Wave energy impact on harbour operations investigated

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The oscillations are continuously present in the marina—but during storm events, they become energetic and oscillation heights reach a maximum 0.5m, in contrast to calm sea conditions where they mostly remain below 0.1m.Image: John

Infragravity period oscillations—waves that occur between 25 and 300 seconds with a wavelength between 100m and 10km—can have an impact on berthing operations, depending on a harbour's geometry.

A study by University of WA researchers explored the effect of the

oscillations at Two Rocks Marina, given the area experiences continuous swell and frequent storm systems.

Study author, PhD candidate Darshani Thotagamuwage, says the period when infragravity waves surround a harbour can be in close proximity to what is known as its "natural period".

"The natural period is a fundamental property of a harbour basin and depends on its geometry such as length, width and depth," she says.

"A harbour can have more than one natural period depending on how complex the basin shape is.

"When the surrounding infragravity wave period is close to one of the harbour's natural periods, rhythmic motion of water surface and currents [oscillations] can be generated inside the harbour.

"Even if the surrounding infragravity wave amplitude is small, higher amplitude oscillations can occur through resonance phenomenon.

"In such conditions, berthing operations can become unsafe and be interrupted due to excessive vessel movements causing damage to mooring lines and fenders."

Results showed four dominant oscillations prevailed in Two Rocks Marina within the infragravity period range.

The oscillations are continuously present in the marina—but during storm events, they become energetic and oscillation heights reach a maximum 0.5m, in contrast to calm sea conditions where they mostly remain below 0.1m.

"Two Rocks Marina is located in a region of complex offshore

bathymetry consisting of a submerged reef system that runs parallel to the coastline at distances of 3.2km and 4.7km respectively," Ms Thotagamuwage says.

Reef linked to infragravity waves

"We found infragravity waves are generated during the propagation of wind/swell waves over the offshore reef systems.

"During storms, the energy of infragravity waves over the reefs increases by a factor of about 10, compared to its energy beyond the reefs.

"This increase of offshore energy results in increasing infragravity wave energy surrounding the marina and, in turn, generates oscillations with high amplitudes."

Ms Thotagamuwage is now trying to find a methodology to overcome the infragravity period oscillations in harbours with similar conditions.

"In an environment with high-energy background infragravity waves, oscillations can be minimised by regulating the harbour's geometrical parameters," she says.

"The requirement is to make sure the harbour's natural period does not come within close proximity to the surrounding infragravity wave period range."

More information: Darshani T. Thotagamuwage, Charitha B. Pattiaratchi, "Influence of offshore topography on infragravity period oscillations in Two Rocks Marina, Western Australia," *Coastal Engineering*, Volume 91, September 2014, Pages 220-230, ISSN 0378-3839, DOI: 10.1016/j.coastaleng.2014.05.011.

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