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# ABUTMENT SCOUR DEVELOPMENT DURING FLOODS

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**ABSTRACT:** Development of scour around elliptical guide banks and bridge abutments in flood was studied. Although the problem on scour development during the floods, when the hydraulic and bed characteristics of the flow change, is of great importance, scour phenomena at bridge abutments on plain rivers has not been investigated. Using the differential equation of equilibrium of the bed sediment movement for clear water, a new method for computing the scour development with time at the abutments during the floods was elaborated.

The tests with a fixed bed were performed for different flow contractions and Froude numbers, so that to investigate the velocity and the water level changes near the embankment, along it, and near a model abutment. The tests with a sand bed were carried out with the purpose of studying the influence on scour of the hydraulic parameters and the contraction rate of the flow, grain sizes of the bed material, its distribution over the depth, and time.

The local velocity at the abutments in combination with the vortex structures forms a scour hole. The local velocity varies with a change in hydraulic parameters of the flow during the flood and with the formation of the scour hole. It depends on the contraction rate, the value of backwater, and scour depth.

In the tests, it was accepted that the Froude numbers for model and real conditions are equal. The duration of tests in flumes was 7 hours, which, with a vertical scale of 50, was equal to 2 days in real conditions and corresponded to a time step of the flood hydrograph.

To determine the scour depth, the flood hydrograph of required probability was divided into time steps with duration of 1 or 2 days, and each time step was divided into time intervals from several minutes to several hours. The scour depth can be calculated after one, two, or several floods of the same or different probability. During the first flood, the depth of scour increases rapidly, and the process usually stops at the peak of the flood. During the next flood of the same probability, the scour depth continues to develop. However, this time, the process of scour proceeds with less intensity and less duration. The scour starts not from the moment when the water covers the flood plain, but later on when the local velocity exceeds the velocity at which the sediment movement starts, i.e., at a step of the hydrograph closer to the flood peak. The time of local scour at the bridge abutments is always less than the time of flood.

A theoretical analysis of the method suggested allowed us to estimate the effect of contraction rate, relative grain size of the bed material and its distribution over the depth, kinetic parameter of the flow, relative depth and velocity of the flow, Froude number in relation to the slope, unsteadiness of the flow, time of scour, and duration of the flood on the relative depth of scour near the abutments. The method presented was confirmed by experimental data obtained in tests in flumes.