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Turbulent Flow Characteristics and Bed Morphology around Circular Bridge Pier

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Abstract : Scour is the natural phenomenon brought about by erosive action of the flowing stream in alluvial channels. Frequent scouring around bridge piers may cause damage to the structures. In alluvial channels, a complex interaction between the streamflow and the bed particles results in scouring around piers. Thus, the study of characteristics of flow around piers can give sound knowledge about the scouring process. The present research has been done to investigate the turbulent flow characteristics around bridge piers and corresponding changes in bed morphology. Laboratory experiments were carried out in a tilting flume with a sand bed. The velocities around the pier are measured by Acoustic Doppler Velocimeter. Measurements show that at upstream of the pier velocity and Reynolds stresses are negative near the bed and near the free surface at downstream of the pier. At the downstream of the pier, Reynolds stresses changes rapidly due to the formation of wake vortices. Experimental results show that secondary currents are more predominant at the downstream of the pier. As the flowing stream hits the pier, the flow gets separated in the form of downflow along the face of the pier due to a strong pressure gradient and along the sides of the piers. Separation of flow around the pier leads to scour the bed material and develop the vortex. The downflow hits the bed and removes the bed material, which can be carried forward by the flow circulations along sides of the piers. Eroded bed material is deposited along the centerline at the rear side of the pier and produces hump in the downstream region. Initially, the rate of scouring is high and reduces gradually with increasing time. After a certain limit, equilibrium sets between the erosive capacity of the flowing stream and resistance to the motion by bed particles.

Keywords : acoustic doppler velocimeter, pier, Reynolds stress, scour depth, velocity
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