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2D-Numerical Modelling of Local Scour around a Circular Pier in Steady Current

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Abstract : In the present investigation, the scour around a circular pier subjected to a steady current were studied numerically using two-dimensional MIKE21 Flow Model (FM) and Sand Transport (ST)Modulewhich is developed by Danish Hydraulic Institute (DHI), Denmark. The unstructured flexible mesh generated with rectangular flume dimension of 10 m wide, 1 m deep, and 30 m long. The grain size of the sand was d50 = 0.16 mm, sediment size, sediment gradation=1.16, pier diameter D= 30 mm and depth-averaged current velocity, U = 0.449 m/s are considered in the model. The estimated scour depth obtained from this model is validated and it is observed that the results of the model have good agreement with flume experimental results.In order to estimate the scour depth, several simulations were made for three cases viz., Case I:change in sediment transport model description in the numerical model viz, i) Engelund-Hansen model, ii) Engelund-Fredsøe model, and iii) Van Rijn model, Case II: change in current velocity for keeping constant pile diameter D=0.03 m and Case III:change in pier diameter for constant depth averaged current speed U=0.449 m/s.In case I simulations, the results indicate that the scour depth S/D is the order of 1.73 for Engelund-Hansen model, 0.64 for Engelund-Fredsøe model and 0.46 for VanRijn model. The scour depth estimates using Engelund-Hansen method compares well the experimental results.In case II, simulations show that the scour depth increases with increasing current component of the flow.In case III simulations, the results indicate that the scour depth increases with increase in pier diameter and it stabilize attains steady value when the Froude number> 2.71.All the results of the numerical simulations are clearly matches with reported values of the experimental results. Hence, this MIKE21 FM –Sand Transport model can be used as a suitable tool to estimate the scour depth for field applications. Moreover, to provide suitable scour protection methods, the maximum scour depth is to be predicted, Engelund-Hansen method can be adopted to estimate the scour depth in the steady current region.

Keywords : circular pier, MIKE21, numerical model, scour, sediment transport
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