METEOTSUNAMI RISK AND THE USE OF DYNAMIC MOORING ANALYSIS AND SHORETENSION TO MITIGATE RISK IN FREMANTLE PORT

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METEOTSUNAMI HAZARD

Meteotsunamis are generated by meteorological events, particularly moving pressure disturbances due to squalls, thunderstorms, frontal passages and atmospheric gravity waves. Relatively small initial sea-level perturbations, of the order of a few centimetres, can increase significantly through multi-resonant phenomena to create tsunami like destructive events resulting in injury, loss of life, damage to infrastructure and significant economic loss.

Although meteotsunamis are not catastrophic to the extent of major seismically induced basin-scale events, they have, nevertheless, caused millions of dollars of damage to boats and harbours around the world (Pattiaratchi & Wijeratne, 2015).

FREMANTLE CASE STUDY

On the 17th August 2014, severe metocean conditions (including 27.8 m/s wind gusts and a meteotsunami) resulted in the vessels Grand Pioneer and AAL Fremantle breaking loose from their mooring at Berth 11 and 12 in Fremantle Port. One of the vessels collided with a railway bridge closing the commuter railway line for two weeks. Royal HaskoningDHV was commissioned by Fremantle Ports to undertake a hydrodynamic investigation (Figure 1) and a dynamic mooring analysis (DMA) to determine the cause of the event and provide a technical solution to provide safe moorings in the port.

DYNAMIC MOORING ANALYSIS OF THE EVENT

The basic requirement of a mooring system is to prevent the vessel from drifting away from a berth or from colliding with adjacent moored vessels.

Regardless of the size of the vessel, a mooring system should be able to restrain vessel movement by the means of an adequate number of mooring lines, compatible with the conditions of wind, tide, weather and other effects likely to be experience during the relevant period of the vessels stay at the berth.

The mooring lines are in fact springs restraining a mass under the form of a vessel to a fixed support which is the berth. The response of this mass-dashpot-spring system to external excitation such as wind, waves or current is under the form of oscillations. The way the mooring system responds is highly depending on the dynamics of external forces and the response characteristics of the vessel. Dynamic mooring analysis (DMA) uses advanced software to predict vessel movement and mooring line forces.

For the DMA analysis carried out of the Fremantle case the mete-tsunami signal was represented in the hydrodynamic model by a sine curve with 0.125m amplitude and 3.5 hour period superimposed on the predicted tide. The resulting currents and observed winds were then used in the DMA to confirm the observed mooring failure (Figure 2). To prevent such failure in the future, the ShoreTension® mooring system (Figure 3) was recommended, the effectiveness of which was also demonstrated in the DMA.

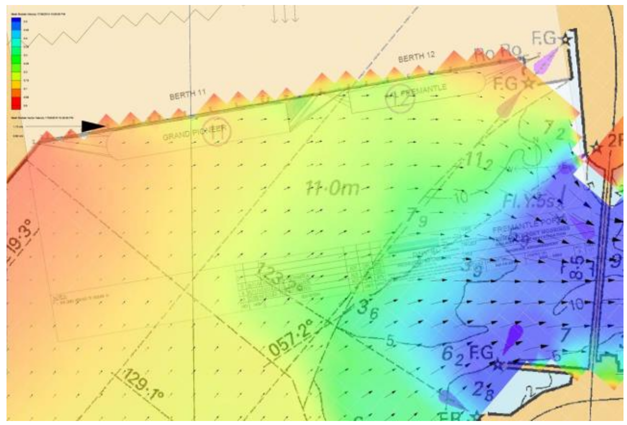

Figure 1: Fremantle Modelled Peak Currents 17 Aug 2014

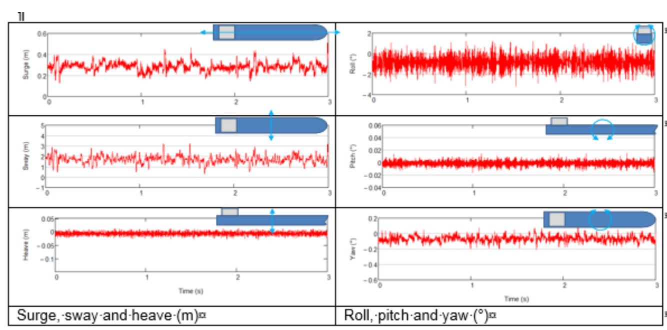

Figure 2: Predicted Grand Pioneer Ship Motions during event

Figure 3: The ShoreTension system

REFERENCES

Pattiaratchi & Wijeratne (2015): Are meteotsunamis an underrated hazard? *Phil. Trans. R. Soc. A* **373**: 20140377. http://dx.doi.org/10.1098/rsta.2014.0377