

Modifying Your Crane to Service Larger Ships: Requirements, Considerations, and Costs

**AAPA Facilities Engineering Seminar
Vancouver
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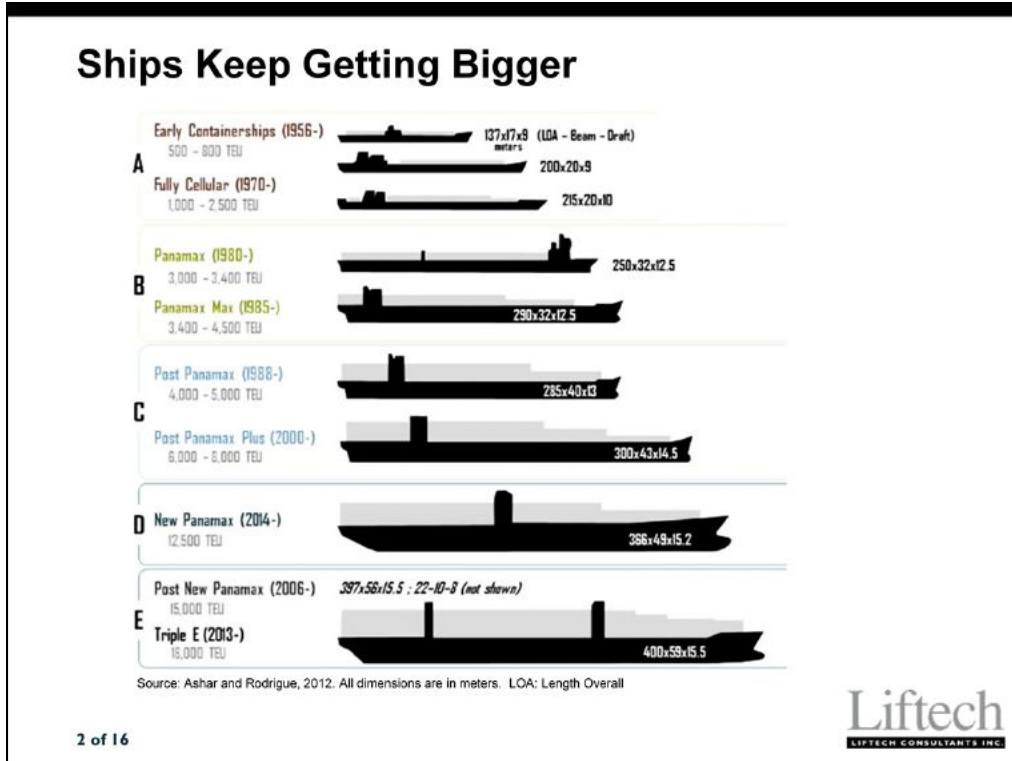
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Liftech specializes in the design of cranes and other complex structures. Mike Jordan, our founder, designed the structure of the first container crane in 1958 and Liftech has been involved in new crane designs ever since. We also provide other crane and wharf related design services, including crane modifications.

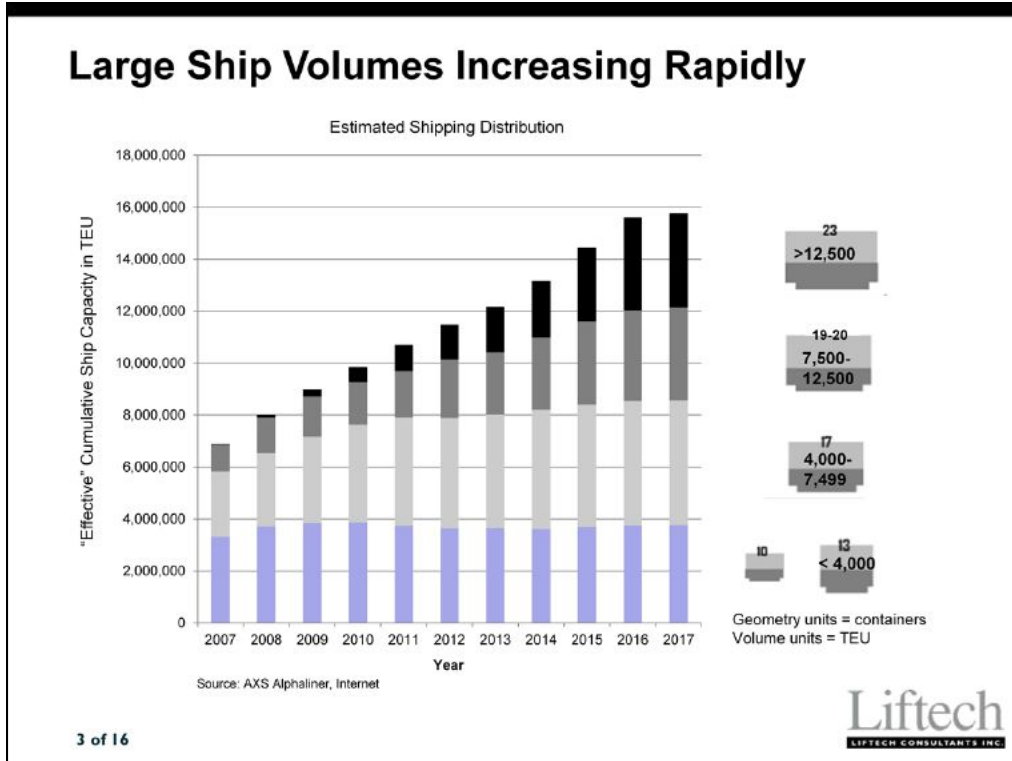
Mr. Soderberg is a registered professional engineer with extensive experience in container crane design, modification, specifications, and procurement. In addition to working with cranes, his responsibilities include wharf design and the design of other crane systems. Mr. Soderberg joined Liftech in 1994.



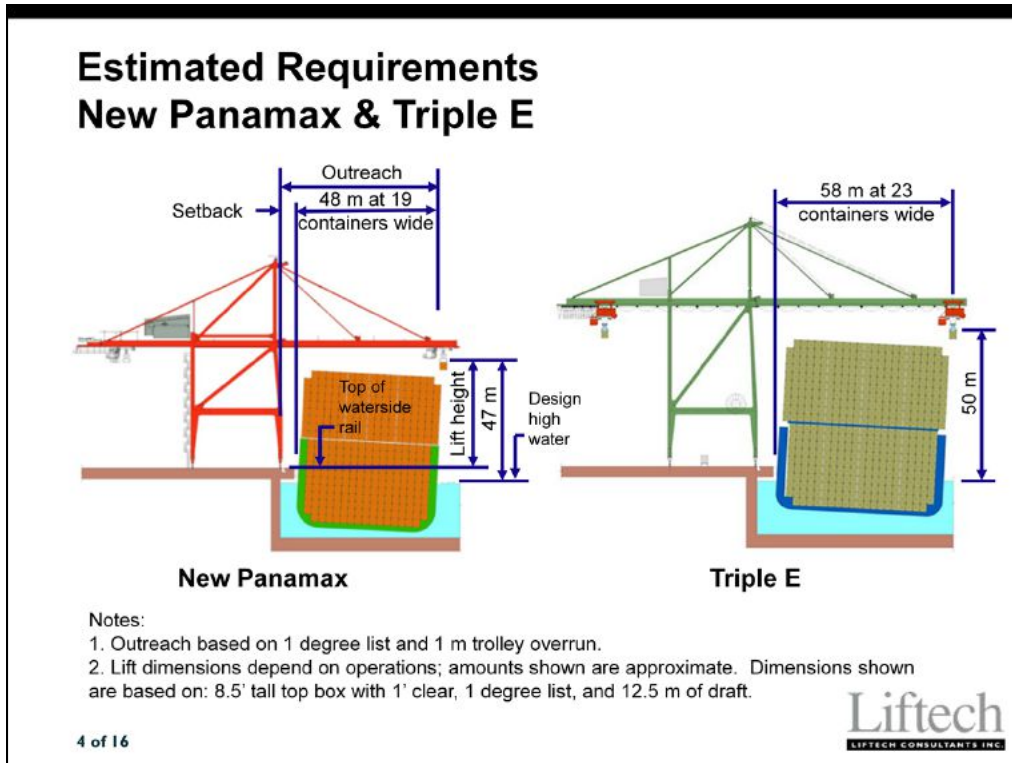
This Ashar graphic shows the historical development of container ships.

Most of these ships are still in service today.

The volume of containers carried by the “D” and “E” sizes is increasing rapidly due to the Triple E deployment and the impending New Panama Canal.

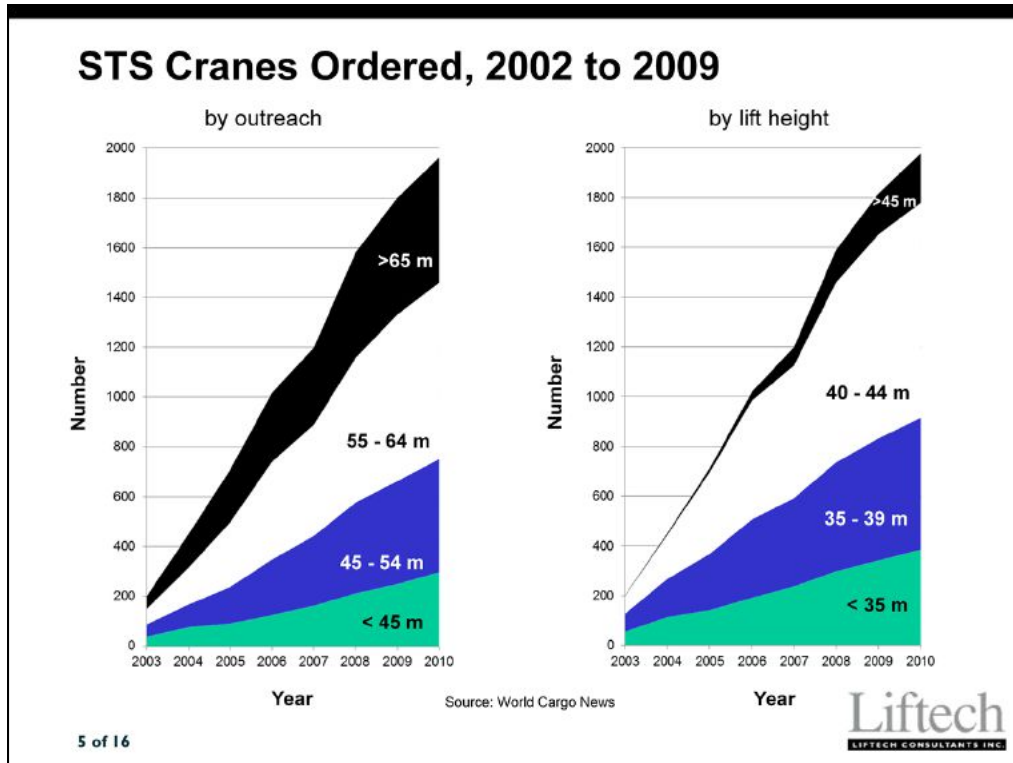


The number of containers carried in the largest two categories of ships shown will double from 2013 to 2016. By 2016, the largest two categories will carry nearly half of all containers.



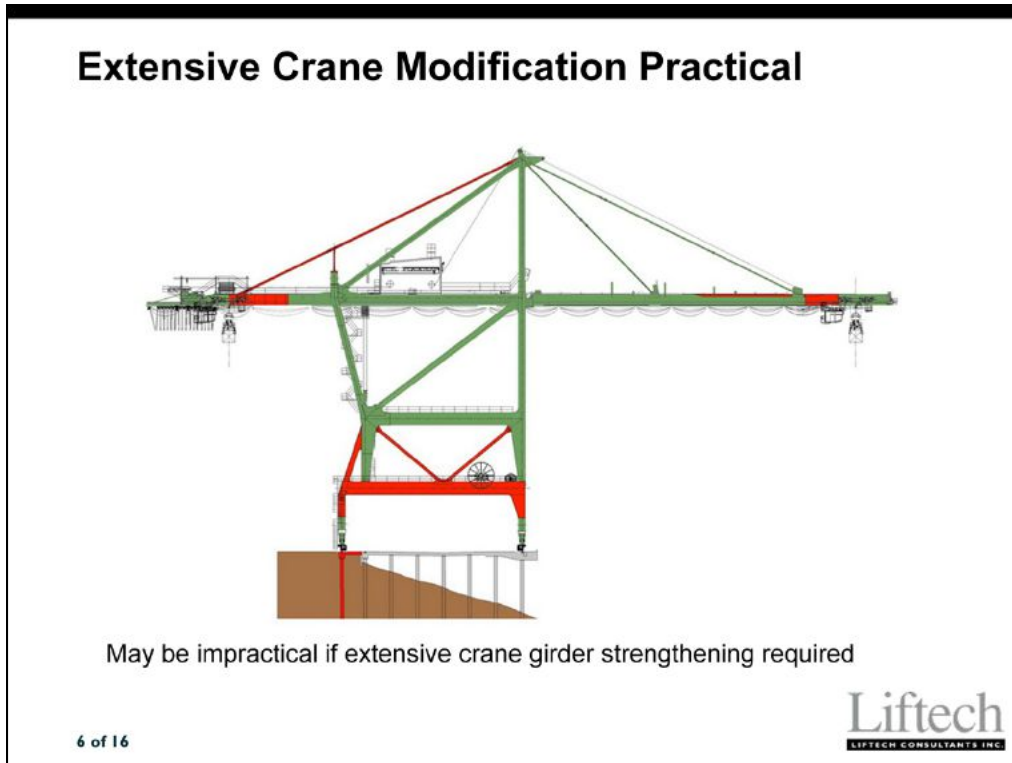
For a 3 m setback, the outreach required for the New Panamax and Triple E are about 51 m and 61 m respectively.

For a crane rail elevation 3 m above the design high water, the lift height for the New Panamax and Triple E is about 44 and 47 meters.



This slide shows the cumulative number of cranes ordered between 2002 and 2009 grouped by outreach and by lift height, each broken into four categories of lift outreach and lift height.

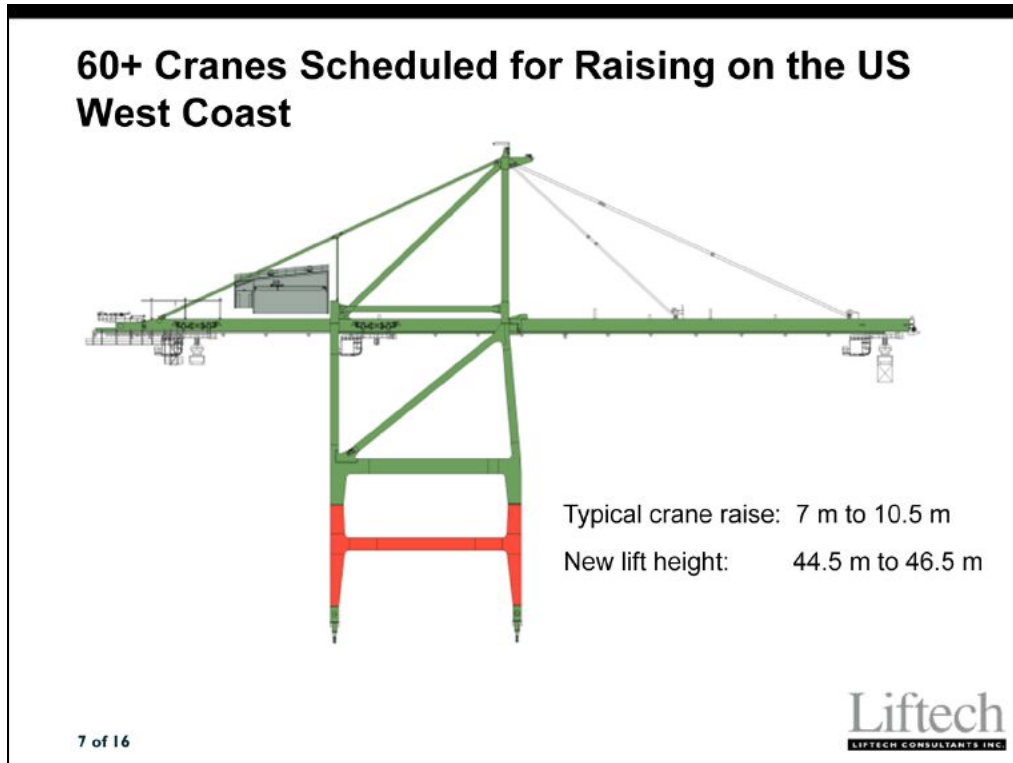
As shown, many recently ordered cranes have significant outreach, but not significant lift height compared to what is required of the New Panamax and Triple E ships. Many recently ordered cranes would require modification for the larger vessels, in particular raising to increase lift height.



A variety of crane modifications are practical, and due to increased labor, material, and fuel costs, have become more competitive with procuring new cranes.

This slide shows the modifications considered in a recent Liftech study to extensively modify a set of existing cranes in Europe. The estimated modification and transport costs varied between about \$4.25 and \$7.75 million, averaging about \$6 million per crane. The client ultimately decided to procure new cranes due to cost and other considerations. But the findings in this study show that even significant modifications are within reason, and that less extensive raises and boom extensions are reasonable.

Modifications mostly become impractical when extensive crane girder strengthening is required; however, if larger cranes are required, this may also be true for the new crane alternative.



For these scheduled raises, we have seen up to 10.5 m raises to bring the lift height up to about 46.5 m.

The raise height is typically limited by the infrastructure:

- Crane girder structure capacity

- Pile capacity – typically limited by soil capacity

Crane Modifications - Some Considerations

1. Design ship
2. Stability, ballast, and wheel loading/girder capacity
3. Construction impact to terminal operations
4. Electrical system upgrade?
5. Seismic upgrade?
6. Main hoist drum - rope capacity
7. Boom hoist lift capacity
8. Other – see speaker notes



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For the design ship, the decision is whether to design for an imminent larger ship or an even larger unknown future ship.

Calculating the crane stability and ballast requirements and calculating the wheel loads is important to understand if the existing girder rated capacity will be adequate, or if a girder capacity study should be initiated to determine if strengthening will be required.

The terminal operator will want to understand the impact to his operations. Typically, modifications can be limited to a portion of the terminal by rearranging cranes during modifications.

The electrical system should be evaluated. Systems more than ten years old are often upgraded.

Incorporating seismic upgrades into the modifications, particularly for older cranes designed to more lenient criteria, is often worthwhile as the modifications are mostly limited to the portal frame of the crane, which will be modified in the raise.

Other considerations:



Crane raise:


1. Tie-downs & stowage socket capacity
2. Gantry drives & brakes
3. Platforms, stairs, and ladders
4. Elevator
5. Lighting levels after raise
6. Service hoist
7. Limit switches, software
8. Spreader cable reel capacity
9. Cable reel – increase or maintain cable distance

Boom extension:

1. Fatigue reliability
2. Method: Extend girder or local modifications to trolley, stops, end platform
3. Tie-downs & stowage socket capacity
4. Gantry drives & brakes

Costs and Durations


		
	Boom Extension	Raise
Cost		
US West Coast:	\$0.75 M to \$2.0 M	\$1.5 M to \$2.5M
US East Coast:	\$0.5 M to \$1.5 M	\$1 M to \$1.5 M
Duration on site:	3 to 5 weeks	4 to 6 weeks


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Typical costs and durations are provided. Costs and durations vary significantly depending on the magnitude of the extension and raise, and the difficulties encountered.

Raise Event - Within a Day



PACECO CORP.
TRAPAC CRANE RAISE
PORT OF LOS ANGELES
1ST HOUR

<http://www.youtube.com/watch?v=kyAsOUfB6vg&feature=youtu.be>
Source: Paceco Corporation

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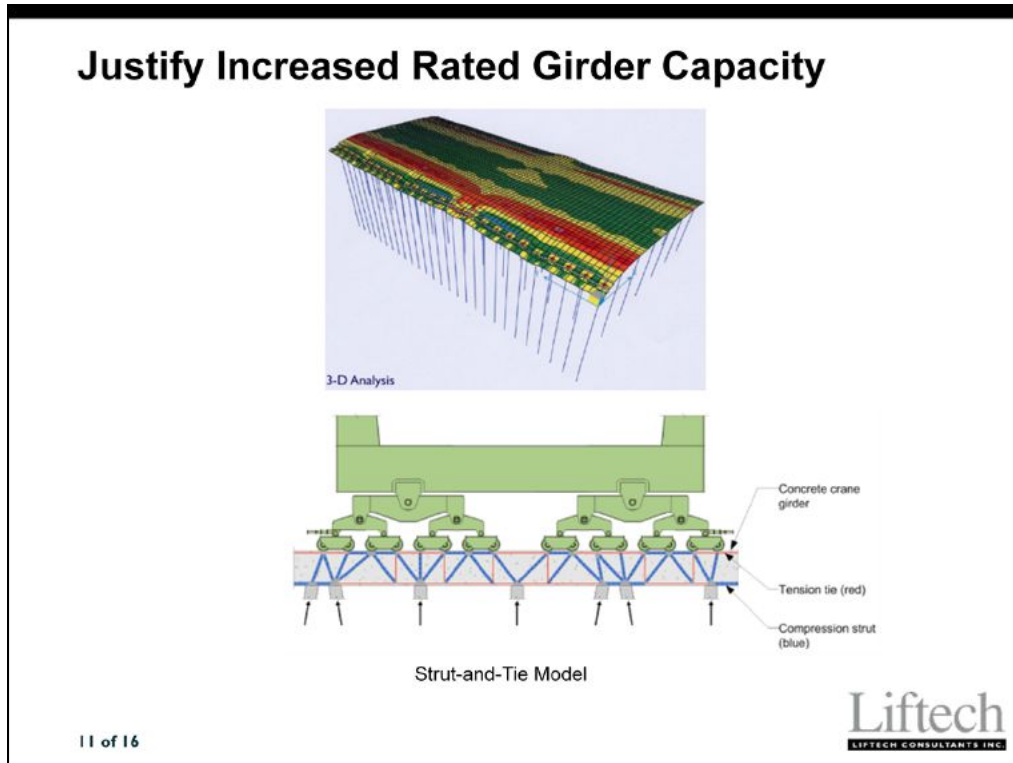
The picture shows a recent crane raise in Los Angeles at the TraPac terminal. Paceco is currently raising the fourth of seven cranes.

Liftech designed the jacking frame.

This frame is installed on the sill beams of the crane, and hydraulic double acting jacks are used to raise the crane.

This raise itself takes a few hours, but the crane was out of service about five weeks.

The modification cost was about \$1.5 M per crane.



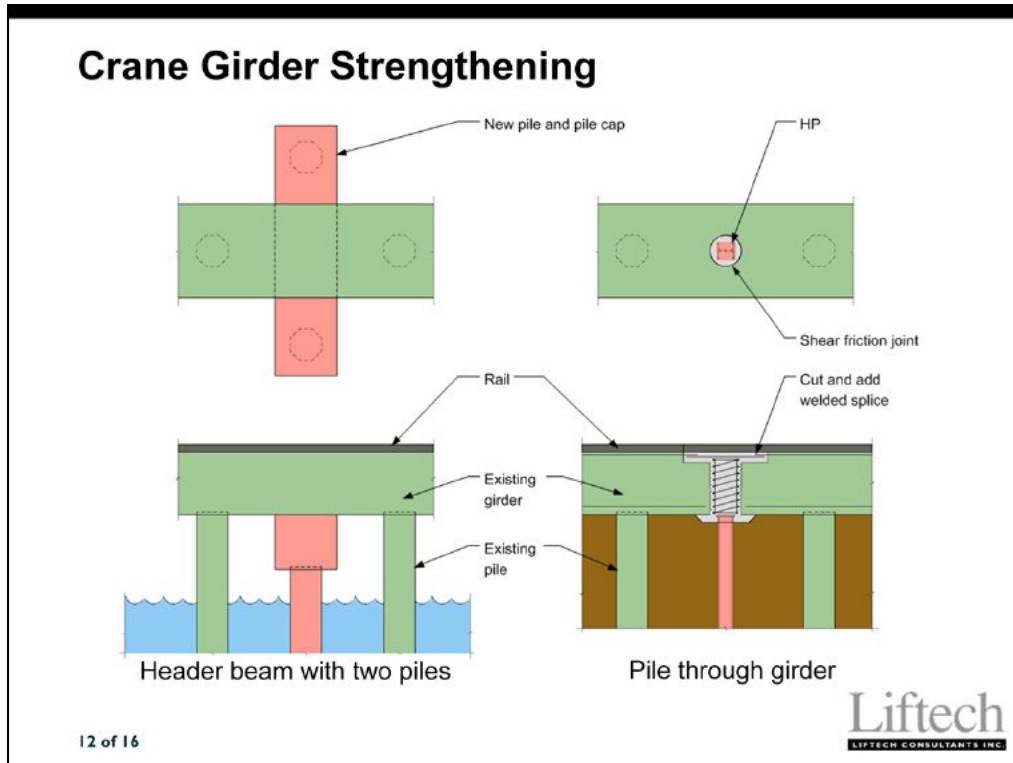
We have evaluated many existing wharves. In most cases, the rated girder capacities can be increased by using more modern analysis methods.

Finite element analyses are particularly worthwhile when the girder is integrated into a deck or have cross beams that permit load distribution.

Strut-and-tie analysis is worthwhile when the shear strength calculated using more conventional methods is inadequate.

Other methods are available.

The engineering costs to evaluate an existing girder structure are typically a fraction of strengthening costs, and some of the engineering effort can be applied to the strengthening design if needed.



Crane girder strengthening can be done in many ways. A common method is to drive piles on either side of the girder and install a header beam between them.

Liftech has two current projects where we are considering coring a hole through the girder, installing an H-pile, roughening the cored wall of the girder, and connecting the load from the girder to the pile with shear friction. The substantial longitudinal girder reinforcing will provide the required confinement. A similar approach has been successfully used in the offshore oil industry with grouting between the platform leg jacket and leg.

Summary

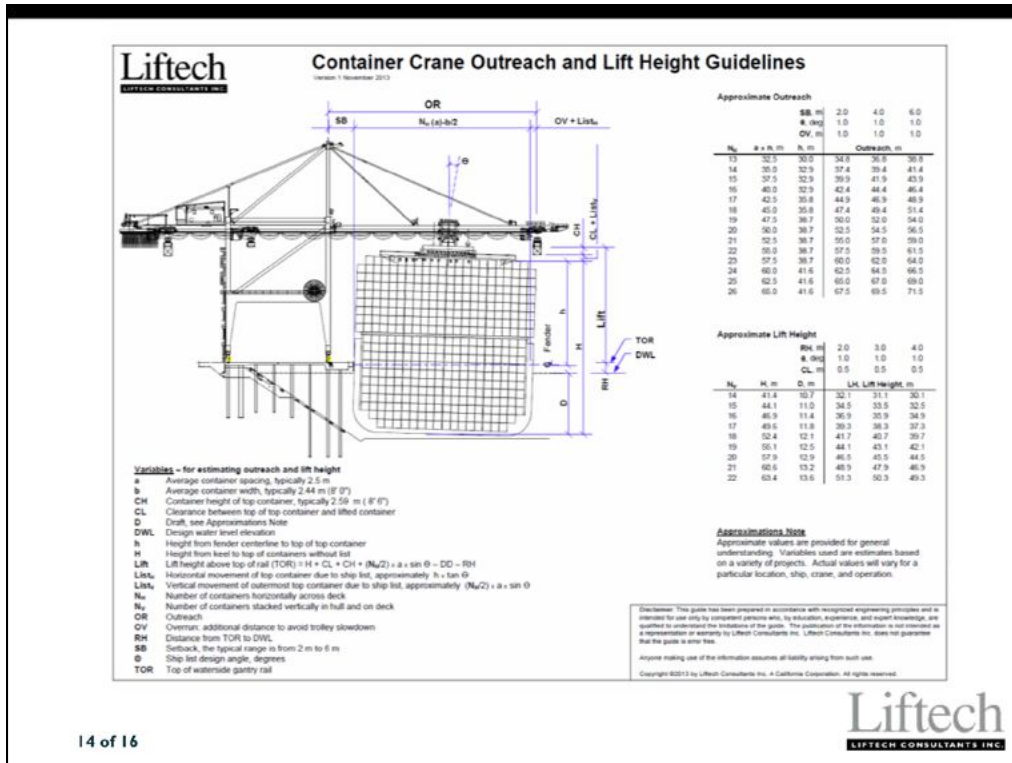
Larger ships coming

Crane modifications are practical

Raise costs \$1 to 2.5 M per crane and takes four to six weeks

Boom extension costs \$0.5 to 2 M per crane and takes three to five weeks

Additional crane girder rated capacity can often be justified without strengthening



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The presented handout provides some guidance on outreach and lift height and was developed to supplement this presentation. It is available on our website.

This presentation is available for download on our website:

www.liftech.net

Thank You



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The image shows a large gantry crane at a port. The crane is white and red, with a long jib extending to the right. The words 'Port of Vancouver' are visible on the crane's structure. The background shows a clear blue sky and a distant shoreline with buildings. The Liftech logo is in the bottom right corner of the image area.

Our presentation with speaker notes is available on our website.

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