II -183 UNSTEADY FLOW VELOCITY VARIATIONS IN A COMPOUND CHANNEL WITH OR WITHOUT A VEGETATED FLOOD-PLAIN

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INTRODUCTION

The most important feature of compound channel flows is the strong interaction between main channel and flood-plain flows. For channels with vegetated flood-plains, flow structure indicates complicated three dimensional behaviors and it becomes more complex for unsteady flows.

In this technical note, using velocity and depth measurements taken across a compound channel with or without vegetation on the flood-plain for unsteady flow condition, comparison of velocity distribution is made. Furthermore it indicates that the velocity distribution across the channel section causes secondary flows and eddies in the interactive contact zone, which dissipates energy and has effects on the water surface elevation, too.

EXPERIMENTS AND RESULTS

The same tilting flume as described in Tu et al.(1994) was used and experiments were conducted for a compound channel with or without a vegetated flood plain Fig(1.a). For the vegetated food-plain, rigid wooden cylinders were used as model plants, in order to make a rigid vegetation layer. The diameter and height are 0.2cm and 5cm respectively. The model plants were set in a square pattern of 2.5cmx2.5cm on an acrylic resin plate, which was itself fixed on the flood-plain. The thickness of the resin plate is 1.45cm, such that the flood-plain thickness is 6.45cm. The measuring section was selected at a distance of 12m from the flume entrance while the vegetated zone was 8m long. Detailed velocity and depth measurements were taken throughout the experiments.

Figure 2.b shows that the water surface elevation in the interactive contact zone is significantly lower than those of other area for the channel with vegetated flood-plains, whereas it is less significant for the compound channel without vegetated flood-plains. For the channel with vegetated flood-plain, The longitudinal velocity components in the main channel are very much higher than those on the flood-plain and velocity gradient close to the interface is also very high Fig(3.b). Even this phenomenon is valid for the compound channel without a vegetated flood-plain, it is not so prominent there because the energy dissipation in the interactive contact zone is significantly higher for the channel with vegetated flood-plain than that for the channels without vegetated flood-plains.

For both cases, it shows that, for an equal water depth, the velocity difference between rising and receding stages is relatively smaller on the flood-plain as compared that in the main channel. But that difference is comparatively higher for the compound channel without a vegetated flood-plain. Furthermore, velocity distribution is highly non-uniform for both rising and receding stages specially for the channels with vegetated flood-plains.

The transverse velocity distributions in the interactive contact zone show a different phenomena for these two cases. From the Fig.(4.a), it can be seen that transverse velocity components in the interactive contact zone is always towards the main channel under the given condition. However, for the vegetated flood-plain with almost similar conditions, it is positive in the rising stage, indicates that the flow is towards the flood-plain direction whereas in the receding stage, it is towards the main channel.

CONCLUSIONS

From the results presented above, it may be concluded that: (1) For the channels with vegetated flood-plains, because of the higher energy dissipation in the interactive contact zone, water surface elevation is lower than that in compound channels .(2) Velocity difference between main channel and flood-plain is significantly higher for the channels with vegetated flood plains.(3) Velocity distribution in the transverse direction is highly non-uniform in the both rising and receding stages and velocity gradient close to the interface is quite high, specially for the channels with vegetated flood-plains.(4) The transverse velocity distribution across the section is considerably different for these two cases.

REFERENCES

[1] Shimizu, Y. and T. Tsujimoto (1993), "Comparison of Flood Flow Structure between Compound Channel and Channel with Vegetated Zone", Proc.of XXV Congress of IAHR, Vol.I, pp.97-104

[2] Tu, H., N.Tamai and K.Kan (1994), "Unsteady Flow Velocity Variations in near an Embayment ", Proc.of Hydraulic Eng., JSCE, Vol.38, pp.703-708

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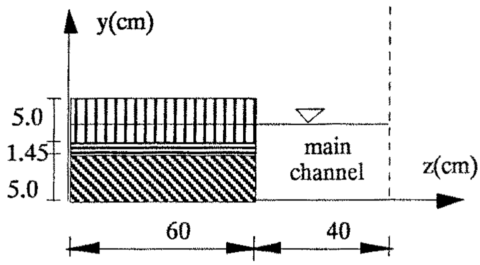

Fig.1.a A sketch of the measuring section

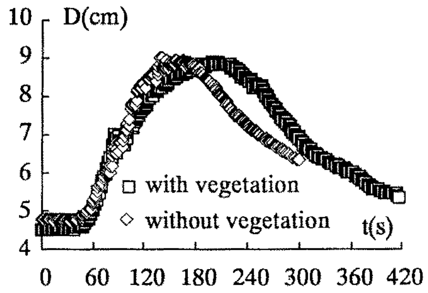

Fig1.b Hydrographs in the experiments

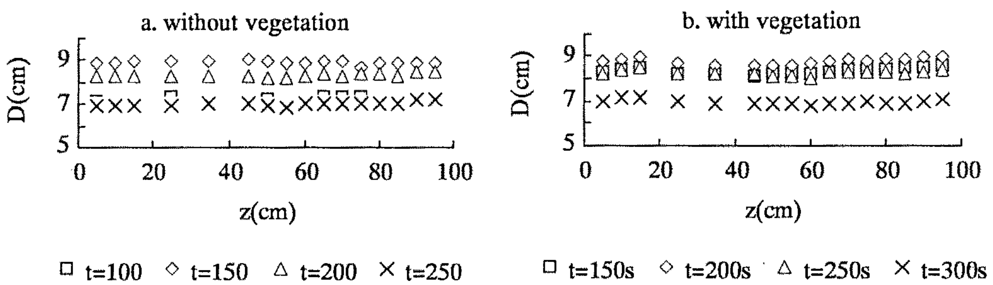

Fig.2 Surface water elevations at different time instants

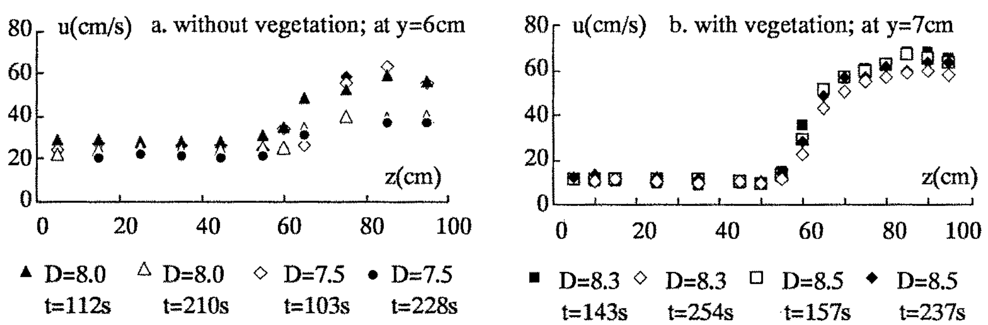

Fig.3 Transverse variations of the longitudinal velocity component, u

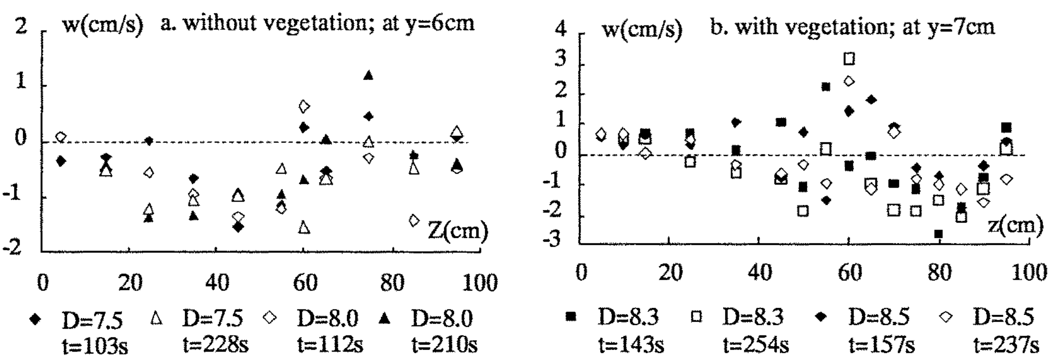

Fig.4 Transverse variations of the transverse velocity component, w
Positive w-values indicate flows to the flood plain direction, and vice versa