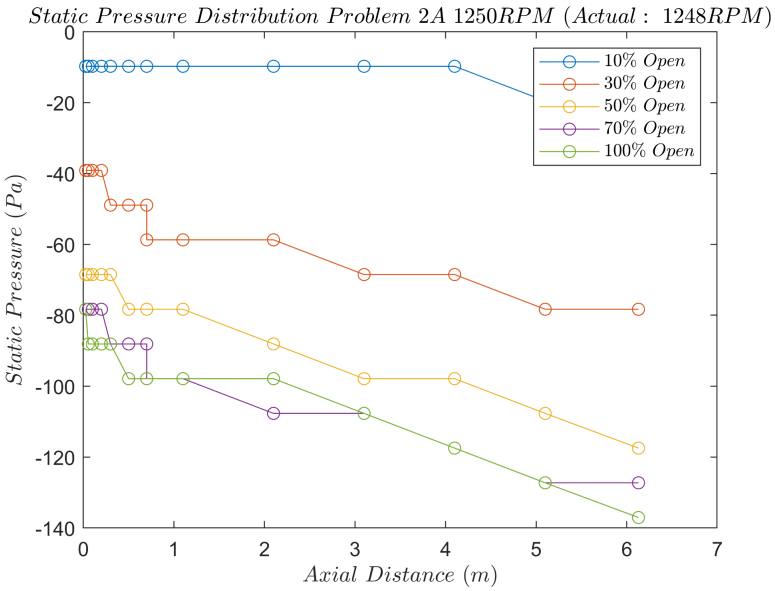
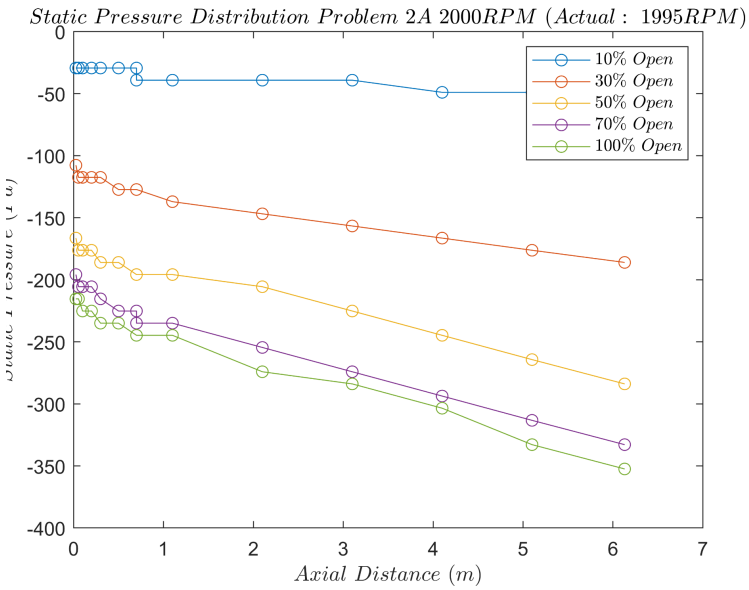
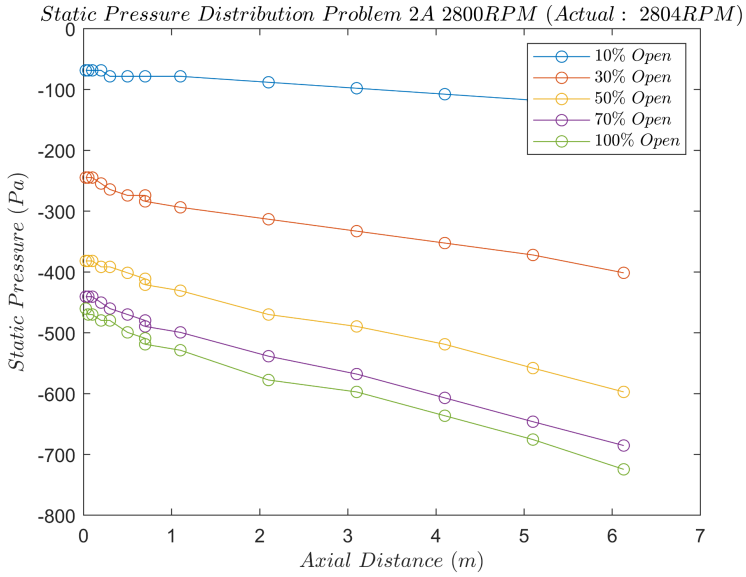
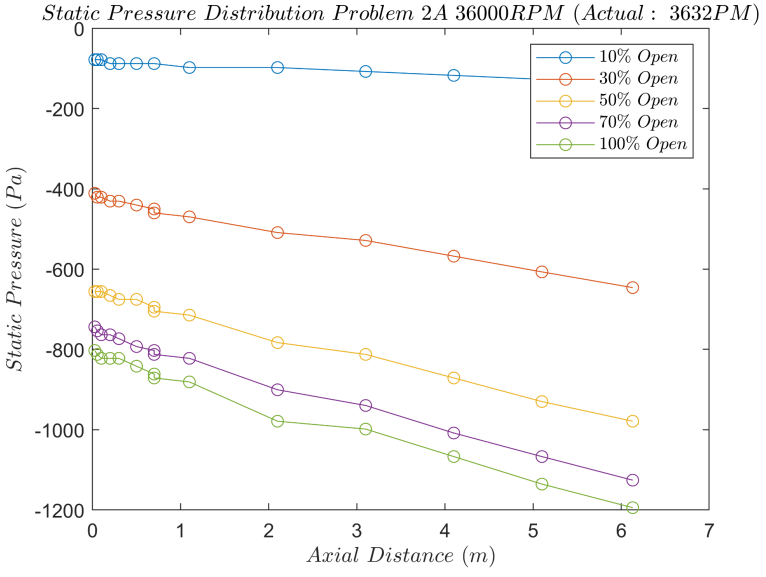
Technical Memo Lab 2: Flow Through a Pipe

1. Plots of static pressure distribution along the pipe (Tap 1 to Tap 14) for all four different fan speeds at 100% opening, i.e., pressure vs. distance.

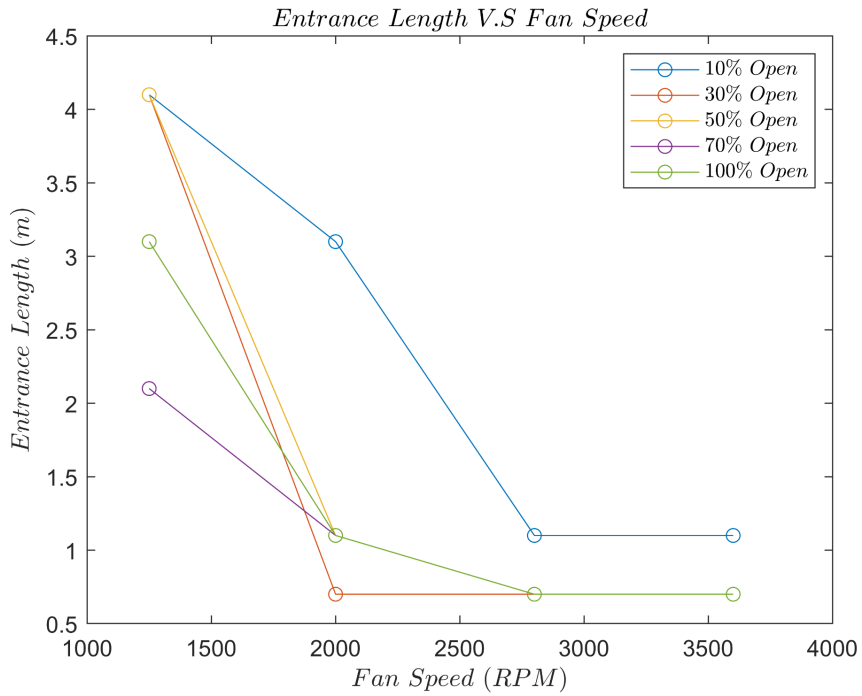






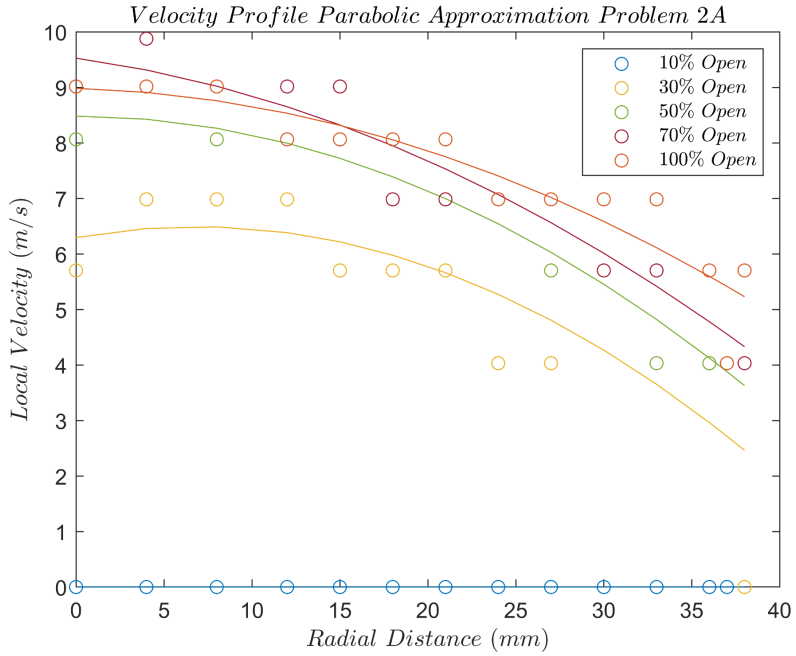


2. Table and plots of normalized entrance length L_e/D vs fan speed, with data visually obtained from the pressure distribution plots

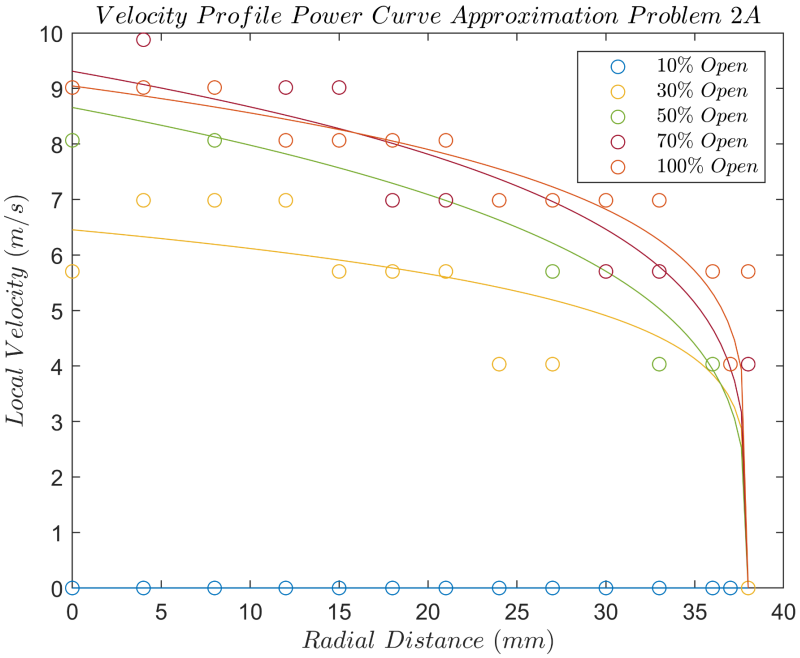


Discharge	1250 RPM	2000 RPM	2800 RPM	3600 RPM
10%	$4.10\,m$	$3.10\,m$	$1.10\,m$	$1.10\,m$
30%	$4.10\,m$	$0.70\,m$	$0.70\,m$	$0.70\,m$
50%	$4.10\,m$	$1.10\,m$	$0.70\,m$	$0.70\,m$
70%	$2.10\,m$	$1.10\,m$	$0.70\,m$	$0.70\,m$
100%	$3.10\,m$	$1.10\,m$	$0.70\,m$	$0.70\,m$

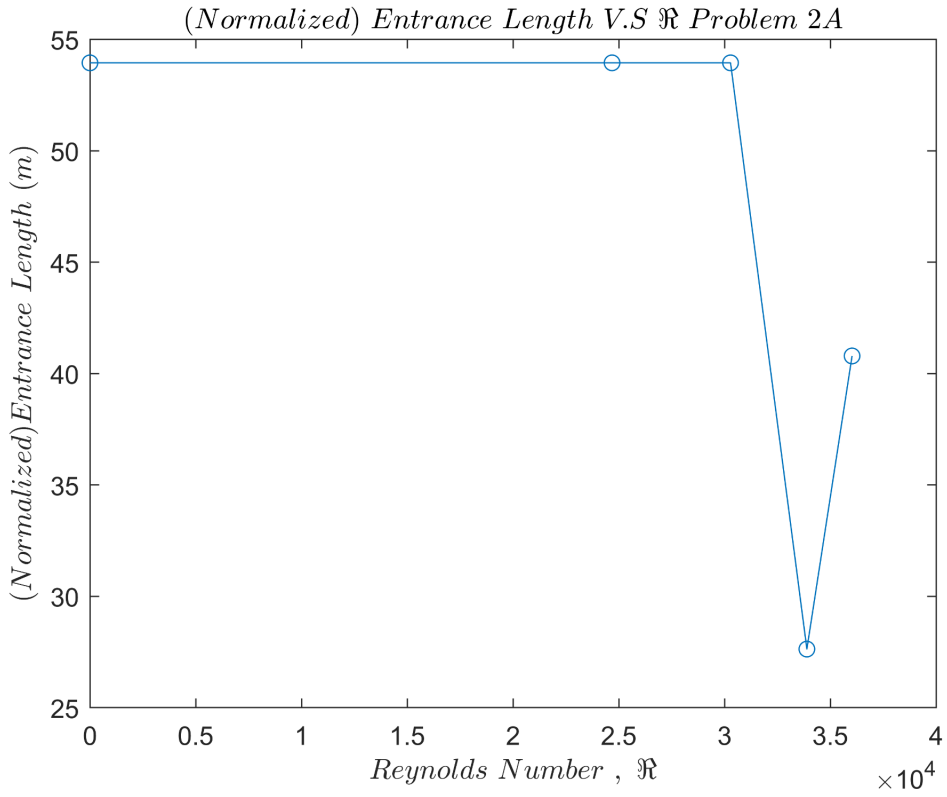
3. Parabolic fit velocity profile for all five different discharge openings.



4. Power Curve fit velocity profile for all five different discharge openings.



5. Table and plot of the Entrance Length v.s. Reynolds number for fan speed of 1250 RPM



Discharge	$Flow\ Rate\ (\frac{m^3}{s})$	$Reynolds\ Number,\ Re$	$Flow\ Type$	L_e/D
10%	0.000	0	$Laminar$	$53.9474\ m$
30%	0.022	24,677	$Turbulent$	$53.9474\ m$
50%	0.027	30,277	$Turbulent$	$53.9474\ m$
70%	0.030	33,885	$Turbulent$	$27.6316\ m$
100%	0.032	36,021	$Turbulent$	$40.7895\ m$

1. Describe the pressure distribution along the pipe length and identify the different stages (entrance vs. fully-developed) of the pipe flow.

   Because the cross sectional area of the pipe never changes, the pressure will monotonically decrease along the length of the pipe. However, due to the entrance length, and head loss, that pressure does not decrease at a constant rate. Around the beginning of the flow, the pressure tends to stay around the same value, until becoming fully developed, at which point, the pressure starts to decrease more sharply.

2. How does the pressure change axially in a fully-developed pipe flow?

   Once the flow becomes fully developed, the pressure starts to decrease more sharply, and at a (mostly) linear rate.

3. How does fan speed and discharge opening affect the pressure distribution?

   The faster the fan spins (or more accurately, the more energy is put in to match that RPM), the more drastic the magnitude of the pressures become.\

4. How was the entrance length determined?

   In this lab, the entrance length was visually obtained from the static pressure distribution plots, where the static pressures started to decrease at a sharp linear rate. The x coordinate point of where that sharp turn started was decided to be the entrance le

5. How does a laminar velocity profile differ from a turbulent velocity in a duct flow?

   I do not appear to have a satisfactory laminar flow to make a conclusion from lab data, however, a turbulent flow would resemble more of a “solid wall” profile, where as a laminar flow would be more sharp.

6. How does the discharge opening affect the Reynolds?

   Changing the percent discharge would affect the velocity of the flow, which would affect the Reynolds Number. Decreasing the opening seems to increase the velocity of the flow, but seems to lower the pressure a pump can generate. This affects the static pressure distribution, by lowering the magnitude of each static pressure.