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Outer Layer Turbulence Similarity for Rough Wall Boundary Layers KAREN FLACK, United States Naval Academy, MICHAEL SCHULTZ, JONATHAN CONNELLY — The outer layer similarity hypothesis of Townsend states that the turbulence beyond a few roughness heights from the wall is independent of the surface condition. In order to explore a limiting roughness height for boundary layer similarity, an experimental investigation was carried out on six rough surfaces representing two types of three dimensional roughness (sandpaper and woven mesh) in which the boundary layer thickness to roughness height varied from 16 to 110. The measurements were conducted in a closed return water tunnel, over a momentum thickness Reynolds number range of 6,100 to 13,000, using a two-component, laser Doppler velocimeter (LDV). The Reynolds stresses, and higher-order moments, as well as quadrant analysis of the rough surfaces show collapse with smooth wall results outside of a roughness sublayer. These results indicate that turbulence similarity in the outer layer may be more robust than previously thought and changes to the turbulent structure appear to be confined to a roughness sublayer, even for very large roughness.

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