Tandem 40 Dual Hoist Cranes and the Floaterm Concept

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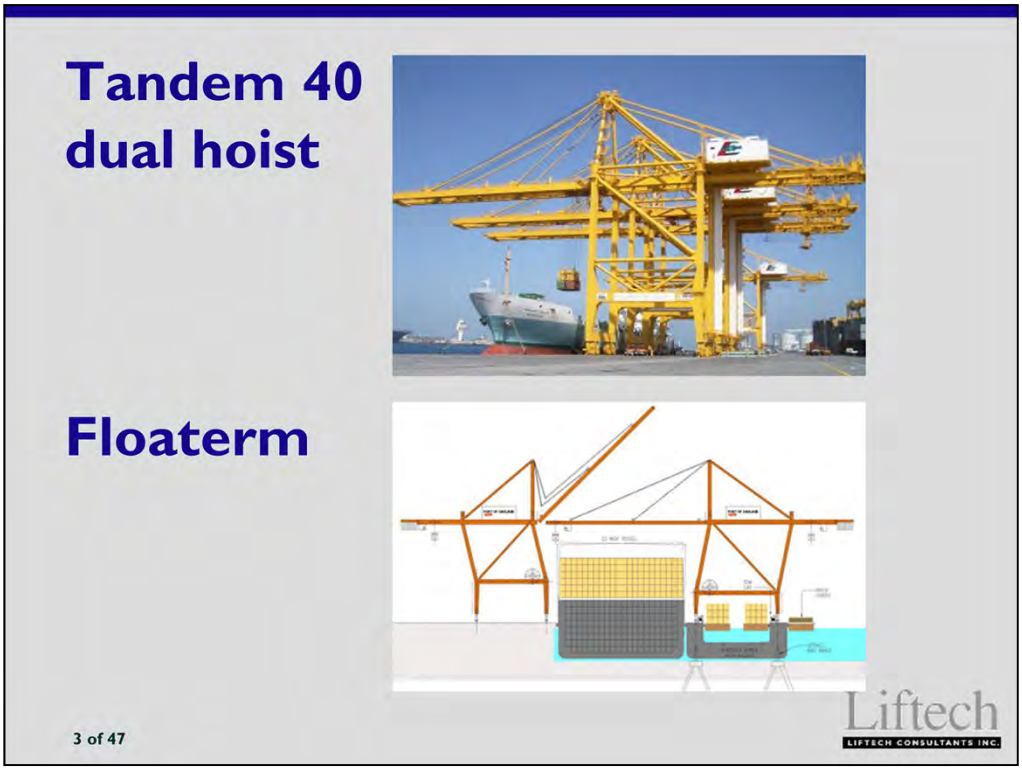
The Port of Oakland Berths 55-59 cranes are some of the world's largest single hoist container cranes. Now, even larger and heavier cranes are being designed and are in operation.

In 1959 Matson Navigation Company awarded Paceco a contract for the world's first dockside container crane shown in the foreground. Concurrently, Matson also developed the design of the first ship built to be a "Container Ship."

Today's speaker was fortunate to be a member of the engineering team that developed the first dockside crane, and the first container ship.

Now, cranes are over three times larger in size and five times greater in weight than the Matson-Paceco crane. Ships are many times larger than the Matson ship, yet the vessel time at berth is less. Improved designs and improved operations have made this possible.

More improvements are needed to resolve the current congestion problems we face. Further improvements will be necessary to avoid more serious congestion problems in the future.

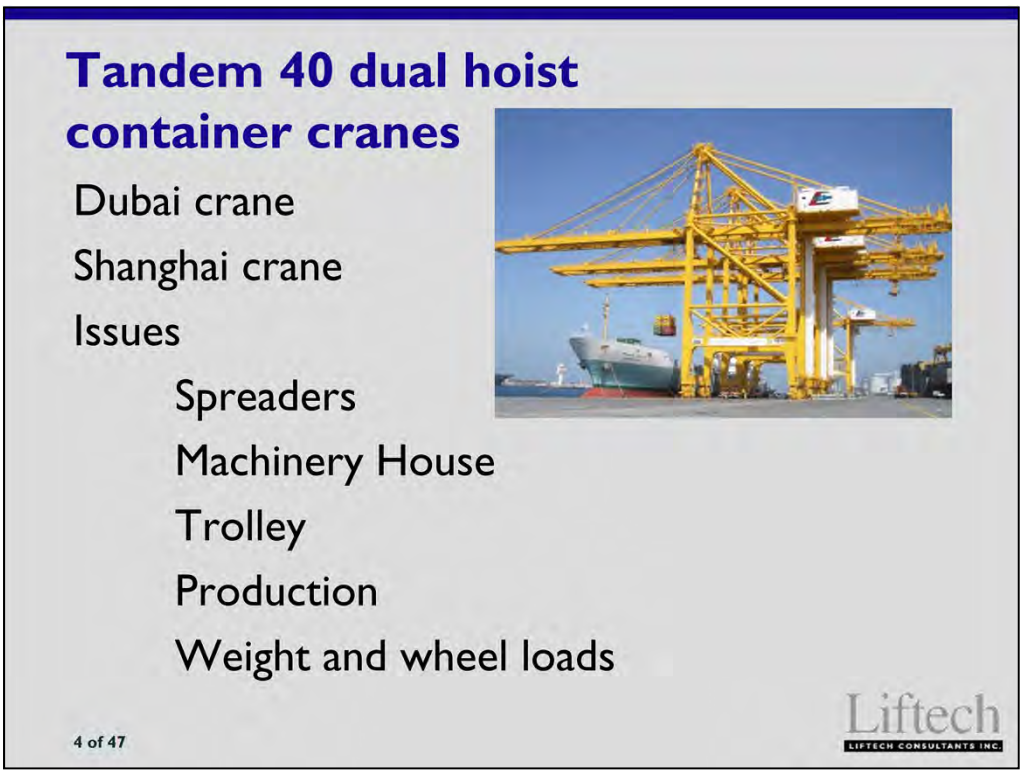


This presentation discusses two of the many designs being developed to reduce the vessel time at the berth. One design is already in use and one may be in use in the future. Many other concepts and issues are important but not addressed here, such as automation.

Today we will discuss two designs:

Tandem 40 Dual Hoist Cranes – Cranes that lift two forty-foot containers in tandem.

Floaterm – A scheme to service vessel midstream or to increase vessel to shore throughput.



Two existing tandem 40 cranes will be shown; the Port of Dubai cranes and the Shanghai cranes.

The tandem 40 design issues include:

Spreaders
- The spreaders must be controlled relative to each other at all times.
- They must be able to adjust to the vessel and shore conditions.
- They must not be damaged by a snag event.

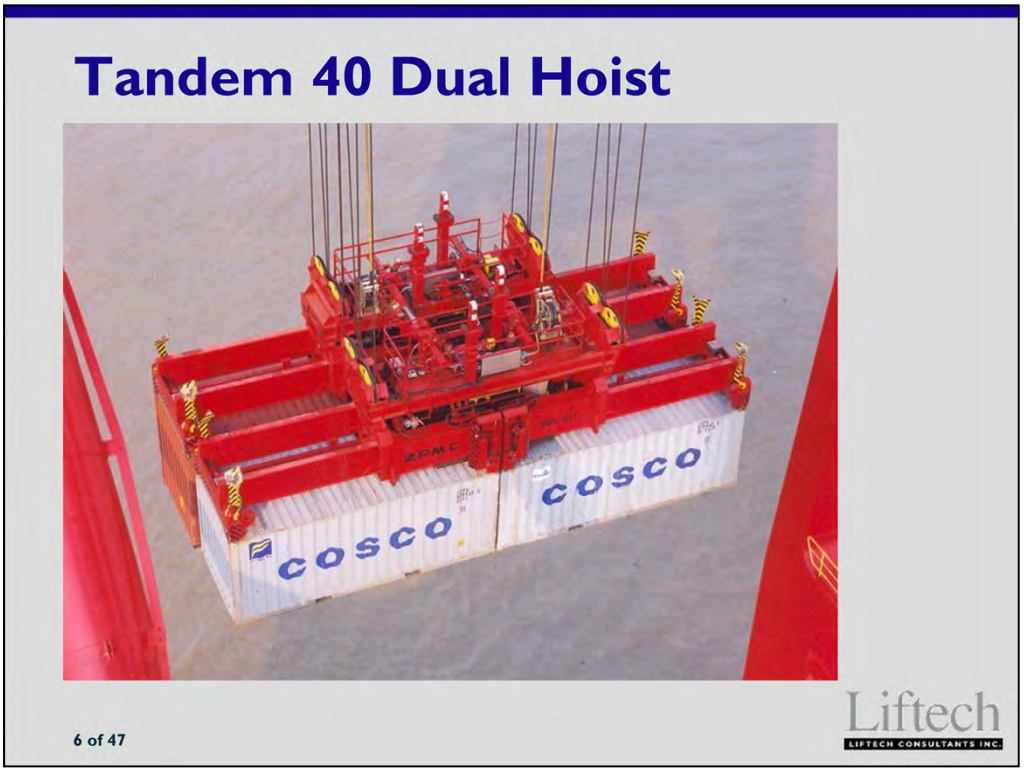
Machinery House
- Two main hoists are needed. Should they be independent or combined?

Trolley
- Should there be two trolleys with two operators, or should there be one combined trolley with one operator?
- Should the trolley be able to operate efficiently in the single lift mode?

Production
- What will the increase in moves per hour be?
- Will the yard be able to keep up with the crane?

Weight and wheel loads
- How much?

Some tandem containers are handled with one headblock and two spreaders. The single headblock tandem lift system has a significant disadvantage of needing to be balanced.



Some tandem 40s are handled by two independent, but sometimes connected, headblocks and spreaders. Balancing is not required.

ZMPC has provided dual hoist tandem 40 cranes to the Port of Dubai. These cranes are conventional and do not have special IBC connection removal platforms or a shore hoist.

The cranes designed by ZPMC for operation in Bremerhaven, Germany, have platforms and a shore hoist.

Dubai tandem 40

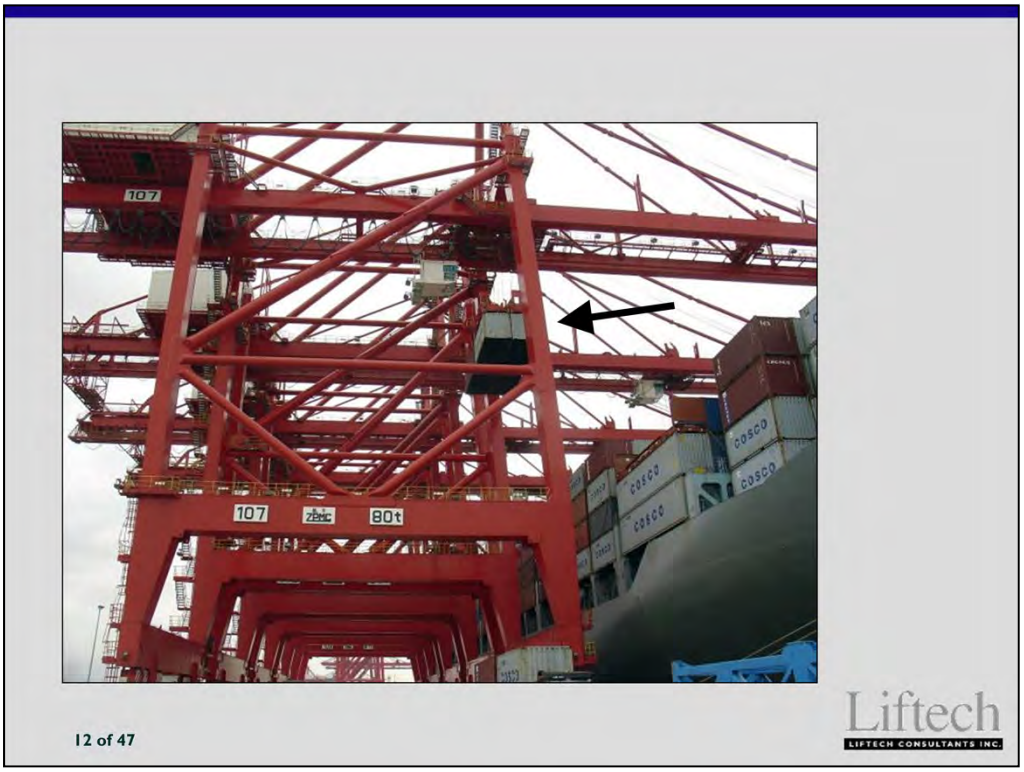
Tandem trailers are also used in Dubai.

Notice the bomb carts allow for IBC removal after the crane sets the containers.

The ZPMC crane in Shanghai, China is the first tandem 40 dual hoist crane.

Many features on this crane will be used on future cranes. Some features will be improved. The rated load for some tandem 40 dual hoist cranes is 120 long tons.

The next series of slides present the arrangement of the trolley and containers during dual hoist tandem 40 operations.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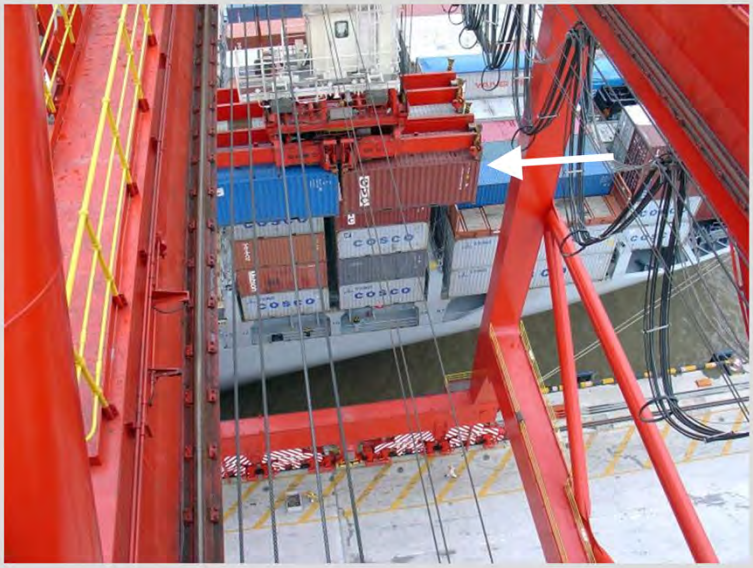
Twin Tandem 20s



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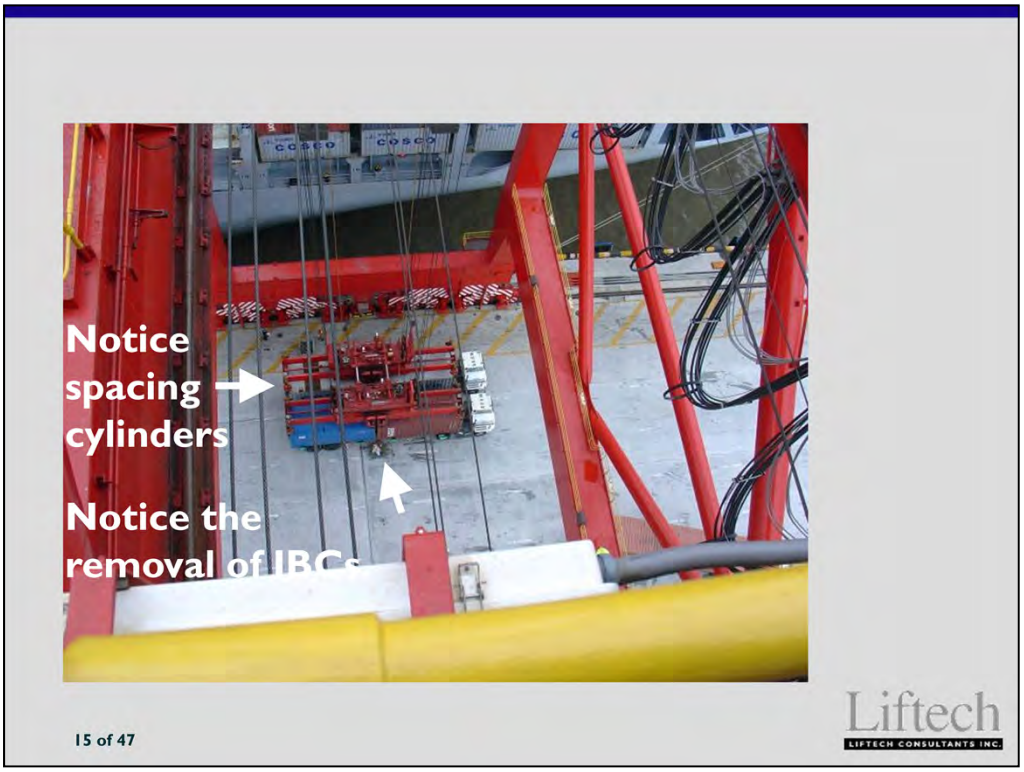
Two tractors and chassis have been positioned to receive the containers. Good drivers can position the two chassis as fast as one and still meet the geometric requirements of the crane.


Notice spacing cylinders
Notice the removal of IBCs
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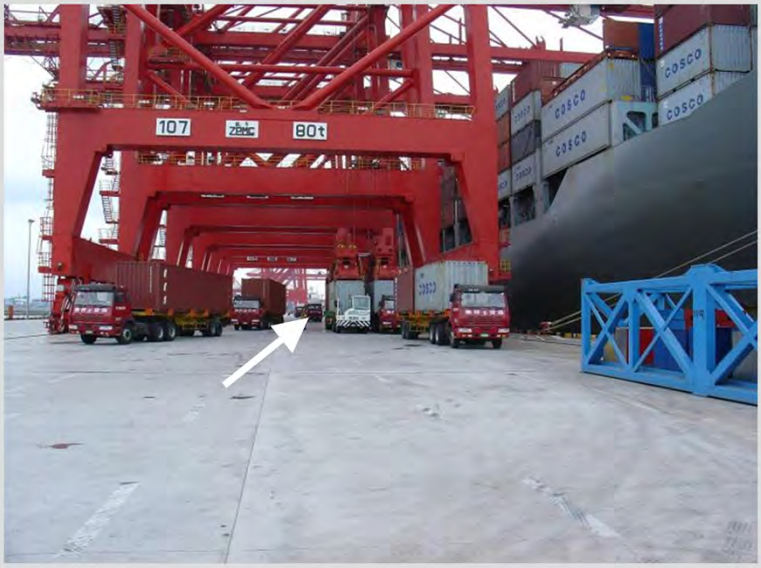
Lowering to Chassis



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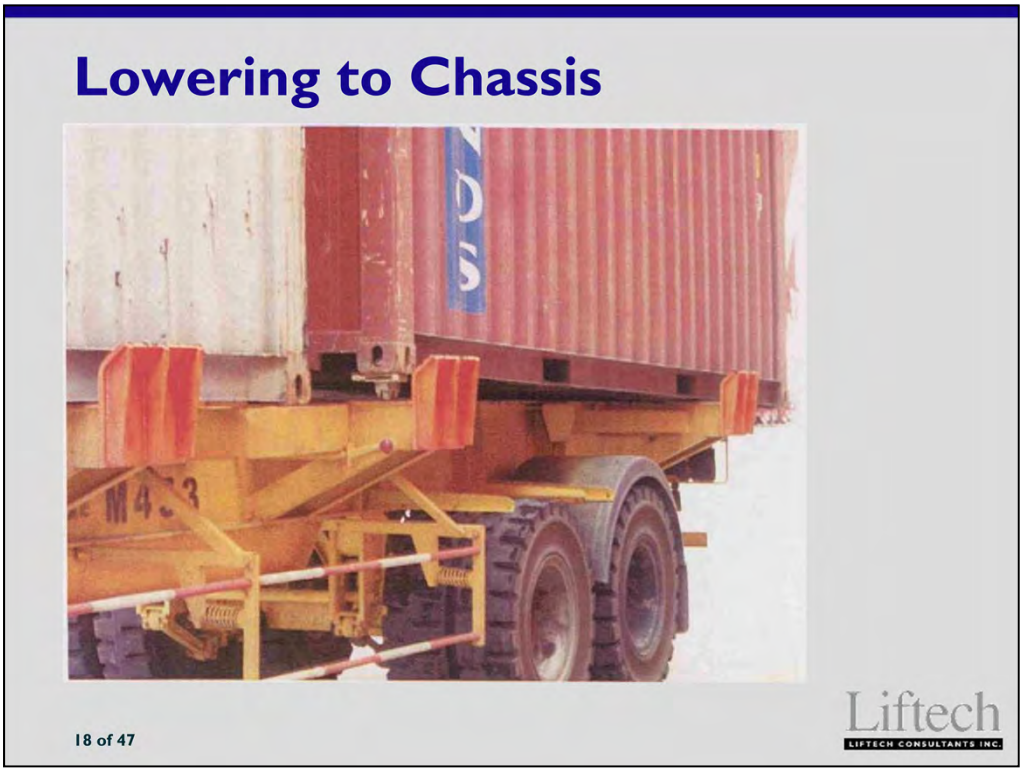
Removal of the interior IBCs is a problem. They can be removed at the crane, as shown here; removed at special platforms on the crane; or in the backlands.



Notice the problem: The IBC is sitting on the chassis.

IBC Removal

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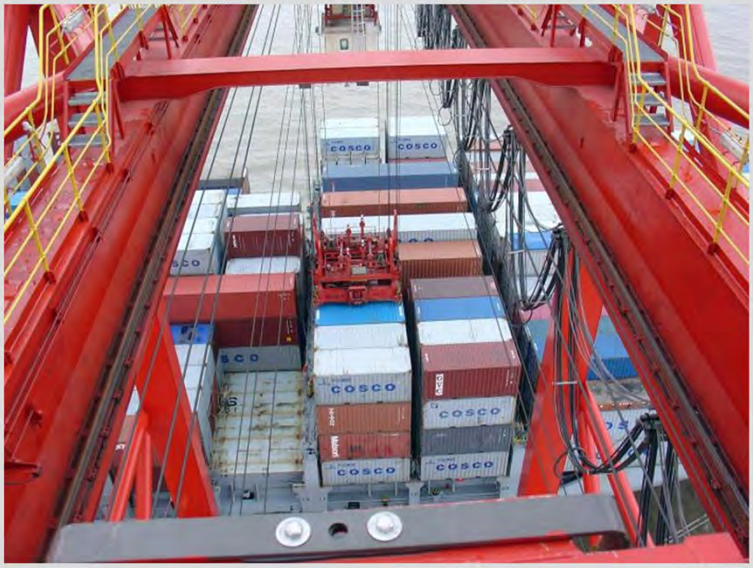
The crane can handle single 20s while both spreaders are attached, or the second spreader may be locked to the trolley in the idle position.

While the second spreader is locked to the trolley, the crane operates like a single hoist conventional crane.

Tandem 20s



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Notice
spacing
cylinders
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Each headblock is connected to its captive spreader in the usual way.

The headblocks include special cylinders to position them to each other. The connection between the headblocks must release quickly, in less than 0.1 second, if one spreader snags in the ship's hold.

To accommodate different height containers, the cylinder allows for a headblock elevation difference of about 18."

Spreader Spacing Cylinders

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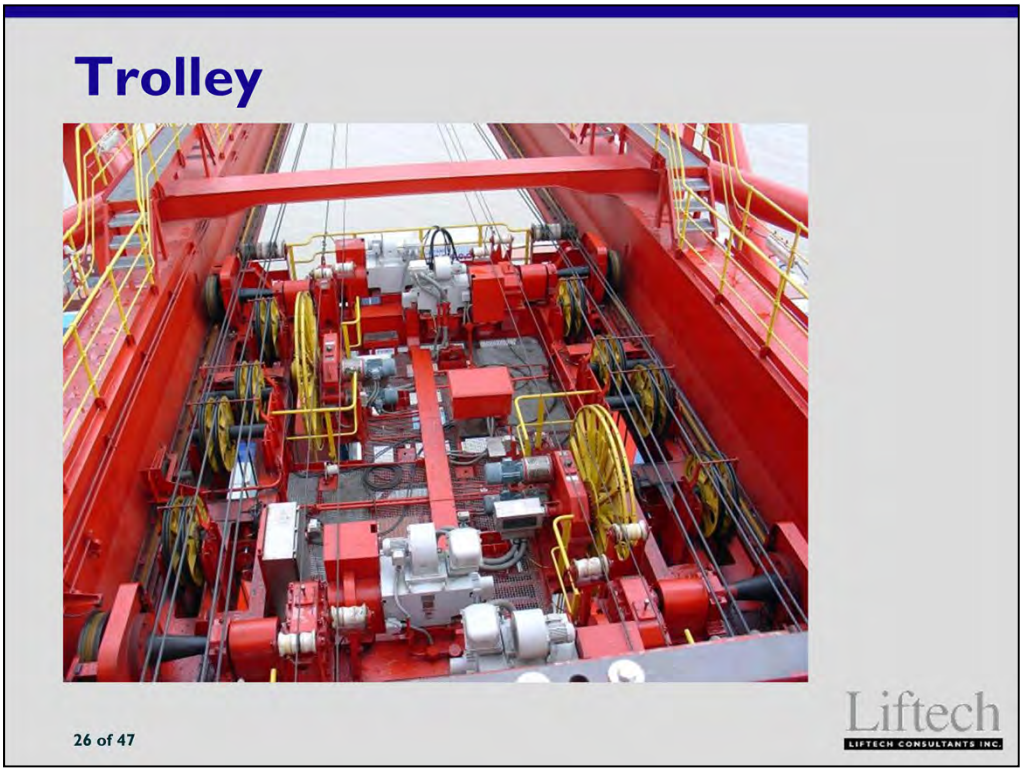

The trolley – a duplex of a single hoist rope trolley.


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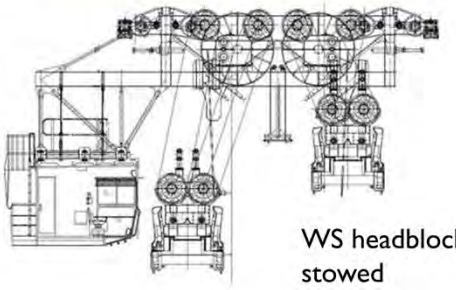
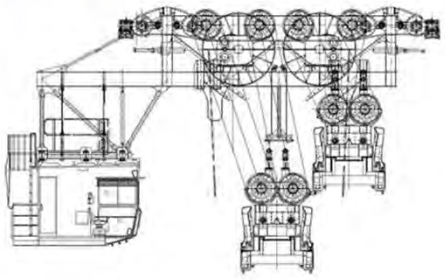
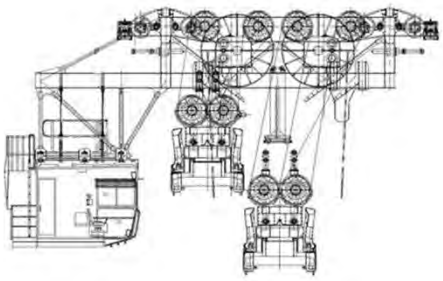
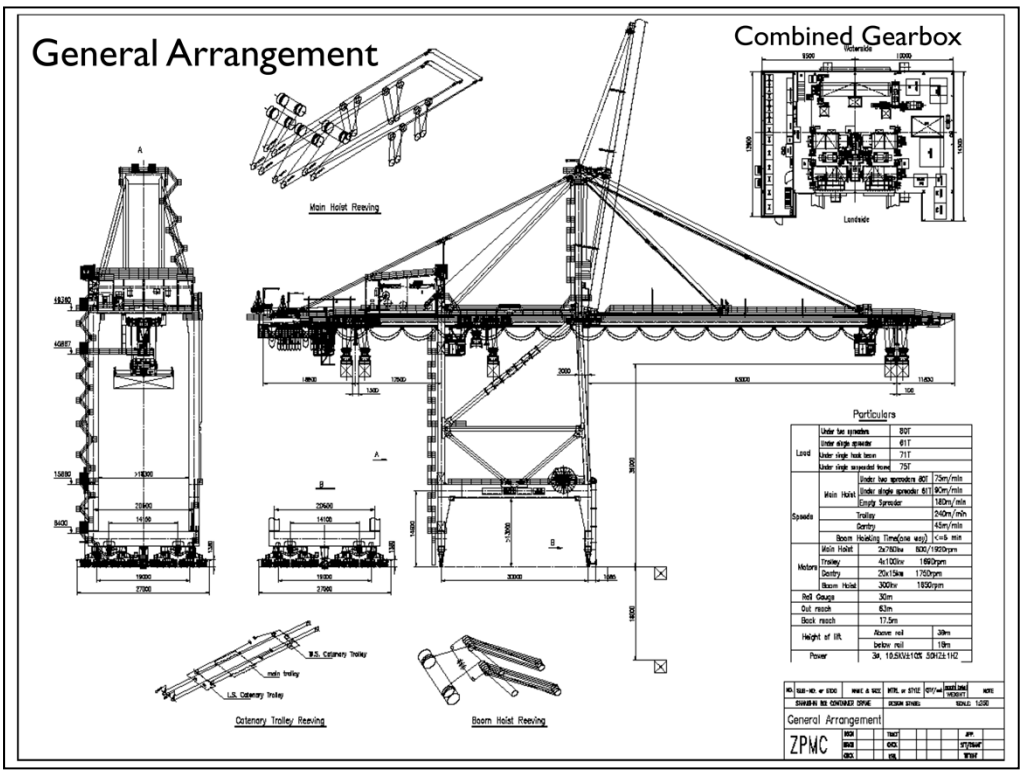
Trolley Arrangement



WS headblock
stowed

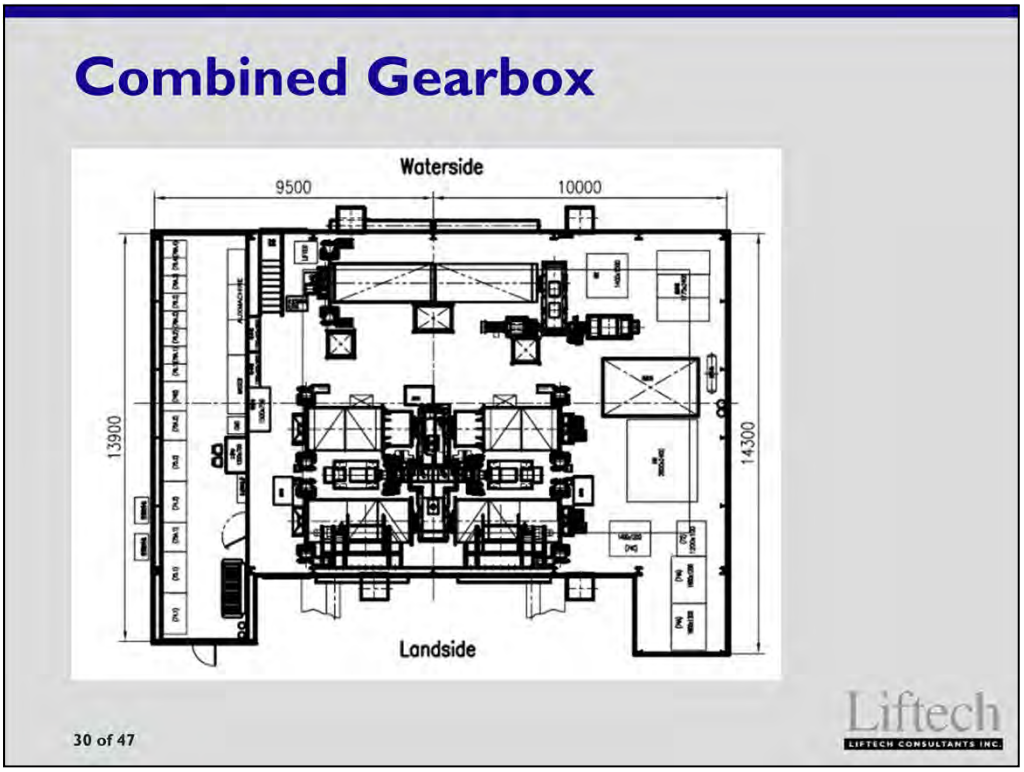






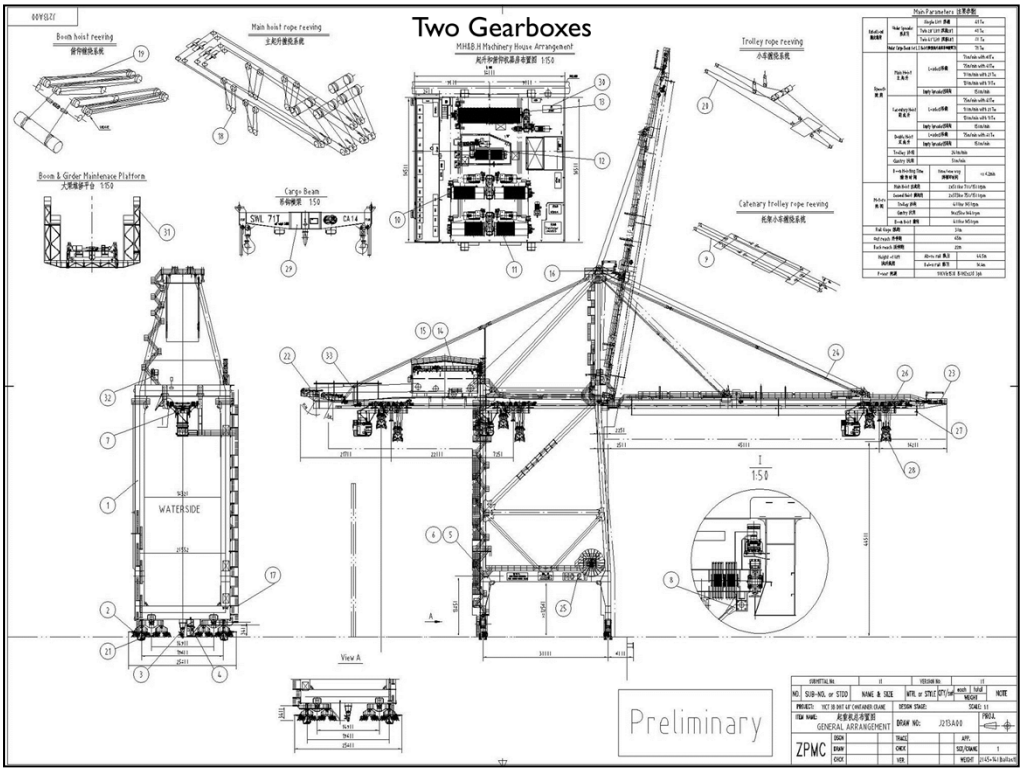
The following arrangement is of a tandem 40 crane with a single, combined gearbox for both hoists.

The combined gearbox must operate all the time, even when lifting a single container.

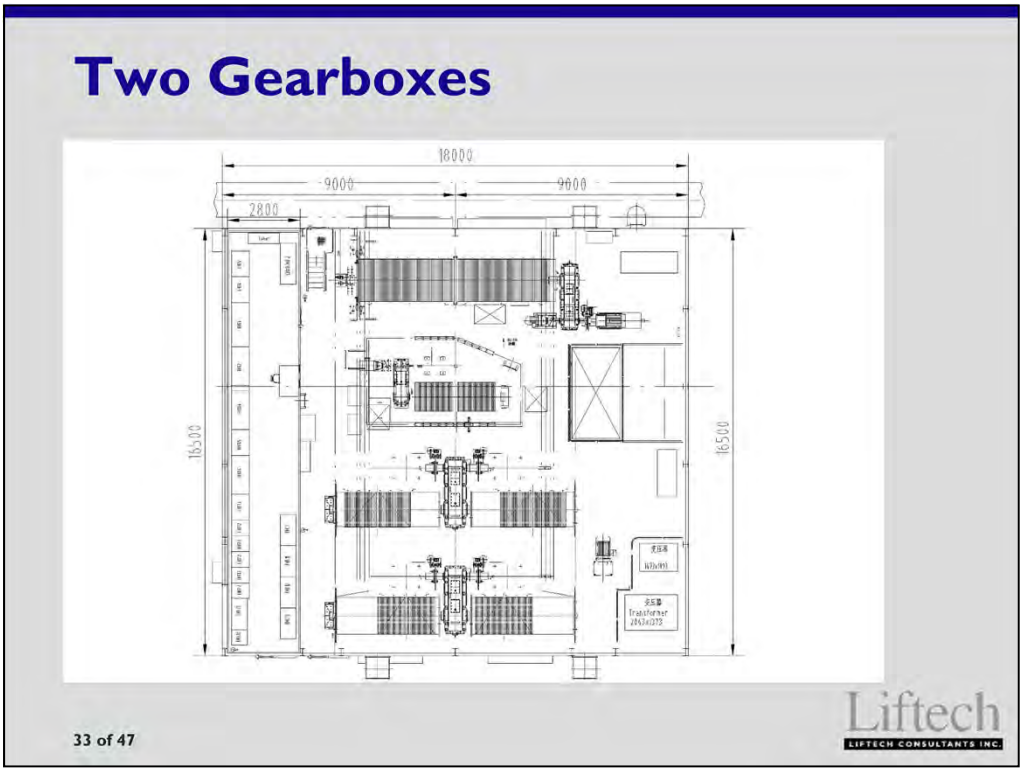


The combined gearbox design cannot be easily converted to a single hoist system.

Large combined gearbox



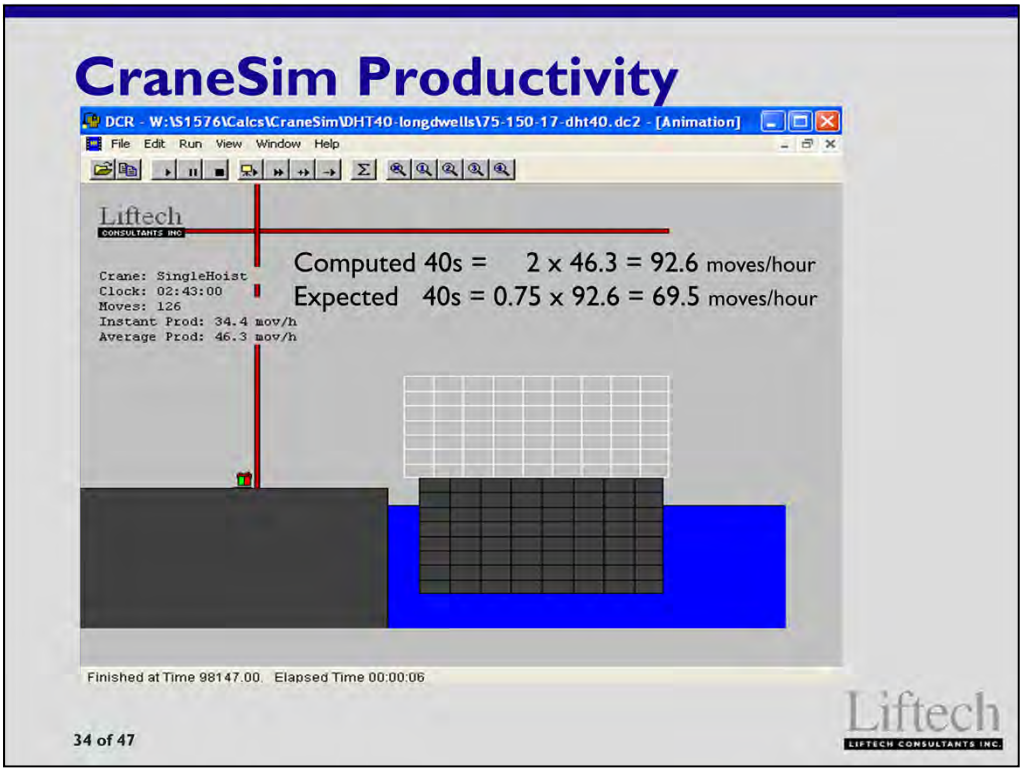
The following arrangement is of a tandem 40 crane with two conventional hoist systems, i.e., two hoist gearboxes.



With two gearboxes, the crane can be operated similarly to a conventional single hoist crane.

Why is this a consideration?

This design permits use of conventional machinery and allows the option of adding the second hoist machinery in the future. The capital risk is less with the independent gearboxes.



The theoretical productivity calculated by Liftech's CraneSim indicates tandem 40 production is approximately 80% greater than the single 40 production for 18-container-wide ships.

Actual production is usually about 70-80% of the CraneSim calculated theoretical production due to yard delays, crane movements, etc.

A Few Statistics

Crane	Single Hoist 65 lt capacity Oakland B55	Tandem 40 Dual Hoist 80 lt capacity Yantian, China
Weight metric tons	1300	1800
LS / WS Factored Operating Rail loads kips/ft	35 / 55	55 / 70
40s per hour	30 – 45	45 - 70

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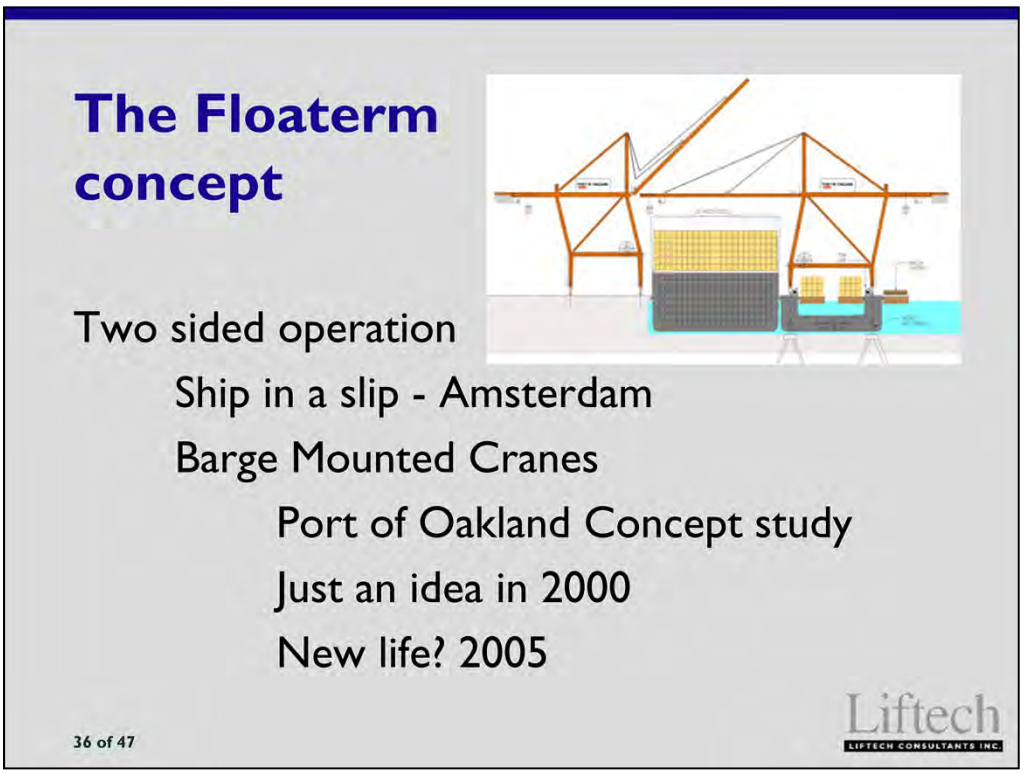
120 long ton capacity cranes will be about 5% heavier than the 80 LT capacity crane.



Operating cranes on both sides of a vessel has been discussed for years. The Amsterdam “Ceres Terminal” is the only such location in existence. This terminal has not been fully operational. The results in Amsterdam will, no doubt, influence the acceptance of two-sided operations.

The concept of two-sided operations, using water based cranes, has been explored by Liftech, Dr. Ashar, and others.

Two-sided operations will probably not be tried again until the Ceres Terminal is proven to be effective.

Double the Moves?

Amsterdam ship in a slip

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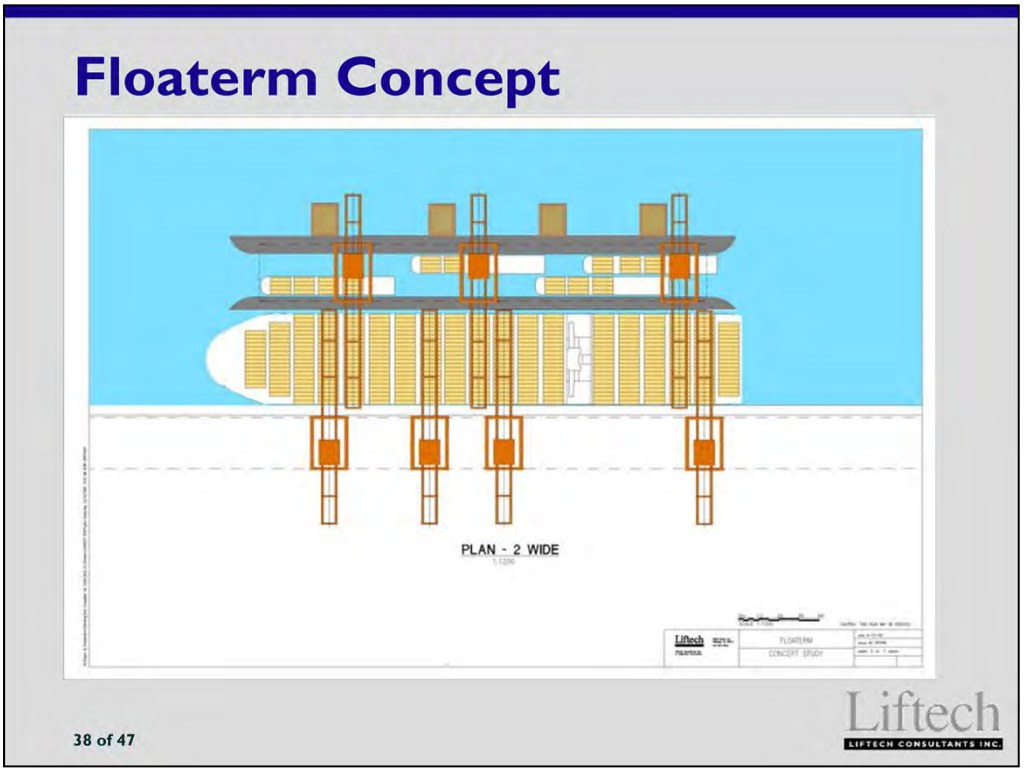


The floating terminal concept widely discussed in the late 1990s and early 2000s is being discussed again. Some references from the circa 2000 discussions include:

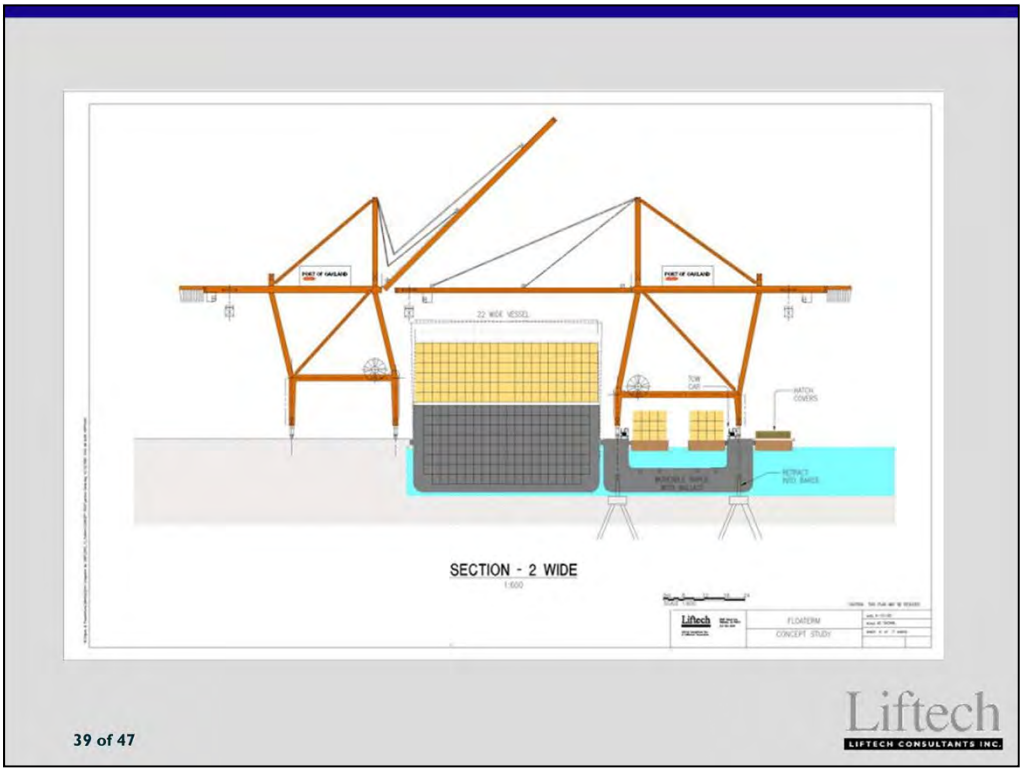
“The Fourth Revolution,” Dr. Ashar, Containerization International (CI), December 1999

“2020 Vision,” Dr. Ashar, CI, January 2000

“Revolution Now,” Dr. Ashar, CI, 2002

The concept in this presentation was done for the Port of Oakland in 2000 and involves barging containers to a rail intermodal location far from Oakland.

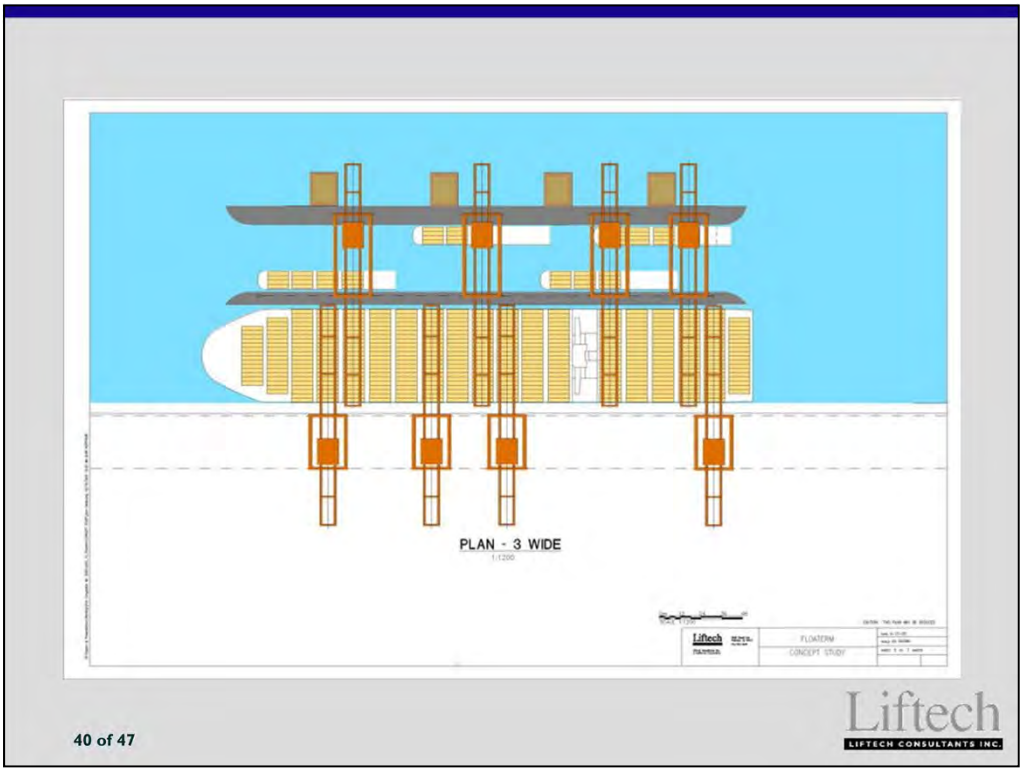
This concept provides one solution for solving the floating terminal stability problem.



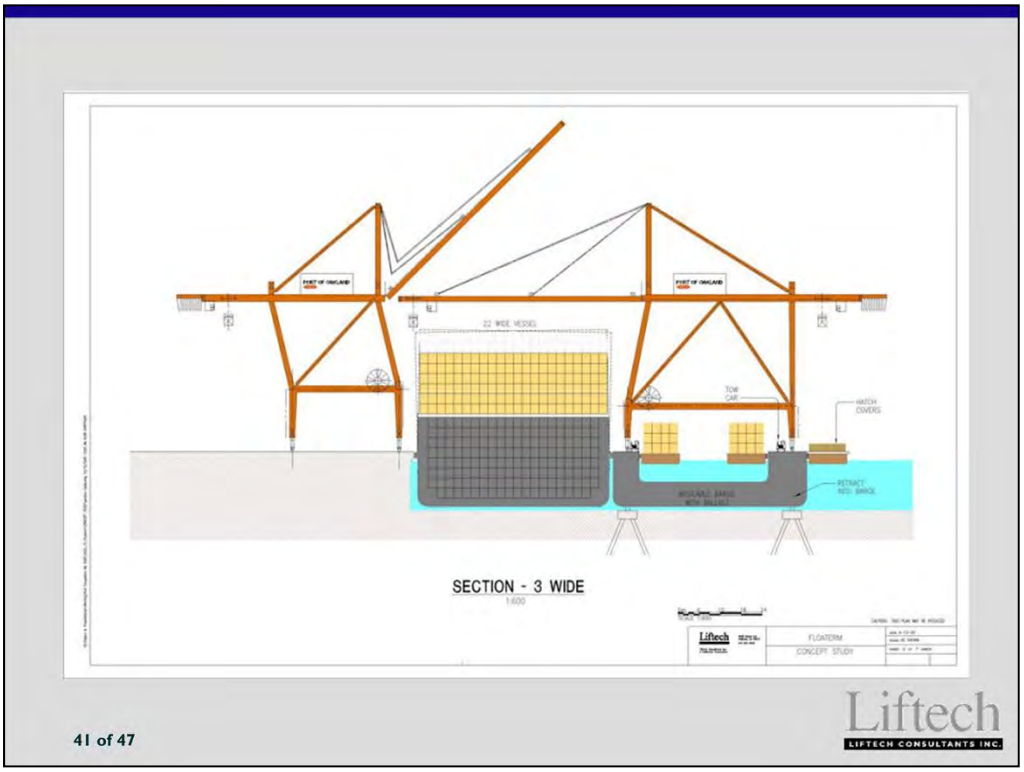
In this Floaterm concept, stabilizing spuds are extended from the barge to recesses in the support structure. Water jets clear conical depressions in the support pads. The spuds only carry the tipping loads and do not carry a significant portion of the balanced load.

Stabilization is required to eliminate barge movements induced by both waves and container handling.

Liftech calculations indicate that this concept is practical and the loads are reasonable.



The center waterway provides space for barges to pass one another.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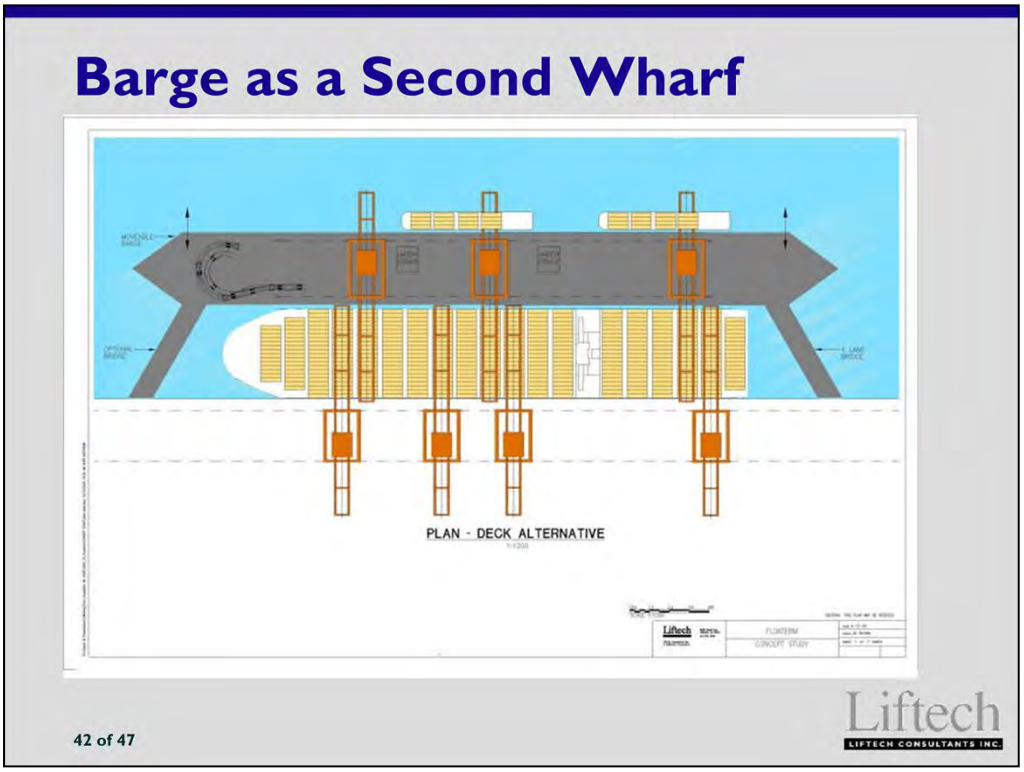
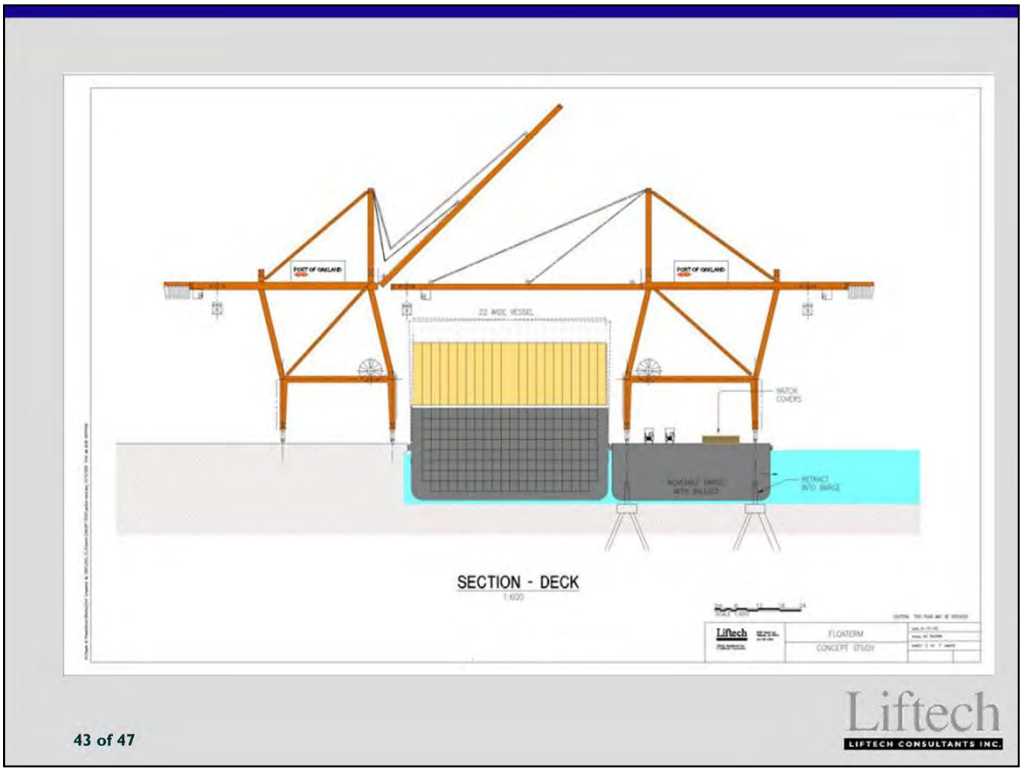
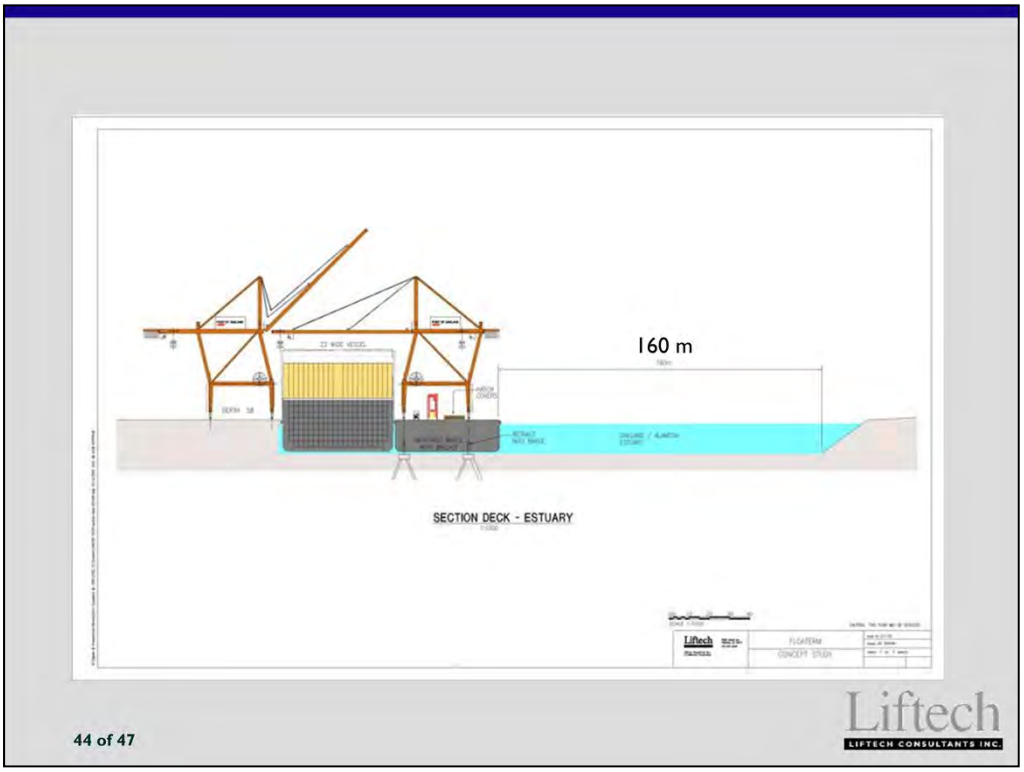


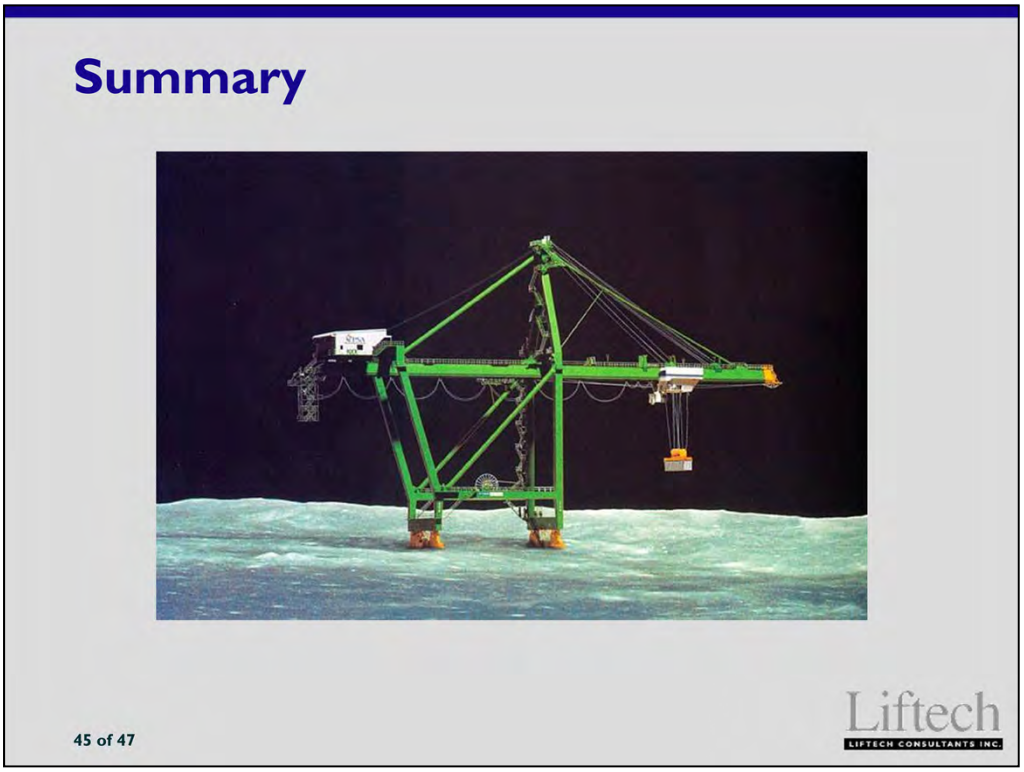
Bridges can be designed to be attached to, and lowered from, the barge; partially pontoon supported; or both.



Hatch covers can be stacked on the primary barge as shown, or on secondary barges that can be placed waterside of the primary barge for stacking hatch covers.



This section shows the remaining Port of Oakland estuary clearance at Berths 55-59.

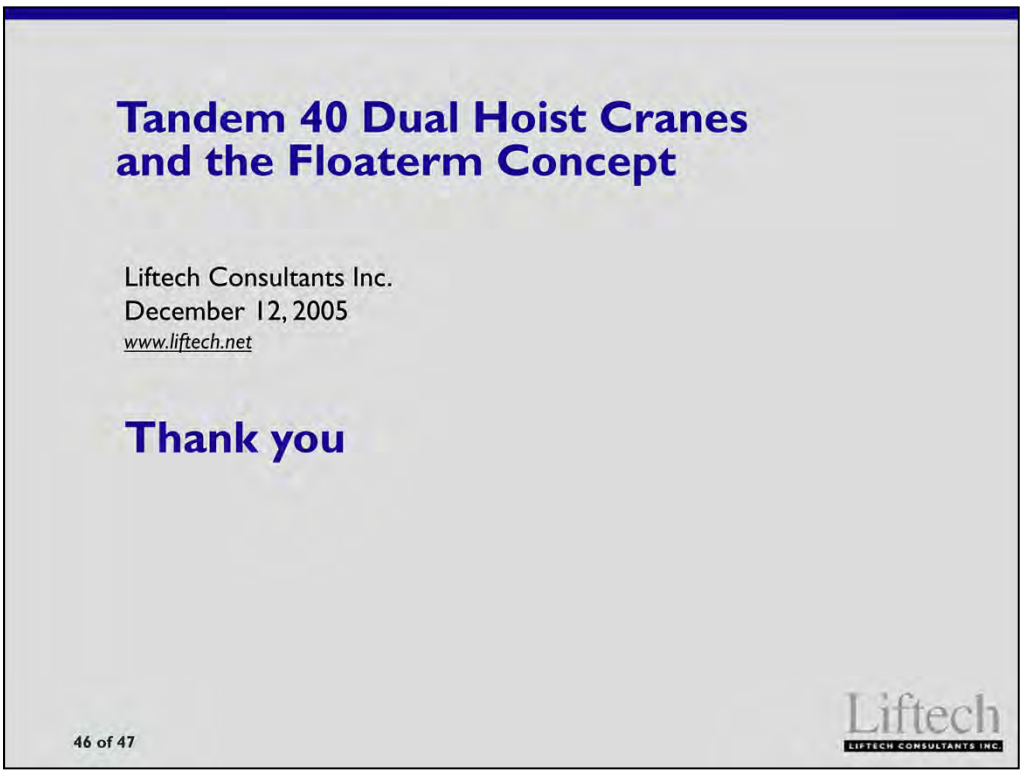


Dockside cranes will continue to be larger and more productive.

Two designs that will significantly increase crane productivity have been presented today:

Tandem 40 cranes with potential production of 50 or more moves/hour, a system in the infancy stage of development.

Floaterm: a concept with production of 60 to 70 moves/hour per pair of opposite cranes.



Feel free to contact us with questions.

Thank you.

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