SCOUR IN LONG RECTANGULAR CONTRACTIONS

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Contraction scour is a significant problem of engineering concern which should be carefully considered in the design of foundations for hydraulic structures. It can occur when natural constraints (longitudinal bars, confluences, debris accumulations, etc.) or man-made structures (bridge embankments, lateral banks, spur dikes, etc.) restrict a river bed on its flood plains or even its main channel. Figure 1 shows an example in which scour is mainly caused by lateral banks along the river and by the road approach embankments of two bridges in between the stream is narrowest.

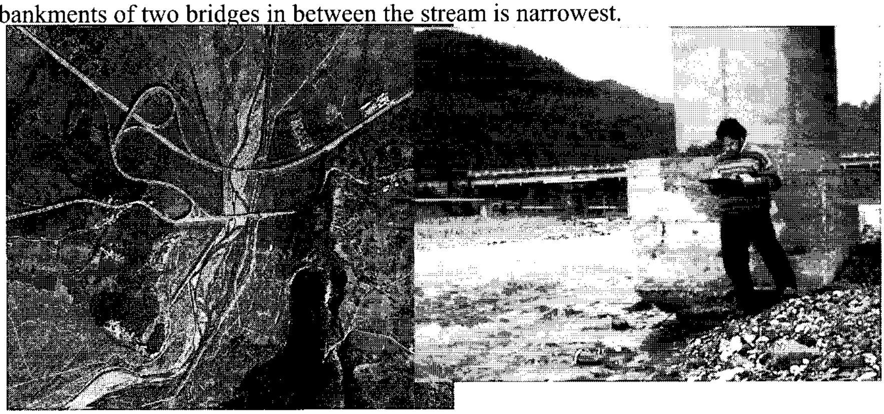

Fig. 1 Contraction scour on Frida Creek (Italy). Aero photograph (left) with the flow from the bottom to the top and bridge piles exposition (right) due to the erosion process

When the flow is subcritical, the constriction induces an increase in bed shear stresses and bed scour consequently. Most of the published works refers to the long contraction case, which in general occurs when the length of the constrained reach is one to two times the width of the undisturbed approach reach. Straub (1934) was probably the first to introduce a simplified one-dimensional approach for long contractions. Afterwards, many equations have been suggested, most of which was derived using Straub's approach (e.g. Laursen, 1960; Komura, 1966; Gill, 1981). A detailed references list is provided by Melville and Coleman (2000). However, experimental data to confirm these equations are scarce. This paper aims to provide a contribute in this ambit. It is a part of a wider project

on the morphological bed evolution in and around a river constriction. Some experiments were carried out at University of Basilicata. They were of long duration to: ensure an adequate accuracy, especially for low degree of contraction; get conditions of quasi-equilibrium; and reduce the interdependence between local and contraction scour effects. Although the number of tests was limited, the results appear wide-ranging and can be summarized as follows: (i) the temporal evolution of the maximum (contraction) scour depth followed a logarithmic trend and an equilibrium stage was never observed; its location was frequently sited downstream of the constriction model; (ii) the Laursen's (1960) method would seem too conservative whereas the methods of Komura (1966) and Gill (1981) appear more reliable, but scatters were frequently found consistent; (iii) starting from the monomial form of sediment transport formulas a power relationship was conjectured in the light of the densimetric Froude number. Observed data validated this relationship and results were found in agreement with the well known Engenlund-Hansen's formula.

Keywords: River; Hydraulics; Contraction scour

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