

Probabilistic Reliability Assessment of Industrial Heritage Bridges

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Summary

Methods for reliability assessment of bridges registered as industrial heritage are developed taking into account principles of EN 1990, ISO 13822 and ISO 2394. A proposed probabilistic procedure allows for consideration of new information obtained from inspections or monitoring and satisfactory past performance. Application of general principles is illustrated in the assessment of a reinforced concrete road bridge. The study reveals that reliability assessment of bridges registered as industrial heritage can be based on probabilistic methods. Modelling of degradation processes seems to be a key issue of the reliability analysis.

Keywords: industrial heritage; bridges; reliability assessment; probabilistic methods.

1. Introduction

A number of industrial buildings and bridges has been registered as industrial cultural heritage. Such structures are mostly of a significant architectural, historic, technological, social, or scientific value [1]. For instance about 350 bridges are included in the Czech Register of the Industrial Heritage.

Road bridges have become an essential part of cities' transport infrastructure. However, unfavourable environmental effects and ever-increasing traffic loads may yield severe deterioration. Therefore, rehabilitation of existing bridges is presently an urgent issue of bridge engineers and responsible authorities in many European countries. The final report of the COST Action 3-45 [2] indicates that there is about a million of existing bridges in 27 European countries. The best estimates of the replacement costs of these bridges reach up to about 400 milliard €. Present expenditures on maintenance and rehabilitation are limited and seem to be inadequate.

Qualified decisions concerning existing bridges should be based on available information on actual resistances, loadings, unfavourable environmental effects and potential consequences of bridge malfunctioning. One of the most important parts of the decision making is the assessment of structural reliability. It is recognised that simplified conservative procedures based on the design methods applied for new structures may lead to expensive interventions. Present prescriptive requirements on new structures are often more severe than provisions of original national codes. Nevertheless, existing bridges that might not fulfil these requirements may still serve their purpose for a specified remaining working life. Relevant uncertainties in the description of actual conditions of existing bridges including deterioration processes are to be considered in the reliability assessment. In accordance with ISO 13822 [3] these uncertainties may be effectively taken into account by probabilistic methods.

The paper is aimed at the development of methods for the reliability assessment of industrial heritage bridges considering principles of Eurocodes EN 1990 [4] and EN 1991-2 [5] as well as of the international documents ISO 13822 [3] and ISO 2394 [6]. Obtained results are compared with the target reliability levels indicated in ISO 2394 [6] and those based on an empirical procedure accounting for the cultural heritage value [7]. Application of general principles is illustrated in assessment of an existing reinforced concrete road bridge.

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