

Assessment of Vibrations in the Turning Part of the Turbulent Flow at the Water Outlet of the Karkidon Reservoir

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In the channel of the Karkidon reservoir with sloping walls, hydraulic processes that are formed in the diversion of the current flowing in the water transfer tunnel:

If the channel has a transverse slope, then a Virage is formed in the stream. The lower part of the cross-section at the turn of the Uzan can be straight or curved. In turn, there are many works dedicated to the calculation of flow parameters, the study of which was carried out in the ideal fluid flow. When researching a real, i.e. Real liquid flow, it is usually assumed that only the longitudinal composition of the velocity is present. There are also works in which fluid circulation is also taken into account, and in turn the flow is again considered two-dimensional ($u_z = 0$).[1]

We derive the calculated dependencies from the Euler equation in polar coordinates. Stable motion is written as follows in the system of equations corresponding to the lower plane in the system of cylindrical coordinates:

$$\left. \begin{aligned} u_r \frac{\partial u_r}{\partial t} + \frac{u_\theta}{r} \frac{\partial u_r}{\partial \theta} - \frac{u_\theta^2}{r} &= g_r - \frac{1}{\rho} \frac{\partial p}{\partial r} \\ u_r \frac{\partial u_\theta}{\partial t} + \frac{u_\theta}{r} \frac{\partial u_\theta}{\partial \theta} + \frac{u_r u_\theta}{r} &= g_\theta - \frac{1}{\rho r} \frac{\partial p}{\partial \theta} \\ 0 &= -g_z - \frac{1}{\rho} \frac{\partial p}{\partial z} \end{aligned} \right\}$$

To make the above system of equations closed, we use the form of the Continuity equation written in the system of cylindrical coordinates:[2,3]

$$\frac{\partial(ru_r h)}{\partial r} + \frac{\partial(u_\theta h)}{\partial \theta} = 0$$

In the future, the transformation of equations is carried out taking into account the calculation scheme considered in each case.

For example, the current in the horizontal plane along the arc of the circle, when rotated, becomes the following:

$$u_r = 0, g_r = 0$$

The first equation of the system takes the form below:

$$\frac{u_{\theta}^2}{r} = \frac{1}{\rho} \frac{\partial p}{\partial r}$$

After joining the second equation of the system to the Bernoulli equation, the equation becomes inverse. For the equation remains unchanged:

$$g_z + \frac{1}{\rho} \frac{\partial p}{\partial z} = 0$$

By integrating the last equation, we form the expression below:

$$p = -\rho g z + C$$

We write the effect of atmospheric pressure on the free surface of the current as follows:

$$p = p_{am}, z = z_{nos}$$

from this:

$$C = p_{am} + \rho g z_{nos}$$

Or

$$p = p_{am} + \rho g (z_{nos} - z)$$

The transformation of equations is carried out in each case, taking into account the calculated calculation scheme of the plots.[4.5.6]

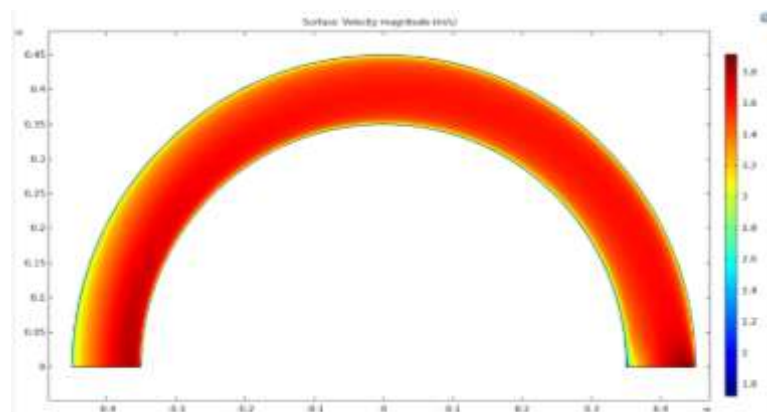


Figure 1 A describes the flow rate and pressure isolines.

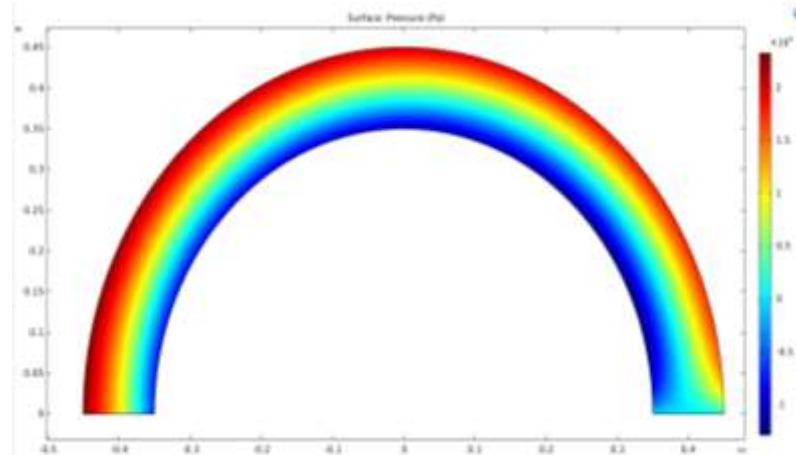


Figure 1 B is the flow rate and pressure isolines.

The figure below shows the pressure distribution along the outer and inner radius of the pipe.

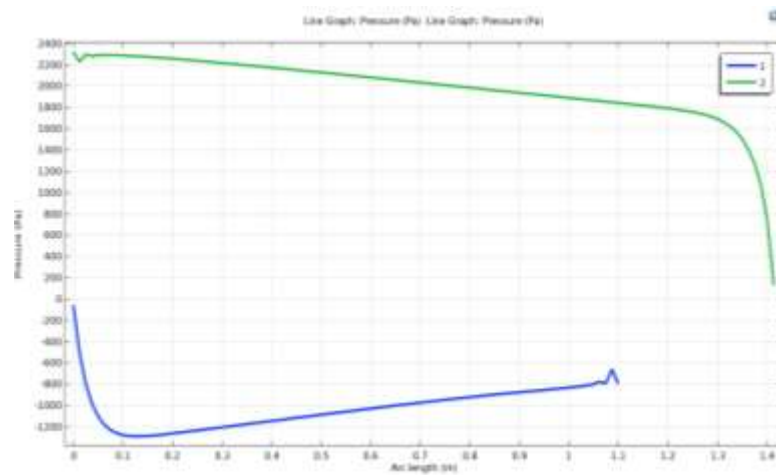


Figure 2. 1) pressure distribution along the inner and 2) outer radius of the pipe.

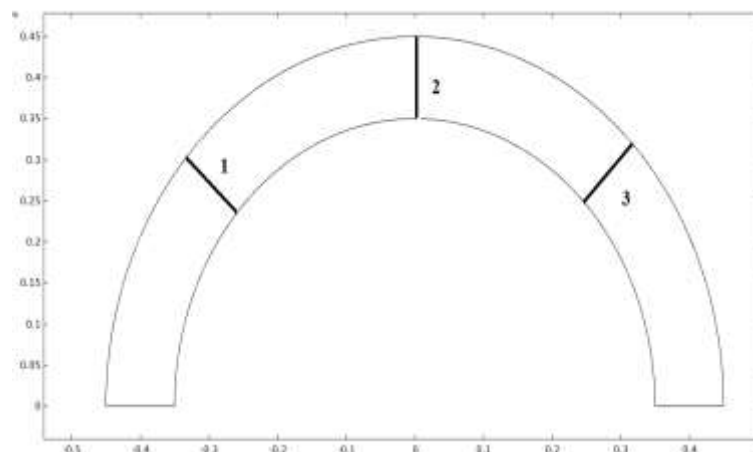


Figure 3 we divide the pipe into 3 sections to study the processes occurring inside the pipe. Figure 4-5 give flow rates and pressure in 3 sections.

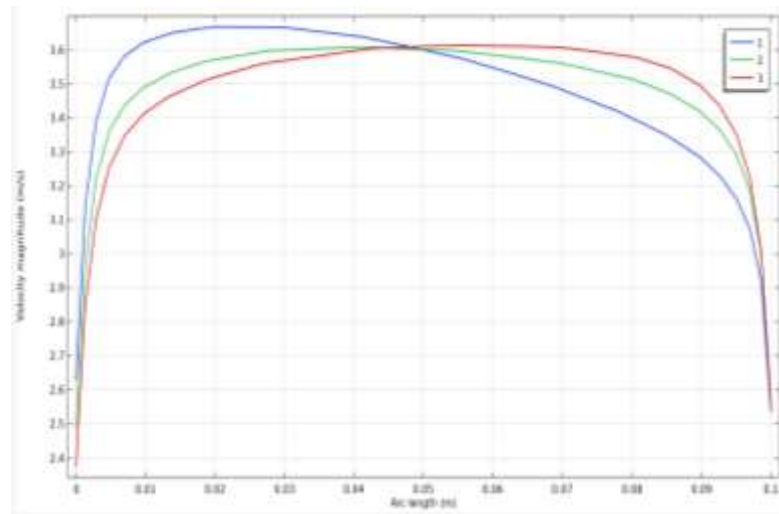


Figure 4. The result of the flow rate in different sections.

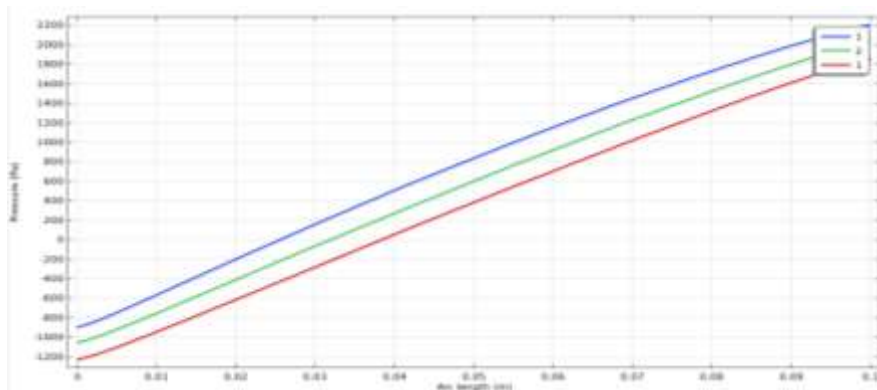


Figure 5. The result of current pressure in different sections.

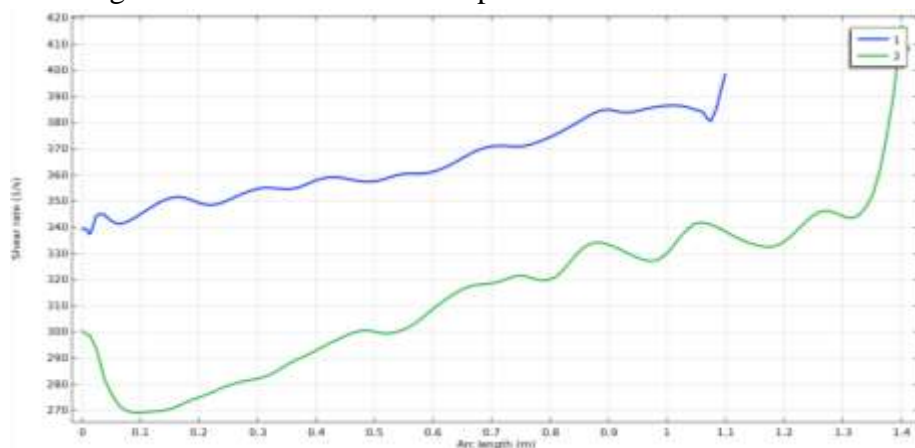


Figure 6. 1) internal and 2) change the koefisient of resistance of the wall along the outer radius of the pipe.

Figure 6 shows the change in the resistance coefisient of the wall along the outer and inner radius of

the pipe.
$$C_f = \frac{2}{Re} \left(\frac{\partial U}{\partial y} \right)$$

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