Articulated Concrete Block Stability under Hydraulic Jump Conditions on Sloped Channels

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Abstract. The hydraulic jump is commonly used to dissipate energy in hydraulic structures. In order to protect such structures from the erosive forces caused by shear stresses exerted onto the channel boundary, revetment structures must be designed. Most major dam spillways are designed to incorporate United States Bureau of Reclamation type stilling basins and chutes lined with concrete. However, for smaller spillways and outlet structures, other revetment methods are commonly used. These include, but are not limited to, riprap, gabions, rock mattresses, grout filled bags, and articulated concrete blocks. Performance thresholds of articulated block systems on sloped channels have been researched at the Colorado State University in the Hydraulics Laboratory of the Engineering Research Center. However, there is little information surrounding the performance of such revetment systems subject to controlled hydraulic jump flow conditions. During the summer and fall of 2006, two articulated block revetment systems were tested under controlled conditions to identify the stability of the system over a wide range of hydraulic jump flow conditions. Vertical sluice gates were used within two existing four-foot wide flumes with slopes of 50 and 13 percent in order to induce a hydraulic jump within the defined test section. Data obtained during the testing was used to create a plot of the energy ratio, defined as the ratio energy lost with a jump to the ratio of the energy loss without a jump, as a function of the Froude ratio, defined as the ratio between the Froude numbers upstream and downstream of the jump. Through data obtained with additional testing of articulated concrete block revetment systems in channels of varying slopes, a general performance threshold equation may be obtained.

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