

## ENSC-283

### Assignment #4

Assignment date: Monday Feb. 2, 2009

Due date: Monday Feb. 9, 2009

#### Problem1: (Nozzle)

The converging-diverging nozzle shown in Fig. 1 expands and accelerates dry air to supersonic speeds at the exit, where  $p_2=8kPa$  and  $T_2 = 240K$ . At the throat,  $p_1 = 284 kPa$ ,  $T_1 = 665K$ , and  $V_1 = 517 m/s$ . For steady compressible flow of an ideal gas, estimate (a) the mass flow in kg/h, (b) the velocity  $V_2$ , and (c) the Mach number  $Ma_2$ .

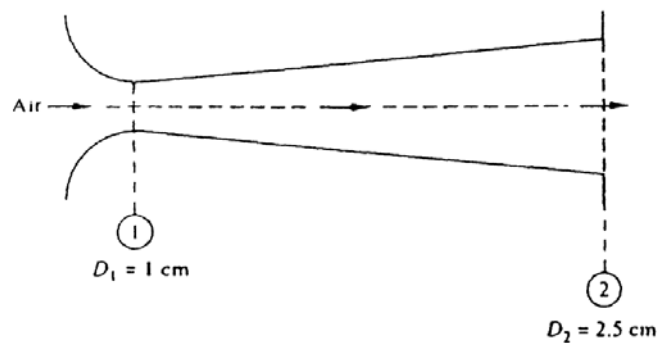


Figure 1 schematic of the converging-diverging nozzle

#### Problem 2 (water jet)

A steady two-dimensional water jet,  $\frac{1}{2}$  inch thick with a weight flow rate of  $1960 N/s$ , strikes an angled barrier as in Fig. 2. Pressure and water velocity are constant everywhere. Thirty percent of the jet passes through the slot. The rest splits

symmetrically along the barrier. Calculate the horizontal force  $F$  needed, per unit thickness into the paper, to hold the barrier stationary.

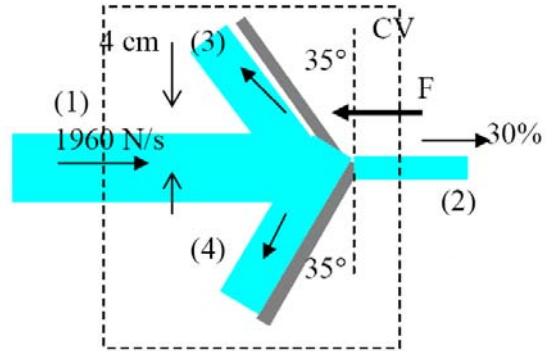


Figure 2 schematic of water jet