COMPONENT RESISTANCE PREDICTION IN COMPOUND CHANNELS

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Resistance plays an important role in determining conveyance capacity and sediment transport in compound channels. In the paper, all kinds of representative methods for predicting component resistances were systematically summarized, i.e. cross-sectional division method's five types which were vertical division (VDMT1, VDMT2 and VDMT3) and inclined division (IDMT1 and IDMT2), momentum transfer method (MTM) (Wang, 1998), Liu and Dong's method (LDM) (Liu & Dong, 1995), channel coherence method (COHM) (Ackers, 1993), Shiono and Knight's method (SKM) (Shiono &, Knight, 1991).

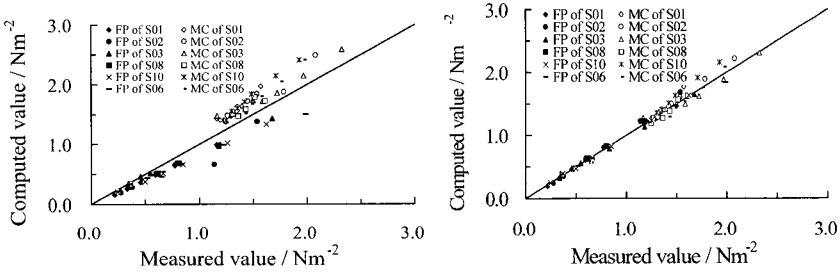
On the basis of experimental data from Science and Engineering Research Council Flood Channel Facility (SERC-FCF), the mean boundary shear stresses of each subzone were computed for different series. From Table 1, the computed results indicate that SKM and inclined division method type 1 (IDMT1) obtain very high precision, and the other methods can not fit to assess the component resistances. By comparing the two cases of considering and ignoring the effect of secondary flow by SKM, it is found that the secondary flow strongly affects the distribution of boundary shear stress, shown in Table 1 and Fig. 1. If ignoring it, we can not correctly assess the component resistance. The reason why IDMT1 have high precision, lies in the fact that inclined shear stress may be ignored for a symmetric compound channel. But its main difficulty is in finding the position of the division line for all the shapes of compound channel. SKM considers the action of secondary flow. In the meanwhile, it is pointed out that the reasons why the other methods mentioned above are not fit for compound channels, are analyzed. VDMT1 doesn't consider the effect of the vertical apparent shear stress. VDMT2 and VDMT3 don't reflect the fact that the apparent shear stress on the vertical interface between the main channel and the flood plain drives the flow of flood plain to move. The assumption of IDMT2 that the apparent shear stress exists on the inclined interface and equals to the boundary shear stress in the main channel, is not consistent with the experiment of SERC-FCF. However simply altering the wetted perimeter by the vertical line doesn't completely reflect the interaction effect because this interaction effect is not a simple function as the flood plain flow depth increases. Although MTM, LDM and COHM consider the effect of momentum transfer, they ignore the influence of secondary flow on boundary shear stress. As a result, the three method's precisions are not high.

In assessing the component resistance in a natural compound channel with irregular cross section, the authors think that SKM is considered first. For a symmetric compound channel, IDMT1 may be also considered. The experiment (Knight, 1990) testifies that the inclined apparent shear stress may be ignored. If we determine the resistance in the main channel only, COHM may be considered also.

Table 1. Mean values of absolute value of relative errors for component resistances

by different methods

Series / Method		S01		S02		S03		S08		S10		S06		Mean	
		FP	MC	FP	MC	FP	MC	FP	MC	FP	MC	FP	MC	FP	MC
SKM	Γ≠0	4.4	5.0	7.3	4.0	4.2	4.0	3.8	3.3	3.4	6.0	3.2	3.6	4.4	4.3
	Γ=0	19.7	16.6	22.7	14.0	12.8	14.0	16.4	12.0	18.3	20.8	15.9	14.8	17.6	15.3
IDMT1		13.5	16.3	12.4	7.1	17.7	6.2	12.5	8.3	8.4	4.6	16.5	7.0	13.5	8.2
COHM		22.0	8.6	25.9	4.4	35.7	18.4	24.7	7.5	25.2	3.5	30.3	10.6	27.3	8.8
LDM		8.4	14.0	20.9	19.9	60.9	19.8	16.7	17.6	22.4	17.1	22.0	8.8	25.2	16.2
MTM		26.5	16.8	26.5	16.8	26.9	20.5	27.6	20.6	28.4	13.7	26.5	16.8	27.1	17.5
VDMT1		22.0	31.1	25.9	20.7	35.7	11.0	24.7	23.2	25.2	20.5	30.3	14.6	27.3	20.2
VDMT2		22.0	25.4	25.9	14.2	35.7	5.0	24.7	15.9	25.2	14.7	30.3	11.4	27.3	14.5
VDMT3		22.8	25.4	27.7	14.2	39.9	5.0	26.6	15.9	27.0	14.7	31.9	11.4	29.3	14.5
IDMT2		13.5	40.0	12.4	45.8	17.7	50.1	12.5	41.3	8.4	47.2	16.5	26.2	13.5	41.8



(a) ignoring secondary flow (b) considering secondary flow

Fig. 1 Effect of secondary flow on component resistance according to SKM

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