# Validation of a crack growth model using observed cracks in a bridge

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## Abstract

Fatigue life or crack growth predictions that use information from crack inspections have been applied to offshore structures and, in recent years, also to steel bridges. Apart from inspection data, a probabilistic crack growth model and knowledge of the distributions and correlations of the variables are required for such predictions. The performance and validity of such predictions has been demonstrated in laboratory environments but validations for actual, practical situations are currently lacking because of a lack of field data. In particular, realistic distributions and correlations for practice are difficult to obtain. This situation, however, has now changed. Extensive inspections of a specific bridge came recently available, showing multiple cracks in similar details. This provides unique data for validation purposes. This paper uses the inspection data to demonstrate the validity of probabilistic crack growth predictions for this real application.

**Keywords:** Fatigue, fracture mechanics, monitoring, inspection, existing bridges, orthotropic bridge deck.

## 1 Introduction

Crack growth prediction models based on fracture mechanics (FM) have been available since many years. These models have been put into probabilistic frameworks in order to determine failure probabilities, [1-2], or partial factors, [3]. These models also enable the use of data from crack inspections to update the failure prediction, e.g. [4-9]. Accurate distributions of the variables in the prediction model are key in accurate failure probability predictions, but these are difficult to obtain for practical conditions.

Recently, inspections of a specific steel bridge provided 47 cracks out of 1020 locations of a typical detail in the orthotropic steel deck (OSD). This valuable data has been used for validation purposes in this paper.

Distributions and correlations of variables are estimated and updated based on the inspection data of a certain part of the bridge. A probabilistic FM model is applied to predict the number of cracks in the entire bridge deck as a function of time. The prediction is compared to actual numbers of cracks observed in inspections.



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