CRANE RAISE AT THE PORT OF OAKLAND

- **FAST**
- **SAFE**
- **ECONOMIC**

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INTRODUCTION

Container crane owners and operators often find they must modernize their cranes to keep existing tenants or attract new ones. However, modernizing cranes can be disruptive to the shipping operations. Many owners look for alternates to avoid the disruptions or defer the modernization until a suitable time.

In order to seize an opportunity to expand their business, the Port of Oakland modernized their cranes with minimal disruption to the operator. This paper describes the Oakland project and offers some information that may help you make an objective evaluation of your situation.

BACKGROUND

Berths 25 and 26 in the Transbay Container Terminal at the Port of Oakland are served by two Paceco container cranes. The cranes built in 1978, worked ships with containers stacked three high on deck. Early in August 1992, the Port's engineering department was asked to evaluate the feasibility of raising the two cranes by 20 feet to work on K-Line's new class of 3500 TEU vessels with containers stacked five high on deck. The cranes needed to be raised by December 1992, before the vessel's maiden voyage to Oakland. The tenant's weekly service could not be disrupted and the cost of modernization could not be excessive.

Traditionally, an engineering consulting firm would prepare the construction documents for the Port and the Port would request bids from qualified contractors. The process of selecting the firm, preparing documents, inviting bids, and awarding the contract usually takes about four months. Another three to four months are required for construction. The Port had to explore ways to reduce the administrative, engineering and construction time if they were to meet the dead line.

It became apparent that raising a crane and returning it to normal service within five days was the key to seizing this opportunity. The raising operations must be safe and economic. A concept was developed by Liftech to do just that, using conventional towers, jacks, and jacking rods. Once convinced that the tenant's operations would not be disrupted, the Port short circuited the administrative process by sole sourcing the project to Paceco, the original crane manufacturer. Paceco was asked to retain Liftech to prepare the construction documents for raising the cranes and review the contractor's erection scheme. Paceco was required to obtain three bids for the erection work.

Rigging International, a specialized rigging contractor, was the successful erection subcontractor.

The Port chose to take the two cranes out of service for twenty days when the cranes were expected to be raised and the mechanical components modified. The operator was able use the adjacent Maersk Lines cranes for the 20 day period. The contractor was allowed access to the cranes when they were not working the ships. The cranes were returned to service three days ahead of schedule.

JACKING SYSTEM

The jacking system consists of basic components that were used by the contractor on previous crane raise projects. The existing components included a set of towers, jacking assemblies and jacking bars. New lifting beams, tower bracings and stabilizing trusses were designed to complete the jacking system. See sketch 1.

The jacks, located at the top of the towers, lift jacking bars. In turn, the bars raise the lifting beams which are mounted under temporary brackets on the crane legs. The tower bracing maintains the tower gage during the raise. The stability trusses provide stability to the jacking system and transfer lateral loads from the crane to the rails.

Two hydraulic consoles, one for each side, for pressurizing the jacks are conveniently located on the wharf.

The system is designed to be placed on the crane sill beams. The total weight is transferred to the crane rails without imposing any load on the wharf. It is designed to withstand loads from storm winds or earthquake while the crane is being raised.

RAISING THE CRANE

The crane was outfitted with permanent reinforcing consisting of pipe diagonals under the portal beams and stiffeners on the legs. Temporary jacking brackets were installed on the legs.

While the work was being performed on the cranes, the jacking system was assembled in two sub-assemblies on the wharf away from the operating cranes. Each sub-assembly included two jacking towers with jacks, bars and lifting beam, and tower bracing. Immediately after taking a crane out of service, it was moved over the assembled jacking frames and the two sub-assemblies were placed on the crane sill beams. The preassembled stability trusses were mounted on the jacking frames.

The bolts connecting the sill beam to the legs were removed and the crane was raised on the jacking system. To maintain control, landside or waterside of the crane were raised alternately. The raised side was on jacks while the other side was on holding pins. The differential between the two sides at any time was limited to the jack stroke which was eight inches. Safety shims were used on the jacks to limit the crane drop to no more than one inch in case of a hydraulic leakage.

DIMENSIONAL CONTROL

Using a transit, a plane defining specific points on the two sill beams and two trolley girder support beams was established. The points were monitored during the raise and after the new legs were installed. Offset of the trolley girder support beam would indicate shifting of the frame upper works. This would cause the boom to be skewed with respect to the gantry rail. In an extreme case, the operator would have to gantry while the crane is working a single bay.

The offset of the trolley travel over the ship was limited to 1 inch.

Excessive frame offset could be corrected by installing shims on one side of the bolted connection. The asymmetric shimming introduces a moment on the leg bottom which in turn shifts the top of the frame. See sketch 2.

Proper bearing must occur between the connection plates at the leg/sill joints. For the original construction, these plates are match drilled, bolted together, and then welded to the respective components. The clamping prevents the plates from distorting during welding. This option is not available for modifications.

The alignment of the connection plates were carefully surveyed and the new legs were ordered to fit the existing conditions. However, means had to be provided for uniform bearing if the joints did not fit properly. Several years ago, Liftech developed a scheme to provide uniform bearing even if the bearing surfaces did not match perfectly. High strength epoxy is injected into the voids between the connection plates after the legs are installed. To ensure the passage of the epoxy, grooves were machined in the new connection plates. The perimeter of the joint is sealed by welding. See sketch 3.

MECHANICAL AND ELECTRICAL

The main hoist drums were modified in place to receive the longer ropes. The contract documents called for mounting new junction boxes at the top of the new legs and splicing all wires. The contractor decided it was faster and cheaper to eliminate the junction boxes and pull new wires instead.

CONTRACT TERMS

PRICE:

The total contract price of $2.1 million included raising the cranes, installing new elevators and complete repainting. The cost for raising the cranes was $720,000 each, including engineering

SCHEDULE:

The contract required the two cranes to be raised and returned to service in three months and to be out of service for no more than twenty days.

LIQUIDATED DAMAGES:

Contractual liquidated damages were $3,000 per day per crane. These did not apply since the cranes were finished early.

CONCLUSION:

This project demonstrates a method for crane owners to modernize container cranes quickly, safely, at conventional prices, and with little disruption to the daily operations.

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