Available Tests to evaluate Residual Prestressing Forces in Concrete Bridges

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Abstract

The reduction of the structural capacity and eventual collapse of existing concrete bridges is often related to the loss of the initial prestressing forces. This loss can be associated to immediate or time dependent factors such as elastic shortening, creep, relaxation, loading, and cracking, among others. In addition, environmental factors can lead to corrosion of the strands with the subsequent reduction of their area, loss of bond with the concrete and additional cracking which in turn will influence the value of the residual prestress force and the bridge capacity. Therefore, the evaluation of such losses is critical in the decision-making process of defining a financial and environmental cost optimized intervention strategies (e.g., strengthening or replacement). In this paper, a detailed literature review regarding destructive and non-destructive methods for measuring the residual force in prestressed concrete bridges is carried out and used to develop a database of existing experimental tests.

Keywords: concrete bridges, residual prestressing forces, prestressing losses, evaluation prestressing force, methods residual stress, in situ tests, assessment of PC bridges, flexural bearing capacity.

1 Introduction

European road traffic has greatly increased during the past years due to several reasons such as the requirement of supplying for a larger population, reduction of transportation costs, and an urge of decreasing polluting emissions [1]. This issue has been being formally acknowledged by 96/53/EC directive (The Council of the European Union, 1996), which allows the circulation of Long and Heavy Vehicles (LHVS) [1] within European member union states, on an equal and not discriminatory basis. As consequence, there is a pressing need of not only ensuring structural reliability but also, reducing the maintenance and repairing costs of the existing road infrastructure.

One of the most critical issues regarding the assessment of the structural capacity of existing concrete bridges is related to the evaluation of the loss of the initial prestressing forces. This loss can lead to a significant reduction of the bridges' structural capacity and their eventual collapse [2]. Among the factors that are associated to a decrease in the initial prestressing force, it is possible to find time-dependent factors such as elastic shortening, creep, relaxation, loading, and