Structural Health Monitoring and Safety Evaluation System for Sutong Yangtse River Bridge

Yufeng Zhang
Civil Engineer
Jiangsu Transportation Research Institute, Jiangsu. Nanjing. China
kolya@ti.js.cn

Yufeng Zhang, born 1974, received his civil engineering degree from the South-east University

Y.Q. Ni
Assistant Professor
The Hong Kong Polytechnic University. Hong Kong. China
ceyqni@polya.edu.hk

Y.Q. Ni, born 1964, received his civil engineering degree from the Hong Kong Polytechnic University

Pei Yao
On-Scene Commander
Jiangsu Provincial STB Construction Commanding Department,
yb@stbridge.com.cn

Pei Yao, born 1961, received his civil engineering degree from the South-east University

Summary

The Sutong Bridge being currently constructed in Jiangsu Province, China, is the world's longest cable-stayed bridge with a main span of 1088 m. With the purpose of securing the operational and structural safety of the bridge throughout its 100-year life span and facilitating the bridge inspection and maintenance, a sophisticated long-term structural health monitoring system, called Structural Health Monitoring and Safety Evaluation System, has been devised and is being implemented in synchronism with the bridge erection progress. This paper outlines technology achievements in the research and design of this monitoring system through exploring its five modules: (i) sensory system (SS); (ii) data acquisition and transmission system (DATS); (iii) data processing and control system (DPCS); (iv) structural health evaluation system (SHES); and (v) portable data acquisition system (PDAS).

Keywords: bridge; health monitoring; safety evaluation

1. Introduction

Together with the deterioration of the material performance, it induces that various structural components produce the damage and deterioration with different degree before it reaches the design age limit at all under the action of many factors, such as the environment, corrosion, vehicle, wind, earthquake, fatigue, and man-made interference, etc. If the damage could not be timely detected and repaired, the traffic safety will be affected and the bridge service lifetime will be decreased, in the extreme it would lead to sudden destruction and collapse of the bridge. Therefore, it is very important to strengthen the bridge health monitoring and evaluation, in order to ensure the applicability, safety and durability of the bridge structure.

Traditionally, the structure health state evaluation is performed through visual inspection or by the information measured by portable devices. Visual inspection has major limits in practical application, with the main drawbacks: (1) Requiring large amount of manpower, materials and financial resources with many blind spots in inspection; (2) Strong subjective judgment, difficult to quantify; (3) Lacking in integrity and continuity; (4) Affecting the normal traffic; and (5) Long period and poor real time quality.

The main drawbacks and limits decide that the traditional inspection methods can not be applied in the health inspection of great bridges efficiently, therefore, the comprehensive monitoring system is urgently needed which can monitor the real-time structural response of the bridge under the performance of all factors such as environment and loads, can provide efficiently the scientific evidence of maintenance and management, and can improve greatly the management level in integrity resulting in securing the safe performance in the extreme, diagnosing the damage of the bridge in advancement and prolonging the service lifetime.

https://doi.org/10.2749/weimar.2007.0024