TRENDS IN TERMINAL DESIGN AND OPERATIONS

September 24th 2009

Marine Terminal Management Training Program

Outline

- What do we mean by automation?
- What are the current system and equipment choices?
- What is different about planning and designing an automated terminal?
- What are some of the critical civil design issues?

What Do We Mean by Automation?

- Robotic operation
  - The physical movement of the container by the system
- Operational optimization using effective and efficient information technology
  - Receive containers
  - Store containers
  - Retrieve containers

What Do We Mean by Automation?

- The key operational elements that are optimized
  - Service
  - Terminal capacity / throughput
  - Space utilization
  - Terminal traffic
  - Operational cost
    - Fixed
    - Variable

What Do We Mean by Automation?

Port

- Capacity
- Revenue
  - Port ROI
  - Local economic benefit
  - Jobs
- Negative impacts minimized
  - Traffic
  - Emissions

Tenant

- Capacity
- Productivity
  - Vessel
  - Gate
  - Rail
- Cost
  - Lowest total cost per lift
  - Highest revenue potential

Why Automate?

- Predictable capacity & productivity
- Higher limit to optimization
- Predictable return on investment
  - Lower total cost/lift
  - Competitiveness
- Sustainability
  - Emissions
  - Traffic
  - Worker health and safety

What are the current system and equipment choices?

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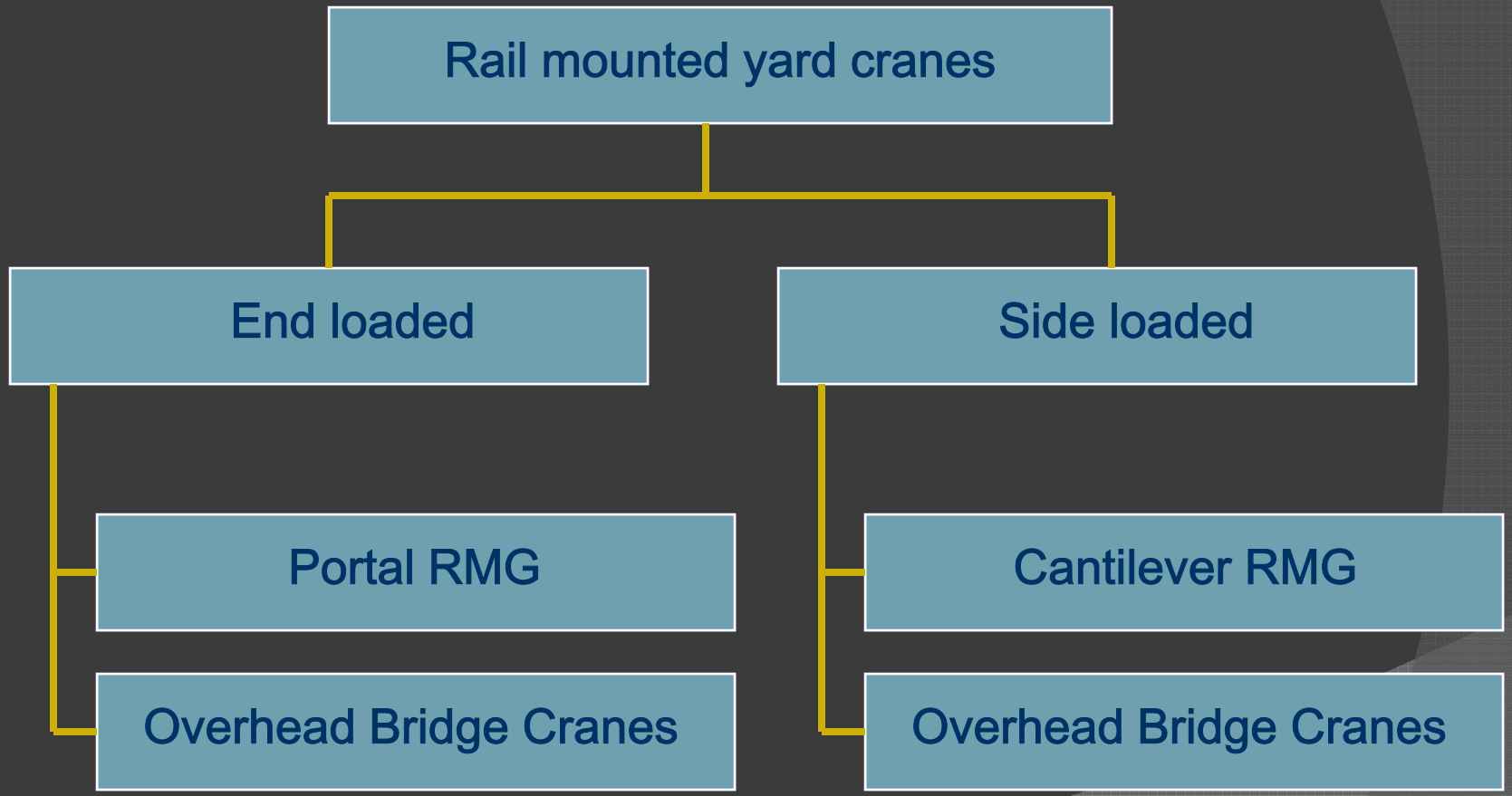
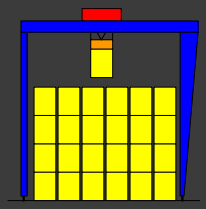
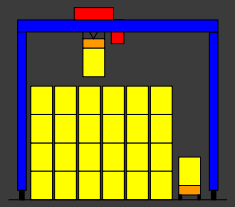


What are the current system and equipment choices?

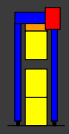
Yard stacking equipment evolution in size



6 wide, 1 over 4 high RMG
[ect]



6 wide, 1 over 4 high RTG



3 high SC

Wheeled

What are the current system and equipment choices?

1. Generation

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What are the current system and equipment choices?

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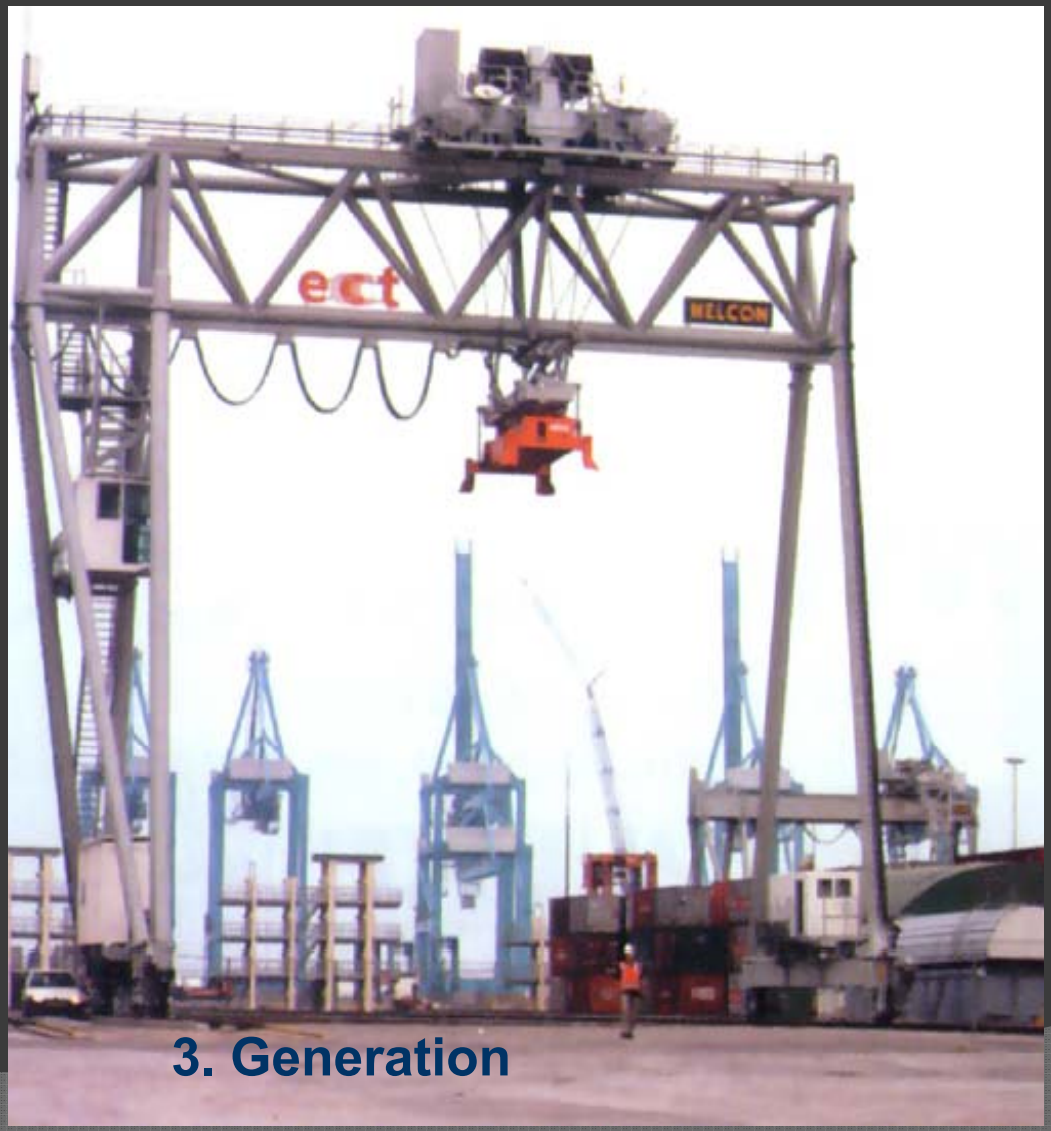

3. Generation

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What are the current system and equipment choices?

Pilot crane at Antwerp

Guide post for load control

What are the current system and equipment choices?

What are the current system and equipment choices?

Autostacking RMG at CTA

What are the current system and equipment choices?

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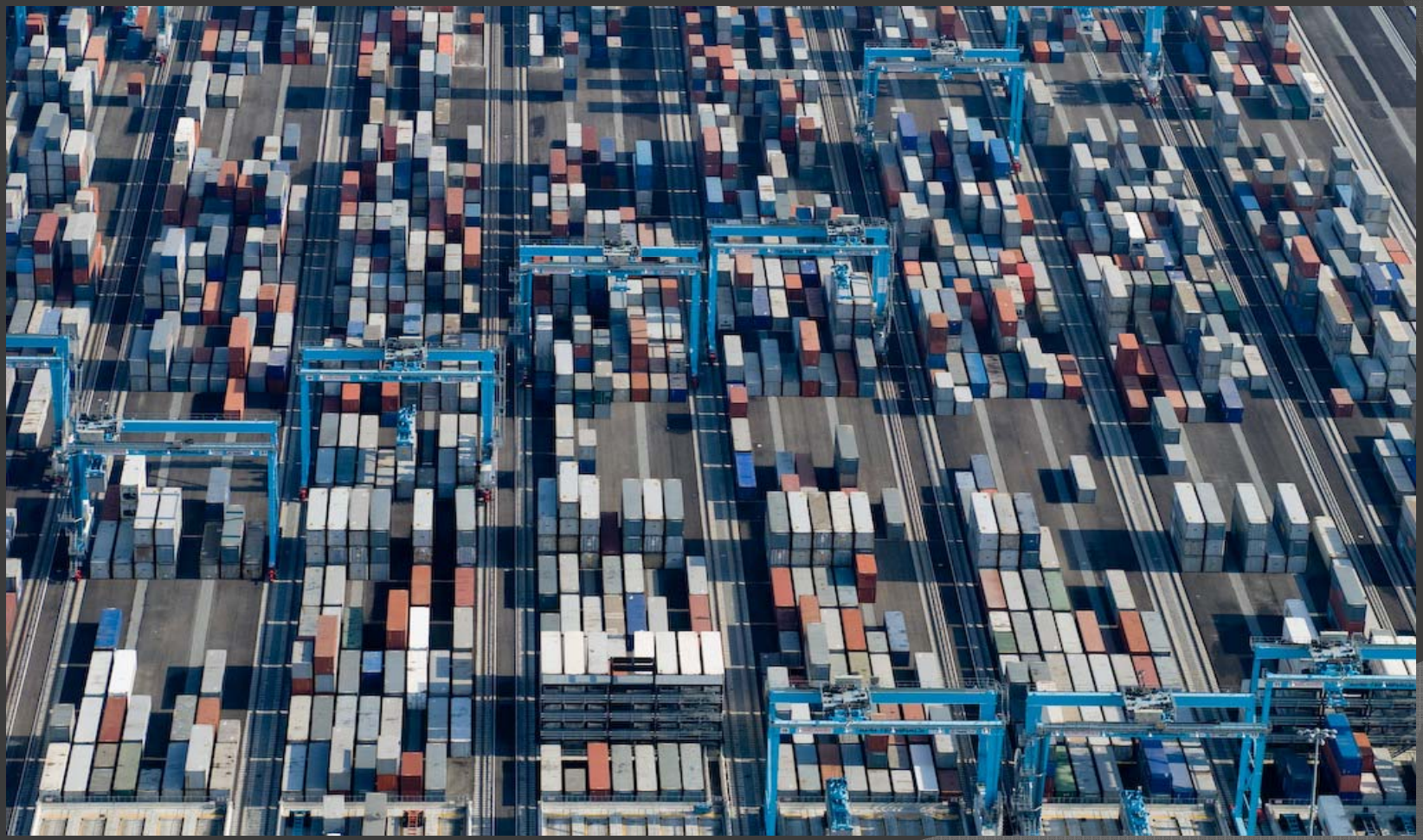
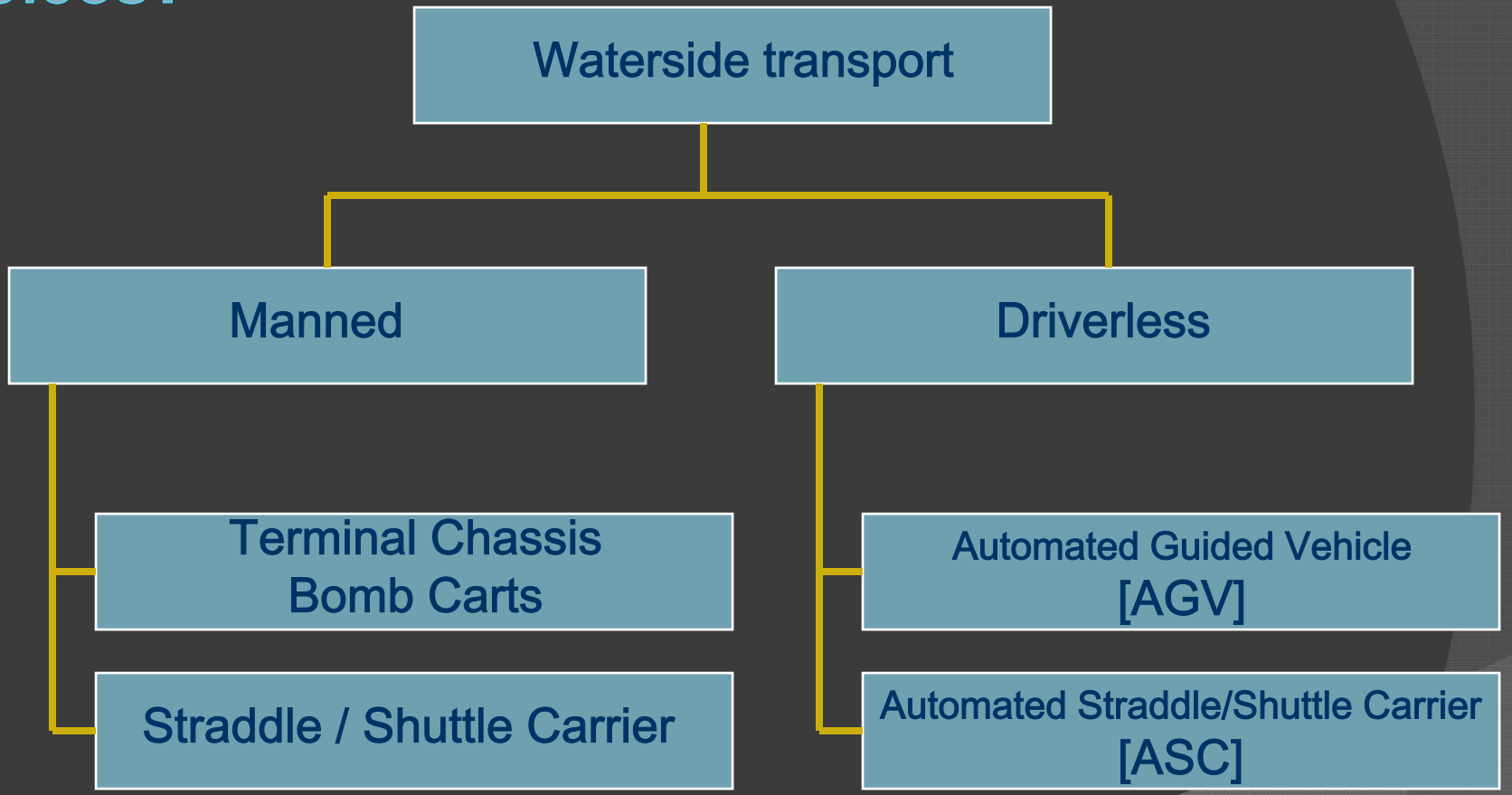


What are the current system and equipment choices?

In operation since 1998

1 over 8 high
42 m span

What are the current system and equipment choices?



What are the current system and equipment choices?

AGV at CTA

travel speed
3.5

position
accuracy +/- 50
mm

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What are the current system and equipment choices?

Driverless Straddle Carrier at Patrick Terminal, Australia

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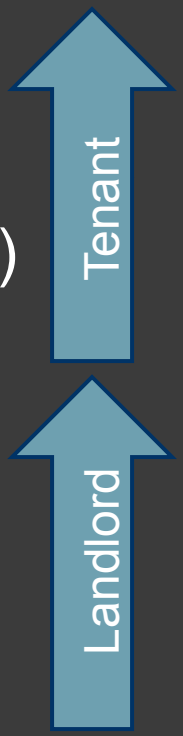
What is different about planning and designing an automated terminal?

- Operations
  - TOS/Logistics
  - Equipment
  - Maintenance
- (Top of Pavement)
  - Pavement
  - Elect/Comm
  - Wharf
- Infrastructure

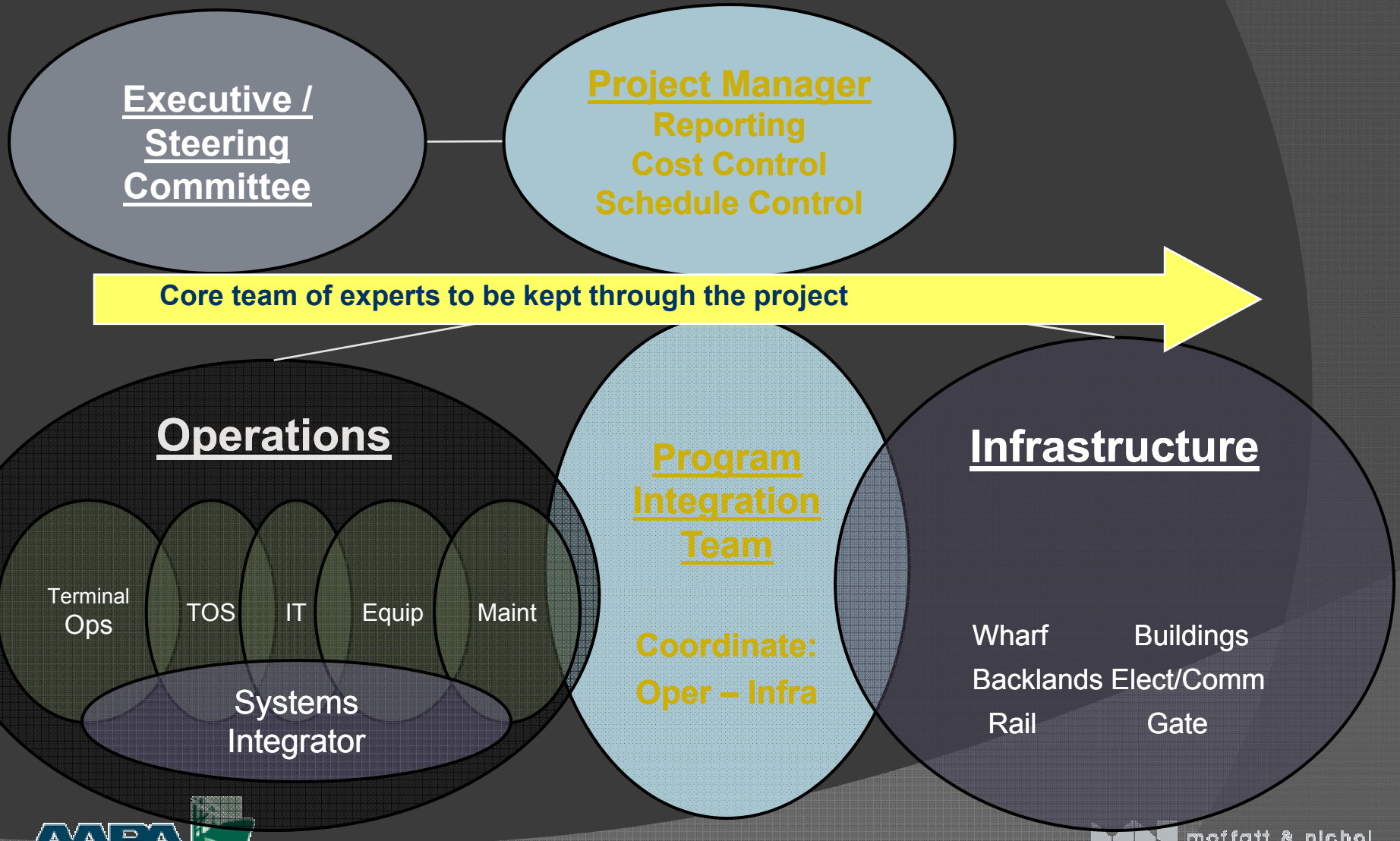


Manned Equipment

- Operations
  - TOS/Logistics
  - Equipment
  - Maintenance
- (Top of Pavement)
  - Pavement
  - Elect/Comm
  - Wharf
- Infrastructure

Automated Equipment

What is different about planning and designing an automated terminal?



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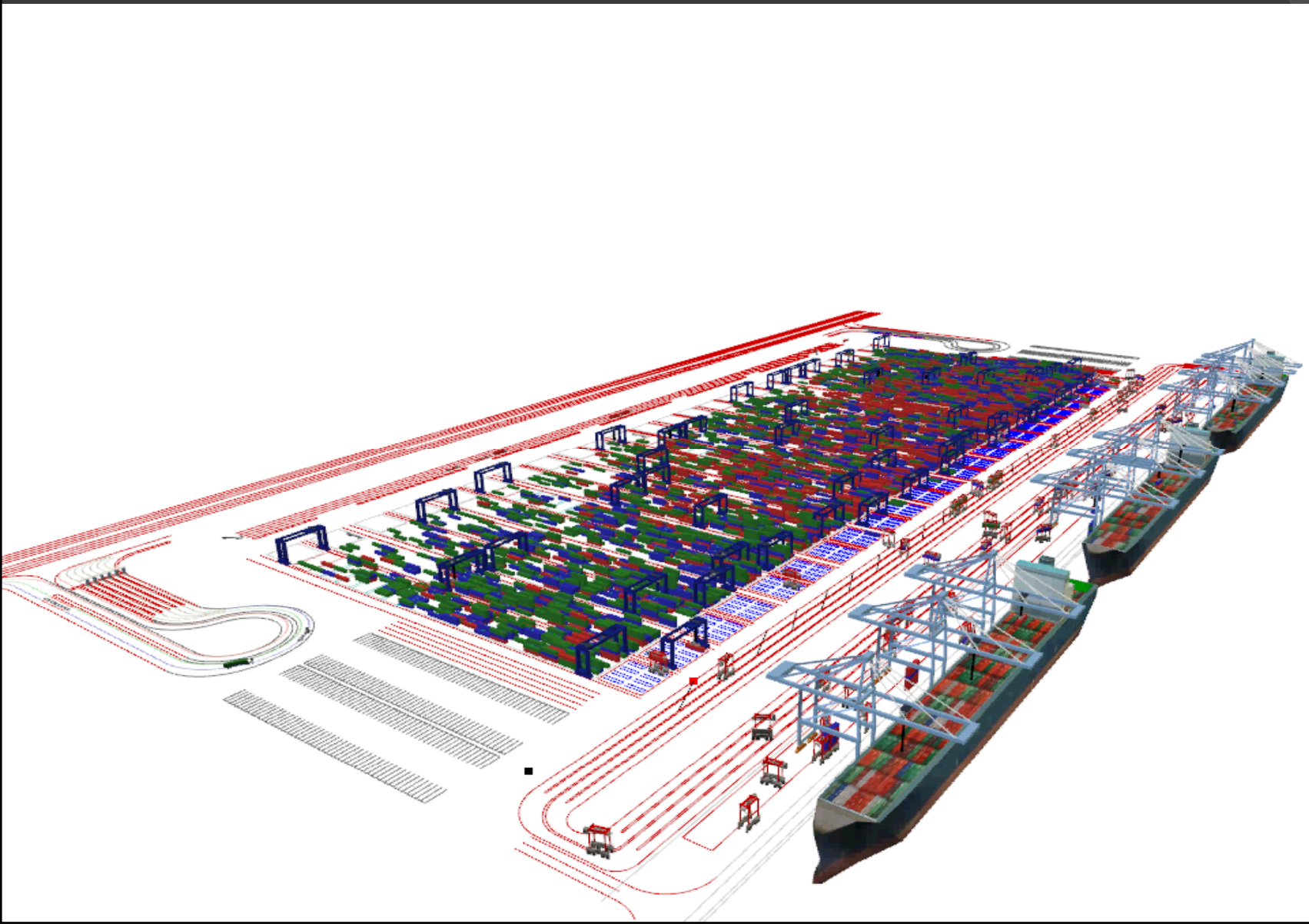
What is different about planning and designing an automated terminal?

- A clear understanding and statement of goals is the first requirement for any project, but even more so for an automation project;
  - Project planning horizon (or economic life)
  - Terminal design capacity
  - Performance criteria
    - Berth
    - Road truck receiving and delivery
    - Rail loading
  - Environmental compliance
  - Financial

What is different about planning and designing an automated terminal?

- Set Goals
- Assigned Team
- Terminal Planning
  - Study individual systems
    - Simulation
  - Study interfacing systems
    - Simulation
- Emulation and Terminal testing
  - Simulation
- Operations Training
  - Simulation

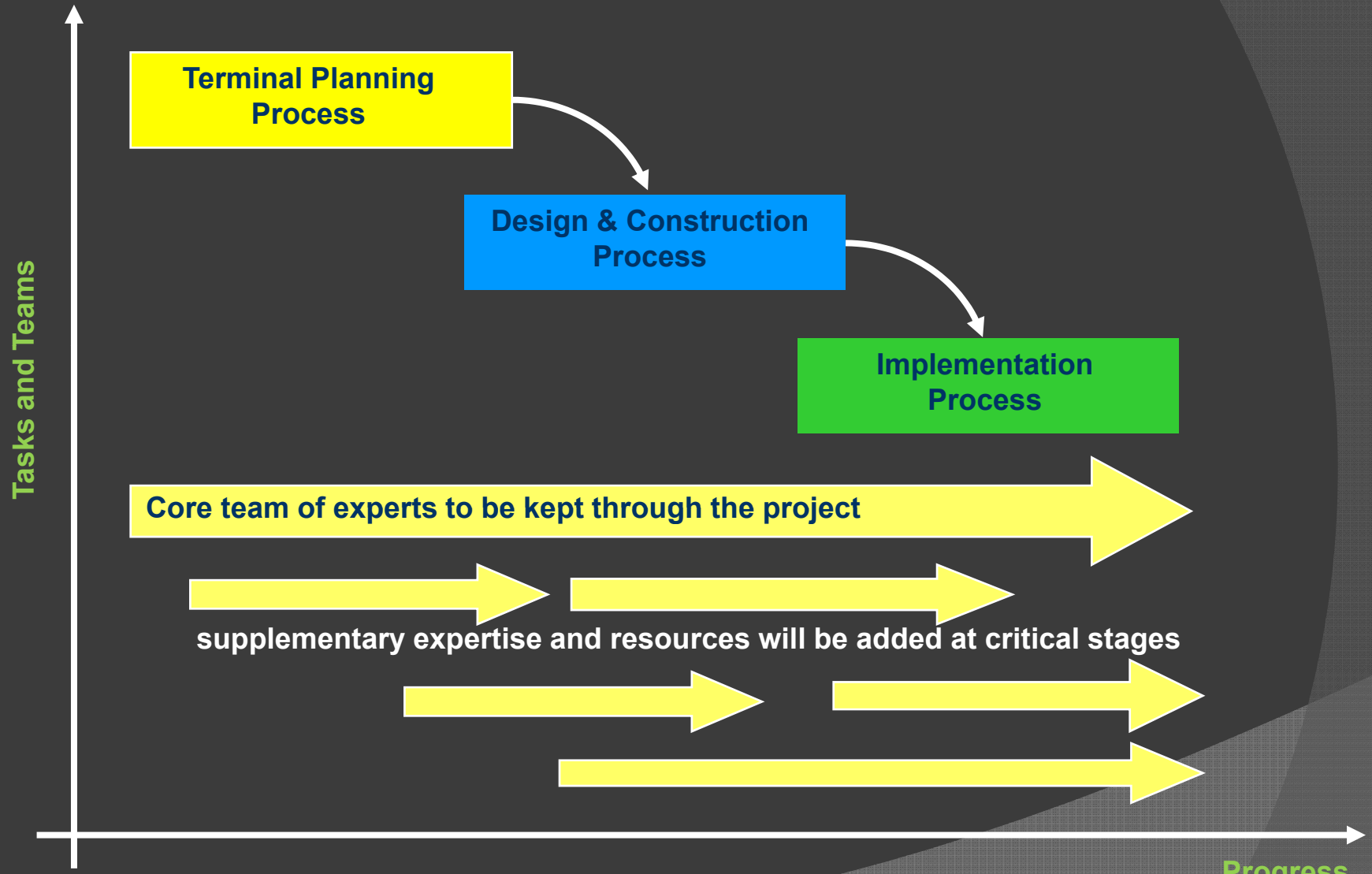
What is different about planning and designing an automated terminal?



The planning and design process

- Composition and selection of core team
  - from planning to production
  - multidiscipline composition. The perfect composition of this team would include:
    - Operations
    - Equipment
    - Maintenance
    - Infrastructure
    - Finance
    - IT Systems

The planning and design process

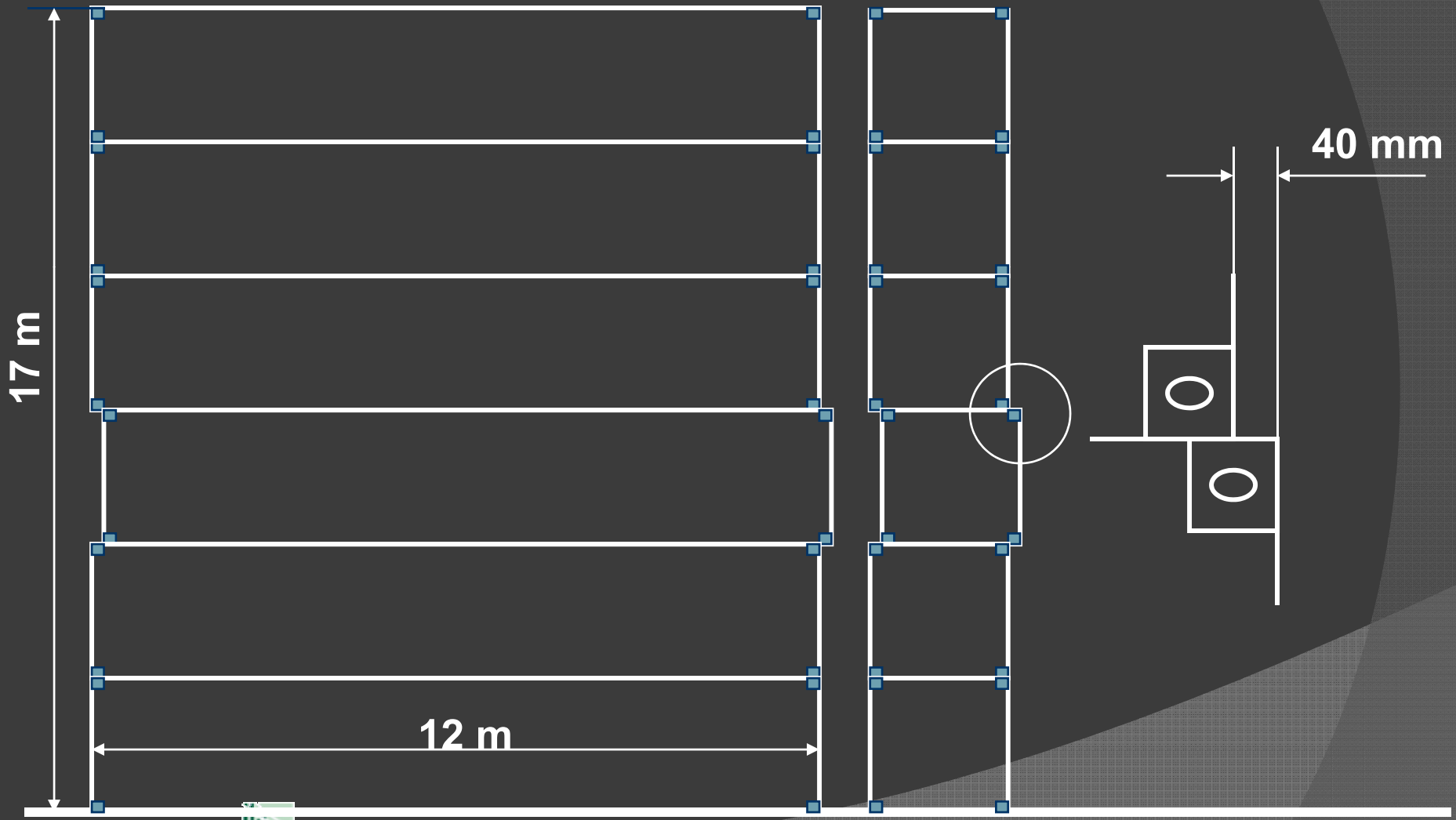


What is different about planning and designing an automated terminal?

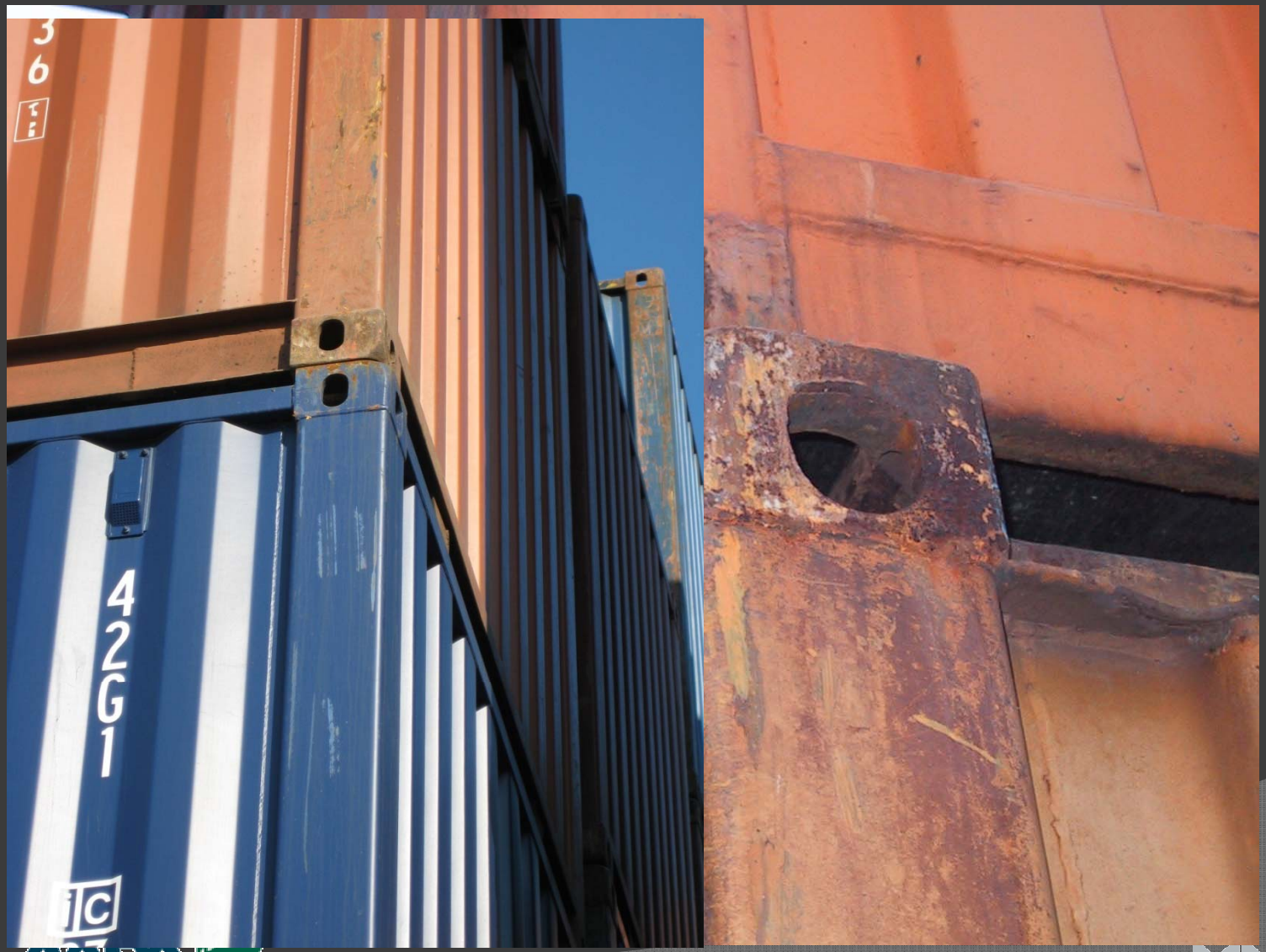
Equipment specification

1. Fit for the purpose
   to move / stack containers in an modern large marine terminal
2. Safe
   Must comply with national safety standards
3. Reliable
   The MMBF is a deliverable and testable item
4. Fast
   Operating speed and performance must be specified and demonstrated
5. Maintainable
   Designed to be maintainable
   accessability, fault detection and reporting, documenation
6. Durable
   Design with headroom

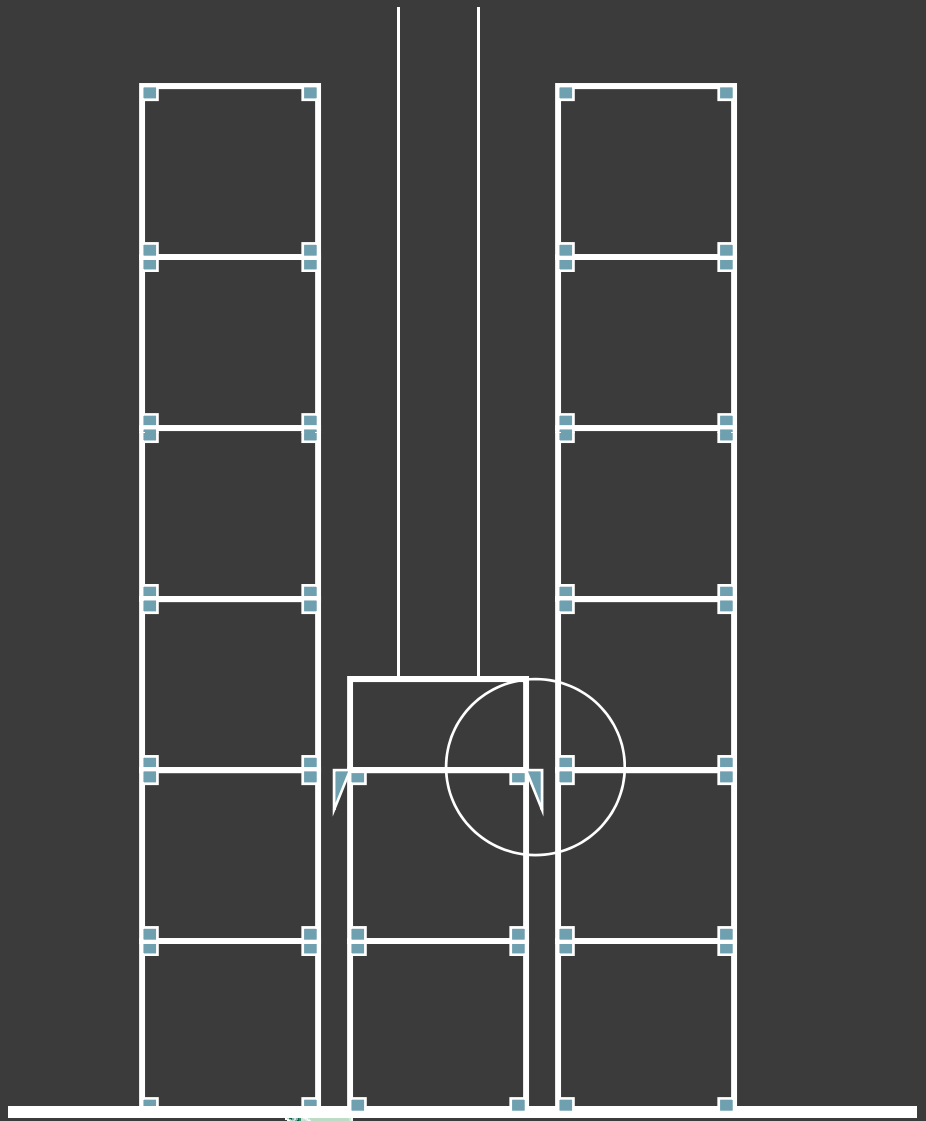
Stacking accuracy (1)

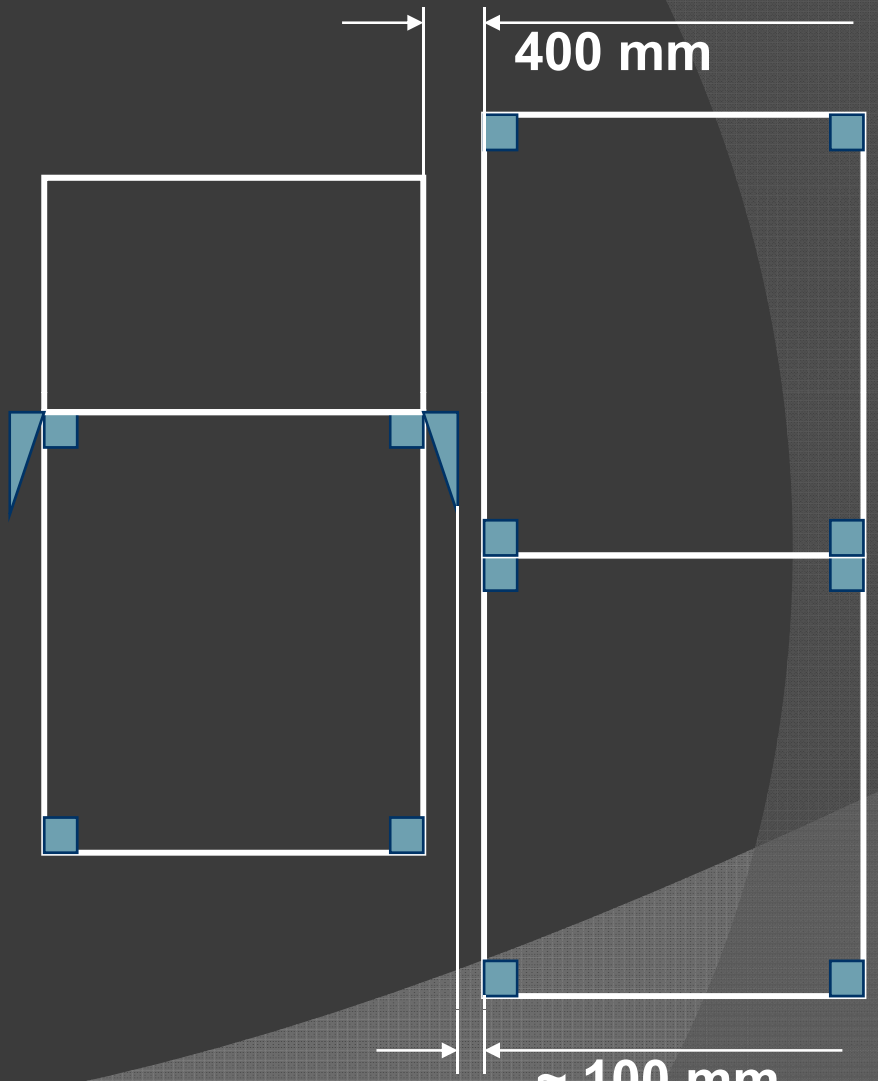


Stacking accuracy



Stacking accuracy (3)





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Maintenance issues

- No operator or driver on the equipment
  - No ear and eye to hear and see any malfunction
  - No human that can report any malfunction
  - No driver that can work around any malfunction
- Fenced area of operation, difficult to access
- High equipment utilisation
  - work around the clock
  - high investment demands high utilisation and leaves less room for maintenance

- Sophisticated control technology

- The fleet of automatic stacking cranes at CTA contains:
  > 500 tv cameras
  > 120 laser scanner
  > 60 load position sensors
  > several hundreds of sensors, encoders
  > several hundreds of plcs of different size
  > hundreds of computers (pc´s & server)
  > network components

  and lots of software:
  operating systems – control software - application software - communication software – firmware – databases - parameters

Maintenance issues

each crane does

> 65,000 moves p.a.

24 hours operation

approx. 1,700 lifting hours p.a.

more than 18,500 km (10,000 miles) of gantry travel p.a.

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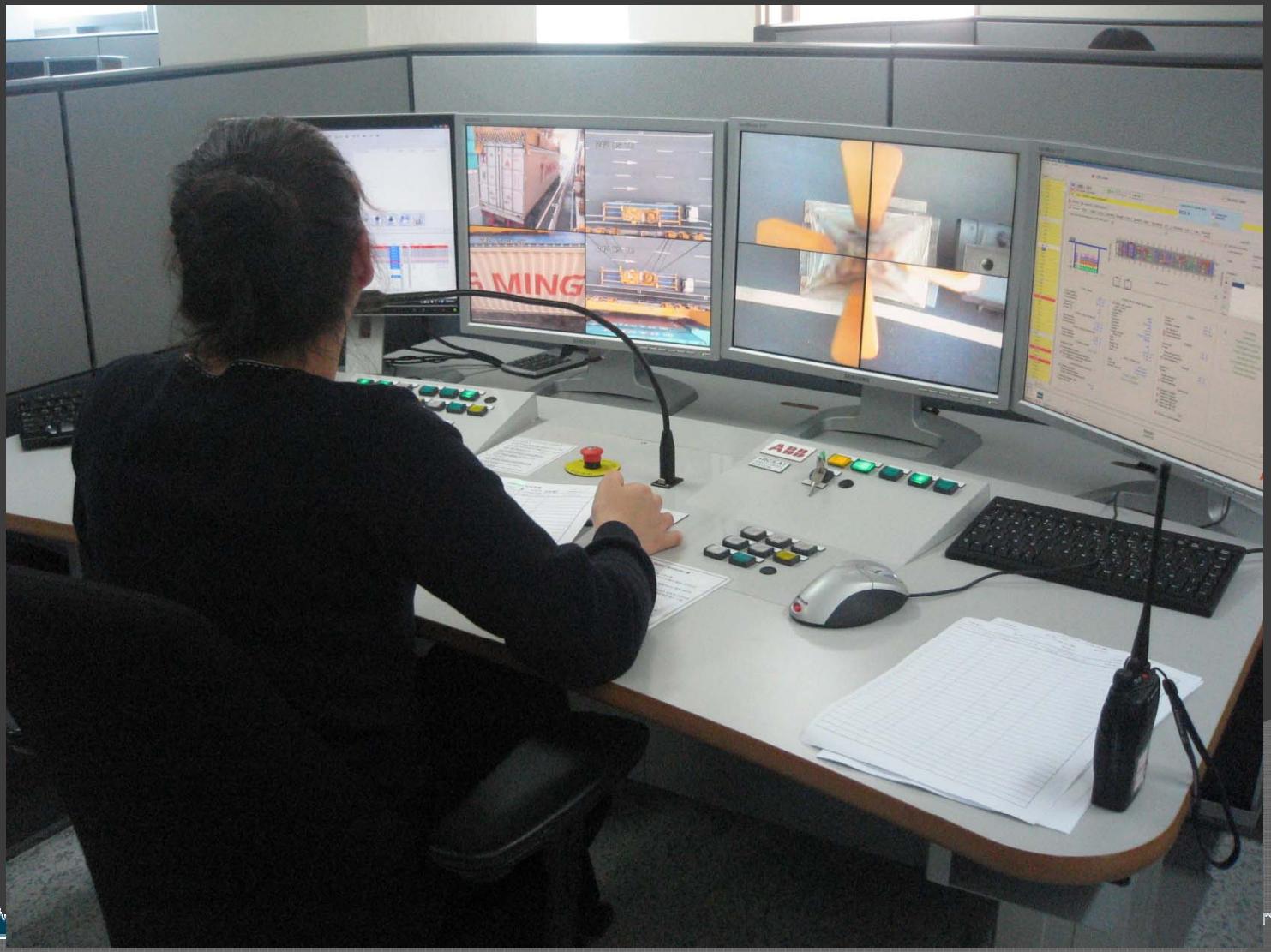
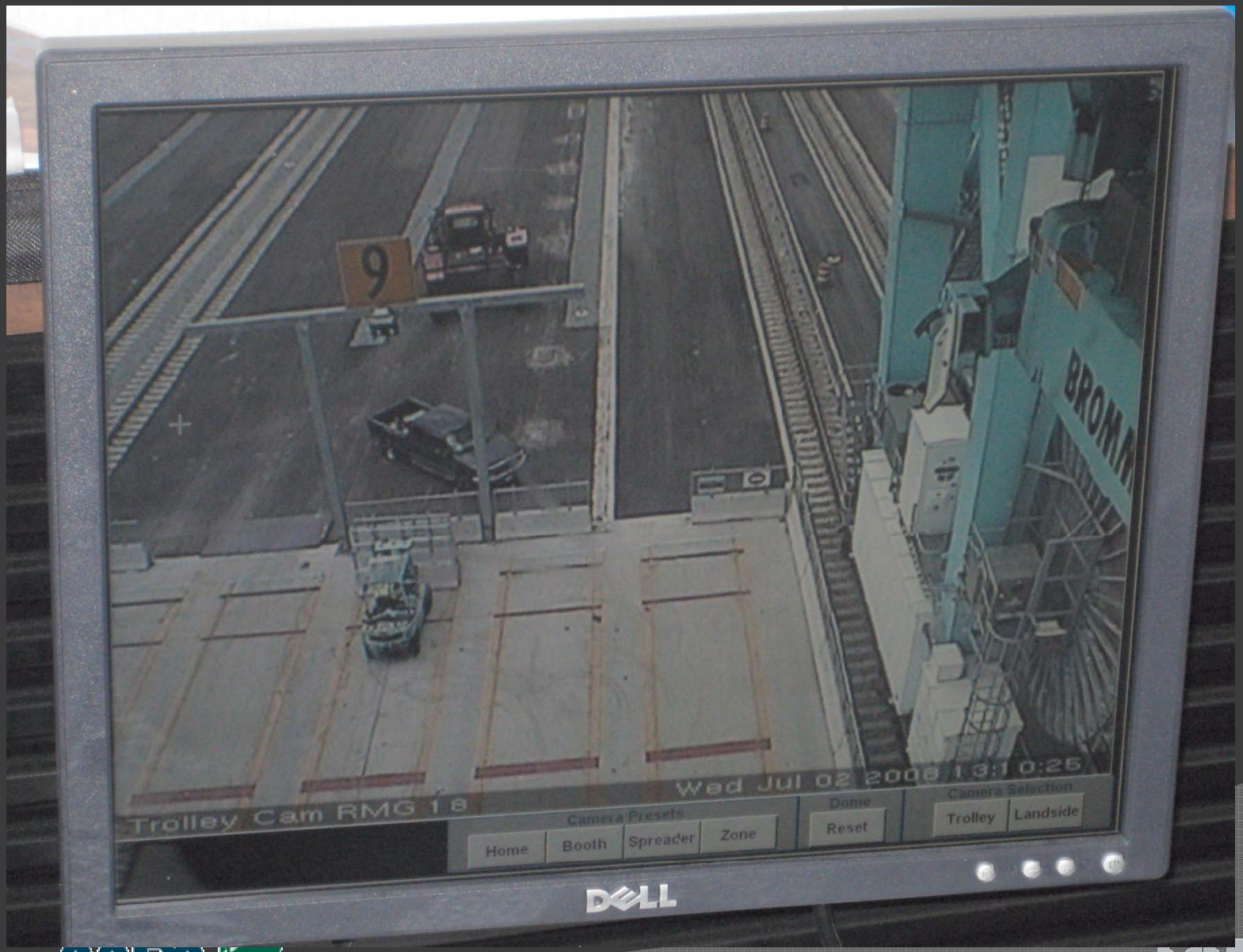
Autostacking Crane System




Call Booth
Call Zone
Cancel Move Door Direction
Maintenance Operator
Overview Screen
Ready For Auto
Spreader Cam RMG 1e
Trolley Cam RMG 1e
TWISTLOCK BYPASS
ROPE SLACK BYPASS
CONTROL RESET-ON
CONTROL OFF
FLIPPER LEFT
TWISTLOCK LOCK
SPREADER CENTER
SHIFT FWD
TRIM LEFT
TRIM RIGHT
SKEW CCW
SHIFT LEFT
GANTRY LEFT
GANTRY RIGHT
SHIFT RIGHT
TROLLEY REV
SHIFT REV
HOIST UP


BROMMA
DANGER
LIFTING
EQUIPMENT
CLHU 835
45G1


Spreader Cam RMG 18
Wed Jul 02 2008 13:10:31
E-Stop Status
Driver on Mat
Stack Left
Unlocked
Stack Right
Wait for Instruction
Auto Ready
Flipper Down
Landed Left
Locked
Landed Right
Flipper Down
Complete
Trim
0.01 DEG
DELL


9
Trolley Cam RMG 18
Wed Jul 02 2008 13:10:25
Camera Presets
Home
Booth
Spreader
Zone
Dome
Reset
Camera Selection
Trolley
Landside
DELL

Terminal Control - Key Requirements

- SPREAD THE WORKLOAD
  AVOID OVERLOADING SOME AREAS AND UNDER-UTILISING OTHERS
- POOL RESOURCES
  MORE PRODUCTIVE UTILISATION OF RESOURCES
- PREDICT & PLAN AHEAD
  OPTIMIZE RESOURCE SCHEDULING
- DECIDE AT THE LATEST POSSIBLE MOMENT
  ALLOW LAST MINUTE CHANGES

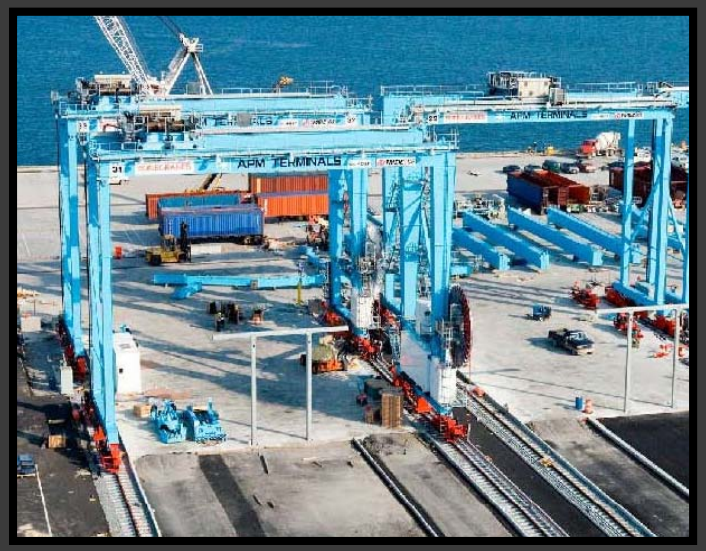
What are some of the critical infrastructure design issues?

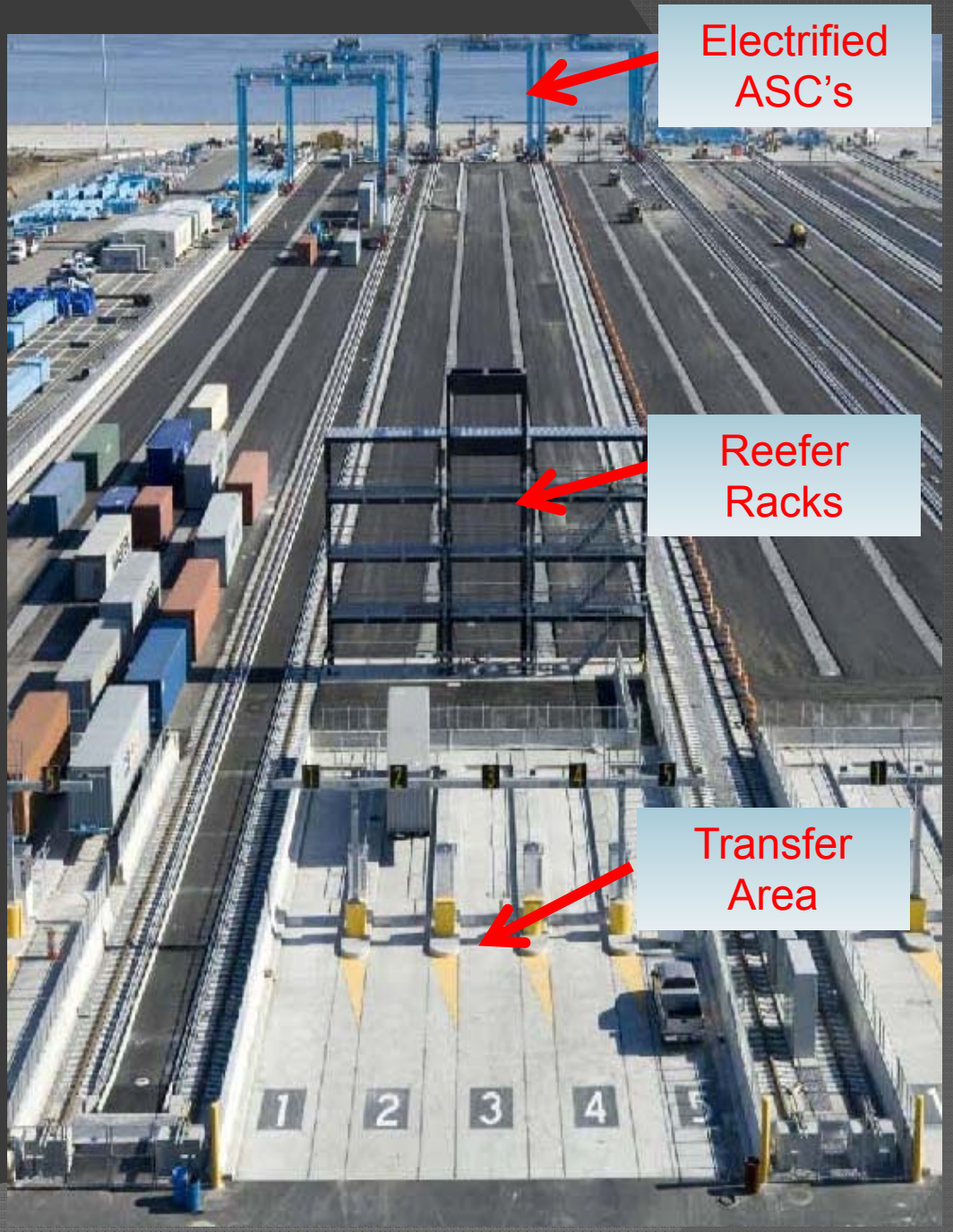
- Site Geotechnical Condition & Improvements
- Grading & Drainage
  - Stacking areas
  - Crane rails
  - Transfer areas
  - Aisles and travelways
- Electrical & Communication System
- Fire Detection, Protection, and Access
- Security & Safety
- Pavement System
- Infrastructure Expandability

Storage Yard Design

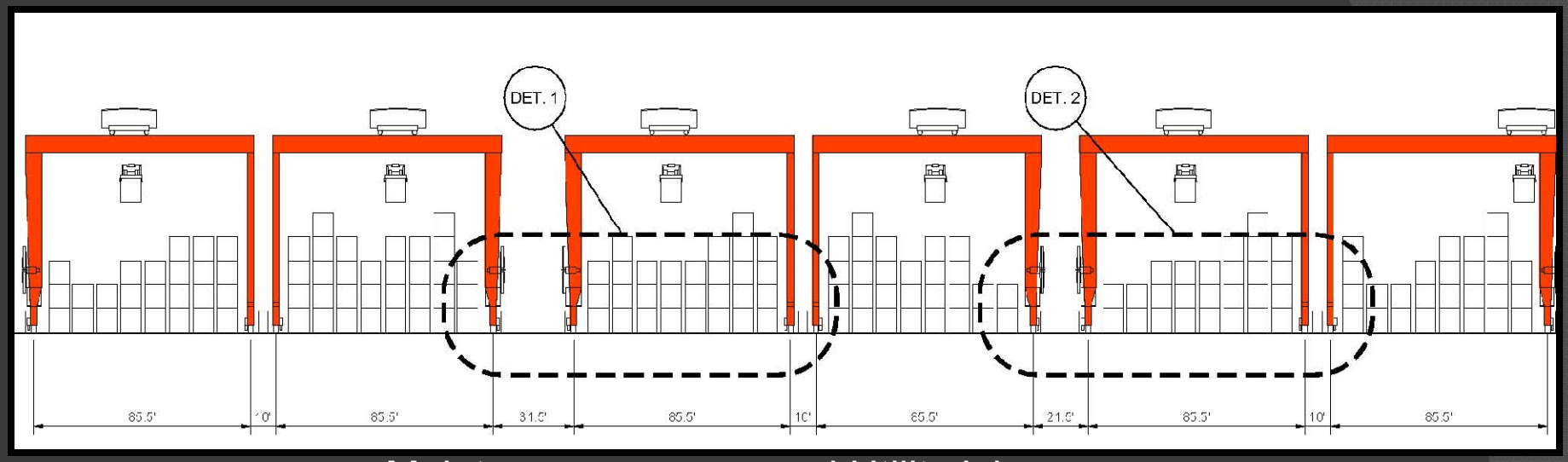
Automated Stacking Cranes (ASC's)

- 2 ASC's per Stack
- Integrated Reefers Racks

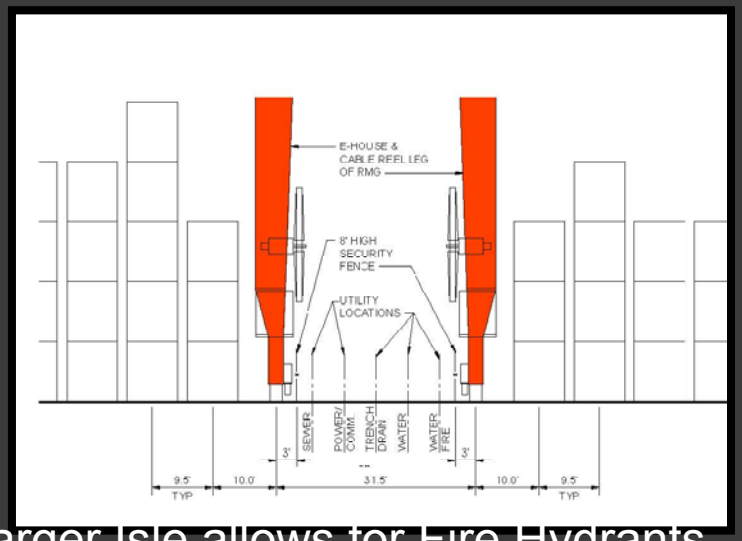




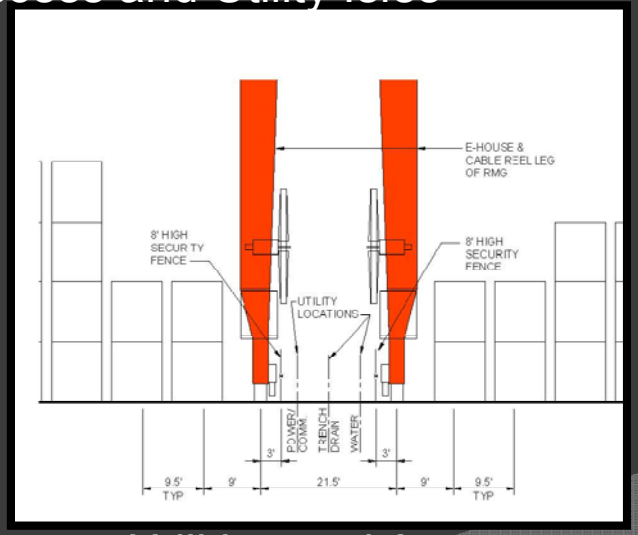
Storage Yard Design – RMG Storage Stacks



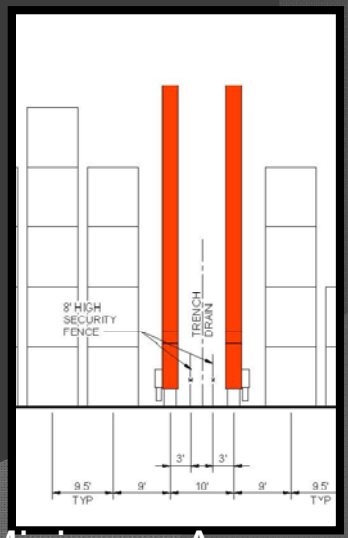
Maintenance access and Utility Isles



Larger Isle allows for Fire Hydrants



Utilities and Access



Minimum Access

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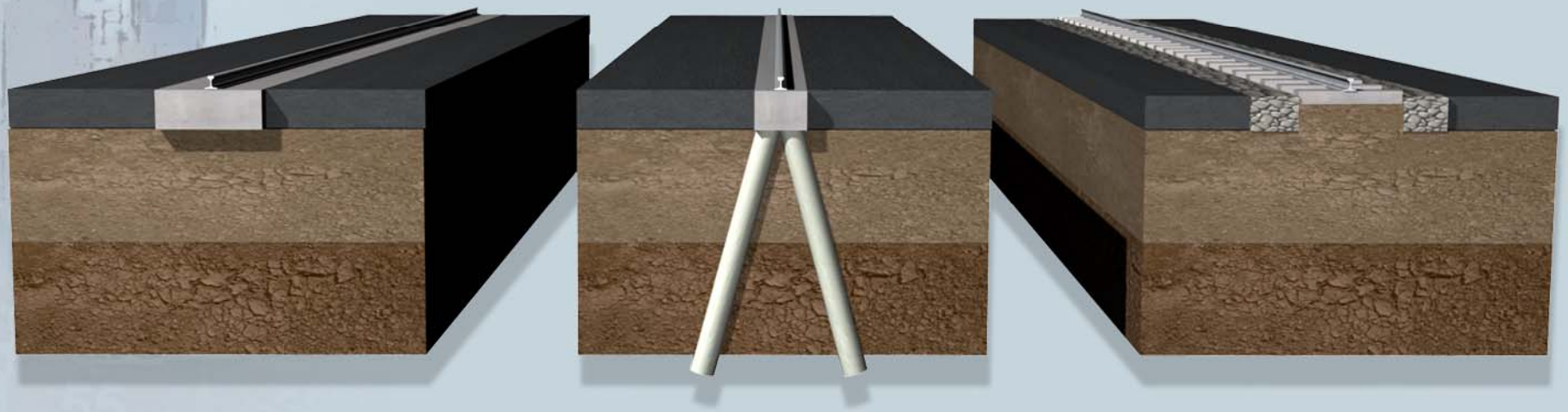
Fotos zum Besuch AAPA
Portsmouth am 02. Juli 2008

Site Geotechnical Condition & Improvements

- Options for Crane Rail Foundation
  - Crane Rail on Spread Footing
  - Crane Rail on Pile Supported Footing
  - Adjustable Crane Rail System

ASC Rails



Site Geotechnical Condition & Improvements

- Crane Rail on Concrete Tie

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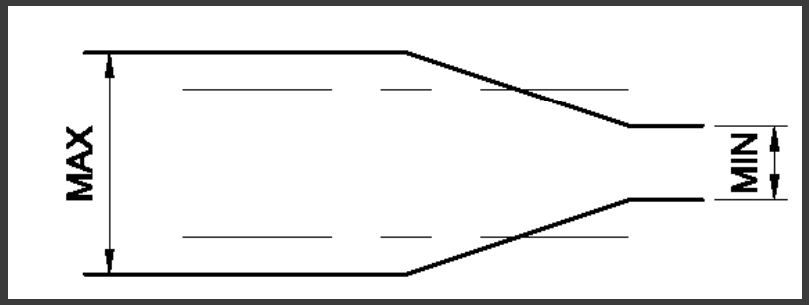
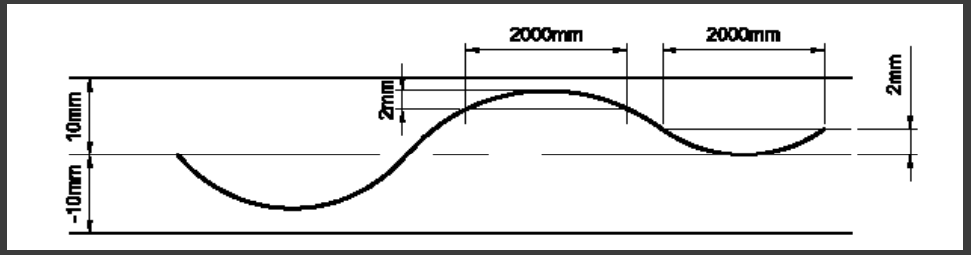
Site Geotechnical Condition & Improvements

- Stacking Area Foundation / Pavement
  - Grade Beam and Gravel
  - Concrete Slab at Corner of the Containers
  - Concrete Pavement
  - Asphalt Pavement

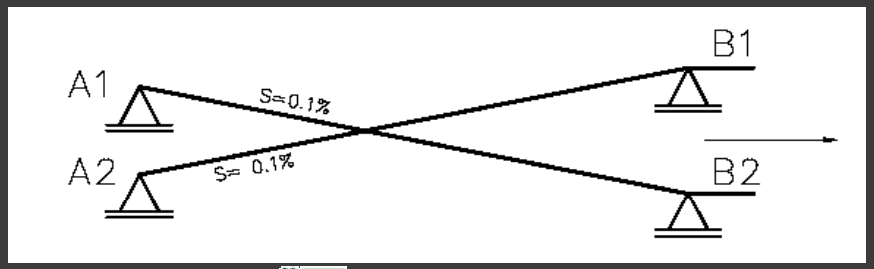
Strict ASC Rail Design Tolerance



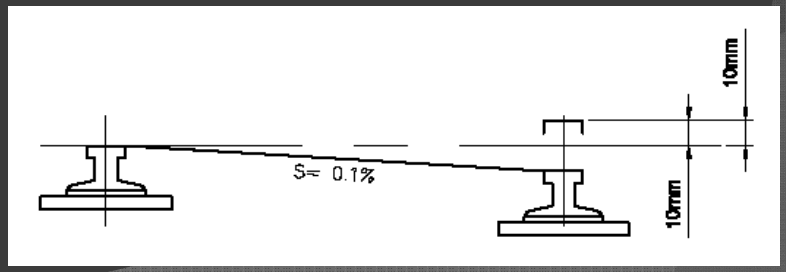
Rail Span Tolerance



Longitudinal Track Differential



Allowed Track Slope Alternate Direction Tolerance



Cross Section Differential

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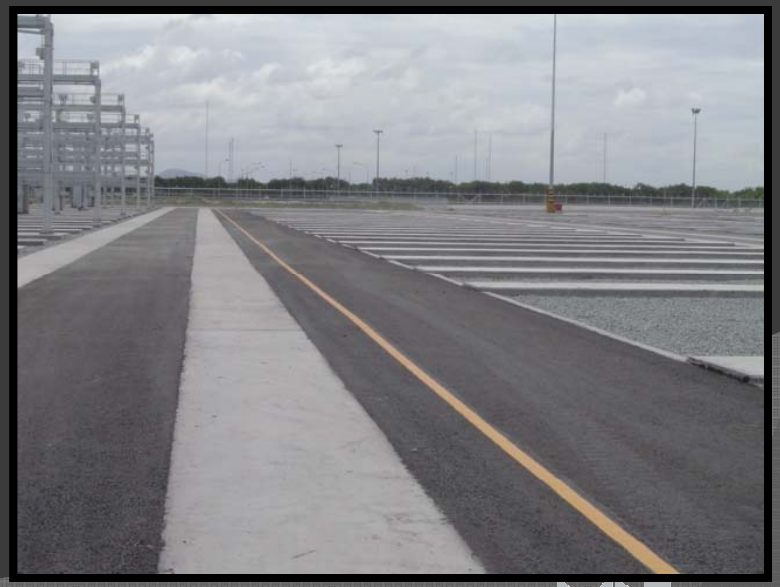

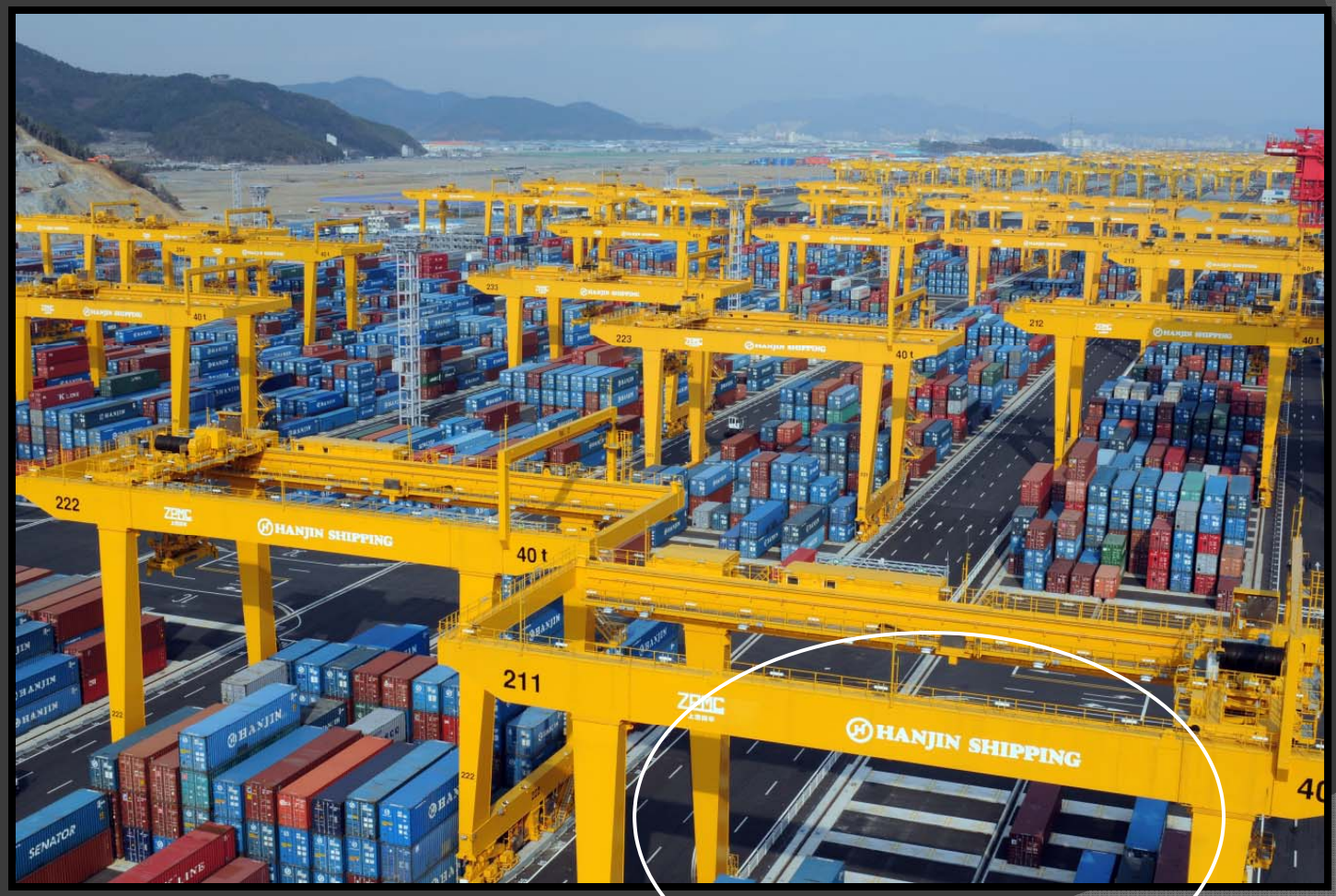
222
HANJIN SHIPPING
40 t
211
HANJIN SHIPPING
SENATOR

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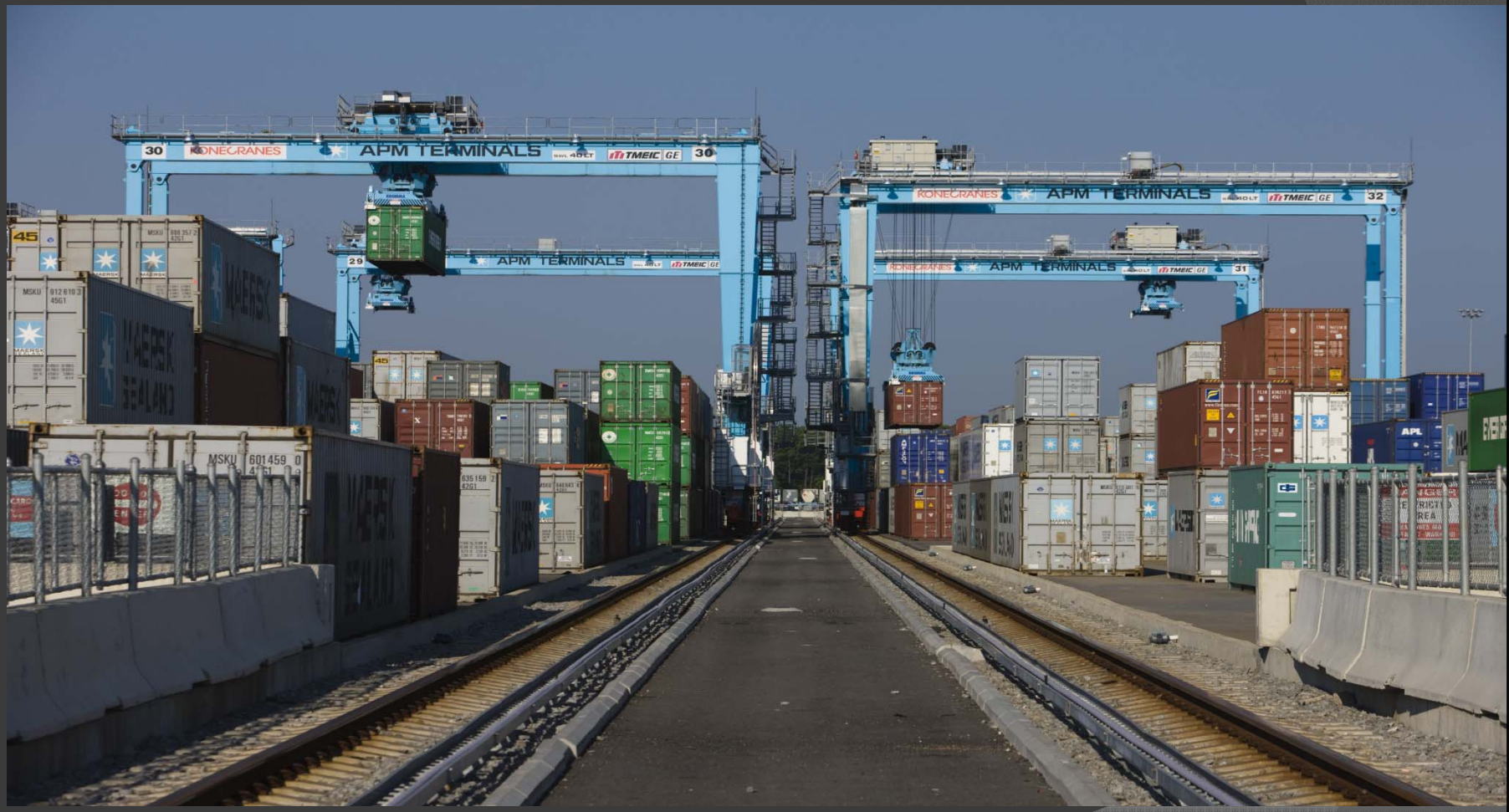
Pass-through Aisle

Site Grading & Drainage



Transfer Area

Electrical & Communication System

- Power Requirements
- Availability and Reliability of Power
- Lighting Requirements
- Communication System Infrastructure
  - Camera System
  - data networks
  - has to be 100% fault tolerant

Other Requirements

- Fire Detection, Protection, and Access
- Security and Safety
- Pavement System
- Infrastructure Expandability

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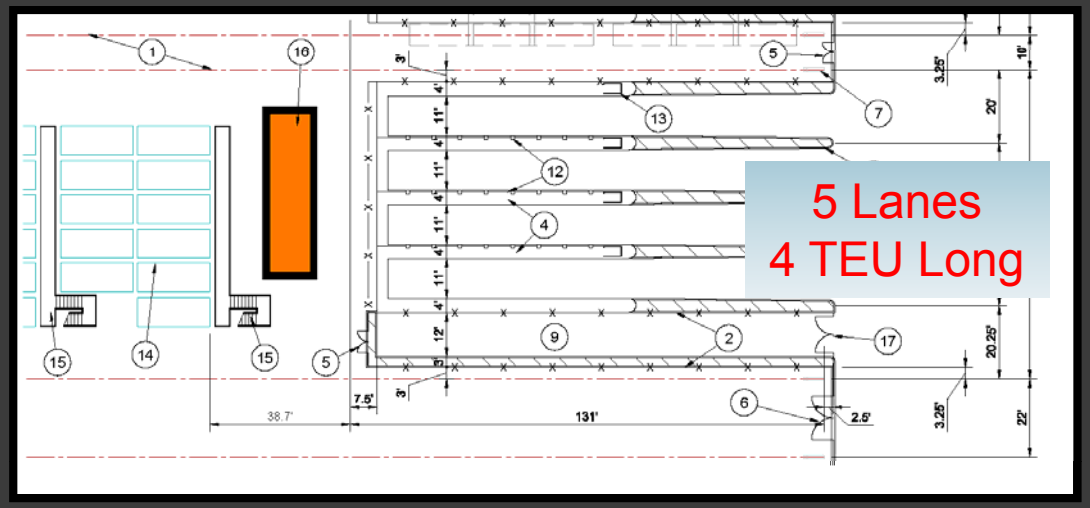
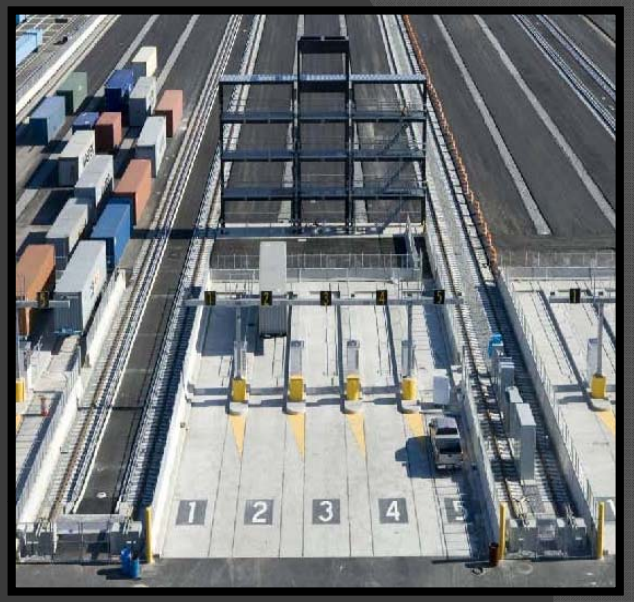
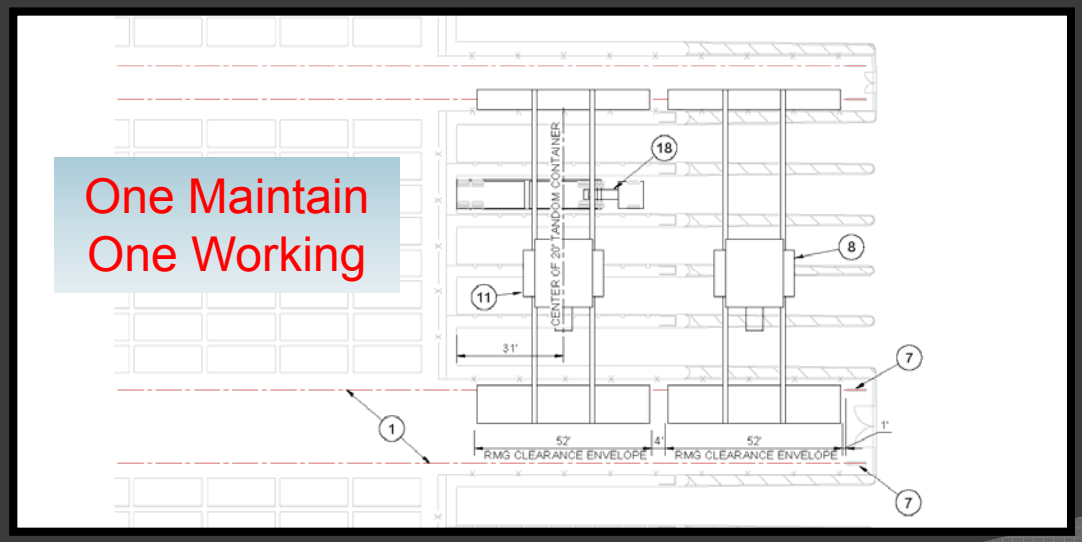
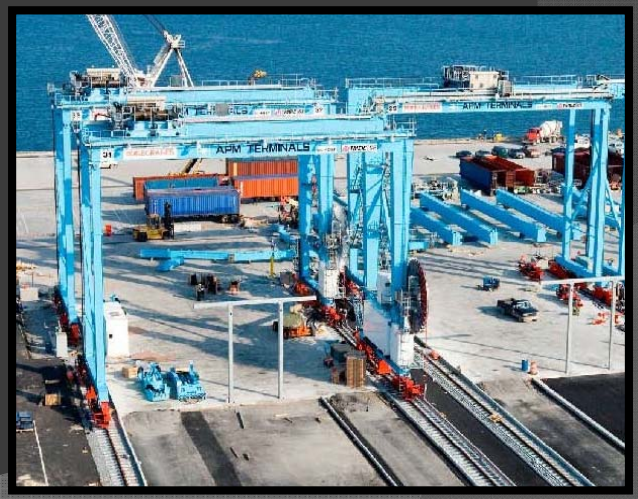
Storage Yard Design – Transfer Areas



Landside Transfer Zone – Reefer Access







Landside Transfer Zone – RMG Maintenance Position

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9


14
KONECRANES
APM TERMINALS
SWL 40 LT
TMEIC GE
14
BROMMA
MAERSK SEALAND
1
7
2
3
4
7
5


MAERSK
MAERSK
MAERSK
SEALAND
MAERSK
DANGER
RESTRICTED
AREA

Fotos zum Besuch AAPA
Portsmouth am 02. Juli 2008

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Receiving – Data Collection Portal

- Truck ID used to reference collected data
  - TWIC Card or RFID, etc
- Drive Through OCR
  - Inspection Image Obtained
  - Container Number, Chassis Number
  - Link information to Data Package

Receiving – Transaction Interchange Pedestals

- Data Collected/Verified by remote clerks
  - Empty Containers Checked
  - Equipment Inspected Remotely
  - Container Weight entered
  - Seal Checked
- Yard Instructions Printed

THE END