NATURAL EROSION PROCESSES IN THE KORITNICA RIVER, W SLOVENIA, AFTER THE STOZE DEBRIS FLOW

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On November 17, 2000, the Stoze debris flow devastated the Koritnica River valley, a typical narrow alpine valley in W Slovenia (Mikoš et al., 2004). It was the largest event of this kind in the last century in Slovenia. This paper is about the planned river engineering measures successfully carried out to erode debris flow deposits by stimulating natural river erosion processes.

The Stoze debris flow was mainly depositing its masses along its flowpath in the channel of the Predelica Torrent and only locally eroding some very narrow sections. Around 400,000 m^3 of debris material were thus deposited along the debris flow pathway upstream the valley, and nearly 700,000 m^3 were deposited in the valley itself, locally with a thickness up to 10 m. Finer fractions of debris masses were immediately transported downstream in suspension together with wooden debris, and deposited along the Soča River, where some local floodings were caused.

An outline scheme for river engineering measures was adopted in order to stimulate natural river erosion processes. As a basis for this scheme, the results of a hydrologic analysis, granulometric analysis of debris deposits, and preliminary evaluation of cross-sectional sediment transport capacities were used.

The computations of sediment transport capacities used the Meyer-Peter-Müller equation and were based on the variations around the characteristic channel bed slopes of the two streams ($I \sim 2.2$ % for the Koritnica River and $I \sim 4.6$ % for the Predelica Torrent). A flood wave with the duration of 133 hours and the return period of 2 years was created from the measured field data. The computed optimal channel bed width giving the maximum sediment transport capacity in a cross section was strongly related to the mean sediment size and was achieved at the selected channel bed slopes only for mean sediment sizes less than 20 mm. Because the mean size od debris flow deposits was rather larger than 20 mm, channels as narrow as possible had to be chosen.

Routing of three consequtive flood waves using the 1-D mathematical sedimentological and hydraulic model was computed to show the effect of proposed narrow channel bed widths. The applied 1-D model was a fractional model using the active layer approach and suspension of finer bed load fractions but lacking the possibility to take bank erosion into account. Despite intensive sediment supply from the Predelica Torrent (estimated to 4,525 m^3), the sediment input was balanced by the sediment output (computed to 4,574 m^3 of bed load and suspended load) from the computational reach. The channel bed erosion for these 3 consecutive flood waves, whose duration was 16 h for the Koritnica River and 8 h for the Predelica Torrent, respectively, was computed to 1,507 m^3. These results confirmed the effectivness of the proposed narrow channels with the channel bed width somewhat

less that half of the normal channel bed widths prior to the debris flow event: 8 m for the Koritnica River (I ~ 2.2 %, Q_{100} = 211 m^3/s), and 3 m for the Predelica Torrent (I ~ 4.6 %, Q_{100} = 77 m^3/s).

The evolution of river cross sections (Fig. 1) and their longitudinal profiles after the debris flow event in November 2000 was evaluated using field survey data. Altogether, from around 700,000 m^3 of debris flow deposits 100,000 m^3 of fines were transported out of the area immediately after the event, 350,000 m^3 were eroded by the end of 2004, nearly 100,000 m^3 were excavated and put to higher elevation within the cross sections, and 75,000 m^3 were excavated and put to the dumping sites in the area. Up to now, in some parts of the reach of the Koritnica River the initial elevation of the river bed prior to the event was achieved or even exceeded.

This case study has shown that after a major debris flow event river engineering measures must combine fast mechanical excavations of debris deposits in order to form rather narrow channels which will stimulate natural sediment transport processes. In the first phase, incision prevails, which later turns to lateral erosion. Such processes were in the case of the Stoze debris flow deposits successfully stimulated by choosing channel widths of less than 50 % of the normal channel width. Using this approach, in the first 4 years nearly half of the debris flow deposits have been eroded from the devastated area in the Koritnica River valley by natural processes of river erosion.

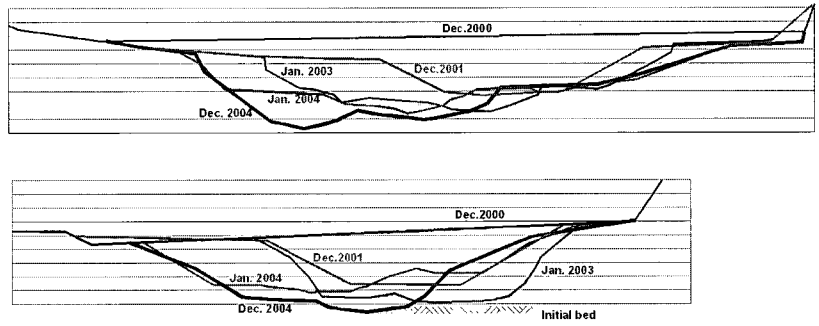

Fig. 1 The evolution of two cross sections (above km 1.129 and down km 1.312) of the Koritnica River after the debris flow event in November 2000. Vertical step is 1 m.

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