Panama Canal Expansion Impacts on Fleet Patterns and Challenges in Terminal Design

Presented by Michael Horton, C. Eng, P.E.
Agenda

- Panama Canal Expansion, the Coming Fleet
  - Fleet Vessel size
  - Container Vessel Size

- Design Criteria, Present & Future
  - Terminal Requirements for the Future
  - Options for Berth Construction

- Challenges, Moving Forward
  - Time
  - Money

- Conclusions
The New Generation

<table>
<thead>
<tr>
<th></th>
<th>Panamax</th>
<th>Post-Panamax</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Containers (TEUs)</td>
<td>4,500</td>
<td>12,000</td>
</tr>
<tr>
<td>Dimensions:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beam</td>
<td>32m (106')</td>
<td>49m (160')</td>
</tr>
<tr>
<td>Length</td>
<td>294m (965')</td>
<td>366m (1,200')</td>
</tr>
<tr>
<td>Draft</td>
<td>12m (39.5')</td>
<td>15m (50')</td>
</tr>
</tbody>
</table>

Source: ACP
Expansion of the Panama Canal could bring a windfall to East Coast ports. But will they be ready for the bigger vessels and the jump in cargo volumes?

'Revenge of the East Coast ports'
In 1995 the Regina Maersk was big at 6,500 TEU

- 5,800 trucks
- 25 barges
- 550 cargo planes

Regina Maersk (1995)
Now We Have the Emma Maersk at 11,000 or 13,000 TEUs

Emma Maersk (2006)
But Still Not The Biggest Vessel On The Water
Typical Maritime Transport Costs


40% Saving
But the Curve Flattens at 12,500 TEUs
<table>
<thead>
<tr>
<th>Capacity (TEUs)</th>
<th>Draft (m)</th>
<th>LOA (m)</th>
<th>Beam (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,000-2,999</td>
<td>11.6</td>
<td>239</td>
<td>31.5</td>
</tr>
<tr>
<td>3,000-3,999</td>
<td>12.1</td>
<td>259</td>
<td>32.4</td>
</tr>
<tr>
<td>4,000-4,999</td>
<td>13.0</td>
<td>284</td>
<td>33.2</td>
</tr>
<tr>
<td>5,000-5,999</td>
<td>13.7</td>
<td>281</td>
<td>39.0</td>
</tr>
<tr>
<td>6,000-6,999</td>
<td>13.9</td>
<td>302</td>
<td>40.6</td>
</tr>
<tr>
<td>7,000-7,999</td>
<td>14.6</td>
<td>343</td>
<td>42.6</td>
</tr>
<tr>
<td>8,000-8,999</td>
<td>14.3</td>
<td>329</td>
<td>42.8</td>
</tr>
<tr>
<td>9,000-9,999</td>
<td>14.7</td>
<td>344</td>
<td>44.0</td>
</tr>
<tr>
<td>&gt;10,000</td>
<td>15.5</td>
<td>398</td>
<td>56.4</td>
</tr>
</tbody>
</table>
Immediate Demand (ECSA carrier)

- **(2010) - 6,300 TEUS:**
  - Length: 300 Meters
  - Beam: 40 Meters
  - Draft: 14.5 Meters
  - DWT: 76,000

- **(2014) - 8,800 TEUS:**
  - Length: 338 Meters
  - Beam: 46 Meters
  - Draft: 15.5 Meters
  - DWT: 116,000
Vessel Size: Conclusion

• Panama Canal sets the new top end?
• Vessel size will be a factor of route, market potential and facilities availability
• With or without the Canal expansion, terminal operators should expect to receive much larger vessels
• Different rules for transshipment and gateway terminals?
Future Fleet Impact on Container Terminals

- Crane Size
  - Dynamic Load
  - Multiple Hoists
- Dredge Depth
- Platform – Load Capacity, Width
- Navigation Approaches
- Terminal Sized for Peak demand
Future Cranes

- Outreach – 22 – 24 Containers
- Multiple Hoists
- Lift – 4 × 40 feet boxes, full?
- 5 Cranes/Ship?
- Crane Weight - Up to 2,500 Tons
## Post-Panamax Crane Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outreach (containers)</td>
<td>16, 18, 20, 22-24</td>
</tr>
<tr>
<td>Rail Gage (meters)</td>
<td>30.5, 30.5, 30-35, 35-45</td>
</tr>
<tr>
<td>Height /Hoist (meters)</td>
<td>50, 52, 54, &gt;60</td>
</tr>
<tr>
<td>Width (metres)</td>
<td>27, 24-27, 24-27, 24-27</td>
</tr>
<tr>
<td>Outreach Total (meters)</td>
<td>45-47, 50-52, 56, 60-65</td>
</tr>
</tbody>
</table>
Fleet Capacity and Draft

Global Container Ship Fleet, Relationship Between TEU Capacity and Draft
Fleet Capacity and Beam

Global Container Ship Fleet, Relationship Between TEU Capacity and Beam
Design Criteria: Draft at Berth

- 1970 – 10 meters
- 1990 – 11 meters
- 2000 – 12 meters
- 2014 - 16.5 meters
- 2020 – 18.5 meters?

16.50 m covers 7,000 – 13,000 TEU range
Design Criteria: Live Load

- 1970 – 600 lbs/ft²
- 1990 – 850 lbs/ft²
- 2000 – 1,000 lbs/ft²
- 2007 – 1,200 lbs/ft²

Not totally controlled by vessel size
Terminal Design for Post Panamax Vessels

• What is the design target for new work?
  – 6,500 TEU?
  – 8,000 TEU?
  – 12,500 TEU? (new Panamax)
  – 18,000 TEU?

Conclusion – Plan for 12,500 TEUs, dredge for short term?
Open Piled Quay Structure
Design Issues - Piled Wharf
Caisson Option
Combination Alternative
# Caissons vs Open Piled Deck

## (US$2005)

### Caissons

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost (Location 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cofferdam Cell</td>
<td>$34,469,648</td>
</tr>
<tr>
<td>Piles</td>
<td>$24,272,100</td>
</tr>
<tr>
<td>Deck</td>
<td>$22,792,500</td>
</tr>
<tr>
<td>Vessel-associated Hardware</td>
<td>$3,520,000</td>
</tr>
<tr>
<td>Crane Rails</td>
<td>$2,435,000</td>
</tr>
<tr>
<td>Associated Crane Items</td>
<td>$4,295,560</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>$884,000</td>
</tr>
<tr>
<td>Civil/Infrastructure</td>
<td>$2,769,000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$95,437,808</strong></td>
</tr>
<tr>
<td>Cost Per Meter</td>
<td>$59,625</td>
</tr>
<tr>
<td>Cost Per Square Meter</td>
<td>$1,122</td>
</tr>
</tbody>
</table>

### Piled Deck

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost (Location 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piles</td>
<td>$64,896,250</td>
</tr>
<tr>
<td>Deck</td>
<td>$53,147,000</td>
</tr>
<tr>
<td>Vessel-associated Hardware</td>
<td>$3,520,000</td>
</tr>
<tr>
<td>Crane Rails</td>
<td>$2,435,000</td>
</tr>
<tr>
<td>Associated Crane Items</td>
<td>$4,295,560</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>$1,134,000</td>
</tr>
<tr>
<td>Civil/Infrastructure</td>
<td>$2,769,000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$132,200,000</strong></td>
</tr>
<tr>
<td>Cost Per Meter</td>
<td>$62,625</td>
</tr>
<tr>
<td>Cost Per Square Meter</td>
<td>$1,555</td>
</tr>
</tbody>
</table>
Master Plan - CONTECSTAR

Ultimate Capacity - 1.90 to 2.25 MTEUs
Cost Implications
Quay/Wharf Projects

• 1990 - US $22,500/meter
• 2000 – US $30,000/meter
• 2007 – US $70,000/meter
• 2010 – US $95,000/meter (???)

Latin American Equivalents – 60 to 75%
Dredging Costs

- 1990 - $1.39/m3
- 1995 - $3.75/m3
- 2000 - $4.50/m3
- 2005 - $7.00/m3
- 2007 - $8.00 to $16.00/m3

Major spreads on bids

Based on awards for contracts in excess of 2.00 million m3, dredging in soft material without mob. and demob.
Cost Increases

- Steel – 100% in two years
- Middle East Project demands (dredging)
- Fuel
- Cement
- Cranes
- Equipment
Cost Impacts

- Bigger wider Quay structures
- Heavier cranes
- Deeper Dredging
- Increasing costs
- Middle East construction boom
- Panama Canal Expansion
Conclusions

- With or without the Canal expansion, future terminals will need to accommodate larger vessels.
- Future routes will be determined by the “haves” and the “have nots”.
- Most of the Latin American ports are facing serious capacity constraints.
- Get ready for much higher investment costs.
Developing a Global Strategy

moffatt & nichol

Ocean Business Center, Mezzanine, Oficina 328
Avenida Aquilino de la Guardia y Calle 47
Apartado Postal 0816-02273
Panamá, Republica de Panamá