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A Comprehensive Review on the Suspension Bridge Rehabilitation: Conceptual Approach

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ABSTRACT

This paper deals with the history of suspension bridge rehabilitation through case studies made and proposes the concept to strengthen the main cable without its replacement. Since modern-type suspension bridges appeared in 1850s, over 70 suspension bridges had been built all over the world by 1970s. Many of these suspension bridges confront degradation over the years. In order to assess the main deterioration of suspension bridges, historically core concepts enhancing the modern suspension bridges were categorized as key components of suspension bridges and their characteristics, and as a consequence, how the assessment should be made for the rehabilitation. Although major case studies for the rehabilitation showed to repair decks and suspenders, several cases were made to rehabilitate main cables which are the backbone of suspension bridges. A newly proposed method to increase the strength of main cables without their replacement is presented with demonstrating its effectiveness throughout the analysis. This paper aids in facilitating the health assessment and determining associated rehabilitation techniques for suspension bridges.

Keywords: Suspension bridge, Rehabilitation, Decks, Suspenders, Enhancing main cable strength

1 INTRODUCTION

The origin of the suspension bridge goes back to the primitive times when organic matters such as rattan vines and wooden logs were utilized to build the bridge. In the 19th century in Europe, early modern-type suspension bridges were constructed in which steel bars with pins (*cf.* main cables) were used for suspenders. Around the same time, suspension bridges adopting small-diameter steel wires arranged in parallel for main cables appeared in the world. The Air Spinning (AS) method by John A. Roebling (1855) implemented for the parallel-wire main cable installation enhanced modern-type suspension bridge playing a decisive role in the increase in suspension bridges [4]. Since then, many suspension bridges have been built across large bodies of water serving as a crucial artery for nation's infrastructure.

With ages, many of these suspension bridges reached their lives. While the construction cost of these bridges are high, the socio-economic costs to be paid off when traffic gets blocked are enormous. Hence, most aged suspension bridges have been in use with great effort in maintenance.

As a representative example, in the vicinity of New York area where the Brooklyn Bridge is located (regarded as the beginning of a modern suspension bridge completed in 1883), 10 suspension