, the octagonal shape as opposed to a round shape provides a normal face to the wind of about one third of the house diameter. The structure must be strong enough to withstand that force. Some lifting force is imparted due to the overhangs, but they are a small percent of the roof area.

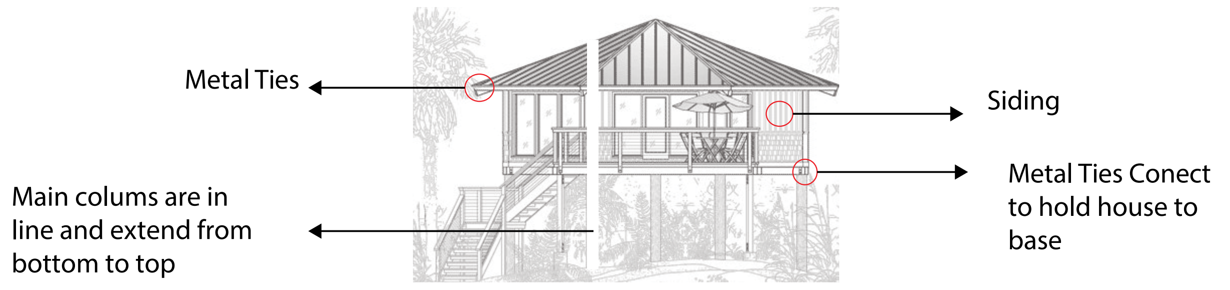


MATERIAL

The house uses higher than normal strength wood framing, plywood , impact glass and other premium materials throughout, limiting the possibility of debris induced damage. The wooden columns that support the house are round also limiting wind and water forces on their surfaces.

JOINTS

The house uses oversized metal connectors for framing, linear columns that extend from the foundation to the roof with extensive metal strapping that also extends from roof to foundation.



SITE

The site is not specifically altered for this house.

Figure 3.12

3.4 CORE HOUSES

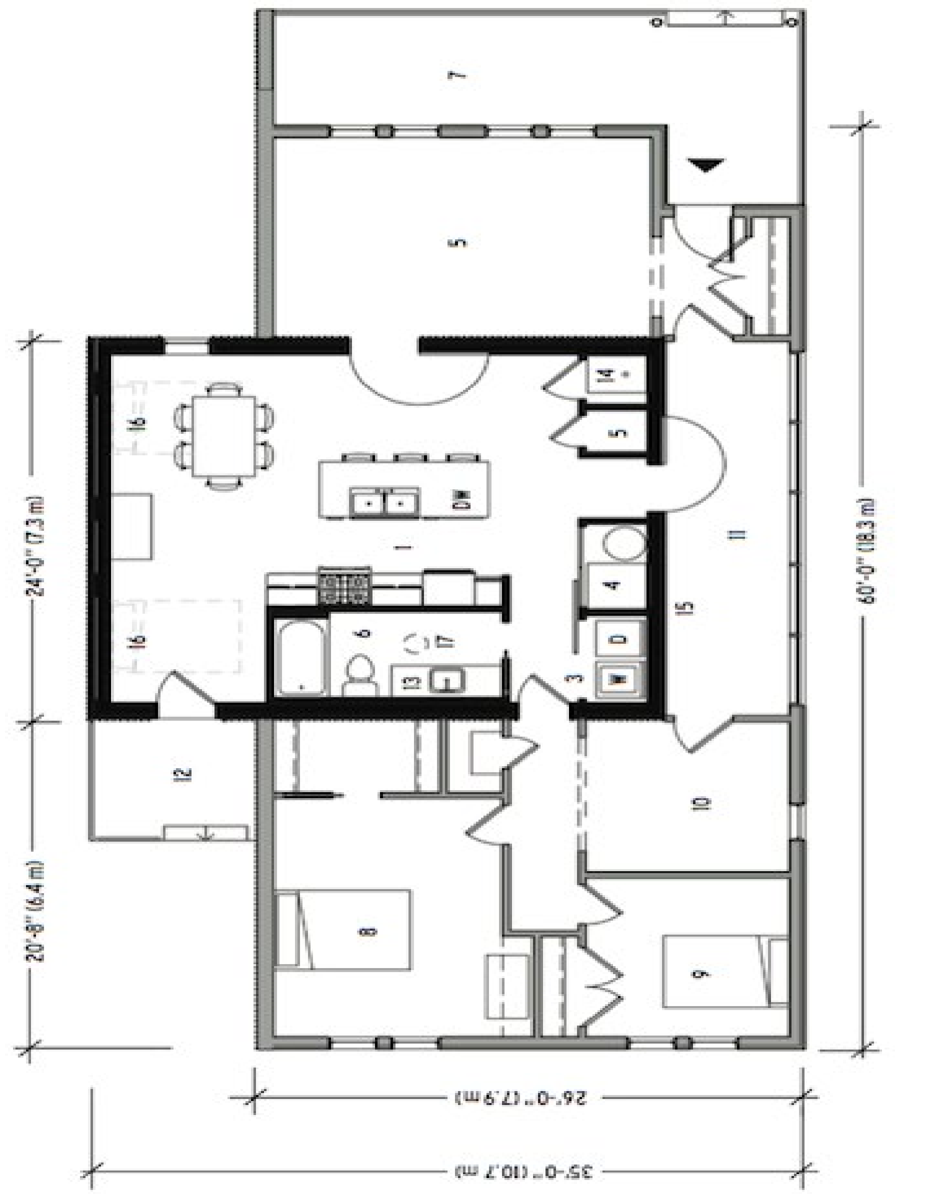


Figure 3.13

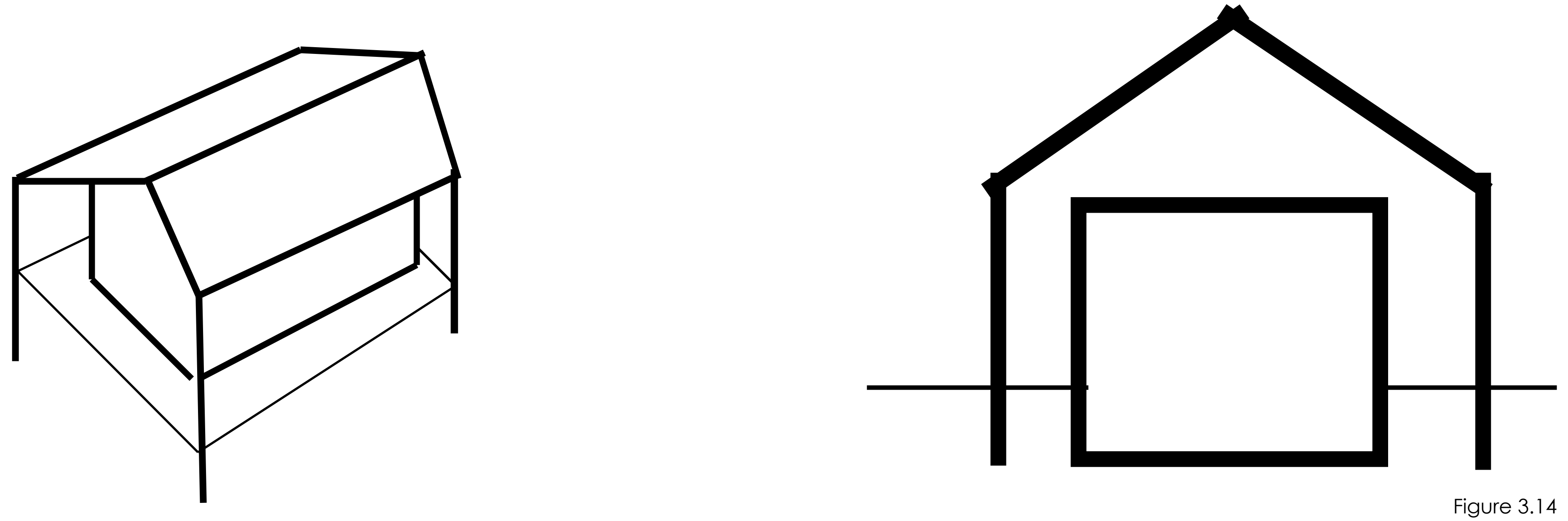


Figure 3.14

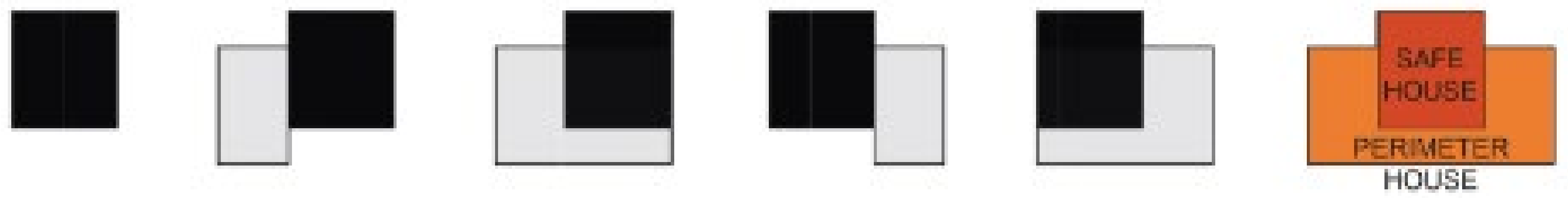


Figure 3.15

The core house is a design concept developed by the Q4 group. The site that they used was Joplin, MO. The house was designed so that the main components would be protected by a very solid base allowing the rest of it to break away. The house was designed based off the idea of a safe room with a hardened exterior structurer in a portion of the house. The house is built for natural disasters such as earthquakes, tornadoes and hurricanes.

The project features a 600 square foot indestructible concrete core that has spacious daylight rooms wrapped around it. The home's core, which is sealed off with heavy-duty tornado doors, houses Murphy beds, a kitchen, bathroom and access to backup systems.The walls of the Safe House are constructed of filled and anchored carbon-neutral concrete masonry units. The outside of the house is built with various cheap materials. They designed it this way because they expected the outside of the house would be a protective barrier for the inside core. The out-side is meant to be rebuilt while the main and expensive components of the house remain intact with in the core. The core design allows for a very flexible design strategy allowing for many different arrangements and varieties of houses built to withstand high winds.

From:http://www.q4architects.com/projects/core-disaster-resilient-design/

3.2.4 CORE HOUSES ANALYSIS

FORM

In a sense, the shape of Core Houses is irrelevant. The intent is that the exterior blows or is washed away leaving only the indestructible core, functioning a life boat for the inhabitants.

CONSERVATION

Conservation is not a factor for these houses

FORCES

The force of the storm is meant to tear away the exterior of the house, leaving essentially a square concrete box. Forces will concentrate on one face of the box due to wind, but the overall strength of the unit should make these forces irrelevant. This design will become a wind borne debris generator for its neighbors, possibly resulting in zoning restrictions.

MATERIAL

The house uses disposable exterior material. The concrete survival core is essentially impervious.

JOINTS

The concrete core units are anchored to each other and in place. The remainder of the structure uses non-survivable joints by design.

SITE

The site is not specifically altered for this house.

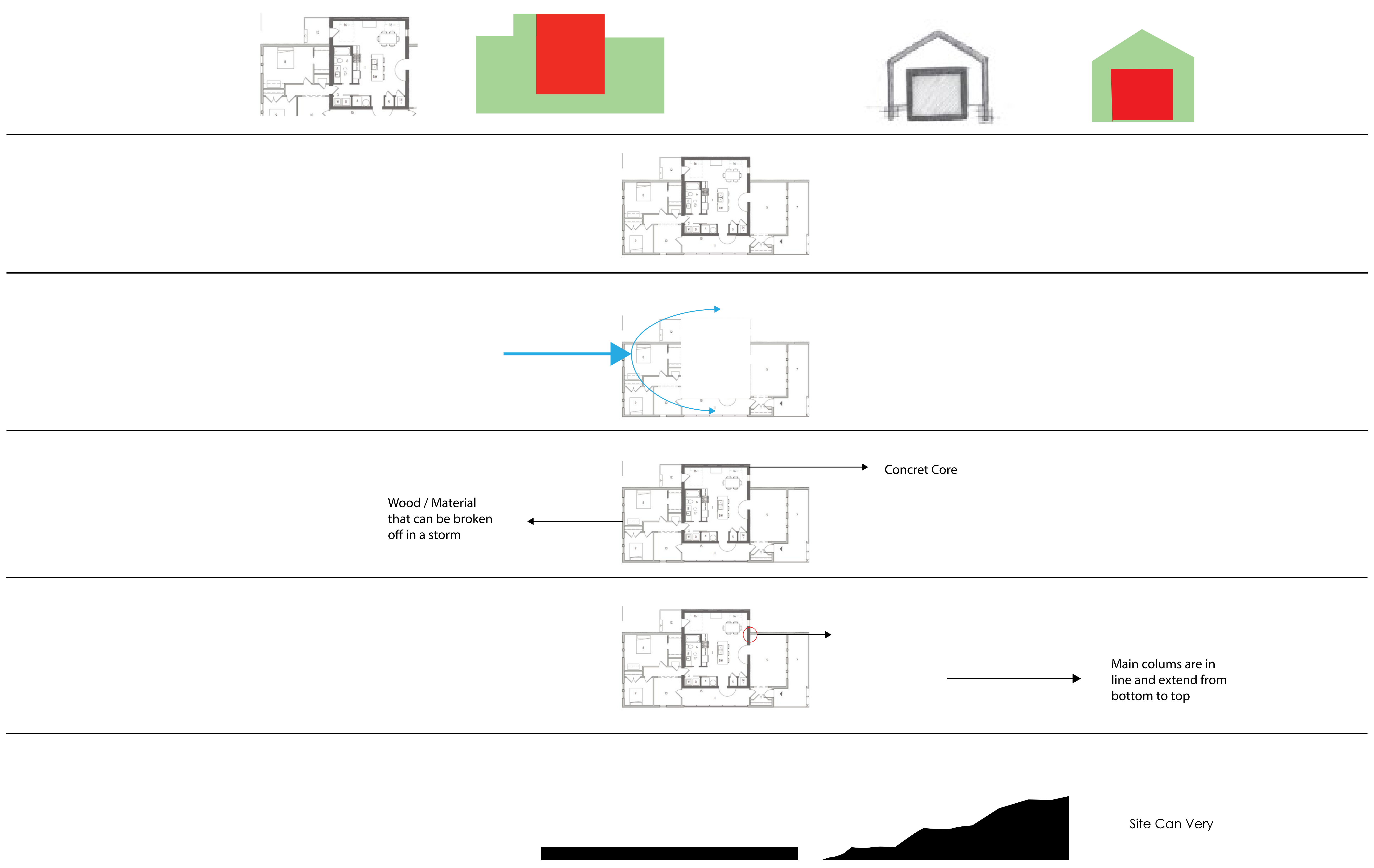


Figure 3.16

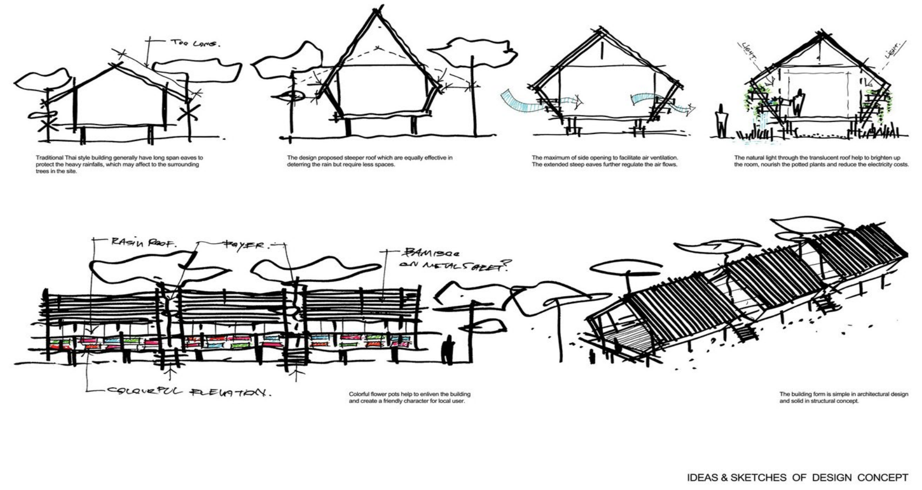
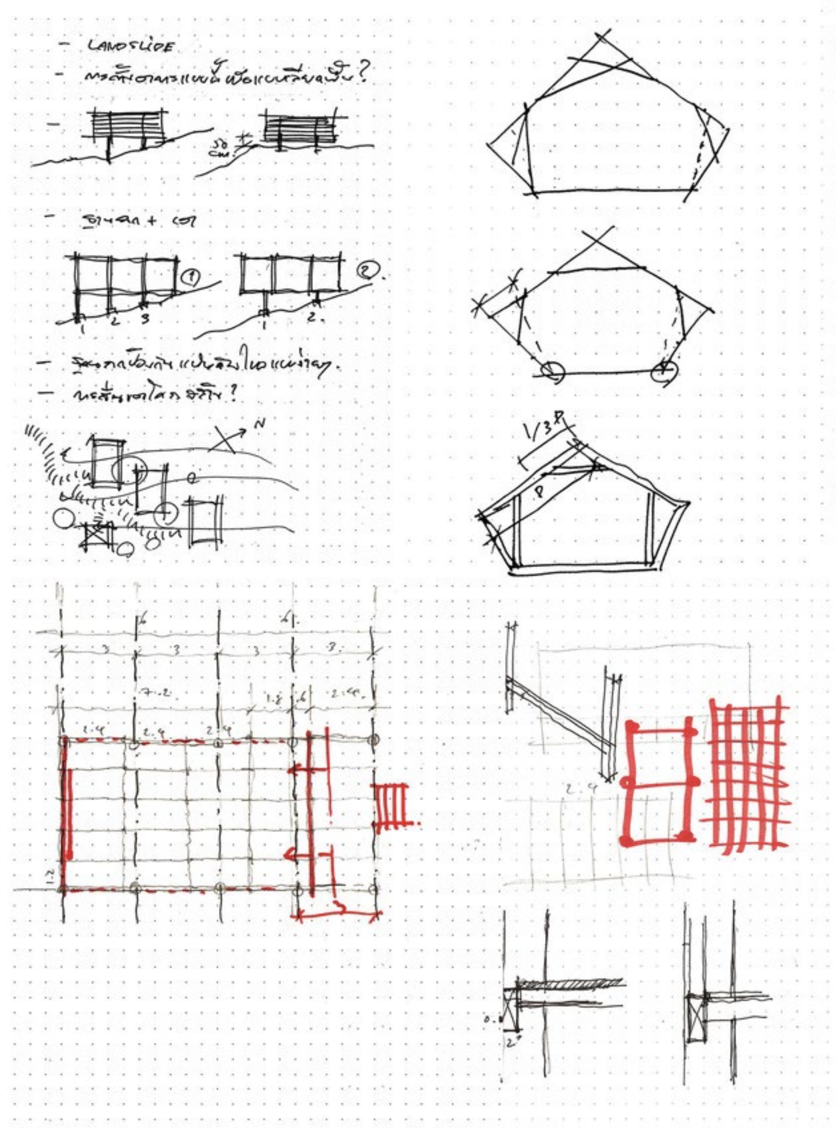


Figure 3.17



3.5 EARTHQUAKE SCHOOL

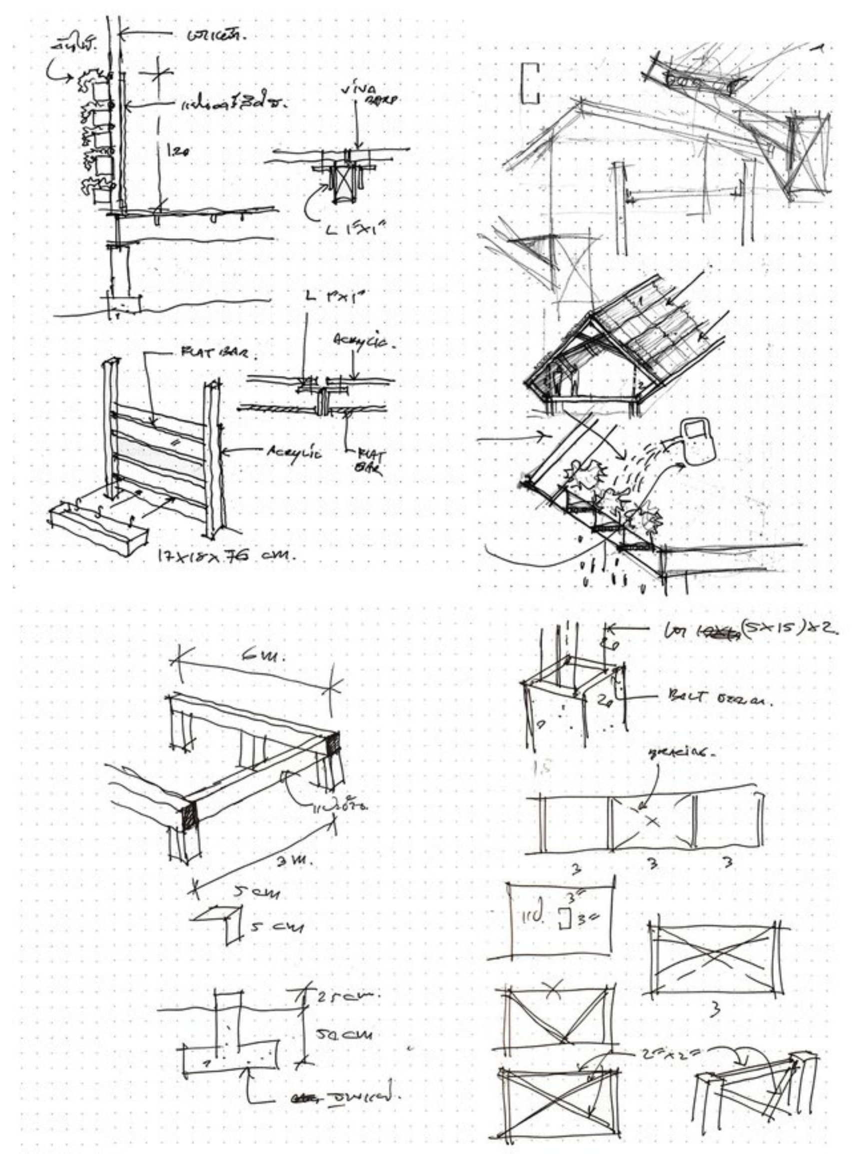


Figure 3.18

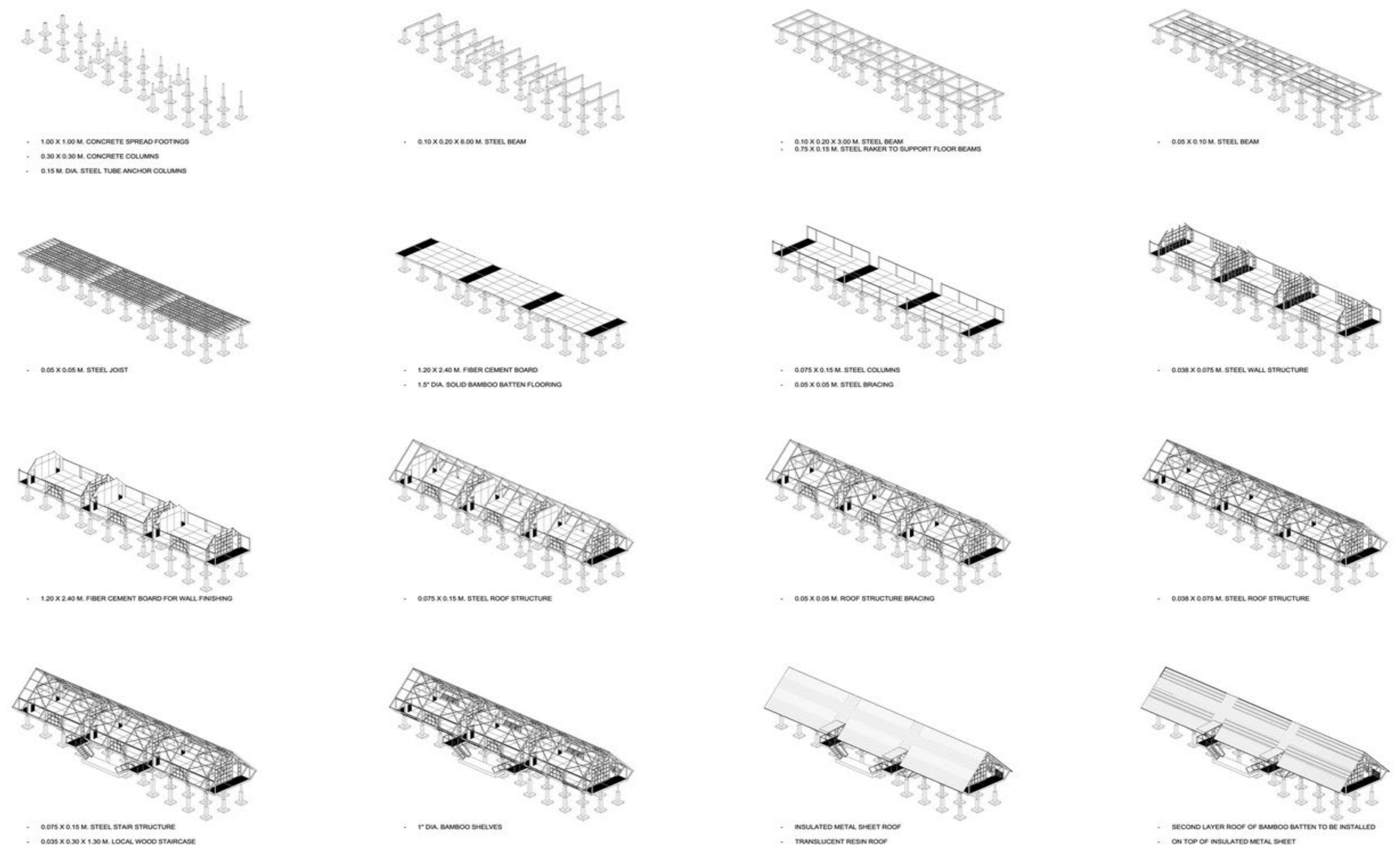


Figure 3.19

The earthquake school was designed by Vin Varavarn Architects. It is located in Chiang Rai, Thailand and was built in 2015. The school sits on a sloped site and is held up by pillars. The building was designed to withstand the shaking of the earthquakes that are frequent in the region.

Most of the selected building materials were lightweight to reduce horizontal momentum caused by the weight of the building during an earthquake. Most material was light weight steel but there were bamboo and timber as well. Some materials were clad in a combination of fiber cement and bamboo. The roof was made of resin panels inserted into bamboo and metal roof frame members. The structure touches the ground on one end and is raised up by steel stilts on the other. The structure was designed in such a way to convey safety and reduce finishing costs. The diagrams show their design process and how they looked at the forces and loads that needed to be considered in the project based on the earthquakes in the surrounding area.

From:https://www.dezeen.com/2015/10/28/earthquake-resistant-school-vin-varavarn-architects-raised-on-stilts-thailand/
http://www.archdaily.com/776325/bann-huay-san-yaw-post-disaster-school-vin-varavarn-architects

3.5.1 EARTHQUAKE SCHOOL ANALYSIS

FORM

The Earthquake School's shape was chosen for earthquake survival. It is not optimized for the flooding or wind of hurricanes. Its partial elevation on posts would provide some protection against flooding.

CONSERVATION

The location on an elevated slope is the only conservation feature of this structure.

FORCES

The force of winds coming from the sides would be minimized to some degree by the sloped sides that would channel wind over and beneath the structure. Winds parallel to the long axis of the building would impart significant forces on the facing end, but it is narrow compared to the building as a whole and there is a significant gap under the building to channel the wind.

MATERIAL

The low mass of the lightweight steel frame is idea for earthquakes, but may work against the building in hurricanes. The resin panels and bamboo components of the roof covering may not survive well if the openings to the building are compromised.

JOINTS

Diagonal bracing appears to be well employed in the building structure. The main columns are linear and extend from the top to the foundation of the structure

SITE

The site slope allows for space below the structure for wind flow. No other site accommodations were made.

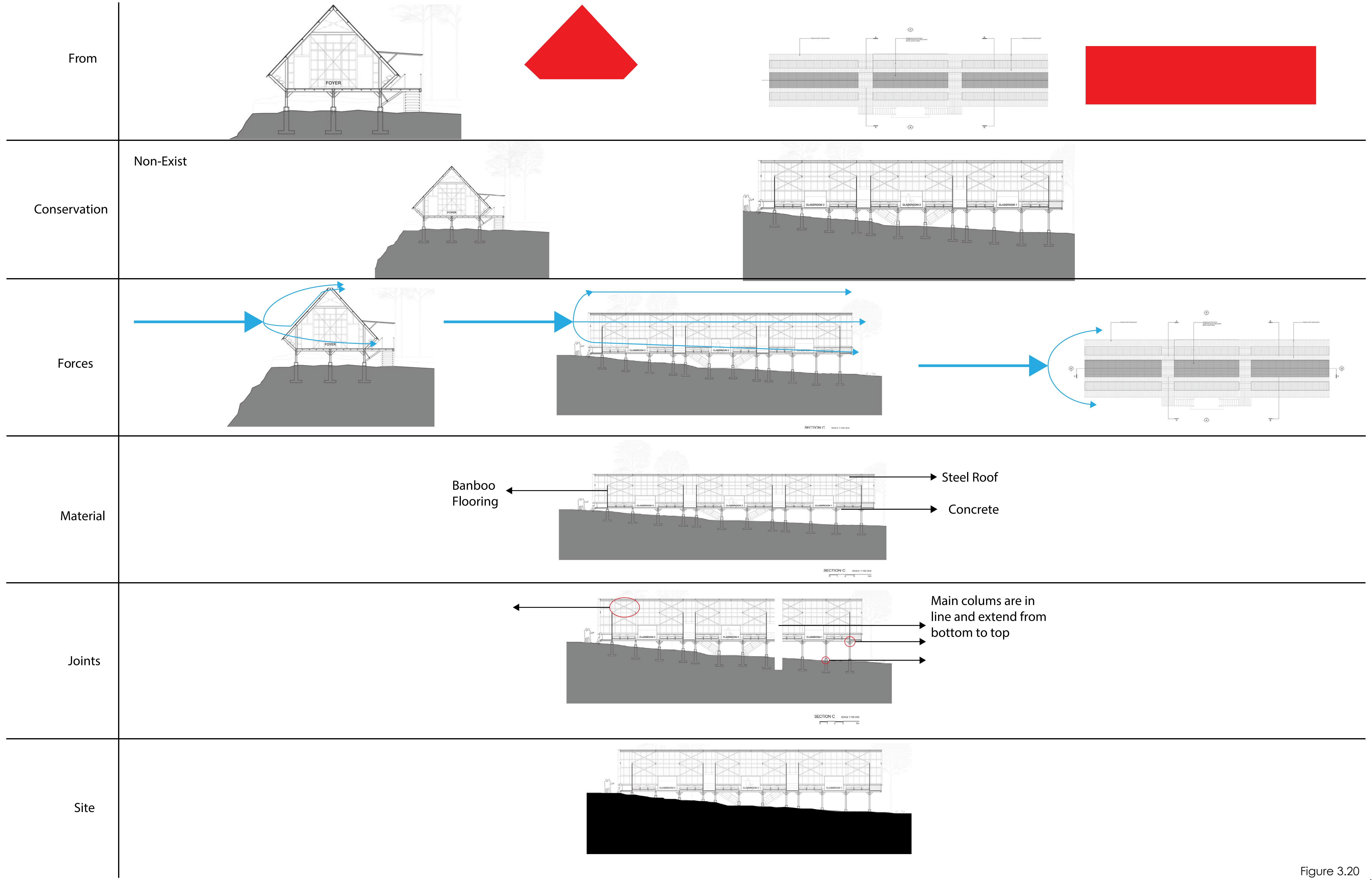
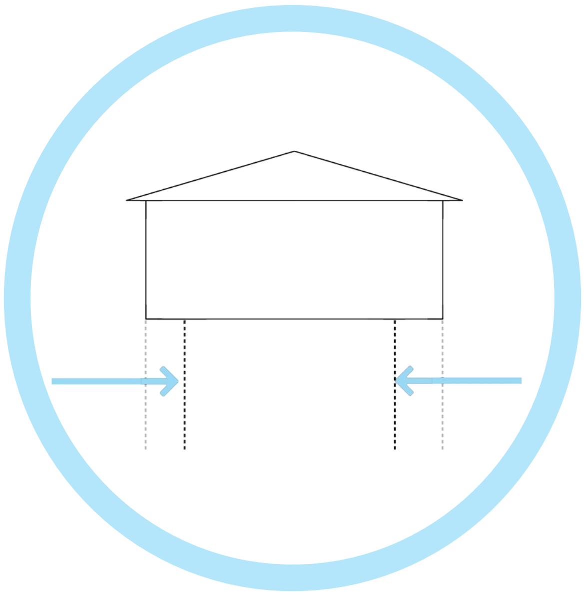


Figure 3.20



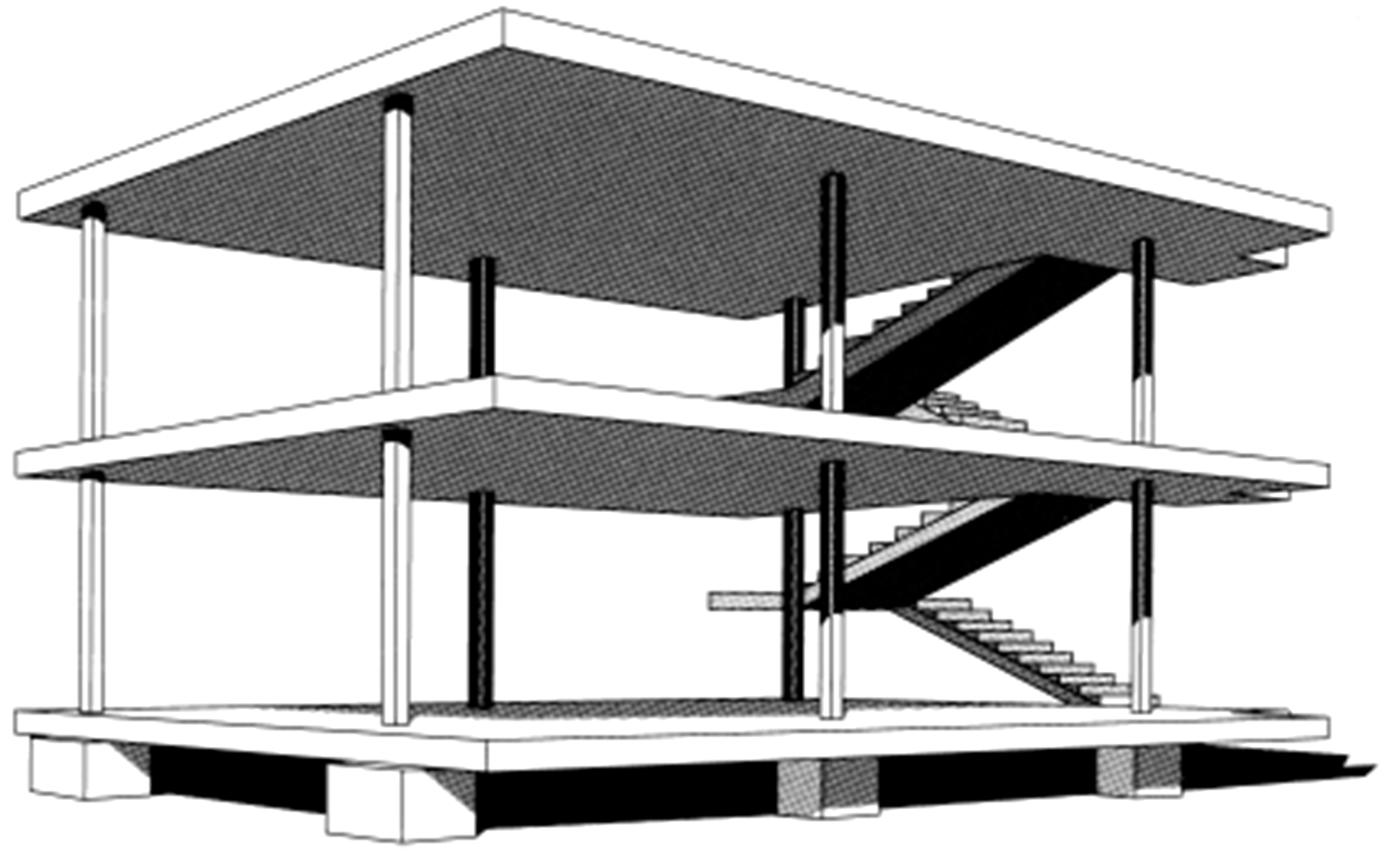


Figure 3.21

3.6 THE DOMINO STRUCTURE

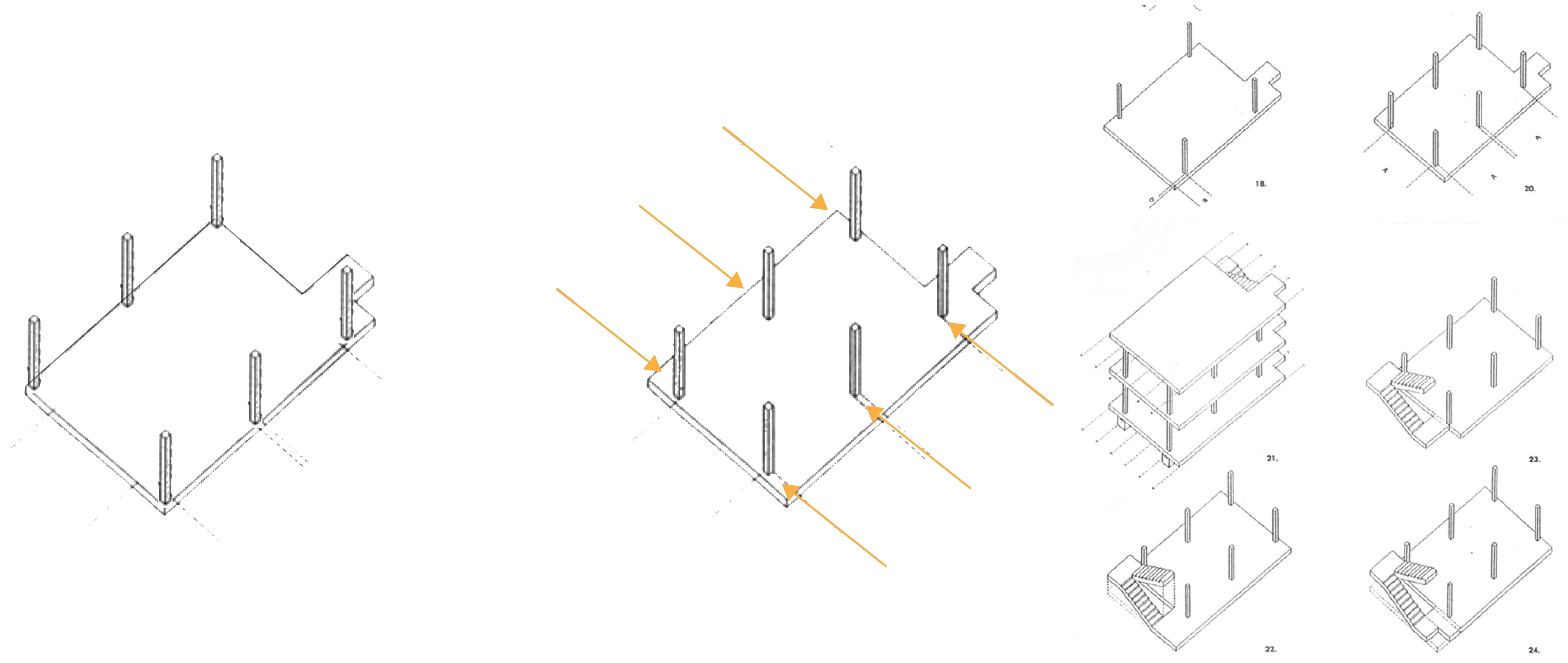


Figure 3.22

The Domino structure was designed by Le Corbusier. It is a theoretical project and can be assembled anywhere. It was designed in 1914-15. The structure was based on the architectural order found in classical architecture. The structure was design so that columns moved to the inside and there which would allow a open adaptable interior space.

The frame is meant to allow freedom within creating an open floor plan and eliminating load bearing walls and elaborate supporting beams for the ceiling. The concept was designed during the war and came about because buildings were being destroyed faster than they could be built. Thus, The domino house was built so that the exterior could be completely destroyed and the main frame would stay in place allowing for an easy transition to the next rebuild.

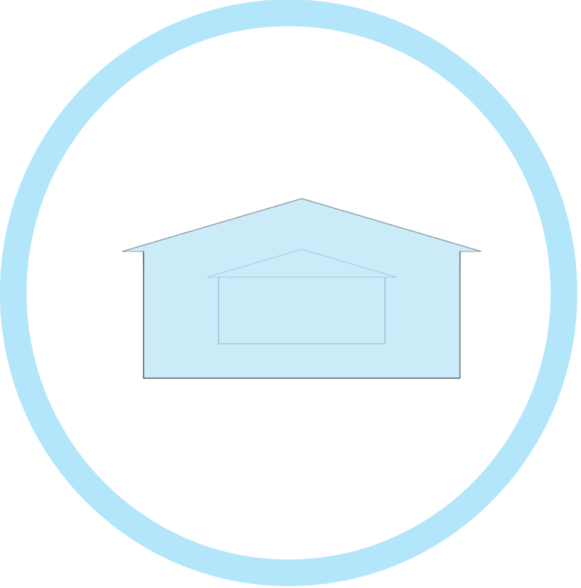


Figure 3.23

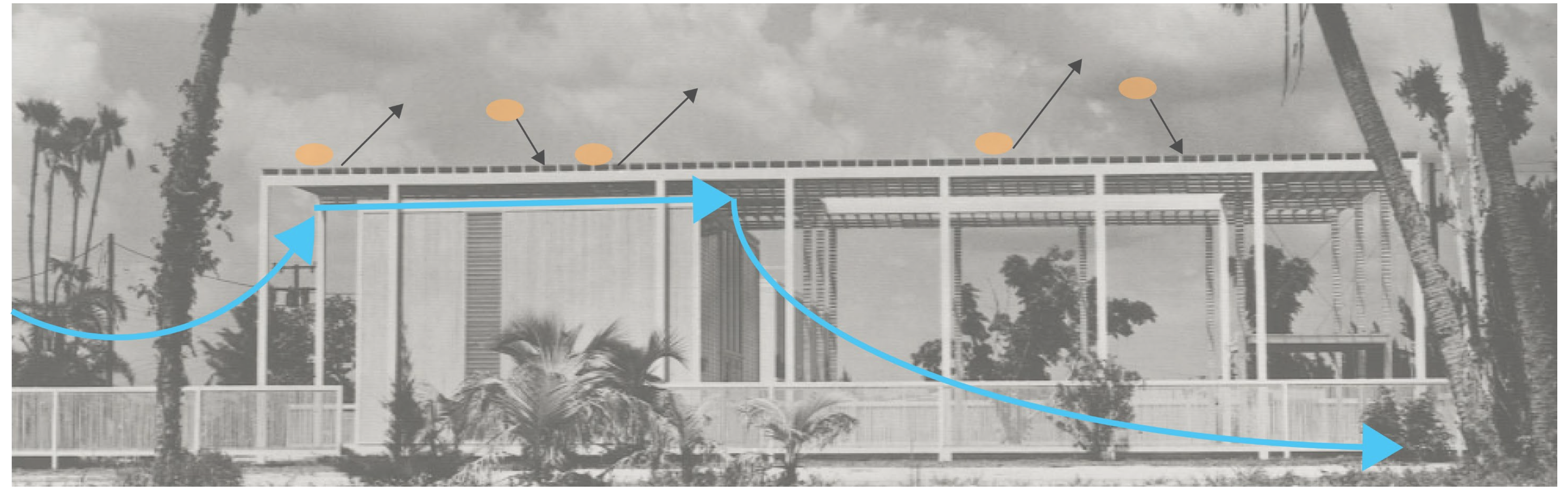


Figure 3.24

3.7 THE UMBRELLA HOUSE

Figure 3.25

Figure 3.26

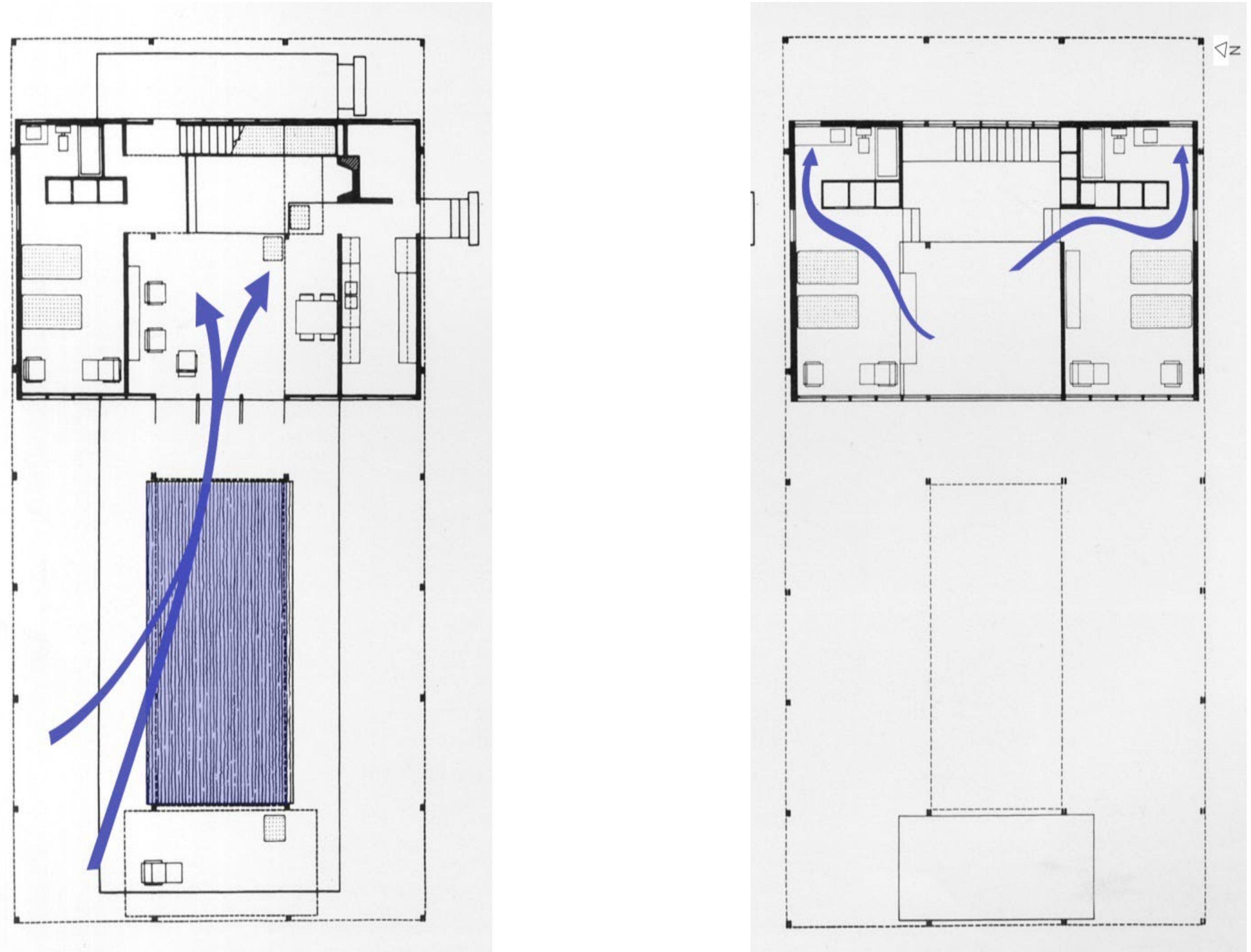


Figure 3.27

The Umbrella house was designed by Paul Rudolph in 1953. The house is a one story 3 bed, 3 bath house located in Sarasota, Florida.

The Umbrella House is unique due to its second roof. The intent was to have a second roof that could be replaced easily if flying debris damaged the roof during hurricanes. Also, during normal living conditions the house is well ventilated through large windows that allow breezes from the ocean to move through the house.

The house is built out of a steel frame with a wood corigated roof, glass and concrete. The steel roof however was originally made of wood and provided a sun shade for the back yard. However a hurricane took the roof, thus the the new one was put on. Thus the roof is an important detail to this house because it protects the main structure from flying debris and in the case the roof is blown away it is a relatively cheap renewable resource that can be easily replaced.

https://www.dwell.com/home/umbrella-house-885e22eb
http://northmetroatlantahomes.net/real-estate-news/home-and-design/umbrella-house
http://modernmag.com/shedding-light-on-paul-rudolphs-umbrella-house/

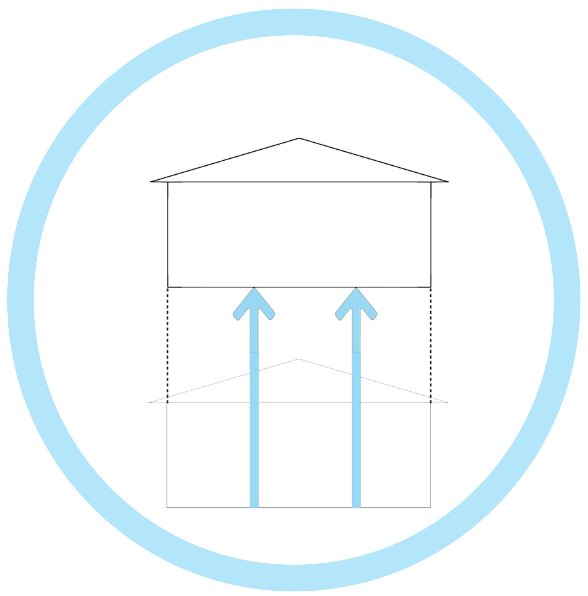


Figure 3.28

Figure 3.29

3.8 DELTA HOUSE

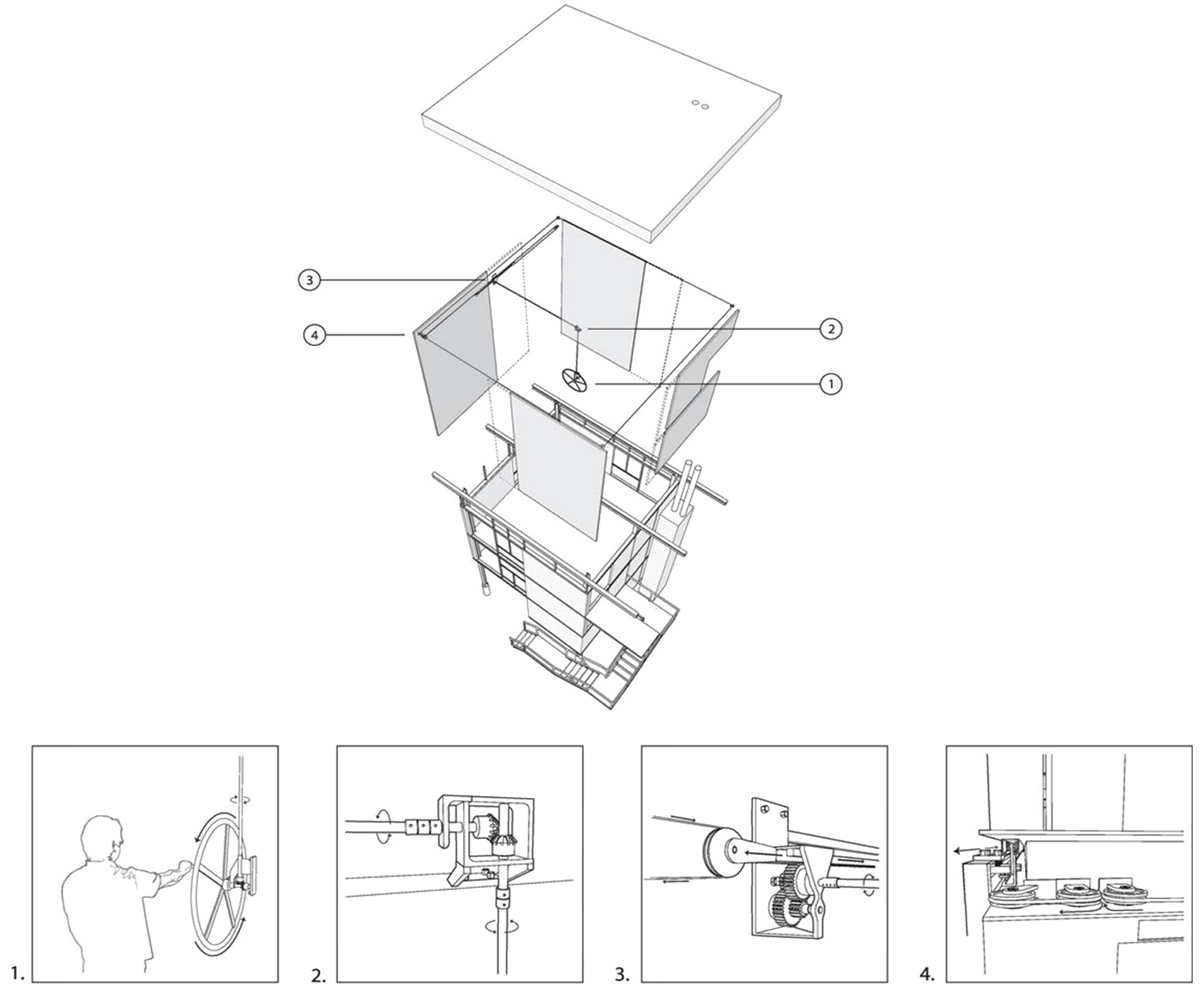


Figure 3.30

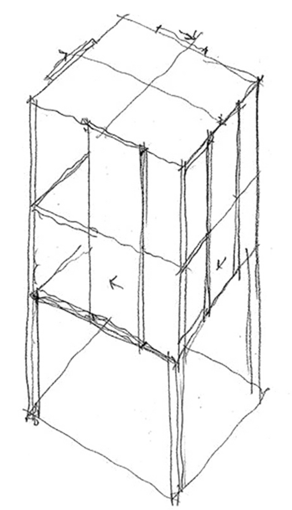


Figure 3.31

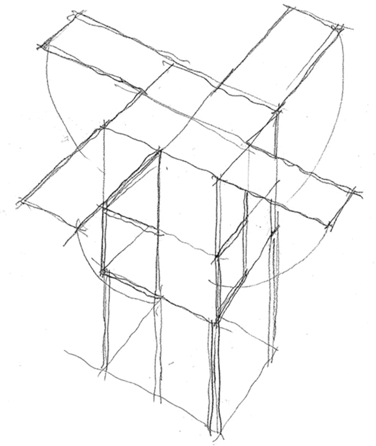


Figure 3.32

The Delta Shelter was designed by Olson Kundig. It was a 1,000 sqm house built in 2005. The house is located in Mazama, United States. The house is an easy matenace with large panels that can be replaced. The doors are hand operated by a large wheel and pulley system in the inside of the house. The interior is made of plywood which kept the cost of the house down. The columns and exterior panels are made of steel which supports the main structure and frame of the house.

The Delta House is a steel house that has operable panels that act like a shell in bad weather, however in good weather the protective shell can be slid back to enjoy the outside. Also, du to the lifted floor plan the house can withstand up to 10 feet of snow or in the case of the thesis 10 feet of water. This was a desirable precedents because it offered a solution to the storm and an everyday use comfortability design.

https://www.archdaily.com/215448/delta-shelter-olson-kundig-architects

3.9 SEA SIDE COMMUNITY

Figure 3.33

Figure 3.34

Figure 3.35

Sea Side community is located in Walton county Florida. It was built in 1979 by Andres Dunany and Elizabeth Plater-Zyberk. The community is on the panhandle of Florida it is an urban planning project that sits on the coast. The community is a mixed use and contained densities greater than conventional suburban development. The plan was able to have minimal zoning issues because there were no zoning ordinances at the time. The inhabitants were vacationers and people who lived there for months at a time. There are strict limitations on the external aesthetics of the house

Figure 3.36

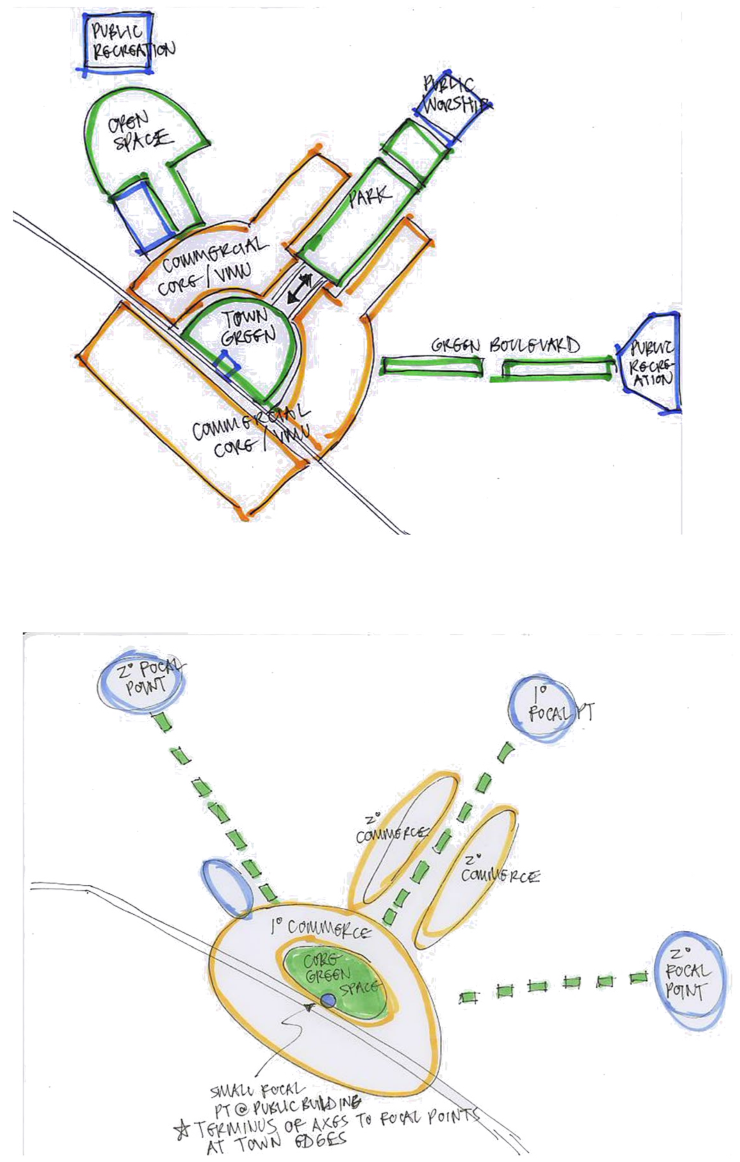


Figure 3.37

http://architecture365.blogspot.com/2010/04/seaside-florida.html
seasidefl.com
https://www.pinterest.com/pin/554365035352655522/

3.10 ELEMENTALS CHILE REDESIGN

Figure 3.38

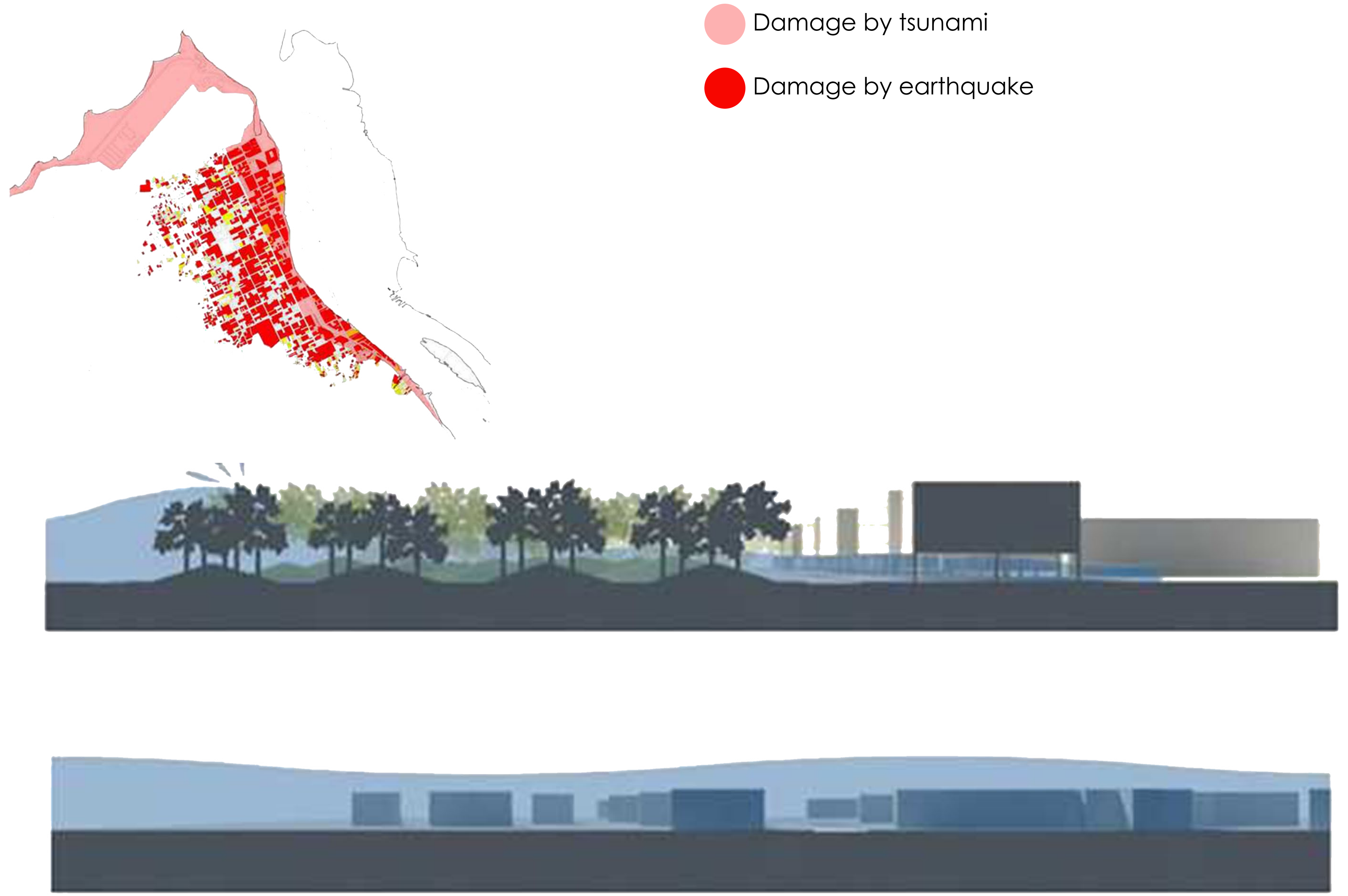


Figure 3.39

Figure 3.40

Figure 3.41

Post-Tsunami Sustainable Reconstruction Plan of onstitucion is a project located in Constitucion Chile. It was purposed and built in 2010. The design principle behind the site was to create low cost housing for local people that was able to be easily rebuilt and protected the houses from tsunamis caused by the local, reoccurring earthquakes.

The site was hit by a 8.8 earthquake that cause a massive tsunami that destroyed most of the houses in the area and almost 500 people died from debris and flood waters. Elements design team was given three months to come up with a design to improve the durability of the town for future tsunami. They designed a forest in between the city and the sea that wouldn't try to resist the energy of nature, but dissipates it by introducing friction. When the waves first hit Constitución, they were 12 meters tall; a forested island to the north of the city dissipated their energy and, by the time they reached the city center, they were only 6 meters tall. Our idea was therefore to protect the city by redeveloping the riverfront with trees. The design for the houses was an idea that part of the houses would be built keeping cost down and the rest would be developed over time. They were also designed in groups so that one house could rely on the other if another storm was to hit.

This alternative was the most challenging, politically and socially, because it required the city to expropriate private land. However, it was validated by the people and government. The forest would be able to damper flooding, slowing it down before it hits the buildings.

TTo pay the historical debt of public space (before the tsunami struck, there were only 2.2 sqm of public space per person, with riverfront forest that would increase to 6.6), and to provide democratic access to the river (the plots around the river were privately owned at that time).

http://www.elementalchile.cl/en/projects/pres-constitucion/
https://www.lafargeholcim-foundation.org/awards/3rd-cycle/latin-america/
Images

CHAPTER

04

SITE & PROGRAM ANALYSIS

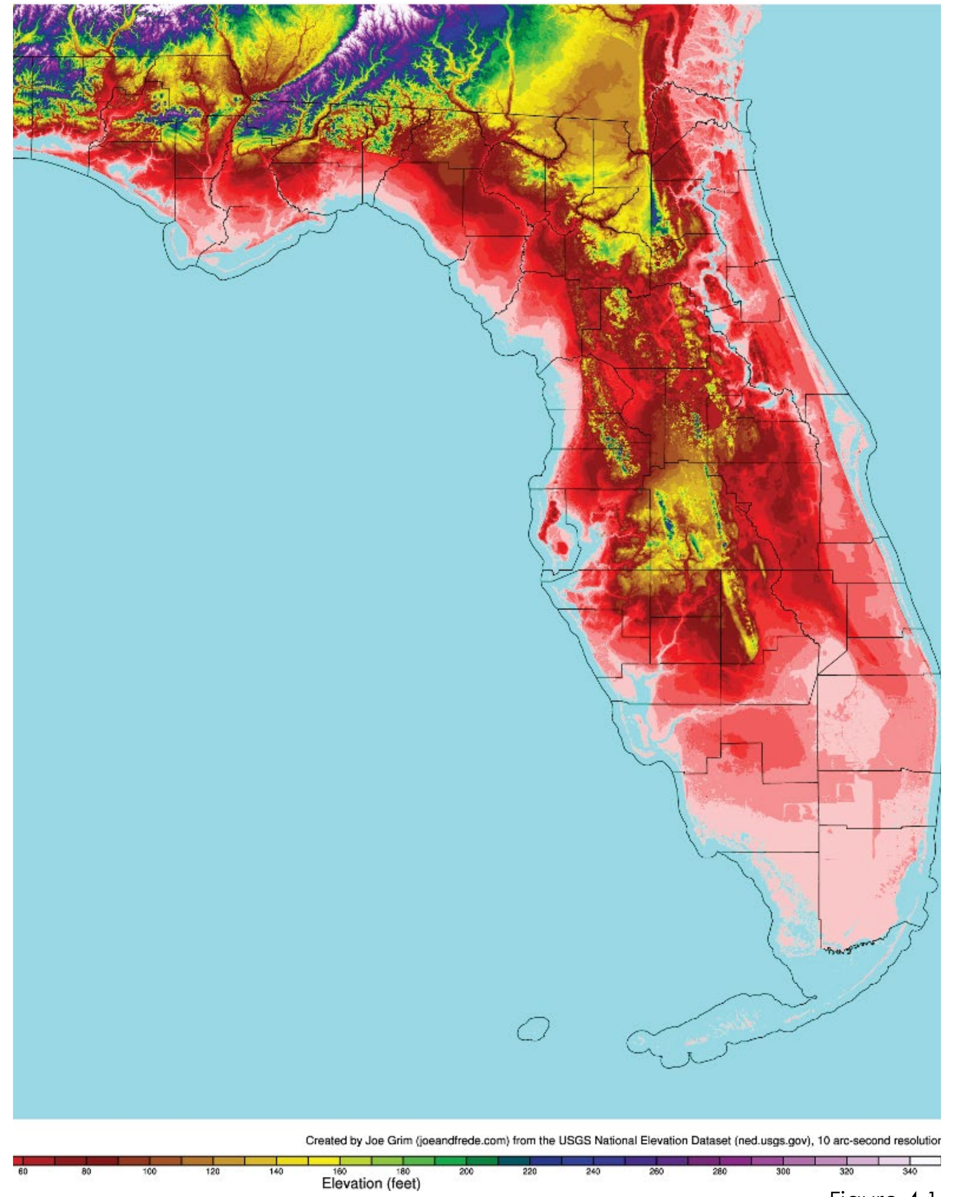


Figure 4.1

4.1.1 GEOGRAPHICAL AND HISTORICAL PATTERNS

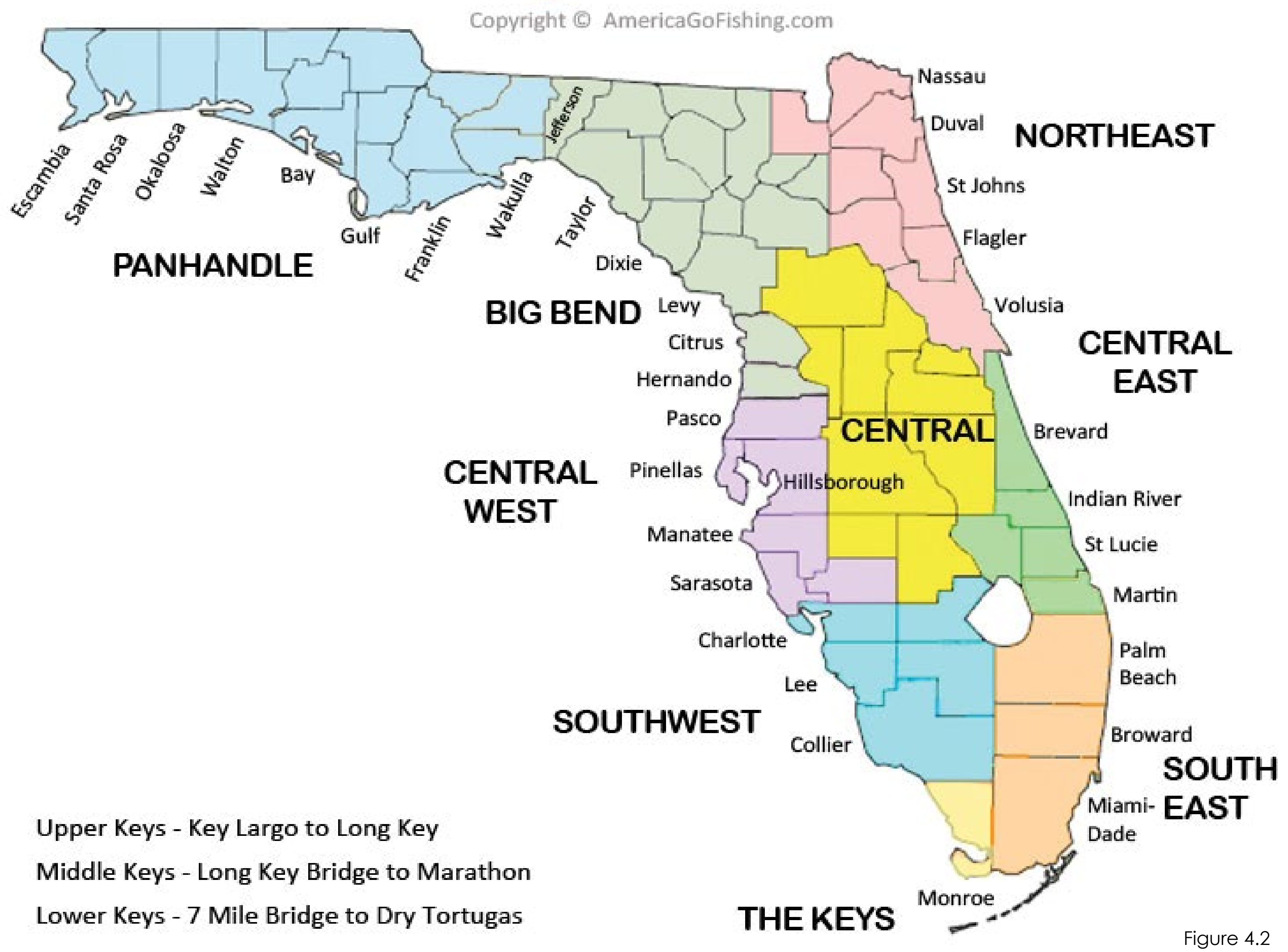


Figure 4.2

The two images above show how Florida is broken up into districts such as: Northeast, Central East South East, Central, The Keys, South West, Central West, Big Bend and Panhandle. The state is the broken down into independent counties. This is important to note because before hurricane Andrew the counties had individual building codes. However after hurricane Andrew they had district building codes and now they have state wide building codes. This is also important to determine which parts of Florida have been most effected by hurricanes in the up coming data figures.

Figure 4.1 shows the topography of Florida with the light pink showing the lowest point and the purple and white at the top showing the higher points. The graph is broken up into 10 feet increments. This graph is useful in the design hypothesis because it shows were water is mostly to come on land first during a hurricane. It also shows where natural barriers like hills or mountains, which Florida contains very minimal of both. This leaves Florida very vulnerable for high hurricane waters which if the house is not raised or the roof is not well attached water damages could be the third worst part of the storm, where fling debris and wind strength are the first two big issues for housing during hurricanes.

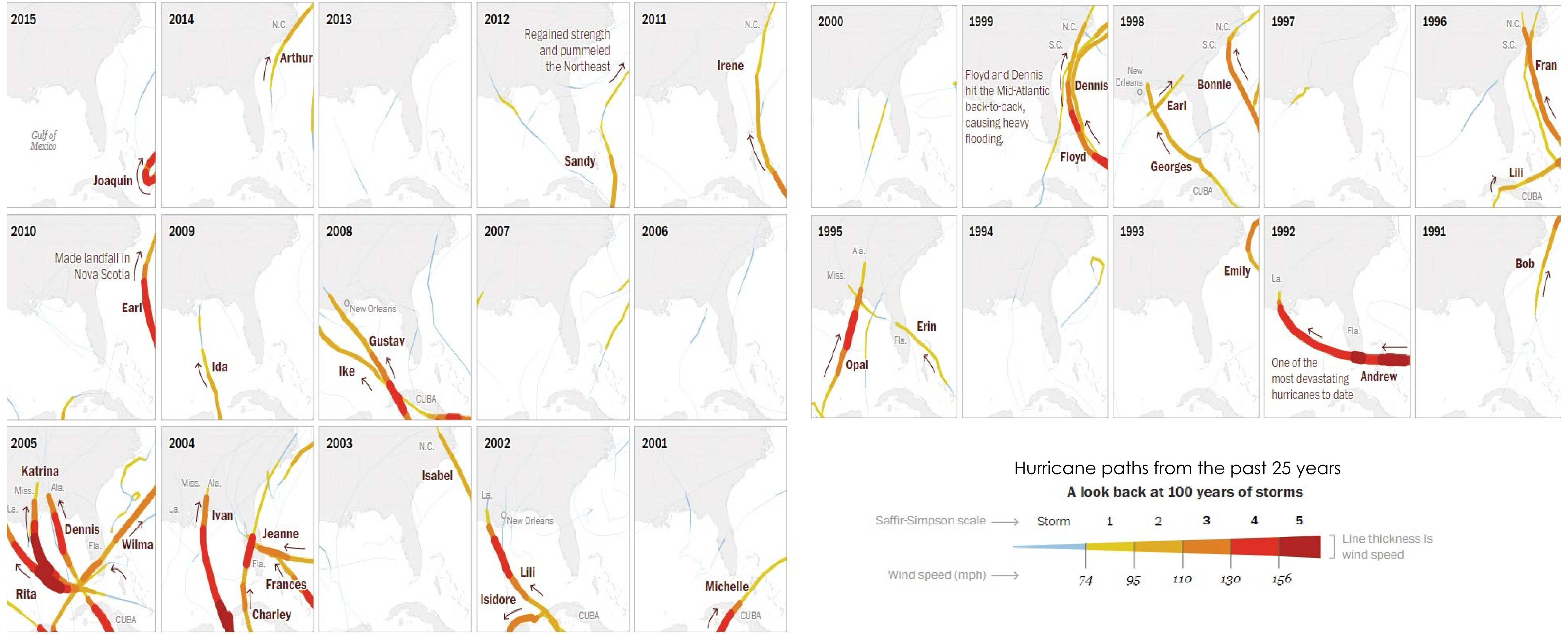


Figure 4.3

What the hurricane data shows are the parts of the USA that have been hit the most. In the past 25 years Florida has been the most effect with the worst hit in 1992 when Andrew came through the South Florida. This is the reason South Florida was selected as a study site for improved, hurricane resistant housing. Andrew through the thesis is studied and examined because of the high winds and devastation it brought to the houses of south Florida.

The figure 4.3 show all the hurricanes that have hit Florida and the ones that have had the most devastation.

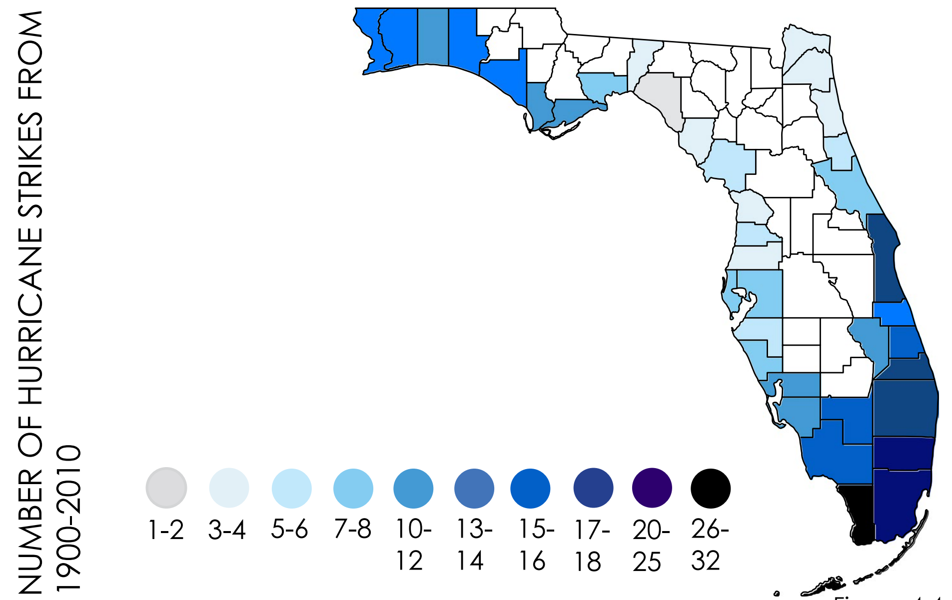


Figure 4.4

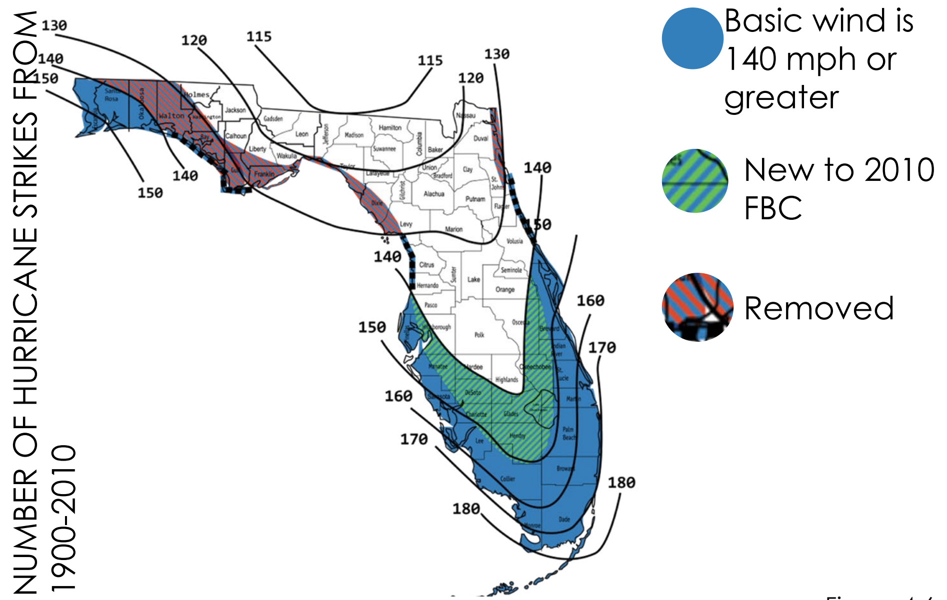


Figure 4.6

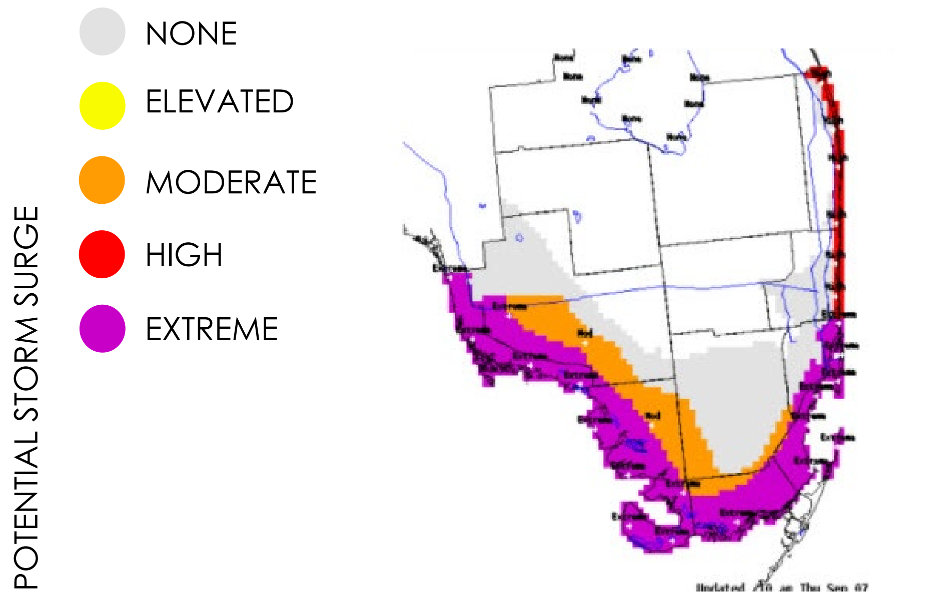


Figure 4.8

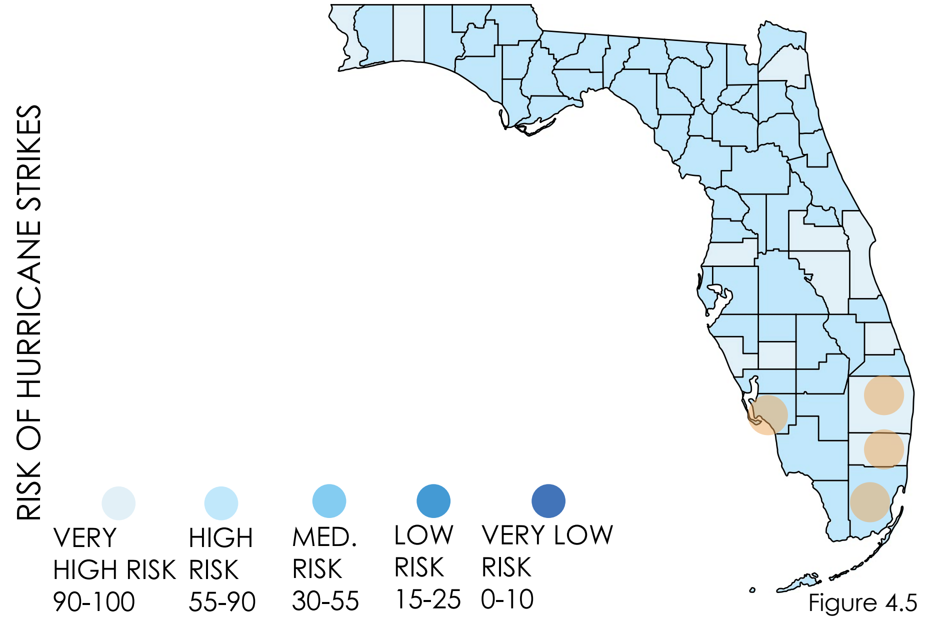


Figure 4.5

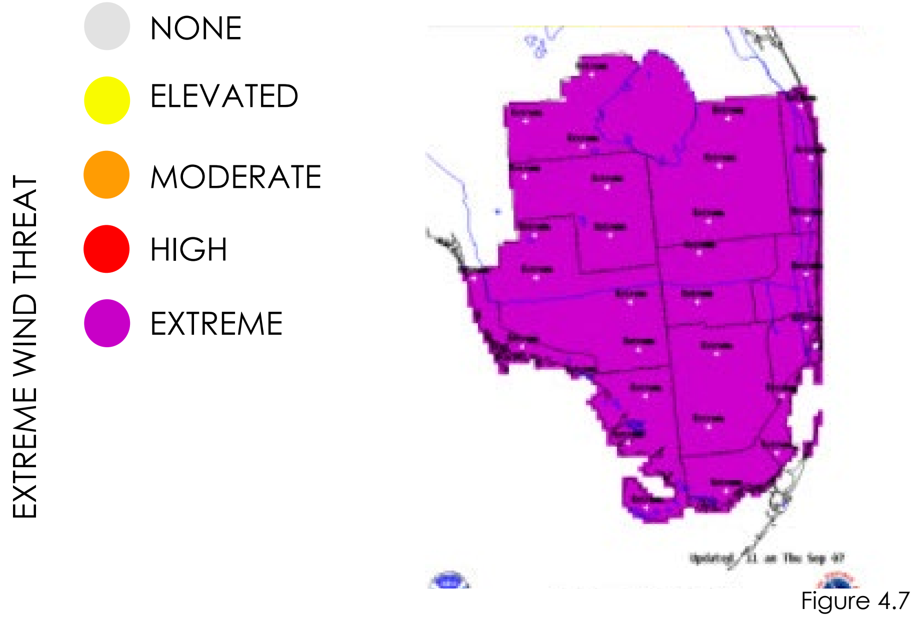


Figure 4.7

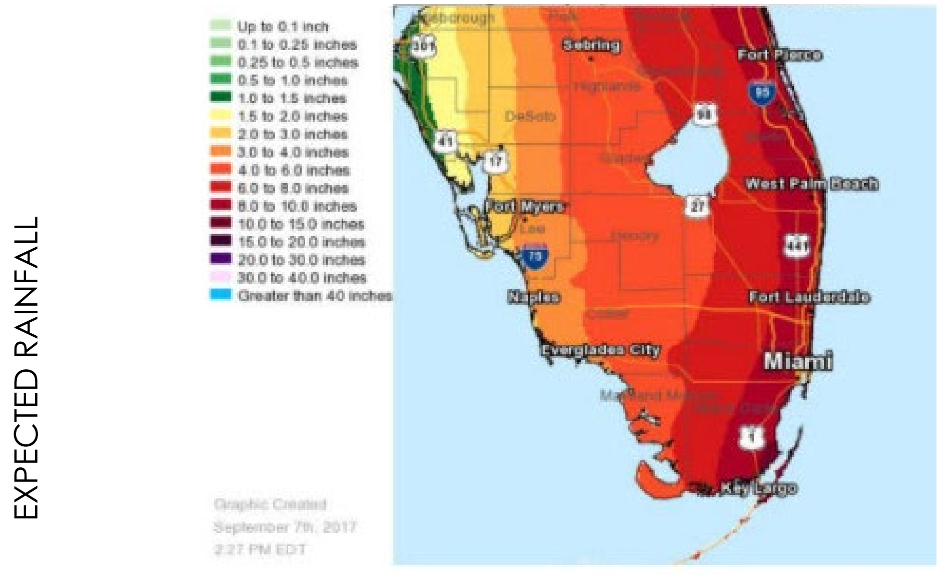


Figure 4.9

Figure 4.4 shows the number of times each county in Florida has been it by hurricanes. This is important to determine which county would be best for conducting a study on the related hypothesis topic. The red represents places that have been hit the worst and as seen in the color scale on the picture moving towards blue represents places that have not been hit as much.

Figure 4.5 shows the risk factor of being hit by a hurricane in a year glance for the counties of Florida. The red is a very high risk factor and as we move to green that is a very low risk factor for counties hit by hurricanes.

Figure 4.6 shows the parts of Florida that has high, blue, to low, pink, of wind-borne debris. The worst parts to be for wind-borne debris in Florida is south Florida.

Figure 4.7 shows extreme wind threat and potential places that are impacted by high winds. The purple represents extreme winds and the gray is the lowest or no wind threat.

Figure 4.8 shows potential storm surge threats to the lower Florida regions. The threat for storm surges tends to stay towards the base of the Florida peninsula and dies down as it gets closer to the center of the state.

Figure 4.9 shows expected rain fall for hurricane Irma as it goes over Florida. As we can see by from the image the southeast coast of Florida is getting the most rain fall from Irma.

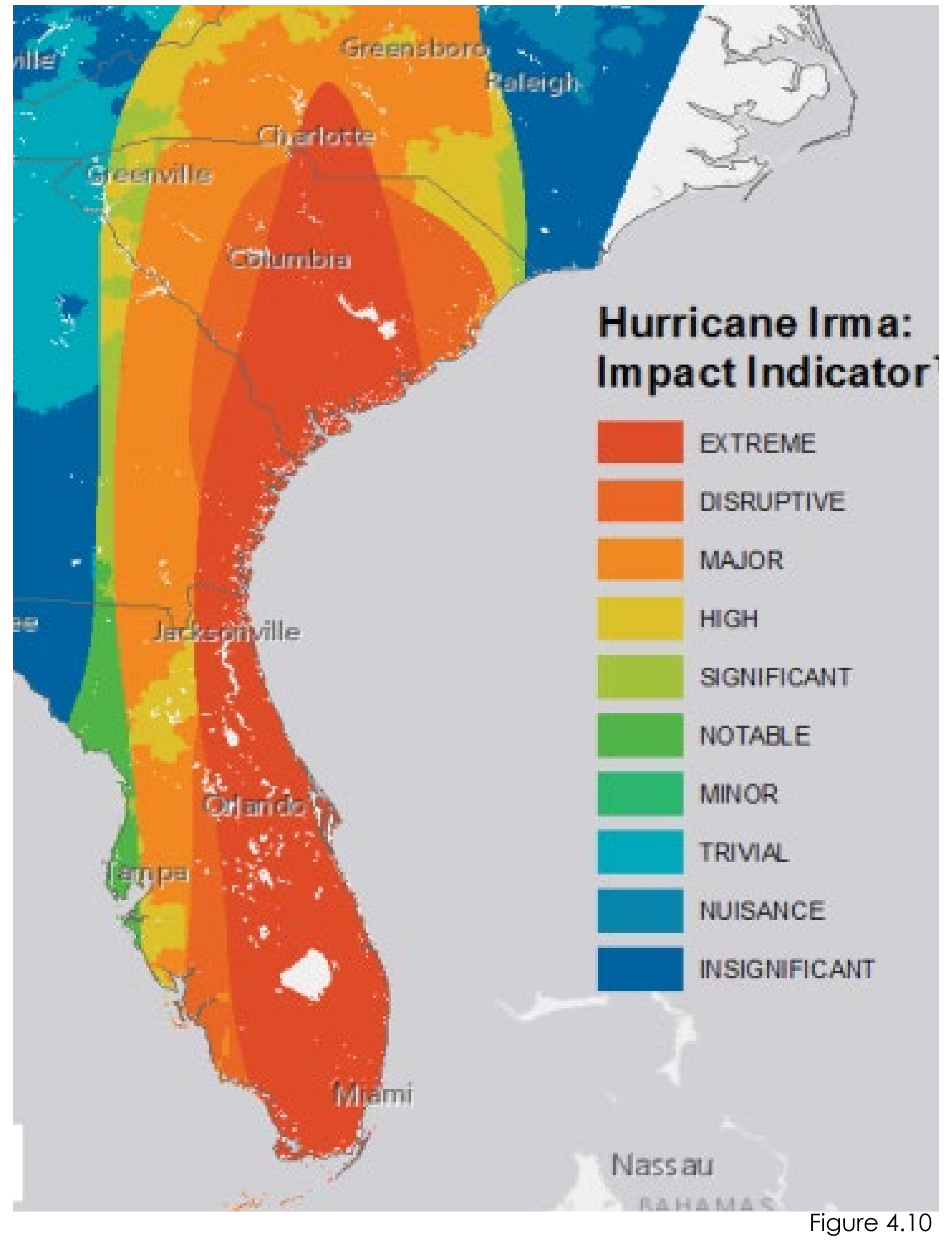


Figure 4.10

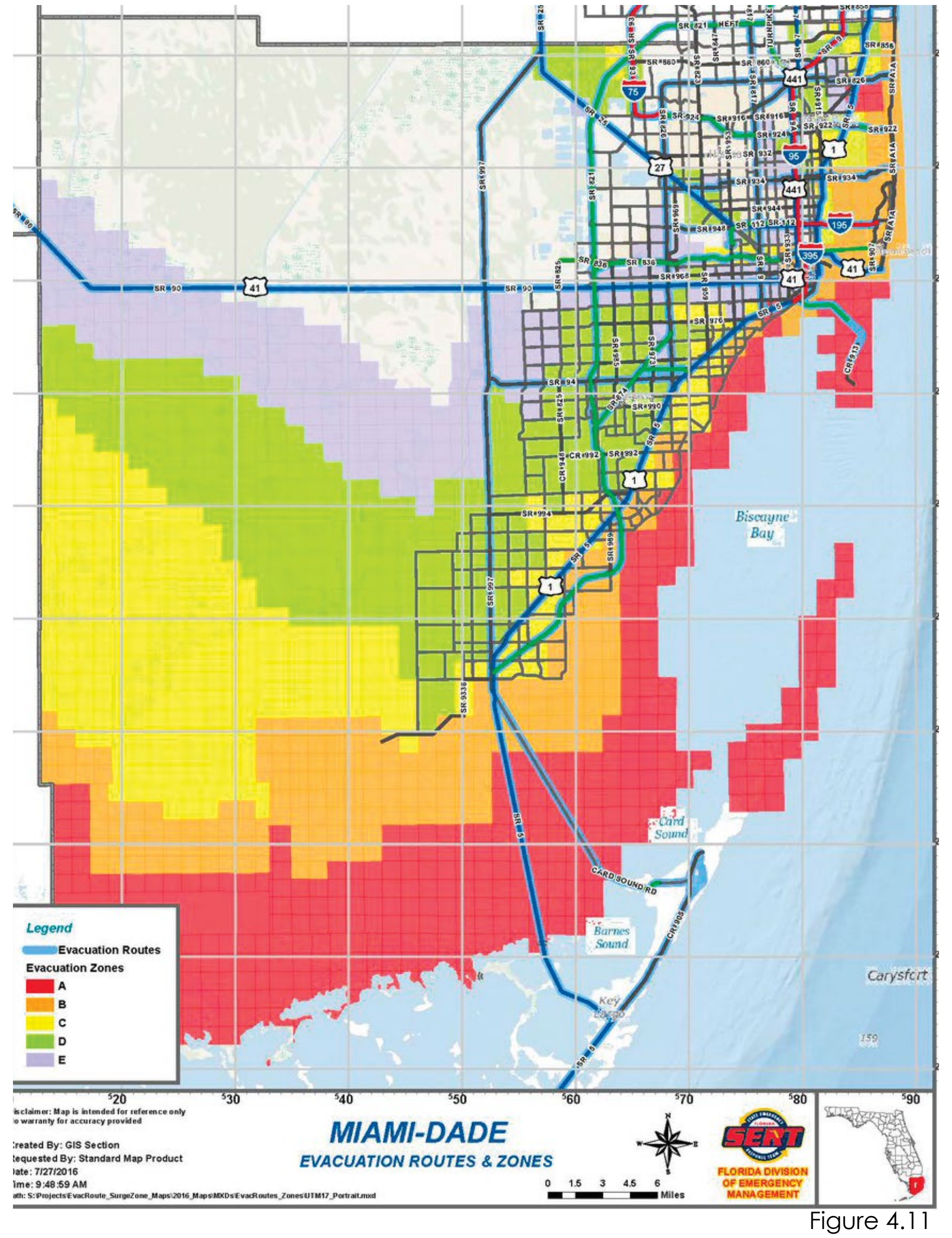


Figure 4.11

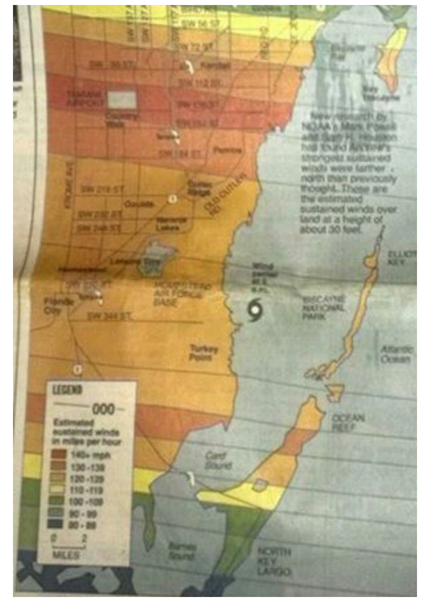


Figure 4.12

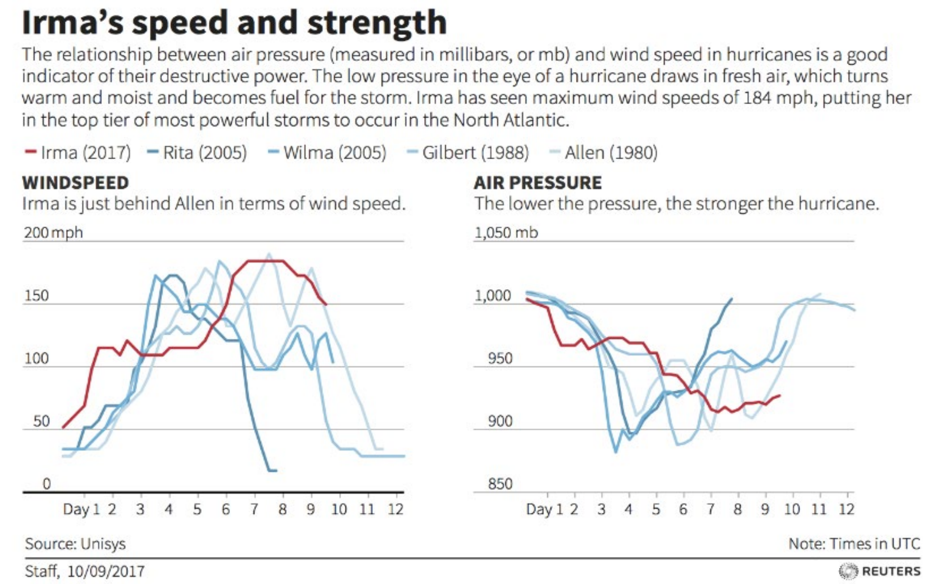


Figure 4.13

Figure 4.10 shows the destruction path of hurricane Irma, which just happened last year, 2017. This data is important to the design hypothesis because it gives the study a more up-to-date analysis on which counties in Florida were impacted by hurricanes last year and what we can expect for next year.

Figure 4.11 shows the evacuation plan for Dade County during a hurricane. The red zone is the people that are evacuated first and goes up to the purple people were they are the last people to evacuate if the hurricane gets that bad. The blue line is the main evacuation route were as the black smaller lines are ways to get to the main route if people are located more inland. What this graph provides for the design hypothesis is that I need to look towards the lower part of Miami for a site to examine.

Figure 4.12 is an article that shows where the eye of Andrew hit when it passed through Florida. In figure 4.13 we can start to see the more recent hurricane that hit Florida and with minimal reports as of now I was able to gather what the wind and air pressure speed was, giving a more updated information on the recent hurricanes. All of the information from the images put together allows me to hon in on a specific county where the hurricanes hit the worst. The data collected indicates that Culter Bay has been effected most by hurricanes.

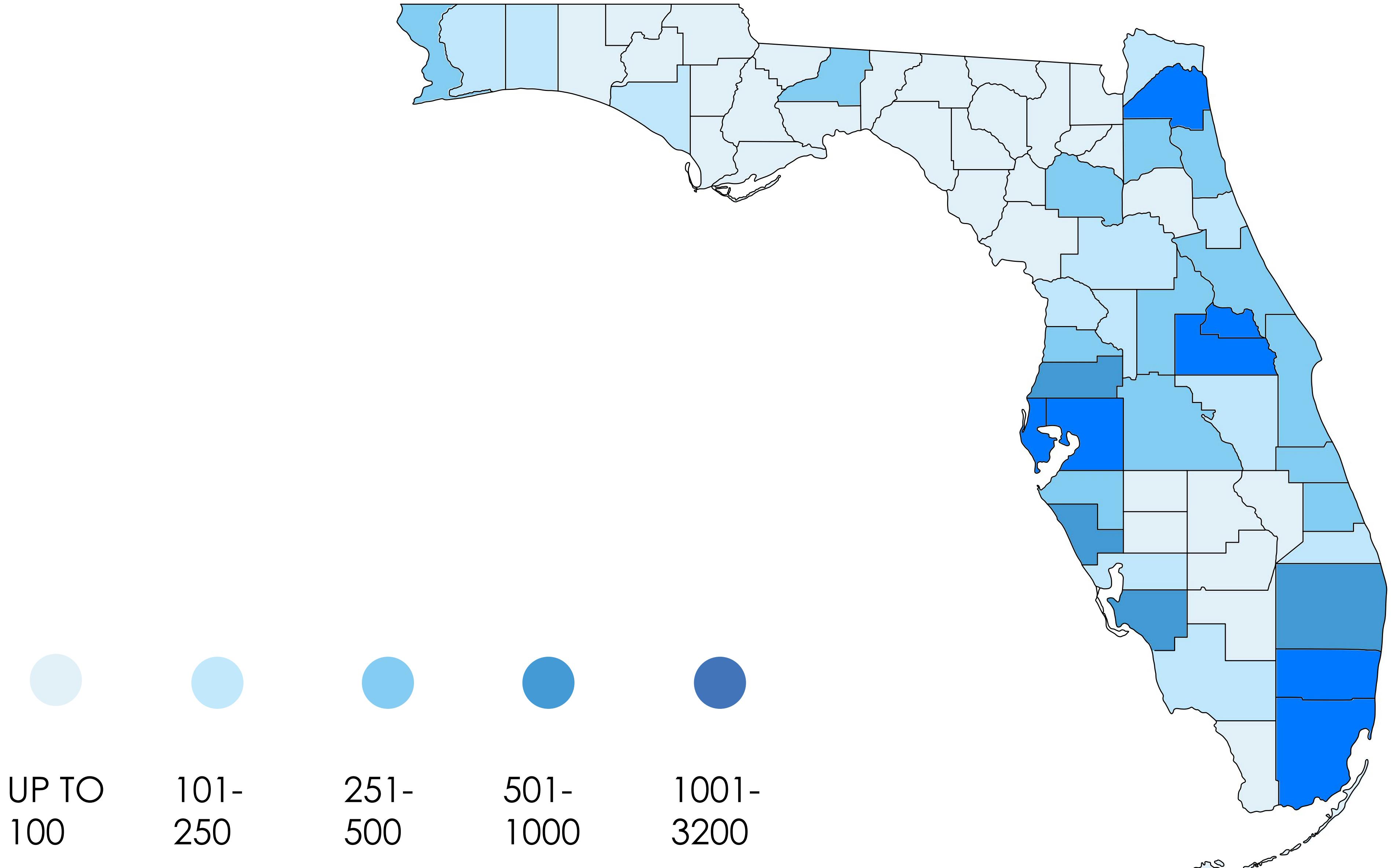


Figure 4.15

4.1.2 PHYSICAL AND SOCIO-SPATIAL PATTERNS

The Florida in figure 4.15 shows housing density per square km. The dark blue areas are places with high housing density where as the light blue is where there are no houses. From this diagram I was able to determine which counties would be best for a study looking at residential houses.

This graphs help with the design hypothesis because they point out which counties would be better suited for the design study. The design study focuses on a high populated middle class residential housing that is in harms way of hurricanes.

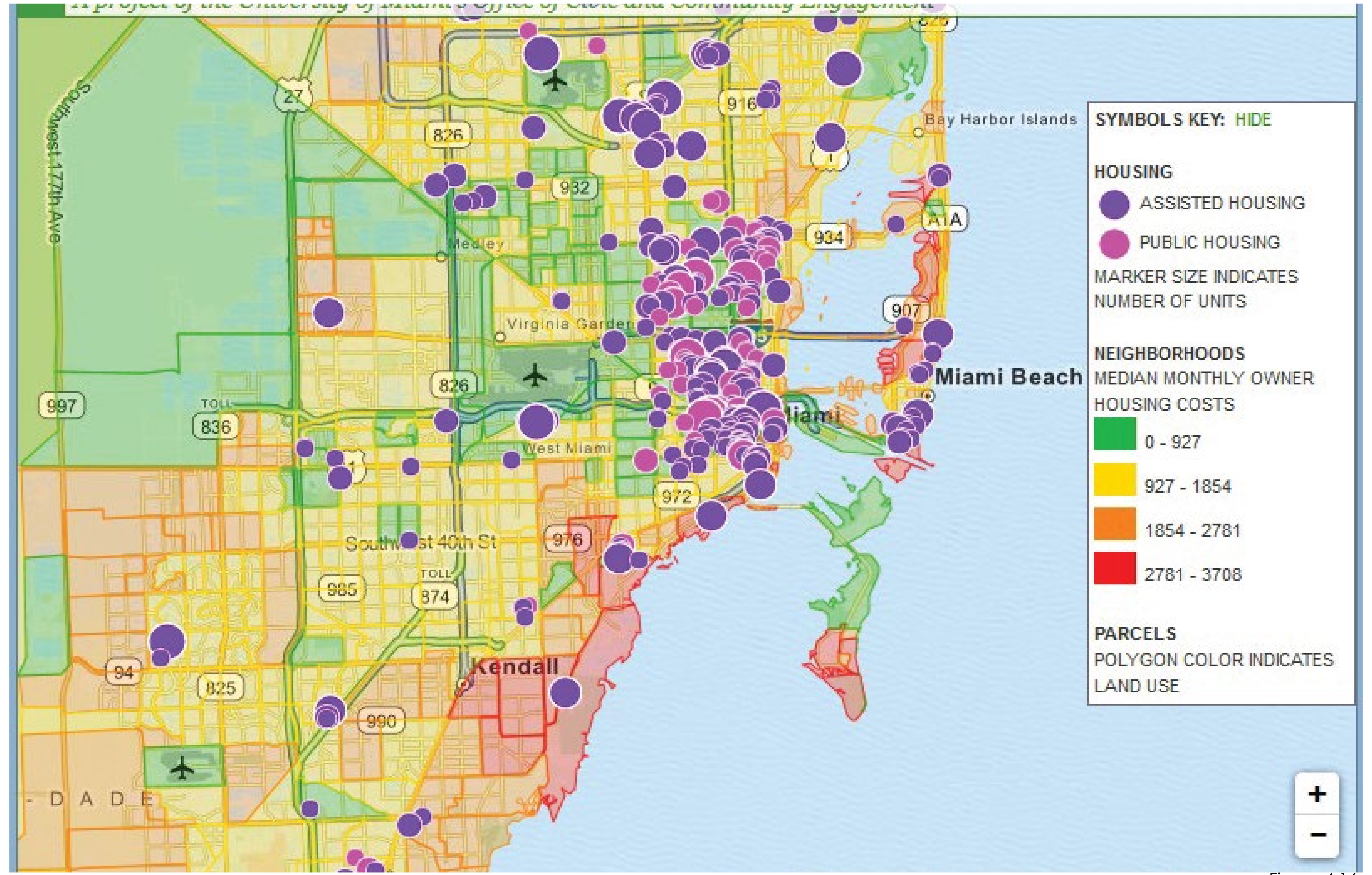


Figure 4.16

Figure 4.16 very similarly to figure 4.17 looks at housing and assisted and public housing. However what this graph offers that the other one does not is the median monthly owner housing cost in neighborhoods. The Colors go from green to red with green representing the lower monthly coast or lower income neighborhoods and the red representing the higher monthly coast or higher income neighborhoods. Figure 4.16 is important to the design hypothesis because it focuses on the range of people and their income which helps show places where there are poor and rich and the in-between. Since the design hypothesis focus on the in-between I will be focusing more on the range of yellow and orange.

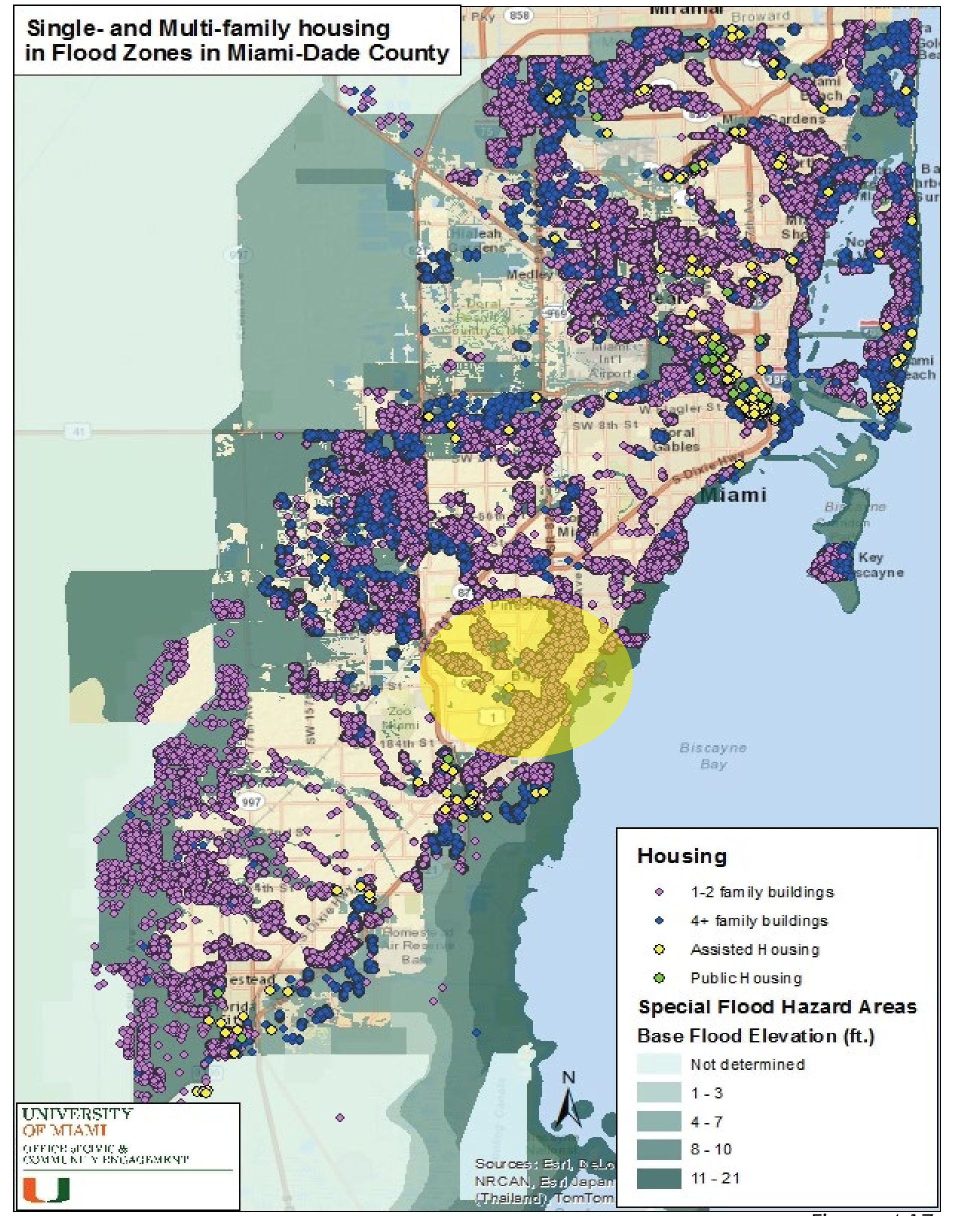
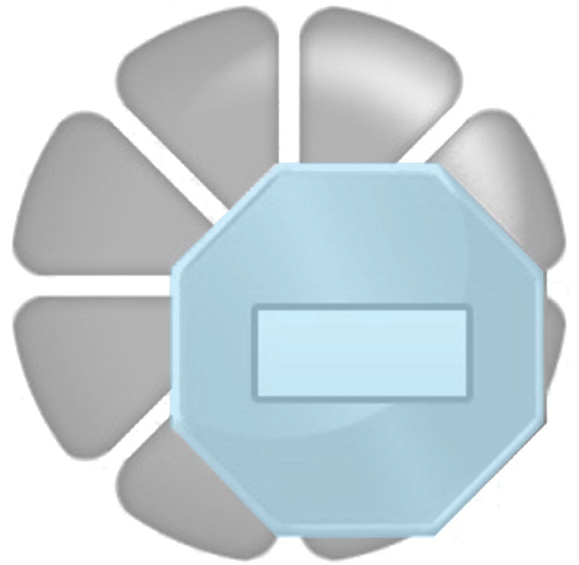
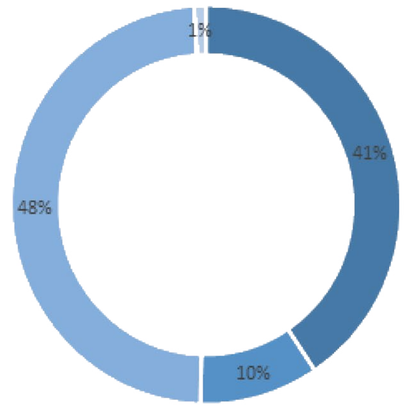


Figure 4.17

Figure 4.17 looks at single and multi-family housing in Dade county and the flood hazard areas based on elevation. The purple dots are 1-2 family housing, blue is 4+ family housing, yellow is assistant living and green is public housing. What this graph offers to the design hypothesis is where 1-2 family homes are, which is the type of family house I am looking at for the design study. Once the areas where the most purple was determined I looked at which ones where the closest to the coast. The two areas were the purple was the closest to the coast were downtown Miami and Culter Bay. Comparing this graph with the previous ones Culter Bay where already have a good foundation for study matched up in the range of income. Thus, I chose Culter bay as my site to study and look at for this design hypothesis.



HOUSING DENSITY PER SQ. MILE:	998.83
AVERAGE NUMBER OF ROOMS:	526
HOUSEHOLD SIZE:	4-3
AVERAGE HOME VALUE:	203,300
AVERAGE MONTHLY RENT:	1,112
MOST HOUSES BUILT WERE IN:	1976

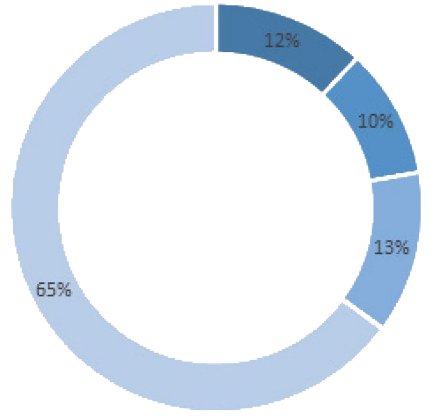


DETACHED

1 UNIT ATTACHED

2 < UNITS ATTACHED

MOBILE HOME

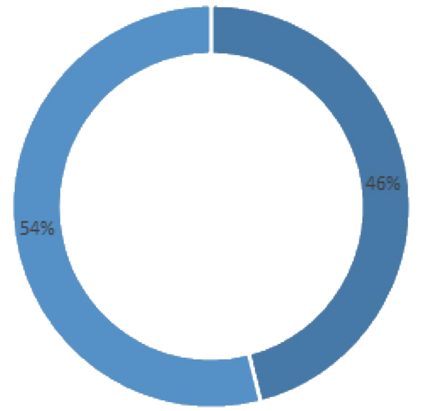


2010 - 2013

2009 - 2000

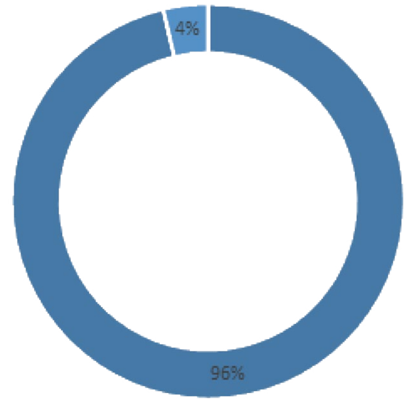
1999-1990

1980 > LATER



RENTED HOMES

OWNED HOMES



OCCUPIED

VACANT

4.1.3 EXISTING SITE CONDITIONS

Now that I had a site, I looked at specific statistics of the area that would be important to the upcoming re-design of houses. I looked at cost, housing units, owner ship, number of rooms/baths, floor plan layout, year built of houses and housing shape. Each category is represented above by a blue icon and the breakdown of each are represented in a blue box. What this data adds to the design hypothesis is the program in which the design hypothesis will be applied.

The type of housing found in Florida refers to the number of units, how large each unit is and overall density of the houses. It also shows the average appearance and design of a typical Florida house. From this data I identified that houses in Florida are typically of wood frame construction with a stucco outer shell and tile roof. I also determined that most of the housing units are single detached homes and the rest consist of mostly apartments and town homes. This is important because it, along with the program, shows the need for newly designed detached housing units in the state of Florida.

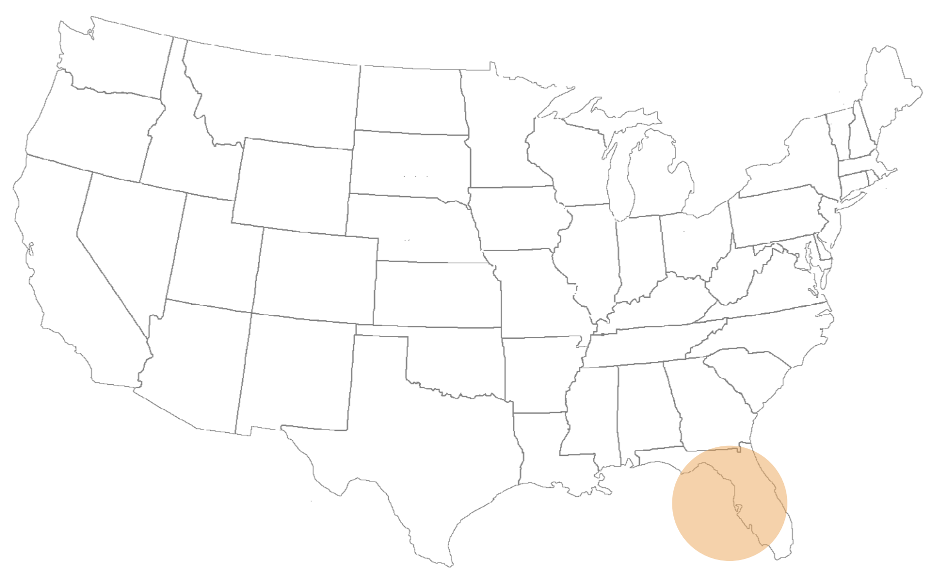
Year built and home value are important because they tell us that the houses built in Florida are mostly from 1980 and earlier which means they are built to the old building code standards, which we know were not adequate from a hurricane survivability perspective. They could fail in any upcoming hurricane season. It is time or a systematic upgrade plan for middle class working neighborhoods, so that people can transition into a more reliable stable house that is better built to survive hurricanes if theirs is lost.

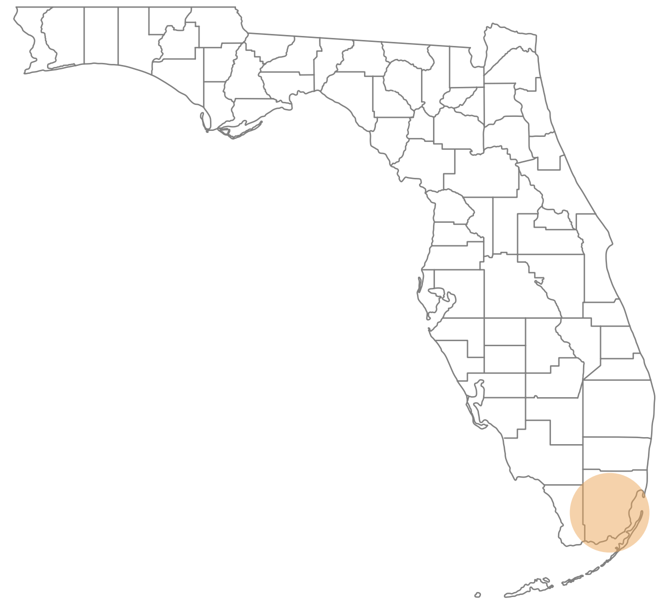
Program as shown above is important to the design hypothesis because it tells us what most houses are like in the area, what most people are expecting to see and what most people need to accommodate their living/ family needs. What program shows is that the majority of houses will need 3-4 bedrooms and most shapes are square or rectangular which from our previous studies we know that this is not the best design for a hurricane proof house. What this data also shows are the importance of the houses remaining standing after a hurricane because most of the houses are occupied and half of them are still owned by the same family.

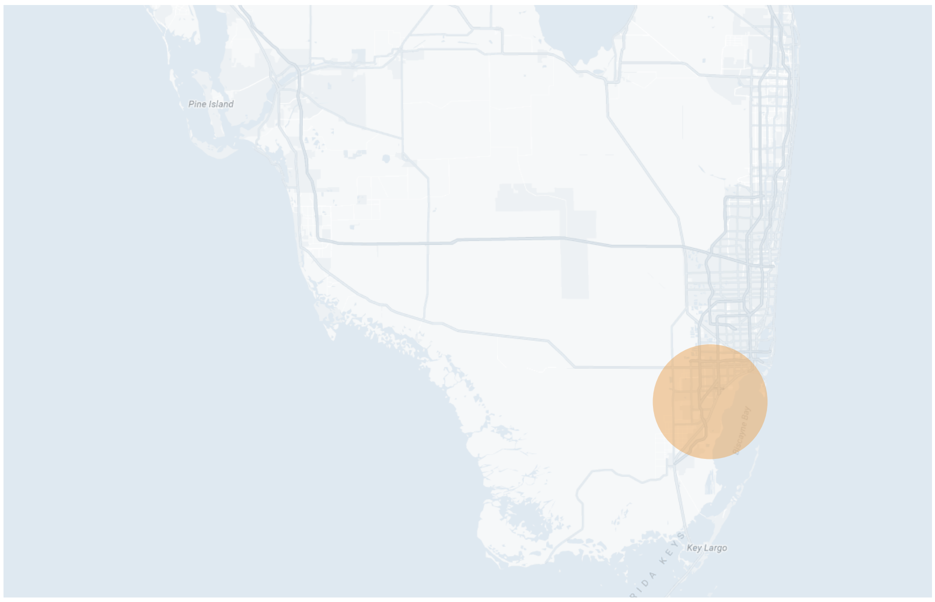
CHAPTER

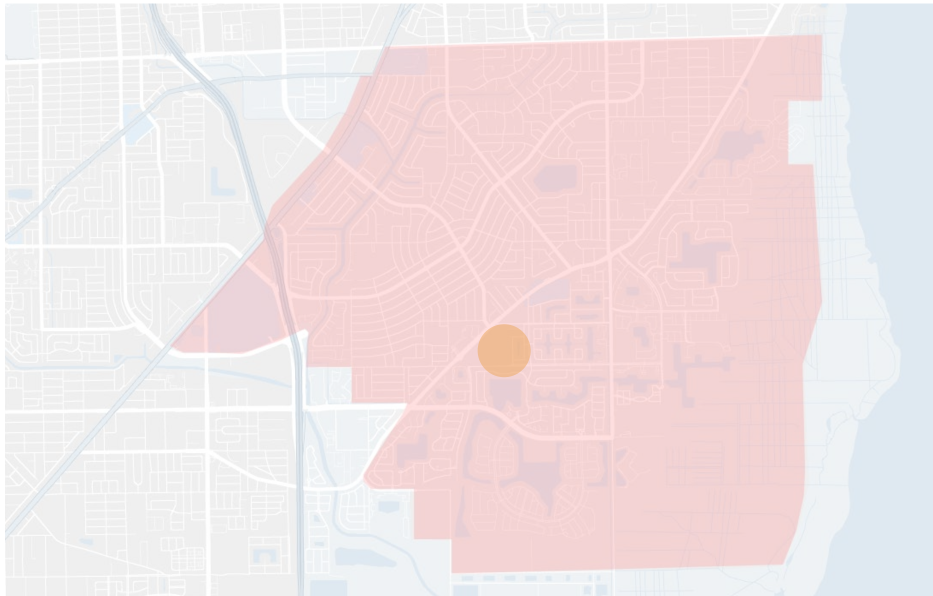
4.2

SITE & PROGRAM ANALYSIS









4.2.1
SITE RELATIONSHIP AND USAGE PATTERNS

Figure 4.18 represents the selected area of study based on the data presented above. I chose three sites around the area to study and analyze. The site location that was selected is in Miami Dade County Florida. It is called Cutler Bay. The three sites I selected were chose because each represents a repeating grid for neighborhoods in Florida. Each site has different natural and layout features that would affect houses during a hurricane.

https://www.google.com/maps/place/Cutler+Bay,+-FL/@25.5721743,-80.3427664,920m/data=!3m1!1e3!4m5!3m4!1s0x-88d9c2e89769bd13:0x1e551b89da719cd!8m2!3d25.5808323!4d-80.3468593

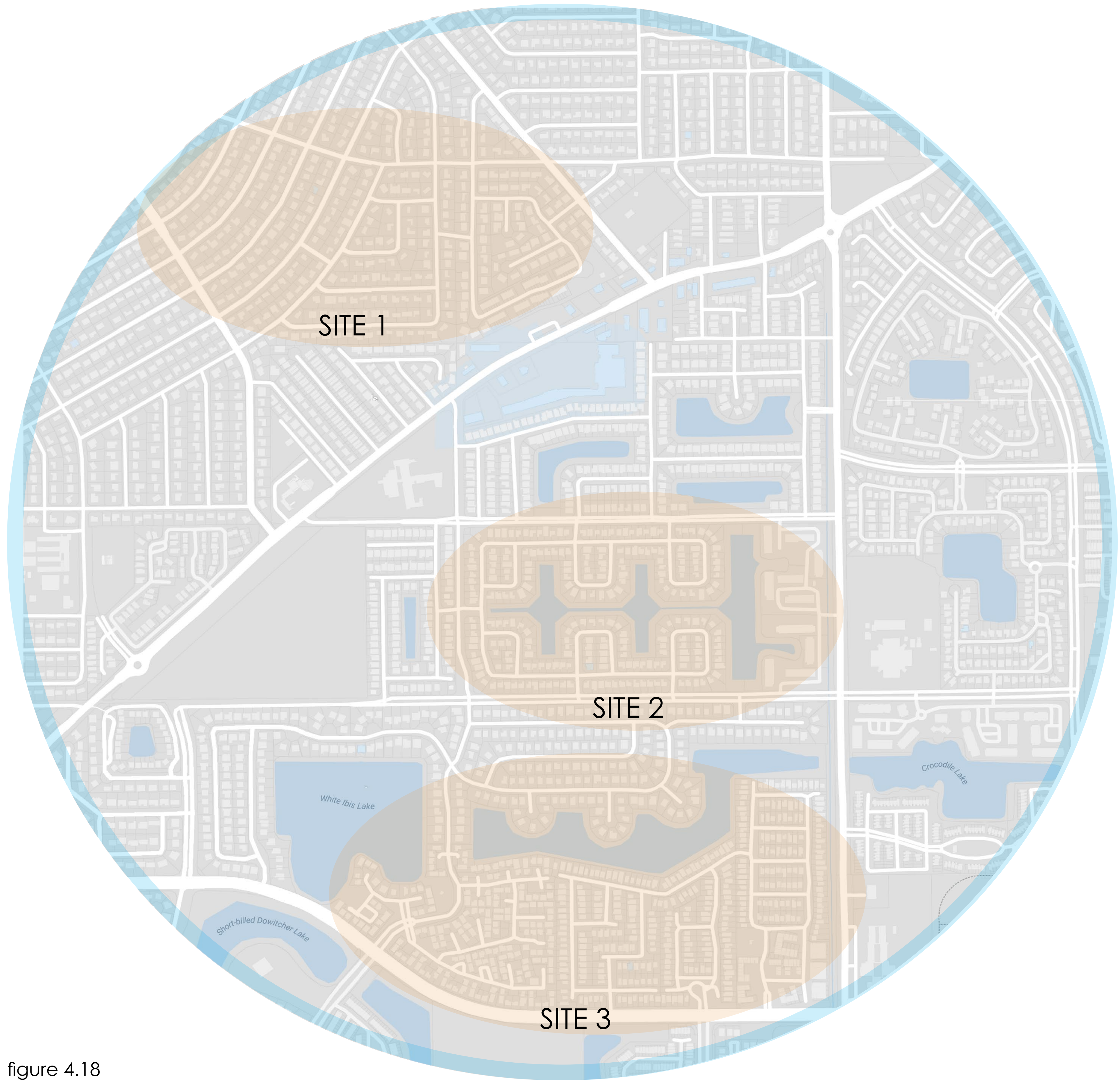
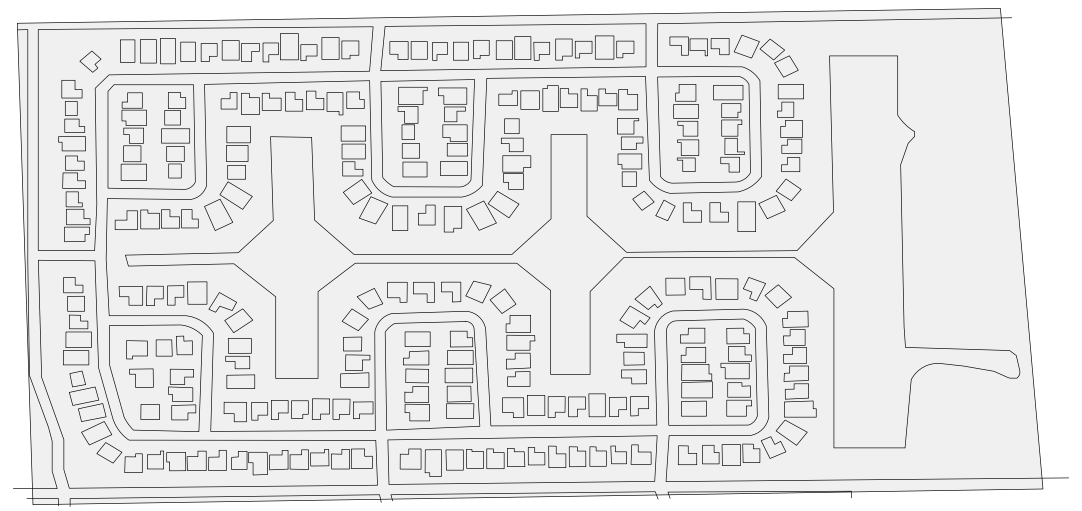
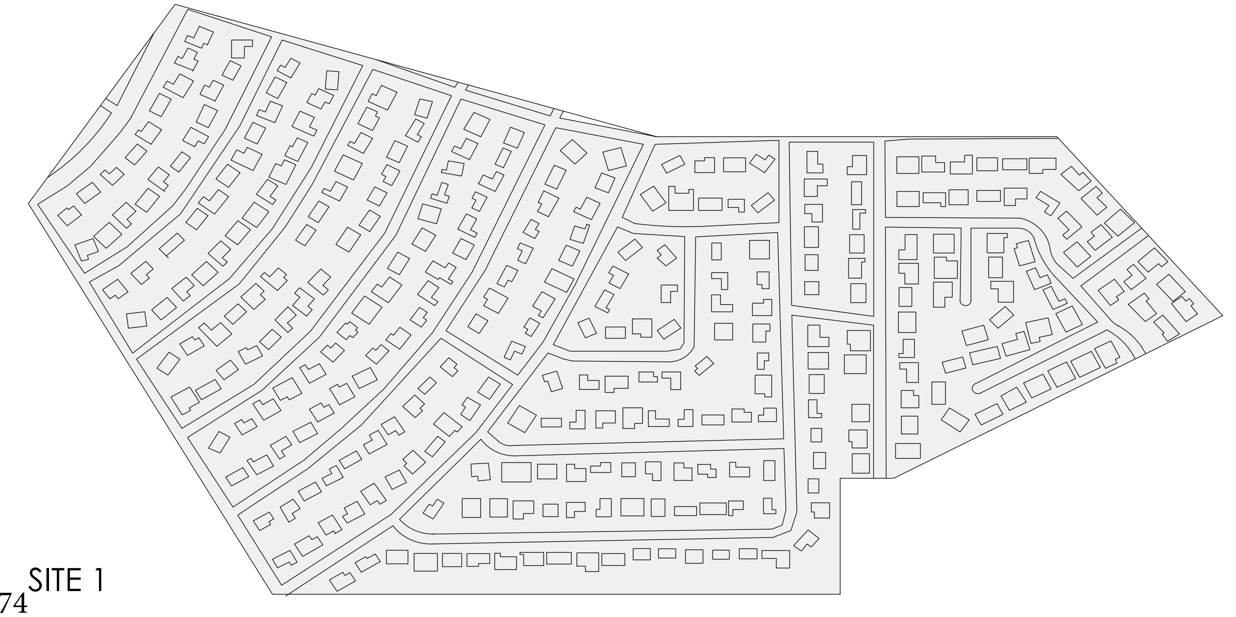


figure 4.18

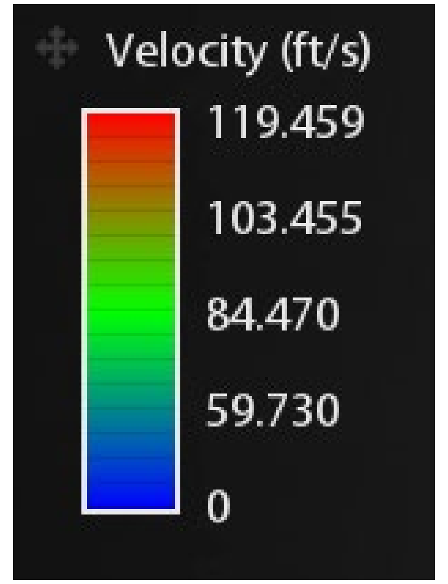


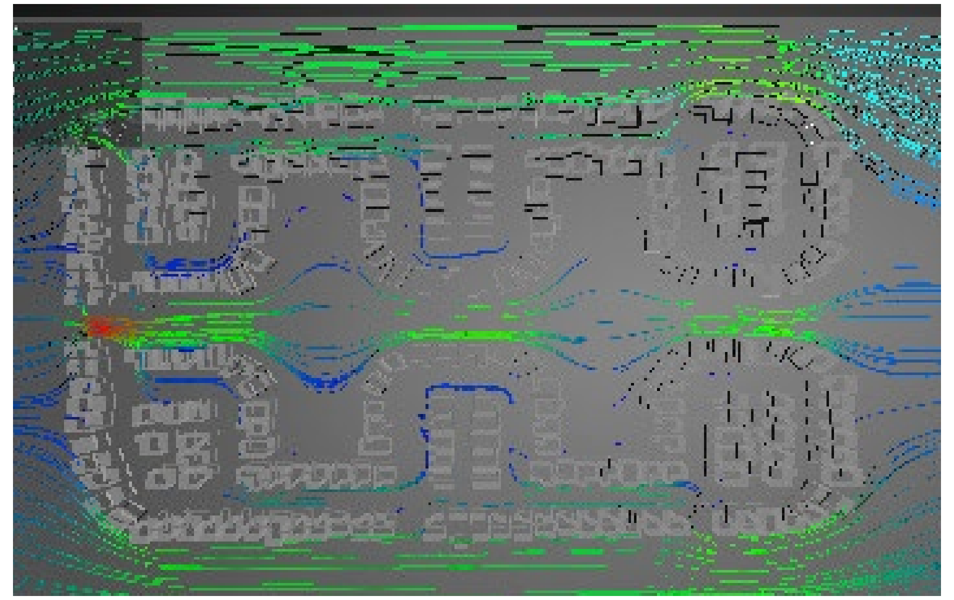
SITE 2

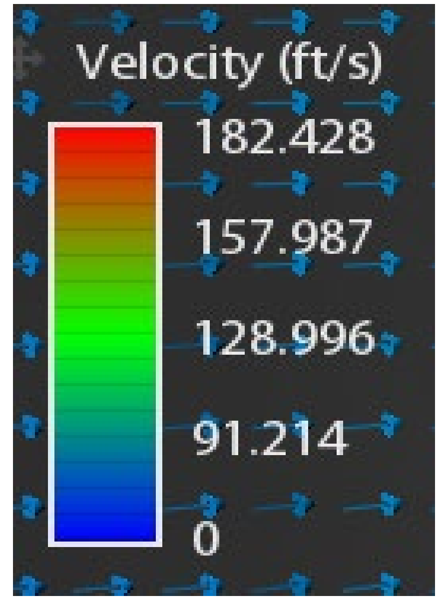
SITE 3

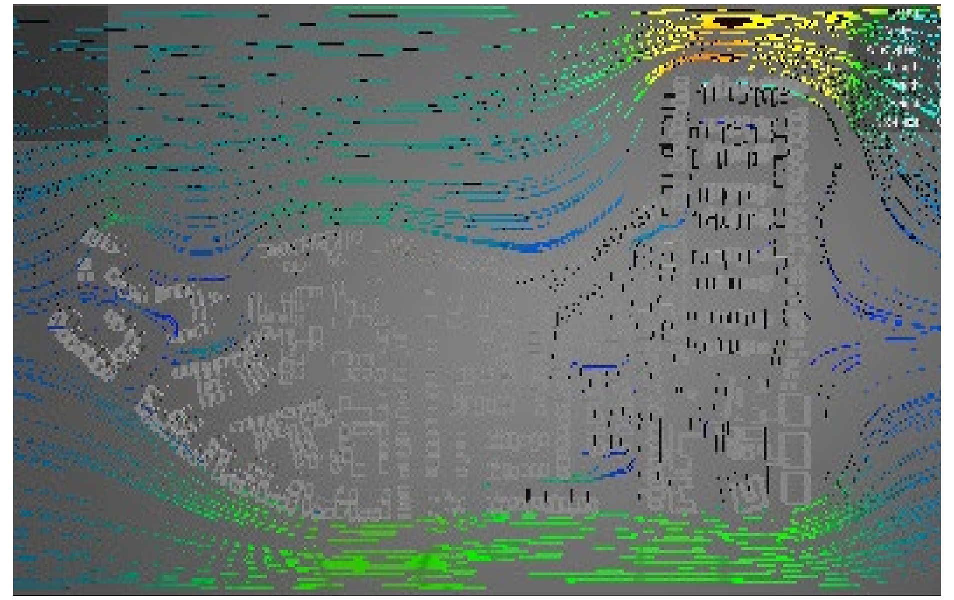


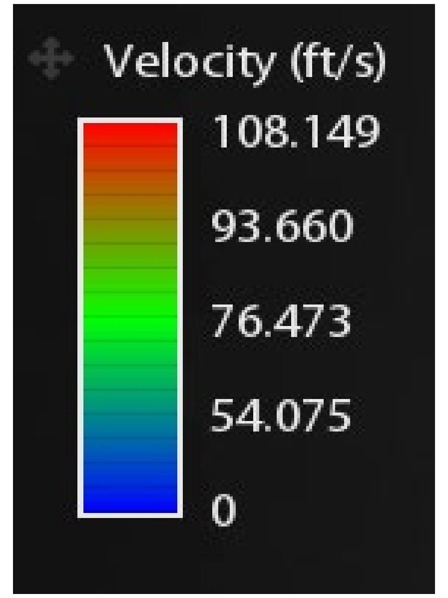
SITE 1

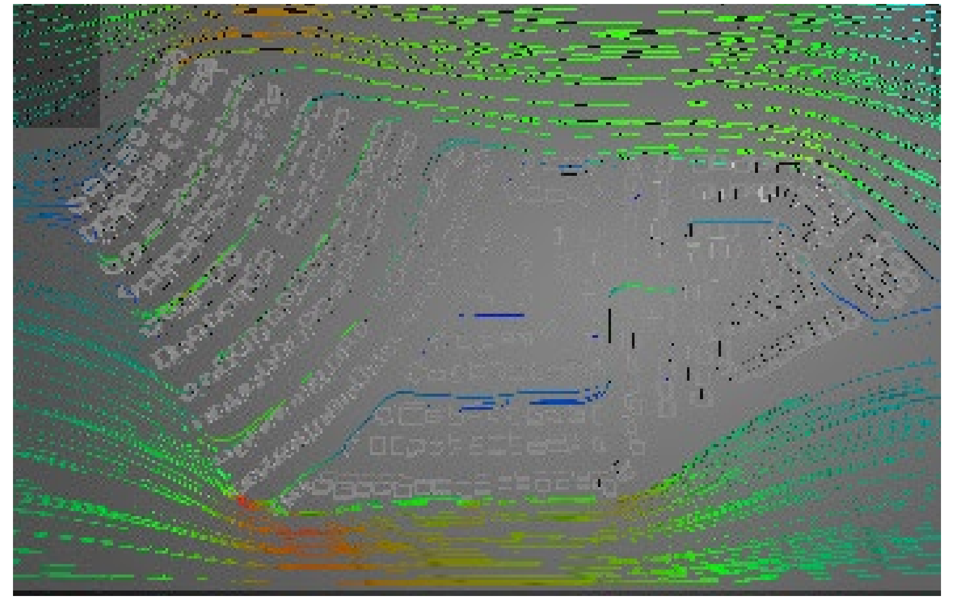




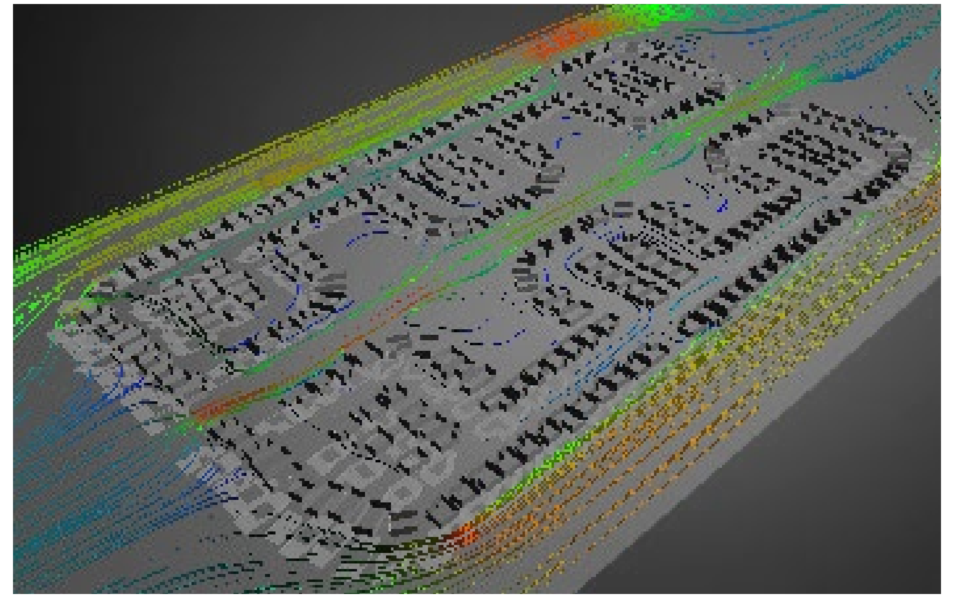


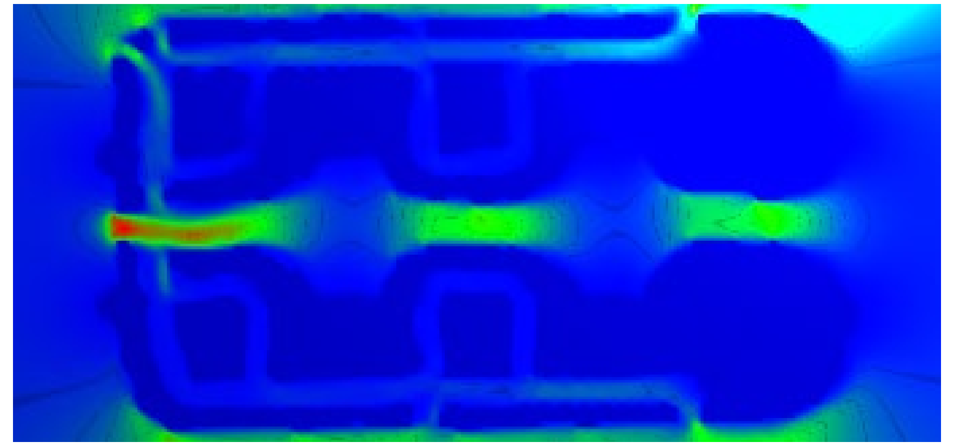




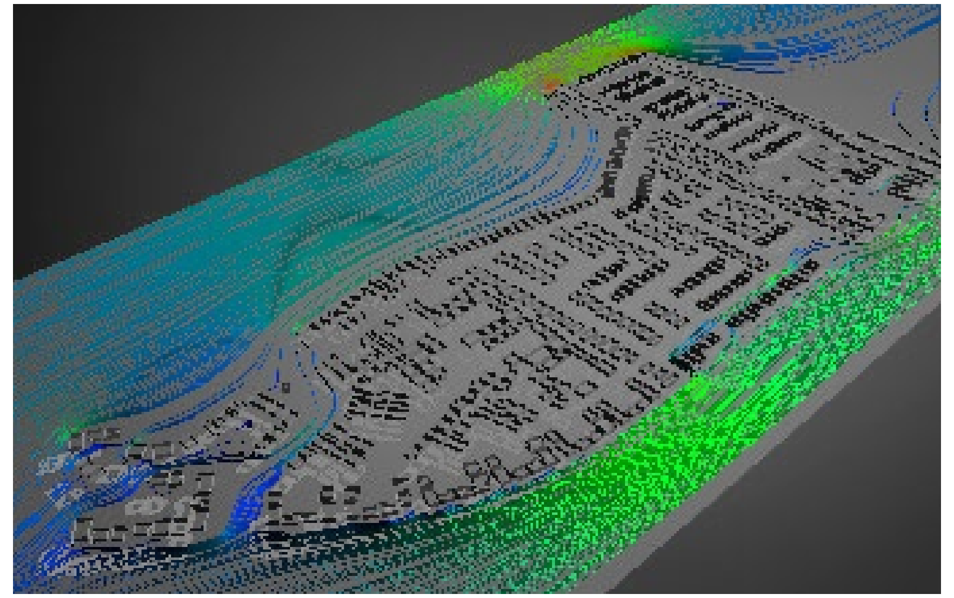


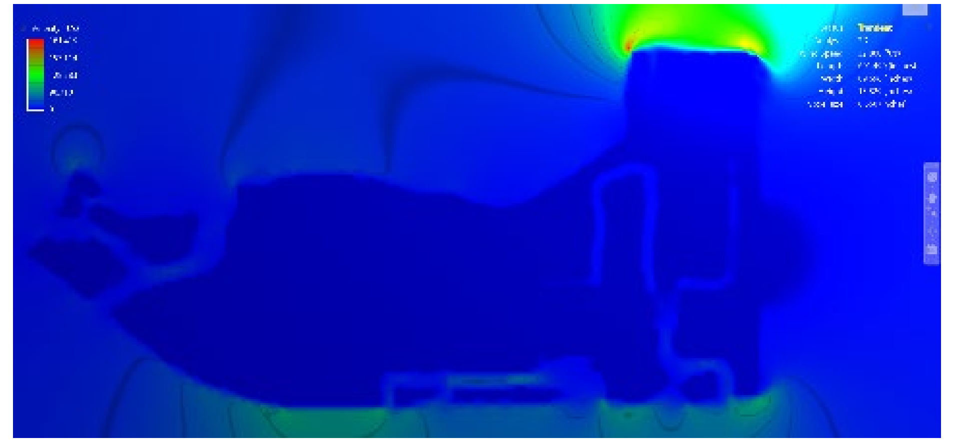
TOP VIEW WIND STUDY



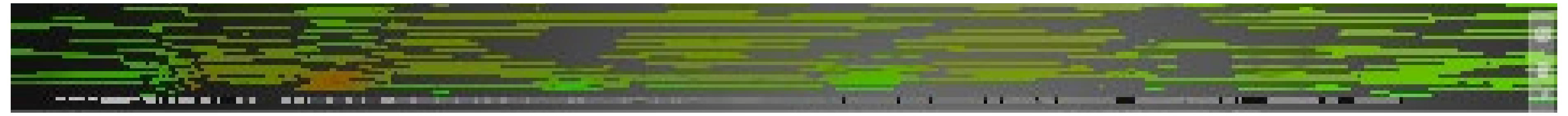


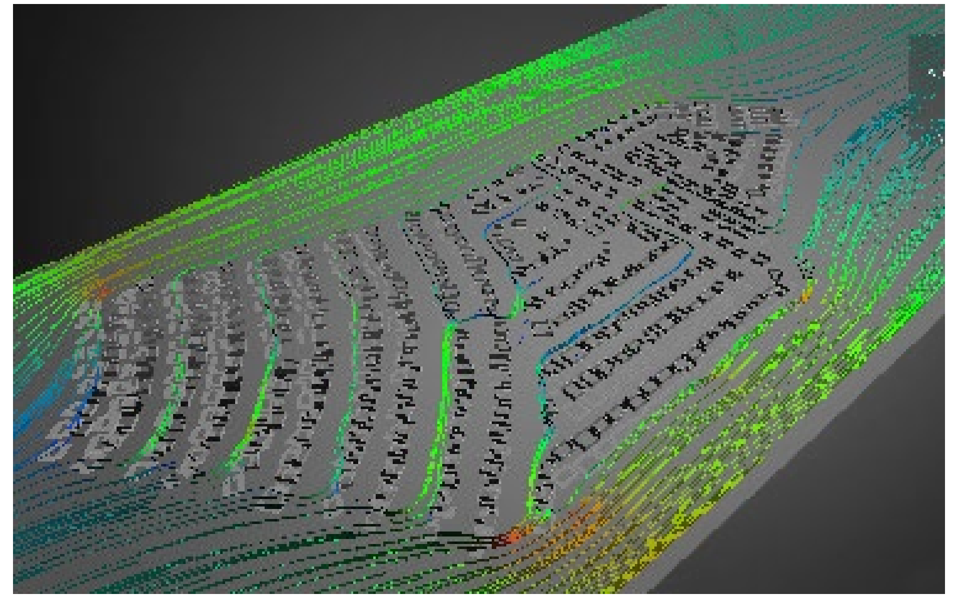
For site 1, as seen here and on p76, wind is flowing smoothly around the main soutside of the neighborhood and through the center. But we start to see wind being trapped in the smaller more compact pockets. However, the wind on the outside is stronger flowing around and right down the middle than in the smaller pockets where is has been dissipated by the surrounding houses.

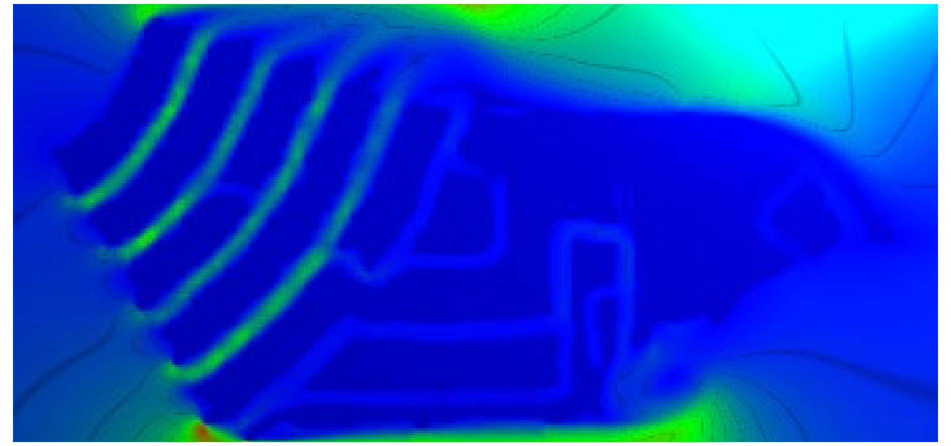




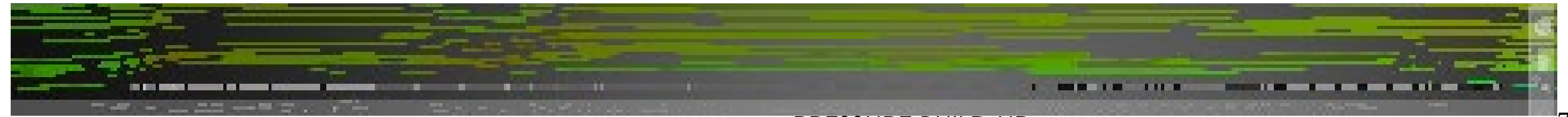
For site 2 , as seen here and on p76, the wind is stronger on the top right corner of the neighborhood where there is a jut out. This happens because the wind has been allowed to build up and then peak at this point. But unlike the first site, we see wind that moves through the center has been slowed and is not as strong as well as broken up.







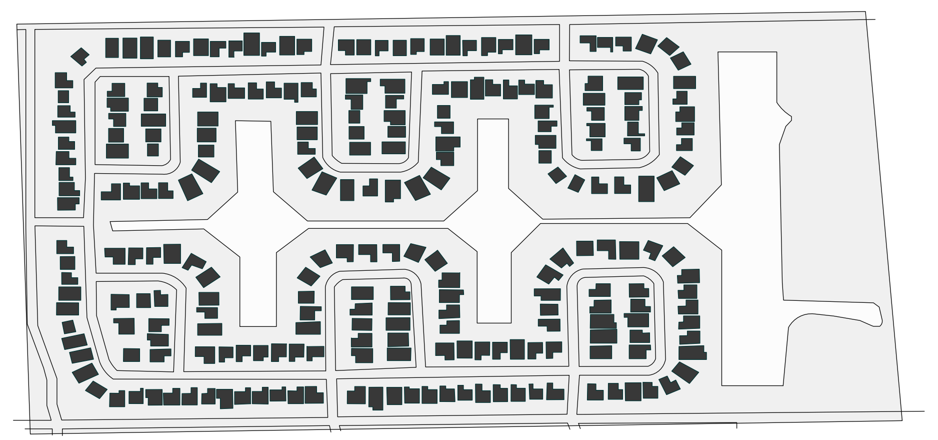
For Site 3 , as seen here and on p76, the stronger wind forces are all on the outside and the wind is broken up as it gets closer to the center of neighborhood, similarly to site 2.



PERSPECTIVE

ELEVATION

PRESSURE BUILD UP



SITE 1

SITE 2

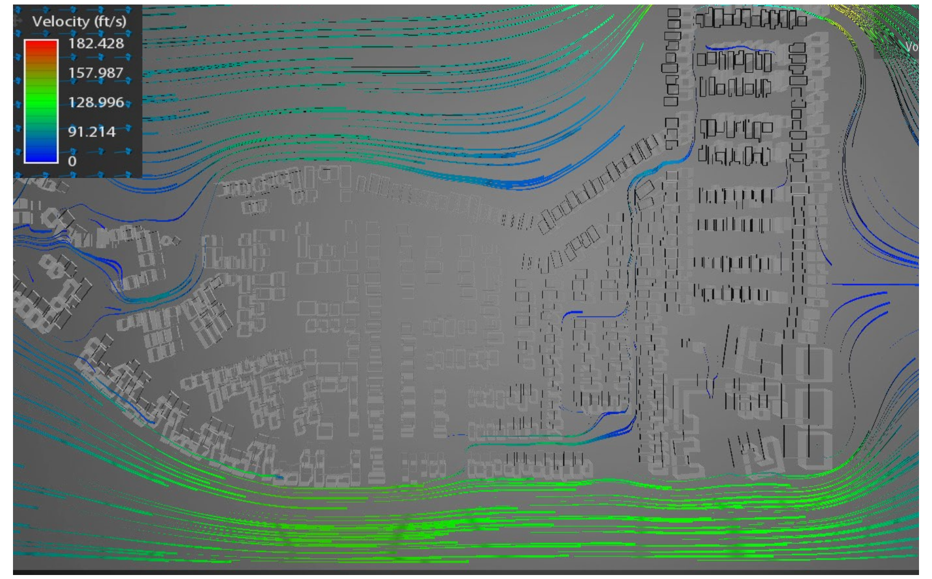
SITE 3

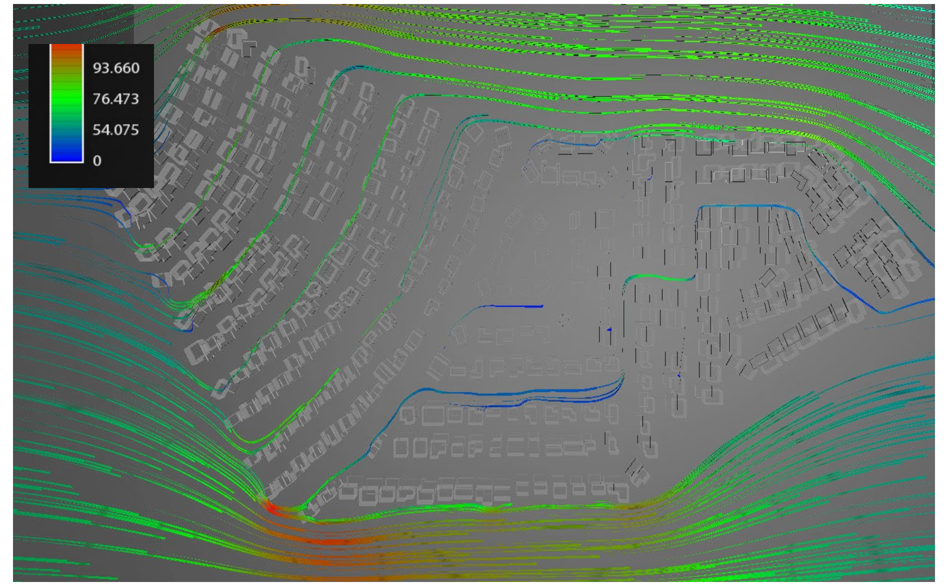
4.2.2 FIGURE GROUND RELATIONSHIP AND USAGE PATTERNS: HOUSING SHAPE

The images that are represented on page 76 show figure ground. Which is the relating to or denoting the perception of images by the distinction of objects from a background from which they appear to stand out, especially in contexts where this distinction is ambiguous. What these images show is the relationship between houses, site and streets. Relative to shape

Housing
Roads

Rectangle Housing
Square Housing
One Jut-Out
Two-More Jut-One

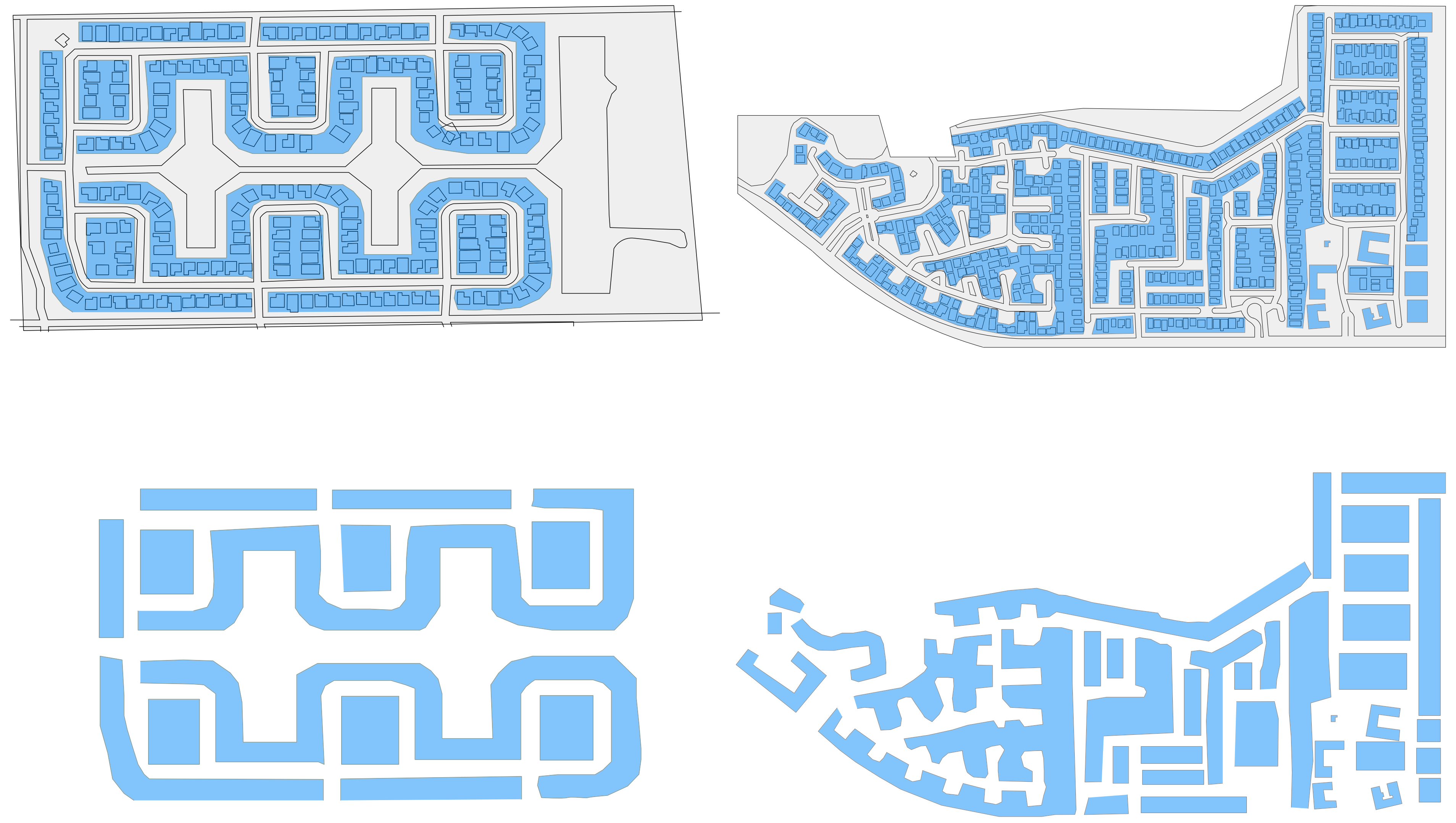




The images that are represented on page 77 show different shapes of the houses, whether they are rectangular or square shape. What this shows is if the houses in the neighborhood are more adaptive to hurricanes or not and if you refer back to pages 26-31 to the principles, we can see that the shape is important because the wind impacts square and pocket shapes worse than rectangular shapes. What these diagrams allow us to see is how well the neighborhood is designed to withstand a hurricane.

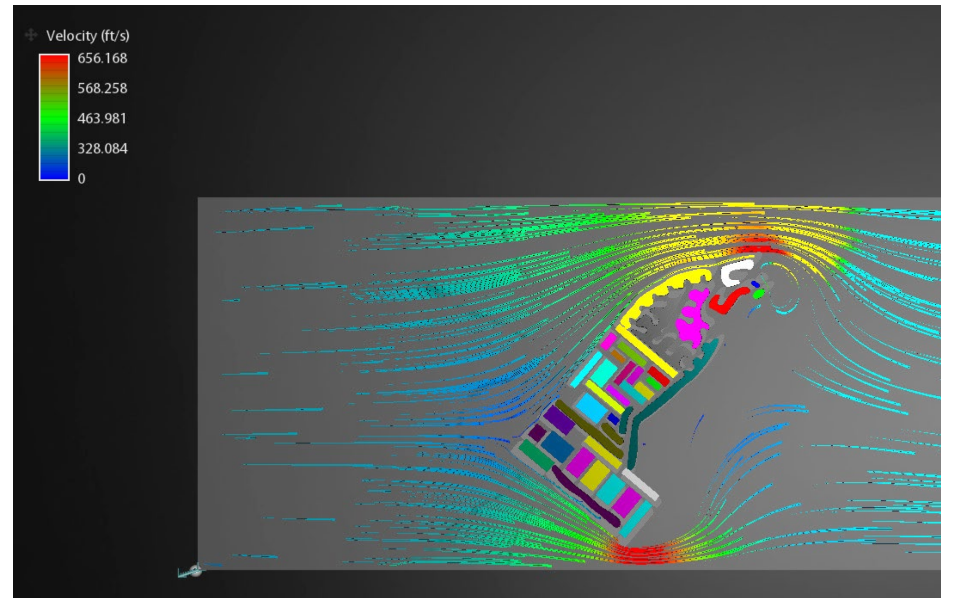
Wind builds up speed as it wraps around corners. The diagrams above show wind of a category 5 hurricane, 157 mph, and how it picks up and decreases speed as it moves throughout the different shapes of the neighborhood. The points of the neighborhood are where the wind picks up the most, but this is assuming nothing els is surrounding the neighborhood. In this pattern the wind is dispersed at the front but is concentrated to the sides giving the sides higher wind speed.

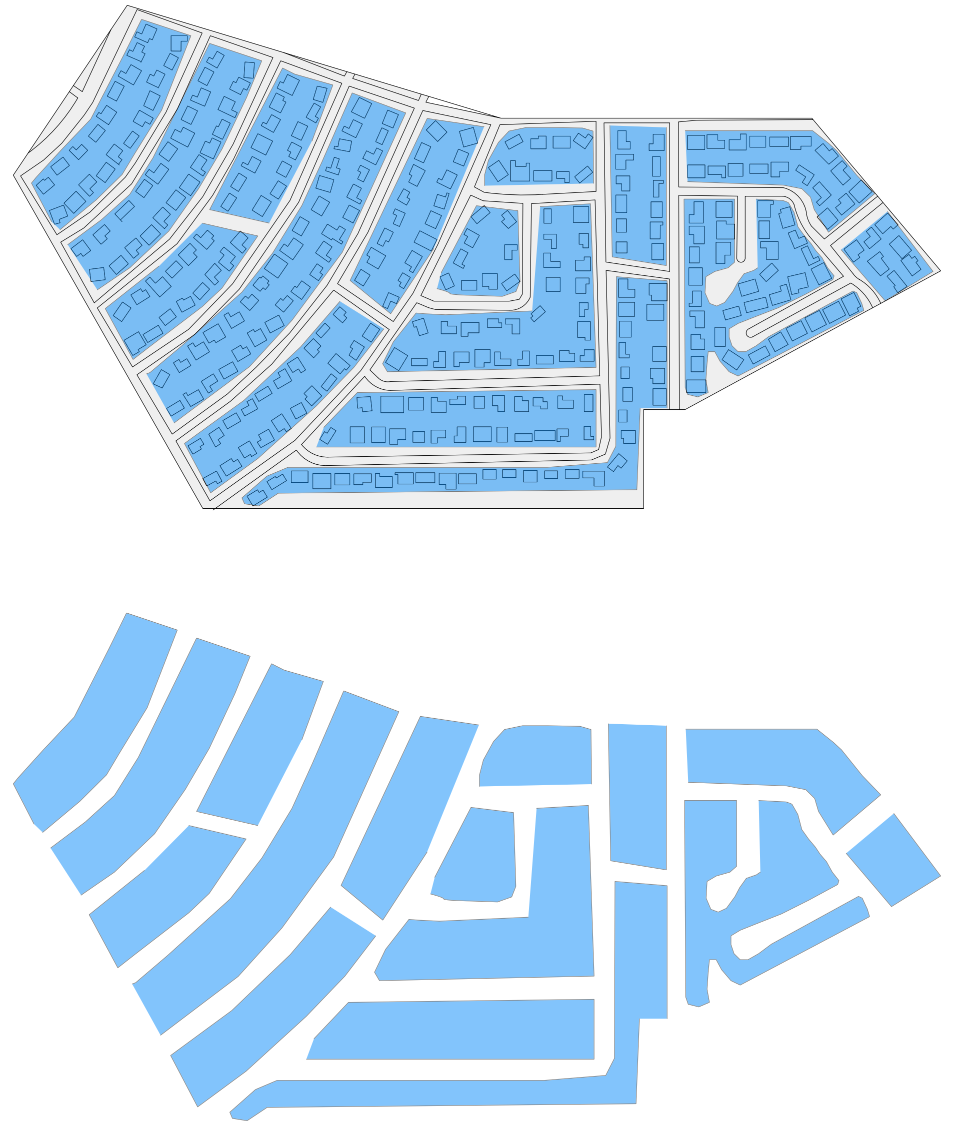
Wind builds up speed as it wraps around corners. The diagrams above show wind of a category 5 hurricane, 157 mph, and how it picks up and decreases speed as it moves throughout the different shapes of the buildings. The points of the neighborhood where the wind picks up the most are on the outside, but this is assuming nothing else is surrounding the neighborhood. In this pattern we can see that the wind is moving through most of the spaces and being dispersed and slowed down toward the center,

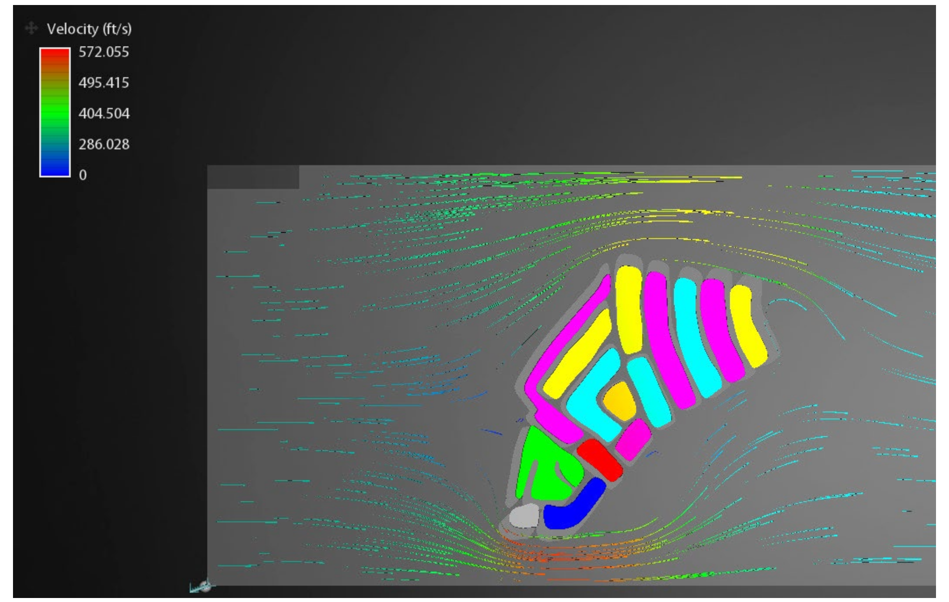


Housing Cluster

4.2.2
FIGURE GROUND RELATIONSHIP AND USAGE PATTERNS: HOUSING CLUSTERS

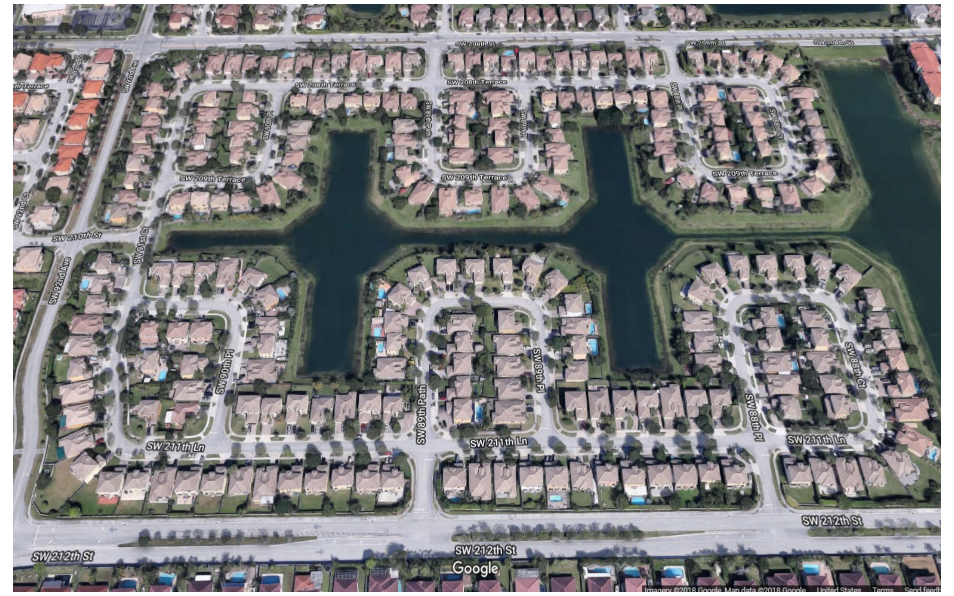


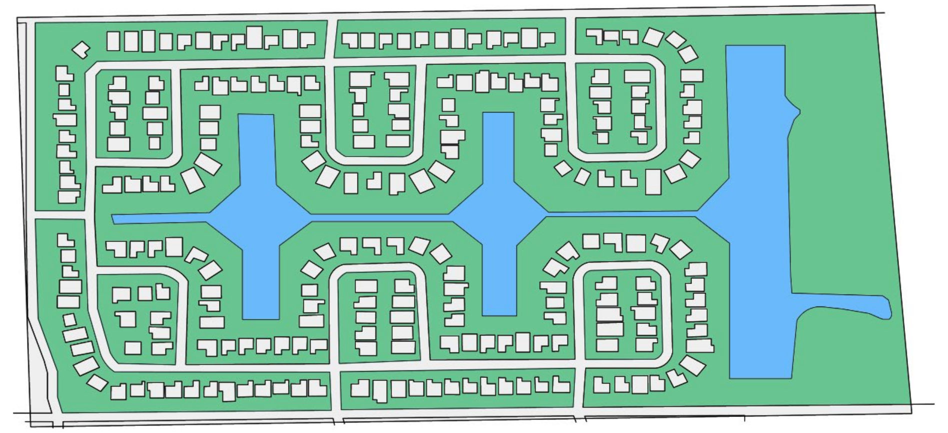


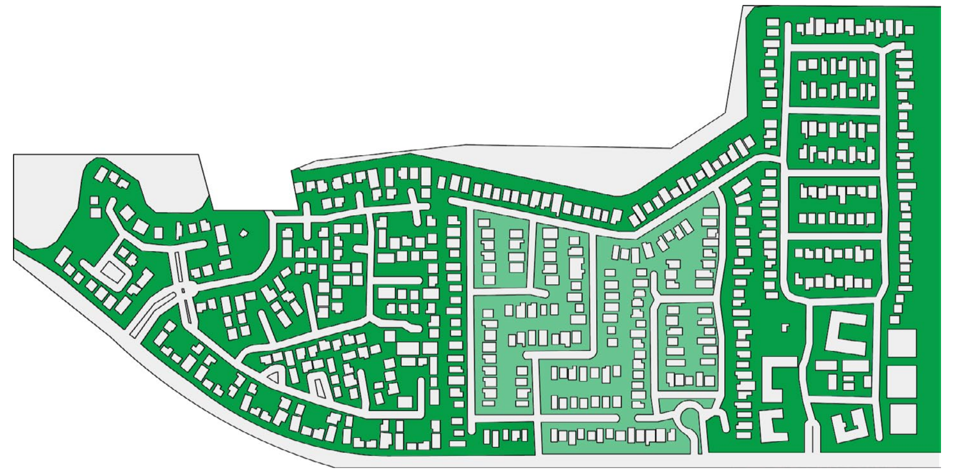


CLUSTERING	SITE 2	SITE 3
ORGANIC GOOD		●
LINER MODERATE		
MIXED BAD	●	
WIND (FT/Sec)		
150-250 GOOD		
250-450 MODERATE		
450-OVER BAD	●	●

The images that are represented on pages 78-79 are what happening if we look at the houses in clusters vs. individually. What this study does is look at the neighborhood from a different perspective. The cluster introduces the idea of a large canopy covering several houses for wind protection. The concept of this study is using each individual house as an extension of the next.

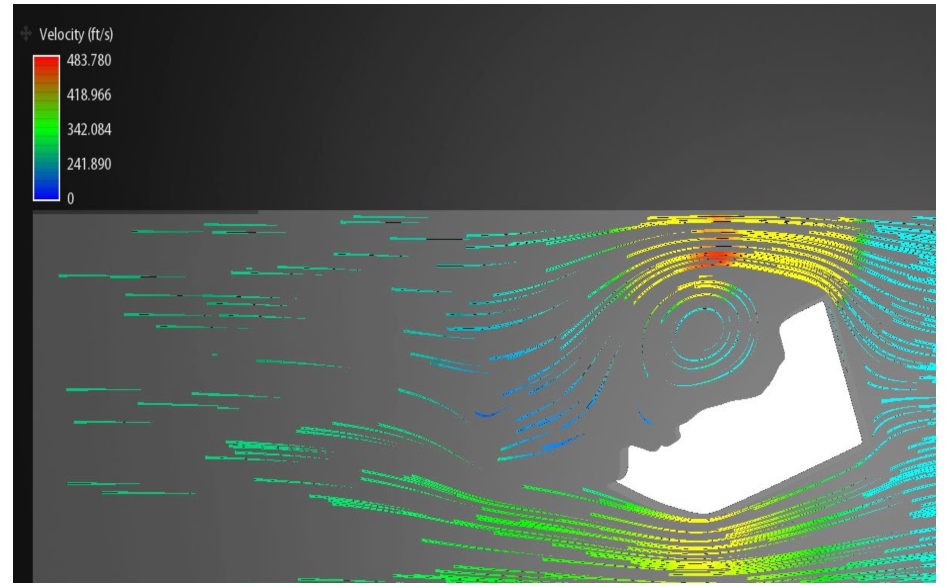


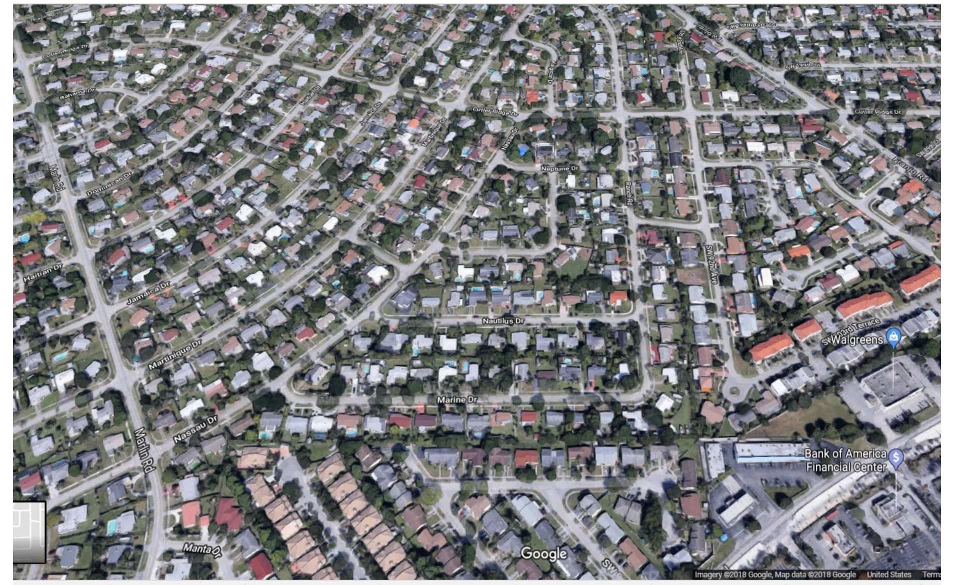


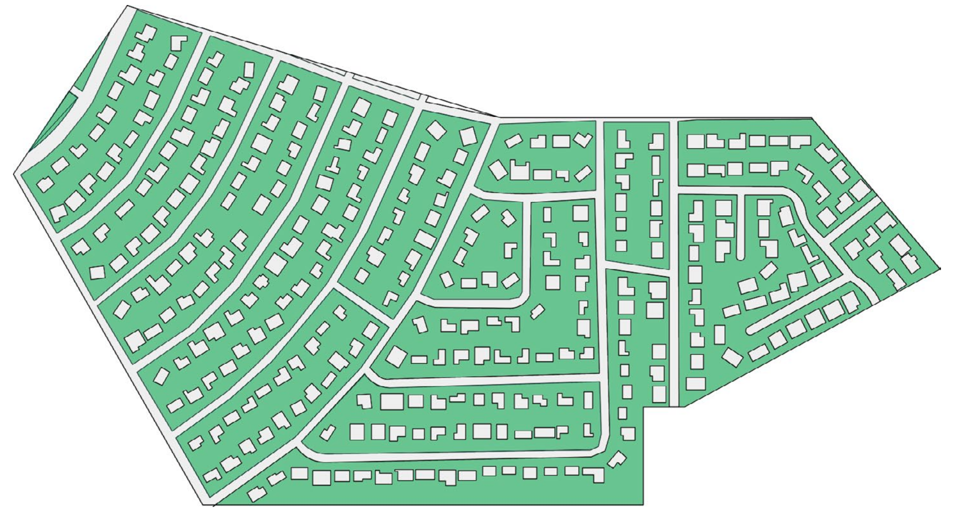


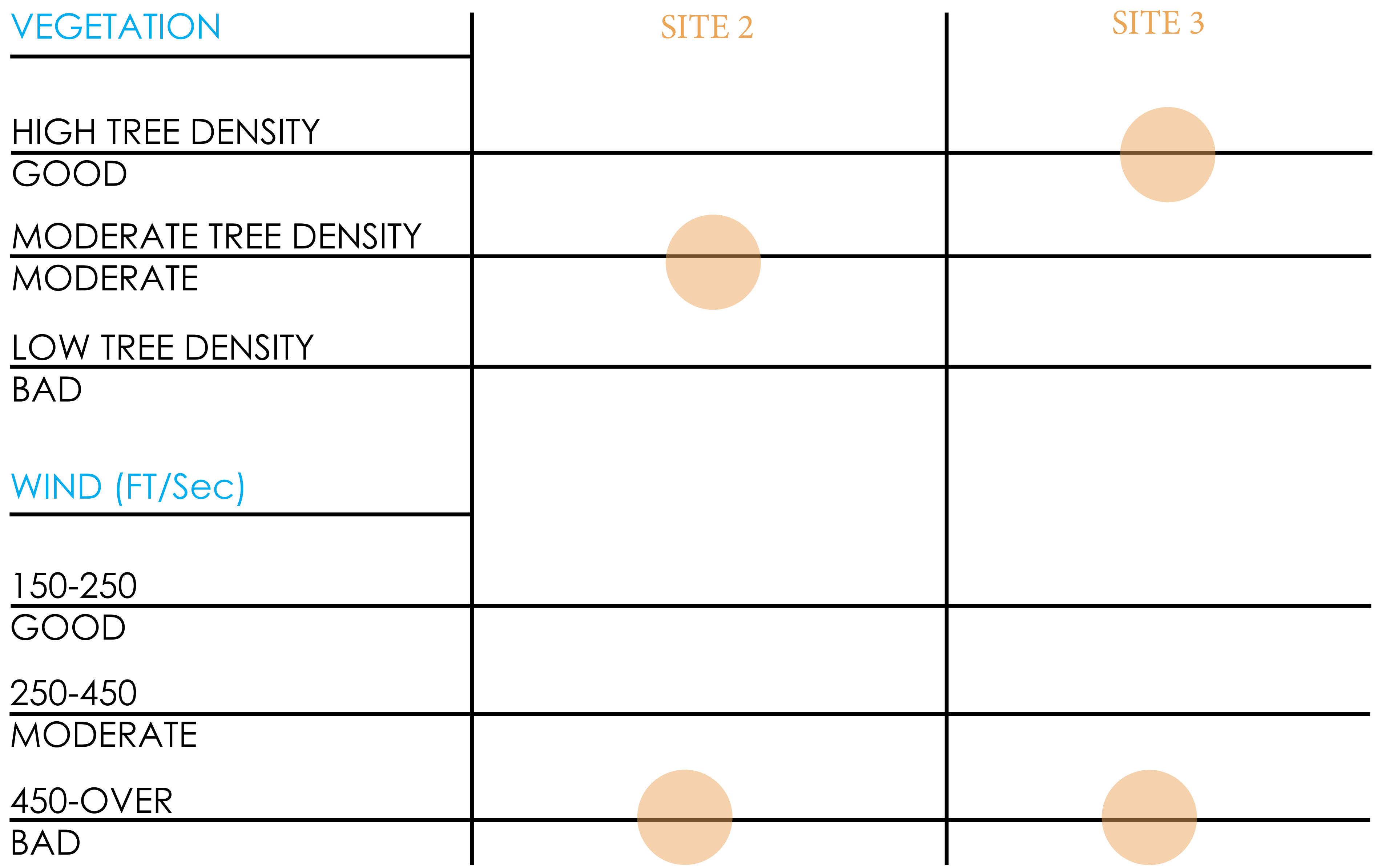
4.2.2 FIGURE GROUND RELATIONSHIP AND USAGE PATTERNS: VEGETATION

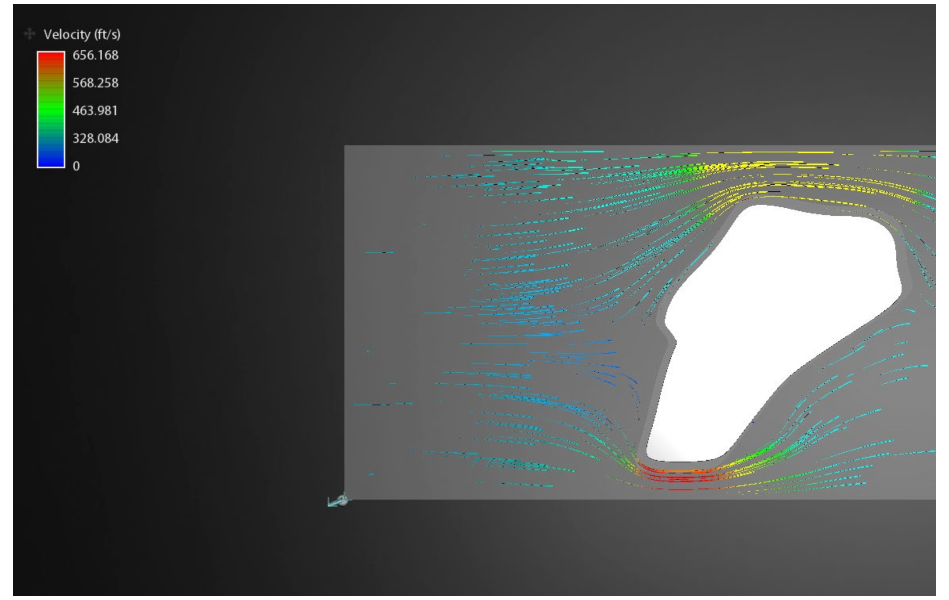
High Tree Density
Moderate Tree Density
No Tree Density
Water











The images that are represented on pages 80-81 show where water is and the density of trees surrounding houses in the neighborhood. The reason these diagrams are important is because they show what type of protection the neighborhood has due to vegetation. The trees help soften the forces of the hurricane winds. However, what we have to be careful of is with lots of trees around, the ones that are knocked over in a storm pose a potential threat to the houses from immediate impact and flying debris.

ANALYSIS ON THE NEIGHBORHOOD

I looked at neighborhoods around my site to determine how the plan, nature and shape of the houses reacted and allowed wind to flow through different layouts of neighborhoods around the site. Site one is above my site and is a mixture between a grid layout and an organic layout. Site two is a totally organic plan creating different sized clusters. Site three was excluded because it was extraneous information but sitll held representation value.

Both sites had moderate vegetation, houses with one protrusion or less and allowed the wind to flow more around the larger site than through it, which builds up the wind on the outside of the site.

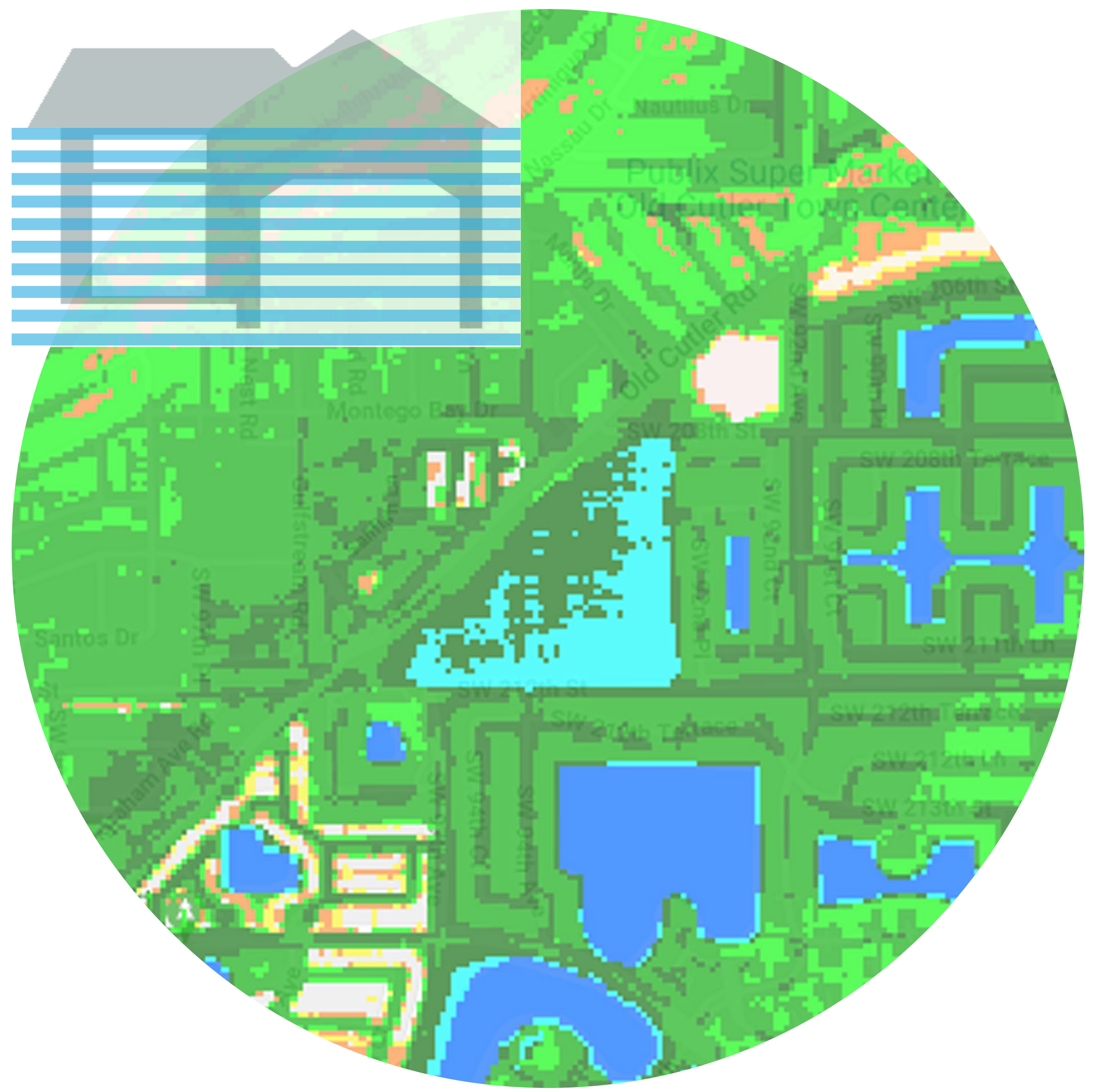
EXPECTED DEPTH OF FLOODING

KEY

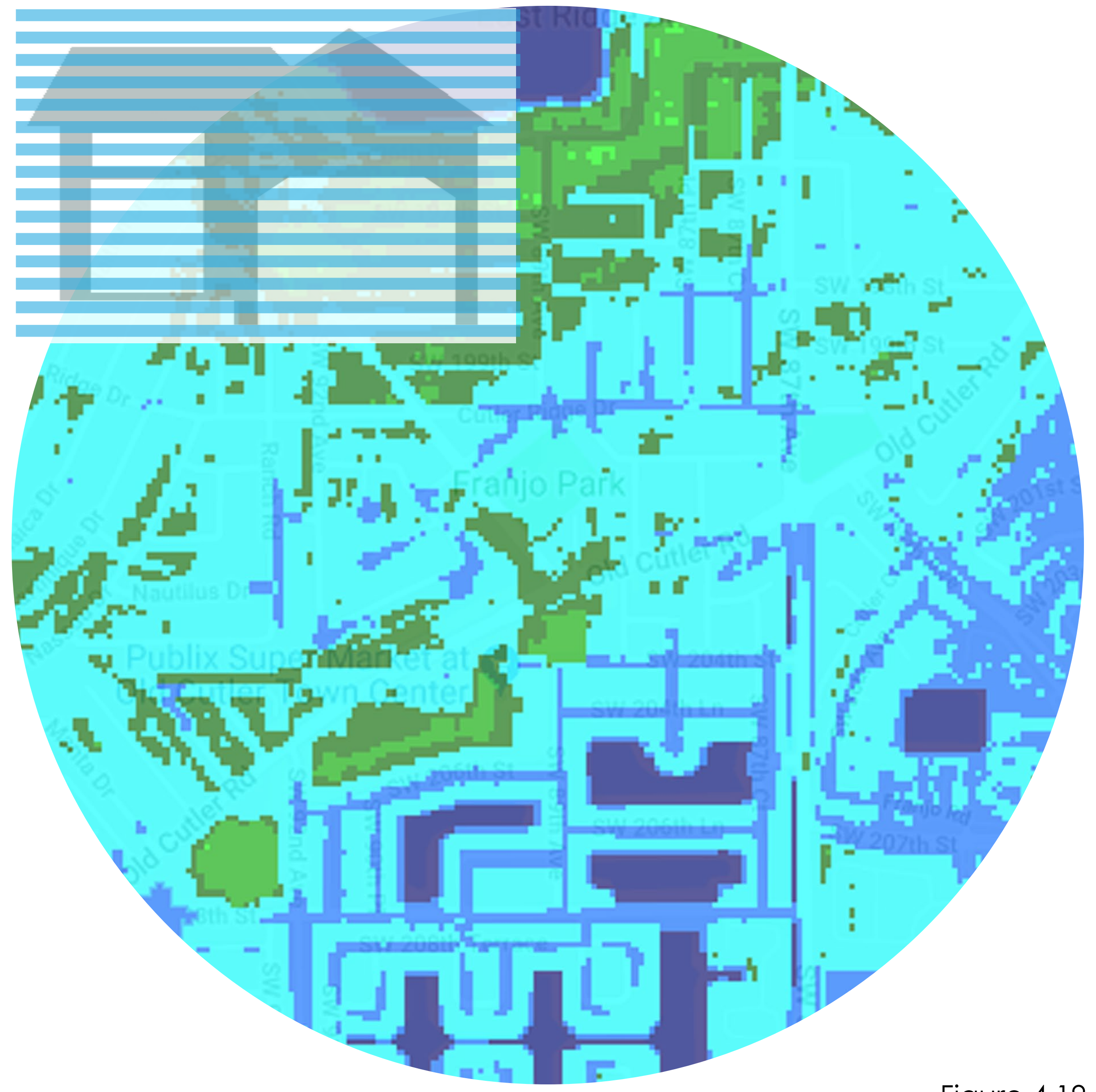
1 FT	7 FT
2 FT	10 FT
3 FT	15 FT
5 FT	20 FT
	1 FT

4.2.3 SITE PLAN: PHYSICAL CHARACTER ANALYSIS: FLOOD ANALYSES

CATEGORY 2 HURRICANE
WIND SPEED: 96-110 MPH



CATEGORY 3 HURRICANE
WIND SPEED: 111-129 MPH



CATEGORY 5 HURRICANE
WIND SPEED: 157 MPH

Figure 4.19

4.2.4 CONTEXTUAL ANALYSIS

KEY

PRIVATE

PUBLIC

NA

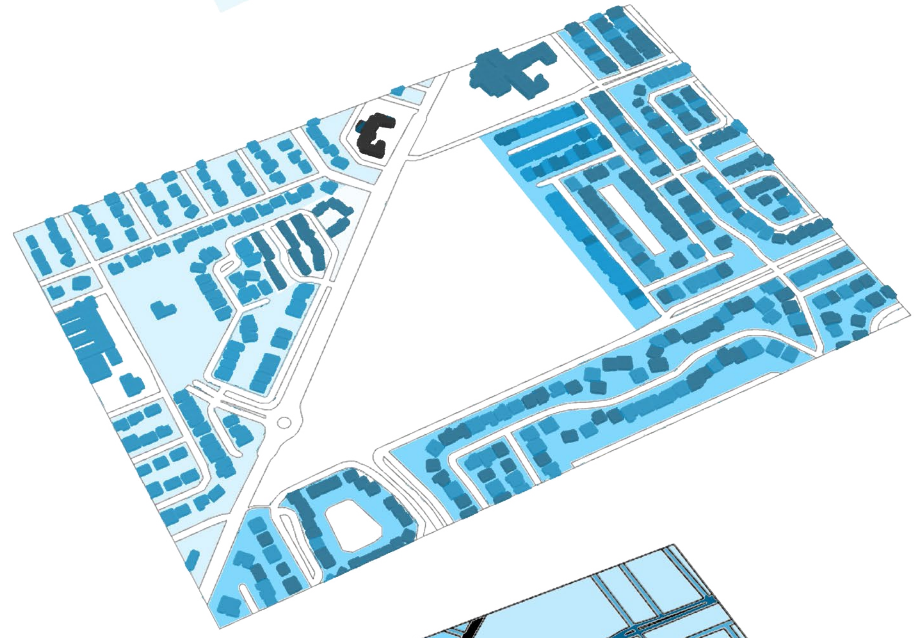
HOSPITAL

SCHOOL

CHURCH

BUILDING TYPE

The figure to the left highlights public and private spaces. The figure also shows what surrounds the site and what is near it. The hospital, church and school are good places to start a community. However, the site is lacking a necessities store such as a grocery store or convenience store.



KEY

100,000-200,000

200,000-300,000

300,000-400,000

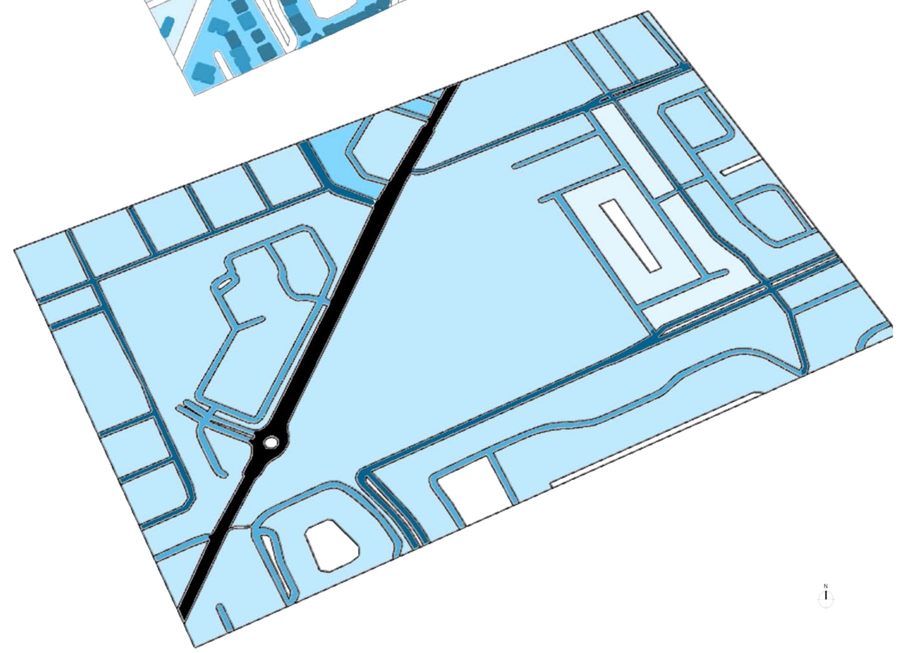
1 STORY

2 STORY

3 STORY

BUILDING HEIGHTS & COST

The figure to the left highlights how tall each building is, which influence the heights of the new building. The design intent calls for buildings that are no more than 3 stories tall. The diagram also highlights the price range the homes should stay within, which is between 200,000 and 300,000.



KEY

LOW TREE DENSITY

MODERATE TREE DENSITY

HIGH TREE DENSITY

TERTIARY STREETS

SECONDARY STREETS

PRIMARY STREETS

STREETS & VEGETATION

The figure to the left highlights major roads that influence the entry into the site and the connections to other neighborhoods. The lighter portions of the site represent tree density and how protected the site is by natural influence. From this diagram there will need to be more natural elements incorporated in the site for optimal protection of the buildings.

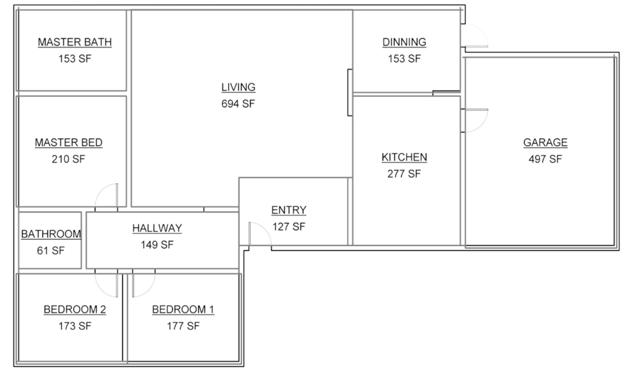
4.2.5 HOUSING PATTERNS

Figure 4.20

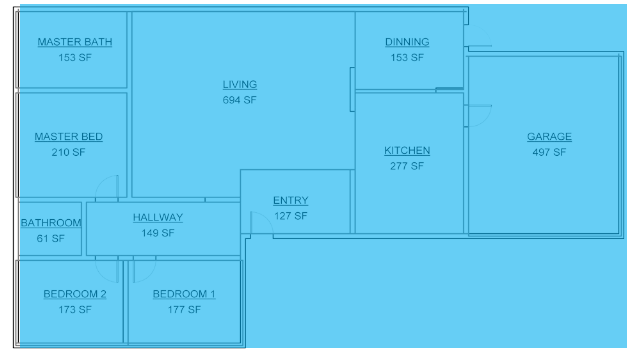
Figure 4.21

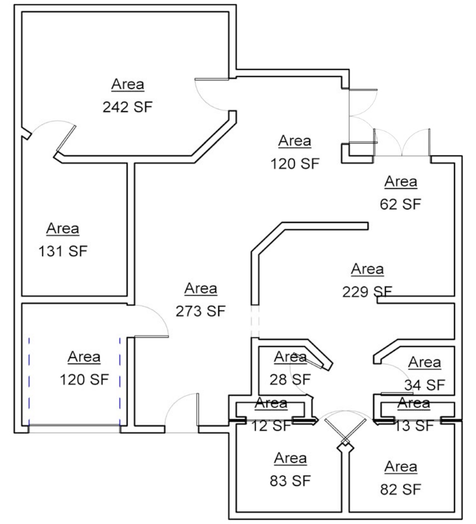
Vegetation Study

The two house that are found within the sites studed in chapter 4.1.5 are used as a study of how vegetation and house relate. Since the vegetation is lacking around most houses there is a need for more vegetation. The reason vegetation is important is because it creates a second/third skin of protection for the house as well as help sun heat for ventilation around the house.

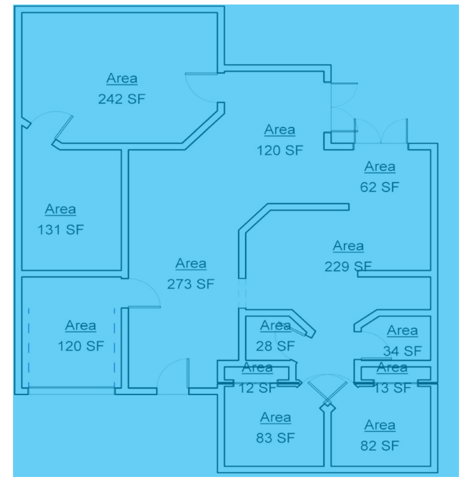


GENERAL SHAPE (Rectangle)

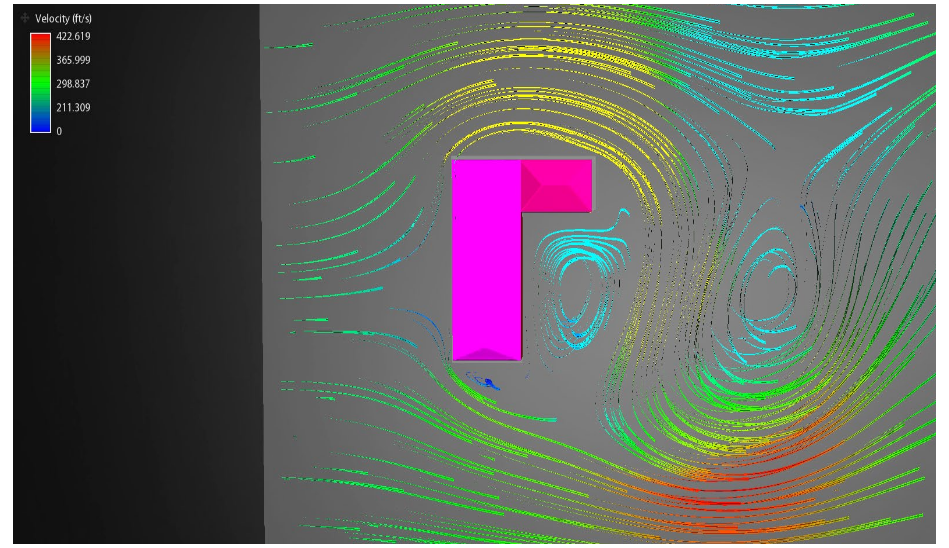


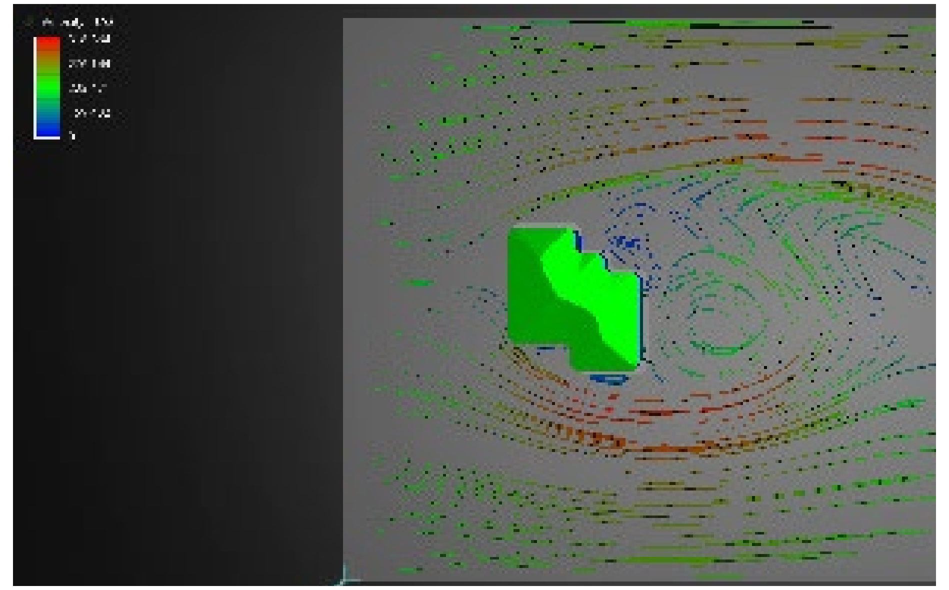


GENERAL SHAPE (Square)

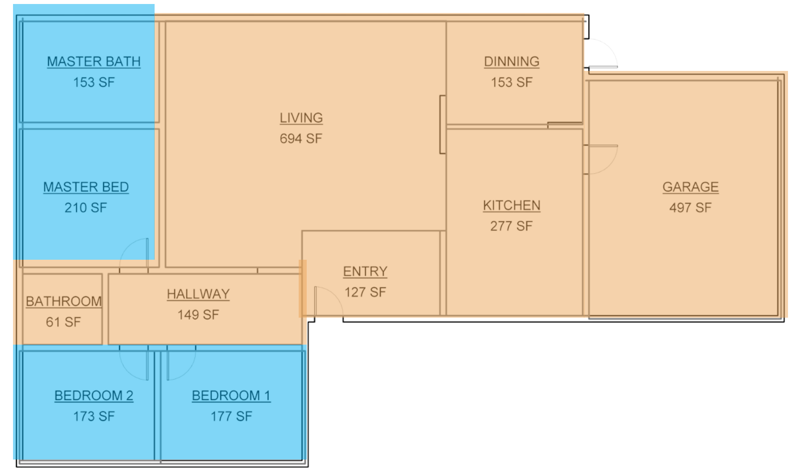


WIND SHAPE STUDY



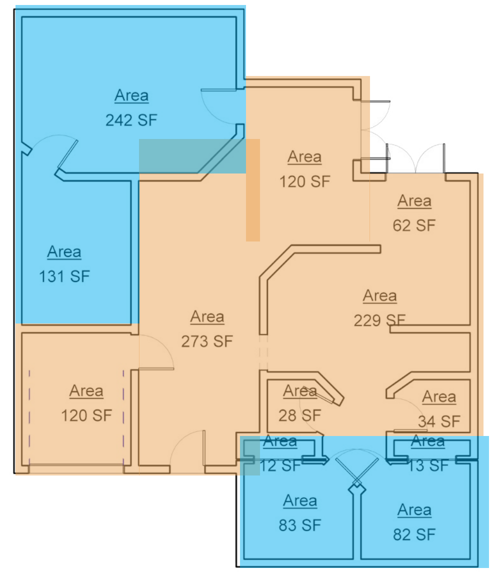


In house one the longer house builds up more wind spirals behind it. However when turned 90 degrees there is a better reaction. But the corners still have the highest wind speed. When thinking about putting a shear wall on this structure positioning it at the front would be the best. The more square house creates smaller wind spirals behind it. But as in the other diagrams the wind is highest at the corners.



PUBLIC

PRIVATE



PUBLIC

PRIVATE

4.2.6 HOUSEING PATTERNS

MATERIALS

SITE 2 | SITE 3

SHINGLE ROOF
GOOD

METAL ROOF
MODERATE

TILE ROOF
BAD

POSITION

LIFTED 15' OR MORE
GOOD

LIFTED 6' OR MORE
MODERATE

5' OR BELOW
BAD

CLUSTERING

SITE 2 | SITE 3

RECTANGLE
GOOD

SQUARE
MODERATE

HOUSE WITH JUT-OUT
BAD

WIND

150-250
GOOD

250-450
MODERATE

450-OVER
BAD

PROGRAM AND SPATIAL EXPLORATIONS

CHAPTER

4.3

CONCEPT STATEMENT

The design intent for the site is to create a space where the community can go for refuge during a hurricane. However, when there is no potential threat, the space can be used to house and entertain the community, bringing it together. Since the site is triangular and the hypotenuse is on the main road, I want to maintain the edge between the inside of the site and the main busy road. I will do this by placing the shops on the long edge and placing the houses more towards the back in the neighborhoods. Most of the site will be meant for pedestrians, but I will maintain the per-existing street grid.

The community space provides an area that people can feel comfortable in and interact with one another through activities. This currently does not existing on the site. The space should be geared towards the pedestrian and not the vehicle in case of a hurricane. During the storm, it can provide shelter; after the storm, a rallying and recovery coordination point.

The lack of resources within the vicinity is important because during a hurricane it is difficult or impossible to drive to acquire food or other necessities. Thus, grocery stores, hardware stores and pharmacies should be added to the existing site. These will also be needed after the storm as the community struggles to recover.

4.3.1 COMMUNITY SCALE

Not Enough Vegetation

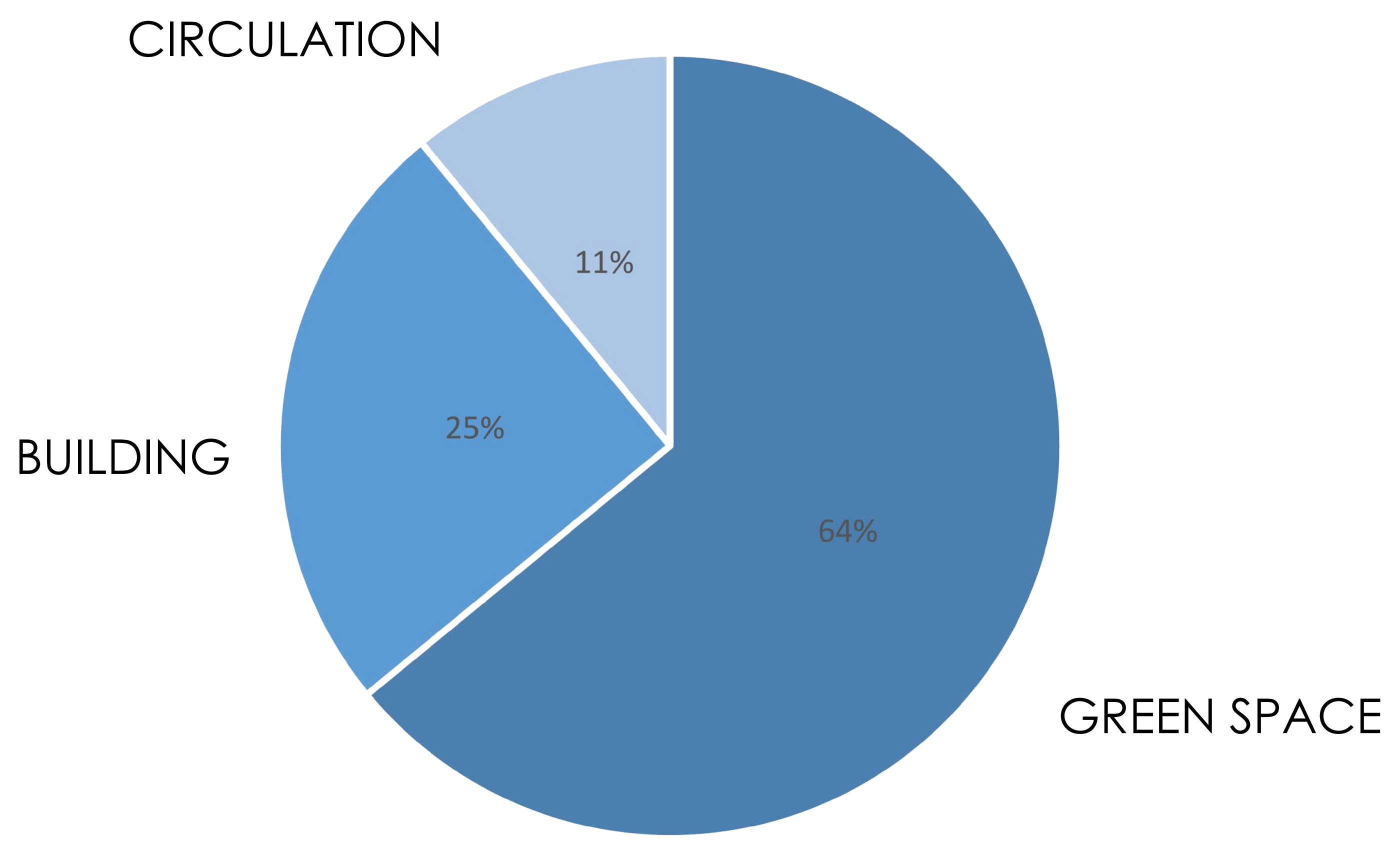
The site has medeocre vegitation. Little vegitation is bad because it leaves the house exposed to wind and debris. The need for more natural vegitation is desiarable.

No Community Space

The community space provides an area that people can feel comfortable in and interact with one another through activities. This currently does not existing on the site. The space should be geared towards the pedestrian and not the vehicle in case of a hurricane.

No Resources with the vicinity

The lack of resources within the vicinity is important because during a hurricane it is difficult or impossible to drive to acquire food or other necessities. Thus, grocery stores, hardware stores and pharmacies should be added to the existing site.

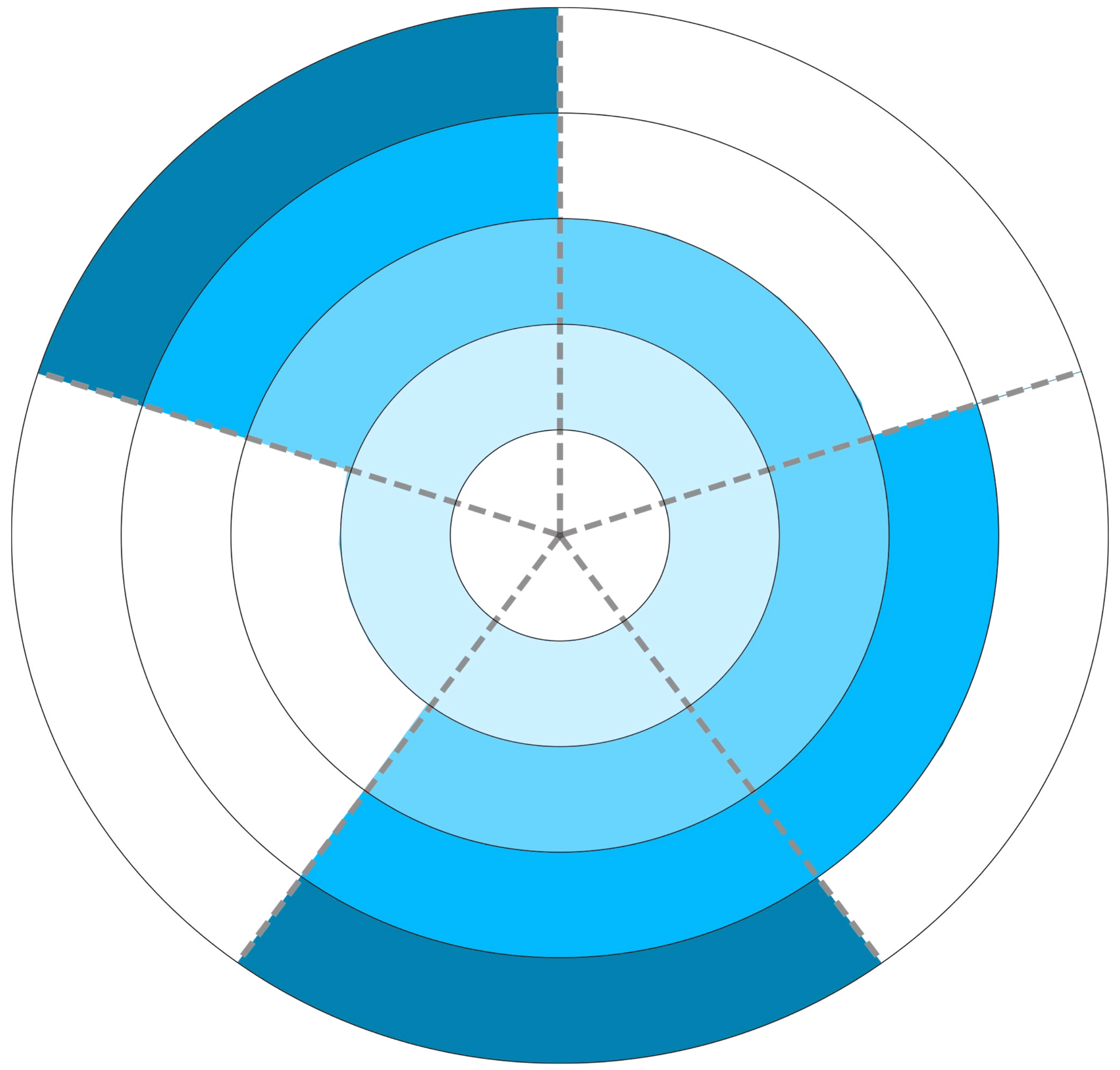


COMMUNAL

ACCESSIBLE FOR THE COMMUNITY
NEW PROGRAM INTRODUCTED
TRANSPARENT YET PROTECTED
DETACHED AND ATTACHED HOUSING

PUBLIC VS. PRIVATE REALM

COMMUNITY PROGRAM



CUSTOMIZABLE

ADAPTIVE ABILITY
OPERABLE ENCLOSURES
SELECTIVE DETAILS
PREP-FABRICATED ELEMENTS
STATIC FUNCTION

AFFORDABLE

STAYS WITHIN PREP-EXISTING BUDGET
EQUITABLE PROGRAM & PLAN
HOUSING:
- 3 BEDS / 2 BATHS
- KITCHEN
- LIVING ROOM
- DINNING ROOM
- ENTRY
- CAR ENCLOSURE

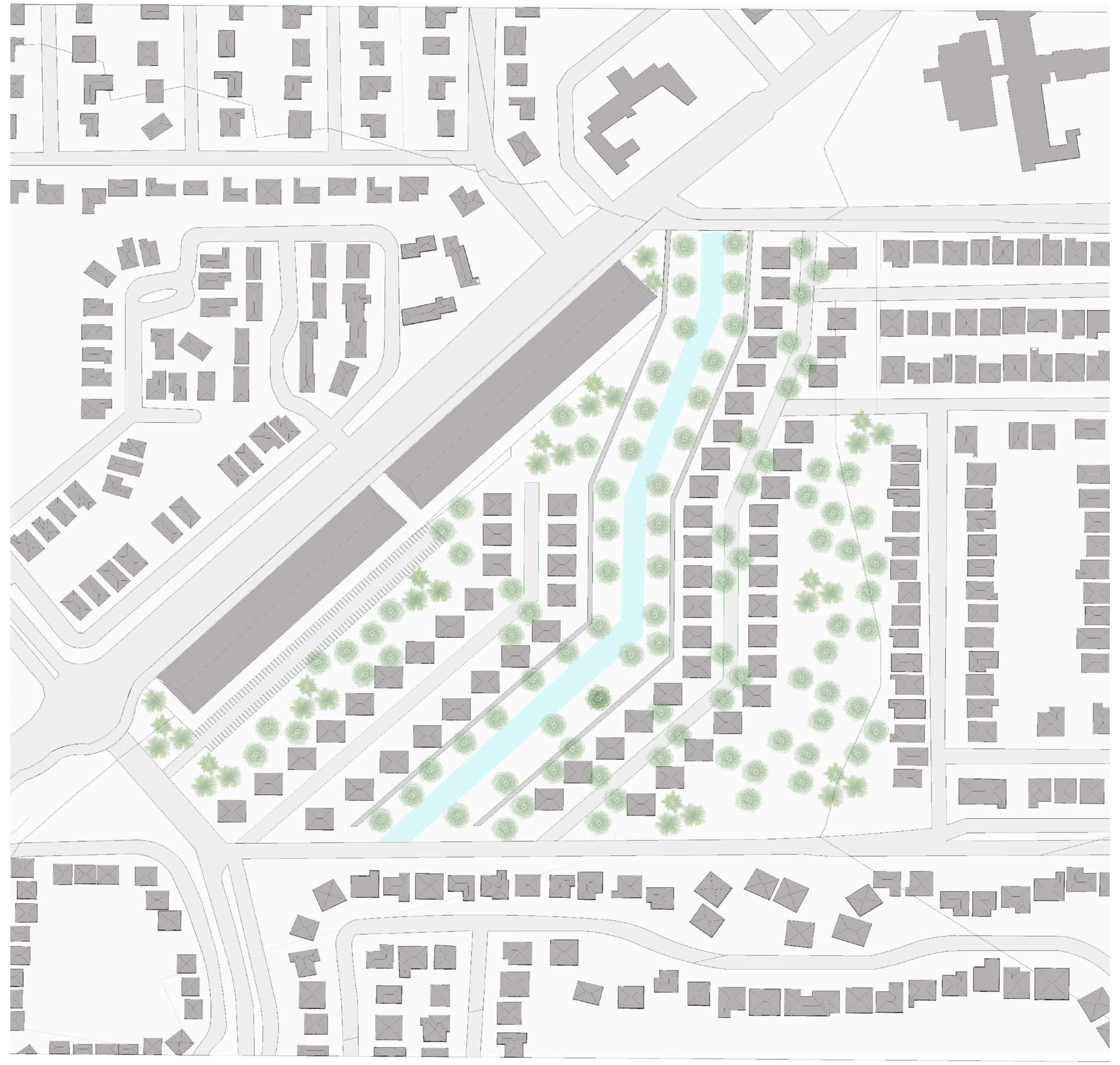
ADAPTABLE

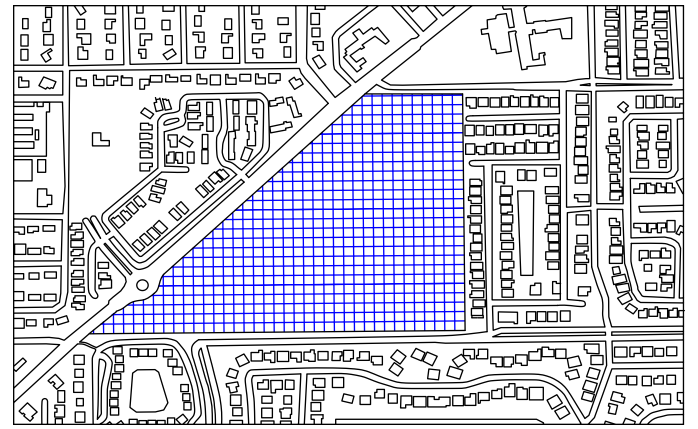
TRANSFORMABLE INFRASTRUCTURE
NATURAL ACTIVATION
DIVERS/REDUNDANT SYSTEMS
ANTICIPATING CHANGE AND RESPONDING TO IT

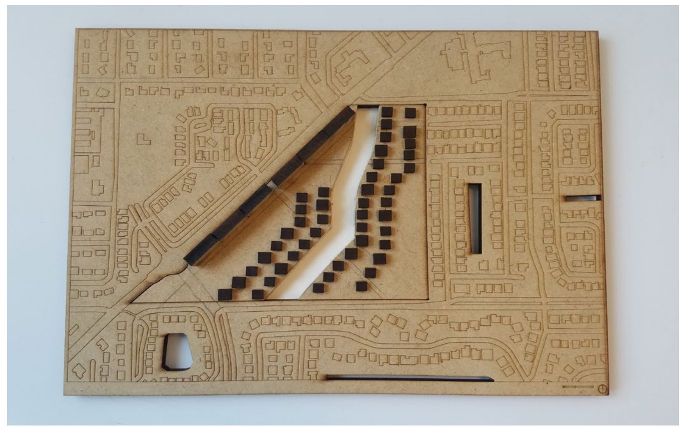
RESILIENCE

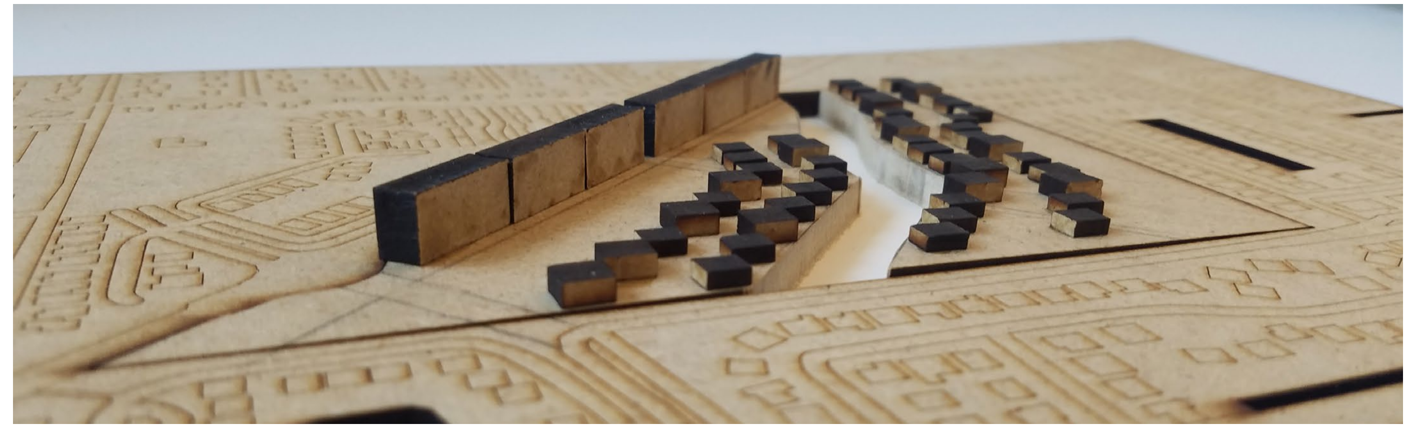
NATURAL BARRIER
BLANKET
ENVELOPE SYMBIOSIS

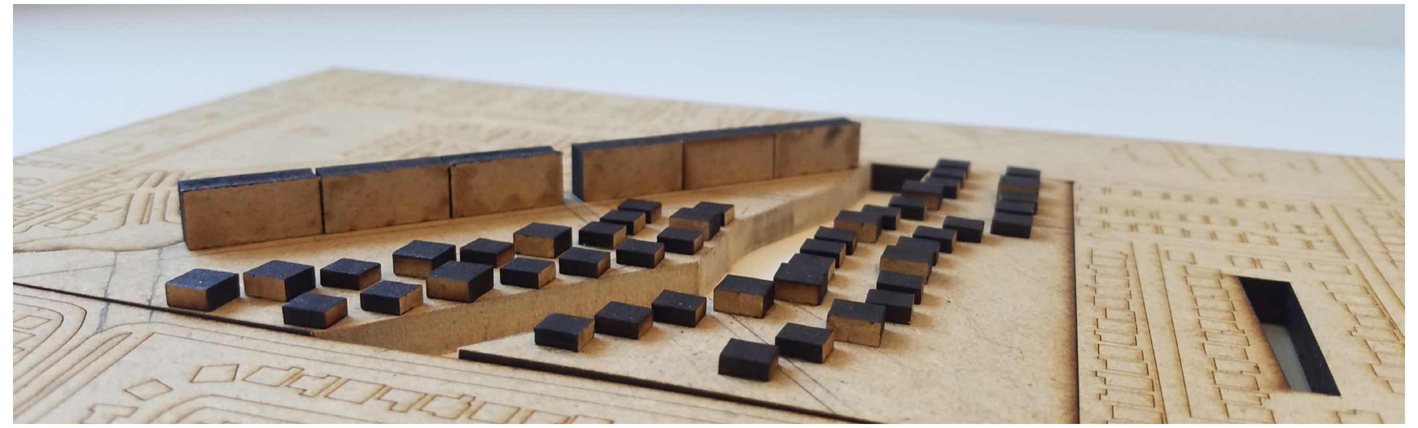
4.3.2
SITE DESIGN EXPLORATIONS AND ANALYSIS











GRID

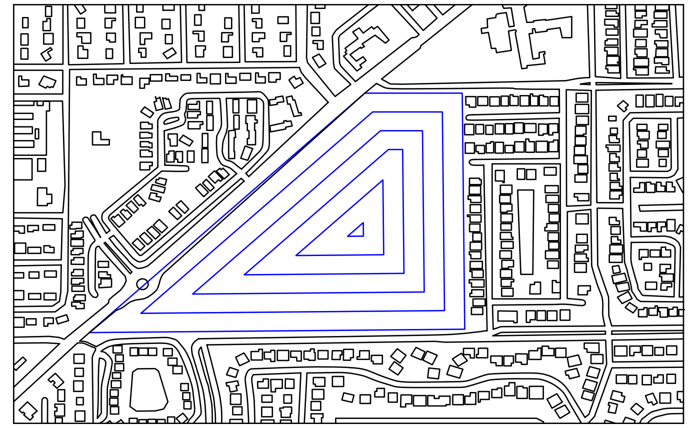
The design option above addresses the design intent by adding multiple levels to the site, added vegetation and creating a transition from shops to residential spaces. The line down the center separates program.

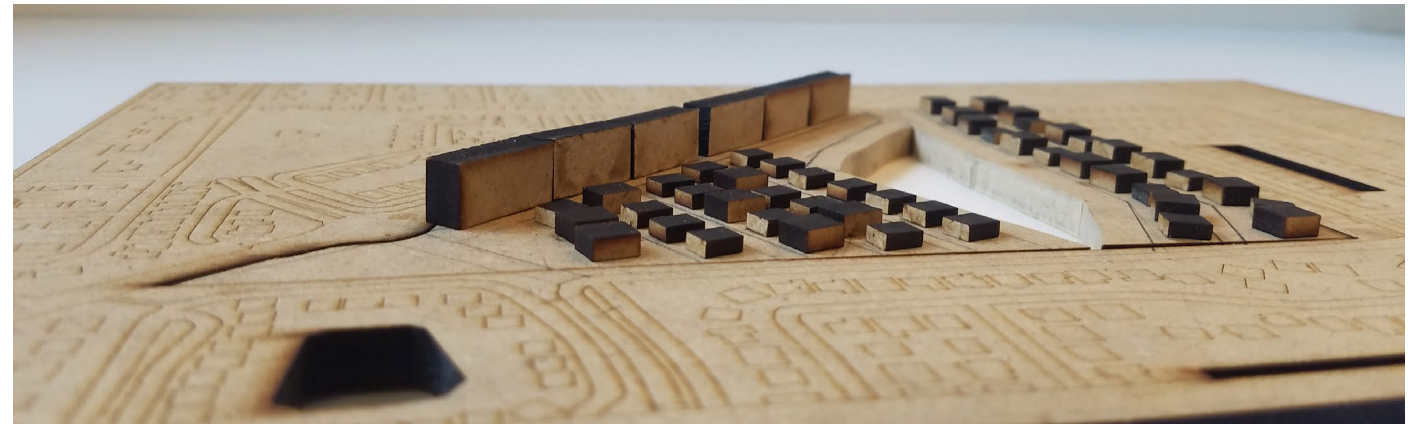
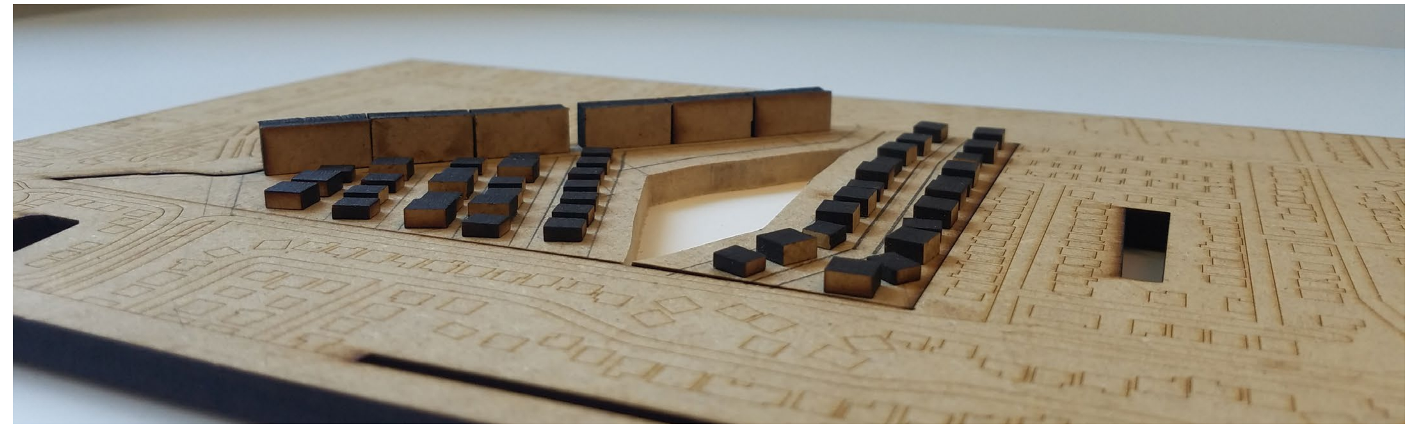
Pros

The line is kept between the street and the site which protects the pedestrian from the main street. There is an organic flow of the neighborhood, allowing people to meander. Lastly, the water feature in the center allows an open green space that acts as a community center creating visual guide through the site and keeps movement flowing. It also acts as a flood plain during a hurricane.

Cons

The issue with this layout is that it is very structured and straight lined which makes the site monotonous to walk through. A parking lot takes up a lot of the green space. The grid creates lots of un-used spaces in the site because it cannot connect the rest of the existing streets and site very well.

OFFSET

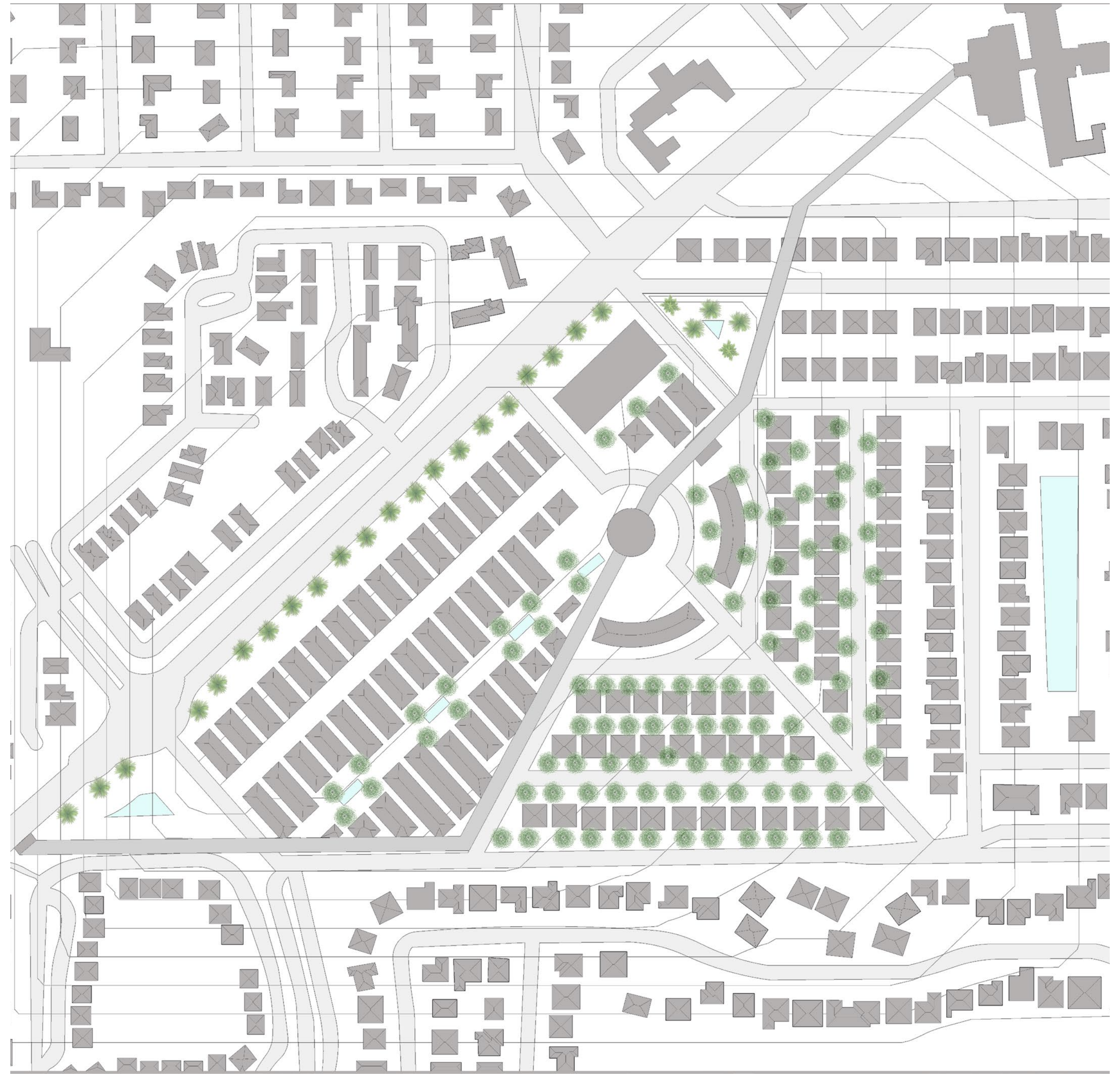
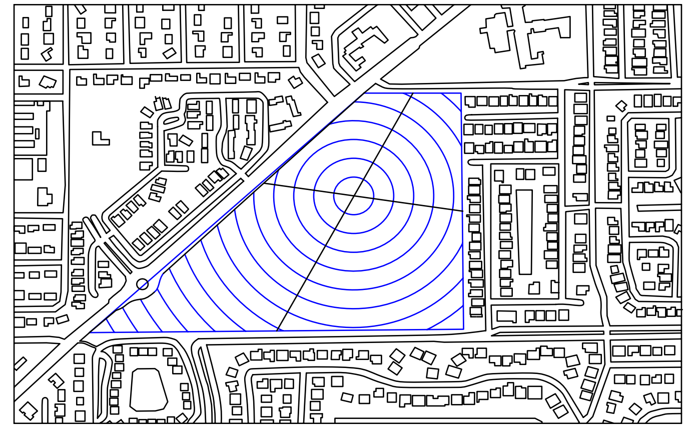
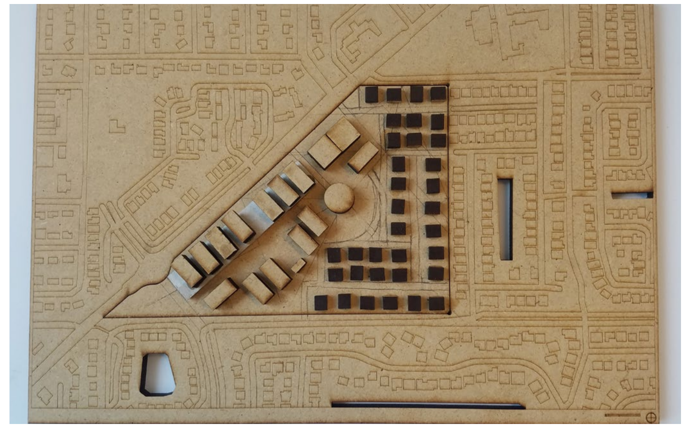
The design option above addresses the design intent by adding multiple levels to the site, added vegetation and creating a transition from shops to residential spaces. It has a center path that radiates out separating the program up into sections.

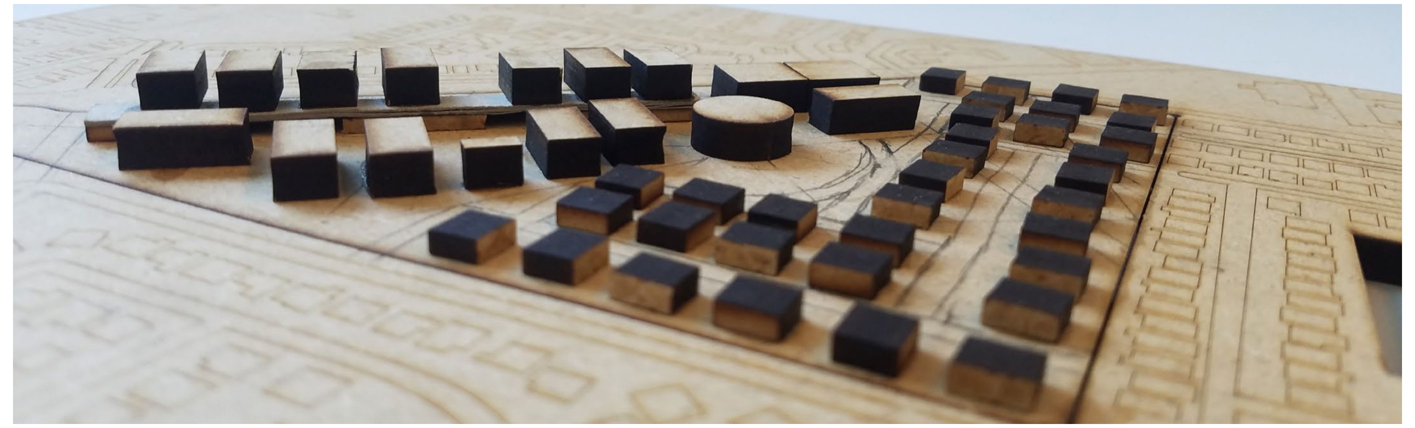
Pros

This design separates the shops from the street similar to the previous one helping keep the pedestrians safe from the main road. The water feature in this one, however, is more centralized creating a gathering space for the community. The water feature that flows with the site creates more opportunities for houses to be placed. This design connects well with the existing grid.

Cons

There are similar cons with that of the first concept. There is a harsh separation between the residential and the shopping areas. It still contains a monotonous shopping area. The large water feature takes up space that could be used for other programs.



RADIATING

The design option above addresses the design intent by adding multiple levels to the site, added vegetation and creating a transition from shops to residential spaces.

Pros

There is a central area for the community to gather for events and in refuge after a storm. The program has a better transition from one area to the next. There is a better integration between an organic flow of shopping and the gridded patterns of the existing site.

Cons

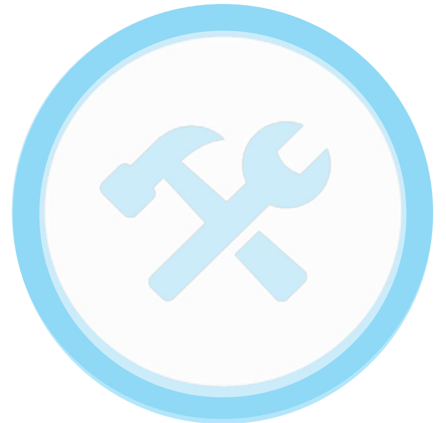
The shopping area is filled with rows and rows of straight lines that become monotonous to walk through. The line that runs through the site tries to connect the surrounding neighborhoods with a walking path, however, it fails to do so and is more of a separation between programs.

Not Enough Vegetation

The site has medeocre vegitation. Little vegitation is bad because it leaves the house exposed to wind and debris. The need for more natural vegitation is desiarable.

PROTECTION / SUN SHADES

Places within the community should be allowed to be customizable for the inhabitance. This allows for the community to start to build a more organic and personalized space. The structural frame will remain the same but the exterior will be flexible.



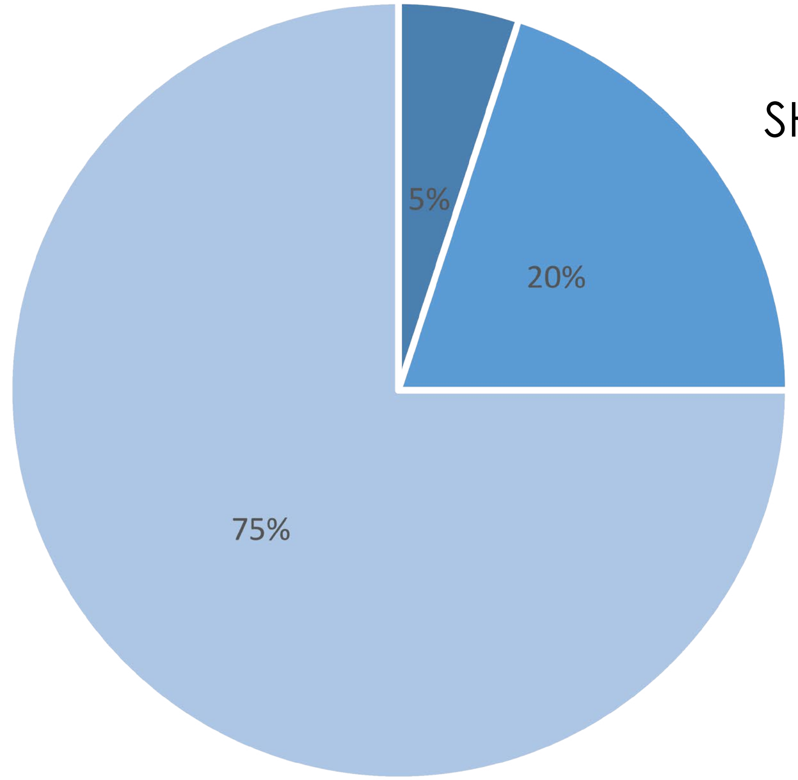
MATERIALS

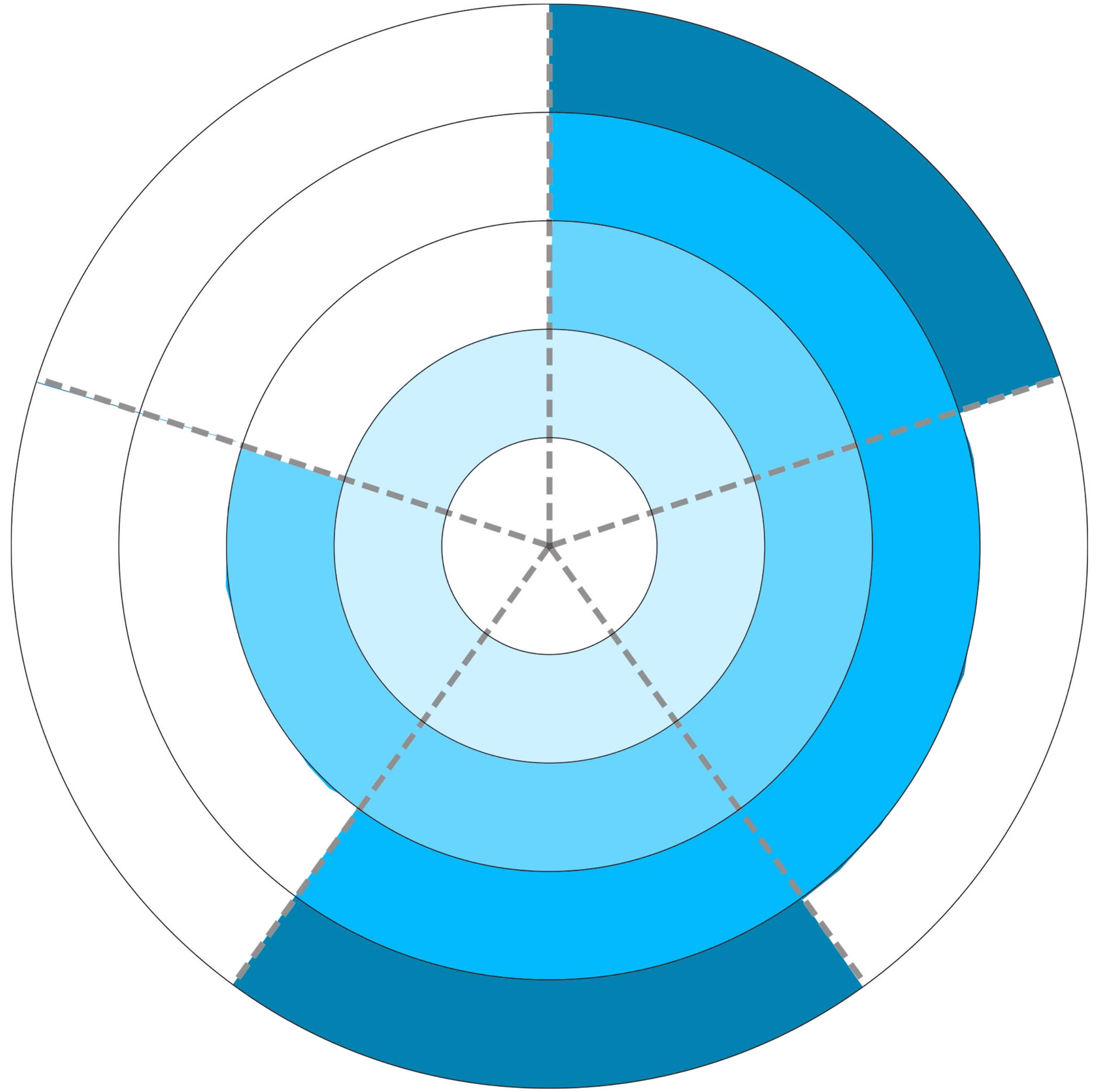
The materials used in the original houses are installed porly and are not the best choose. A slab foundation is also not the best design choice for Florida.

4.3.3 BUILDING SCALE

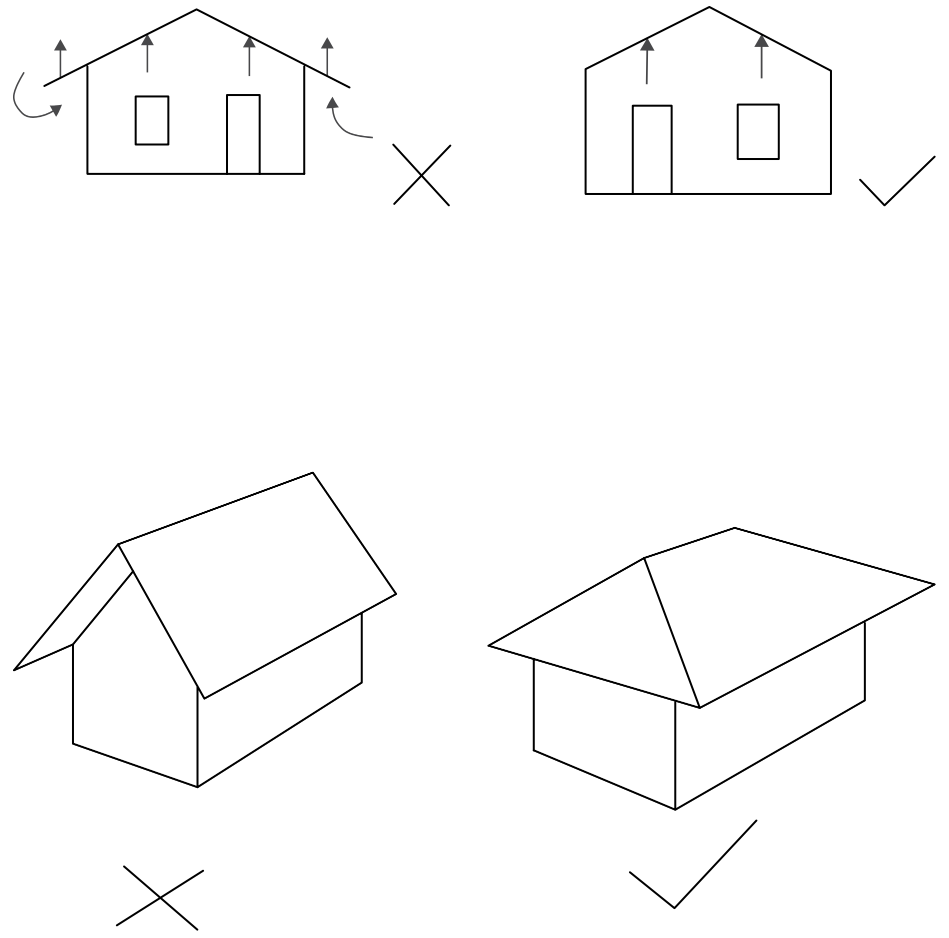
CONCEPT STATEMENT

The design intent for the house is similar to the Domino house and the Tsunami house. The structure is based on the Domino concrete open column plan. This allows the houses to be almost fully customizable. However, there are certain criteria that the houses must meet before construction can begin this includes the design intent of the bottom floor to be used as a flood room based on the Tsunami house. This feature will be used for all houses to keep high waters away from the important electrical components. Places within the community should be allowed to be customizable for the inhabitants. This allows for the community to start to build more organic and personalized spaces. The structural frame will remain the same but the exterior will be flexible.





ROOF



4.3.4 EXPLORATIONS THAT HELP INFORM HOUSE DESIGN

MATERIALS

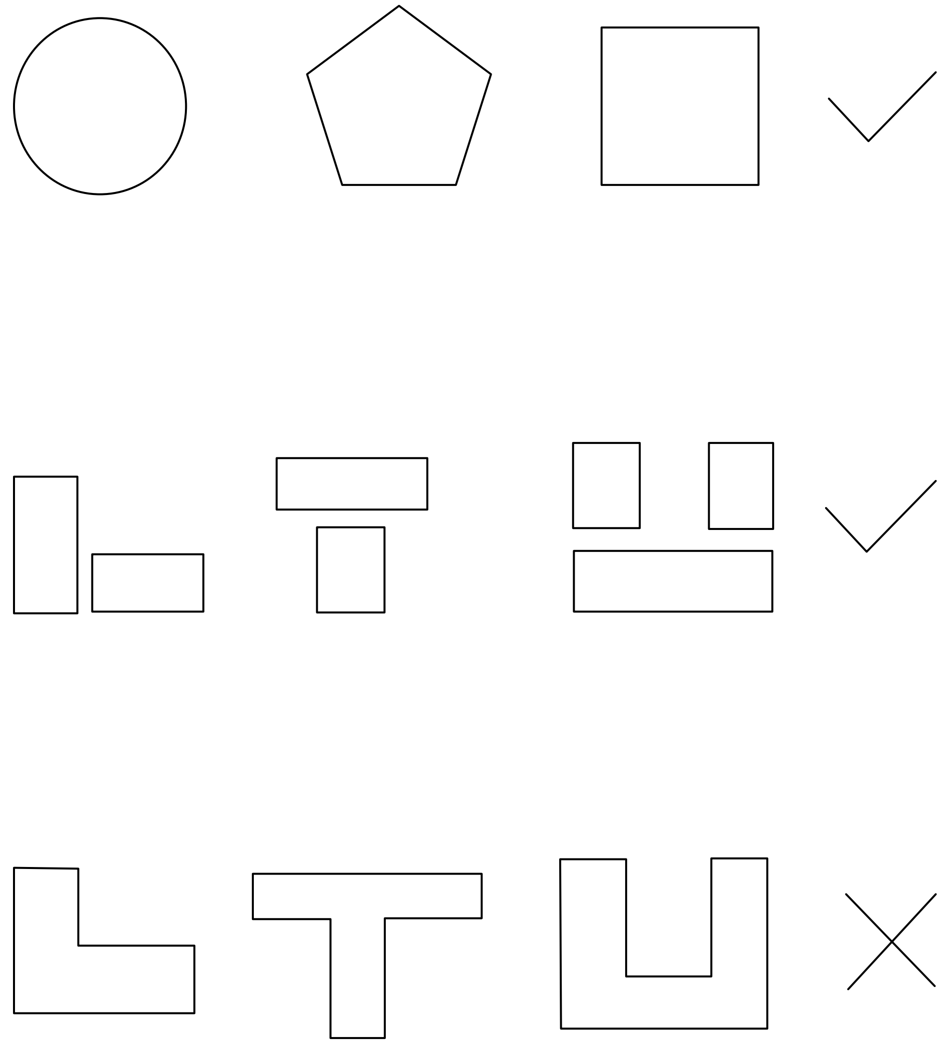
Asphalt shingles

Metal Roof

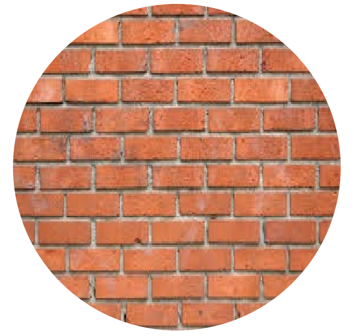
Tile Roofing

The roof is best as a hip roof. There are three basic materials a roof can be made. The materials are laid out so that the best option of roof materials is on the top and the worst is at the bottom. The order was determined by its ability to be installed with ease, how well it deals with uplift and the ease of access and making it is.

SHAPE



SKIN



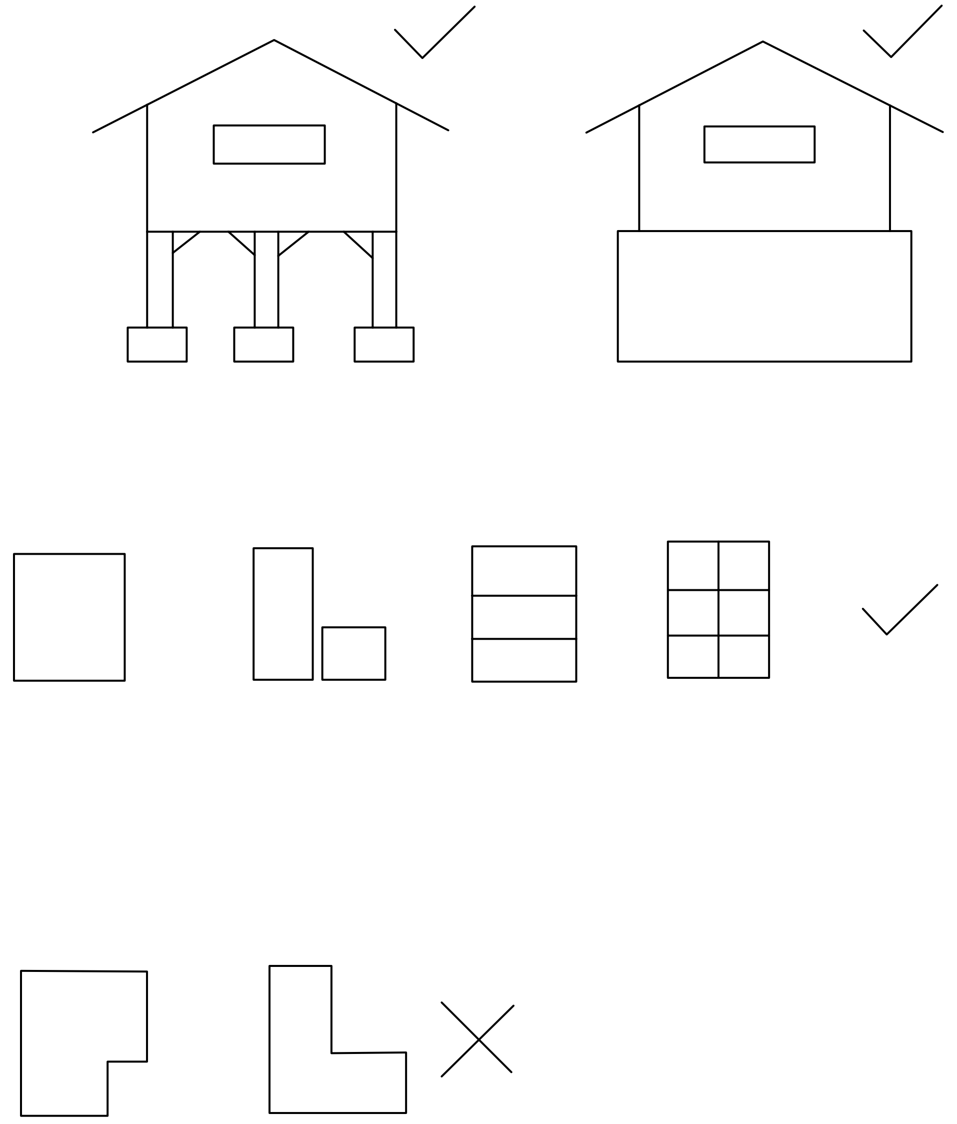
Brick

Stucco

Wood Plank Siding

The layout for a house plan in the hurricane consist of three basic shapes rectangles, circles and types of hexagon,pentagon, octagonal, etc. shapes. There are three basic materials a roof can be made. The materials are laid out so that the best option of roof materials is on the top and the worst is at the bottom. The order was determined by how the material dealt with uplift, how water resistant it was, how easy it was to install and how cheap it was to reinstall if damaged.

STRUCTURE



MATERIALS

Concrete

Metal

Wood

The structure of the house was a major component but the rules found in chapter 1 showed that if a structure can extend from top to bottom with no interruptions it will be the most stable. There are three basic materials a roof can be made. The materials are laid out so that the best option of roof materials is on the top and the worst is at the bottom. The order was determined by its ability to be installed with ease, how structurally sound the material was, how well it reacted with water and how costly it was to use.

4.3.5 EXPLORATION FOR HOUSE DESIGN OPTIONS

ORIGINAL ISSUES

VEGETATION

STRUCTURE

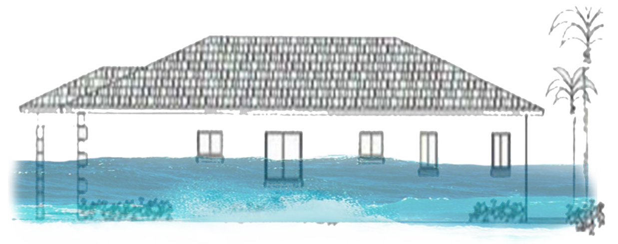


Figure 4.22

SLAB STRUCTURE

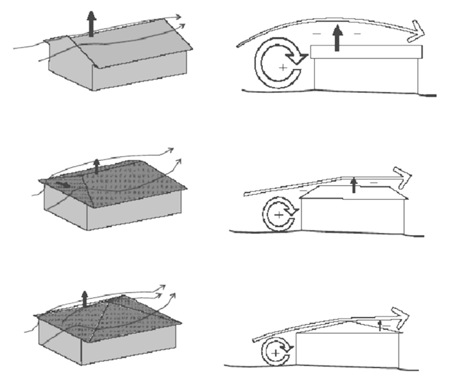


Figure 4.23

ROOF MATERIAL AND OVERHANG

VEGETATION TO INCREASE

SOUTHERN RED CEDAR

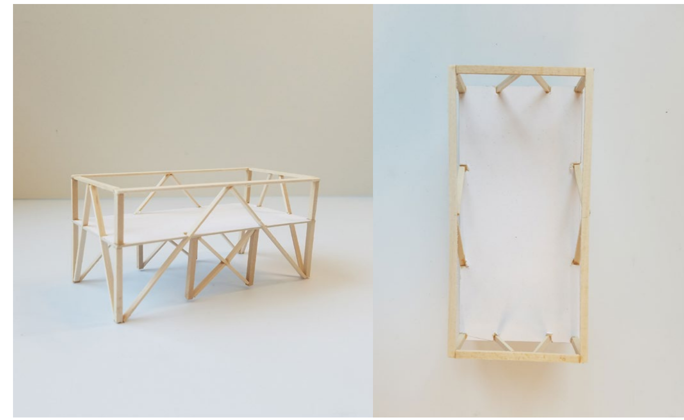
BAMBOO

OAK TREES

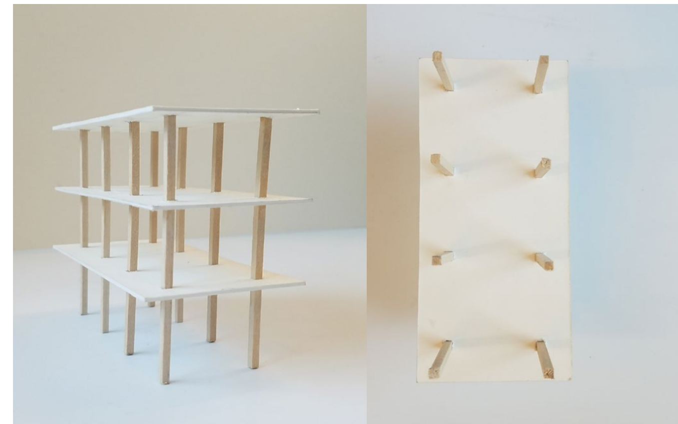
CABBAGE PALM

Figure 4.24

STRUCTURE

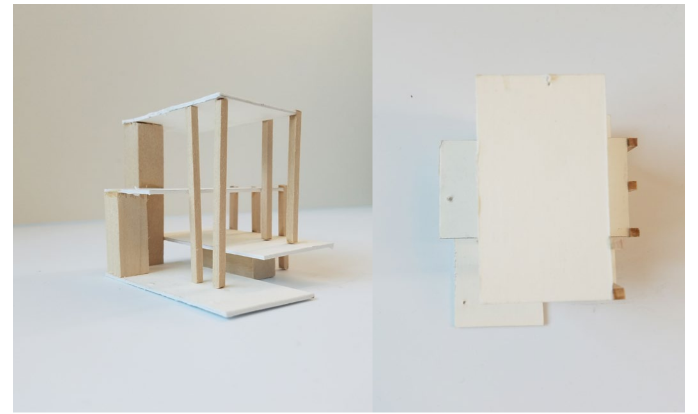


RAISE FLOORS (15')



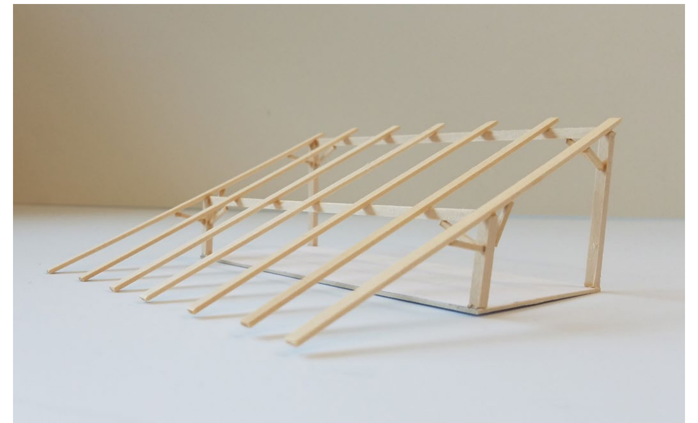
PUSH COLUMNS INTO THE STRUCTURE

RAISE FLOORS 10' ADD 5' OF WATER DRAINAGE

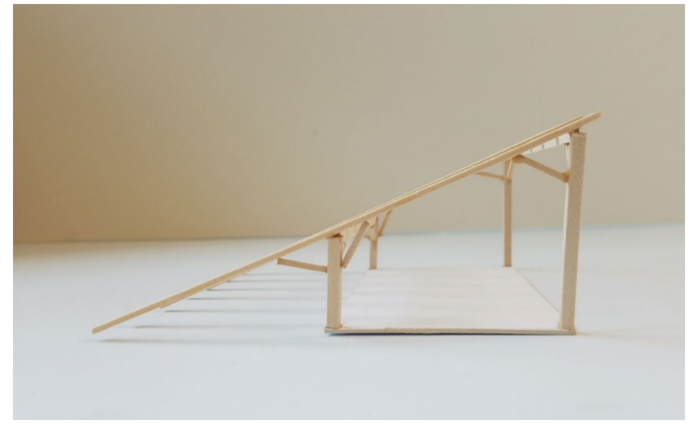


SPLIT THE FLOORS INTO MULTIPLE LEVELS

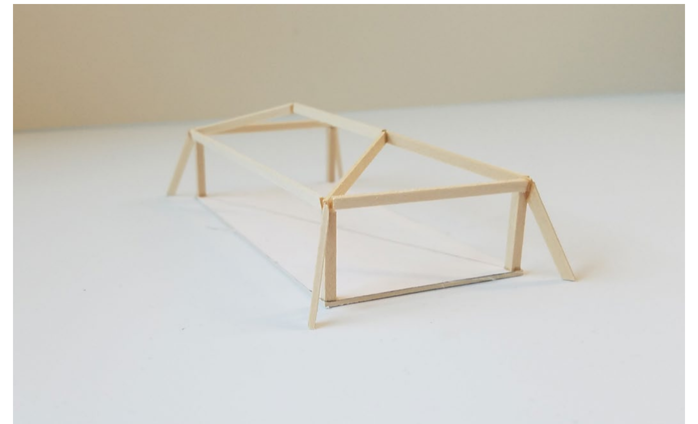
DIFFERENT WAYS OF THINKING ABOUT THE ROOF EXTENSIONS



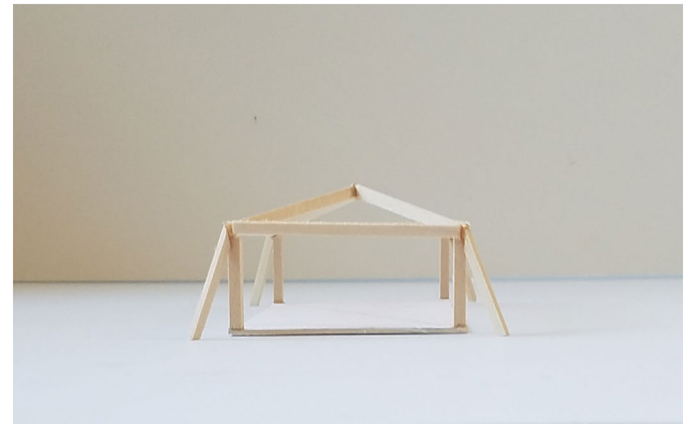
OPTION 1 SLANTED ROOF



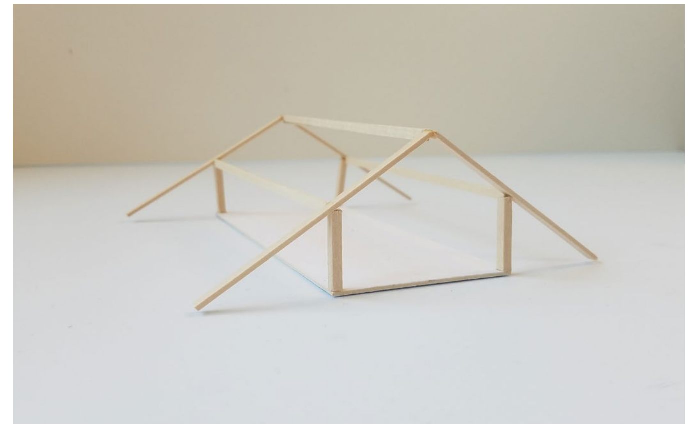
DETAILS OF COMPONENTS



OPTION 2 EXTEND EXISTING ROOF

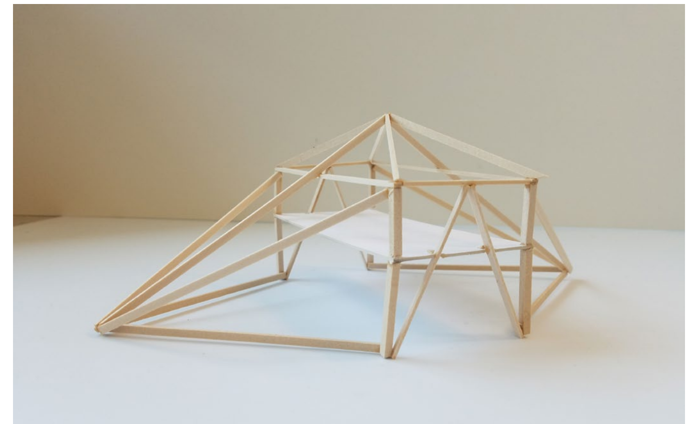


DETAILS OF COMPONENTS

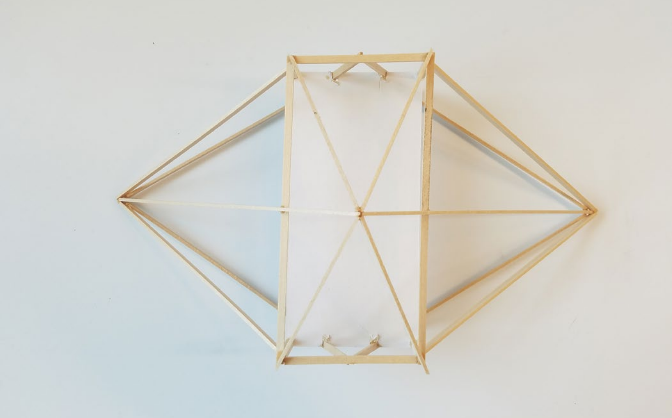


OPTION 3 GABLE ROOF EXTENDED

DETAILS OF COMPONENTS



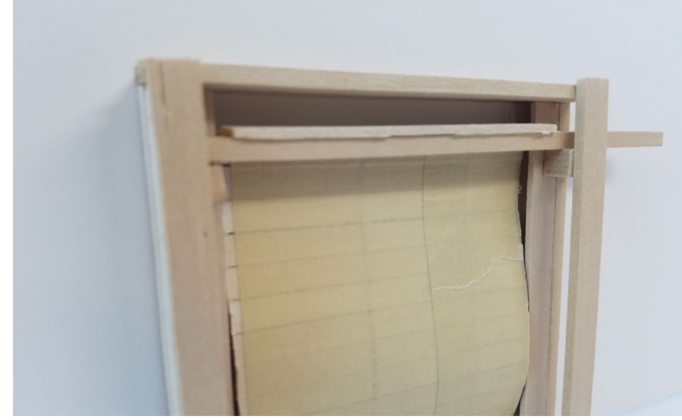
OPTION 4 CREATE POINTS LIKE A PLANE TO SLICE THROUGH THE WIND



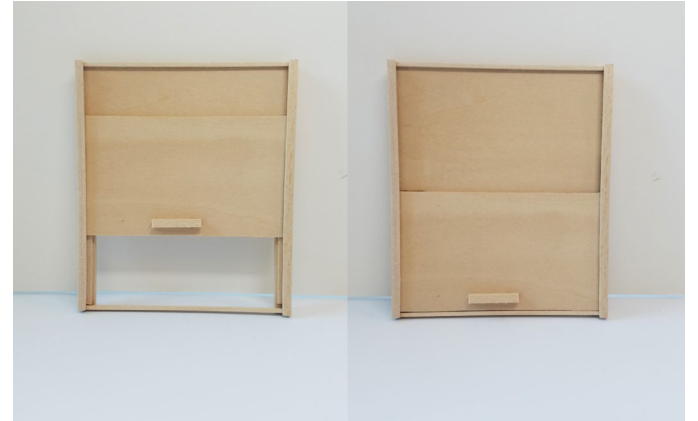
DETAILS OF COMPONENTS

OPEN AND CLOSING METHODS

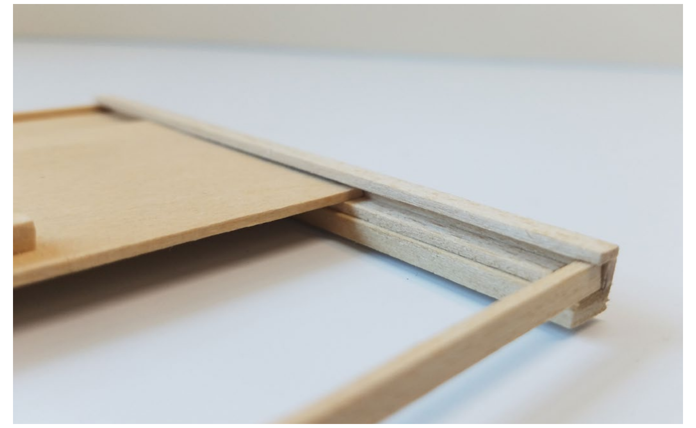
ROLL UP DOOR



DETAILS OF COMPONENTS

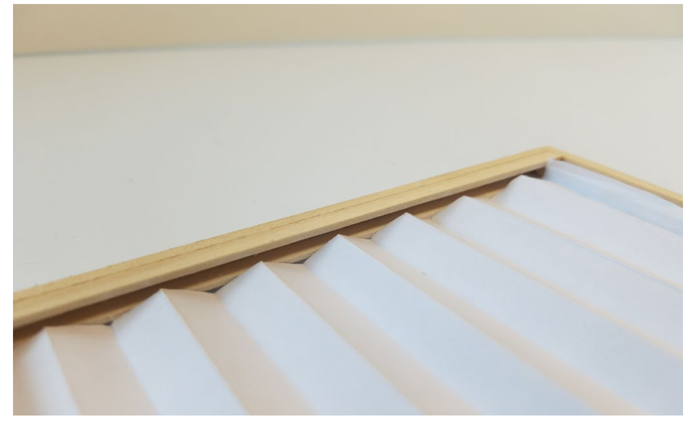


SLIDING DOOR



DETAILS OF COMPONENTS

FOLDING PANELS



DETAILS OF COMPONENTS

ROTATING PANELS

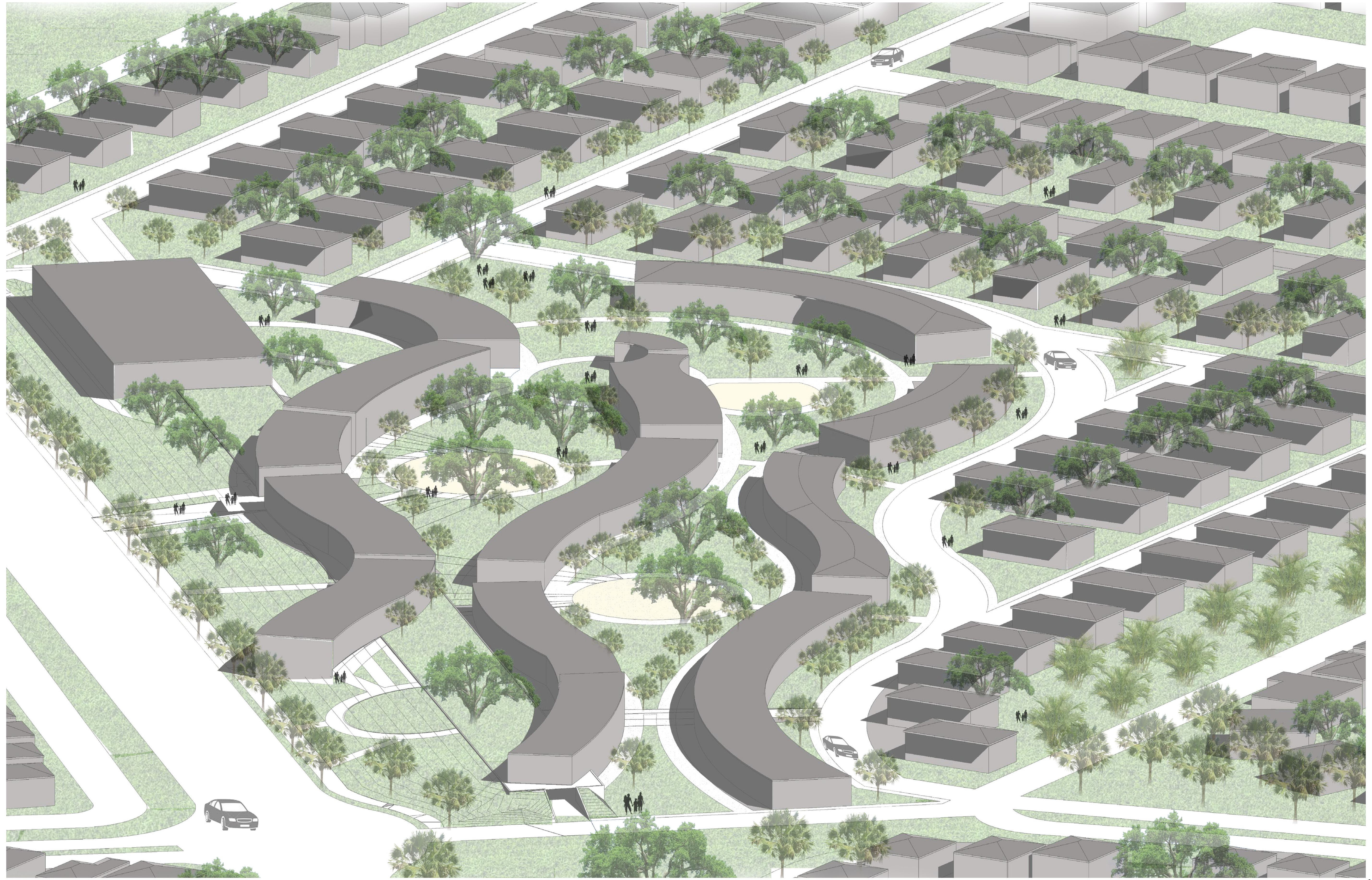
DETAILS OF COMPONENTS

CHAPTER

05

PROGRAM AND SPATIAL EXPLORATIONS

5.1 DESIGN SOLUTION



5.2 OVERVIEW OF THE PROJECT

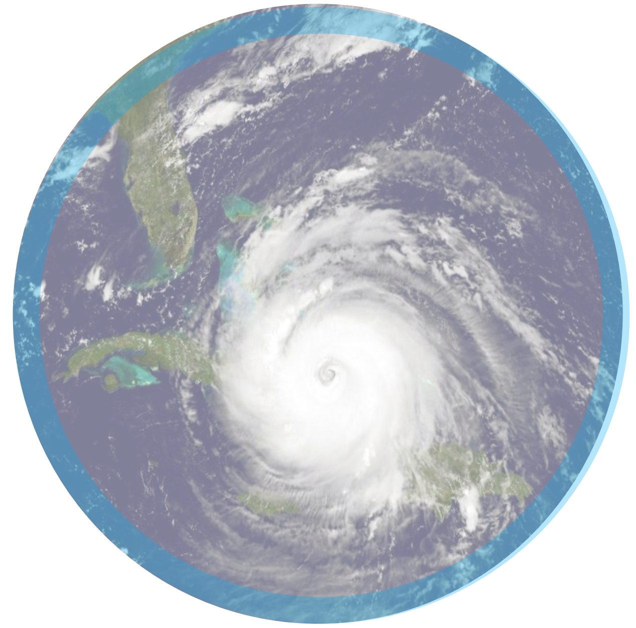


Figure 5.1

THESIS TOPIC

Designing a hurricane community in Cutler Bay Florida that improves survival of house structures and minimizes emotional damage.

Figure 5.2

WHY IS THIS TOPIC IMPORTANT

Hurricanes disrupt many peoples lives and recovering is a long and tedious process

Figure 5.3

ISSUES OF CURRENT CONDITION

Materials are poorly installed and wind picks up the roof allowing water damage in the house. There is no community space. Vegetation is lacking. There are no necessary resources in the vicinity.

Figure 5.4

SOLUTION PRECEDENTS

Change roof conditions, raise lower levels and use flood rooms. Pull main structure supports into the structure.

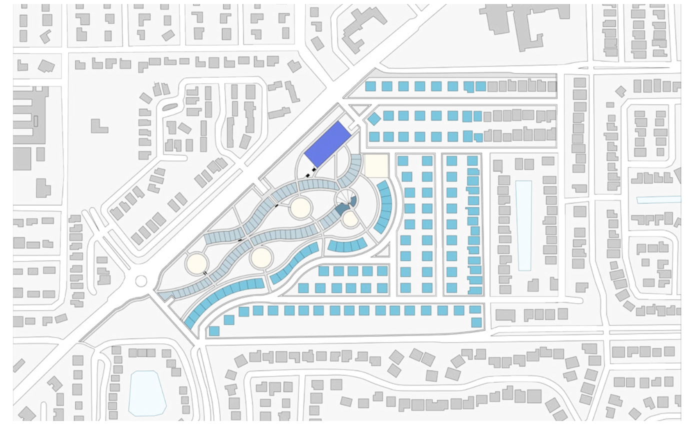
DESIGN

Add vegetation to the site. Create a more organic and open flow for wind between and around buildings.

CONCLUSION

There is a better way to protect and design communities for hurricanes, through simple layout and design additions.
.

5.3 FINAL SITE DESIGN PROCESS



GROCERY STORE

SHOPS

COMMUNITY CENTER

RESIDENTIAL HOUSES

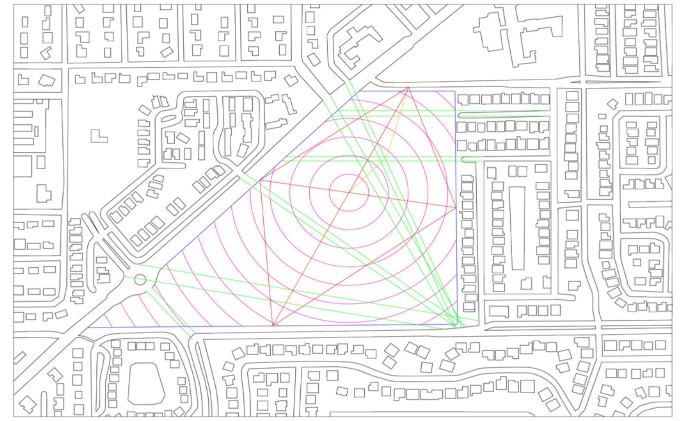
ACTIVITY NODES

DESIGN REASONING

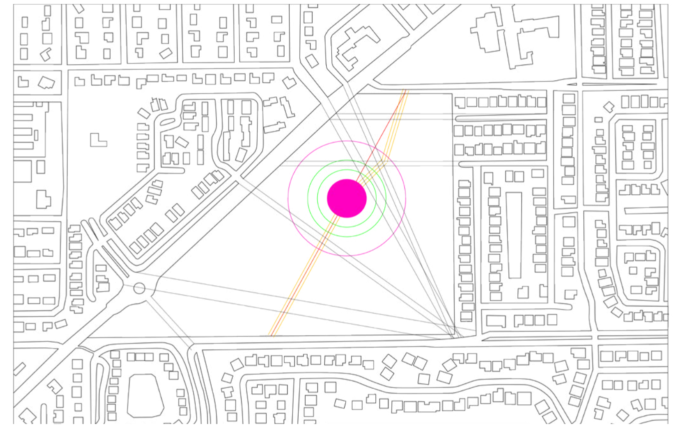
The design of the site features an organic shopping and refuge area to face the hurricanes at the front. The back of the site where the boundaries meet the existing neighborhood blend the rest of the site with the preexisting neighborhood. Since the area lacked a place for people to congregate, go during a storm, and a store that had essentials for everyday and emergency needs, the new organic shopping and refuge area would provide all the missing needs, especially during a storm, along with new houses that could withstand hurricane winds and water.

The reason I kept with the existing grid so that there would be a way to transition the newer more adaptive houses into the existing neighborhoods and help encourage rebuilds or remodels to the older houses around the area.

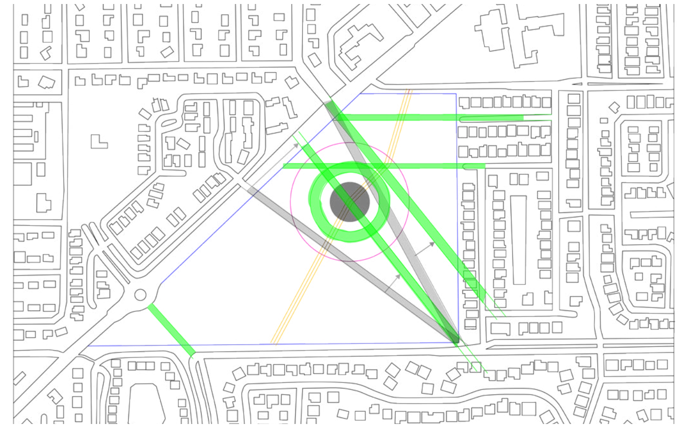
EXTRUDING SITE ELEMENTS



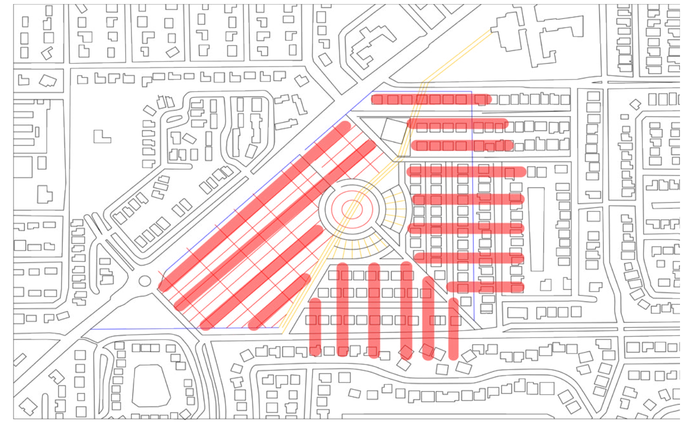
FINDING THE CENTER



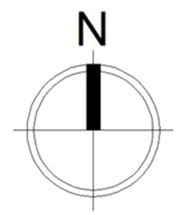
MOVING AND EXTENDING THE STREETS

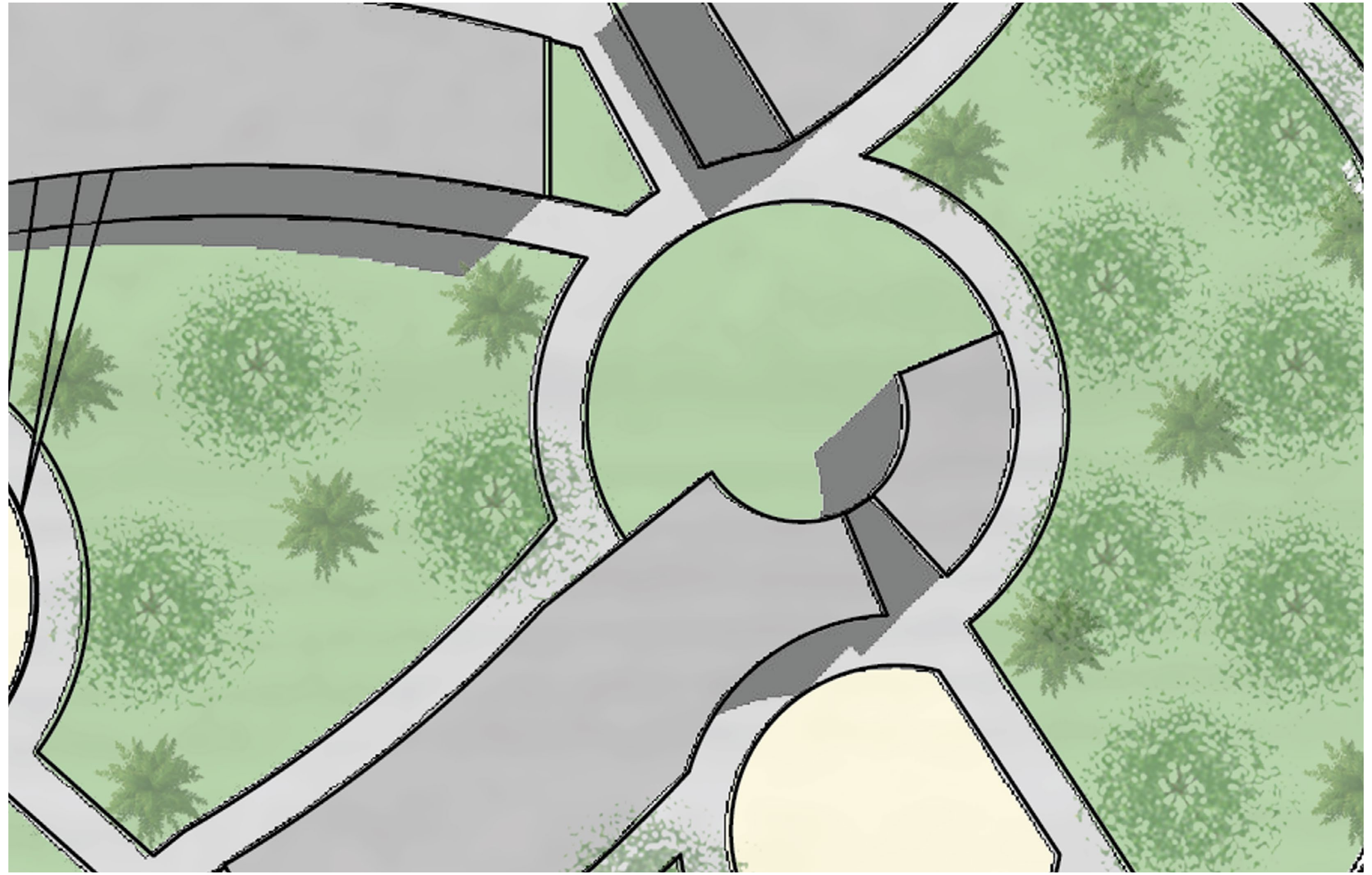


EXTENDING THE GRIDS



SITE PLAN



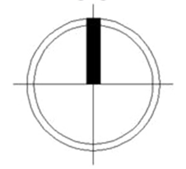


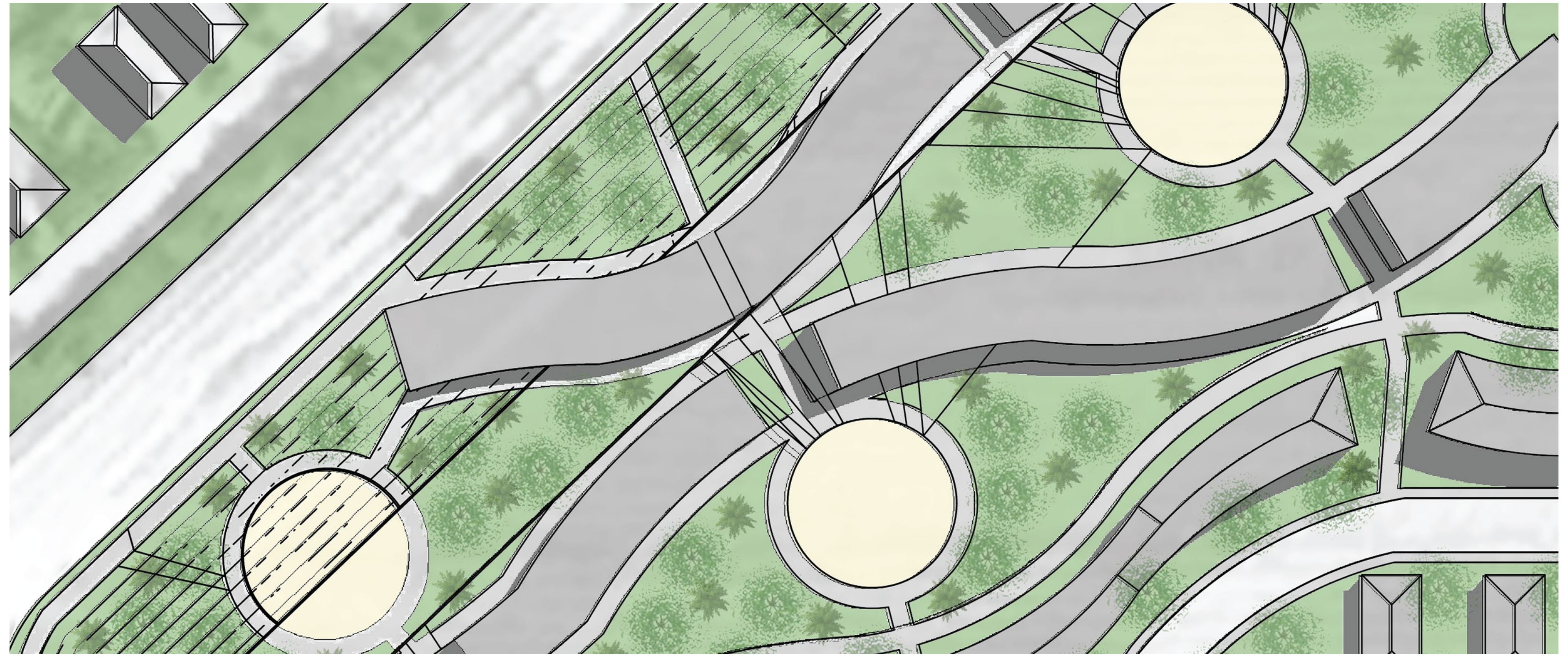
PLAN

PERSPECTIVE

5.4 COMMUNITY CENTER

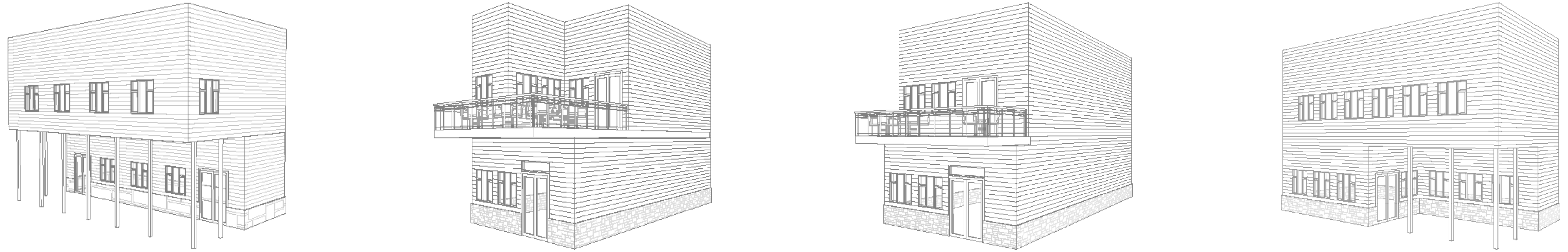
SECTION





PLAN

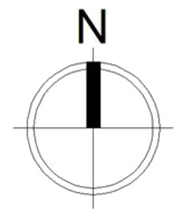
SHOP DESIGN OPTIONS

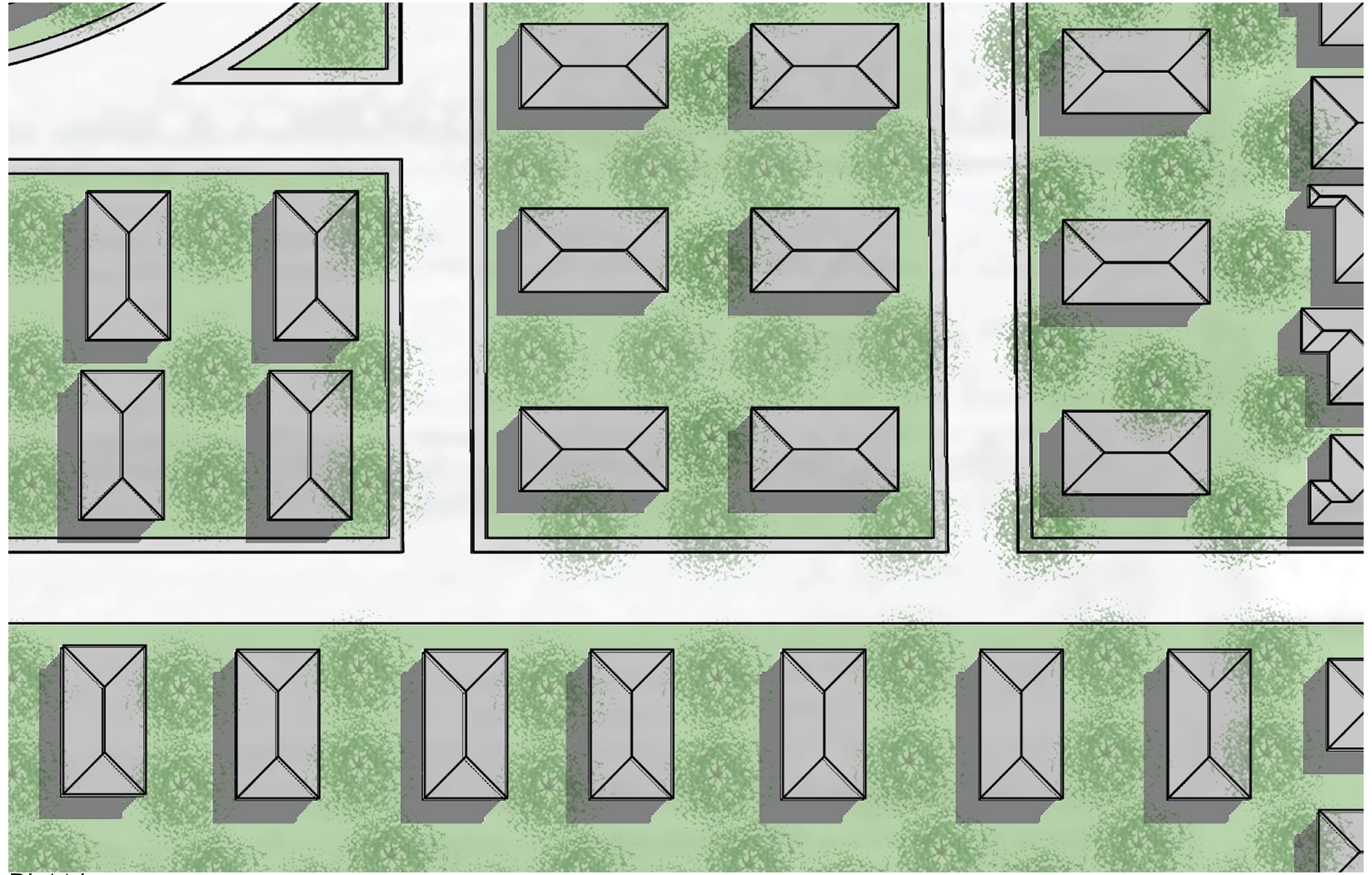


5.5
SHOPPING AREA

PERSPECTIVE

SECTION





PLAN

PERSPECTIVE

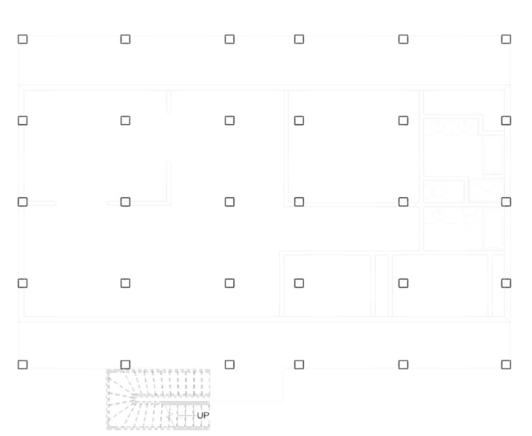
5.6 RESIDENTIAL AREA

SECTION

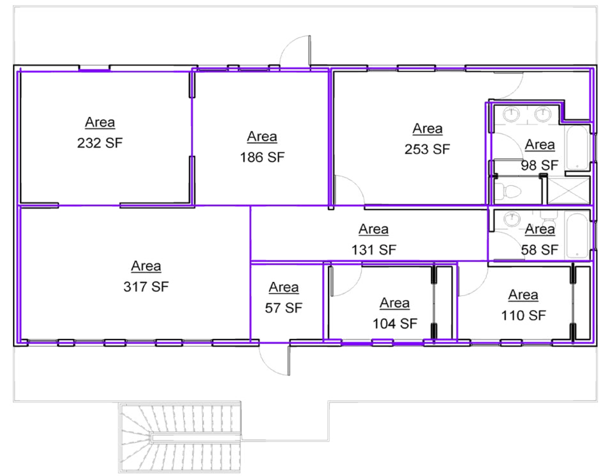
5.7 HOUSE DESIGN AND ANALYSIS

PERSPECTIVE

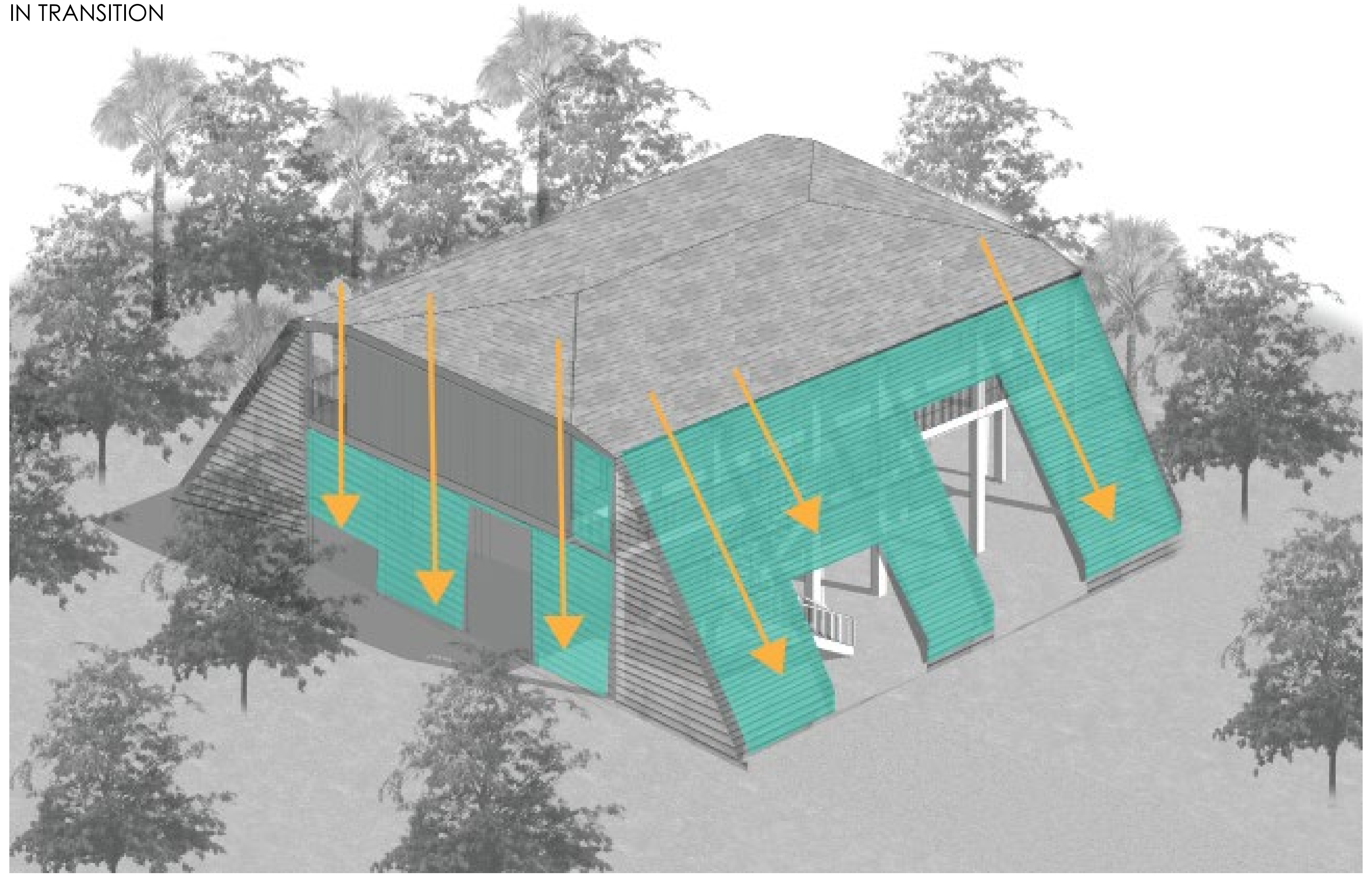
LEVEL 1

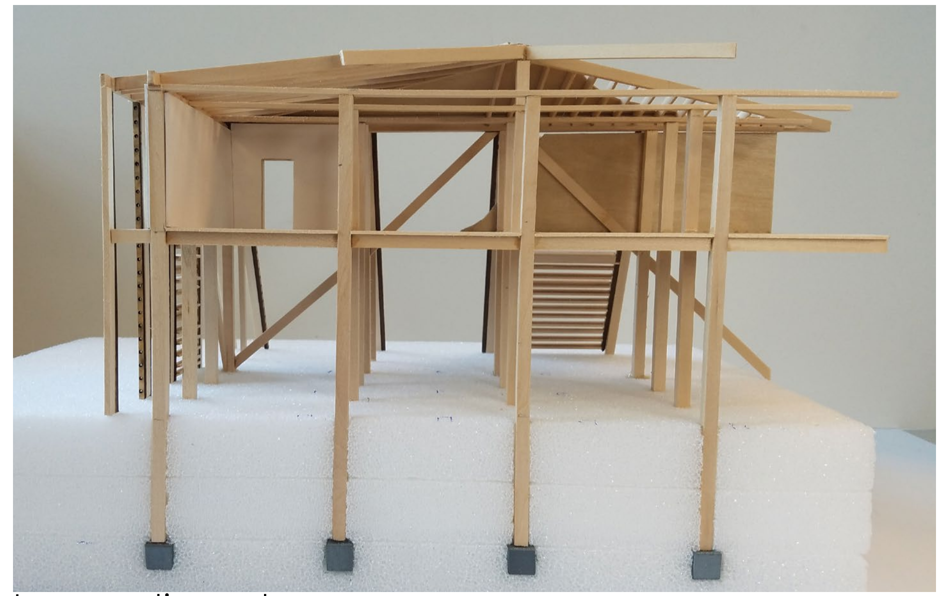


LEVEL 2



IN TRANSITION

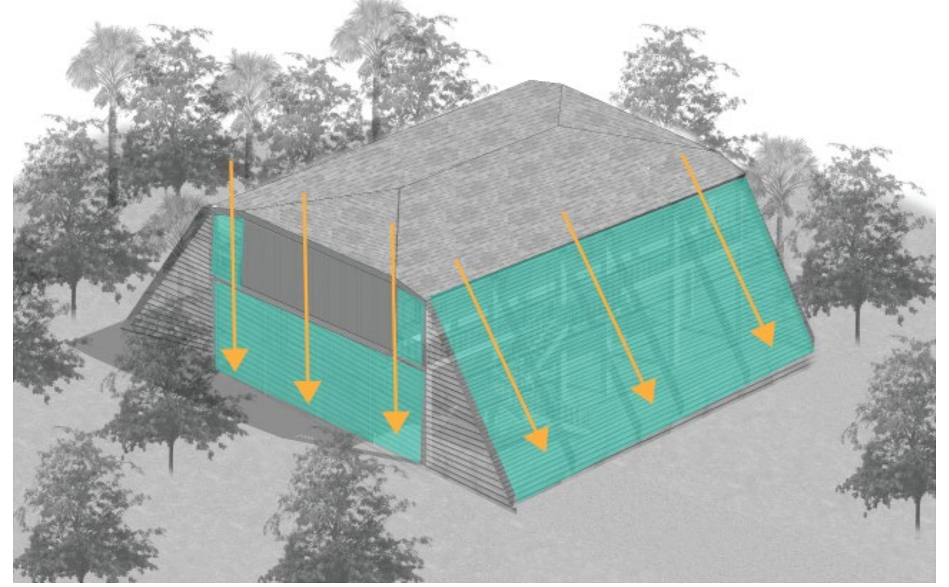




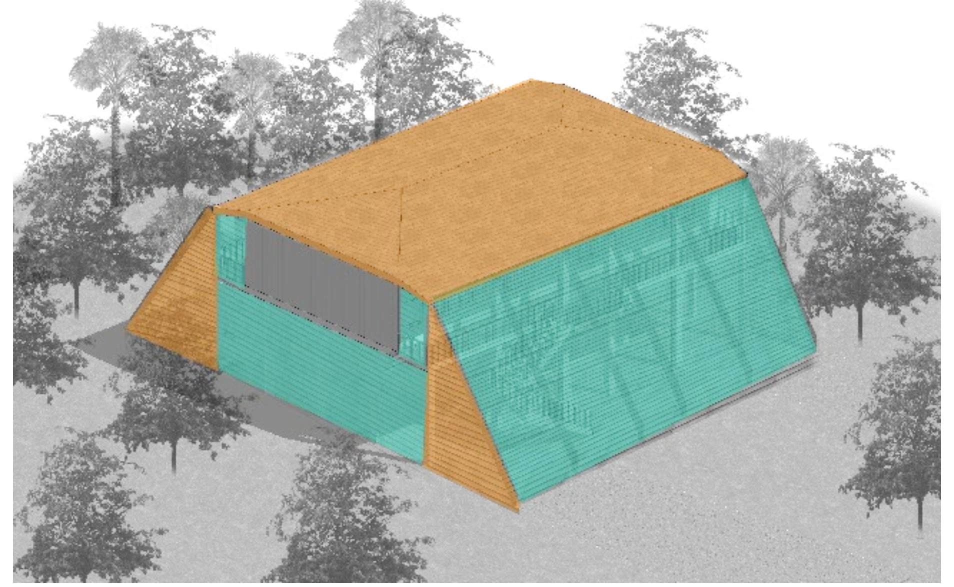
Long section cut

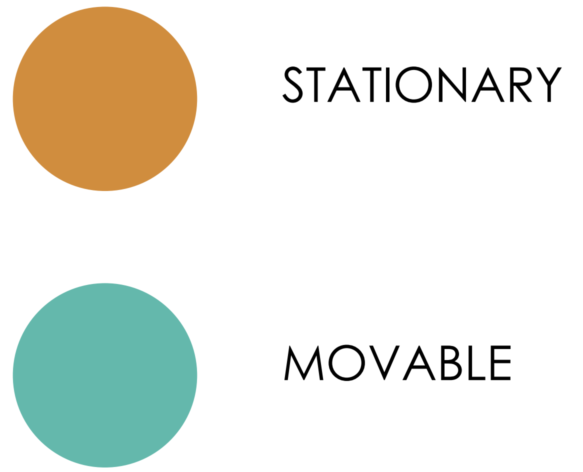
Short section cut

CLOSED SCREENS

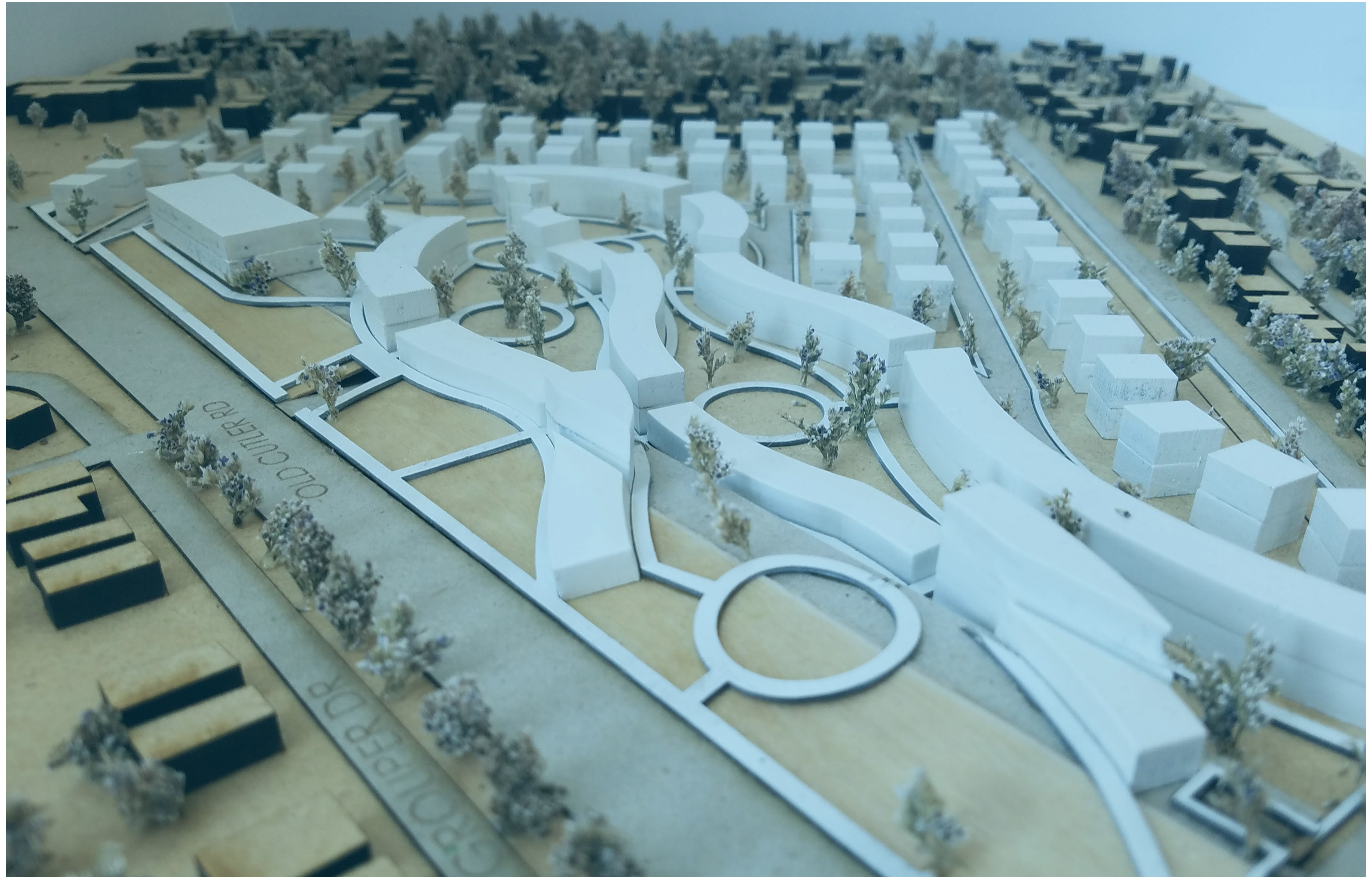


MOVING VS. NON-MOVING

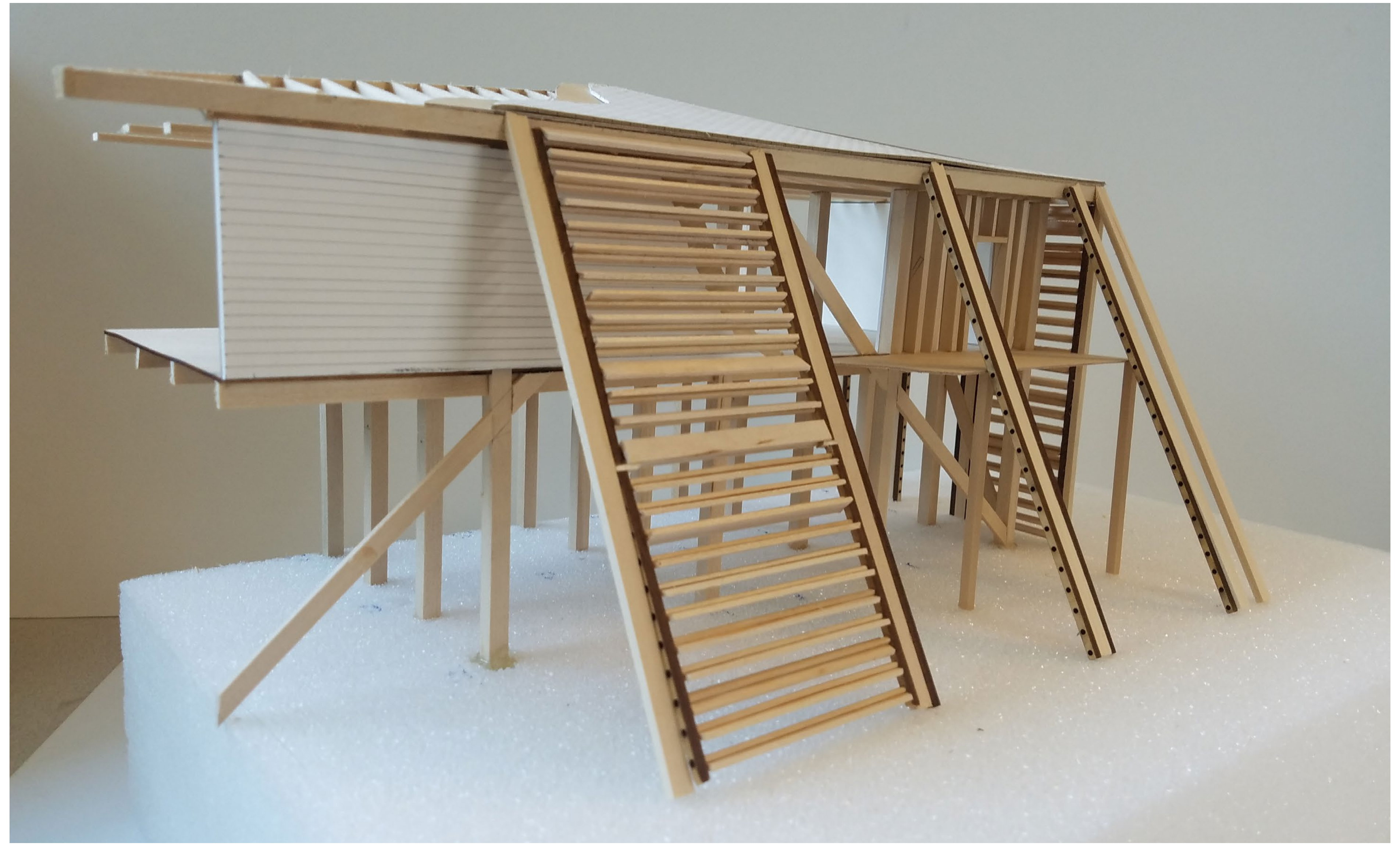


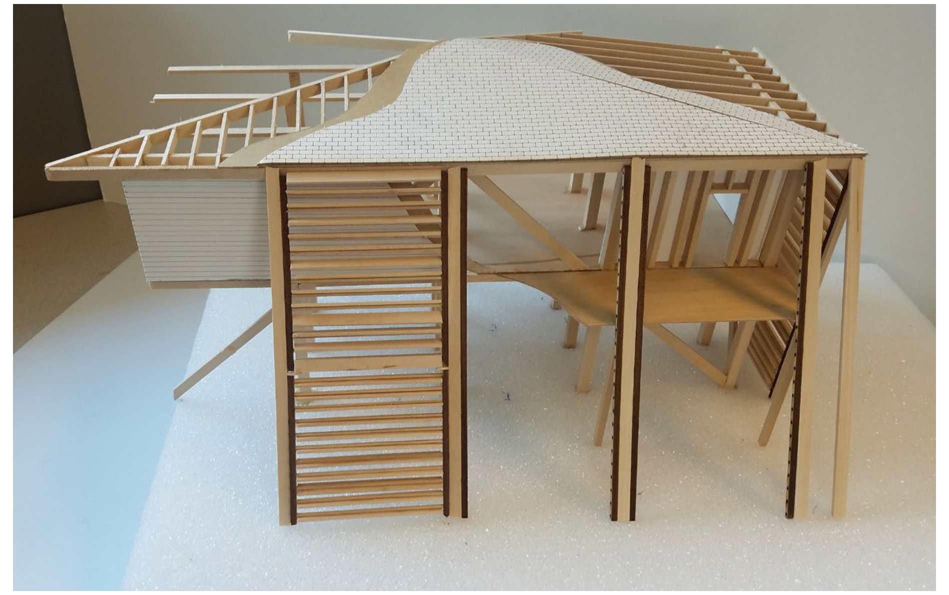


5.8 MODEL DOCUMENTATION

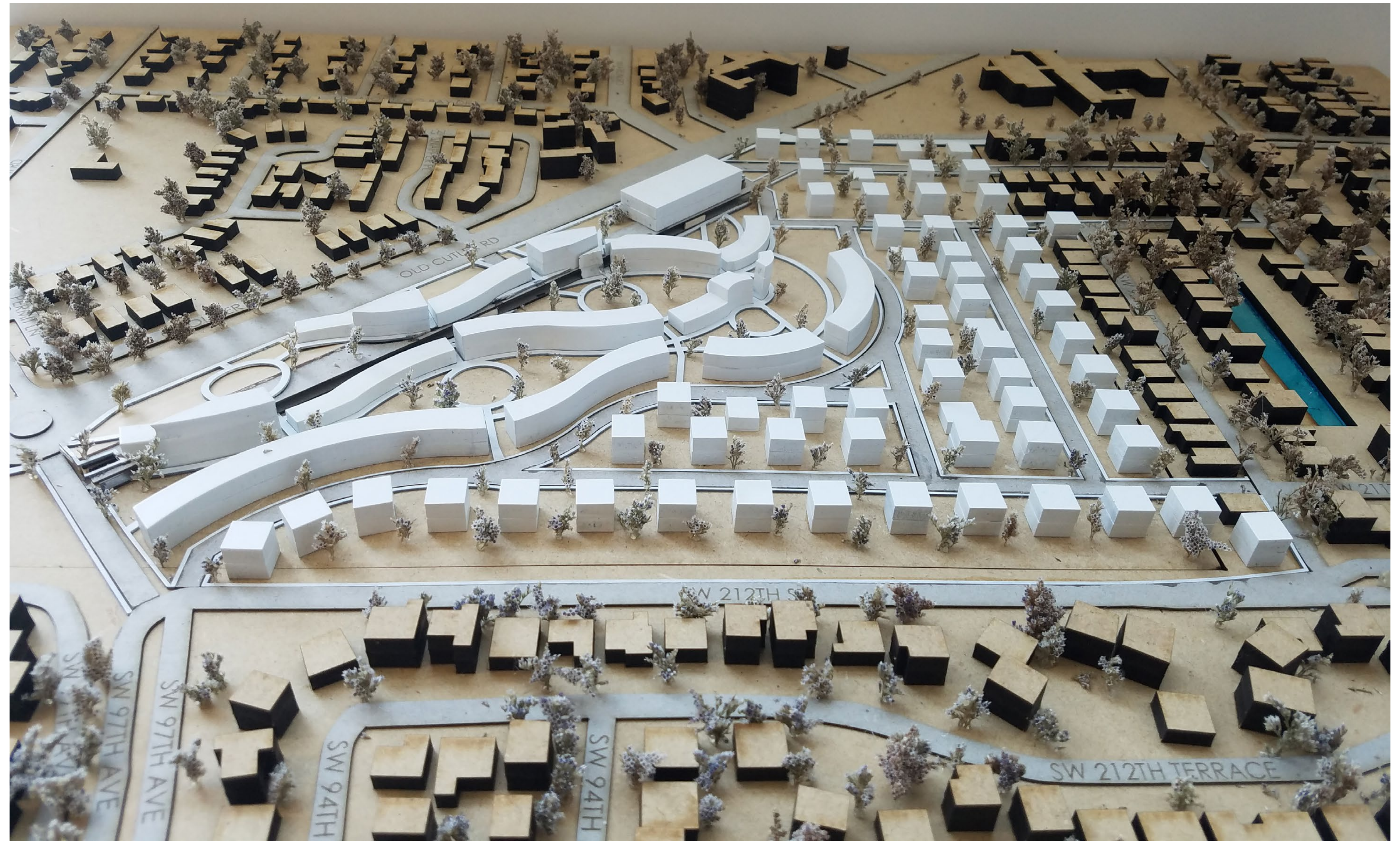


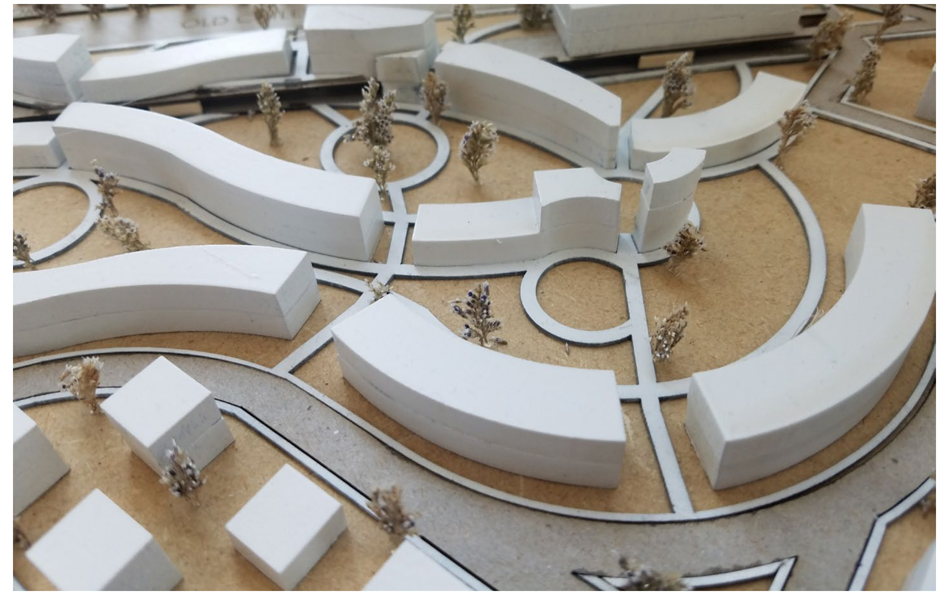
SECTION MODEL





URBAN PLAN MODEL





CHAPTER

06

REFLECTIONS AND CONCLUSION

6.1 REFLECTIONS AND CONCLUSION

THE GOOD: POSITIVE REMARKS AND SUCCESSES

The thesis was successful in its design to protect the house and had a good start in understanding what it means to be resilient and harmonious for two colliding concerns, the existing grid and organic flow. The thought of a hurricane is that it brings damaging high winds and water that make aftermath costly and stressful. The concept behind the thesis was to find a way to create a condition for envelop and buildings to deal with hurricanes as a fact of life and a part of this community just as much as a regular day or any other weather condition. Designing the house to have a softer material like wood or carbon-fiber panels allowed the appearance on the outside to seem less hard then if I were to create a bunker. The design to create flood rooms and plains throughout the site to deal with the extreme flooding during the storm and house cars or parks was a good way to use a space for more than one condition and was very successful. Lastly creating multiple levels and extending the roof was a simple move that made a huge impact on the pre and post-storm environment because it gave the structure more support when needed and provided a place to put sun shades to help against Florida's high temperatures when there is no threat. The multiple levels allowed different viewpoints and mixed-use spaces to be introduced into the site as well as allowed water to rise and fall during hurricane season.

THE BAD: FEEDBACK AND CRITIQUES

I consider this thesis project to have been somewhat successful. Elements that could have been more thought out and improved included affordability, ground conditions, a more detailed designed shopping area and community center. The biggest challenge when designing for a storm beforehand is that the structures either needs to be added to or the materials used need to be of a higher quality and this can be expensive, making it undesirable for mid-class families to invest in such items as a house. Thus, it was difficult to create a structure that was affordable and protected. The transition to the main part of the house being on the second level and the bottom of the house left open or meant for a garage or flood room made the ground condition difficult to figure out transitioning from house to street level because many people wouldn't naturally be on the ground level except for walking and going to their cars. Thus, I left the options open to the public on how to address right under their house by creating a room to inhabit on the ground floor that could be flooded and replaced easily. This created a place for people to dwell in and explore/expand into. The design of the house, community center and shops were all intended to read the same language. With the colliding grids of the site and the desire for the shops to be more organic than the gridded pattern of the houses the need to mix the two was the design decision, however, it would have been better if the organic started at the front of the site and expanded/grew to the surrounding area. This was difficult though because of the number of displaced people. Also, it would have been better if there was more detail in the design of the shops and community center to adapt like the house did to hurricane winds and water, however, working on two scales urban and small building scale was already a large scope of research to address. Lastly more testing of the community and house with a wind tunnel would have beneficial to the thesis to better inform if the project was a full success or not.

THE CONCLUSION: WHAT WAS LEARNED

Throughout the thesis there were many things tested, learned and discovered. Trying to create an urban space that was on a triangular site with colliding desires, between the grid and the organic flow, was difficult but there were benefits to both and benefits to mixing the two. I learned that working with purely wind in a hurricane is difficult because the wind is constantly spinning in different ways every time and the issue of water is always present. However, there is a way to achieve house protection and a working post-hurricane community for both wind and water issues. I learned a lot about how the Florida codes have tried to address and upgrade the current building codes to improve the protection of residential houses. Lastly, I learned a lot about how hurricanes work and the large impact they have on people's emotional state due to their destructive impact. Ultimately, I learned a lot about the effects of hurricanes, the response for communities in the after math of the storms and how architecture can help achieve a symbiotic relationship between the storm and the community.

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