CUP AWARDS JUDGING

Name of Project: Test-Case breakwater installations
Project Use: Water barrier
Project Location: Southern Chesapeake Bay, tributaries, Md.

Project Description
Owning a house by the beach is a dream come true – that is until it becomes the nightmare of shore erosion and a waterfront house suddenly sliding into the briny. As hurricane winds and rising tides pummel the land, coastal communities have begun to grapple with the inexorable problem of rapidly retreating shorelines.

View photos for this project in a new window

In many erosion scenarios, engineers have used seawalls and jetties, but these structures have become controversial. Seawalls buttress the shoreline behind a hard, unnatural barricade that can wreak havoc on coastal ecosystems – not to mention provide a poor perch for sunbathing. Jetties have been known to break tidal patterns, diverting sands along the up-drift face while starving the down-drift beach. Those municipalities faced with receding beaches have come to realize that the seaboard is a long, linked ecosystem. Changing natural tidal patterns and robbing one shore to feed the other does not solve the greater coastal erosion problem.

One expensive and temporary fix involves dredging sand from deep waters and pumping it up onto the beach. But a more permanent and cost-effective solution comes with a precast concrete product invented 40 years ago by the most unsuspecting type of inventor: a British grandmother. Now, after nearly 15 years of testing, it has found itself embedded along U.S. coastlines to prevent erosion, and helped restore seaside habitats and the pride of beachfront homeowners.

A WWII inspiration has its day
A few years after the final pitched battles of World War II, Silvia Gouldsborough walked along the English Channel, where the Royal Navy had once built a bulwark of scrap metal and concrete debris to impede a German landing. She noticed that directly behind the tangle of rusting steel and chunks of concrete, sands gathered and the beach grew wider. She wondered why, and the phenomenon intrigued her enough to ask her husband, a marine biologist, what was happening. He observed the mangled structure diverting sand and came to the same conclusion. Then they both wondered if a manufactured structure capable of mimicking this phenomenon had commercial draw. The couple was decades ahead of the environmental movement, and after designing a prototype, the product never entered the marketplace.

Fast forward 30 years. Having immigrated to America, the Gouldsboroughs now lived in Maryland near the Chesapeake Bay. Once again, walking along the beach, observing the steady scouring of tides gnawing away at the beautiful coastline, Silvia rethought her erosion-stopping idea. This time she was determined to follow through with production and started to inquire among concrete manufacturers to see if any would consider her husband's invention. A recommendation led her to a local precaster specializing in development and licensure of precast concrete products. "She had some crude drawings," said the precaster, "and her husband had built a model using three 2-foot-tall concrete triangles bolted together with a steel rod. The idea intrigued me."

The genesis of beach prisms
The idea was simple: A series of prism-shaped concrete blocks spaced about 6 inches apart, sitting parallel to the shore in shallow water and acting as a wave barrier. The intermittent gaps would allow free tidal flows, but as fast-moving water hit the barrier and the barrier absorbed its energy, sand particles suspended in the turbulence would drop and accumulate along the base of the prism-like structure – at least that's how it would work in theory. The precaster said he agreed to manufacture a more refined version of the prototype and test it in a coastal environment.

Despite the initial excitement, the product had to prove itself over time. Representatives from a local engineering company were present at one the first installations at the Terrapin Nature Center on the eastern shore of the Chesapeake Bay. Workers placed a row of prisms about 50 feet off shore using a small crane. Surveyors from the firm recorded a detailed topography of the area as a benchmark to serve in a future evaluation of the product's success or failure. In June 2004, Lane completed a 15-year follow up. Despite the ravages of Hurricane Isabel in 2003 along the East Coast, the prisms had survived virtually intact and 7,465 tons of new sand was replenished along the shore. "That's 117,410 square feet of new sand," said the precaster.

M. Stephen Ailstock, Ph.D., chairman of the Biology Department and director of the Environmental Center at Anne Arundel Community College, Arnold, Md., recently published an article about the prisms that were placed in a highly sensitive ecological wetland. It was a shallow wildlife spawning ground separated from the Magothy River by a narrow sand spit. It had eroded so badly that the spit was in danger of disappearing thus endangering the sensitive ecological wetland and a boat anchorage area.

"It took workers about a half hour to install the prisms off a barge outfitted with a crane," Ailstock said. "The installation had practically no impact on the sensitive landward environment." Other traditional erosion control systems tend to be hard on the environment. Two years later, Ailstock led a reporter to view the results of the installation. "Behind the precast concrete there were so many minnows and grass shrimp that the reporter must have suspected I put them there," said Ailstock, who views precast concrete shoreline erosion control systems as possibly the best method to curtail the loss of wetlands.

Erosion has already robbed the United States of more than 100 million acres of life-sustaining shallows. He also sees precast concrete structures as an ideal means of repairing levee breaches quickly. "Just drop them in place with a helicopter and you have an instant levee plug – much more efficient than the rocks and sand bags used currently," Ailstock said.

Building better breakwaters
Because they are designed for both fresh and saltwater applications, the prisms are cast from high-quality, sulphate-resistant concrete suitable for prolonged exposure in marine environments. The concrete has a 5,000 psi compressive strength. Individual castings are reinforced with corrosion-resistant, epoxy-coated reinforcing steel. The geometric slots cast into the modules were designed using wind tunnel data to assure maximum wave energy reduction. The pyramid shape ensures a wide base and an aerodynamic surface that minimizes the tidal drag that often displaces parapet-style structures.

The system works best in river, lake and bay environments with moderate to high tidal swells. Thus far, beach prisms have not worked well on open oceanfront.
The precaster said that while the prism is designed to slow or prevent erosion, rebuilding the beach is a promising attribute, but not guaranteed.

"It all depends on how much sand is suspended in the water," the precaster said. "Without raw materials, you can't build anything, let alone a shoreline. The benefits of a precast concrete breakwater come with ease of installation and its off-shore location. Property owners then don't have to sacrifice sandy beachfront to stone, walls or jetties."

Although the triangular shape gives the prism a lower profile than concrete walls and stone jetties, a ribbon of gray sitting off the coastline isn't preferred by most beachfront dwellers. Accumulating sands eventually bury most of the precast modules, but still, enough stick up above the water to indicate an artificial structure. The precaster is considering using colored concrete to camouflage the product, or even a fertilizer added to the mix to stimulate the growth of marine algae. "The specially designed slots already provide protection to young sea life and turtles from predators," the precaster said. "And promoting vegetation growth on the modules could create a precast concrete reef structure that not only looks natural but has real ecological benefits. Another possibility would be covering the beach prisms with oyster shells (with industrial adhesives) to allow oyster larvae to attach and produce artificial oyster reefs in the Chesapeake Bay."

Peyton Bradley owns Tidewater Landscapes in Trappe, Md., specializing in marsh reconstruction, stone revetment and offshore breakwaters. Although Bradley hasn't installed any beach prisms yet, he sees great promise in the precast concrete product.
"Because they don't stop the wave energy but just slow it down, I think they're going to last a lot longer than a solid breakwater," Bradley said.

Bradley estimates installations will go 60 percent faster than conventional erosion-stopping products.

"When erecting with stone, some of the underwater structure gets washed away even as we build, but with the precast concrete product, it just goes in place and you get exactly what you paid for," Bradley said. Currently, Bradley is bidding three of the trademarked Beach Prisms projects and expects to start using the product by the end of the year.

When ecology and economy combine with speedy installation, look forward to precast concrete becoming a common erosion-stopping feature that will protect some of America's best beaches.