



## Design of floating bridge girders against accidental ship collision loads

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### Abstract

The Norwegian Public Roads Administration is running a project “Ferry free coastal route E39” which includes replacing ferry crossings by bridges or tunnels across fjords in Western Norway. A floating bridge concept was proposed in the fjord-crossing project for Bjørnefjorden. As there are regular cruise routes passing by the bridge, it raises the concern for the consequences of accidental ship collision with the bridge girder. During the collision, the interactions between the bridge girder and the ship structure can be significant. Thus, in the design of the proposed bridge it is vital to evaluate the safety of the ship and the bridge. In this paper, detailed finite element models of a cruise ship and a steel box girder are developed. The impact scenarios and structural damages are studied. The results show that the proposed bridge girder design is generally safe to resist normal accidental ship collision loads. Numerical model of the whole bridge is also developed for further study of bridge global response subjected to ship collision load.

**Keywords:** Ship collision; floating bridge; impact force, girder damage

### 1 Introduction

The Norwegian Public Roads Administration (NPRA) is planning to build a new coastal highway Route E39 along the Norwegian west coast from Kristiansand to Trondheim. The background for the project is that previous studies show that compared with ferry crossings, fixed crossings can stimulate the development of trade and industry along the E39 route [1]. The project includes replacing existing ferry connections by fixed installations of bridges or tunnels. Totally eight new bridges or tunnels will be built along the

route. As most of the fjords are wide and deep, structures with large spans will be designed and installed across the fjords. The new installations can substantially increase the transportation efficiency compared to ferries. However, these fixed installations will narrow the navigable waterways in the fjords. In addition, the structures are under potential threats of accidental ship collision loads. The consequences of such accidents can be catastrophic including people casualties and financial losses. Therefore, bridges or tunnels should be carefully designed for ship collision.