Analytical Study on the Effect of the Condition of Cable Members on the Structural Safety of a Long-Span Suspension Bridge

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Abstract

We have studied on an evaluation method to assess the structural soundness of the long-span suspension bridges taking into account of the condition of the suspender ropes, such as the break of the suspender rope.

This paper reports that an analytical study for Innoshima Bridge which is a long-span suspension bridge with a central span length of 770m, focusing on the effects of the modelling of the entire bridge model, the condition of cable members, and the analysis method.

Keywords: long-span suspension bridge; finite displacement analysis; break of suspender rope.

1 Introduction

In Japan, since 2014, regular inspections of road assets such as bridges and tunnels are carried out every five years through close visual inspection [1]. However, there are some problems such as budget and personnel shortages for the close visual inspection for all the structural members of the highway bridges. Furthermore, the soundness and the progress of deterioration of the bridges are not completely grasped only by the close visual inspections [2]. The trend can be seen particularly in cable supported bridges which are composed of many structural members of the same functions and the members that are not easy to see in close proximity, and the optimization of the periodic inspections is required.

In recent years, small suspension bridges in Japan and abroad have been aging, and there have been cases of accidents and failures such as cable rope, hanger rod, and strand breakage due to corrosion damage and bridge collapse accidents due to cable breakage, for example [3].

Therefore, it is important to optimize the inspection of suspension bridges, i.e., to rationalize and improve the reliability, in order to maintain them in the future.

The changes in the condition of the cable members may include cross-sectional reduction, rupture, and creep due to corrosion and other factors.

These studies on state changes include: a study of center stays, which are assumed to rupture during earthquakes in design [4], and a recent analytical study that clarified changes in stress state and vibration characteristics by analysis that takes into account creep phenomena in cables, which greatly affects deformation in small- and medium-scale non-reinforced suspension bridges [5].

However, it is considered insufficient to evaluate the effects of changes in the condition of the cable members on the function of the bridge.

In light of this situation, this paper focuses on long-span suspension bridges, which are representative of suspension bridges, and discusses analytical methods to be applied to evaluate the effects of

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