Laboratory study on steep wave interaction with fixed and moving cylinder

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ABSTRACT

In this paper, a new set of experiments on the focused wave (using the 2\textsuperscript{nd} order wavemaker theory) and current interactions with cylinder is being carried out. In order to represent a uniform current in laboratory, cylinder is towed with a velocity opposite to the wave propagation directions. This paper discusses about the experimental setup and test cases that was released for the comparative study in the ISOPE 2020. In order to obtain good correlation with different runs, the repeatability of the experiments is confirmed by comparing the surface elevation measurements at the fixed wave gauge location near the wave paddle and uncertainty analysis was carried out. Different test cases with varying frequency bandwidth of the focusing waves, speed of the cylinder and the locations of focusing are investigated and will be reported in this paper. Further, a comparison for the dynamic pressure on cylinder is reported between experiments with wave and wave with uniform current.

KEY WORDS: moving cylinder, focusing wave, second order wave maker, current, dynamic pressure.

INTRODUCTION

Any structure that deployed in ocean should be studied extensively as the cost involved in construction and deploying in ocean are huge. Further, many offshore structures have been and will be designed and operated for offshore and marine engineering, including the emerging technologies for harnessing marine renewables and offshore wind energy. The wave characteristics and its effect on the structure must be analysed as a part of the design process. A vast amount of work has been studied and well written about the wave characteristics. Various linear and non-linear theories are developed and currently various orders and approximations of wave models are available for determining the wave characteristics and its interactions. These theories and models hold good for non-breaking cases. But in offshore environment steep waves or breaking waves over the structure plays a major role in creating a very high impact pressure. The kinematics of the steep/breaking waves is not well understood like the linear waves, since, at the onset of breaking point, the air-entrainment may also play a major role in large scale. As the kinematics are not fully understood, the wave loads due to the breaking waves are still a topic of intense research. The general procedure for the estimation of the wave forces.

Fig. 1: Cylinder with a diameter of 0.22m and three wave gauges located 0.57m in front of the cylinder centre, on a level with the centre of the cylinder and 0.71m behind the cylinder.