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DETERMINATION OF CRITICAL PEAK WAVE LOADINGS FOR OVERALL STABILITY OF MONOLITHIC STRUCTURES PLACED ON ROCK RUBBLE MOUNDS

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INTRODUCTION

The paper deals with the wave loadings for calculation of the overall stability of caisson breakwaters and crown walls.

Wave pressures on vertical walls contain very high but short duration values, even when caused by waves which are not breaking on the front of the structure. The wave loadings and their distribution over the front and base of the structure are usually determined in physical scale model tests by means of simultaneous sampling from pressure gauges.

Two questions appear in such tests: Which sampling frequency is necessary for catching the load peaks, and how should time averaging be done in order to exclude peaky loadings which are not critical for the stability of the structure.

In case of 3-dimensional conditions (e.g. caused by oblique waves and/or short crested waves) the extra problem of space averaging appears.

It is well known that the short duration pressures and their impact on the structure depend on the mass distribution of the structure and the deformation characteristics of the foundation. This holds both for the physical scale model and the prototype. Because of the very different deformation characteristics in the model and the prototype it is in principle not possible to convert the recorded pressures or loadings from the model to prototype by the use of the Froude scale law, although this is normal practise.

The paper presents an investigation into the problem of deciding pressure sampling frequency and time-averaging of pressures as function of deformation characteristics in the model and prototype for the 2-dimensional case. Based on this is presented a method for conversion of the model test loadings to prototype conditions. The method is applicable also when total forces on a front panel in the model are recorded by strain gauges.

The inherent problem of scale effects related to non-Froudean representation of surface tension and elastic forces affecting the air inclusion, will not be dealt with. This limits the direct application of the paper to conditions of no large airpockets enclosed when the front of the waves hits the structure. Such inclusions should anyway be avoided in the design as it generates very large pressures.

STUDY OF INFLUENCE OF DEFORMATION CHARACTERISTICS OF PHYSICAL MODELS ON RECORDED WAVE LOADS

The dependence of the wave loading (variation in time) as function of deformation characteristics is studied in normal scale physical models with different deformation characteristics.

In these tests both the loadings (in terms of time history of pressures) and structure responses will be recorded. Subsequently is calculated by numerical modelling the transfer functions linking loads and responses in the physical models of different deformation characteristics.

The changes in the loading caused by the changes in model deformation characteristics are analysed. On this background is given an evaluation of the ability of conventional scale model set-up to give unbiased information about the wave loading. This will be the case only if for the normal range of deformation characteristics of the model the loadings are marginally influenced by the various stiffnesses of the models. This influence is quantified.

TRANSFER OF RESULTS TO PROTOTYPE CONDITIONS

For the range of wave loadings recorded in the models of various stiffnesses are studied - after Froude scale conversion - the range of responses which can be expected in prototypes. For this purpose is the rubble mound response modelled by a dynamic finite difference model which takes into account porous flow and compressibility. The known range of stress-deformation characteristics of rockfill will be used in a sensitivity study.

RESULTS

The outcome will be information on the uncertainty related to conversion of small scale model test wave loadings to prototype conditions. Moreover, the analysis will give guidance to time-averaging of peaky wave loadings.