

The Management and Cadastral Survey of the Public Utility Networks for the Localities and the Creation of the Data Bank

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Abstract: *In approaching the Specialized Cadastral survey of the public utility networks within the localities, it is necessary to have a unique technology and a proper management that would lead explicitly to the uniformity of the cadastral work, to have easy access to the data bank and on going modernization of it - objectives considered by the present paper.*

1. General issues

The Public Utility Networks are technical networks that supply the housing, the social-cultural ensembles, the institutions, the economic agents, etc., as well as the technical industrial networks within the urban space that can be underground or at surface.

The Cadastral Survey of the public utility networks is part of the cadastral survey of the urban fund which deals with the *inventory and systematic evidence* of the public underground and over ground facilities within the perimeter of the built up area of a locality under technical and quality aspect as well as by performing maintenance and updating works.

The Objectives of the Cadastral survey for the public utility networks follow the establishing of the methods, techniques, means and proceedings that would provide and define from technical, economic and judicial point of view the sphere, content and the products of the general cadastral survey for the public utility networks within the localities as well as the informative systems of the territory that have at their base the cadastral data concerning the facility networks.

The Purpose of the cadastral survey for the public utility networks within localities is the following:

- Establishing the elements of the general cadastral survey in correlation with the cadastral survey for the public utility networks;
- Establishing the unitary methods for the development of the cadastral survey for the public utility networks;
- Providing unique criteria for the assessment, verification and acceptance of the cadastral work for the public utility networks;
- Correlating the work of different agents for the performance of the cadastral work for the public utility networks within a locality;
- Supplying real and qualitative information on informative support.

The Mandatory elements of the cadastral survey of the public utility networks are the following:

- *The evidence and the inventory* of the public utility networks based on network types: water, sewage, gas, district heating, electrical, and telephones;
- *Determining the position in plan* of the buildings and arrangements for the public facilities;
- *Determine the elevations* of the significant elements/points of the facility networks (manhole cover, pipes' aprons from manholes, etc.).

Qualitatively, technical features of the cadastral survey for the public utility networks such as the construction material, its diameters, the status of the networks, the flows, the capacities, etc. are materialized on standard, unique schedules.

Schedule, the cadastral survey of the public utility networks are done at the scales 1:500 and 1:1.000, which besides the requirements, already justified, technical details, all structured on levels (roads, constructive elements, arranged areas, etc.) and specific to each type of network are needed.

2. The Content of the cadastral survey for the public utility networks in localities

2.1. The Drinking water supply network is made of:

- The drinking water supply network;
- The drinking water supply network for the maintenance of the green areas, streets, etc.;
- The industrial water supply network.

In general, the drinking water supply network is made of the following systems: over ground and underground intake, pumping, improving the quality of the water, storage and transport to the user's connections. The three networks can be separated within the big localities or can be common within the small localities.

2.2. The Sewage network includes the catchments, treatment and discharge of the waste water and storm water into an emissary and is made of:

- The exterior, street and catchments sewage network;
- Pumping and re-pumping stations;
- Pre- treatment and treatment installations;
- Collector and discharger.

2.3. Gas network is made of:

- Conveyer pipe line supplying gas to localities;
- Transmission pipeline;
- Splitting station in different underground or over ground sectors;
- Underground or over ground Gas-distribution network;
- Connecting pipes;
- Control stations recessed in the walls and fences of the buildings or applied on the exterior walls of the buildings.

The underground gas pipes are recessed at 0.90 m under the green areas and at 1m under the sidewalks.

2.4. The District heating network is used for the transport of hot water, steam, condense coming from the industrial steam or from other heat carrying mediums from the supplier to the consumer. The cadastral survey of the public utility networks must supply data concerning the following:

- Supply main (Ø 0,4-1 m) of heat agent as source for the residential quarters and industrial areas;
- Distribution network (Ø 0,2-0,4 m) from mains to consumer;
- Additional constructions along the pipes;
- Valves, air cocks, delivery valves, measurement installations with thermometers and manometers that are found in the inspection chambers;

The heating pipes can be underground – in channels or over ground – on walls.

2.5. Electrical cables network can be set on poles or sit directly underground, under sidewalks or green areas at depths of 0.80...1.10 m for which the cadastral survey must supply data concerning:

- The transport network (tension 1 kilowatt);
- The distribution network to consumers (of low voltage);
- Transformation points for pressure relief;
- Low tension switch rooms and manhole chimneys;
- Underground cables of 110 kilovolts and 220 kilovolts sit in channels with cooling installations and marked by benchmarks.

The order of electrical cables sitting under the sidewalks from the building to the carriageway will be the following: low voltage distribution cables, medium voltage distribution cables and the public lighting cables. The crossing of streets will be perpendicularly at their ends.

2.6. The telecommunication network includes the following networks: telephones, television, radio and telegraphy. They can be sit on poles or underground, either in concrete or PVC tubes, or in prefab concrete blocks with 4 or 6 closings to a depth of 0.80 m to 1.20 m. The cadastral survey for the public utility network must supply the following elements:

- Routes of the main telephone lines, installed in concrete blocks with several closings;
- Routes of the secondary telephone lines, installed in tubes and identifiable through the inspection chambers and the manhole chimneys;
- Routes of the over ground telephone lines, through the position of the poles and indicating arrows;
- Routes of the TV lines, suspended or underground.

2.7. The Street traffic control lights networks are sit underground in PVC tubes, under the green areas or sidewalks at a depth of 0.70 m. The cadastral survey must supply the following elements:

- Routes of the underground cables through manhole chimneys and channels;
- Traffic lights set on poles or suspended;
- Special poles for traffic lights;
- Aerial cables for the suspended lights;
- Automatic machines for traffic control;
- Detectors of heavy traffic or for adapted street-traffic control.

2.8. The Industrial networks are the following:

- Intake mineral water network;
- Intake thermal water network;
- Network for pneumatic water;
- Telecommunication network of optical fiber and cable TV.

These networks are specific to the area and benefic to the City hall and economic agents, etc.

3. Cadastral survey Work for facility networks within localities

Through the cadastral work are registered in graphic and analytical documents the following:

- *The position in plan and the height* of each network;
- *The elements and installations* concerning each network;
- *The qualitative elements* of each network.

The buildings and the technical arrangements represent component parts of the public utility networks which they serve and are the following:

- Inspection chambers;
- Water intakes, aqua ducts, tanks, constructions and installations for improving the water quality;
- Inspection chambers specialized for valves, outlet cocks, etc.;
- Discharge;
- Pumping stations;
- Waste treatment stations;
- Control-measurement stations for the important consumers;
- Transmission pipeline;
- Heating points for connection or preparing domestic hot water;
- Underground, on the ground or on poles Supply points and transformation points;
- Switch rooms and manhole chimneys;
- Main technical or connection manholes;
- Service or abandoned tunnels;

- Road and pedestrian passageway and underground garages;
- Underground depots and hangars;
- Underground wash rooms, public toilets, bomb shelters;
- Technological halls and underground storehouses;
- Bridges, suspended road passageway, and rising scaffold bridges;
- Tram lines and railway tracks from the localities, depots, and garages;
- Passenger ropeway and funiculars;
- High voltage power lines;
- Garbage disposal-plant;
- Subways, represented by contour lines of the area which include all its components.

The cadastral survey of the facility networks can be performed before, during and after the implementation of the general cadastral survey within the localities, to its making take part both the surveys and the references to scale 1:500 or 1:1.000 as well as any document that has been at the base of the designing, marking and building of the network, and possible modifications. The survey methods are the specific ones.

A special problem is the *cadastral survey marking* in the field of the facility networks, with marks specific to the type of network regarding the point, the sewer and the distances between the previous and the following sewer, etc. Along the streets, the positions of the sewage, water, electrical, and telephone networks must be marked.

Following the measurements and the calculations the following are obtained:

- Elements for cross section and longitudinal profile wording;
- Inventory with the coordinates of the points that belong to the facility network, the centers of the manhole lids or of the manhole chimneys, of the additional facility arrangements, air holes, connections, etc.;
- Surveys of the street manholes;
- Sketches of the facility network sections;
- Traffic Lane, standard and sole charts.

4. The Content of the complete documentation

4.1. The Detailed Technical Facility Plan represents the part elaborated at the scale 1:500 or 1:1000, on map-drawing and standardized sections on undistorted material. The wording includes all the facility networks with the following elements:

- Points from the survey and support network;
- Limits and axis of traffic lanes, markets, alleys, properties, forbidden areas, water, green areas, industrial areas;
- The main subscribers of the networks (housing, social–cultural buildings, institutions, stores, food stores);
- Inscriptions such as traffic lanes, postal numbers, public space names, parks, gardens, sport grounds, pleasure grounds, swimming pools, subway stations, art works, servitude, industrial areas, forbidden areas, water etc.

The elements of the technical facility plan are rendered by conventional signs and are the following:

- Manhole lids written as a fraction (lid elevation/ foundation elevation);
- Electric network poles, benchmarks for the underground routes, voltage, number of cables;
- Routes of the facility networks with all the utilities, connections, branching to the subscribers (sewers, hydrants, valves, water meters, fountains, drinking fountains);
- Additional facility buildings and arrangements put at scale or conventional schedules which are small, inscriptions associated to the facility networks (pipe diameters, number

of cables sitting altogether, construction materials, pressures, voltages, elevations, etc.), all under a figure or symbol shapes.

4.2. The theme plan is identical with the one specialized on one or several common networks. Practically, it is derived from the complete technical facility plan and has the advantage that depending on the beneficiary's request it can be worked on supports lacking useless details.

4.3. The longitudinal profile is drawn up only for the sewage and water supply network having the length scale equal with the plan scale, and the height of the scales is chosen dependant on the specific grades, different for each area and with the following elements:

➤ *For the sewage network:*

- Serial number for the manholes in agreement with those from the traffic lane chart;
- Partial Distances between manholes;
- Accumulated distances for the manholes;
- Elevations for lids, slab foundation, pipe entry and exits in the manholes;
- Diameters of sewage pipes at entry, exit and connections;
- Section of manholes;
- Construction materials of pipe, nature of the lid;
- Additional information (clogged, partially clogged, totally clogged, damages, etc.).

➤ *For the water supply:*

- Serial numbers of points from the profile and manholes;
- Partial distances between points and manholes along the route of the pipe;
- Accumulated distances in front of the same points;
- Elevations to sewer lids and slab foundations;
- Elevations on pipes in manholes ;
- Pipe diameters and materials from which they are made;
- Sections through manholes.

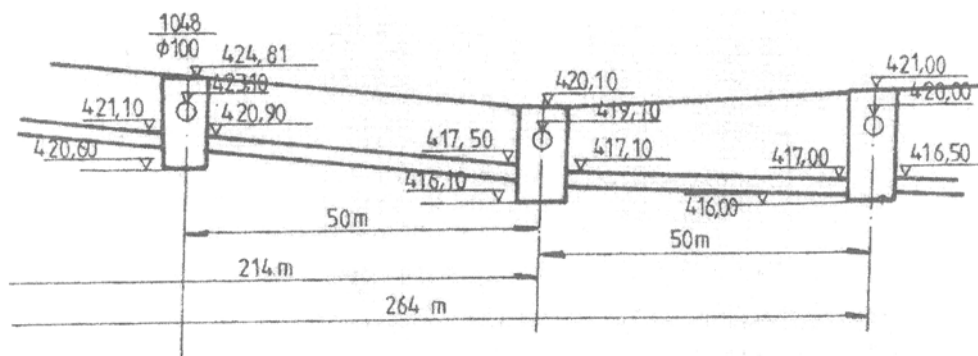


Figure 1. Longitudinal Profile for sewage

4.4. The Cross sections are drawn up at two scales, one for the length (1:100) and the other for the height (1:10 or 1:50). The cross sections must be grouped for each traffic lane and contain the following:

- Points that define the ends of the profiles;
- Symbols of the facility networks marked in the profile;
- Partial distances between networks;
- Accumulated distances from the left end of each network;
- Elevations of sewage and water supply networks obtained through measurements for lids, slab foundation on pipe and at connections;
- Sitting depth for the rest of the technical networks obtained through detections with proper apparatus or from information of the managing agencies;
- Miscellaneous (data of putting into service, their status, information on failure, etc.).

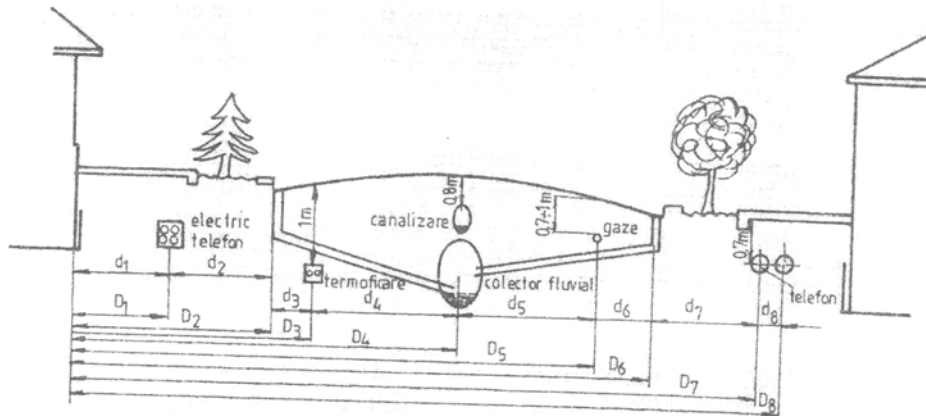


Figure 2. Cross section for sewage

4.5. Sole schedule contains the constructive elements for the networks.

4.6. Standard schedule contains the sitting details.

4.7. Miscellaneous documents used for the drawing up of the project:

- Old topographic and cadastral plans;
- Plans taken from the network owners with annotations resulted from the analysis of the land;
- Sketches, sections, and schedules drawn up for stations, reference points, profiles, etc.

4.8. Sewer surveys, manhole surveys and other additional construction survey drawn at convenient scales, established in agreement with the beneficiary and dependant on their content.

4.9. Sections schedule, on types of networks, are drawn up within the traffic lane schedule, at a convenient scale for presenting a whole view on that network section.

4.10. Traffic lane schedule contains data referring both to the lane as well as data referring to each type of network:

➤ *Referring to traffic lane:*

- Identifying date of the lane: schedule number, code and lane type, lane name, roof sections, etc.;
- Lane schedule: axis, number and position of the cross sections, axis and names of lanes that are intersected;
- Constructive elements: length, width of carriageway for lane and sidewalk, nature of the covering.

➤ *Referring to facility networks:*

- The Enterprise (name, address, telephone, fax);
- Network schedule: routes of the pipes divided on sections, main subscribers, postal codes, additional buildings/constructions;
- Additional constructions and installations: type, coordinates in plan, elevations (for lids, pipes and slab foundation), numbers/codes of standard and sole schedules where they are detailed;
- Pipes: the section and its length, type of the pipes (transport, services), nominal width, sitting modality.

5. Data Banks in the Cadastral survey of the Facility networks

5.1. General

The **Informative system** of the cadastral survey of the facility networks considers the following *objectives*:

- The Development of informative products in the field of facility networks and the insertion in the current activity of the users;

- The Development of new technology concerning the acquisition and analysis of the topographical-cadastral data.

The informative system of the cadastral survey of the facility networks as base, contains the data supplied by the general cadastral survey of the locality.

Data bank of the cadastral survey of the facility networks represents an informative system at locality, county and country level allowing the acquisition, update and integration upon request of the data that constitute the activity object of the cadastral survey of the facility networks.

The Object of the data bank is the activity of updating the cadastral date of the facility networks as well as data concerning other activity sectors such as administration, environment, etc. Through given information, the data bank serves to the stability of self strategies of the institutions that support them, to the solving of some operative situations of the local administration as well as to drawing up general development strategies for localities.

The Principles, on which the developments of the data bank model relay within the cadastral survey of the facility networks, are the following:

- *The Main support* in creating such a bank is the *urban data base*;
- *The Architecture* they have is of GIS type which means considering the hardware, software and organized components;
- *The nature of the information* that it holds is of *graphic type*, providing thus the localization of the objects in space (spatial reference) and of *features type* (of defining), providing the qualitative and quantitative definition of the objects;
- The Data Bank represents a *system developed at the level of each agency*, the information being consulted by other institutions through different communication networks;
- *The connection to the general cadastral survey systems* and of real estate advertising.

The Information owned by the data banks is for:

- The network users for maintenance work, investments, development, quick interventions in case of damage, periodical revisions, repairing, etc.; the information are reliable, extensive and available in real time;
- The decision factors that analyze and know the site situation in view of adopting some strategies for locality development.

The Functions of the informative system used for the development of a data bank are the following:

- Data Loading;
- Data processing;
- Consulting, interrogating, viewing and editing the information;
- Data analysis;
- Data management and update;
- Maintenance of graphic and non-graphic data base.

The model of the informative system used by the data base implies the following:

- Standardization of the graphic and numeric information referring to networks;
- Development of classified lists based on network type;
- Design and Standardization of the data entries and exits;
- Drawing up algorithms in GIS context;
- Organizing the graphic data on layers in a tree-like hierarchy shape (basic topographic layer, traffic lane, lane section, section type like of specialized network, etc.).

5.2. Development of data base of the cadastral survey for the facility networks

The data bank contains two structural components that follow the integration with the component of the general cadastral survey, the creation, maintenance and presentation of data and self information:

- *Graphic data Bank* contains information referring to graphic details such as plots, lane sections, network sections (water, sewage, etc.);
- *The alphanumeric data bank* contains information referring to features of the networks.

5.2.1. The acquisition of the information for the development of the data base

The gathering of information for the development of the data base is done differentiated for the graphic data base and the alphanumeric data one.

The Graphic data base is obtained:

- By scanning of the plans, of the cross sections, and longitudinal profiles and construction surveys and additional installations following the obtaining of the raster data in *.tif* and *.bmp* format;
- By digitizing the thematic topographical plans of the facility networks;
- By generating points having the coordinate inventory as base.

Also the conventional sign libraries are used for the topographical plans at different scales, especially at scale 1: 500.

The alphanumeric data base can be developed with the following sources:

- The cadastral register of the plots and owners;
- Cadastral plans (scale 1 : 1000);
- Topographical plans of facility networks (scale 1 : 500);
- The archives of the agencies (S.C. Electrica S.A., S.C. Distrigaz S.A., R.A. Romtelecom S.A., etc.);
- Other documents, designs, schedules, etc.

5.2.2. The Layers of the data base

The data base can contain the following layers:

- *Basic layer* (topographic layer) with information referring to the support geodesic network, the survey network and the detail points;
- *The traffic lane layer* contains information referring to the entity of the traffic lane;
- *The layer of the lane section*;
- *The layer with all types of network* includes the following:
 - *Water network* – containing information referring to administrator, feed pipe, distribution net, manholes, status, value, technical information, subscribers, etc.;
 - *Sewage network* – containing information referring to administrator, value, status, main collector, secondary collectors, sewers, manholes, technical information, subscribers, etc.;
 - *Gas network* – containing information referring to administrator, value, status, distribution net, connections, air let, technical information, subscribers, etc.;
 - *Heating network* – containing information referring to administrator, value, status, mains, distribution net, heating channels, manholes, connections, technical information, subscribers, etc.;
 - *Electrical network* – containing information referring to administrator, value, status, lighting poles, manhole chimneys, low and medium voltage aerial electric cables, technical information, subscribers, etc.;
 - *Telecommunication network* – containing information referring to administrator, value, status, aerial telephone lines, urban and international lines, technical features, subscribers, etc.

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