

Relative research contributions towards the characterization of scour in bridge piers based on operational modal analysis techniques: numerical model calibration.

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Abstract

The importance of bridges, both for their heritage value and their useful life, is not reflected in the maintenance policies currently employed by managers, as they continue to experience collapses all over the world [1]. Consequently, this publication aims to obtain the scour depth (the main pathology responsible for the collapse of bridges with piers over river channels [2]) by measuring the vibrations at the pier heads of these bridges by means of an operational modal analysis. This analysis uses the bridge's own vibration frequencies (obtained by means of an analytical model) in order to subsequently be able to diagnose the structural health of the bridge in terms of this pathology by means of a representative numerical model of the bridge (twin model).

The procedure followed was, firstly, to design the necessary hardware equipment, consisting mainly of a triaxial accelerometer, a data acquisition system, a communication system and a power supply system; secondly, the software was designed to obtain the bridge's vibration frequencies from the accelerations recorded by the equipment by means of an analytical model, consisting of the spectral potential density technique and the application of the MAC (Modal Assurance Criterion) correlation criterion. Both systems have been validated on the railway bridge over the river Leza.

Finally, the numerical model capable of analysing the dynamic behaviour of the pile-soil assembly, which provides information on the scour depth, has been developed and calibrated, i.e. the properties of the bridge in which there is uncertainty (including the loss of stiffness of the pier due to the presence of scour) were adjusted so that the experimental information recorded on the bridge over the river Leza match those generated by the numerical model. Once calibrated, a comparison between the results before and after the scour reparation action of the bridge over the river Leza was carried out.

References

[1] Deng, L., Wang, W y Yang, Y. (2015). State of the art review on the causes and mechanisms of bridge collapse. *Journal of Performance of Constructed Facilities* 30 (2)

[2] Federal Highway Administration (2012). *Evaluating scour at bridges*. Fifth edition.

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