Contribution to determining the discharge coefficient of orifices and hydraulic nozzles

Flows through orifices and hydraulic nozzles were used as water clocks from antiquity to the 16th century. Nowadays, orifices and nozzles are used for flow measurements. Some components of water intake, wasteway and spillway structures function as orifice or nozzle. Most of the work was conducted in constant flow, without taking too much time on the specific aspects of flow with relative minor loads and diverse configurations of bell-mouthed entry and output components of the structures. That said, these specific aspects have a proved effect on the hydraulic working and on the conveyance of the structures under review consequently.

The thesis's objective is to make a contribution to the discharge coefficient determination of the wasteway and spillway structures for relative minor loads, on the basis of a test-study with a fully-consideration of the factors that have an influence on hydraulic working and operating conditions of the structures under review, and in particular the relative load factor (H/d).

Test-studies for steady flow that yields horizontally through cylindrical orifices and nozzles, were performed in ENSH's hydraulic laboratory on a test installation that consists of a head tank with h = 1.3 m height ,and a base area of 0.5x0.5 m^2 and a return tank with a 0.5 m height and a base area of 1.5 x 0.5 m^2. On the vertical wall of the load tank, an opening was made for attachment of the various models of tests, orifices and nozzles (input and output).

Results of the experiments performed on flows by sharp-edged orifice, showed that Froude's number has an influence on the conveyance, for relative loads $\frac{H}{d} < 15$.

Experiments were also performed on flows through cylindrical nozzles (output and input) for large variation ranges of Reynolds number (Re) and relative load $\frac{H}{d}$. In the working range of Reynolds number, we found that this setting has no effect on the flow characteristics. However, the discharge coefficient depends on the relative length 1/d and the relative load $\frac{H}{d}$. Surface tension forces have no effect on the rate of discharge by nozzle.

Based on test results, we found that with equal conditions $\frac{H}{d}$ and $\frac{l}{d}$, and

discharge coefficient of input nozzle is below than that of output nozzle with 13 %. This confirms the fact that with equal diameter and equal load, discharge rate and velocity in the input nozzle are below the output nozzle.