Offshore & Dredging Engineering

Technische Universiteit Delft

Antifouling on Bottom Founded Offshore Structures

Marine growth (also known as biofouling) is an accumulation of biological organisms on wetted surface. Figure 1 shows marine growth occurrence on parts of a steel tubular structure located at the splash zone. This marine growth is unwanted for a number of reasons, including the increased hydrodynamic action (wave and current force) on the structure. Therefore, the industry is interested to assess methods to avoid, slow down and/or manage the marine growth.


Figure 1 - Accumulation of marine growth


Figure 2 – Comparison of surface protected and unprotected by Micanti antifouling

One of the options is to apply Micanti antifouling, which is a biocide-free solution and is extensively used by the ship industry. The Micanti antifouling is a self-adhesive foil which acts as a physical barrier against the marine growth. Despite its good performance on protecting ship hulls from marine growth, Micanti antifouling has not been applied yet on fixed offshore structures, including bottom founded offshore steel structures (BFOS, i.e. jacket and tower). The effectiveness of Micanti antifouling in protecting submerged (steel) surface is shown in Figure 2.

Combining above mentioned problem of marine growth and available potential solution has led to the first objective of this MSc graduation thesis i.e.: explore the advantage (and possible disadvantage) of applying antifouling on BFOS for both newly built and existing structures. Since the primary concern of marine growth on BFOS is the additional effective diameter and increases of the drag and inertia coefficient in Morison's equation, the advantage antifouling is assessed by comparing the hydrodynamic force on the marine fouled structure with the "protected" structure (i.e. when the antifouling is applied). For this study, quasi-static behavior of the 'M3 platform', an existing offshore tower platform located in Malaysian offshore, was used as an example case. The behavior was assessed for both the SLS and ULS limit states using the finite element program USFOS (Ultimate Strength For Offshore Structure).

The second objective of the graduation project was to determine the optimum design of the antifouling coverage on BFOS. A more thorough analysis of hydrodynamic load distribution was conducted to find the position of the tower members that contribute most to the total hydrodynamic load. Both the effect on Base Shear and Overturning Moment has been assessed. In addition, a parametric study was conducted comparing different levels of antifouling coverage to resulting hydrodynamic load reduction. Further, structural checks were conducted according to the ISO design parameter investigating the elements status under different loads intensity. An optimization study was carried out to balance (maximum) load and quantity of heavily stressed element reduction for (lowest) antifouling application cost.

The study found that applying antifouling could reduce up to 43% of the hydrodynamic load increase caused by the marine growth for newly built and existing platforms. Furthermore, it was found that applying a 30-meter section of antifouling started from members located near the MSL gave optimum result in term of load reduction and antifouling application cost. Micanti antifouling in particular performed moderately well compared to other antifouling systems. The greatest advantage was on the environmental friendliness aspect while the drawback lays on the limited visual inspection. There were two aspects, i.e. maintenance and durability that required to be justified and improved.

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