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Advance hydraulic modeling of irrigation channel CP10, in irrigation system Teba – Timisat, Romania, Timis county

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Abstract – Study case is situated in irrigation system Teba - Timisat. To solve theoretical problems of movement of water in the channel CP10, it requires modeling of water flow in this case. Numerical modeling 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 result the water level in each cross sections.

Key words: hydraulic modeling, irrigation channel

I. INTRODUCTION

Arrangements cuprinds in this area are: Teba - Timisat, Rudna - Giulvăz, Bociar and Caraci. They arranged a total surface of 43,335 ha. But because of drainage arrangements can be made independently on each fitting generally most suggestive aplor planning for evacuation in state border surrounding area is arranging Teba - Timisat.

The purpose of the performed works is remove excess moisture from the surface, and soil in the active profile on areas with specific requirements in order to adjust its moisture, creating appropriate conditions for making timely farming operations, with positive effects on production.

To achieve this goal were achieved partly works and drainage ditches in the area of 28 063 ha in Teba-Timisat drainage system, as follows:

- Main collector drain arrangement (regulation Timisat, Teba, Temesit) and connection of large channels or valleys extending the length of 65 km;
- Completion of drainage works by thickening and deepening the existing channel network in an area of 22213 ha;
- New network of drainage channels on an area of 5,850 ha;
- Closed horizontal drainage works cross type on an area of 285 ha, located in a high groundwater level trough north of town Ionel.

From the administrative point of view, the drainage system Teba - Timisat is located in the western part of Timis County, including related land cadastral territories Foieni, Giulvăz, Peciu Nou Uivar, Sanmihaiu Roman and Sag in the localities falling perimeter system: Cruceni Foieni, Ionel, Otelec, Ivanda, Sinmartinu Sarbesc, Sinmartinu Maghiar, Sînmihaiu Roman partially Dinias.

Irrigation system Teba - Timisat has a total area of 28,063 ha, is located in interfluves TIMIŞ - BEGA downstream of Timisoara, the basin of the rivers Timis and Bega, is limited to the north of Bega navigable channel to the west of Serbia, south Timis river and drainage systems Rudna - Giulvăz and Caraci and east system Sag - Topolovăţ.

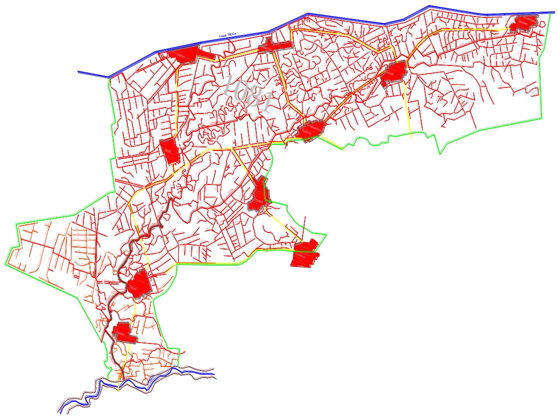

Figure 1. Irrigation system Teba – Timisat

The level of groundwater in the area is influenced by several factors, namely:

- Change the channel levels Bega and Timis river;
- Precipitation on surfaces located in the upstream side of the perimeter of the system (planning);
- Rainfall in the period from October to May each year.

Hydrogeological zoning made prior to execution, based on observations made during the period 1973 - 1984 drilling IMH network and IEELIF existence field highlighted areas related to groundwater depths intervals as follows:

- 0.5-1.0 m: 974 ha
- 1.0-1.5 m 4643 ha
- 1.5-2.0 m: 7406 ha
- 2.0-3.0 m: 9873 ha
- 3926 m over 3 ha

Following regionalizing technique, maximum levels recorded in the same period, it appeared that the

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perimeter, 78% of the area in the spring has deep phreatic level at 0 - 1.00 m.

Groundwater flow direction is oriented NE - SW with average gradient of 0.3%.

Excess moisture in the arrangement Thebes - Timis appear differently on surfaces varying depending on the orographic, soil and local hydrogeological comes from rainfall and groundwater perimeter fueled partly navigable channel Bega.

Climatic factors that influence the excess moisture situation were analyzed for Timisoara resort and partialy Dinias-Rauti points, resulting in:

- Average yearly rainfall 639 mm and 540.4 mm station to station Timisoara evil;
- Amplitude precipitation: 350-400 mm in dry years or 500-850 mm in wet years;
- Duration excess moisture in dry years 5 months;
- Duration excess moisture in wet years: 7-8 months;

General natural slope of the land is northeast to southwest, being a 0.2-3%.

Emissaries vacating the main river waters are navigable Timis and Bega channel. Timis River gravitational allow downloads of inland waters in about 70% of days of average, and for about 131 days during the growing season.

Typical levels in Timis river discharge in the main section SP Cruceni are:

- 5% = 80.00 mdMB level (Q = 880 m / s)
- 1% = 80.75 mdMB level (Q = 1200 m / s)
- 0.3% = 81.30 mdMB level (Q = 1400 m / s)
- Share dig = 81.43 mdMB canopy.

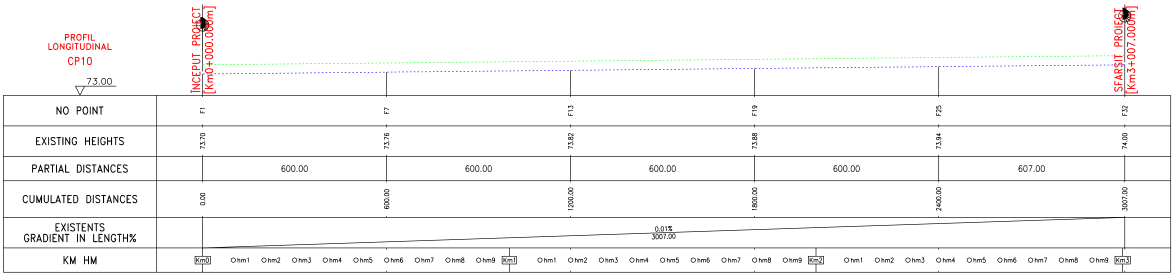

Figure 2. Longitudinal profiles in channel CP10

In terms of chemical groundwater presents a mineralization of 0.53 to 5.73 gr / l.

The concentration of salts is lower near permanent water courses in the area, Bega and Timis. In the Dinias - Sanmartinu Sarbesc, Ivanda, Foeni appear mineralization of 4.3 to 5.73 g. / L, which also led to secondary soil salinization.

II. MATERIAL AND METHODS

Movement of water in canals, rivers or partially filled pipes are examples of free level movements. Uniform motion is done free level canals, straight and prismatic (canals, galleries, gutters, ditches, etc.). Free level uniform motion is made in white artificial straight and prismatic (canals, galleries, gutters, ditches, etc.). Analytical solutions are obtained by hydraulic calculation formulas Chezy type by substitutions with Manning relationship with general equations. In general, technical applications currently are using Chezy formula type:

$$V = C\sqrt{Ri} \tag{1}$$

Associating continuity equation is obtained for flow:

$$Q = VS = SC\sqrt{Ri} \tag{2}$$

Hydraulic radius is explicit and obtain

$$Q = SC\sqrt{\frac{S}{P}i} = \frac{S^{\frac{3}{2}}}{P}C\sqrt{i} \tag{3}$$

Associating Chezy formula is obtained for flow:

$$Q = \frac{1}{n}\frac{S^{1,5+y}}{P^{0,5+y}}\sqrt{i} \tag{4}$$

By replacing Manning relationship is obtained:

$$Q = \frac{1}{n}\frac{S^{\frac{5}{3}}}{P^{\frac{2}{3}}}\sqrt{i} \tag{5}$$

For the particular case of trapezoidal section is noted that the area (S) and the wetted perimeter (P) can be expressed as:

$$S = bh + mh^2 = (\beta + m)h^2 \tag{6}$$

$$P = b + 2\sqrt{1+m^2}\,h = \left(\beta + 2\sqrt{1+m^2}\right)h \tag{7}$$

Resulting in replacement:

$$Q = \frac{1}{n}\frac{(\beta+m)^{1,5+y}}{\left(\beta+m'\right)^{1,5+y}}h^{2,5+y}\sqrt{i} \tag{8}$$

where the m' were noted:

$$m' = 2\sqrt{1+m^2} \tag{9}$$

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 Noncohesive sediment transport modules. The MIKE 11 HD module solves the vertically integrated equations for the conservation of continuity 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

III. RESULTS AND DISCUSSIONS

Based on these theoretical foundations analytical calculations were performed for proposed pipeline and the existing channel.

Topographic studies for existing channel result input the following data:

b = 2 m,

m = 2,

i = 0,0006,

n = 0,02 (concrete)

The construction curve Q = Q (h) is presented in Figure 3:

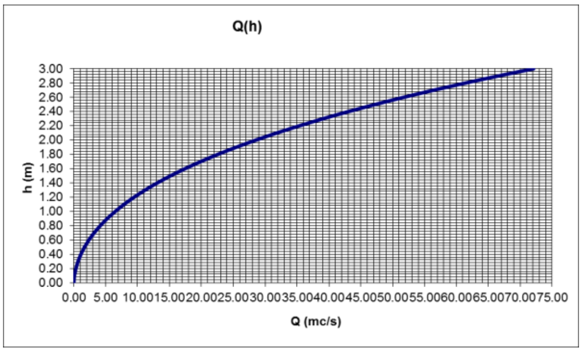

Figure 3. The construction curve Q = Q (h)

The volume of water that can be stored in the channel is determined by the relationship:

$$V = (b + m \cdot h) \cdot h \cdot L_{canal} \qquad (10)$$

$\cdot L_{canal} = 3007m$ the length of the channel is designed

Respectively calculate the volume of water that can be stored in the drainage channel for different water depths curve was drawn next channel. The construction curve V = V (h) is presented in Figure 4:

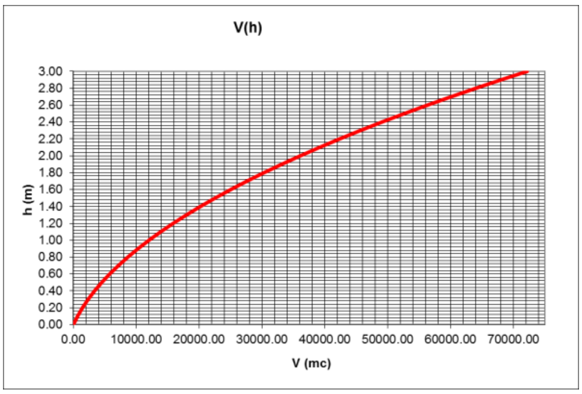

Figure 4. The construction curve Q = Q (h)

Numerical modelling was performed with the program MIKE11. Initially modelled the existing situation with CP10 trapezoidal channel. Site plan in this situation is shown in Figure 5. Cross sections through the channel as topographical surveys are shown in Figure 6.

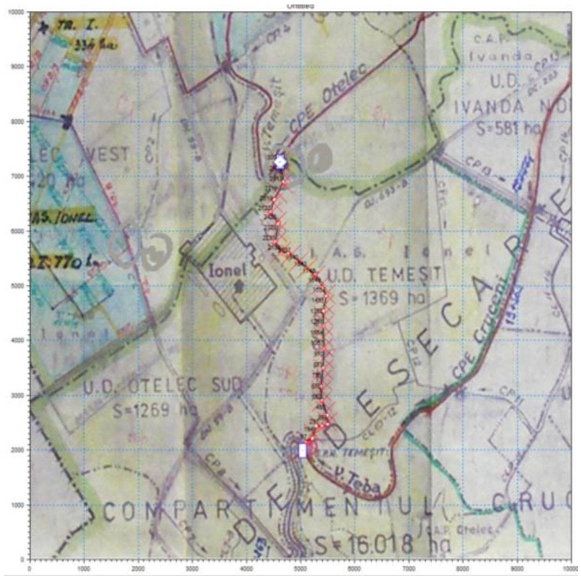

Figure 5. Plan view with the network model for the existent trapezoidal channel CP10

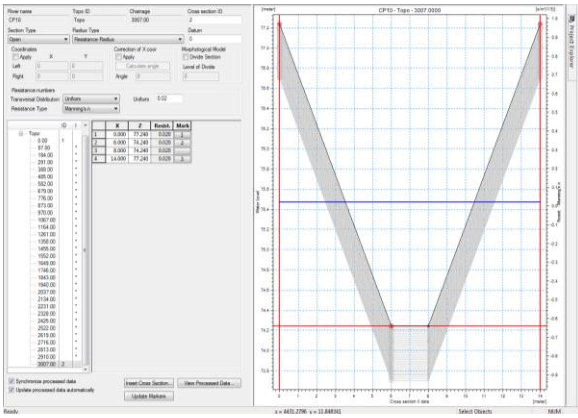

Figure 6. Cross section for the trapezoidal channel CP10

According to data entry or formulated boundary conditions, namely the upstream inflow at chainage 3007 are time variant inflow (Figure 7) and in the downstream at chainage 0 curve key for downstream section of the channel. After running the program MIKE11 was obtained through existing channel longitudinal profile, presenting water levels along the channel (Figure 8).

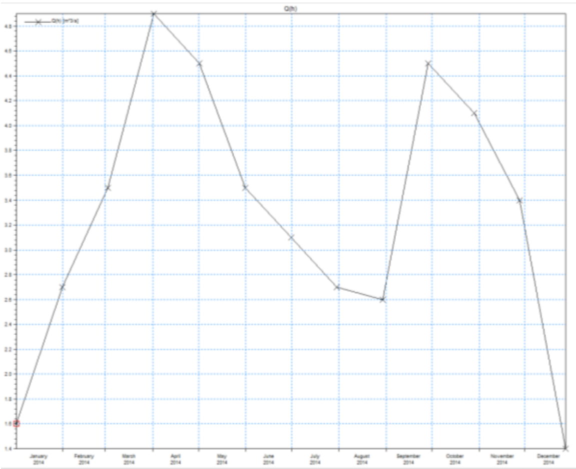

Figure 7. Time variant inflow.

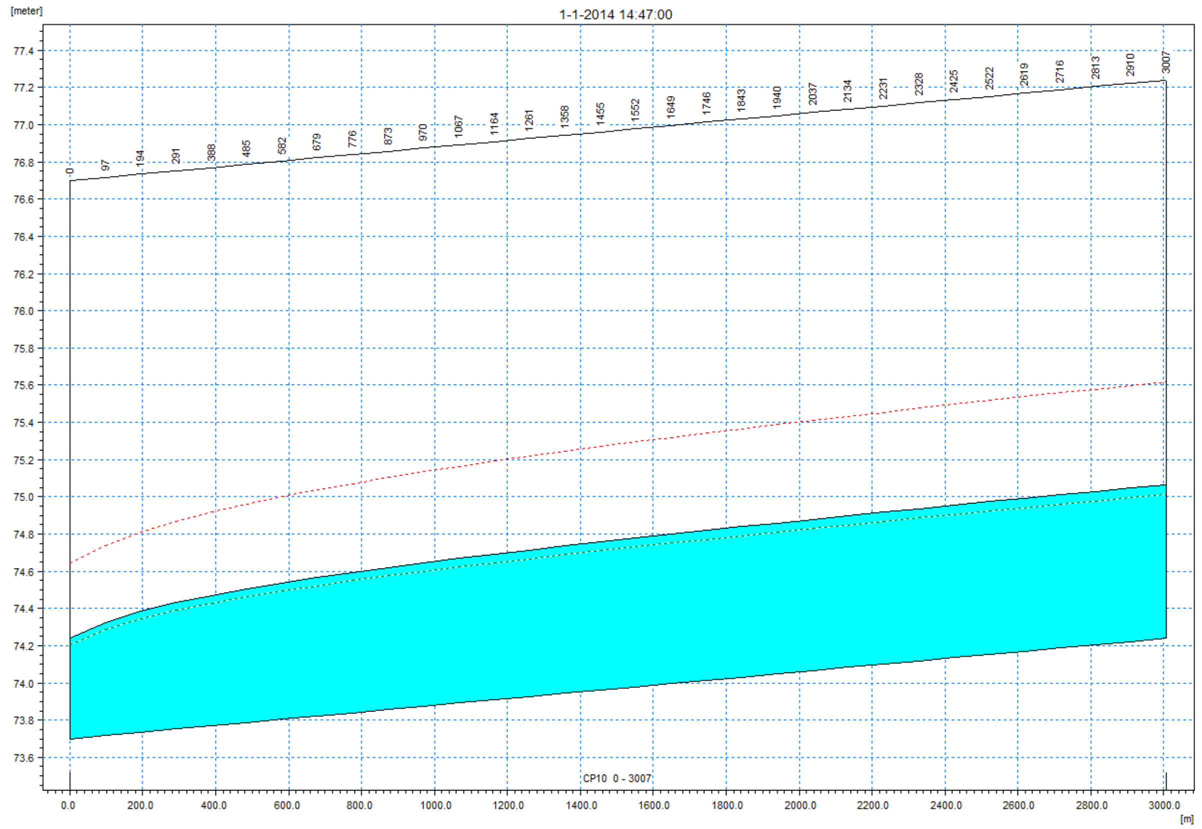

Figure 8. Longitudinal profile in channel CP10.

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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