Absorbency in Tidal Resiliency | The Thickened Pier

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Absorbency in Tidal Resiliency

The Thickened Pier

Shauna Strubinger

Advisor: Julie Larsen
Syracuse University School of Architecture
“They work with appreciation of the fact that design in an estuary, particularly an estuary in the problem of flood not by flood-control measures but by making a place that is absorbent and resilient.”
- Sea and Monsoon Within: A Mumbai Manifesto

“...in a estuary where the sea and monsoon are insiders rather than outsiders, making a place where ambiguity and possibilities, rather than clarity and certainty, are the norm.”
- Sea and Monsoon Within: A Mumbai Manifesto

“...these [adaptive design] and their forms must be adaptive and resilient to sudden, discontinuous environmental change - change that is normal, but cannot be predicted with certainty or controlled completely.”
- Insurgent Ecologies (2010)

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Contention

The inevitable truth of climate change has placed coastal cities at great risk. Past natural disasters in the United States such as Hurricane Sandy and Katrina, displaced many people because these communities’ only protection was their failed infrastructure. Although hard and soft infrastructure strategies have addressed the rising sea level, architecture at the building scale creates static surfaces and divisions that are slow to adapt to flooding and leave little to no room for the ambiguity of tidal flooding and storm surge. Though numerous areas are at risk of sea level rise across the globe, the Chesapeake Bay area is one of the areas to face the highest risk in the Americas with several growing urban metropolises and an expansive estuarine environment. This thesis responds to the current threat of sea level rise on coastal population cities and proposes to create an absorbent condition through spatial repetition of the module that adapts to the local conditions.

According to architect and theorist Stan Allen, field conditions, specifically “mats”, allow for ambiguity and uncertainty of a space. This thesis seeks to re-evaluate Allen’s Thick 2D as a resilient, absorbent architecture by speculating the mat building as a landscape condition at the infrastructural scale, while further examining the thickened surface at the edge between land and water at the architectural scale. As a thickened surface, a pier prototype would function as a resilient and adaptable breakwater. The pier consists of a repetitive module that can be expanded, widened, shortened, and based on the topographic and programmatic constraints of each site.

In order to allow for the pier to evolve over time, the surface consists of an altered breakwater unit to create a structural module. By observing the state of the Chesapeake Bay, the seed buoy will provide the greatest benefit as a soft material device for the pier by improving the ecology of the bay and allowing for wave attenuation. The materiality of the module can be both soft and hard based on the edge of the specific deployment of the infrastructure. This thesis proposes a network of the fisheries and fish markets on the Chesapeake Bay that respond to the fluctuations of sea level rise and storm surge and the stages of ecological restoration.

Response: This statement supports the thesis critique that architecture can no longer be static but needs “ambiguity” aka absorbency.

Adaptive = ABSORBENT = Ambiguity

“More than a formal configuration, the field condition implies an architecture that admits change, accident, and improvisation. It is an architecture not invested in durability, stability, and certainty, but an architecture that leaves space for the uncertainty of the real.”

- Stan Allen from “Field Conditions” in Points + Lines


Building Destruction from the Rising of the Tides

Global warming is causing depletion of the ozone layer, the temperature of the Earth to rise, and the ice glaciers to melt and the sea level and tides to rise. Because of the amount of greenhouse gases in the atmosphere already, we are and are going to be faced with major, long term consequences that won’t be as easily resolved. One of those consequences is most coastal or major waterway areas will be at risk of severe flooding. Areas that are beginning to show these changes are around the Chesapeake Bay area, Louisiana, and the western Gulf of Mexico. Hurricane Sandy and Katrina are significant examples of how damaging tidal flooding with storm can impact a coastal city. Both hurricanes caused major damage and displaced many people, because the communities only protection was the infrastructure, and it failed them. Buildings were exposed to rushing water and swept away.1

“The monuments of the past, including the skyscraper, a modernist monument to efficient production, stood out from the fabric of the city as privileged vertical moments. The new institutions of the city will perhaps occur at moments of intensity, linked to the wider network of the urban field, and marked by not by demarcating lines but by thickened surfaces". 
- Stan Allen from "Field Conditions" in Points + Lines

"…section is not the product of stacking (discrete layers as in a conventional building section) but of weary, warping, folding, oozing, interlacing, or knotting together".
- Stan Allen in "Mat Urbanism: The Thick 2/D"

Rethinking the Thick 2D

Thick 2D: Moires, Mats

'Mat-building' has the potential to be speculated as a form of resilient architecture.

Engage the edge

Thesis’s critique on Mat Urbanism: Its primary focus formally on plan and the horizontal landscape.

How can the sectional relationship between the land and water affect the Thick 2D?

Rather than a form, it is a system of relationships, between the built and the natural.

(def) Field Condition

“The process, a growing structure of additive elements characterized by a delicate interplay between variations and repetitions of form"
From MoMA's Rising Currents workshop and exhibition, a biodiversity armature to nurture and develop an oyster bed to help improve the water quality and to provide the community with an engaging public space. The web of rope helps with wave attenuation. Eventually, the armature will become a part of an interactive harbor.

Response: Oyster-tecture involves the community and the ecology of the local area, while designing a resilient strategy against flooding and hurricane surge. However, the armature can only really operate as a landscape oriented framework.

Water Proving Ground | LTL Architect

From MoMA's Rising Currents workshop and exhibition, it is comprised of artificial landforms and piers that redefine the edge and create a large tidal zone. These landforms are created by redistributing the historic landfill.¹

Response: This project carefully considered the temporality and the degree of severity of tidal flooding. Its creates a variety of landforms connected through a processional boardwalk.


New Aqueous City | nArchitects

From MoMA's Rising Currents workshop and exhibition, the project creates a new type of house that flips it upside down to reduce the total floor area vulnerable on the sea level floor. The housing is connected to a larger system of islands and storm barriers.¹

Response: It is an innovative method of the housing project. The larger system of storm barrier islands seems disconnected with the housing. How does the vertical wall surface handle the rising tides?

Re-generator | Gabriel Munoz Moreno

A construction system that is “organized, distributed and expands as cells” elevated above the ground, to make way for the recovery of the wetlands. As a translucent and permeable structure, it allows for the natural regeneration of the ecosystem. With different “inputs”, the habitats and wetlands are encourage to have self-sufficiency.

Response: It creates a large scaled infrastructure system. The permeability of the framework allows for the growth and restoration of the wetlands. It is a good example of expanding a small scaled element, like a cell, to work at a large urban scale.


Agristructure Ecostructure | Interstice Architects

A network that rethinks the sea wall edge to create a “soft” infrastructure to mitigate the impact of sea level rise while re-mediating the local ecology. The structure consists of low-impact access catwalks and seed distribution networks.

Response: This is a good precedent in how the local ecology impacts the design of the network while creating a public, recreational space. However, it is primarily a horizontal condition with distribution pods and elevated catwalks.

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Context of Contention

(def) Estuary: noun
Estuaries and their surrounding wetlands are bodies of water usually found where rivers meet the sea.

The Chesapeake Bay is the largest estuary in the United States. Estuaries are home to unique plant and animal communities that have adapted to brackish water, a mixture of fresh water from the land and salt water from the sea. The Chesapeake Bay provides important habitats for spawning and nursery grounds, for fish and shellfish species. Not only does this benefit the natural ecosystem, it also plays a significant role in the commercial and fishing industry. Though numerous areas are at risk of sea level rise across the globe, the Chesapeake Bay area is one of the areas to face the highest risk in the Americas.1

1. Jefferson Memorial
2. Lincoln Memorial
3. Naval Yard

Category 2
Category 3
Category 4
State of the Bay

Pollution

The Nation’s River is the Endangered River

“2012 - Potomac river was the nation’s most endangered river”¹

Sedimentation is a major issue in the urban area of the Potomac river. The river is so polluted that it is considered unfit for swimming. Most of the pollution comes from industrial waste and storm water runoff. During storms, the river becomes a major problem because the sewer systems lead to the river. As a result of the rise in water, the systems become blocked, overflow, and flood the area.²

Loss of SAV Habitat

Submerged Aquatic Vegetation (SAV) are a vital part of the Chesapeake ecosystem and quality of water. However, there are not that many SAV beds in the local estuary because of water pollution and invasive species. As a result, many species, specifically blue crabs, are declining because of the loss of habitat, source of food, and shelter during their development.³ There are program and management plans to restore the SAV habitat in the bay.

Decline of Female Blue Crab Population

In 2013 and 2014, the population of adult female dropped considerably. Therefore, the reproduction percentage has dropped significantly as well.⁴

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². Ibid.
⁴. Ibid.
Salinity Levels (ppt)

- 0-2.4
- 2.5-7.5
- 7.5-12.5
- 12.5-15.0
- 15.0-21.0
- 21.0-27.0

Lippson and Lippson (1984)

Dissolved Oxygen Levels (%)

- 0-<20 (Very Poor)
- 20-<40
- 40-<60
- 60-<80
- 80-<100
- 100 (Excellent)

“Dissolved Oxygen Threshold” (2014)
Bay’s Health Index

Chemical Contaminants

- 75.4% PCBs
- 12.3% PCBs + Metals
- 1.5% PCBs + Unknown Toxics
- 7.7% PCBs + Priority Organics
- 3.1% PCBs, Priority Organics, + Metals
- None Listed

“Health Index Threshold” (2014)  Chesapeake Bay Program (2010)
Many species, specifically blue crabs, are declining because of the loss of habitat, source of food, and shelter during their development.¹ In 2013 and 2014, the population of adult female dropped considerably. Therefore, the reproduction percentage has dropped significantly as well.²

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² Ibid.
There are currently many programs and methods occurring to help improve the state of the Chesapeake Bay. One of the methods is a seed buoy filled with eelgrass reproductive shoots. The distribution of the eelgrass seed is performed seasonally during the Fall and Spring. The restoration of the eelgrass would help clean the water of the estuary by filtering pollution and runoff, act as fisheries, and provide food sources. Furthermore, it acts as a natural wave attenuator.1 By observing the state of the Chesapeake Bay, the seed buoy will provide the greatest benefit as a soft material device for the pier by improving the ecology of the bay and allowing for wave attenuation.

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These following typologies were used to observe how the edge is typically negotiated between land and water. Therefore, the edge would be redefined as a thickened surface. As a thickened surface, a pier prototype would function as a resilient and adaptable breakwater.
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Dolos is a breakwater module used to form breakwaters and sea walls to protect against sea level rise and erosion. They work by dissipating the energy of waves. Their particular design is intended to disperse the wave energy and creates an interlocked, porous infrastructure. They become more entangled over time through the movement of water. Dolos is typically made out of concrete from a steel mould. Therefore, the dolosses very heavy, weighing approximately 16 tons.
As a thickened surface, a pier prototype would function as a resilient and adaptable breakwater. The pier consists of a repetitive module that can be expanded, widened, shortened, and based on the topographic and programmatic constraints of each site. In order to allow for the pier to evolve over time, the surface consists of an altered breakwater unit to create a structural module.
From Surface to Materiality | An Absorbent Condition

The materiality of the module can be both soft and hard based on the edge of the specific deployment of the infrastructure. The seed buoy is deployed as a soft material device through the spacings and striations of the module. The empty spaces between the structural module, is filled with a mesh netting. The porous nature of the netting allows for eelgrass shoots to be inserted closer to the edge of the water. This phasing of materiality along the surface allows for an absorbent, blurred condition.
The striated surface of the breakwater pier would vary according to the materiality of each site. Each pier is categorized and designed based on a hard to soft scale. The striations of a “Hard” breakwater pier would begin wider on the land’s edge and become more condensed along the water. While, the “Soft” breakwater pier is the opposite of the “Hard” example. It is dense at the land’s edge and disperses outward along the water. The “Hard + Soft” breakwater pier is a combination of the differing, striated surfaces. These three different patterns display various ways to negotiate the edge between land and water, based on the context of each site.
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**Infrastructural Network | Breakwater Pier**

These three sites in the Chesapeake Bay were selected because of the issue of sea level rise and the failing ecological state of the bay. Each site was categorized based on hard to soft scale of materiality. Washington DC was selected as the “Hard” site, because it is large metropolis covered in concrete and hardscape. Piney Point was selected as the “Soft” site, because it is summer destination filled with sand and marshes. Crisfield falls between the extremes of “Hard” and “Soft” as a declining crab distribution town surrounded by an expansive park and marshland.
Crisfield, located at the most southern tip of Maryland, is well known for its seafood and as a major distribution site in the Chesapeake Bay because of its proximity to both oyster and the crab habitats. However, the nutrient pollution and overharvest of shellfish in the estuary has negatively affected the population of the Maryland Blue Crab. Furthermore, the sea level rise is a major issue for the town for disappearing crab habitats, such as Tangier Island and Smith Island, and flooding/water infiltration in homes. Smith Island is predicted to disappear by 2025.1

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Crisfield + Tangier Sound Ferry Service
Fish Market
Somers Cove Marina
Pocomoke Sound Wildlife
Long Point
Janes Island State Park
McCready Memorial Hospital
Smith Island
Martin National Wildlife Refuge
Pocomoke Sound
Hammock Point
Phase 1 | Site Prep

This phase deals with initiating the breakwater pier. The pier prototypes would begin based off of initial pier connections. Also, the eelgrass shoots need to be grown in water tanks, typically in the summer and fall seasons.
Phase 2 | Foundation + Formwork

The actualy constructions of the breakwater pier begins by using the adapted structural module. The construction of the absorbent, blurred condition is influenced by the materiality of the site.
Adapted Breakwater Module
Phase 3 | Growth

Once eelgrass has matured fully in the water tanks, they are able to be deployed. Additional breakwater piers are constructed and established creating a scalloped edge.
Growth

"Seed Busy"
Phase 4 | Adaptation

The different spatial negotiation of the module can create various programmatic piers based on the particular site. The breakwater piers at DC fish market and Piney Point are designed to negotiate the edge different based on their programmatic, topographic, and material constraints.
Washington DC is the U.S. capital along the Potomac River of the Chesapeake. It’s defined by iconic monuments and historical buildings, such as the Jefferson Memorial, the Pentagon, and the White House. Currently, the estuary city faces approximately 43 floods annually. By 2030, a sea level rise of 5 inches would drastically increase the number of annual floods to 155 floods. By 2045, the amount would be 400 annual floods. Washington DC is dealing with the crisis of a growing population but low-topographic setting with the rising of sea level.

Maine Avenue Fish Market

Maine Avenue Fish Market “The Wharf” is the oldest, still operating fish market in the United States. In 1918, the Fish Market opened and was originally very successful. However, in 1960, the southwest quadrant of Washington DC declined and was planned for urban renewal. Because of the renewal plan, the fish market vendors were displaced to the Washington Channel on barges.1 Currently, it is pushed up against a highway along the river at the edge of the yacht basin. Near L’Enfant Plaza, it is not easily accessible from the rest of the city or visitors and mostly known by the locals. It is isolated from the National Mall of the city.

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Piney Point | Soft

It is a summer vacation destination, previously for Washington D.C. notables, located at the mouth of the Potomac River. The lighthouse is at the southern point of the town and is currently used as a historical museum.¹

It was selected as one of the multiple sites for a program to restore the eelgrass, an important subaquatic vegetation to the estuary, to help improve the overall environmental health and water quality of the Chesapeake Bay.² Its low-lying topography means that it at a great risk of tidal flooding and hurricane surge from sea level rise.

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Images


