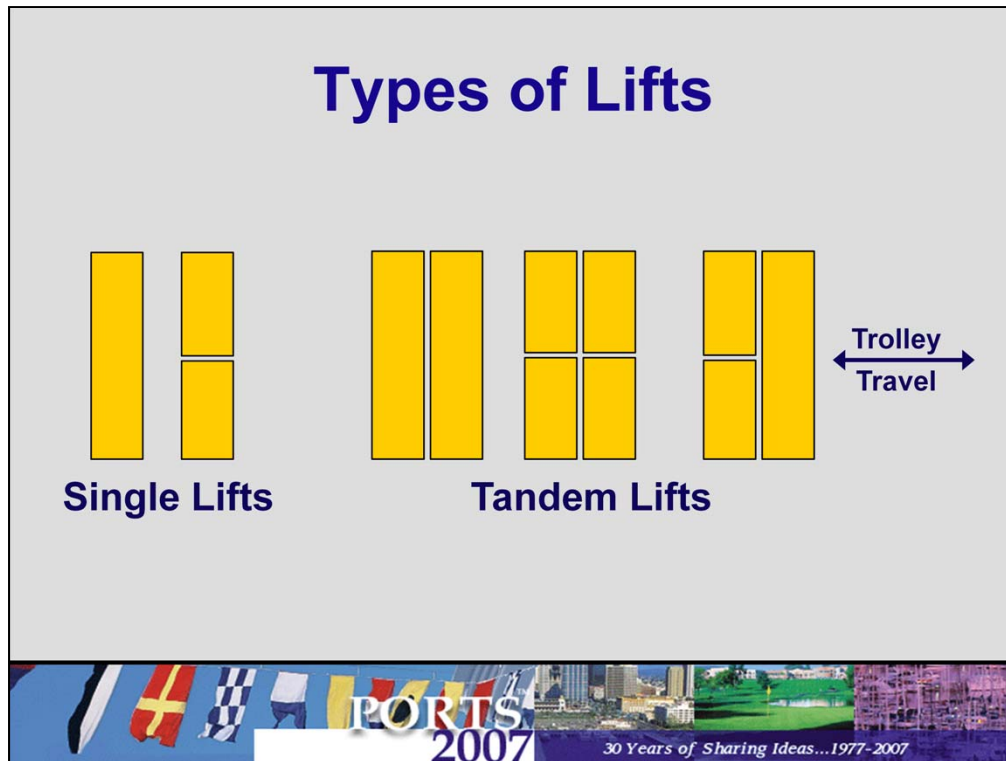


Good afternoon. I'm Derrick Lind with Liftech Consultants.

I'll be talking about "Tandem 40 Dockside Cranes and Their Impact on Terminals". Tandem cranes are no longer a fantasy. These cranes are being used at many terminals throughout the world.



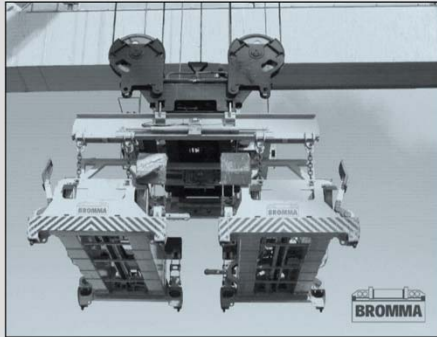
So, what is meant by “tandem”. Everyone is probably familiar with the term “twin-twenty”, but “tandem” is relatively new.

As shown, tandem lifts are when multiple containers which are adjacent to each other in the trolley travel direction are lifted.

Different types of tandem lifts are possible with either 40’ or 20’ containers.

Tandem 40 Crane Types

SHT40 – Single Hoist Tandem 40



DHT40 – Dual Hoist Tandem 40



Generally, there are two types of tandem cranes; single-hoist or dual-hoist.

I'll focus mostly on dual-hoist cranes. However, both types share many of the same considerations.



Single hoist tandem cranes use one hoist system to lift the tandem load.

The hoist system is conventional, except for the hoist capacity, lift system, and control systems. Also, the additional load applied to the crane must be considered in the design.

Some benefits of a single hoist tandem crane are:

- One hoist system = less cost/maintenance

- Possible to convert an existing crane to tandem operations

Some problems with a single hoist tandem crane are:

- Limited access to unequal height stacks

- Reduced hoist capacity

- Slow conversion to single lifts, because the special tandem lift system must be removed.



Dual-hoist tandem cranes use two separate hoist systems to lift the tandem load.

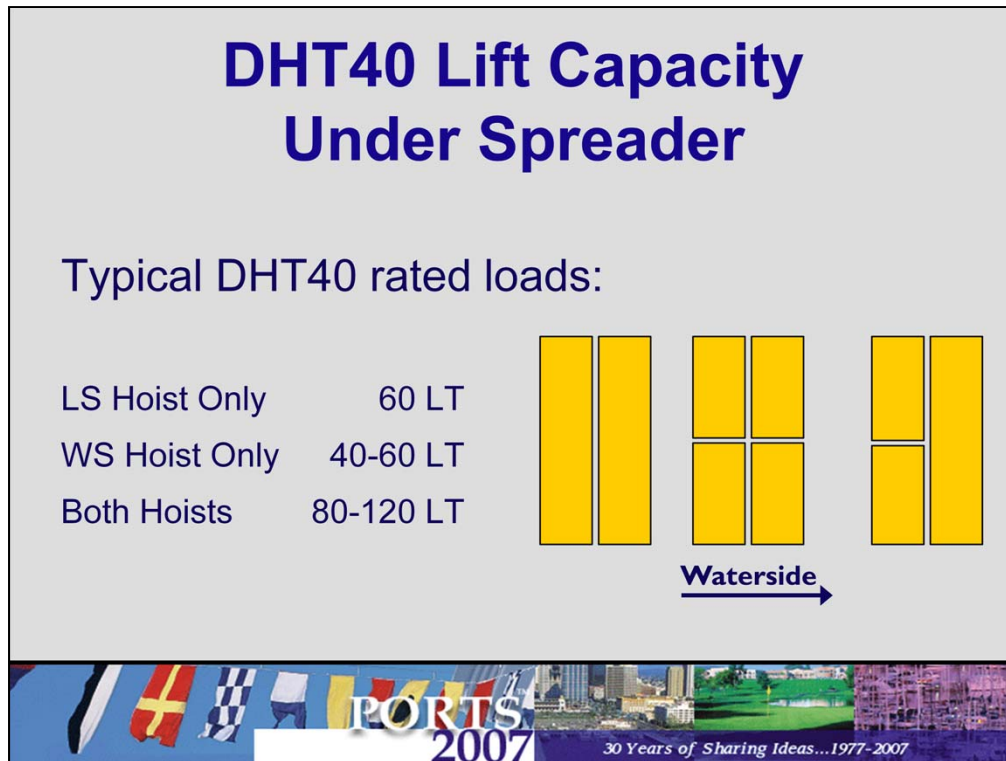
Currently, about 50 ZPMC DHT40 have been delivered, mostly to Chinese ports. 80 more are on order.

Some benefits of dual-hoist tandem cranes are:

- Easily converts to single lift operation
- Handles unequal height stacks


Some problems with dual-hoist tandem cranes are :

- Additional maintenance due to two hoist systems
- Additional weight
- Additional initial cost - approximately 20% - 30% premium over single-lift cranes



For most dual-hoist tandem cranes, the landside hoist is considered the primary hoist system. Typically it has a higher lift capacity.

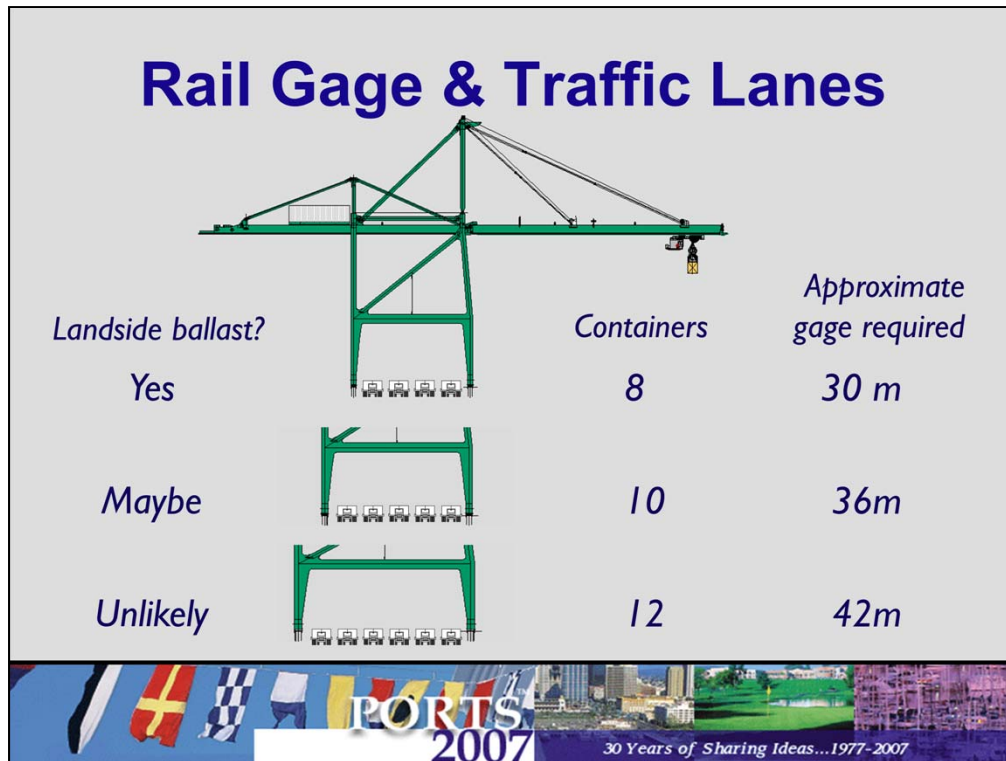
Approximately 90% of DHT40's ordered have an 80 LT total capacity. Only a few have been 120 LT.

Operating Wheel Loads Waterside			
	Single Lift 61 t	DHT40 80 t	Increase
Total Crane Weight	1500 t	2000 t	33%
Service State	85 t	115 t	
Limit State (ASCE 318-99)	120 t	165 t	38%
Rope Towed Trolley Crane in Hurricane Area with 8 Wheels per Corner			
			

Due to the increased weight and lifted loads, tandem cranes have higher wheel loads.

For the same configuration, wheel loads for tandem cranes are approximately 35-40% higher than single-lift cranes.

One way to address the increased wheel loads is to increase the rail gage.

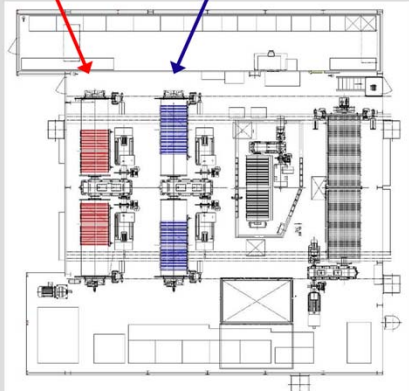


In addition to reducing wheel loads, increasing the gage improves stability and provides more space under the crane. The additional lanes will help with increased truck traffic.


Major Differences DHT40 vs Single Lift

Two Main Hoist Systems
DHT40 Trolley
Complex Dual Head Blocks
Special Operator Controls

WS Hoist LS Hoist



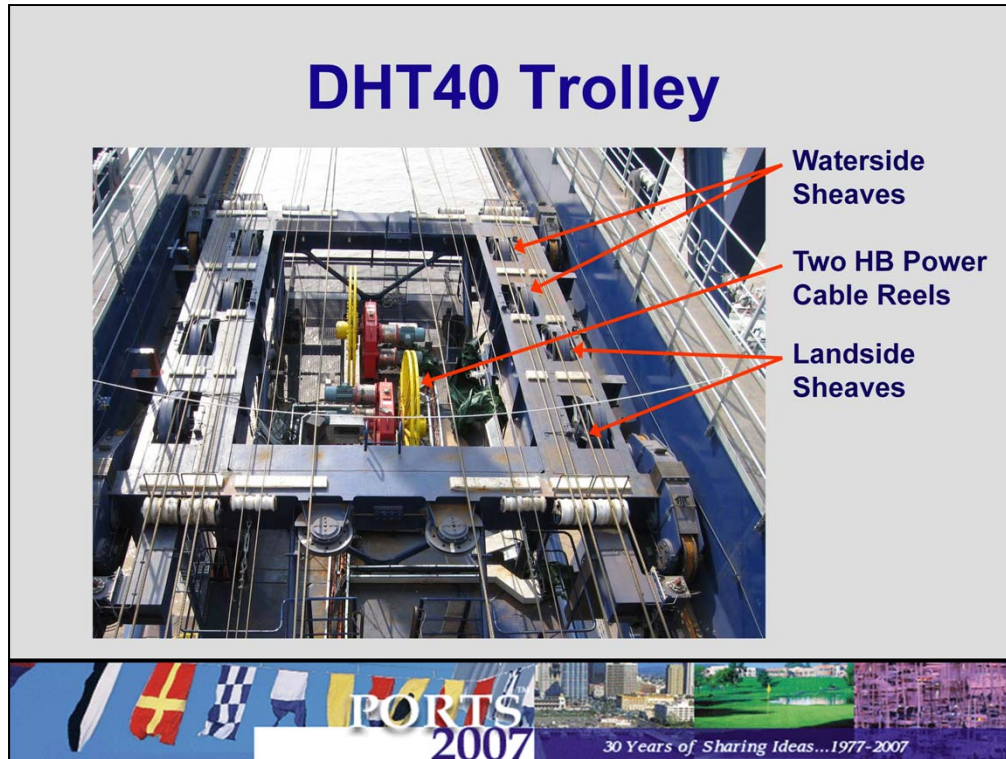
The diagram illustrates the internal structure of a DHT40 crane. It shows two main hoist systems: the WS Hoist (WS for Winch System) and the LS Hoist (LS for Luffing System). The WS Hoist is indicated by a red arrow pointing to a red block, and the LS Hoist is indicated by a blue arrow pointing to a blue block. The diagram also shows the complex dual head blocks and the special operator controls.



30 Years of Sharing Ideas...1977-2007

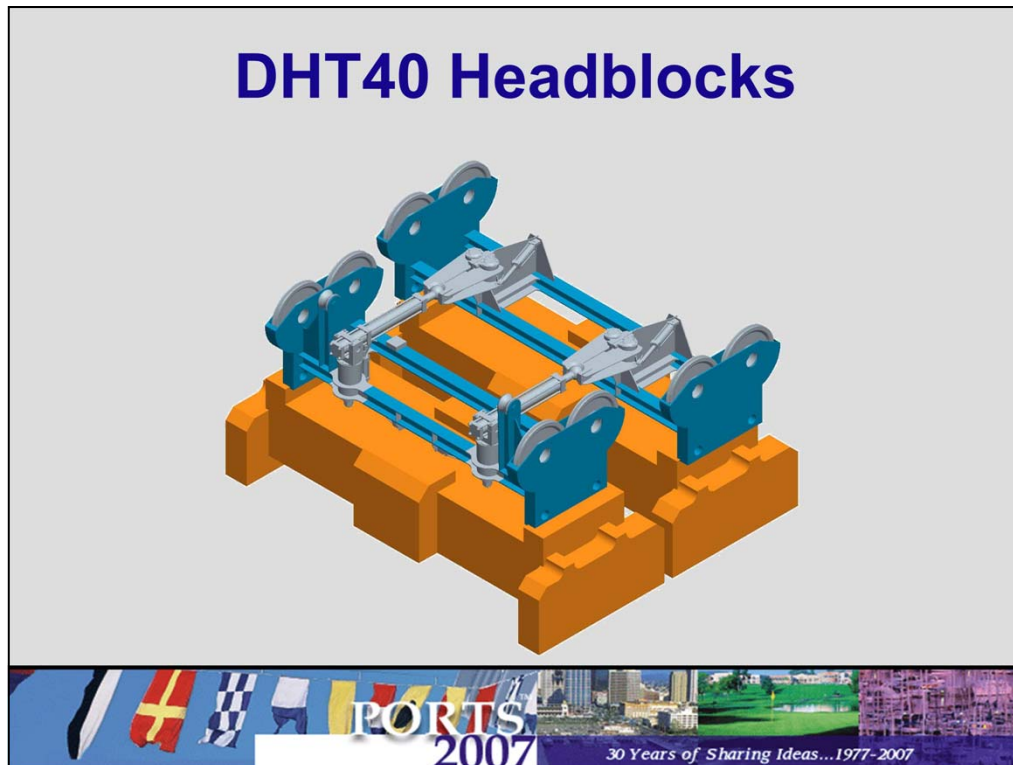
The major differences between DHT40 and single lift cranes are:

- Two Main Hoist Systems
- DHT40 Trolley
- Complex Dual Head Blocks
- Special Operator Controls



DHT40 trolleys are relatively conventional. They are longer to accommodate two sets of hoist sheaves. They also have headblock stowage brackets underneath.

Note the additional hoist set of ropes.



This is an example of a set of DHT40 headblocks. The headblocks include systems to allow coupling and uncoupling, and also separation between the headblocks.

DHT40 – Headblock Coupling



Headblocks uncoupled

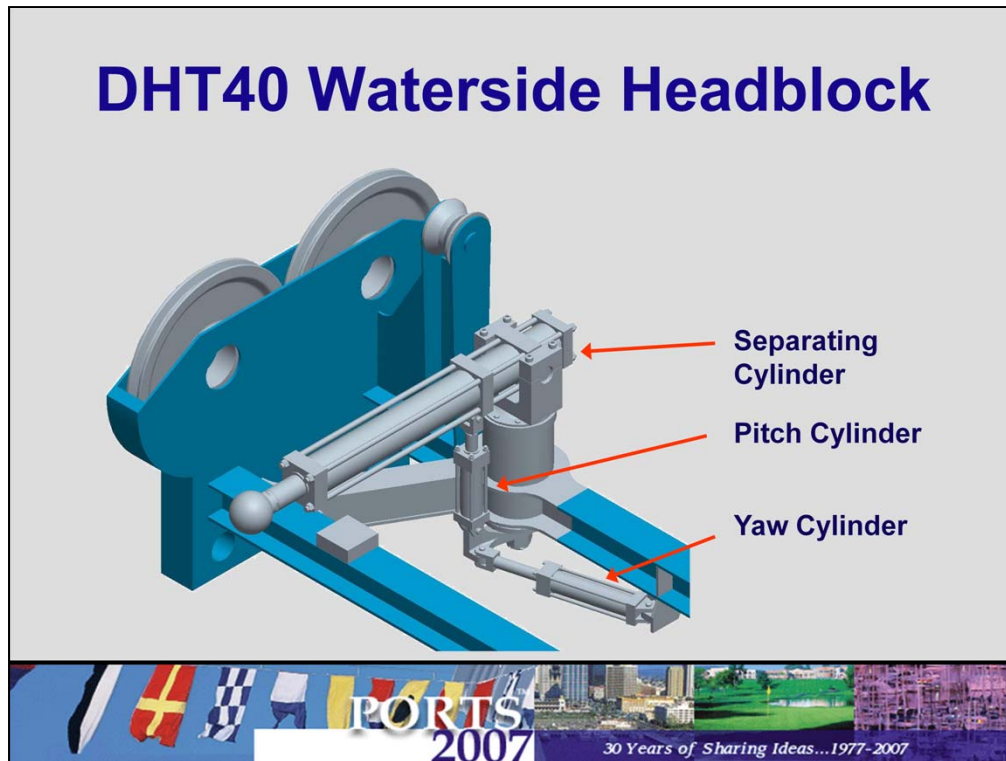


Headblocks coupled

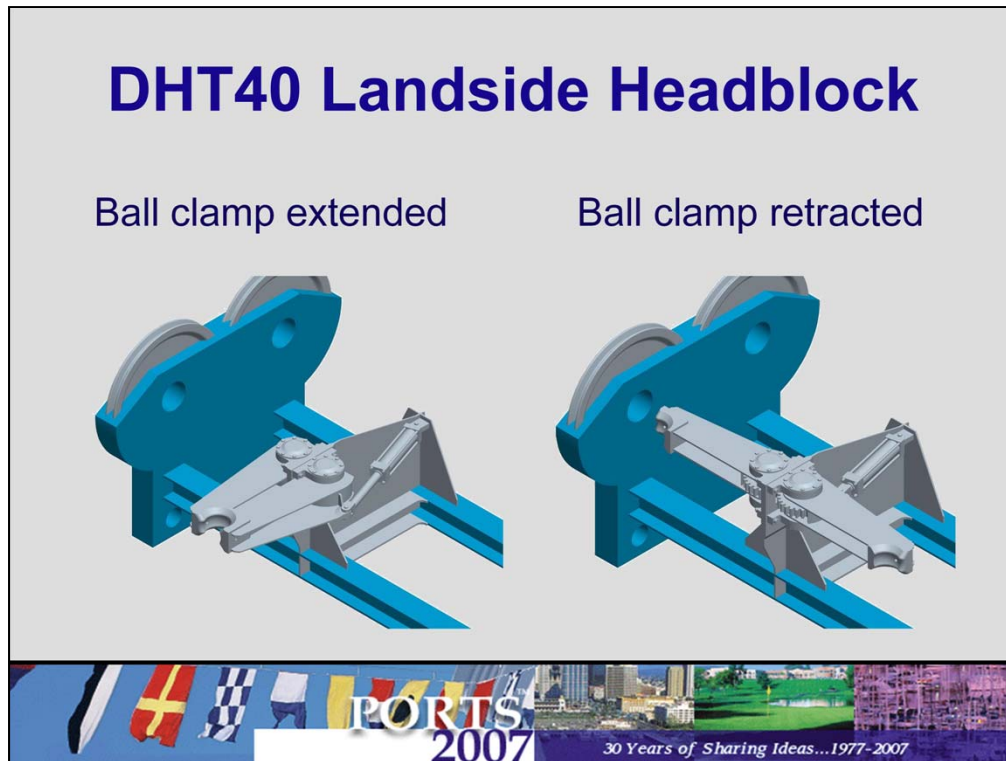


These photos show the headblocks coupled and uncoupled. The design shown uses a ball clamp.

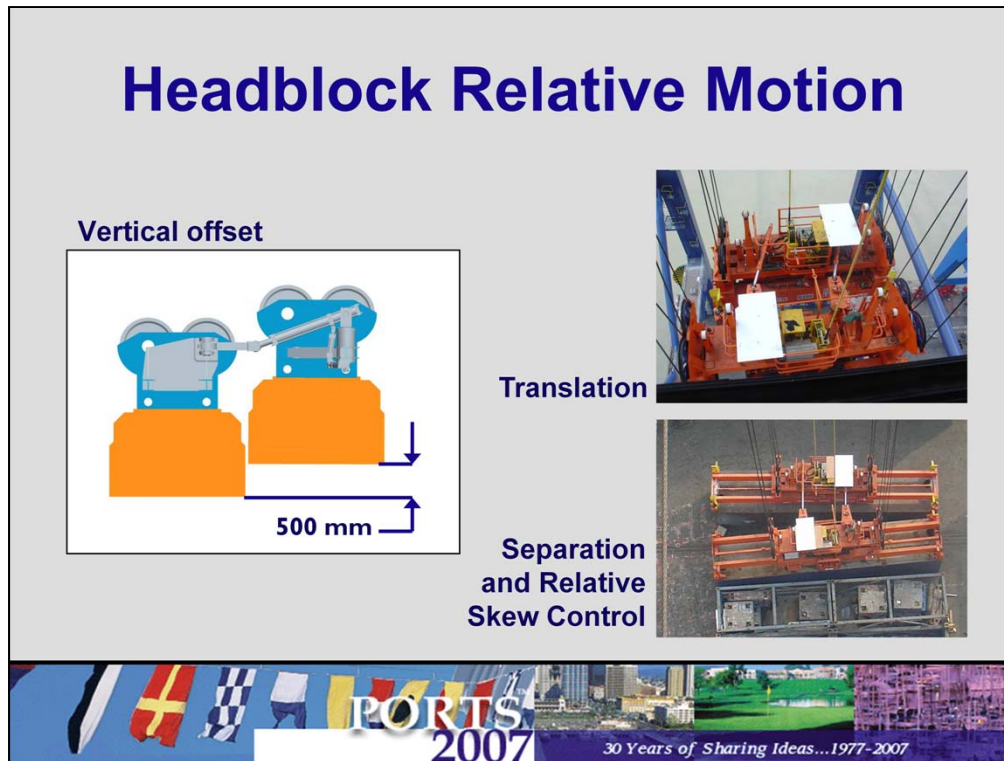
The large white spots are reflectors for a laser height sensor.



The waterside headblock has the ball, which is mounted on a hydraulic system to allow movement in three dimensions.



The landside headblock has the ball clamp. The clamp is designed to release the ball in a snag event.

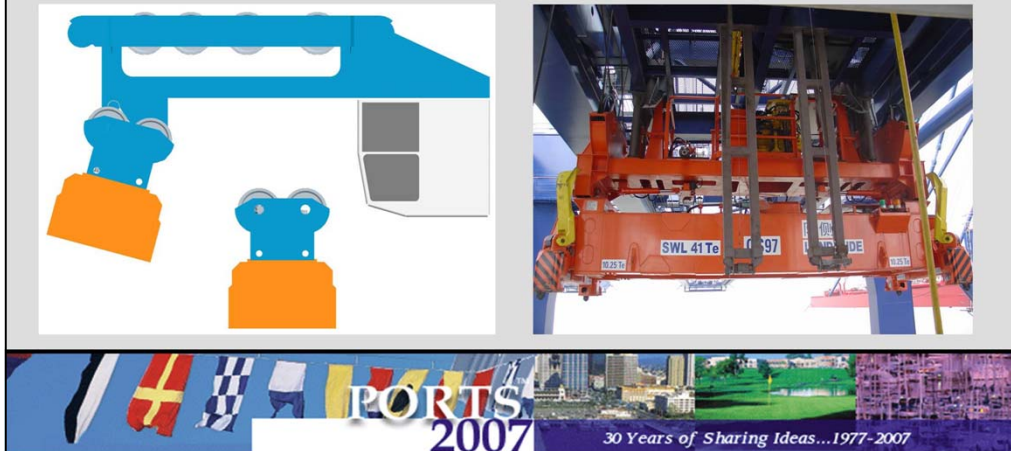


Relative movement between the headblocks is critical to efficient DHT40 operations. The headblocks can move relative to each other in the vertical, horizontal, and rotational directions. These movements allow the operator to pick and release the tandem containers.

500 mm of vertical movement allows the operator to handle uneven stacks without uncoupling the headblocks.

DHT40 – Headblock Stowage

For single hoist operation, unused headblock and spreader “two blocked” against trolley



For single-lift operations, the unused headblock is stowed against the underside of the trolley. This allows the operator to convert from single-lift to dual-hoist operations without assistance.

Typically, the waterside headblock is stowed, because the landside is more visible to the operator.



Productivities as high as ??? have been reported for DHT40 cranes. For optimum productivity, several conditions must be present in addition to an efficient crane design:

- Evenly stacked deck containers
- Equal height containers
- Properly positioned bombcarts
- Timely supply of bombcarts

DHT40 Challenges



At Vessel



At Wharf



In reality, these conditions may not be present. Delays can occur at the vessel and at the wharf.

As you can see, container stacks may not be level.

Also, at the wharf the operator may have to wait for yard personnel.

Terminal Related Considerations

- Increased yard traffic
- Improved truck coordination required
- Additional or wider traffic lanes
- Tandem bombcarts
- IBC removal
- Increased wheel loads and gages



Truck traffic delays will cause the crane operator to have to wait. Improved yard coordination, additional lanes, and tandem bombcarts may help reduce traffic delays.

Also, tandem terminals must consider IBC removal methods and the increased wheel loads for tandem cranes.

Same number of higher productivity cranes will require truck traffic. However, less cranes of higher productivity will allow same productivity, but with less cranes on wharf, which may improve traffic flow.

Tandem Bombcart



Tandem bombcarts avoid the problem of truck timing. Without tandem bombcarts, two trucks may not be available when the crane needs them. When this happens, the operator must wait, which reduces productivity.

If tandem bombcarts are used, then yard configuration and operation will require adjustment.

Inter Box Connectors



Headblock Separation



IBC Removal



For tandem twin-20 operations, IBC removal is difficult. Yard personnel must work between the two trucks, which is dangerous.

Headblock separation can be used to separate the containers. Alternatively, IBCs can be removed farther down the wharf if bombcarts are used.

Note the yard worker in the picture.

Continued Development of Tandem Systems and Operations

Crane functionality

Operator techniques and controls

Headblock interface

Terminal infrastructure and methods

Tandem bombcarts

IBC handling



Tandem crane systems and operations still require further development.

Crane functionality, including an increase vertical separation range of the coupled headblocks.

Operator techniques and controls – training with a DHT40 crane simulator may help with this effort. Also, experience will surely improve performance.

Headblock interface at the vessel and wharf

Terminal infrastructure

Tandem bombcarts

IBC handling methods

Triple 40



ZPMC has built a prototype triple-forty container crane.

It is possible that the tandem or triple forty cranes may become the standard for our industry. Only the future can tell.


Thank you

**Tandem 40 Dockside Cranes and
Their Impact on Terminals**

This presentation is available for download
www.liftech.net

Acknowledgements:
Larry Wright, McKay International Engineers Inc.
Yantian International Container Terminals
Dachan Bay Container Terminals
ZPMC
Michael Jordan, Liftech Consultants Inc.
Jonathan Hsieh, Liftech Consultants Inc.

Liftech
LIFTECH CONSULTANTS INC.

A banner for the ASCE Ports 2007 conference. It features a collage of images including a sailboat, a flag, a city skyline, and a port facility. The text "PORTS 2007" is prominently displayed in the center, with "30 Years of Sharing Ideas...1977-2007" written below it.

I would like to thank the following people for their help with this presentation. Larry Wright with McKay International Engineers, Yantian International Container Terminals, Dachan Bay Container Terminals, ZPMC.

This presentation, the paper, and other material are available at our website to download. See the paper for references and more information.

If you have questions, I can take them now.



DHT40 – Dual Hoist Tandem 40



Dual Hoist Tandem 40



Two Main Hoist Systems



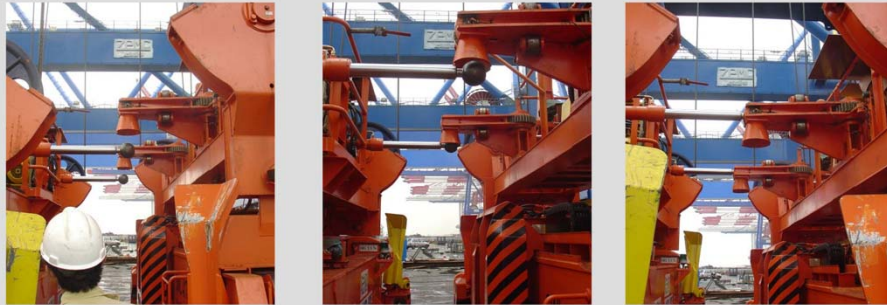
Waterside Hoist
Drive

Landside Hoist
Drive



Headblock Coupling

Strategy used in cell guides and deck containers



Operator Controls



Left Console



8 Foot Switches



Right Console



ZPMC DHT40 Cranes

	<i>PRC</i>	<i>Other</i>	<i>Total</i>
<i>Delivered</i>	<i>37</i>	<i>10</i>	<i>47</i>
<i>On Order</i>	<i>31</i>	<i>49</i>	<i>80</i>
<i>Total Capacity</i>		<i>80t</i>	<i>90%</i>
		<i>100-120t</i>	<i>10%</i>

ZPMC Data - January 2007



Crane Weights

	Single Lift 61t	DHT40 80t	Increase
Dead Load	1455t	1860t	
Trolley	27t	50t	
HB + Spreader	18t	40t	
Total	1500t	1950t	30%

Rope Towed Trolley Crane in Hurricane Area



Copyright 2007 by Liftech Consultants Inc. All rights reserved.

This material may not be duplicated without the written consent of Liftech Consultants Inc., except in the form of excerpts or quotations for the purposes of review.

The information included in this presentation may not be altered, copied, or used for any other project without written authorization from Liftech Consultants Inc. Anyone making use of the information assumes all liability arising from such use.

