Port Canaveral's New Cruise Terminal 3

William E. Crowe, PE
Vice President, Engineering,
Construction & Facilities
Canaveral Port Authority

Contributing Authors:
Rocky Johnson, Vice President
Ivey's Construction Inc.

Gary D. Ledford, PE
Jacobs Engineering Group
Project Director, Ports & Maritime

Port Canaveral's Cruise Terminal 3 was the largest capital project in the Port's history. Built at $155M to accommodate the largest cruise vessel ever constructed by Carnival Cruise Line, the XL-Class Mardi Gras and the first liquified natural gas (LNG) powered "green cruising" ship to sail in North America. Cruise Terminal 3 is a complex system of vertical structures, site and utility infrastructure, marine works and new vessels constructed on both land and sea. Completed in June 2020, the 194,000 square-foot purpose-built campus remains shuttered due to Federal Centers for Disease Control & Prevention shutdown of cruise sailings in U.S. waters; however, when cruising resumes hopefully later this year, the Mardi Gras' maiden voyage from the Canaveral Harbor will be celebrated with the Carnival brand of "FUN!" Cruise guests aboard the much-anticipated ship will be able to experience the first-ever functioning roller coaster at sea on the top deck of the Mardi Gras apply named the "BOLT".

Project Overview

Port Canaveral's Engineering, Construction and Facilities Dept. has increasingly demonstrated that successful implementation of any infrastructure project requires an early adoption of a clearly defined, consistent and strategic collaboration program among all material project stake holders. The purpose of this collaboration is to communicate through as many "day-of-operations" scenarios as can be contemplated by the team as viewed through the eyes of both operational team members and, most importantly, our stakeholders including port users, tenants, visitors, and guests.

The benefit of this collaborative approach has never been more evident at Port Canaveral than on the Cruise Terminal 3 project. Early planning efforts, that would ultimately shape the footprint of the campus, were driven by three distinct challenges for the Port. 1) The Carnival Mardi Gras would be the first LNG-powered cruise vessel in North America. Bunkering LNG fuel required new and unique partnerships between fuel providers and bunkering barge operators and the cruise line. The bunkering process also drove new operational considerations for safety and regulatory practices to support the simultaneous operations (SIMOPS) of passenger debark/embark and LNG fuel transfer. 2) The state-of-the-art mega-terminal and 1,800-space adjacent parking garage would be built near the eastern terminus of a seasonally busy George King Boulevard that provides the single access into Port Canaveral's Jetty Park beach and campground and the Port's Freddie Patrick public boat ramps and parking facilities. 3) The 1,309 linear foot berth required for the massive new Mardi Gras was being constructed immediately adjacent to one of the most active berths in the Port, Cruise Terminal 2, home to the privately-operated gaming vessel, Victory Casino Cruises, which sails twice per day 365 days per year.

The four contractual components of Port Canaveral's Cruise Terminal 3 project built for Carnival Cruise Line (CCL) consists of 1) the 1,309 L.F. berth and marine works, designed by a Jacob's/ATKINS partnership and built by RUSH Marine out of Titusville, FL valued at $38.6M; 2) the 194,000 SF terminal, warehouse, luggage screening hall, and site work designed by Bermello Ajamil and Partners of Miami, FL and constructed by Ivey's Construction out of Merritt Island, FL for $74.5M; 3) the five elevated story, 1,800-space parking garage, an Ivey's / Finfrock design-build joint venture, for $29.5M and; 4) the dual mobile passenger boarding bridges, designed and manufactured by ADELTE located in Barcelona, Spain for $5.25M. In addition to the above construction/manufacturing costs, the Port contracted for just under $10M in design,

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LANDSIDE INFRASTRUCTURE CHALLENGES

Rocky Johnson, Vice President, Ivey's Construction

This project presented a unique and real-time CM challenge when wharf construction was delayed by specialty imported steel delays. The wharf construction delay meant that land upon which the northern limits of the new terminal was to be built was still under water when terminal construction was scheduled to begin. The challenge was exacerbated by the fact that the wharf contractor needed upland real estate, inside the new terminal building's footprint, for equipment and material access. Ivey's team developed a workaround by reversing the terminal construction sequencing direction 180 degrees, building from south (upland) to north (wharf) rather than the intended and far more efficient north to south. Close coordination with the wharf contractor, including shared equipment and resources, mitigated what could have been a devastating schedule delay.

As CM, Ivey's Construction worked with the Port Authority, the design team, our subcontractors and a specialty geotechnical engineer to Value Engineer deep foundations, saving more than $3M and cutting more than four weeks from the deep foundation schedule. In fact, between the terminal and the garage contracts, roughly $10M of hard costs were reduced through a highly-collaborative value engineering process.

The COVID-19 pandemic was also a significant challenge to the project. Team meetings were transitioned to Zoom and similar online platforms, and while we are all well-versed in the art of Zoom now, at the time it was a new and challenging format to many of the stakeholders. Real-time facility walks and reviews were held by way of shared video content, and Procore documents were utilized far more heavily than would have been the case sans the pandemic. Craft labor at the height of the pandemic was no less than 42% under targeted levels, resulting in considerable premium time for those craftspersons able to report to the site.

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engineering services during construction and owner's representative services and paid $1.4M in utility impact fees for new potable water and electric service to the facility. When reflecting on the Cruise Terminal 3 project approach, in conjunction with the use of the AIA Construction Management at Risk contract, Rocky Johnson, Vice President of Ivey's Construction, shared the following: "The Construction Management at Risk contracting method utilized on a complex infrastructure project can offer the Owner, the Designer and the Construction Manager the best of all worlds, but only if all of the stakeholders understand and embrace the symbiotic relationship required for success."

However, land-based infrastructure was

BERTH AND MARINE INFRASTRUCTURE

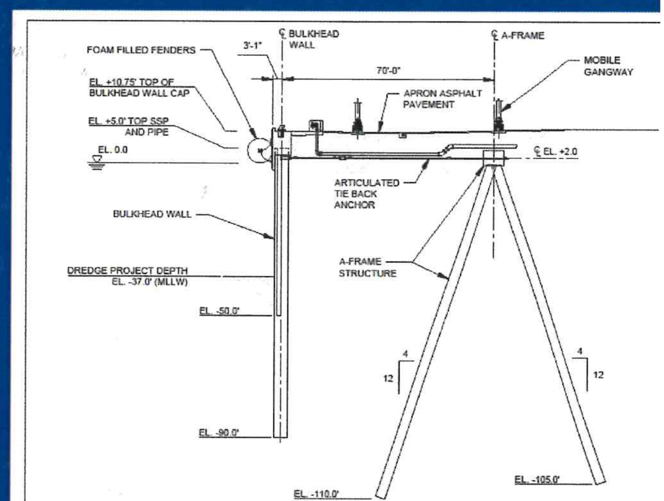
Gary Ledford, PE, Project Director, Jacobs Engineering Group

Bulkhead Wall and "A-Frame" Tie-Back System

Final design of the bulkhead was eventually optimized from a 72-inch to a 54-inch diameter steel pipe pile by using lightweight aggregate fill to lower the demand on the bulkhead wall. This creative solution proved to be a considerable cost saving in steel combi-wall section and depth required, as well as reduced the expected long-term settlement of the site.

Given the poor soils, resisting the anchor loads generated by the combi-wall section proved to be very challenging. A traditional steel sheet pile anchor wall or deadmen anchors were not a viable option for this project due to the magnitude of anchor load, so other options had to be explored. The final design utilized a continuous A-frame structure utilizing battered 36-inch pipe piles to resist lateral loads generated by combi-wall section. This A-frame system could be installed independently of the combi-wall, as the combi-wall section was designed to behave as a cantilever wall until backfilling behind wall was performed. Allowing these systems to be installed independently of each other was critical to the schedule of the project as the A-frame pile driving had to be closely coordinated with the terminal building pile driving.

To mitigate damage to tie-back rods due to long term settlement, an articulated system was designed which can accommodate up to 12 inches of settlement. Final design consisted of 3-inch diameter threaded rods (ASTM A722, grade 75) connected to steel plate/coupler welded assemblies.



Scour Protection

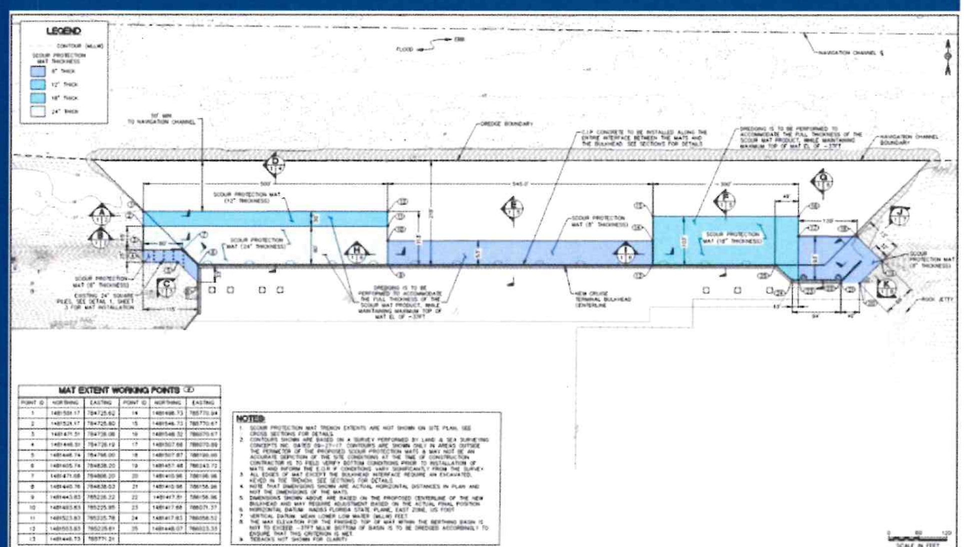
Propeller wash velocities affecting scour protection design were determined by first using momentum jet theory to determine initial efflux velocities, and detailed bottom velocity distributions at the berth were not the sole focus for capital expenditures during this project. In addition to the Mardi Gras from Carnival Cruise Line, Port Canaveral invested in building its capability to service and support LNG-fueled cruise vessels. The Port contracted with Metal Shark Boats out of Jeanerette, LA to construct a 75-foot dry-chemical, fire-fighting vessel capable of responding to LNG based fires at a cost of just under $5M. Lastly, Shell Corporation—the LNG fuel supplier contracted by Carnival to fuel the Mardi Gras—in partnership with Quality LNG (Q-LNG), contracted to build the $73M "Q4000" articulated tug and barge (ATB) with an on-board storage capacity of 1M US gallons, 4000 cubic meters (cbm) of LNG. The ATB system has vapor-recovery and re-circulation capability to maintain cryogenic temperatures within the twin LNG tanks of -260 degrees Fahrenheit. (-162°C).

About the Author

Mr. Crowe is a 23-year veteran of construction management and marine/port development with a breadth of experience in deep-water cruise and cargo port operations. His assignments have included strategic planning, program management, construction management and quality assurance of large marine, civil and industrial projects. Currently, he is the Vice President, Facilities, Engineering and Construction, at the Canaveral Port Authority.

determined using the CFD modeling. The design vessel has four (4) bow thrusters and three (3) stern azipods. The bow thrusters were fixed in location and direction, while the azipods were assumed to be directed either aft at 45 degrees, or at a 90-degree angle towards the wharf bulkhead, in which case only the starboard and center azipods were enabled.

CFD modeling was used to calculate the flow field, the jet interaction with the bulkhead and bottom slopes, and maximum velocities encountered during the simulation. Maximum bottom and slope velocities used for design were those that were computed at any time during the simulation. Two different scenarios were evaluated: the starboard and center azipods directed 90 degrees towards the bulkhead, and all three azipods directed 45 degrees aft. Bow thrusters were also included in both modeling scenarios and resulted in lower velocities and mat thickness requirements. The simulation duration was 60 seconds, which was sufficient time for the flows to reach an approximately steady state condition in terms of peak velocities over the mats.



The scour protection system consisted of geotextile, cast-in-place concrete articulating block mats, and selective concrete injection. The cast-in-place mats included high-tensile strength polyester internal cables, and mat thicknesses varied according to design velocity conditions. Uniform thickness mats were used as the primary system, with pillow-type articulating block mats used around the perimeter. Mat thicknesses ranged from 8 inches to 24 inches. The connections at the bulkhead included a trench filled with marine concrete. The Figure above shows the final scour protection system design.