Evaluation of the innovative Bridge Concepts for the Extreme Norwegian Fjord Crossings

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Abstract

Since the ferry free E39 project was initiated, the feasibility of different Long-Span Bridge concepts have been investigated for some of the most challenging fjord crossings (Bjørnafjorden, Sulafjorden, Halsafjorden). All studied concepts exceed 2 km in length and are faced with depths of the seabed ranging from 400 m to 1200 m, rendering conventional support solutions inadequate. The bridge concepts referred to in the present paper are Single Span Suspension Bridges, Multi-Span Suspension Bridges on floating foundations, Submerged Floating Tube Bridges (SFTB), Side Anchored Floating Bridges and End Anchored Floating Bridges.

The purpose of the present paper is to highlight the main alternatives that have been studied at the time of writing and to provide the reader with an overview of the realm of application of the different concepts.

1 Introduction

In 2009 the Norwegian Public Roads Administration was commissioned to initiate the Coastal Highway Route E39 project whose objective to replace all ferry connections between Kristiansand and Trondheim with fixed connections. The fjords in Norway present considerable challenges both in terms of distances and depths to be spanned and the environmental conditions the bridge is subjected to. Under the auspices of the project various innovative and non-conventional concepts were studied, which use technologies borrowed from other engineering fields.

2 Description of the concepts

2.1 Floating Bridge

Two variants of the floating bridge were considered and have been presented briefly below.

2.1.1 Side Anchored floating bridge

In the straight bridge alternative (see Figure 1), the steel bridge girder rests on floating pontoon support. Mooring lines take up the large lateral loads due to the wind, waves and current conditions expected in the fjord. [1]

Figure 1. Side Anchored Bridge

2.1.2 End Anchored floating bridge

Figure 2. End Anchored Bridge

In the End Anchored bridge alternative (Figure 2), the bridge girder is formed as an inclined arch whose highest point will be the centre of the navigation channel. No mooring line is required in the curved bridge alternative. Its arch shape ensures the side stiffness of the structure. [1]

https://doi.org/10.2749/kualalumpur.2018.0907
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