



# Experimental Study on Scour Depth Monitoring of Bridge Foundation Based on Ultrasonic Wave

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## Abstract

Foundation scour phenomenon is the result of the water current erosion, which could lead to the removal of streambed materials around the foundation of bridge pier or abutment. The structural damage caused by foundation scour usually has no obvious foreboding. It will easily lead to bridge collapse without early warning. Therefore, it is necessary to conduct the real-time monitoring of the foundation scour for bridges. This paper proposed an ultrasonic-based scour monitoring method for the bridge foundation. The local scour test model based on ultrasonic wave method is established by using the glass box in the laboratory. In the test, the possible scour pit is simulated by shaping the fine gravel in the glass box. An acoustic detector made by our research group was used for signal transmitter and receiver in the test. In addition, the influence of different inclination angles of the scour pit on monitoring result is also investigated in this study.

**Keywords:** bridge; foundation; scour; monitoring; ultrasonic wave.

## 1 Introduction

The bridge number of China is increasing day by day with our rapid economic development. Meanwhile, the corresponding number of bridge collapses is also increasing in past decades[1]. One of the main causes of bridge collapses or severe damages is the bridge foundation scouring. Liu et al. [2] have made the statistics on the bridge collapses due to flood scouring in China from 2007 to 2015. Their research found that of the 44 bridges damaged by flood-induced scouring, only two bridges were older than 50 years. In another words, when most of collapsed bridges lost their structural functions, they were far from reaching their design service life. Recently, Xiong et al. [3] summarized the existing research achievements and methods of hydraulic bridge failure and indicated that scour is the primary cause of

hydraulic bridge failure, principally resulting in the failure of beam, truss, and arch bridges. The scour degree of the bridge is significantly correlated to service time, structural state, and annual mean runoff. In addition, the flood-Induced scouring was also deemed to be the main cause of bridge failure around the world[4-6].

In fact, the soil and riverbed around the bridge foundation will form a continuously developing scour pit under the action of flood scouring effect. It would further decrease the bearing capacity of the bridge foundation. Usually, the flood-induced scour failure mode of the bridge foundation is very sudden and so difficult to monitor in extreme flood event. In order to identify the actual scour depth in time during the bridge's service life, it is necessary to assess and evaluate the bridge safety through in-time monitoring. Many scholars at home and abroad have studied the scour depth