THESIS

PHYSICAL MODEL STUDY OF SCOURING PHENOMENON AT PIERS OF WEST CHANNEL BRIDGE OVER RIVER CHENAB NEAR CHINIOT

By

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ABSTRACT

River regimes in the alluvial plains of Pakistan have been significantly disturbed due to human interventions. In case of the Chenab River, even in early and late summer, flows get significantly reduced. This has caused deterioration of main River Channel. Flowing water erodes, transports and deposits sediment in the river, alter its bed elevation and adjusts its boundaries. Changes in bed elevation may be due to natural causes or by the activities of man which lead to change of the river bed or river geometry. Scour around bridge piers is one of the examples of different human interventions with the river.

Scouring phenomenon is linked to approximately 95% of all severely damaged and failed highway bridges constructed over waterways in the world. Local scour around bridge foundations has been recognized as one of the most significant causes of bridge failure. In Pakistan during the floods of August 1996, one of the under construction piers of 2 meter dia of West Channel Bridge over Chenab River near Chiniot was washed away while the central pile showed the sign of settlement in the form of cracks in the transom. The purpose of this study was to evaluate the local scour with time at a bridge pier and effect of pier size on scouring.

Physical model study of scouring phenomenon for piers of west Channel Bridge over Chenab River near Chiniot was carried out in model testing hall of Center of Excellence in Water Resource Engineering. A rectangular flume was constructed by scale downing the river bridge pier dimensions and hydraulic data of selected site. The working section of flume was in the form of a recess which after excavation up to 1.5 ft filled with

bed material collected from the bridge site near Chiniot. The pier model was fabricated in perspex glass rod. Three circular model piers of diameter 0.05 ft (1.5 cm), 0.07 ft (2 cm) and 0.09 ft (2.5 cm) were used for the study. The 0.07 ft diameter pier was actually used to do case study. Before each test, the sand bed was leveled throughout the entire length of the sediment recess. The flume was slowly filled with water to the required depth. The tailgate was adjusted so as to maintain the accurate depth of flow in the flume. The first reading of scouring depth was taken after time of 30 minutes and the next readings at an interval of 60 minutes. The scouring depth data was collected in 8 directions (select four points in each direction which are 1cm apart) around the pier.

The physical model study indicates that the scour depth is largely dependent on time and it is also observed that its extent increases as the time progresses as its value varies from 1.8 cm at time 30 minutes to 7.1 cm at 690 minutes since the experiment started. Deposition is also found during the test at some specific time intervals but no deposition was observed before 2.5 hours of starting time due to the movement of ripple forms on the bed. The maximum observed scour depths are 6.6 cm, 7.1 cm and 7.9 cm around piers of diameters 1.5 cm, 2.0 cm and 2.5 cm respectively, and hence it is concluded that the scour depth increases as the diameter of the pier increases, as scouring is due to the horseshoe vortex system whose dimension is a function of the diameter of pier.