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Vortex-Induced Vibration of an Airfoil Used in Vertical-Axis Wind Turbines[1] BRIDGET BENNER, DANIEL CARLSON, University of Massachusetts Amherst, BANAFSHEH SEYED-AGHAZADEH, Miami University, YAHYA MODARRES-SADEGHI, University of Massachusetts Amherst — In Vertical-axis wind turbines (VAWTs), when the blades are placed at high angles of attack with respect to the incoming flow, they could experience flow-induced oscillations. A series of experiments in a re-circulating water tunnel was conducted to study the possible Vortex-Induced Vibration (VIV) of a fully-submerged, flexibly-mounted NACA 0021 airfoil, which is used in some designs of VAWTs. The airfoil was free to oscillate in the crossflow direction, and the tests were conducted in a Reynolds number range of $600<Re<13{,}300$ and reduced velocity range of $0.6<U*<13$. The amplitudes of oscillations and flow forces acting on the airfoil were measured at various angles of attack, α, in the range of $0<\alpha<90$. The airfoil was observed to oscillate in the range of $60<\alpha<90$, where $\alpha=90$ exhibited the widest lock-in range ($1.67<U*<11.74$) and the largest peak amplitude ($A*=1.93$ at $U*=5.7$). For all cases where oscillations were observed, the oscillation frequency remained close to the structure's natural frequency, defining a lock-in range. Flow visualization tests were also conducted to study the changes in the vortex shedding patterns.

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