457.204 Elementary Fluid Mechanics and Lab.
Elementary Test

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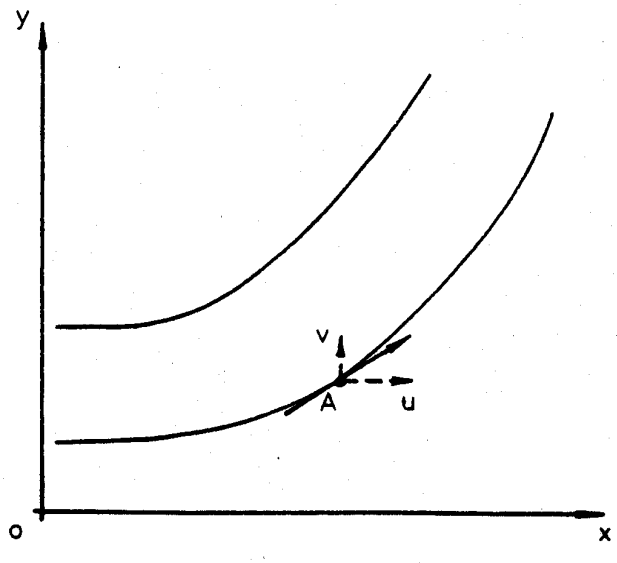
ET 3: Visualization of the flow patterns using Laminar Flow Table

1. Objective

Two-dimensional laminar flow is created between the two glass plates by the combination of low fluid velocity and the narrow gap between the plates. In this experiment, simulate laminar flow with water and visualize various flow patterns. The objective of this process is to learn about characteristic of streamlines.

2. Summary of Experiment

1) Streamline Equation



Slope of streamline at point A is;

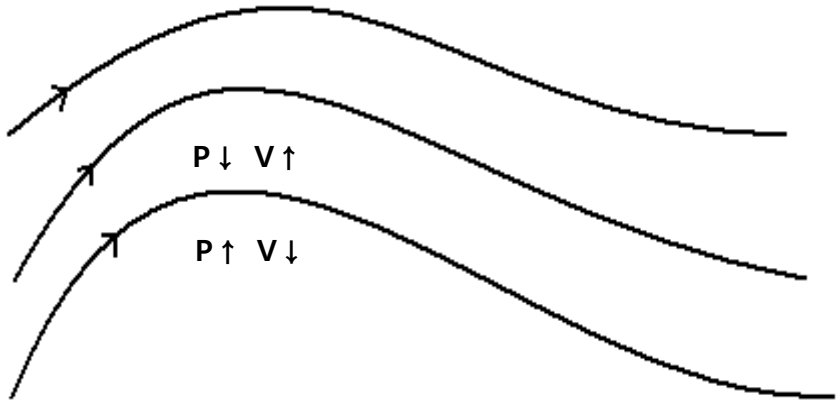
$$\frac{dy}{dx} = \frac{v}{u}$$

The streamline equation is;

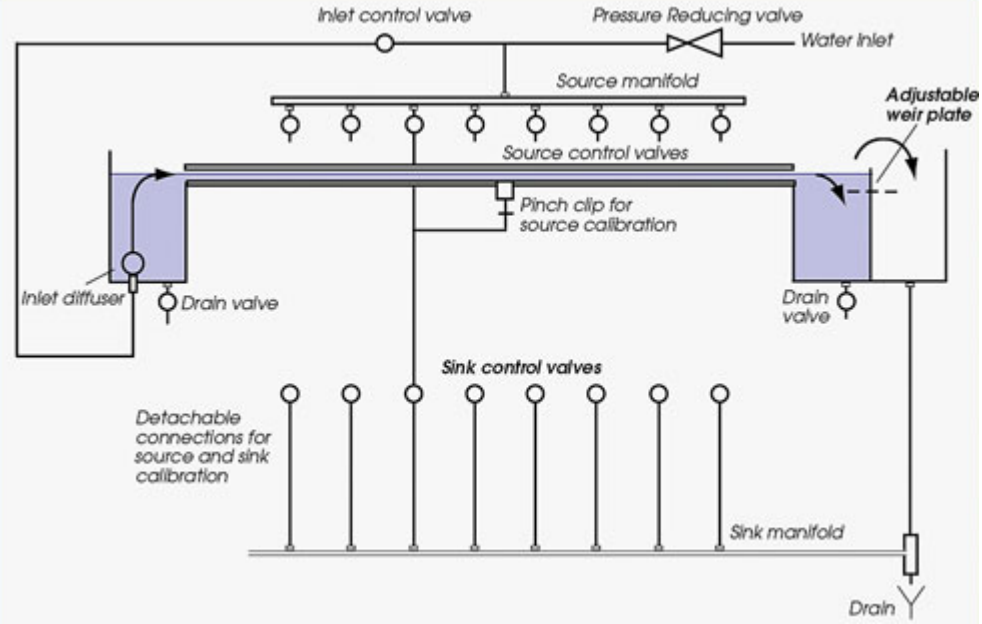
$$udy - vdx = 0$$

2) Streamline

Streamline pictures are of both qualitative and quantitative value to the engineer. They allow visualization of fluid flow through mathematical and experimental determination of the streamlines and to locate regions of high and low velocity and, from these, zones of low and high pressure, respectively. High velocity and low pressure occurs at convex side, low velocity and high pressure occurs at concave side.



3. Experimental Set-up



Schematic diagram showing pipework for one sink and source

4. Procedure

① Close the Source and sink valve.

② Connect water supply to laminar flow table with hose.

③ Prepare to mix dyes and water. (3 milligram of dye per 1 liter of water)

④ Adjust the table to make it level.

⑤ Slightly open the dye-inflow valve to remove the air in hypodermic needles.

⑥ Open the water-inflow valve. The amount of flowrate should be 0.25 liters/sec.

⑦ When water has reached steady state, measure the flowrate and flow velocity.

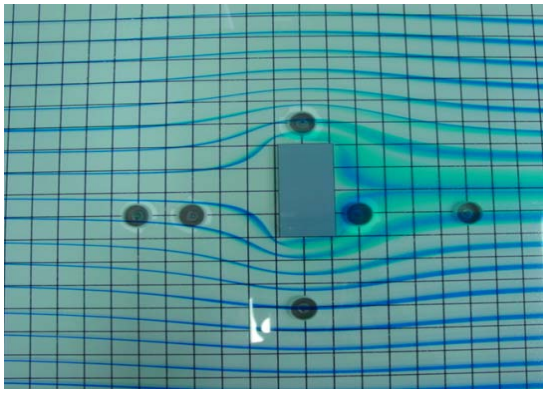
⑧ Open the dye-inflow valve and observe the dye-flow pattern.

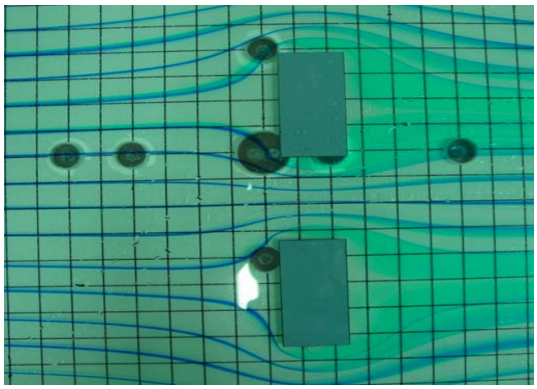
⑨ Observe the dye-flow pattern after inserting several of models between glasses.

⑩ Through opening/closing of variable valves, observe several dye-flow patterns near the sinks and sources.

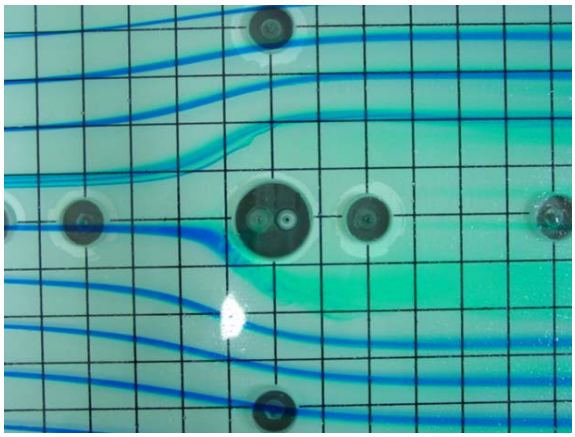
5. Result

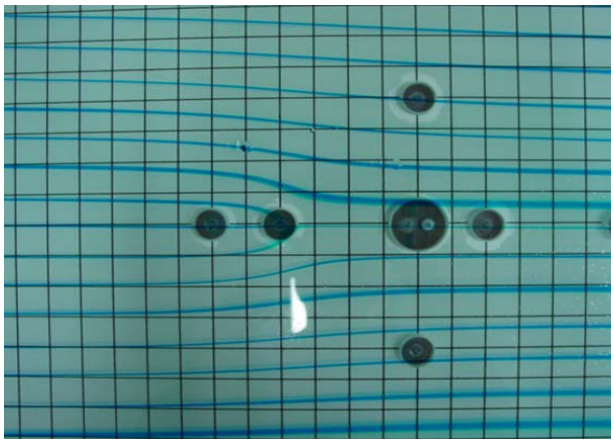
1) Installation of rectangular shape model





2) Sources and sinks





6. Conclusion

- Confirm the flow is laminar. Find the calculated Reynolds constant.
- Is the flow of the dye a streamline?
- Measure the density of the streamline in each case. With this result, study for relations between streamline density and flow velocity.
- Find examples of this experiment in real world situations.