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Characteristics of turbulent flow in compound channels with rigid vegetation on floodplains

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Contemporary rules of controlling rivers suggest leaving vegetation on the floodplains for the sake of its environmental functions. Natural re-shaping of river valleys requires detailed recognition of the hydraulic processes of flow in vegetated channels. Renaturizated river valleys can have vegetated floodplains, which are easily flooded, when big discharges appear. Expanding of cross-section area and significant increasing of channel resistance cause decreasing of mean velocities and change of velocity distributions.

Two sets of laboratory investigations were realized under steady-state conditions. First part was carried out in the Institute for Hydraulic Engineering in Braunschweig in Germany in a two-stage laboratory channel with one-side floodplain. Woody cylindrical sticks representing trunks of riparian trees were evenly placed in a floodplain-pocket. Instantaneous longitudinal and transverse velocities were measured with use of a two-component acoustic Doppler velocity meter. Water stages were determined with a pointer gauge. The tests were run for two different discharges and different arrangements of simulated trees. A case with no vegetation was also considered to provide a frame of reference. Vertical and horizontal velocity distributions, change of water depth caused by occurrence of vegetation and variations of velocity distributions caused by different density of vegetation were studied.

The second part of investigation was run in a compound laboratory channel in the Agriculture University of Warsaw in Poland. Long series of measurements of longitudinal, transverse and vertical components of velocity give chance to provide good information about turbulence in channel with vegetated floodplains. Analyses of the distributions of turbulent intensities and higher order velocity moments and their dependence on the occurrence of riparian vegetation will be discussed and presented.

Mean velocity distributions in the main channel hardly depend on the density of veg-

etation. Large differences between values of mean velocities in the main channel and the floodplain are observed and the latter can be even 5 times lower. Almost uniform vertical velocity distributions were observed on the floodplains. The turbulent intensities are visibly higher in the interaction zone between the main channel and the floodplains and slightly higher on the floodplains than in the main channel. Contour maps of velocity and turbulent intensity are presented to show spatial differences in their distribution in a cross-section.