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Turbulent boundary layer structure over sparsely-distributed roughness[1] MICHAEL SCHULTZ, U.S. Naval Academy, BHARATHRAM GANAPATHISUBRAMANI, Imperial College London — Experiments were performed on a surface consisting of sparsely-distributed rigid circular cylinder roughness elements to examine the effects of solidity on turbulence structure. The solidity (λ) of the roughness (defined as frontal area of the roughness elements per unit wall-parallel area) is 0.08. This value was chosen to lie in the "sparse" regime ($\lambda \leq 0.1$) while maintaining a large equivalent sandgrain roughness height (k_s). Measurements were made using both two-component LDV and wide-field planar PIV techniques at two Reynolds numbers, $Re_\tau = 1800$ and 4000. The results indicate that the relative roughness height of these elements (k/δ) is approximately 0.09. The value of ${k_s}^+$ is greater than 350 in both cases indicating that the flow is in the fully-rough regime. The mean velocity profile in defect form at both Reynolds numbers conforms to outer-layer similarity. The Reynolds stresses appears to exhibit outer-layer similarity for $y > 3k_s$. However, differences between the two Reynolds numbers are observed closer to the wall. Specifically, a broad peak in the streamwise Reynolds normal stress is observed around $y/\delta = 0.12$ for $Re_\tau = 4000$. Further analysis using both the PIV and LDV data will be performed and presented.

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