Monitoring and Assessment of Bridge Cable Stays Consisting of Bundles of Fully Locked Coil Ropes

Rudolf Ároch, Michal Kováč, Tomáš Klas, Róbert Štecák

Slovak University of Technology, Department of Steel and Timber Structures, Bratislava, Slovakia

Michal Venglár

Slovak University of Technology, Department of Structural Mechanics, Bratislava, Slovakia

Contact: rudolf.aroch@stuba.sk

Abstract

The paper describes the health monitoring of the cables of the largest cable-stayed bridge in Slovakia. The bridge spans the Danube River and is located in Bratislava. It was opened for traffic in 1972. The bridge is known for the restaurant at the top of its inclined pylon. The cables consist of bundles of fully locked coil ropes.

The vibration method was used to assess the forces and damping of the cables. The results were compared with the topographical measurement method. The distribution of the total force in the stays among the individual fully locked coil ropes was also investigated by the vibration method. The measurement was performed in the anchor chambers in the bridge beam where the bundles of ropes spread out. Due to the short lengths of the ropes, the influence of their bending stiffness had to be considered. A non-linear fitting procedure with minimising the sum of squares was used.

A set of up to nine accelerometers was used to measure the vibration of individual ropes. A study on the number of necessary considered mode shapes was also performed. Ambient vibrations were used for the operational modal analysis and impact loads coming from a hammer were used for excitation as well.

Keywords: vibration analysis, cable force calculation, cable bending stiffness

1 Introduction

During inspection and/or monitoring of a cable-stayed bridge, measurement of the cable forces can give a notion of the health state of the structure. Determining cable forces by cable sag measurement or by frequency measurement is a well-known procedure that has been used for some years already. There are plenty of applications often using an approximate solution to also consider cable bending stiffness, its boundary conditions, the cables sag, the vibration plane, etc. [1], [2], [3].

This paper shows how to use the measured data to assess accurate values of the cable tension force and bending stiffness. In this way, it is possible to perform a fairly simple monitoring procedure and compare previous measurements in a longer-term monitoring campaign.