Full scale test of a PC bridge to calibrate assessment methods

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Abstract

In this paper, experiences on the development of an assessment method for existing bridges are presented. The method is calibrated using the results of full-scale testing to failure of a prestressed bridge in Sweden. To evaluate the key parameters for the structural response, measured by deflections, strains in tendons and stirrups and crack openings, a sensitivity study based on the concept of fractional factorial design is incorporated to the assessment. Results showed that the most significant parameters are related to the tensile properties of the concrete (tensile strength and fracture energy) and the boundary conditions. A finite element (FE) model in which the results of the sensitivity analysis were applied, was able to predict accurately the load-carrying capacity of the bridge and its failure mode. Two additional existing prestressed concrete bridges, that will be used to improve further the method, are also described, and discussed.

Keywords: Assessment methods, calibration, boundary conditions, existing prestressed concrete bridges, tensile strength, fracture energy, full-scale testing, finite element modelling

1 Introduction

Demands to keep existing bridges in a healthy condition and able to carry increased loads make the ability to assess their true capacity an important task. Elaborate finite element (FE) methods are available for their capacity assessment, but the results obtained are heavily dependent on the input parameters and how well they describe the object they intend to model. Therefore, an incorrect definition of these parameters can generate large variations when numerical results are compared to real values obtained in tests, see Bagge et al. [1-2]. However, significant improvements on FE analysis can be achieved when in-situ results are available [3-5].

In this paper, a methodology to improve the assessment and FE models of an existing bridge is presented based on the experiences obtained from the full-scale test to failure of a prestressed concrete bridge [2, 6-9]. Assessment methods have been proposed at various levels with gradually increasing accuracy [10-14]. By increasing the efforts, the structural response and the load-carrying capacity can be more accurately estimated. An example of this process, applied to

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