ABSTRACT

This thesis deals with experimental investigation of turbulent slot jet impingement on square and rectangular cylinders in the Reynolds number range of 4,600 to 18,600, slot widths of 10, 20 and 30 mm, angle of inclination of 0^0, 15^0, 30^0, 45^0 of the cylinder to the jet axis and various distances of the cylinder from the nozzle exit. Results are presented for pressure coefficient, drag coefficient,base pressure coefficient and Nusselt number for both the square and rectangular cylinder.

The average Nusselt number for isothermal square and rectangular cylinders are presented for the first time for different orientations of the cylinders with the jet axis and different distances of the cylinder from the nozzle exit. The variation of base pressure coefficient with the Reynolds number and angle of inclination of the cylinder to the jet axis have been presented. The variation of the base pressure coefficient and the drag coefficient with the breadth to width ratio of the rectangular cylinder has been obtained.

It is observed that the stagnation point on the front face shifts towards the leading edge with an increase in the angle of inclination of the cylinder with the jet axis.The minimum pressure coefficient has been obtained on the lower face at an angle of inclination of 15^0 and a separation type flow is observed on the lower face of the cylinder.At an angle of inclination of 45^0 of the square cylinder to the jet axis, the

flow field on the front faces is symmetrical and behave like a wedge flow. For the rectangular cylinder at an inclination of 45^0 with the jet axis, the flow field on the front faces are not symmetrical as the leading edge does not lie on the jet axis.There is no remarkable variation of pressure coefficient on the rear and upper faces of the cylinder because of the existence of a separated flow region. The negative base pressure coefficient has been found to be maximum within the range of breadth/width ratios of 0.5 to 1.0 for rectangular cylinders. The maximum value of drag coefficient has been obtained within the range of breadth/width ratios of 0.67 to 1.5 for rectangular cylinders.Both the negative base pressure coefficient and the drag coefficient initially increase, reaches a maximum and then decreases with the increase in breadth/width ratio of the rectangular cylinder.

Heat transfer studies of the square and rectangular cylinders indicate that in the lower range of Reynolds numbers (4600 and 8100) the average Nusselt number is maximum when the cylinder is located at a distance of eight times the slot width from the nozzle exit,in most of the cases . At higher Reynolds numbers (11600 to 18600) an increasing trend of average Nusselt number is observed. There is no significant variation of Nusselt number with the angle of inclination of the cylinder.In most of the cases, a gradual decreasing trend of Nusselt number has been observed between the angle of inclination of 30^0 and 45^0 of the cylinder to the jet axis. Empirical correlations for average Nusselt numbers are presented for both square and rectangular cylinders.