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Artificial seabed; a mooring concept for crossing long and deep waterways

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Abstract

Based on the incentive from the Ministry of Transport and Communications in Norway of replacing ferry crossings with permanent fixed crossings, there is a need for new crossing technology for the deepest and widest fjords. The present paper presents a concept consisting of a floating pontoon bridge with a submerged floating tunnel at mid-span, the latter to facilitate ship traffic. These elements are further side moored down into a submerged anchoring system. The benefits with the presented concept are that there is no need for a tall bridge for the fairway, and the fairway is flexibly placed where it is needed for the specific crossing. The concept is independent of water depth and sea bottom conditions. The concept makes use of technology and element sizes known from both offshore oil- and gas and civil construction. The paper presents the overall concept and the global behavior of the structures.

Keywords: Floating bridge, submerged floating tunnel, mooring system, dynamic analysis, slender structure, artificial seabed.

1 Introduction

To date, the world's longest suspension bridge, Akashi-Kaikyo, spans 1991 meters while the longest floating bridge is the side moored Governor Albert D. Rosellini Bridge in Lake Washington crossing 2300 meters in shallow waters. Two end moored floating bridges were built in Norway about 20 years ago, the Bergsøysundet and Nordhordland bridges at 980 and 1240 meters, respectively. Bergsøysundet bridge was the worlds' first end anchored floating bridge while the Nordhordland bridge is the world longest. End anchoring was chosen for these two bridges primarily due to the water depth at the two sites. The end anchored bridges are placed in a horizontally curved alignment and they have a lateral structural stiffness that will withstand buckling and excitations in first mode sway. Hence, an end moored floating bridge will primarily experience tension and compression forces in the abutments.

Most floating bridges are placed close to the water surface and may therefore introduce an obstacle to marine traffic. Ship passage is often provided close to shore. This is also the case for Nordhordland bridge. This bridge is a combination of a floating bridge anchored to shore in the north and to a reef in the south, and a cable stayed bridge from the reef to shore in the south facilitating ship traffic. By placing the ship passage close to shore, ships may have to change course to navigate through the ship passage. This increases the risk of strikes. An alternative is a submerged floating tunnel [1]. From a cost point of view, the submerged floating tunnel

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