The analysis of the main deck subjected to deaerator load

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Abstract. Many types of equipment placed at the deck structure of an offshore structure. The equipment is used as production facilities, exploitation, explorations, and so on. Besides, loads are also acting on the deck and make it becomes heavy and need to be analyzed. In this study, the main deck pipe subjected to the deaerator of the jacket structure is analyzed. The modeling and analysis are conducted using the finite element method. The deaerator is assumed as a static load acting on the pipe of the main deck. The result obtained by the finite element method is presented in terms of the stress-strain curve and deformation.

1. Introduction
The equipment installation at the main deck, including the piping system of an offshore structure, is cumbersome. These become an additional weight and axial load to be distributed among jacket legs. The installation, like the crane, piping, and so on acting at the main deck, must be analyzed for the safety and structure itself. Therefore, the analysis of installation equipment must be taken into account.

The influence of the brace structure on the bearing capacity and load transfer mode from the top to bottom of the jacket structure was studied Zhang [1] using numerical simulation. A structural optimization design method for jacket platform structure has been developed by Tian [2] based on topology optimization theory. Muis Alie [3] analyze the effect of symmetrical and unsymmetrical configuration shapes on buckling and fatigue strength analysis of the fixed offshore platform. Two models of the fixed offshore structure were taken to be analyzed with the same dimension but different configuration shapes. Yang [4] conducted the seismic collapse performance of jacket offshore platforms with a time-variant zonal corrosion model. Muis Alie [5] discussed the configuration effect of fixed offshore structure with symmetrical and unsymmetrical shape toward buckling failure. Two kinds of the offshore structure were analyzed. The numerical analysis was adopted to calculate buckling failure under axial and lateral load. Eldin [6] conducted the sensitivity analysis on the seismic life-cycle cost of a fixed-steel offshore platform structure. The sensitivity analysis was performed using different methods such as tornado diagram analysis, first-order second moment, and Latin hypercube sampling. Guede [7] presented a method for risk assessment and inspection plan development as part of the risk-based structural integrity management of the offshore jacket platform. The numerical calculation was performed to investigate the buckling and fatigue strength of both structures. Hezarjaribi [8] performed the nonlinear response of jacket-type platforms against extreme waves that were examined utilizing sensitivity analyses.
The objective of the present study is to analyze the main deck of an offshore structure subjected to deaerator. The model and analysis are performed using the finite element method. The result obtained by finite element is also presented in terms of stress and deformation.

2. Methodology
The deaerator installed on the piping system is modeled using the finite element method, as shown in figure 1. The deaerator is an axial load place above the pipe. The quadrilateral mesh is applied to the entire model, as described in figure 2, including boundary condition.

Figure 1. FE model

Figure 2. Meshing
3. Results and discussion
The deformation shape of the piping installation system subjected to the deaerator load is illustrated in figure 1. It is observed that the elements around the middle are deformed caused by the deaerator load. The deformations are denoted with the shadow lines. In figure 2, the deformation takes place at the brace in the middle of the piping installation. It is found with the red color, where the maximum deformation is denoted by the MX symbol. It should be noted that the elements located in the middle of the model are not symmetric.

Figure 3. Deformation shape

Figure 4. Maximum deformation

Figure 5. Maximum stress
Figure 5 shows the maximum stress of the model. According to figure 5, the maximum stress placed in the middle of the model caused by the deaerator load acting on the braces. Therefore, the braces among them are denoted by red color with the symbol MX. This phenomenon is respected in figure 6, where it is shown for the stress-strain relationship.

4. Conclusion
The installation piping system model subjected to deaerator as the axial load has been analyzed using the finite element method. It is found that the maximum stress and deformation are located around the middle of the model. Particularly at the braces were denoted by the symbol maximum of stress and deformation.

References
[1] Zhang P, Li J, Gan Y, Zhang J, Qi X, Le C and Ding H 2020 Bearing capacity and load transfer of brace topological in offshore wind turbine jacket structure Ocean Engineering 199 107037
[2] Tian X, Wang Q, Liu G, Liu Y, Xie Y and Deng W 2019 Topology optimization design for offshore platform jacket structure Applied Ocean Research 84 38–50
[3] Yang Y, Wu Q, He Z, Jia Z and Zhang X 2019 Seismic Collapse Performance of Jacket Offshore Platforms with Time-Variant Zonal Corrosion Model Applied Ocean Research 84 268–278
[4] Nour Eldin M and Kim J 2016 Sensitivity analysis on seismic life-cycle cost of a fixed-steel offshore platform structure Ocean Engineering 121 323–340
[5] Guédé F 2019 Risk-based structural integrity management for offshore jacket platforms Marine Structures 63 444–461
[6] Muis Alie M Z 2016 The Effect of Symmetrical and Asymmetrical Configuration Shapes on Buckling and Fatigue Strength Analysis of Fixed Offshore Platforms International Journal of Technology 7 1107
[7] Hezjarjaribi M, Bahaari M R, Bagheri V and Ebrahimian H 2013 Sensitivity analysis of jacket-type offshore platforms under extreme waves Journal of Constructional Steel Research 83 147–155
[8] Muis Alie M Z 2015 The Effect of Symmetrical and Asymmetrical Shape in Buckling Strength on Fixed Offshore Platform Proceedings of the Twenty-fifth (2015) International Ocean and Polar Engineering Conference vol 7 p 1107

Figure 6. Stress-strain relationship

![Stress-strain relationship graph](image)