SHM system vs. FEM model – comparison between measured and calculated data of a cable-stayed bridge

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Abstract

The Rędziński Bridge in Wrocław is the biggest Polish concrete cable-stayed bridge. It is equipped in a large Structural Health Monitoring system which has been collecting the measured data since the bridge opening – from the year 2011. After 7 years [2] a comparison between the measured data and the FEM calculations is presented in this paper.

Keywords: bridge, cable-stayed bridge, concrete bridge, Structural Health Monitoring, SHM, FEM analysis

1.   The Rędziński Bridge

The Rędziński Bridge was built in 2011 and it is the main bridge on the Wrocław ring-road motorway [1]. The structure is a concrete cable-stayed bridge with spans 49.00 m + 256.00 m + 256.00 m + + 49.00 m. The H-shaped pylon is 122.00 m high (Fig 1).

Figure 1. Aerial view of the Rędziński Bridge (photo by Władysław Kluczewski).

The characteristic feature of the bridge are two separate box girder concrete decks under each road suspended to one pylon with 160 stay cables (Fig. 2). Because of its size and outstanding structure the Rędziński Bridge was equipped with 222 sensors of Structural Health Monitoring (SHM) system (Fig. 3).

2.   SHM system and FEM model

2.1   SHM System of the Rędziński Bridge

The installed sensors are measuring values like: stress, temperature, accelerations and displacements [2], [3]. The connection with the system is allowed by an internet browser application that provides an overview of each sensor. It allows to see alerts and notification, if some sensors are not working properly. Furthermore the application gives the opportunity to create diagrams of measured values and to export them as .csv files which are compatible with calculation programs. After 7 years a database of the measured values was made and compared with calculations conducted on a bridge FEM Model.

2.2   The FEM model

The bridge FEM model was created in the program SOFiSTiK [4] (Fig. 4) by using projects and drawings provided by the bridge designer.