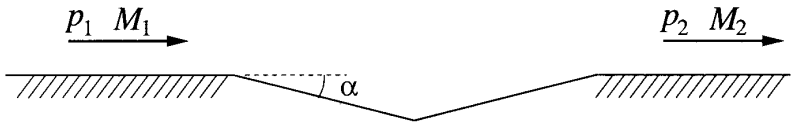
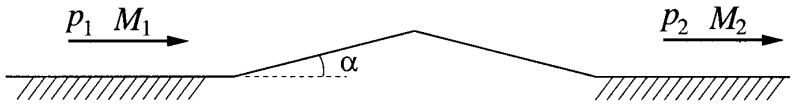
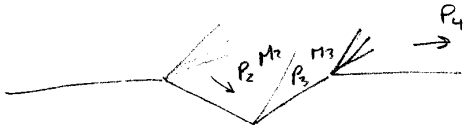
INGENIERÍA DE FLUIDOS 4-12-03

Considere una corriente de aire supersónica con $M_1 = 4.0$ y $p = p_1$ que se mueve paralelamente a una pared. Se quiere estudiar el efecto que tiene en el movimiento la presencia de un pequeño defecto en la pared. Para ello, se pide considerar separadamente el caso de una protuberancia y de una grieta, que se modelizan de acuerdo a la figura adjunta, donde $\alpha = 10^o$. Para ambos casos determine el valor de la presión, p_2, y del número de Mach, M_2, inmediatamente aguas abajo.







$\theta = 10 = \nu(M_2) - \nu(M_1)$, $\nu(M_2) = 75.7^\circ$ (65.7 + 10), $M_2 \simeq 4.88$

$$\frac{p_2}{p_1} = \left(\frac{1 + \frac{\gamma-1}{2} M_1^2}{1 + \frac{\gamma-1}{2} M_2^2}\right)^{\gamma/\gamma-1} = 0.33$$

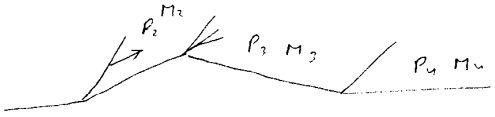
$M_2 = 4.88$, $\delta = 2\alpha = 20$, $\beta = 30$, $M_{2n} = M_2 \operatorname{sen} 30 = 2.44 \rightarrow M_{3n} = .5189$, $M_3 = \frac{.5189}{\operatorname{sen} 10} = 2.99$

$p_3/p_2 = 6.779$

$\theta = \nu(M_4) - \nu(M_3)$, $\nu(M_4) = 59.5$, $M_4 = 3.36$

$$\frac{p_4}{p_3} = \left(\frac{1 + \frac{\gamma-1}{2} M_3^2}{1 + \frac{\gamma-1}{2} M_4^2}\right)^{\gamma/\gamma-1} = 0.436$$

$$\frac{p_4}{p_1} = \frac{p_4}{p_3}\frac{p_3}{p_2}\frac{p_2}{p_1} = 0.975$$



$\beta_2 = 22$, $M_{2n} = 4 \operatorname{sen} 22 = 1.5$, $M_{2n} = .7011$, $M_2 = \frac{.7011}{\operatorname{sen} 12} = 3.37$

$p_2/p_1 = 2.46$

$\theta = \nu(M_3) - \nu(3.37)$, $\nu(M_3) = 76.4$, $M_3 = 4.95$

20 + 56.4

$$\frac{p_3}{p_2} = \left(\frac{1 + \frac{\gamma-1}{2} M_2^2}{1 + \frac{\gamma-1}{2} M_3^2}\right)^{\gamma/\gamma-1} = 0.1247$$

$M_3 = 4.95$, $\delta = 10$, $\beta_2 = 19$, $M_{3n} = 4.95 \times \operatorname{sen} 19 = 1.61$, $M_{4n} = .6655$, $M_4 = \frac{.6655}{\operatorname{sen}(19-10)} = 4.25$

$\frac{p_4}{p_3} = 2.86$

$$\frac{p_4}{p_1} = \frac{p_4}{p_3}\frac{p_3}{p_2}\frac{p_2}{p_1} = 0.891$$