New STS crane design is ABC

US crane consultancy Liftech Consultants Inc. has launched a new STS crane concept called the Articulated Balance Crane (ABC) as an alternative to traditional A-frame STS crane structures for terminals where wheel loads, tie-down loads or excessive maintenance at the boom hinge point are issues for crane owners.

STS cranes have increased in size dramatically since the first A-frame crane structure was developed by Liftech’s founder in 1959. However, despite outreach requirements growing to 68m+ and lift height requirements extending to 48m+, terminal operators still require cranes that are no wider than 27m between the buffers, with a 100ft rail gauge for existing terminals. Putting more and more crane structure on the same footprint increases wind and wheel loads significantly, particularly when the boom is in the stowed position, beyond what older wharf structures can accommodate in many cases.

With its ABC concept, Liftech has come up with a way to lower crane weight by approximately 8% within existing footprint restrictions, and reduce wheel loads on the crane rails when the crane is in the operating and stowed positions by as much as 15% – without radically changing the whole crane structure and mechanical systems.

The ABC features an elongated boom that extends back to the landside legs of the crane, with a shorter crane girder section that remains horizontal as it is lowered, as the boom rotates into the raised position for vessel clearance and stowage.

There are different options for the raising and lowering mechanism, including a machinery system that uses the same main components as a conventional boom hoist, but with a different rope reeving pattern, fleet angles, and sheave arrangement. On the waterside leg, Liftech envisions that the boom pivot point at the waterside shoulder beam would be similar to boom hangar connections used by some crane manufacturers in the industry today, which can be inspected and replaced if needed.

Other design features include a system for securing the crane girder at the raised and lowered positions. Liftech was involved in the design of the elevating girder crane in Virginia, which has an upper section that can be raised and lowered, and was built by ZPMC. Liftech envison that a similar pin insertion method could be used on the ABC to secure the girder in the landside leg for stowage.

Some design details, such as how the electrical cabling and personnel access would be managed need to be worked out with a crane manufacturer, but Liftech believes they can be met using existing components and without overly complicating the crane design.

Where the ABC design is a departure from standard crane design today is its use of 10 cable stays instead of two H-beam steel sections for the boom forestays. Liftech believes it is possible to use technology from cable-stayed bridges to incorporate lighter cable stays into the ABC design, without creating a potential corrosion problem, and without compromising the stiffness and deflection characteristics of a conventional forestay support system.

Liftech has not patented the new design, and is willing to work with users and manufacturers to put it into practice. See page 17 for full details.
Reducing weight and wheel loads

Liftech’s new concept for an Articulated Balance Crane can reduce the weight and wheel loads of very large STS cranes*

The operating and stored positions of the ABC concept

To evaluate the concept, Liftech redesigned a recent erected trolley crane (RTT) STS crane model for the ABC concept and compared the crane weight, wheel loads, and stability of the two cranes. Liftech has only performed an initial evaluation of one RTT crane design, but the ABC concept could be applied to RTT or machinery-on-trolley (MOT) crane design.

A three-dimensional view of the RTT ABC concept

On a standard STS crane, the fixed trolley ‘girder’ extends from the landside of the crane near the wharf edge and is supported under the landside and the waterside cross beams (trolley girder support beams). The ‘booms’ are supported by jiggers at the trolley girder and by fore stays that extend to the fixed apex supported by A-frame pylons over the waterside cross beam. This layout allows the boom to be raised, to provide clearance when ships arrive and when the crane must gantry past the ship bridge along the wharf.

The key to the new ABC concept is that the boom is continuous, extending from the boom tip to the landside cross beam, instead of the waterside cross beam. In the design concept, a shorter landside trolley girder, supporting the machinery house, is connected to the boom at the landside cross beam, and supported by a parallel linkage connected to the waterside cross beam.

In the ABC concept, the trolley girders, the machinery house, and the parked trolley. The boom is hinged to the frame at the waterside cross beam. The parallel linkage support of the trolley girder keeps the machinery house and trolley horizontal during the boom raising and lowering motions. Depending on the crane geometry, the landside girder, machinery house, and trolley could be stowed near the height of the portal beam, with the boom raised near 60 degrees. In the stowed position, the trolley girder would be locked to the frame, either at the landside leg or at the portal beam.

In the ABC concept, raising of the boom and associated lowering of the trolley girder are controlled by standard boom hoist machinery with modified reversion between the machinery house, the main girder, and the landside cross beam. With this concept, the boom is similar to a cable-stayed bridge with one pylon.

Cable stay design

The ABC concept uses multiple stays to support the boom, with five power steel cable stays to support the waterside portion of the boom, and two pairs of stays to support the landside portion. On a standard STS crane, two pairs of heavy steel ‘H-beam’ sections are used for the foresays. The use of many stays should result in a lighter boom structure per unit length, and the total weight of the 10 stays is expected to be comparable to the total weight of the four conventional steel H-beam foresays.

Other Content is Not Shown