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New biogeotechnical and hydrotechnical techniques for restoring watercourses

Răzvan VOICU*, Karol PLESIŃSKI**, Doru BĂNĂDUC***, Liliana VOICU*

*National Institute of Hydrology and Water Management, București-Ploiești Street 97, București, Romania, RO-013686, getiiliberi@gmail.com, ORCID: 0000-0002-3459-173X, lilianavoicu80@gmail.com, ORCID: 0000-0001-9164-7042.,

** University of Agriculture in Krakow, Department of Hydraulic Engineering and Geotechnics, Mickiewicza Avenue 21, Krakow, Poland, PL-31-120, k.plesinski@ur.krakow.pl, ORCID: 0000-0003- 2157-2502, (correspondence author),

***Lucian Blaga University of Sibiu, Applied Ecology Research Center, Dr. Ion Raţiu Street 5-7, Sibiu, Romania, RO-550012, ad.banaduc@yahoo.com, ORCID: 0000-0003-0862-1437.

ABSTRACT: Green and gray or blue and green techniques began to develop rapidly in the world due to the continuous degradation of water courses (habitat, water quality, bank erosion, etc.). The subject of article represent an European theme of great topicality and interest regarding the restoration of the water courses affected by the hydromorphological pressures created by the presence of transversal and longitudinal works which lead to the interruption of longitudinal connectivity of rivers. Climate change amplifies the deterioration of canalized (anthropogenic) watercourses. Thus, it is necessary to find eco-friendly solutions that help to restore them ecologically. The presented solutions help to restore the ecology of watercourses.

SOLUTION 1

Ecological restoration of concrete channels with the help of floating modules

The floating module is built of durable plastic, aluminum or wood treated to withstand water. This module can also have the shapes that the concrete channel has. The upper part of the system is trapezoidal in shape and is crossed inside by the water captured from the canal. About half of the floating trapezoidal channel is filled with water. The water enters the trapezoidal canal due to the fact that it is equipped with river stones, earth on the edges and a metal counterweight (fig.1). A metal frame (vault) is fixed to the edges of the concrete channel, to which two metal bars are fixed (welded). These metal bars are vertical and penetrate the existing holes in the sheet piles that are fixed to the floating module (fig.1). These metal bars allow the system to move vertically depending on the fluctuation of the flow in the concrete channel. An important thing is that due to the sliding of the two bars by which it is fixed to the floating mode, it will have a constant flow inside even if in the concrete channel its flow is decreasing or increasing. We can say that these floating modules have variable geometry in the vertical plane. Due to the earthen carpet fixed with the help of plastic dowels, aquatic and semi-aquatic plant species can be planted in the same way (fig.1 and fig 2). In order to be able to float, the module has a metal counterweight bar (if necessary) (fig.1) but also a space inside to float with the model of the marine buoy. The modules are connected to each other by rubber membranes (as are the buses with rubber bellows in the middle) (fig2). These rubber membranes provide mobility to the modules especially when water hits these modules from the side. The module can have different dimensions but the same shape depending on the size of the concrete channel and the depth of the water in it. Floating modules can take many forms. In this case I will choose a module consisting of a circle and a rectangle(fig.2). Inside these modules you can find habitats corresponding to different species of fish, amphibians, insects, waterfowl, etc. The system brings a substantial ecological contribution to the area. If they are flooded and the floating modules suffer some damage, they can be changed quickly, restoring the functionality of the system. But also landscaping is beneficial for the area but also in terms of filtering the water of the concrete canal. In the cities it brings an extra useful greenery.

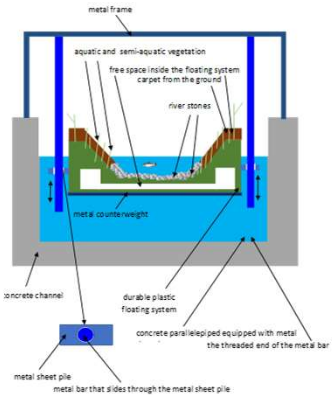

Figure 1 Cross section of the system

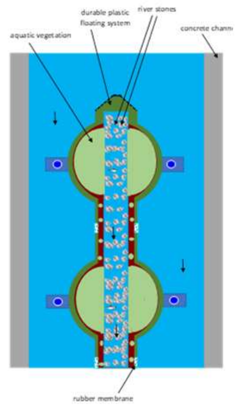

Figure 2 System overview

SOLUTION 2

River shore stabilization technique with wooden sheet piles and metal springs

River bank stabilization techniques in areas severely affected by erodibility are relatively high. These bioengineering techniques for stabilizing the banks are effective where there are no frequent and strong floods because the plants can take root and thus stabilize the banks. There may be some problems before the plants take root. Bioengineering techniques are also used to stabilize sloping valleys even on lake shores. But in heavily flooded areas, engineering techniques are used (gabions filled with stones, etc.). In order to console any shore, it must first be linearized, filled, built in steps or not (fig.1 a, b, c).

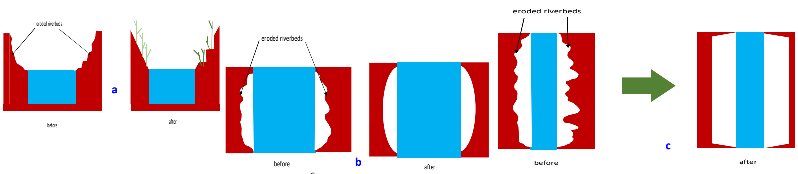

Figure 1 a, b and c Eco-engineering ways to restore eroded riverbeds

Prior to redirection, the river water must be redirected using a metal semicircular sheet pile. After linearization and construction of the steps on their horizontal surfaces, semi-aquatic shore stabilization plants are planted. Circular holes are drilled in the vertical parts of the steps. All the holes are below each other at all steps (fig.2). Plastic tubes are inserted into the holes. Resistant metal springs are inserted in these plastic tubes. A water-resistant wooden plate will be fixed to the near end of the metal arch, resistant both to water and to blows received by floating elements (logs, branches and even dragged stones). The other end of the metal spring will be fixed with a metal ring to a metal bar that is fixed perpendicular to the riverbed (fig.2). Thus, the resistant wooden sheet will always be under pressure and will keep under pressure the vertical surface of the ground step.

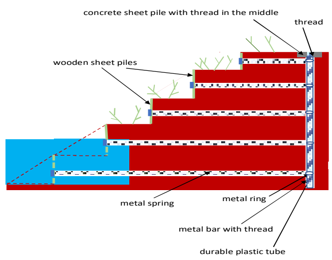

Figure 2 Stabilization system with resistant wooden sheet piles and metal spring of the river banks

The twigs in the twigs (recently fixed when the plants have not developed an efficient root system) that are used are usually not resistant in cases of heavy hail or drizzle dripping on the slope. The heavy-duty wooden sheet pile, which is under pressure due to its springs, is resistant to these weather conditions. Thanks to the plastic cylinder and the concrete plate with threaded thread, the metal bar resists in a vertical position. Even if there are earthquakes and droughts this system resists the classic ones suffer damage and no longer have the performance for which they were designed.

SOLUTION 3

Shores of wood or durable plastic with variable geometry

Due to the floods, the banks of the rivers erode, in some cases very pronounced (fig.1). For the beginning, it is proposed that both the riverbed and the banks be filled but also to be linearized (fig.2).

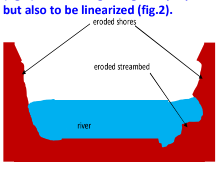

Figure 1 Eroded riverbed and banks

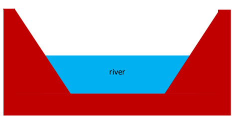

Figure 2 Filling and linearization of the riverbed and the banks

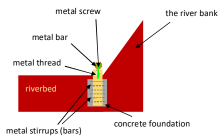

Figure 3 Fixing the metal bar that supports the sheet piles with variable geometry

The river banks being fixed, they fully support the destructive force of the floods. The idea is that the banks must have variable geometry in order to attenuate the force (erosion, impact, etc.) of the water. How do we accomplish this? At the base of the bank or banks, in the riverbed, spaces will be built (drilled) in the form of cylinders. Circular pillars with a smaller diameter than the cylindrical space will be fixed in these cylindrical spaces (fig.3). Each pillar will have in its body metal bars about one centimeter thick (stirrups). These metal bars will stabilize the concrete pillar after the concrete is poured into the cylindrical space. The cylinder will be about 10-40 cm higher than the cylindrical space depending on the characteristics of the river when it is filled with cement (concrete). The end of the concrete cylinder will have a thread (fig.3). The pillars and their concrete foundations consolidate the riverbed and the shore.

The plate (sheet pile) built of wood or resistant plastic with variable geometry has in its components a resistant metal spring that rests on a wooden surface fixed to the shore (fig.4). The metal bar is fixed to each (fig.5) pillar, with the help of metal circular rings, and can have a length of 200m. As can be seen in Figure 5 a pillar supports two sheet piles with variable geometry. If the concrete pillar is more robust, it can also support 4 sheet piles with variable geometry. Floor mats with semi-aquatic grass can be fixed on wooden or resistant plastic floorboards (fig.6).

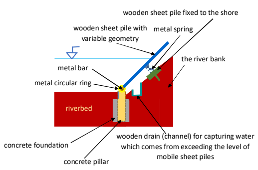

Figure 4 Positioning the attic relative to the river bank

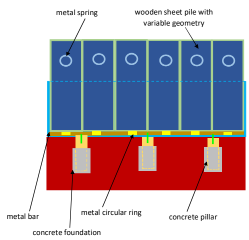

Figure 5 Positioning of variable geometry sheet piles on the metal bar

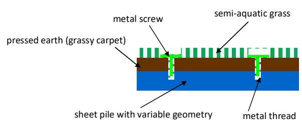

Figure 6 Fixing the grass mat on the sheet pile with variable geometry

When the water level rises in the riverbed, the sheet piles are folded with the help of springs, so the coefficient of friction between the body of water and the sheet piles is lower. If during the floods the floating elements hit the palpations with variable geometry, they dampen the shocks due to the metal springs. At the base of the sheet piles there are drains for capturing water that are useful in high floods, when the water level exceeds the sheet piles with variable geometry. With the help of these drains the water reaches the water course avoiding the damage of the system. In the event of damage, any component of the system can be replaced. This system can be built in cities as well as outside cities.