Moored ship motions in the Port of Geraldton
Tim Gourlay

Nautical Institute mooring session, 22nd March 2017
Acknowledgments

- Scott Ha & Mal Perry, Curtin University
- Mid West Ports Authority / Geraldton pilots
Natural harbour longwave periods

Case study – Panamax, berth 5
Fenders and mooring lines
Motions video – 20x real-time
GNSS-measured ship motions
# Maximum peak-to-peak motions

<table>
<thead>
<tr>
<th></th>
<th>Berth</th>
<th>Long wave (cm)</th>
<th>Surge (m)</th>
<th>Bow sway (m)</th>
<th>Stern sway (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nord Libra (Panamax)</strong></td>
<td>4</td>
<td>7</td>
<td>0.71</td>
<td>1.28</td>
<td>2.41</td>
</tr>
<tr>
<td><strong>Sea Diamond, ballast</strong></td>
<td>5</td>
<td>7</td>
<td>1.62</td>
<td>2.02</td>
<td>1.55</td>
</tr>
<tr>
<td><strong>Sea Diamond, loaded</strong></td>
<td>5</td>
<td>9</td>
<td>2.62</td>
<td>2.98</td>
<td>2.46</td>
</tr>
<tr>
<td><strong>KS Flora (Handymax)</strong></td>
<td>6</td>
<td>9</td>
<td>0.66</td>
<td>1.68</td>
<td>1.42</td>
</tr>
</tbody>
</table>
MoorMotions software

- Developed by Perth Hydro
- Time-domain code for moored ship motions, line loads and fender loads
- External forcing can be waves, wind gusts, currents or passing ships
- Can combine with 10-day or 16-day weather forecasts to predict ship mooring line breakage over the forecast period
- [www.moormotions.com](http://www.moormotions.com)
Reconstructed loads – 20x real-time
Natural ship motion periods
Ship motion resonance
Do fenders affect mooring line loads?
Importance of fender damping

- Fender friction is the primary mechanism of surge damping
- Fender energy dissipation is an important mechanism of sway and yaw damping

Figure 2.1 energy absorption

Figure 2.2: Curve 1 represents the compression of the fender, Curve 2 the decompression of the fender, whereas the area between those two curves is the energy dissipated (warmth generated) as a result of hysteresis.

Fender damping

Line pre-tension
Higher pre-tension → Lower peak loads!

\[ T = 90s, \ H = 15cm \]
How does it work?

- Higher mooring line pre-tension
  - higher reaction force from fenders
  - higher friction force
  - more surge damping
  - lower surge motions
  - lower mooring line elongation
  - lower mooring line peak load

- Higher mooring line pre-tension
  - keeps ship on fenders
  - more energy dissipation by fenders
  - lower sway and yaw motions
  - lower mooring line peak load