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離岸風機支撐結構沖刷保護工之數值分析
Numerical Analysis of the Scour Protection Mechanism for the Support Structure of the Offshore Wind Turbine

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摘要

本研究採用 Splash3D 針對離岸風機支撐結構之海床底泥沖刷進行三維數值模擬。採用非連續雙黏性流模式，設置結構物於可變動之海床上，分別探討基樁結構為單樁或桁架式時，加設保護工前後與周圍流場交互作用影響基樁周圍局部淘刷之情形。分析結果顯示，若於底樁外圍加設外徑為 12 公尺，高度 2 公尺之沖刷保護工，會加大底床變動範圍，保護工周圍之高程變動較未加設保護工時劇烈；保護工可以有效避免上游端泥砂之沖刷，但對下游端之保護效果有限，此結果可能是由於下游端流況有渦流產生，流況較上游混亂且劇烈。未來可以透過調整保護工之高度、半徑、形狀甚至孔隙率等參數敏感度分析，並提出更有效之保護工設計。另外，本研究目前於非連續雙黏性流變模式中所採用之各項泥砂流變參數乃是透過文獻與數值實驗所得之結果，並非於預定場址採樣、物理實驗所得之數據。未來若可取得預定場址之泥砂採樣或觀測資料，並進行各項材料流變參數試驗以取得非連續雙黏性流變模式所需之參數，使本研究能夠更準確的評估離岸風機設置後可能造成的海底地形變遷，並提供環境影響之具體分析成果。

關鍵詞：離岸風機、支撐結構、沖刷、保護工

Abstract

In the present study, the three-dimensional numerical model for the scour of the support structure of the offshore wind turbine (OWT) is developed using the code of Splash3D. The support structure of the OWT is installed on the moving seabed and the discontinuous bi-viscous rheological model (DBRM) is implemented to describe the behavior of the moving seabed. Both of the jacket-type and monopile support structure are investigated, and the flow variation upstream and downstream of the solid substructure with/without the protection mechanism against the scour is studied. Results showed that larger disturbed area and severer height variation were observed when using the protection mechanism with diameter of 12 m and height of 2 m. The upstream scour is effectively reduced using the protection mechanism, but its effect is minor for the downstream scour. This may due to the complicated and severer flow behavior in the downstream region. In the future, more effective protection mechanism could be proposed by using the developed numerical model to investigate parameters of the protection mechanism such as height, diameter, shape and porosity. Besides, the employed parameters of the DBRM were obtained by the numerical experimental conducted in the present study, not from the measurement at the designated wind farm. As long as the data from the demo wind farm is available, the site-specific evaluation could be conducted, and more practical suggestion could be proposed for the scour protection mechanism of the support structure of the OWT.

Keywords: Offshore wind turbine, support structure, scour, protection mechanism