Cylinder wakes in quasi-two-dimensional flows with surface friction I: instability and scaling\textsuperscript{1} JEMIN SHIM, JAMIE H. W. LI, DAVID F. RASCHKO, PAUL W. FONTANA, Seattle University — We measured the frequency of vortex shedding produced by cylinders in a quasi-two-dimensional system with homogenous drag. The system is characterized by the Reynolds number $Re = \frac{U_0 D}{\nu}$ ($U_0$ = flow speed without the obstacle, $D$ = cylinder diameter, $\nu$ = kinematic viscosity), and a dimensionless drag parameter, $\alpha^* = \frac{D^2}{(L_s^2 Re)}$ ($L_s$ = length scale above which drag force exceeds viscous force). We investigated the scaling of the Strouhal number $St = \frac{f D}{U_0}$ ($f$ = vortex shedding frequency) and compared it with conventional measurements in flows without homogenous drag. The dynamics bifurcates above a critical diameter $D_c \sim L_s$, indicating that the effect of surface friction becomes important. Increased fluctuations beyond the bifurcation indicate the onset of a previously unobserved instability associated with the drag. Also, near some critical parameters, shear instability without vortex shedding is observed, with vortex streets appearing at both higher and lower Reynolds number; the mode at lower Reynolds number has not previously been observed.

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