Developments for Upgrading Facilities/Terminals for Large Vessels

E. D. Allen, Moffatt & Nichol

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Infrastructure Dependent on Ship Size

- Navigation Channel Widths/Depths
- Turning Basins
- Berth Length
- Crane Size
- Wharf Loading/Appurtenances
  - Larger Crane Loads
  - Greater Berthing/Mooring Forces
- Revetment Loading (Bow Thrusters)
Channel Improvement Challenges:

- Channels Under Federal Jurisdiction
- Deepening and Widening Approvals Require Many Years to Obtain
- Environmental Issues Potentially Slow Process Further
- Competition for Federal Funds for Improvements
- 22-Wide Cranes
- 1,300’ + Length
- 184’ Beam
- 51’ Draft
- 25 Ton Thrusters
What Ship Size Should You Plan For?
<table>
<thead>
<tr>
<th>AN. SHIP CALLS</th>
<th>6,000 TEU</th>
<th>8,000 TEU</th>
<th>10,000 TEU</th>
<th>12,000-13,000 TEU</th>
<th>12,000 TEU</th>
<th>14,000 TEU</th>
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</thead>
<tbody>
<tr>
<td>LENGTH</td>
<td>985</td>
<td>1089'</td>
<td>1150'</td>
<td>1265'</td>
<td>??</td>
<td>1302'</td>
</tr>
<tr>
<td>BEAM</td>
<td>134</td>
<td>142'</td>
<td>150'</td>
<td>158'</td>
<td>??</td>
<td>184'</td>
</tr>
<tr>
<td>BOXES</td>
<td>16</td>
<td>19</td>
<td>18</td>
<td>19</td>
<td>??</td>
<td>22</td>
</tr>
<tr>
<td>DRAFT</td>
<td>47'</td>
<td>49'</td>
<td>49'</td>
<td>50'</td>
<td>??</td>
<td>51'</td>
</tr>
</tbody>
</table>

MSC HEIDI  XIN LOS ANGELES  NEW PANAMAX  SUEZMAX  MAERSK EMMA
“New Panamax” Vessel is Defined as Follows:

- 12,000-13,000 TEU
- 105,000 Short Tons (DWT)
- 366m Length (1,200 ft)
- 48.2m Beam (158 ft) (19 Container Wide)
- 15.5m (51 ft) Draft
- 61m (200 ft) Air Draft

- Is this the future? Probably, for foreseeable future.
Current Terminal Design Vessels in USA

• New Panamax – (Previous slide)
• Suezmax – Similar to New Panamax
• Emma Maersk Class – in Some Cases for Berthing/Mooring Loads and Crane Outreach.
<table>
<thead>
<tr>
<th>Delivery Date</th>
<th>2009: 2-10,000, <strong>5-13,000+</strong></th>
<th>2010: 6-10,000, 8-11,000+, <strong>8-12,000+</strong>, <strong>16-13,000+</strong>, <strong>10-14,000</strong></th>
<th>2011: 3-10,000, 16-12,000+, <strong>41-13,000+</strong>, <strong>6-14,000</strong></th>
<th>2012: 8-10,000, 11-12,000+, <strong>14-13,000+</strong></th>
<th>2013: 8-12,000+, <strong>4-13,000+</strong></th>
<th>2014: 4-10,000, 1-12,000+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ship Orders:</td>
<td><strong>10,000 TEUs and Greater</strong></td>
<td></td>
<td></td>
<td><strong>10,000 TEUs and Greater</strong></td>
<td></td>
<td><strong>10,000 TEUs and Greater</strong></td>
</tr>
</tbody>
</table>
Design Factors for Channels:

National & International Guidelines

PIANC  -  Detailed (Update due 2010)
USACE  -  Summary Fashion
NAFAC  -  Summary Fashion
ASCE  -  Summary Fashion (Update coming)
PIANC 1997 → Updated 2010

- Revises and Updates Horizontal and Vertical Channel Dimensions
- Squat can now be Better Predicted
- Addresses Higher Windage, Larger Bulbous Bows, Wider Sterns, Minimal Parallel Mid Bodies
- Addresses Wave Energy vs. Ship Motion and Simulation
Increased path due to crab angle

5° crab:

180’ → 290’
158’ → 270’
Factors That Affect Channel Depth:

- Tidal Change During Transit and at Berth
- Static Draft
- Squat and Dynamic List
  - $1^\circ$ list = 1.6 feet deeper (180’ Beam)
  - $2^\circ$ list = 3.1 feet deeper (180’ Beam)
  - $3^\circ$ list = 4.7 feet deeper (180’ Beam)
More Factors Affecting Channel Depth:

- Waves
- Net Safety Underkeel Clearance
- Bed Level Uncertainty
Factors that Effect Ship Motion:

- New PIANC Guideline for Allowable Container Ship Motion will be Based on Surge Motion Primarily
- Long Period Energy in Rectangular Basins are a Problem
- Problematic Basin are those with 90-120 Sec Natural Response Frequencies (Resonant Frequencies)
- “New Panamax” Size Shifts Response Away From 90-120 Sec Waves
How Does Ship Size Impact Wharf and Cranes?
What Will Be Needed Landside?

• Wharf Structure Strengthening
  – Depth
  – Crane Loads
  – Fendering/Mooring
  – Rock Revetment Size

• Crane Upgrades
  – Rope Lengths
  – Wheel Modifications
  – Replacement/More Cranes?

• Ship-to-Shore Power

• Terminal Equipment Transformation
Modified Wharf

- SHEETPILE WALL
- ORIGINAL DEPTH
- STRENGTHENED CRANE GIRDER
- DREDGE TO -53'
- SHEETPILE WALL

(America Association of Port Authorities)
<table>
<thead>
<tr>
<th>What’s Needed at Wharf</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fender Capacity</td>
<td>1570 ft/kips</td>
</tr>
<tr>
<td>Reaction Force</td>
<td>585 kips</td>
</tr>
<tr>
<td>Mooring Capacity</td>
<td>200 tons</td>
</tr>
<tr>
<td>Spreader Clearance</td>
<td>120 ft</td>
</tr>
<tr>
<td>Crane Outreach</td>
<td>201 ft (22 wide)</td>
</tr>
<tr>
<td>Ship Power</td>
<td>7.5+ MVA Min</td>
</tr>
</tbody>
</table>
What Rock Revetment Size is Needed:

• Recent Physical Model Test Confirmed Higher Initial Velocity
• Recent Test Refined Stability Coef. For Bow Thruster Force Against Rock Revetment
• Full Scale Measurement Confirmed Factors Above

“Results are Large Stone Requirements for Under-Wharf Revetments”
Potential Scour Profile
Infrastructure NOT Dependent on Ship Size

- Terminal Size
- Gate Size
- Yard Equipment
- Pavement
- Railyard Size

One 10,000 TEU Ship = Two 5,000 TEU Ships
Terminal Size Dependent Upon:

- Containers Discharged/Loaded per Day
- Dwell Time
- Storage Mode
- Intermodal Yard Operation – Hot Boxes Vs. Steady State
IY Size Dependent Upon:

- Volume of Intermodal Boxes
- Hot Boxes Vs. Steady State
- Ship Arrival Schedule
Other Infrastructure Challenges:

- Growing Highway Volume and Congestion
  - 12,000 TEU → 24 trains or 6,800 trucks
- Rail Terminal And Mainline Capacity/Frequency
- All, however, are Problems of Growth, Requiring more Investment and Labor
Initiatives to Deal with these Challenges

- Extended Gate Hours
- Congestion Pricing (Pier Pass)
- Shuttle Trains
- Virtual Container Yards
- Enhanced On-Dock Rail
- Dedicated Truckways
- Inland Port Concepts
What the Ports Need to Consider:

• Time to Get Permits!!
• Acceptable Channel Dimensions
• Logical Areas to Dredge
• Options
  – Zones to Pursue
  – Ship-in-Slip Potential
• Forward Plan
  – Mid Term VS. Long Term
  – Studies (Forecasts, Engineering)
• Terminal Transformation Issues
• Off Terminal Impacts
  – Road
  – Rail
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