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Buoyancy-Induced, Columnar Vortices[1] MARK SIMPSON, ARI GLEZER, Georgia Institute of Technology — Free buoyancy-induced, columnar vortices (dust devils) that are driven by thermal instabilities of ground-heated, stratified air in areas with sufficient insolation convert the potential energy of low-grade heat in the surface air layer into a vortex flow with significant kinetic energy. A variant of the naturally-occurring vortex is deliberately triggered and anchored within an azimuthal array of vertical, stator-like flow vanes that form an open-top enclosure and impart tangential momentum to the radially entrained air. This flow may be exploited for power generation by coupling the vortex to a vertical-axis turbine. The fundamental mechanisms associated with the formation, evolution, and dynamics of an anchored, buoyancy-driven columnar vortex within such a facility are investigated experimentally using a heated ground plane. Specific emphasis is placed on the manipulation of the vortex formation and structure and the dependence of the vorticity production and sustainment mechanisms on the thermal resources and characteristic scales of the anchoring flow vanes using stereo-PIV. It is shown that manipulation of the formation and advection of vorticity concentrations within the enclosure can be exploited for increasing the available kinetic energy.

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