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National Water Program
A Partnership of USDA CSREES & Land Grant Colleges and Universities

USDA-CSREES 2007 National Water Quality Conference

Rock Cross Vane Design Reccomendations

The rock cross vane, a structure used in stream restoration projects, consists of a U-shaped weir with the apex upstream at bed elevation and arms that increase in elevation and tie into the bank downstream. The cross vane turns flow away from the bank, reducing near-bank velocities. It allows a protected drop in bed elevation and scour pool development. The pool allows for recirculation and dissipation of energy and provides habitat. This study assesses the degree of flow contraction, the average center velocity to average outer velocity, caused by a range of geometric configurations of the cross vane that are implemented in practice. A stream segment is modeled by a rectangular channel and the different configurations of the cross vane are installed and tested in a dimensionless flume study at North Carolina State University. Results show quadratic, linear and cross product effects of arm angle and drop over the structure with slight effects of arm slope on flow contraction. Observations of flow depth at the head of the vane also show that constriction over the cross vane arms is occurring at high arm slopes and medium to high arm angles. In a subsequent study, the Rock Cross Vane Rapid Assessment Tool (RCV-RAT) and Failure Guidebook were developed and used to assess rock cross vanes on North Carolina stream restoration projects. Failure indicators were identified and ranked and potential primary and secondary causes of failure were assessed. The data was used to determine the most common failure modes and points of weakness in rock cross vane design. Failure probabilities are also regressed over stream data such as watershed area, age of project, d50, and length of project. Out of the 120 rock cross vanes observed, 109 had at least one incidence of failure. 81 rock cross vanes had at least one incidence of slight failure, 50 had at least one occurrence of moderate failure, and 47 had at least one occurrence of extreme failure. Results imply that sufficient drop is essential to creating flow contraction for scour pool development, while arms too steep and narrow may risk bank stability and have minimal contribution towards scour pool development and may in fact increase risk of bank erosion and other functional failures.

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