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Evaluation of existing relationships for maximum scour depth around circular bridge piers

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Scour is defined as the processes of removal of sediment particles from water stream bed by the erosive action of activated water, and also carries sediment away from the hydraulic structures. Scour is the main cause of pier failure. Precise prediction of scour near the circular uniform pier may lead to the economic design of piers and avoid disastrous instances. Present study mainly deals with cohesionless sediment. Several relationships are available for estimating temporal scour as well as maximum scour depth at equilibrium scour stage. The present study describes the phenomenon of equilibrium scour depth around circular bridge piers and deals with the methods for its estimation. The accuracy of five maximum scour depth relationships, proposed by Kothyari et al. (1992), Richardson and Davis (2001), Sheppard et al. (2004), Khan et al. (2012) and Sheppard et al. (2013) are also checked in this study by using clear water scour data available in literature as well as present experimental data. After graphical and statistical analysis, it is found that the relationship proposed by Sheppard et al. (2013) performed the best in laboratory conditions, while it over predicts the maximum scour depth for field data. It is experimentally observed by authors that the value of densimetric Froude number has a significant effect on maximum equilibrium scour depth. The other parameters like critical have got only secondary importance on equilibrium scour. It was also observed by authors that the maximum scour depth always occurs at the upstream face, at the nose of the pier of the pier and eroded sediment is deposited at the downstream face. In the present study, three equilibrium scour time relationships, proposed by Summer et al. (1992), Melville and Chiew (1999) and Choi and Choi (2016) are also used for checking the accuracy of equilibrium time of scour. For equilibrium time of scour, the relationship proposed by Choi and Choi (2016) gives better agreements with observed values.