



Vertical axis wind turbine wake in boundary layer flow in a wind tunnel

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A vertical axis wind turbine is placed in a boundary layer flow in a wind tunnel, and its wake is investigated. Measurements are performed using an x-wire to measure two components of velocity and turbulence statistics in the wake of the wind turbine. The study is performed at various heights and crosswind positions in order to investigate the full volume of the wake for a range of tip speed ratios. The velocity deficit and levels of turbulence in the wake are related to the performance of the turbine. The asymmetric incoming boundary layer flow causes the rate of recovery in the wake to change as a function of height. Higher shear between the wake and unperturbed flow occurs at the top edge of the wake, inducing stronger turbulence and mixing in this region. The difference in flow relative to the blades causes the velocity deficit and turbulence level to change as a function of crosswind position behind the rotor. The relative difference diminishes with increasing tip speed ratio. Therefore, the wake becomes more homogeneous as tip speed ratio increases.