

Abstract Submitted  
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**Effect of Freestream Turbulence over Rough, Favorable Pressure Gradient Turbulent Boundary Layers** SHEILLA TORRES-NIEVES, JOSE LEBRON-BOSQUES, BRIAN BRZEK, LUCIANO CASTILLO, Rensselaer Polytechnic Institute, RAUL BAYOAN CAL, CHARLES MENEVEAU, The Johns Hopkins University — Laser Doppler anemometry measurements are performed downstream of an active grid in the Corrsin wind tunnel at The Johns Hopkins University to study the effect of freestream turbulence ( $Tu \leq 7\%$ ), surface roughness and external favorable pressure gradient. Overall, the effect of freestream turbulence has proven to be dominant over pressure gradient and roughness. Mean profiles show that freestream turbulence effects alter the entire boundary layer including the inner flow. A reduction in the wake is also seen. Moreover, freestream turbulence increases the Reynolds stresses, making the values near the edge of the boundary layer to be non-zero. For the streamwise fluctuations, turbulence intensity affects the inner and outer regions, while the wall-normal and shear stress only change in the outer flow. Also, it is seen that roughness prevents the streamwise fluctuations from increasing near the wall, mainly because of the destruction of the viscous regions. Furthermore, a 20% increase in the skin friction is reported, 25% more than the increase obtained over smooth surfaces.

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