Common quay crane modifications

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Why do it?

Crane modifications are often required to service larger vessels, increase productivity, allow for a different terminal operation, or reduce maintenance costs.

Modifying existing cranes is quicker and often a more economical alternative than purchasing new cranes.

Modifications to the crane's geometry allow an existing crane to service larger vessels. The most common geometry modifications are increasing the lift height or increasing the outreach, backreach, or both. Occasionally, taller yard vehicles require more clearance under the portal beam.

Crane upgrades are often implemented in conjunction with relocation to another terminal. When cranes are relocated, they usually need some modifications. Common modifications include strengthening the structure for increased storm winds, adding or strengthening stowage hardware, crane gage changes, and changing the power supply system.

Common quay crane structural modifications

Increase lift height

Cranes are commonly raised about 6 m, but larger raises are also possible. Raises of up to 9 m have been completed. Lift height can be increased by inserting a new section of leg, inserting a sill beam cap, or extending the main equaliser brackets below the sill beam. For raises greater than about 3 m, a leg insert is the most practical raise method.

Figure 1 shows the leg insert crane raise method. The truss work is the temporary lifting frame. Figure 2 shows a sill beam cap and local leg reinforcing. This method raises the crane and provides added strength and stiffness to the O-frame. Figure 3 shows a main equaliser bracket extension. As mentioned above, this is the most economical crane raise method for raises of about 3 m or less.

These methods of crane raises can usually be accomplished relatively quickly and with limited disruption to the terminal operations.

Frequently, it is necessary to strengthen or stiffen the raised frame for lateral loads. The strengthening can be accomplished by the addition of cover plates on the legs, and knee braces between the legs and support beams (see Figure 4).

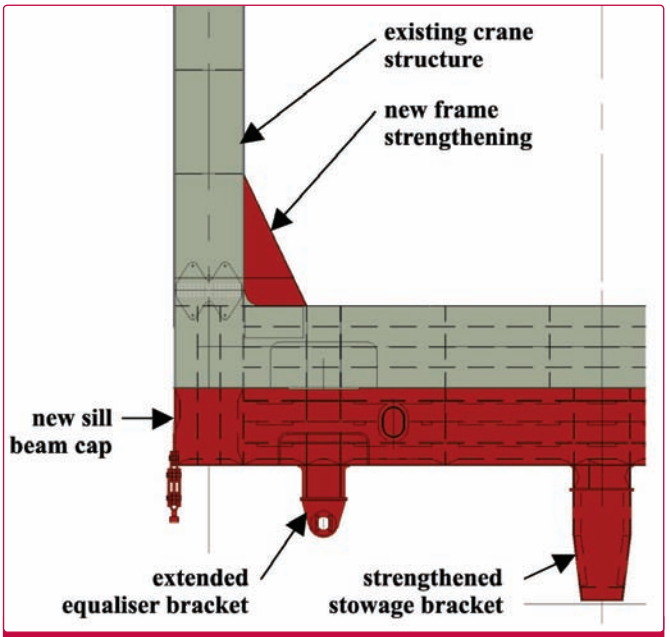

Figure 2. Sill beam cap crane raise method.

When a crane's lift height or outreach is increased, it is necessary to check the main hoist system for its capacity to handle additional hoist rope length. Depending on the size of the existing main hoist rope drum, it may be necessary to extend the grooving or double wrap the hoist rope. Double wrapping the main hoist rope may be problematic and should be avoided.

Elevators, stairs, and platforms will also need to be modified for raised cranes.

Increase outreach or backreach

An increased outreach can be achieved by inserting a new section into the boom. For some cranes, it may be possible to extend the outreach without extending the boom by moving the trolley stop and adjusting the mechanical systems.

Figure 1. Leg insert crane raise method.

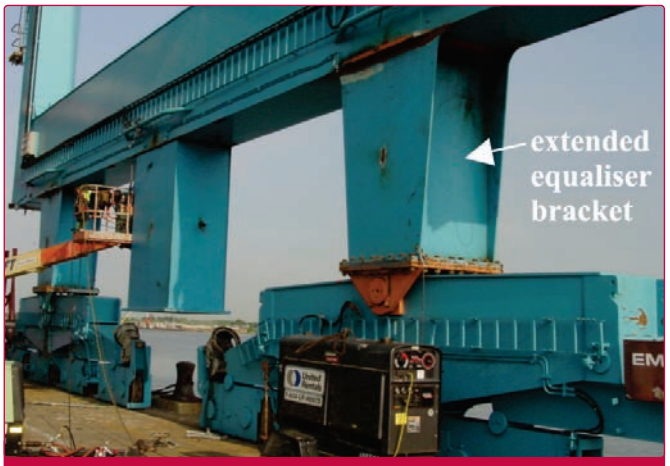

Figure 3. Main equaliser bracket extension.

It may be necessary to relocate tie beams and modify the boom hoist system. Other changes may be required to the festoon system and catenary trolleys. Increasing the outreach or backreach always increases wheel loads on the wharf by a relatively small amount. Usually, the wharf structure has enough excess strength to handle the increase.

For significant boom modifications, it may be more economical to take the boom down and make the changes at grade.

Increase clearance under portal beam

When a terminal converts to a strad operation, increasing the clearance under the portal beam may be required. One of the crane raise methods discussed in the 'Increase lift height' section above can achieve increased portal clearance. If the needed increase is small, modifying or raising the portal beam may be feasible.

Figure 4. Additional frame bracing for a raised crane.

Quay crane upgrades related to relocation

Figure 5 shows two cranes bound for Panama from North America. One crane's gage was increased from 15.2 m to 21.3 m and the other crane's gage was decreased from 30.5 m to 21.3 m.

Strengthen for increased storm loads

Relocating a crane to a site with higher design wind speeds requires strengthening the structure to resist the increased wind loads.

Figure 5. Relocation to another terminal by barge (note gage change modifications).

Strengthening the following items may be required: the structural frame, the boom latch, the crane stowage hardware, and gantry braking system. See Figure 6 for an extreme example of frame strengthening for high storm winds. The example is a crane that moved from the US West Coast to Guam. It may also be necessary to install or upgrade tie-downs, and strengthen the crane stowage hardware in the wharf.

Crane stowage systems may need to be modified to accommodate the new terminal's existing wharf hardware configuration.

If the crane is moved on a vessel, the voyage forces should be considered in developing the frame strengthening.

Gage change

Gage changes are necessary when the new location has a different crane rail gage from the original site. Although they may be perceived as difficult, gage changes are relatively straightforward. Existing crane gages can either be increased or reduced. When reducing a crane's gage, stability of the crane is a concern. Additional ballast, stronger tie-downs, or both may be required.

Power change – Shore power to diesel, Diesel power to shore

A crane's new location may require a different power source than the original location. Power sources can be diesel genset, cable reel, or bus bar.

A new or expanded house will be required when converting to a diesel generator. A complete generator system weighs about 25 tonnes. Usually, the crane structure is adequate to support this additional weight and wind load without strengthening. At some locations, environmental conditions may complicate or prohibit using a diesel genset.

Adding a cable reel is not difficult structurally.

Miscellaneous modifications

There are many other less common types of modifications, including decreasing out-to-out of gantry bumpers, bumper alignment, replacing the operator's cab, adding a man-lift, replacing the electrical control system, replacing the main hoist drive, and modifying the snag protection.

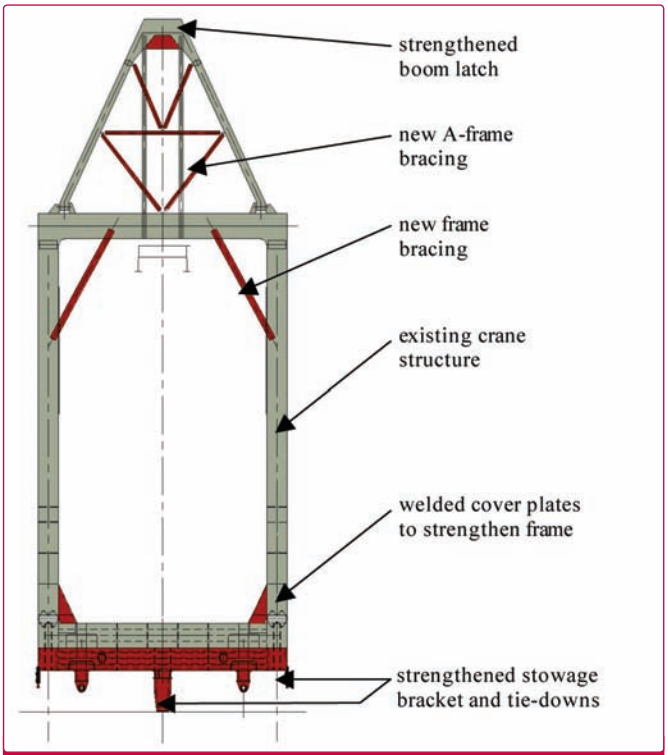

Figure 6. Frame strengthening for increased storm wind loads.

Future trend

Convert to a tandem lift (two 40 foot containers) system

Many cranes now being purchased include a large main hoist capacity in expectation of future conversion to a single-hoist tandem lift operation. Future tandem lift capacities are typically 80-100 t. Several headblock manufacturers, including Stinis, Ram, and Bromma, have developed tandem lift systems for single-hoist cranes. Depending on the required tandem operation capacity, conversion to tandem lift systems may also be practicable on cranes with standard lift capacities. The structure needs to be evaluated for the increased lift system weight and increased lifted load. It may be necessary to restrict operations to empties or light containers. Alternatively, the structure can be strengthened to maintain the same reliability as the original design.

Recommendations

When existing cranes are inadequate, three alternatives are worth consideration: purchase new cranes, modify existing cranes at the current terminal, or purchase and modify cranes from other terminals. New cranes have the advantage of state-of-the-art design and less maintenance, and the disadvantage of cost and delay. The cost of modifying existing cranes is usually significantly less than that of new cranes, and they can be delivered months ahead of new cranes. Nevertheless, a modified crane may not meet operational requirements as well as a new crane and maintenance costs will be higher.

The investor should keep an open mind.

ABOUT THE AUTHOR

Derrick Lind is a Structural Engineer and Associate at Liftech Consultants Inc. He has over eight years of experience in designing and evaluating various structural systems for commercial, industrial, and transportation facilities.Recently, he has managed three dual-hoist tandem container crane projects for clients in Hong Kong and Singapore. His work includes structural analysis and design, supervising engineers, coordinating sub-consultants' work, and managing project budgets and schedules.

ABOUT THE COMPANY

Liftech Consultants Inc. is a consulting engineering firm, founded in 1964, with special expertise in the design of dockside container handling cranes and other complex structures. Our experience includes structural design for wharves and wharf structures, heavy lift structures, buildings, container yard structures, and container handling equipment. Our national and international clients include owners, engineers, operators, manufacturers, and riggers.

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