ENERGY DISSIPATION BY FLOW CHARACTERISTICS OF NAPPE AND SKIMMING FLOW

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Energy dissipation is one of the most important features in the design of many hydraulic structures.

Drop structure is usually installed to protect the stream bed against scour since it is the typical case for energy dissipation. It may be more useful for energy dissipation by the stepped type of the downstream part of the flow section. Thus, stepped drop structures are assuming a new role for energy dissipation and for reduction the size of the retention basin.

The flows over the stepped drop structures are characterized by the large amount of self-entrained air. The macro roughness of the steps leads to a sharp increase in the thickness of the turbulent boundary layer. Where the boundary layer reaches the free surface, air is entrained at the so-called inception point of air entrainment.

The present study deals with the air entrainment and the energy dissipation by flow characteristics at the stepped drop structure. Hydraulic analysis on the air entrainment and the energy dissipation by the nappe flow and the skimming flow, and the relationships of the energy dissipation to the hydraulic parameters were presented through the hydraulic experiments.

Nappe flow occurred at low flow rates and for relatively large step height. Dominant flow features included an air pocket, a free-falling nappe impact and a subsequent hydraulic jump on the downstream step as shown in Fig. 1.

Skimming flow occurred at larger flow rates with formation of recirculating vortices between the main flow and the step corners (Fig. 2).

Energy dissipations in both cases of nappe flow and skimming flow were proportional to the step height and were inversely proportional to the overflow depth, and were not proportional to the step slope. Significant energy dissipation takes place through the maintenance of recirculating vortices and the variations of free surface water profile. Experimental values showed the similar results as the theoretical ones, but they must be verified quantitatively through further more results.

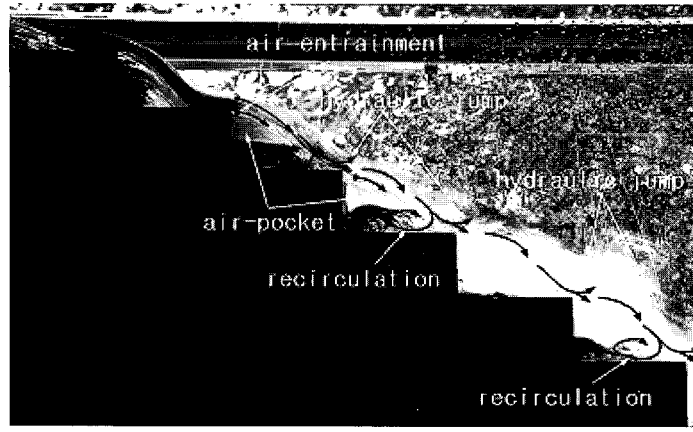

Fig. 1 Nappe flow

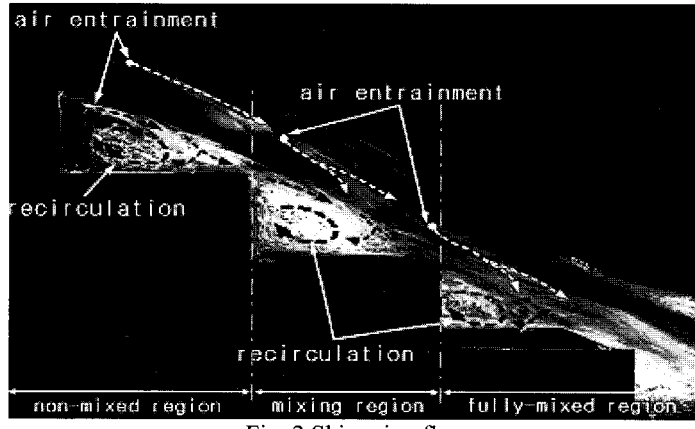

Fig. 2 Skimming flow

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