World Applied Sciences Journal 15 (10): 1442-1444, 2011
ISSN 1818-4952

Experimental Investigations of Effect Intake Angle on Discharge in Lateral Intakes in 180 Degree Bend

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Abstract: Diverted flow has been the subject of interest for researchers and hydraulic engineers for many years. In general, diversion flow can be categorized as natural and artificial flow. Natural flow diversion usually occurs as braiding or cut-off in bend rivers, while artificial flow is man-made to divert flow by lateral intake channels for water supply. This paper presents the results of a laboratory research into effect intake angle on discharge ratio in lateral intakes in 180 degree bend. Investigation on lateral intake and determination of intake angle is among the most important issues in lateral intake on discharge ratio with model intake angle were measured in a laboratory flume under clear-water. Experiments were conducted for various intake angles and different locations with one Froude number. The results of the model study indicated that in all locations at 180 degree flume bend, increases discharge ratio occurs at angle of lateral intake of 45 degree.

Key words: Lateral Intake · Intake angle · Discharge ratio · 180 degree bend

INTRODUCTION

Intake structures on channels are intended to divert a certain amount of water Q from the channel for various purposes of use (irrigation, potable water supply, hydroelectric power). It must be possible for both the diverted water and the remaining supply to be evacuated without damage being caused.

Open-channel dividing flow is characterized by the inflow and outflow discharges, the upstream and downstream water depths and the recirculation flow in the branch channel. Ramamurthy and Satish, [1], Ingle and Mahankal [2], Ramamurthy *et al*. [3] and Hager, [4] recognized that the downstream-to- upstream discharge-ratio of the main channel is the most relevant parameter in the analysis of open-channel 90 degree dividing flow.

The results from the above analyses compared quite satisfactory to some experimental observations. Most of the analyses restricted themselves to the development of a relationship for depth ratio, discharge-ratio and energy losses through the division.

Neary and Odgaard [5] concluded that the bed roughness as well as the branch-channel to main-channel velocity-ratio would affect the three-dimensional flow structure. The primary objective of the present study is to propose a depth-discharge relationship and energy loss coefficient for subcritical, equal-width, right-angle 2 dividing flow over a horizontal bed. With known upstream discharge and the prescribed branch flow discharge and downstream depth, the upstream depth is determined from energy considerations. The energy loss coefficient due to division is expressed as a function of Fru, Q and Y. The contraction coefficients at the maximum width-contracted section in the recirculation region and the cross-sectional mean flow angles at the branch entrance are determined using velocity measurements.

Lateral intake rock is a simple structure which is consists of a channel on the river lateral to the river flow (Fig. 1).

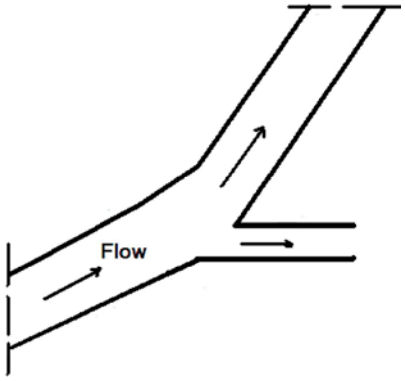

Fig. 1: Sketch of lateral intake

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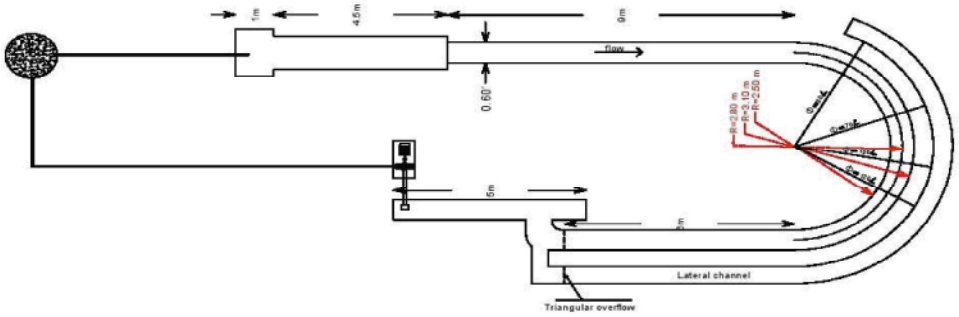

Fig. 2: The experimental setup (Plan)

MATERIALS AND METHODS

The experiment reported herein was conducted in a recirculation flume, with central angle of 180 degree, central radius of Rc=2.8m and width of B=60cm. Relative curvature of bend was Rc/B=4.7 which defines it as a mild bend. Straight entrance flume with the length of 9.1 m was connected to the 180 degree bend flume. This bended flume is connected to another straight flume with the length of 5.5m. The test area of the flume is made up of an aluminum bottom and Plexiglas sidewalls along one side for most of its length to facilitate visual observations. At the end of this flume a controlling gate was designed to adjust the water surface height at the desired levels. Lateral channel was wide b=0.25 m and ended with a weir to ensure that the considered downstream sections were sub critical and nearly uniform. The division corner to the branch channel was sharp-edged rectangular and open-channel junction consisting of a main channel (Fig. 2). The lateral intake was placed at locations of 30, 70, 100 and 120 degree at 180 degree flume bend [6, 7].

The experiments were carried out using four position 180 degree bend flume under four different angle of lateral intake 45, 60, 75 and 90 were used [7, 8]. In this study the experiments were performed under clear-water without sediment conditions at one Froude number 0.47 applied in order to investigate the effect of flow conditions on the discharge ratio. All the experimental tests where conducted under the same flow depth.

The water discharge was supplied by a constant head tank located upstream of the inlet section of the flume. Both the water diverted by the lateral intake and the water flowing downstream were collected in a tank located below the flume and pumped through a recirculation pipe to the head tank. The total water discharge (Qt) was measured through one triangular weir located at the first section of the flume and water discharge diverted through

Fig. 3: Lateral intake

the lateral intake (Qs) was measured through one triangular weir located at the end downstream of branch channel. The water surface was measured automatically along the axis of the flume by a profiler mounted on a carriage moving along two rails parallel to the bottom of the flume (Fig. 3).

The value of discharge ratio (Qr) was calculated using the measured data from the following equation:

$$Q_r = \frac{Q_s}{Q_t} \quad (5)$$

RESULTS AND DISCUSSION

Effect of Angle of Lateral Intake on the Discharge Ratio: Figure 4 shows effect of angle of lateral intake α = 45, 60, 75 and 90 on the discharge ratio at locations θ = 30, 70, 100 and 120 degree at 180 degree flume bend for one Froude number 0.47. Results shown, in all locations at 180 degree flume bend, increases discharge ratio occurs at angle of lateral intake of 45 degree. The main reason of such finding is that angle of 45 degree is agreement with streamline flow at flume bend and maximum of discharge diverted through lateral intake [7, 8].

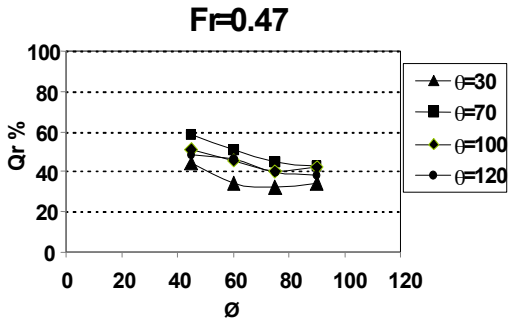

Fig. 4: Effect of Angle of Lateral Intake on the Discharge Ratio

ACKNOWLEDGEMENT

Author thankfully acknowledges the financial support provided by Islamic Azad University Ahvaz Branch.

REFERENCES

1. Ramamurthy, A.S. and M.G. Satish, 1988. Division of Flow in Short Open Channel Branches. J. Hydr. Engrg. ASCE, 114(4): 428-438.
2. Ingle, R.N. and A.M. Mahankal, 1990. Discussion of 'Division of Flow in Short Open Channel Branches. by A.S. Ramamurthy and M.G. Satish. J. Hydr. Engrg. ASCE, 116(2): 289-291.
3. Ramamurthy, A.S., D.M. Tran and L.B. Carballada, 1990. Dividing Flow in Open Channels. J. Hydr. Engrg. ASCE, 116(3): 449-455.
4. Hager, H., 1992. Discussion of 'Dividing Flow in Open Channels. by A.S. Ramamurthy, D.M. Tran and L.B. Carballada. J. Hydr. Engrg. ASCE, 118(4): 634-637.
5. Neary, V.S. and A.J. Odgaard, 1993. Three-Dimensional Flow Structure at Open Channel Diversions. J. Hydr. Engrg. ASCE, 119(11): 1223-1230.
6. Raudkivi, A.J., 1993. Sedimentation. Exclusion and Removal of Sediment from Diverted Water, IAHR.
7. Razvan, E., 1989. River intake and diversion dams. Elsevier Science Publishing Company Inc. New York. NY. 10010. USA.
8. Novak, P., A. Moffat and C. Nalluri, 1990. Hydraulic Structures, Pitman. London, pp: 546.