Prediction of serviceability condition of arch bridges using structural reliability theory

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The aim of this paper is to introduce a methodology to evaluate the service condition of arch bridges. Initially a model based on structural reliability was generated to predict the performance. It was based on the axle load that can be applied on the bridge under consideration. The model developed to predict the performance and remaining lifetime as follows,

$$M = PAL - AAL \quad (1)$$

where M is the safety margin, PAL is the Permissible Axial Load in kN and AAL is the Applied Axial Load in kN. Both variables are considered to behave as random variables. The variable PAL can be found from Military Engineering Experimental Establishment method (MEXE). At first provisional axle load is roughly estimated and then modifications are carried out considering the variation of span/rise ratio, non-parabolic profile, and quality of the material in arch ring and fill, condition of mortar and overall condition of the bridge. AAL is measured from weigh in motion measurements at the bridge site. Once both variables known with their probabilistic parameters, then reliability index and then the failure probability is estimated.

This method was applied to a case study arch bridge situated in Hatton. The span of the bridge is 10 m and it has been built with stones. Application of this method gives the present failure probability of 10^{-6} which implies the present condition of the bridge is within satisfactory level.

This method can be applied to any arch bridge varying in sizes, shapes and materials present in Sri Lanka, and it is quite possible to take an impression about the serviceability condition on the selected bridge.

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