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Retrofitting of Bridge Piers against the Scour damages: Case Study of the Marand-Soofian Route Bridge

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ABSTRACT

Bridge piers which are constructed in the track of high water rivers cause some variations in the flow patterns. This variation is a result of the changes in river sections. Decreasing the river section, bridge piers significantly impress the flow patterns. Once the flow approaches the piers, the stream lines change their order, causing the appearance of different flow patterns around the bridge piers. New flow patterns are created following the geometry and the other technical characteristics of the piers. One of the most significant consequences of this event is the scour generated around the bridge piers which threatens the safety of the structure. In order to determine the properties of scour holes, to find maximum depth of the scour is an important factor. In this manuscript a numerical simulation of the scour around Marand-Soofian route bridge piers has been carried out via SSIIM 2.0 Software and the amount of maximum scour has been achieved subsequently. Eventually the methods for retrofitting of bridge piers against scours and also the methods for decreasing the amount of scour have been offered.

Key Words: Scour, Bridge pier, numerical simulation, SSIIM 2.0

1 INTRODUCTION

Local scour at bridge structures has been extensively studied over the past fifty years with both experimental and numerical methods. When an obstacle is placed in a flow on an erodible bed, a scour hole forms at the footing of the obstacle. On river beds, this phenomenon typically occurs in the vicinity of bridge abutments and bridge piers, often leading to the structure collapse.

Construction of an obstacle against flow causes a difference in hydrostatic pressure at upstream and downstream of the structure which will cause a whirlpool disturbance around it. These whirlpool flows account for the main local scoring mechanism which produces large vortexes at the vicinity of pier and this phenomenon may lead to structure's failure.

Local scour holes are formed around bridge pier due to the action of flow against these obstructions. Estimation of the depth of scour at the vicinity of piers has been the main concern of engineers and researchers for years. Therefore, knowledge of the anticipated maximum depth of scour for a given discharge is a significant criterion for the proper design of an pier foundation or utilizing a method for decreasing scour around the structure. Numerous researchers like: Dey (2005), Chiew (1992), Mashahir et al (2004), Hua et al (2006), Kayaturk (2004), Molinas et al (1992), Melville (1992) and Kumar (1990) made variety of experiments in order to investigate the scour phenomenon around bridge piers and bridge abutment [1,2,3,4,5,6,7,8,9]. Beside experiment studies, variety of CFD models have been developed for computing sediment transportation and calculating bed changes in channels and around hydraulic structures or obstructions; like SSIIM, Fluent and Flow-3D. In the present study, SSIIM 2.0 three-dimensional model was used to compute sediment transport and scouring phenomenon around bridge pier and its capability for simulation scour structures was investigated.