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Prediction and correction of scaling effects on velocity profile in hydraulic laboratory experiments

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ABSTRACT

Due to the geometric distortion in distorted hydraulic laboratory experiments, velocity profile cannot maintain as constant as required by the traditional criteria. Scaling effects, which lack quantitative researches, cannot be avoided even if the Froude and drag coefficient similitude criteria were satisfied. Prediction formulas of scaling effect rate are established in this research to theoretically reveal the quantitative relations between velocity profile distortion and experimental parameters. They are directly related to three parameters, distorted ratio, relative water depth, and relative bed roughness. In vertical direction, most effects happen near the bed and the deviation increases with distortion ratio. The similarity of secondary flow is worse and more complicated than that of stream-wise flow. The correction method, which is the improvement of traditional similitude criteria, can effectively reduce scaling effects when converting experimental results into their corresponding values in the prototype. Three dimensional numerical models are built to verify the accuracy of the prediction formulas and correction method.

Keywords: Distortion ratio; Laboratory experiments; Scaling effects; Correction method; 3-D numerical models

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