Pressure Flow Effects on Local Scour in Bridge Openings

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Scour is the removal of sediment by a swift current of water. A scour hole is the depression left behind when sediment (sand and gravel) is washed away from the bottom of a river. Specifically related to bridges, there are three types of scour. Local scour is the removal of sediment from around bridge piers or abutments. Contraction scour is the removal of sediment from the bottom and sides of the river. Degradational scour is the general removal of sediment from the river bottom by the flow of the river. Before 1985, design and construction of highway bridges did not include the effects of scour. After several bridge failures during flood conditions, bridge design was required to include the effects of scour. Consequently, bridge scour estimation procedures have undergone scrutiny in an attempt to improve the techniques available for use by the hydraulic engineering community.

One particular area of bridge scour estimation that needs more understanding is scour caused by the occurrence of pressure flow. Pressure flow is defined as flow in which the bridge low chord becomes inundated and the flow through the opening transitions from a free surface to a pressurized condition. A majority of scour estimation techniques are for free surface conditions. Research conducted at the Engineering Research Center at Colorado State University between 1996 and 1998 provided two sets of pressure flow data. Dr. Larry Arneson analyzed the first set of data and developed three scour estimation equations for pressure flow conditions. The three equations were developed for conditions known as vertical contraction. The second set of data was collected for conditions known as vertical and horizontal contraction, and will be analyzed using the same procedures developed by Dr. Arneson to produce three new equations. The new equations will be compared to the previous equations to determine if one set of equations is valid for both horizontal and vertical contractions under pressure flow conditions.