Types of Cranes

- Container Gantry
- Dry Bulk Gantry
- Mobile
Typical Container Gantry Crane
Typical Dry Bulk Loader
Types of Wharf Structures

- Gravity
- Pile Supported
• Cost relatively insensitive to crane loading
Port Salalah Container Terminal, Oman
Typical Pile Supported Wharf Structure

- Cost sensitive to crane loading
Pile Supported Pier

- Cost very sensitive to crane loading
Crane Characteristics Needed for Design

- Dimensional
- Loading
Crane Dimensional Characteristics

- **Gage** (spacing between rails)
- **C – to – c distance** between corners
- **Number of wheels per corner**
- **Spacing of wheels**
Crane Loading Characteristics

Maximum Load Per Corner

• Operating Condition
  – Water Side Vertical
  – Land Side Vertical
  – Horizontal

• Extreme Condition
  – Water Side Vertical
  – Land Side Vertical
  – Horizontal
### Example Super Post-Panamax Crane Dimensional Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Jebel Ali, Dubai</th>
<th>Doraleh, Djibouti</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gage (spacing between rails)</strong></td>
<td>42</td>
<td>30.48</td>
</tr>
<tr>
<td><strong>C – to – c distance between corners</strong></td>
<td>14.1</td>
<td>15.5</td>
</tr>
<tr>
<td><strong>Number of wheels per corner</strong></td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td><strong>Spacing of wheels</strong></td>
<td>1.3</td>
<td>1.2</td>
</tr>
</tbody>
</table>
### Example Super Post-Panamax Crane Loading Characteristics

<table>
<thead>
<tr>
<th>Load</th>
<th>Maximum Load Per Corner</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Jebel Ali, Dubai</td>
</tr>
<tr>
<td>• Operating Condition</td>
<td></td>
</tr>
<tr>
<td>– Water Side Vertical, kN</td>
<td>11,200</td>
</tr>
<tr>
<td>– Land Side Vertical, kN</td>
<td>9,600</td>
</tr>
<tr>
<td>– Horizontal, kN</td>
<td>800</td>
</tr>
<tr>
<td>• Extreme Condition</td>
<td></td>
</tr>
<tr>
<td>– Water Side Vertical, kN</td>
<td>12,000</td>
</tr>
<tr>
<td>– Land Side Vertical, kN</td>
<td>12,000</td>
</tr>
<tr>
<td>– Horizontal, kN</td>
<td>2,100</td>
</tr>
</tbody>
</table>
Crane and Wharf Cost vs. Rail Loading

CRANE COST*

WHARF COST

* For given crane performance requirements
Modifying Existing Wharves

- Deepening issues
- Crane load issues
- Fender system
- Mooring system
- New code requirements
• Reduces Global Stability
• Reduces Local Stability
• Reduces Pile Embedment Capacity
• Reduces Pile Structural Capacity
Global Stability
Local Stability
Crane Load Issues

- Increased reach
- Increased lifting capacity
- Increased weight

RESULT

- Increased rail loading
- Increased tie-down forces
APM Port Elizabeth Container Terminal
### APM Port Elizabeth Container Terminal

#### Existing Features
- Constructed ca. 1970
- 40 ft water depth
- 50 ft wide platform
- 30 ton timber piles
- 20 kips per ft rail load
- 100 ft rail gage
- 500 psf deck live load
- 85 ton bollard @ 120 ft
- Minimal timber/rubber fender system
- No seismic criteria

#### Upgrading Requirements
- 52 ft water depth
- 250 ton steel piles
- 50 kips per ft rail load
- 165 ton bollards @ 40 ft
- Fender system for Super Post-Panamax vessels
- Seismic zone 2
APM Port Elizabeth Container Terminal

Existing Wharf Structure
APM Port Elizabeth Container Terminal
King Pile Cut-Off Wall

KING PILE – SECTION

EXIST. TIMBER PILE (TYP.)
STEEL H-PILE
EXIST. RIPRAP
EXIST. MUDLINE
STEEL SHEET PILE
FUTURE BREDGED DEPTH
APM Port Elizabeth Container Terminal

Crane Rail Capacity Increase

- Same Location as Existing Rails
- Landward of Existing Rails
- Seaward of Existing Rails
APM Port Elizabeth Container Terminal
New Rails Same Location as Existing Rails
Howland Hook Container Terminal
• **Existing Features**
  - Constructed ca. 1970
  - 35 ft water depth
  - 67 ft wide platform
  - Concrete and steel piles
  - 20 kips per ft rail load
  - 50 ft rail gage
  - 500 psf deck live load
  - 85 ton bollard @ 88 ft
  - 15” φ rubber cylinder fender system
  - No seismic criteria

• **Upgrading Requirements**
  - 52 ft water depth
  - 300 ton steel piles
  - 42 kips per ft rail load
  - 100 ft rail gage
  - 100 ton bollard @ 44 ft
  - Fender system for Super Post-Panamax vessels
  - Seismic zone 2
Howland Hook Container Terminal

Existing Wharf Structure

- Inboard Crane Rail
- Outboard Crane Rail
- Top of Rock
- Mudline EL. varies -34’ to 40’
- MLW EL. 0.00’
- 50’-0”
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