

Ship Impact Studies for the Forth Replacement Crossing

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Summary

The Forth Replacement Crossing (FRC) is a EUR 2.2 B project to construct a 2.6 km cable stayed bridge together with associated network connections. The Firth of Forth, which the bridge crosses, is a navigable waterway with tankers, ferries and container vessels up to 45,000 tonnes displacement passing under the bridge. Marine risk and ship impact loads are important design considerations.

A quantitative marine collision risk assessment and cost-benefit analysis was carried out in accordance with the As Low As Reasonably Practical (ALARP) principle to determine the required impact resistances of the piers. Unique aspects of the methodology were the development of a semi-holistic model for collision probability and an explicit function for probability of collapse.

Keywords: cable-stayed bridge; design; ship impact; Eurocode; risk assessment; ALARP.

1. Introduction

The Firth of Forth is a dramatic estuary which separates the Scottish capital of Edinburgh from the Kingdom of Fife to the north. A new bridge will be built slightly to the west of the two existing downstream crossings making use of Beamer Rock, a natural dolerite outcrop in the middle of the Forth, which allows the wide estuary to be crossed by a pair of 650 m cable stayed spans (Figure 1). The development of the unique design of the bridge has been described by Carter et al [1].

The bridge is being designed to the structural Eurocodes which have recently replaced British Standards as the basis of design for bridges and other structures in the UK.

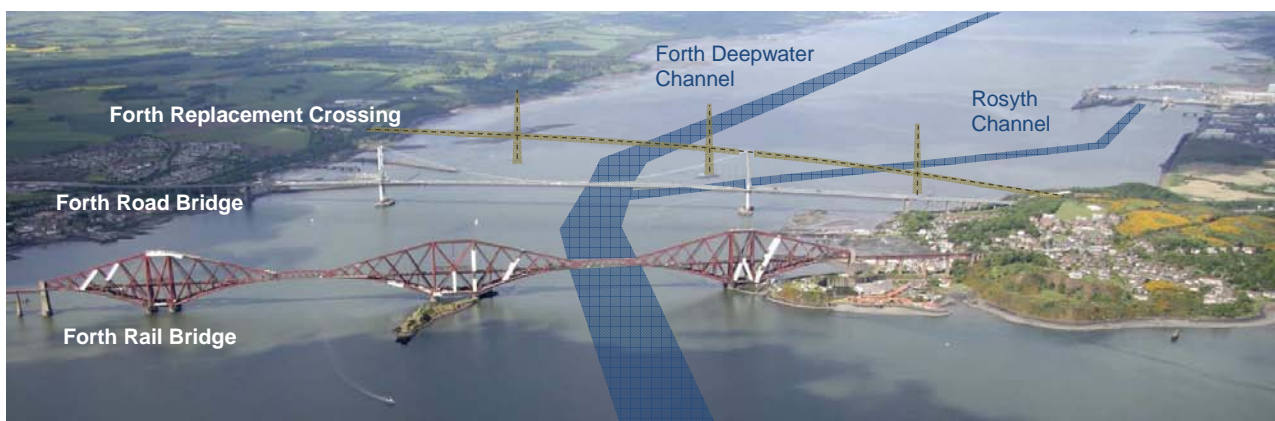


Fig. 1: Location of the Forth Replacement Crossing

The southern main span crosses the Forth Deepwater Channel (FDC), the main access to the upstream ports. Grangemouth is Scotland's main oil port and home to one of the biggest petrochemical plants in Europe. It is also a busy container port, handling trade with North America