Long-Term Sustenance Issue of Cables for Cable-Supported Bridges

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Abstract

Cable-supported bridges are marvels of modern engineering. The construction and use of these have been on the rise for the last fifty years. Cables, with higher strength than the structural sections and innate flexibility, offer an economic solution for medium and long-span bridges. The reduced weight of the structure helps in contributing to the demands of sustainability. From a structural standpoint, cable-stayed bridges are complex and have many critical areas that need attention from the design stage itself. The complexity in the maintenance of these bridges is getting evident with reports of deterioration of several bridges after use of fewer than twenty years, a rather grim situation; after large investments made for such elegant structures.

The present paper reviews the situation and the challenges for the engineering community in ensuring safe sustainable cable-supported structures for the future and also actions needed to avoid sudden failure of structures, already built without giving adequate thought to inspection, maintenance, and rehabilitation aspects.

Keywords: Cable-Stayed Bridges, Extra dosed bridges, corrosion, fatigue, inspection, maintenance, rehabilitation

1 Introduction

Since the dawn of civilization, flexible materials (like cables) have been used to facilitate crossings. Drawing inspiration from nature, that of creepers' ability to cross long distances and offer steady means of passage, human use of artificial cables and linked bars or chains has become more widespread. The lower Himalayan region of India is credited with the first use of parallel cables in pairs, which permitted the introduction of a horizontal deck with the use of vertical hangars from the cables, which led to the construction of early cable-supported bridges. The usage of cables allows for flexibility in construction and material economy because these have significantly higher tensile strength than any conventional structural material. As spans increase, the economy of cable-supported bridges improves, and practically all bridges in the world with a span of more than five hundred meters are Cable Supported bridges. A high span-depth ratio gives these bridges an elegant appearance, which is an added benefit. Over the past 50 years, Cable Stayed and Extra dosed bridges have emerged as a cost-effective and efficient structural solution for long-span bridges [1].

There are three main types of cable-supported bridges: (a) suspension bridges, where the cable is suspended in the shape of a parabolic catenary and crosses over tall towers and is anchored at the ends with rigid supports; (b) cable-stayed bridges (CSB), where the inclined cables that hold the deck are supported from tall towers; and (c) extradosed bridges (EDB), where cables are held from towers of smaller heights to support the deck girders and may be considered as a hybrid concept between girder bridges and CSB.

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