

DAMAGE EVOLUTION FORMULATION: A NEW APPROACH

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Abstract

The ProCoast-3D project focuses on developing, applying, and testing methodologies to predict the structural behaviour of rubble-mound breakwaters (RMBs).

The study aims to revisit Melby and Kobayashi's (1999) damage evolution formulas for RMBs, adapting them to the behaviour of Tetrapod and Antifer cubes armour layers. It proposes recalibrating the empirical coefficients to better predict damage in breakwaters with these armour layers, by conducting three-dimensional, long-duration scale model tests. In a previous study, Lemos et al. (2023), adapted Melby's formula, which traditionally applies to rock armor layers, by developing a similar predictive model for Tetrapods. The present work aims to consolidate this study, in a 3D scale model of the Ericeira breakwater, located on the western coast of Portugal. Tests were conducted at a 1:65 scale model, representing the port basin up to the entrance (Fig. 1a).

Tests comprised two water levels: high water level (+2.0 m)CD and high water level with setup (+4.0 m)CD. The wave conditions tested consider peak periods of 14 s and 16 s and significant wave heights ranging from 5.0 m to 8.0 m. Tests were conducted according to three different test sequences: The first two sequences (Sequence A and Sequence B) were conducted with increasing water levels, peak periods and significant wave heights. The difference between sequence A and sequence B was in their duration. In sequence A, the sea states were repeated indefinitely, until damage stabilization, before moving to the next sea state. It comprised 56 tests. On the other hand, sequence B had as pre-defined duration of 15 tests. Sequence C also comprised 15 tests conducted with increasing significant wave heights, but this time with decreasing water levels and peak periods.

For each test sequence, the non-dimensional damage parameter (S) is determined through the eroded volume of the armour layer. The eroded volume was obtained by comparing 3D surveys carried out at the end of each test using a Kinect position sensor - Fig. 1b), 1c) and 1d).

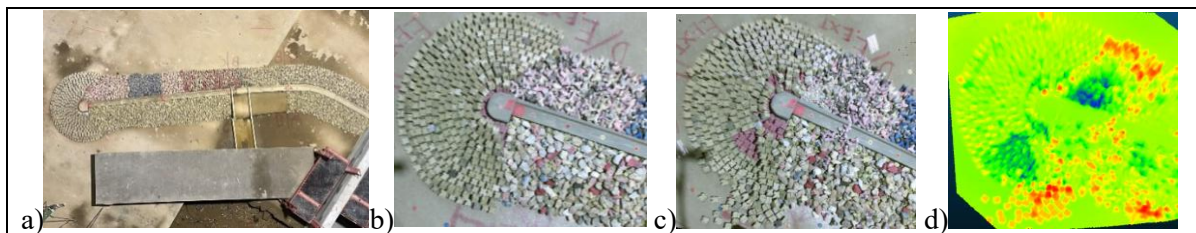


Figure 1. Overview of the 3D scale model (a). Surveys of the breakwater at the beginning (b) and at the end of test sequence B (c). Height differences between surveys (d)

Keywords: Breakwaters, Scale model tests, 3D surveys, Eroded volume

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