Fluid mechanics lab report assignment

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Report Tips and Report Rules Abstract Experiments were performed to observe the features of fluid flowing pass obstacles (a cylinder and a narrowed gate) in practice and compared with theoretical predictions. The phenomenon of experiment was recorded and sketched and then used to provide some comments with respect to the observations. Introduction In the domain of civil engineering, it’s quite common to have structures reacted under the effect of fluid, such as high rise buildings and chimneys under wind or bridge pier resisting water thrust. They are immersed structure in fluid and are sensitive to this kind of dynamic load.

On the other hand, the effect applied on structures by fluid is related to the flow rate. Therefore, it's necessary to study the behavior and interaction between object and surrounding fluid flow under different rate. 2. Experimental Methods The experimental instruments for velocity patterns and head differences and depicted below: Figure 1: Experiment model 2. 1. Velocity patterns Proceed rest: 1 . The diameter (D) of the cylinder, distance between two gauges (d) and the water temperature (T) were measured. Then, cinematic viscosity (v) was looked up according to temperature. 2.

The flow was established and a float (tea leaves or a piece of paper) was used o time the flow within two gauges, which was repeated 5 times and averaged. 3. The cylinder was placed at the middle of the tank. 4. Tea leaves were dropped in spots across the tank well upstream from the cylinder and surface streamlines were sketched in worksheet. 5. Bottom streamlines were observed and sketched similarly in worksheet using potassium permanganate. 6. Potassium permanganate was dropped in the still zone behind the cylinder and the wake oscillations sere observed. The time for 10 oscillations was recorded and repeated 5 times.

Steps 2 to 6 above were done 3 times to gain exults at three different flow rates except Steps 4&5. Following equation was used to determine theoretical ideal streamlines: = C – 02 0 02 +02 Where C is the discharge co-efficient (incoming velocity) and R is the radius of the cylinder. (The origin locates at centre of the cylinder, the x-axis is in the direction of the flow and the y-axis is perpendicular to the flow direction). The example of R= 2. 5 unit and C= 4 units/ second can be calculated in Excel and shown as in Figure 2 below: Figure 2: Theoretical Streamlines plotted around a cylinder 2. 2. Head Difference as a Flow Meter 1 .

Measurement of the flow depth (y) and the channel width (b) was taken. 2. A steady flow was created, and the surface velocity (V) was measured using the same method outlined in ‘ Velocity patterns’. 3. Two blocks were positioned to create an orifice as illustrated in Figure 1 above. 4. A potassium permanganate trace was again added upstream of the orifice and the subsequent streamlines for the flow through the conduit were sketched. 5. The head at positions 1 (h 1) and 2(h2o) in Figure 1 was measured using the steel rule. The above procedure was repeated for 3 different flow rates, excluding step . 3. Results 3. 1.

Velocity patterns The subsurface flow observed was characterized by the oscillations occurring periodically about the cylinder. The streamlines for subsurface flow around a cylinder is sketched in Figure 3. It can be seen that smaller vortices were produced when the flow moved around the cylinder and larger vortices occurred along the distance away from the cylinder. Figure 3: Sketch of observed subsurface flow around a cylinder 3. 2. Head Difference as a Flow Meter The sketching of subsurface passing through a narrowed gate is shown in Figure 4. Clearly, the velocity of flow increased when it was about to pass the gate.

Besides, behind the two channel blocks, there were two points of flow stagnated. The dye of potassium permanganate remained relatively stationary with an evident slow moving vortex. Figure 4: Sketch of streamlines passing through a narrow gate The recorded observations during experiment were tabulated in appendix in last page. Discussion From the comparison between the theoretical ideal streamline and experimental results, it is obvious that the inconsistency is the existence of vortices with oscillation in the actual case. The main reason is that the assumption of no viscosity for ideal fluid can’t be satisfied in real situation.

Therefore, drag is created by shear stress within the fluid and between fluid and tank and cylinder. For the cylinder, the velocity increases from 0 at the interface to a maximum value, which means fluids somewhere away from the cylinder move faster, furthermore, there is already a circular path around the cylinder, thus a relative rotation or vortex is formed among fluids in different position away from the cylinder. On the other hand, the tea-leaf trajectory was different form the trajectory f potassium permanganate. Tea leaves flowed faster than the dye while the path is slightly different from each other.

And tea leaves struck the surface of the cylinder whereas the streamlines of potassium permanganate did not. The reason is that the velocity differs along the depth of flow. Due to the drag mentioned above, the surface flow is faster than the subsurface flow. Therefore, they performed in different ways according to corresponding velocity. When fast flow struck the cylinder, the fluid would be rebounded back by the surface of the cylinder, and then a water “ shield” was formed around the cylinder, which reverted the tea leaves away from the cylinder surface.