TU Delft

Offshore & Dredging Engineering

Technische Universiteit Delft

Modelling Soil Damping for Suction Pile Foundations

In pursuit of saving mother nature, man has been extending his boundaries to find renewable sources of energy. Wind being one of them, has been exploited in the past years with offshore wind gaining high popularity in the recent years. Owing to the high capital costs of the offshore wind sector, research has been directed to focus on technology and science that could ultimately contribute in cost reduction of offshore wind projects. One such science is the mechanism of **damping**.

Damping, which is often described as 'dissipation of energy stored in a dynamic system', can indirectly play an important role in determining the structural configuration of the support structure and the foundation of an offshore wind turbine. A higher value of overall damping can be associated with either an increase in fatigue life or a reduction in overall structural weight. In both the cases there is significant aid to foundation cost cutting.

Currently, a typical value of 2-3% (of critical) is used within the industry as an overall damping estimate with little understanding about the contribution of soil damping. This thesis focusses on developing a methodology to compute soil damping coefficients for the case of suction pile foundation and further apply it to a Suction Installed Wind Turbine (SIWT) structure (refer Figure) to find soil damping in the form of modal damping percentage.

Suction Installed Wind Turbine

The thesis objective is tackled by using two case studies from projects executed by SPT Offshore. The first case study proposed a method to calculate the vertical damping coefficient (C_v) for an individual suction pile using forced vibration analysis in PLAXIS. Two interesting conclusions were drawn from this case-study;

- the C_v increased with an increase in the forcing amplitude.
- the C_v decreased with increasing loading frequency (ω), while the product of C_v and ω increased with increasing ω.

The second case study implemented the proposed methodology (of the first case study) to a SIWT structure in order to calculate the modal soil damping percentage for the first two modes of the structure using modal analysis. The results when compared with logarithmic decrement percentages, gave similar estimates. The found influence of soil on the damping of this particular structure is significantly larger than the order of magnitude used in the industry today.

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