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Using Finite Element Simulation, the impact of soil-pile interaction on the response of the platform to lateral impact loads is investigated

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Abstract:
Seaward stage structure can oppose wave stacking, wind stacking, activity stacking, and transport crash, in this manner, it is critical to research the auxiliary conduct of stage contemplating soil-structure-heap association when the stage is exposed to deliver sway at an alternate area on deck section. The current investigation manages stage bolstered by heap establishment. The impact of soil-heap communication on conduct of stage to parallel effect load is examined by utilizing limited component recreation which is performed by ABAQUS programming. From the outcomes acquired, clearly the boat impact position on stage will be thought about extreme limit of structure so the structure will experience to free extreme limit because of harm that happens from the boat crash. This examination contains examination of heap horizontal removal, heap turn edge, heap shear power circulation, heap twisting second dispersion and deck chunk relocation. It likewise explains that the heap relocation has been considered heap basic length. The contort point of the heap is progressively delicate to soil type and stacking condition. It is appears that the shear power dist ribution and twisting second appropriation are influenced by stacking condition and soil type. At long last this examination shows that the reaction of deck chunk relies upon soil type, soil-heap collaboration and stacking condition.
Keywords*:* Ship Impact; Offshore Platform; Clay Soil; Loading Condition.

I. Introduction

Offshore platforms are normally used for berthing of oil tankers. So the design of these platforms must be considered as the resistance to heavy impacts from ships in addition to the environmental loads [1]. Fenders can be described as absorption energy device whose fundamental target is to transform severe impact load into a reaction that both the structure and the ship can safely sustain [2]. The popular method which is used in fender systems design is the kinetic energy method [3]. Several researches have dealt with the problem of offshore structure to the collision of the ship. In 1983 Edvardsen et al. worked on the resistance of offshore structures against the impact loading from vessels and dropped objects [4]. In 1983 Amdahl investigated the circular tube deformation to lateral impact. The lateral force was applied parallel to the axis of the tube by using rigid plate [5]. In 1988 Wierzbicki and Suh investigated the circular tube deformation to the lateral impact. The load was applied by a line impact onto one section of the tube [6] In 2000 Al-Jasim investigated the berthing dolphin of Khor-Al-Amaya terminal number 8 to impact load from an oil tanker of 330000 DWT at 60% cargo [7]. In 2003 Hussein studied the dynamic response of three-dimensional offshore structure to couple load which consists of ship impact and wave loading [8].

In 2012 Kadim studied the dynamic response of dolphin of Khor-Al-Amaya berth No.8 to ship berthing impact [9]. In 2014 Travanca and Hao investigated the dynamic behavior of offshore platform to impact with high energy from vessel. This study included a procedure to improve equivalent systems [10]. In 2016, Hasan analyzed the Um-Qaser dolphin structure, He also investigated the influence of pile dimensions and soil characteristics on structural behavior to impact loading in which the soil was considered as elastic-plastic soil. Hasan concluded that the response of structure will be decrease as pile diameter and length increased and the applied load will also increase. Also, he found that the variation in soil properties will be reflected on the response of the structure. He found as compression and swelling index increases the response of structure will increase while the increase in soil density and undrained soil strength lead to decrease in response of structure [11]. Liu et al. (2017) investigated the behaviour of a steel square plate under the lateral impact force. Their investigation included finite element simulations and carried out experiments, they also evaluated the plastic response till failure in a quasi-static and dynamic manner [12]. Ali et al (2017) evaluated the cylindrical rubber fender behavior due to applied impact force from a mooring ship with a capacity which is equal 330000 DWT [13]. Liu et al (2018) implemented numerical studies and experimental series to investigate the behavior of tubular components and T-joint under the action of transverse impact forcing. They obtained a good agreement between simulation and tests [14]. Daliri and Naimi (2018) investigated the simplification of construction procedures and how to increase the offshore jacket structure serviceability life. This paper adopted ANSYS program. The transient dynamic load which was applied on offshore jacket composed of extreme wave loading and impact load of vessel [15]. In 2019, Li et al. investigated the relationship between the energy dissipation owing to lateral impact and the residual ultimate strength of circular damaged tube by the impact load. The effect of several variables is considered in this investigation such as diameter, thickness and length of the circular tube and the energy of impact. Also the software LS-DYNA is adopted to achieve nonlinear numerical simulations [16].

This paper was based on numerical simulation which was performed by using ABAQUS program to investigate the response of offshore structure under the impact dynamic load. The applied lateral impact dynamic load have a vital role in evaluating the serviceability life of offshore structure under the different levels of applied force which lead to reduce the ultimate capacity of structure and/or extensive damage. The soil is modelled as elastic – plastic material during the investigation of the current problem taking into consideration the different loading conditions. Also this study adopts three clay soils (soft, medium and stiff) characterized by different physical properties. The present study adopts three different loading condition of ship impact. The first case indicates the load which is applied at mid-span of deck while the second the load indicates the one which is applied at the corner of deck span and third case is represented by the impact of two ships located in opposite direction to produce torsion. In conclusion the structure must be designed to resist reasonable impact load.

II. Research Methodology

The aim of this work is based on investigating the behavior of an offshore platform to ship collision load. The model is achieved by adopting ABAQUS software to find the influence of several factors on platform behavior in connection to soil-structure interaction. The following elements are used to represent the frame – soil system

Beam element B32 (Timoshenko beam): It refers to beam with three nodes and material that has linear elastic properties. Brick element C3D20R: It refers to solid with 20-nodes that has nonlinear properties and is utilized to model soil. Mohr-Coulomb model is used to model nonlinear behavior. The coulomb criteria of failure can be written as Naylor et al. (1981) [17]:

III. Conclusions

The following points can be obtained from the present paper

- Displacement and critical pile length have a significant influence on evaluating the structural behavior of pile based on majority factors such as soil type and loading condition.
- Twist angle has a vital role in assessing the behavior of pile head under different loading conditions considering the various variables such as different types of soil. It is found that the twist angle is more sensitive to type of soil.
- Shear force and bending moment describe the real behavior of pile under different loading condition and should be considered in the design of pile embedded in the soil.
- Deck displacement reflects the structural behavior of the deck under different loading condition.
- Soil types have major effects on the structural behavior of pile and deck of the platform.
- Different loading conditions, especially torsion, reveal the real behavior of the platform to encounter the risk of different load during serviceability life.

IV. Conflicts of Interest

The authors declare no conflict of interest.

V. References

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