Moored ship motions in the Port of Geraldton

Tim Gourlay

Nautical Institute mooring session, 22nd March 2017

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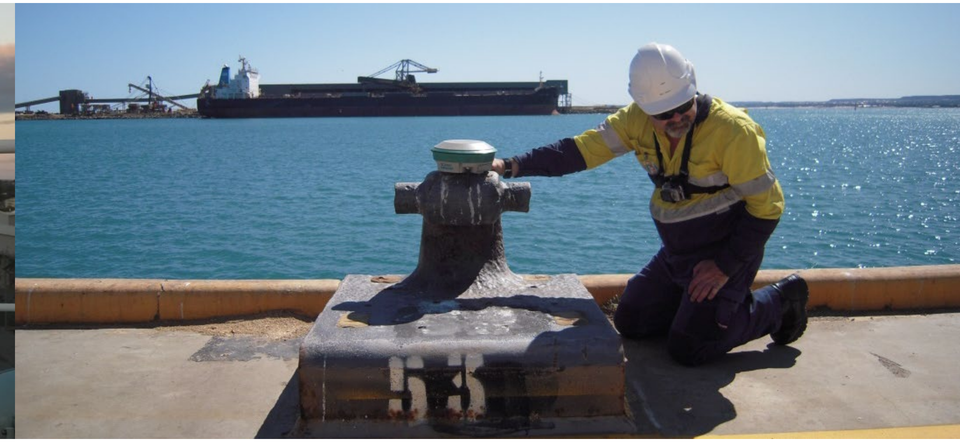
Perth Hydro

Acknowledgments



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

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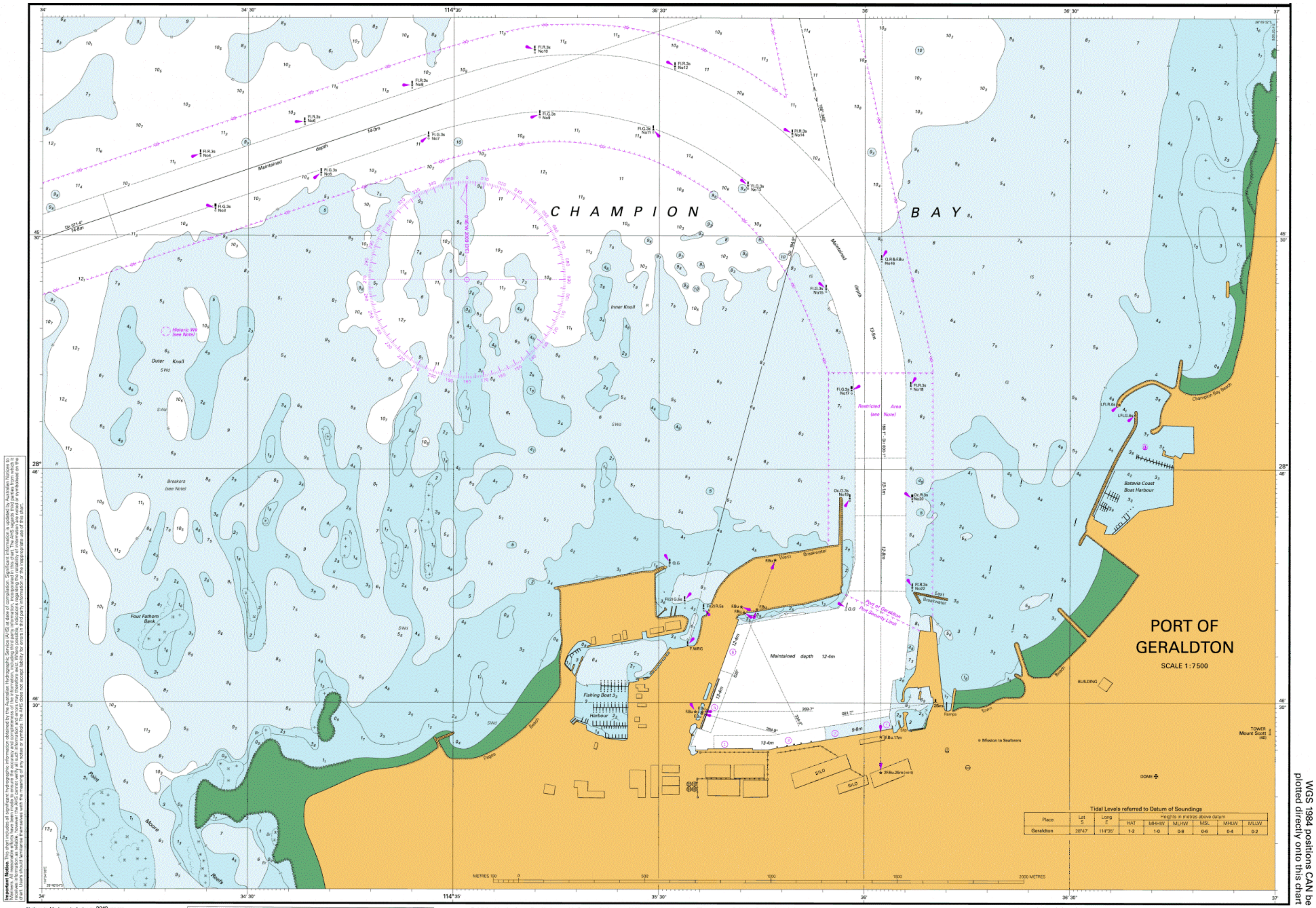

Tidal Levels referred to Datum of Soundings

Place	Lat S	Long E	Heights in metres above datum					
			HAT	MHHW	MLHW	MSL	MHLW	MLLW
Geraldton	28°47′	114°35′	1·2	1·0	0·8	0·6	0·4	0·2

WGS 1984 positions CAN be plotted directly onto this chart

Notices to Mariners inclusive to 2012-102-328-

Published by the Australian Hydrographic Service, 21 January 2005, under the direction of Commodore R. Nairn, R.A.N., Hydrographer of Australia.
8 Station Street, Wollongong, NSW 2500, Telephone (02) 4223 6500, Fax (02) 4223 6599.
www.hydro.gov.au

Edition Number 2
Edition Date 17 Jul 2009

DEPTHS IN METRES

(651·9 x 1117·9mm)

Aus 81

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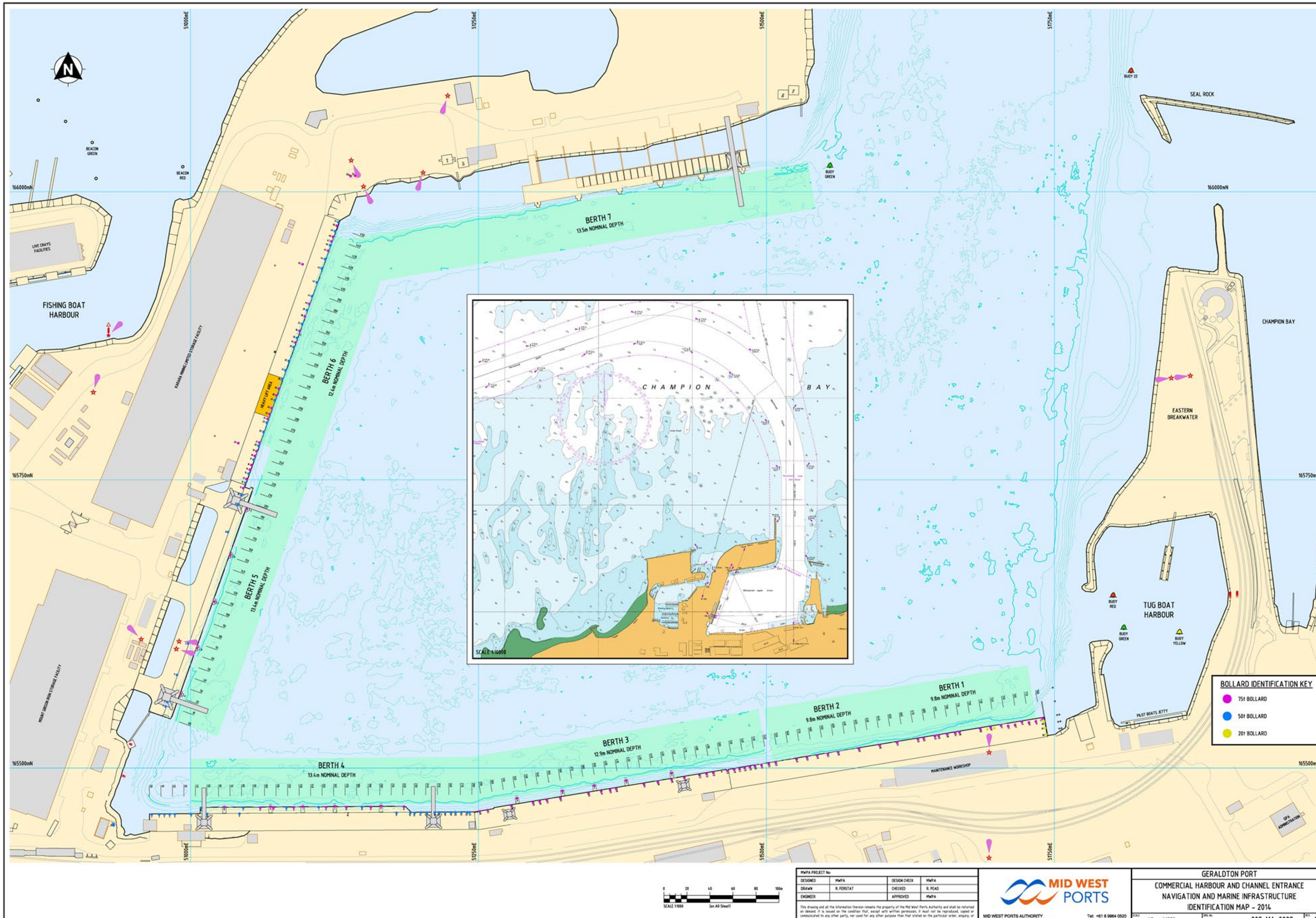

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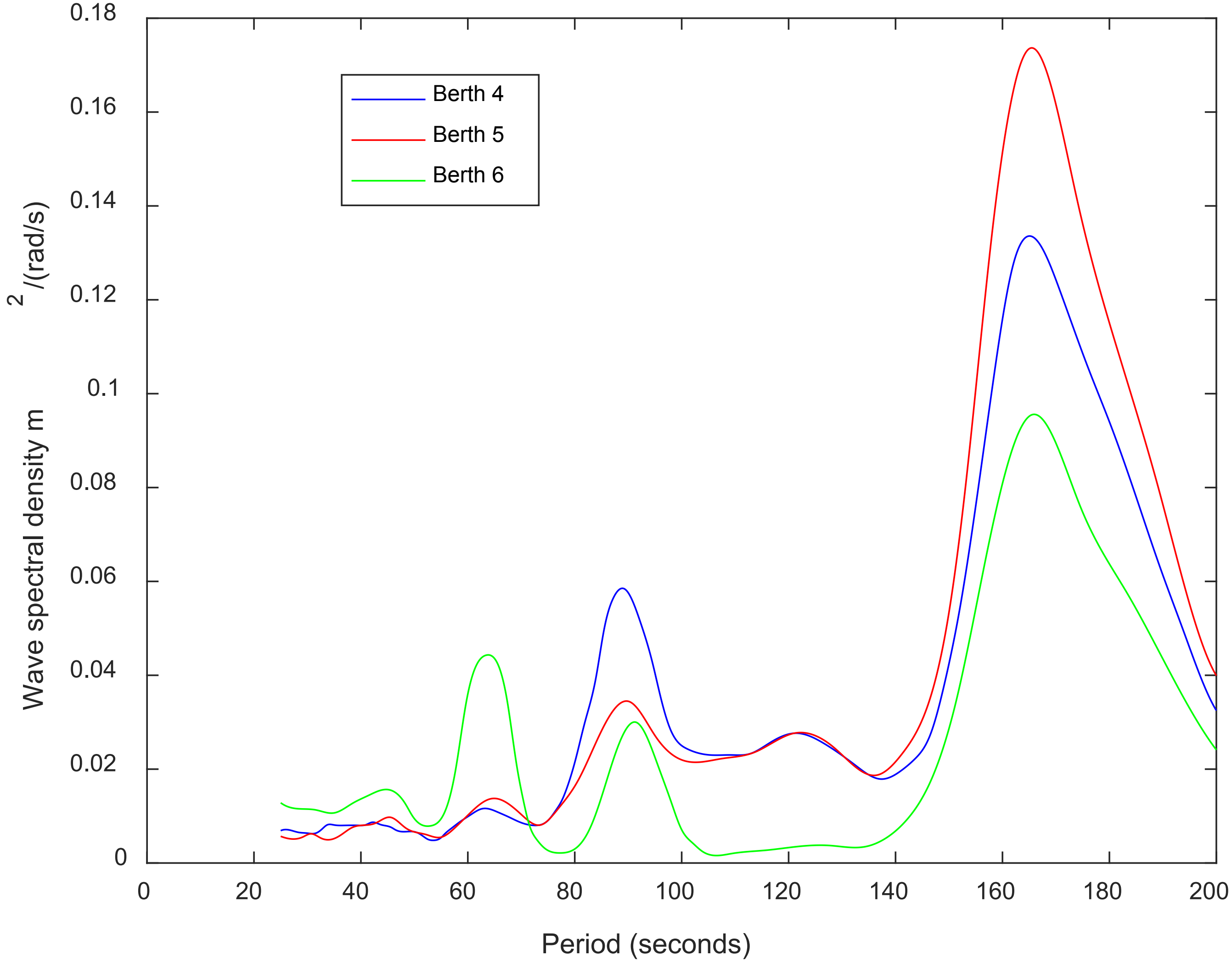
Natural harbour longwave periods



Zyngfogel, R., Thiebaut, S., McComb, P. 2015 Measured longwave spectral characteristics at ports in Australia and New Zealand. Proceedings, Coasts and Ports, Auckland.

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Case study – Panamax, berth 5

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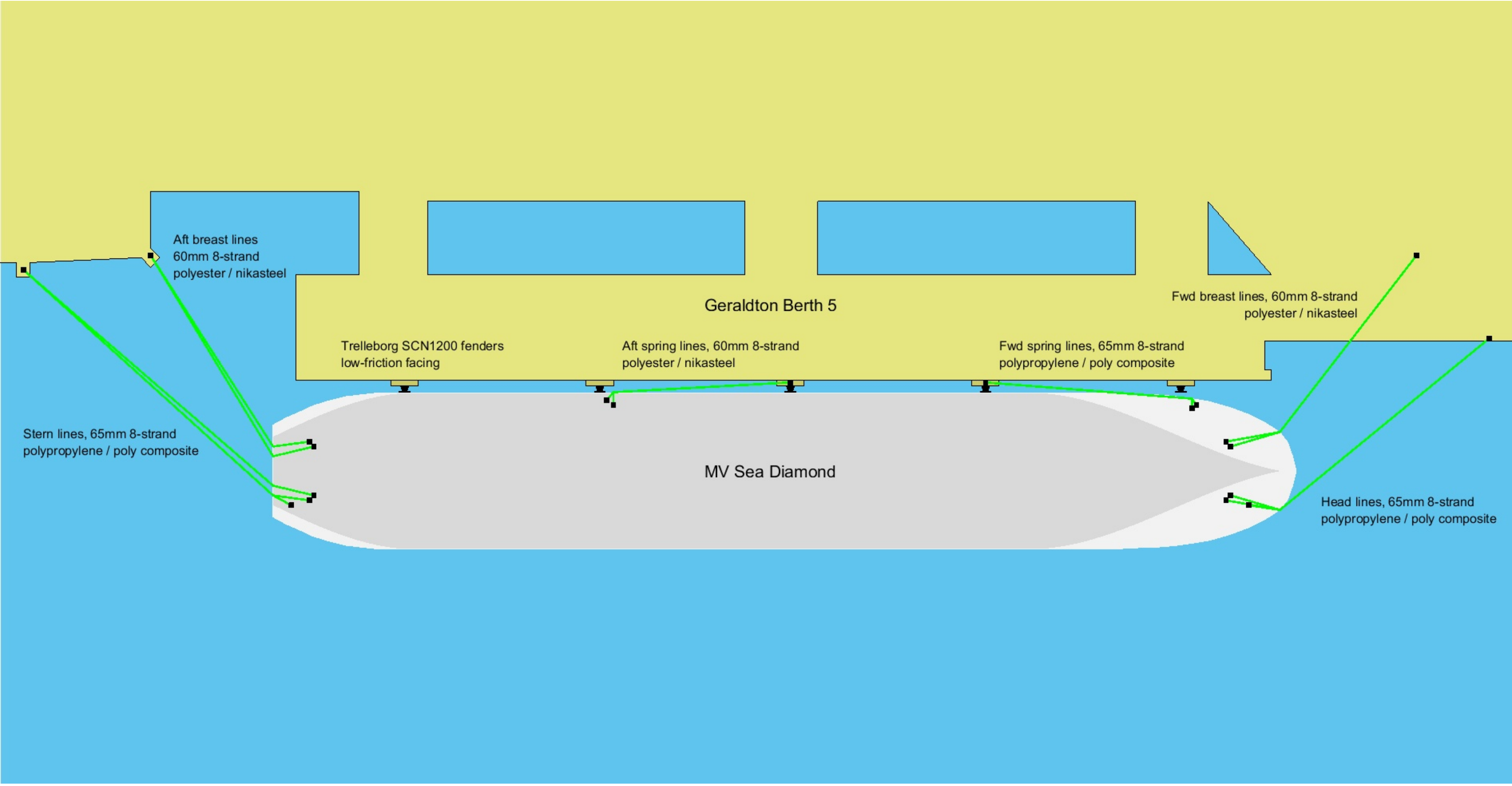
Fenders and mooring lines



Motions video – 20x real-time

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GNSS-measured ship motions

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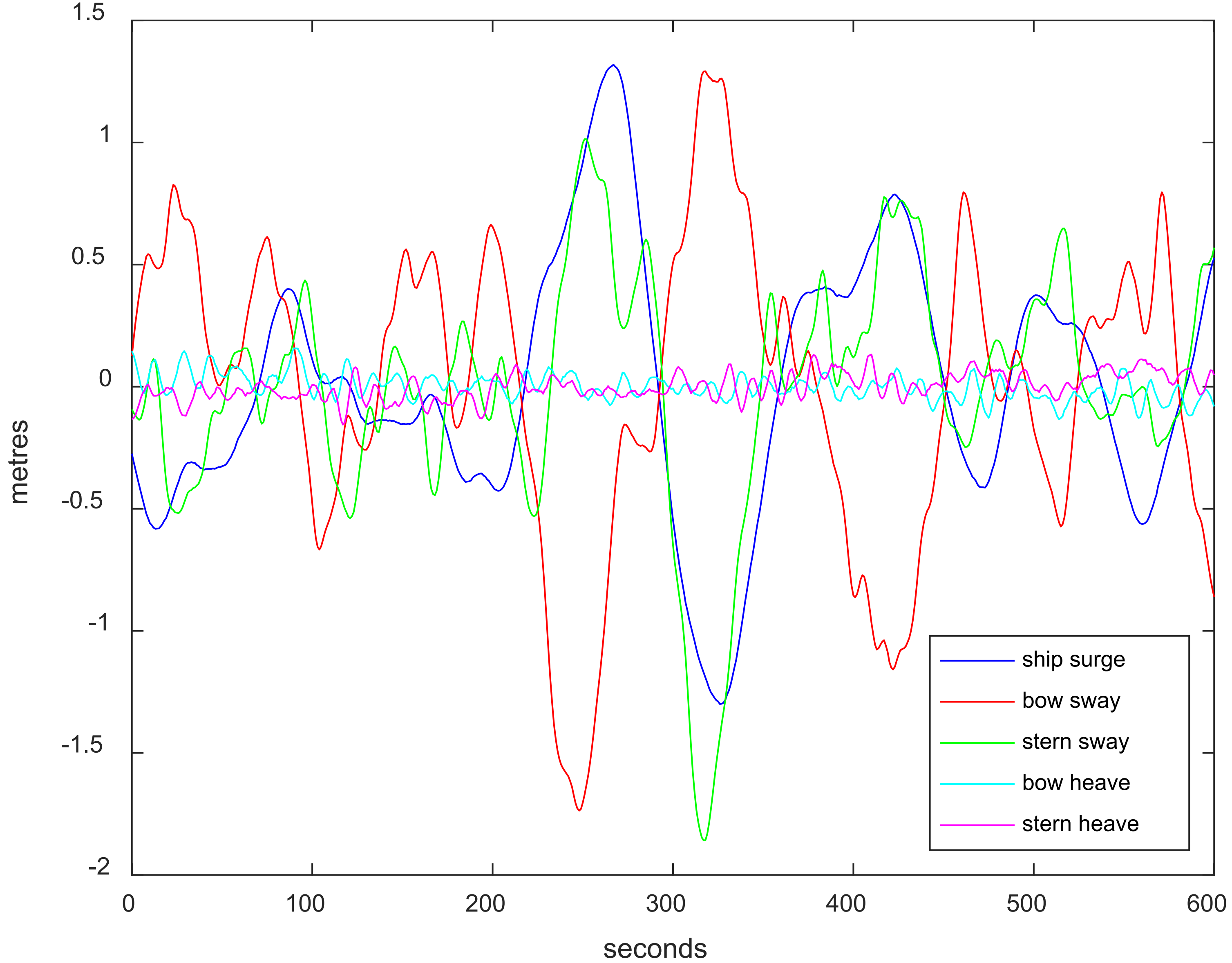
Sea Diamond (loaded condition) - 10 minute motions snapshot



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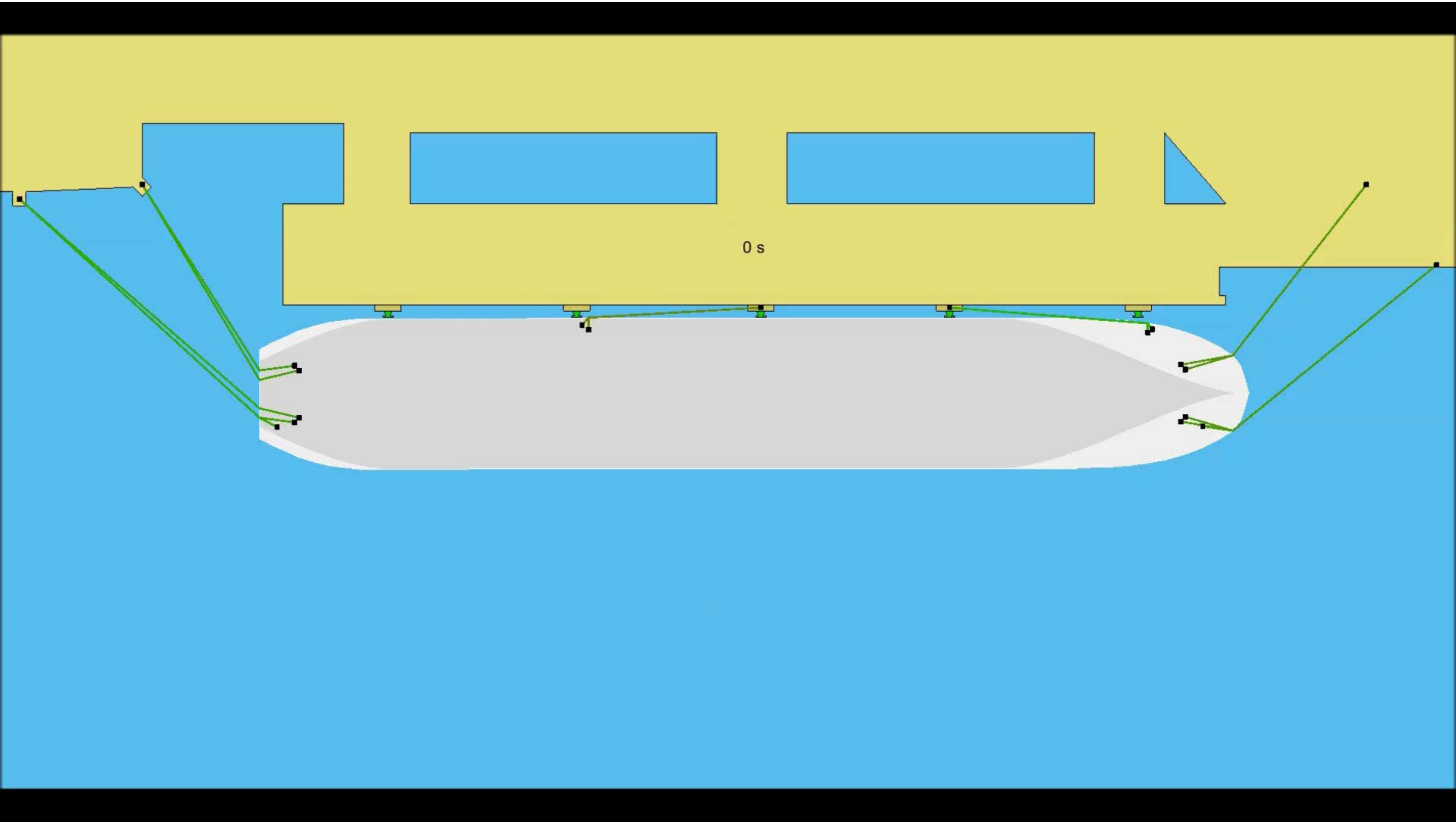
Maximum peak-to-peak motions

	Berth	Long wave (cm)	Surge (m)	Bow sway (m)	Stern sway (m)
Nord Libra (Panamax)	4	7	0.71	1.28	2.41
Sea Diamond, ballast	5	7	1.62	2.02	1.55
Sea Diamond, loaded	5	9	2.62	2.98	2.46
KS Flora (Handymax)	6	9	0.66	1.68	1.42

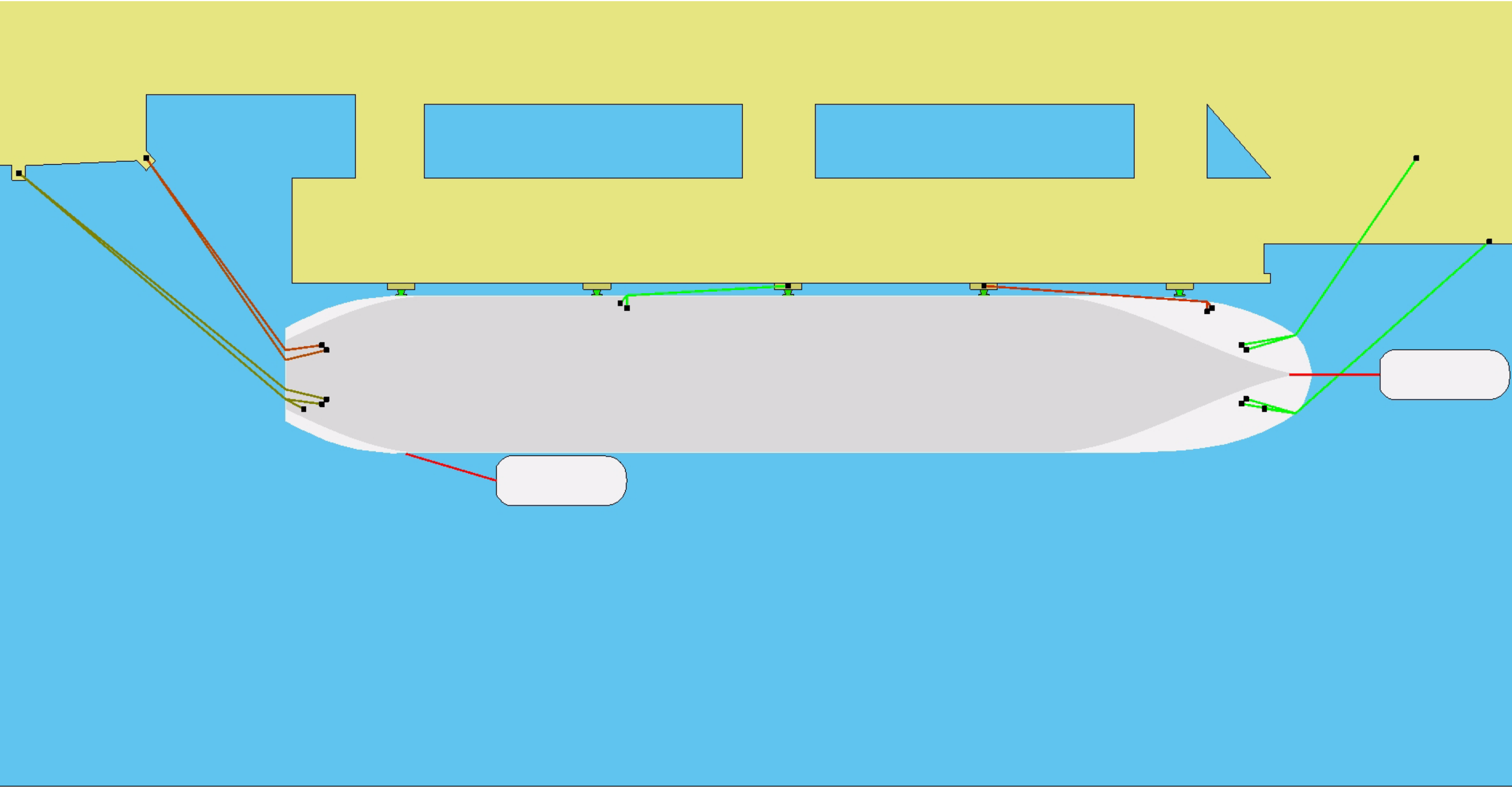
MoorMotions software

- 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

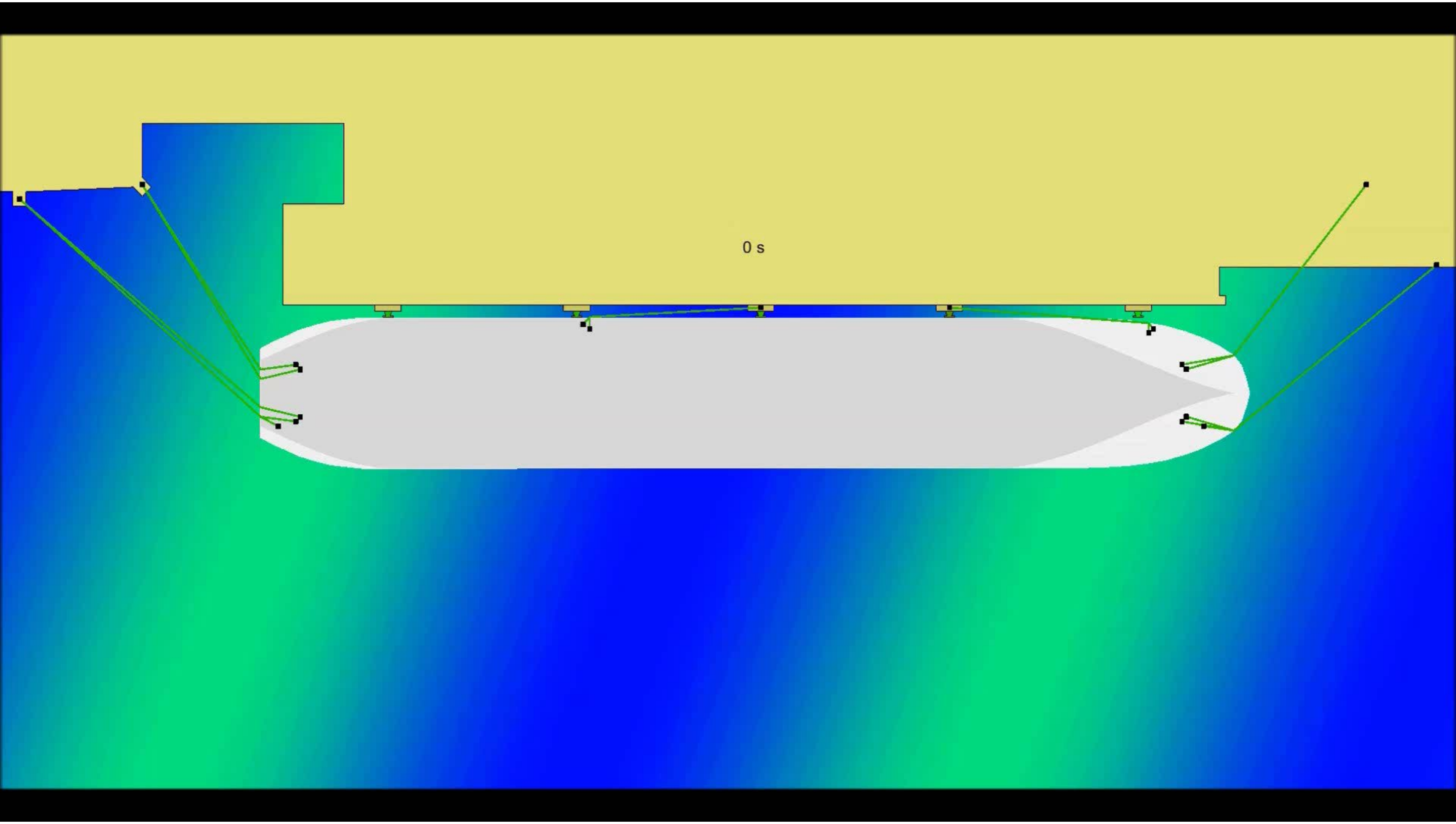
Reconstructed loads – 20x real-time



Natural ship motion periods



Ship motion resonance



Do fenders affect mooring line loads?

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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*

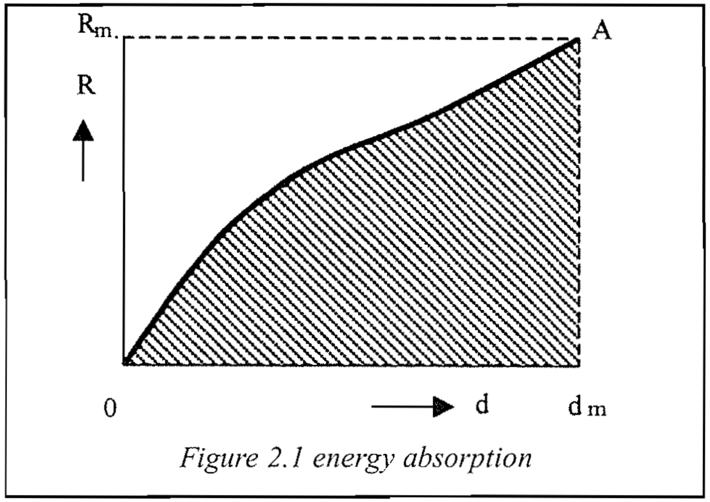


Figure 2.1: the shaded area represents the energy absorption; factor f is equal to the shaded area divided by the rectangular area **O-Rm-A-dm**

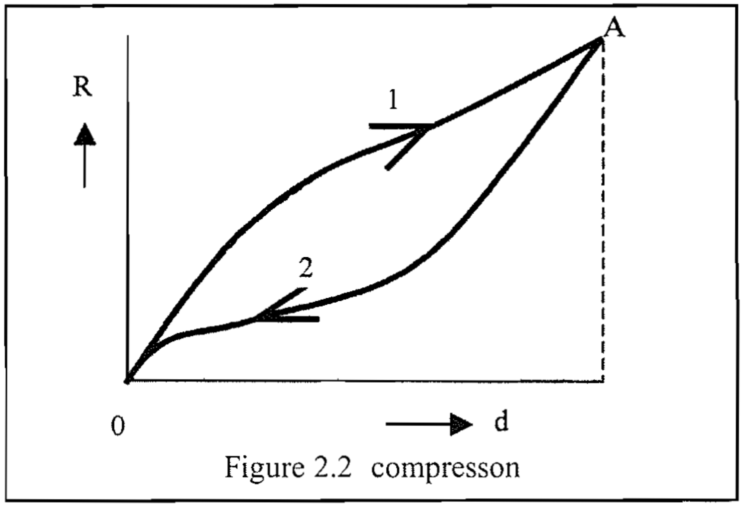
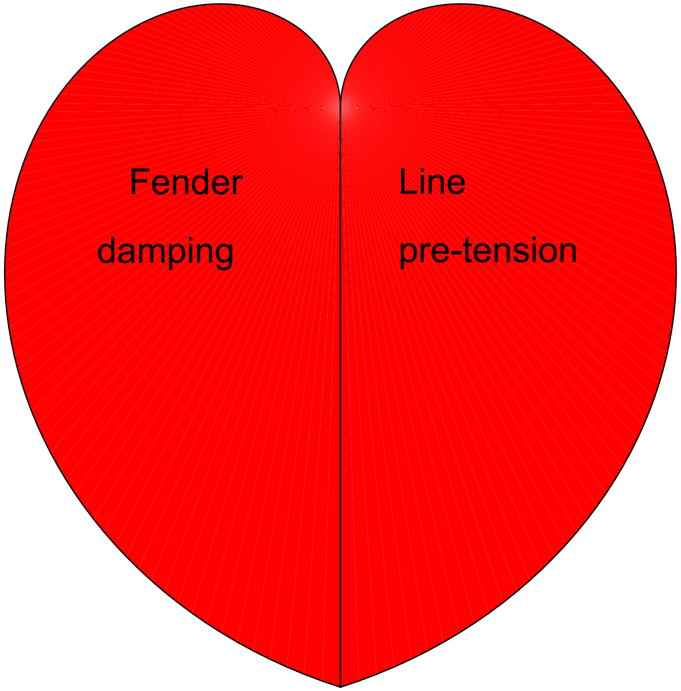
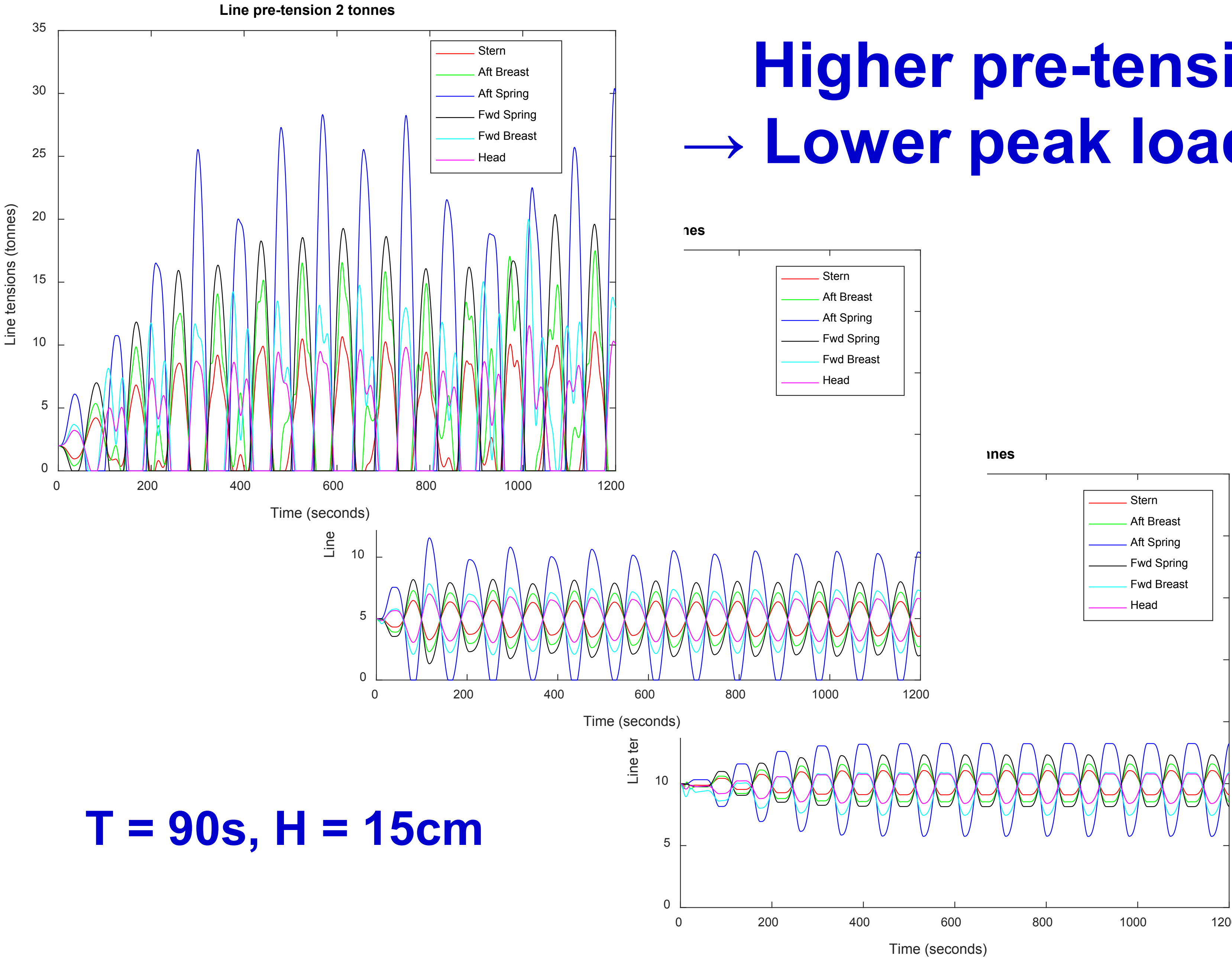


Figure 2.2: Curve 1 represents the compression of the fender, Curve 2 the decompression of the fender, whereas the area between those two curves is the energy dissipated (warmth generated) as a result of hysteresisis.

PIANC 2002 Guidelines for the design of fender systems. MarCom Report of Working Group 33.


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

Q & A

www.perthhydro.com