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VISUALIZATION OF FLOW PAST A VERTICAL CYLINDER IN SHALLOW WATER

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It is known from the literature (e.g. Seal and Smith, 1999) that vortex structure above the plate can lead to the eruption of boundary layer. It seems that similar phenomenon was observed behind a vertical cylinder placed in shallow water.

Vortex formation from a vertical cylinder in shallow water was investigated using visualization by dye marker. Experiments were conducted in a water channel equipped with settling reservoir and two packets of drinking straws. The main test section is 100 mm in depth, 100 mm in width and 2000 mm in length. The entrance to the test section is preceded by Witoszynski nozzle guaranteeing the uniform flow in this cross-section. Schematic of the shallow water experimental setup is shown in the Fig. 1. The dye injection was placed in the base of cylinder and carried out with the help of infusion pump. Letting in the dye marker is schematically presented in Fig. 2.

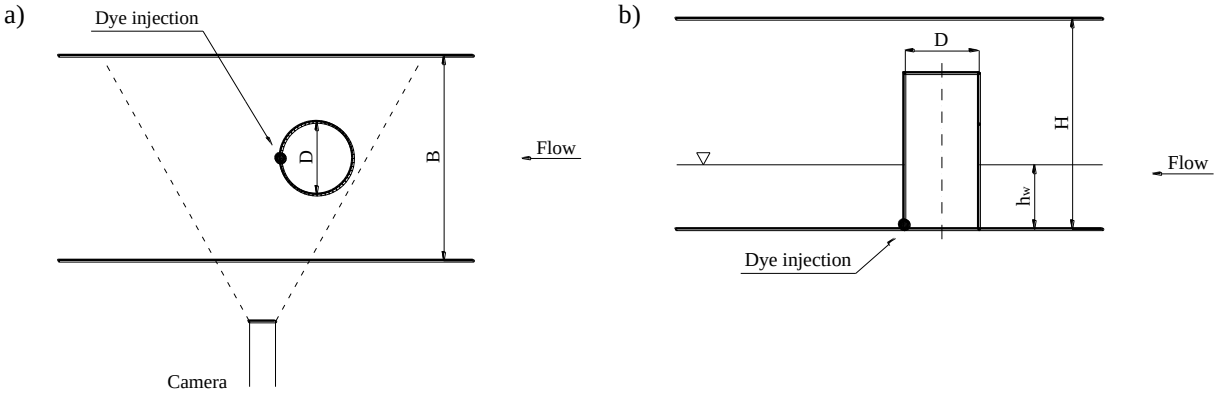

Fig. 1. Schematic of experimental setup: a) plan view, b) side view.

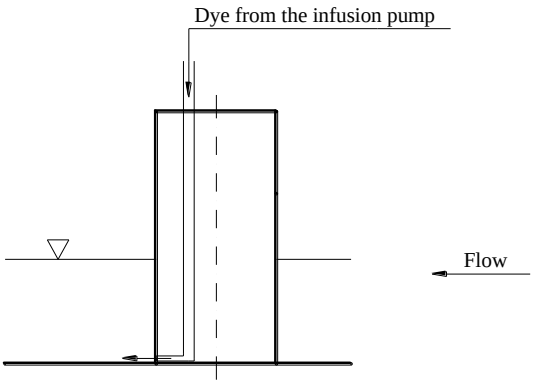

Fig. 2. Schematic of the dye marker letting in.

The vertical cylinder D = 14,65 mm in diameter was separated from the entrance to the test section and located at a distance of 1000 mm from it to ensure the fully formed velocity profile.

Previous investigations of flow past a vertical cylinder placed in shallow water were carried out for law values of h_w/D, where h_w is the water depth in the test section, e.g. $h_w/D << 1$ (Chen and Jirka, 1995) or $h_w/D = 0,5; 1; 2$ (Akilli and Rockwell, 2002).

Present researches were conducted for h_w/D changing in the range of 0,8-4,8 for various mean velocity and various Reynolds number. Formation of three-dimensional horizontally oriented vortex in the near-wake region was observed by dye visualization. It was noticed that the size, shape and evolution of this vortex structure depend on h_w/D and mean velocity. Exemplary images for h_w/D = 1,43 and 2,05 (the Reynolds number Re = 440 for both cases) are presented in Fig. 3.

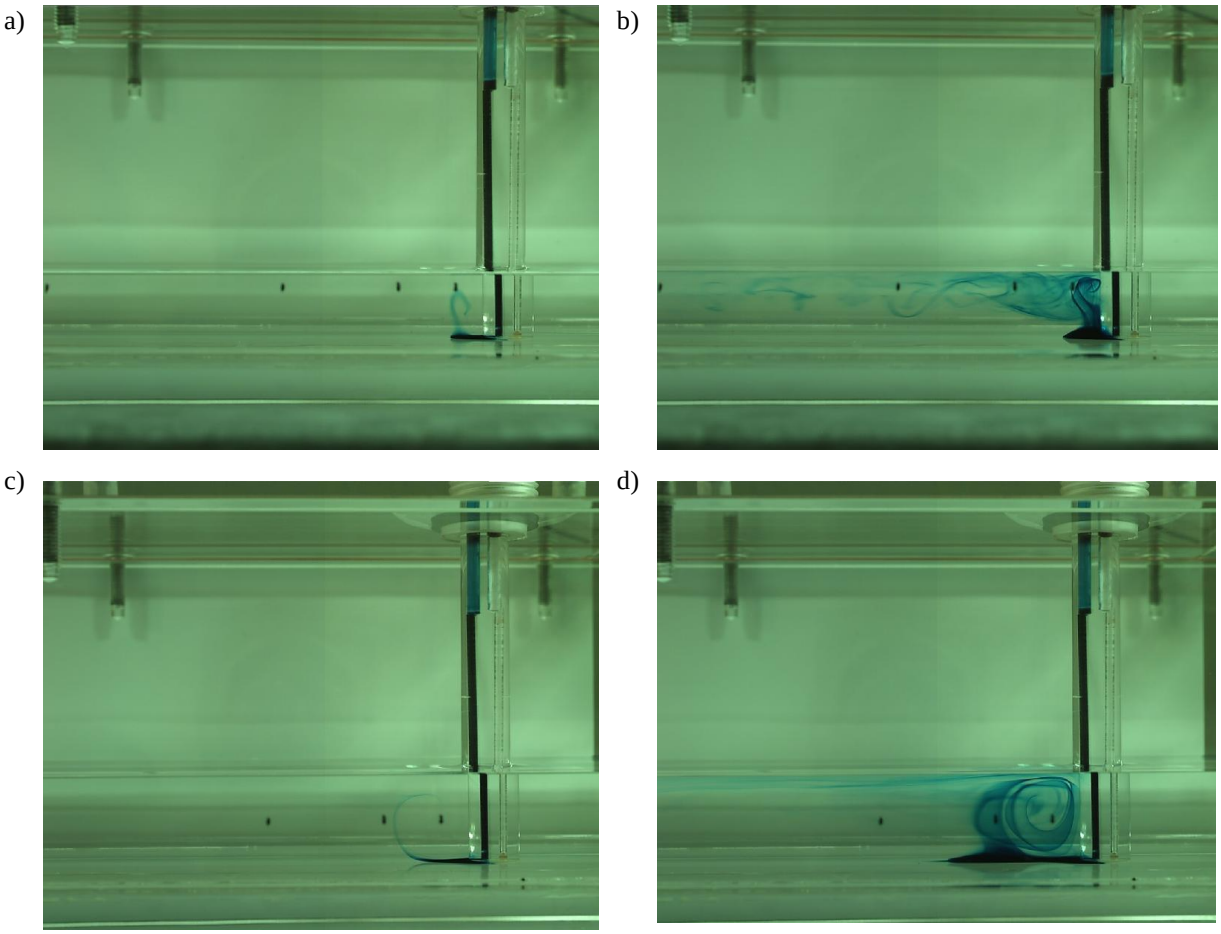

Fig. 3. Exemplary images of the near wake region for:
a) h_w/D = 1,43 – vortex formation, b) h_w/D = 1,43 – vortex evolution,
c) h_w/D = 2,05 – vortex formation, d) h_w/D = 2,05 – vortex evolution.

References

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