

Problem 250E

A laminar boundary layer in a planar, incompressible flow experiences a velocity external to the boundary layer which increases linearly with distance, x , measured along the surface:

$$U = Ax$$

where A is a constant. Approximate boundary layer methods (the Karman momentum integral equation) are to be used with the approximate profile

$$\frac{u}{U} = 2 \left(\frac{y}{\delta} \right) - \left(\frac{y}{\delta} \right)^2$$

for which the profile parameters are $\alpha = 2/15$, $\beta = 2$, $\gamma = 1/3$.

Given that the boundary layer thickness, δ , turns out to be independent of x , find an expression for δ in terms of A , α , β , γ and the kinematic viscosity, ν , of the fluid.