GUIDE THE FLOOD

Miami Vulnerable Neighborhoods Flood Adaptation Design

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A thesis submitted in partial fulfillment of the requirements for the Master of Landscape Architecture Degree in the Department of Landscape Architecture of the Rhode Island School of Design, Providence, Rhode Island.

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Contrast between the new and old building, the level has changed much higher because of the flood issue

Contents

Overview

When it comes to the future of Miami, what else could be instead of waiting to be swallowed by the sea?

This thesis starts with a group pre-research on different aspects related to the rising up sea-level in Miami. By analyzing the existed urban fabric and typologies, the author tries to use the current segregated open space in every block to create a new open space system to reduce the sea-level-rise influence. Therefore, the goal for the thesis is to provide a powerful and gynamic open space system to the rising sea-level.

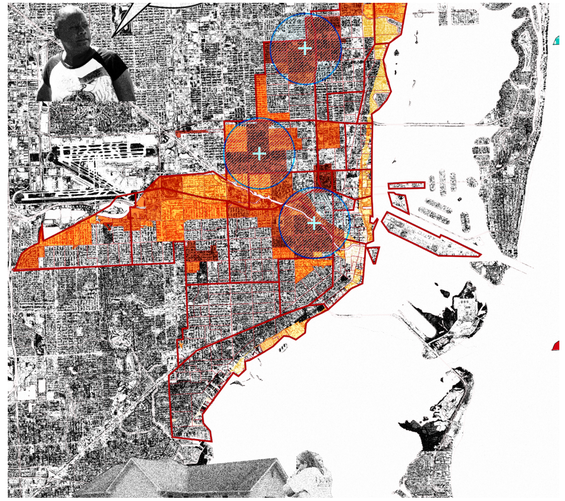
The thesis is structured in three phases. In Phase one, by analyzing the flood-related issues including where the water come from, the failed urban infrastructure system and the influence to the ecology and people, the author get a holistic understanding of how terrible the climate is in Miami, where and how the water comes to Miami, what people have done to reduce the impacts and who has already been attacked by the water. In Phase two, half of the effort is dedicated to knowing a detail information about the vulnerable neighborhoods through the field trip to Miami. And the other half is dedicated to understanding the site by analyzing the neighborhood typologies to get to know the potential of the existing vulnerable neighborhoods condition. In Phase three, time is spent on identifying and establishing typical blocks design under a series of resilient strategies in neighborhood scale. Through the analysis in phase two, three typical blocks are identified to cover all the blocks in Miami, “mid-tree”, unpermeable and the affordable apartments. With every typical block redesign, a water collect area is created as a contemporary collection basin, with the other area are designed to drain and slow the draining process.

The thesis ends with a design stage zooming out from single block scale to the whole neighborhood scale. It will create several green corridors which not only serves as a flood resilient areas but also offers recreational places for the vulnerable neighborhoods which only have some concentrating spots around some street corners now.

Site

Little Havana, Allapattah, Little Haiti are three low-income neighborhoods in Miami lower ground. According to the NOAA projection, in 2050, these neighborhoods would be threatened by the flood issue caused by the rising sea level and terrible climate in Miami. Most of the site are filled with densed low lying houses in a grid city system now, which gives the author an opportunity to create a design process from typical to general, from block to neighborhood, from Miami to other cities that are also suffering from flood issues.

Poeple who are in the site now are most immigrants from other countries like Cuba and Haiti, when they came to Miami, they preferred stay and live together. However, the lack of money and education has made these neighborhoods lose their cultural features.



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Phase 1 Background

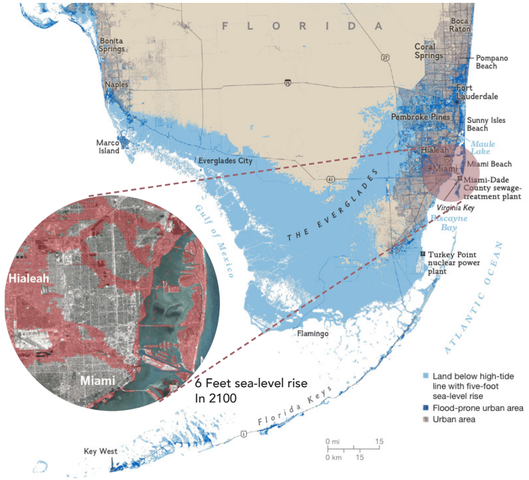
Undestand The Vulnerability Of Miami

Abstract

In phase 1, the investigation seeks to understand the condition of Miami under the impact of sea-level rise and climate change, which included the reason for flooding, the impacts of the flood on the ecosystem and people in Miami, the inefficiency of existing flood-related infrastructure. Instead of a basic information gathering platform, this phase spoke four narratives to identify the critical issues that water creates for Miami.

1. Flooded Miami
2. Destabilized Ecosystem
3. Threatened Cultural Diversity
4. Vulnerable infrastructure

Beyond that, by collecting GIS information, overlapping layers of different systems, several analytical maps were created through different criteria including the vulnerable neighborhoods distribution in Miami and the predicted ecosystem distribution.



Maps and graphics by ryan morris, alexander stegmaier, and john tomanio. Sources: climate central; u.S. Army corps of engineers; noaa

Introduction

The City of Miami had been disturbed by water from several directions for a long time. Phase one aimed to understand the relationship between the city and water to get a clear awareness of the importance and the possible impacts on Miami.

The big issue was broken into several questions in different areas to find the sources of the rising water and the vulnerable groups under this inevitable water condition. Specifically, it includeed what was larger context ecosystem and water cycle system like of Miami; what would happen to the ecosystem if the flood was on the way coming; what kind of infrastructures had been used to solve the flooding and why didn't they work now; the people influenced most in Miami and what were their living conditions look like.

The goal for phase 1 was to get a holistic understanding of the relationship between Miami and different water resources that influenceed the flood frequency of Miami, the current and future impacts of flood and the effectiveness of measures that had been carried through to solve the flood issue. The purpose of these studies was to identify the critical issue that water createed for Miami. Additionally, this phase was also a think tank to generate a specific design problem or a thesis question that had a solid background information for Phase 2 and 3.

Methods

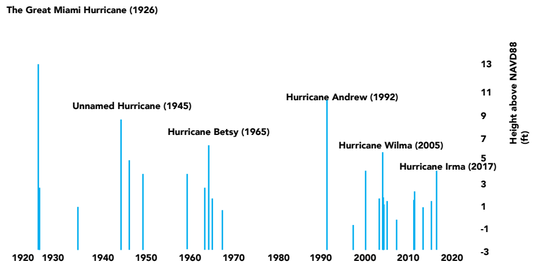
1. Visualize and map the history of immigrants coming to Miami from 1900
2. Literature review on Miami flooding
3. Diagramming the existing condition of Miami
4. Mapping the basic GIS inforamtion and overlapping to analyse
5. Urban transect to show the typical condition of each neighborhood in Miami

Miami is Flooding

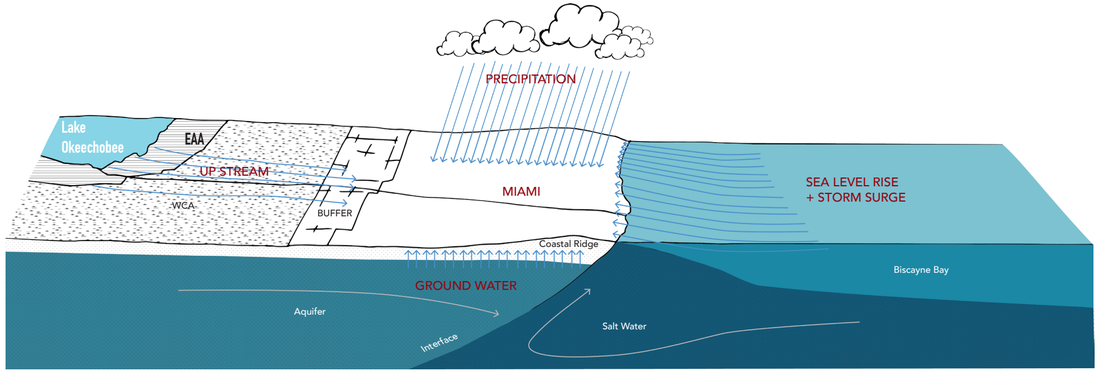
Different from other cities which would be under flooding issues in the coming future caused by the Global Sea Level Rise Phenomenon, Miami had suffered from it for a long time. From the last ten years' data, the sea level in the Miami county had been rising up at a speed of almost one inch per year which is around ten times rate of average speed of global sea level rise. According to NOAA's (National Oceanic and Atmospheric Administration) Intermediate-High projection, the sea level would go up to two feet in 2050 and there would be a 6 feet sea level in 2010.

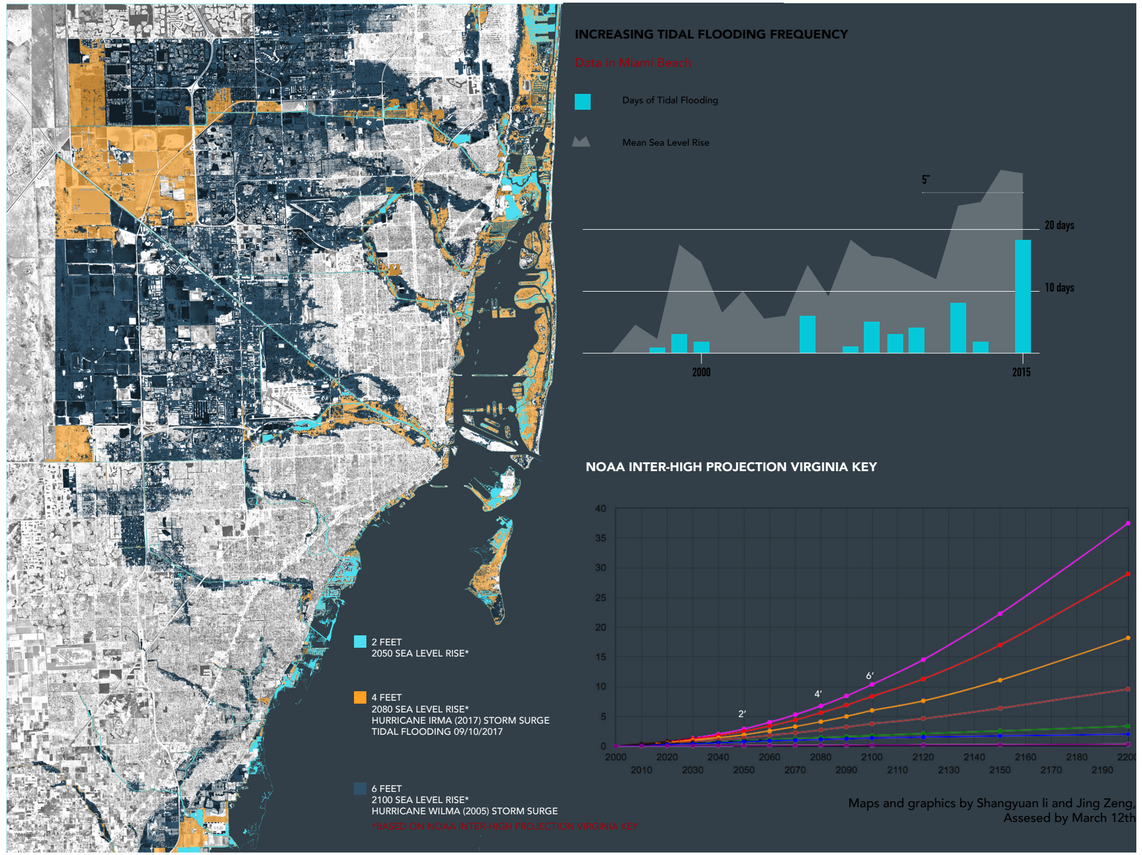
However, because of tropical monsoon climate condition, Miami city also had to face the huge amount of water from heavy precipitation and frequent hurricanes. The monsoon season in Miami lasted from every April to November which not only influenced the above ground condition by taking the extra water from Lake Okeechobee to the city but also had an impact on the underground condition through the cycle anticipated by stormwater to the sea and saltwater intrusion. What made the condition worse was the hurricanes. In the past 100 years, a large number of hurricanes had caused storm surges like Irma last year which caused a 4 feet storm surge and 83 billion damage including property damage and lost economic output.

SEVERE STORM SURGE CAUSED BY HURRICANE



WATER RESOUCES LEAD TO MIAMI FLOOD FROM SIX DIRECTIONS

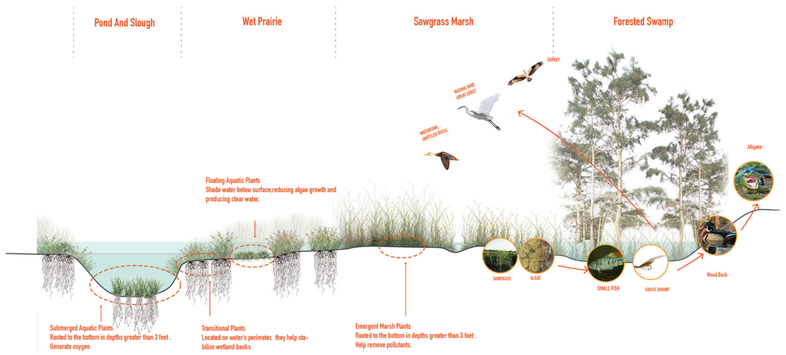




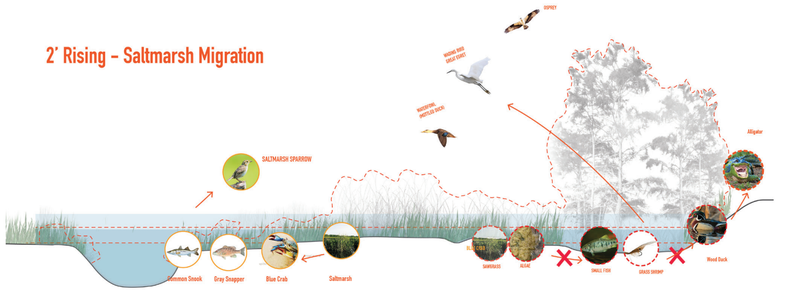
Maps and graphics by Shangyuan li and Jing Zeng.
Assesed by March 12th

Species Migration Process

The Everglades was a natural region of tropical wetlands in the southern portion of Florida, surrounding Miami city from west and south. It was definitely the core of the whole Miami ecosystem, providing habitats for thousands of species, offering water resources for agriculture and city, dealing with the potential flood from south and west. South Florida could not live without The Everglades. Unfortunately, based on the knowledge of the inevitable sea level rise condition, in a scale of the whole Miami County, The Everglades would experience a series of species migrations and finally change to an open water.



2' Rising - Saltmarsh Migration



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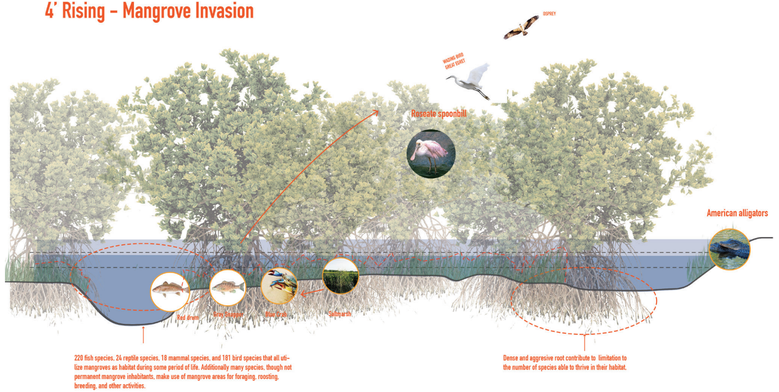
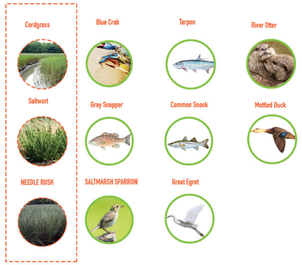
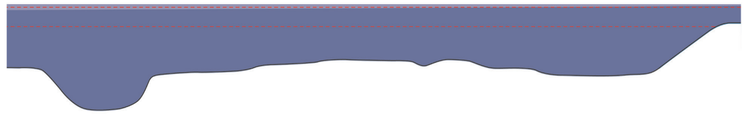
4' Rising - Mangrove Invasion





6' Rising - Open Water In The End



This process was highly related to the moving salt-fresh water distribution, so it was a dynamic system influenced by the sea level rise and topography. When the sea level rose up to a certain elevation, the new distribution of fresh-brackish-salt water condition would lead the related species to the dynamic migration process. However, The Everglades was a low lying ground area, when sea level goes up to 6 feet, the whole system would be under salt water.

Maps and graphics by Siyu Zheng and Chuxiong Feng,
Assesed by March 12th

Major Infrastructure Failure During Flooding

The climate and on-going sea level rise were not the only reasons which made the city of Miami suffer from a flood, backward infrastructure system and underground geology structure also should be considered. When flooding happened, current related flooding control system, sewage system, and the transportation system could not efficiently help with city and citizens solve the problem and even made the condition worse. Specifically, the flooding control infrastructure couldn't work during storm surge time because of the soil saturation and the current green infrastructure was far behind enough from controlling the flood.

Maps and graphics by Wushuang Xing,Jiongye Li,Jin Yan and Chuxiong Feng, Assesed by March 12th

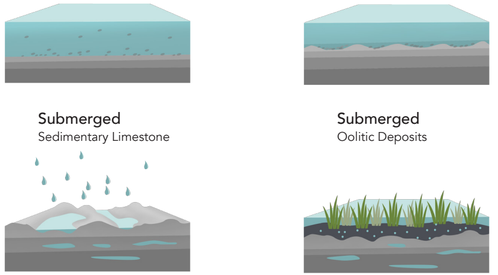
Inland Flooding

Different from other coastal cities, Miami had a totally different geology structure underground created by the dynamic sea level of the past millions of years.

During the last Ice Age (2.6 mya-120000 years ago), the sea level ranged from 400 feet lower to 100 feet higher than today. The organic elements like calcium carbonate of sea creatures and algae remained and formed sedimentary limestone bedrock of the region as the sea level went up and down. When the sea level became lower again, the limestone layer was exposed. With the erosion from acid rainwater, the nowadays porous limestone layer was created. After that, the fresh water was stored in this layer and that was also the reason of The Everglades formed.

But when the sea level went up again like what Miami was facing now, the special structure became a problem. As sea level went up, salt water from the sea would also occupy the porous layer and the whole layer would be filled with water. As a result, when heavy rain came, water couldn't infiltrate too much because of soil saturation. What's worse, water from the sea would go back to the city through the sewage system causing inland flooding.

Aquifer Forming & Saltwater Intrusion



Submerged
Sedimentary Limestone

Submerged
Oolitic Deposits

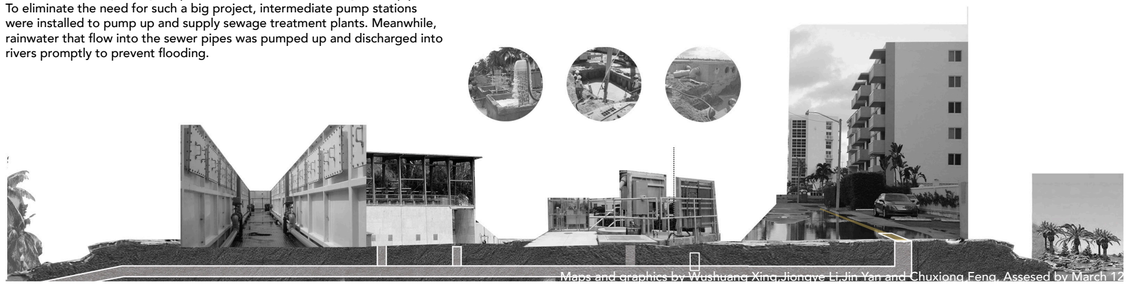
Exposed
Dissolution of Limestone
– Porosity
Soil Formation

Deposition of Peat
Accumulation of vegetation
Freashwater Storage

Maps and graphics by Shangyuan li and Jing Zeng,
Assesed by March 12th

Existing Sewage System

To send sewage from households to a sewage treatment plant by gravity, it would be necessary to dig deep into the earth when installing sewer pipes. To eliminate the need for such a big project, intermediate pump stations were installed to pump up and supply sewage treatment plants. Meanwhile, rainwater that flow into the sewer pipes was pumped up and discharged into rivers promptly to prevent flooding.



Maps and graphics by Wushuang Xing,Jiongye Li,Jin Yan and Chuxiong Feng, Assesed by March 12

Immigration History

Miami, known as the capital of affluent Latin America, concentrated people from almost all the Latin America countries in its different neighborhoods. Compared to the process of how The Everglades formed, the process of how Miami people came to here was much shorter.

From the 1890s, the railroad magnate Henry Flagler extended the Florida East Railway to the coastal area which was now known as Miami City. It started the process of bringing thousands of residents and tourists from the other area in Florida to Miami for its warm weather and gambling every decade throughout the 20th century.

The immigrants from the Carribean started before 1959 when the Cuban revolution happened, but the revolution indeed had a huge impact on the immigrants in Miami. Thousands of Cuban immigrants went back to their motherland while, at the same time, people who failed in the revolution started their immigrant's life. The other parts of immigrants from Central America and Haiti also came to Miami in the next decades as their hometown were no longer suitable to stay. People from different backgrounds coming to Miami mostly share the same language, the Spanish, but lived in different neighborhoods as they had their own lifestyles, let alone the local residents who could speak English. That was also the reason why Miami could have the multicultural neighborhoods.

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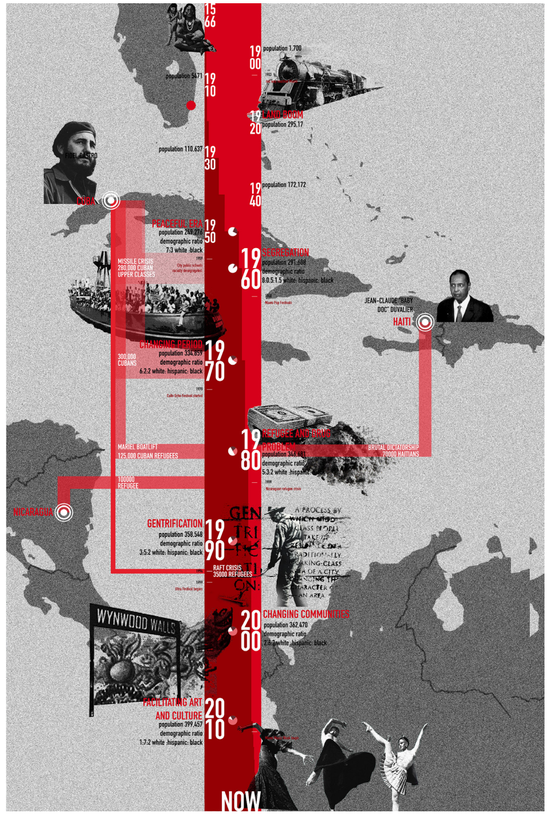


Multicultural Neighborhoods

Instead of coming and interacting with local residents, the immigrants brought their own cultures and lifestyles to Miami as they come in an amount of 100,000 or more at one time. Therefore, Miami had developed an unexpected case of cultural diversity with many cultural enclaves

There were 24 neighborhoods in all in Miami which were divided by huge city infrastructures like I-95 and I-195 highway, Miami River and some other main roads such as the west-east direction Biscayne Blvd.

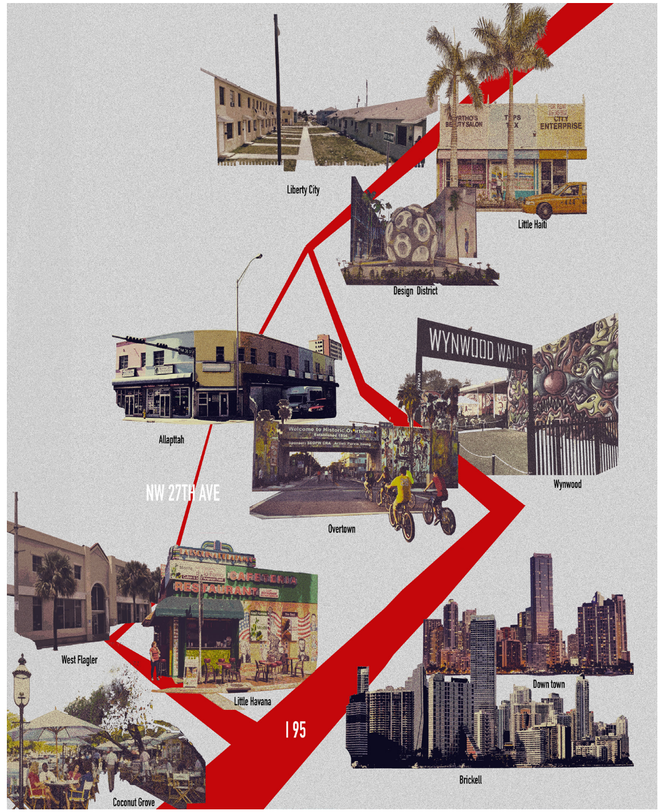
The diagram on the right showed every typical Miami neighborhood from north to south. The Liberty City neighborhood was the largest concentration of African Americans in South Florida with low-income residents and affordable houses.
On the other side of the I-95 was the Little Haiti neighborhood, which was obviously a neighborhood of Haitian immigrants. It was famous for its French-Creole style street life, dance, and music. Although the houses here were also low-rise houses, they were colorful. At the corner of Little Haiti, there was a fashionable neighborhood called Design District. After decades of urban decay, it became to a creative neighborhood with a lot of retail stores, a wide range of dining, entertainment, and public art installations.

At the south of these three neighborhoods, the composition from west to east was Allapattah, Wynwood, and Overtown.

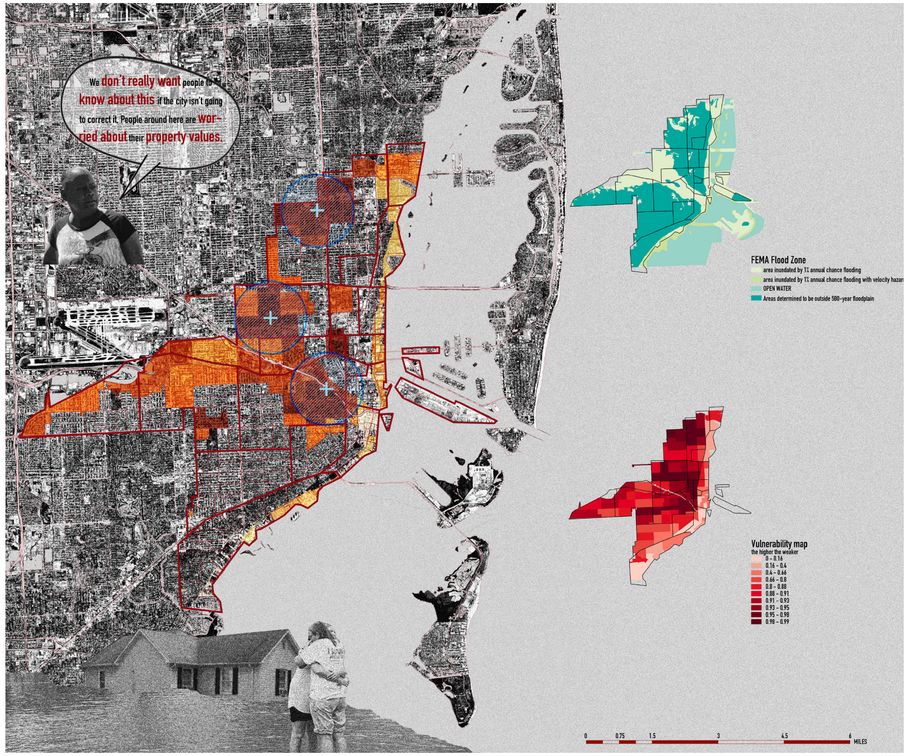
Allapattah was a melting pot of Hispanic residents from all Caribbean countries, but still, they had their own living areas and several famous Latin markets are also in this neighborhood. Now, Wynwood was well known for its graffiti walls which attract thousands of tourists every year. However, it was formerly an industrial district with abandoned warehouses. Thanks to the "Midtown Miami Development Construction", the neighborhood was gradually occupied by artists, restaurants and retails. The Overtown was another low-income neighborhood which was highly influenced by infrastructure as the highway intersection locates here and occupied huge amount space.

The Downtown, Brickell, and Coconut Grove were the richest neighborhoods which along with the south coastal Miami. Although Miami river was a clear boundary between Downtown and Brickell neighborhoods, this two area almost shared same functions as consulates, banks, and skyscrapers. While the Coconut Grove was regarded as a recreational neighborhood as amounts of outdoor restaurants and events were here.

The other side of I-95 was Little Havana, which had most Cuban immigrants and holds the Hispanic largest festival every March



Vulnerable Neighborhood



By intergrating information between the social vulnerability mapping and Fema flood zone, information overlayed showed that Little Havana, Little Haiti, Liberty City and Allapattah were highly Vulnerable. Unfortunately, those neighborhoods were also the area where poverty and social justice conflicts happened most.

Findings + Conclusions

After completion of the first phase of these investigations, several conclusions were made through the four narratives of critical issues, including the reason why Miami had been surrounded by water from it was established, how ecosystem and people in Miami were influenced by the flood and assessment of the existed infrastructure.

First of all, Miami city was influenced by water coming from six directions:
1&2 Rising tidal and underground water because of the permanent sea-level rise
3&4 Heavy precipitation caused by the feature climate and frequent hurricanes
5&6 Miami canal flood flow lead by the water both from upstream and sea
All of them lead to the nowadays easy flooded Miami.

Secondly, the inevitable sea-level rise would generate a dynamic distribution of salt water and fresh water in Miami. Beyond that, the plants and animal species were highly influenced by this new system, showing trends of gradual migration from salt water condition to freshwater condition. The final result of this new distribution was that the Everglades known as the fresh water source of this area will fade away.

Thirdly, the cultural diversity in Miami was threatened because the most vulnerable areas influenced by the flood are the neighborhoods where immigrants concentrated and celebrated their original culture like Little Havana and Little Haiti.

Last but not least, the flood-related infrastructure in Miami failed in two aspects under two different conditions. One was the inefficiency of drainage infrastructure system mainly caused by lack of green infrastructure and sewage infrastructure. The other was the inefficiency of evacuation infrastructure system because of the lack of shelters and inaccessibility of transportation system during the flood.

Phase 1, working as a think tank and research base, offered the background information varying among several scales and system. While the Phase 2 and 3 were the stages that the research should first focus a more in-depth understanding of a specific issue and then come up with proposals. The next step of the research would focus on the understanding of flood issue in Little Havana which was one of the most vulnerable neighborhoods decided by aging structure, income level, the ability of evacuation.

Assessment

Given the findings and conclusions from the phase 1, the research seemed to need to take a slight turn around. There was still some critical information missing about Little Havana including the typical building typology, urban fabric structure, the flood frequency. It was necessary to make room and time to answer them as soon as possible.

Research would surely benefit from new knowledge and physical site observations. In order to get to the right research direction of Little Havana neighborhood, a field trip to Miami needs to be realized through phase 2. Additionally, a physical model showing the dynamic flood issue of Little Havana neighborhood should be finished and working as a basic research tool.

Research would also benefit from more built precedents about flood neighborhood renewal that are functioning and could be observed.

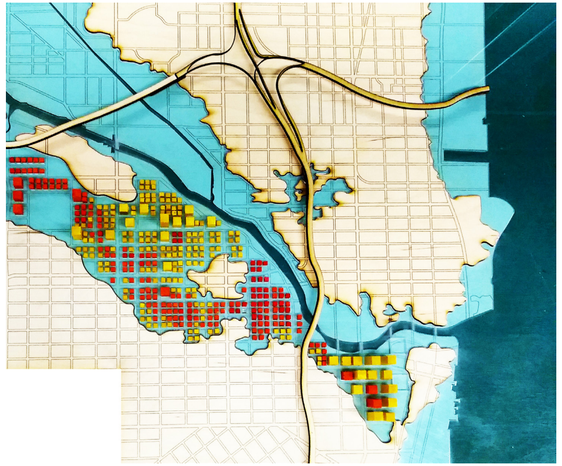
Phase 2 should confirm the direction of this research and help refine the key question and final deliverables.

Phase 2 Potential Future for Vulnerable Neighborhoods

Site issues and potential prototypes

Abstract

Based on a better understanding of Miami Vunerabe Neighborhoods from Miami field trip, phase two investigated and analysed the common but specific issues in the vunerable neighborhoods under the 2050 NOAA sea level projection. Besides that, used the existing protypes or precendents which is for and even has been used in Miami Beach as a potential direction for proposed site future. It was a stage not only solving the current situation but also creating a new site image before 2100 when the site would be all under water.



Model illustrates the contrast between Little Havana and Downtown area housing density.

Introduction

In Phase two, the investigation aimed to get a deep understanding of the specific issues in vulnerable areas and propose a future design direction for those areas which was a result of overlapping the social income map and Fema flooding zones.

Phase two was built on the knowledge from phase one that sea level rise in Miami was inevitable and influencing Miami city now when thinking its flat plain, porous geology and heavy precipitation. The other fact that should be considered for phase two from Miami visit and a local resident interview was that the low-income and multicultural neighborhoods did not realize and could not solve the problem by themselves.Based on that, there would be some proposed, flexible prototypes which could both solve the existing flooding issues and offering a much more positive base for Miami future thinking. Phase three would be a design stage trying to use design strategies to deal with flood issues spontaneously by local residents under the social awareness.

The flooding zone in Little Havana neighborhood in Noaa 2100 sea level projection was chosen based on whether it could stand for the vulnerable neighborhoods and its flexibilities. Boundaries by two liner structures, the Miami River and the six feet high contour, the site shared the same block typologies with other vulnerable area but had its own cultural background as in a concentration of 80% Cuban immigrants.

The projects and precedents chosen for the site were all in Miami Beach which could share the common climate and geology condition. The proposals from them were in different scales in different stages which would help build a dynamic proposal respond to the keep changing sea level.

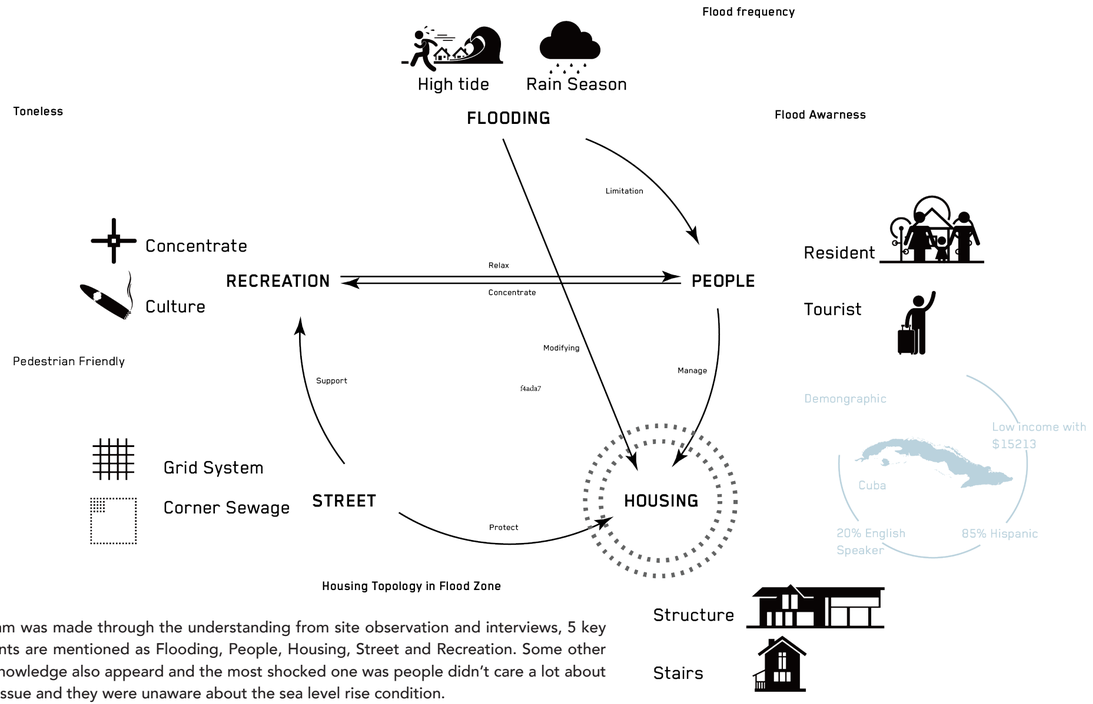
Future proposals under the Noaa 2050 sea level projection was a stage between current flooding influenced the situation and the future Miami when the site was all in under water. It got inspiration from both historical Miami Mangroves County and the problematical current situation. And it gave not only tech advice on the urgent flooding issues but also permanent ecology future possibilities.

Methods

1. Site visit including site observation and analysis, site interview and note taking, photography
2. Model Making to understand the current site situation including the flooding order and the relationship between site and context
3. Literature and precedent review to decide what could be possible directions for the site
4. Mapping of watershed-specific to the site to understand the dynamic influence of the flood.

Site Condition

Site Observation and Analysis

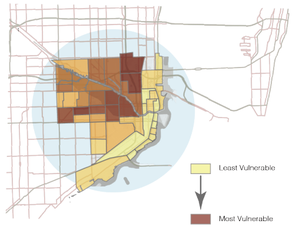


Housing Topology in Flood Zone

Diagram was made through the understanding from site observation and interviews, 5 key elements are mentioned as Flooding, People, Housing, Street and Recreation. Some other new knowledge also appeard and the most shocked one was people didn't care a lot about flood issue and they were unaware about the sea level rise condition.

Urban Relationship

Survival Transportation in Tidal Flood



Social Vulnerability

Existing Sewage System

Based on the knowledge from Phase 1, here are three related condition showing the vulnerability of the site and the reason why the site is so influenced by the flooding condition

Inland Flooding

Kind Tide Flood Now (2 feet)

2050 Sea Level (4 feet)

2100 Sea Level (6 feet)

Another thing that made the site special was the inland flood, because of the limestone geology structure, water would come back to the city from the sewage system when the limestone layer was filled with water in heavy precipitation season.

Site Photos





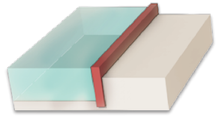




Ongoing Strategies and Technologies

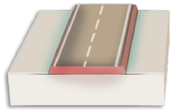
For now, there were mainly four ways dealing with the flood in Miami Beach; building a sea wall, rasing the streets, Creating a Mangrove Habitat and creating dunes between the city and water. The former two were the contemporary ways while the last two are more permanent. Besides that, some high-tech installation was also built in a really simple and cheap way like The Fushion Tech company's idea of building a huge tank between the street and sea to control the water amount and time to solve the flooding issue.

Flooding Strategie Realized in Miami Beach



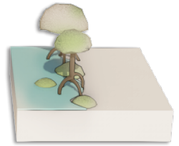
Sea Walls

"Physically protects from high tides on the Biscayne Bay side. There are a total of 3 miles 3-foot-high sea walls, and the city hopes to raise them to five feet."



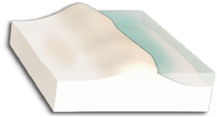
Higher Streets

"The city has also begun discussions for raising the levels of the lowest-lying streets. Also, new buildings are being rased in a new city standard"



Ecology

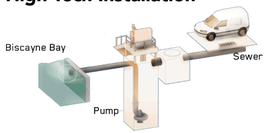
Miami used to be covered with mangroves, which naturally absorb water and prevent flooding. The city hopes to maintain and grow its mangrove supply.

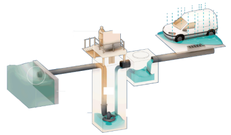


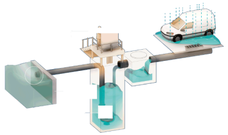
Dunes

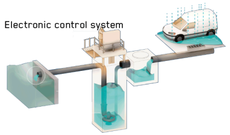
The city's sand dunes form another natural barrier against sea level rise, and the city is devoting resources to keep them nourished.

High Tech Installation





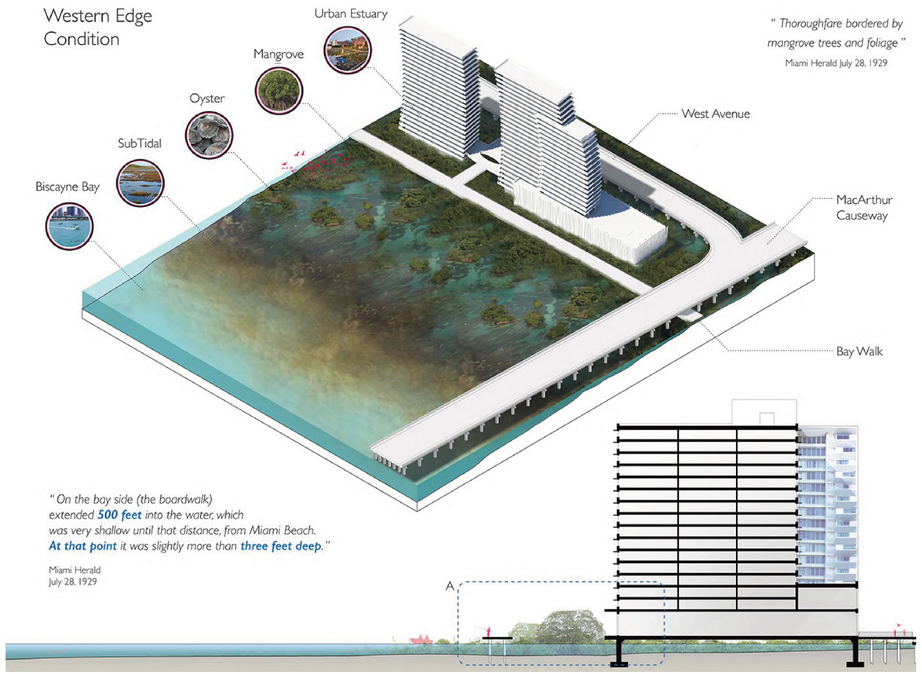


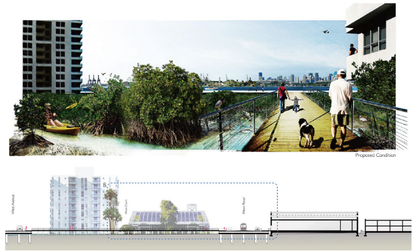


high tech but low budget installation by fushion company
http://interactive.fusion.net/pumpit/

Precedent

This was a project made by Issac Stein when he was at the University of Miami. The proposals brought back a layer of the natural landscape to protect the city from the rising sea, more than 50% of the building in the district were on the historic register. It was a project across the whole Miami beach. As the sea rises, the project proposed that mangroves should be planted everywhere on the western side. Mangroves historically existed on the whole western coast of Miami Beach, and bringing back these natural storm-surge-reduction plants was vital to managing the rising tides. Once the Mangroves get established, the next step would be the rasing walkways going through them and also recreational water ways. The project offered a direction that flood could be used and played with.



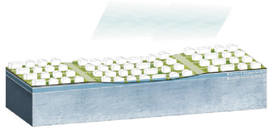


This Visionary Plan Could Help Miami Beach Deal with Rising Sea Levels https://www.vanityfair.com/news/photos/2015/11/miami-beach-rising-sea-levels-plan

Proposed Development Strategies

19 Century Habitat

From the historical view, the whole Miami City area was in the same condition as The Everglades was now, a perfect habitat for large amounts of species. The word mangrove was used to describe several trees, not closely related to one another, that flourish in salty environments. The mangroves, with their impenetrable root systems, help to keep waters clean and clear. It was a highly ecological plant species as every part of it had its own function and provide food, shelter or nest for animals. Flooding and sea level rise were not problems but only the elements which would influence the distribution of species.



Current Development

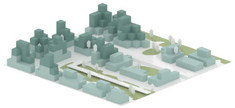
However, as the railroad came to the city, bringing more and more people here, all the ecological habitats were occupied by city infrastructures and houses. People in the low land have to face the flooding issues as the special geology structure could not help water infiltration. At the same time, the average of the land use condition with houses array reduced the recreational and ecological function of open space.

Proposed Stage to 2050

What the project in phase two proposed was a stage which could deal with the dynamic flooding condition and create a solid base for the future design. In order to achieve that, the new division and function of city plan should be created. The new type of residential area should be a dense area with most residents lived in the second or third floor of the houses. The low land area should be used as the recreational and ecological space at this stage.

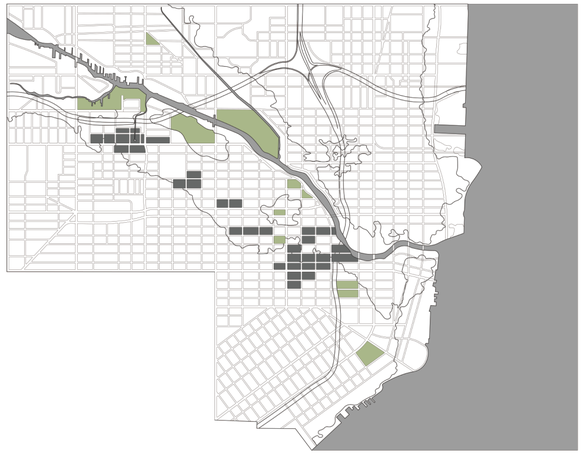
Housing in the HighLand

Modify the First Level and Open Space



Above Level Development

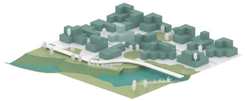
Above Level Connection



The proposed process of how the strategies would be applied to the site through a cubic system. While the dark grey area was the areas which would be flooded before 2050, and the green area was the potential open space which could be used as a contemporary space solving the removal problem of flooding zone residents.

Housing in the Flood

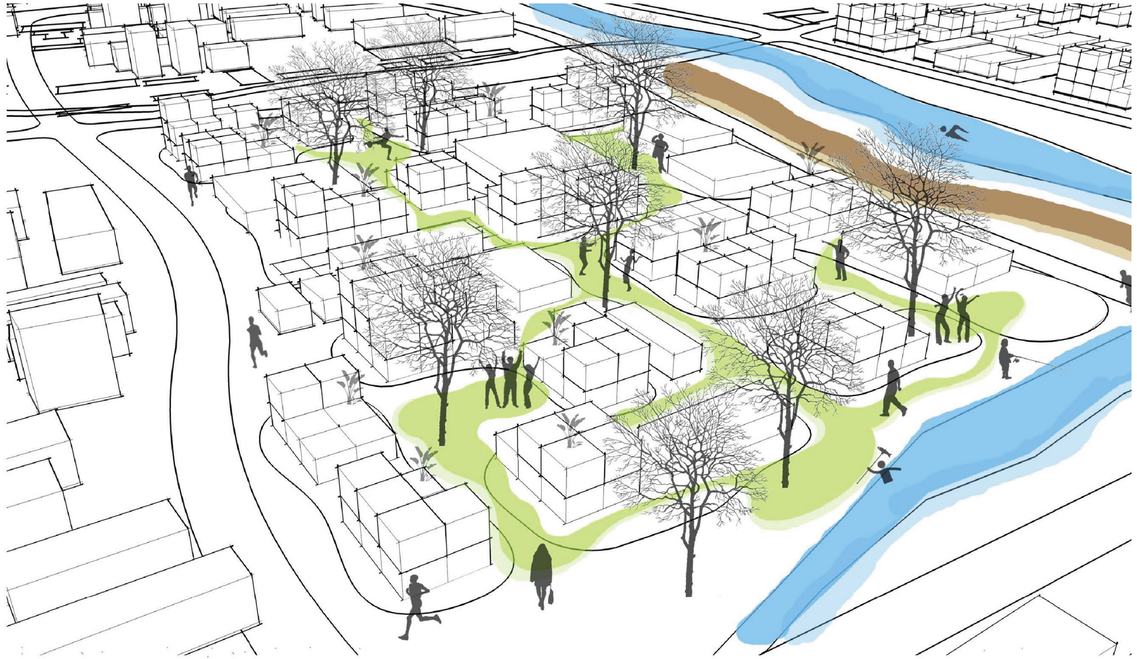
Clean and Create the Open Space



First Level Structure Design

Above Level Design and Connection

Proposed Views



Findings + Conclusions

After completion of the second phase of these investigations, there was a clear understanding of the city and site. However, the potential prototypes seemed a little confused as the relationships between the proposed plan and site condition are unclear.

First of all, there were two separate directions of proposals now
One was the modular system to solve the flooding condition issue, the other is the mangrove system to help with flooding issue permanently.These two directions are both lacking enough data and information to support their arguement.

Secondly, the existing analysis of a current situation was too general to create a core problem which could be dug into a deeper level.

Phase two originally should serve as a middle platform for a better understanding of the core problem and create a solid base for phase three. Since the project is still not clear enough, there should be a back and forth process at the beginning of Phase three to have a strong argument for the design process.

Assessment

During phase two, the field trip was helpful to get a clear image of what had been investigated in phase one. Except that, some new and key issues also came out through the trip as the unawareness of the flooding issue and sea level rise influence in the coming future. However, the analysis for the trip was a little out of control and was separated from the basic solid base from phase one. That was the main reason the proposed plan seems confused.

This phase was a little far behind the expected schedule as too much time was used for testing the presence of Model. In order to move to phase three, an intense and back and forth process should be realized quickly and efficiently. Phase three would begin with a direction of analyzing the existing block typologies in flooding zones to get a better understanding and common feature of Miami vulnerable neighborhoods. Then based on the knowledge and finding from that, create a dynamic proposal to respond to the changing sea level rise.

Phase 3 Design Proposal

Flood adaptation design in Miami vulnerable neighborhoods

Abstract

Phase 3 was separated into two parts, first part was the back and forth part, it aimed to find a clear and specific direction related to the site. The author zoomed out to a neighborhood scale in a plan view and find some common but potential features for every block. With these features, analysis on how and where to use the block was made.
The other part was the design process, the main goal was to create a resilient system in neighborhood scale related to every block. While the exact design was made in three typical blocks which could almost cover all the block typologies in these three vulnerable neighborhoods.

http://www.kokomotribune.com/news/heavy-rain-causes-severe-flooding-in-parts-of-miami-co/article_b2dec472-584b-11e7-90a8-57925d037832.html

Introduction

In Phase 3, some typical neighborhoods pattern were chosen from three vulnerable neighborhoods flood zones according to the distribution of permeable or impermeable feature.

Based on the identified potential areas above, designs and transformations were made in neighborhood scale and block scale.

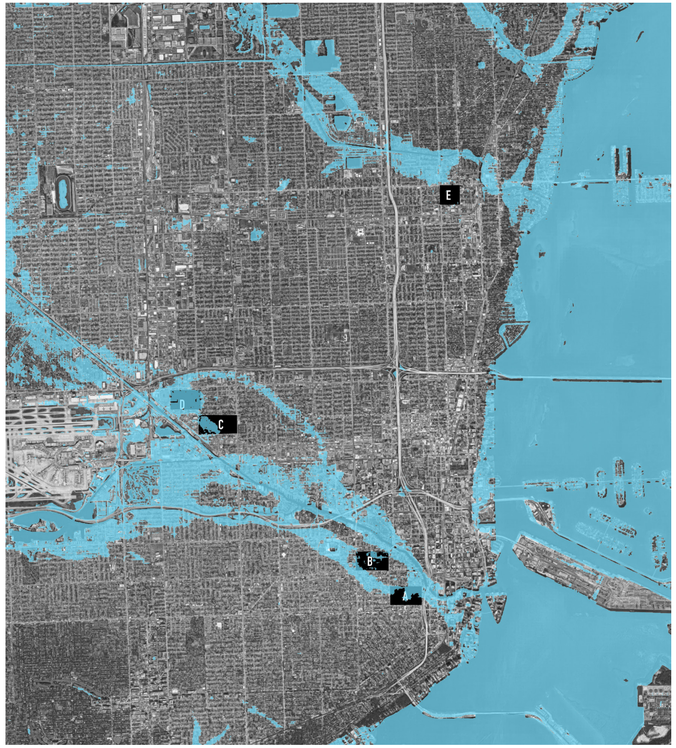
To the neighborhood scale, with the special underground geological structure of limestone, Miami was hard to infiltrate the water from the ground, which decided the core of the resilient system is “drain-collect-dispatch”. Every single block was regarded as a contemporary collect basin. And through the pipe structure, the water collected in the block would be guided to a concentrate ponds area which transformed from the existing urban park.

To the block scale, three typical block types were chosen from the existing neighborhoods for redesigning with some same strategies like collection water, permeable paving, rain garden along the street, roof garden. Beyond that, these new designs were also used to providing recreational space for local residents and public visitors like urban plaza and street corner parks.

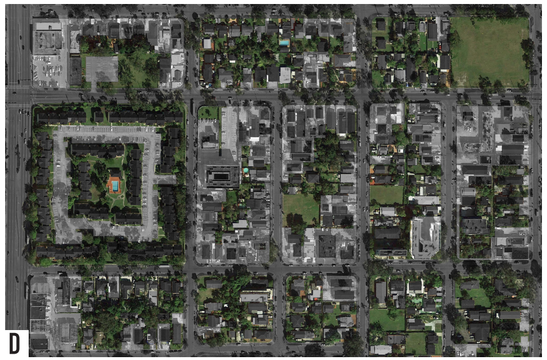
Methods

1. Mapping the existing urban morphologies
2. Literature review on Resilient city design
3. Diagramming the systematic strategy of Miami
4. Physical model making to show the typical topologies block
5. Perspective view to show the proposed design w

Neighborhood Pattern



When the sea-level rise up to 4 feet, these neighborhood would be all under the water



Zooming out to the neighborhood's scale,the relationships among green, grey and houses could be concluded in 4 categories.
1. All permeable 2. All impermeable 3. Half and Half 4. Tree-lines in the Middle

Through these patterns, all the grey space are open space now working as parking lots or abandoned areas. All the green space are open space now being covered by lawns and trees. It is easy to say from the pattern that enough open space is not occupied by buildings, infrastructures or other constructions which are hard to move in a vertical level. In other words. Miami vulnerable neighborhoods have enough space to transform it to a much more resilient city.w

Neighborhood Proposal

Oversized Pipe

Curb Design

Roof Garden

Rain Garden

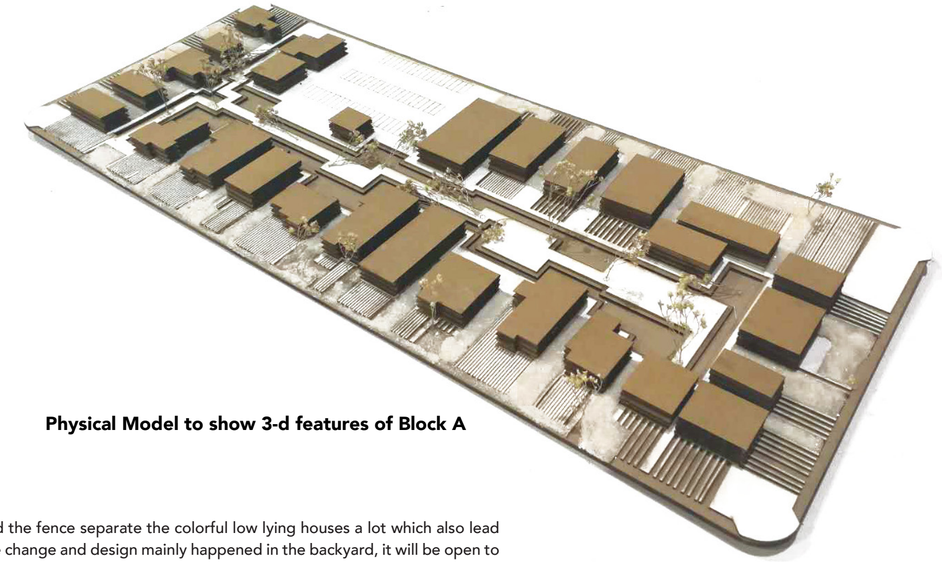
Detention Pond

Neighborhood B is used to show proposed neighborhood strategies as Drain-Collect-Dispatch. The Main Strategy is every block will have its water collection area and they will go through the oversized pipe to ponds area which will locate in the existing large open parks. All the other strategies including the roof garden, rain garden, and permeable pavers will serve as slow areas to guide the water because the special limestone geological structure would not allow too much water infiltrate through these areas.

Zoom from the neighborhood into block scale, it is more about how to use the stormwater management strategies designs to correspond to the program design both for public and private.

There are 3 typical blocks almost covered all the block types of vulnerable neighborhoods except the all green block. The one with tree line in the backyard, the all impermeable area one and the affordable apartment which share huge lawn in their block. In all of three, the one with tree line in the backyard is the most typical one as most of the low lying residence is like this way. All the block designs are related to topography change, front yard and backyard design, parking lot design and new function replaced.

Typical Block Design-A

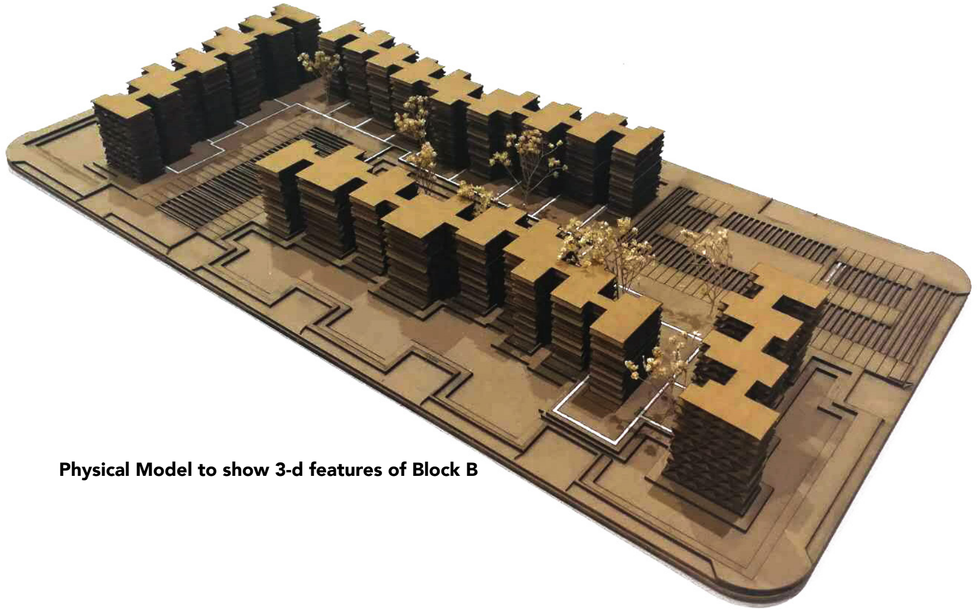


Physical Model to show 3-d features of Block A

The original tree lines and the fence separate the colorful low lying houses a lot which also lead to a boring street life. The change and design mainly happened in the backyard, it will be open to the public as treeline plaza. And topography modification is to use as collecting water in certain areas.

Besides that, the rain garden along the street will work as a new fence to keep the privacy. And the front yard originally served as parking areas will move their cars to one concentration parking area. And residents could have more space for their garden design.

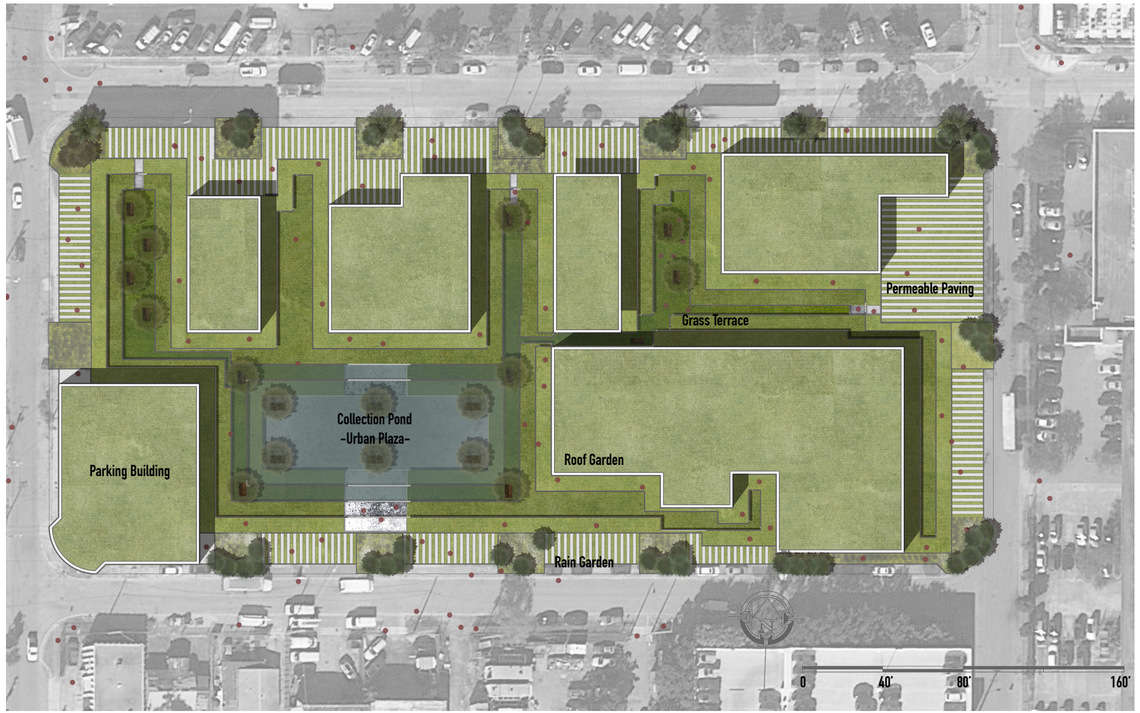
Typical Block Design-B

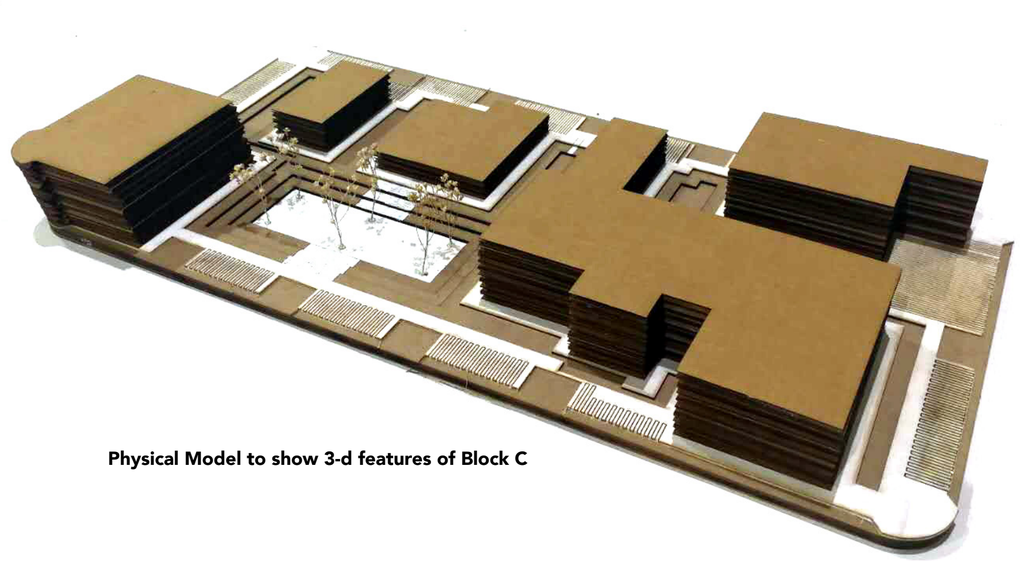


Physical Model to show 3-d features of Block B

For block b, water will be collected in three areas, one detention pond in the middle and two grass trenches along the street. And the existing condition of this block is that it has enough permeable lawn, so it is more about the topography changing to collect water. And the green roof areas are served just for rainwater collection. The permeable pavers in the parking areas are used to slow the water. The rain garden along the street are designed together with the front yards lawn of the apartment as an area which could be occupied by the public for recreation.

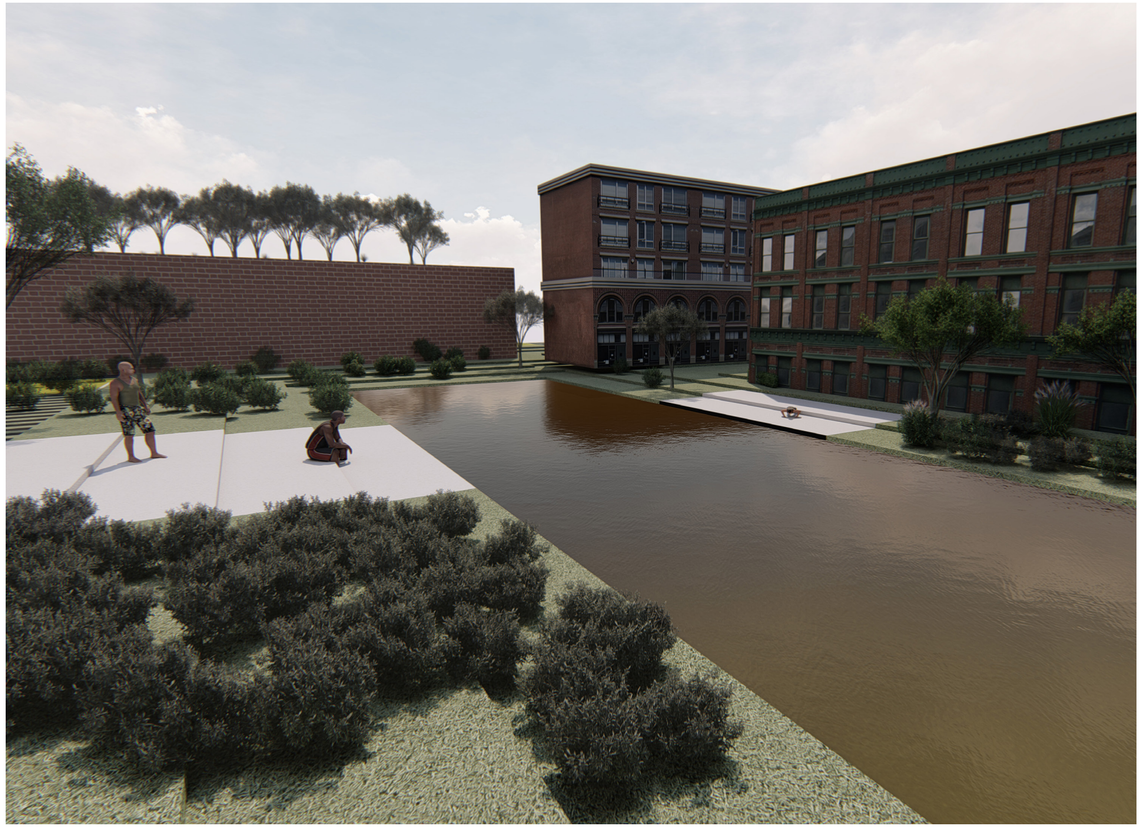
Typical Block Design-C



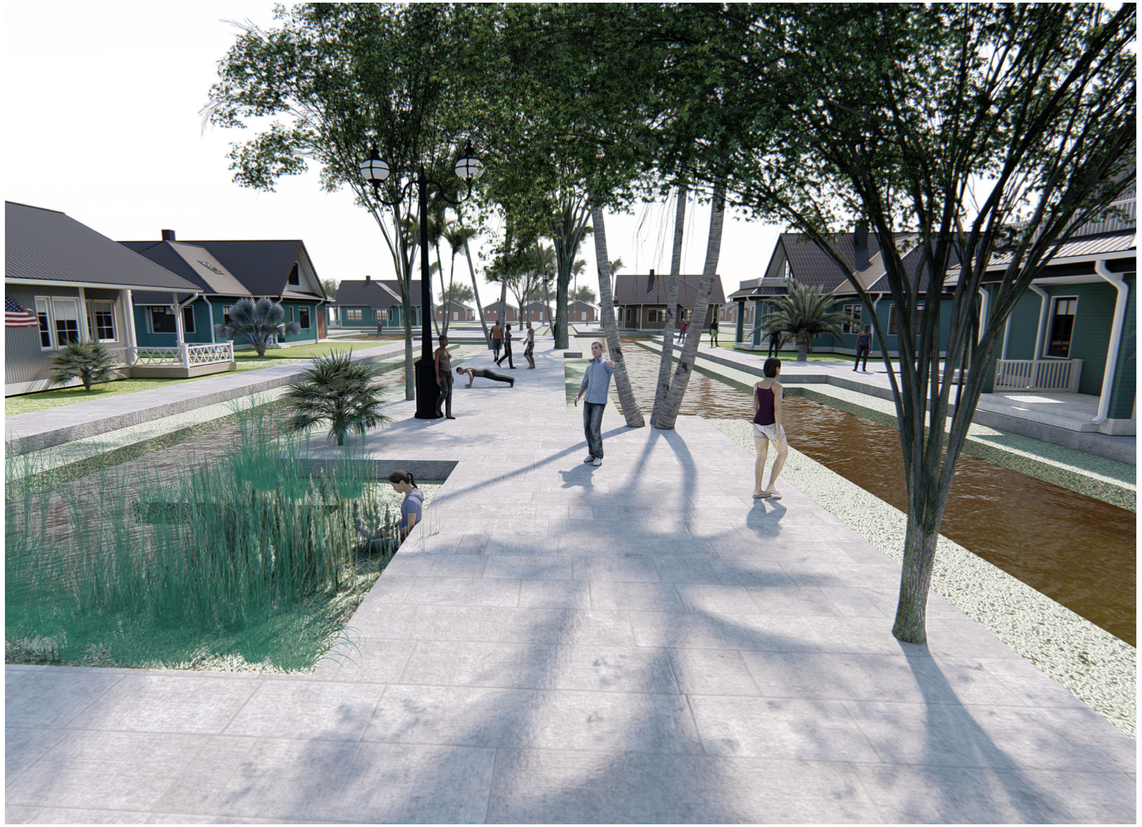


Physical Model to show 3-d features of Block C

For block c, the flood water will finally go to the urban plaza as a contemporary collection area and it will create a reflection pool as well. As these buildings in the block are almost all public ones as market or retail. They are highly sensitive to parking areas. So a new building for parking will be at the corner so that original parking areas could be served as resilient area. And the roof will also be open for the recreational area while the rain garden along the street is used for the street flood issues.



Proposed view for Block C



Proposed view for Block A

Proposed view for Block B

Findings + Conclusions

After completion of the third phase of these investigations and designs, a systematic design for Miami future resiliency had been created through two linear systems. One is through the grid street, the other is going through the backyard of every typical Block A.

However, the specific design seems a little awkward as the proposed design happens on the site owned by privacy. And it is hard to say whether it could be allowed by the local residents as they are not knowing the flood would come in the coming future.

The other thing needs to be reconsidered is the program space, the design is proposed not only to used for resiliency but for people recreation. For now, after the redesign, some local cultural features are still lacking as phase one mentioned. Miami is a multicultural space, the recreation should be tightly related to this feature.

Assessment

During phase three, the back and forth process help the argument from neighborhood scale to block scale more reasonable and site-based.

Also, the scales zoom from city to neighborhood and block has shown the potential of how the resilient strategies work as a whole system. But because of the limitation of time, the feasibility of the design is lacking consideration on the specific owner.

However, even the design is not feasible to some degree, it shows the other potential of shareable houses model with front and backyard for vulnerable neighborhoods as the shareable economic seems much more popular than before.

Overall Assessment

Final Conclusions

The goal of the thesis is to put forward a design proposal in Phase 3 for the site based on the analysis and research made in Phase 1 and Phase 2. The project has raised several important sentiments about research, design, and profession.

Flood influence and the reason for the flood

Flood in Miami is the combination of water from six directions, rising tidal and underground water because of the permanent sea-level -rise; heavy precipitation caused by the feature climate; frequent hurricanes; canal flow lead by the water both from upstream and sea. And the influence would be strengthened in ecology, infrastructure, and people. Specifically, the changing distribution of salt and fresh water caused by the flood will decide the changing distribution of plants and animals and will finally become a salt lake. The people in Miami vulnerable neighborhoods could not deal with the coming flood because of the topography and economic reasons, according to the projection of 2100 by NOAA, all of the vulnerable neighborhoods including Little Havana, Little Haiti, Allapattah would be swallowed by the flood.

There is enough open space in vulnerable neighborhoods for a better resilient Miami

Based on the site visit and interview, the author has found that there are huge amounts open space could be used in Miami vulnerable neighborhoods in different morphologies. As the special geological underground structure in Miami suggests that Miami could not allow water to infiltrate through the ground, the grey and green open space would both be the potential areas which allow the resilient strategies to happen. And these areas are distributed in every block.

The linear resilient system could be realized through the block and neighborhood design

Through the design Phase, the transformation was made between the block scale and neighborhood scale. The changing scale of the design made it easier to realize the systematic and detail design at the same time. The systematic resilient design would be realized through two linear system, one is along the street by rain gardens, the other is through the treelines in the typical block A with water collection area and people program area.

Final Assessment

Although the thesis topic is given by the directed studio, it is in a way corresponding to the author's original intention in modular design and stormwater management design.

Throughout the whole thesis process, the author tried to complete a design which generates from typical sites but could be used and realized in other floods vulnerable city or neighborhoods. It is a site-specific design but a mode could be generated through this process and the final design result.

This is a challenging topic because Miami vulnerable neighborhoods are very complex sites, where economic and cultural interests play an important role. Any proposal made or created should be evaluated with the question " Why do they want to follow your strategies".According to the interview in Miami with local residents in vulnerable neighborhoods, people there did not know exactly what would happen to the city and their houses. So the design should be realized mostly under the help or slowness of local residents.

However, now, the design is a little aggressive and unfriendly to them. It is still hard to elaborate many issues or ideas generated through the whole process. It is still hard to situate the author's stance in a projection attitude with society and time issue. But, in the other words, the whole process implied that it needs a much longer time and more efforts to realize it.

For the next step, there may be future explorations of the specific block of the relation between the design and the property, the ownership of the ground to lead the project more reasonable.

The other thing generating from the design process is about the future living mode. As a generation with popular shareable economic, the special mode of front yard and backyard, the privacy and public would be influenced by the shareable idea. Where could be shared and where is the privacy are in vulnerable neighborhoods where most the people are treated in an unfair way.

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