MONITORING SPECIAL URBAN INSTALLATIONS WITH THE GIS MODEL

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Abstract: *GIS models are currently used in many areas of activity where they combine field data, maps, plans and applications to provide useful information in the shortest possible time. A new field of applications for GIS models is the in-service monitoring of the water networks. GIS models are made in different programs, ArcMap, Autocad and are structured on custom layouts. Work layers require attachment of data banks for characteristic parameters of the water supply system. Management is more effective in a monitoring program using GIS applications, based on the speed of work and the complexity of the attached data. Thematic maps, work reports and mathematical models for design and exposition in a relatively short time can be developed through GIS models. The monitoring is done both for the entire water supply system and separately for each construction and water-supply system in part.*

Key words: *pipeline network, monitoring, database, hydrants, street manhole*

1. Introduction

The implementation of a GIS system for a local water supply network involves carrying out multi-layer work. The working layers have different substrates, which have attached information to the management of the municipal cadastre. The information collected and processed ensures the authenticity, timeliness and objectivity of the assessments in the substantiation, implementation of decisions on the control of the water supply system. Data taken from land and cadastral plans, orthophotomaps, feasibility studies, etc., are structured in tables and attached to specialized programs for use in field queries and topic maps. The GIS system requires three types of data: point data referring to the hydrotechnical constructions of the system, line data that are the subject of the distribution network and polygon data related to the cadastral system (Lateş I, 2017).

The water supply system is a complex of constructions, installations and measures designed to ensure water quality and quantity required by a user. For a better understanding of this complex it is necessary to schematize it: capture, pumping stations, treatment stations, adductions, storage tanks, distribution network, special constructions (hydrants, street manhole) (Mănescu Al. .et al., 1994).

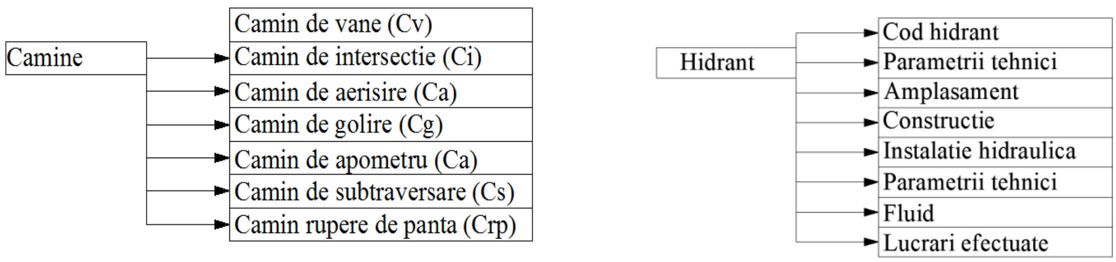
Special building constructions also have characteristic features attached to them. The street manhole are of different types: valves, intersections, ventilation, drainage, water meter, underwater, slope breaking. All of these receive specific codes to be added more quickly to the GIS model and to serve the information on the exploitation process. A particular problem is presented by pipeline hydrants who will receive identification codes for their location and constructive and functional features (subterranean and surface hydrants).

GIS models will allow more efficient management of data collected from water system components during different time periods. Thus, GIS models can contribute through their data to the elaboration of water rehabilitation projects as well as to their equipping with additional hydrants. Lately, there has been a stringent demand for redesigning the way of supply of hydrants to the pipelines serving the social and economic areas of the Romanian localities.

The research for the study area is created in several stages in the field and in the office, is continuing and it is enhanced by taking data from other types of studies (Lateş I, Crenganiș L., 2017).

2. Analysis of the structure of the GIS model

The water supply system is structured on the following major components; capture, water treatment, adduction, pumping station, reservoirs and distribution network. All of these elements are transposed into a GIS monitoring model using a customized layout complex. For example, the street manhole on the pipeline will have layers like (Fig.1.a), as well as the hydrants (Fig.1.b) and similarly the other components.



a b

Fig. 1. Types of used layers: a - stack layout set and their code; b - the set of hydrant specific layers.

After the place where the hydrants are located, they can be of two kinds (Luca M., 2015, Giurconiu M., et al., 2002) (Fig. 2 and 3):

a) Indoor fire hydrants with a diameter of 50 mm, fitted with hose connections and discharge pipes.

b) Hydrant networks on the street pipeline, which are used to extinguish the fire, sprinkle the streets, water the parks etc. Hydrants may be by surface or underground.

According to NP 133-2011, the diameters of the pipelines on which the hydrants are placed are 100 mm for Dn 80 mm hydrants, 150 mm for Dn 100 mm hydrants and 250 mm for Dn 150 mm hydrants. The flow of an external hydrant is considered to be 5 l / s, 10 l / s.

External hydrants must be located in such a way as to be accessible, protected and properly signposted where the distance between them is not more than 100 m.

3. Case study – Aviației Plateau, Iași City

The Aviation Plateau area is located in the East of Iaşi and is delimited: in the North side of Margina Street, in the Margina East side, Obreja Street, Holboca Street, Aviaţiei Street, in the south side of the Aterizaj Street in the West Aurel Vlaicu Street, Holboca Street, Airport Street.

a b c

Fig. 2. Types of hydrants used in localities: a - hydrant box inside the building; b - surface hydrant; c - underground hydrant

In order to achieve a GIS water network model for the Aviation Plateau area, textual data were attached to the graphic information. Thus, by means of cadastral plans, measurements, orthophotomaps, the study area was delineated. After the cadastral plans were aligned, the digitization of the stable elements in time, that is the roads that delimit the area, digitized the parcels, then the buildings. The location of the water supply network in the area and the specific structures related thereto were provided by SC APAVITAL IAŞI

a b

Fig. 3. Street underground hydrant: a - general view; b - detail, the hydrant box.

The creation of the GIS model involved the correlation of the information provided by SC APAVITAL IAŞI with the information gathered from the cadastral plans and the OCPI Iasi database. After correlating graphical information follows the attachment of textual information and the structuring of patterns on specific layers of work.

In the vectorial model it is considered that any geographical entity can be graphically represented either as a point, as a line (or arc), or as a surface (or polygon). The geometric entities listed above (dots, lines or polygons, also called graphical primitives) are attached with more user-defined attributes representing the characteristics of the phenomena or objects represented. Hydrants are represented by point entities to which the attribute data is attached as can be seen in fig. 4 b.

a) b)

Fig. 4. Study area Aviation Plateau: a - delimitation of the area; b - data attached to the model

The GIS case study model in the Aviation Plate (Fig 4), Iasi County, claims the allocation of 15 fire hydrants, the distribution network at the key points to ensure coverage of territorial areas in case of fire. The distribution network was put into operation at the level of 2007, when it provided a number of 15 hydrants, of which the hydrant with code H9 on Lt. Popovici was canceled (Fig 5).

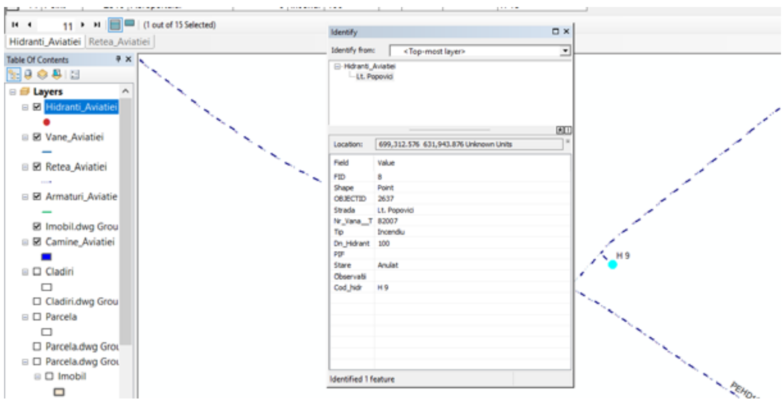


Fig. 5. The identificcation the canceled hydrant

From a hydro-edilitar point of view, hydrants of the water supply network in the Aviation Plateau area can be monitored using GIS models according to the textual data attached to the graphic entities. The program inputs are: identification code, ground position of the hydrant (underground, overhead), position on the ground (pavement, green space), diameter, flow, pressure, etc.

Identifying problem hydrants depending on the field *Observation* from the text data attached to the model. Thus, 15 hydrants are placed in the study area and one of them is reported as a lack of lid. Better monitoring of water supply systems requires a field check of the water supply system. Thus, the GIS model can be continuously updated even with the help of field photography (Fig. 3).

From the field analyzes, the degradation status of the structure and functionality of the street hydrants is found. Thus, a number of hydrants were placed on degraded sidewalks or lost their stability over time (Figure 3). The installation of the hydrant is accessible and can no longer be protected. The top of the hydrant is not maintained, and the mark is temporary and may be removed.

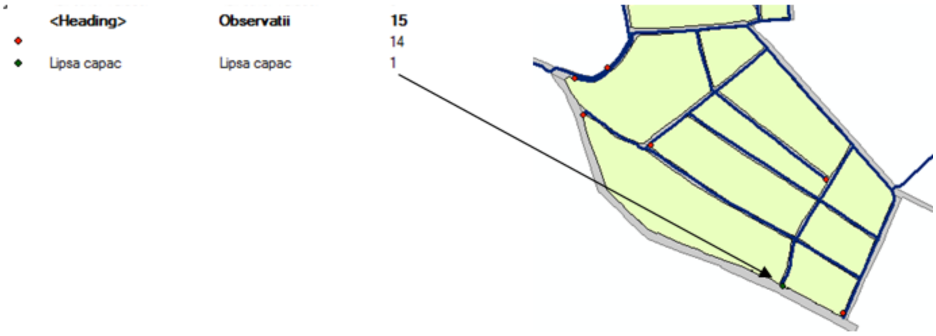


Fig. 6. Map identifying problem hydrants

The structural and functional analysis completed with field photographers shows the possibility of verifying the accuracy of the GIS model and validating the identification of hydrants in case of fire. For example, the H15 hydrant located on the Airport Street is not appropriately signaled on the ground. For this reason, he was not even identified in the field.

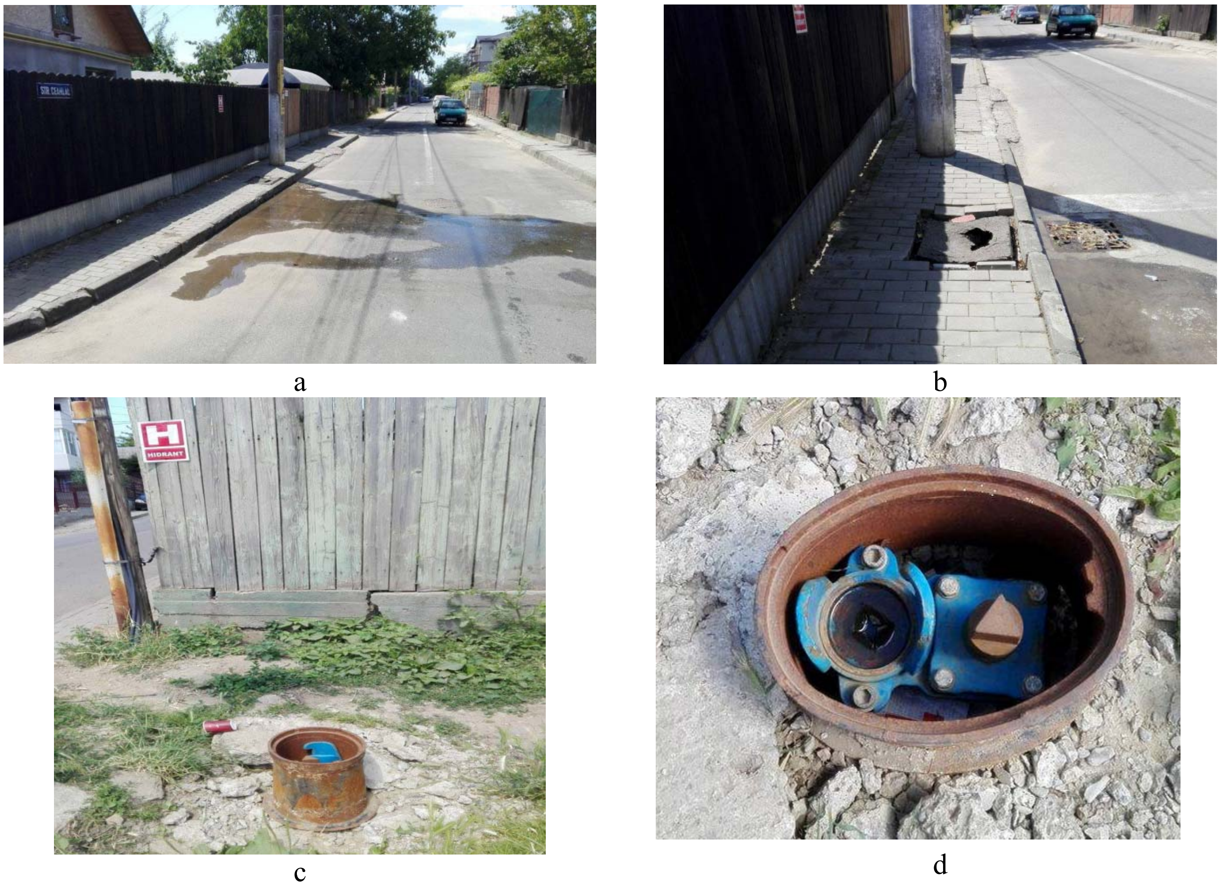


Fig. 7. General view and details of the status of street hydrants: a - general view of Ceahlău street, Iaşi city; b - general view Aurel Vlaicu street, Iasi city; c - the location of the underground hydrant; d - details of the hydraulic installation in the hydrant box.

Also, the H13 hydrant located on Ceahlău Street is partly covered with asphalt, so in case of a fire, the layer must be removed beforehand. This situation does not allow the location of the hydrant and its introduction into fire-fighting operations. The absence of the hydrant or its degradation are major causes of the firefighters' task.

These aspects of the state of degradation of the hydrants are introduced into the specialized layer and referred to as emergency rehabilitation. With the rehabilitation of the hydrant, the observation is updated and remains only the year of rehabilitation. Research is done both on the ground and in the office. Layers are periodically complemented by field studies.

The rehabilitation of water supply networks has forced the change of diameters and the increase in the number of street hydrants under the new fire-extinguishing regulations (P118 / 2-2013). The GIS monitoring model contributes to improving design data for rehabilitated pipelines through the required number of hydrants and street locations. Covering the urban land with new civil and industrial constructions requires changing the parameters of the water supply pipes, as well as introducing hydrants for the distribution of the fire extinguishing flow. In this context, the GIS model improves the civil database, but also hydro-technical. The new data base is used in the design of the water supply pipeline network in the area concerned.

4. Conclusion

GIS models are used both to monitor total water supply system separately, and separately for each hydroelectric construction and installation.

The analysis of the monitoring parameters of the special constructions and installations is made according to the specific data attached to them.

Monitoring technology is evolving continuously, and there is a need to continuously improve GIS models by interlinking different databases and upgrading work schedules to raise the technical level to consumer requirements.

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