Study hydraulic properties and design criteria for the river subsurface intake with a porous medium without cut off

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Abstract

Collection of surface and subsurface waters in small seasonal rivers is very crucial, particularly in dry seasons. In this study a kind of intakes introduced, the system acts as a river drainage network. In this study an experimental model of the subsurface intake was constructed and the effective parameters such as upstream discharge, installation depth, and drains interval were evaluated. The results showed that the water diversion mostly influenced by the upstream flow rate. The very small drain interval caused the discharge of each drain to be reduced. It was also revealed that the total drained discharge in the very transmitting media was mostly controlled with the number of drain and drain interval did have a marginal effect. Finally the regression equations were established to estimate the discharge of each drain based on dimensional analysis, which facilitate the design of this structure.

Keyword: subsurface intake, porous media, drainage system, design criteria

1. Introduction

Rivers are considered as one of the providers of water and energy for the nature and the human. The provision of water has been the most important economical role of the rivers and the suitable design of a river intake is one of the oldest issues in hydraulic engineering. However, due to complexity of river flows, designing an intake in a natural river has remained as an important topic in the river engineering.

The water diversion method depends on flow conditions, topology and morphology of river and economical considerations. The multitude of types of intake from rivers can be divided into lateral intakes, frontal intakes and bottom intakes (Raudkivi, 1993). In bottom intakes that are used mostly in mountainous rivers; the flow is diverted through a conduit installed underneath the river bed. Some parts or all of the length and width of the conduit in river bed are made as openings and water is unloaded into the conduit through these openings. Garot (1939) conducted experiments on the bottom intake with longitudinal bars as the horizontal grid. Other researches such as De Marchi (1947), Bouvard (1953), Kuntzmann and Bouvard (1954), Noseda (1956 a, b), Mostkow (1957), Brunella (2003), Righetti and Lanzoni (2008) and Maghrebi and Razaz (2009) have investigate different aspects of the bottom intakes with the reticular bottom.

Problems such as clogging, corrosion, freezing, storage and discharge of sediment to the system limit the applicability of this type of intake (Castillo and Lima, 2010). These disadvantages caused the replacing the meshed conduit with a porous media to be advised. Naqhavi et al. (2010) studied the properties of bottom intake with the porous material experimentally. The