SPURS IN RIVER ENGINEERING – A PRELIMINARY STUDY

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Spurs are river engineering elements to protect river banks from erosion and to concentrate flow to the river axis. Today, spurs are also employed for promoting environmental conditions along a river bank (Melville and Coleman 2000, Richardson et al. 1975). These elements are characterized by a large variety of mainly geometrical parameters, of which none is fixed. This study identifies optimum spur arrangements in a straight river thereby considering a particular granulometry and restricting mainly to the clear-water flow regime. Laboratory observations were conducted to investigate four typical spur arrangements (Fig. 1): (1) Uniform spurs, (2) Staggered height spurs, (3) Staggered width spurs, and (4) Combined staggered height and width spurs. It was observed that the first two or three spurs undergo significantly more scour than the tailwater spurs, such that spur arrangement (1) is a poor technical solution. Arrangement (2) performed satisfactorily provided the first spur has half height of the tailwater spurs, such that only a portion of the oncoming flow impinges the front spur. Spur arrangements (3) and (4) were found to have no advantage as compared to arrangement (2). Given the simple spur configuration of constant spur length b along with a constant spur height $s=(1/2)(s'+s'')$ except for the first spur for which $s_1=s/2$, a technical feasible and economical suitable proposal was elaborated. Note that these observations were conducted in a rectangular straight channel (Oliveto and Hager 2005).

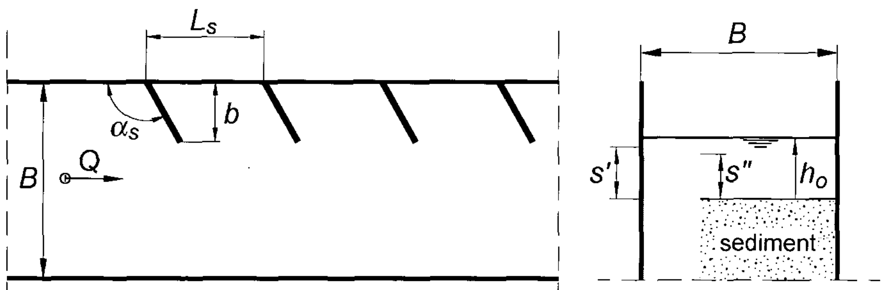

Fig. 1 Definition sketch (a) plan, (b) sectional view

Fig. 2 shows views from the upstream channel end along the spurs perpendicular to the left bank (α_s=90°) of which the relative height was $S=s/h_o$=0.75. A densimetric Froude number of $F_d=V_o/(g'd_{50})^{1/2}$=2.2 was selected, where h_o=approach flow depth, V_o=approach flow velocity, g'=reduced gravitational acceleration and d_{50}=average sediment size. The relative spur width was 10%, if the present model is considered a half model of width 2 m. Three spur spacings $\lambda=L_s/b=1$, 2 and 4 were investigated. The effect of spur spacing is noted to be relatively small for this intermediate discharge load (Figure 2), and is similar for lower and higher discharges. However, the first spur was scoured much more than the remaining spurs, indicating that the main flow impacts onto the front spur, which protects the downstream spurs, therefore. In addition, each spur being scoured generates a streamwise bar that normally protects the following element both by flow deflection and by sediment supply.

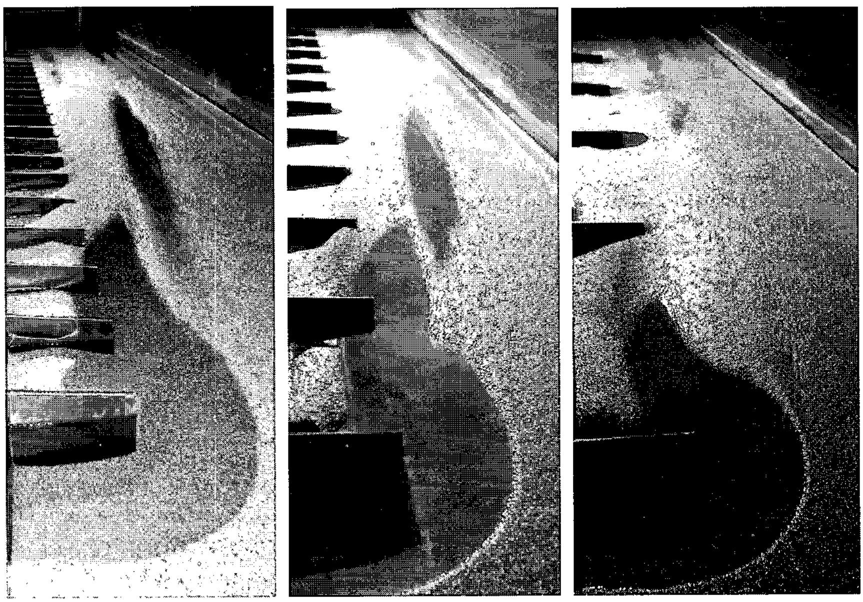

Fig. 2 Effect of spur spacing $\lambda=1$ (left), $\lambda=2$ (center) and $\lambda=4$ (right) for $F_d=2.2$ at time $t=20$ h. View from upstream

The results of the study indicate that the first spurs need additional protection by a suitable riprap to promote nearly uniform scour conditions along the entire spur region. This research is exploratory with photographs describing the essential flow features.

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