Burnside Marine Terminal Expansion

Boh Bros. and GRL Engineers team up in Ascension Parish, La.

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Impala, a global warehousing and logistics company (a wholly-owned subsidiary of Trifigura), specializes in the transportation and storage of bulk commodities such as metals, minerals and coal. Impala stores, blends and delivers the commodities using state-of-the-art storage and warehousing facilities around the world.

To expand their network, in 2011 Impala acquired Ormet's Burnside Terminal located on the lower Mississippi River in Ascension Parish, La. Reportedly, more than $250 million have been committed for upgrades of the facility. The most significant upgrades include construction of a state-of-the-art bulk terminal for coal, bauxite and aluminum. High performance handling equipment such as a 20,000-ton Gottwald floating crane and ship loaders will be used for loading bulk solid materials into and from marine vessels on the river. Once fully operational, the Burnside Terminal will be the fourth of its kind on the Mississippi River and the only one with the possibility of both rail-to-vessel and barge-to-vessel capabilities.

The Impala acquisition has substantially increased business and economic activity locally, including hiring local residents and using local Louisiana-owned service companies and contractors. Among the various contractors performing work at Burnside, Boh Bros. Construction Co., of New Orleans, La. was awarded the West Yard Conveyor and Tower Foundations project in addition to the complex Wharf Superstructure Foundation upgrade project (Figure 1). Armed

Figure 1 – Ringer crane barge at wharf superstructure

with over 100 years of piling experience and a company-wide philosophy of quality, dedication and safety, Boh Bros. quickly mobilized to the site with numerous piling crews and heavy equipment in support of the rigorous project demands.

Boh Bros. has earned a reputation for delivering projects on time and the current Impala Burnside expansion is no exception. Since the 1950s, Boh Bros. has developed extensive pile driving experience along the Gulf Coast and lower Mississippi River, working on large projects in the refining and petrochemical industries such as Chevron's Pascagoula, Miss. plant to Texaco's Convent, La. plant when these projects were first built. Boh Bros. was the first heavy contractor in the area to acquire a 300-ton barge-mounted ringer crane and now has a fleet of four 300-ton and one 600-ton ringer barges. Boh Bros.' large marine fleet enables the driving of piles 200 feet long in one piece and weighing up to 200 tons to deliver a faster and safer project.

GRL Engineers of Louisiana was selected by Boh Bros. to be the foundation testing team for the project. The dynamic testing program confirmed the foundation design requirements and expedited the construction process.

Pre-construction GRLWEAP studies

The terminal upgrades required numerous and extensive preliminary wave equation studies be performed across the landside and waterside geologic limits of the site. In preparation for the potentially difficult pile installations, accurate modeling of the soil, pile and hammer systems was required for proper equipment selection and stress control evaluation.

Driveability studies were performed using the GRLWEAP program to evaluate selected air, diesel and vibratory pile driving hammers. Numerous pile types were analyzed ranging anywhere from 60-inch diameter pipe piles to the new HP 18 x181 HP sections (Table 1). Maximum pile lengths of 195 feet were evaluated for the project. In all, based on the GRLWEAP output, seven pile driving hammers were approved for installing six pile types to the required tip elevation across the construction site (Figure 2).

Hammer Class	*Manufacturer & Model*	*Pile Type*
Vibratory	ICE 44 B	36" x 0.5" OEP
External Combustion	Vulcan 010	HP 14x89
	Vulcan 012	24" x 0.5" OEP
	Vulcan 512	24" x 0.5" OEP
Open-End Diesel	Delmag D46	36" x 0.5" OEP
	APE D62	HP 18x181
	PILECO D100	36"x0.5", 42"x0.5", 60"x0.75" OEPs

Table 1 – Approved hammers based on driveability studies

Figure 2 – PILECO D100 installing pipe piles to tip elevation on the Mississippi River

Field testing & analysis of dynamic measurements

To accommodate the dynamic testing requirements of the project, GRL used a Pile Driving Analyzer® (PDA) Model PAX manufactured by Pile Dynamics. PDA Wireless radio technology proved to be a valuable asset when multiple piling crews required "back-to-back" dynamic testing (initial driving, restrike or combination thereof). As a potential time saver, GRL was equipped with the capability to collect dynamic data for multiple piling crews from either a single location on the construction site or remotely from the office using their proprietary SiteLink® system (Figure 3). This remote system has the advantage of enabling testing at the convenience of the contractors' schedule and eliminates any waiting for the test engineer to arrive onsite. Test data is sent remotely from the PDA onsite to the engineer in the office via a broadband internet link. The engineer has no idle time onsite and can fully observe the testing from his office, reducing travel time and expediting the reporting process.

Figure 3 – Wireless and remote capabilities of PDI's PAX

Wireless and remote capabilities of PDI's PAX

The wireless data acquisition technology was greatly appreciated by the onsite safety teams. The technology allowed for sensor attachment prior to lofting the piles and consequently eliminated the need for piling crew members to climb the leads prior to a dynamic test (Figure 4). Just prior to testing, hard foam "gage protectors" provided an extra "insurance" when the crews lifted and placed larger diameter pipe piles into the hammer leads.

Over the course of the project, dynamic restrike testing with the PDA was performed for all pile types. Interestingly, the restrike time duration for piles in the testing program ranged from three to 47 days, which provided the owners' engineers a nearly complete picture of pile "setup" capacity within the site perimeter. Typically, the ultimate static shaft capacity was determined to be 1.6 to 3.2 times the shaft capacity measured at the end of drive, with the individual setup factors converging to a value near 3 after about a one-month time period. The average site setup factor was 2.2 (Figure 5).

Figure 4 – Wireless sensor gage protector use

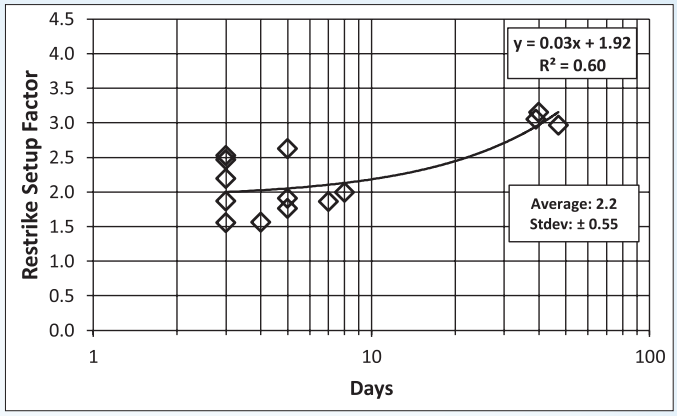

Figure 5 – Restrike setup factors for representative HP and pipe piles

The inherently critical nature of the restrike testing also required that quality measurement data be collected. As such, eight channels of data acquisition were recorded for testing the pipe piles to obtain average force and acceleration measurements over the cross section while supplying backup for crucial restrikes. The traditional four channel data acquisition proved ideal for the HP pile installations.

Following the field testing and data acquisition, the numerical signal matching program, Case Pile Wave Analysis (CAPWAP®), analyzed a hammer blow from each restrike test. Force and velocity measurements (Figure 6 top plot) are input into CAPWAP to obtain the ultimate mobilized static capacity and soil resistance distribution along the pile length and toe. The simulated static load vs. pile top and toe displacement plot is seen in the bottom plot of Figure 6.

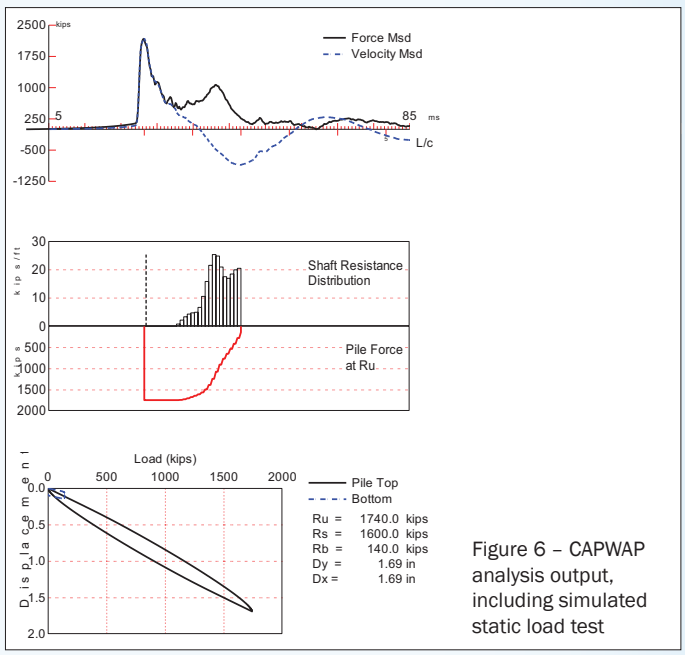

Figure 6 – CAPWAP analysis output, including simulated static load test

The Burnside Marine Terminal dynamic pile testing program resulted in considerable savings in cost and contract days to the owner compared to a conventional full-scale static load testing program of similar magnitude. Mobilized ultimate capacities exceeding design requirements for the project were obtained through this type of testing. Additionally, the selection of the dynamic testing method economically allowed for more piles to be tested across the site, allowing improved site variability assessment and providing a greater degree of confidence to the overall quality of the newly installed foundations. ▼