Ain Shams University
Faculty of Engineering

ANALYTICAL STUDY OF OFFSHORE COMPLEX STRUCTURES

By
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A Thesis
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ABSTRACT

Assessment of existing offshore structures is performed in order to extend the service life of the facility, if one of the assessment initiators exist then the structure shall undergo for the assessment process, structural assessment is divided into steps as one of these steps is performing non-linear static analysis to demonstrate that the structure has an adequate strength and stability to withstand a significant overload with respect to the applied loads.

In this thesis non-linear static analysis was adopted in the analysis of the structural models to perform the progressive collapse analysis for offshore structures using SACS to get the structural capacity and study the effect of the mitigation procedures sponsored by API to improve the structural performance during the extreme environmental conditions in the non-linear static analysis.

A pre-study is performed in order to verify SAP2000 to investigate its capabilities in wave calculation and non-linear static analysis with comparison with SACS. The wave verification was done in two models , the first is a simple cantilever and the second one is a jacket model and are subjected to different wave loading conditions , the wave accelerations and velocities, base shear reactions , straining actions and displacements results shows that SAP2000 wave calculations are accepted in comparison with SACS results. The Comparison study between SACS(5.2) and Sap2000 revealed that SAP2000 can be used in design for offshore platforms for preliminary stages of the project and in the initial assessment steps. The Non-linear static verification model is a subsystem of a jacket model was used previously in USFOS verification using FENRIS, the load displacement diagram and collapse mechanisms results for SAP2000 and SACS are approximately the same with the FENRIS results.

Non-linear static analysis was performed for two offshore models, the first model is PS-2A Platform which contain of two jacket linked together with the top jacket bracings and the deck structure, this platform was pushed till the collapse occurred. The collapse failures was occurred in piles due to loss of soil capacity and the platform is very weak in resisting the extreme environmental conditions and the same steps was done to second model (P-1 Platform) as the platform is a four

legged jacket with X vertical bracing, the collapse failure was occurred in piles, the platform can withstand the extreme environmental condition.

The parametric study for the two models were done to study the effect of equivalent linear pile stubs, effect of reduction of vertical loads, effect of reduction hydrodynamics forces, platform strengthening ,increasing the jacket redundancy and decreasing jacket redundancy.

Using equivalent linear pile stubs is not recommended for pushover analysis however using equivalent linear piles stubs can be a good sign for determining the structure weak joints and members.

The mitigations actions procedures of **J.W. Turner, 1994 [17]** were studied which are reduction of vertical loads, reduction of hydrodynamics forces and platform strengthening and these procedures improved the platform collapse behavior under environmental loads for both cases of studies.

Finally using soldier piles in strengthening improved the collapse behavior of the platform especially when the connection of the new soldier piles and the existing piles are rigid enough.

STATEMENT

This dissertation is submitted to Ain Shams University for the degree of Master of Science in Structural Engineering.

The work included in this thesis has been carried out by the author in the Department of Structural Engineering, Ain Shams University, from March 2006 to October 2011.

No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

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