

Problem 260B

This problem concerns the boundary layer on an infinitely thin flat plate of length, L , set parallel to an oncoming stream of velocity, U . The plate is smooth and the fluid is incompressible with a constant kinematic viscosity, ν . The Reynolds number, UL/ν , is 600,000. Transition from a laminar to a turbulent boundary layer occurs when $U\delta_D/\nu$ reaches 600 (where δ_D is the displacement thickness). Assume for simplicity that the entire transition process occurs at this location, that the boundary layer upstream of this point is laminar and that it is turbulent downstream of this point. Also assume that the displacement thickness is continuous through transition. Find the ratio of the displacement thickness at the trailing edge of the plate to the length of the plate. [Use the Blasius one-seventh power law profile for that part of the boundary layer which is turbulent.]