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Modelling of the velocity profile in a channel partly covered by submerged vegetation

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ABSTRACT

The presence of vegetation in the channel significantly affects water flow, transport and mixing processes, water quality as well as morphodynamics and ecology (Rowiński et al. 2018). All scientific research related to flow and transport processes become very complicated in the channels with vegetation, and although many experimental and numerical studies have already been carried out to determine the effect of vegetation on flow hydrodynamics, there are still many questions and problems that require further analysis.

Following the definitions of Nepf (2012), the present study investigates deeply submerged grassy vegetation corresponding to conditions on floodplains with maintained vegetation during high flows. The experiments were conducted in the 20 m long, 0.6 m wide Environmental Hydraulics Flow Channel at Aalto University. Artificial grasses with a height H=20 mm covered 38% of the flume width in the 10 m long test reach while the rest of the flume bottom consisted of smooth PVC (see Fig. 1). The measurements in the laboratory channel were performed for several different variants, for different type of vegetation and different flow rates.

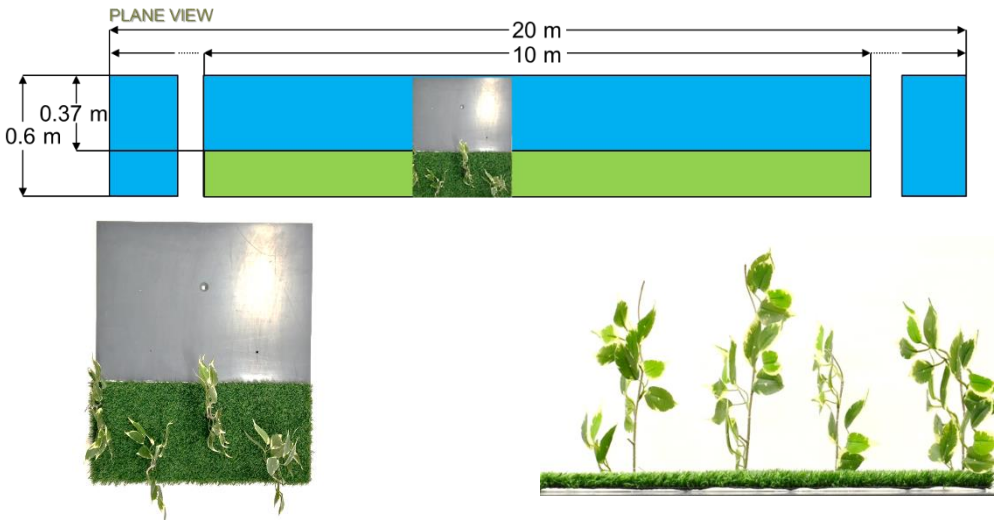

Fig. 1. Laboratory channel.

For each laboratory measurements variant, many numerical simulations were performed to obtain the right model parameters to replicate the results of laboratory tests best. Two different models have been used: the CCHE2D model, a two-dimensional depth-averaged hydrodynamic model for unsteady turbulent free surface flows (Jia & Wang, 2001; Ye & McCorquodale, 1997) and Shiono and Knight, a quasi-two-dimensional mathematical model (Shiono & Knight, 1990 & 1991). The results of measurements and numerical simulations for selected variants for submerged vegetation have been presented in the study.

References

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