Vertical shaft of the "Chemin des Vignes d'Argent" (Lausanne, Suisse) - 2005

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The vertical shaft located on the drainage system of the 'chemin des Vignes d'argent' at Lausanne city includes two canals at the upstream and downstream parts of the system (Figure 1). Total surfaces of the catchments area connected to the upstream and downstream parts are approximately 1'490'507m^2 and 560'172 m^2 respectively. The total lengths of the vertical shaft and the surge shaft are 29.55 meters and 4.27 meters respectively. (figure 1).

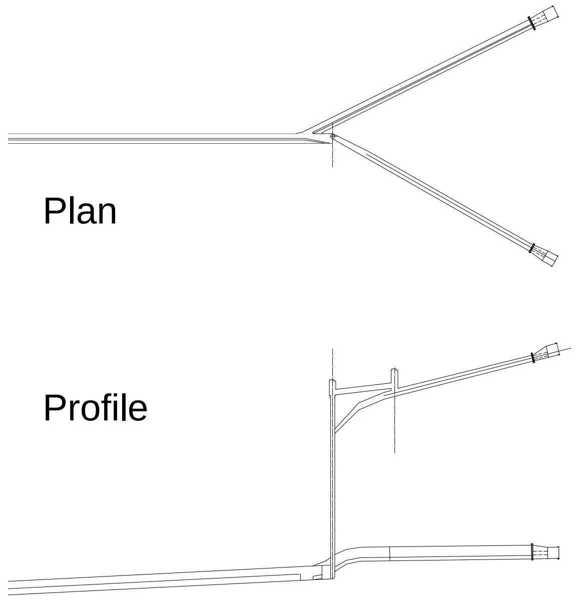

Figure 1   General configuration of the main elements of the system reproduced on the physical model

In case of heavy rain the 'Vignes d'argent' system is often overflowed. To solve this dysfunction, the system was already modified by adding a supplementary horizontal conduit between the first surge shaft and the vertical drop shaft. However, the hydraulic capacity remains insufficient. To solve this problem, a physical model of the complete system was submitted to experimental tests (Figure 2).

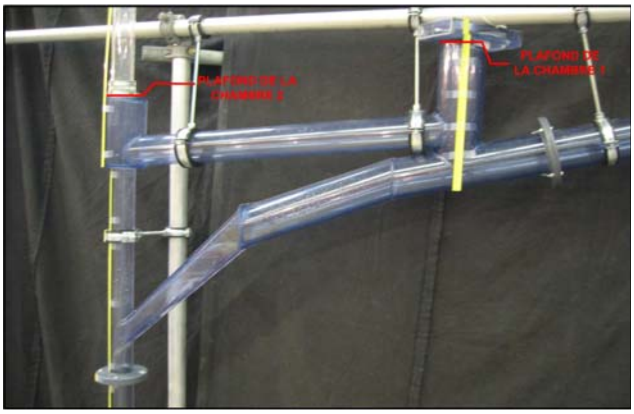

Figure 2   View of the upstream part of the physical model of the vertical shaft of the Vignes d'Argent.

Physical modeling

A 1:10 scale physical model of the existing system was primary submitted to experimental tests. With the help of measurement and visualization devices the behavior of the system could so be documented. It is important to notice that the flow in the vertical shaft is characterized by high air-water mixing. The density of the water column in the shaft is by fact not related to pure water but almost to a lighter mixture.

Among the reasons which limit the capacity of the system, one first hypothesis was related to an insufficient orifice area of the shaft outlet. Furthermore, the vertical shaft ends with a 90 ° circular bend which increases the contraction effect. In order to investigate this effect, a movable van was installed at the outlet section, so that it was possible to change the surface of the orifice as much as needed to reach the best performance. However, this geometrical change revealed insufficient to increase significantly the hydraulic capacity of the vertical shaft (Figure 3).

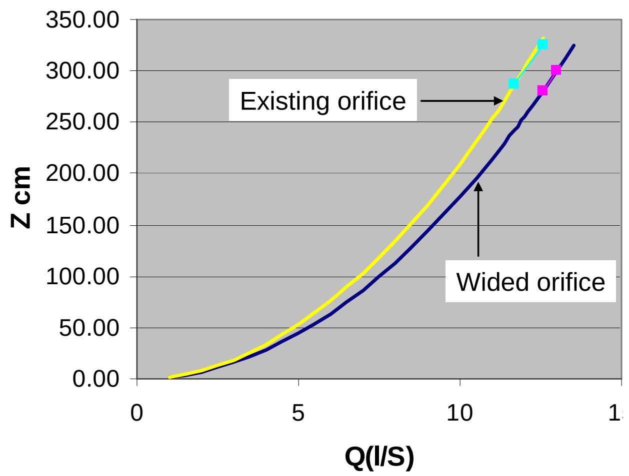

Figure 3   "Water level-Discharge" relation before and after the modification of the outlet

Numerical modeling

In order to investigate the influence of additional geometrical characteristics, a numerical model of the system was built using the program "Hydraulic System", developed at LCH. The simulation was completed by adding a weir and a reservoir at the top of each shaft to be able to measure the flow which is spread out of the shafts (Figure 4).

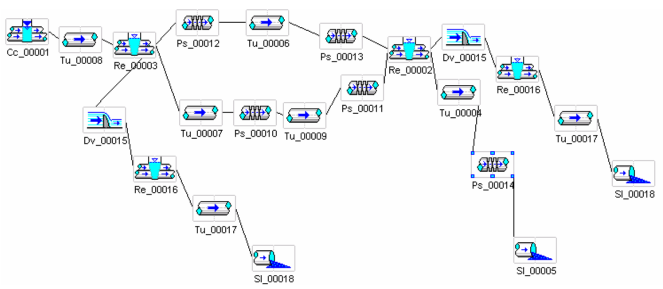

Figure 4   Numerical scheme of the stationary simulation of the complete system using Hydraulic System

The best solution to increase the hydraulic capacity of the system revealed finally to be the increase of the diameter of the drop shaft.