

高液化潛勢區離岸風機基礎穩定性評估

執行單位

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計畫主持人

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國內廠商無法藉由國際合作取得離岸風機基礎設計核心技術，本計畫成果可支援建構對應技術，並已由國內顧問公司實際應用於基礎設計。

- 支撐結構(含上部塔架、接合元件及基礎)行為數值模擬技術
- 離岸風場工址地震力評估及海床液化潛勢評估技術
- 高液化潛勢地區離岸風機基礎設計地工參數決定技術
- 強震區高液化潛勢離岸風機支撐結構穩定性評估技術

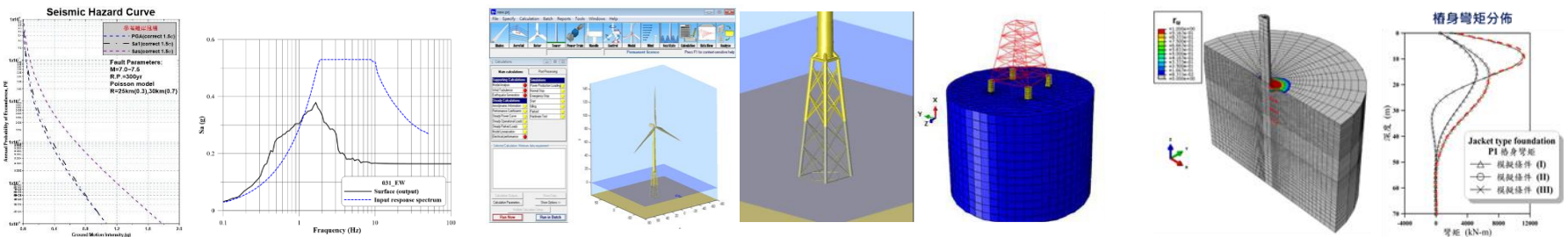


圖1. 參考離岸風場之地震反應譜 圖2. 4MW 風機及套管基礎整機分析模型

圖3. 風機支撐結構有限元素數值模型

- 歐洲離岸風場均無設置於強震區之經驗，亦沒有明確之方法將海床液化影響納入支撐結構設計考量；為確保我國離岸風場運轉安全，本計畫利用土壤動態力學試驗搭配數值分析模型，於離岸風機支撐結構設計流程中增加高液化潛勢強震區設計考量技術區塊：包括(1) 強震區高液化潛勢離岸風機支撐結構整體設計流程、(2)離岸風場土壤調查及地工設計參數、(3)離岸風機設計載重、(4)離岸風場地震力評估、(5)液化潛勢評估及(6)液化土壤基礎穩定性評估等。
- 說明風場開發商、風機製造商、支撐結構設計顧問單位、支撐結構製造工廠、海事工程施工單位及第三方驗證單位於各設計區塊的分工與關聯，以協助離岸風機支撐結構設計公司釐清離岸風機基礎設計工作項目，完成高液化潛勢區離岸風場支撐結構設計。

Foundation Design of Offshore Wind Turbine with High Liquefaction Risk

Execution Unit

Dep. of Hydraulic and Ocean Engineering, NCKU

Project Director

Associate professor Yu Shu Kuo

- Dynamic responses analysis of offshore wind support structure.
- Evaluation design earthquake force and seabed soil liquefaction potential for offshore wind farm near Changhua County.
- Determination of geotechnical parameters of offshore wind farm in the area with high liquefaction potential.
- Stability analysis of offshore wind turbine foundation in liquefiable seabed soil.

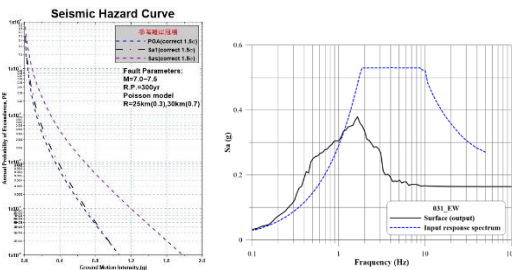


fig. 1. Seismic Response Spectra

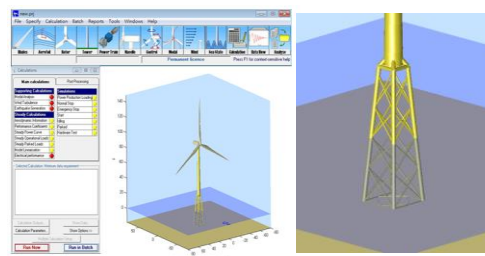


fig. 2. 4MW OWT and support structure numerical model

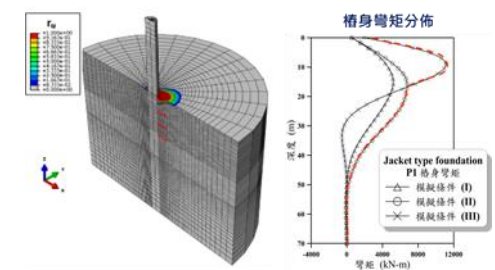


fig. 3. finite element model of foundation and analysis results

- As the existing European offshore wind farms are not located in the strong earthquake area, the foreign consultant companies have no experiences designing the supporting structures considering the effects of strong earthquakes and the corresponding seabed liquefaction potential. The lack of experiences may lead to an unsafe or conservative. In this project, the research team cooperated with CECI Engineering Consultants, Inc. and National Center for Research on Earthquake Engineering to solve the above problem. In order to consider the seismic force and the corresponding seabed liquefaction, the following design steps are suggested in the design process of offshore wind turbine foundation in liquefiable seabed soil : (a) Evaluation of seismic force of offshore wind farm, (b) Assessment of seabed liquefaction potential, and (c) Determination of foundation design geotechnical parameters. Following the proposed design procedure, the seismic force and corresponding liquefaction depths of the offshore wind farm outside of Taiwan's Changhua County were determined reasonably by using the results of seismic hazard and site response analysis. The foundation stiffness then was calculated from the updated geotechnical parameters, and the stabilities of supporting structures were evaluated by considering the design loading cases with seismic loadings. This project provide the design procedure of the offshore wind turbine supporting structure by in principle for offshore wind farm with high soil liquefaction potential in Taiwan.