NUMERICAL INVESTIGATION OF HYDRODYNAMIC FORCE ON OUTLET GATES

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The design of hydraulic structures is usually consisted of physical model studies to check the performance of these structures. The main problem is that physical model studies are not only very expensive but also time consuming. However, with the construction of fast and powerful computers, it is possible to solve complicated problems in various fields of engineering practices, using numerical simulations. The results were then used to modify the geometry and hydraulic characteristics of the structure with low cost. In this paper numerical analysis of flow through bottom outlet conduits were applied to determine the hydrodynamic force caused by flow on leaf gates. The model was applied for various gate openings of 10%-100% to check the effect of gate opening on the accuracy of the results. A 1:12 scaled physical model of Dasht-e-Abbas bottom outlet tunnel at Khuzestan province of Iran was also used to check the results. A set of pressure tapings were fixed on the upstream side of the gate and the effective force was computed, having the piezometers areas and their measured pressure.

Dasht-e-Abbas bottom outlet consists of a service radial gate (2.5m×2.1m) and an emergency leaf gate (2.6m×1.7m) which are expected to operate under a maximum head of 51m. The model, scaled of 1:12, was made of plexy glass at Water Research Institute of Iran for this study (WRI 2001). The model also consists of an upstream 3.5m diameter of inlet tunnel, and a 7.0m transition to direct the entering flow to the main section, where it is controlled by the service and emergency gates. Downstream of the service gate, air entrainment through surface water is allowed to eliminate cavitation damages.

The discharge was measured using a sharp-crested weir to calculate the velocity inside the tunnel. Measurements were repeated for different gate openings to check its effects on pressure distribution and thus, the effective hydrodynamic force on leaf gate.

A computer program based on $k-\varepsilon$ turbulence model was applied to simulate the flow within bottom outlet conduits. The results were then compared with those of experimental results of Dasht-e-Abbas irrigation bottom outlet conduit. With different gate openings, the results of the effective vertical and horizontal forces on leaf gate show a reasonable agreement between the experimental and numerical analysis, especially at higher gate openings. The discrepancy between the results for small gate openings is more pronounced. Similar conclusion is also valid for top and bottom force coefficients of K_t and K_b. This information shows the capability of the model to predict the flow characteristics within the

bottom outlet conduits. In some extend, it will also help the designers of such structures to stay away from relatively costly experimental measurements and physical model studies.

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