Gravity Current around Circular Cylinder

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Abstract

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The present study is to exam the interaction of a fully developed gravity current with a circular cylinder. A series of experiment was performed in a water tank of 16.62 m long, 0.61m wide and 0.45 m deep. The lock exchange scheme was used for generation of the gravity current. Specific gravity of the saline water used for current generation in the experiments was controlled in the range of 1.0035 to 1.0040. Motions of the gravity current interacting with a 14 cm diameter circular cylinder situating at 5.05 m downstream were recorded with a 3CCD digital camera with the Laser Induced Fluorescence (LIF) technique. Quantitative and qualitative results of these experiments are reported.

In general, when the current met the cylinder, two main processes were observed. Part of it split and went around the cylinder while part would run up the cylinder front. The split current merged back together at the downstream end of the cylinder and appeared as a fully developed one at about 1.7 to1.9D (D = diameter of cylinder) downstream of it.

From the present observations, the run up process of the current on the cylinder front could be divided into three stages; they are impact stage, transition stage, and steady stage. The maximum run up heights of the impact stage and transition stage were 55-65% and 73 % of the total water depth, respectively. Variation of the observed maximum run up height at the impact stage appeared to depend on the Froude number of the incoming current. At the same time, the maximum run up height in the transition stage could be controlled by the flow circulation induced by the reverse

fresh water flow around the cylinder and above the saline water. The steady stage of the run up process on the cylinder began when the first reflected jump in the upstream end of the cylinder occurred. It was found that the subsequent reflected disturbances had a cyclic characteristic influenced by the vortex shedding process generated from the reversed fresh water flow around the cylinder in the upper fluid layer.

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