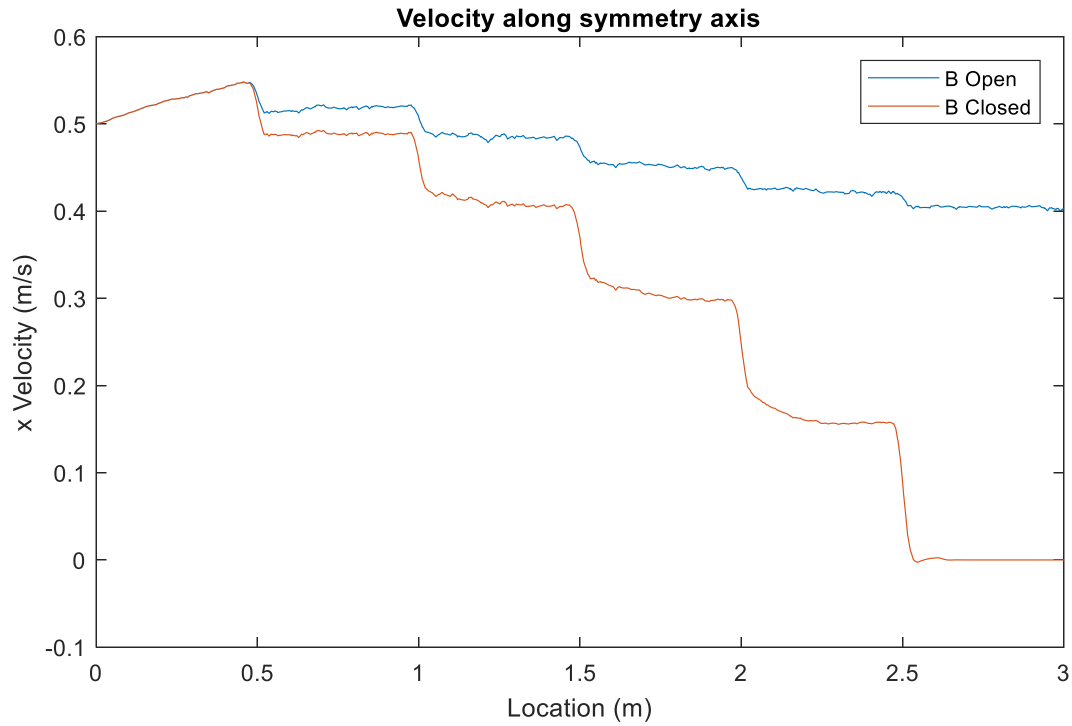
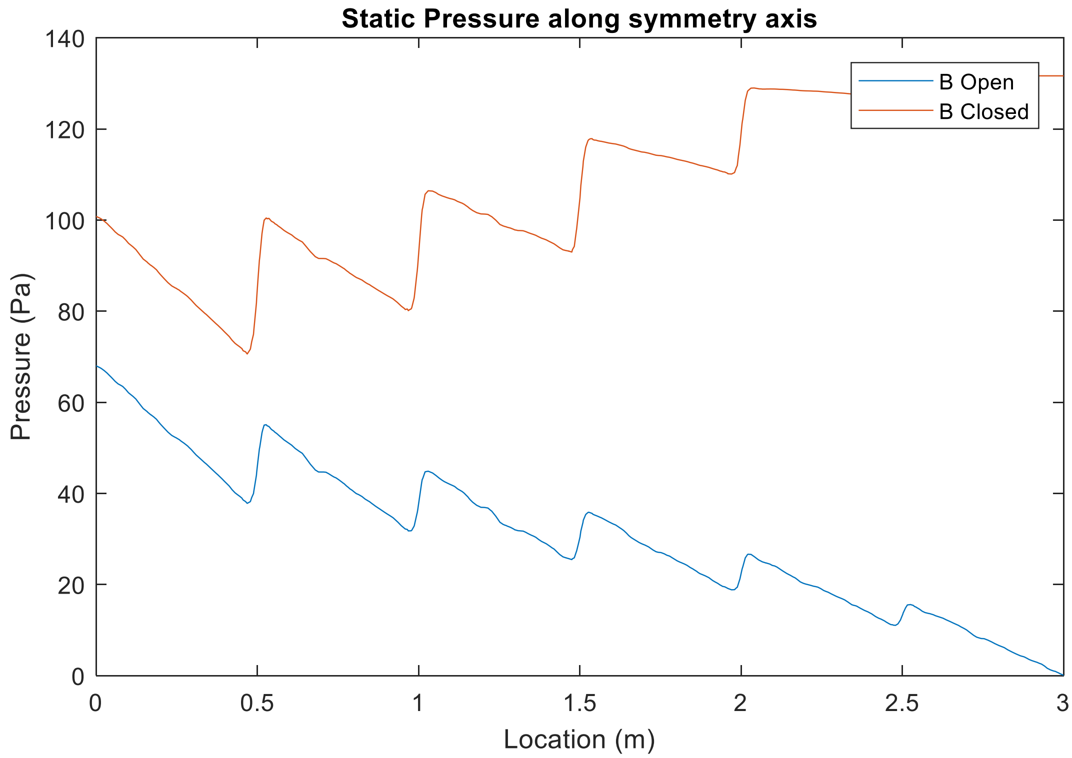
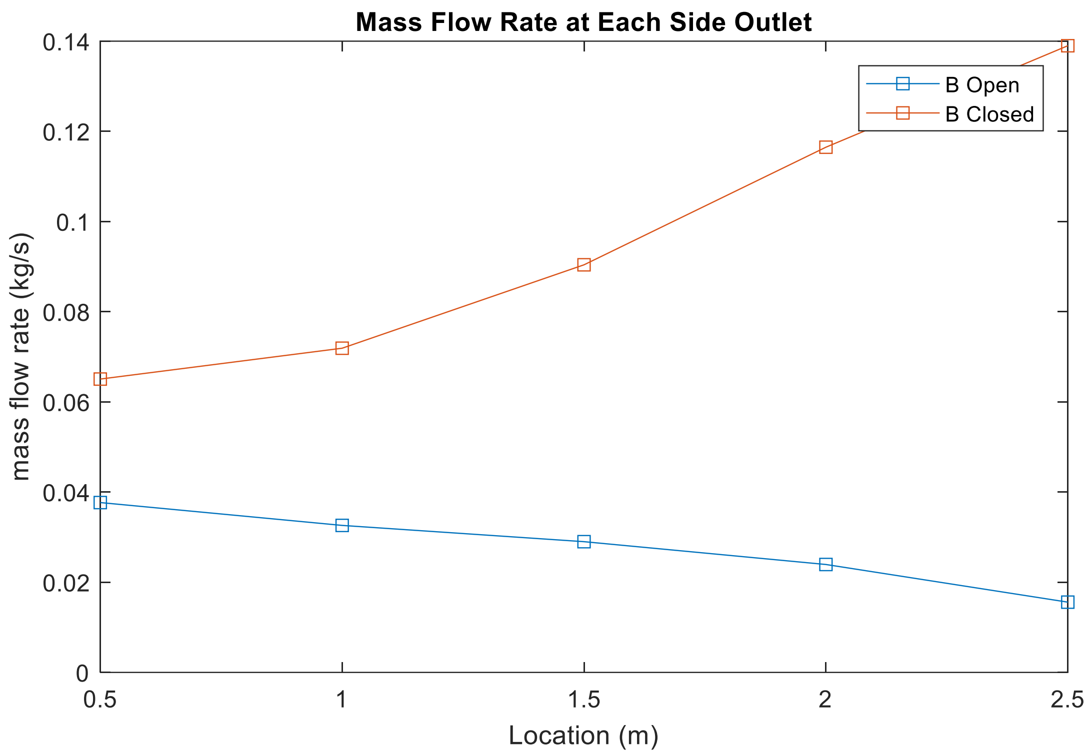
MAE 494 Project 2

Task 1





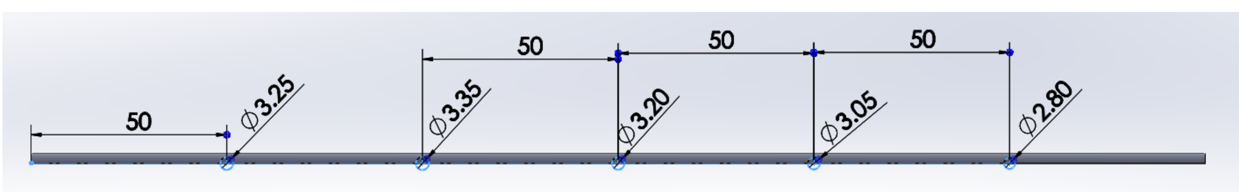


Task 2

i) Best Case Obtained

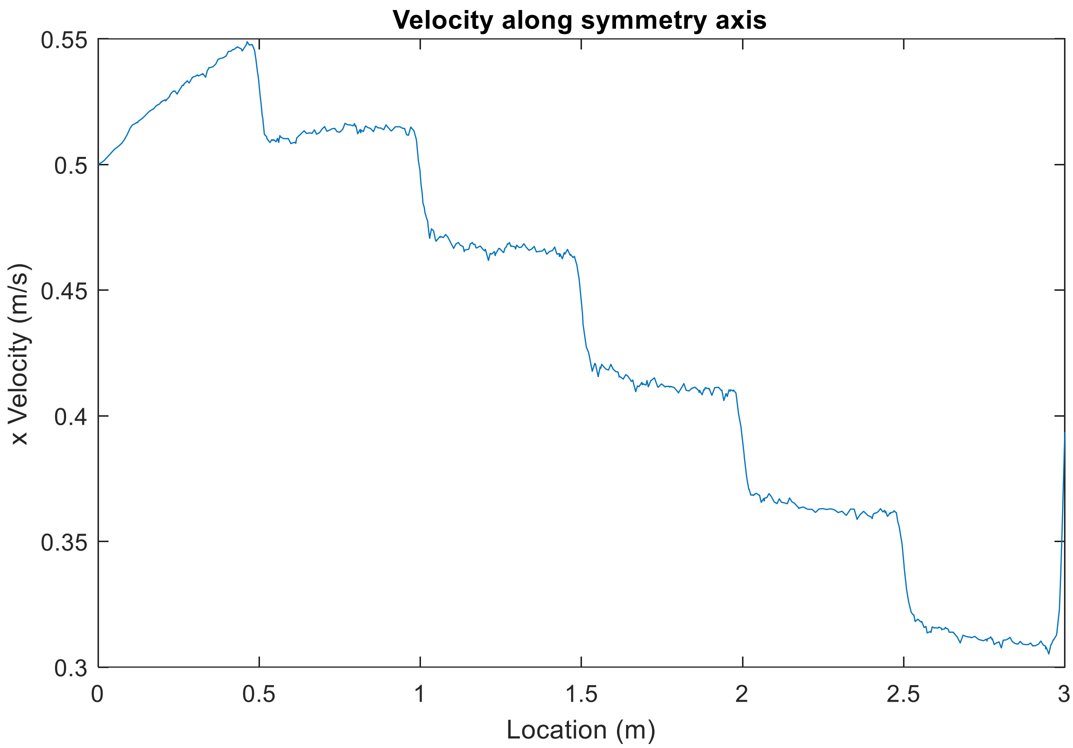
It was decided that the opening at B should be a circular opening that the center of the pipe with 4.3 cm diameter.

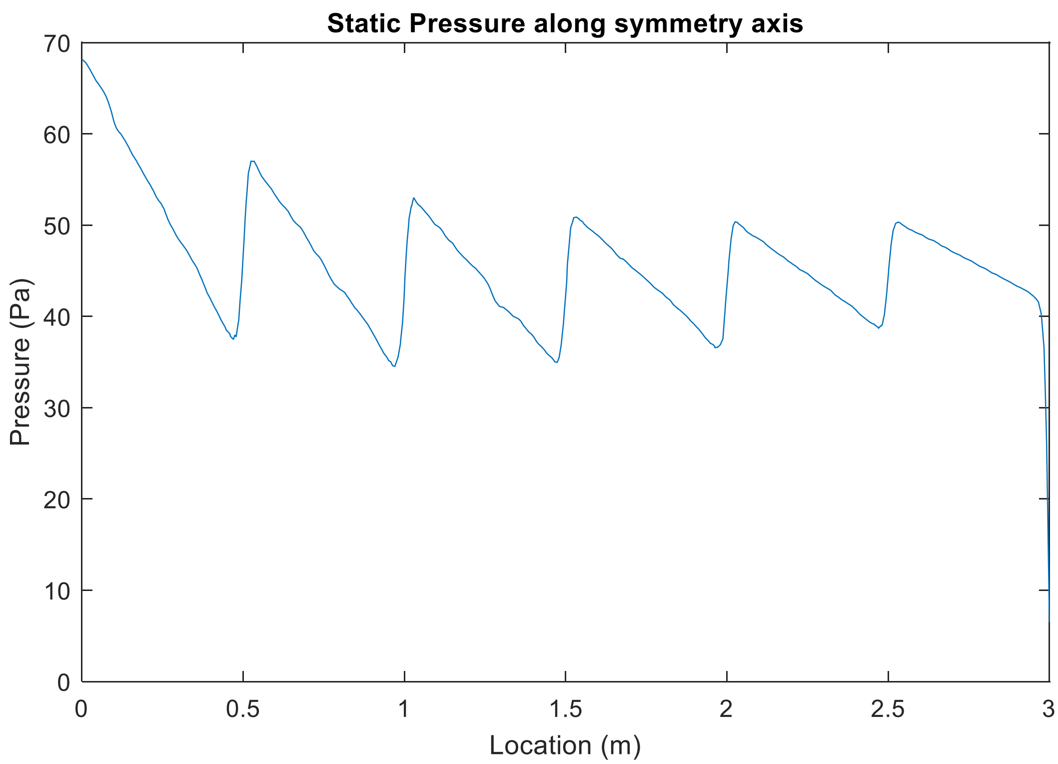
The side-pipe geometry should be set up as follows:



The results using these conditions are as follows:

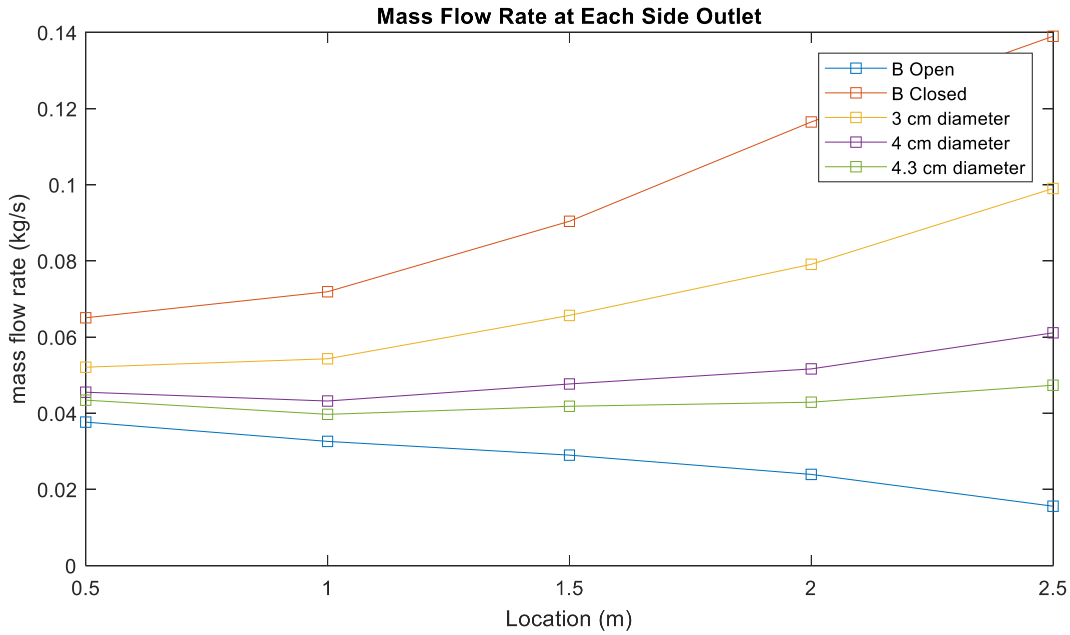
$$S = 0.0326$$


Velocity along symmetry axis
0.55
0.5
0.45
0.4
0.35
0.3
x Velocity (m/s)
0
0.5
1
1.5
2
2.5
3
Location (m)


Static Pressure along symmetry axis
70
60
50
40
30
20
10
0
Pressure (Pa)
0
0.5
1
1.5
2
2.5
3
Location (m)

ii) <u>Description of optimization method used</u>

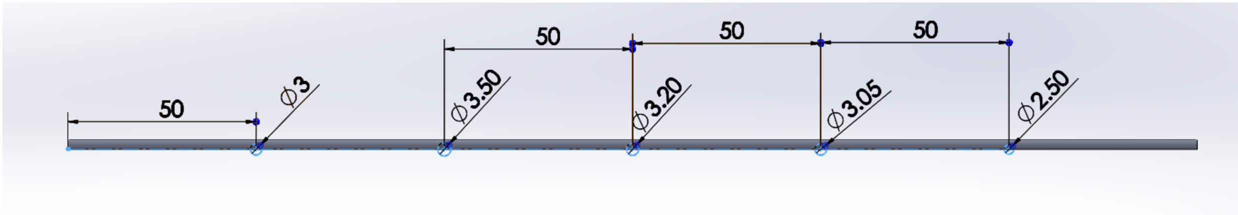
The method I used to make the mass flow out of each side pipe equal was to first find the optimal opening size of B. To do this, I iterated changing the hole size several times until the best possible size was found as follows:

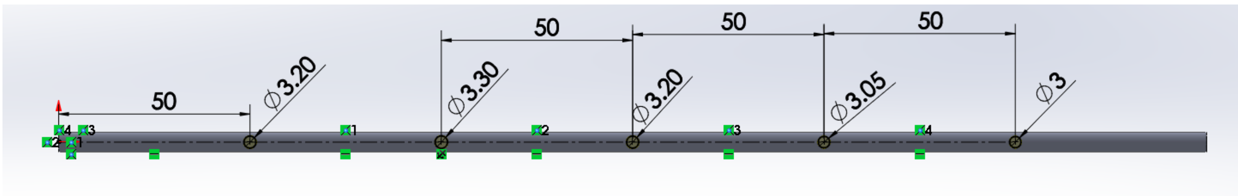


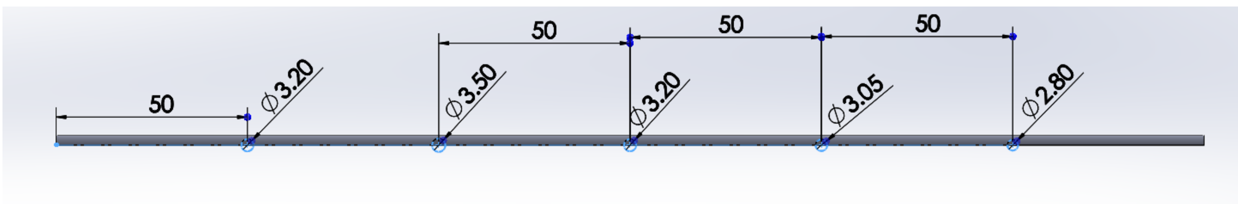
From this plot, we see that the 4.3 cm diameter opening at B provides the flattest (and therefore best) line. The standard deviation of each of these support my findings:

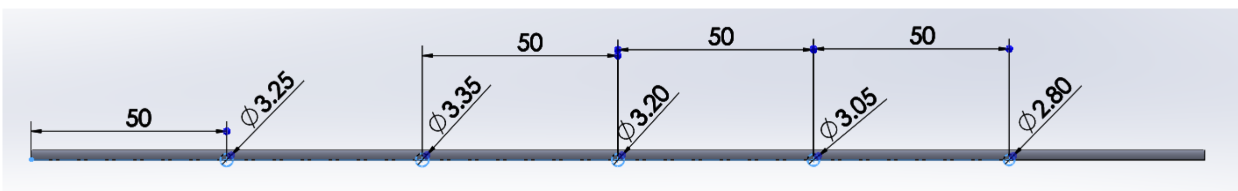
Opening at B	**Standard Deviation of mass flow rate**
Open	0.5154
Closed	0.5774
3 cm	0.4858
4 cm	0.2350
4.3 cm	0.0976

After this point, I kept the opening at B constant with a 4.3 cm diameter opening at the center. Now, I only altered the diameters of the side pipes to fine tune the mass flow at each pipe. I first noticed that the mass flow of the pipe at 1 m was low, so I made the diameter larger. I did the same for each other pipe to try to match the mass flow at the first pipe. This process was completed 4 times to find the best possible standard deviation of mass flow rate as follows:

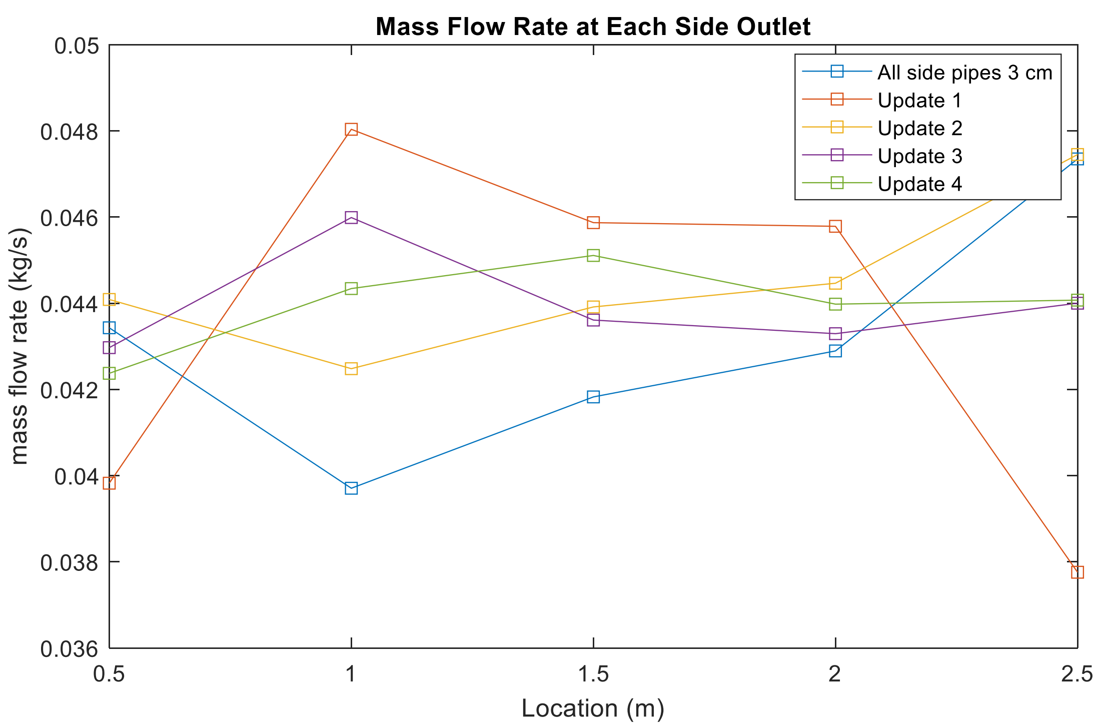








This plot shows the mass flow for each update of the pipe diameters:



The standard deviations were calculated for each update of the pipes to find the most optimal solution:

Iteration #	**Standard Deviation of mass flow rate**
1	0.1920
2	0.0598
3	0.0416
4	0.0326

With more iterations of the side pipe diameters, I have no doubt that it would be possible to reduce the standard deviation even further.