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Scaling the Rough Favorable Pressure Gradient Turbulent RAUL BAYOAN CAL, The Johns Hopkins University, BRIAN BRZEK, R.P.I., GUNNAR JOHANSSON, Chalmers University of Technology, LUCIANO CASTILLO, R.P.I. — Laser-Doppler anemometry measurements of the mean velocity and Reynolds stresses are carried out for a rough surface favorable pressure gradient turbulent boundary layer. The experimental data is compared with smooth favorable pressure gradient and rough zero pressure gradient data. The mean velocity deficit profiles collapse, but to different curves when normalized using the free-stream velocity for constant upstream conditions. The friction velocity scaling shows the effects of the favorable pressure gradient condition, but tends to group the rough data. The effects of the pressure gradient and roughness are clearly distinguished in the outer region of the boundary layer. When scaled with U_{∞}^2 , the $\langle u^2 \rangle$ component of the Reynolds stress augments due to the rough surface up to about 50% despite the imposed favorable pressure gradient; while when using the u_*^2 scaling, it is dampened more than 100%. This influence is the most evident where the shape of the profile completely changes and becomes 'flatter' in the inner region. Similarly, the pressure gradient imposed on the flow changes the magnitude of the Reynolds stress profiles especially on the $\langle v^2 \rangle$ and $\langle uv \rangle$ components for the u_*^2 or U_∞^2 scalings. The Reynolds stress profiles augment and possess a Reynolds number dependence due to the pressure gradient condition when scaled with u_*^2 .

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