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VELOCITY PROFILES IN CONTINUOUS BENDS OVER IDEALIZED BARS

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1. INTRODUCTION

As the first stage of the series program of experiments, fixed bed model is utilized[1]. For the second stage, experiments were performed in a flume with alluvial bed[2]. To make quantitative description of flow in bends with alluvial bed possible, it is necessary to harden the bed topography with idealized bars. Flow characteristics in the flume which has a similar planimetric shape as rivers and ten consecutive bends were studied for comparison between the original and the idealized bed topographies .

2. IDEALIZED BARS

To make a theoretical analysis tractable, it is necessary to idealize the bed bars. The idealized bed bars were determined from the bed elevation measurements of channel-bed topography for equilibrium bed in the previous work[3] which has done in the same experimental flume. The mean bed slope was reduced to accommodate the absence of the dunes. The idealized bed topography was obtained by utilizing the quadratic Eq.1.

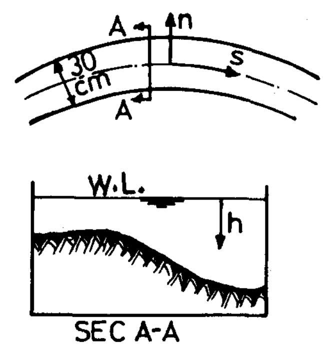

Fig. 1, Definition sketch

$$H = N(C_1 \sin ks + C_2 \cos ks) + (N^2 - 1/3)(C_3 + C_4 \sin 2ks + C_5 \cos 2ks) \qquad (1)$$

where (see Fig. 1)

$H = (Ho - h)/h$, h = bed elevation ,

C_1, C_2, C_3, C_4 and C_5 = constants,

$N = n/15$, $k = 2\ /L$,

L = total path distance along a meander,

s = longitudinal coordinate parallel to the tangent of the centerline of meander , and

n = lateral coordinate taken perpendicular to s- axis.

Contour lines for the equilibrium original model and the idealized bars model in one unit bend are shown in Fig. 2. The overall agreement is fairly good from the general features.

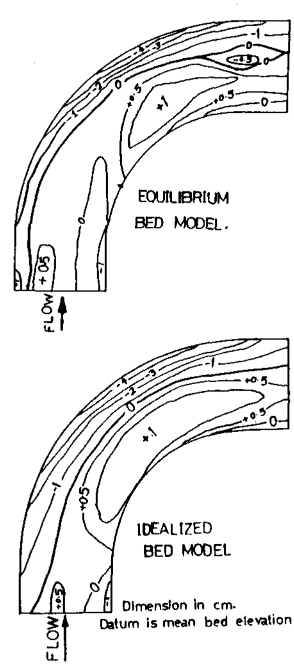

Fig. 2, Elevation contours for bed models

3. VELOCITY DISTRIBUTION

For comparison of the flow characteristics over the idealized bars with those over the original equilibrium bed , velocity measurements were carried out in one unit bend. The measurements covered 9 sections in the unit bend , at every /12 rad. In the transverse direction 14 sub-areas were set for measurements. The angle between the flow direction and s - axis and the magnitude of the velocity vector were obtained separately.

Fig. 3 shows isovels of the mean longitudinal velocity . From inspection of the velocity contours in Fig. 3 and the same one in the previous case[3] it can be clearly seen that the general flow pattern over the idealized bars has shifted downstream by /12 rad compared with that observed in the original case. At the same time the change has no effect on the magnitude of the primary velocity especially near the bottom.

The distribution of the radial mean velocity component is shown in Fig. 4. For a comparison between the previous case[3] and the present case , the secondary current behavior appeared to be similar in both cases.

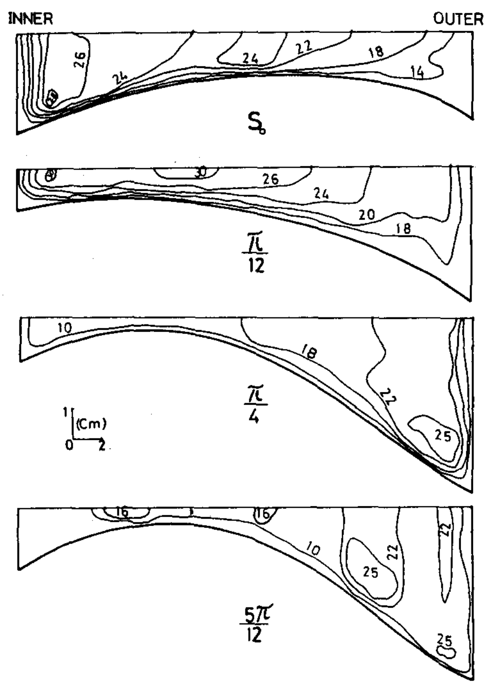

Fig. 3, Isovels of primary velocity (cm/sec)

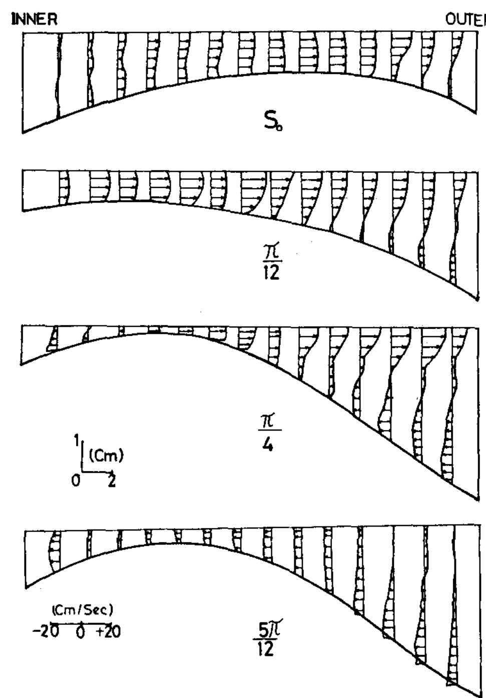

Fig. 4, Distribution of secondary currents

4. CONCLUSIONS

Bed topography in continuous bends can be expressed by Eq.1. It is found that the velocity field for the original movable bed is reproduced over this idealized bed. Measurement of the bottom shear stress is planned utilizing this hardened bed topography.

REFERENCES

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