# Channel Concentration and Reflections from Dredge Channels

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Gravity wave reflections from steep sided channels are recognised in coastal engineering literature as a potential problem for many harbours with dredged approach channels and at some rare coastal features, Channel reflections typically increase wave heights on the seaward side of the channel, while reducing wave energy leeward of the channel.

A 3D physical modelling study of wave processes for the Port of Townsville showed that waves do not reflect from all directions described by the classic reflection theory. Instead, for shallow approach angles, waves concentrate and break along the edge of the channel batter.

There is very little information available on this process, particularly since it can have dramatic effects on breakwater heads, seawalls, beaches and harbors. This paper presents the findings of the modelling study.

## REFLECTION vs CONCENTRATION

Channel reflection is characterised by a free wave propagating away from the channel at the same (or similar) angle as the approach angle. Very little energy is lost and reflected wave heights are close to that of the incident, and a diamond pattern wave field results.

Channel concentration is charaterised by a localized increase in wave height immediately seaward of the channel, along the length of the channel. Energy may be lost in depth-limited wave breaking. Some short period waves are released from both sides of the area of concentration as a secondary effect.

## MODELLING

WRL conducted 3D physical modelling of the coastal foreshore area of the Port of Townsville to assist SMEC in the design of a rock seawall for reclamation works. The study aimed to determine the design wave conditions at the structure due to near shore processes such as shoaling, reflection, diffraction and channel reflection.

The potential for increased wave heights due to wave reflection near the Townsville harbor was flagged in Nielsen et al (2011), with photos demonstrating the wave height differential experienced along the current revetment. Anticipating channel reflections, we were surprised to observe strong wave breaking at the channel boundary, and very little energy as a free-wave reflection. This effect is rarely reported in engineering literature, with a notable exception in Zwanborn and Grieve (1974)

Through a series of tests over several wave directions, and including monochromatic, JONSWAP and dual-peak wave spectra, we were able to characterise conditions which induced channel reflection, and those which resulted in channel concentration.

Channel concentration is most obvious with monochromatic waves. Broad spectra and directionally spread waves make the effect difficult to observe, and typically results in the transmission of some wave components. However, even under bimodal wave conditions it was shown that channel concentration significantly increased the wave climate at the channel edge. A significant reduction in wave energy within the channel was also measured.

The study showed that channel reflection and channel concentration can significantly transform the local waves, resulting in multidirectional wave fields and higher design wave conditions. They should be an important consideration for infrastructure and coastal management in regions with dredge channels.

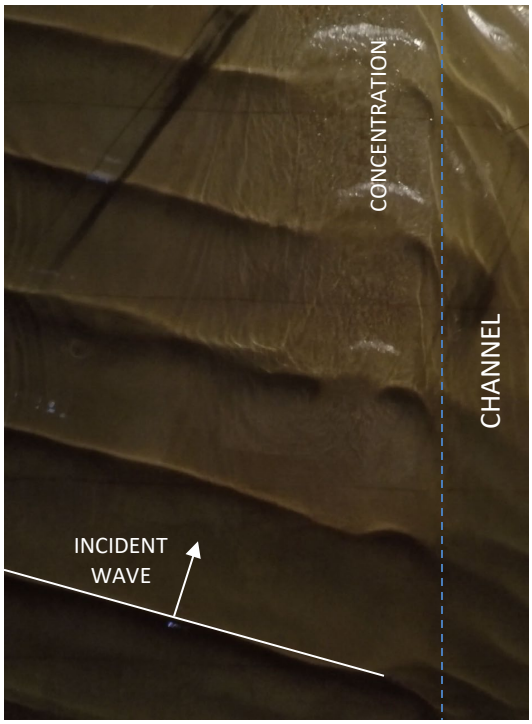


Figure 1 – Channel concentration recorded in the model

## REFERENCES

Nielsen A., Bonner R., Berthot A. (2011) *Wave Energy Reflections off Dredged Channels* 34th World Congress of the International Association for Hydro- Environment Research and Engineering

Zwanborn and Grieve (1974) Wave Attenuation and Concentration Associatied with Harbour Approach Channels