Handout Chapter 4

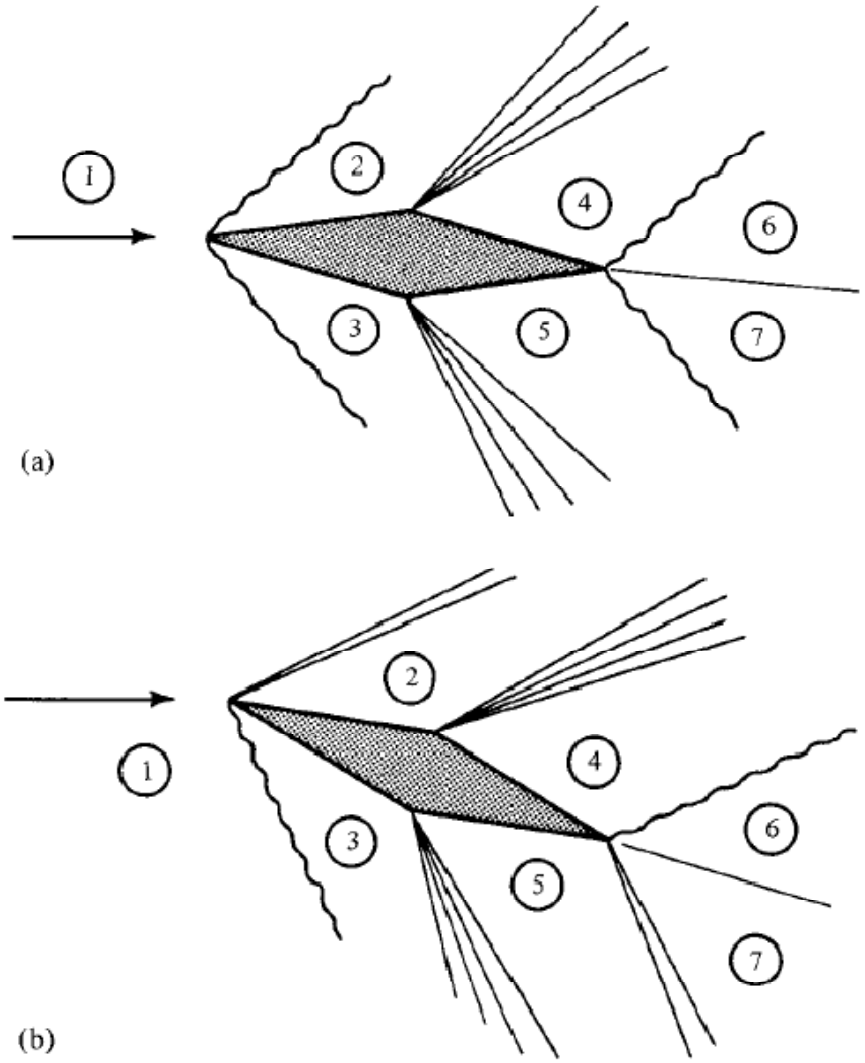
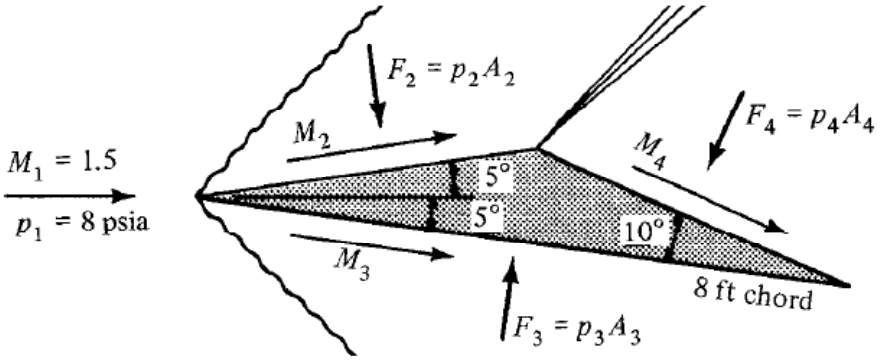


Figure 8.13 Double-wedge airfoil. (a) Low angle of attack. (b) High angle of attack.

Example It has been suggested that a supersonic airfoil be designed as an isosceles triangle with 10° equal angles and an 8-ft chord. When operating at a 5° angle of attack the air flow appears as shown in Figure E8.7. Find the pressures on the various surfaces and the lift and drag forces when flying at $M = 1.5$ through air with a pressure of 8 psia.



From the shock chart at $M1 = 1.5$ and $\delta = 5°$, $\theta = 48°$:

$$M1n = M1 \sin \theta = 1.5 (\sin 48°) = 1.115$$

From the shock table,

$$M2n = 0.900 \text{ and}$$

$$p2/p1 = 1.2838$$

The Prandtl–Meyer expansion turns the flow by 20°:

$\nu 4 = \nu 2 + 20 = 6.7213 + 20 = 26.7213$ and $M4 = 2.012$

Note that conditions in region 3 are identical with region 2. We now find the pressures. The lift force (perpendicular to the free stream) will be

$$L = F3 \cos 5° - F2 \cos 5° - F4 \cos 15°$$

Show that the lift per unit span will be 3728 lbf.

The drag is that force which is parallel to the free-stream velocity. *Show* that the drag force per unit span is 999 lbf.