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Physical modelling of pressurized sediment flushing using lightweight material

Sanat Kumar Karmacharya and Nils Rüther
The Norwegian University of Science and Technology

Physical models are generally a scaled down representation of prototype, which can be used to study different processes within the prototype under controlled laboratory environment and to predict the response of the prototype to different impacts. For studies related to fluvial hydraulics, Froude scaled physical models can be used for satisfactory results. Froude scaled mobile bed models are often used for studying problems related to non-cohesive sediment transport. Scaling down prototype parameters to model is pretty straight-forward with Froude similarity criteria until prototype has very fine sediments which when reduced to model scale will require fine cohesive sediments to be used in the model. By compromising similarity criteria for particle Reynolds number, lightweight materials (density lower than natural sand) of bigger sizes can be used in the model to represent fine non-cohesive sediments in the prototype. Till now, such models are mostly used for qualitative studies.
The objective of this study is to develop scaling relations among parameters of prototype and lightweight model so that such models can be conveniently used for quantitative studies of processes involving sediment transport. Regarding this, cone development upstream of undersluice gate under pressurized flushing condition was studied in a model using lightweight sediment. The study was carried out for varying discharge, water depth, thickness of upstream sediment layer and height of gate opening, and the results were compared to previous studies on development of flushing cone under pressurized flushing condition. The results of this study can be useful in developing a scaling relation for quantitative interpretation of model study results to prototype values and vice versa.