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Multi-span suspension bridge on floating foundations - behaviour under ship impact

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Abstract

The multi-span suspension bridge on floating Tension Leg Platform (TLP) foundations is one of the proposed concepts for the crossing of the E39 Bjørnafjord in Norway. One of the challenges in the design of the fixed link is to ensure sufficient robustness with respect to ship impact. In this work, the structural response to a ship impact event is evaluated using nonlinear finite element analysis. The simulations are based on a bow model of a 186 m length over all container vessel, which is estimated to transit the bridge crossing weekly. Impacts from a conventional container vessel bow without ice reinforcements cause minor damage to the floater hull. Most of the energy is dissipated in the striking vessel. Impacts from an ice-reinforced vessel gives considerable more damage to the floater hull. The damage extent for all the simulated impacts are repairable on site. However, impacts from the conventional vessel cause only minor denting and can be repaired at a convenient time, whereas impacts from the ice-reinforced vessels necessitates major repair work.

Keywords: Multi-span suspension bridge, floating foundations, ship impact, nonlinear FEA, steel, fracture.

1 Introduction

The Norwegian Public Roads Administration (NPRA) has initiated one of the most ambitious and ground-breaking large scaled infrastructure programs whose objective is to connect Kristiansand to Trondheim without ferry crossing.

The present paper deals with the evaluation of robustness of a multi-span suspension bridge on floating supports for the crossing of Bjørnafjorden when exposed to ship impact, see Figure 1. The overall length of the bridge from anchorage to anchorage is approximately 5200 m, while the maximum depth of the fjord is about 550 m. A consortium consisting of Aas Jakobsen, COWI and

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