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Advance hydraulic modeling of Mehadica river, Romania, Caras Severin county

Beilicci Robert[1] Beilicci Erika[1]

Abstract: Study case is situated in Caras Severin county. To solve theoretical problems of movement of water in the river Dognecea, it requires modelling of water flow in this case. Numerical modelling was performed using the program MIKE11. Advanced computational modules are included for description of flow over hydraulic structures, including possibilities to describe structure operation. The input data are: area plan with location of cross sections; cross sections topographical data and roughness of river bed; flood discharge hydrograph. After simulation with MIKE 11 the water level in each cross sections resulted.

Keywords: numerical modelling, roughness of river bed

1. INTRODUCTION

The area upstream from Mehadica comprises a basin that produce heavy rainfall where the flood flow high, leading to washing and breaking the banks.

Due to the strong erosion on soil breakage occurs large areas of banks, leading to degradation of riparian lands and an accumulation of material alluvial are clogged riverbed leading to the formation of arms located on land in the area, actually negative impact on village downstream .

Currently in the towns Mehadica, Cuptoare and Crusovat manifest phenomenon of erosion of the banks of jeopardizing the stability of dwellings (90 households) and the county road over a length of 300 m.

To ensure the stability of the riverbed, it is necessary to execute regularization works mentioned riverbed route, consisting of:

- Recalibration of chanell length L = 2628 m (Mehadica - L = 560 m, Cuptoare - L = 1108m, Cruşovăț -L = 960 m)
- Consolidation of banks with gabions in three rows, filled with stone, L = 3530 m (Mehadica - L = 1120m, Cuptoare - L = 1160m, Cruşovăț -L = 1250 m)
- Thresholds compensation slope (Thresholds bottom) 6 bucăți Ltot = 181m (ovens Ltot = 81 m, Cruşovăț - Ltot = 100 m)
- Consolidation of existing shore protection works (Mehadica - L = 230 m; Cuptoare - L = 60 m; Crusovat - L = 70 m)

So the analysis of more than 30 cross-sections of riverbed Mehadica studied the entire length of 2.6 km,

the longitudinal profiles of the riverbed, the left bank and right bank and plan situation, the designer sets the following regularization works creek Mehadica;

- Recalibration bed by riverbed correction that will slope Mehadica 12 ‰ to 3 ‰ to 4 ‰ to Crusovat and Cuptoare according deforestation longitudinal profiles presented by abundant vegetation from trees to the dwarf;
- Realization on both sides of the shore protection of mattresses and gabions filled with coarse stone to a height of 2.5 m as follows:
- Gabion mattress 0,5 x 2 x 4 m;
- Gabion 1 x 1.5 x 4 m;
- Gabion 1 x 1 x 4 m;

Whites recalibrated and new route is a route fluent corrected that eliminated the obstacles that currently exists.

Under mattresses and gabion baskets will run from 14 mm diameter steel concrete in m m and will run all the stirrups of reinforced concrete Ø 10 mm from 0.5m to 0.5m. Will be in place with a 2.8 mm galvanized wire

Execution of works is facilitated because it is provisioned machines digging and supply of existing roads in the village, knowing that work was carried out only in the towns.

In terms of geomorphology, land has the following stratification:

- Topsoil -0.6 m
- Brown sandy clay - 1.5 m
- Follow medium and deep sands

From the latest but not least, the size of the raw stone and gabions filled mattresses that must be 2.5 times the diameter of the mesh galvanized.

- mattresses will measure 0.5 x 2 x 4 m
- Gabions are of two types:
- 1 x 1.5 x 4 m
- 1 x 1 x 4 m
- The chimney must be made in reinforced concrete Ø 14 mm bars m m with steel bars and stirrups Ø 10 mm from 0.5m to 0.5m.
- Post wire Ø 2,8 mm will be galvanized
- Fill baskets with rough stone will execute manual carefully so as not to disturb or degrade galvanized wire mesh.

[1] Politehnica University Timisoara, Faculty of Civil Engineering, Department of Hydrotechnical Engineering, George Enescu Street No. 1/A, 300022, Timisoara, Romania, erika.beilicci@upt.ro

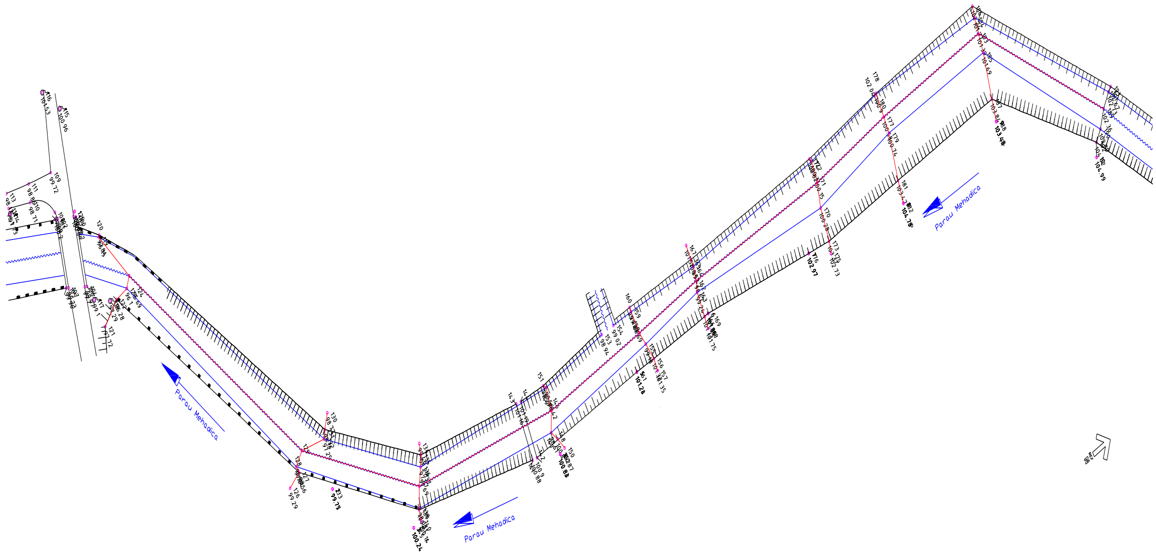

Figure 1. Plan view

2. MATERIAL AND METHODS

Numerical modelling was performed using the program MIKE11. MIKE 11 is a professional engineering software package for the simulation of flows, water quality and sediment transport in estuaries, rivers, irrigation systems, channels and other water bodies.

MIKE 11 is a user-friendly, fully dynamic, one-dimensional modelling tool for the detailed analysis, design, management and operation of both simple and complex river and channel systems.

With its exceptional flexibility, speed and user friendly environment, MIKE 11 provides a complete and effective design environment for engineering, water resources, water quality management and planning applications.

The Hydrodynamic (HD) module is the nucleus of the MIKE 11 modelling system and forms the basis for most modules including Flood Forecasting, Advection-Dispersion, Water Quality and Non-cohesive sediment transport modules.

The MIKE 11 HD module solves the vertically integrated equations for the conservation of mass and momentum, i.e. the Saint-Venant equations.

Applications related to the MIKE 11 HD module include:

- Flood forecasting and reservoir operation
- Simulation of flood control measures
- Operation of irrigation and surface drainage systems
- Design of channel systems
- Tidal and storm surge studies in rivers and estuaries.

The MIKE 11 is an implicit finite difference model for one dimensional unsteady flow computation and can be applied to looped networks and quasi-two dimensional flow simulation on floodplains.

The model has been designed to perform detailed modelling of rivers, including special treatment of floodplains, road overtopping, culverts, gate openings and weirs.

MIKE 11 is capable of using kinematic, diffusive or fully dynamic, vertically integrated mass and momentum equations.

Boundary types include Q-h relation, water level, discharge, wind field, dam break, and resistance factor.

The water level boundary must be applied to either the upstream or downstream boundary condition in the model.

The discharge boundary can be applied to either the upstream or downstream boundary condition, and can also be applied to the side tributary flow (lateral inflow).

The lateral inflow is used to depict runoff. The Q-h relation boundary can only be applied to the downstream boundary.

MIKE 11 is a modelling package for the simulation of surface runoff, flow, sediment transport, and water quality in rivers, channels, estuaries, and floodplains.

3. RESULTS AND DISCUSSIONS

Numerical modelling was performed with the program MIKE11. Site plan in this situation is shown in Figure 2.

Cross sections through the channel as topographical surveys are shown in Figure 3.

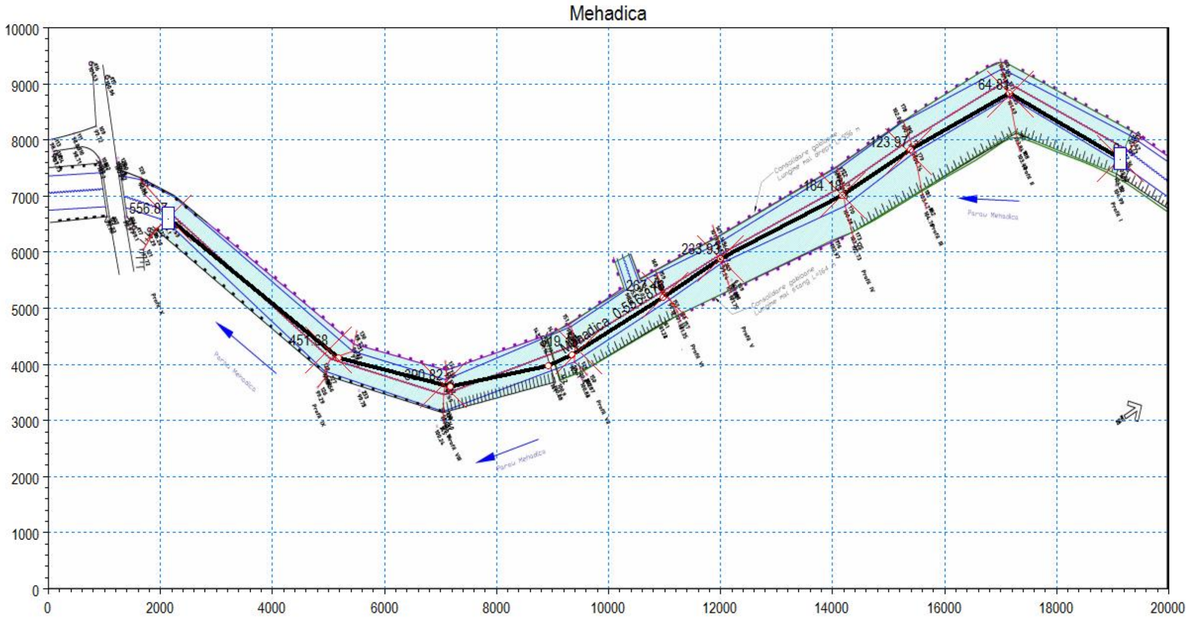

Figure 2. Plan view with the network model

According to data entry or formulated boundary conditions, namely the upstream inflow at chainage 0 are constant Q 96 mc/s and in the downstream at chainage 0 curve key for downstream section of the river. After running the program MIKE11 was obtained through existing channel longitudinal profile, presenting water levels along the channel (Figure 4).

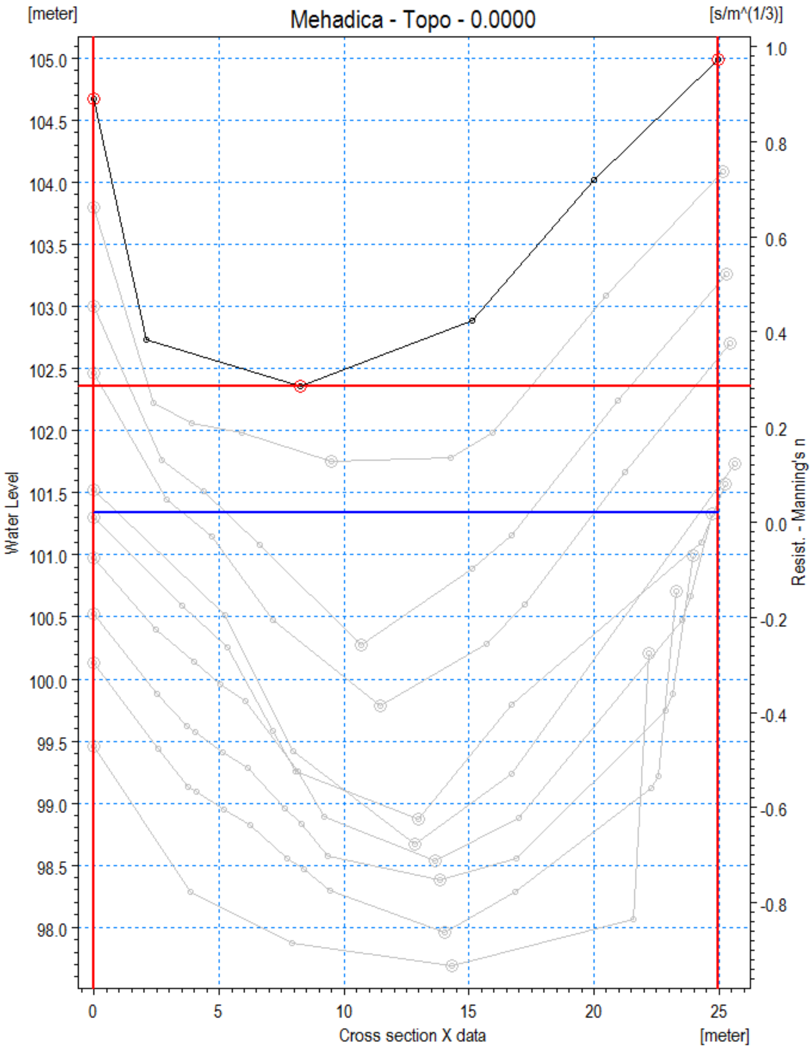

Figure 3. Cross sections

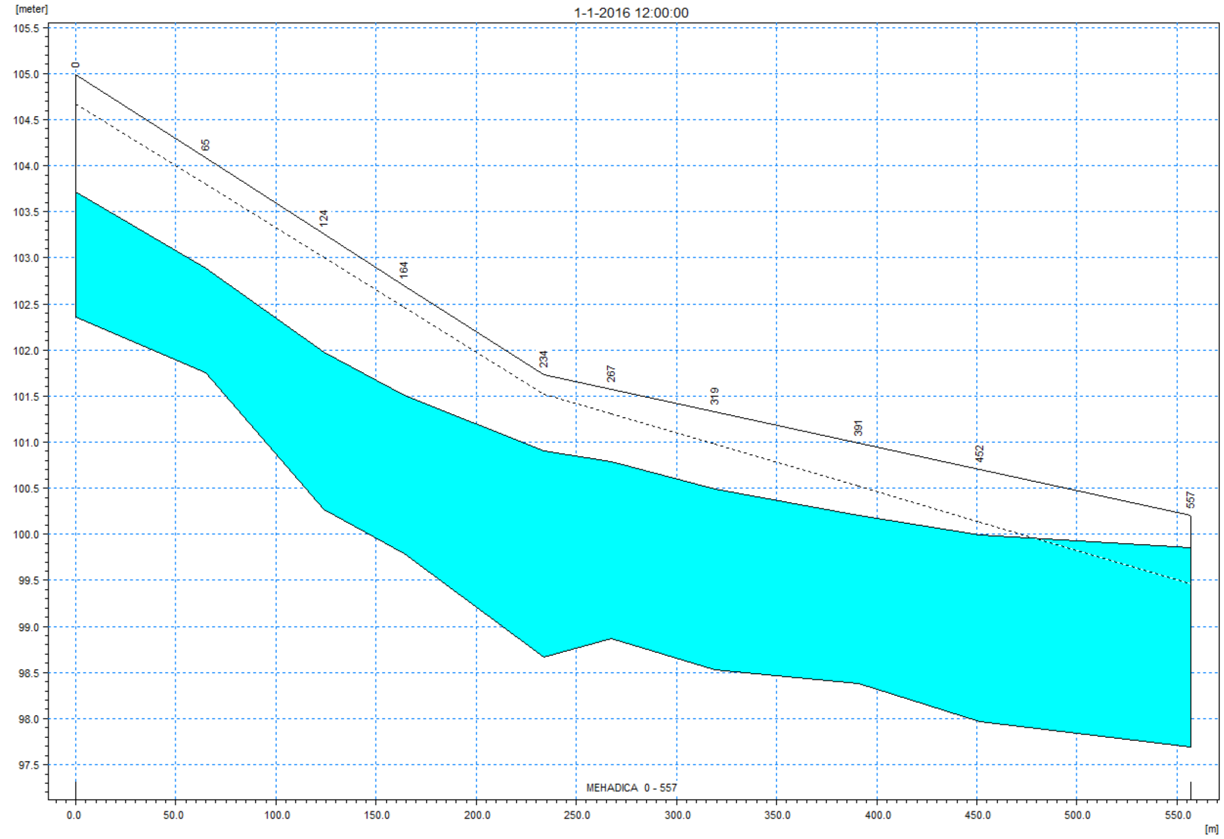

Figure 4. Longitudinal profile

This study presents the application of a 1-dimensional unsteady flow hydraulic model used for the simulation of flow in rivers: the MIKE 11 model from the Danish Hydraulic Institute (DHI).

MIKE 11 is the preferred choice of professional river engineers when reliability, versatility, productivity and quality are the keywords.

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