Bridge Evaluation Using Metrology Methods for Short- and Long-Term Measurements

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Abstract

Many existing major bridges require realistic re-evaluation after having been in use for a long time and as a result of changing traffic requirements and/or material loss, in particular due to environmental influences. Under complex, static conditions, it is expedient to take measurements to determine system behavior and thus enable calculation models to be calibrated more precisely. Short-term measurements under normal traffic conditions or also with increased loads affecting the elastic behavior of the bridges' supporting structure are considered state of the art, even though these measurements, too, place particular requirements on the test and measurement equipment used and on the handling of data. Long-term measurements, i.e. continuous acquisition of all impacts on the bridge structure are increasingly demanded to enable more concrete statements on the remaining useful life to be made. It is well known that data on the previous use of the structure are indispensable for making reliable statements on the remaining useful life.

This method - also called Structural Health Monitoring (SHM) - in some cases places more stringent requirements on both the test and measurement equipment used and the downstream data conditioning.

The presentation shows HBM long-term monitoring solutions that have already been implemented and illustrates the particular challenges, on the one hand, for the sensors used and, on the other hand, for secure data transmission and data conditioning relevant to the respective structure.

It disproves present assessments of strain gauge applications (SG) lacking long-term stability and shows that such measurements can be implemented, taking due account of temperature variations (compensation) and ensuring adequate protection of the installation from environmental influences (humidity, EMC, etc.). Continuous measurement on railway infrastructures - over a period of 8 years to date - without any damage to the strain gauges or resulting influences of errors are proof of this.

The presentation focuses on pointing out the current opportunities and limits of maintenance free test and measurement solutions subjected to different external influences. Meeting these requirements is the substantial basis for real-time evaluation as required today, aiming at, for example, immediate closure of a building based on measured values.