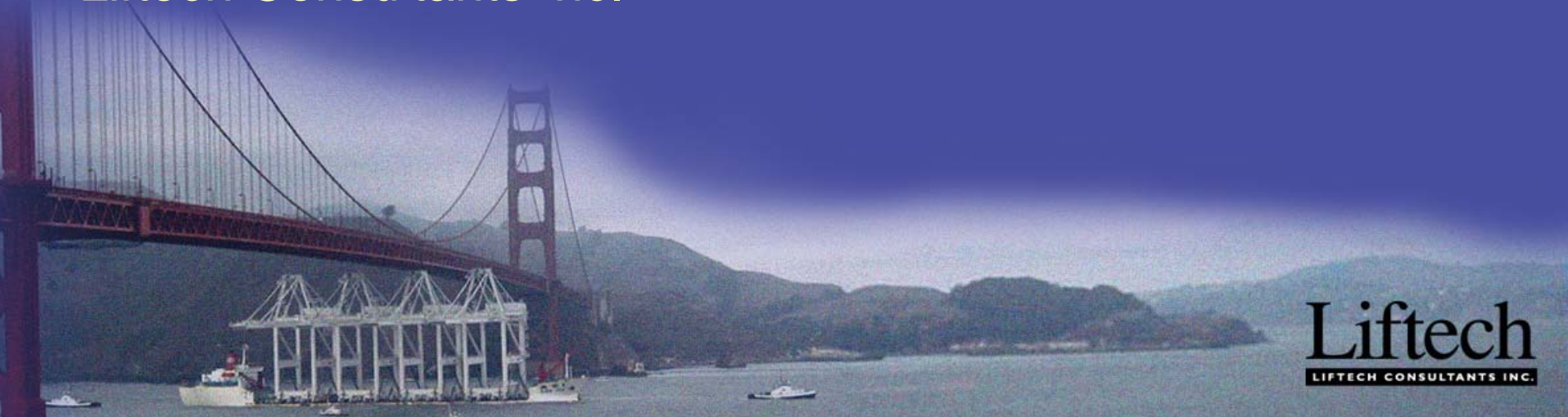


Quay Crane Productivity

Michael A. Jordan
Structural Engineer
Liftech Consultants Inc.



Topics

Quay crane demand

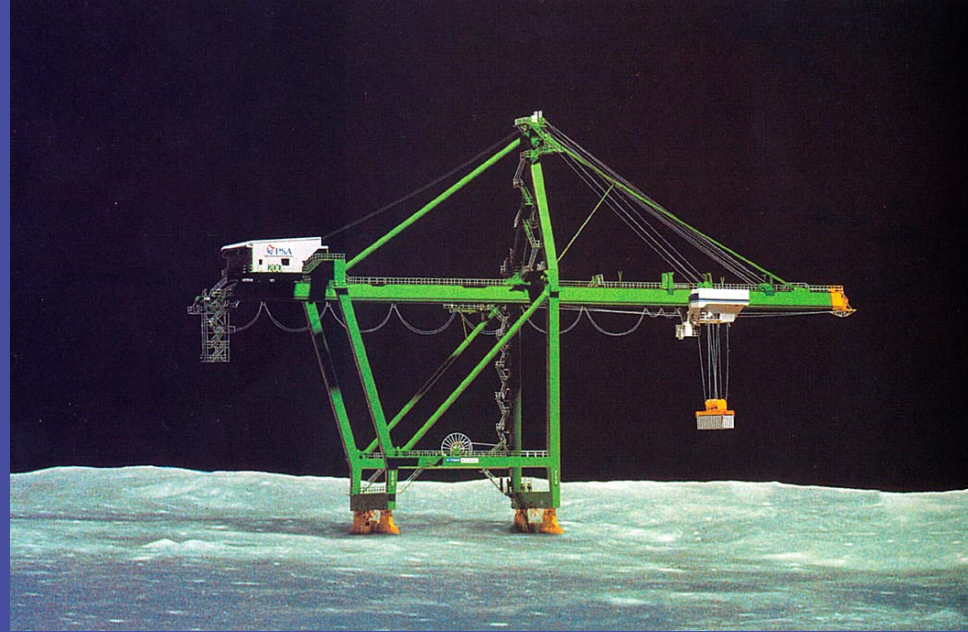
Vessel turnaround time

Look at cycle time segments

Reducing cycle time

Incremental: Up to 25%

Quantum: Over 25%



See the printed paper for details.



The First Ship and Crane

1958 Matson Navigation

A good start

First new Panamax
containership

24 foot box

12 to 15 lifts an hour

3 or 4 days in port



Today's Ship

Post-Panamax

20/40/45 Box

25 to 35 lifts per
hour

2 to 3 days in port

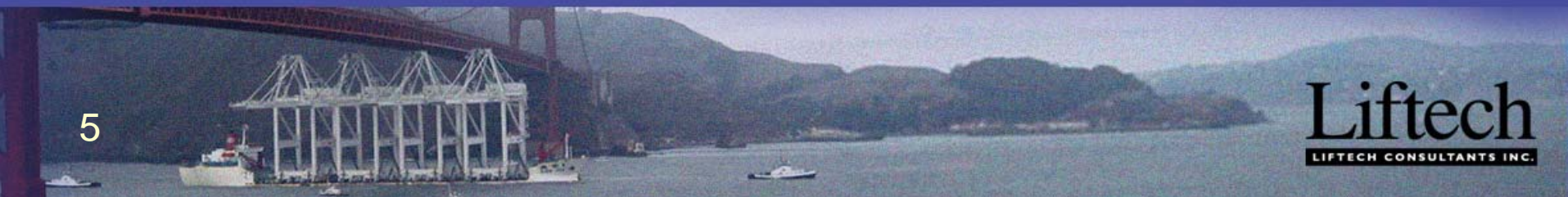


Tomorrow's Crane Today Plan Ahead

How many lifts per
hour?

30, 40, 50, 60, 70

What will the vessel
turnaround time
be?



Vessel Turnaround Time vs. Lifts per Hour

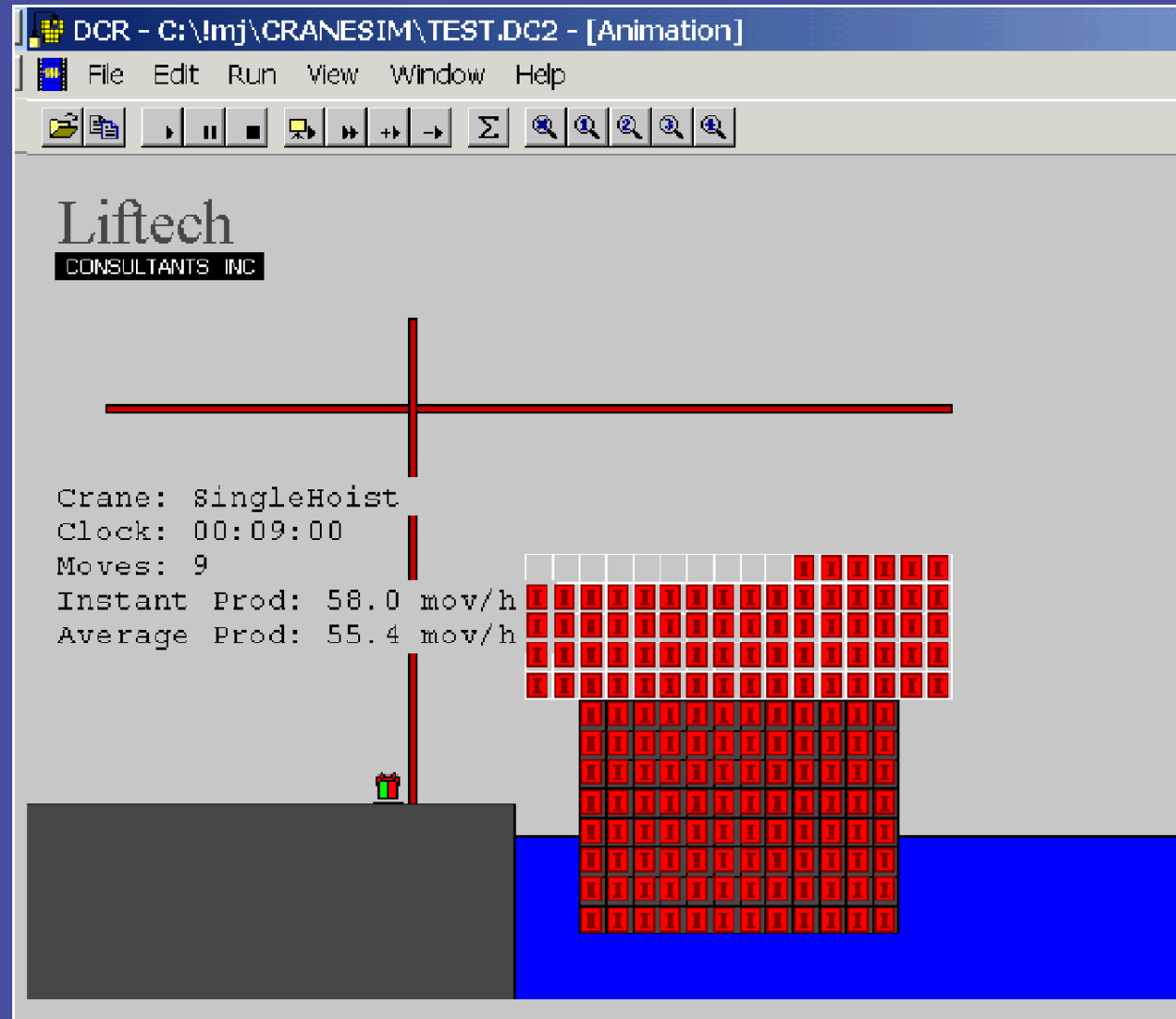
Vessel Size TEU	6,000	8,000	10,000	12,000
Cranes	4	5	6	6
Lifts per Hour	Vessel Turnaround Time, Hours			
20	96	103	107	129
30	64	69	71	86
40	48	51	54	64
50	39	41	43	51
60	32	34	36	43

Parameters: 1.75 TEU per lift. Turnover 75%.
Two eight hour shifts/day.

CraneSim

Calculates
lifts per
hour

Actual 65%
to 80% of
calculated
lifts per
hour



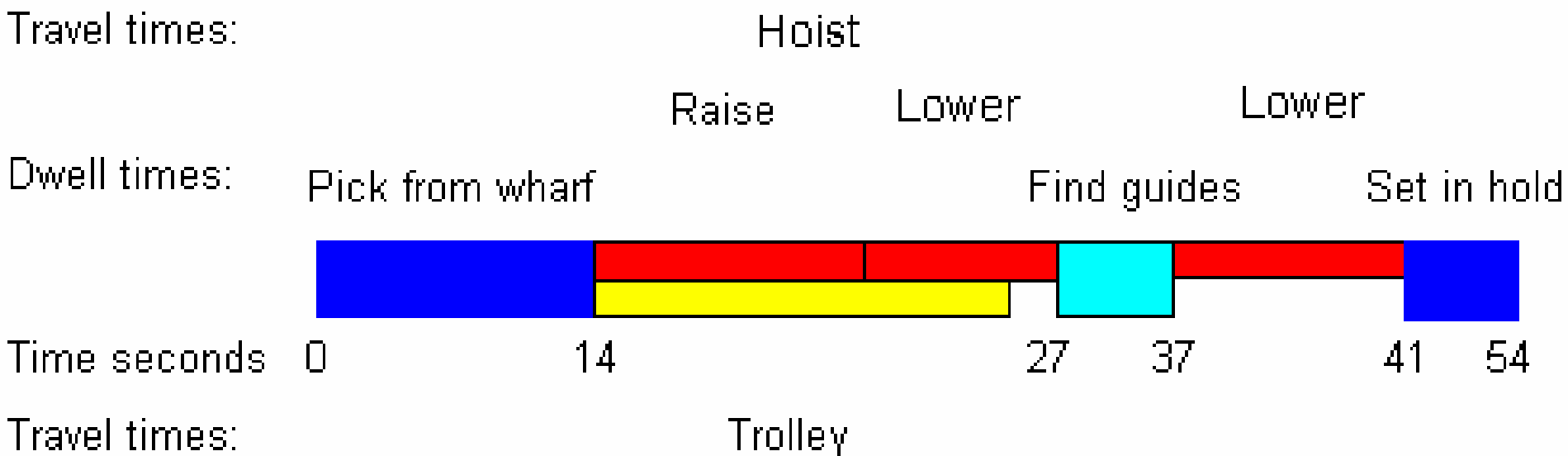
Think Seconds per Lift

Frequency vs. Period

Frequency: Lifts/hour	30	45	60	75	90
Period: Seconds/lift	120	80	60	48	40



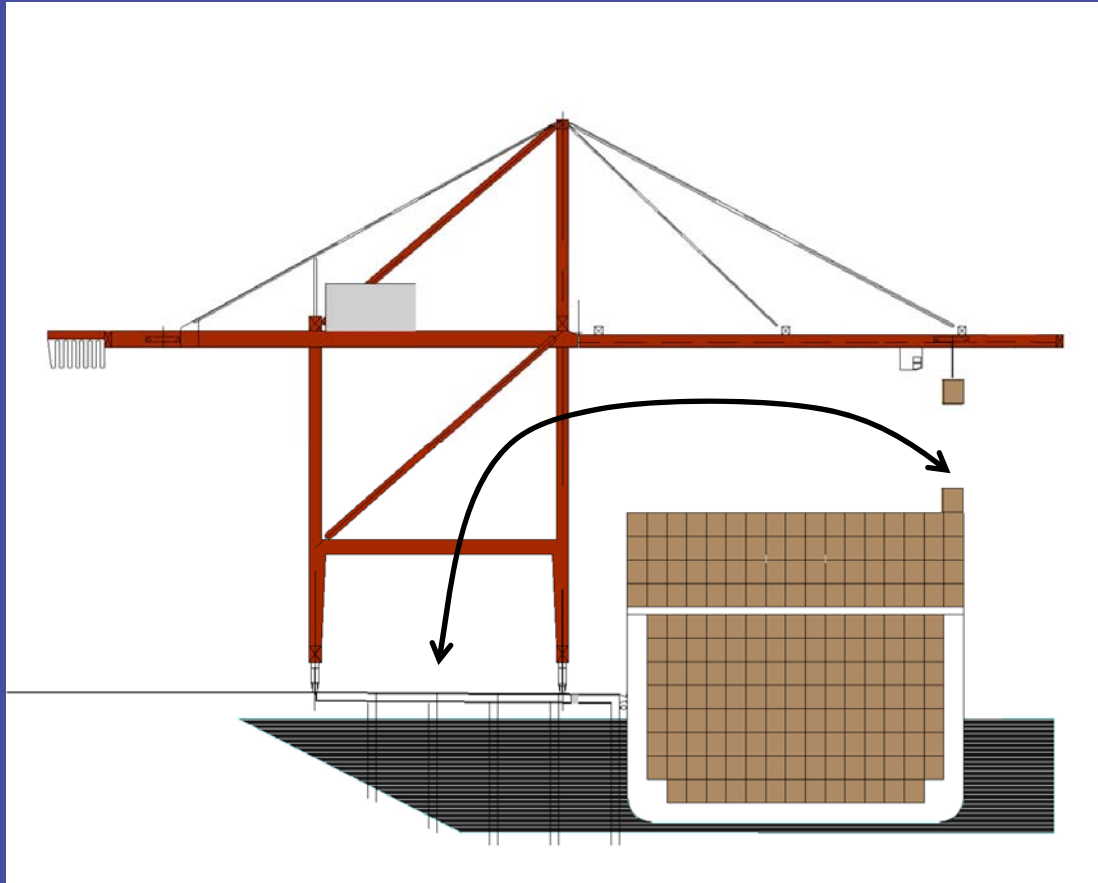
Typical Time Segments: Half-Cycle



Cycle time from the wharf to the inside the ship's hold. Notice the hoist and trolley times are parallel and the Dwell times are in series. The longer parallel time governs. The travel times vary. Depending on the location of the container the hoist or trolley time will govern.

Incremental Improvements (< 25%)

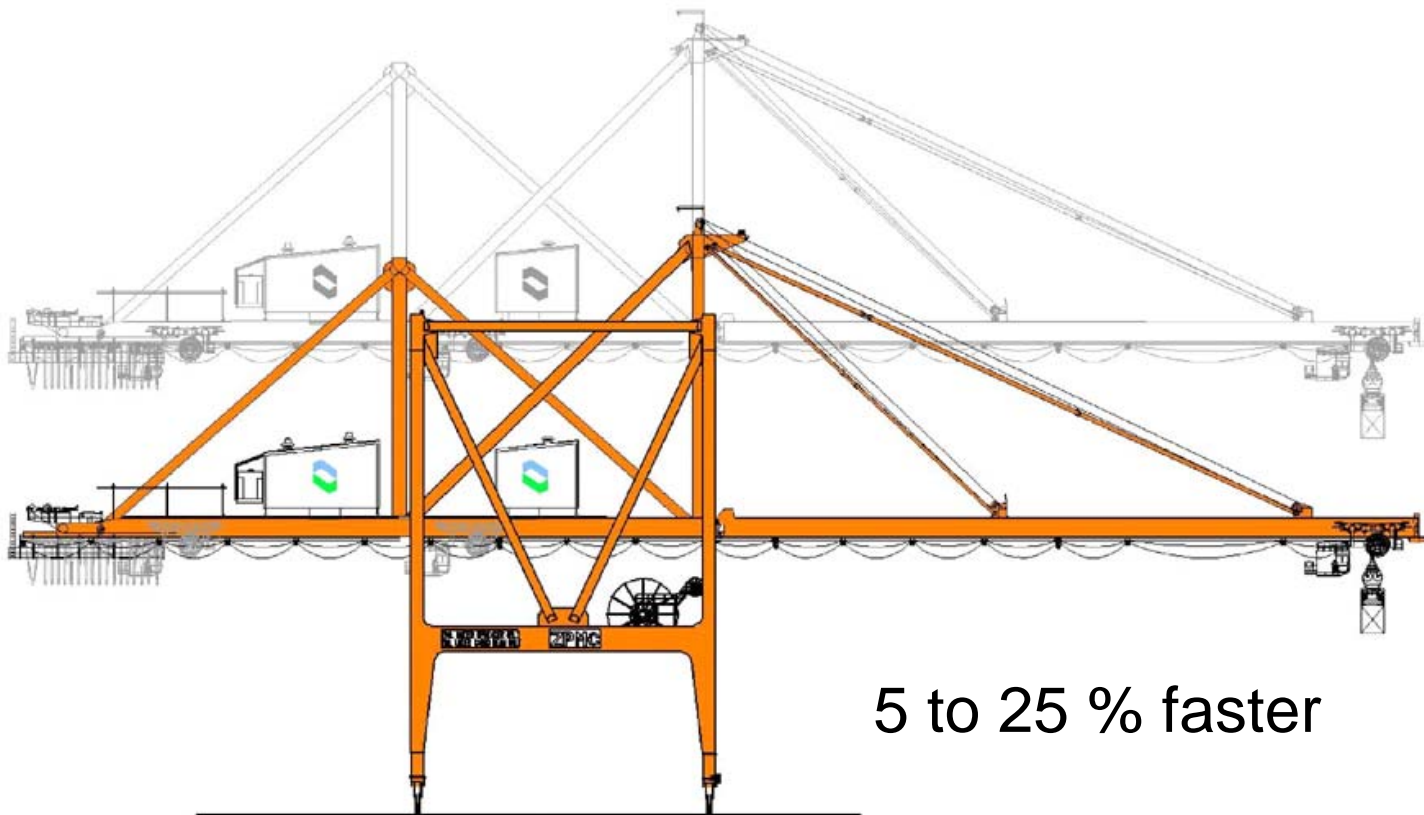
Curvilinear Cranes



Faster motions
Automation
Elevating girder
Tandem forties

Elevating Girders Crane

Virginia Port Authority



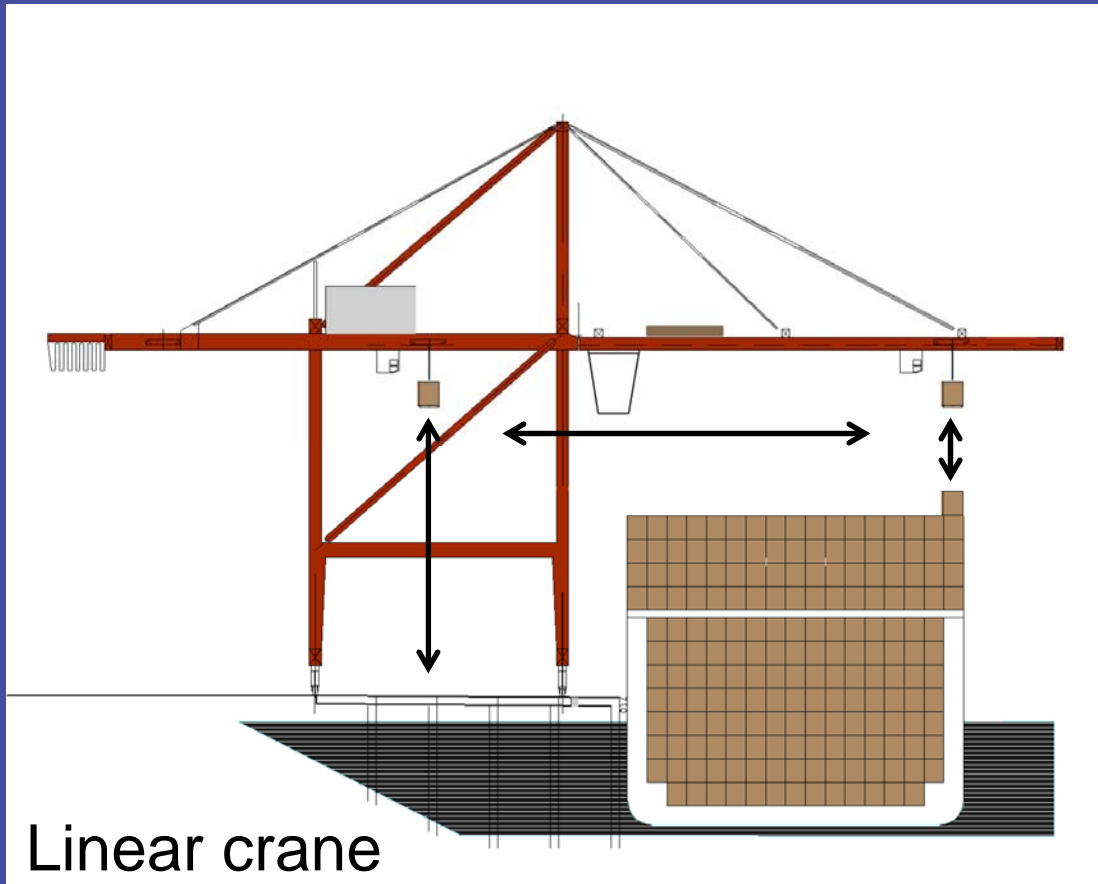
5 to 25 % faster

Tandem Forties

Maersk Bromma



Quantum Improvements (> 25%)



Dual hoist
BufferStation[©]
Ship-in-a-Slip
Shuttle type
Supertainer[©]
Conveyor type
Carrier crane
Technotainer
SuperCrane

Dual Hoist

VPA

1980s

50% faster



Dual Hoist

HHLA

2000s



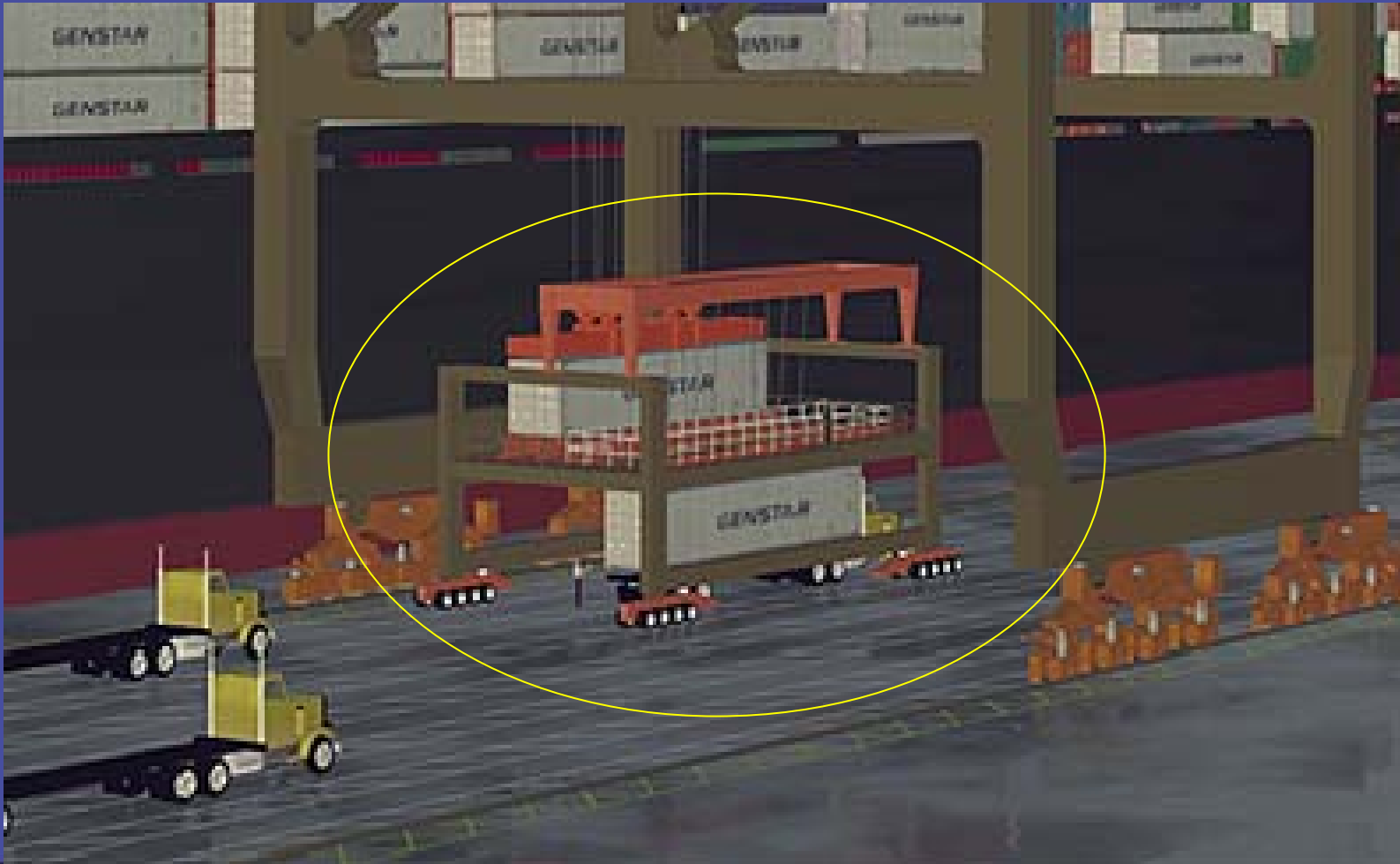
Paceco Bufferstation[©]



Like a second
hoist but
moveable



Paceco Bufferstation[©]



Ship-in-a-Slip

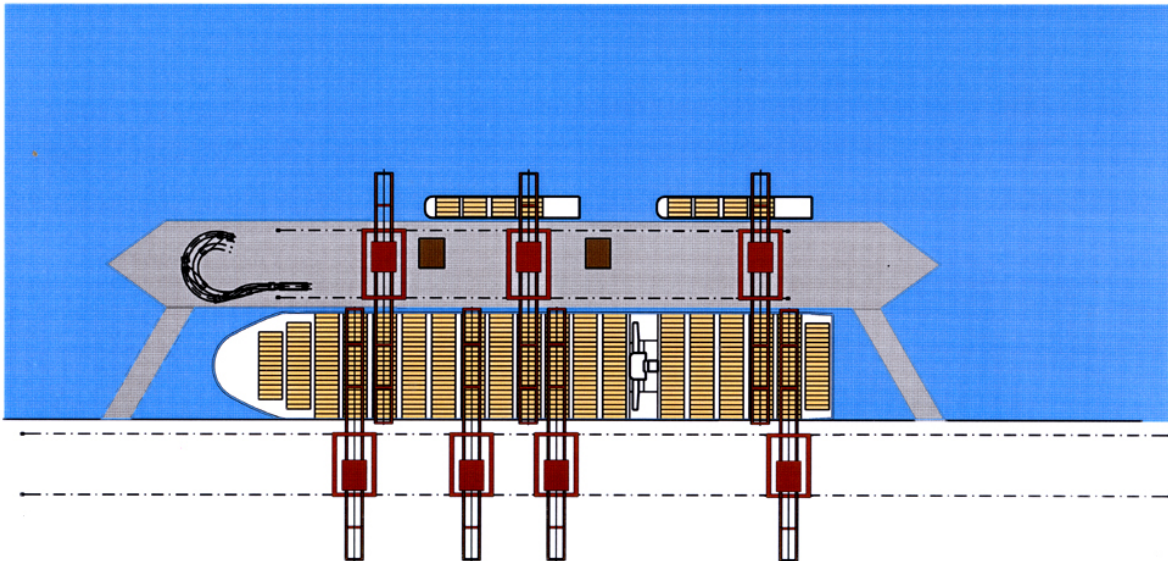
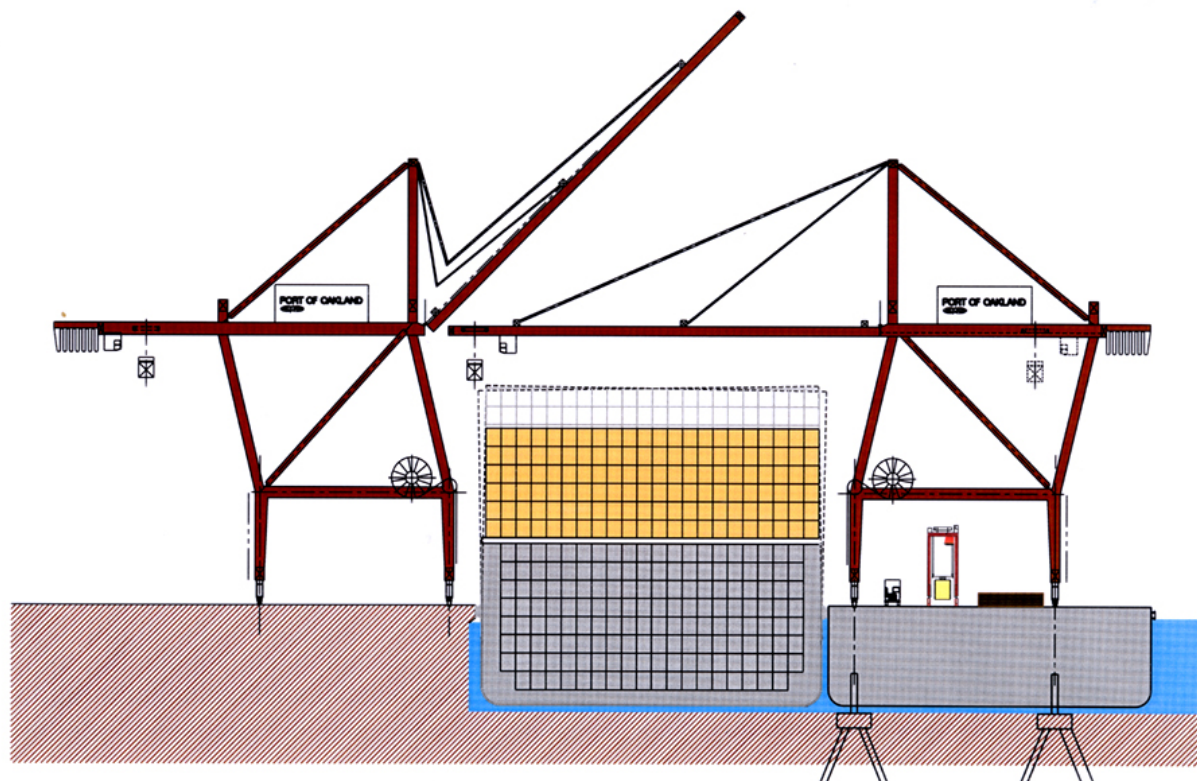
Ceres, Amsterdam



80 – 100% faster

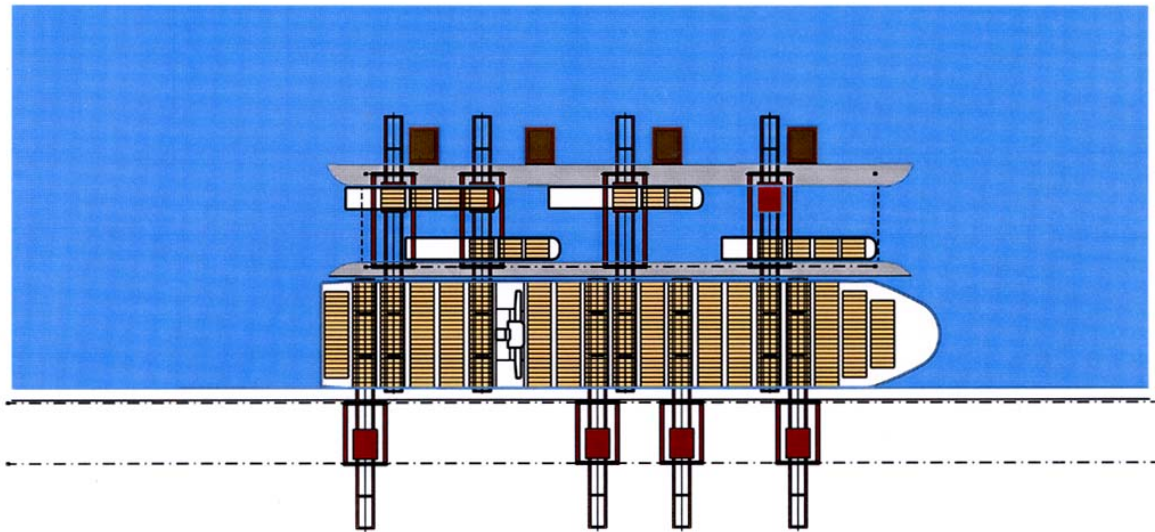
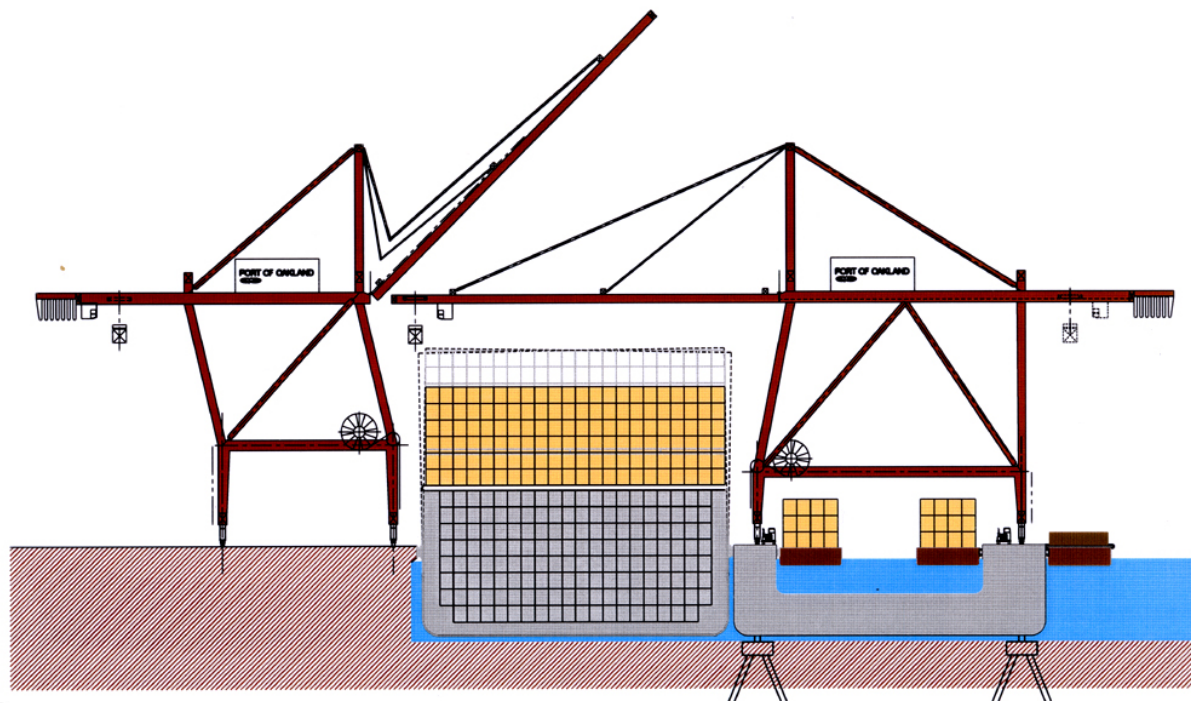
FloatTerm

Quay, ship,
“quay”



FloatTerm

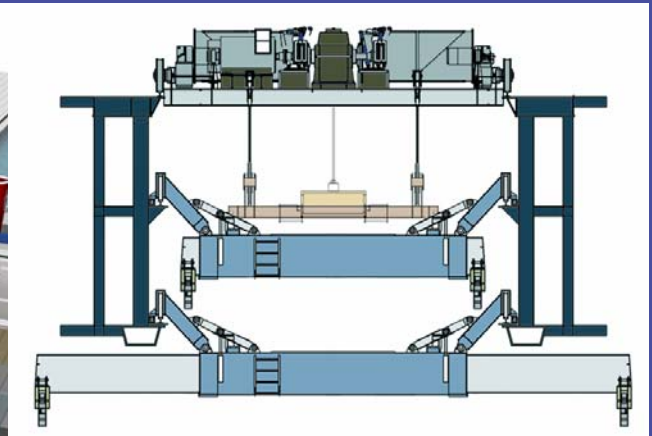
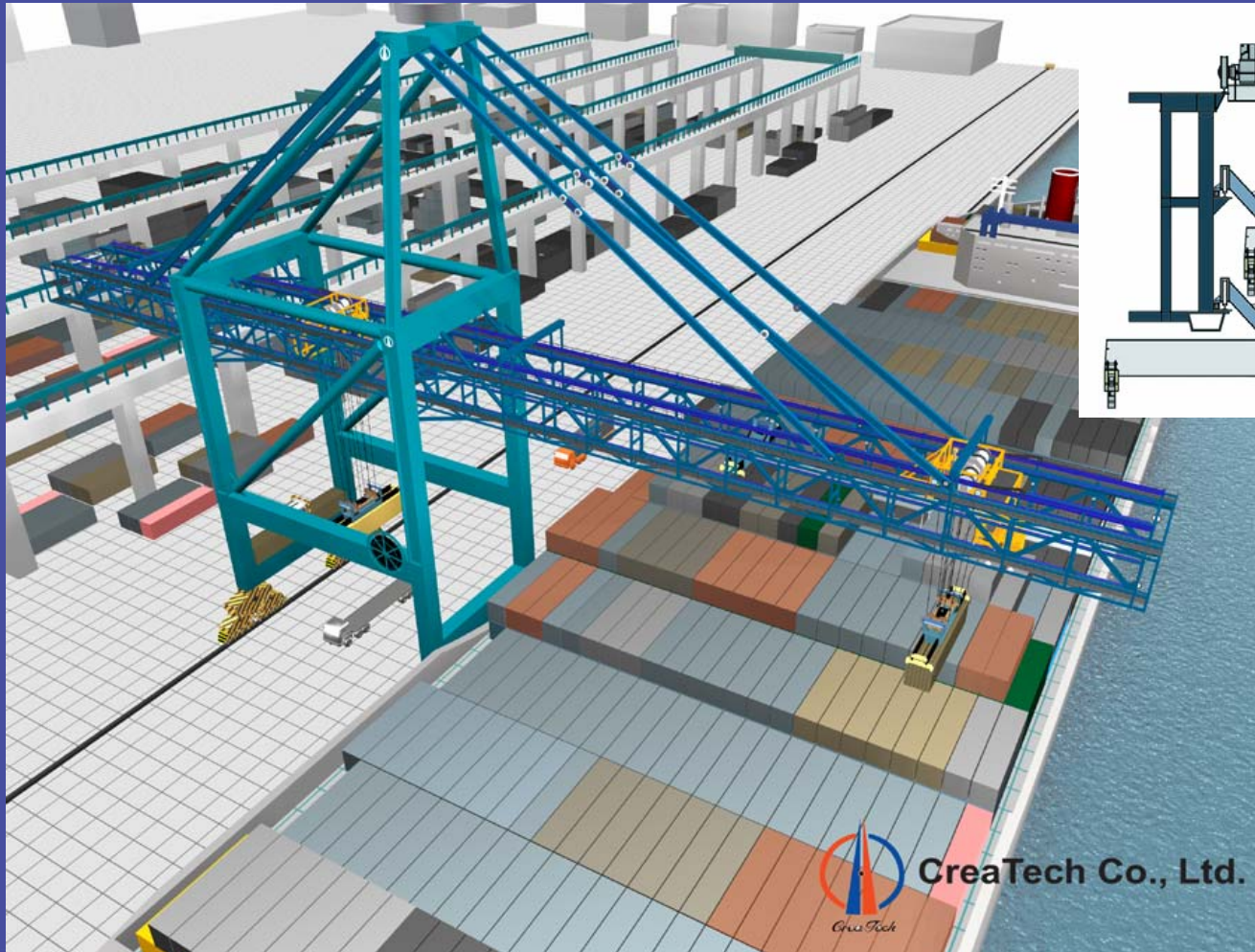
Quay, ship,
barge



Paceco Supertainer[®]



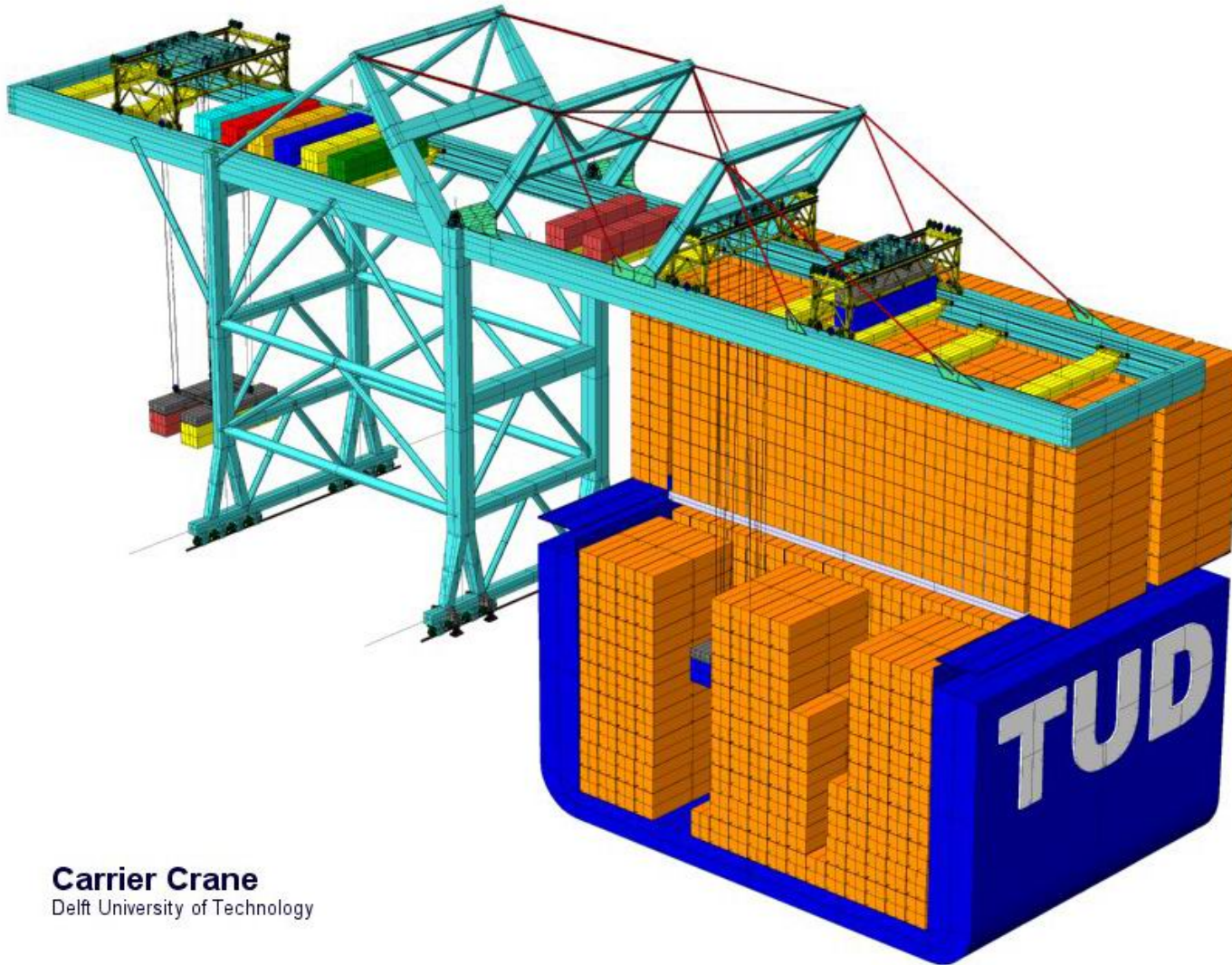
CreaTech Technotainer[©]



Boom section

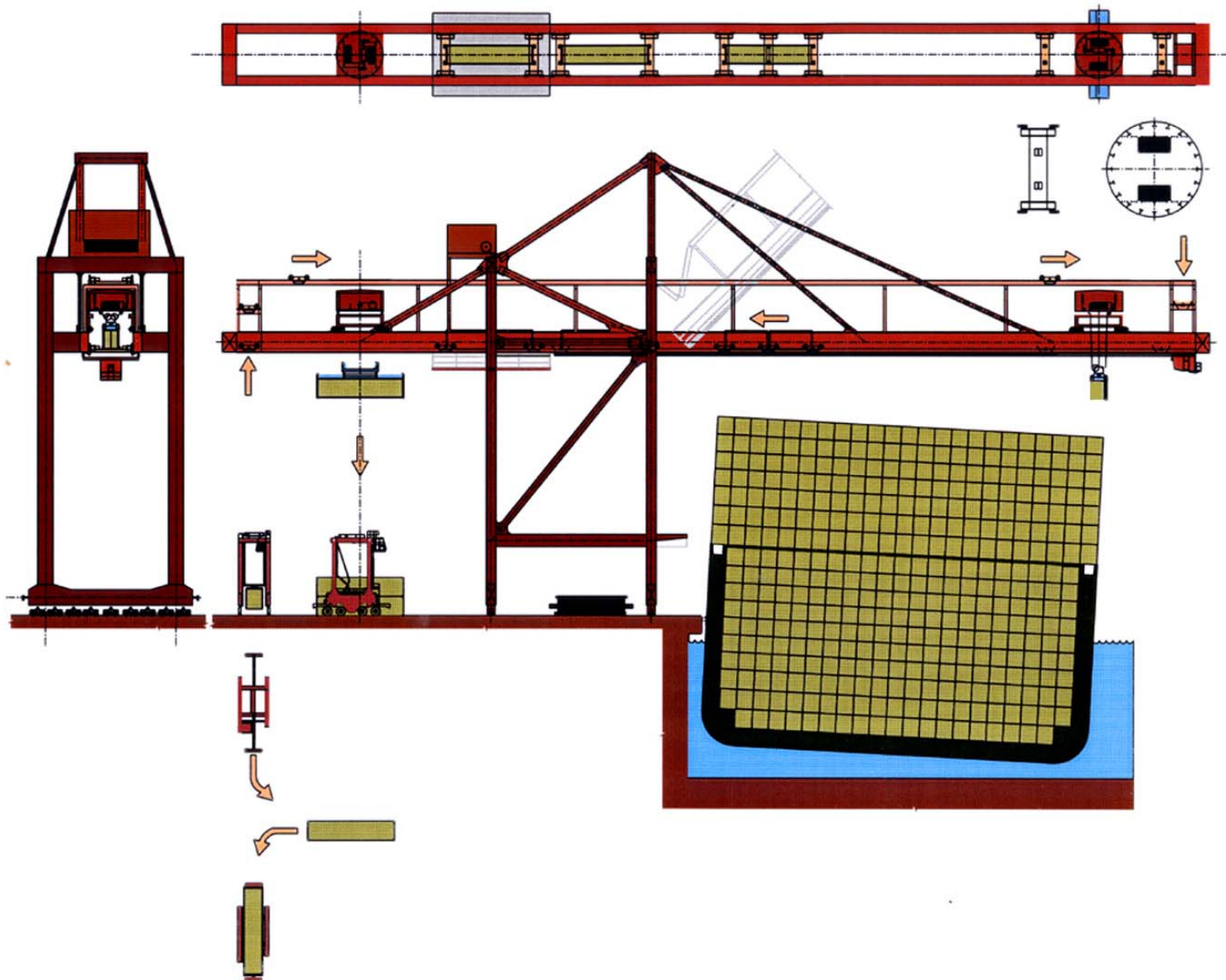


Delft University Carrier Crane

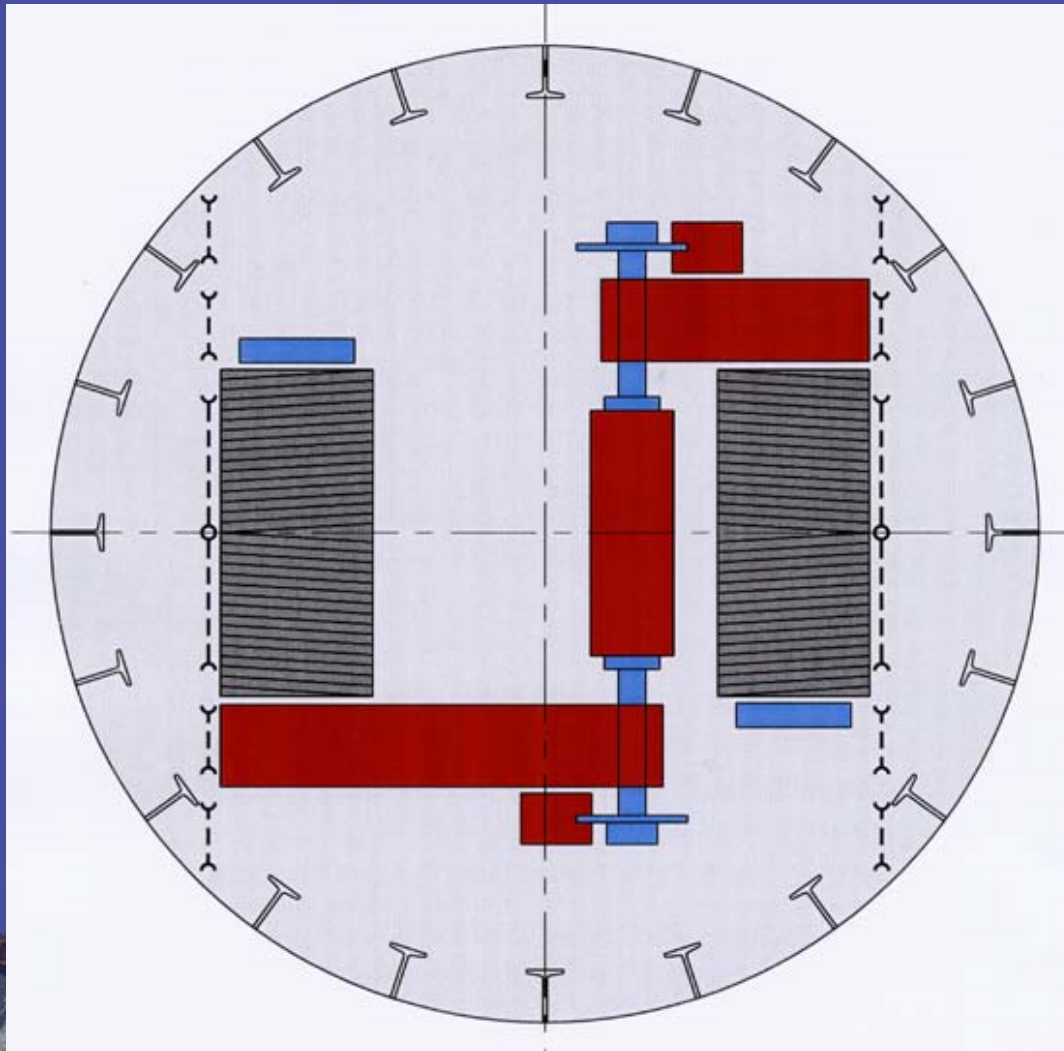


Carrier Crane
Delft University of Technology

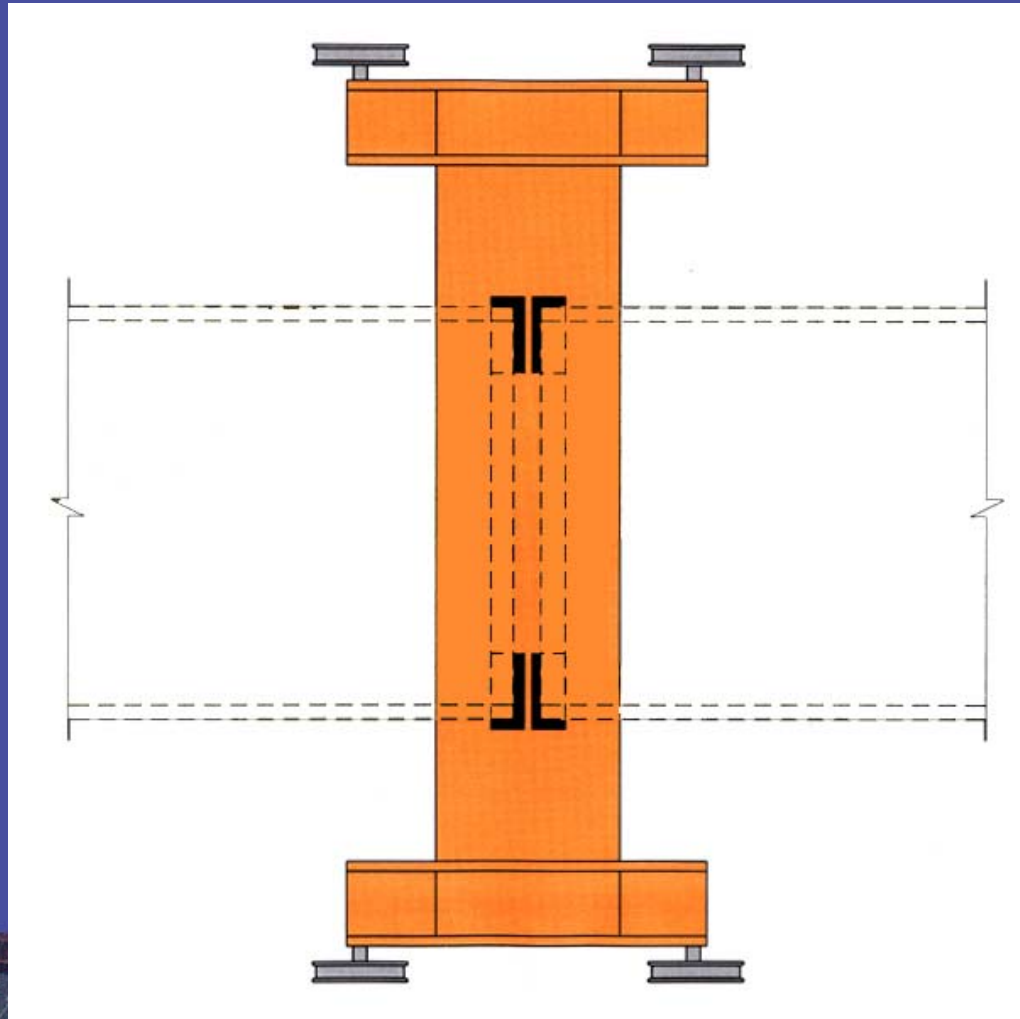
Liftech SuperCrane[©]



Rotating Trolley



Light Weight Shuttle



Boom Section

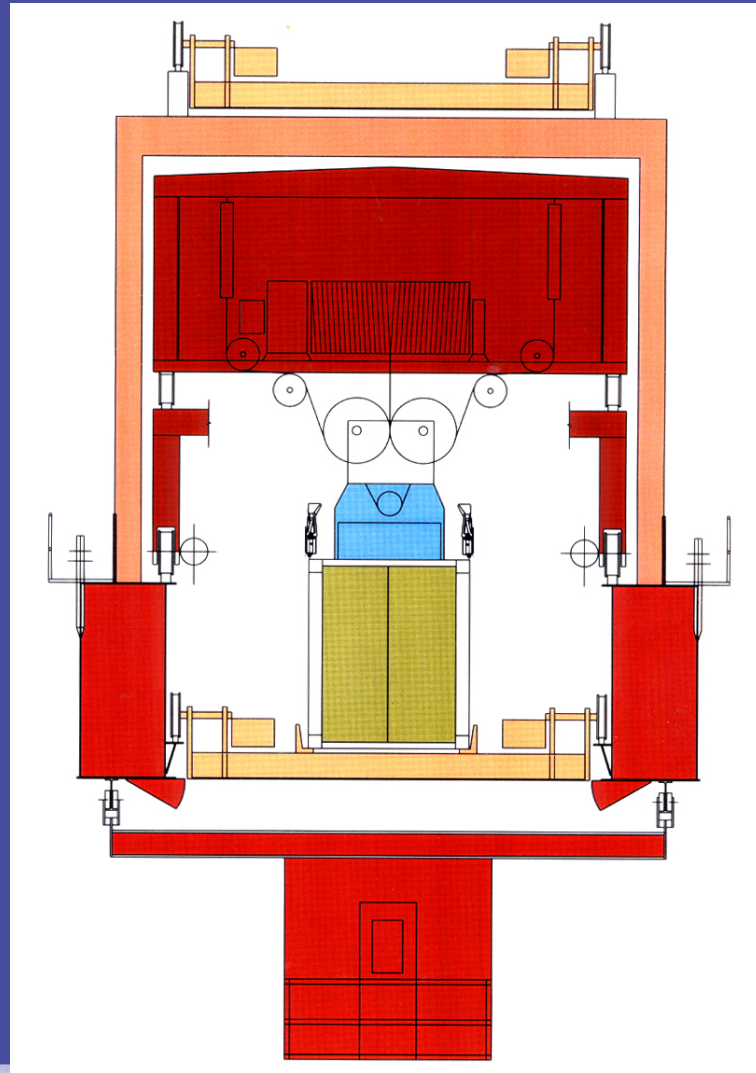
Rotate trolley

Spreader

Container

Shuttle

Operator's cab



Revolutionary Systems—All Costly

New concepts for
gates yards and
cranes

Octopus

Automated
warehouses

Fully automated
system



Port of Singapore, Fully Automated





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