Scalar Resiliency in the Age of Disruption

Brandon Aultman

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SCALAR RESILIENCY IN THE AGE OF DISRUPTION: 
DESIGNING FOR RESILIENCY AGAINST DISASTER AND CLIMATE CHANGE

Area of Study: Biloxi, Mississippi

Thesis Proposal is Presented to the 
Faculty of the Department of Architecture 
School of Architecture and Construction Management 

By

BRANDON PAUL AULTMAN

In partial fulfillment of the requirements for the Degree:

Bachelor of Architecture

Kennesaw State University
Natural storm surges and global sea level rise cause devastating effects, whether it’s leaving over a million residents homeless or dooming an entire coastline ecosystem with little to no hopes of recovery. Current responsive methods consist of unequal prioritization within coastal resiliency design because of site scalar characteristics. A design that incorporates an equity of attention towards all elements of resiliency will lead to a responsive solution that can transcend any scale of site. I will begin to analyze the elements of effective resiliency; adaptation, affordability, community, sustainability and customization, in order to provide a balanced solution to ecological disruption and housing displacement. To reinforce this multi-use strategy, this solution would begin to promote interconnection between programmatic elements; ones that consist of both ecological strategies and housing amenities, in order to unify both nature and people, through the five criteria of effective resiliency. This solution would be applied towards a coastal region along the Gulf of Mexico, one that is prone to natural disruption caused by disastrous flooding, as well as having a history of disaster from a hurricane. This site is Biloxi, Mississippi. This interconnection solution goes beyond the typical resilient design properties of being scale specific and accepts disasters like Katrina and sea level rise; through effective resiliency strategies to create mutual opportunities to allow both nature and people to thrive.
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Dedication to Faculty, Friends and Family

To everyone that helped me and supported me during this final year of architecture school... I would like to personally thank:

My thesis advisors Timothy Frank and Ed Akins II for pushing me to visit Biloxi, MS, giving me their honest suggestions and lastly, having faith in me to complete my thesis with craft and quality.

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My close “arch” friends; Damari, Laura, Jonné, and Giovonni for all the support and friendship, as we all suffer together during our five years in architecture school.

My mom, dad, brothers and childhood friend, Jake, for the much needed refuge and emotional support that was provided during the long weekends and breaks.

And lastly, to my girlfriend, Katrina, for all the patience, encouragement and love during these last five years of school.
1.0 Thesis Relevance: Why is it a problem?
Natural storm surges and global sea level rise cause devastating effects, whether it's leaving over a million residents homeless or dooming an entire coastline ecosystem with little to no hopes of recovery. Current responsive methods consist the issue of unequal prioritization within coastal resiliency design because of site scalar characteristics. A design that incorporates an equity of attention towards all elements of resiliency will lead to a responsive solution that can transcend any scale of site. I will begin to analyze the elements of effective resiliency; adaptation, affordability, community, sustainability and customization, in order to provide a balanced solution to ecological disruption and housing displacement. To reinforce this multi-use strategy, this solution would begin to promote interconnection between programmatic elements; ones that consist of both ecological strategies and housing amenities, in order to unify both nature and people, through the five criteria of effective resiliency. This solution would be applied towards a coastal region along the Gulf of Mexico, one that is prone to natural disruption caused by disastrous flooding, as well as having a history of disaster from a hurricane. This site is Biloxi, Mississippi. This interconnection solution goes beyond the typical resilient design properties of being scale specific and accepts disasters like Katrina and sea level rise; through effective resiliency strategies to create mutual opportunities to allow both nature and people to thrive.
Thesis Relevance of Design Hypothesis

A Glance at Climate Change

Currently, over 53% of the United States population lives near or on coastal regions.\(^1\) With largely populated areas along the coast such as, New Orleans, LA, New York, NY, Savannah, GA, Ft. Lauderdale, FL and other regions, these cities are most vulnerable to even one meter or sea level rise.\(^2\) This is due to the overall lack of resistance or lack of priority that some regions of these cities provide for their coastal inhabitants. As seen with Figure 1 and Figure 2 to the right, these show the results that even a slight global change in temperature would cause on a coastal city. Global climate change is not just comprised of sea levels rising, it is also a result of an increase in CO\(_2\) emissions that increase the GHG (Greenhouse Gases) within our atmosphere, ultimately increasing the global temperature.\(^3\) Which then, causes the ice caps to begin reducing solidity and melt, adding millions of gallons of water into the existing oceans. And unfortunately, at the current rate of GHG's by PPM (parts per million) being contributed towards the atmosphere, we are likely to see a rise in 2°C or 3°C this century.\(^4\) Unfortunately, the last era when the Earth was that warm was 125,000 years ago during the interglacial period, and sea levels rose approximately 4 to 6 meters higher than today.\(^5\)
Results of Disaster

All over the world, natural disasters cause traumatic and destructive results, whether it’s earthquakes, wildfires, avalanches, etc. But, compared to these disasters, the type of disaster that is the most destructive would be the hurricanes. These massive water cyclones not only cause major destruction due to high wind speeds and flying debris, but the surge that follows, flooding thousands of square miles with unsanitary, contaminated and murky water. If the aftermath of a hurricane on a local community doesn’t physically destroy the structures, then the post flooding will.

Within the past 30 years, we as humans prepare for these hurricane disasters in the same way; retrieve the most amount of supplies that we can physically carry, contact our friends and family and hope that we can leave in time before we run into traffic of other people undergoing the same process. But the bigger picture is not what we are bringing with us, it’s what we are leaving behind. Whether it’s through physical destruction or forced evacuation, our homes are abandoned and left in the path of the incoming destruction, and all we can do as evacuees is sit back and observe.

One disaster in particular, Hurricane Katrina, was one of the most destructive natural disasters that the US has ever experienced. Other than the $125 billion dollars in damages, over 500,000 residents were left completely homeless, and within the entire city of New Orleans, more than 80% was under or inflicted by water. Figure 3 and Figure 4 to the right show imagery of the characteristics of a Category 3 Hurricane and the disastrous effect it brings to a city. Not only from a human standpoint, but also, an ecological standpoint.

We seem to understand tragedy only when it affects people, however, we are not the only ones that are traumatized and left hopeless in the wake of this destruction. The ecological infrastructure on the coastlines are heavily affected by these surges, and cause disruption such as reducing freshwater wetlands, increasing areas of erosion and destroying locally grown vegetation that is little to impossible to grow back. This causes a major unbalance between us and nature, and regardless of past theories, we do rely on nature for our own health. And if both us and nature are affected by the same event, it can and will cause multiple issues within the near future.
1.1 Hypothesis Parameters: From research, what characteristics provide effective resiliency?

As we can see, natural storm surges and climate change are inevitable, regardless of other’s theories, and we as a nation that is apart of this changing world need to be conscious of that. And unfortunately, aside from other efforts towards this destructable outcome, a reoccurring problem that we have is a repeated action. We design for resistance against these natural impacts again and again, while heavily relying on insurance policies and large sport arenas for reassurance, comfort and financial aid. For example, Katrina in 2005 relocated millions of people to different states all over the country, decreasing New Orleans overall population by more than 50%.

This concept of an exodus of people after every disastrous hit we endure can not be our only solace or solution towards natural disruption. A solution would need to be developed that can preserve the natural infrastructure while solving the issue of displacement that occurs during these events.

Through analyzing varying theories regarding climate change and storm surge, what parameters can be set in order to provide a resilient solution towards this inevitable problem?

- A solution that *doesn’t resist* the change in environment, but rather *accepts and adjusts* towards it
- Everyone, *regardless of class or income*, shall have *full access* towards this solution
- This solution *promotes interaction* amongst one another so *no one can feel isolated* in this time of hardship
- A strong emphasis on nature with its *regenerative* and *sustaining characteristics*, should be applied towards this final solution
- This solution should equally give *sense of ownership* towards all user groups, allowing them to have a *sensual connection* rather than just physical
The first of the criteria that would be needed is the ability to adjust accordingly towards inevitable disruption in environment, landscape and community. Resistance towards inevitable change causes chaos and destruction and in some cases, more repair time and cost. Figures 7, 8 and 9 below show some of the many examples that can come out of trying to resist natural disruption.

Evidently, resistance is not the only solution, nor is it 100% foolproof, and instead, we should be deciding "whether we should build faster and harder to keep it out, or find a way to gently merge ourselves with the water once again" (Oppenheimer 17).

The title word that is concluded from this summary is: **Adaptability**

**Features:**
- Acceptance of natural elements such as water, wind and sunlight
- Not only allowing change but thriving and benefiting from it

---

**1.2 Elements of Effective Resiliency:** What five terms resemble the criteria of the parameters?

---

Figure 7: Japan Sea Wall failure during 2011  
Figure 8: House pier structure failure in NC during Hurricane  
Figure 9: New Orleans levee failure post Hurricane Katrina
Along with being adaptable, a resilient solution is rendered useless if only a handful of users can successfully use it. Recent projects that contribute towards solving housing displacement due to storm surges and flooding do currently exist, however, both investment and maintenance for a resilient home are far higher than traditional homes. Ultimately, the challenge of designing for resiliency is not just for the performance aspect of the structure, but the ability for anyone to benefit from it, regardless of income. Below are Figures 10 and 11 that show examples of resilient housing solutions, but primed for a specific wealthier user group.

The title word that is concluded from this summary is: **Affordability**

**Features:**
- Size of dwelling is at a minimum
- Use of local materials and simple construction methods

---

**Figure 10: “Dome of a Home”** Available for Rent: $5000/wk

**Figure 11: Amsterdam House Boats** Available for Purchase: $460,000 and $780,000
With effective resilient design, you can possess the adaptability towards incoming change, and the ability to afford it, but socially, what is gained? Social interaction amongst one another within a time of hardship is defined by reaching out to those around you. Giving and receiving support is important. A resilient design that incorporates social rehabilitation is an important asset that most responsive organizations don't offer, but rather just suggest for the individual. Figures 12 and 13 below show examples of community appearing as apart of the emotional healing process.

The title word that is concluded from this summary is: **Community**

**Features:**
- Sense of Place for the individual
- Promoting interconnectivity amongst people

**Figure 12:** Community organizations rebuilding during Illinois tornado

**Figure 13:** Group involvement of rebuilding house after tornado
The ability to prepare for the future through promoting natural strategies and elements within design are a key criteria of effective resiliency. Adaptability is a part of resiliency by it’s preparedness for incoming change or disruption, but how it physically undergoes that is where natural features come into effect. With resiliency design, especially on coastal regions, nature has to be apart of the process, whether it’s through preservation or enhancement. Nature is an element that thrives with us as a species, however, nature’s ability to adapt overtime towards disruption is an important attribute that we as a species can learn from. In order to have an effective resiliency design, nature must become incorporated into the vocabulary of architecture, between topography and bathymetry, land and sea. Figures 14 and 15 below show how nature is emphasized through design to promote a self sustaining ability.

The title word that is concluded from this summary is: **Ecology**

**Features:**
- Strong ecological contribution towards the design
- An equity of health between both nature and humans
Lastly, and effective element of resiliency is a sense of ownership for the individual. During a traumatic event, the individual seems lost, or misplaced within the environment. A solution that has a strong community aspect can be helpful for the individual, but when they are not engaging in social activities, where do they reside? What could make an individual feel better, a tent or a tent that is his/her favorite color? Current relief efforts are effective, but lack the small attribute of being adjustable for a certain user group. Figures 16 and 17 below show current methods of recovery and streamline design of being similar. What would be most effective in resilient design methods or how the community has a sense of ownership, what they build belongs to them. 

The title word that is concluded from this summary is: **Customization**

**Features:**
- Personal attributes can be added or taken away at the choice of the user
- Use of details that fit the user group's preference

![Figure 16: Relief tents in Haiti after Hurricane](image1)

![Figure 17: Use of gymnasium for relief after Sandy](image2)
1.3 Underlying Principles of the Design Hypothesis to the Proposed Project: Specified elements of effective resiliency

After taking the synthesis of the 5 needs for effective coastline resiliency, each element is subdivided into 7 subcategories, in reference to the sources listed below each category. For graphical reference, the chart on the page to the right has each category listed divided into a pie chart graph theme for visual clarity.

Adaptability
- Transformable Infrastructure
- Natural Activation
- Diverse and Redundant Systems
- Find and Promote Adaptation in Nature
- Anticipation Change
- Envelope and Tech Sophistication
- Counteractions and Response

Affordability
- Independence from Infrastructure
- Equitable Program
- Minimum Floor Area/Surface Area
- Geographic Variation
- Streamline Design
- Materiality Usage
- Accessible Transit

Community
- Accessible for Community
- Public Safety
- Programming Initiatives
- Transparency and Openings
- Empowerment
- Layered Program
- Shared Work Areas

Ecology
- Passive Systems
- Ground Articulation
- Recycling use of Materials
- Equity of Health
- Native Landscaping
- Ecological Contribution
- Wildlife Supplement

Customization
- Operable Enclosure
- Personalization
- Additive Ability
- Pre-Fab Elements
- Selective Details
- Static Function
- Mobile Function

RDI (Resilient Design Institute)
Adaption to Climate Change: A Spatial Challenge
By Rob Roggema

Companion: Introduction to housing

Urban Land Institute: Ten Principles for developing affordable housing

Inhabitant: WeWork and WeLive

AIA: Livability 101

Internation Living Future Institute: Living Building Challenge 3.0

P2P Foundation: Open Design and Mass Customization in Architecture: Open Source Building Alliance from MIT

DesignIntelligence: The Design Implications of Mass Customization
Resiliency Pie Chart

CUSTOMIZATION FACTORS

OPENABLE EXCLUDERS
Energy conservers of the exterior flow that help in particular areas to maintain or enhance comfort.

PERSONALIZATION
objectives for the user to impart unique personal preferences better the supplied design.

ADAPTIVE ABILITY
ability to change, adapt to new circumstances or situations that the design.

FINISHED ELEMENTS
begin to be visible in the plane with the ability to impart personal preferences to the design.

SELECTIVE DETAILS
The pieces or parts that can exist in a variety of forms, patterns, styles, and other unique details better the design.

STATIC FUNCTION
The design is an add-on or add-in addition, which is subject to 10% to 20% increase in cost.

MOBILE FUNCTION
The design is a mobile or transportable facility, which usually 15% to 25% increase in cost.

Eco-Friendly
Sustainable designs that have been designed to in an alternative or sustainable building approach.

Author Figure 1: Graphical Pie Chart

ECOLOGY FACTORS

FASING SYSTEMS
Designs that incorporate systems such as walls, water, natural light, and other unique aspects are a result of ecological design.

ECO-IDENTIFICATION
A conscious and deliberate attempt to identify the ecological purity of the building.

RECYCLING USE OF MATERIALS
The design is an add-on or add-in addition, which is subject to 10% to 20% increase in cost.

EQUITY OF HEALTH
The design is a mobile or transportable facility, which usually 15% to 25% increase in cost.

NATIVE LANDSCAPING
The design is a mobile or transportable facility, which usually 15% to 25% increase in cost.

ECOLOGICAL CONTRIBUTION
The design is an add-on or add-in addition, which is subject to 10% to 20% increase in cost.

WILDLIFE SUPPORT
The design is a mobile or transportable facility, which usually 15% to 25% increase in cost.

AFFORDABILITY FACTORS

INDEPENDENCE FROM INFRASTRUCTURE
Energy conservers of the exterior flow that help in particular areas to maintain or enhance comfort.

ECONOMIC RETURN ON INVESTMENT
The design is an add-on or add-in addition, which is subject to 10% to 20% increase in cost.

MINIMUM FLOOR AREA/SURFACE AREA
The design is a mobile or transportable facility, which usually 15% to 25% increase in cost.

GEOPOLITICAL IMPLICATIONS
The design is a mobile or transportable facility, which usually 15% to 25% increase in cost.

STREAMLINE DESIGN
The design is a mobile or transportable facility, which usually 15% to 25% increase in cost.

MATERIALITY SHAPE
The design is a mobile or transportable facility, which usually 15% to 25% increase in cost.

ACCESSIBLE TRANSIT
The design is a mobile or transportable facility, which usually 15% to 25% increase in cost.

COMMUNAL FACTORS

ACCESSIBLE FOR COMMUNITY
The design is a mobile or transportable facility, which usually 15% to 25% increase in cost.

PUBLIC SAFETY
The design is a mobile or transportable facility, which usually 15% to 25% increase in cost.

REFERENCES

Author Figure 1: Graphical Pie Chart

17
1.4 Relevance of Precedent Analysis: Analysis of various precedent projects

As mentioned before, multiple projects have been contributed towards the issue of disastrous flooding, both from storm surge and inevitable climate change. This next section is consisted of analyzing 4 projects that contribute towards resiliency in regards to the graphical chart containing the 5 elements of effective resiliency.

Each project is a different typology of response and design, and through this intensive analysis, the synthesis will begin to reveal patterns or trends that occur between the projects.
Typologies of Case Studies

Galveston, TX
ATLAS OF SUSTAINABLE STRATEGIES FOR GALVESTON:
URBAN CORRUGATIONS / 2009

Pros
Utilizing the person giving them access to
inhabit the natural recreational areas
Ecological sustainability applied throughout
Embracing the water through aesthetic canals and
rivers that are overlooked by the housing structures

Cons
Still left with residual space after different areas
are flooded, meaning, no way to embrace water once
it takes over everything but the buildings
Strong landscape/urban solution, but individual building
structure is questionable against wind/water loads from
hurricane

Characteristics:
Scale: LARGE
Disaster Timeline: PRE / POST
Primary Focus: CLIMATE CHANGE
Status: UNBUILT STUDENT PROJECT
Relevance: HOUSING, WATER MANAGEMENT

Urban Corrugations
Zhour Chen, Elizabeth Mickey
2009
CUSTOMIZATION FACTORS
OPENABLE ENVELOPE
Enabling the system to reveal and conceal parts
PERFORATION
Enabling the system to reveal unique patterns
ADAPTIVE FAILURE
Enabling the system to adapt to changes
DESIGN ELEMENTS
Enabling the system to adapt to the environment
SELECTION DETAILS
Enabling the system to select unique patterns
STATIC FUNCTION
Enabling the system to select unique patterns
MOBILE FUNCTION
Enabling the system to select unique patterns
COMPONENTS
Enabling the system to select unique patterns
EXTERIOR
Enabling the system to select unique patterns
FORAGING
Enabling the system to select unique patterns

ECONOMY FACTORS
PASSIVE SYSTEMS
Enabling the system to select unique patterns
ECONOMIC MODULATION
Enabling the system to select unique patterns
RECYCLING USE OF MATERIALS
Enabling the system to select unique patterns
ECONOMIC VIABILITY
Enabling the system to select unique patterns
NATURE LANDSCAPES
Enabling the system to select unique patterns
ECOLOGICAL CONTRIBUTION
Enabling the system to select unique patterns
WASTE SUPPLEMENT
Enabling the system to select unique patterns

REFERENCES

Author Figure 2: Graphical Pie Chart
Adaptability

Author Figure 3: Galveston Section Diagram

Affordability
**Community**

- Centralized shared space with balconies that promote interconnectivity amongst users.
- Multi-use market space existing ecosystem.

**Programming Initiatives**
Designed initiatives that are allocated to promoting interaction among other user groups within the context.

**Transparency and Openings**
Spaces or moments that are created through the design to allow use to visually, acoustically or physically connect with other users.

**Layered Program**
Areas or spaces that have multiple uses/purposes for different programs. This can make typical privatized space into live public space.

**Accessible for Community**
Design that possesses qualities that are most essential and unique to only the community.

**Ecology**

- Site terra-forming (corrugation) to control flow in rise in water levels.
- Cross-ventilation wind-flow to passively cool the space.
- Tall grass and ponds that provide wildlife habitation.
- Artificial canal with plantings.
- Natural barrier provided by plantings and small vegetation.

**Ground Articulation**
Built structure and site construction, to a limit, does not harm the pre-existing site condition.

**Passive Systems**
Utilizing earth's natural resources such as wind, water, sun, ground as a means of producing energy.

**Wildlife Supplement**
Local wildlife activity is not disrupted and is incorporated into design priority.

**Native Landscaping**
Natural elements/characteristics that are local in order to allow for max regeneration after becoming reduced.

**Equity of Health**
The health conditions for both humans and vegetation are equally emphasized and thriving off one another.

**Ecological Contribution**
The activity of both existing ecology and design mutually thriving. Additionally, the design is enhancing the ecological infrastructure.
Customization

**Static Function**
The design is a static element which is custom to fit one specific site.

**Pre-Fabricated Design**
Design that is custom fit to align with pre-existing elements or another form of tectonic construction.

**Housing Typology Form Derives from Corrugation in Static Landscape**

**Vehicular Circulation Fits Along Same Axis as Water Canal**

**Corrugated Landscape Provides Opportunities for Water Canal Infill**
MOMA, New York
ON THE WATER MOMA EXHIBIT (LITERARY): 
PROJECTS FOR NY’S AND NJ’S WATERFRONT / 2010

PROS

- Natural activation through vegetal elements, promoting resilience with nature
- Terra-formed landscape embraces to climate change by providing pre-formed landscape that diverts waterflows away from mainland
- Adaptive reuse of existing coastal conditions to enhance coastline space to provide both environmental and social amenities

CONS

- Seen as landscape solution to protect existing inhabitants within the mainland, however, no provisions of housing for the possibility of displacement on the coastline
- Affordability of landscape solutions are very low, considering the scale of the projects and the sophisticated strategies/systems used

CHARACTERISTICS:

- SCALE: LARGE
- DISASTER TIMELINE: PRE / POST
- PRIMARY FOCUS: CLIMATE CHANGE
- STATUS: ARTICLE FOR UNBUILT COMPETITION PROJECTS
- RELEVANCE: WATER MANAGEMENT

Hudson River, NJ and NY

WATERLINE: CUMATE, GENERATE, RECYCLE
SITE PLAN
Customization Factors

Adaptable

Ecology Factors

Affordable

Communal Factors

Author Figure 5: MOMA Graphical Pie Chart

Nordenson_MOMA Exhibit:
On the Water / 2010
Adaptability

**Author Figure 6: MOMA Section Diagram**

**Resilience Transcends Scales.**

Strategies to address resilience apply at scales of individual buildings, communities, and larger regional and ecosystem scales; they also apply at different time scales—from immediate to long-term.

**Diverse and Redundant Systems are Inherently More Resilient.**

More diverse communities, ecosystems, economies, and social systems are better able to respond to interruptions or change, making them inherently more resilient.

**Resilience Anticipates Interruptions and a Dynamic Future.**

Adaptation to a changing climate with higher temperatures, more intense storms, sea level rise, flooding, drought, and wildfire is a growing necessity.

**Find and Promote Resilience in Nature.**

Natural systems have evolved to achieve resilience; we can enhance resilience by relying on and applying lessons from nature. Strategies that protect the natural environment enhance resilience for all living systems.

**Social equity and community contribute to resilience.**

Strong, culturally diverse communities in which people know, respect, and care for each other will fare better during times of stress or disturbance. Social aspects of resilience can be as important as physical responses.

**Materiality Usage**

Use of local vernacular materials reduce construction costs, which in parallel, reduces living costs.

**Affordability**

Throughout the proposals, the benefits of a more varied seafloor are espoused in artificial and natural reefs and islands built of materials ranging from recycled glass to systems and conventional landfill.
Community

Author Figure 7: MOMA Section Diagram 2

- Barry Bergdoll
Author / Rising Currents / 2007

Nature itself is incorporated into the design vocabulary of architecture. A trend that has been growing in recent years with the rapprochement between architecture and landscape design…between topography and bathymetry, land and sea.”

Ecology

Author Figure 8: MOMA Section Diagram 3

- Barry Bergdoll
Author / Rising Currents / 2007

Equity of Health
The health conditions for both humans and vegetation are equally prioritized and thriving off one another.

Passive Systems
Utilizing Earth’s natural resources such as wind, water, solar, ground as a means of producing energy.

Ecological Contribution
The activity of both existing ecology and design mutually thrive. Additionally, the design is enhancing the ecological infrastructure.

Site Manipulation
Built structure and site construction to a limit, doesn’t harm the pre-existing site condition.

Natural Activation
Within an alternating environment, rather than building a defense, the design utilizes the change and promotes mutuality with the change.

Renovation Design
Design that resides beyond the baseline and rising to self-sustain itself within the environment without relying on additional outside resources for energy.
"...TYPICAL OF ALL THE RISING CURRENTS PROJECTS IN BEING SITE SPECIFIC WHILE CONTAINING MANY IDEAS WITH FAR WIDER APPLICABILITY."

- BARRY BERGDOLL
Author / Rising Currents / 2007

Customization

Author Figure 9: MOMA Section Diagram
Biloxi Model Home Program, MS
ARCHITECTURE FOR HUMANITY:
Biloxi Model Home Program / 2007

Pros

Inexpensive solution for housing which allows the user to still be connected to higher sense of place
Customization of each home can vary, depending on the user’s preferences
Use of natural/recycled materials for construction

Cons

The raised floor condition creates a lack of connection with the ground, therefore resisting the water rather than adapting
Ground floor will still be in need of repairs in the aftermath of a storm surge

Characteristics:

Scale: SMALL
Disaster Timeline: PRE / POST
Primary Focus: CLIMATE CHANGE/STORM SURGE
Status: BUILT PROJECTS
Relevance: SMALL SCALE CONSTRUCTION WITH VERNACULAR MATERIALS

Biloxi, MS
Author Figure 10: Biloxi Graphical Pie Chart

Customization
- Operable Enclosure
- Transformatory
- Additive Ability
- Pragmatic Elements
- Selective Metals
- Static Function
- Mobile Function

Adaptable
- Customization Factors
- Ecology Factors
- Communal
- Affordable

Architecture for Humanity: Biloxi Model Homes / 2007

Adaptability Factors
- Transformable Infrastructure
- Natural Activations
- Design and Product Systems
- Anticipatory Change
- Energetic and Tech Sophistication
- Counterintuitions and Repose

Affordability Factors
- Independence from Infrastructure
- Ecosystem
- Minimum Floor Area/Surface Area
- Pedestrianism
- Accessibility

Communal Factors
- Accessible Transit
- Equitable Resources
- Public Safety
- Learning Environment
- Shared Work Areas

Ecology Factors
- Passive Systems
- Energy Appropriation
- Recycling Use of Materials
- Equity of Health
- Nature Landscapes
- Ecological Contribution
- Wildlife Supplement

Customization
- Author Figure 10: Biloxi Graphical Pie Chart

References
- Author Figure 10: Biloxi Graphical Pie Chart
Adaptability

Author Figure 11: Biloxi Section Diagram

Affordability

Author Figure 12: Biloxi Section Diagram 2
Community

Author Figure 13: Biloxi Section Diagram 3

Ecology

Author Figure 14: Biloxi Section Diagram 4
Customization

Author Figure 15: Biloxi Section Diagram
Paper Church, Japan
THE HUMANITARIAN WORKS OF SHIGERU BAN:
PAPER CHURCH / 1995 - 2005

Pros

INNOVATIVE SOLUTION FOR A RELIEF STRUCTURE, AND ARCHITECTURAL
DISTINCTION IS STILL STRONG DESPITE THE MINIMAL AMOUNT OF
MATERIALS

Temporary solution that will need to be reestablished
in the next aftermath of another storm surge

Cons

PROJECT IS EFFECTIVE FOR ONLY POST DISASTER

RELEVANCE: HIGH AFFORDABILITY AND
INNOVATIVE MATERIAL USAGE

Characteristics:

SCALE: MEDIUM

DISASTER TIMELINE: PRE / POST

PRIMARY FOCUS: STORM SURGE

STATUS: TEMPORARY BUILT PROJECTS

Kobe, Japan
Customization Factors

Adaptable

Ecology Factors

Affordable

The Humanitarian Works of Shigeru Ban:

Paper Church / 1995 - 2005

Author Figure 16: Paper Church Graphical Pie Chart
Adaptability

**Author Figure 17: Paper Church Section Diagram**

**Social Equity and Community Contribute to Resilience.**
Strong, culturally diverse communities in which people know, respect, and care for each other will fare better during times of stress or disturbance. Social aspects of resilience can be as important as physical responses.

**Diverse and Redundant Systems are Inherently More Resilient.**
More diverse communities, ecosystems, economies, and social systems are better able to respond to interruptions or change, making them inherently more resilient.

**Resilience Transcends Scales.**
Strategies to address resilience apply at scales of individual buildings, communities, and larger regional and ecosystem scales; they also apply at different time scales—from immediate to long-term.

Affordability

**Author Figure 18: Paper Church Section Diagram**

**Promote Leadership**
Taking a stance on leading a community through the effort to develop affordable housing.

**Project Based vs. Tenant Based**
Now regarded as a false choice. Primary focus is provisions for everyone, rather than just the privileged.

**Household Size**
Size of dwelling should be at a minimum, in order to reduce labor costs and SF estimates.

**Work Opportunities**
In order to have the ability to make payments, the design should incorporate part-time opportunities for all users.

**Materiality Usage**
Use of local vernacular materials reduce construction costs, which in parallel, reduces living costs.
Community

**Author Figure 19: Paper Church Section Diagram**

- Sense of Place: Design that possesses qualities that are most essential and unique to only the community.
- Public Safety: The allowance for proper key safety elements that promote the user to feel safe and welcome in the design.
- Empowerment: Activities and other shared common goals that the community possesses that are solved through collective decision making. Doing so builds pride and investment in the community.
- Shared Spaces: Designed initiatives that are allocated to promoting interaction other user groups within the context.
- Alternating Spaces: Areas or spaces that have multiple uses/purposes for different programs. This can make typical privatized space into live public space.
- Interconnectivity: Spaces or moments that are created through the design to allow users to visually, acoustically or physically connect with other users.

Ecology

**Author Figure 20: Paper Church Detail Diagram**

- Passive System: Utilizing Earth’s natural resources such as wind, water, sun, ground as a mean of producing energy.
- Site Manipulation: Built structure and site construction, to a limit, does not harm the pre-existing site condition.
- Recycling Use of Materials: Built structure and site construction, to a limit, does not harm the environment. This also contributes towards net zero carbon emissions of the design.
Customization

Author Figure 21: Paper Church Plan/Detail Diagram
After analyzing the 4 case studies, a common trend began to develop based on the characteristics that each project had and what it attributed towards.

The Galveston and MOMA Projects happened to be at a larger scale than the other two, and through the analysis, these projects seemed to contribute heavily towards the adaptability and sustainability category. This was because of these projects repetitive priority towards ecological preservation and natural activation of the landscape. The remaining 3 categories of Affordability, Community and Customization were not absent in these projects, but overall, these projects had more strategies and techniques developed towards ecological advancement, rather than housing amenities.

With the remaining 2 projects, Biloxi Model Home Program and Paper Church, these projects were at a sizable smaller scale compared to the previous 2. The common trend with these two was the contribution towards Community, Affordability and Customization. This seemed to be because of each project’s scale and program development. The model home program was rehabilitating a house within the hurricane prone area, using local materials and cheap construction which made it sustainable to an extent. However, the main priority of the Biloxi model home was focused more on the housing amenities of the individual. Same with the Paper Church in Japan, it’s main use and purpose was to revitalize the local community through a common place of worship, and constructed at a smaller scale for people, therefore considering the individual.

All 4 projects however did have a contribution towards all of the 5 criteria of effective resiliency, but the main objective of each project had a slightly different purpose, determining each project diverse. As effective as these projects are, they seemed to be linked to one common element, the overall scale of the design.
With both Galveston and MOMA, these projects focus primarily on the ecological enhancement of the landscape, because of its large scale approach.
With Biloxi and Paper Church, the main focus of the projects here began to target the individual, due to its small scale approach.

- Michael Oppenheim

MOMA Exhibit, NY

Adaptability

- Struggles to address resilience apply at scales of individual, buildings, communities, and larger regional, and ecosystem scales, they also apply at different time scale ranging from immediate to long-term.
- More diverse communities, ecosystems, economies, and social systems are better able to respond to interruptions or change.
- Adaptation to a changing climate with higher temperatures, more intense storms, sea level rise, flooding, drought, and wildfire is a growing necessity.
- Strategies that protect the natural environment.
- Within an alternating environment, rather than building a defense, the design utilizes the change and reforms itself in harmony with the change.

Ecology

- Local wildlife activity is not disrupted and is incorporated into design priority.
- The health conditions for both humans and vegetation are equally emphasized and thriving off one another.
- Utilizing Earth's natural resources such as wind, water, sun, ground as a means of producing energy.
- The activity of both existing ecology and design mutually thriving. Additionally, the design is enhancing the ecological infrastructure.
- Built structure and site construction, to a limit, doesn't harm the pre-existing site condition.
- Natural elements that are local in order to allow for new regeneration after reducing it's impact.

- Natural landscaping
- Ground articulation
- Ecolocial contribution
- Passive systems
- Equity of health
- Wildlife supplement

Barry Bengdoll
**Adaptability**

Transformable infrastructure
Redundant Services/Provisions
Flow Control Mechanisms

**Ecology**

Terra-Forming
Ecological Sustenance
Swales and Berms: Ground Articulation
Wildlife Contribution

---

**Adaptability**

Flow Control Mechanisms
Soft Edges/Boundaries

**Ecology**

Shared Spaces between Wildlife/Human
Terra-Forming
Native Landscaping
Flow Control Mechanisms / Terra-Forming

ALTERING LANDSCAPE THAT
CHANNELS AND CONTROLS WATER
FLOW FOR BENEFICIAL NATURAL USE

Soft Edges/Boundaries

NATURAL VEGETAL BARRIERS THAT
PROVIDE PROTECTION FROM FLOODING

Swales and Berms: Ground Articulation

ECOLOGICAL STRATEGIES IN
RESPONSE TO OVER INUNDATION WHILE PROVIDING
HARBOR FOR WILDLIFE

Ecological Sustenance / Native Landscaping

LOCAL VEGETATION THAT PROTECTS
LANDSCAPE AND REGENRATES AFTER
INUNDATION

Transformable Infrastructure

SPACE OR PROGRAM THAT BECOMES
ACTIVATED THROUGH A CHANGING
ENVIRONMENT

Flow Control Mechanisms

ALTERNATE CHANNELS OR WATERWAYS
TO DIVERT WATER TO A PREFERRED
LOCATION

Author Figure 23/24: Conceptual Large Scale Model
<table>
<thead>
<tr>
<th>PRIORITIZED CRITERIA</th>
<th>SPECIFIC FEATURES</th>
<th>MAIN FOCUS</th>
<th>CRITERIA CHART</th>
</tr>
</thead>
</table>
| **Customization**    | User Personalization  
|                      | Universal Elements (Kit) |  | **CUSTOMIZABLE** |
|                      | Mobile Function  |  | **ADAPTABLE** |
|                      | Pre-Fab Elements |  | **AFFORDABLE** |
| **Affordability**    | Equitable Program  |  | **SUSTAINABLE** |
|                      | Minimum Surface/Floor Area |  | **COMMUNAL** |
|                      | Materiality Usage |  |               |
| **Community**        | Accessible  |  |               |
|                      | Visibility  |  |               |
|                      | Community Engaged |  |               |
|                      | Programmed - Layered |  |               |
|                      | **+4** |  |               |
|                      | **+5** |  |               |

<table>
<thead>
<tr>
<th>PRIORITIZED CRITERIA</th>
<th>SPECIFIC FEATURES</th>
<th>MAIN FOCUS</th>
<th>CRITERIA CHART</th>
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<td><strong>CUSTOMIZABLE</strong></td>
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<td></td>
<td>Personal Attribute Ability</td>
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<td><strong>ADAPTABLE</strong></td>
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<td></td>
<td>Universal Elements (Kit)</td>
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<tr>
<td><strong>Affordability</strong></td>
<td>Equitable Program</td>
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<td><strong>SUSTAINABLE</strong></td>
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<td>Efficient Construction</td>
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<td>Streamline Design</td>
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<td></td>
<td>Native Material Usage</td>
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<td><strong>Community</strong></td>
<td>Contextual Placement</td>
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<td></td>
<td>Visible</td>
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<td></td>
<td>Community Engaged</td>
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<td>Programmed - Layered</td>
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<td></td>
<td><strong>+5</strong></td>
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2.0 Site Introduction: Where will this solution be implemented?
Unfortunately, natural storm surges and global sea level rise is not just an isolated issue, this is an issue that is faced all over the world. When investigating a site and its existing parameters, one of the main factors that must be considered is the program.

Based on the previous analysis of case studies, the program would need to be consisted of a community based infrastructure, one that is obviously near the coastline. And also, one that is in the wake of inevitable destruction caused by storm surge or global sea level rise.

Locally, the US is a magnet for hurricanes, and global sea level rise would end up affecting more than 50% of the population, given that they live within an reasonable distance towards the waterline. One of these highly affected areas suffered the same magnitude of destruction but got little acknowledgment during this period of disruption. This city is named Biloxi, Mississippi.
2.1 Relevance of Site to Hypothesis: Why this location?

1 - Hurricane Prone Area  (Recorded Hurricane paths within the past 50 years)

Hurricane Katrina was by far the most destructive hurricane to affect Biloxi. At a total surge height of 25’ in some areas, Katrina was able to remove certain buildings from their foundations, and lift them farther inland, specifically the Miss Grand Casino, as shown above.

Past hurricane characteristics and effects

Inundation map done by Katrina. This map also doubles as the new expanded flood zone for FEMA. Any newly constructed dwelling within this zone will need to be constructed with a F.E. of 17’ above sea level, in order to meet FEMA Code.
Site Visit Impression of Biloxi: NO SENSE OF PLACE & LACK OF COMMUNITY:

Seperation between tourist and residents - through scalar exclusion and no intermedial community spaces that are shared by all user groups
3 - Global Sea Level Rise Risk (Data taken from Surging Seas)

Going from South to North, Biloxi’s terrain goes from higher to lower. When a change in sea level occurs, the north end of the peninsula is affected first. Specifically, the existing wetland / empty field within the cove on the North end, which acts as a canal for channeling water inland.

Author Figure 32: Biloxi Flood Map
David Perkes

Founding director of Community Design Studio, a nonprofit organization established shortly after Hurricane Katrina. David and his team of designers and engineers are responsible for the construction of over 260 new houses along the coastline. Their office is based out of Biloxi, MS, while being an extension to Mississippi State University’s Architecture Department.

Many newly constructed houses in Biloxi didn’t adopt the FEMA Floodmap ordinance height for residential dwellings, which most of these base elevation heights are at 17’ high. This leads to most houses having an extra storage space underneath the house, and different house owners applied different ways to disguise the pier structure underneath the house.

Community Design Studio has done more than 250 new houses after Hurricane Katrina, most houses were on lots that were within the floodzone, and each one has been elevated some amount. Houses are not consistent heights everywhere due to some owners wanting to raise the house higher than the base set elevation for the given street, so the underneath space can be utilized or they can get cheaper flood insurance - free board.

FEMA to local building code requires that all newly residential construction has to be above the base foot elevation, commercial has to be floodproof.

Belongings are more important than the house - harder to replace family photos and memorable objects.

Question is what to do with existing houses that remain after floodzone codes change...
- before Katrina: 11’ height
- after Katrina: 17’ height
- floodzone coverage area increased, adding more homes within the zone
- some houses had to be gutted and redone, money became big issue
- technically, a house does not have to be built to the FEMA flood elevation height, unless the owners begin work on the house that exceeds half of the houses value. If this happens, the house/building must be brought up to code = raising the house up
2.2 Examining Existing Site Conditions: How the current context of the site reflects the 5 elements.

Adaptability

Currently, Biloxi, as a coastal land mass, posses different natural methods for adaptability towards a changing environment. However, one method was carried out artificially by a local office, Gulf Coast Community Design Studio led by David Perkes. This method recreated a bayou with a natural landform that controlled water flow and collection during tidal, and even minor storm surges.

Natural landforms are able to control water more efficiently due to water being organic in nature; the form that controls it should mimic a dynamic, fluid form.

Wetlands act as natural buffers to wave force and recharge the water into the ground over a period of time.

Keegan Bayou

Architects: Gulf Coast Community Design Studio (Biloxi)
Purpose: Retention and release of water if baseline increases, deterring it away from the inland communities.

Author Figure 33/34: Existing Wetland Map, Performatively Wetland Characteristics
Existing methods for floodproof housing

Method 1: Floating Dwelling

**Pros:**
- Buoyancy allows for minimal adaptation
- Utilization reduces the water volume required for better ventilation and cooling strategies

**Cons:**
- Cure for reality and terrestrial living during regular water events
- Requires new infrastructure for building rather than preserving existing

Method 2: Raised Dwelling

**Pros:**
- Dwelling can remain stationary with the existing context
- Raised condition allows for easier renovation

**Cons:**
- Raised dwelling may require time for adaptation through its height

---

Existing housing typologies for Biloxi

<table>
<thead>
<tr>
<th>Surge Height Range</th>
<th>Elevation</th>
<th>FEMA Zone Exposure</th>
<th>Raised First Floor Elevation</th>
<th>Exterior Stair Solution</th>
<th>Dwelling Energy Efficiency</th>
<th>FEMA Upholstered Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>2'</td>
<td>2'</td>
<td>Exposed</td>
<td>Exposed</td>
<td>Exposed</td>
<td>Good</td>
<td>No</td>
</tr>
<tr>
<td>3'</td>
<td>2'4'</td>
<td>Exposed</td>
<td>Exposed</td>
<td>Exposed</td>
<td>Good</td>
<td>No</td>
</tr>
<tr>
<td>4'</td>
<td>3'4'</td>
<td>Exposed</td>
<td>Exposed</td>
<td>Exposed</td>
<td>Poor</td>
<td>No</td>
</tr>
<tr>
<td>5'</td>
<td>4'4'</td>
<td>Exposed</td>
<td>Exposed</td>
<td>Exposed</td>
<td>Great</td>
<td>No</td>
</tr>
</tbody>
</table>

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Author Figure 35/36: Floodproof Housing, Existing Housing Typologies
Affordability

Part of the challenge for designing for effective resiliency is incorporating affordable and inexpensive solutions, in order to provide an equity of usage from all user groups, regardless of income. The Census data below shows the different census blocks and their varying median income as well as current demographics.

Median Household Income

By City-Data.com _ Harrison County, Biloxi, MS
Individual Census Blocks

By City-Data.com _ Harrison County, Biloxi, MS
Community

The current land use of the site is predominantly tourism focused, with high end casinos and resorts that are targeted towards outside visitors. Due to the atmosphere gambling and gaming can bring, the residents of the community prefer not to be strongly associated with casinos.

Currently in Biloxi, there is a strong lacking of true, communal gathering spaces or areas that enrich the public atmosphere. The current residents do wish for more public amenities or public gathering spaces, predominantly focused through a vegetal and natural lens.

Survey of desired park/communal spaces from local residents
Survey conducted by GCCOS for Planning in East Biloxi, MS.

Author Figure 39/40: Main Tourist Programs, Main Resident Desired Programs
Much alike the existing coastline areas along the Gulf (Galveston, Gulfshores, Bay St. Louis), the predominant natural landscape are made up of wetlands and marshes. When looking at Biloxi, approximately, only 20% of the coastline edge are natural wetlands. Wetlands provide a variety of beneficial and natural strategies to preserve the ecological infrastructure along with buffering disastrous floods from storms and sea level rise.

**Existing Wetland Typologies**

- **Eutrophic Wetland**: Eutrophic wetlands are nutrient-rich areas that support a diversity of plant and animal life. They are typically found in areas with slow-moving water, such as the lower reaches of rivers and streams.

- **Scrub/Shrub Wetland**: Scrub/shrub wetlands have a dense understory of shrubs and small trees. They are often found in areas with sandy soils and are well adapted to areas with periodic flooding.

- **Palustrine Emergent Wetland**: Palustrine emergent wetlands are characterized by emergent vegetation that is rooted in the water. They are found in areas with shallow water and are often rich in wildlife.

**Benefits**

- **Density of subtidal flora serves as fish nursery ground**
- **Tall grasses enhance buffer from wave force from storms**
- **Prime bird feeding ground**
- **High amount of roots stabilizes soil conditions**
- **Filters water and improves overall quality and absorbs nutrients**
- **Diversity of plant typologies promote biodiversity**
- **Tall grasses enhance buffer from wave force from storms and provide vital food and habitat**
- **Heavier vegetation provides more effective buffer from storm winds**
- **Can occasionally provide natural barrier to protect wetland and species**
- **Filters water and improves overall quality and absorbs nutrients**
- **Prime feeding ground for migratory birds**
- **Moss and Lichen provides nutrients and food for micro organisms**
- **Well endowed habitat for small invertebrates, reptiles and shellfish**
Existing Wetland Section of Biloxi

- Biloxi Inland
- Marsh and tidal incline
- Tidal marsh pool
- Artificial infrastructure
- Tidal marsh pool
- Marsh and vegetal barriers
- Bay of Biloxi

**Vegetation**

**Natural Drainage**

**Functional Value**
- erosion prevention
- carbon exchange
- oxygen provision
- plant growth
- nursery grounds for both freshwater and marine fish
- protects shoreline
- roots of plants stabilize soil
- algae bloom prevention
- water collection and infill
- manages fluctuating water levels
- slow water release
- floodwater storage
- transportation of people
- efficient vehicular travel
- water collection and infill
- manages fluctuating water levels
- slow water release
- floodwater storage
- protects shoreline
- nursery grounds for both freshwater and marine fish
- water absorption by plants
- land barrier creates natural incline against water rise

Customization

The main user group that involves customization would be the residents, considering they are the ones that own their homes, and have the freedom to express his/her own characteristic preferences. Below are some examples of how the users claim a sense of ownership towards their dwellings.

**Existing Homes**

**Customization**

**Types of Customization**

- Accented Fence color to match house finish
- "Eye catching" detail enhancement
- Additive wooden screen for porous enclosure
- Use of plantings that create a visual barrier
- Exterior placement of seating

**Customized Elements**

- User Modification through COLOR
- User Modification through DETAILING
- User Modification through ENCLOSURE
- User Modification through VEGETATION
- User Modification through EMBELLISHMENT

*Author Figure 43: Existing Customization Features*
3.0 Specific Site for Intervention: Where specifically on the site will this proposal be implemented.
Through the lense of the five key criteria for effective resiliency, the site of East Biloxi was looked at for potential enhancement of each category. The specific area of study is the north bay along the water.
3.1 Current Condition: What is the current water flooding pattern?
3.2 Landscape Articulation: Terra forming the coastline to perform *Adaptability, Ecology* and *Community* to reduce the flooding effect shown above.

**Existing Coastline**

**Push Coastline Edge**
An increase in shoreline edge and "sawtooth" form slows and controls water flow more efficiently

*Adaptability*

**Added Diagonal Grids**
Un-ordered grid layout to promote organic movement from water

*Adaptability*
Added Horizontal Grids
East-West grid layout to continue existing language of neighborhood streets

Shifting/Cutting Land Mass along grids
Sporadically breaking up land mass through cut/fill methods and infilling to promote natural water flow

Implementing Vegetal Borders
Lining edges with wetlands and marshlands that improve the ecological infrastructure and performance of the landscape

Author Figure 46: Landscape Articulation
3.3 Contextual Relationship: How does this articulation relate back to the existing context?

Roadway Circulation

Redeveloping the existing dirt path into a redefined access road horizontally through the site to bring more walkability and access.

Continuing the physical connection between the existing neighborhood roads into the site, in order to continue the programmatic axis of the residential units.

Redeveloped Road

Extending Streets from existing neighborhood

Author Figure 47: Roadway Proposal
Existing Programs

While looking at the site of Biloxi, there are moments that resemble community interaction. These moments are specified by their building types, and their current program. This intent is to implement similar zones or atmospheres that reflect the existing community context, within the new proposal.
Proposed Site Program and Structures

Proposed Structures:
- Eco-Casino
- Community/Learning Center
- Market Stands
- Aquaculture/Innovative Farming Terraces
- Affordable Single Family Resilient Housing

Proposed Land Based Program:
- High/Low Tidal Activated Areas
- Hydro-Integrated Platforms
- Resilient Parks
- Historical Markers
- Vegetal/Educational Zones

Dwelling (Eco-Casino)
- Housing

Preserve
- Nature Trails
- Nature Parks
- Existing Wetlands

Recreation
- Recreational Parks
- Exercise Parks
- Dog Parks

Activated
- Community Center
- Tidal Activated Areas
- Hydro-Integrated Platforms
- Farming Terraces

Communal
- Market Stands/Grocery
- Industrial Markets
- Educational Areas
- Community Gardens

Author Figure 49: Programmatic Plan
4.0 Landscape Typologies: Zooming in on the spaces created from the site articulation form, and creating scalable design moments. (Canals, Ponds, Mounds, etc...)

Boardwalk over the canal made with recycled wood from abandoned piers along the northern coast of Biloxi. Incorporated customizable bench that folds into table for different uses along boardwalk path. Dock condition placed at 6'-7' elevation to anticipate sea level rise / storm surge. Boardwalk connects existing community context into proposed tourism context in order to unify the two user groups. Coastal plantings along ridge-line to enhance the existing ecological infrastructure, while providing adaptation via plant absorption and groundwater recharge.
Platforms made from recycled wood from abandoned piers or abandoned houses. Different platforms and walkways are placed at different heights to anticipate different levels of water rise. Coastal plantings are implemented in order to have artificial and natural elements shared together. Advertisement stands are added throughout in order to give any user the ability to project or sell goods or services to the public. Platforms are open to the public and connect physically or through interconnectivity with one another.
Proposed housing condition matches the current building means and methods of Biloxi by being raised and made from vernacular material. The elevated condition of the house allows for an expectation of different levels of water rise. The use of passive systems and natural landscaping enhances the ecological infrastructure. The user has full personalization towards the house, regarding the color, material, landscaping and the operable panels placed below. The panels below the 17’ FEMA Code give a stronger purpose to the empty unconditioned space and raise opportunity for the user to take advantage of the space.
The active green space doubles as a flood-able park during the time of a storm event. The park is open and free towards everyone, and enriches the concept of equity. Active green space is one desire from the existing community of Biloxi. Heavy vegetation and thriving plant life invites local wildlife to endure. Built in play park which includes playgrounds and workout spaces for children and young teens to enjoy and feel a sense of belonging to.
Retention condition allows for water flooding and depots it away via groundwater recharge. The river element allows for secondary transit including small boating and kayaking. River condition connects back towards community center and casino land pier. Heavy natural vegetation enhances ecological infrastructure and adheres to wildlife. Art kiosk stands placed throughout to allow user to express themselves.
Nature walks and trails provide raised boardwalk conditions as well as heavy vegetation in preparation of storm / sea level rise flooding. The boardwalks are made from recycled material and are open for everyone. Through global sea level rise, the conditions of the boardwalk allow for different program iterations such as fishing or boating. The heavy vegetation acts as a wildlife enhancement and contribution. Along the trails are informational kiosks and historical markers that reive the history of Biloxi and the importance of coastal vegetation.
The wind farm collects and harnesses energy from everyday winds to storm winds at 70mph, and responds by providing energy for the site. The wind farm allows for the independence of mainland infrastructure. The existing community can visit and learn about wind power and energy through educational kiosks. The wind farm uses on natural energy from wind loads, and does minimal impact to the surface. The wind farm can be manually shut off or adjusted for hurricane winds in the event of a storm event.
5.0 Scalar Resiliency Proposal: Overlaying the design characteristics of both Large Scale solutions and Small Scale solutions within one final outcome.
5.1 Large Scale Resiliency: Master Site Plan
Vegetate Borders begin to absorb and transfer more tidal water via groundwater recharge.
4’ Sea Level Rise

Flood-able Zones are inundated and function as water storage basins

Landscape Strategy: Flood-able Park - Land mass basin as a purposeful collector for large bodies of water
6’ Sea Level Rise

Landscape Strategy: **Multi-Use Levee and Temp. Flood-wall** - Increase in filled land and barrier wall to prevent further travel of water inland

**Land Piers/Mounds** and **Temporary Flood-wall** prevent water from reaching farther inland or near inhabitable zones
17’+ Storm Event

**Landscape Strategy:** Multi-Use Levee, Temp. Flood-wall and Raised Structures - Water prevention methods in order to prioritize transport via roadways/waterways towards Relief Center

**Land Piers/Mounds, Raised Structures and Temporary Flood-wall** preserve and prioritize any means of travel towards *Casino/Relief Center* from water inundation.
5.2.1 Intermediate Scale Resiliency: Casino Land Pier

[Diagram of Casino Land Pier with labeled sections: Parking, Casino, Plaza, Hotel]
Current Condition: 0’-2’

Author Figure 69: Current Condition Casino
Sea Level Rise: 6’ + (50yr Span)

Author Figure 70: Sea Level Rise Casino
Storm Event: 17' +

Author Figure 71: Storm Surge Casino
Casino Resort / Disaster Relief Center: How the structure withstands during time of disruption (storm event).

1. \textbf{"Power-Flower" Wind Turbines} (Electricity Generator)
2. \textbf{Sloped Roof} (Water Collector)
3. \textbf{Vertical Chase} (Conduit and Piping)
4. \textbf{Intensive Green Roof} (Water Collector)
5. \textbf{Dome Skylights} (Backup Lighting)
6. \textbf{Concrete Friction Piles} (Resilient Structure)
7. \textbf{"Closed Loop" Geo-Exchange System} (Cooling System)
8. \textbf{Tidal Turbines} (Electricity Generator)
9. \textbf{Water Filtration System} (Water Cleansing)
10. \textbf{Transformer} (Electricity Converter)
11. \textbf{Battery for Wind / Tidal Turbines} (Electricity Storage)
12. \textbf{Grey-water Cistern Storage} (Water Collection)
5.2.2 Intermediate Scale Resiliency: Community Center Zone

Author Figure 73/74: Community Center Plan/Program
Author Figure 77: Community Center Section 2
Current Condition: 0'-2'

Author Figure 78: Community Center Current Condition
Sea Level Rise: 6’ + (50yr Span)

Author Figure 79: Community Center Sea Level Rise
5.3 Small Scale Resiliency: Housing Development

“Everyday” Condition

Storm Event

Author Figure 80/81: Existing/Storm Housing
Temporary Program Iterations

Mobile Home Office Space
Wall Mounted Planters
Wall Drawing Gallery/Storage Space
Extended Wall for Privacy

Interactive Panels for unconditioned ground floor space become utilized into wind breakers for the FFE at 17”

Everyday Condition
Folding panels in a “V” form
Panels are raised through pulley system
Panels are fastened and bolted on upper floor
Storm Event Condition
Author Figure 84/85: Detail Sections of Panel System

- Reinforcement Bolt
- Track Wheel
- Steel Track Rail

- Metal Pivot
- Steel Latching Pin
- Timber Panel Frame
- 3/4" Plywood Sheathing
- 1/2" Corkboard Panel
- 2x4 Stud Reinforcement

- Pulley System
- High Tension Cable
- Metal Hook

Section at Pivot/Track Connection

Section at Pulley System
Current Condition: 0'-2'

Author Figure 86: Housing Current Condition
Sea Level Rise: 6’ + (50yr Span)

Author Figure 87: Housing Sea Level Rise
Storm Event: 17’+
6.0 Reflections and Conclusion: What did I learn from completing this thesis?
**The Good: Positive Remarks and Successes**

In the beginning, I originally thought that the term “resiliency” was another word for “resistance” or prevention against a disaster of some magnitude. However, after thorough research, analysis and conclusion, I’ve come to realize that its more than just “prevention”. Resiliency is a composition of everything from the architecture to the individual. The architecture can be resilient, but if the individual is not, then it’s not true effective resiliency. While as the individual is resilient, but the architecture is not, then same outcome. Resiliency needs to be addressed at multiple scales, to be truly effective. With this thesis, I’ve approached the project as a solution that incorporates large scale resiliency using large scale characteristics as well as small scale resiliency using small scale characteristics. This way, the project responds towards a community that is highly prone to disastrous flooding both long term and short term.

**The Bad: Feedback and Critiques**

Although I deem this thesis project to be overall successful, there were moments and elements that unfortunately could not pass through, considering if this project were to be feasibly developed. For one, the housing development was meant to be not only resilient towards disastrous flooding but also affordable. Although the new houses mimicked the similar building construction techniques of the existing housing in Biloxi, they were however not fully developed in terms of affordability, due to it being considered “waterfront” property. Next, the community center structure was lacking a storm surge adaptation, most likely due to it’s elongated form. The form could have been more developed as well as more detailed in regards of how the materiality is designed to withstand high winds and strong wave currents. Lastly, the floodable models did not perform as fully as intended, most likely due to the coarse surface of the acrylic paint and insulation foam, but did give the overall impression on how the landscape responds to water intake.

**The Conclusion: What was ultimately learned**

Throughout this project, there were successes and failures, but ultimately, the most important aspect is learning from the failures. One element that was understood was the difficult tradeoff regarding affordability and adaptability for housing. It seemed throughout the process of design, one could not be achieved without disregarding the other. Another element that was learned was how water obnoxiously travels in regards to landscape articulation. Although the landscape forms a clean trench or canal for water to travel, it still seems to find ways to seep through different areas that were not intended for it to go. However, as troubling at times this thesis was, I ultimately enjoyed it and learned a good amount about coastal flooding, existing strategies and newly developed strategies that could potentially be incorporated in the near future.
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M.1 Current Condition
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Thank You
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