Future Wheel Equalization System - Part 2

In our June issue we published the first of a two part editorial by Michael Jordan, Chief Structural Engineer, and Erik Soderberg, President, Liftech Consultants Inc. Here the authors present Part 2 – Future Wheel Equalization System.

Two new concepts of equalizing quay crane wheels were introduced in the June 2015 issue of World Port Development, Container Crane & Component Supplement. One concept using a mechanical linkage is described in detail in that issue. An alternative system using elastomeric pads was mentioned but not explained in detail. Here are the details.

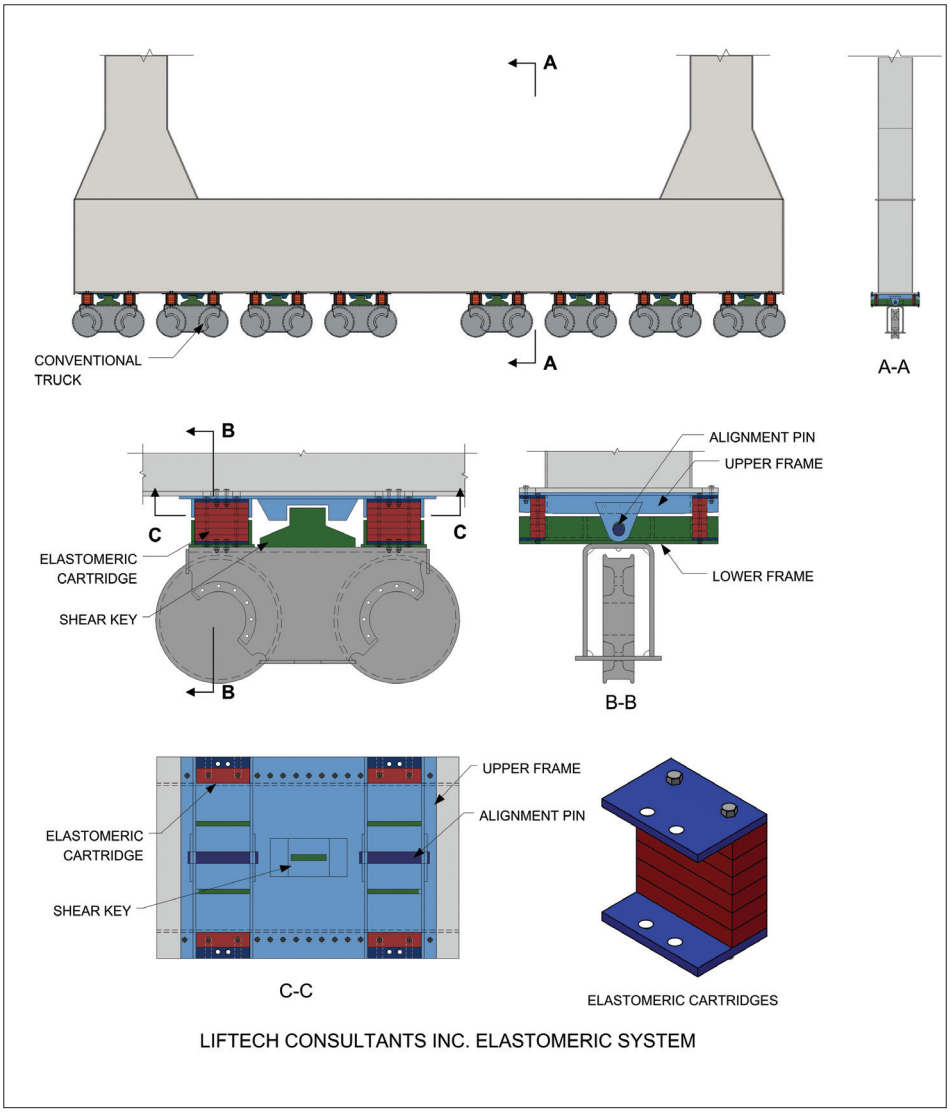
Elastomeric bearing system

The elastomeric bearing system uses elastomeric pads to directly transfer the loads from the wheel trucks to the sill beam. The concept is simpler than the linkage concept, but the crane rail elevation variance tolerance is tighter. The vertical tolerance, however, is not problematic for modern wharves. Liftech reviewed a number of existing rails and found that the elastomeric concept presented below is suitable in every case. The elastomeric concept is practical for both single rails and dual rails. The pads are similar to bridge bearing pads and have a proven track record for low maintenance and high durability. If the pads are damaged, they are easily replaceable.

Components and functions

The truck is conventional, except instead of connecting to a sub-equalizer, it connects to a special insert. The insert includes a lower frame and an upper frame that contain four elastomeric cartridges, alignment pins, and a shear key. The frames contain elastomeric cartridges that provide enough flexibility to equalize the wheel loads within five to ten percent depending on the rail elevation variance and the properties of the elastomeric stacks. The cartridges contain a stack of reinforced elastomeric pads that are preloaded by tension bars. The pretension reduces the vertical deflection during normal operations. The ability to tension also permits reduction of the height of the stack and cartridge for easy installation and, if necessary, removal for maintenance of the truck or its components. Special nuts allow adjustment of the pretension with the cartridge remaining in place. U-shaped holes in the upper and lower frame flanges allow the cartridge to be removed without removing the rods. The pretension rods have fatigue tolerant thread geometry with much better fatigue performance than a standard threaded rod geometry. The rods are sized to limit fatigue stresses and achieve high reliability. Although very unlikely, if a rod were to fail, its parts would be contained within the system. The trucks are held in line by horizontal alignment pins that restrict lateral movement but allow very small rotations and vertical movement. During normal operations loads perpendicular to the gantry rails are small.

During extreme loads the more heavily loaded elastomeric stacks "bottom out" so the load is transferred through steel. The tension loads are carried by the tension rods. The sketches show a typical arrangement. The special insert is shown bolted to the sill beam and welded to the truck. However, it could be bolted to the truck as well. This will allow the insert to be removed by increasing the tension on its pretensioning rod and reducing the height of the stack so the truck could be removed. The crane could temporarily operate with one less truck. The wheel load would increase by one third, which is acceptable for a limited number of cycles. The sketches show the essentials of the concept. Other arrangements and other details have been investigated and are feasible. WPD



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