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Turbulent boundary layer perturbation by two wall-mounted cylinders arranged in tandem at various spacings and height ratios ALI HAMED, ADAM PETERLEIN, Department of Mechanical Engineering, Union College — The perturbation of a turbulent boundary layer by two cylindrical roughness elements in close proximity was experimentally investigated using particle image velocimetry (PIV). The two cylinders were arranged in tandem with center-to-center streamwise spacings of $2d$, $4d$, and $6d$, where d is the diameter of the cylinders. The downstream cylinder had a fixed height (approximately 20% of the boundary layer thickness); the height of the upstream cylinder was varied to achieve upstream to downstream cylinder height ratios of 1, 0.75, and 0.5. The flow measurements were made at $Re = 57000$ (based on the boundary layer thickness and freestream velocity) and included measurements over an isolated cylinder as a baseline case. The results highlight the effects of sheltering by an upstream cylinder on the wake of the downstream cylinder. Flow features in the wake, including the downwash, upwash, recirculation zone, velocity deficit, Reynolds shear stress, and turbulent kinetic energy (TKE), are highly dependent on the degree of sheltering which is governed by both the streamwise spacing and height ratio. Additionally, proper orthogonal decomposition (POD) and quadrant analysis were used to examine the changes to the turbulence structure as a function of both the spacing and height ratio.

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