BERM BREAKWATER TRUNK EXPOSED TO OBLIQUE WAVES
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INTRODUCTION
The major part of the research on berm breakwaters has concentrated on the berm reshaping of a trunk section exposed to head-on waves. Recent research included aspects related to individual stone movements under perpendicular wave attack (e.g. Tomasicchio et al.).

For a berm breakwater trunk section consisting of berm stones smaller than a certain size, the stones will continue to move in the wave direction (longshore transport) when the breakwater is exposed to oblique waves. Only a little research has been made to study the effect of oblique waves on the reshaping and longshore transport of berm breakwaters (e.g. Burcharth and Frigaard, and Van der Meer and Veldman).

A series of comprehensive model tests and subsequent analyses were carried out with the aim to study the influence of wave obliquity on the reshaping process, on the initiation of longshore transport, and on the longshore transport rate. The model set-up and test programme are described in Juhl et al.

TEST RESULTS
A modified stability number, $H^*_{w}$, is introduced in the analysis

\[ H^*_{w} = H_w s^{-1/3} \]  

(1)

where $H_w = H_{w0}/\Delta D_{s0}$ is a dimensionless stability number including the wave height, $H_{w0}$, the relative density, $\Delta$, and the nominal stone diameter, $D_{s0}$; and $s$ is the local wave steepness, i.e. just in front of the structure.

The profiles measured at the trunk show that the angle of incidence has an effect on the reshaping process. A plot of the recession of the berm is shown in Fig 1, and it is observed that the recession is decreasing with the wave obliquity. Further, the influence of the wave steepness on the profile development was studied for waves with an incidence angle of 30°.

The longshore transport rate of berm stones at the trunk was assessed based on analysis of the recorded profiles at the trunk and the roundhead as well as by observing the number of stones passing a cross-section of the trunk. In order to facilitate observations of the threshold conditions for longshore transport and the longshore transport rate, all the berm stones in a one metre wide section of the trunk were painted. Observations were made both during the reshaping process involving a large number of stone movements and on the reshaped profile.

An equation for the longshore transport rate on a reshaped berm breakwater profile was established:

\[ S = \left[ 0.16 H^*_{w} - \left( \tan \frac{2\psi}{3} \right)^{-1/3} \right] \quad 0 < \psi \leq \frac{\pi}{4} \]

(2)

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where $S$ is the number of stones moved per wave and $\psi$ is the angle of wave attack defined as $0^\circ$ perpendicular to the trunk. Fig 2 shows a plot of the longshore transport rates measured in the present study and in previous model tests compared to the established equation.

A presentation of the recession, erosion/deposition areas and volume of transport for the roundhead is made in Juhl et al (1996).

**CONCLUSIONS**

The recession of the berm is decreasing with increasing wave obliquity, and the wave steepness is an important parameter for the reshaping.

An equation for the longshore transport (stones/wave) both during and after reshaping is derived from model tests.

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**REFERENCES**


Alikhani, Tomasicchio & Juhl