Accepted Manuscript

Experimental and numerical investigation on the static and dynamic behaviors of cable-stayed bridges with CFRP cables

Gui-hua Xie, Jie Yin, Rong-gui Liu, Bei Chen, Dong-sheng Cai

PII: S1359-8368(16)31479-2

DOI: 10.1016/j.compositesb.2016.11.048

Reference: JCOMB 4741

To appear in: *Composites Part B*

Received Date: 1 August 2016

Revised Date: 15 November 2016

Accepted Date: 15 November 2016

Please cite this article as: Xie G-h, Yin J, Liu R-g, Chen B, Cai D-s, Experimental and numerical investigation on the static and dynamic behaviors of cable-stayed bridges with CFRP cables, *Composites Part B* (2016), doi: 10.1016/j.compositesb.2016.11.048.

Experimental and numerical investigation on the static and dynamic behaviors of cable-stayed bridges with CFRP cables

Gui-hua Xie[a], Jie Yin[a, b, *], Rong-gui Liu[a], Bei Chen[a], Dong-sheng Cai[a]

[a] Department of Civil Engineering, Faculty of Civil Engineering and Mechanics, Jiangsu University, Zhenjiang 212013, China

[b] Department of Civil and Environmental Engineering, University of Wisconsin–Madison, Madison, WI 53706, USA

* Corresponding Author, e-mail: jyin34@wisc.edu

Abstract: In this study, carbon fiber reinforced polymer (CFRP) cables in cable-stayed bridges is studied in terms of their static and dynamic behaviors. Firstly, both experimental inspection and numerical simulation were carried out on an existing short-span CFRP cable-stayed bridge to validate the reliability and feasibility of the finite element model. The verified model was thereafter employed to simulate an existing 648m-span cable-stayed bridge with steel cables and replace them by CFRP cables for comparison. The results showed that the static and dynamic properties of cable-stayed bridges are significantly influenced by the nonlinear effects. Side-span vertical displacement (S-V), main-span vertical displacement (M-V) and pylon top horizontal displacement (P-H), are different for CFRP and Steel cables at three different cases designated as case *a*, case *b* and case *c*. The results of displacements calculated between CFRP and steel cables are close to each other in case *a* when we neglect the cable lagging effect and consider the effects of big deformation and beam-column interaction. The differences are significant in case *b* when we consider the cable lagging effect and ignore the effects of big deformation and beam-column interaction. The S-V value differs more significantly with less differences in M-V and P-H values between CFRP and steel cables in case *c* when we consider all of the nonlinear effects. The nonlinear effects on dynamic performance of cable-stayed bridge is smaller than that on static performance. The use of CFRP cables improves the fundamental frequency of bridge. The 1st torsional frequency increased greatly by 20.48% for use of CFRP cables. Moreover, as the span increases, the equivalent elastic modulus of the CFRP cable-stayed bridges will gradually exceed that of the steel cable-stayed. The fundamental frequency, torsional frequency and the ratio of torsional frequency to bending frequency also increased significantly by use of CFRP cables instead of steel. Therefore, CFRP cables can be used in long-span cable-stayed bridges with better mechanical performance.