ETH zürich

Morphological dynamics in braided river

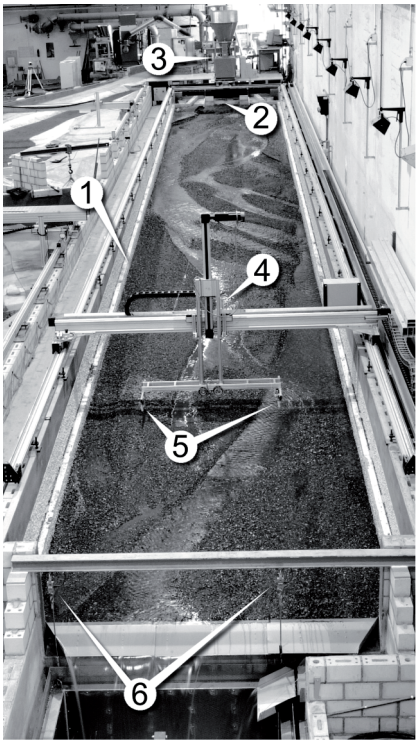

Fig. 1: Overview of the laboratory flume:
1) laterally moveable side elements.
2) water inlet.
3) sediment feeder.
4) xyz-positioning system.
5) laser and ultrasonic sensors.
6) filtering basket with automatic scales.

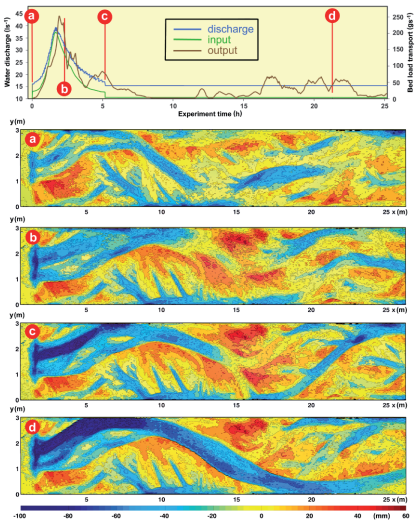

Fig. 2: Morphological changes of the river bed during a hydrograph run (for details see text).

In context of sustainable flood protection, nowadays efforts are made to give the rivers at least parts of their former space back again. The aim of these measures is to improve flood protection and at the same time to eliminate some ecological deficits. Thus, the behaviour and particularly the safety against flooding of wider river sections have to be investigated more frequently. Conventional approaches for the discharge and bed load transport capacity often cause inadequate results, because they are mostly derived from one-dimensional experiments.

To understand the morphologically dynamic processes of such wider river sections, in the late nineties two research projects were carried out at the Laboratory of Hydraulics, Hydrology and Glaciology (VAW) of the Swiss Federal Institute of Technology (ETH) in Zurich. The new flume study "morphological dynamics in braided rivers" is basing on these works of Zarn (1997) and Hunzinger (1998).

The aim of the current study is to gather bed load transport and detailed topographic data under equilibrium conditions for steeper slopes and bed material with a wider range of grain size to enlarge the existing data sets. This enables to test, and if necessary to improve existing bed load transport approaches for braided rivers. For this purpose, in a new laboratory flume (Fig.1) experiments with constant discharge and bed load supply are conducted until an equilibrium state is attained.

Beside the data concerning bed load transport, detailed topographic information, are measured several times during the experiment. This enables to develop different morphological aspects concerning bank and scour formation in braided rivers.

Further, the effect of flood peaks and the influence of long periods with little bed load input on the morphological development and on the bed load transport are investigated (hydrograph runs). Such periods with little bed load input are common in Alpine rivers, mostly due to anthropogenic factors such as stabilisation and bed load retention in tributaries, exploitation of hydropower, as well as gravel extraction from river. The development during such a hydrograph run is exemplarily shown in Fig. 2. In the uppermost diagram the water discharge (blue), the bed load input rate (green) and the bed load output flux (brown) are given. The morphological changes are highlighted with topographic measurements taken at the indicated times a) to d). In Fig. 2a the topography before the hydrograph run is shown. Blue areas mark erosion zones, while red marks aggradation zones (flow direction is from left to right). Fig. 2b shows the situation shortly after the peak discharge and 2c after the recession of the flood wave. Erosion near the inlet progressed downstream but at 15 m a bifurcation is recognisable and near the outlet of the flume 3 or 4 anabranches are still present. Only after the phase of low bed load input massive erosion lead to a single incised channel (Fig. 2d).

Keywords:	gravel-bed braided rivers, bed load transport, flume study, re-widening
Commissioned by:	Swiss Federal Institute of Technology Zurich (ETH)

Laboratory of Hydraulics, Hydrology and Glaziology
Versuchsanstalt für Wasserbau, Hydrologie und Glaziologie