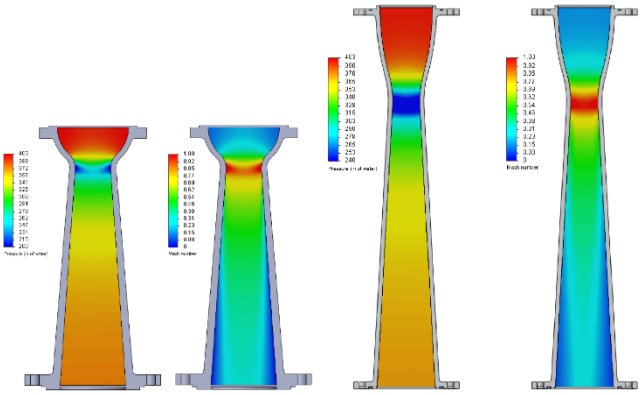
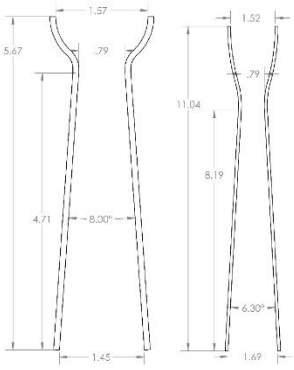
Explain the effect of our restrictor that we have to run





- It is a design constraint that curbs power output by impending airflow at high RPM
- https://www.researchgate.net/post/How_does_the_restrictor_affect_the_engine_output_power
- "In a typical SI engine, higher the fuel quantity that can be burnt in a cycle higher is the power output which means higher would be the air mass flow rate. Now as the air velocity increases with increasing RPM it can reach sonic velocity (Mach 1) at the restrictor due to its small cross section (reducing area accelerates the flow - mass conservation) and the flow now becomes 'choked'. This limiting condition restricts any further increase in air flow velocity, engine RPM and hence power output. The isentropic choked flow equation can tell when this would happen. This can be overcome by turbocharging and most FSAE engines peak at about 10k RPM whereas the designed RPM is little higher"

Justify a general shape for the plenum and why we want/need a plenum and not just a straight pipe

- "The plenum chamber is **a chamber located in front of the windshield, where air pressure is above atmospheric**. It provides a volume of air which is drawn into the car from the chamber through the heater, air-conditioner or vents. ... Later cars with a plenum chamber had a grille, which was the opening to the chamber"
- "The plenum is a volume of air that is big enough to run the engine efficiently when you go to full throttle and high revs. At that point you are not relying on the volume of flow through the compressor or intercooler, it's basically the size of the airbox as we used to know it that dictates this."

How does plenum volume affect performance?

> “First, an increase in plenum volume resulted in a **significant increase in steady state engine torque and volumetric efficiency** for the majority of the engine's operating speed range. In particular: Torque was shown to improve at all engine speeds above 6500 rpm.”

> “Experimental results showed that engine performance increased modestly as plenum volume was increased from 2 to 8 times engine displacement (4.8 l). Increasing plenum volume beyond 4.8 l resulted in significant improvement in performance parameters. Overall, peak power was shown to increase from 54 kW to 63 kW over the range of plenums tested.”

> “Additionally, transient engine performance was evaluated using extremely fast (60 ms) throttle opening times for the full range of plenum sizes tested. In-cylinder pressure was used to calculate cycle-resolved gross indicated mean effective pressure (IMEPg) development during these transients. Interestingly, the cases with the largest plenum sizes only took 1 to 2 extra cycles (30–60 ms) to achieve maximum IMEPg levels when compared with the smaller volumes.”