HYDRAULIC CHARACTERISTICS OF FLOW OVER FLEXIBLE GRASS AND AN ANALYSIS OF EXPERIMENTAL DATA

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Since the knowledge of the hydraulics of flow over vegetation, like seagrass (see e.g. Schanz 2003), is very important for the understanding of fluvial processes in river hydraulics as in coastal areas research on the change of the boundary layer between the flow and soil through the influence of flexible vegetation has been carried out at the Department of River and Coastal Engineering of the University of Hamburg Harburg , Germany.

The logarithmic distribution of the medium speed over the depth of water supplies a good description of the flow situation in running waters with unimpaired flow cross sections. Thus it applies to flows by and over vegetative roughness only with restrictions. Here additional flow losses arise by form drags and friction at additional surfaces apart from the viscous wall shear stresses. In which measure the boundary layer profile is changed, depends in the main on as far the vegetation extends into the water gauge inside. With an increasing relationship of the vegetation height to depth of water the logarithmic distribution cannot be proven the velocity of flow over the entire water gauge or also in the free part over the vegetation any more. Thus, within the paper to be presented here, three different zones of the vertical speed profile with respect to the vegetative roughness are distinguished.

In order to describe the flow velocity profile more precisely experiments have been carried out at the laboratory flume of the Federal Institution for hydraulic engineering (BAW), department of hydraulic engineering in the coastal range, in Hamburg with vegetation and with real seagrass. The speed measurements took place with a laser doppler anemometer (2d-LDA), and the determination of the vegetation elevator as well as of the inclination of the plants took place photographically. The evaluation of the experiments focused on the influence of the vegetation roughness. As an example the dependence of the plant roughness on the Reynolds number is represented in figure 1, where the computed coefficients of drag decrease with rising Reynolds number (cp. von Lieberman et al., 2005).

All results of the experiments revealed that the presence of flexible small vegetation has a substantial influence on the boundary layer between soil and flowing water. The taking place energy exchange is registered in higher water ranges and deeper soil ranges. These effects are caused by the sheets moving in the flow current as well as by the roots projecting into the soil. Thus an absorption of the transferring energy takes place into deeper soil ranges in the comparison of soil without vegetation. Although the entire mathematical collection of the arising phenomena did not succeed yet, already individual effects can be physically seized.

The paper to be presented here closes with an insight into further steps and goals of research.

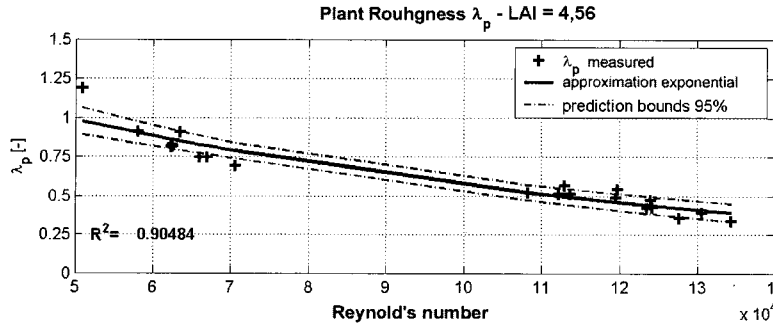

Fig. 1 Roughness of the plants LAI 4,56 and Reynoldsnumber

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