Effect of bridge foundation stiffness on dynamic behavior of bridge structure

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Abstract

Problems affecting the foundation of a bridge are always difficult to see because the structure is on the ground or covered by water flow. Scouring around piers and abutments can lead to unpredictable consequences that can result in sudden collapse of the structure. In this paper, the effect of foundation stiffness (before and after the bridge repair works) on the dynamic response of the bridge structure is investigated. The results will help to diagnose the bridge foundation in the future. Based on the results of span monitoring before and after repair works combined with numerical model analysis on a bridge in Vietnam, the effects of scouring at the bridge piers are determined. The research results reveal that the dynamic responses of the structure make it possible to detect damage to the foundation and determine whether scour is likely to occur in the vicinity of the bridge foundations.

Keywords: Dynamic behaviour, Foundation stiffness, Scour effects.

1 Introduction

The leading cause of failure of bridges over waterways is scour of the soil around the bridge foundations [1]–[4]. Scour usually occurs quite rapidly and without warning, which can lead to fatalities. The loss of embedment around a bridge foundation caused by scour leads to a reduction in the stiffness and stability of the bridge and can even cause the bridge to fail, resulting in significant service interruptions and financial losses. Therefore, it is necessary to investigate and provide early warning of scour at the bridge foundation [5].

A more efficient and economical method of preventing scour is to monitor its development over time and take the necessary corrective actions. There are many solutions for monitoring scour at bridge foundations. Direct scour monitoring is the most commonly used option today. Divers are most commonly used to investigate scour at bridge piers. Briaud et al. [6] used disposable devices consisting of float-out devices and tethered buried switches that can detect scour at their deployment sites. Yu and Yu [7] proposes the use of time domain reflectometry (TDR) to determine scour depth at a given location using radar. Similarly, Ground Penetrating Radar (GPR) uses high frequency electromagnetic waves

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