理想流体力学演習問題 (a)

12-x-2003

by E. Yamazato

番号・氏名

1.The shape of a hill arising from a plain can be approximated with the top section of a half-body as is illustrated in the figure. The height of the hill approaches 60m as shown. (a)When a 18m/s wind blows toward the hill, what is the magnitude of the air velocity at a point on the hill directly above the origin (point (2))? (b) What is the elevation of point (2) above the plain and what is the difference in pressure between point (1) on the plain far from the hill and point (2)? Assume an air density of 1.25kg/m^3.

（解）

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（解）

(a)At point (2), $\theta = \frac{\pi}{2}$, $r_2 = \frac{\pi m}{2U} = \frac{\pi r_s}{2}$

$V^2 = U_2^2 + m^2(\frac{4U^2}{\pi^2 m^2}) = U^2(1 + \frac{4}{\pi^2})$; $V_2 = U(1 + \frac{4}{\pi^2})^{1/2}$

$\therefore \quad V_2 = 18 \times (1 + \frac{4}{\pi^2})^{1/2} = m/s$

$(b) y_2 = \frac{\pi r_s}{2} = \frac{\pi m}{2U} = \frac{1}{4}\frac{Q}{U} = \frac{1}{4}H_{max} = \frac{1}{2}\frac{H_{max}}{2}$

$\therefore \quad y_2 = \frac{60}{2} = 30m/s$

$\frac{p_1}{\rho g} + \frac{V_1^2}{2} + y_1 = \frac{p_2}{\rho g} + \frac{V_2^2}{2} + y_2$

$p_1 - p_2 = \frac{\rho}{2}(V_2^2 - V_1^2) + \rho g(y_2 - y_1)$

$p_1 - p_2 = \frac{1.25}{2}(21.3^2 - 18^2) + 1.25g(30) = 448.5Pa$