Frantisek KŘOVÁK*

The revitalisation of creeks

Abstract

In the past the main goals of rivers with small catchment design were primarily concerned with technical function such as flood control, agricultural use of adjacent fields, and outlet of drainage systems.

Ecological function of the design were often suppressed. The possibilities of how to restore the ecological function, which would be redefined in many cases, are suggested. Some ideas on alignment design, longitudinal profile, crossection, lining of crossection, structures and vegetation are noted. The ecological consequences of revitalisation of small rivers on territorial system of ecological stability are mentioned. Some examples revitalisation of structures are shoved.

Key words: Revitalisation, small rivers, ecological function, construction of structures

Introduction

The revitalisation of small rivers and drainage channels aims at reconciling or the ecological function of these rivers with respect of their technical aspects.

The main **ecological goals** of revitalisation can met with these criteria:

- hydrobiological (transportion function of water, life conditions of organisms),
- hygienic (self-purification ability of water body),
- microclimatic (influence of water and vegetation),
- hydrogeological (drainage effect of river and river valley),
- aesthetic and landscape design (dividing of the landscape by rivers and their ecological consequences).

The main **technical criteria**:

- runoff from catchment and flood control,
- design and use of adjacent fields,
- the river stabilisation due to erosion and sedimentation,
- the possibility of drainage outlet,
- inlet structures,
- maintenance simplicity, etc.

The manner of the revitalisation of creeks

The remedies of how to reach above mentioned goals can be stated as follows: [Ehrlich et al. 1992].

Biotype – Basic conditions is clean water. At least 3rd class of purification (under CZ State Norm) is demanded. The

* Czech University of Agriculture Prague, Faculty of Forestry, Department od Water Resources, Kamýcká 129, 165 21 PRAGUE 6.

biological and biochemical processes must be supported by oxygenation of the water body through changing of the slopes of the river bed and by the small weirs. A maximum flow velocity of 2–2.5 ms^{-1} during the design discharge is recommended. During the low discharge (Q_{330d}) the minimum volume of water per square meter and maximum flow velocity, would be for [Zuna 1993]:

type of streams	min volume (litres m^{-2})	max. velocity (m^3s^{-1})
low land	130	0.35
hilly land	110	0.60
undermountain	120	0.80

Minimum depth of water in calms would be 0.3 m. Minimum depth of river bed sediment is 0.1–0.3 m.

Design Discharges – Can be reduced out side of villages, where flood means lower damage to compare to the ecological aspects. For hydrobiological conditions of life, the low discharges Q_{330d}, Q_{90d}, Q_{30d} are important.

Alignment – The alignment design will not be changed in most cases. Main reasons are cost of these changes and property relationships. Only in the lower part of cross-section interior meanders can changes be made by using natural materials. Next designs can be made in convex part of the banks. Some possibility is to mark out river corridor of suitable width, where the alignment will be develop itself.

Longitudinal Profile – must respect the demands of biological conditions. It is essential to alternate high and low slopes. The maximum depth of channel will usually be 1.2 to 1.5 meters. The drainage outlet can be put under weirs. The slope design must respect onsite material of the stream channel (compensation slope) or utilise natural materials to stabilise the higher slopes. After determining a stable bed slope, sills, weirs and chutes are built into channel to remove the difference between the original and designed slope.

Cross Section – The single trapezoidal cross section will be probably changed by double trapezoidal or dished cross section. The lower part, called the cunette, is designed to convey the annual flow with sufficient depth for a 30-day flow. The upper section's floor, called the berm, is designed for design discharges.
The shape and dimension must respect low discharge from hydrobiological point of view.
In creeks with higher slopes, the discharge is always associated with the determination of a stable channel-bed slope gradient.

Channel lining – includes the lining of the bottom and of the side slopes. The decision as to which type of lining to choose depends on the critical velocity corresponding to each particular type of lining and, if any, on former lining. This velocity must be higher than the average channel velocity at design discharge.
The reduction of the critical velocity in the channel parts exposed to the greatest

should be taken into account when considering the type and parameters of lining for parts of the bottom on concave side bend.
The lining could be done if onsite materials are not resistant against the water current forces. Natural materials in non-vegetation lining (stones, wood) are recommended. Vegetation lining and combined lining are among the environment--friendly interventions. Small transformations of profile are allowed.

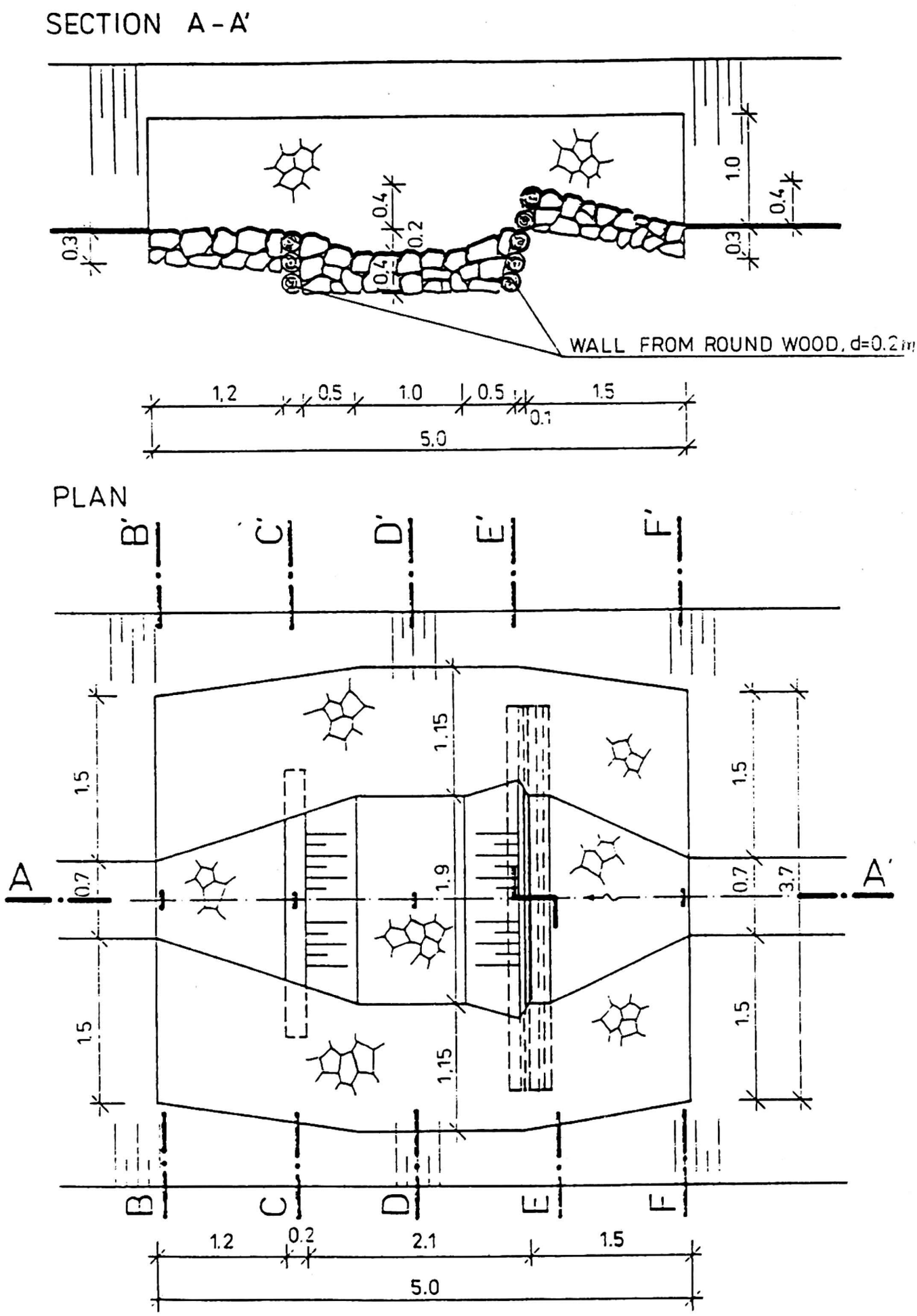
Structures – The main structures to use in revitalisation of creeks include sills, small weirs, chutes and recesses. Their constructions must respect fish migrations and all aquatic life. From these reasons maximum height should not be exceed 0.6 m. Stone and wood are the most preferably materials for building them. The structures must be hydraulically effective, resistant against scouring and environment-friendly.
Some example of the structure is on Figure 1. It is Small Weir suitable for low land and hilly land creeks with width of bottom till 1.5 m. The body of the weir and apron sill is built from round woods. From static reasons the wier body is made on the skew, 0.1 m throw out of parallel against the upstream. The lining of the upstream bed and banks are made from riprap (diameter from 0.15 to 0.20 m). An apron is lined by riprap (diameter from 0.20 to 0.30 m) and arranged like hole 0.20 m depth and 2 m length.
The purpose of this small weir is modification of the slope, backwater of water level, the forming of hole 0.2 m depth with 2×1.9 m water surface under weir. Revitalisation effect consists in forming permanent and deeper water on smaller watercouses in a reduced flow which creates a refuge for fishes, amphibians and invertebrates.

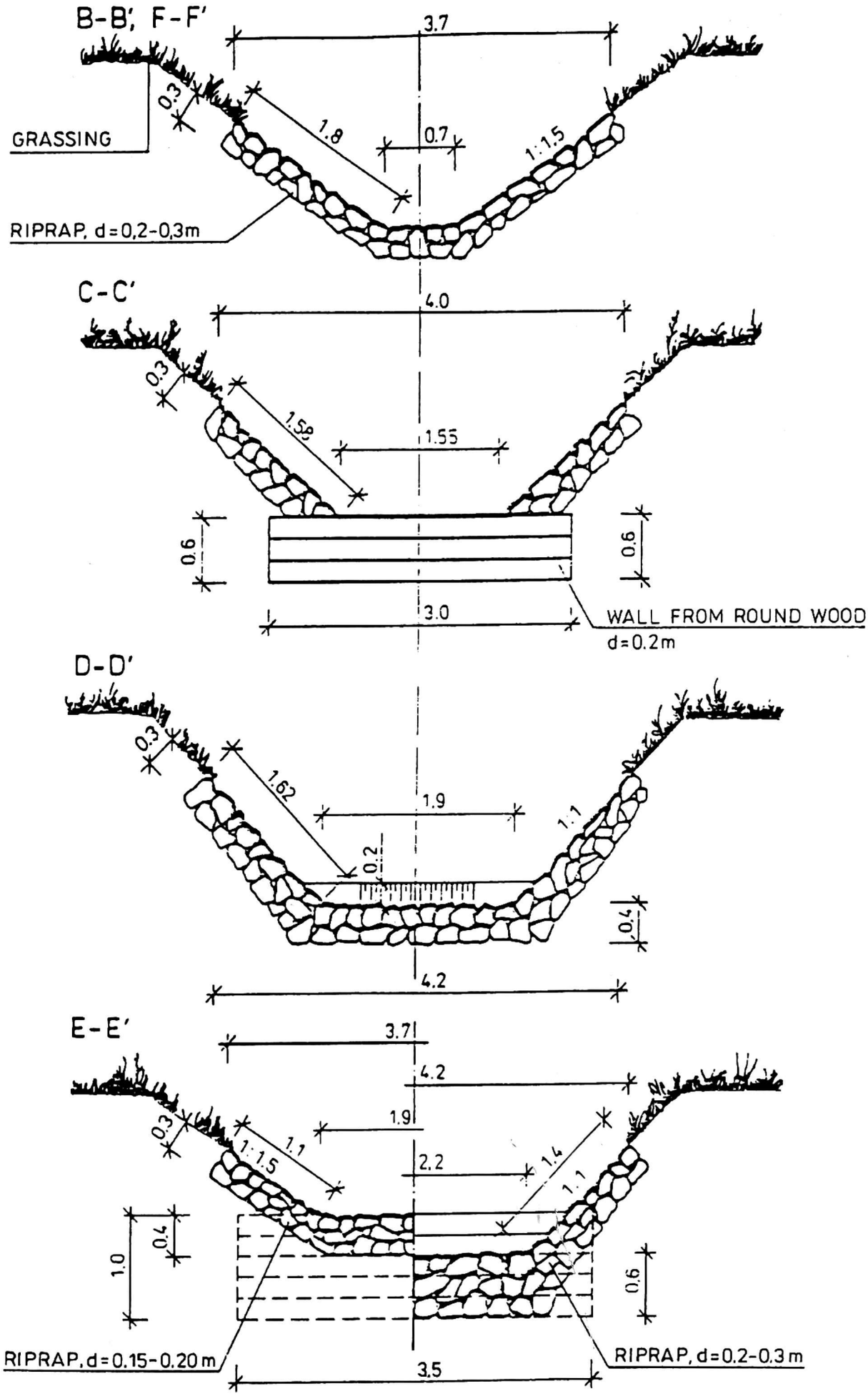
Vegetation – Is a native part of channels. Besides the spatial, stabilising, self--purification effect etc., vegetation creates wider corridors of waterways and can be a component of the territorial system of ecological stability. These corridors also protect water in the channed from off site damage from water erosion because runoff from the land carries sediments, fertilisers and pesticides into the body of water. Last but not least, the structure and species composition of vgetation influences aesthetics and creation of the landscape.

Hydraulic design – The revitalisation usually changes the original design parameters. New design of hydraulic characteristics must be namely calculated:

- capacity of the channel for design discharges including the structures,
- discharge circumstances (depth, velocity in characteristic profiles, silting up. uvergrowing) for low discharges,
- the bottom and banks stability against the water flow,
- the influence of the structures and vegetation on discharge and stability of channel,
- expectable and allowable transformation of channel.

Fig. Small weir




B-B', F-F'
3.7
0.3
GRASSING
1.8
0.7
1:1.5
RIPRAP, d=0,2-0,3m
C-C'
4.0
0.3
1.59
1.55
0.6
0.6
3.0
WALL FROM ROUND WOOD
d=0.2m
D-D'
0.3
1.62
1.9
1:1
0.2
0.4
4.2
E-E'
3.7
4.2
1.9
0.3
1:1.5
1.1
2.2
1.4
1:1
0.4
1.0
0.6
RIPRAP, d=0.15-0.20 m
RIPRAP, d=0.2-0.3 m
3.5

For complicated hydraulic calculations the computers programs are possible to use (for example HYDROCHECK 1, 2, 3 from Hydrosoft Ltd. Prague).

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