土木学会第51回年次学術講演会（平成８年９月）

II-131

Effects of Unsteadiness on Velocity in Compound Channel Flow

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INTRODUCTION

The knowledge of unsteady flow characteristics is important for solving river engineering problems such as sediment transportation and deposition etc. Unsteady flow structures are complicated and three dimensional. In this technical note, effect of temporal depth variation on velocity is discussed.

EXPERIMENTS AND RESULTS

The same tilting flume as described in Tu et al. (1994) was used and experiments were conducted in a compound channel with one side flood plain (Fig.(1)). Short term and long term unsteady flow hydrographs shown in Fig.2 were generated. For more details, see Jayaratne et al. (1995). Detailed velocity and depth measurements were recorded for both hydrographs using electromagnetic probes and limnimeters at a section 12m from the flume entrance, which guarantees a fully developed flow.

Vertical velocity profiles of longitudinal velocity components (u) at z=65cm, 80cm and 90cm are shown in Fig.3 and Fig.4, for the water depth 7cm and 8cm respectively. These diagram show the velocity variations at a particular water depth in rising and falling stages for both hydrographs. The rates of change of water depth with time were calculated using water depth measurement for corresponding time instances relating to the above mentioned conditions. To minimize the effect of fluctuation of water depth in calculations, averaged water depths for 3 seconds were used. Calculated results are given below.

Depth (cm)	Data	Short term		Long term	
		Rising	Falling	Rising	Falling
7	time at:	99s	252s	151s	558s
	d(D)/dt	0.062	-0.022	0.0521	-0.0162
8	time at:	112s	210s	176s	490s
	d(D)/dt	0.074	-0.030	0.067	-0.014

Here, d(D)/dt in cm/s.

According to the figures, velocities close to the interface are much smaller than that at middle of channel due to momentum transfer between main channel and flood plain flows. Temporal water depth variations in rising stage for both hydrographs at considered water depth have little difference and velocities also are quite same. However, temporal water depth variations are quite higher in falling stage for short term hydrograph than that for long term hydrograph at above mentioned depths (see.Table) and velocities at falling stage are smaller for the short term hydrograph.

CONCLUSIONS

From the results presented above, it may be concluded that temporal water depth variation acts as an indicator of unsteadiness and when it changes rapidly, velocity variation is also rapid.

REFERENCES

(1) Jayaratne BL, H.Tu, N.Tamai , K.Kan(1995), xxvi IAHR, London, vol.1,pp.385-390
(2) Tu, H., N. Tamai ,K. Kan(1994), Proc.of Hydrau. Eng., JSCE, Vol.38, pp.703-708

Acknowledgements: We would like to express our grateful thanks to Mr. H.Sato Graduate student at Univ. of Tokyo, Asso. Professors K. Kan and I. Maruyama of the Shibaura Institute of Technology for their valuable contribution in experimental campaign.

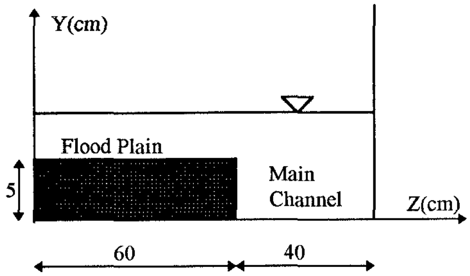

Fig.1 A sketch of the measuring section.

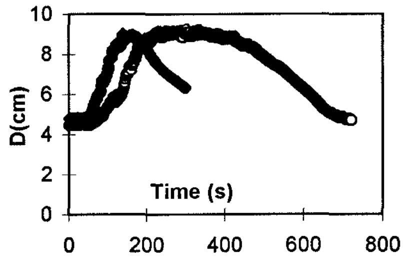

Fig.2 Hydrographs.

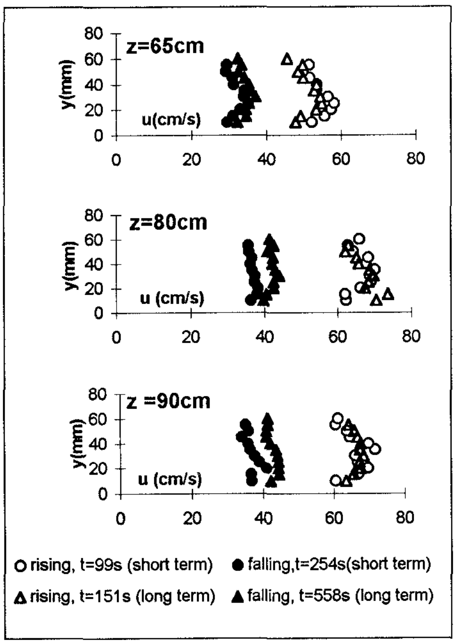

Fig.3 Vertical profiles of u, at water depth 7cm.

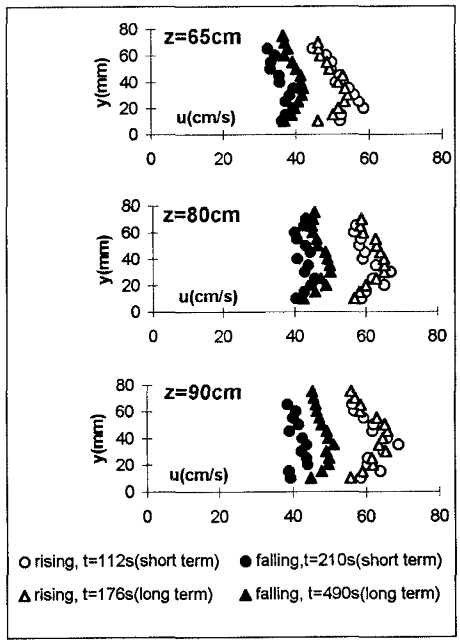

Fig.4 Vertical profiles of u, at water depth 8cm.

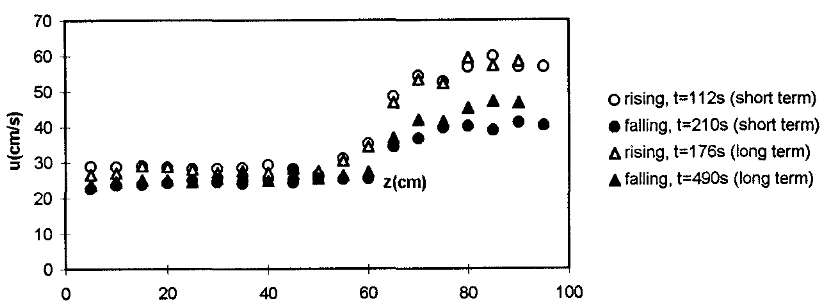

Fig.5 Variation of u, across the channel section at water depth 8cm.