

## SPATIALLY VARIED FLOW IN NON-PRISMATIC CHANNELS I: DYNAMIC EQUATION<sup>1</sup>

S. KOUCHAKZADEH\* AND A. R. VATANKHAH MOHAMMAD-ABADI

*Irrigation and Reclamation Engineering Dept., University of Tehran, P.O. Box 4111, Karaj, 31587-11167, Iran*

### ABSTRACT

The bottom width of channels carrying spatially varied flow with increasing discharge is usually flared in the flow direction. This produces a non-prismatic section. This paper, based on the law of linear momentum conservation, presents a new form of the governing dynamic equation for flow in such circumstances. In addition to the computed water surface profile, the proposed equation affects the position of the control section and its flow depth as well. Copyright © 2002 John Wiley & Sons, Ltd.

KEY WORDS: irrigation channel; modelling; flow equation; spatially varied flow id + numerical solution, experiment

### RÉSUMÉ

La largeur du lit de cours d'eau, variée spatialement par l'augmentation du débit, influence la direction de l'écoulement. Cette procédure crée une coupe irrégulière de cours d'eau. Cet article présente une nouvelle forme de l'équation dynamique dans cette situation de l'écoulement. La méthodologie est basée sur la loi de conservation linéaire de momentum. L'équation proposée est capable de calculer le profil de niveau de l'eau. Elle affecte aussi sur la situation de coupe de contrôle et la profondeur de l'écoulement. Copyright © 2002 John Wiley & Sons, Ltd.

MOTS CLÉS: canal d'irrigation; modélisation; écoulement spatialement varié; équation de transfert id + analyse numérique, expérimentation

### INTRODUCTION

When the discharge,  $Q$ , varies along a channel the flow is classified as spatially varied flow. According to the positive or negative variation of  $Q$  in the flow direction, spatially varied flow with increasing or decreasing discharge are recognized respectively. In unsteady spatially varied flow, both the spatial and temporal variations of flow characteristics are also presented. In this study, steady spatially varied flow with increasing discharge is considered. Flow within road ditches, roof gutters, drainage conduits, wash-water trough flows in water and wastewater treatment plants, and side channel spillways are some practical examples of structures conveying spatially varied flow with increasing discharge. Side channels are frequently used in conjunction with emergency side spillways to evacuate excess water, which usually emerges in an irrigation network because of flood movement, sudden decrease in the downstream demand, and sudden shutdown of pumps following power failure. Also upstream of major structures in an irrigation network such as long inverted siphons, a side spillway with its channel is usually utilized to safely remove excess water to the nearest natural or man made drainage channel. Figure 1 shows a schematic presentation of a side spillway and its channel.

\* Correspondence to: S. Kouchakzadeh, Irrigation and Reclamation Engineering Dept., University of Tehran, P.O. Box 4111, Karaj, 31587-11167 Iran.

<sup>1</sup> L'écoulement varié spatialement dans un cours d'eau irrégulier. I: Equation dynamique.

*Received 29 September 2000*

*Revised 15 July 2001*

*Accepted 23 August 2001*