

Crack width calculation methods for large-scale concrete structures for the Ferry-Free E39

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Abstract

Motivated by the establishment of a Ferry-Free E39 coastal highway route, crack width calculation methods for design of large-scale concrete structures are discussed. It is argued that the current semi-empirical formulas recommended by Eurocode 2 is inconsistent and overly conservative for cross sections with large bar diameters and covers. A suggestion to formulating a more consistent crack width calculation method is given.

Keywords: Crack width calculation methods, large-scale concrete structures, Ferry-Free E39.

1 Introduction

The coastal highway route E39 stretches along the west coast of Norway, and has a total length of approximately 1100 km. The highway route includes several fjord crossings, which can be up to several km long. The crossings today are operated by seven different ferry-connections and the route has a total travel time of 21 hours. The Norwegian Public Roads Administration (NPRA) has initiated the Ferry-Free E39, which has the aim of replacing the ferry-connections with bridges and tunnels. This would ultimately reduce the travel time by the half. An example of one of many conceptual studies for the fjord crossings is the two-span suspension bridge depicted in Figure 1, each span being up to 2 km long. The suspension tower connecting the two spans can be up to 480 m in height over the seawater level, resting on a gravity based concrete structure that is to be founded at a depth of 450 m, see Figure 1b).



Figure 1. Conceptual study of a two-span suspension bridge for the crossing of one of many fjords at the Ferry-free E39. Illustrative photo by the Norwegian Public Roads Administration (NPRA).

The suspension tower structure is one of many large-scale concrete structures that is intended to be part of the Ferry-Free E39. The experience feedback from designing such structures is that the crack width calculations in the Serviceability Limit State (SLS) often becomes unfavourably governing in determining the reinforcement amount. The need of controlling the crack width is in the design