



# National Gypsum Breasting Dolphin Replacement

Aluminium Walkway Sys

Gerwick recently completed the structural design and construction support of four new breasting dolphins for National Gypsum Company's (NGC) Richmond Terminal. A recent

underwater inspection of the 1960s-era structure revealed corrosion of the steel H piles, in particular just below the concrete jackets. NGC selected Gerwick to provide updated designs to replace the existing cast-in-place concrete and steel H pile dolphins. We were chosen to lead the project, coordinating activities from start to finish.

Key tasks performed included:

- Coordinated with local and national NGC staff
- Coordinated geotechnical and topographical investigations
- Detailed structural design including mooring and berthing analyses
- Obtained permits from the Bay Conservation and Development Commission, USACE, Regional Water Quality Control Board, and City of Richmond

- Issued release for construction drawings and specifications
- Assisted with procurement of piles, fenders, and mooring hardware
- Construction oversight

## Design

The first step in the design process was to identify the range of vessels that may call at the Terminal, both currently and in the future. While the Terminal is primarily serviced by a stern unloading bulk carrier, the CSL Trailblazer, the dolphin layout had to accommodate other bulk carriers with various conveyor locations. Once the optimum

dolphin layout was determined, several different dolphin designs were explored. We selected a steel monopile type design, as it provided a number of advantages. First, the monopile design allowed for significant offsite prefabrication and a shortened on-site construction duration. Since the Terminal had to remain operational during construction, the shorter construction duration allowed the dolphins to be built between vessel arrivals. Second, the steel monopile could be installed using a vibratory hammer, avoiding some of the permitting complications and marine species impacts associated

with using impact hammers in the San Francisco Bay. To guarantee suitability throughout the design life of the dolphins, piles were designed to accommodate a potential future increase in dredge depth.

We coordinated a geotechnical investigation with Treadwell and Rollo. Using their p-y curves, the steel pipe piles were designed considering both mooring and berthing demands. A 66-inch-diameter pipe pile was selected with a variable wall thickness to match the demands from the moment diagram and to optimize construction costs. Pipe piles were fabricated by XKT at their Mare Island facility and delivered to the project site on barges.

To provide energy absorbing capabilities, a Maritime cone fender and panel with shear, tension, and weight chains was selected based on the berthing energy requirements of the design vessels. To prevent vessel surge, the breasting dolphins were outfitted with mooring points. We performed a mooring analysis considering laden and ballast conditions, maximum flood and ebb

currents, high and low tides, and passing vessel effects. Based on this analysis, we elected to use 100-ton single bitt bollards as the mooring hardware.

A precast concrete deck was selected for the deck of the dolphins. By precasting the deck, the on-site construction duration was minimized. The anchorages for the fender chains, bollards, and handrail were precast into the deck.

To provide access between the dolphins, aluminium walkways were installed. To limit construction costs, we incorporated existing walkways into the access plan. Since monopile dolphins are flexible in nature, the walkways were supported by a pinned connection at one end and a roller type connection at the other. This detailing prevents berthing and mooring forces from being transferred to the walkways. In addition to the new dolphins, the existing unloading platform was strengthened and expanded by driving 24-inch-diameter steel pipe piles around the perimeter of the platform. Dowels were epoxied into the existing

concrete and then cast-in-place concrete was placed to form the deck expansion and connect the piles to the existing platform. Other work completed included abutment repair and riprap placement for shoreline protection.

#### Permitting & Bid Assistance

Acting as NGC's agent, we obtained the permits for the project from all the public agencies involved. Since pile driving in the area is restricted to a fish window, obtaining the permits in a timely manner avoided delays and allowed the construction to commence in the fall of 2010. We also assisted NGC during the bid phase by writing the RFP for the construction contract.

#### Construction

CS Marine Constructors was selected to perform the construction. Prior to mobilizing to the site, CS Marine precast the concrete decks at their yard. Piles were installed using an APE 400 vibratory hammer.

Unanticipated hard driving was encountered on the first pile, which led to early refusal about 3ft above the required tip elevation. To ensure the



Lofting 66-inch Diameter Pipe Pile

required thicker walled portions of the piles and the corrosion protection coatings were located in correct zones, we worked closely with the geotechnical engineer and the contractor to develop a solution by slightly shortening the remaining piles. Once piles were driven and cut off, the prefabricated head pieces were spliced onto the pile. Fenders, handrail, and walkways were then installed and the new dolphins were ready to receive vessels in February of 2011.

#### Collaboration

Working with NGC staff (Stephen Miller, Maynard Sinclair, Gene Whittington, Steven Ciapponi, and Mike James), CS Marine (Casey Stockon, Jeff Thompson, and Mark Weisz), and Treadwell and Rollo (Haze Rodgers), we were able to survey, design, permit, and construct the project within schedule and budget constraints.



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