

Critical hydraulic gradient of non-cohesive suspended sediment laden flow through pervious rockfill dam

ABSTRACT

Clogging of pore spaces of pervious rockfill detention dam during passage of suspended sediment laden flow through it, is one of the important issues which has been studied by some of researchers. Further study is still needed to achieve generable results to the real field condition. In this research we investigated semi empirically the initiation of sediment particle motion inside the pervious rockfill dam by conducting laboratory experiments alongwith dimensional analysis. A series of larger scale laboratory tests than previous studies has been conducted to collect experimental data. A dimensional analysis has been performed including all of effective hydraulic and physical parameters especially inertia of flow and rockfill characteristics. Applying of inertia of flow and rockfill characteristics have been done to the previously proposed formula for laminar flow to improve and make it applicable for turbulent flow through pervious rockfill dams. The derived equation has been calibrated using a linear regression analysis with a correlation coefficient (R^2) of 0.92. It has been validated with a mean square error (MSE) of $4.46E-05$ and correlation coefficient of 0.94 utilizing its predicted critical hydraulic gradient versus laboratory measured critical hydraulic gradient. The validation showed a good agreement between predicted and measured critical hydraulic gradients. This equation also compared with the equations proposed by two other researchers and the results indicated a better agreement of predicted critical hydraulic gradients by the derived equation in this study to the measured values than by two other equations. The correlation coefficients and mean square errors of the present study's and two other formulas were respectively, 0.94 and $4.46E-5$, 0.75 and 0.0003, 0.48 and 0.0293. The proposed formula in this study should be a guide for hydraulic engineers to design pervious rockfill detention dam such a way that no clogging of pore spaces take place during sediment laden floods.

Keyword: Critical hydraulic gradient; Non cohesive suspended sediment laden flow; Reynolds number; Rockfill dam