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Mean flow scaling in transitionally-rough turbulent boundary layers[1] MICHAEL P. SCHULTZ, KAREN A. FLACK, U.S. Naval Academy — Results of an experimental investigation of the flow over several mildly-rough surfaces are presented. Three fine-grit sandpaper surfaces and two commercial ship bottom paints were tested over a large Reynolds number range (Re_θ = 2,600 – 30,000) in order to document the roughness function (ΔU^+) behavior in the transitionally-rough flow regime. In all cases the root-mean-square roughness height was a very small fraction of the boundary layer thickness (k_{rms}/δ <1/1,100). The results indicate that the mean velocity profiles for the rough surfaces agree with smooth-wall profiles using outer scaling. However, some significant differences in the behavior of ΔU^+ in the transitionally-rough flow regime are noted among the five rough surfaces. For example, the roughness functions for the sandpaper surfaces show reasonable agreement with the results of Nikuradse for uniform sand, while the paint surfaces do not. These results, along with others from the literature, will be used to illustrate how surface topography may give rise to the differences that are observed in roughness functions for the transitionally-rough regime.

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