

Advancing coastal resilience

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Why Model?

To reduce risk and uncertainty,
provide confidence in designs

To optimise designs
Reduce cost and impact

Why Physical Modelling?

To reproduce complex coastal
processes

To reproduce complex interactions
between water and structures

Because some processes aren't well
represented in numerical or empirical
models



Modelling complex coastal processes

Physical modelling of Nanumaga to assess overtopping hazard.

Lagoon pumping due to wave setup is a key process impacting wave heights and runup at the back of the lagoon

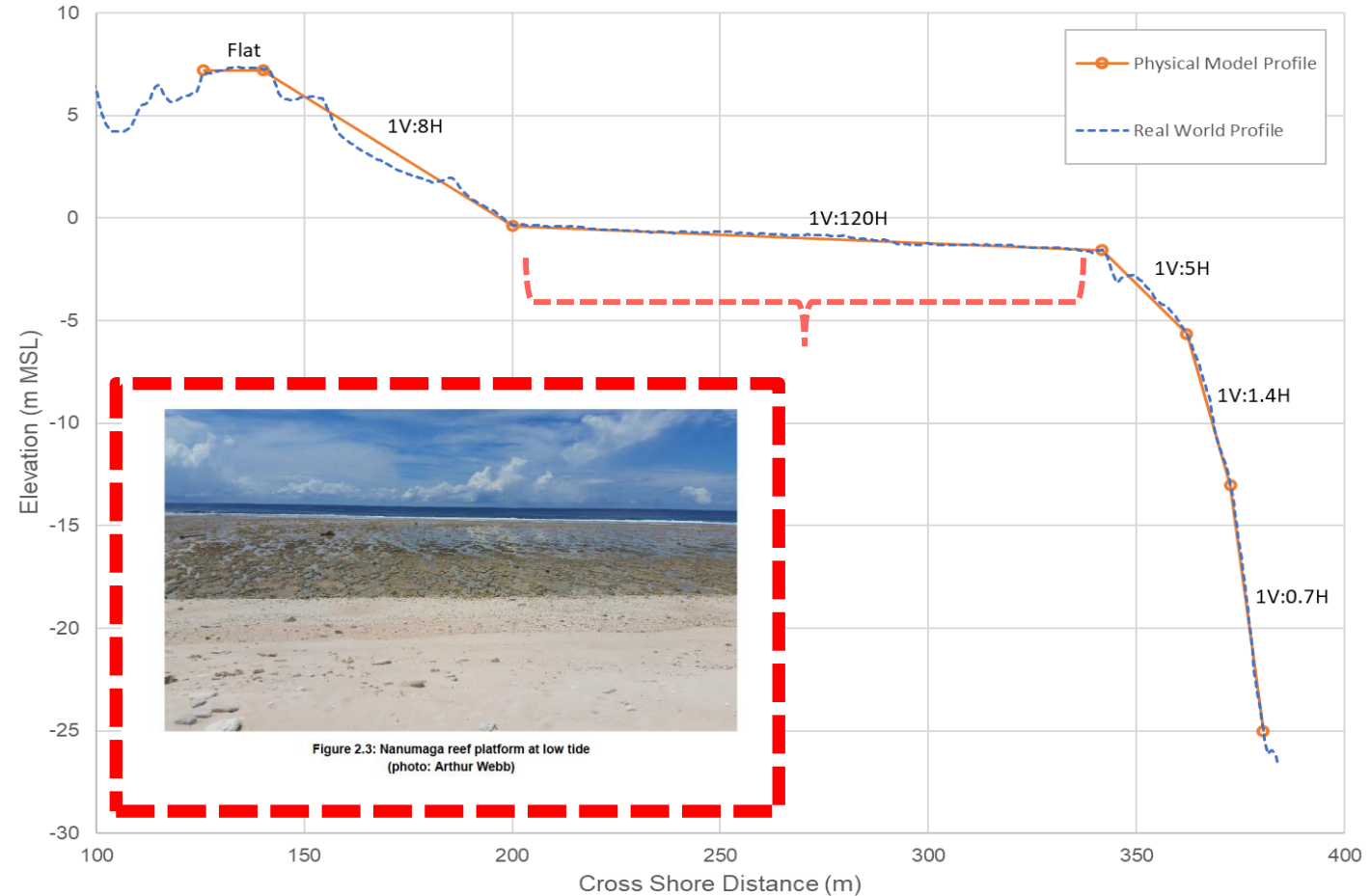


Figure 2.3: Nanumaga reef platform at low tide
(photo: Arthur Webb)



Reef flat

Reef crest

Fore reef slope





Affordable coastal protection

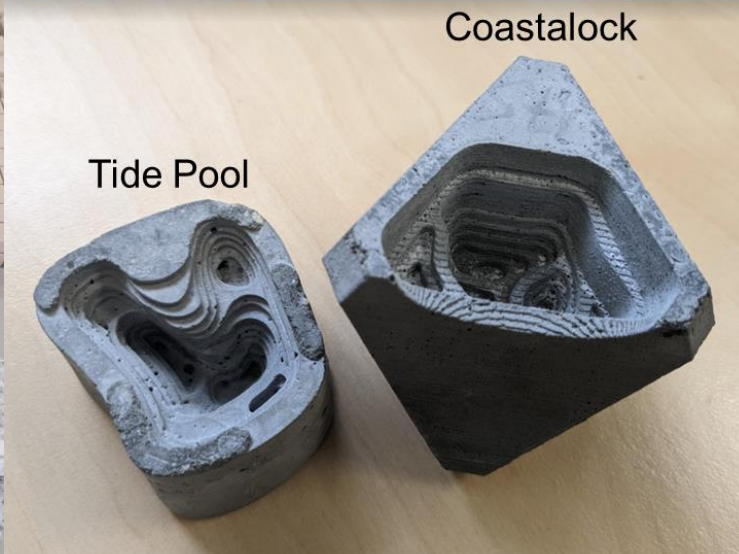
For very remote locations, communities can be limited to local materials and basic building supplies.

A study for PRIF determined the stability of besser block, and hand-filled geobags, for low cost protection works.

While not suitable for open coasts, they may provide some benefit for communities on coral lagoons.



Ecological enhancements

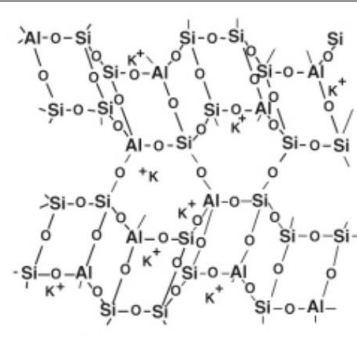
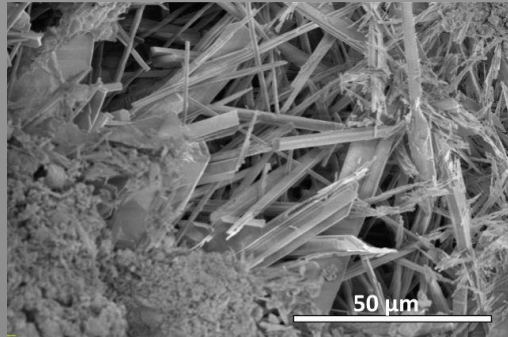


Tide Pool

Coastalock

High-Density Low-Carbon geopolymer concrete trial

Geopolymer Concrete



Portland Cement (crystalline)

Geopolymer

CO2 emissions reduced by 50-80%

Uses industrial waste:

Steel slag, blast furnace slag, fly ash

Concrete manufacture contributes 4-8% of global emissions

70-80% reduction in CO₂ emissions for Geopolymer concrete

Uses industrial waste products

Low value waste from steel manufacture is used

Higher Density aids resilience

The higher density of the geopolymer concrete provides a stability advantage to coastal protection

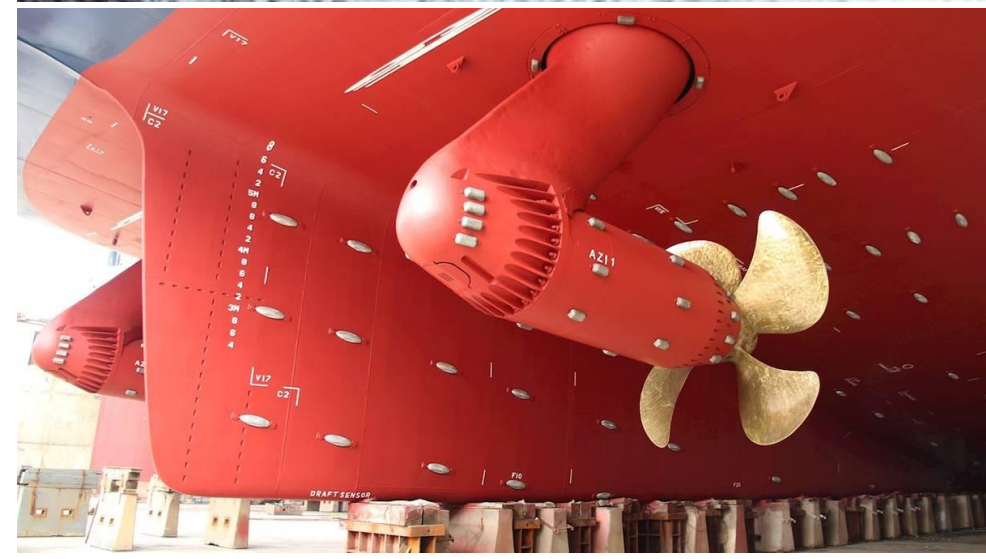
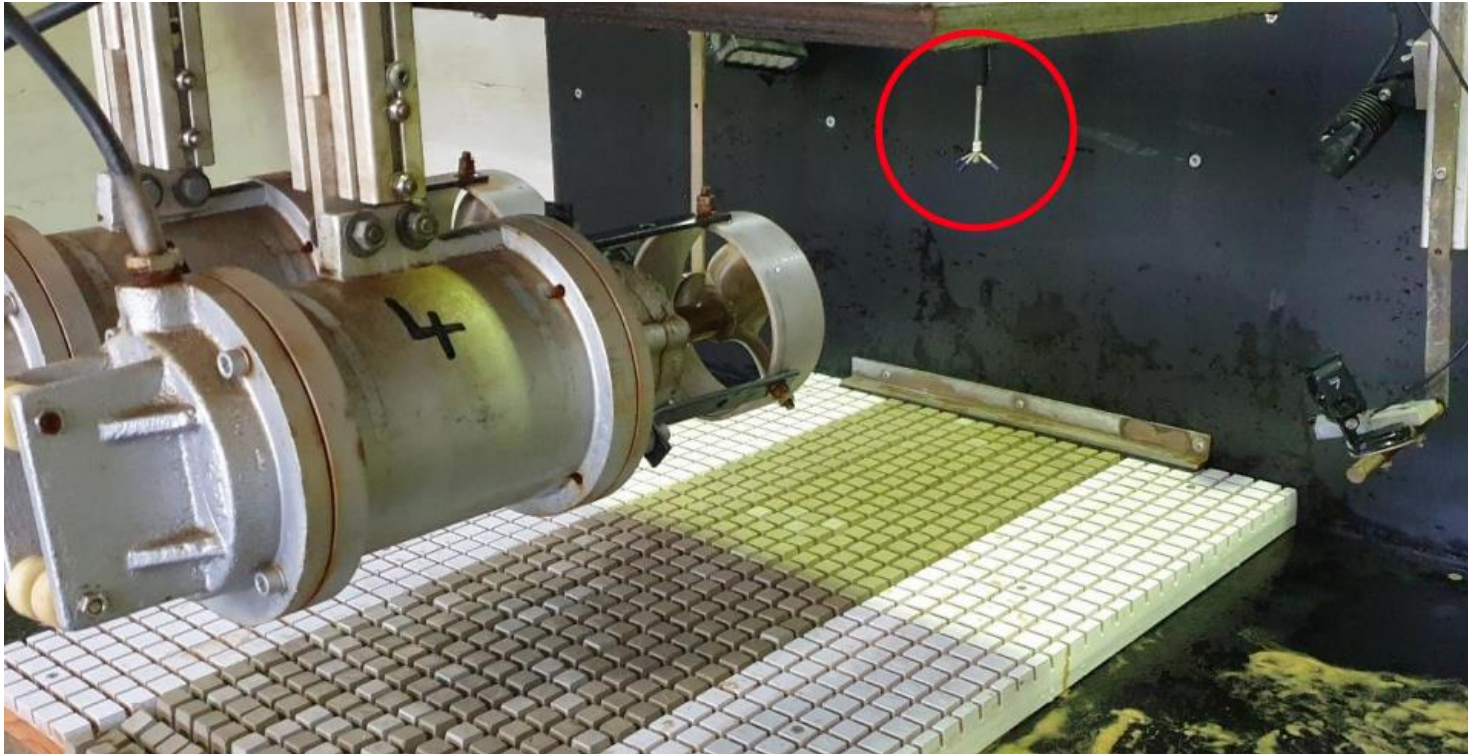
$$W_{50} = \frac{\rho_r g H^3}{K_D \Delta^3 \cot \alpha}$$

2.35 tm⁻³ -> 2.6 tm⁻³ => ↑68%



Ship thruster scour protection

- Very high power and velocities
- Directed at port infrastructure (quay walls, piers)
- The thruster jet is constrained by the ships bulk, directing flows to the bed and along quay walls





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E001 Toe Scour, Design Cond.



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Ship thruster scour – rock bag protection

Protection by
rock bags –
flexibility to
reapply bags
to coastal
protection.

Working with Nature





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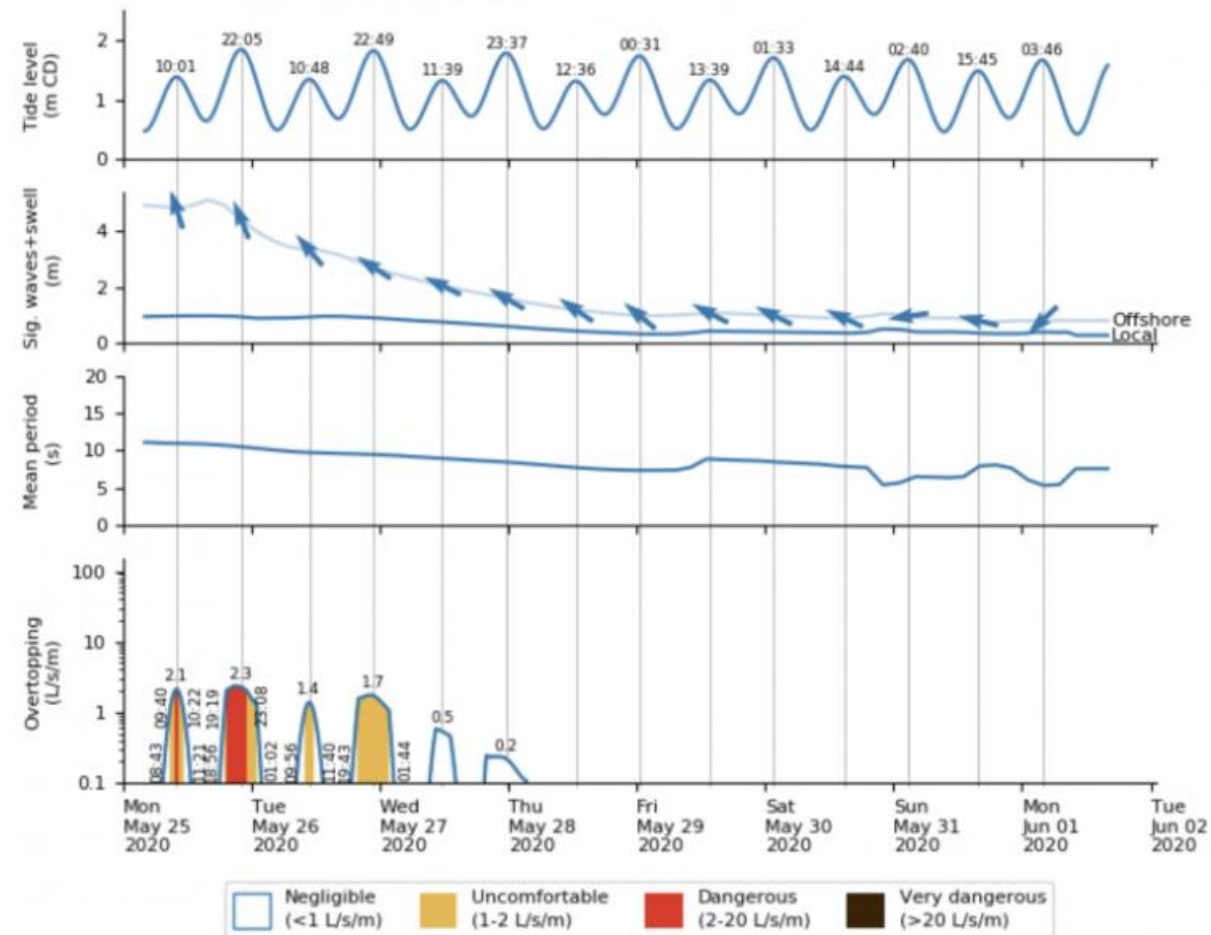
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Early warning system for overtopping hazard

WRL developed an early warning system for Fairybower (Sydney) to address overtopping hazards to pedestrians at a tourist hotspot.

It incorporates tides, waves and wind forecasts which are fed to a model which estimates potential overtopping rates.

The forecasting system is used by council to anticipate overtopping events and prepare to close of the area to pedestrians, reducing risk to council.



Future of physical modelling

Advances in instrumentation

Can measure new aspects of the model
(eg overtopping with LiDAR)

Easier, more accurate -> Better data can be
taken from the model

Model construction (eg 3D printing)

Can cost effectively model fine features
(eg corals and plants)

New Problems & Solutions

Working with Nature

New technologies for protection

New challenges for our coasts and ports