

Ocean Brick System (OBS) Used as a Foundation Structure for Offshore Wind Turbine

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The Ocean Brick System (OBS) is a modular system consisting of hollow concrete precast blocs (10m x 10m x 10m) piled up like cubes and interconnected to create a stiff, light and strong structure and which can be used for artificial islands, artificial reefs, evaluation of vulnerable low lands, deep water ports, breakwaters and foundation of offshore wind turbines. The entire structure or components can be built in a dry dock and then floated and towed to the planned construction site. OBS Ltd. has commissioned the Leichtweiss-Institute to conduct systematic hydraulic model studies on the wave loading and hydraulic performance of different types of structures made of ocean bricks such as foundation of offshore wind turbines, and harbour breakwaters. The first study on the wave loading and the stability of an OB-made foundation structure has now been completed (Oumeraci et al, 2008).

The objective of the paper is to introduce first the advantages and possible applications of the OBS, including a brief discussion on the limitations. The major part of the paper will focus on the discussion of the experimental results related to the wave loading (total horizontal and vertical forces, overturning moment) and the sliding/overturning stability of the OB-structure used as a foundation of offshore wind turbines.

In a brief section the model set-up is first described, including the observation and measuring techniques deployed and the testing programme. Focus is put on the description of a special transducer which has especially developed for the measurement of the total wave loads on the fully submerged large structure.

In the major part of the paper the experimental results related to the total horizontal and vertical forces, including the resulting overturning moment, are first analysed and semi-empirical formulae are derived for the prediction of maximum wave loads of the submerged structure subject to irregular waves. It is found that the most relevant influencing parameters are the diffraction parameter $2\pi a / L$ (L = wave length, a = characteristic dimension $a = I_3^2 / I_1$, where I_3 = height of the structure and I_1 = length of the structure in wave direction) and the relative water depth h / L . Surprisingly, no similar study could be found in the literature, so that an attempt is made to use wave theory to develop approximate formulae for comparison. A further method used to check the semi-empirical prediction formulae was to perform sliding tests outside the wave flume and to determine the friction coefficient between the concrete structure and the rubble foundation. Using the obtained friction coefficient and the results of stability tests in the wave flume for which the total wave forces were previously determined, the developed prediction formulae could finally be verified. Example calculation for given design wave conditions are provided to illustrate applications of the prediction formulae and diagrams.

Surprisingly, no prediction formulae could be found in the literature for the design of the required size of the armour units required for the rubble foundation of large submerged structures, so that hydraulic model tests were also conducted for this purpose. The results of these tests and recommendations for the design of the rubble foundation are therefore given in a final section.

Oumeraci, H.; Pförtner, S.; Kudella, M.; Kortenhaus, A. (2008): Ocean Brick System (OBS) in a Wave Flume – Part I: A Foundation Structure for Offshore Wind Turbine. LWI Report No. 972, Leichtweiss-Institute, pp. 59 + annexes.

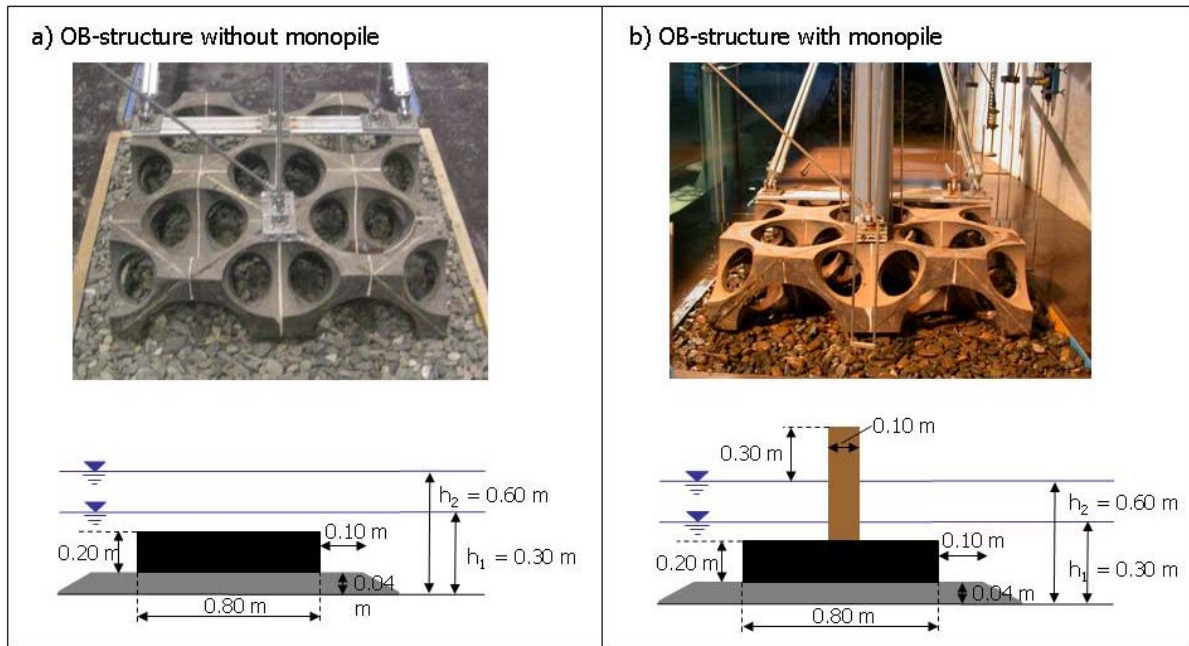


Figure 1 Ocean brick used as a foundation structure for offshore wind turbine (model scale 1:50)

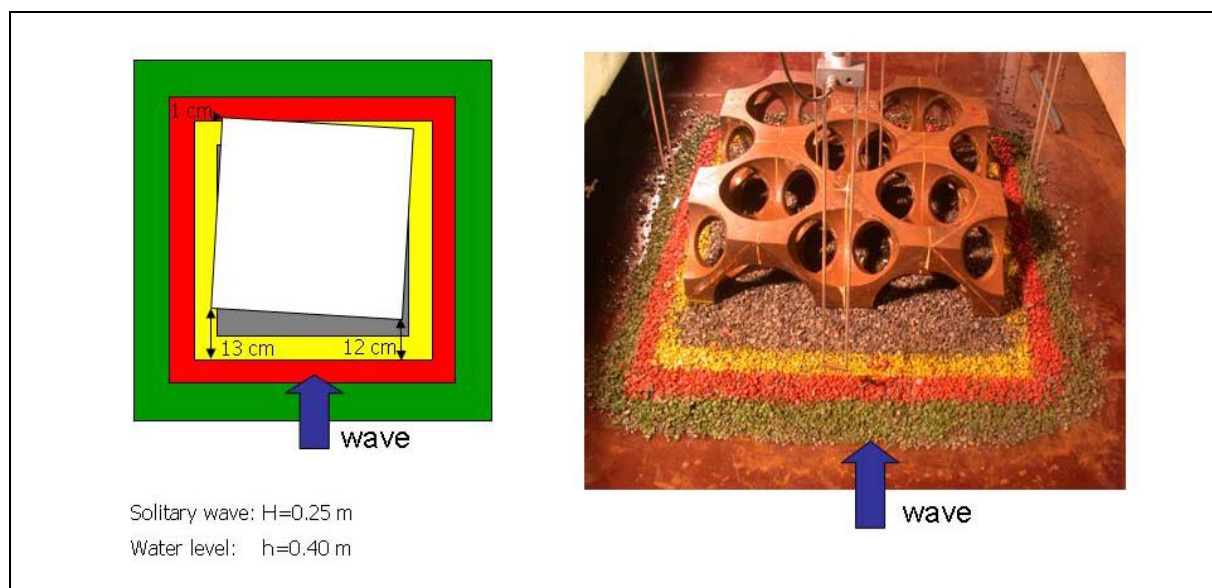


Figure 2 Sliding of the ocean brick structure on rubble foundation

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Keywords

modular structure, offshore wind turbine, total wave loads, sliding/overturning stability, rubble foundation