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Application of Hydraulic Geometry to High Gradient Rivers in Southern Ecuador

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Abstract

Using hydraulic geometry (HG) theory, we investigated three rivers typical of the Ecuadorian mountainous region with longitudinal slopes ranging from 0.8% to 10% and coarse bed material with d_{50} ranging from 3 to 54mm and values of d_{90} up to 908mm. Extensive field measurements were performed to characterize geometric and hydraulic properties at 33 sites. Using these field data, at-a-station HG relationships were obtained for top width, average flow depth, and average flow velocity. Dimensional and dimensionless downstream HG relations were obtained for these parameters as well as the channel bed slope using the bankfull discharge estimated with at-a-station HG. The correlation

coefficients indicate that the dimensionless equations adequately represent the observed data for all quantities with the exception of slope. In addition to a low correlation coefficient, the exponent on non-dimensional discharge was small in the downstream HG relation for slope. This small exponent indicates that slope is not dependent on discharge. Based on this finding, the non-dimensional HG relations were reformulated using both dimensionless discharge and bed slope as independent variables. These new relations show improved correlation coefficients and demonstrate the role of slope in determining channel width, flow depth, and average velocity in high gradient rivers.

Author keywords

high gradient rivers; hydraulic geometry; slope

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