STUDY ON SCOURING IN PILE OF OFFSHORE WIND FARMING BY NUMERICAL ANALYSIS USING BUILDING-CUBE METHOD

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INTRODUCTION

In recent years, offshore wind farming has spread all over the world, and there has been rapid growth of not only conventional onshore wind farming but also offshore wind farming in the sea. However, there are many problems to be solved in offshore wind farming. Among them, the scour of the ocean floor caused by wave and tide has a great influence on the support structure. The purpose of this study is to clarify the scour phenomenon from the flow field and vortex generation conditions by numerical simulation using Building Cube Method. We conducted the simulation of the experiment which handles scouring around the monopile performed by Chen et al. (2018).

RESEARCH METHOD

The Building Cube Method was developed by Nakahashi and Kim (2004). In this study, we used CADMAS-BCM (developed by Arikawa et al.) that 3-D Navier-Stokes simulation model using the Building Cube Method. In this model, the 3-D Building Cube Method was applied using multiple roots. Moreover, because the calculation area is divided according to simple rules, it has features such as good compatibility with parallel computers, and grid generation by a simple method is useful for calculating the flow around objects with complex shapes.

RESULT OF CALCULATION

In this study, we examined the experiment performed by Chen et al.(2018) based on numerical simulation. The experiment was conducted under the conditions that both current and waves are existed. In this study, we investigated the current around monopile under waves by numerical simulation using Building Cube Method. The computational domain is shown in Fig. 1, The grid-cell size was set as 20 divisions in each cube level. As a result, the maximum current velocity and wave period at the bottom of the monopile and the Kc number represented by the diameter of the monopile are reasonably reproduced in each case. The experiment of Chen et al.(2018) showed that the maximum scour depth increases as the Kc number increases, and the maximum scour depth moves toward the rear of the monopile. The vorticity distribution in the z direction based on the bottom mean current velocity in this calculation was shown in the Fig.2. As the Kc number increases, the point with large vorticity moves behind the monopile. Similarly, it can be confirmed that the position of the maximum scour depth in the experiment and the position of large vorticity in the calculation are almost the same.

CONCLUSION

In this study, we investigated the relationship between the fluid field, vorticity distribution based on numerical analysis using CADMAS-BCM and scour depth around the pile. This model used the Building Cube Method, which enables efficient and accurate calculations. As a result, the underwater fluid field and vortex, which could not be confirmed by experiment, were confirmed by numerical simulation. The flow condition around the monopile was successfully reproduced, and it was clarified that the scouring around the monopile occurred from the relationship with the local current velocity and vorticity. Although the maximum scouring depth has not been quantitatively evaluated, it is qualitatively inferred that the scouring is occurred due to the relationship with the local current velocity and vorticity.

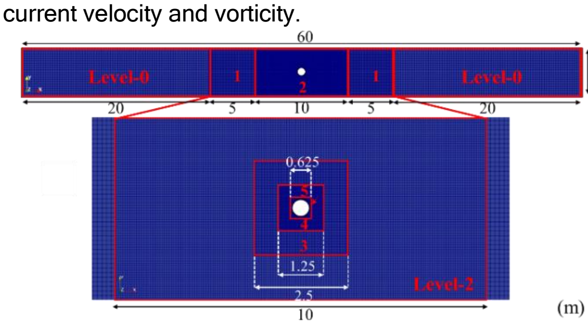

Fig. 1. Computational domain of this calculation.

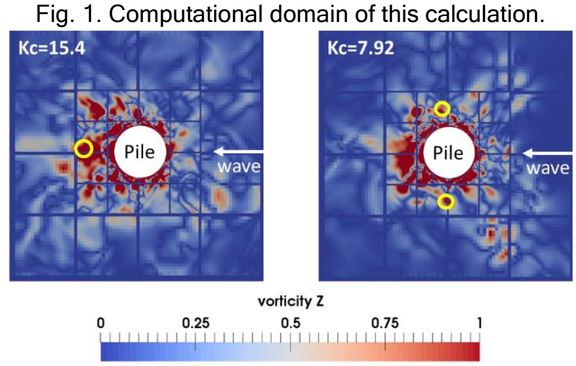

Fig. 2. Vorticity distribution in the z direction around the monopile (yellow circle: position of maximum scour depth in experiment)

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