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HYDRAULIC ANALYSIS OF A WATER DISTRIBUTION SYSTEM

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1. INTRODUCTION

The main function of a water distribution system (WDS) is to transport water from the treatment facility to the customers. Furthermore, distribution systems provide storage, flow and pressure suitable for the system. In this project, a water distribution system for a small village is modelled. Initial data of the water distribution system were given by the Hydrodynamic Systems Department at Budapest University of Technology and Economics. To compute the hydraulics parameters in the water distribution system and run hydraulic simulations, the software Staci was used, which was developed by the same department.

2. OBJECTIVES

The modeling process includes:

- Choosing a suitable pump that have a frequency converter and can deliver 150% of the required amount of water based on recorded average consumption.
- Verify through Staci's simulations that the velocities in the pipes do not exceed 2m/s, due to leakages.

3. THEORICAL BACKGROUND

The main Water distribution System's elements are:

- Link: It is a segment of a distribution network that transports water from one place to another (pipe) (Supply link, Distribution link).
- Node: It is a point where two or more links meet, a link begins, a link ends, a pipe diameter changes or a point denoting a pump or a pressure reducing valve
- Loop: It is a closed figure obtained by starting from a node, travelling only once along any of the connected links, passing only once through the connected nodes and returning back to the starting node.

4. METHODS

The design of the project was already done in Staci (provided by Hydrodynamic Systems Department), so it was needed to open the file, place the pool on the highest point in the WDS system, excluding the pump's connecting node, set the bottom level of the pool in the same as the height of the connecting node. Through Staci it could be found which node had the higher consumption and by simulations it was found that a adding 30m to the pool size would be more suitable. In Fig. 1, it can be seen the WDS topology through the use of Staci.

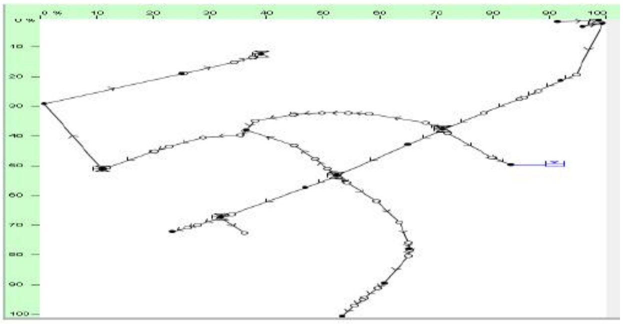

Figure 1 – WDS represented in Staci software. Pool is highlighted in blue.

After that, the nominal consumption had to be calculated. The consumptions of the individuals nodes were found in Staci, so it was used a tool in this software, which copy this information to an excel sheet and using it we could find the nominal consumption of the system, which was 0.78528 m^3/h. This was needed, because of the high number of nodes in the system.

The next step was to run hydraulic simulations to be able to draw the system's Height x Q(flow rate) curve. It was put a negative value in the consumption node in which the pump would go once selected. The values would vary from 0,1*Qn until 1,9*Qn, in order to get the height of the System for each flow rate, as it can be observed in Tab. 1.

Table 1 - System's flow rate and Height values for different consumptions.

	0,1	0,3	0,5	0,7	0,9	1,1	1,3	1,5	1,7	1,9
Q(m^3/h)	0.078528	0.235584	0.39264	0.549696	0.706752	0.863808	1.020864	1.17792	1.334976	1.492032
H(m)	220,525	220,527	220,528	220,529	220,53	220,532	220,534	220,536	220,539	220,543

Once the simulations were finished, the data for the height were obtained and it was possible to build up the system curve using Excel. In Fig 2, such curve is represented.

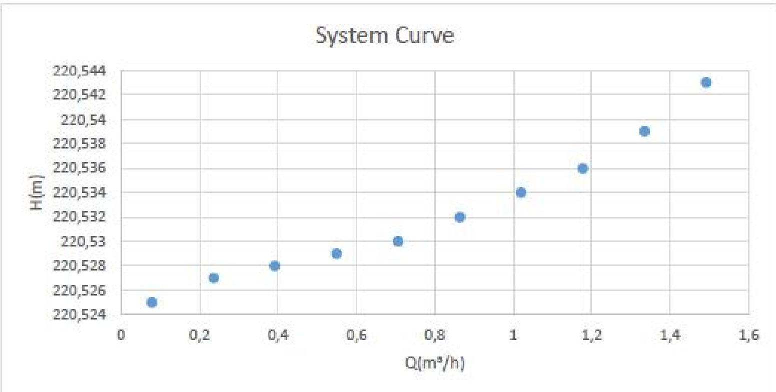

Figure 2 – System Curve.

To select the pump it was required that it was used 150% of the system (Q = 1,17792 m^3/h and H = 220,536m). By looking in the Grundfos's pump site catalog we could find one that fulfills the requirements of height, flow and it has frequency converter. The pump selected was CRE 1-27 A-FGJ-A-E-HQQE – 96553824. The curves plotted in Excel and from the manufacturer site can be seen in Fig. 3 and 4.

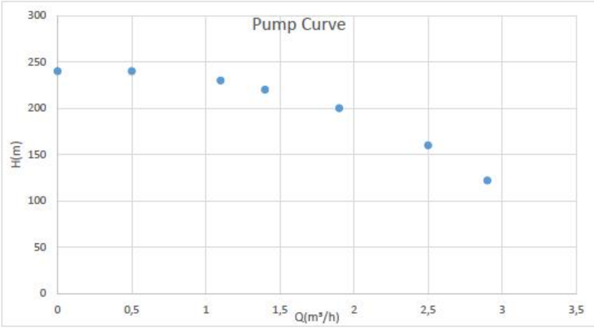

Figure 3 – Pump's Curve.

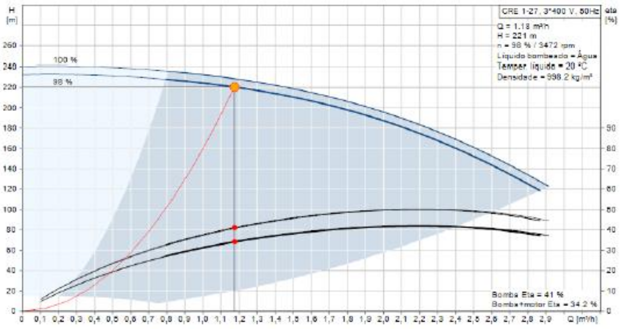

Figure 4 - CRE pump curve from the grundfos website

The information of the pump's curve was inserted into Staci and so simulations were made to see if the system would respond in an efficient way. Figure 5 e 6 show information regarding the successful simulation and data obtained by it.

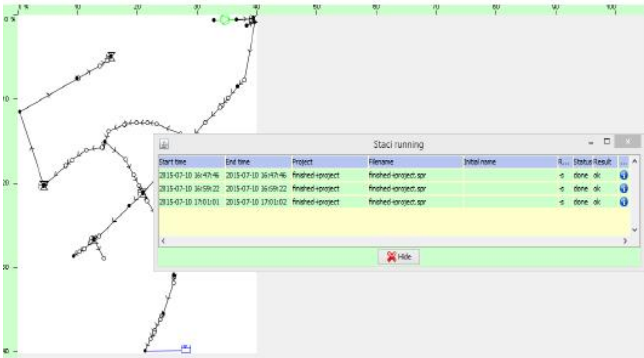

Figure 5 – Successful Simulation on Staci. Pool highlighted in blue and pump in green.

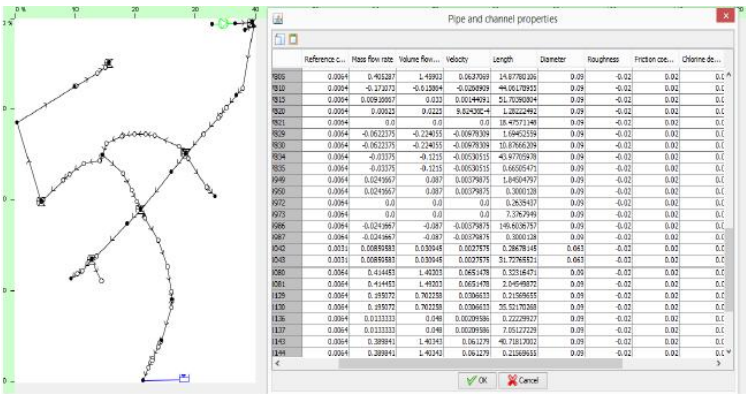

Figure 6 – Pipe velocities in the system.

5. CONCLUSION

The simulations occur without any problems and through it, it was possible to obtain a lot of data regarding the system, one of which is important for this project, which is the velocity in the pipes. All velocities were below 2m/s, satisfying the conditions for a good performance of the system.

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