Large Containership Technical Challenges

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## 50 years of growth

<table>
<thead>
<tr>
<th>Period</th>
<th>Size Range</th>
<th>Dimensions</th>
<th>Number of Containers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Early Containerships (1956-)</strong></td>
<td>500 - 800 TEU</td>
<td>137x17x9 meters (LOA - Beam - Draft)</td>
<td>6 containers across 4 containers high on deck</td>
</tr>
<tr>
<td><strong>Fully Cellular (1970-)</strong></td>
<td>1,000 - 2,500 TEU</td>
<td>200x20x9</td>
<td>4 containers high below deck</td>
</tr>
<tr>
<td><strong>Panamax (1980-)</strong></td>
<td>3,000 - 3,400 TEU</td>
<td>250x32x12.5</td>
<td></td>
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<tr>
<td><strong>Panamax Max (1985-)</strong></td>
<td>3,400 - 4,500 TEU</td>
<td>290x32x12.5</td>
<td></td>
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<tr>
<td><strong>Post Panamax (1988-)</strong></td>
<td>4,000 - 5,000 TEU</td>
<td>285x40x13</td>
<td></td>
</tr>
<tr>
<td><strong>Post Panamax Plus (2000-)</strong></td>
<td>6,000 - 8,000 TEU</td>
<td>300x43x14.5</td>
<td></td>
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<tr>
<td><strong>New Panamax (2014-)</strong></td>
<td>12,500 TEU</td>
<td>366x49x15.2</td>
<td></td>
</tr>
<tr>
<td><strong>Post New Panamax (2006-)</strong></td>
<td>15,000 TEU</td>
<td>397x56x15.5; 22-10-8 (not shown)</td>
<td></td>
</tr>
<tr>
<td><strong>Triple E (2013-)</strong></td>
<td>18,000 TEU</td>
<td>400x59x15.5</td>
<td></td>
</tr>
</tbody>
</table>
Existing vs. New Locks

Existing Locks Max Vessel: 4,400 TEU’s

New Locks Max Vessel: 12,000 TEU’s

ABS
Technical issues with larger ships

- Summary of Recent Casualties
- Technical Challenges
- Regulatory Changes
Notable Casualties

- *MOL Comfort* in 2013 – Structural Failure
- *MSC Napoli* in 2007 – Structural Failure
MOL Comfort

- **MOL Comfort** in June of 2013
  - Passed IACS Longitudinal Strength Requirements
  - High transverse stresses in bottom due to secondary bending between bulkheads
  - Buckling in bottom plating due to biaxial stress
  - May be identified with a 3 Hold Finite Element Analysis such as SafeHull
Hold 5 Bottom Shell and Double Bottom Structure
Load Case 4 Displacements and von Mises Stress

Output Set: Load Case 4 (Total-Full)
Criteria: VonMises Stress
MSC Napoli

- **MSC Napoli** in 2007 – Structural Failure
  - Buckling of bottom plating in way of transverse framing at forward end of engine room
  - Buckling checks not carried out along full length of vessel
  - Casualty reports indicate that whipping contributed to damage
IACS - Regulatory Changes

- **Rena**
  - IACS revised longitudinal strength requirements to specifically indicated locations to be checked

- **MOL Comfort**
  - Longitudinal strength requirements updated for containerships (Jul ‘16)
  - New unified requirements (UR S34) specifies for Load Cases
    - Finite Element Analysis
  - Minimum extent of FE model will include 3 cargo holds
  - Buckling and yielding to be checked using FEA
ABS Requirements for Large Containerships

- For containerships with length greater than 350 m
  - ABS Guide for Slamming Loads and Strength Assessment for Vessels
  - Guidance Notes on Whipping Assessment for Container Carriers
  - Guidance Notes on Springing Assessment for Container Carriers

- For vessels using Higher Strength (HT 47) Steel
  - ABS Guide for Application of Higher-Strength Hull Structural Thick Steel Plates in Container Carriers
  - Analysis required includes
    - Full ship FE Analysis per ABS Guide for Dynamic Load Analysis
    - ABS Spectral Fatigue Analysis

  - Optional Notation covering enclosed cargo holds and open decks of container carriers
LNG as Fuel
Motivation

- **Emissions**
  - NOx, SOx and GHG

- **Economics**
  - Fuel price uncertainty
  - Carbon regulations
Fuel Properties

- Boiling point: -163°C at atmospheric pressure
- Critical Temperature: 82°C
- S.G.: ~ 0.5
- Liquid and Gas Volume: ~ 1/600
Fuel Tank Capacity

Gross Calorific Values
- HFO 41.2 MJ/Kg
- LNG 55.5 MJ/Kg

And

Density
- HFO 991 Kg/m³
- LNG 464 Kg/m³

- For the same energy input, LNG need 1.6 times more storage volume (m³)
- Type C tanks with access around tank, it could be 3 to 4 times
- Tank Type is a function of required capacity
Tank Location
Location of Tanks

- Risk of fire in adjacent space causing over pressure
- Risk of leaked flammable product causing fire and explosion
- Risk of leaked cryogenic fluid leading to loss of structural integrity