ARCOSA
LIGHTWEIGHT

GEOTECHNICAL FILL

CASE STUDY:

PORT CANAVERAL, FLORIDA

Port Canaveral, one of the world's busiest maritime operations, developed a new berth to serve today's larger cruise ships with Arcosa Lightweight. Arcosa's Jack Moore says in this project, developers basically created new land by extending the existing port out into the water.

"Where there's land they're constructing a new terminal building. Where there's no land, only water, they are installing sheet piles and filling behind them with lightweight aggregate to create a berth for the cruise ship. So yes, they are creating land where currently no land exists except underwater."

Major Expansion

In 2012, the Port embarked on a $163-million campaign to improve and redevelop the facility's Cruise Terminal 3 (CT-3), which first opened in 1983. One major part of the project was a $35-million rebuild of the existing wharf to accommodate today's fleet of ultra-large cruise ships. Construction of the cruise terminal's marine facility got underway in 2018 with the demolition of an existing obsolete, open-pile pier.

Replacement Pier

The replacement is a new 1,309-ft long berth for the cruise ship, Mardi Gras, said to be the largest Carnival Cruise Line ship ever constructed. The berth's design includes the use of expensive steel pipe and sheet piling. The use of lightweight aggregate fill material was one way to keep the project cost-efficient and on-budget.

"The properties of this material that are important to this project are very low density and a very high angle of internal friction, also known as the phi angle," says Moore. "The combination of those two properties results in a tremendous reduction in lateral pressure against the sheet pile structure. Because of that reduction in lateral force, the designers were able to reduce the gauge and length of the sheet piles resulting in a significant cost savings."

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Lightweight aggregate weighs roughly half that of common fill materials like quarried stone. This advantage, coupled with its predictable high internal friction angle, can reduce lateral forces by more than one half.

Moore says manufactured lightweight aggregate has distinct properties that differ from quarried materials. "It has very low density compared to quarried materials, Additionally, it has a very high internal friction angle, which makes it very stable. Lightweight aggregate provides other benefits including reduced lateral earth pressures and applied vertical stresses."

Product Placement

On the jobsite, the material requires no special handling procedures. Lightweight aggregate is easily placed using typical loaders, rollers and plate compactors.

"The compactive effort required to get suitable density for a project typically is much less than a select granular fill material," notes Moore. "Consequently, fill placement is relatively quick with fewer passes of compaction equipment required to get adequate densities."

Delivery Logistics

Just like ordinary granular fills, lightweight aggregate is delivered by barge, truck or rail. In the case of Port Canaveral, it was a combination of two transportation methods.

"We started out running from Livingston, Alabama by rail down to an unloading facility which is about 15 miles from the project," Moore says. "The lightweight aggregate was then unloaded from the railcars and trucked to a nearby staging area."

Moore says once the material arrived at the holding area, spot checks were made by an on-site lab technician.

"The lab was out here to check the unit weight of the material just to be sure that it's within spec. We had a specification that required the material to be a certain density and therefore we pulled samples periodically throughout each day."

550 railcars were used to deliver roughly 60,000 cubic yards of material. "All this was pulled off without a hitch," he says. "It's called coordination with all parties involved."

Successful Completion

Construction of the berth at Port Canaveral Cruise Terminal #3 required steel pipe and sheet piling bulkhead walls, a steel pipe pile tieback A-frame, and the installation of monopile and multi-pile shore and offshore mooring dolphins.

The new berth now accommodates the next generation of "Oasis Class" cruise ships with an overall length of more than 1,300 feet and a capacity of more than 6,000 passengers and about 2,000 crew members.