



Research on cable safety based on monitoring data and time-dependent reliability

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Abstract

Different from judging whether the proposed structure meets the requirements in the design stage, the evaluation of the existing structure has always been a difficult issue for structural engineers. Using the four-years monitoring data of a long span cable-stayed bridge in this paper, the probability distribution of the load effect is studied based on the reliability theory. The purpose of this paper is to provide a theoretical reference for the safety assessment, operation management and maintenance reinforcement decision of existing structures. The results show that the load effect obeys the normal distribution or the beta distribution. The reliability indexes of the cable are calculated separately in months and in years. It is noted that the reliability indexes varies with the different time period. This study also conducts a preliminary discussion on the remaining life of the cable based on the regression analysis of reliability index.

Keywords: existing structure; time-dependent reliability; variable load effect probability density; reliability index.

1. Introduction

A stay cable is one of the main force members of a cable-stayed bridge. Whether in design or operational phase, safety is one of the priorities that engineers need to consider. The design phase mainly ensures the structural safety by controlling the cable safety factor. However, there is no unified understanding of the cable safety assessment of the existing cable-stayed bridge structure during operation, especially how to determine the remaining service life of the cable.

At present, the evaluation of the cable during the operation period can be roughly divided into qualitative and quantitative methods. In China, "Code for the Maintenance of Highway Bridges and Culverts" and "Standards for Technical Condition Evaluation of Highway Bridges" are mainly qualitatively and comprehensively assessed by

visual inspection and with simple tool measurements[1, 2].

Based on the grey theory, some scholars [3, 4] have carried out subjective comprehensive evaluation of the cable from the aspects of cable protection, detection of cable tension and corrosion of anchoring system. This evaluation is based on expert experience or expert systems. Moreover, the results obtained can only be applied to the safety evaluation of a cable surface, but cannot be used for the safety evaluation of a single cable.

The quantitative assessment is mainly based on the detection of cable force. The core is to roughly evaluate the damage of the cable by studying the influence of cable force changes on the static and dynamic performance of the cable-stayed bridge structure[5].

In China, the method specified in the "Specification for Inspection and Evaluation of Load-bearing