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Use of cable to prevent local scouring around bridge pier

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Abstract

Scouring is a natural phenomenon caused by erosive action of flowing water on the bed. The formation of a scour hole around bridge piers has been the subject of intensive research for many years. Researchers have been introduced a lot of techniques to prevent and reduce local scour at bridge piers. In this paper reduction of scour around circular piers using cable have been carried out and compared with single pier for the case of clear-water flow over uniform sediment. The efficiency of cables, with different diameters and thread angles are studied through the experiments. The result indicated that cable act as a roughness and transits the laminar flow to turbulent flow and pushes separating point to ward downstream and reduces the strength of wake vortex. In addition cable reduces the strength of down flow and horseshoes vortex, therefore cable is shown to be effective in reducing scour depth. The results showed that with increasing cable diameter and decreasing thread angles the reduction of scour depth increases.

Keywords: Scour; Bridge; pier; Cable.

INTRODUCTION

Local scour around a pier is a result of the interaction amongst the pier, the approach flow and the erodible bed. A main cause of bridge failure is scour around the pier. Bridge failures through out the world, as reported in literature, have attributed general attention to understand the scour process and for developing improved ways of protecting bridges against scour.

The two major countermeasure techniques employed for preventing or minimizing local scour at bridge piers can be classified into two categories: (i) bed armoring countermeasures and (ii) Flow-altering. In the former case, the objective is to combat the erosive action of the scour inducing mechanisms using hard engineering materials or physical barriers such as rock riprap. In the latter case, the objective is to either inhibit the formation of the scour inducing mechanisms or to cause the scour to be shifted away from the immediate vicinity of the pier. Chiew and Lim (2000), Lauchlan and Melville (2001), and Dey and Rajkumar (2007) focused on the first category and using armoring devices for reducing local scour at bridge piers [1,2,3]. Efforts have been made to reduce scour by using submerged vanes [4], a delta-wing-like fin in front of the pier [5], and slot through the pier [6,7].

In this study, the scouring is controlled by threading cable spirally around the pier. Use of cable cause delay in separating point and reduce the strength of wake vortex and also weaken the down-flow and the horseshoe vortex. The objective of this research is to investigate the effect of cable diameter and thread angle on reducing the scour depth as an economical device when compared to other countermeasure techniques like riprap.

Threading was suggested by Dey et al. (2006) as an economical and easy-to-install countermeasure in wave and current flow [8]. Tafarojnoruz et al. (2010) reviewed the previous studies and indicated that the results of several tests were influenced by side-wall, sediment size, flow shallowness and temporal effects [9]. They have shown the results of Dey et al. (2006) were affected by side-wall and sediment size effects. These weaknesses warrant further investigation. The other objective of this study is to evaluate the results of Dey et al. (2006) by considering three cables diameter and three-threaded angle.