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Marine Terminal Automation Today and Tomorrow

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Overview

- Current State in terminal automation
- APMT Norfolk – first North America ASC installation
- PAG Oakland – first West coast ASC Terminal ?
- When to do something different and or why would you make a change?
- Factors to consider when converting to an automated terminal
- Use of Emulation

Automation on Marine Terminals

- Container handling: Focus of this Presentation
  - Yard Transport
  - Yard Cranes
- Other Areas
  - Gate process
  - Vessel mooring

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Altenverder, Hamburg

Nested ASCs that can Pass are Unique to Altenverder

With end loaded CY systems, trucks back up to the landside end of the CY stacks and are served by remote operators

With no need to creep forward, trucks can shut off engines while waiting for service

Console for Remote Yard Crane Operations for Gate Service in Hamburg

APMT Norfolk

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AMPT Norfolk Landside Operation

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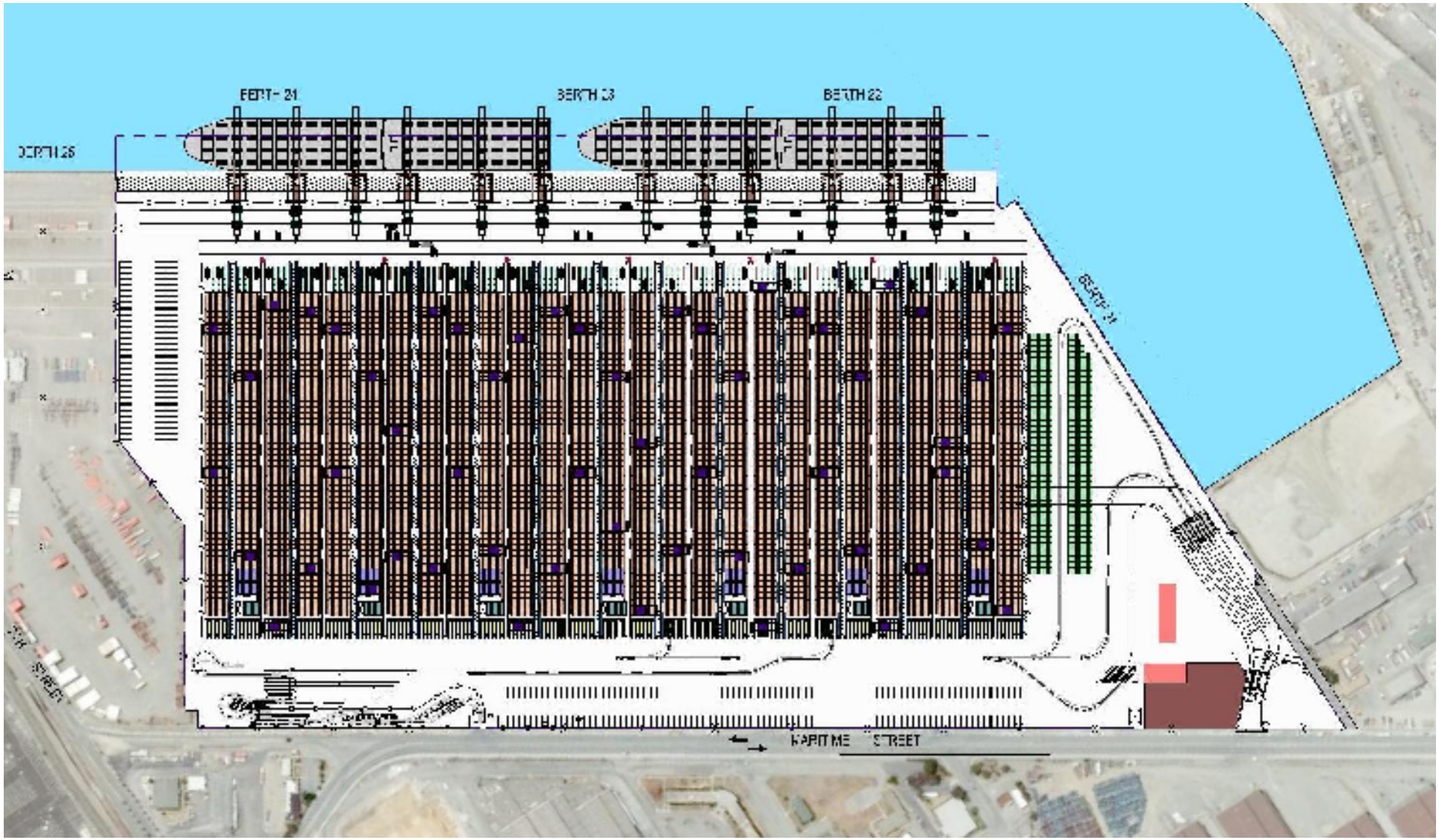
PAG Oakland (Berth 21 – 24)



ASC Implementation at different Automated Terminals

Location	Cranes per block	Stack width (boxes)	Waterside transport	Landside transport
Thamesport	2 on same rails	9/7	Trucks drive to side of ASC	Trucks back-in to landside of ASC row
ECT Rotterdam	1	6	AGVs to end of ASC	Trucks served via strad interface
CTA Hamburg	2 on separate rails	10	AGVs to end of ASC	Trucks back-in to landside of ASC row
APMT Norfolk	2 on same rails	8	Manned shuttles at end of ASC	Trucks back-in to landside of ASC row
Euromax Rotterdam	2 on same rails	10	AGVs to end of ASC	Trucks back-in to landside of ASC row
DPW Antwerp	2 on same rails	10	Manned shuttles at end of ASC	Trucks back-in to landside of ASC row
CTB Hamburg	3, on two sets of rails	10	Manned shuttles at end of ASC	Trucks back-in to landside of ASC row
NYCT New York	2 on same rails	11/9	Trucks drive to side of ASC	Trucks back-in to landside of ASC row
PAG Oakland	2 on same rails	8	Manned shuttles at end of ASC	Trucks back-in to landside of ASC row

Common factors in Automated Terminals to Date

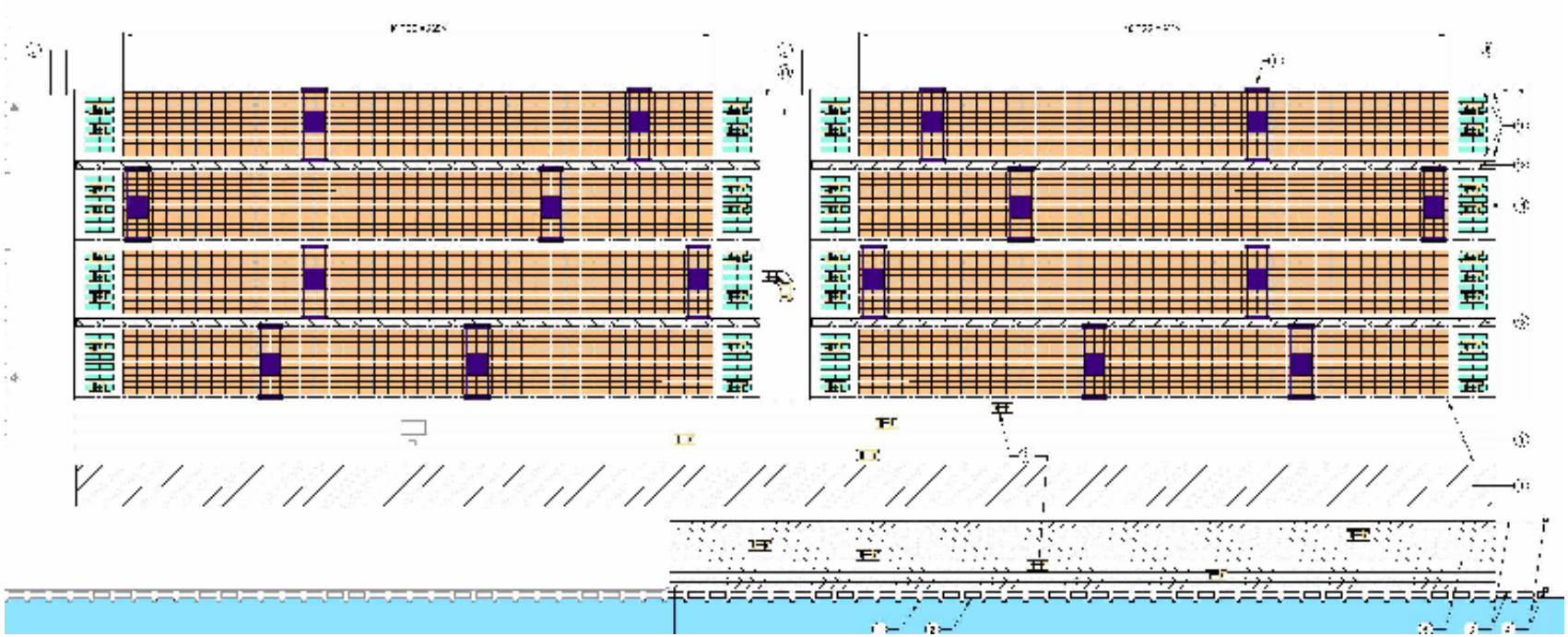
- ASC runs normally perpendicular to the wharf
- Trucks back into transfer zones (or slots) on the Gate side end
- Most of the terminals other than Hamburg prefer two cranes on same rails
- ASC stack width range from 8 to 10 wide and 4 to 5 high

Why Would you Make a Change?

- Transhipment terminals
  - Need more ASCs to service the stevedoring
  - Gate ASCs not heavily utilized in case of two ASCs on same rails
- Rail
  - Rail side operations have not been automated as of yet
  - Higher rail fraction terminals would prefer automating the rail operations
- Terminal shape
  - Depth of the terminal does not allow perpendicular ASC runs
- Phasing with a truck environment (NYCT)

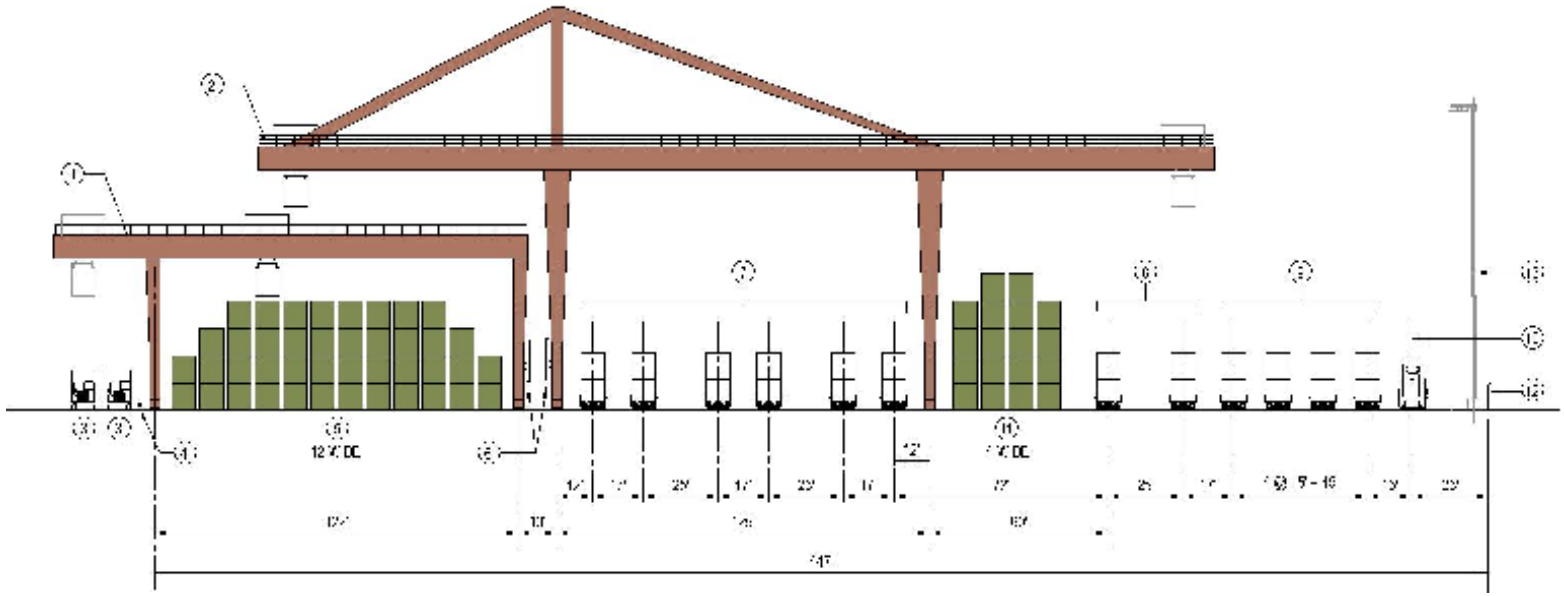
Transhipment Options

- Use separate rails (CTA) to allow both cranes to work waterside
- Rotate 90 deg to get buffers on both ends



Rail Service

- Direct wharf-rail access
- Automated end transfer



An Option for Direct AGV/ IY Access

Bridge Crane System for CY to IY Transfer

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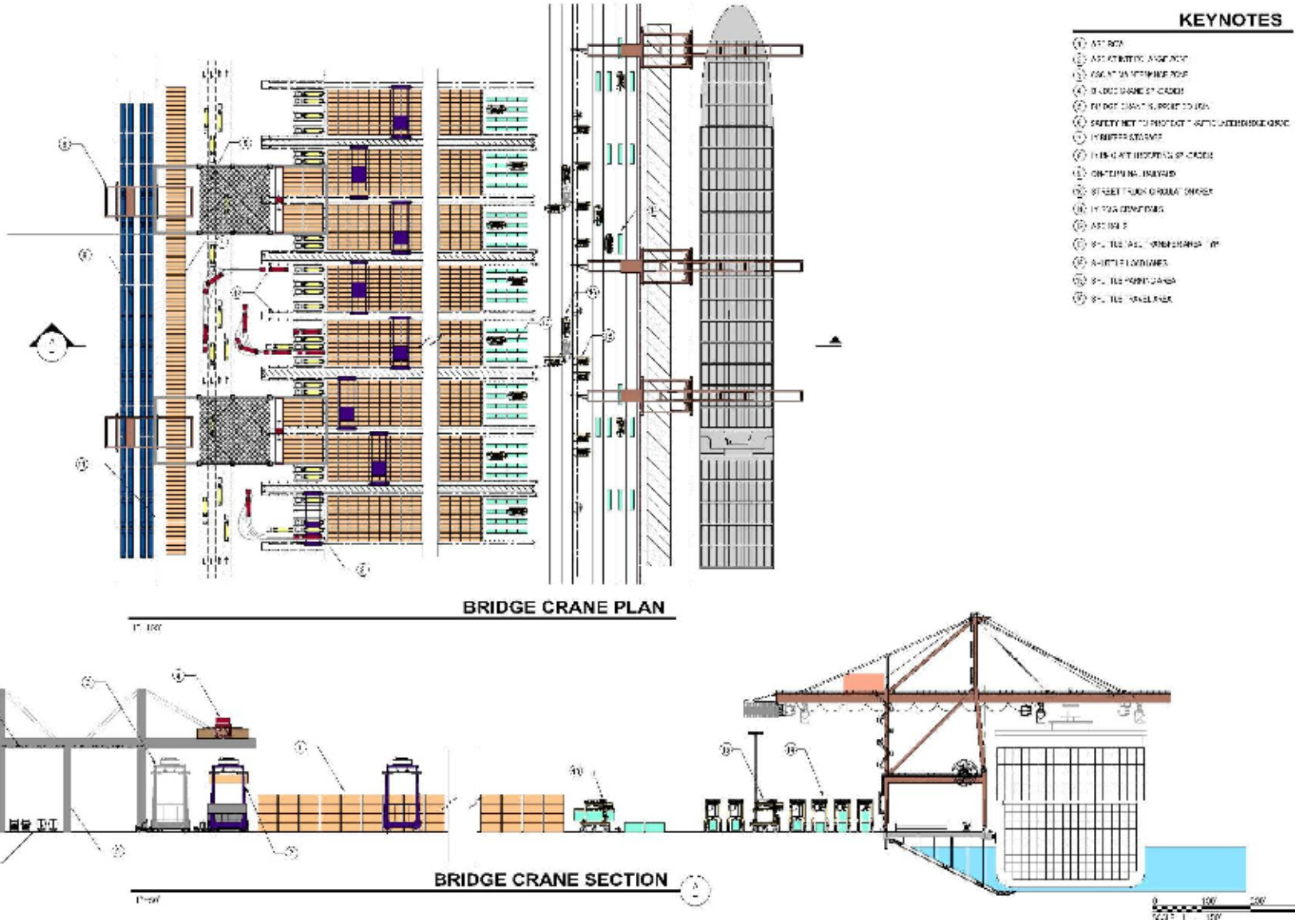
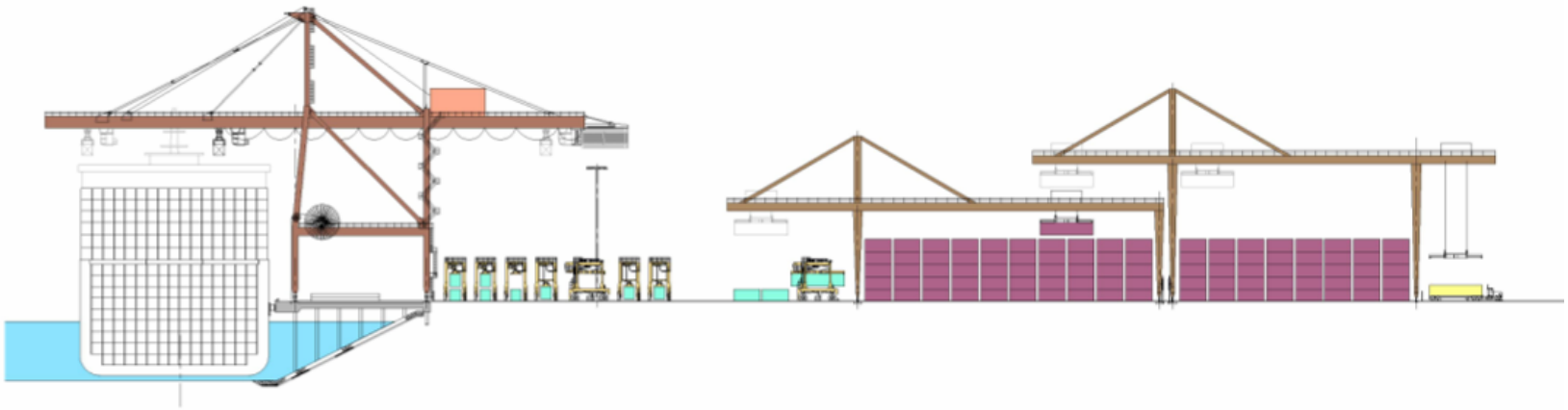


Options for Narrow Terminals

- **ADVANTAGES:**
- Very high storage density on small footprint
- Ability to use different number of landside and waterside RMGs
- High buffer capacity
- Horizontal transfer ability within stacks
- Narrow machines allow more RMG density

- **DISADVANTAGES:**
- Unique TOS
- Higher cost per RMG than portal RMGs
- Landside RMGs not available for vessel work
- Difficult to manage more than two parallel rows
- Difficult to phase construction



Big Nested RMGs are Already In Use in the US
BNSF Memphis

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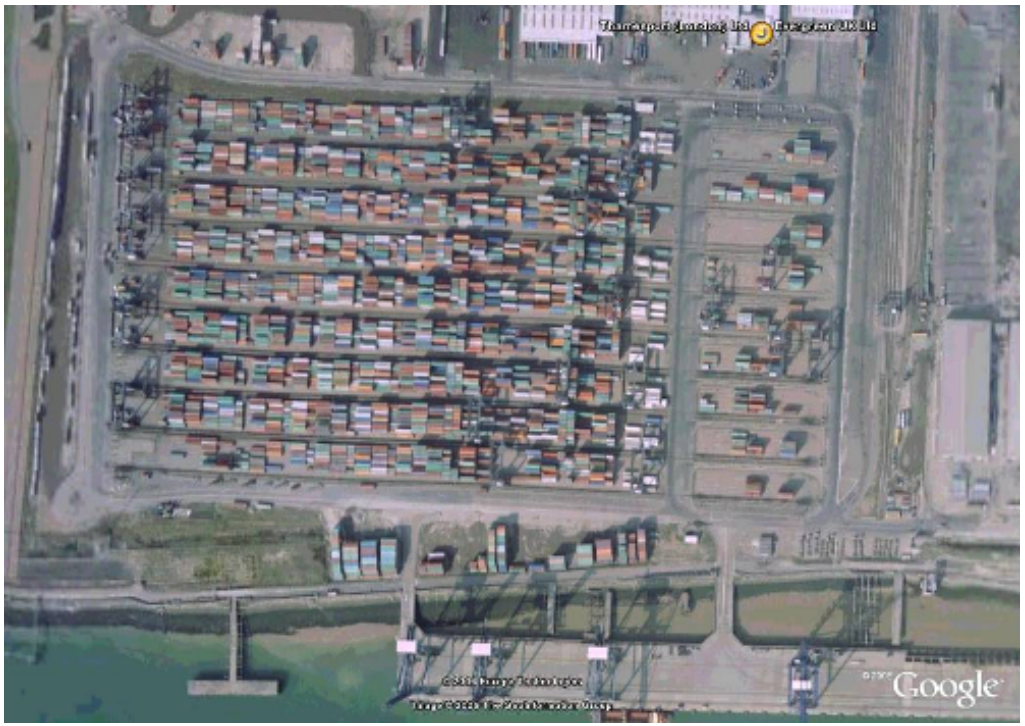
Phasing With Trucks

ADVANTAGES:

- The operation can be phased into an automated mode of operation without changing the physical infrastructure on the ground
- Easy addition to an existing terminal with terminal tractors. For e.g. a RTG terminal with terminal tractors

DISADVANTAGES:

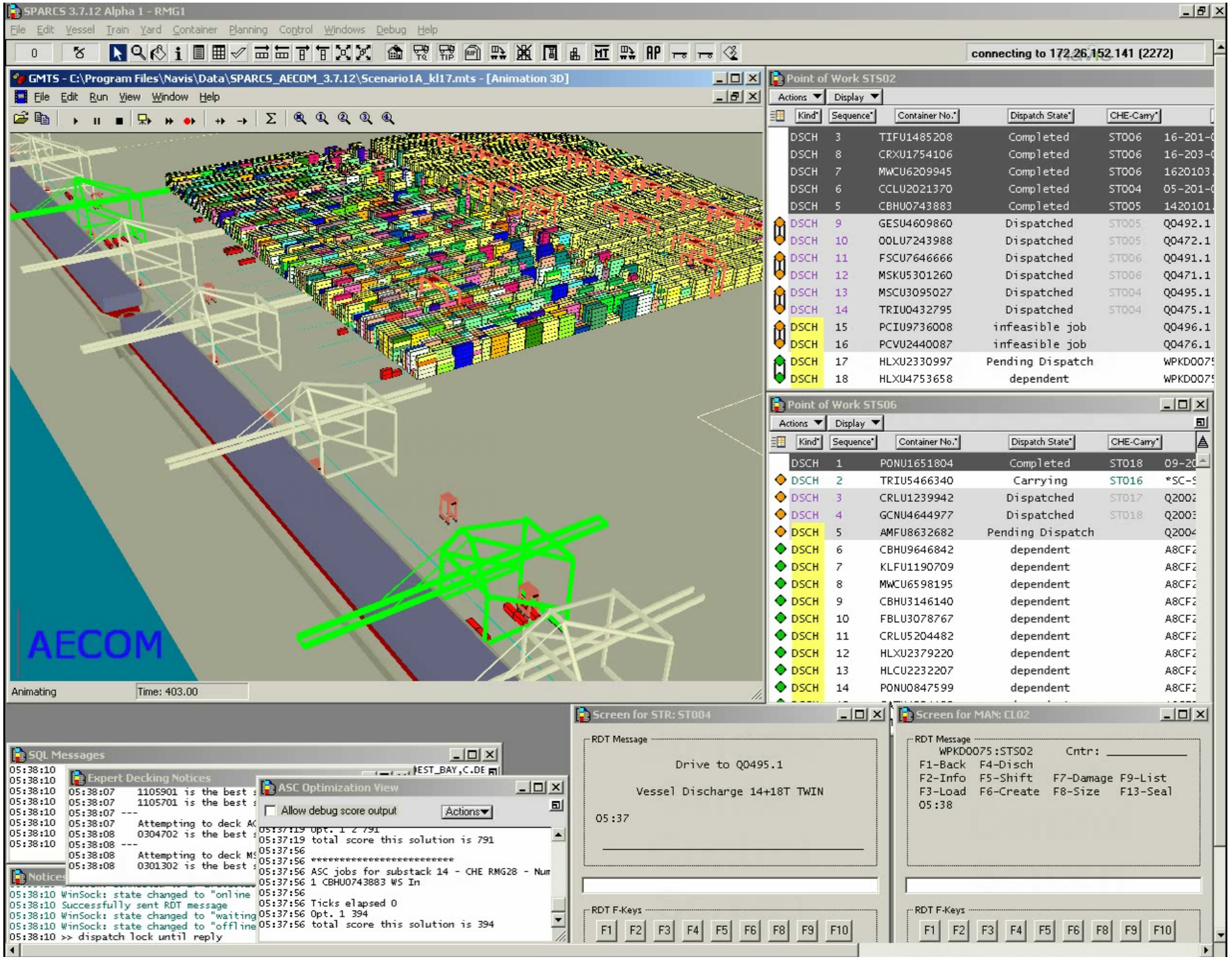
- Less yard density in comparison to perpendicular ASC systems due to the circulation aisles used for the waterside terminal tractors



Phasing with a Truck Environment (NYCT)

Factors to consider when moving to Automated Terminal

- Yard geometry relative to berth
- Cost and availability of labor vs. expected throughput
- Terminal Operating System Risks


SPARCS 3.7.12 Alpha 1 - RMG1
File Edit Vessel Train Yard Container Planning Control Windows Debug Help
connecting to 172.26.152.141 (2272)
GMTS - C:\Program Files\Navis\Data\SPARCS_AECOM_3.7.12\Scenario1A_kl17.mts - [Animation 3D]
File Edit Run View Window Help
AECOM
Animating
Time: 403.00
Point of Work STS02
Actions Display
Kind Sequence Container No. Dispatch State CHE-Carry
DSCH 3 TIFU1485208 Completed ST006
DSCH 8 CRXU1754106 Completed ST006
DSCH 7 MWCU6209945 Completed ST006
DSCH 6 CCLU2021370 Completed ST004
DSCH 5 CBHU0743883 Completed ST005
DSCH 9 GESU4609860 Dispatched ST005 Q0492.1
DSCH 10 OOLU7243988 Dispatched ST005 Q0472.1
DSCH 11 FSCU7646666 Dispatched ST006 Q0491.1
DSCH 12 MSKU5301260 Dispatched ST006 Q0471.1
DSCH 13 MSCU3095027 Dispatched ST004 Q0495.1
DSCH 14 TRIU0432795 Dispatched ST004 Q0475.1
DSCH 15 PCIU9736008 infeasible job Q0496.1
DSCH 16 PCVU2440087 infeasible job Q0476.1
DSCH 17 HLXU2330997 Pending Dispatch
DSCH 18 HLXU4753658 dependent
Point of Work STS06
Actions Display
Kind Sequence Container No. Dispatch State CHE-Carry
DSCH 1 PONU1651804 Completed ST018
DSCH 2 TRIU5466340 Carrying ST016
DSCH 3 CRLU1239942 Dispatched ST017
DSCH 4 GCNU4644977 Dispatched ST018
DSCH 5 AMFU8632682 Pending Dispatch
DSCH 6 CBHU9646842 dependent A8CF2
DSCH 7 KLFU1190709 dependent A8CF2
DSCH 8 MWCU6598195 dependent A8CF2
DSCH 9 CBHU3146140 dependent A8CF2
DSCH 10 FBLU3078767 dependent A8CF2
DSCH 11 CRLU5204482 dependent A8CF2
DSCH 12 HLXU2379220 dependent A8CF2
DSCH 13 HLCU2232207 dependent A8CF2
DSCH 14 PONU0847599 dependent A8CF2
SQL Messages
Expert Decking Notices
ASC Optimization View
Allow debug score output
Actions
05:37:19 total score this solution is 791
05:37:56 ASC jobs for substack 14 - CHE RMG28 - Num
05:37:56 1 CBHU0743883 WS In
05:37:56 Ticks elapsed 0
05:37:56 Opt. 1 394
05:37:56 total score this solution is 394
Notices
05:38:10 WinSock: state changed to "online
05:38:10 Successfully sent RDT message
05:38:10 WinSock: state changed to "waiting
05:38:10 WinSock: state changed to "offline
05:38:10 >> dispatch lock until reply
Screen for STR: ST004
RDT Message
Drive to Q0495.1
Vessel Discharge 14+18T TWIN
05:37
RDT F-Keys
F1 F2 F3 F4 F5 F6 F8 F9 F10
Screen for MAN: CL02
RDT Message
WPKD0075:STS02 Cntr:
F1-Back F4-Disch
F2-Info F5-Shift F7-Damage F9-List
F3-Load F6-Create F8-Size F13-Seal
05:38
RDT F-Keys
F1 F2 F3 F4 F5 F6 F8 F9 F10

Thank You

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Appendix

Glossary

- ASC = Automatic Stacking Crane, an end loaded RMG without a driver on the crane. Controlled remotely as needed
- RMG = Rail Mounted Gantry Crane
- DCRMG = Dual Cantilever Rail Mounted Gantry Crane
- AGV = Automated Guided Vehicle. Robotic transporters used for container transport
- Shuttle Carrier = A short (1-over-1) straddle carrier used only for transport, not for stacking
- AutoStrad = a robotic unmanned straddle carrier
- DGPS = Differential Global Positioning System, a very precise location technology that combines satellite navigation (GPS) with local reference points