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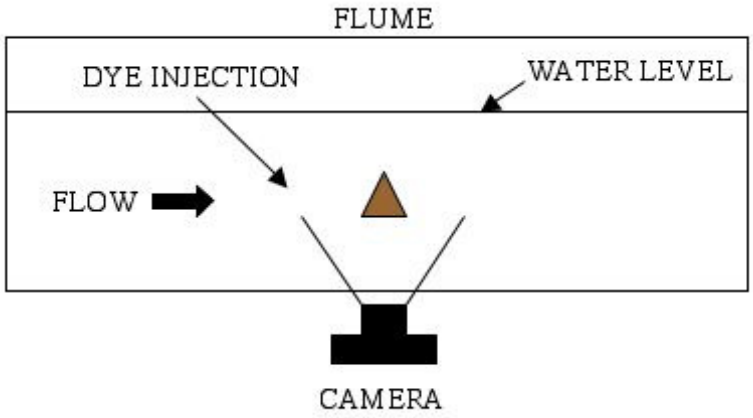
MCEN 4228
Group Project 2

This image was taken from an assortment of images photographed as part of the second group project. It attempts to display the fluid flow patterns around a bluff body. The team experimented with water flows of various depths and velocities around bluff bodies of different shapes and orientations, using injected dyes to visualize the flow. The final image shows the effect that a triangular wooden dowel has on water flow in the flume.

To create this image, the ITLL flume was used with a 2-in diameter circular wooden dowel cut into a triangle. The dowel was cut to be the exact length of the gap between flume sides, and inserted into the flume with a flat edge of the triangle downstream, perpendicular to the flow. The basic flow seen is flow over a submerged obstacle. The opaque white backdrop was hung on the flume and was backlit to prevent glare. 50% dilutions of red and blue dye were injected near the back and front walls of the flume, respectively, approximately 4 in upstream of the dowel. The experimental setup is shown below:



The flume was set to a water flow rate of approximately 0.5 m/s when the dyes were injected. They were injected directly level with the front edge of the dowel so that the dye would flow equally over the top and bottom sides. The dye is denser than the water, but the horizontal flow and small distance between injection and the dowel meant that the increased density did not cause the dye to drop substantially. As the dye left the needles it appeared to be turbulent, but the flow in the flume resulted in a Reynolds Number low enough that the dye and the water were in laminar flow as they approached the submerged dowel. The dye shows that fluid flow slows down just at the surface of the submerged object because of frictional forces. There is a space of no flow behind the dowel, and as the fluid leaves the surface of the dowel and enters the faster surrounding flow of the flume, vortexes are formed as the flow speeds up.

The flume was used to create the effect seen in the final image, with water circulating and 50% dilutions of red and blue dye injected. An opaque white backdrop was used, which was backlit. This was the only light, other than ambient light in the room, used to light the image.

The field of view seen is approximately 10 cm wide by 8 cm tall. The lens is 20 cm from the edge of the flume. The lens has a focal length of 92 mm, an aperture of 9.0, a shutter speed of 1/160 sec, and the camera's ISO was 400. The photo was taken with a Canon EOS Digital Rebel, and the final image is 1109 x 962 pixels. Photoshop was used to crop the photo, increase contrast, and remove blemishes such as bubbles.

The image is effective at clearly displaying the flow of fluid around a bluff body in water. It is interesting to use dye to show the normally invisible behavior of fluids around submerged obstacles. I like the use of two different colored dyes to give depth and layers to the image. Some interesting phenomena are seen, including the standard vortexes formed as the fluid leaves the surface of the dowel, as well as vortex rings. I would like to further investigate the flow of fluid around submerged obstacles through the use of different shaped obstacles and varying the speed of the fluid flow over a wider range.