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Structural Design of Float-over Type Fixed Offshore Platforms – A Disruptive Method Using Knowledge-based and AI-aided Technique

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ABSTRACT

Design of offshore structures starts with an assumed structural deck plan followed by the preparation of a preliminary equipment layout. Based on the assumed deck size, a preliminary jacket and deck configuration including the size of the members are assumed in the form of a 3D analytical model. Structural design is performed through a series of structural analyses due to anticipated pre-service and in-service loads. Structural response for each loading condition is checked against the limiting criteria as required by the design specifications. Final design is arrived after completing several analyses incorporating changes from each analysis. Alternatively, an existing design of similar deck size is altered to meet the requirements of the new platform. Both of these methods consume significant design time and sometimes take months to obtain a first-pass analytical model primarily because of inter-disciplinary engineering issues. For the float-over platforms, details of the transportation barge should also be considered as important design parameters.

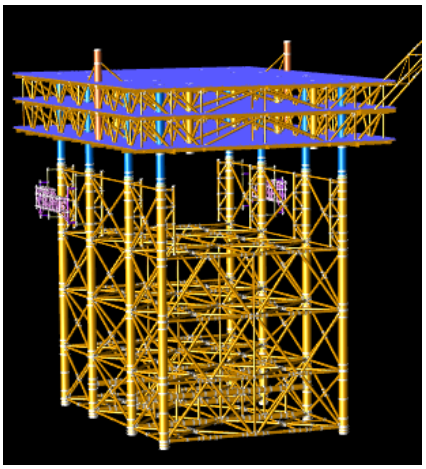

Figure 1: Auto-designed 8-legged float-over platform

Kling et al (2019) have presented a method on automated jacket design by using genetic algorithms. Qian et al (2023) have presented conceptual design method of offshore jackets using self-developed database. Recently, Chatterjee (2024) introduced a knowledge-based design technique that completes the preliminary design of conventional fixed offshore platforms without actually carrying out any structural analysis. The method requires only a few basic input parameters to generate a detailed analytical model of the structure.

This paper presents a knowledge-based and AI-aided method to configure and size of float-over type offshore platforms when details of the topsides are unavailable. Only an approximate weight of the topsides (excluding the deck structure) along with the water depth, design wave height and seismic coefficient are required as input. The method bypasses the common sequence of various analysis steps and provides a preliminary design of the entire structure in a few seconds including the boat landing, mudmat, crane pedestal, flare boom, jacket launch truss, expected size of the transportation barge and number of anodes. The computer program developed for the purpose creates a detailed analytical model of the structure and a summarized material take-off (MTO). The design can be immediately verified by applying conservative loads on the structure in absence of an equipment layout. The analytical model can be updated with a single click whenever the equipment details are available and may require minor local modifications during detailed design. The advantages of the proposed method include (i) quantum reduction of the design time compared to the traditional design approach (ii) immediate availability of a structural model helps in quick development of further activities such as modelling of the equipment, piping and utilities as well as fabrication details of the structure (iii) project cost analysis can be immediately performed with the MTO.

References

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