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Meeting the demands of larger vessels with larger and faster cranes

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Super-Post-Panamax cranes

To be able to operate on the new Super-Post-Panamax container vessels, with a width of 22 rows or more, container cranes are becoming higher and have a longer outreach. ABB has delivered electrical systems for a large number of these Super-Post-Panamax ship-to-shore container cranes in recent years.

Larger cranes are more expensive, making it even more important that they are effective. Productivity, measured in moves per hour, is essential when evaluating a crane system. Introducing automation is one way of increasing productivity. Another is to use either a double trolley system or a double hoist system on cranes.

A double trolley system includes a second trolley that runs on the portal beams. This so-called portal trolley handles the containers between a lashing platform and the discharge area on the quay. A main trolley normally handles the containers between the ship and the lashing platform. The main trolley is manned but is normally operated in a semi-automatic mode with the operator only performing the actual set-down or pick-up on the ship. The rest of the cycle – from above the safe height over the ship to set-down or pick-up on land – can be fully automatic. A portal trolley is unmanned and is fully automatic. ABB has delivered such systems to Le Havre in France and Euromax in the Netherlands.

A double hoist system includes two hoisting systems on the main trolley for handling two 40-foot containers or four 20-foot containers at the same time. ABB has delivered, or is in the process of delivering such systems to Hanjin Shipping in Korea, Pusan Newport Company in Korea, Port of Xiamen in China and TSI in Canada.

Cranes are not only becoming higher and with a longer outreach, they are also becoming faster. The normal hoisting speed is now 180 m/min with an empty spreader and 90 m/min with a rated load. Acceleration ramp times, from zero to base speed, are normally two seconds. Main trolley speed is typically 240 m/min and the acceleration ramp time is five seconds. Gantry speed is 60 m/min with an acceleration ramp time of five to eight seconds.

Since the beginning of the 90s, hoist and trolley speeds have nearly doubled. This has of course affected the dimensioning of the motors and drive systems. Motors and drive systems are larger and more expensive today, but the question is if this increase in maximum speeds really pays off since the travelling distances for hoists and trolleys are still relatively limited.

The energy required to move a container from a ship to a wharf is theoretically defined by the weight of the container and the lifting height. Regenerative drives that feed back energy when loads are lowered represent common technology today. The only way to further reduce energy consumption is to reduce losses in the system by using components that are as energy efficient as possible, however, the auxiliary power needed for cranes to operate ventilation, lighting, heating, etc. is in a simplified way independent of the number of containers that are being moved. Under normal operating conditions, the auxiliary power can be as much as 30 to 40 per cent of total energy consumption. By increasing the productivity of a crane, i.e. increasing the number of moves per hour, this percentage will decrease.

Figure 1. Example of a double trolley system.

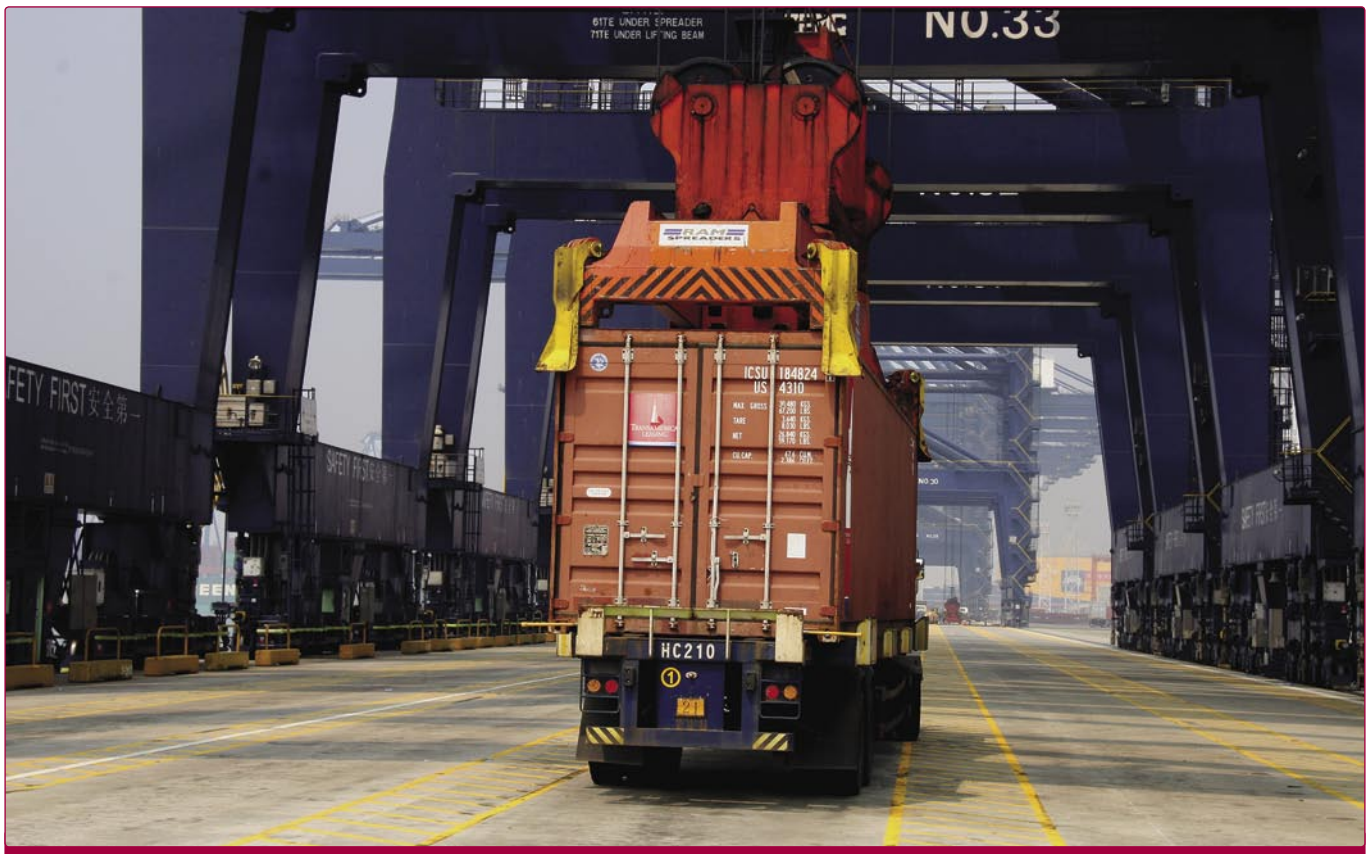

Figure 2. Skew control corrects any unwanted movement caused by wind or unevenly loaded containers.

The obvious conclusion is that the total amount of auxiliary energy used to move a specific number of containers is lower for a more productive crane. Hence, faster and more productive cranes save energy.

Automation

As cranes become larger and faster, operations become increasingly more difficult. The greater distance from the operator's cabin to the vessel deck impairs visibility and reduces the level of detail for the operator. Faster motor speeds, shorter ramp times and longer ropes make it even more difficult to control spreader movements.

There are several ways to aid the operator. One is to assist in the difficult stages; another is to relieve him of some of the work so that he can give his full attention to the more difficult tasks.

ABB offers a complete range of automation building blocks for mixing and matching into a crane system to assist the operator in the best possible manner.

With combined sway and position control, movement between quay and ship or vice versa can be fully automated, with the operator only supervising. If there is a connection between the crane and the terminal operating system, work orders with predetermined destinations can be sent to the crane. Once an operator accepts a work order, the production cycle is performed automatically. When the hoist reaches a safe height above a ship or the ground, the operator takes over and performs the landing.

A skew control system corrects any unwanted skew pendulum movement caused by wind or unevenly loaded containers. Uncontrolled skew movement often becomes visible at the end of a production cycle, when the operator attempts to lower the spreader into the ship cells or when landing a container over the quay. Skew movement is difficult for an operator to control and can result in loss of valuable seconds each time it occurs. Over time, these seconds add up and will affect overall productivity. With a skew control system, the time spent waiting for skew to dampen will significantly decrease.

Over the quay, there are systems for aligning and positioning chassis, straddle carriers and AGVs. For example, a chassis alignment system can guide the truck driver to the correct position. Once the truck is there, the exact position of the truck or container is used as reference for the position and skew control system, ensuring that the spreader is in the optimum position for a pick-up or set-down. The positioning and measurement system, in combination with skew control and position control, speed up the landing cycle and minimise lost time due to wrongly positioned containers, chassis or AGVs.

Cranes equipped with the latest features, such as double hoists or double trolleys, will benefit even more from the supporting systems. These cranes offer high potential capacity, but also require a well-integrated terminal process. The time saved due to extra capacity is easily lost when trying to line up chassis, dampen skew or when positioning headblocks. Double hoist cranes can incorporate the following features:

- Sway and position control systems for one or two headblocks

Figure 3. The chassis alignment system guides the driver to the correct position.

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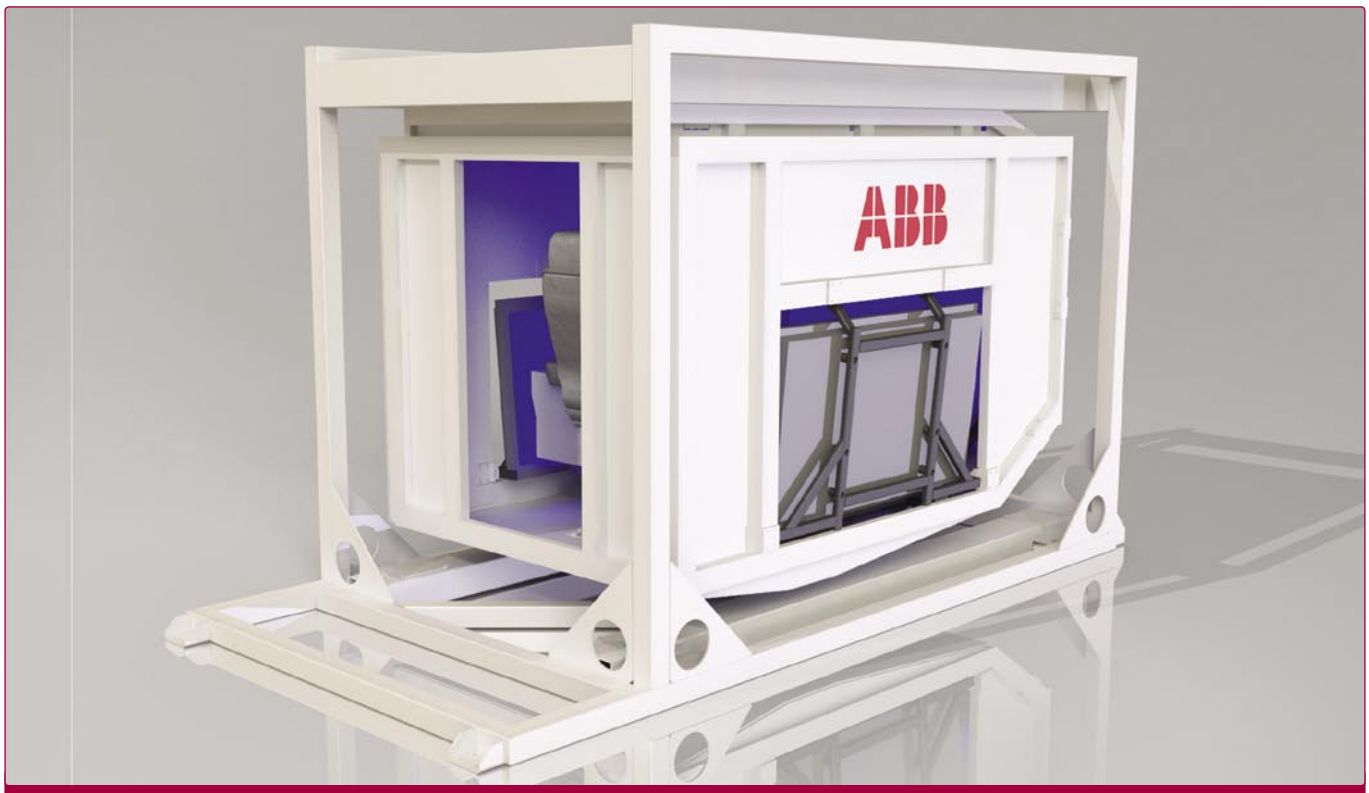

Figure 4. Crane simulator's increase safety and productivity.

- Skew control for one or two headblocks
- Sensors for measurement of the relative positions for synchronisation of the two hoist motions during operation and fine positioning of headblocks for spreader connections
- Automatic clamping of headblocks
- Chassis alignment systems for two simultaneous chassis

Yard automation

Faster and more productive ship-to-shore cranes also demand highly efficient yard systems. Fully automatic stacking cranes are essential in an efficient material handling system. For ABB, fully automatic stacking cranes no longer represent new technology; the technology is now well proven. ABB has received orders for 229 automatic stacking cranes with remote operation capabilities worldwide, and 88 are already in operation. Because automatic stacking cranes are faster, have higher ground utilisation and require less maintenance than traditional rubber-tired gantry cranes, they are well suited for loading and unloading the vessels of tomorrow.

Simulator assistance

With ships and cranes becoming increasingly larger, it is imperative to prepare crane operators in advance so as to achieve maximum productivity, and without compromising safety or failing to meet new work environmental challenges.

Instead of taking cranes out of production and risking physical damage, you can use a realistic in-house simulator to bring your operators safely up to speed.

Ports using the ABB ship-to-shore crane simulator have experienced the importance and benefits of operator training on simulators, with on-crane training time decreasing by 40 to 60 percent after only three days on the simulator. What is unique about the ABB simulator is its incorporation of the latest technology, with state-of-the art, real-time physics simulation and advanced 3D graphics, which enable training in exceptionally life-like situations. Moreover, the ABB training strategy enables customers to turn out trained operators with a high degree of conformity, due to the disposition of predefined scenarios, with trainees following a path from basic crane operation to advanced operation.

An investment in a simulator is easily justified with a simple return-on-investment calculation. Your investment will be returned in less than a year, assuming that there are two shifts daily and that 57 operators are trained. And this does not even take into account the savings gained by keeping cranes in production.

"The simulator is a powerful tool and we can offer ports ship-to-shore crane simulation for both single and double hoist systems," says Hans Pettersson, product manager at ABB Cranes Systems.

ABOUT THE COMPANY

ABB Crane Systems' main mission is the efficient and optimised handling of containers, bulk materials and steel products in ports, power plants and steel mills. The productivity and quality of the installations are improved in a cost-effective way by applying total solutions based on knowledge of the customer's processes.

ENQUIRIES

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