

Design Service Life Determination for Bridge Structural Elements

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Summary

Through definition of design service lives for bridges and their elements, element classification according to structural systems, durability type research as well as investigations of their actual operating lives and recommended design service lives in specifications home and abroad, a direct method and also a simplified one were proposed in order to determine design service lives of bridge structural elements based on life-cycle cost analysis. In direct method, element service life schemes were established, and then the one with optimal economy could be selected through life cycle cost calculation of each scheme. In the simplified method a calculation formula was presented, for applying which the classification and evaluation of the influence coefficients were discussed and recommended foundational design service lives of bridge elements were brought forward based on professional investigations. In the end, a certain sea-crossing project was used as an example to illustrate the process of design service life determination for bridge structural elements.

Keywords: bridge engineering; durability design of bridges; design service life of bridge elements; LCCA

1. Introduction

Provisions related to durability and design service life were seldom found in existing bridge design and construction specifications all over the world. According to bridge construction practice in China, determination of design service life for bridges and their elements was commonly just the requirement of the bridge owners, lacking corresponding design theory foundations. During the service life of bridge structures, different bridge elements had different degeneration mode as well as different management both in maintenance and replacement [1~2]. Therefore, prescribed service life of each bridge element should be drawn up respectively and appropriately, which was the first step of bridge durability design and of great value in the reduction of bridge life-cycle cost. Following method was adopted in this paper: firstly defined the concept of design service lives for bridges and their elements, then investigated actual service lives of bridge elements and recommended design service life for structures home and abroad, processed bridge element classification and their durability assortment, researched on the contributing factors of service lives for bridge elements, finally obtained two methods to determine design service lives for bridge elements with optimal life-cycle cost, taking into account all kinds of influencing factors.

2. Design service lives of bridges and their elements

In BS7543 [3], service life was divided into required service life, expected service life and design service life according to different attentions of each participating party. Although quite a few technological documents of European countries [4~7] adopted this definition, design service life was always recognized as required service life in domestic engineering circle, that was to say, bridge owner's or user's requirement on bridge service life.

According to further discussions on service life, it was generally agreed that it should at least cover three aspects as technique, function and economy. As the requirements from the three aspects