

PROCEEDINGS PAPER:
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Marine Terminal Docking Aid System/Instrumented Mooring Points

The ConocoPhillips Marine Terminal in Rodeo, California is a “T-Type” Wharf located near the southern shore of San Pablo Bay approximately one-mile west of the Carquinez Bridge. The Earl and Wright Consulting Engineering Company of San Francisco designed the Terminal in 1953 and it was placed in service in 1955.

The terminal and shore approach causeway is of concrete construction. The main berthing section of the terminal has pre-cast 6-inch decking with a 5-inch concrete overlay. The berthing areas, M-1 and M-2, are supported by 923 – 18 inch square, pre-cast concrete piles, and 218 - 14-BP-73 batter piles with a gunite overlay. The approach section has a combination of concrete pre-cast piles and gunite overlay H-beam type piles.

In 2001, a project was developed to improve the overall operations and safety of the Terminal. The project goals were as follows:

- To provide information to vessel pilots to aid in docking the vessel.
- To provide a continuous status of individual mooring line loads.
- To reduce operational risks during transfer operations.
- To minimize environmental impacts from spills.

The Terminal equipment installed in 1955 consisted of air powered winches with a wire rope lead used to pull the mooring lines to the attachment point. The mooring points were cast iron bollard posts; some were equipped with a rotating pelican release hook. There were 34 mooring posts total with 16 mooring posts equipped with rotating pelican release hooks. On the barge side of the Terminal there are 13 mooring cleats.

The docking system relied on the pilot’s judgment to determine the vessel’s approach speed and approach angle. The spring backed fendering system with wooden fender piles allowed for ships up to 105,000 DWT to be berthed safely at the Terminal. The critical limits for docking are approach speed in ft/sec and the angle of approach.

The new mooring system has a quick release type mooring hook in four different design considerations:

- Two Hook Stationary
- Two Hook Swivel
- Three Hook Stationary
- Quad (4) Hook Stationary

The new design hooks are instrumented to provide load data for each individual line load from a load cell in each pivot pin to a computer terminal in the control room. The hooks are individually rated at 75 tons capacity. The load information is displayed at the hook controller display window and displayed on the computer terminal inside the control room. This information is stored on the computer for future reference. The computer displays a digital ship and all mooring lines with the line load for each individual line. The load range may be set for each hook. The load range can include both a minimum load and a maximum load desired for the individual mooring line. If the load on a line falls below a pre-set minimum or above a pre-set maximum, the unit's alarm horn will sound and the unit's control light will change from green to amber. The computer display will also change the line from a green line to an amber line. The alarm horn can only be reset at the alarming hook. If the required change is not made within fifteen minutes, the alarm will sound again.

The quick release hooks have several options for releasing the mooring line. The line may be released mechanically by a lever pulled at the hook. The line may be released electrically at the hook with a push button. And all lines may be released from a panel in the control room. The electronic release pushbuttons at the hooks have a built-in delay to prevent accidentally releasing the lines, and the release in the control room requires simultaneous key operation to affect a release. The hooks all have a 10hp electric capstan winch built-in to be used to pull the line from the vessel to the hook. The winch is operated with a "dead-man's" switch and is powered for both forward and reverse operations. The center of the dock is open with pipelines and handrails. With the new location of the hooks, it was necessary to install fairways to provide clearance for line handling during mooring operations.

The Docking Aid System consists of two (2) Laser Beam Sensors at each berth used to determine approach speed in feet per second and distance to contact with the dock. The information is provided to the vessel pilot by means of a signboard with 18 inch letters. The desired approach speed and maximum approach angle limits are programmed into the computer and warning lights on the sign indicate if the limits are exceeded. The sign provides the approach speed in ft/sec and the distance the bow and stern is from the dock face, which will indicate the vessel approach angle. The information is displayed on the computer in the control room. After the vessel is mooring at the berth the Laser Beam

Sensor is used as a vessel drift monitor. If the vessel drifts off the dock facing more than the allowable limit, 18 inches, an alarm sounds and the display board reads the distance the vessel has drifted off the face of the dock.

The project was placed in service in the spring of 2003. To date the entire system has operated with minimum problems. The project was completed on budget and within a eighteen months schedule. With this installation we feel the wharf operation safety has been improved. By providing the operators with exact knowledge of mooring line tension, vessel docking information and drift monitoring they are much better equipped to perform their duties.