IRRIGATION SYSTEM DESIGN OF THE LANDSCAPING PLAN OF „LACUL DULCE BRĂILA" PARK

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Abstract

This study was conducted during the design and execution works of an economically and competitive irrigation system for the „Lacul Dulce" Park, located in Braila. Technical project planning of the irrigation system is a vital component in the overall project planning of the park, built to improve quality of the environment and the green space area that is available per capita. The irrigation project is fully integrated and consists in automated, competitive and efficient equipment which is functioning at the designed parameters that allow sustainable use of landscape of the park and provide benefits to the population the area.

Key words: development, irrigation, park, landscape, environment

Designing of the professional irrigation systems is a key factor in planning, management and administration of the green spaces (IA, 2005). Programming, design and execution of irrigation of the green spaces in the parks are essential steps in the overall process and the planning and designing for landscaping and irrigation systems must be proficiently done by rigorous analysis of the area situation in conjunction with the water requirements for the flowers, the trees, the shrubs and the lawn that has to be arranged in terms of landscape (Technical Documentation). Also the effectiveness by professional designing of an irrigation system is positively influencing the future economy (Aitken et al., 1994) and quality of management of the site development of these areas (White, R 2004). The Park which will be built is located in the southwest side of the Braila city, Romania, in the „Lacul Dulce" neighbourhood (Law 49/2008). The Braila climate is characterized by cold winters with low temperatures and strong storms, slightly improved by the presence of the Danube (in January:-21.6 °C ->26.5°C). Summers are hot but also temperate due to the presence of surface aquifers (July: 40.5°C - > 41.5 °C).

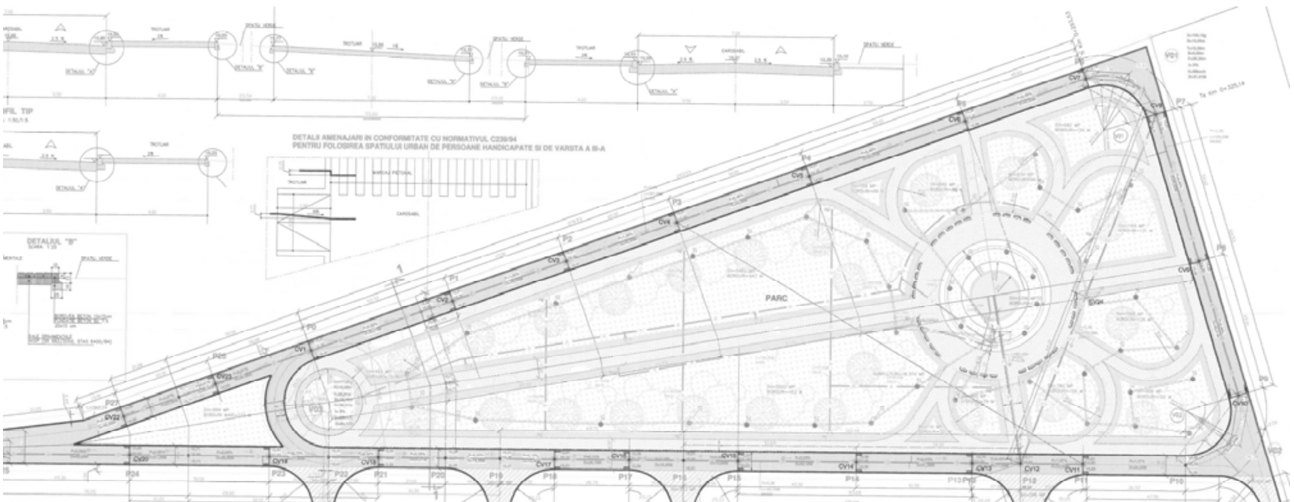

Figure 1 **Braila's Lacul Dulce, Park's general plan**

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Values presented expresses moderate continental climate due to the presence of the Danube in the immediate vicinity.

Sunshine duration totals 2000 hours during the year, surpassed only by the Black Sea coast and some localities in the southern Romanian Plain. Maximum is reached in July at approx. 300 hours. Average duration of sunshine per day varies between 10 hours / day in June and July, and less than 4 hours / day in December and January. Nebulosity has an annual average of 5.6 tenths, with a variation between 7 tenths in the winter and four tenths in the summer from July to September. Moisture has an average annual value of 74% to 80% in winter from November to January, and 66% in the summer from June to July.

Annual rainfall totals 440 mm, a low value corresponding to this region. Generally, the rainiest month is June when there is recorded an average of 70 mm; in the driest month there is recorded a monthly quantity of less than 20 mm.

Morphologically, the site is located on the Braila terrace, the area which consists of land with eoliano-alluvial nature (loess, dust, sand, etc.).

The geotechnical analysis which was developed in the emplacement site, showed the following stratification of the foundation soil:

- the surface, a layer of 1.6 to 1.8 m of unconsolidated fillings, composed from rubble, bricks, etc.
- under the layer of fillings, is encountered a loess horizon, coursed pored, wet sensitive plastic consistency, plastic flow, up to 8.2 m depth.
- under the loess layer it is developed a sand dust layer, yellow, immersed, of aeolian nature .
- groundwater level was found at a depth of 4.5 - 5. m from natural ground level
- depth of frost for the Braila city according to STAS 6054/1997 is 1.0 m.

Loess horizon has high porosity, high or very high compressibility both in natural and in flooded state, lower values for shearing strength parameters.

He has a plastic consistently, plastic flow, due to lower humidity of the land from the superior layer and the gradually soaking in the deep.

These characteristics are enflaming the foundation soil of the studied site in the weak foundation lands group, which requires improvement measures for direct foundation of the constructions.

The site is located (according P100-1/2006) in the area with peak values of ground acceleration for earthquakes with IMR = 100 years = 0.24g and L-control period (corner), Tc - 1.0 sec, corresponding to the seismic VIII level MSK scale - 64 (STAS 11100/1-77). According to CR 1-1-3-2005 - Design Code - evaluation of the snow action to the building - construction was in the "C" zone for calculating the action of the snow. According to the NP 082-04 - Design Code. Wind action. Construction is in the "B" zone for calculating the wind action. (STAS 6054/1977), depth of frost is 1.00 m from the systematic terrain or the natural terrain.

MATERIAL AND METHOD

The green space areas of the " Lacul Dulce Brăila " park for which it has been designed an automated irrigation system, have been established after analyzing the landscaping development general plan of the park, and after the surveying measurements had revealed a total area for the green space available for its design of around 18,500 square meters (Technical Documentation). When calculating the watering time and the amount of water, it was considered the ratio of 5mm/day (5 l/sqm) for all the surfaces in consideration , following that for the shaded areas to adjust watering times during the operating phase (The Irrigation Association - Water Management Committee, 2005). Estimated water volume necessary to ensure this precipitation norm, in the condition of complete absence of the natural rainfall will be:

$$(18.500m^2 \times 5\ l)/1000 + 10\% = about\ 100\ m^3/\ irrigation\ cycle$$

To enclose the irrigation cycle for a period of 8 hours a day (night) and a maximum frequency of watering for two days of complete irrigation, water supply will have a flow rate of about:

$$100\ m^3/h : 16h = 6{,}25\ m^3/h$$

The water will be ensured from existing water supply network that was provided for the hydrant system that will be replaced. Existing water supply capacity and pipes diameter installed are adequate to ensure the indicated flow parameters.

It was elaborated the location design plan of the fixed and rotary sprinklers for the entire proposed area at the 1:500 scale, then under its consideration it was realised the general technical Project of the irrigation system, the distribution of areas for watering and indication of all the elements that follow to be executed below ground at 1:500 scale (Law no. 24/2007).

RESULTS AND DISCUSSION

The designed automatic irrigation system is the watering solution with professional equipment produced by the Rain Bird and K-Rain companies and consists of the watering equipment, designed to bring daily intake of water needed for survival and development of plants in local climate conditions.

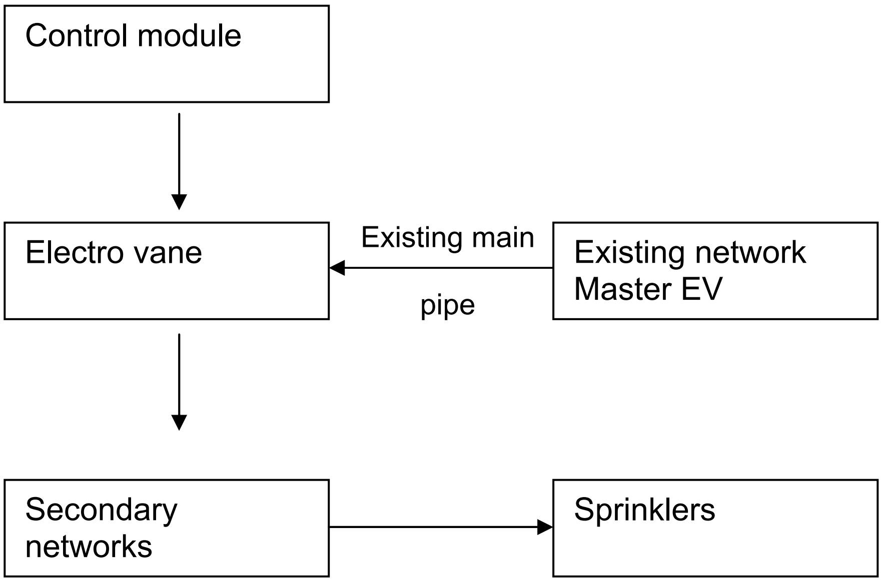

Figure 2 **The main components of irrigation system**

For choosing the solution for the project has been considered the following technical elements:

1. To be provided the necessary water flow and pressure for the proper functioning of sprinklers located in any point of the area, according to the watering plan.

2. Waste parameters of dynamic pressure and water rate for not to overstressing the water pipes and irrigation equipment, above the parameters guaranteed by the manufacturer, using the existing water supply network for hydrants.

3. To distribute the water trough the aspersion method all over the area proposed to function as green space, and without spraying the concrete walkways or the places where the irrigation is not required, with a high degree of homogeny in order to minimize the water and energy consumption.

4. Irrigation of green areas has to be done Automated, using battery-powered control modules without being necessary to perform a new branching for electricity or any additional excavation for installation of signal cable network along the main existing supply pipe.

Also, given the exposure to vandalism of the green space surfaces located on public sector, from the project stage there has been provided some elements that reduce the risk of destroying the irrigation system automatically that was installed below ground:

1. Rotating sprinklers medium-range was planed, that leads to the use of a smaller number of sprinklers to cover all plants.

2. The specified rotary sprinklers are equipped with "memory arc" which makes the watering to be maintained even if the rotating body is rotated trough unauthorized intervention in the wrong direction (i.e. towards the alley).

3. The mounting devices have been provided with "continuous rotation" for sprinklers, which are not allowing their removal from the surface.

4. Specified electrical control modules have IP68 degree of isolation which allows the complete burial below the ground, in the valves box, and minimum exposure to external interventions.

5. Master electro valve that was provided only ensures water supply for the system during the operation, thus reducing water loss and damage caused in case of failure of the main pipeline.

6. Electro valves chamber will be of fibreglass reinforced polyethylene, very resistant to accidental or intended impact, it supports also the auto traffic or heavy loads.

7. Closing of the chamber is done with Pentagonal screw which requires a special wrench.

8. The fully automated system and integrally installed below ground, is designed to fulfil the green space watering during the night period when the human presence in the park is very low, and the telescopic pipes that comes out of the ground are hardly visible. The system is virtually invisible during the day time if it was correctly installed.

The water will be provided from the water supply network for the existing hydrants, consisting on the pipe with De 63mm, indicated on the plan. This will be provided with some new sections to fully cover the proposed area.

The network will ensure a flow of 6.3 m3 / h at a dynamic pressure of 50 MCA.

All network-related spraying pipes will be installed below ground, according to the project. Branching links to the electro valves irrigation system are executed in polypropylene manholes with green cover, flush-mounted in the green space area, according to the project. Secondary water distribution networks from the electro valve to the sprinkler (irrigation areas) are made of De32mm HDPE, flush-mounted.

The pipeline route from the existing network to the irrigation area is done with De50mm HDPE mounted below ground.

Connections between the pipes are made of polyethylene with fittings sealed by compression PN10. For all the spraying network (filling column and secondary networks with sprinklers) will be used PE80 SDR17, SDR21 PE100 with PN 6 or 6 bar pipes.

The electro valves allows the division of the system in different areas, the division that serves to decrease the instant system flow during operating and adjusting the watering time and rain rates to the specific needs of different areas (shade, stronger drainage etc.). Irrigation system is divided into watering areas to avoid a high instantaneous water consumption, which would involve the use of large pipes, difficult to install and much more expensive and that would exceed the availability of branching to the existing water supply. Irrigation areas control is provided by FI 1 electro valve with circuit coil controlled with a voltage of 9V (battery).

Diameters, flow rates and pressure losses of these are correlated with the pipeline on which they were mounted. Electro vane must be installed below ground in special polyethylene chambers where branching is done with the water distribution network and the connected to the secondary networks of sprinklers. Valve chambers are mounted below ground in rectangular polygonal pits, and are installed on a gravel bed and geotextile foil. Inspection cover is green and is mounted at ground level.

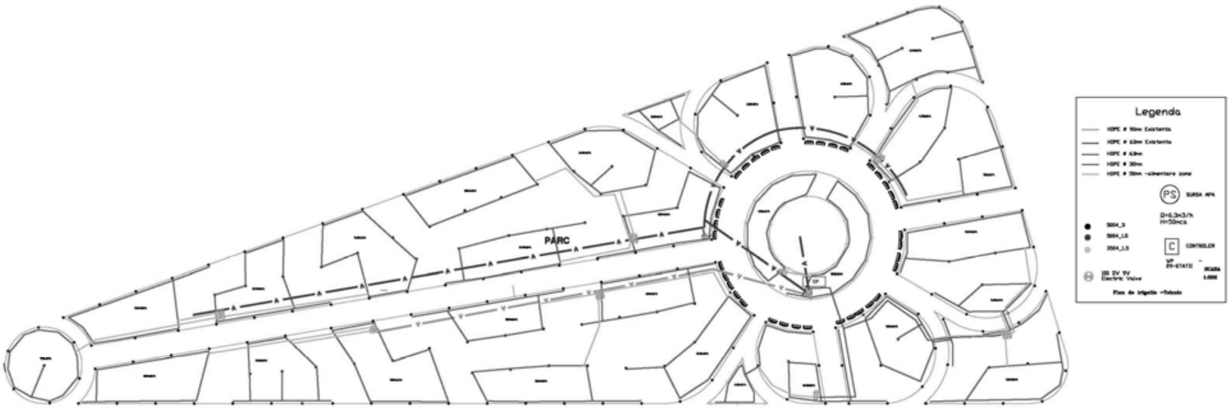

Figure 3 **Plan of distribution columns**

Water pressure in the distribution columns rises up to 10 cm the telescopic sprinklers and also drive the rotation mechanism (in case of rotor type sprinklers), resulting in a evenly distributed spraying within a radius / area around the sprinkler. Upon completion of spraying time set by the program, the control system transmits an electrical closing signal to the electro vane, which are closing the circuit of water sprinklers and the sprinklers retract into the ground at a level close to ground level, established trough installation (usually -1.00 cm).

The process is repeated until all areas of watering areas were operated under the established water delivering schedule necessary for the serviced land area. The used sprinklers are the telescopic type (pop-up) with installation below ground, with rotating mechanism or spraying on the predefined area, and it works by raising the internal piston provided with spraying nozzle, at 10 cm above the ground level. Each type of nozzle is indicated by colour code in the "installations below ground" irrigation PLAN legend completed within the project, and the sectors on which they splash and also the spray nozzle are indicated in the layout of sprinklers Legend. For a uniform application of artificial rain, the sprinklers are positioned apart one another at a distance equal to the radius of the sector in the case of circular splash, respectively the width for the rectangular sectors.

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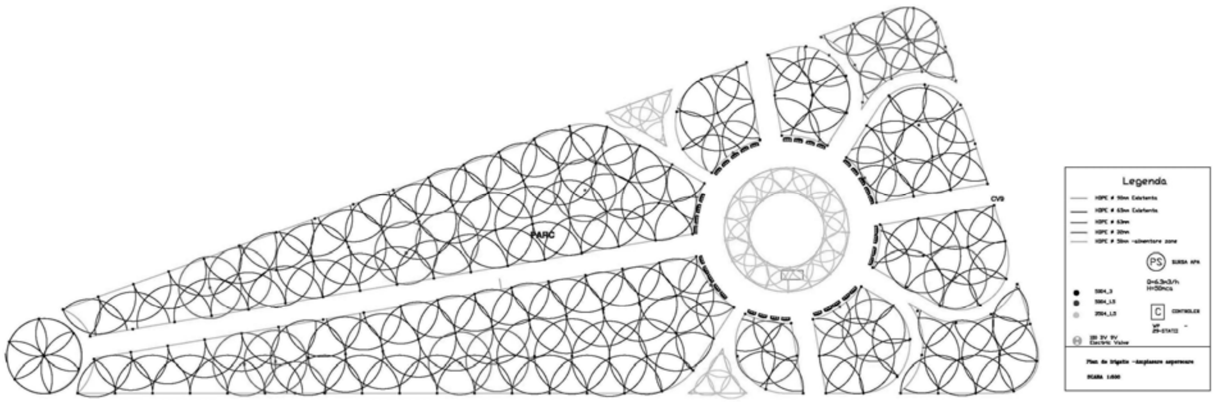

Figure 4 **Plan location of sprinklers**

Table 1

Watering Equipment

Series - Rotary Sprinklers (Applications Residential / Commercial. Spraying range from 5.1 to 15.5 m)	Model
MINI*PRO*™ series *(FI - 1/2").* Lifting 10 cm, set nozzles, adjustable 40-360 °, 360 ° roundtrip	13003
SUPER*PRO*™ series *(FI - 3/4"). MEMORY ARC. CLOSING SCREW WATER* Lifting 12.7 cm, set of nozzles, adjustable arc 2 in 1, at 40-360 ° or 360 ° full circle	10003

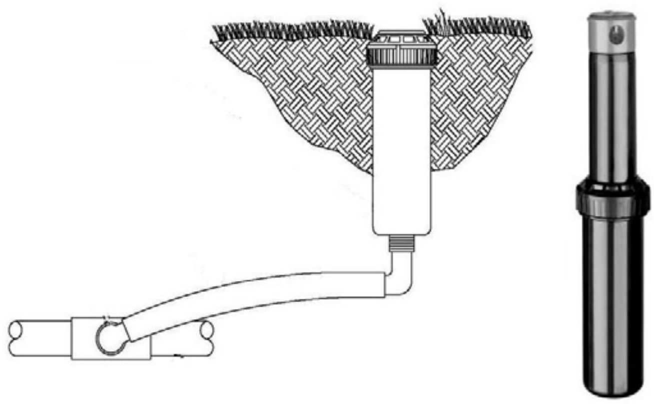

Figure 4 Sprinkler Model SUPER PRO ROTOR (www.krain.com)

The control system proposed in this irrigation project consists of the following elements:

1. Electro valve Control Module + Master + Rain sensor;
2. Battery-powered control module for 2 or 4 Valve;
3. Electro valve with solenoid 9V c.c.

In the control modules are realised and stored the irrigation programs for each one of the electro valve. The panel will be activated at the scheduled time and will pass through all scheduled phases of the cycle. At a time established by the program, the control panel sends a voltage of 9V for a Valve coil opening command and thus for the water supplying to the section served by that electro valve. After watering time completion, the panel sends a new impulse of 9V that closes the electro valve which is in operation and moves to the next zone, repeating the process until all valves that were scheduled were opened during the time set by the program.

In case of raining, the Valve control module receives an order from Master Rain Sensor and Valve Master and thus closes the water supply system.

Figure 6 **WP 8 controller (www.rainbird.eu)**

CONCLUSIONS

Both the design and installation of green areas irrigation systems requires detailed topometry, geotechnical and site's climate studies, in order to achieve a viable and feasible operation solution from the technical-economical point of view for the implemented system (White R. et al., 2004).

Automated irrigation systems are custom made designed for each site, park, green area, sports field, in order to ensure the water needs of existing and planted vegetation, a uniformly distributed rainfall rate and water economy, all correlated with the characteristics of the available water source (Water Corporation of Western Austalia, 2001).

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