CHAPTER 6

CONCLUSIONS

In the present investigation an experimental study of locations of wake axis parameters (L_{jp}, L_{mrv} and PASP) of circular and elliptic cones were carried out. Static pressure measurement behind the circular and elliptic cones without base-jet is analyzed. Variation of time averaged mean velocity and velocity fluctuations were studied with various base-jet configurations. Flow visualization study in near wake zone of the cones with base-jet also analyzed. Effect of base-jet injection ratio (IR), area ratio (AR) and jet cross section shape on the wake axis parameters were studied. Some of the notable conclusions made from the experimental results are as follows.

6.1 STUDY OF STATIC PRESSURE MEASUREMENT

- Irrespective of the freestream velocity of the experiment, Distance between base of elliptic cone and location of P_{max} is 32% shorter than that of a circular cone.

- At all the tested freestream velocity, distance of P_{min} from the cone base is same for both the cones. At a constant freestream velocity, difference between pressure at the base of circular and elliptic cone is insignificant.

- Along the wake axis of elliptic cone, increase in freestream velocity results to decrease in magnitude of P_{min} and P_{b} (20%). Change in location of P_{min} and P_{max} of circular and elliptic
cone with respect to increase in freestream velocity is insignificant.

- A similarity parameter ($C_p^2$) based on $P_{\text{min}}$ and $P_{\text{max}}$ holds good similarity between pressure distribution along the wake axis of circular and elliptic cone at lower freestream velocity.

6.2 STUDY OF MEAN VELOCITY MEASUREMENT ALONG THE WAKE AXIS

6.2.1 Without Base-Jet Injection

- At 25 m/s freestream velocity, length of reverse flow region of elliptic cone was averagely 38\% shorter than that of circular cone.

- Within the reverse flow regions of both the cones, length of decelerating zone was 24\% greater than length of accelerating zone along the wake axis.

- Within the recirculation zone (upstream of PASP), similarity in the mean velocity distribution between circular and elliptic cone exists, but $(u')_{\text{rms}}$ of elliptic cone is 15\% greater than that of circular cone.

6.2.2 With Base-Jet Injection

- Effect of base-jet orifice shape on $L_{jp}$ is insignificant when the base-jet size is smaller (AR = 0.005 and 0.01). Change in jet shape from circle to square results to small reduction (0.05d) in $L_{jp}$ while the base-jet AR is high (0.015).

- Velocity gradient of base-jet is not affected by its cross section shape at smaller AR (0.005 and 0.01). At higher AR (0.015)
velocity gradient of hexagonal jet is greater than other two jets due to the existence of lower value of \((u')_{rms}\) within the jet active region, hence \(L_{jp}\) of hexagonal jet is 0.2d lesser than circular shape base-jet.

- At higher base-jet momentum, \(L_{jp}\) of square jet is similar to circular jet behind both elliptic and circular cone. But \((u')_{rms}\) of square base-jet is greater than that of circular jet. Hence to inject a base-jet at higher momentum, it is suitable to use a square shape base-jet than circular and hexagonal shape base-jet.

- Irrespective of the jet shape (circular, square and hexagon), at constant base-jet momentum ratio (MR), increase in size (AR) of the base-jet results to decrease in \(L_{jp}\) of base-jet injected from circular cone. But effect of increase in jet size is insignificant on \(L_{jp}\) of base-jet injected from elliptic cone.

- At the downstream of PASP, for all the tested AR and IR, effect of base-jet shape on magnitude of \(U_m\) distribution is insignificant.

- At the far wake region of circular and elliptic cone, irrespective of the jet shape and size there is insignificant difference in \((u')_{rms}\) between with and without base-jet.

- Irrespective of the tested base-jet shape and size, \(L_{jp}\) of base-jet injected from elliptic cone is found to be 26% lower than that of circular cone. Hence the jet injected from elliptic cone can mix earlier with recirculating fluid than a jet injected from circular cone.
From the curve fit analysis, an empirical relation was derived between \( L_{\text{jp}} \) and base-jet momentum ratio (MR). The empirical relation is logarithmic in nature as \( L_{\text{jp}}/d = A \cdot \ln(MR) + B \), (A, B are constants).

6.3 FLOW VISUALIZATION STUDY

- At lower jet momentum, penetration of base-jet fluid is blocked before it reaches the location of MRV and a mushroom shaped flow pattern is formed for all the base-jet cross section shape. Hence penetration of base-jet fluid into the recirculating region is strongly decided by its momentum.

- Velocity gradient of base-jet injected from the elliptic cone is more compare with jet injected from circular cone. Hence length of penetration of base-jet injected from an elliptic cone is less than that of circular cone. Hence the result obtained from the velocity and pressure analysis is confirmed by flow visualization also.

- Increase in area ratio at constant base-jet velocity (54 m/s) results to average increase of 0.1d in \( L_{\text{jp}} \) for all the three cross sectional shape due to increase in momentum of jet.

6.4 FUTURE SCOPE OF THE WORK

- Number of elliptic cones can be increased, in addition with circular cone \((a/b = 1)\) and elliptic \((a/b = 3)\), elliptic cones of ellipticity ratio \(a/b = 2\) and \(a/b = 4\) can be added for the same type of experiments.

- Instead of single wire hot-wire anemometer sensor, a ‘X’ wire probe (or) three component probe can be used to get the
components of velocity and more turbulence properties at the different location along the wake axis

- Velocity measurement can be done along the vertical direction also. Using the vertical measurements, shape and size of reverse flow region of different cones can be obtained.

- Non-intrusion methods like LDV or LDA or PIV can be used to measure the velocity and turbulence properties in the reverse flow region of the cones.