A Continuous Simulation Method of Load Transfer Process During Twin-Barge Float-over Installation

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ABSTRACT

During twin-barge float-over installation of topsides, there are two mating phases with load transferring. In this study, the load transfer process of the first mating phase is carried out continuously by approximately simulating ballast tanks with time-dependent point masses in the commercial software SIMA. Simplistically, linear stiffnesses are applied to simulate the characteristics of deck support units (DSUs) and leg mating units (LMUs). According to the numerical results, variations of the impact loads acting on the DSUs and LMUs are clearly recorded. The variations are captured similarly in the model test, indicating the feasibility of this continuous simulation method.

KEY WORDS: Float-over installation; mating phase; load transfer; continuous process; numerical simulation; model test.

INTRODUCTION

As the topside of offshore platform becomes larger and larger, twin-barge float-over installation is widely used as a cost-effective alternative for installing large-sized topside, compared with heavy lifting installation and single-barge float-over installation. In marine engineering, the entire float-over process is generally divided into six phases: standby, pre-docking, docking, pre-mating, mating, undocking (Liu, and Li, 2017). In these phases, the mating phase has always attracted wide attention because of the load transfer. During the mating phase, the stabbing cones of the topside will gradually contact the receptors of the LMUs on the top of the substructure to transfer the weight of the topside. Thus, there will be impact loads between the stabbing cones and the receptors, which will be absorbed by elastomers inside the LMUs. Different from the other two installation methods mentioned above, as shown in Fig. 1, there are two crucial mating phases with load transferring during the twin-barge float-over installation. The first mating phase refers to the load transfer process of the topside from the transportation vessel to the two installation vessels, while the second mating phase from the two installation vessels to the substructure.

Fig. 1: Two mating phases during twin-barge float-over installation

Float-over installation is widely applied to install topsides of fixed and floating platforms, which depends on the type of substructure to choose single-barge or twin-barge float-over method. Generally, the single barge method is used for jacket platforms with slots designed and semi-submersible platforms, and the twin-barge method for jacket platforms without slots designed and Spar platforms. Jung, Kwak, Oh, Kwon, Nam, Kim, Lee, and Sung (2018) carried out time-domain mating analyses to check the load values on DSUs, LMUs, and sway fender during installing a 20,000-ton topside using a deck transportation vessel. Qin, Wang, Wang, Yu, Cai, Liu, and Zhu (2018) performed a parametric sensitivity study to investigate the shallow water effect on float-over installation with a T-shaped vessel in different drafts and wave directions. Kim, Nam, Kwon, Park, Cho, and Sung (2019) conducted a series of model tests to study the relationship between the characteristics of impact loads and the motion responses of the deck transportation vessel and the semi-submersible platform. Li, Yu, Wang, Wang, Cai, Liu, and Zhu (2019) achieved the load transfer process continuously during the mating phase of float-over installation with hydraulic jacks by a T-shaped vessel, and extracted the impact loads and motion time series by using the commercial software SIMA. Koo, Magee, Lambrakos, Beyko, and Sablok (2010) demonstrated the feasibility of twin-barge installation method for a Spar in the Gulf of Mexico with data on motions and loads, generated by performing a