

Strength Decrease of Wood Materials in Kintaikyo Bridge used 48 Years

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Hideyuki Honda, born 1950, received his civil engineering degree from the Kyoto University, Japan. His main area of research is related to structural performance and design method of modern timber bridges by field test and three dimensional static and dynamic structural analyses.

Summary

Kintaikyo Bridge has been constructed in 1673, and is an important timber pedestrian bridge with the history in about 334 years in represents Japan. The bridge subjected in this study is the bridge constructed in 1953 and reconstructed in 2001. During 48 years, the static deflection, strain and natural frequency in the field test have been measured to monitor the change of structural performance in every five years by Waseda University. This study was investigated analytically the change of Young's modulus of the wood materials based on the experimental values of natural frequency over 48 years measured in every five years, and then strength decrease of the wood materials was estimated by the change of Young's modulus. From the analytical estimation considered the change of unit product weight on wood, it was obtained the result which strength of the main wood materials constituted Kintaikyo Bridge decreased about 64.4 % during 48 years.

Keywords: Historical timber bridge; pedestrian bridge; during 48 years; strength decrease of Wood materials; natural frequency; Young's modulus; eigenvalue analysis.

1. Introduction

Kintaikyo Bridge has been constructed by Hiroyoshi Kikkawa of third generation feudal lord of the Kikkawa feudal clan in 1673, and is an important timber pedestrian bridge with the history in about 334 years in represents Japan. The bridge subjected in this study is the third span bridge of Kintaikyo Bridge constructed in 1953 and reconstructed in 2001. The geometric size is as, span length: 36.98 m, clear width: 4.18 m and longitudinal slope: 5.02 m. Each cantilever beam is stretched a little, and Kintaikyo Bridge becomes generally the peculiar structure as arch style. The woods of main member are zelkova, pine and cypress. During this common use 48 years, the static deflection, strain and natural frequency in field test have been measured to monitor the change of structural performance in every five years by Waseda University [1].



Fig. 1: Kintaikyo Bridge subjected in this

To begin with the analysis, the three-dimensional static and eigenvalue analyses of Kintaikyo Bridge were carried out using FEM by MSC/NASTRAN, and the consistency between the measured and analyzed values on static deflection and static shape, and natural frequency were confirmed. Using the structural analysis model of Kintaikyo Bridge with the good analysis accuracy, this study was investigated analytically the change of Young's modulus of the wood materials based on the experimental values of natural frequency over 48 years measured in every five years, and then