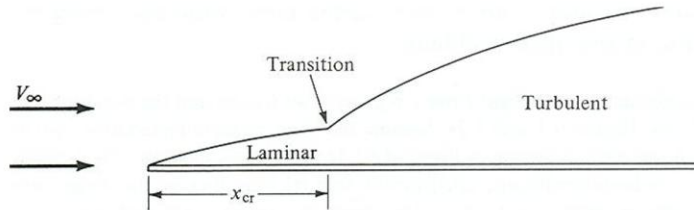
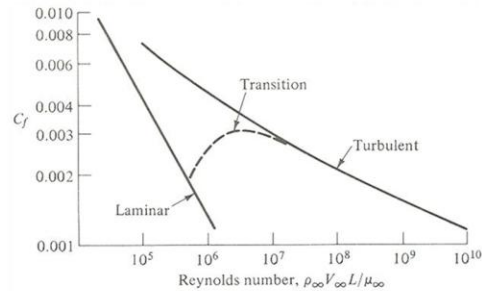
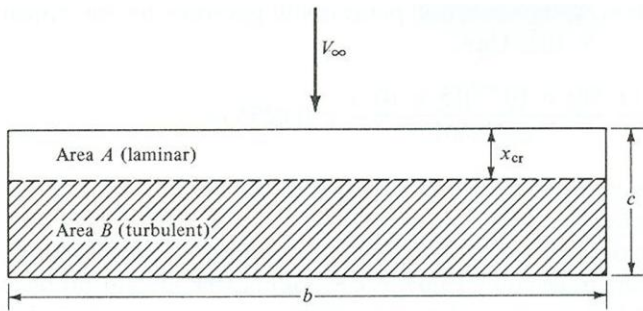


(EXAMPLE) [D-3-2]



Boundary layer sketch (source: J.D. Anderson "Fundamentals of Aerodynamics" 2016)



The wing span of Wright Flyer I (biplane) is 40 feet 4 inches, and the wing planform area is 255 ft². Assume that the wing is a simple rectangular shape, overlaying exactly on top of each other. If this aircraft is in flight in standard sea-level condition with 30 mph airspeed, estimate the "total" skin friction drag force ("total" means all two wings of flat plate, both top and bottom surfaces each). Assume that the flow transitions from laminar to turbulent with transitional Reynolds number (Re_{tr}) of 6.5×10^5 . The solution procedure can be summarized as follows:

- (1) Calculate D_f for the combined area $A + B$, assuming that the flow is completely turbulent.
- (2) Obtain the turbulent D_f for the area B only, by calculating the turbulent D_f for area A and subtracting this from the result of part (1).
- (3) Calculate the laminar D_f for the area A .
- (4) Add results from parts (2) & (3) to obtain total drag on the complete surface area $A + B$.
- (5) Note that the Wright Flyer I is a biplane and has total 4 surfaces (top & bottom and 2 wings), so the total skin friction drag on the complete biplane wing configuration will be the $\times 4$ of the skin friction drag on a single surface, calculated from part (4)

Lined area for notes, consisting of multiple horizontal dashed lines.