MACCAFERRI

CASE HISTORY

Ref: CH/INT/US/CP004 - Rev: 01, Nov16

BREAKWATERS AT CITY OF FT. PIERCE MARINA

FORT PIERCE, FL, USA

COASTAL PROTECTION

Product: MacTube®, MacBag®, Maccaferri Polymeric Marine Mattress (MPMM)

Problem

The Ft. Pierce City Marina is located on the Indian River Lagoon, a long and wide estuarine water body separated from the Atlantic Ocean by barrier islands on Florida's southeast coast. In 2004, Hurricane Frances made a slow 34 hour approach toward the marina as a Category 2 hurricane. Out of 269 slips, the hurricane totally destroyed the 138 slip floating dock portion of the outer marina and incurred additional damage to the inner marina basin slips. The hurricane caused approximately $14.9 million in damages to the boats and $13 million in damages to the marina facilities.

Damage caused by Hurricane Frances

Solution

The City of Ft. Pierce recognized that simply replacing the marina facility 'in-kind' was not the solution for long term protection from potential future storms. The proposed solution was to create a permanent wave barrier configured as a carefully sculpted, but naturally appearing, artificial island breakwater to protect the marina from a 100-year storm event, as mandated by FEMA regulations. The project consisted of constructing a 12 island breakwater and one peninsular structure storm protection system to harbor the marina and adjacent public waterfront areas, while providing storm protection, habitat creation, and water quality enhancement (grand total of 14.66 acres). Along with providing storm damage protection of the marina, upland infrastructure, and surrounding downtown waterfront area, the islands also provide significant environmental enhancements that include mangrove planting (1.54 acres), oyster recruitment (1.28 acres), shorebird habitat and natural limestone artificial reef areas. The State of Florida has recognized this project as a pilot study for its environmentally friendly and sustainable elements, potentially setting the bar for future storm damage protection projects as an alternative to typical shoreline hardening solutions.

Islands under construction

Together with the City of Ft. Pierce and the coastal consulting firm, Tetra Tech, Inc., Maccaferri assisted in developing the MacTube® dimensional tube geometry, and fabric type. The MacTube® OS500 material was selected based on its strength properties. MacTube® OS500 is composed of high-tenacity polypropylene yarns, which are woven into a network in such a manner that the yarns retain their relative position to each other. The MacTube® OS500 material is inert to biological degradation and resistant to the most naturally encountered chemicals, alkalis, and acids.

Maccaferri Polymeric Marine Mattress installation

Client:

CITY OF FT. PIERCE, FL

Main contractor:

CASHMAN/LUCAS MARINE

Designer:

TETRA TECH

Products used:

MACTUBE®, MACBAG®, MPMMI*

Date of construction

FEB 2012 - MAY 2013

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Technical Characteristics

The storm protection breakwater system is anchored by a 10.5 acre peninsular island, known as Tern Island, which shelters the marina from large open water fetch and harsh wave climates to the south and southeast. This island is comprised of;

a. T–groin stabilized, crenulated beaches on the windward side of the island
b. A coastal sand dune in the island center, and
c. A bench for oyster recruitment and mangrove planting along the leeward side.

The project foundation consists of nearly 10,700 LFt (3,300m) of geotextile containment structures, including MacTubes® and small MacBags®. These structures were used in conjunction with 250,000 SF (23,000m^2) of Maccaferri Polymeric Marine Mattresses to establish the perimeter of Tern Island and provide a foundation and structural core for the groins.

Approximately 35,000 tons of limestone armoring units were used to provide structural integrity to the breakwater system while providing ecological enhancements.

In order to achieve the specified island design elevations, four tube configurations were used. Single tubes were used in shallow water locations in the central portion of the island while two tier configurations were utilized in the deeper portions of the island. One configuration consists of a single 45' (13.7m) circumference bottom tube and a top layer of sand bags which was utilized along portions of the perimeter for oyster bench/dike creation. Another two tier configuration was utilized in deeper water consisting of two base tubes and a single top tier tube. A pyramidal stack of 30' (9.1m) circumference tubes was utilized for the structural core of groin #1, while a pyramid stack of 45' (13.7m) circumference base tubes was utilized along the leeward side of the island in order to maximize the oyster bench area.

Maccaferri Polymeric Marine Mattresses were installed in conjunction with the geotextile tubes and served as a critical component to their successful installation and structural protection of the island.

Aerial view


Maccaferri Polymeric Marine Mattress installation


MacTube® installation

** = Not all products are available in all Maccaferri subsidiaries around the world. Please contact your local Maccaferri technical office for support to identify the optimum solution on your project.*

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CASE HISTORY

Ref: CH/INT/US/CP005 - Rev:01, Nov16

DEER ISLAND AQUATIC ECOSYSTEM RESTORATION

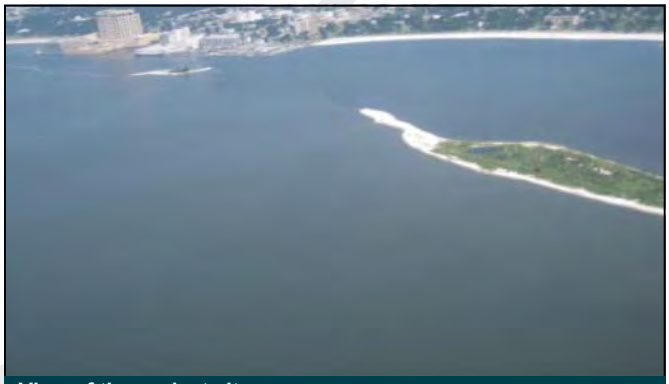
DEER ISLAND, MS, USA

COASTAL PROTECTION

Product: MacTube®, MacScour

Problem

Deer Island is located in the Mississippi Sound near the mouth of Biloxi Bay and the City of Biloxi, MS. It is a spindle-shaped, 4.5 mile-long island that is not a true barrier island but is a remnant of the mainland. It has long provided a diverse habitat eco-system and provided the City of Biloxi with long-term coastal erosion protection by reducing the energy of wind and waves moving on-shore. Hurricanes Camille (1969), Ivan (2004), Dennis (2005), Katrina (2005), Gustav (2008), and Ike (2008) are noted to have had significant adverse impacts to Deer Island's structural integrity and ecological diversity. In the past 25 years, the strong storms have significantly eroded beaches, breached an entire section of the island, reduced island elevations and severely damaged the forested areas.



View of the project site

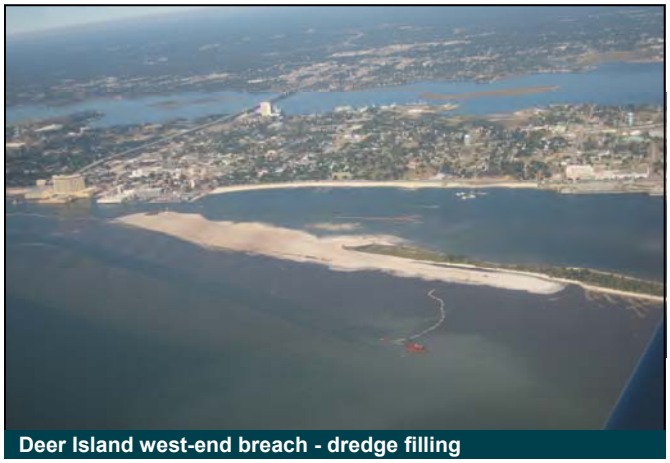
Solution

The first step of the solution was using MacTubes® to close the West End Breach. This breach had not only occurred and widened over time due to prior storm events, it had also significantly deepened as a result of scour. To fill the 4,300ft (1,310m) west end breach and restore the southern shoreline, a total of 1.95 million CUY (1.5M m^3) of sand was needed. The sand was locally sourced and hydraulically dredged from a nearby borrow site.

Instead of stabilizing the west end breach with an emergent rip-rap dike, MacTubes® were placed in the breach template below surface level and utilized a robust, strategic native planting effort involving over 300,000 plants.

This design enabled the project to minimize the overall boundary footprint, as well as maintain natural shoreline egress and ingress activities for faunal species and recreators. This effort also reduced the need for (and associated cost of) rock resources and the construction and maintenance of over-dike access points.

MacScour & MacTube® placement adjacent to filled MacTube®



Deer Island west-end breach - dredge filling

Client:

US ARMY CORPS OF ENGINEERS

Main contractor:

MIKE HOOKS INCORPORATED

Designer:

USACE, MOBILE DISTRICT

Products used:

MACTUBE®, MACSCOUR*

Date of construction

August 2010

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At the conclusion of the project, 40 tubes, equal to 10,000 linear feet (3,000m) of MacTube® OS500 with 30ft (9.1m) circumference and 280,800ft^2 (26,000m^2) of MacScour OS150 with integral double anchor tubes, were used.

MacTube®/MacScour Installation procedure:

- Sand dredged and placed
- MacTube® alignment excavated
- MacScour placed and anchor tubes filled
- MacTube® placed and filled
- MacTube® covered to surface level

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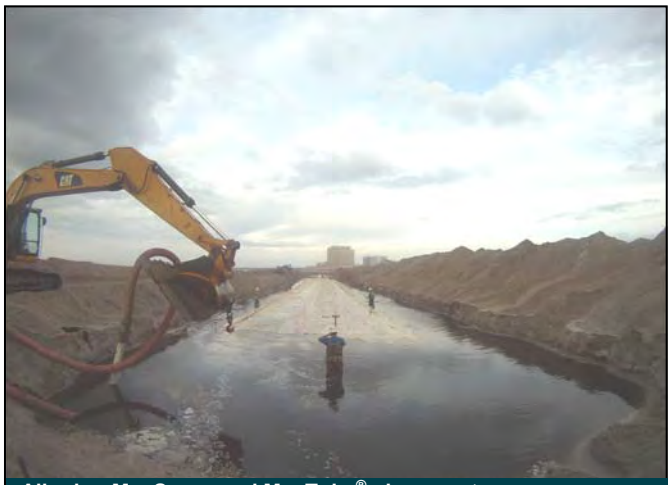
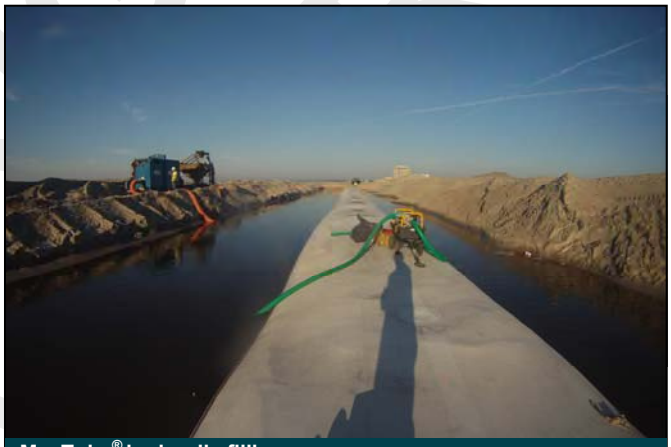


Aligning MacScour and MacTube® placement

Deer Island west-end branch



MacTube® hydraulic filling

Final beach fill coverage over MacTube® / MacScour, to surface level

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CASE HISTORY

Ref: CH/INT/IN/CP006 - Rev:01, July16

SILTATION REDUCTION WORKS PETRONET LNG

KOCHI, INDIA

COASTAL PROTECTION

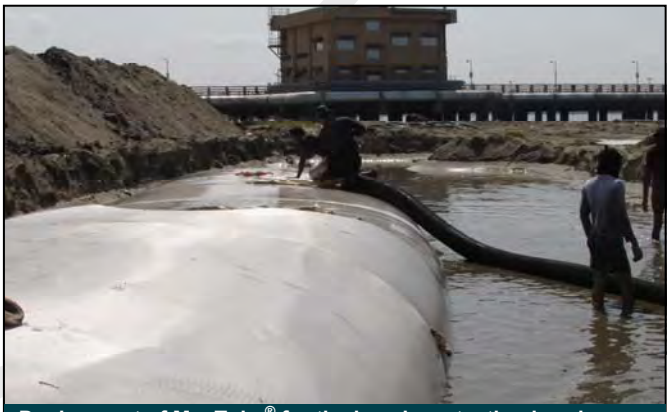
Product: MacTube®, MacBag®

Problem

The Petronet LNG Ltd. Terminal at Puthuvypeen, Kochi, has a capacity of 5MT p/a to meet the great demand for natural gas power, fertilizers, petrochemicals and various other industries in the southern states of India. The LNG terminal is in an estuary where the Periyar River flows into the sea.

Repetitive dredging has been required to maintain access to the import/export trestle due to the ongoing accumulation of large amounts of silt. This maintenance commitment was starting to restrict the use of the trestle. A solution was required which:

- Protected the beach from erosion
- Reduced siltation at the LNG trestle
- Reduced siltation in the LNG Basin



Deployment of MacTube® for the beach protection bund

Solution

Beach erosion was progressively removing the toe of the beach and a bund was proposed to protect it. MacTubes® were installed along the beach toe to replace the eroded volume, and also to provide erosion protection for the future. The tubes were filled with pumped slurried sand; the water component drains through the walls of the tube leaving the sand contained within the MacTube®. The beach could then be replenished behind this new protection system.

To address the siltation at the LNG trestle, a MacTube® groyne was installed approximately perpendicular to the shoreline This interrupted the movement of silt towards the trestle, encouraging depostion away from the trestle.

To provide a long term solution for reducing siltation in the LNG basin, Maccaferri MacTubes® and MacBags® were used to extend the existing rubble mound breakwater towards the sea by approximately 500m. The breakwater was installed in a water depth of 1m near to the shore and 3.5m depth at its seaward end.

The protection bund and onshore groyne were straightfoward to install due to their location. However, the breakwater structure is in the wave breaking zone, complicating the installation. An experienced team of four divers worked at the change of the tides to install the geotextile tubes with the aid of a hydraulic pumping systems. This limited the time available for construction.

For the offshore structures, the MacTubes® were floated into position using a pontoon and then filled insitu with pumped slurried sands.

Protection bund nearing completion awaiting backfilling

After construction of 500 m long protection bund structure

Groyne after construction

Client:

PETRONET LNG LTD

Main contractor:

MACCAFERRI ENVIRONMENTAL SOLUTIONS PVT

Products used:

MACTUBE®, MACBAG®

Date of construction

JANUARY 2015

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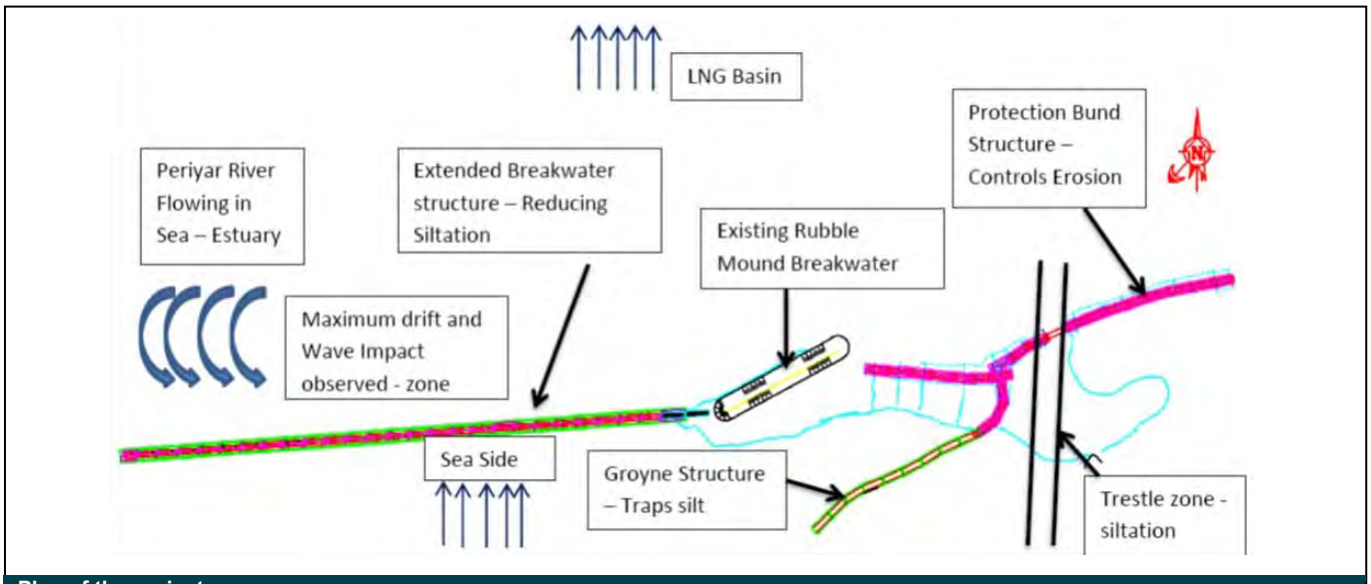
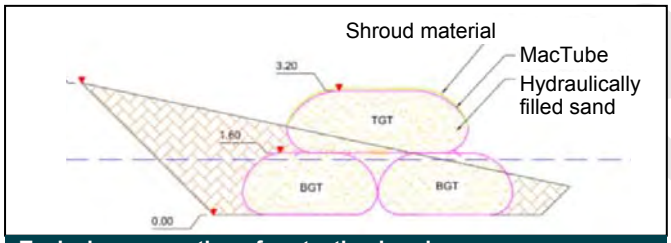
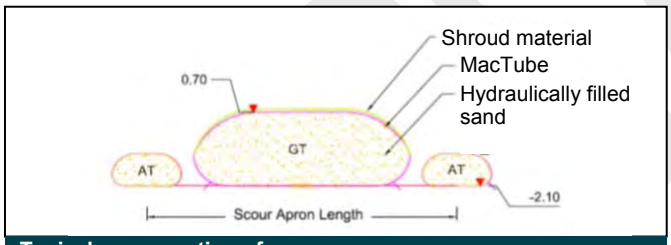


Plan of the project

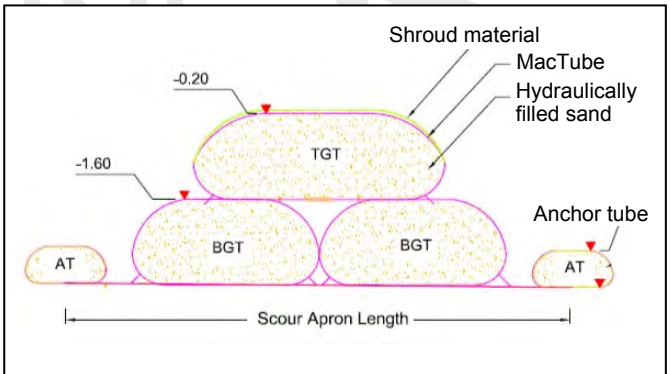


Typical cross section of protection bund

Transfer of tubes into the sea using pontoons



Typical cross section of groyne



Typical cross section of breakwater

During construction of breakwater

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