A Shell of a Good Time: A Design Framework for Oyster Sanctuaries and Playful Parks

“A Shell of a Good Time:
A Design Framework for Oyster Sanctuaries and Playful Parks”

A Thesis Submitted to the Department of Architecture
Harvard University Graduate School of Design, by

Mai Lee

In Partial Fulfillment of the Requirements for the Degree of
Master of Architecture

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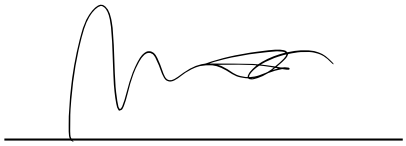
Mai Lee



Andrew Witt

M.ARCH I
THESIS
FALL 2023

"A SHELL OF A GOOD TIME"

A DESIGN FRAMEWORK FOR OYSTER SANCTUARIES AND PLAYFUL PARKS

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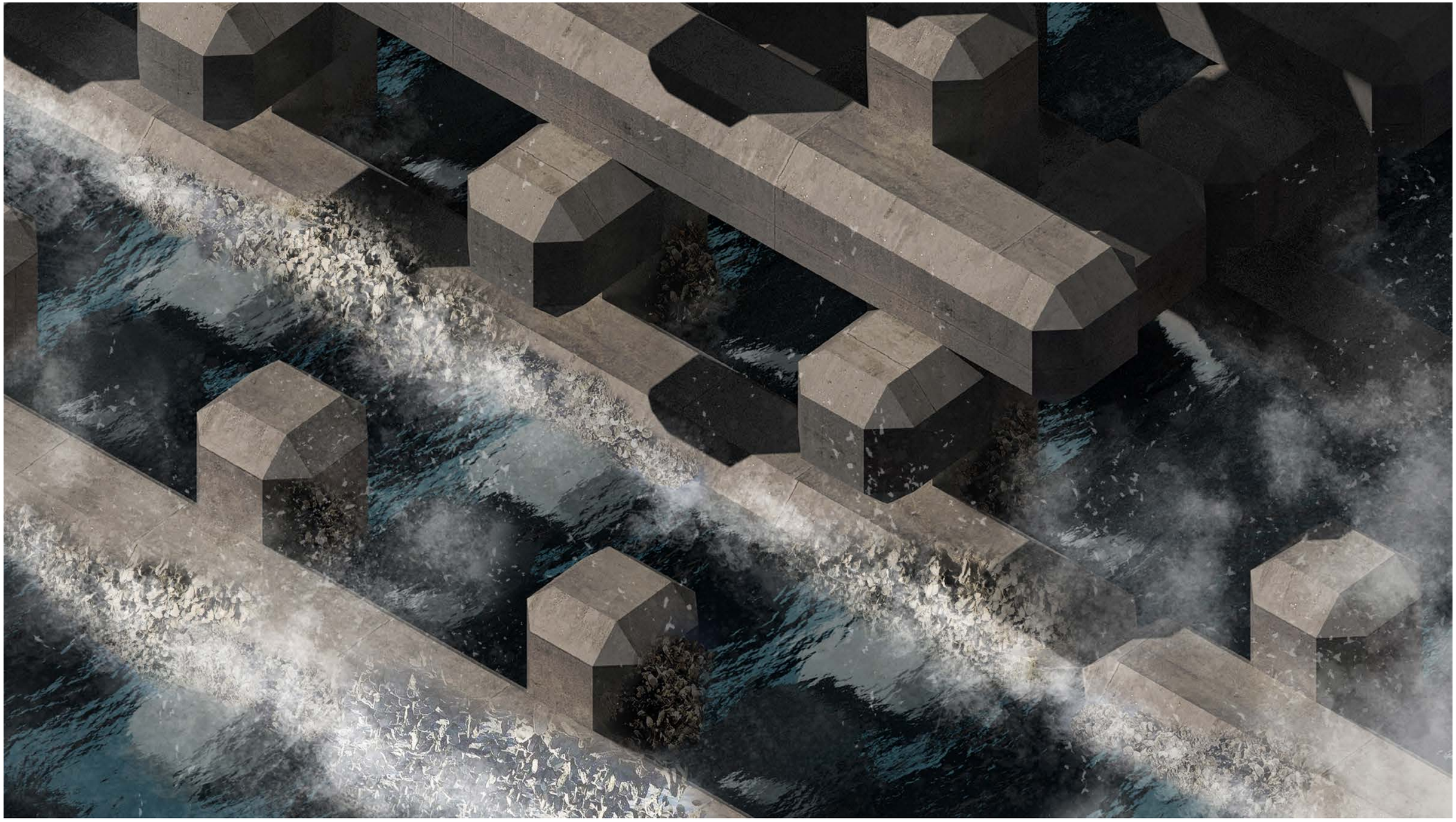

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PROJECT PROPOSAL

ABSTRACT

Oysters play a crucial role in maintaining healthy marine ecosystems through their ability to filter water and provide habitat for various species. The Billion Oyster Project, a New York-based initiative, has been working tirelessly to educate the public about the importance of oysters and restore their populations in the waters around the city. This project combines education and restoration efforts, with a mission to engage both marine life and people in a symbiotic relationship.

The central inquiry of this architectural thesis is: How do we design spaces that harmoniously coexist with marine life and serve as recreational and educational resources for the public?

In the context of contemporary discourse, this research question addresses critical issues of marine conservation, urban environmental reclamation, and flood protection, as well as modular design and fabrication. The rapid depletion of oyster populations, the reclamation of post-industrial waste sites, and the need for resilient coastal infrastructure have become pressing concerns. By exploring a novel approach that integrates oyster restoration, public engagement, and architectural design, this thesis aims to bridge the existing gaps in these crucial domains. This thesis envisions the creation of an educational and recreational park for the Billion Oyster Project using modular forms inspired by existing wave dissipation blocks. While providing oysters with a habitat to thrive and filter the surrounding water of what was historically an industrial waste dumping site, the modularity also considers replicability and fabrication, as issues of marine conservation and coastal resilience are not endemic to only New York City. The park not only contributes to oyster restoration but also offers a unique platform for public education and recreation. The project postulates that architecture can be a catalyst for the synergy between human and marine life. The outcomes of this research project provide a conceptual framework for future urban waterfront development that can balance the needs of marine ecosystems and human communities.

THE OYSTER

The oyster, a vital keystone species, plays a crucial role in maintaining the balance of marine ecosystems. Serving as diligent filter feeders, these remarkable creatures cleanse our oceans and rivers with extraordinary efficiency, with a single adult oyster capable of purifying over 50 gallons of water daily. Their filtration process targets algae, thereby enhancing water quality burdened by excessive nutrients and curbing the occurrence of algal blooms.

In addition to their purifying prowess, oysters serve as architects of underwater havens. Their nooks and crannies offer refuge for small fish and crabs, fostering a diverse aquatic habitat. The oyster's contribution doesn't end there; it becomes a canvas for mussels, barnacles, and sea anemones, creating thriving ecosystems that become abundant food sources for commercially valuable fish.

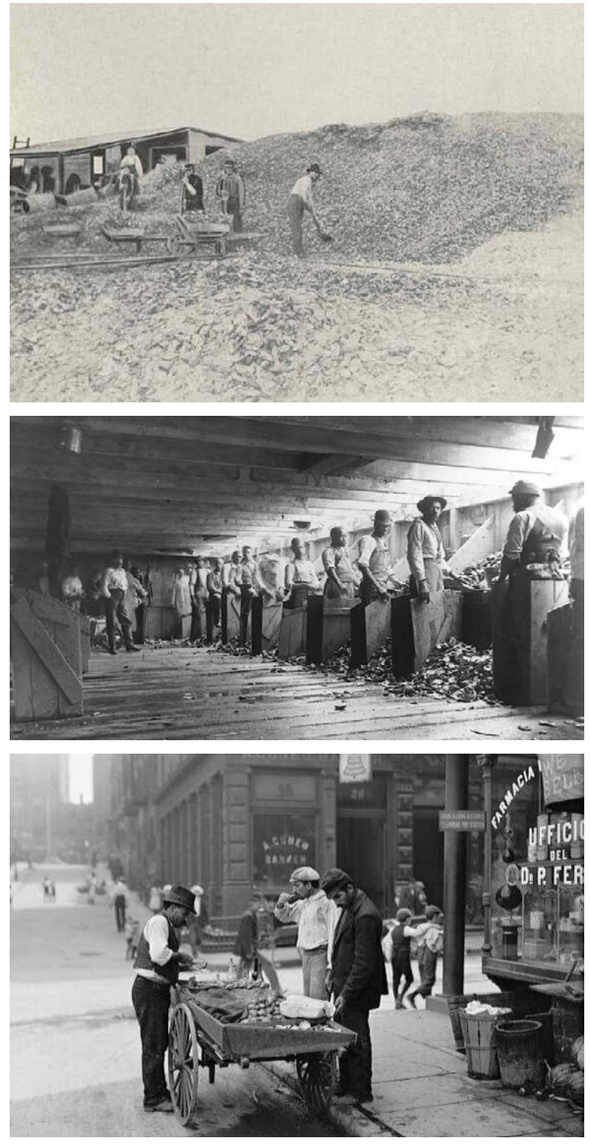
Beyond their ecological significance, oysters bestow numerous benefits upon humanity. They serve as a source of sustenance and livelihoods, providing food and jobs to communities. Moreover, oyster reefs act as nature's sentinels, forming natural storm surge barriers that safeguard against erosion and protect vulnerable estuaries. This protective role is particularly critical in the face of climate change, offering essential services to coastlines, including those at risk, such as the dynamic shores of New York City.

HISTORY OF OYSTERS IN NYC

Throughout its rich history, New York has shared an enduring connection with oysters. In his book "The Big Oyster: History on the Half Shell," author Mark Kurlansky astutely notes that "the history of the New York Oyster is a history of New York itself." These humble mollusks not only played a pivotal role in cleansing the city's waters but also served as a vital source of sustenance and employment for its burgeoning population.

During the 17th century, an astonishing 350 square miles of oyster reefs adorned the waters surrounding the NYC harbor, boasting nearly half of the global oyster population. These oysters were notably grander in size, with shells from the 19th century measuring up to a remarkable 10 inches or even a foot in length.

In a bygone era, oysters were ubiquitous on the streets of New York City, standing as the original street food long before the likes of pizza, hot pretzels, bagels, and hot dogs. However, the tale takes a somber turn as overharvesting and pollution besieged the harbor's waters, leading to the tragic demise of the once-thriving oyster population. By the turn of the 20th century, these once plentiful creatures were sadly considered virtually extinct. The rise and fall of the New York oyster mirror the changing tides of the city's own narrative.



BILLION OYSTER PROJECT

The Billion Oyster Project, established in 2014 as a non-profit endeavor, holds a steadfast commitment to the revitalization of New York's oyster population. Simultaneously, the organization seeks to impart knowledge about the city's profound historical connection with these bivalves to students, volunteers, restaurants, and community scientists. Their ambitious goal, as reflected in their name, is to reintroduce one billion oysters into New York waters by the year 2035.

In my project, I have chosen the Billion Oyster Project as my hypothetical client. The objective is to seamlessly integrate my design and processes into the existing frameworks established by the organization. By aligning my efforts with the mission of the Billion Oyster Project, I aim to contribute to the ongoing initiatives and further enhance the impact of their commendable work.

In the summer of 2023, I was fortunate to engage in volunteer work alongside the dedicated team at the Billion Oyster Project (BOP) on Governor's Island. Our collective efforts were centered around the meticulous task of cleaning shells, sourced from various restaurants across the city. These shells, having undergone a natural curing process in expansive piles known as middens, were being readied to serve as essential substrates for the growth of new oyster spat.

Top: Billion Oyster Project Volunteers working to restore the oyster population

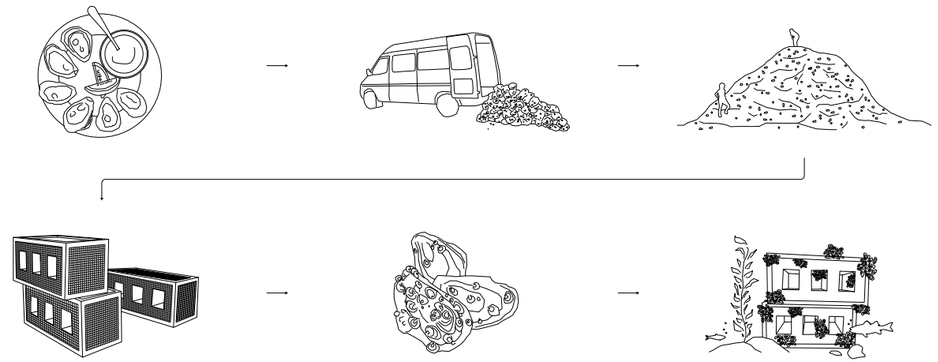
Right Page: Photos taken from my volunteering experience with BOP during Summer 2023. Here, volunteers and wash shells collected from NYC restaurants that have been curing in the elements for a year to prepare for new oysters to adhere onto

BOP SUMMER 2023 VOLUNTEERING

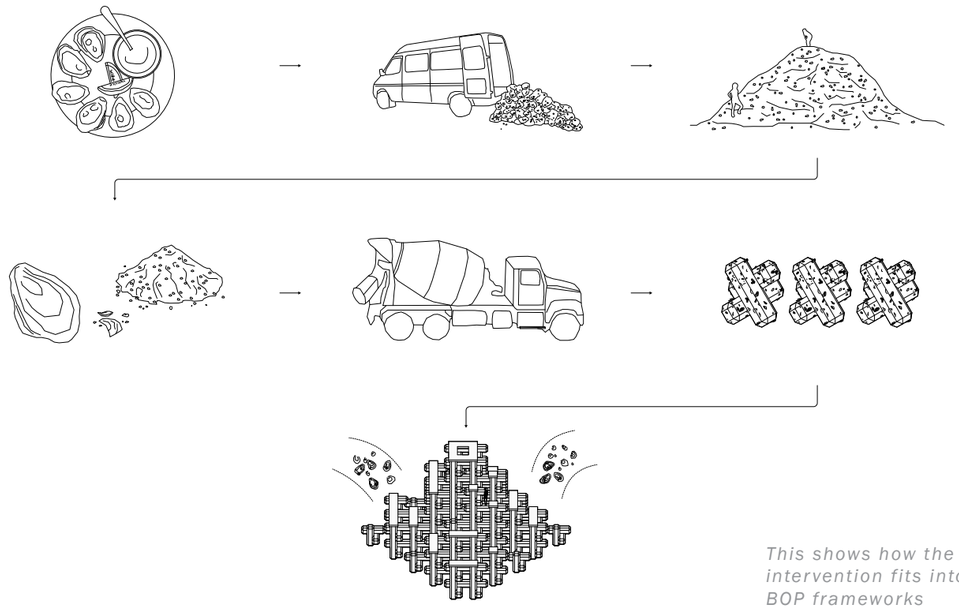
UTILIZING EXISTING SYSTEMS

The cleaned shells are placed into durable metal cages before attaching the oyster larvae onto them. Concrete modules, where oyster spat adhere, were also observed. Recognizing these elements, it became apparent that this could potentially be an area for intervention.

CURRENT BOP PROCESS



PROPOSED PROCESS



This shows how the intervention fits into existing BOP frameworks

PROJECT SITE

Coney Island Creek, a 1.8-mile waterway in Brooklyn, New York, is a product of 18th-century land filling and digging activities that transformed a series of streams and inlets. Originally spanning 3 miles and separating Coney Island from the mainland, the creek was closed off in the early 20th century due to ongoing land development and construction projects. Today, only a small portion of the original creek remains.

Surrounded by recreational areas like Kaiser Park, Calvert Vaux Park, and Six Diamonds, Coney Island Creek offers a mix of sports facilities, birdwatching spots, and a unique history. Kaiser Park, with its football field and ballfield, also hosts migrant birdwatching. Despite a dormant ferry terminal project, the dock in the park now serves as an oyster nursery station for the Billion Oyster Project. Calvert Vaux Park is known for the Seaview Rotary Wings RC Helicopter Club, while Six Diamonds features six baseball diamonds.

Teeming with wildlife on both land and in the water, Coney Island Creek attracts local recreational fishers and birdwatchers. Notable landmarks include a yellow submarine turned shipwreck and its proximity to the famous Coney Island Beach, amusement park, and the New York Aquarium.

This vibrant and diverse context, rich in both environment and culture, provides a unique opportunity for a design project. Whether exploring existing amenities like the dock and submarine, connecting with cultural destinations like the Coney Island boardwalk and the New York Aquarium, or delving into the wealth of species in this nature reserve, there are numerous elements that could inspire and inform a compelling thesis project.

The area is a popular area for recreational fishing

An abandoned submarine in the creek is a local landmark

The dock remains from the failed ferry landing project

The Billion Oyster Project maintains a site at the dock

LOCAL WILDLIFE


Eastern Oyster


Fluke


Arctic Tern


Great Blue Heron


Striped Bass


Atlantic Herring


Horseshoe Crab

THE SURROUNDING PARKS

Kaiser Park

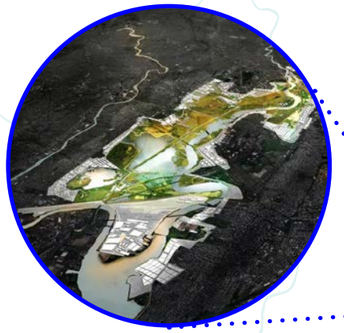
Six Diamonds Park

Calvert Vaux Park

Coney Island Creek Park Shore

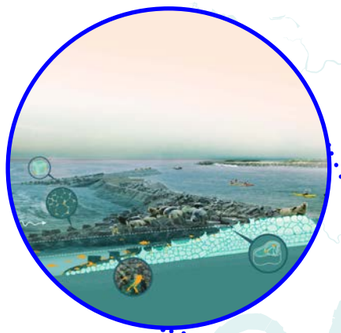
NYC COASTAL RESILIENCY PROJECTS

NEW MEADOWLANDS



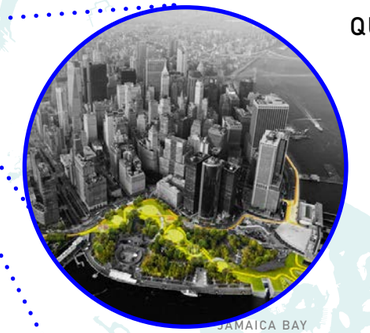
NEWARK

RESIST, DELAY, STORE, DISCHARGE



LIVING BREAKWATERS

BILLION OYSTER PROJECT
GOVERNORS ISLAND



LOWER MANHATTAN COASTAL RESILIENCY

HUNTS POINT LIFELINES

LIVING WITH THE BAY

HUDSON RIVER

EAST RIVER

LONG ISLAND SOUND

THE BRONX

MANHATTAN

QUEENS

LONG ISLAND

STATEN ISLAND

UPPER BAY

JAMAICA BAY

SANDY HOOK BAY

ATLANTIC OCEAN

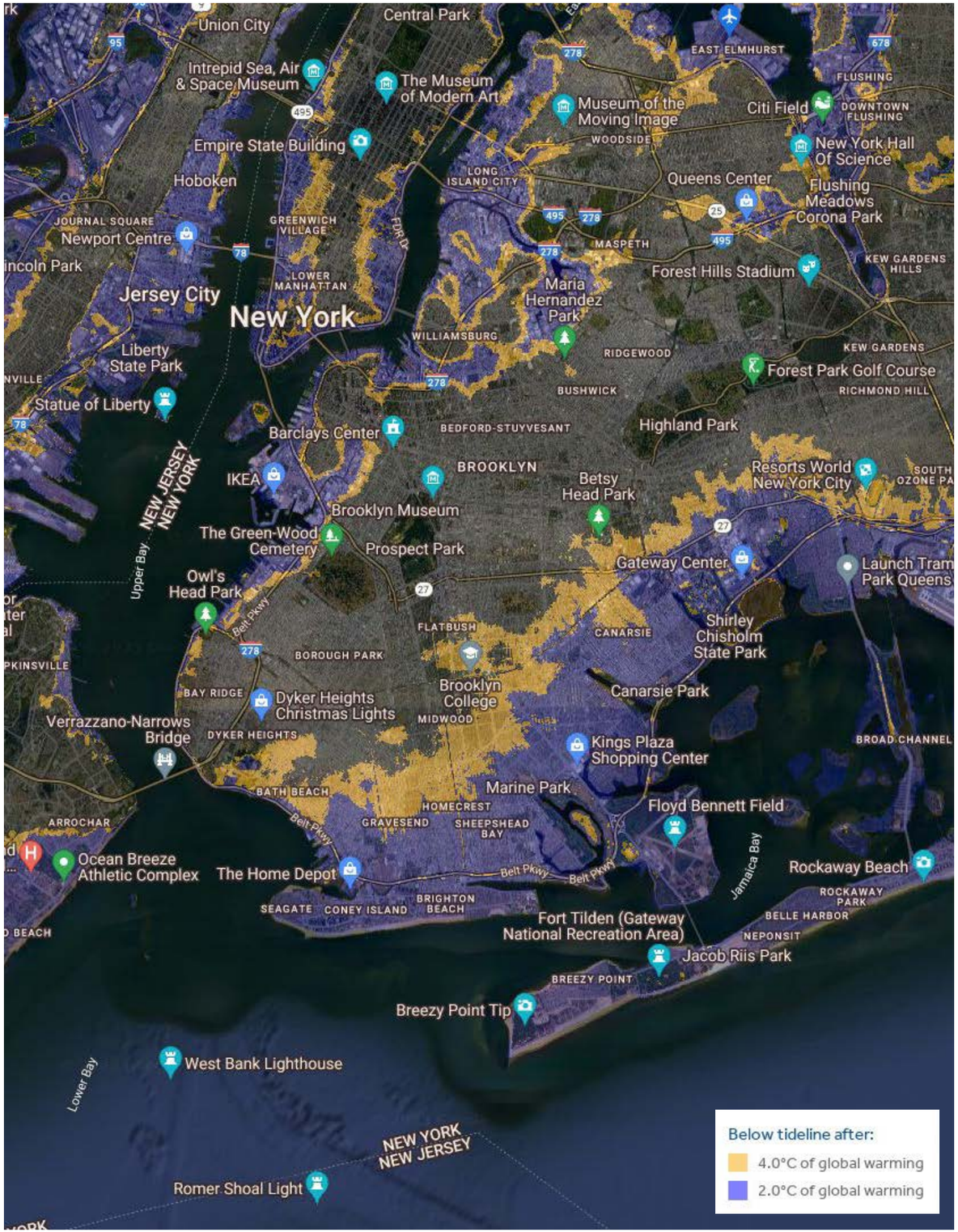
NYC FLOOD RISK & HURRICANE SANDY IMPACT

100 Years at 1%

500 Years at 0.2%

Hurricane Sandy


MAMARONECK
YONKERS
MOUNT VERNON
PATERSON
208
19
80
GSP
CLIFTON
PIP
BPP
HRP
95
87
21
3
BLOOMFIELD
ORANGE
NJTP
NEWARK
JERSEY CITY
FDR
495
678
295
CIP
GCP
278
78
95
BAYONNE
678
BP
VALLEY
440
NYC Recreational Areas
Public Access Areas
Waterfront Zoning Tax Lots
Lots with Future Access Areas


Union City
Central Park
Intrepid Sea, Air & Space Museum
The Museum of Modern Art
EAST ELMHURST
FLUSHING
Museum of the Moving Image
Citi Field
DOWNTOWN FLUSHING
WOODSIDE
Empire State Building
New York Hall Of Science
Hoboken
LONG ISLAND CITY
Queens Center
Flushing Meadows Corona Park
JOURNAL SQUARE
Newport Centre
GREENWICH VILLAGE
MASPETH
Forest Hills Stadium
KEW GARDENS HILLS
Jersey City
New York
LOWER MANHATTAN
Maria Hernandez Park
WILLIAMSBURG
Liberty State Park
RIDGEWOOD
KEW GARDENS
Forest Park Golf Course
Statue of Liberty
BUSHWICK
RICHMOND HILL
Barclays Center
BEDFORD-STUYVESANT
Highland Park
BROOKLYN
IKEA
Resorts World New York City
Betsy Head Park
NEW JERSEY
NEW YORK
Brooklyn Museum
The Green-Wood Cemetery
Prospect Park
Gateway Center
Launch Tram Park Queens
Upper Bay
Owl's Head Park
Belt Pkwy
FLATBUSH
CANARSIE
Shirley Chisholm State Park
BOROUGH PARK
Brooklyn College
Canarsie Park
BAY RIDGE
Dyker Heights Christmas Lights
Verrazzano-Narrows Bridge
DYKER HEIGHTS
MIDWOOD
Kings Plaza Shopping Center
BROAD CHANNEL
BATH BEACH
Marine Park
HOMECREST
Floyd Bennett Field
ARROCHAR
GRAVESEND
SHEEPSHEAD BAY
Ocean Breeze Athletic Complex
The Home Depot
Jamaica Bay
Rockaway Beach
ROCKAWAY PARK
SEAGATE
CONEY ISLAND
BRIGHTON BEACH
BELLE HARBOR
Fort Tilden (Gateway National Recreation Area)
NEPONSIT
Jacob Riis Park
BREEZY POINT
Breezy Point Tip
West Bank Lighthouse
Lower Bay
NEW YORK
NEW JERSEY
Romer Shoal Light
Below tideline after:
4.0°C of global warming
2.0°C of global warming

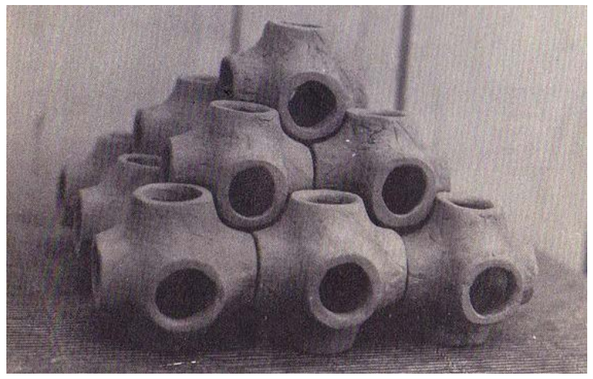
THE MODULAR OBJECT

Upon scrutinizing the BOP oyster modules, several discerning observations unfolded. Firstly, a compelling need emerged for the recycling of shells, redirecting them from a fate in landfills. Notably, the modules displayed a remarkable trait of stackability and replicability. Furthermore, in fostering optimal oyster growth, the orchestration of an ideal water flow to facilitate nutrient transport became paramount. In acknowledging these intricacies, it became apparent that there exists a compelling opportunity for intervention in this realm, with the potential to enhance the habitat for oysters and contribute to their sustainable flourishing.

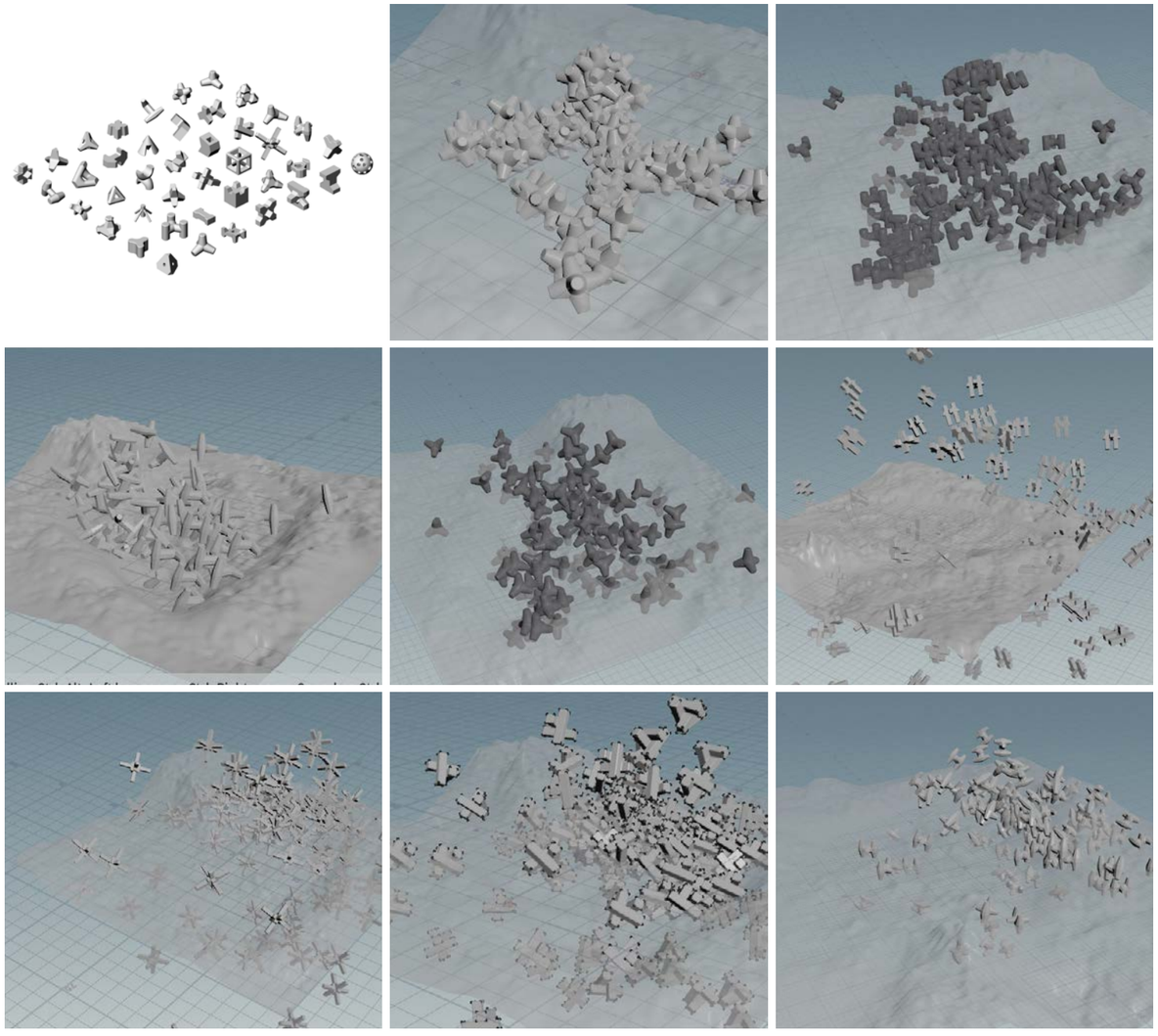
With this marine modularity, the unmissable example is the concrete breakwater form, such as the tetrapod form, showcasing their efficacy in providing coastal protection and dissipating wave forces through the simplicity of piling rather than intricate joinery or adhesives. The exploration expands into a myriad of forms and aggregation techniques, as evidenced by BOP's modules exclusively tailored for oysters and marine life.

Yet, the inquiry doesn't cease there; it contemplates the modules' potential to contribute to the human experience. The journey into module studies commences with a thorough examination of breakwater armor units, guided by the principle "If it ain't broke, don't fix it." Acknowledging the sophistication embedded in existing forms—crafted and calculated by engineers and scientists—the exploration extends digitally through Houdini simulations, unveiling the free aggregating behavior of these structures.

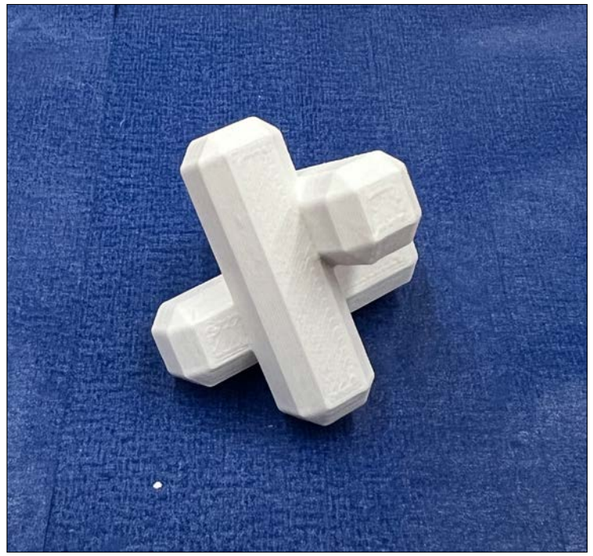
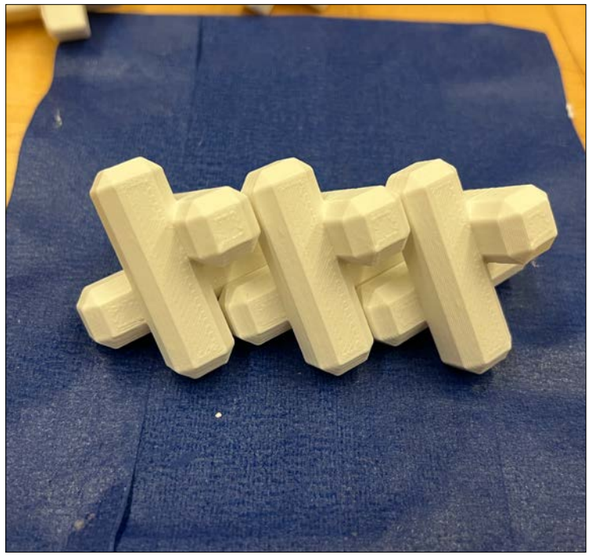
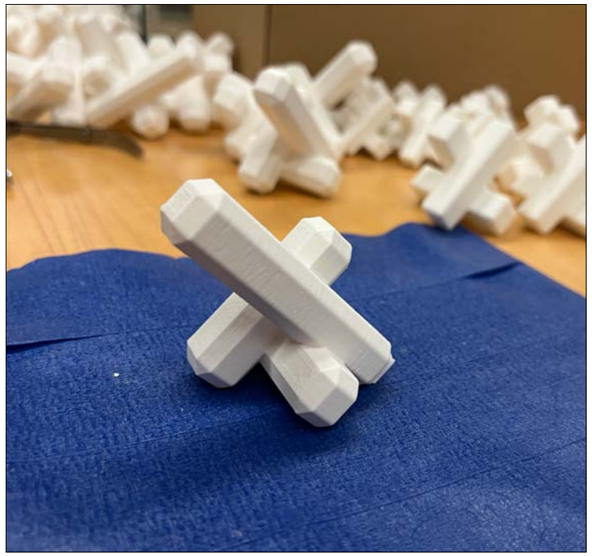
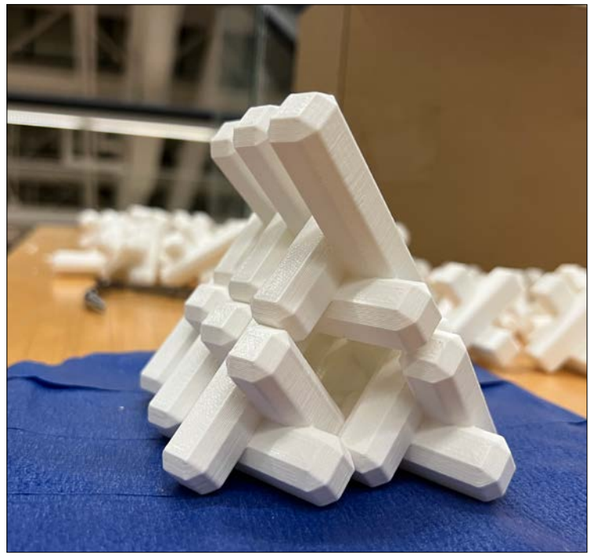
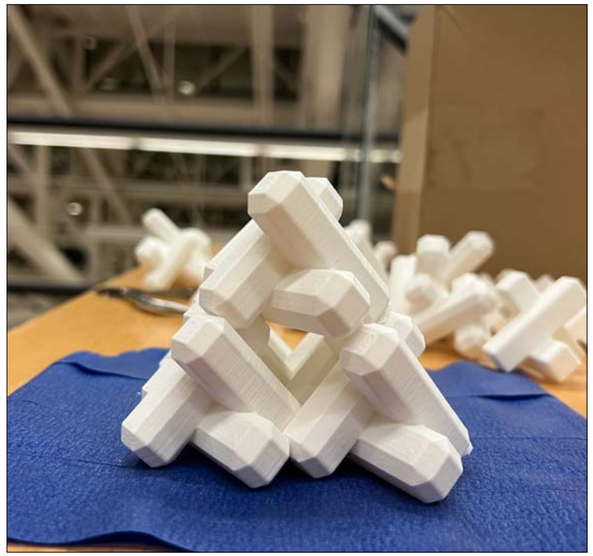
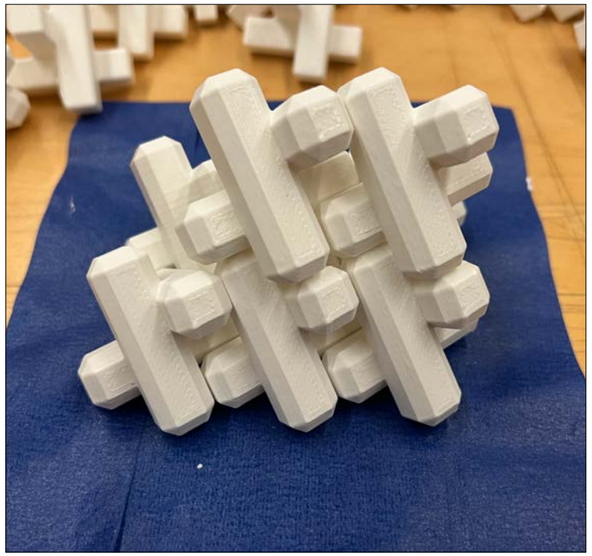
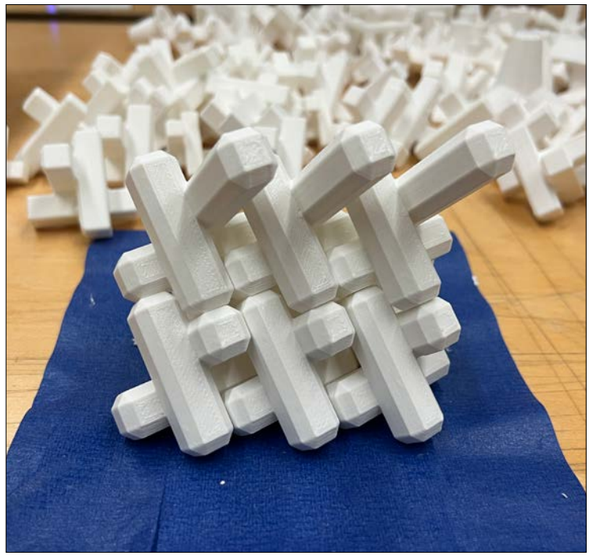
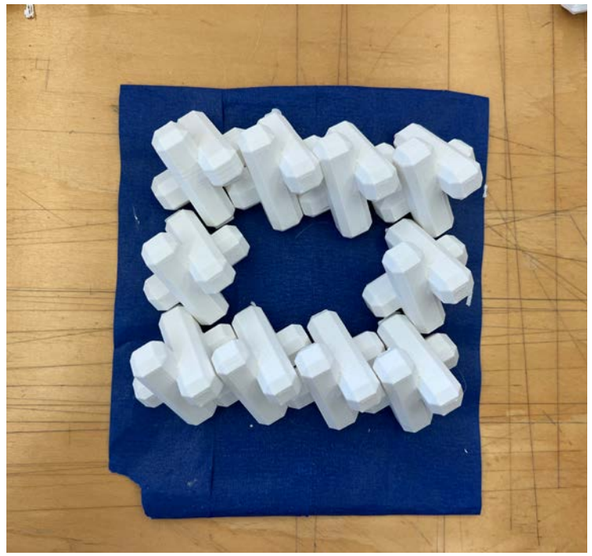
A proclivity emerges for forms exhibiting orderly stacking, reminiscent of the randomized piles observed in coastal deployments. The investigation extends to multi-module examples, involving the 3D printing and testing of diverse forms. The study encompasses a nuanced understanding of different modules and their aggregate behavior, not only exploring default methods of aggregation but also envisioning novel configurations that may emerge.



FORMAL EXPLORATIONS
DIGITAL & PHYSICAL



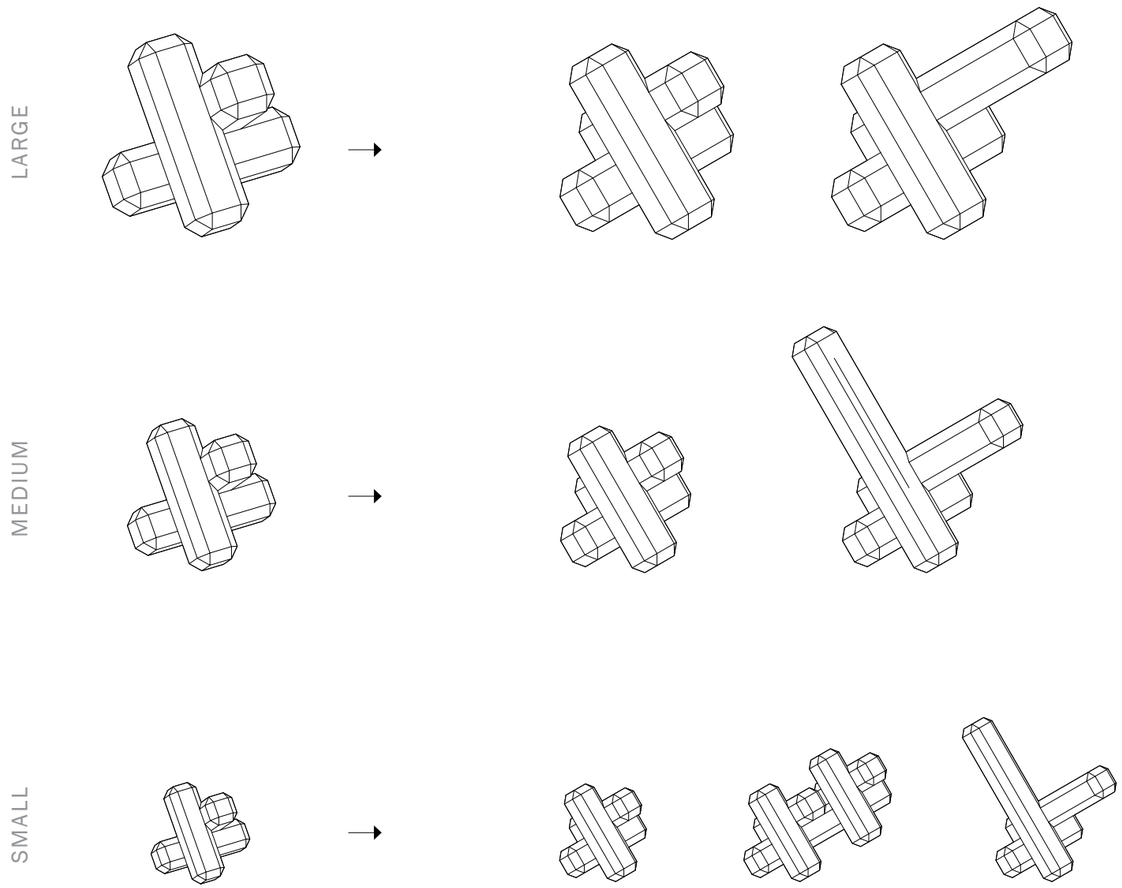
TRIPOLE FORM EXPLORATION

TRIPOLE FORM EXPLORATION

During the exploration of various concrete armor unit forms, I decided upon the tripole form, for its stackability and infinite variety of configuration potential. The tripole form, as identified through research, originated and was deployed in Japan. It exhibits an orderly stacking pattern, a feature deemed significant for designing intentional spaces for people and programming, even within a bottom-up approach. The contemplation of modifications to this form arises, including considerations of lengthening the arms or changing the scale, with a focus on understanding potential impacts on aggregation, spatial, or structural properties. Three aspects of the tripole are explored: scale, arm length, and orientation.

The design implementation involves three different scales of the module, with minimal manipulations within each size category, such as extending one arm length, two arm lengths, or combining two modules together. These modifications are justified in terms of practicality, aiming to avoid significant changes to the fabrication process and the need for highly specialized skills, labor, or equipment, such as large-scale 3D printing.



OYSTER CONCRETE MATERIAL STUDIES

Central to the process is the oyster concrete, serving as the elemental material for crafting the modules. Herein lies the seamless integration of the project with Billion Oyster Project's established procedures, encompassing the collection and purification of shells. The substrate, derived from these shells, forms the bedrock for nurturing burgeoning oyster populations.

The project explored various oyster aggregate sizes and mixtures to observe its properties.

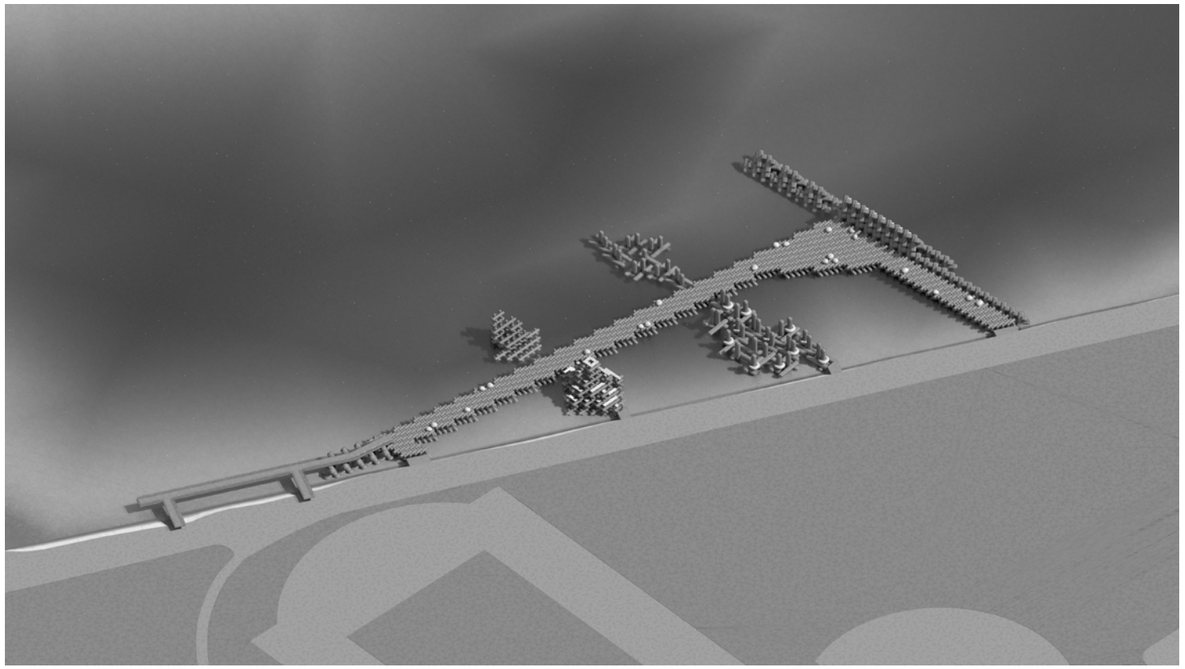
THE CLUSTERS

In crafting this project, the focus extended beyond individual modules as they were modified and aggregated into unique configurations—referred to as clusters. Each cluster presents a different experience that fits into BOP's educational curriculum as well as provide a recreational amenity for New York City.

The Jungle Gym cluster showcases modules with booleaned structures arranged in an orthogonal, gridded pattern. This design not only provides a lofty vantage point for river observation, ideal for birdwatching—a cherished community activity at Coney Island Creek—but also facilitates wildlife sketching, aligning with the educational curriculum for school field trips developed by the Billion Oyster Project (BOP). Beneath this structure, the growth of oysters adds an ecological dimension.

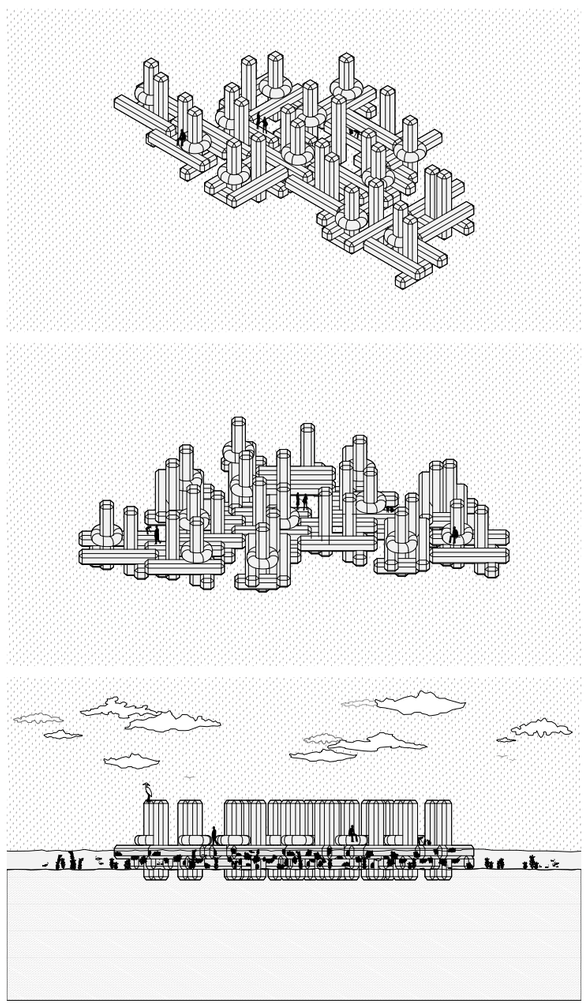
A contrasting cluster, the Tidal cluster, emerges from the pairing of two large modules, creating a tide pool-like environment that invites attention downward. Aligned with BOP's educational goals, this cluster facilitates the observation of marine life, measurement of oysters, and other essential data gathering activities. Similarly, an "animals only" cluster on the opposite side of the promenade remains inaccessible to humans due to its semi-submerged state, providing an exclusive habitat for aquatic life.

The third cluster, designed as a Gathering Space, offers a broader area suspended over the water—ideal for social gatherings, educational programs, or artistic events. This space, envisioned as a versatile platform, could host in-the-field lectures by BOP scientists, fundraising concerts, or other informal gatherings. Connecting all these clusters is the Promenade, which not only serves a circulatory function but is also envisioned as a leisurely space where people can linger along its edges—a nod to the atmospheric canalside gatherings seen in European locales like Canal Saint Martin in Paris. This multifaceted design reflects a harmonious blend of ecological awareness, community engagement, and aesthetic considerations.

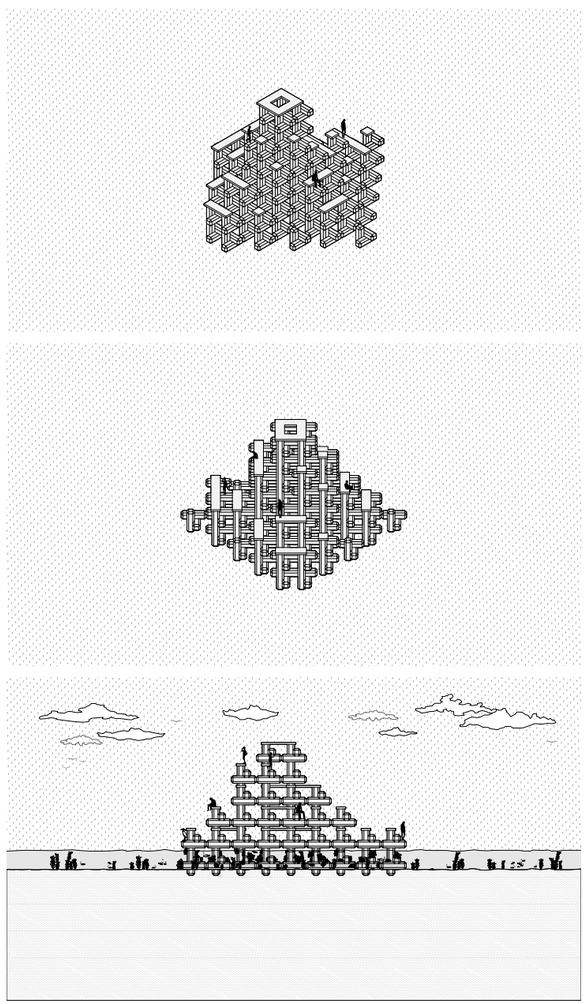


CLUSTER TYPES

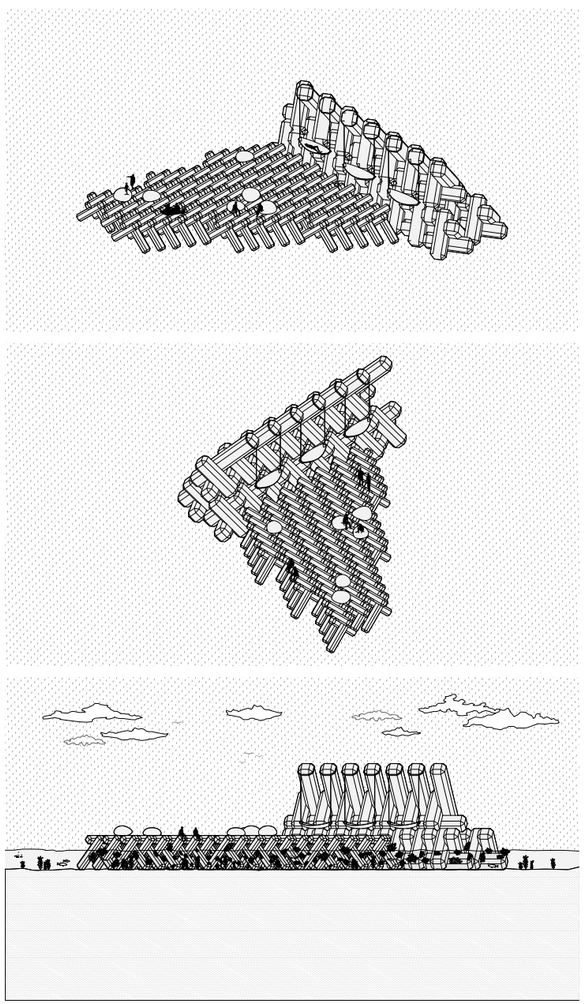
TIDAL CLUSTER



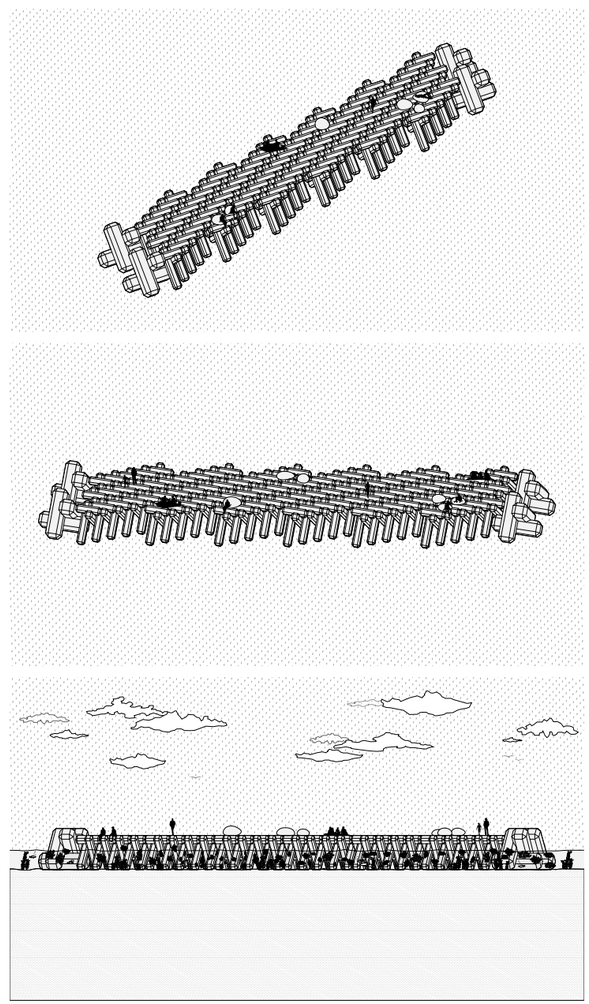
JUNGLE GYM CLUSTER

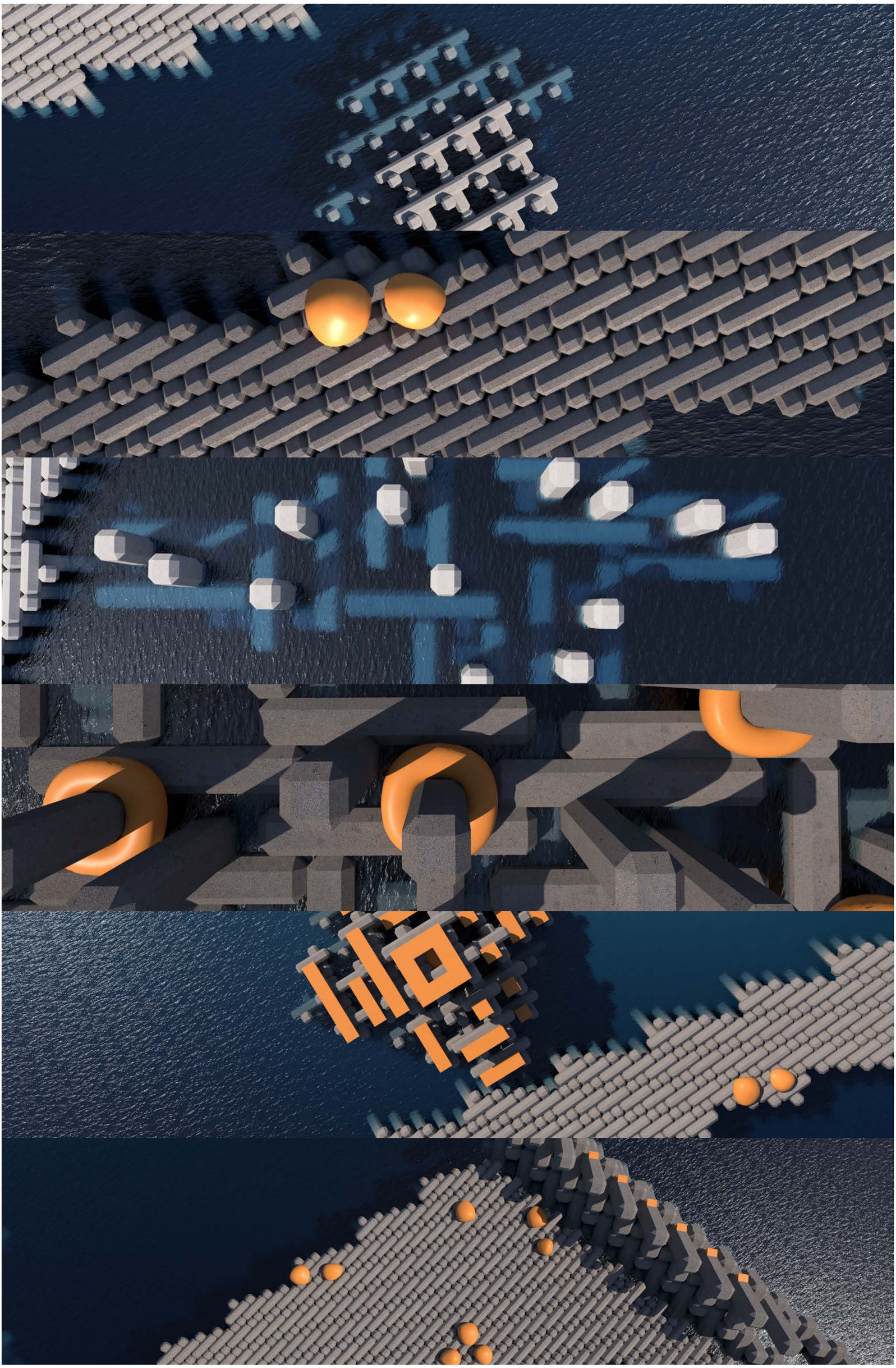


GATHERING SPACE



PROMENADE

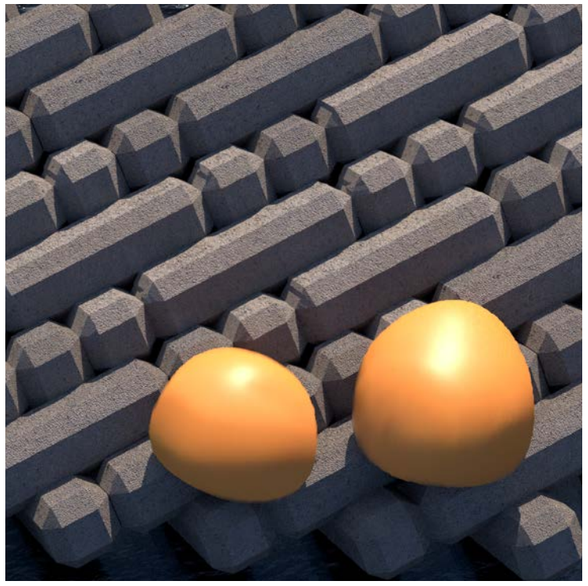


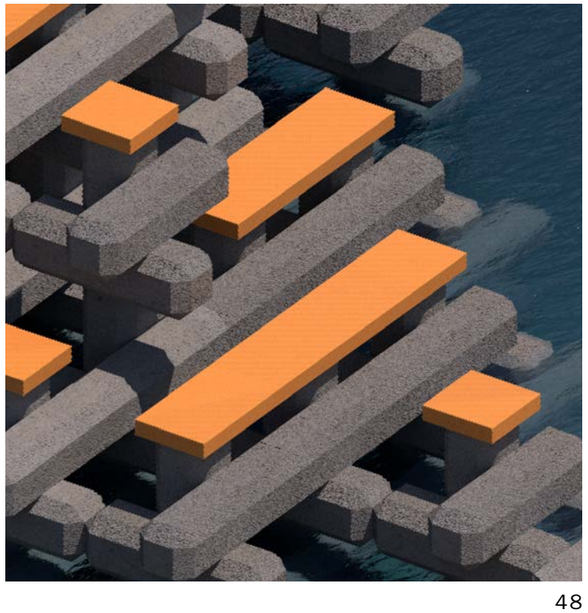


SOFT INTERVENTIONS

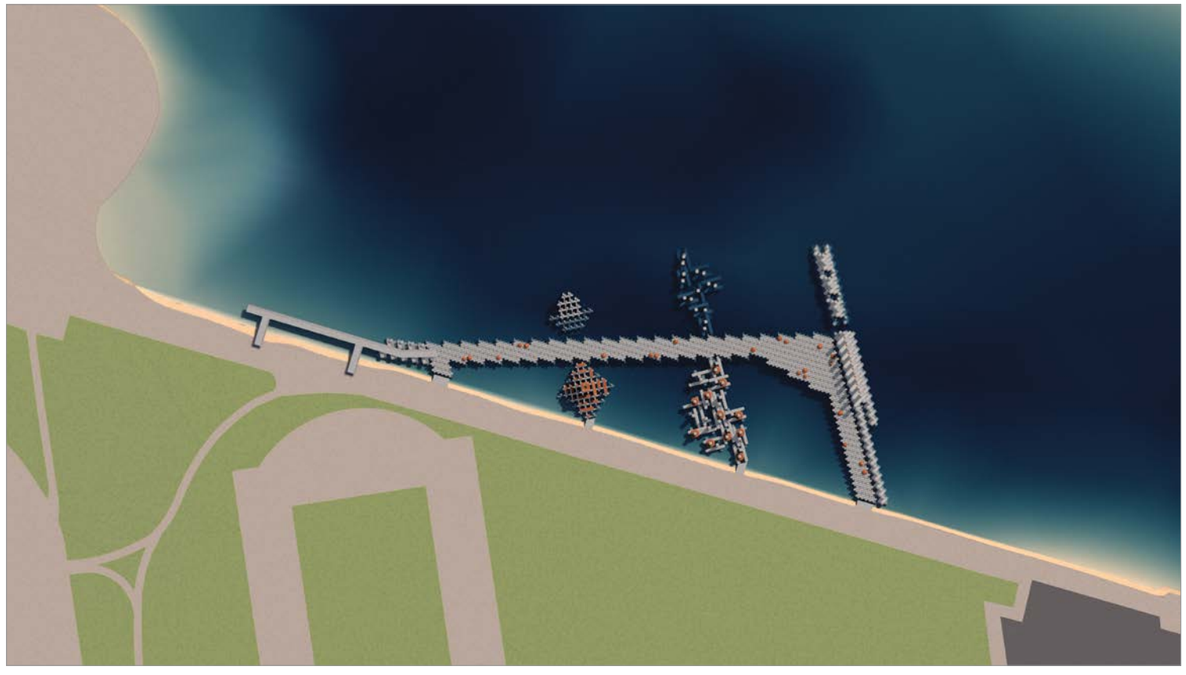
An unconventional “architecture” calls for an equally unconventional “furniture” or “accessories.” Responding to the challenge posed by urban spaces adorned with hostile architecture, designers have introduced interventions like benches that affix to Jersey Barriers or attachments transforming bollards into seating elements. Beyond mere functionality, these interventions aim to foster human interaction.

Through the incorporation of soft shapes, this unique “furniture” reinstates a human-centric scale and comfort, a departure from the rigid and almost brutal nature of the concrete clusters. Unlike oysters, humans exhibit a certain finickiness, and the designed furniture not only enhances comfort but also subtly guides occupants on how to engage with the space. In essence, this intervention represents a thoughtful layer added onto the initial intervention, creating a nuanced and humane approach to reshaping urban environments.

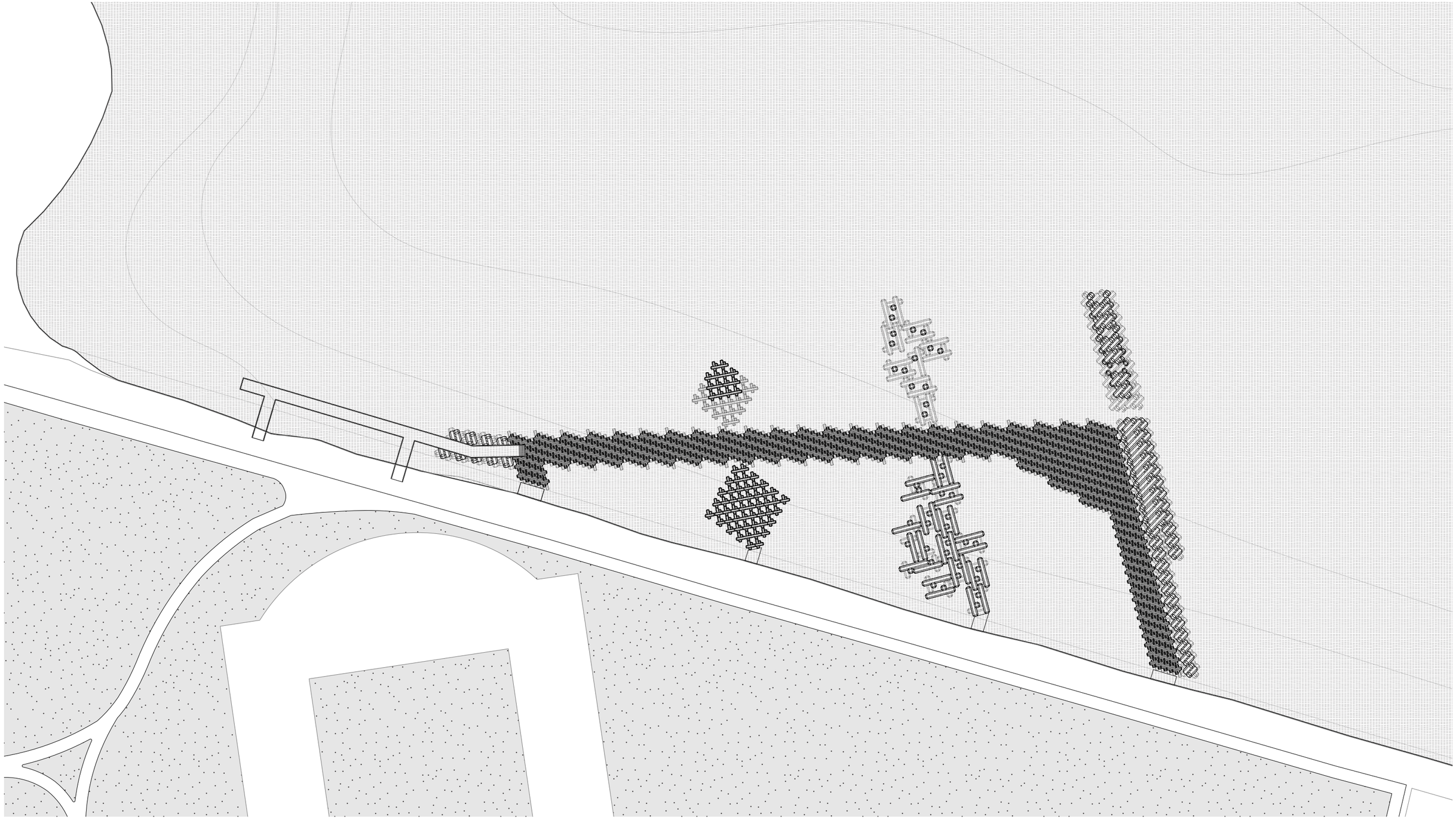


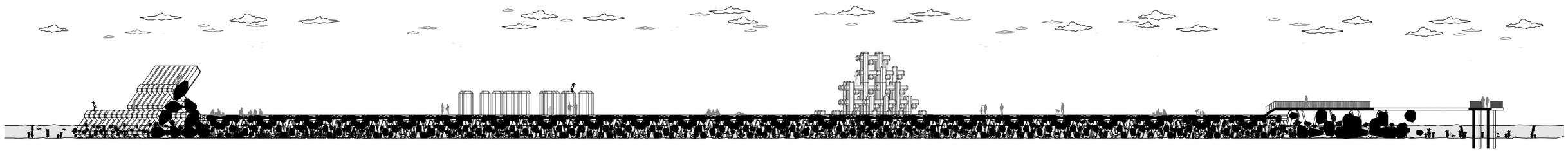


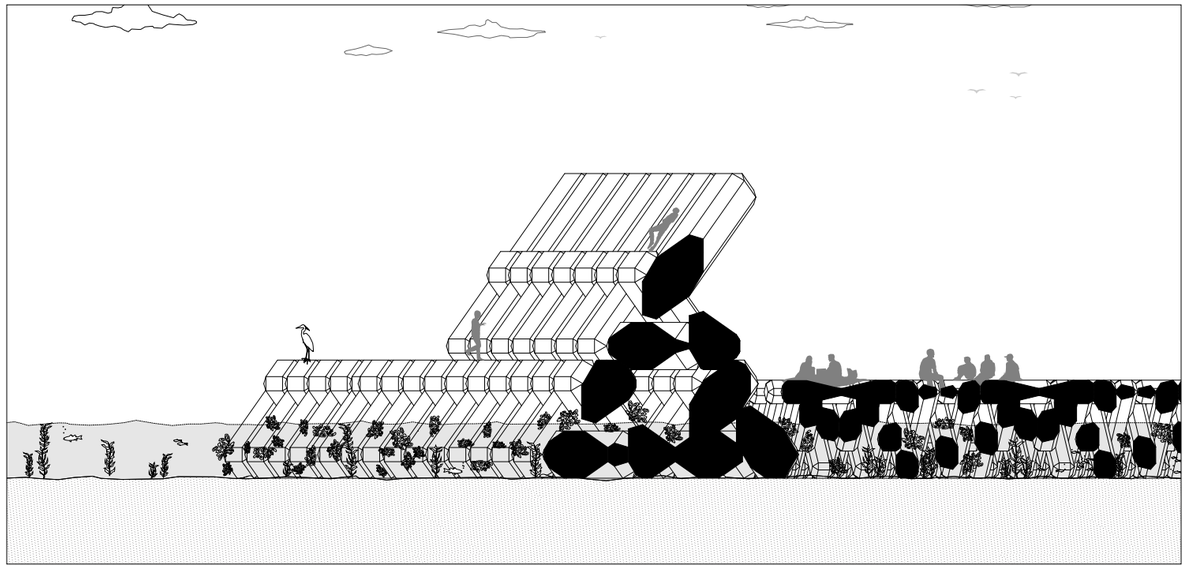
THE URBAN FORM

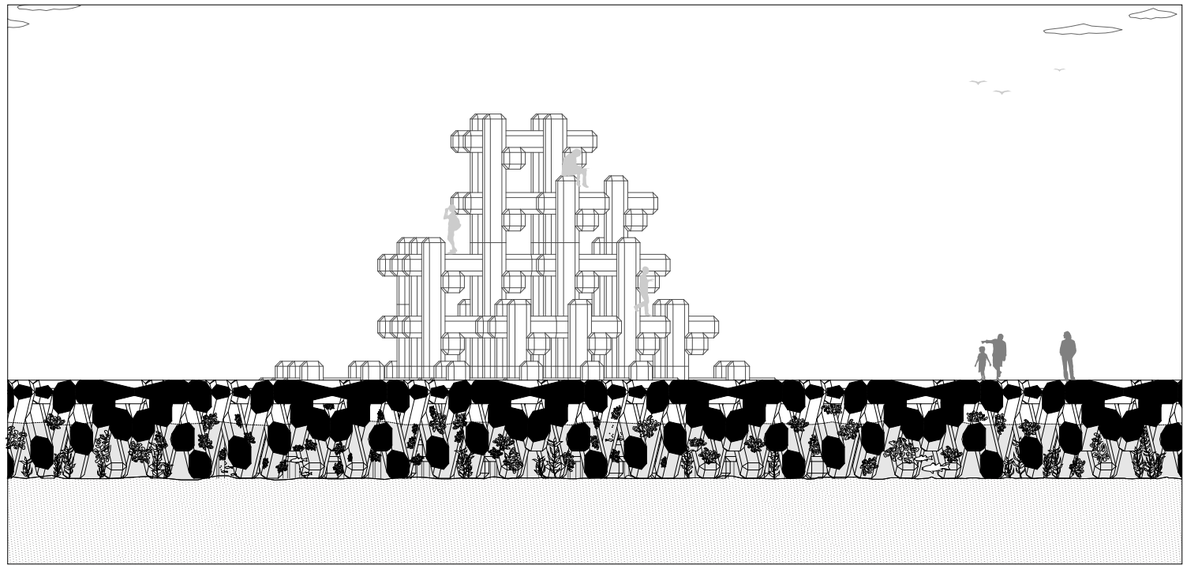


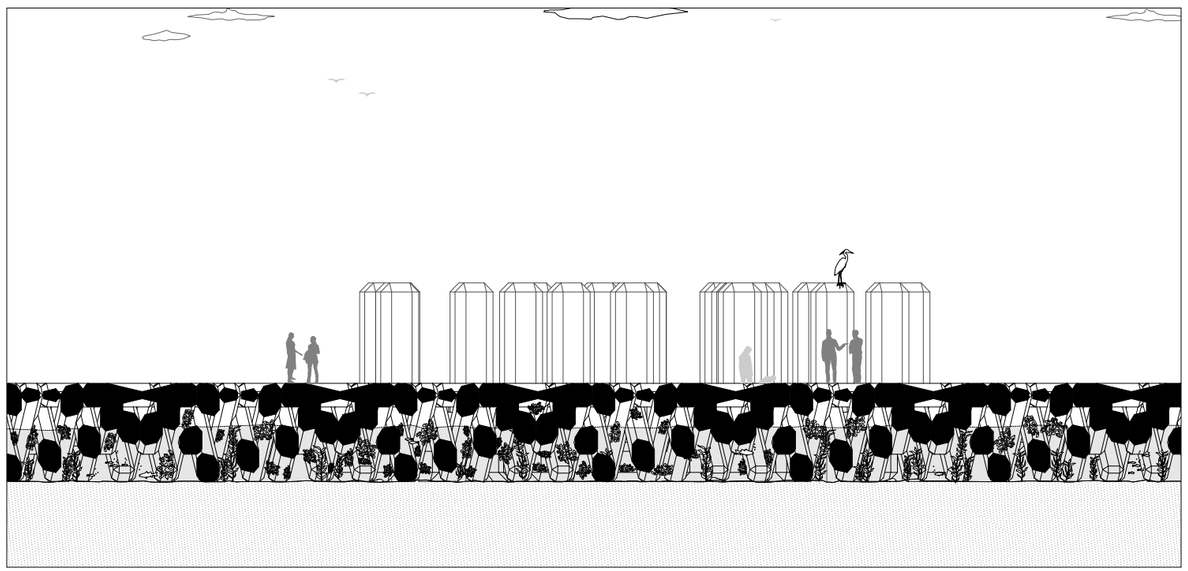
Positioned along the northern perimeter of Kaiser Park, the design intricately intertwines with the remnants of the forsaken ferry terminal project and seamlessly merges with the pre-existing dock structure. A deliberate alignment shapes the promenade, influenced by the module aggregation pattern, culminating in a triangular configuration. Serving as the central circulatory spine, the promenade not only enhances the design's connectivity but also acts as a demarcation between the clusters and the exclusive "animals only" cluster. This submerged portion, inaccessible to humans, provides a sanctuary solely for marine animals and birds, underscoring the project's ecological considerations.

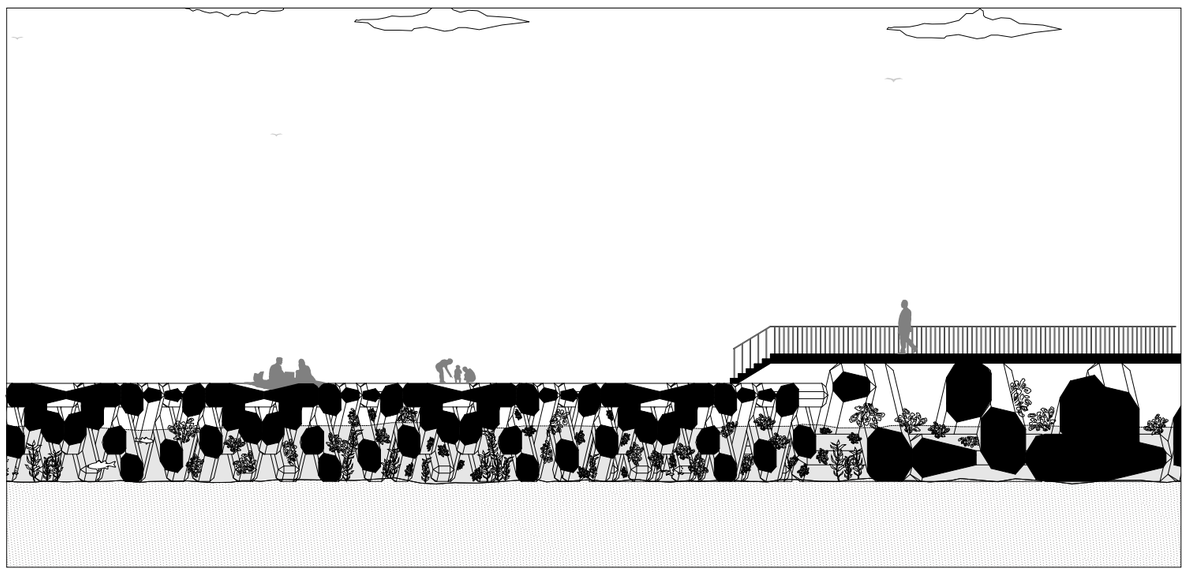


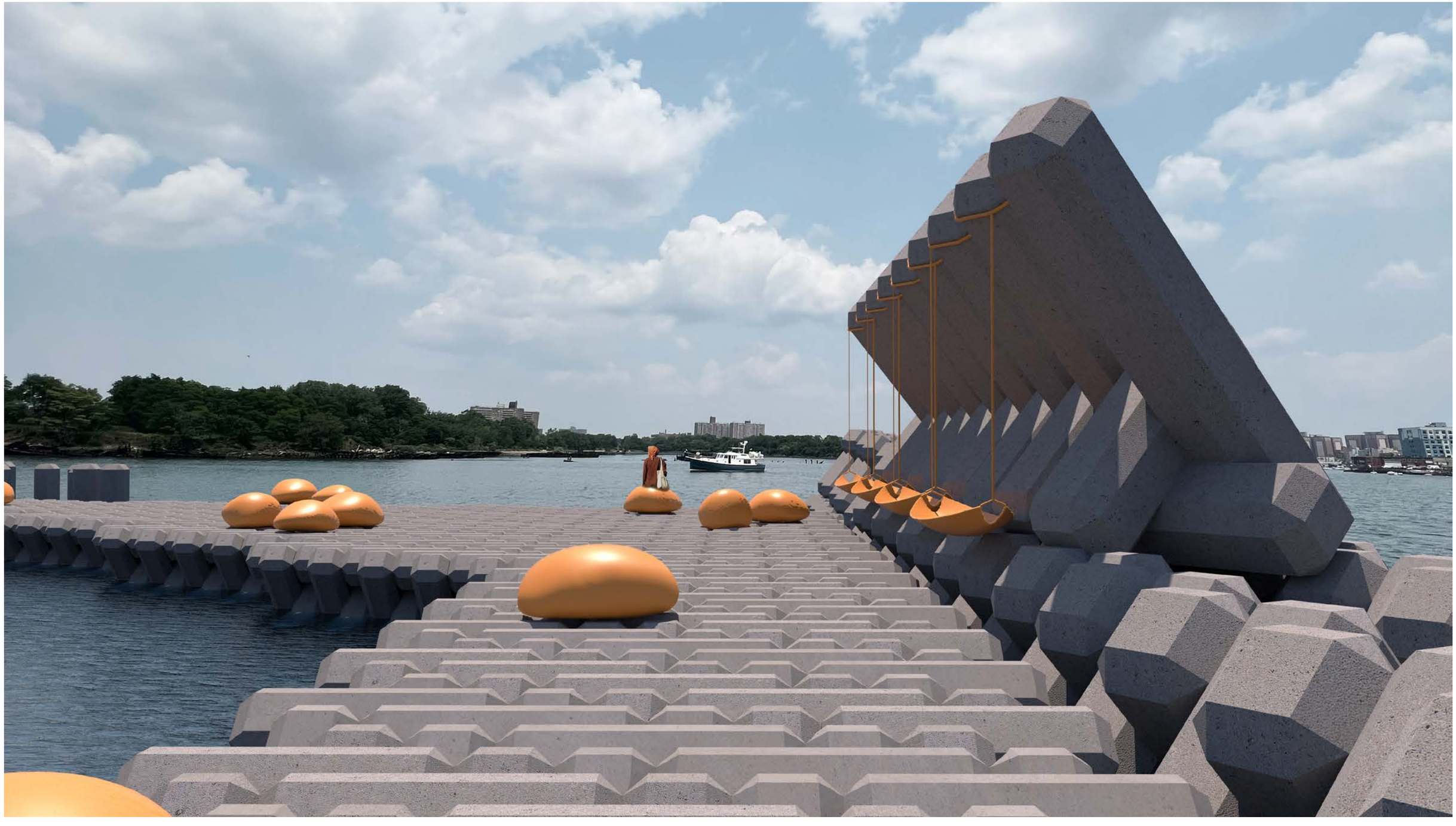


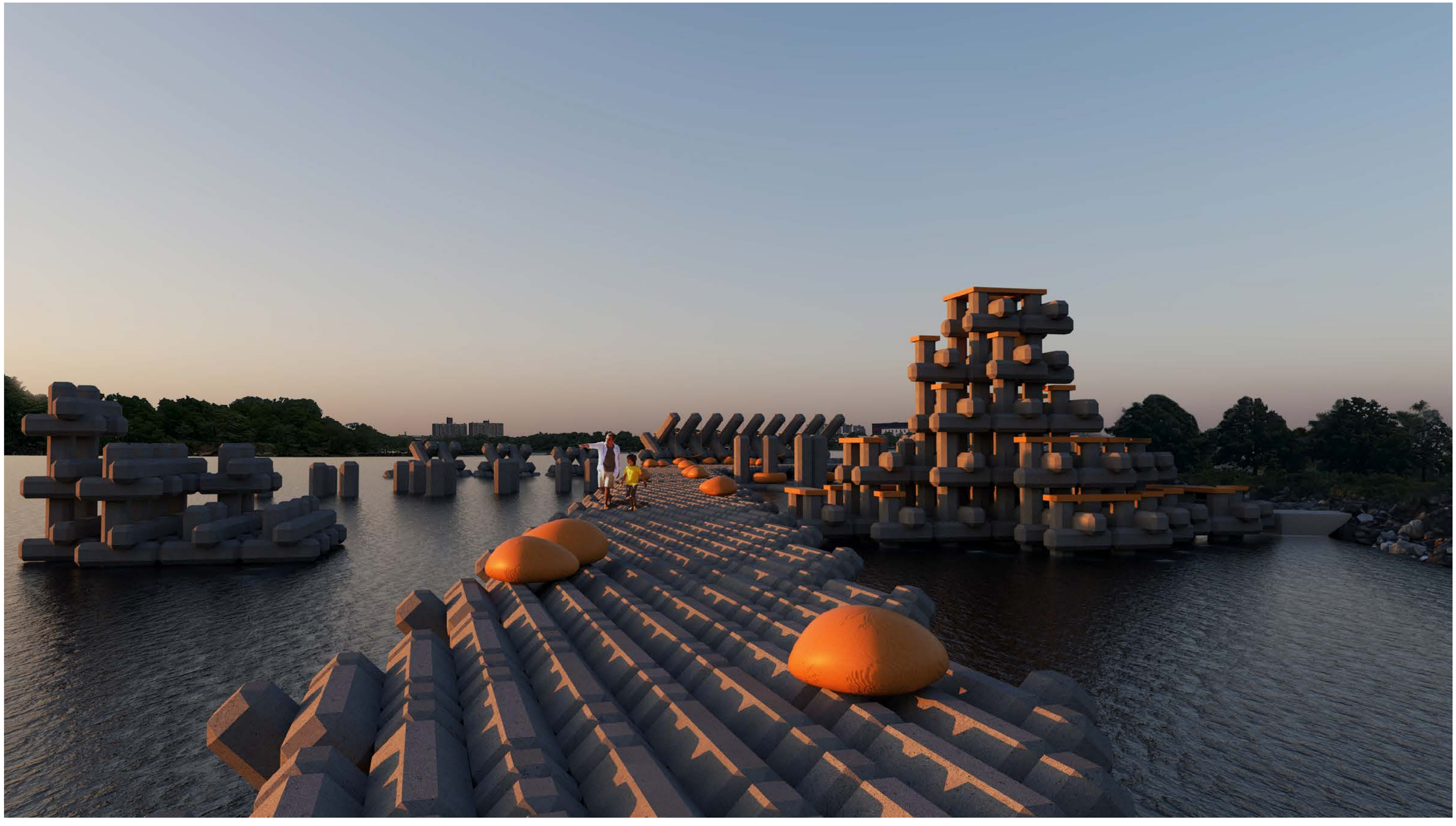


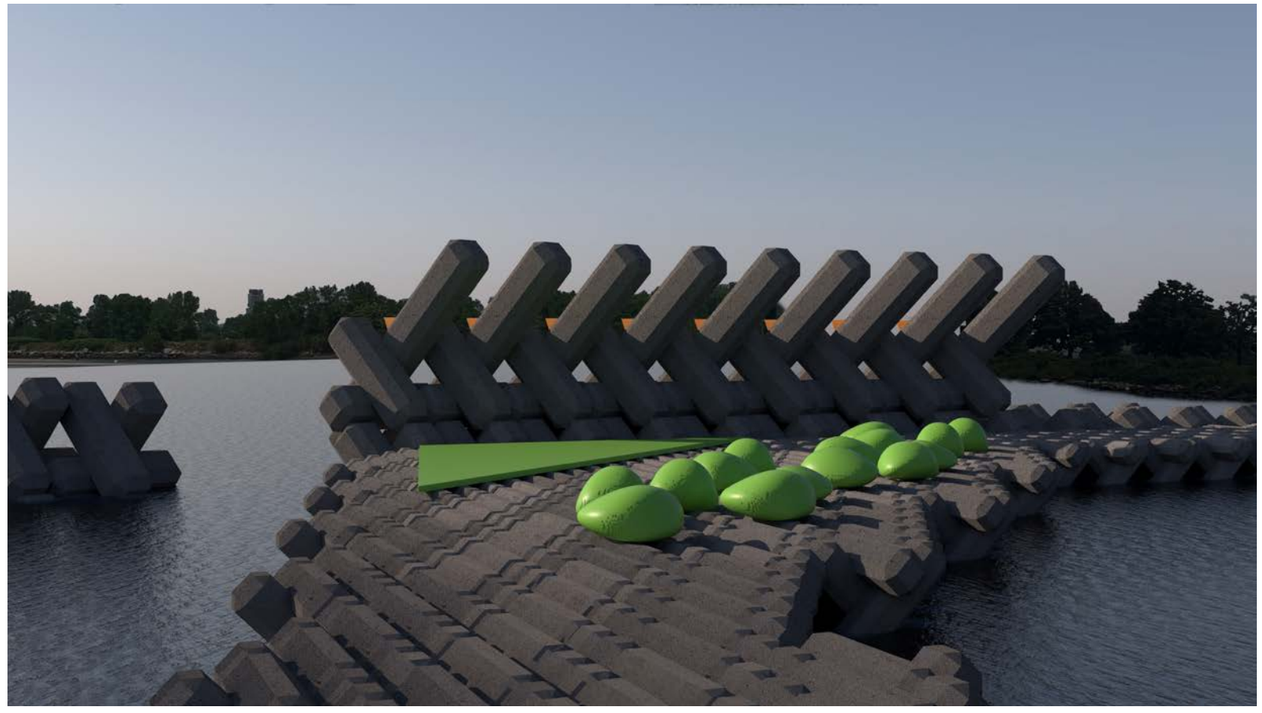


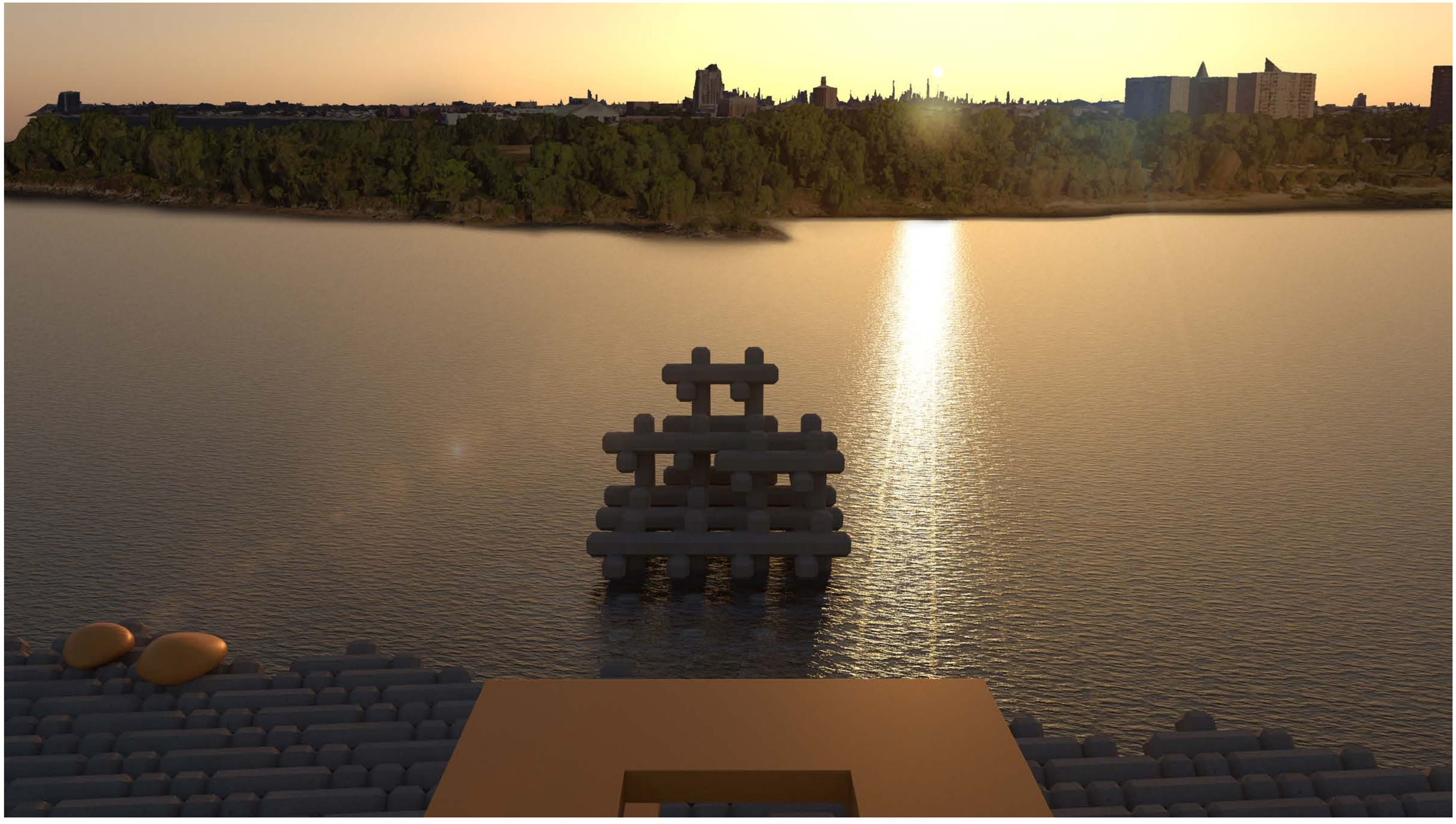












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