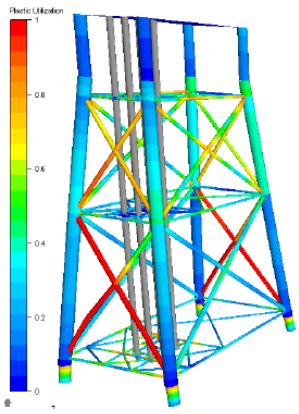
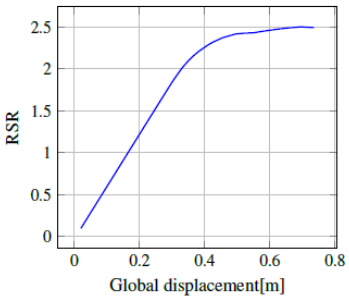
Offshore & Dredging Engineering

Technische Universiteit Delft

Reliability based design of Bottom Founded Offshore Structures

The offshore industry and especially the oil and gas production, has faced a remarkable growth in the last decades, causing an increase in the population of offshore structures. The overwhelming majority of these structures are bottom founded and mostly made out of steel. Over these decades much experience has been gained with the design and construction of these steel offshore structures. A number of structural regulations such as the ISO 19902 have been developed based on the industry best practice and is currently used worldwide. The design routine is based on the conventional Load and Resistance Factor Design (LRFD) method where the design is guided by the use of partial factors for the load and resistance. These factors were derived based on calibration work and on older regulations trying to achieve the same inherent level of safety. This caused the picture about the intended design target reliability level of the ISO 19902 to be a little vague and as a result the required level of safety is not explicitly defined.





The goal of this MSc study is to investigate the intended target reliability when designing bottom founded offshore steel support structure with the ISO 19902 and specifically to research about how the reliability analysis procedure can be engaged during the design phase of offshore steel structures. To this end, the principles of nonlinear pushover analysis, system based and reliability based design are investigated and discussed. A code has been developed that allows interaction with Matlab and the nonlinear analysis program USFOS. A jacket structure has been designed and optimized based on the ISO 19902 and the achieved reliability level has been estimated.

Further a reliability analysis has been performed more explicitly through Monte Carlo simulations accounting for a number of stochastic variables such as the yield stress, the marine growth and the hydrodynamic coefficients. A sensitivity analysis has been carried out in order to determine which are the parameters of influence to the reliability level.

Finally, a method of designing with the focus on the desired reliability level is proposed and demonstrated in the examined jacket. The application of the reliability based design method offers the potential benefit of reducing the structural steel and ensuring that the required reliability level is achieved.

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