UNCERTAINTY EVALUATION IN THE DESIGN OF INSTREAM STRUCTURES FOR STREAM RESTORATION

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Many communities have tried to restore urban streams to a more natural condition and to stabilize unstable streams using ecologically friendly methods. A number of procedures have been developed for stream naturalization/restoration. However, considerable uncertainty exists in the application of these procedures particularly with respect to stream stability. Uncertainty analysis has been applied to one design procedure for stream stability design to illustrate its usefulness to improve the design procedure. A procedure used by the Maryland State Highway Administration (MSHA) to check the safety of instream structures used to stabilize streams in stream restoration projects was selected as the example. In this procedure the maximum shear stress in the designed channel computed for the 100-year flow is compared to the critical shear stress for the boulders used to build the structure. If the maximum shear stress is less than the critical shear stress, the structure is considered safe. Uncertainty in Manning's n, the design flow, and the critical shear stress are considered in a Monte Carlo evaluation of the uncertainty in the MSHA procedure applied to Piney Run Creek. It was found that for the 100-year flow the instream structures had a 34.2 percent chance of moving (i.e. maximum shear > critical shear). Further evaluation of the procedure found that the instream structures have 32.5 and 24.9 percent chances of moving for the 50- and 25-year flows, respectively. It also was found that failing to consider the uncertainty in the critical shear stress, as is common in most design procedures, could result in a 20 to 30 percent underestimation of the true failure probability of an instream structure. The results of the uncertainty analysis give engineers and decision makers a clearer picture of the safety and acceptability of the design.

Keywords: Uncertainty Analysis, Instream Structures, Stream Restoration, Critical Shear