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RIVER BEND BANK PROTECTION
BY SIDE VANES INSTALLED AT THE OUTER WALL

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1. INTRODUCTION

A feature typical of alluvial rivers is tendency toward meandering. In each bend helical current is produced and causes a variation in bed elevation. This variation is caused by the presence of centrifugal force, which is a consequence of the channel and streamline curvature. As a result of the vertical gradient of streamwise velocity, difference of centrifugal forces between the upper and lower portions of the fluid arise. Consequently, a secondary current is imparted to the fluid as it moves around bend. The present work is an attempt to study the new secondary flow pattern generated by the installation of special devices refered as "vanes" in the outer wall of a circular channel. This new line of analysis emerged from the studies in channel bend flow by Odgaard and Kennedy (1). In their model, the idea is to eliminate or reduce the secondary flow. In the present model the concept involves the modification of the transverse flow pattern in such a way that the new one could generate a double cell of the transverse currents. That is, the modification of the riverbed process in bends of channels in order to generate deep scour process near the channel central axis, and consequently improving the alignment of the course for better navigation and bank protection.

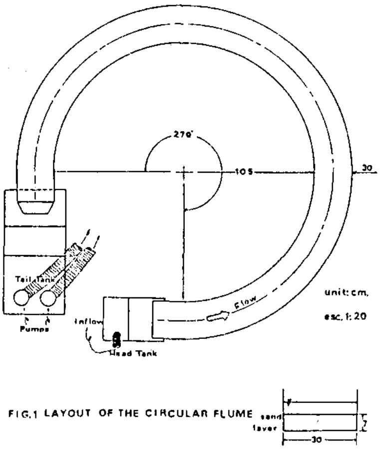

FIG.1 LAYOUT OF THE CIRCULAR FLUME

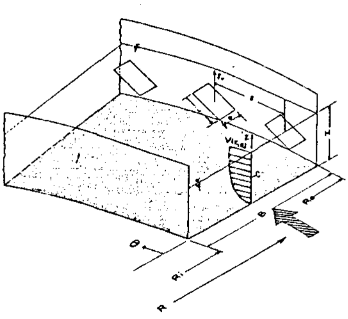

FIG. 2 FLOW IN THE CHANNEL BEND AND VANE ARRANGEMENT

2. EXPERIMENTAL OBSERVATIONS

The first part of the experiments was conducted in a fixed rough bottom in order to study the features of secondary flows with and without side vanes.(Fig. 1 shows the experiments flume). For that purpose, a thin layer of sand(d=0.93 mm) was attached. The velocity distribution of the radial component is shown in Fig. 3. Keeping similar conditions for the channel, experiments were performed with vanes (2 x 4 cm.) installed at an angle of incidence of 15^{o} approximately in the outer wall with centerline spacings of 10 and 20 cm.(Fig. 2). The radial velocity distributions in the same section for flow with and without vanes are shown in Figs. 3 and 4, respectively. It is seen that the influence of the vanes in the creation of a new pattern of secondary flow is evident, and Fig. 4 shows that the expected double cell of transversal currents was obtained .

In order to analyse the bed configuration under influence of secondary currents, a layer of sand (same characteristics of the described above)with a uniform thickness of 7 cm, was spread over the flume bottom and the experiments were performed without and with the use of vanes spaced in a similar way by 10 and 20 cm. The temporal evolution of bed profile was observed for both cases. Fig. 5 shows the variation of transverse bed profile with time for flow without vanes. It is clearly observed the scouring and deposition process near the outer and inner walls. For the second case, it is shown in Fig. 6 that new generated bed profile is a consequence of the transformation of secondary currents originated from the installation of vanes. It is evident that the double cell affects the lateral bed profile. In another way of analysis, comparative states of the transverse bed profile after 180 minutes of flow are shown in Fig. 7. In this figure the effect due to vanes is more clearly observed.

3. CONCLUSIONS

The new concept of vanes would appear to offer a different line of analysis for the treatment of a new favorable secondary flow distribution. That is, the generation of a new pattern as a help to improve the alignment of the channel course for better navigation and an alternative of river bend bank protection.

REFERENCES

1.Kennedy, J.F. and Odgaard, A.J.: Jour. of Hyd. Div., ASCE, Vol. 109, No.8 August 1983.

2.Kikkawa,H., Ikeda,S., et al.: Proc.JSCE.No.219,1973

3.Kikkawa, H.,Ikeda, S., Kitagawa, A.: Proc. of JSCE No.251, 1976 (in Japanese).

FLOW WITHOUT VANES

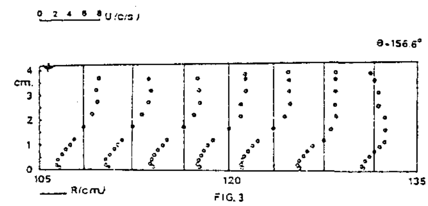

FIG.3

FLOW WITH VANES INSTALLED AT THE OUTER WALL S=20cm.

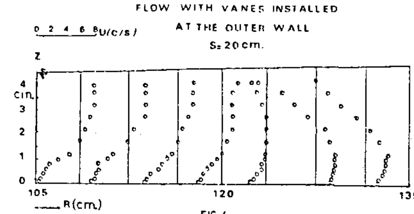

FIG.4

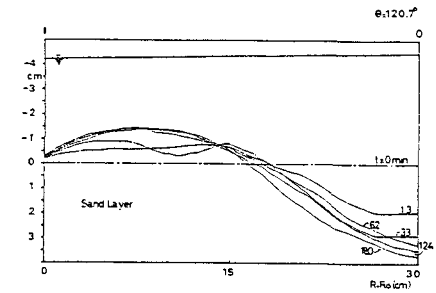

FIG.5 VARIATION OF TRANSVERSE BED PROFILE WITH TIME

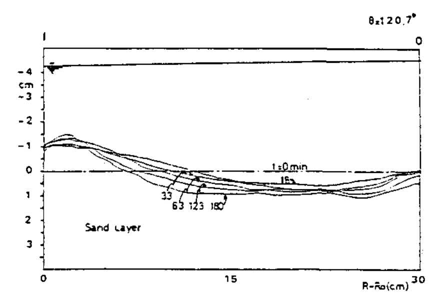

FIG.6 VARIATION OF TRANSVERSE BED PROFILE WITH TIME

FLOW WITH VANES INSTALLED IN THE OUTER WALL S=20cm.

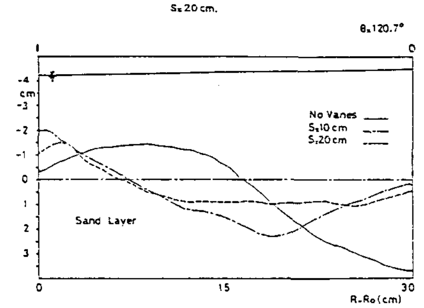

FIG.7 BED PROFILE AFTER 180min. OF FLOW