



Effect of Interaction between Bridge Piers on Local Scouring in Cohesive Soils

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Abstract

Local scour at the piers is one of the main reasons of bridge foundation undermining. Earlier research studies focused mainly on the scour at a single bridge pier; nevertheless, modern designs of the bridges comprise wide-span and thus group of piers rather than a single pier are usually used to support the superstructure. The flow and scour pattern around group of piers is different from the case of a single pier due to the interaction effect. Reviewing the literature of local scour around bridge piers group revealed that the local scour around bridge piers group founded in cohesive soil bed was not investigated, and most of the scour studies were related to scour in cohesionless soils. The objective of the present study is to investigate the effect of the interaction between two in-line (tandem) circular bridge piers of variable spacings founded in cohesive soil on the local scour. A set of laboratory flume experiments were conducted under the clear-water scour condition to investigate this effect. This study is the first that investigates experimentally the scour around group of bridge piers in cohesive bed. It was found that the maximum scour depth at the upstream pier of the two in-line piers occurred at a spacing of two times the diameter of the pier, scour at the downstream pier was reduced due to a sheltering effect, the interference effect will be reduced for pier spacings larger than three times of the pier diameter. A recent pier scour equation was used to estimate the scour depths at the two in-line piers in cohesive soil and compare the estimated value with the measured scour depths in the laboratory. The comparison indicated that the proposed scour equation overestimates the scour depths at both the upstream and the downstream pier.

Keywords: Tandem Piers; In-line Piers; Bridge Pier Interaction; Cohesive Soils; Sand-clay Bed.

1. Introduction

Local scour around the piers and abutments of bridges is a primary risk of structural instability and collapse. Local scour occurs due to the erosive action of the flowing water that excavates and carries away the soil from around the bridge piers and abutments when they are constructed in erodible beds. Therefore, the understanding of the scour mechanisms at the foundations of a bridge must be considered for design purposes. Studies of bridge pier scour have been conducting since the 1950s, and numerous design methods and predictive equations were developed for the assessment of the local scour depth around bridge piers from various points of view and under different conditions. There are a considerable number of research studies about the scour and flow structures around a single bridge pier, on the other hand fewer researches were done about the scour and flow field around group of piers.

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