Monochrome Vortex

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Team 1st Image
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Flow Visualization
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The purpose of this assignment is to observe the vortex made by water flow and objects in the flume. The first team image is the vortex created by the water flow in a flume at ITLL lab. We let the water flow into the flume and put a block inside of it. From the picture, it can be found that on the right part of the image, there is a deep vortex and several bubbles.

Figure 1 Flume at ITLL

Figure 2 Armfield Open Channel Water Flume

Figure 3 Water Tank

In fluid dynamics, a vortex [1] is a region within a fluid where the flow is mostly a spinning motion about an imaginary axis, straight or curved. In our team picture, because of the block stop the regular water flow, water went down suddenly and then rolled back to form the vortex. The kinematic viscosity of water at 20°C is $1.004X10^{-6}$ m^2/s [2], the equation of Reynolds number (Re) [3] is:

$$\mathrm{Re} = \frac{\rho \mathbf{v} D_H}{\mu} = \frac{\mathbf{v} D_H}{\nu} = \frac{\mathbf{Q} D_H}{\nu A}$$

To obtain the best picture, we set a white board on the back of wall and a light above the flume. When the water flow came out, it hit the block first and then suddenly went down but following a roll back action to form bubbles and vortex.

Figure 4 Picture of vortex (unedited)

The original picture was taken with exposure time of 1/3000 seconds, ISO speed of 1600 and focal length of 50 mm. Because there is the bottom of flume and block in the original images which are a bit distracting, I use Photoshop to crop them out as well as the scratch on the glass wall. Although we inject dye into water to make it colorful later, the water has no color in this picture. I made the final image monochrome so that the vortex and bubbles can be more obvious.

Reference

[1]: http://en.wikipedia.org/wiki/Vortex

[2]: http://www.engineeringtoolbox.com/water-dynamic-kinematic-viscosity-d_596.html

[3]: http://en.wikipedia.org/wiki/Reynolds_number