# ON THE BEDLOAD TRANSPORT CAPACITY IN GRAVEL BED RIVERS

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## SUMMARY

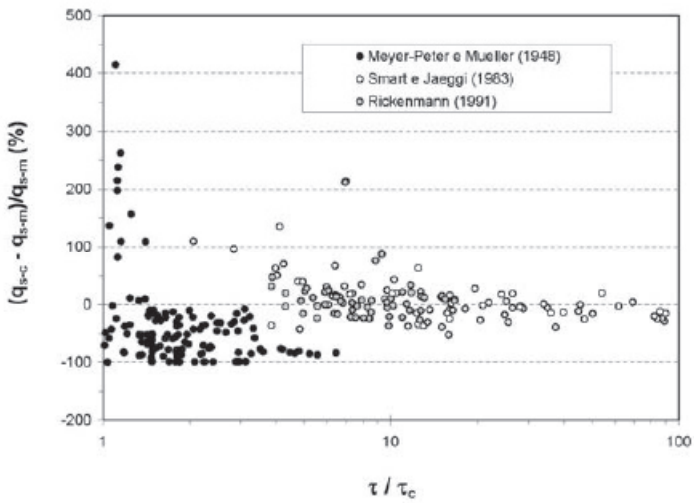
Bedload transport capacity in gravel bed rivers has been studied for a century in laboratory (Graf, 1971). On the other hand a sediment supply conditioning exists in the field that often limits the actual sediment transport respect to the transport capacity (D'Agostino and Lenzi, 1999). Although this discrepancy, the transport capacity assessment is basic to design protection works and to map hazard scenarios for the largest floods occurring in mountain catchments.

The laboratory experiments carried out at the ETH of Zurich (1948-1991) offer a consolidated data set to the scientific community, along with the Meyer-Peter and Müller (1948), the Smart and Jaeggi (1983), and the Rickenmann (1999) bedload transport formulas. The contribution focuses on a new analysis of these well known experiences and it proposes an unpublished physic schematisation of the phenomenon.

The whole data set has been reorganized and homogenized.

At a first step a comprehensive equation has been proposed, shedding on the light the different behaviour of the low gradient Meyer-Peter and Müller data (Fig.1) and a negligible weight, in terms of obtainable accuracy, of the grain size distribution ($d_{90}/d_{30}$; $d_{xx}$=diameter for which the xx% of the sediments are finer; Smart and Jaeggi, 1983). Then, a dynamic equilibrium model has been suggested for the bedload transport estimation at a fully-developed stage.


**Fig. 1**: Relative errors in computing the unit bedload rate ($q_s$) with the comprehensive equation against the ratio between the mean shear stress ($\tau$) on the bed and the critical shear stress at threshold condition ($\tau_c$) ($q_{s-c}$ and $q_{s-m}$ are computed and measured unit sediment discharges respectively).

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The theoretic relation was suitable for calibrating satisfactorily a new bedload equation through the ETH data. The parameter of calibration is unique and the computed value it agrees with its physical meaning. Moreover, some literature findings proposed for hyperconcentrated flow and debris flow (Takahasi, 1991; Ou and Mizuyama, 1994; Marchi and D'Agostino, 2004) join well for appropriate sediment concentration with the new proposed equation.
Some remarks are finally formulated to assess properly the bedload transport in designing torrent control works both for weak and for highly-developed sediment rates.

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