WEDA 2013 Environmental Dredging Award

Category:
Environmental Dredging

Project:
Embraport Container and Bulk Terminal
Santos, Brazil

Project Summary:

Empresa **Bra**sileira de Terminal **Port**uarios S.A. (Embraport) is an 848,000 m^2 container and liquid bulk port terminal, being constructed on the north shore of the Estuario de Santos opposite the City of Santos in the State of Sao Paulo, Brazil. The project is an undertaking of Odebrecht Transportation in partnership with Dubai World Ports and Coimex. When completed, the Embraport terminal facility will not only be the largest privately owned port facility in Brazil with over 600,000 m^2 dedicated to container storage, but it will be the largest in South America. Also, the terminal will be able to turn over 2 million TEUs (Twenty-foot Equivalent Units) and 2 billion liters of bulk liquids per year. Total investment for all phases will be $1.15 billion/USD.

50% of the footprint of the Embraport project is located in a tidal zone. Because of this fact, it will require approximately 1.5 million m^3 of select fill material that must be imported to reach the design platform elevation of +3.5m taking into consideration consolidation and settlement of the insitu subgrade during and after the construction phase. In addition, there was 600,000 m^3 of contaminated sediments that must be removed from the turning basin and entry channel to the Embraport terminal. To meet Brazilian federal environmental regulations, the contaminated sediments must be contained in a secure upland disposal facility. These two site conditions would greatly increase the project development cost and could threatened the economic model and financial viability of the project.

Odebrecht project engineers contacted Allonda Geossinteticos Ambientais of Sao Paulo to provide an alternative to an upland disposal facility. The Allonda engineers proposed a unique design using TenCate Geotube® containment and dewatering technology. 208 fabricated Geotube® units (36.5m circumference x 65 m long containing 2,300m^3 each) would contain and dewater the 600,000m^3 of dredged contaminated sediments inside three 65,000m^2 dewatering cells encircled by impermeable clay dikes all located within the tidal zone portion of the project footprint. The Geotube® dewatered and consolidated dredged contaminated sediments would replace more than 400,000m^3 of imported fill. Over the dewatering cells, overburden up to 8 ton/m^2, would be placed to facilitate final settlement and consolidation. Once final consolidation and settlement is achieved, the overburden would be removed and the pavement section installed.

Allonda designed, installed, and managed the automated polymer system and dredged discharge thru the manifold distribution system to each Geotube® unit in the dewatering cells. The system was designed to receive 1,400 m^3 /hr.

The dredging and dewatering phase of the project took 18 months to complete and saved the owner more than $50 million/USD by eliminating the requirement to acquire additional land or use part of the project site for an upland disposal facility, and eliminate the importation of more than 400,000m^3 of expensive select fill.

Project Team Members:

Project Owner – **Embraport**

- Giorgio Bullaty

Dredger – **Jan de Nul**

Environmental Engineering and Project Management – **Allonda Geossinteticos Ambientais**

- Luiz Antonio de F. Escobar
- Leo Cesar Melo
- Luiz Gustavo Escobar

Geotube® Design and Fabrication – **TenCate**

- Ed Trainer – WEDA Member
- Tom Stephens

Environmental Benefit:

By designing onsite cells and adopting TenCate Geotube® Technology to contain and dewater the dredged contaminated sediments over which the container storage yard could be constructed, the following Environmental Benefits were achieved:

1. The total quantity of dredged contaminated sediments from the entry channel and turning basin could be securely deposited within the site footprint.
2. The requirement to acquire additional land and construct an upland disposal facility was eliminated.
3. The full area of the site can be developed and no area was required to be set aside for an upland disposal facility.
4. Eliminating the importation of more than 400,000m3 of expensive select fill that would have to have been quarried and transported to the site.
5. By adapting the TenCate Geotube® Containment and Dewatering Technology, to securely contain and consolidate the dredged contaminated sediments onsite and replace +425,000m^3 of imported select fill, the Carbon Footprint was reduced by 7,903 metric tons of CO_{2e}.

Innovation:

There were several major innovations that were adapted or developed for the Embraport project. They are:

1. The use of dredged contaminated sediments that are dewatered inside of Geotube® units to replace imported select fill.

2. The use of Geotube® Technology to contain and dewater dredged contaminated sediments over which a container yard is constructed that will allow 7 layers of ocean containers to be stacked.

3. The development of an automated polymer make down and injection system that is capable of providing accurate levels of flocculates for a dredge stream of 1,400m^3/hr.

Economic Benefits:

The innovative design and use of Geotube® technology allowed the owner to realize a savings in excess of $50 million/USD by not having to either purchase additional land for an upland disposal facility and not having to import more than 400,000m^3 of expensive select fill.

Transferability:

There are many potential projects around the world that have the same contaminated sediments and requirement for select fill conditions as the Embraport project. Because of the success of this project, the design and construction techniques can be adapted on these many projects.

Outreach and Education:

The Embraport project from inception to construction completion has been fully monitored, with results recorded, and with all activities photographed. The modeling and forecast have been compared to actual results and verified to be extremely comparable. The paper published at this conference for the Embraport project is an overview project and focuses on the benefits of the beneficial use of dredged contaminated sediments for construction of a container terminal. At least two additional papers will be published about this project; one focusing on the environmental aspects of the project and one focuses on the geotechnical aspects. There is at least one master's thesis that has been written and published. This body of published work will be presented to engineers who practice marine engineer for port development and to student who are studying in civil and environmental engineering. Finally, the Embraport project will be featured in TenCate and Allonda promotional and marketing literature.

TENCATE Geotube

Embraport
Before Development
2008

TENCATE Geotube

Embraport
Geotube® Dewatering Cells
Feb. 2011

TENCATE Geotube

Embraport
Overburden Continuning To Be Placed Over The Top Of Geotube® Units In Cell #1,
Geotube® Units Being Filled In Cell #2
May 2012

TENCATE Geotube

Embraport
Pavement Section Installed Over Cell #1,
Overburden Being Installed Over Cell #2
First Ship Unloading Equipment
March 2013