بسم الله الرحمن الرحيم

شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم

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MONA MAGHRABY

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جامعة عين شمس

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قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
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The behavior of a Tension Leg Platform wind turbine subjected to Environmental loads

A Thesis submitted in partial fulfillment for the requirements of the degree of
Master of Science in Civil Engineering

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Statement

This thesis is submitted as a partial fulfillment of Master of Science in Civil Engineering Engineering, Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Abstract

Wind turbines are a source of electrical energy, based on wind renewable energy. WT may be constructed on-land or offshore. In this study wind turbines are set to be offshore. Tension Leg Platform structures are mainly used for supporting petroleum platforms and wind turbines. The use of TLP structure is one of the best choices for deep water as it is a floating structure such that the structure is supported by buoyancy force exerted on it by seawater, the tendons supporting the structure are only constructed to set the structure in its certain site.

A literature review is done for successive papers, and theses to be able to have a line of research concerning the TLPWT structures and TLP structures for any other purposes. Books are being implemented in the literature review to be able to understand offshore structures' concepts, structural dynamics effect on a structure, different effects of environmental loads on offshore structures, and the main concept of TLP structures.

In this thesis, a study is done on the loads acting on the TLPWT structure including dead loads acting from the weights of all components of the structure, as hull, tendons, electrical cables, and wind turbine, and concerning environmental loads with the most significant loads, wind, current, and wave loads, and other loads acting on the structure as seismic load, tides, icing, marine growth, scour, and tsunami. These loads are studied and listed in the different possible load combinations acting on the hull, including the whole lifetime of the structure starting from the construction of parts reaching the final lifetime stable set, the loads are factored by factors of safety as the reduction done to the resistance properties of the hull, to ensure maximum safety for the structure.

The shape of the structure has been discussed, using the ship's structural shapes as a significant floating structure, and considering the shapes of the offshore floating and submerging structures, to set the best shape implemented by past researchers.
The materials of the structure are being chosen to start from the gross parts including the hull, passing by the smaller parts like tendons, footings, and electrical cables, reaching the smallest materials used for connections, including bolts and weld materials, to be able to set the best materials to be used in the modeling of the hull. The author implemented a different material to be used in the production of the tendons, FRP material, which needs further research to be set as a practical alternative.

Design considerations must be set by the designer, are given to ensure the maximum use of the constructed elements. The master point of consideration is to prevent resonance occurrence, the total displacement of the whole structure in 6 degrees of

freedom must be checked. The elements are set to design equations including thickness requirements and stiffeners. Bolted and welded connections are designed to resist the different loads acting on the hull.

A model was set by ANSYS AQWA, to set the properties of the hull's structure and the loads acting on the hull. The main loads implemented in the model are its weight, wind load, wave load, and current load. A parametric study was done concerning the pontoons and column, the pontoons' parametric study includes changing the pontoon's length and cross-section to reach the best properties of volume for deepwater reaching 900m water depth, the column's parametric study includes changing the column's cross-section. The author implements differentiating the cross-section along the elevation. The loads acting on the model are collected as the environmental loads acting in the El-Zaafarana region in eastern Egypt. Outputs are derived from the model to ensure the implemented ideas.

Finally, the TLPWT hull is recognized as the most important designed part of the structure as it is the connecting part between the WT and the mooring system, where all environmental loads act. The stability of the hull ensures the stability of the whole structure.

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