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LIFTECH CONSULTANTS INC.

Jumbo Crane

The jumbo ships are coming: 9000, 12000, even 15000 TEUs. We will need ways to transfer containers between jumbo ship and quay and between quay and yard, rapidly *and* economically. Liftech and Jordan Woodman Dobson have been wrestling with these challenges for 30 years, but never before has it been so interesting.

Today, we have much better tools. Controls, lasers, optical devices, and computers have advanced, enabling a new look at ideas that were too complicated to manage just a few years ago. One idea that we have looked at again is a conveyor crane.

Early on, we realized reversing motions were undesirable and buffers were needed between operations to absorb delays. We attempted to develop a conveyor system, but met so many practical difficulties: controls, staffing, the removal of the interbox connectors, and the need for the conveyor to be 15 meters wide. We never developed a practical solution, then.

Times have changed. Our second look addresses all the difficulties and results in the jumbo crane shown.

What is the jumbo crane?

A very large crane for very large ships, although it could be scaled to service 9100 TEU ships. Its components are:

Ship operator's cab (1)

> The independent cab rides under the boom on the waterside of the hoist. The crane operation is semiautomatic. The operator controls the ship hoist only when the spreader interfaces with the ship, otherwise the ship hoist is automatic. The shore hoist is also automatic. If needed, a shore operator's cab can be located landside of the shore hoist.
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> The operator may make an emergency exit at any position using a ladder from the top of the cab to continuous walkways on the boom.

Rotating ship trolley (2)

> The ship trolley transfers containers between the ship and the carts. The trolley also handles the hatch covers.
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> The main hoist house in the trolley rotates 90° while the container is being hoisted. Notice the machinery arrangement is unusual. This reduces the size of the house, so the distance between the girders is kept to a minimum. The girder spacing must allow for the required distance between the main falls, about 5100 mm. This distance is needed to handle two twenties, one loaded and one empty, without the excessive tilt a rotating spreader would allow.
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> The house roof opens for full access to all machinery. A maintenance crane is not required in the house.

Power can be supplied by a festoon system, collectors, or a power chain. The power train needs to extend only to the IBC platform, since the ship trolley never passes the IBC platform.

Small conveyor carts (3)

The carts are identical and move independently, each driven by small motors. The carts can carry one end of a single container or the adjacent ends of two containers, e.g. twin twenties.

The carts can receive power and signals through the rails, a induction loop, or collectors.

IBC handling platform (4)

The interbox connector platform extends across the girders. The working conditions for the IBC handlers are comparable to or better than those on the quay. The platform can be enclosed, if necessary, to protect the handlers during inclement weather.

Containers are automatically lowered by the shore trolley to the platform. The handlers can stop the operation at any time. When ready, the handlers press a button to continue the cycle.

The IBCs are returned to the ship by the ship trolley.

Shore trolley (5)

The shore trolley picks the container from the carts at the IBC platform. The carts spread to provide clearance. The landside cart continues to the elevator.

The drawing shows a rotating trolley. Containers can be set in rows perpendicular, parallel, or at an angle to the quay.

Crane wheel system (6)

The traditional heavy and complex conventional equalizer system is not required on new quays. The crane rail joints are welded and mounted on elastomeric pads. The deflected shape of the quay and the crane can be accurately predicted using computer analysis.

The independent trucks transfer their load through elastomeric pads under the sill beam. Each truck may be easily removed for maintenance and repair.

Strad transfer point (7)

The containers are automatically set on the quay, to a maximum of two high. The strad paths can be along the quay or perpendicular to it. Since the strads are not confined between the crane legs, the yard operation will be much more productive.

Buffers (8)

One of the most important features of an efficient production line, whether it be in a factory or a terminal, are buffers where containers can be stored while a variable time operation takes place somewhere along the line. Local delays do not delay the line.

One buffer is between the ship hoist and the IBC platform. If, for some reason, the IBC operation is delayed, the ship hoist can continue to operate without delay.

A second buffer is between the IBC platform and the quay. If a strad is slow, the shore trolley can operate and wait near the stack.

A third buffer is the stack itself. If a strad is late the shore hoist can still stack containers.

The various local delays are not cumulative.

Quay (9)

The waterside crane rail is shown set back from the waters edge to allow for access to the ship. The rail gage is 25 meters to allow room for the hatch covers and maintenance vehicles between the legs.

The crane loads on the quay are relatively high. But the increased cost of a new quay is relatively low.

How productive is the jumbo crane?

The production will be controlled by the lowest of the following four rates:

Ship hoist cycle time

This is the time to pick a container from the ship, raise and rotate it, and set it on the carts, and for the carts move it out of the way so the ship hoist can lower the spreader. The time to rotate is a delay only for the top rows of containers. Since the hoist rotates and lifts simultaneously, the rotation is not a delay for most lifts. The guides on the carts and cushioned corner landing pads keep the setting time to a minimum.

It will take about 5 to 6 seconds to set the container on the carts and another 5 to 6 seconds to move the container out from under the spreader.

The square cycle also adds time over the conventional parabolic operation. The elimination of trolley travel time more than compensates for the square cycle.

Double cycles are not possible. This will add some time, but not as much as for a conventional crane.

Time at the IBC platform

This will not be a critical time.

Shore hoist cycle time

This is the time for the shore hoist to move the container from the IBC platform and set it on the quay. The shore hoist can keep up with the strads.

Strad time

> This is one of the critical times. It will be much shorter than operating between the legs. According to Mark Sisson, VP and Planner with our sister company, Jordan Woodman Dobson, the strads could move about 90 containers an hour, if a strad is ready every time a container is set on the quay.

The production will therefore be less than 90 moves and hour, but how much less? The controlling time will be the ship hoist cycle time. This depends on the ship, the speeds and accelerations, the normal delays in handling the container at the ship, and the added time to set the container on the carts and move the container from under the spreader.

We expect the typical production to be 50 to 60 moves per hour, maybe more. Since the outreach is not a factor, the crane will be relatively more productive for wide beam ships. Computer simulation will predict the production for each facility and to optimize the system.

Now what?

The concept presented is not complete. There is room for improvement. However, many of the practical problems have been solved. It can be built in increments. The eventual system will be fully automatic except for the spreader-ship interface.

We will see what develops.

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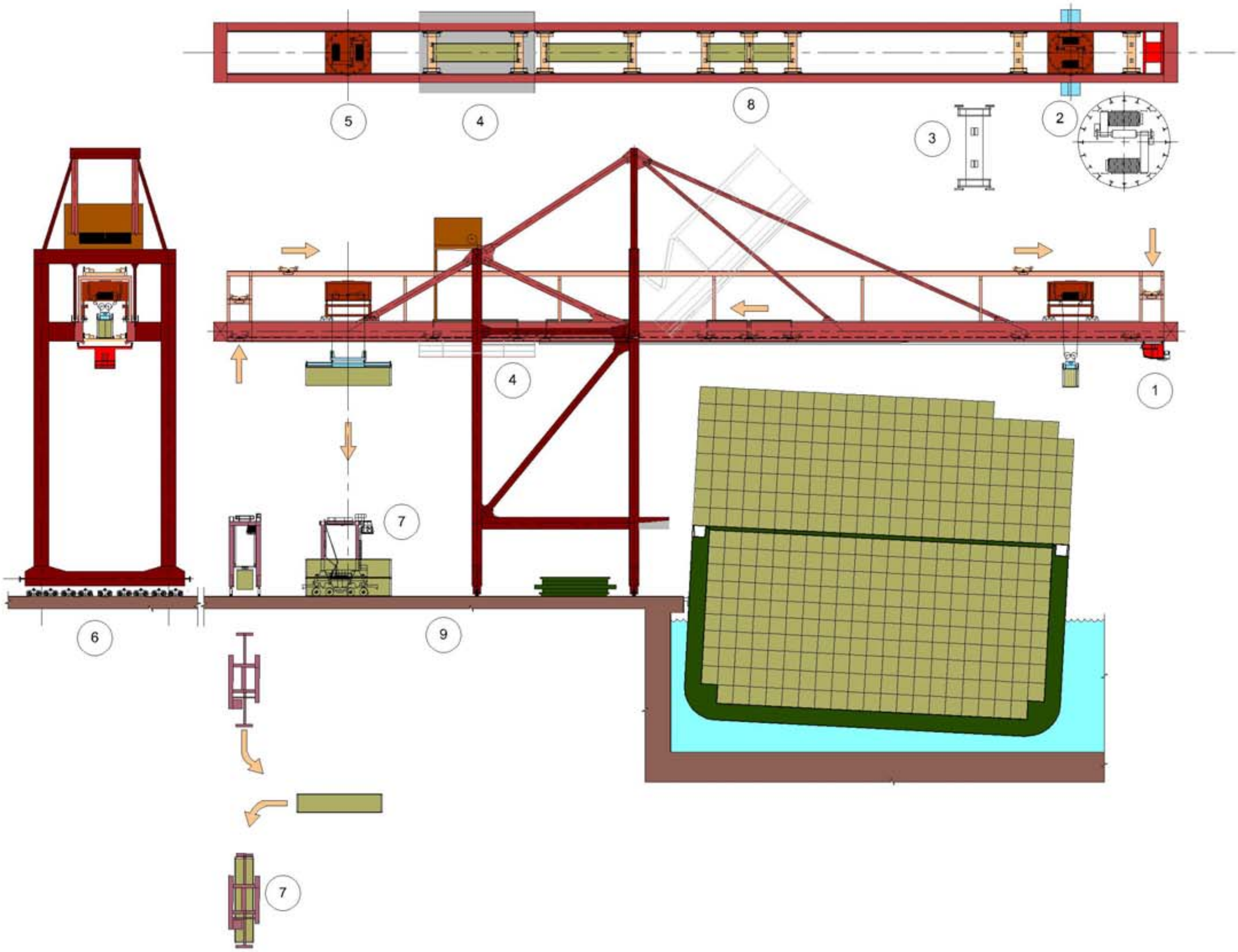

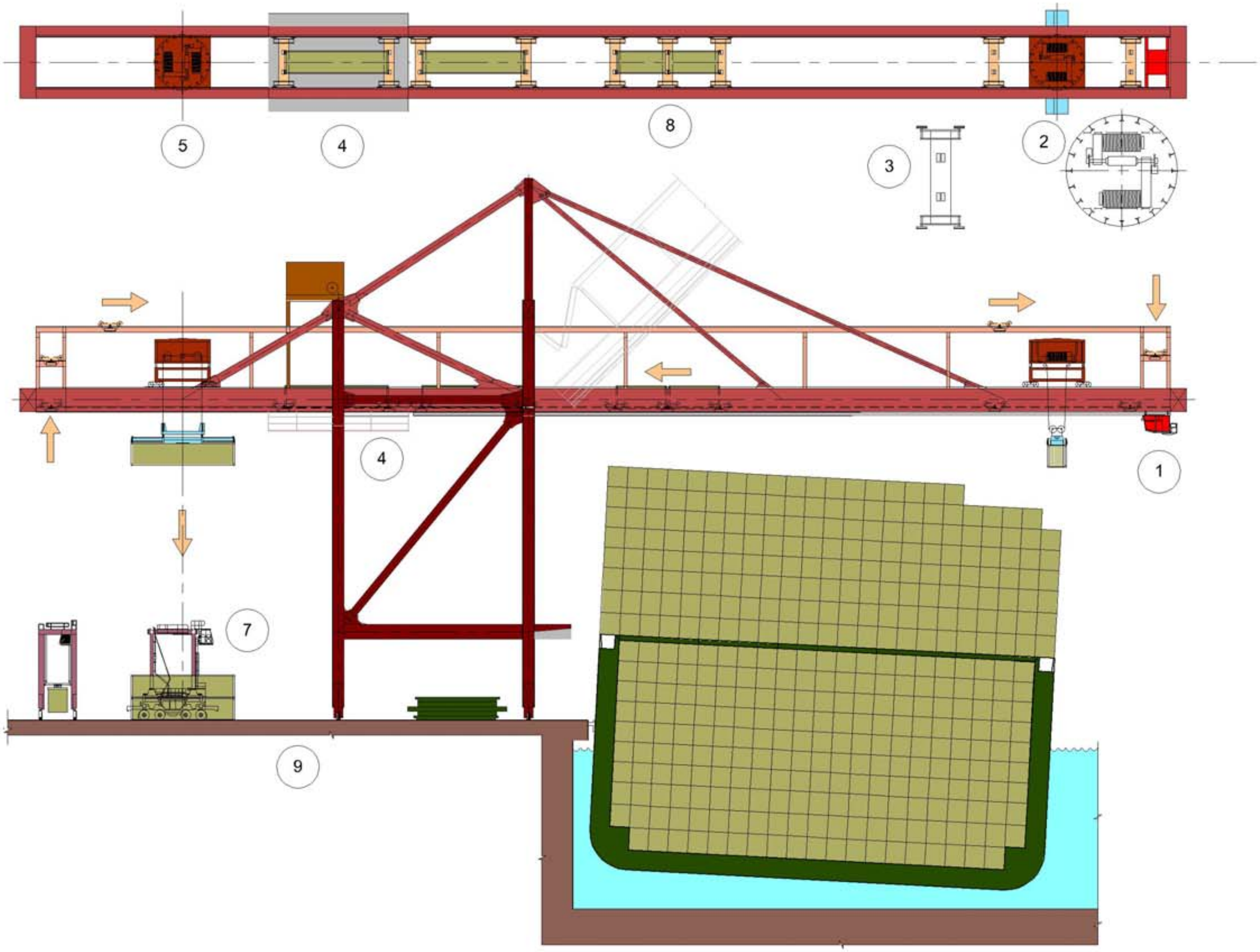
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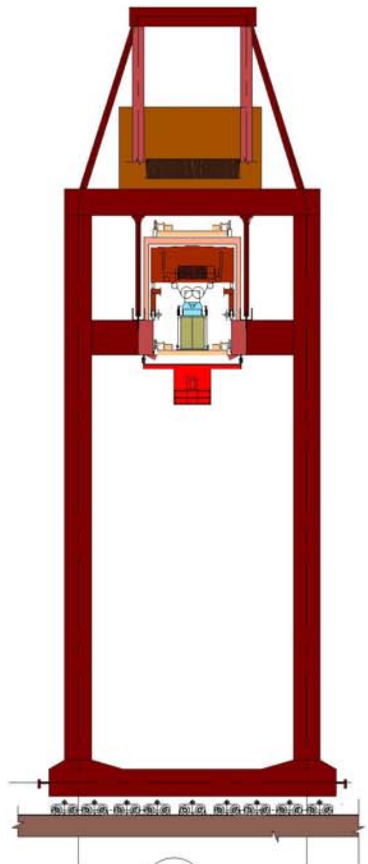

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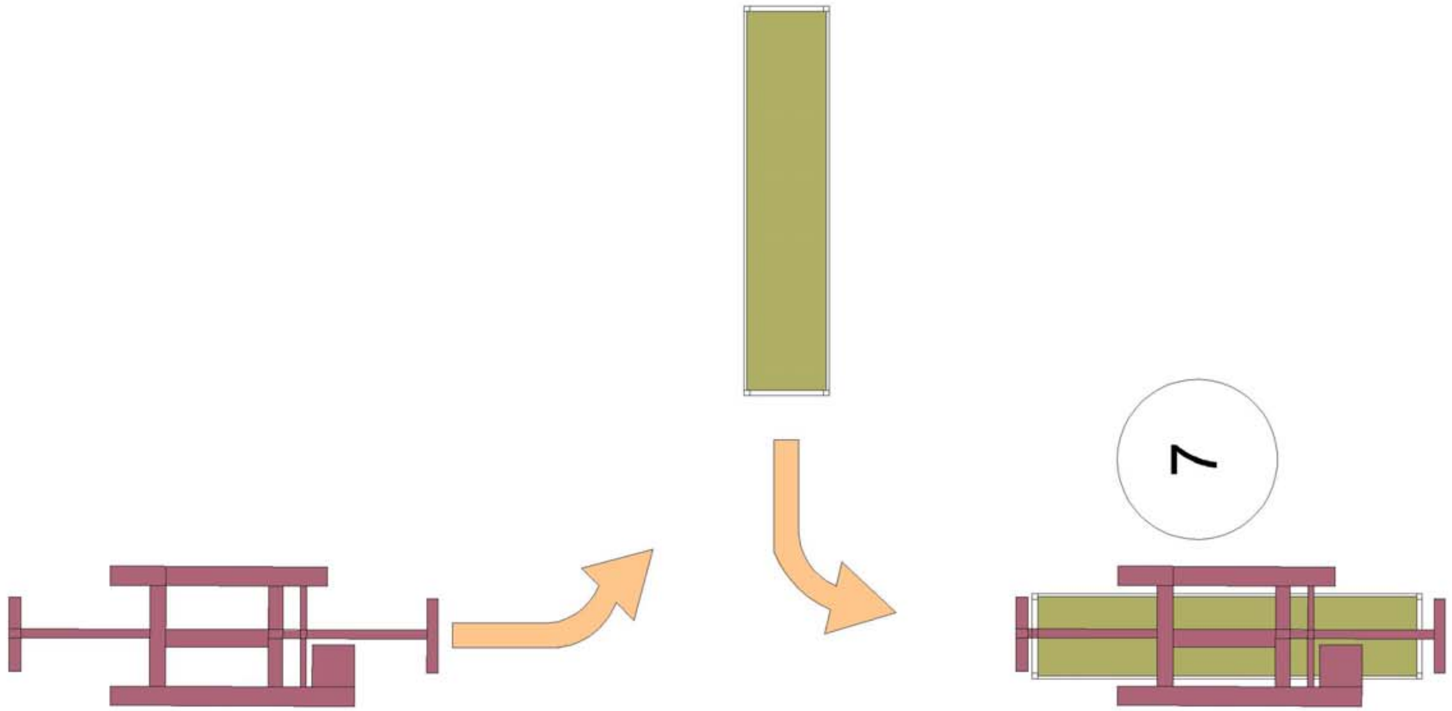
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