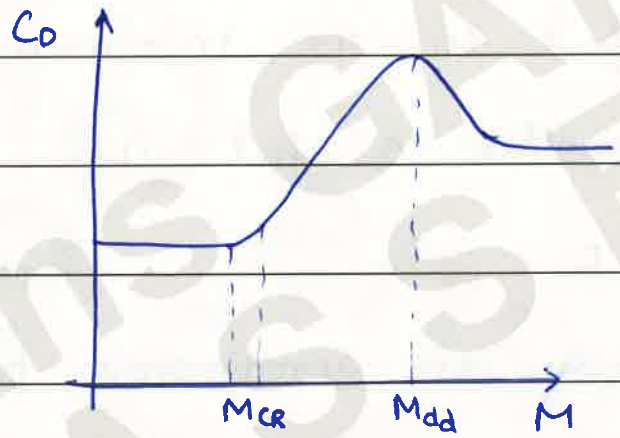
GATE SOLUTIONS

[2007]

16. The drag divergence Mach No. of an airfoil.

Sol^n → (b) is always higher than the critical Mach No.



19. The Joukowski airfoil is studied in aerodynamics because –

Sol^n → It is easily transformed into a circle.

By changing center and radius of circle, we get different airfoils. So, by inverse mapping we can easily transform a/fs to circle.

27. Two airfoils of the same family are operating at the same AoA. The dimensions of one a/f are twice as large as the other one. The ratio of minimum pressure coefficient of the larger airfoil to the minimum pressure co-eff. of the smaller airfoil is-

Sol^n→ (c) 1.0

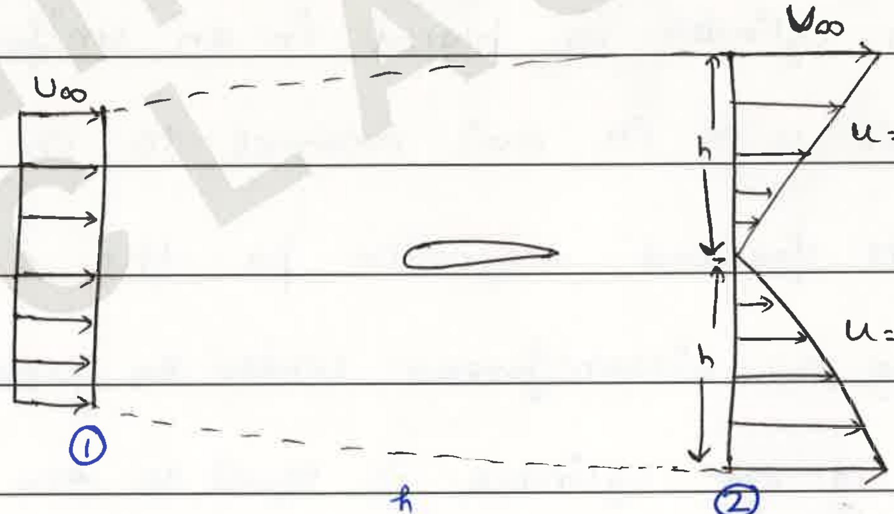
Same family so aerodynamic properties remains same.

28. Wing A has a constant chord c and span b. Wing B is identical but has a span 4b. When both wings are operating at the same geometric AoA at subsonic speed, then

Solⁿ→ (a) Wings A and B produce the same lift coefficient.

- Same airfoils so C_L produced is same, although Lift produced will be different.

57. For the control volume shown in the figure below, the velocities are measured both at the upstream and the downstream ends.



Solⁿ→ $D = \rho \int_{-h}^{h} u_2 (u_1 - u_2)\, dy$

$$D = 2\rho \int_0^h \left(\frac{u_\infty y}{h}\right)\left(u_\infty - \frac{u_\infty y}{h}\right) dy$$

$$= \frac{2\rho u_\infty^2}{h} \int_0^h \left(y - \frac{y^2}{h}\right) dy$$

$$= \frac{2\rho u_\infty^2}{h}\left[\frac{y^2}{2} - \frac{y^3}{3}\right]$$

$$= \frac{\rho u_\infty^2 h}{3} \quad (a) \quad \underline{\underline{\text{Ans}}}$$

64. A circular cylinder is placed in an uniform stream of ideal fluid with its axis normal to the flow. Relative to the forward stagnation pt., the angular positions along the circumference where the speed along the surface of the cylinder is equal to the free stream speed are

Soln →

$$V = U\sin\theta\left[1 + \frac{a^2}{r^2}\right]$$

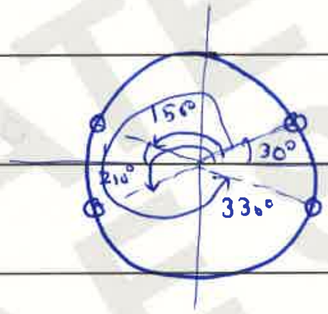
On surface of the cylinder,

$$V = 2U\sin\theta$$

$$V = 2V\sin\theta$$

$$\sin\theta = 1/2$$

$$\theta = 30^\circ$$



(a) 30°, 150°, 210° and 330°

Linked Questions 78 and 79.

A model wing of rectangular planform has a chord of 0.2 m and span of 1.2 m. It has a symmetric alf section whose lift curve slope is 0.1 per degree. When this wing is mounted at 8° AoA in a freestream of 20 m/s, it is found to develop 35.3 N lift, $\rho = 1.225$ kg/m³.

78. The lift curve slope of this wing is :

Solⁿ →

$$L = \frac{1}{2}\rho V^2 S \cdot C_L$$

$$C_L = \frac{2L}{\rho V^2 S} = 0.6$$

$$a = \frac{dC_L}{d\alpha} = \frac{0.6 - 0}{8 - 0} = 0.075 / \text{degree}.$$

79. The span efficiency factor of this wing is :

Solⁿ →

$$a = \frac{a_0}{1 + \frac{a_0}{\pi e AR}}$$

$$a_0 = 0.1 / \text{degree}$$

$$AR = b/c$$

$$e = 0.75$$ Ans.