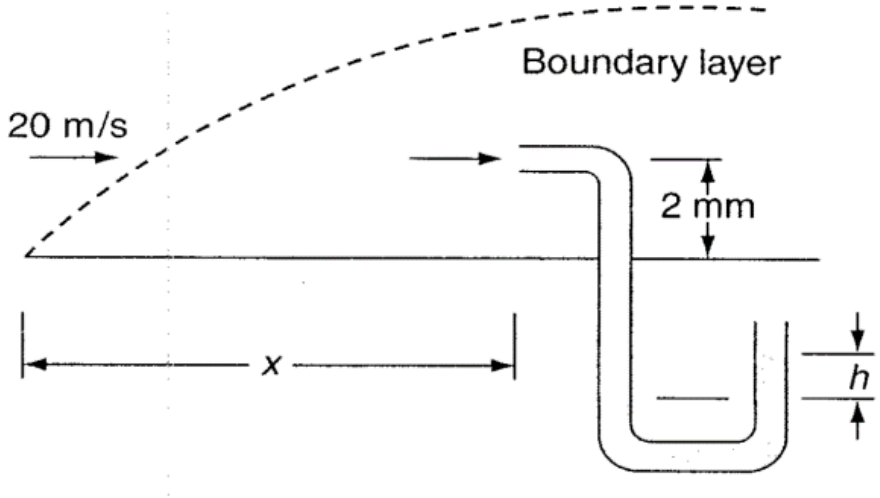
PROBLEMS FOR CHAPTER 4

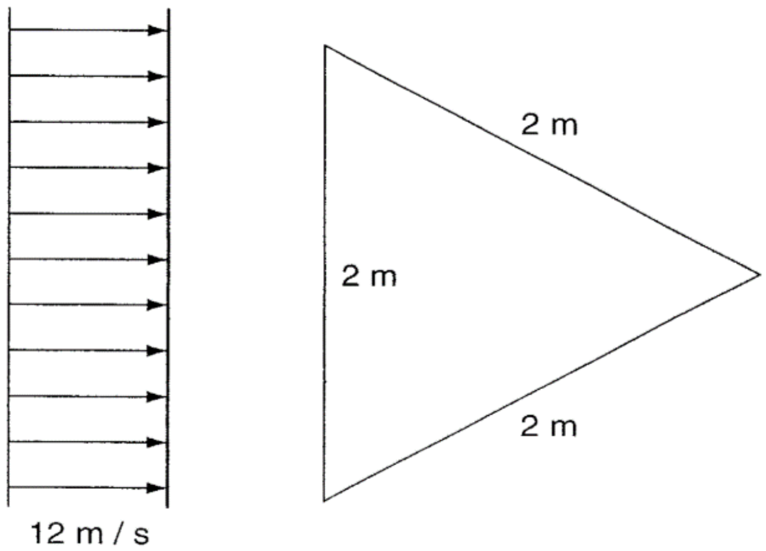
4-4

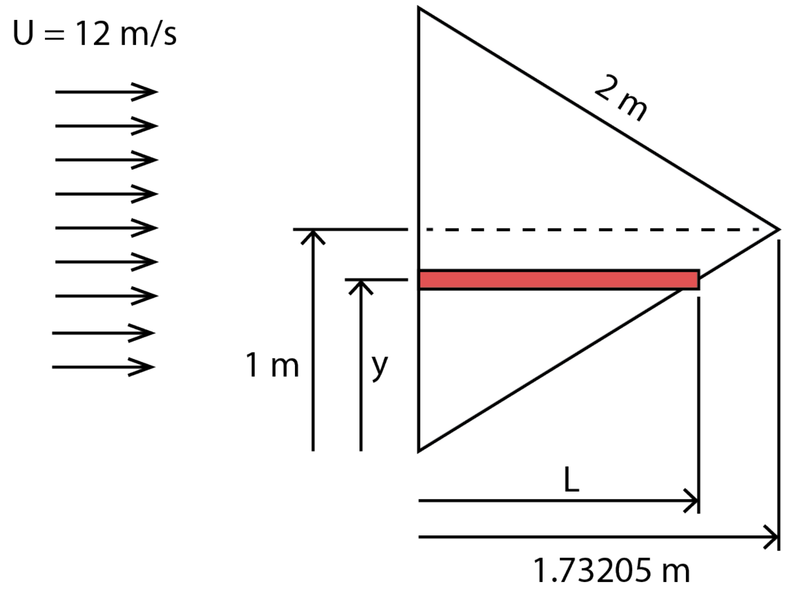
Air at 20°C and 1 atm flows past a smooth flat plate as in Fig.P4-4. A pitot stagnation tube, placed 2mm from the wall, develops a water manometer head, h=21mm. Use this information with the Blasius solution, Table 4-1, to estimate the position x of the pitot tube. Check to see if the flow is laminar.



4-11

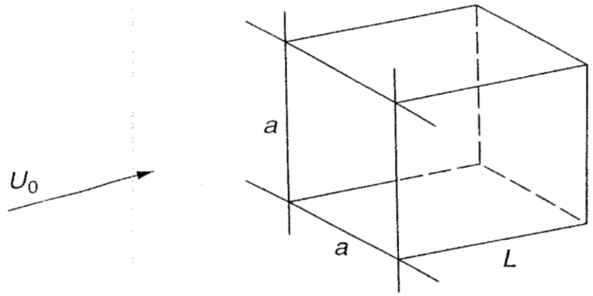
A thin equilateral triangle plate is immersed parallel to a 12 m/s stream of air at 20°C and 1 atm, as in Fig.P4-12. Assuming laminar flow, estimate the drag of this plate in Newton?





4-13

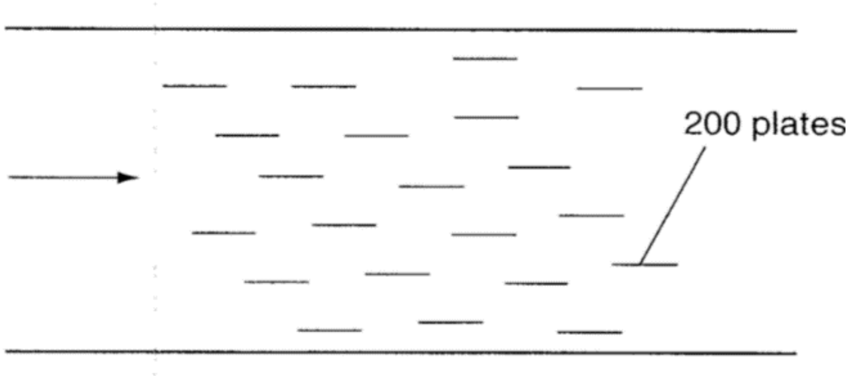
Flow straighteners consist of arrays of narrow ducts placed in a flow to remove swirl and other transverse (secondary) velocities. One element can be idealized as a square box with thin sides as in Fig. P4-13. Using flat plate theory, derive a formula for the pressure drop Δp across an $N \times N$ bundle of such boxes.



Consider the equation for laminar flow over flat plate.

4-50

Air at about 1 atm and 20°C flows through a 12 cm "square-duct" at 0.4m³/s, as in Fig.P4-50. Two hundreds (200) thin plates of 1 cm chord length are stretched across the duct at random positions. They do not interfere with each other. How much additional pressure drop do these plates contribute to the duct flow loss.



4-52

A conical diffuser of initial radius R expands at a uniform angle θ, as in Fig.P4-52. The flow enters at uniform velocity, U_0. Assuming a one-dimensional freestream, use any laminar boundary layer method of your choosing to estimate the angle θ for which flow separation occurs at $x = 2R$.