EFFECT OF REYNOLDS NUMBER ON CHARACTERISTICS OF SKIMMING FLOWS IN STEPPED CHANNELS

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Stepped Channels are effective for dissipating the energy of heigh-velocity flows in channels. The flow condition of stepped channels is characterized by an aerated flow.

Recently, the air-concentration profile for skimming flows has been discussed by many researchers [e.g.: Chamani and Rajaratnam (1999); Boes (2000); Chanson (2000); Boes and Hager (2003); Ohtsu et al. (2000 and 2004)]. The air-concentration profile might depend on a scale of experimental model. However, a scale effect on the air-concentration profile of stepped channel flows has not been clarified.

For the hydraulic design of stepped channels, it is significant to clarify the range of Reynolds number in which the effect of viscosity on the air-concentration profile is negligible.

This paper presents the effect of Reynolds number on the air-concentration profile of skimming flows in stepped channels. The analysis of the experimental data including the data of Boes and Hager (2003) revealed that the effect of Reynolds number R_e on the magnitude and distribution of air-concentration ratio C and the relative aerated flow depth $y_{0.9} / d_c$ is negligible for $4.0 \times 10^4 \leq R_e \leq 3.7 \times 10^5$ [$R_e = q_w / v_w$; q_w is discharge per unit width; v_w is kinematic viscosity] (Figs. 1 and 2). For $R_e \geq 4.0 \times 10^4$, a similar air-concentration profile $C = F(y/y_{0.9})$ for different Reynolds number R_e is obtained under given channel slope θ and relative step height S / d_c [S is step height and d_c is critical flow depth] (Fig.1). Also, for $R_e \geq 4.0 \times 10^4$, the relative aerated flow depth $y_{0.9} / d_c$ is independent of R_e (Fig.2). In the range of $R_e < 2.0 \times 10^4$, the magnitude and distribution of air-concentration ratio C and the value of relative aerated flow depth $y_{0.9} / d_c$ depend on Reynolds number R_e (Figs.1 and 2).
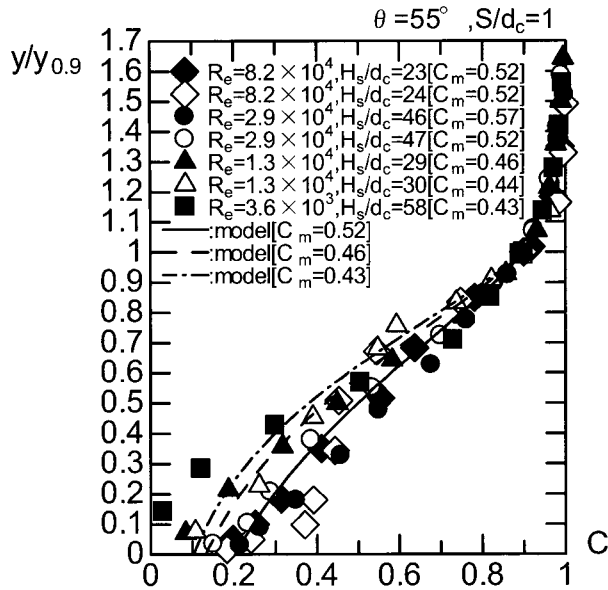
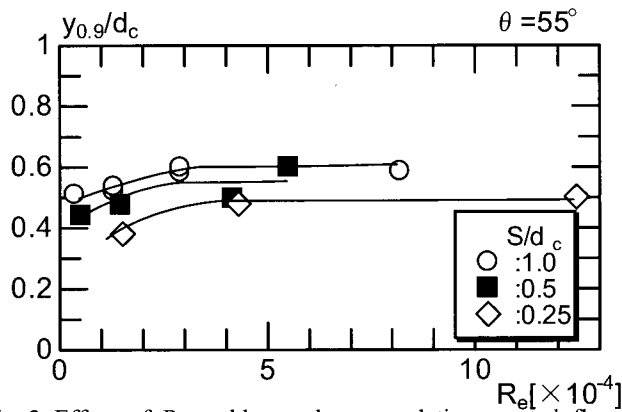Fig.1 Effect of Reynolds number on air-concentration profile

Fig. 2 Effect of Reynolds number on relative aerated flow depth $y_{0.9}/d_c$

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