UPDATE OF THE TOPOGRAPHIC PARAMETERS OF THE STRUCTURAL ELEMENTS TO THE PIPES NETWORKS

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***Abstract**: The paper presents a way of updating the parameters of representation and tracing of the structural elements to the water supply networks in the execution or rehabilitation phase. Between the design phase and the construction phase of the pipe network components there are divergences in the field tracing. This situation arises, in particular, in the execution of rehabilitation works for water supply pipes. The case study on the rehabilitation works of the Timisesti - Iasi adduction pipeline that underlines the river Moldova confirms the necessity of changes in time of the topographic documentation of the execution. The morphological changes of the Moldova River bed during the period between the implementation of the rehabilitation project and its application in practice necessitated the modification of the situation plan and of the longitudinal profiles. The updating of the topographical documentation was carried out during the start of the execution of the works (plans for the location of the constructions and installations) and then during the rehabilitation works (longitudinal and transversal profiles).*

***Keywords**: pipelines, situational plan, longitudinal profile, transverse profile, marking.*

1. Introduction

Achieving hydro-technical objectives in the riverbed requires the use of a complex of technical and financial documentation. A set of studies is used to draw up technical projects, including: topographic studies, geotechnical studies, hydrological studies, hydraulic studies, climate studies, hydrogeological studies, etc. In all these studies, an important place, and even the first place, is the topographic documentation. Preparation of technical documentation at various design phases, respectively feasibility study, technical project, execution details, project execution organization, construction authorization documentation, etc. are based on topographic surveys.

A special situation is provided by technical documentation for carrying out river regularization works and shore defence works. Also in this situation are the works that take place in the riverbeds, such as bridges, pipelines subterranean, water inlets etc. The aforementioned works are carried out in correlation with the geometric and hydrological characteristics of the riverbed. The hydrological regime of the river permanently changes the structural parameters of the bed in the area where the works are located. It results in the need to change over time the topographical documentation for hydrotechnical works.

2. Material and research method

The study and research material consists of the technical documentation for the design of the rehabilitation and modernization works for a complex of hydrotechnical works located in the Moldova riverbed, in the area of Sochi, Iasi County (Fig.1). The role of hydrotechnical works is to achieve the undercrossing of the three adduction pipes through the riverbed of the Moldova River in safety and stability conditions (Fig. 2).

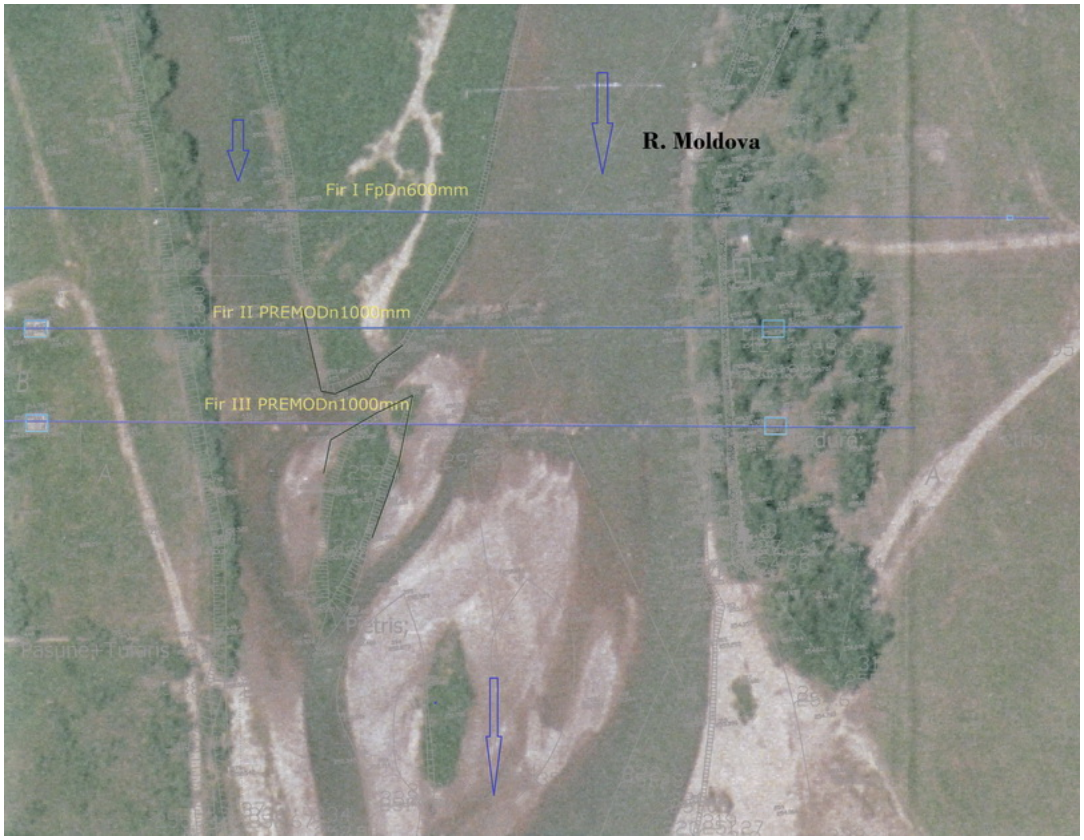

Fig. 1. Ortofotoplan with the location of hydrotechnical works on the Moldova River

The hydrotechnical complex consists of the following components (Luca M., 2012):

- the river undercrossing hydrotechnic construction for three adduction pipes, AdI, AdIIa and AdIIb; the pipelines are part of the drinking water supply Timisesti - Iasi; the pipes are located transversely on the water wire at a distance of 25.0 m between them;
- calibration works on the Moldova riverbed on a 370 m section;
- river regularization works bed regulating by achieving an routing ditch and a bottom threshold;
- defense works on the left bank and right bank for protection against water erosion.

The Moldavian River presents two separate whites of an island in the undercrossing area (Fig 2, Fig. 3 and Fig 4.b). The shape of the river bed was modified in 1970 (Fig. 4.a) when the second conduction pipe was executed. The left arm of the river is more developed (it was the main course of the river) and takes up about 70% of the conveyed flow. The right arm of the river was created artificially, and in small waters it has a low flow. The length of the undercrossing area is about 140.0 - 155.0 m, and the length of the regulated bed of 400.0 m. The distance between the three undercrossing pipes is 25.0 m (Fig. 1). The riverbed of River Moldova has an average width of 110-120 m in this area. The left and right banks are protected by simple concrete slabs.

For the design of the hydrotechnical complex, a topographic documentation was carried out, which served the various design phases: technical expertise, feasibility study, technical project, execution details, notices and agreements etc.

Fig. 2. Downstream general overview of the Moldova riverbed in the undercrossing area of the three adduction pipes (Photo Luca M., 2012).

The first topographic documentation was carried out in 2005 and the second one in 2012. The topographic documentation was completed in 2008 and 2010 for the service of research on the erosion phenomenon of the Moldova riverbed in the undercrossing area of the pipeline. An important component of the topographic study is the riverbed profile (longitudinal profile and cross-sectional profile).

a b

Fig. 3. Elements of placement of the Timisesti - Iaşi adduction pipeline in the riverbed of Moldova River: a - pipeline layout on the left arm of the river; valve houses situated on the left bank.

The research method consists in the analysis of the situation plans, the longitudinal sections through the river bed in the design / research sector, the cross-sectional profiles through the river bed and the bank in the design / research sections, the longitudinal profile along the river bed

For the adduction pipe locations, the depths of erosion in the bed were calculated. For the left bank the erosion lengths were calculated in the period 2004 - 2005.

3. Results of the theoretical and experimental study

The river Moldova presents in the study area a bed developed in a mass of noncohesive rocks (ballast layers). The base frame favours the appearance of morphological changes in longitudinal and transverse profile on the river bed. Such changes have intensified over the last 25 years and are also favoured by the frequent floods formed in the river basin of the Moldova (Luca M., 2007). All these changes must also be represented in the topographical documentation prepared for the study and design phases of the river bed

The case study drafted on a Moldovan River sector in the Soci area, Iasi County, highlights the need for continuous updating of the topographic documentation. Updating topographical documentation occurs in the following situations:

- drawing up engineering design documentation for constructions located in the river bed;
- updating the situation plans, cross-sections and longitudinal profile through the riverbed;
- drawing up the topographical plan, the longitudinal and the transversal profiles at the completion of the riverbed works;
- the preparation of the topographical documentation necessary for the elaboration of studies and researches in riverbeds (e.g. research of the erosion phenomenon of the river bed).

The study compared the basic topographical plans for the geographical area concerned and the plans for research and design (Fig. 4).

a b

Fig. 4. Morphological state of Moldova River, Sochi study area, presented in topographical plans; to plan in 1970 (extracted from the plan with 1: 25,000 scale); b - plan of situation compiled in 2005 (scale 1: 1000, according to (Luca M., 2006)).

The basic plans used (carried out before 1970) do not mention the structural change of the Moldova riverbed in the undercrossing area (Fig. 4.a). White is calibrated and the banks protected by concrete slabs have an acceptable stability. The new situation plans (Luca M., 2016, Luca M., 2012) highlighted the modification of the bed, respectively the presence of the two riverbeds and the island (Fig, 4.b). New topographical plans were executed in the STEREO 1970 projection, with the Black Sea reference plan 1975.

Research on the hydrodynamic erosion phenomenon of the bed between 2004 and 2015 necessitated the updating of the situation plans, especially of the right bank route. Starting with 2004 there was a strong erosion of the right bank, as a result of the floods formed on the Moldova. The shore protected by shore defense works was continuously eroded on depths of 4.0 - 15.0 m (Fig 5). The action of the water caused the alluvial cleaning (Fig. 5.a), the breaking of the shore protection and the river bedside flow (Fig. 5.b).

Figure 5. General view of the evolution of Moldova's river bank to the effects of floods: stable in 2005; b - eroded in 2012 (Luca M., 2016).

The phenomenon of hydrodynamic erosion has degraded the riverbed vertically and horizontally. The vertical erosions caused the bottom of the bed to be lowered by about 1.50 – 3.20 m. This led to the unveiling of the adduction pipes located in the bed and their degradation (Luca M., 2012).

The rehabilitation and modernization of water supply, river regulation and shore defence on the Moldova River in the Sochi area required the development of technical documentation at all phases of design. The project was carried out between August - December 2012 (Luca M., 2012b). The project was implemented in 2015 year.

The design database included the Topographic Survey compiled for the site area (Topographic Studies, 2012). The study includes the following main pieces: the general situation plan (scale 1: 1000); two longitudinal sections through the bed (one profile per river arm, P1a, P2a); seven transverse sections through the riverbed (P1 ... P7); five left side cross sections (P8 ... P13) (Fig. 6).

Topographic documentation has been updated over time several times, corresponding to the usage phases.

Upgrading topographical documentation during the design phase:

- the first update was carried out during the design period and consisted in adding a cross-sectional profile across the bedside area (profile P14);

- the second update of the status plan was carried out during the design period and consisted in the design by the designer of five shore cross sections for the design of shore defence works.

Upgrading topographical documentation in the start-up phase:

- the first update of the situation plan was carried out in April 2015 to trigger the execution of the rehabilitation works of the hydrotechnical complex; the situation plan has been restored to the left bank, in particular, to restore the alignment and quotas of natural terrain eroded by floods; floods produced on the Moldova river in 2012 (autumn), 2013, 2014 and 2015 have degraded the bedside, shore defence works (some have been completely destroyed) and have partially modified the water course; the slope of the bed in the left bank was 0.50 - 4.20 m in the period 2012 - 2015;

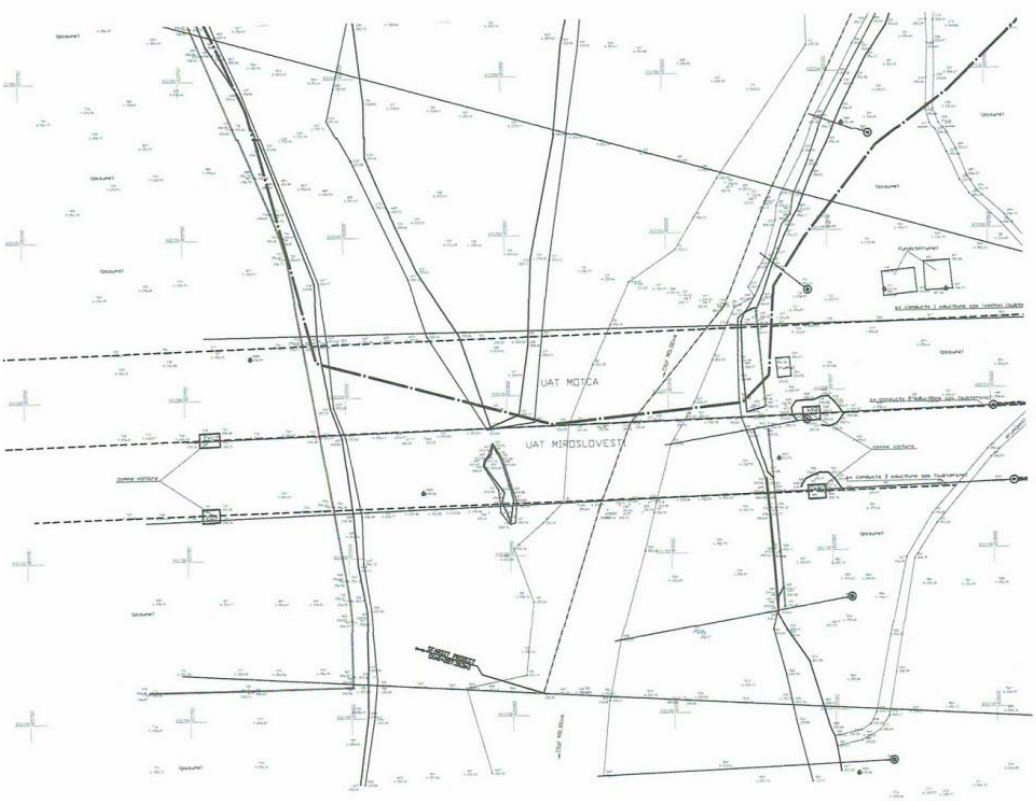

Fig. 6. Topographic situation plan with the existing hydro-technical works in the site and positioning of the transverse and longitudinal profiles through the riverbed of Moldova

- the second update was made on the left and right bank cross-sections, given the erosive water action caused by the floods in the period 2012-2015; cross-sectional shore profiles are used by the builder to carry out shoreline defense work, and land shares must be as accurate as possible to obtain the actual volume of construction material; the transversal river crossing profile in October 2012 no longer corresponds to the one existing in 2015 in April (Fig. 7).

Fig. 7. Details of the erosive water action on the left bank of the river Moldova upstream of the undercrossing of the adduction pipelines: a - defence of total degraded river (2012); b - left eroded with the collapse of shore defence (2012) (Luca M., 2012a).

- the third update took place in 2015 and was requested to achieve the longitudinal profile through the riverbed of the Moldova river for the rehabilitation of the AdI conduit; this pipe was executed in 1911, being made of cast iron tubes 800 mm in diameter buried in the bed and the bank of the river; the longitudinal profile of the pipe was not known; at the execution was excavated the land on the shore and in the bed for viewing the pipe and the parameters of the location; the data obtained updated the longitudinal profile of the conduit in the undercrossing (Fig. 8) (Luca M., 2012b);

- the fourth update took place in 2015 and was requested to provide additional cross-sections through the left and right bank for the execution of shore defence works; changing the line and quotas on the left and right bank imposed this update for the exact calculation of the volumes of works executed;

- the fifth update took place in 2015 and was requested to achieve the longitudinal profile for the AdIIa conduit during the execution; the updating of the longitudinal profile was imposed by the change of the altitude quotas (decreasing of the quotas due to the hydrodynamic erosion from August 2012 to September 2015) and by the shore; this pipeline was executed in 1970, being made of 1000 mm diameter steel tubes buried in the riverbed and the river bank;

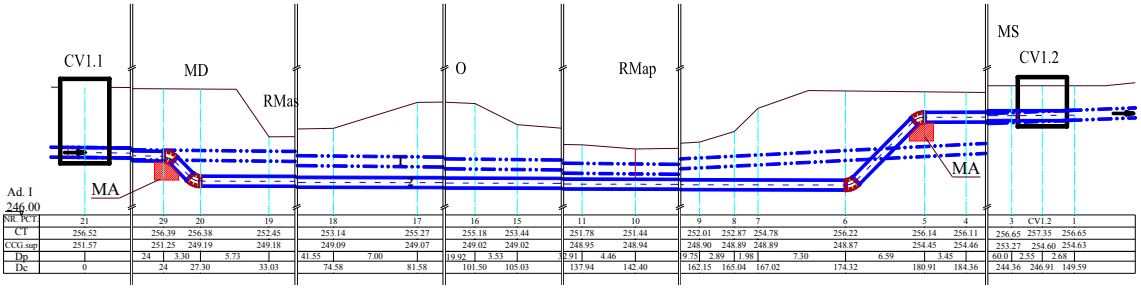

Fig. 8. The longitudinal section of AdI adduction pipe undercross: discontinued line - pipeline executed in 1911: continuous line - pipeline designed in 2012; CV1.1 and CV1.2 – camps with taps executed in 2012.

- the sixth update took place in 2015 and was requested to achieve the longitudinal profile for the AdIIb conduit during the execution period; updating the same conditions presented at the AdIIa pipeline; the AdIIb conduit was built in 1970 from 1000 mm diameter steel tubes.

Upgrading the topographical documentation in the final phase of the works:

- the update took place in 2015 at the completion of the hydrotechnical works and was requested to transpose the position of the left bank and the right bank line, the final shares of the works executed, the position of the hydrotechnical objects and objects water supply;

- the final situation plan contains the real situation of the site on the field of the designed and executed objects.

The final situation plan, the shore cross sections with shore defence works and the longitudinal profiles through the undercrossing pipes become top topographical drawings in the Construction Book. The case study analyzed highlights the need to update the topographical documentation at the design stage, at the start of the execution and during the hydro-technical objective. The current state of play regarding the achievement of hydro-technical objectives in the river bed confirms the conclusions of the case study. The long time span between the development of technical projects for river bed works and its implementation involves the updating phase of topographical documentation.

The complexity of the works to be executed, the modifications of the site (riverbed), the lack of knowledge of some geometry of the existing constructions in the field, the adaptation of the designed works to the land required the continuous updating of the topographic

5. Conclusions

1. Topographic documentation is an important component in the elaboration of technical projects for the execution of hydro-technical works in the river bed, and its updating is required by the changes in time of the river bed morphology.

2. The design of hydrotechnical works in the riverbed is strongly influenced by the temporal changes of the geometric and functional parameters of the whitish, requiring the continuous adaptation of topographic surveys over time

3. Upgrading topographic documentation can be done in the design phases to complete plans with details that take into account the modified site features.

4. Updating topographical documentation is required during the start-up phase of the goal to take into account site-site changes in the "design-execution" range, as required by the most accurate assessment of the workload and cost.

5. Upgrading of topographical documentation is required during the execution phase of hydro-technical objectives in river beds to correlate the parameters presented in the plans with the existing situation in the field at the time of execution.

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