

Zilwa Marina, St Annes, Seychelles

Physical Model Tests of Wave Penetration, Breakwater Stability and Overtopping



Background

In August 2008 WSP Africa Coastal Engineers approached the CSIR to undertake physical model studies for the proposed Zilwa Marina at the St Annes Island in the Seychelles. The objective of the model tests was to determine the breakwater stability, wave overtopping of the breakwater and wave penetration in the marina under selected wave conditions.

Approach

The model was constructed at a 1:60 scale in a 32 m long by 12 m wide 3D basin. The near-shore bathymetry was accurately constructed with a cement layer using masonite templates. A precise replication of the bathymetry is necessary to include the correct wave dynamics on the main breakwater.

A blend of different stone sizes, making up the core of the breakwater, was scaled to reproduce the flow through the core. Accurate scaling of the breakwater core was done to correctly model damage levels and overtopping discharges at the breakwater

Shallow water wave generators were used to generate recurring storm conditions. The most severe angle of wave attack was used as the mean wave direction for all of the tests.

Physical model study

Combinations of several different recurring wave conditions and water levels were modelled to assess the effect on wave penetration, breakwater stability and overtopping at the marina.

Wave conditions on the outside of the main breakwater were measured using capacitance probes. Water level fluctuations inside the marina basin due to wave penetration and overtopping were measured using the Keofloat measuring system. The Keofloat measurement system is capable of measuring small waves and is therefore used inside the marina.

The overtopping discharges were measured by placing a series of trays on the breakwater structure. Average overtopping discharges at different locations were obtained by measuring the volume of water collected in the trays.

Damage analyses were done on various sections of the main

breakwater. The movement of the armour units were tracked with digital cameras. The number of armour units that moved as well as the distance it moved have been recorded and analysed.

Conclusions

The physical model tests showed that damage levels on the breakwater were within acceptable limits. However, certain areas of the breakwater were recommended for regular monitoring.

The measured overtopping discharges were relatively high and generally above the safety limits for vehicles and pedestrians, but within those for structural damage.

Wave measurements inside the marina showed that the waves due to wave penetration and overtopping are small and within safety limits.

Some recommendations could be made to improve the design of the marina based on the results from the physical model tests.

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