

Abstract Submitted
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Von Karman re-visited¹ DONALD M. MCELIGOT, U. Idaho, KEVIN P. NOLAN, Imperial College, EDMOND J. WALSH, U. Limerick — A number of authors have presented extended versions of the integral momentum equation, allowing for perturbations or fluctuations in the boundary layer. “Conventional wisdom” is that these added terms can be neglected and one can apply the von Karman version directly. For two-dimensional turbulent boundary layers at high Reynolds numbers, experience shows this assumption to be reasonable. However, recent examination of entropy generation in bypass transition with zero pressure gradient shows a term for turbulence energy convection can be important in determining the energy dissipation coefficient [Walsh et al., JFE 2011]. The present study employs the direct numerical simulations of Zaki and Durbin [JFM 2006] for bypass transition with streamwise pressure gradients to quantify the additional normal stress term when estimating the skin friction coefficient via a momentum balance. It is found that this term becomes noticeable in the pre-transitional laminar boundary layer and can exceed forty per cent of C_f in the transition region. Thus, it should be included in such calculations.

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