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RAMS evaluation for a steel-truss arch high-speed railway bridge based on SHM system

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Abstract. The evaluation theory of reliability, availability, maintainability and safety (RAMS) as a mature theory of state evaluation in the railway engineering, can be well used to the evaluation, management, and maintenance of complicated structure like the long-span bridge structures on the high-speed railway. Taking a typical steel-truss arch bridge on the Beijing-Shanghai high-speed railway, the Nanjing Dashengguan Yangtze River Bridge, this paper developed a new method of state evaluation for the existing steel-truss arch high-speed railway bridge. The evaluation framework of serving state for the bridge structure is presented based on the RAMS theory. According to the failure-risk, safety/availability, maintenance of bridge members, the state evaluation method of each monitoring item is presented. The weights of the performance items and the monitoring items in all evaluation levels are obtained using the analytic hierarchy process. Finally, the comprehensive serving state of bridge structure is hierarchical evaluated.

Keywords: high-speed railway; steel-truss arch bridge; SHM; RAMS; state evaluation

1. Introduction

Long-span bridges are the vital projects on the high-speed railway lines. With the continuous construction of the high-speed railway network in China, the safe operation and routine maintenance of long-span high-speed railway bridges, which aim at service performance, become the challenges of the civil engineering (Ding *et al*. 2017, Zhao *et al*. 2017). The structural health monitoring system has been assumed to take the important task of the guidance of bridge maintenance and management since its appearance (Nagarajaiah and Erazo 2016). The mean and maximum of structural responses are usually used to evaluate the bridge structure during daily operation. However, the evaluation based on a simple calculation of structural response can not fully reflect the serving performance of existing bridge structures (Guo *et al*. 2016). Hence, a more efficient method to evaluate the serving state of existing bridge structures, which can guide the maintenance and management of bridge, is required (Yi and Li 2016).

The RAMS is an abbreviation of Reliability, Availability, Maintainability and Safety, which

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