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# *INVESTIGATION OF WAVE OVERTOPPING RATE AT RUBBLE-MOUND BRAKWATERS USING FIELD MEASURMENTS*

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## *ABSTRACT*

*One of the main tasks in the design and safety assessment of coastal structures is the prediction of wave overtopping rate. In this work, model tree was used to develop a model for estimation of wave overtopping rate at rubble-mound breakwaters. The main advantages of the model trees are that they produce meaningful formulas. The field measurements in the CLASH database were used for building of the model and the conventional governing parameters were used as the input parameters. The results of the new model were compared with those of previous empirical formulas and artificial neural network model. It was shown that the developed model is more accurate than the previous ones.*

***Key Words:*** *Wave Overtopping Rate, Prototype Measurements, model tree, rubble-mound breakwaters.*

## *INTRUDUCTION*

*Safe and economic design of coastal structures is an important task in coastal and ocean engineering. One of the main parameters in the safety assessment of coastal structures is wave overtopping rate. Overtopping can cause fatalities and significant economic damage to the overtopped structure. Hence, the overtopping rates are usually limited by the allowable rate in these structures [1].*

*In the last decades, several studies have been performed to predict wave overtopping rate at coastal structures. As a result of these studies, different types of empirical formulas have been proposed for various coastal structures. These formulas are summarized in the Coastal Engineering Manual [2] and the Eurotop Engineering Manual [3].*

*One of the well known empirical models is the model of Van der Meer and Janssen [4]. Their formula was presented for estimation of overtopping rate at sloping structures. They suggested a model for straight and bermed impermeable slopes considering the influences of surface roughness, shallow foreshore, oblique wave attack, and structural berm [2]. The formulas are as follows:*

$$\text{If } \xi_{op} < 2 \text{ then } \frac{q}{\sqrt{g \cdot H_S^3}}\sqrt{\frac{S_{op}}{\tan\alpha}} = 0.06\exp\left(-5.2\frac{R_C}{H_S}\frac{\sqrt{S_{op}}}{\tan\alpha}\frac{1}{\gamma_r \cdot \gamma_b \cdot \gamma_h \cdot \gamma_\beta}\right) \quad (1)$$