

APPLICATION OF COLLARS AND SACRIFICIAL PILES TO CONTROL SCOURING AROUND THE PIERS

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Failure of bridges due to scouring is common occurrence and each year a significant amount of money is spent to repair or reconstruct bridges whose piers and/or abutments have been under-cut. Because of failure experiences, many researchers have studied scour phenomenon during the last decades. Most of the researchers have tried to obtain the maximum scour depth or time variation of the scour depth around the bridge foundation. But, investigating the maximum scour depth is not enough to solve the problem of bridge failures, which are caused by scouring. An important task for the hydraulic engineer is the concern of the protection against local scour. Various methods have been attempted to control scouring around bridge foundations, such as using riprap, slots through the bridge structures, a group of small piles in front of the bridge structures, and collars. In this study the effectiveness of collars placed on bridge piers and also sacrificial piles placed upstream of the bridge piers on the local scour around the bridge piers were tested. Experiments were carried out near the threshold of sediment motion with two circular piers having diameters of $D=5$ cm and 10 cm. The sizes of collars placed around the bridge piers were $D_c=3D$ and $5D$ for the pier of $D=10$ cm, and $D_c=2D$ and $3D$ for the pier of $D=5$ cm. Collars were placed around the piers at three different levels as; $Z_c=0.00$ cm, -2.50 cm, and -5.00 cm where Z_c is measured with reference to the bed level (Fig.1). After each experiment, collar effectiveness on the maximum scour depth and on the time development of the maximum scour depth around the pier were investigated. It was found that, As the size of the collar increases compared to the pier diameter, the effectiveness of the collar on reducing the maximum scour depth around the pier increases. For $D_c=5D$, the percent reduction of the maximum scour depth reaches its maximum value as 73%. When the collar is placed at the bed level around the pier, the highest performance on reducing the maximum scour depth around the piers is observed.

The piers having collars around them have the equilibrium scour depths much smaller than those of piers having no collars. Even if a collar can not stop the formation of the scour hole around the pier, it slows down the scouring depth considerably.

The sizes of the sacrificial piles placed upstream of the bridge piers were $d=0.5$ cm, 1 cm, 1.5 cm and 2 cm for $D=5$ cm, and $d=1$ cm, 2 cm, 3 cm and 4 cm for $D=10$ cm. All sacrificial piles were placed at a distance of $L=2D$ from the center of the bridge pier to the center of the sacrificial pier (Fig.2). It was observed that sacrificial piles can be used at the

upstream of the piers to reduce the maximum scour depths around the piers. The maximum reduction in the maximum scour depth obtained in this study is about 35% at $d/D=0.4$. when the distance between pier and the pile is $2D$ for the pier of $D=5$ cm.

Key words: Bridge pier, scouring, collar, scour reduction, sacrificial pile.

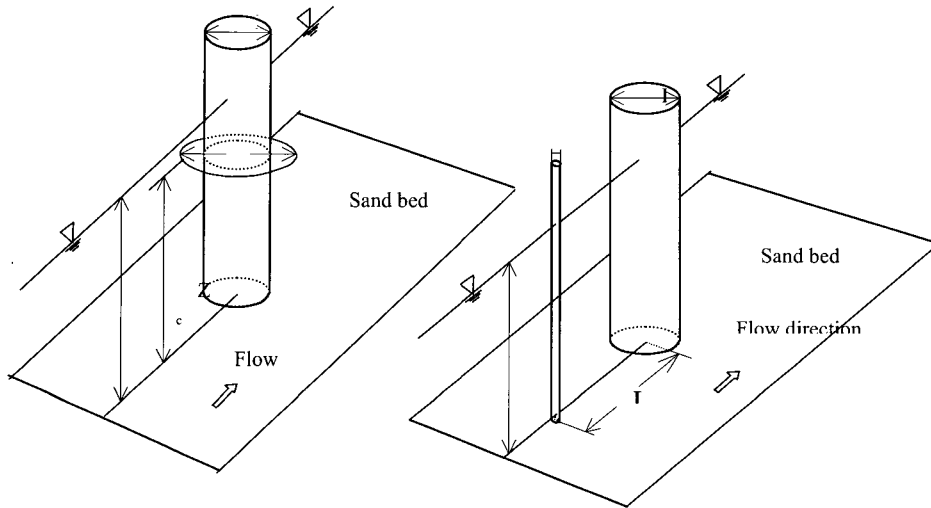


Fig. 1 Definition sketch of collar-pier arrangement

Fig. 2 Definition sketch of sacrificial pile-pier arrangement