



Engineering With Nature[®]

AN ATLAS, VOLUME 2



Reefs

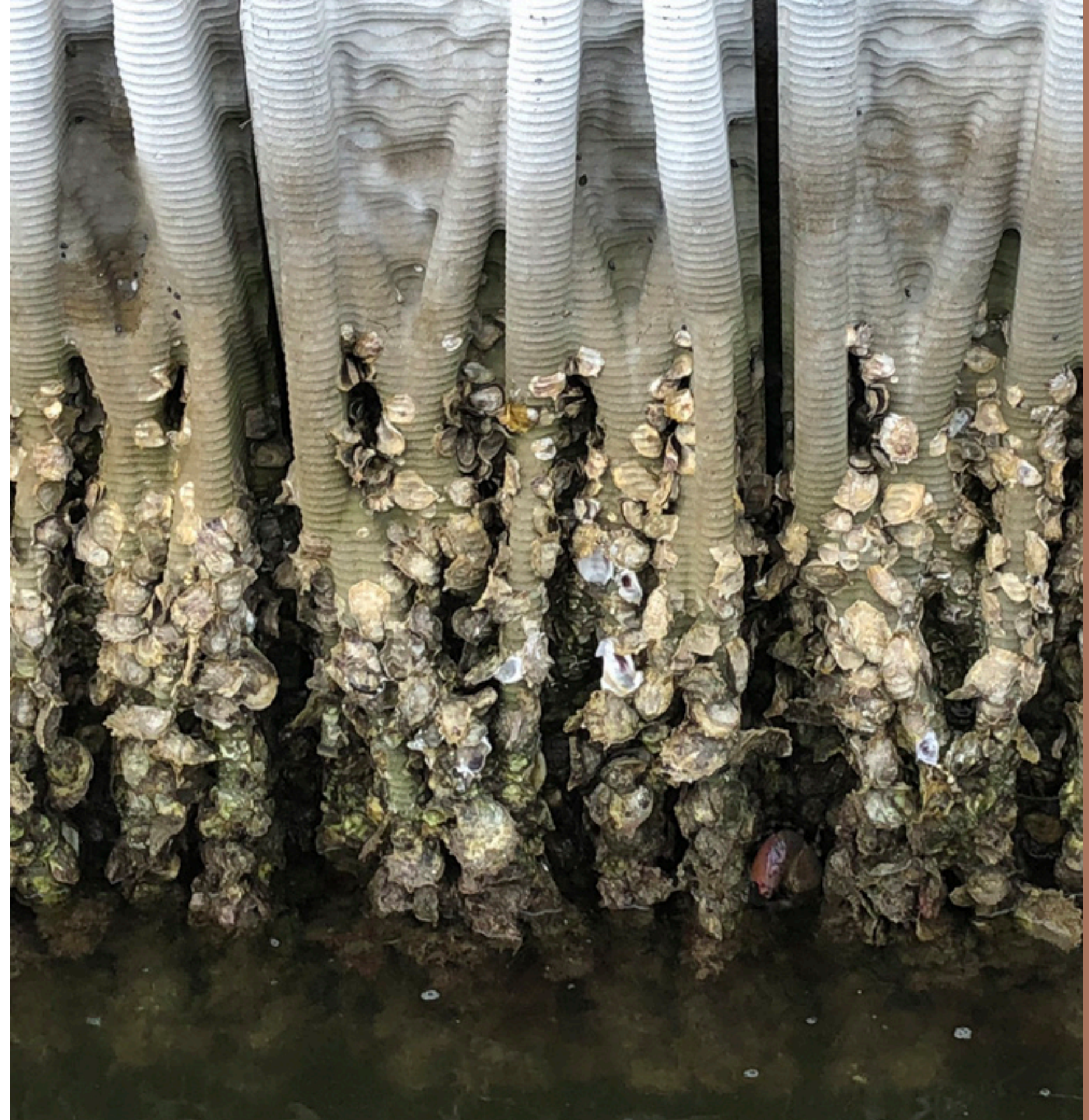
*STABILIZING SHORELINES
AND CREATING HABITAT*

Reef makers along the Cape Fear River (project details on page [INSERT--Brunswick Town Fort Anderson (BTFA)]).

Mangrove Reef Walls

*ENGLEWOOD AND FORT PIERCE,
FLORIDA, UNITED STATES*

Blending art and science to create a new type of seawall. Florida has more than 17,700 kilometers of waterways, much of which is lined with concrete seawalls installed in the mid-twentieth century and now undergoing replacement. Tidal ecosystems previously occupied these areas, rich in species that filtered water and formed nursery and hunting grounds for recreational and food-source species. Traditional seawalls have negatively affected these ecosystems. To counteract this, Mangrove Reef Walls are seawall-enhancing panels that create engineered-living tidal habitat along urbanized waterfronts, particularly in areas where conventional living shorelines are not feasible, such as in narrow canals or high energy zones. The panels, installed in two Florida locations—Englewood in 2016 and Fort Pierce in 2018—provide optimal conditions for a range of foundation species: oysters, tunicates, sponges, and other primary ecological producers that colonize the surface and enhance the constructed habitat. The reef walls provide a hierarchy of habitat niches to fill the void created by human development along these waterways. Although the panels will not recreate living mangrove trees, other foundation species perform many of the same services as mangrove shorelines and create habitat patches in developed areas that better connect the surrounding environment.





PRODUCING EFFICIENCIES

Mangrove Reef Wall panels ensure an ecologically responsive and viable approach to shoreline enhancement. No longer passive, the seawall articulates the exposed water side to improve the environment. The custom high-strength concrete is balanced with oyster flour, silica fume, and macrofiber reinforcement to attract oysters, resist saltwater deterioration, remove spalling risk, and double the material's lifespan. Restaurants' disposal of huge quantities of oyster shells creates a potential waste stream for producing these ecofriendly seawalls. Further, the design uses existing seawall production methods, creating a high-impact investment when replicating many panels.



USING NATURAL PROCESSES

Mangrove Reef Walls create a scaffold for nature, enhancing ecosystems alongside human development. The walls' ability to dissipate wave energy in the same way that mangroves do improves water clarity by reducing suspended sediment and increases the walls' longevity by preventing sediment erosion. Oysters form bonds across seawalls and, in some cases, strengthen the walls with nacre—a material that exceeds concrete in strength. The small eddies produced by the uneven surface of the walls help attract drifting colonizers, diversifying the ecosystem and attracting grazing species, which in turn attract larger predators.

Previous page: Viewed from the water, Mangrove Reef Walls create a hierarchy of habitat relief and aerate tidal waters via wave and flow action across the panels. (Photo by Keith Van de Riet)

Right: Precast wall panels, developed by Keith Van de Riet, founder of Mangrove Reef Walls and associate professor at University of Kansas Architecture, awaiting installation. (Photo by Jose Beltran)



BROADENING BENEFITS

The filtration capacity of tidal ecosystems directly affects water quality. Therefore, improving tidal environments can enhance Florida's multibillion dollar tourism industry. Increasing filter-feeder populations may also mitigate harmful algal blooms (red tides), one of the most serious environmental and economic threats to Florida communities. In addition to improving the quality of waterways' ecosystems, the presence of this visually appealing infrastructure further enhances public awareness of shoreline issues and possible integrated solutions. The project promotes stewardship from waterfront property owners to create healthier nearshore environments that can be enjoyed by all.



PROMOTING COLLABORATION

Many individuals and organizations supported the development and design of the Mangrove Reef Walls, including Jessene Aquino-Thomas of Florida Atlantic University and Turrell, Hall, and Associates. CTS Cement Products, the WannaB Inn, and the Ocean Research and Conservation Association, Inc. provided sponsorship. The interdisciplinary project team participates in many outreach events—critical for encouraging mainstream adoption of next-generation living shoreline technologies. Currently, a collaborative study with Florida state agencies is evaluating the design's potential positive impacts for the numerous canals and other waterways that cannot accommodate traditional living shorelines.

Top: Digital fabrication creates a complex surface for marine life to adhere to.

Middle: Oyster and other marine colonization of actual mangrove roots. (Photo by Keith Van de Riet)

Bottom: Flat seawall construction eliminates tidal habitat and enables invasive species to dominate waterways, challenges the Mangrove Reef Walls address. (Photo by Keith Van de Riet)

