Development and Application of IATS for Structural Health Monitoring

Rinaldo Paar, Ante Marendic, Ivan Jakopec, Miodrag Roic and Hrvoje Tomic (Croatia)

Key words: Bridge surveying; Engineering survey; Low cost technology; Professional practice; IATS, SHM, displacements, natural frequencies, bridge, technological development, low-cost

SUMMARY

In the last fifteen years, the technological development of Image Assisted Total Stations (IATS) has enabled much wider integration of these types of geodetic instruments with their sensors for the purpose of structural health monitoring (SHM), i.e., for the displacement and deformation monitoring of structures. IATS can be used for periodic or continuous monitoring of structures, or during regular structure inspections. Also, they can be used for structural and geo-monitoring, i.e., for the determination of static and dynamic displacements and deformations, as well as for the determination of civil engineering structures' natural frequencies. This way we can collect essential data about the current condition of structures. All instruments and sensors have their advantages and disadvantages. IATS's biggest advantage is their high level of accuracy and precision and the fact that they do not need to be set up on the structure, while their biggest disadvantage is that they are expensive.

So, we developed low-cost IATS prototype, which consists of an RTS Leica TPS1201 instrument and GoPro Hero5 camera. After the laboratory experiment, where simulated dynamic displacements and natural frequencies were determined, the IATS prototype was used in the field for the purpose of static and dynamic load testing of the bridge.

This paper describes the technological development of IATS from early 2000s, considering they were introduced some 20 years ago. The application of IATS is presented through several experimental studies that were performed for the purpose of static and dynamic load testing of the bridges. The procedure of conducting measurements with IATS, as well as the analysis of acquired data and achieved results, is elaborated. Determination of bridge dynamic displacements and natural frequencies from the measurement data obtained by means of IATS prototype is presented. Obtained results were analyzed and compared with the frequencies determined by accelerometers,

and the data from the accelerometers were taken as a reference for the comparison.

From the performed experiments, we manage to successfully determine bridge natural frequencies as they match the results gained by accelerometers.