

September 15, 2003

Mr. Ray Newby
Texas General Land Office
Resource Management, Room 620
1700 N. Congress
Austin, TX 78701

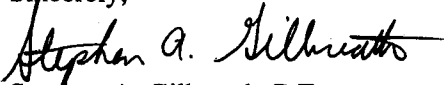
**RE: Texas General Land Office – Coastal Engineering Standards Compliance Review
Geotube Technology Product Review**

Dear Mr. Newby:

Lockwood, Andrews & Newnam, Inc. (LAN) has completed the evaluation for the Texas General Land Office of the ProTecTube II developed by Advanced Coastal Technology, Inc. as a potential product for use in coastal projects along the Texas Coast. Our review focused primarily on the technical applicability of the ProTechTube II as a tool for coastal stabilization projects. Additionally, LAN also reviewed the State of Texas's policy on allowing for the installation of "sand filled geotextiles" along the shoreline. In addition to our report, we have also included copies of the reference material provided by ACT to assist the review.

If you have any questions or comments please feel free to contact me at (713) 821-0420.

Sincerely,

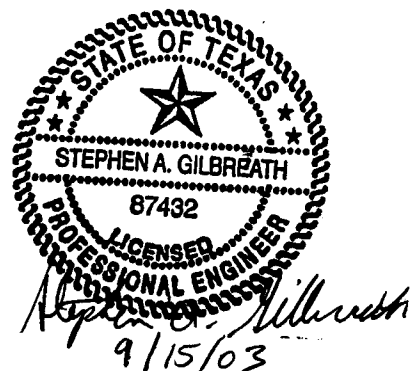

Stephen A. Gilbreath, P.E.
Project Manager

Attachments

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GENERAL LAND OFFICE



ProTecTube II

Product Review for Texas General Land Office

Scope

Lockwood, Andrews & Newnam, Inc. (LAN) was tasked by the Texas General Land Office (TGLO) to evaluate the ProTecTube II as a potential product for use in coastal projects along the Texas Coast. Our review focused primarily on the technical applicability of the ProTecTube II as a tool for coastal stabilization projects. In addition, LAN also reviewed the State of Texas's policy on allowing for the installation of "sand filled geotextiles" along the shoreline. This information was compiled from the following sources:

- Presentation of the ProTecTube II by Advanced Coastal Technology, Inc. (ACT)
- Manufacturer information including case studies, technical reports, reference letters, and product samples
- Direct discussions between LAN and other coastal engineers and owners familiar with the product, including references provided by ACT
- Review of the CEPR and Coastal Coordination Council policies on the use of geotextile structures for coastal protection

ProTecTube II Description and Performance

ACT made a presentation to LAN on August 13th and 14th to specifically discuss the ProTecTube II. Jay Sample, President of ACT, presented a case history of sand filled containers and described the evolution and development of the ProTecTube II. Mr. Sample provided technical information on the product and discussed the performance of the ProTecTube II, which has been installed primarily in Florida and along the East Coast.

The ProTecTube II is a sand filled container installed at the toe of the dune and designed to form a wedge-shape, achieving typical slopes ranging between 1:3 to 1:4 (V:H). The ProTecTube II serves as toe protection for a dune system and promotes wave energy dissipation along the surface of the tube rather than reflecting waves seaward. Reducing the reflection of waves minimizes scour potential seaward of the devices, which is critical to the sustainability of a geotextile structural solution.

When installed, the ProTecTube II achieves a maximum slope height of approximately 54 inches and a horizontal width of approximately 13 to 18 feet. The ProTecTube II is designed for installation above the mean high water line at the seaward toe of the dune, which differs from the placement of traditional geotubes that are typically positioned further landward from the water to serve as a foundation for the dune system.

ACT indicates that for the Texas Coast, the inner core of the ProTecTube II should be constructed from a non-permeable woven polyester fabric with a polymer coating on each

side. This design would allow for the tubes to first be filled with water and ultimately form a wedge shape following the injection of a sand slurry into the tubes. The tube section is divided into three compartments, which are hot welded together at the factory and function as a singular unit. As the tube is filled, excess water is decanted through a series of dedicated openings in the top of each compartment, leaving a sand-filled membrane at completion.

As part of the product evaluation, LAN contacted several outside references associated with previous ProTecTube II projects to discuss their observations and opinions of the technology. These references included:

- Jim Quinn, former manager of the Seaplace Condominiums, where 750 feet of ProTecTube II was installed in 1988
- Cliff Truitt, P.E., PhD., Senior Coastal Engineer at Coastal Tech, and chief engineer on several early ProTecTube II projects;
- Lee Harris, P.E., PhD., Professor of Ocean Science and Engineering at Florida Tech, and a design consultant on several projects involving the installation of ACT products.
- Ralph Clark, P.E., P.L.S. and Senior Coastal Engineer for the Florida Department of Environmental Protection.

Based on our discussions with the aforementioned individuals and additional available sources, the ProTecTube II has not been shown to contribute to any significant up-drift or down-drift impacts upon the natural littoral process and sediment transfer along coastal shorelines. The effects appear to be much less significant than those of vertical walls or rock structures placed along the shoreline. Because of the gradual transition of the structure at each of its longitudinal ends, no excess coastal erosion has resulted in the vicinity of previously completed projects. The ProTecTube II's gradual slope and scour apron may also aid in the prevention of foundation damage during a storm event.

References also reported minimal scour around the apron of in-place ProTecTube IIs, indicating that the tubes are not easily exposed once in place. In 2002, however, the landfall of successive tropical storms followed by Hurricane Isidore adversely affected the ProTecTube II located at the Sans Souci Condominiums in Pensacola, Florida. The storm surge from Isidore caused structural damage to the ProTecTube II, which had been uncovered during the recent storm events, by scouring out the sand behind it. With the exception of this event and several other minor occurrences of product exposure, in-place ProTecTube IIs historically have maintained their structural integrity during severe conditions. If uncovered at any time, sand covering the ProTecTube II should be replaced to allow it to function as designed. Recovering of the tube can be achieved through the natural return of sand along the structure, as reported by sources in several locations along the Florida coast, or by manual placement of sand along the ProTecTube II.

Based on information provided by ACT and on conversations with several references, the composition materials for the ProTecTube II appear to be stronger and more durable than

other similar products. The ProTecTube II contains no sewn or attached seams laterally or longitudinally along the length of the structure, effectively strengthening otherwise vulnerable areas. This is achieved by hot welding all of the seams along the ProTecTube II. ProTecShield, which is the outer armor layer, or shroud, surrounding the geotextile fabric consists of polyester strands coated with a polymer compound, which increases product strength, provide UV protection and run prevention should tears or punctures occur. Although large debris has come into contact with in-place ProTecTube II, few noticeable damages have been reported. This is attributed to the durability of the exterior fabric. Should a puncture or tear in the fabric occur, repairs can be accomplished by welding the material back together with a portable hot air welder and a field patch, or by using PVC adhesive and a patch of the shroud material.

The ProTecTube II, which acts as a subsurface dune protection system, typically comes in factory-fabricated lengths of 100', costing approximately \$16,000 per module. Additional costs associated with the use of the ProTecTube II include preparation and installation. The foundation must be a flat grade before sand filling of the tube may commence. Based on data provided by ACT, installation costs for previous projects ranged from \$75 to \$150 per linear foot, including the sand fill process, assuming the sand utilized is located in the project vicinity. Additional costs would be incurred if the sand used for fill had to be brought in from off-site. Assuming an average installation cost of \$110 per linear foot of ProTecTube II would result in an estimated cost of \$1.4 million per mile of project. It should be noted that these numbers may be skewed slightly because many of the previous ProTecTube II projects were relatively short in length; therefore installation costs may have been greater than those accompanying a project of larger scale.

State Policy Related to Geotextile Products for Shoreline Erosion Control

The Coastal Coordination Council permits the use of geotextile products as a structural erosion response method along Texas Gulf beaches under certain strict guidelines, which are outlined in Rule 501.14 of the Texas Administrative Code (TAC). Although the use of a ProTecTube II or similar product for specific projects is allowed legally under various stringent classifications, it is suggested numerous times within TAC Rule 501.14 that a soft structures such as unconfined beach fill material should be used whenever possible. Other states also have stringent policies in regard to hard and soft structures protruding from or being located on public beaches, and allow exceptions only under certain circumstances.

In ACT's description of the ProTecTube II, the company calls it "our most versatile soft beach or structure defense system." The *United States Army Corps of Engineers Coastal Engineering Manual* refers to similar products as erosion response methods. These descriptions differ in wording and meaning.. The ProTecTube II can be used in response to coastal erosion, but it dually serves as a structural defense system when in place.

Further, the *United States Army Corps of Engineers Coastal Engineering Manual* defines a geotextile tube as a form of a revetment because it functions as such. Under its current guidelines, the Coastal Erosion Planning and Response Act (CEPRA) deem a revetment a hard structure. Geotextiles can therefore be interpreted as hard structures, and CEPRA does not currently authorize or fund hard structures on Texas Gulf beaches. Their policy supports a more natural solution such as a completely soft structure in place of any foreign product.

To date, the ProTecTube II has not been utilized on the Texas Gulf coast. The effectiveness of the ProTecTube II is dependent on the proper design and installation of the product. Should use of the technology become more widespread within the State of Texas, the education of prospective developers, engineers and contractors concerning the unique attributes of the ProTecTube II would be critical to the successful implementation of the product. Potential users would benefit from ACT participation in project engineering design and from ACT led workshops structured to familiarize the contracting community during the pre-bid and construction phases.

Conclusions

Overall, the ProTecTube II appears to be a viable product that could be considered for dune toe protection. The application of this product should be evaluated on a project specific basis by a knowledgeable coastal engineer. The engineer should evaluate the applicability of a geotextile solution and analyze potential impacts to adjacent beaches, structures, beach accessibility and any other environmental issues related to installation of these devices.

Under the apparent constraints of CEPRA with regard to sand filled containers on the open coast, the TGLO may chose to consider the use of a ProTecTube II as a demonstration project along an inland beach where dune protection is needed. There may also be opportunities for private or other public agencies to consider using the ProTecTube II funded separately from CEPRA. If properly engineered, this may provide an opportunity for the TGLO to monitor the performance of the product at no cost to the CEPRA program.

In either of these scenarios, it is recommended that the initial projects focus on a localized solution in an area where dune erosion has been defined as a problem. The coastal engineer should work closely with ACT in the design and bid phase for a project of this type to ensure that all design and installation issues are adequately addressed.

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