# DESIGN AND AERODYNAMICS OF A PORTABLE WIND TUNNEL FOR SOIL EROSION AND FUGITIVE DUST RESEARCH

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ABSTRACT. A portable wind tunnel was designed and built to research wind erosion of soil and simultaneous emissions of fine dust from agricultural fields. This approach allowed for time efficient, in situ measurements of erosion processes under controlled wind conditions. The tunnel had an overall length of 13 m with a working section 7.3 m long, 1.0 m wide, and 1.2 m high. Power was supplied using a 33-kW gasoline engine driving a 1.4-m industrial fan.

Tunnel aerodynamic design provided for development of a velocity profile comparable to that in an atmospheric boundary layer to a height of 1.0 m over a clean-tilled field. This was accomplished using ( 1) extensive flow conditioning (perforated plates, honeycomb and screen) to eliminate flow instability, and (2) a non-uniform shear-grid positioned at the upstream edge of the working section.

Experimental results indicate that the flow conditioning produced the desired velocity and turbulence profiles which were both maintained beyond a downstream distance of three times the tunnel height, 3H. In addition, the grid established lateral uniformity in both velocity and turbulence as a function of height. A tunnel Froude number of 12.3 indicated that the flow was free of constraint and shear velocity was relatively unchanged after a distance of less than 3H. These aerodynamic characteristics provided a measuring window in the working section that was 80 cm wide x 1.0 m high, a flow area of 0.8 $m^2$.

Keywords. Wind erosion, Portable wind tunnel, Boundary layer, Turbulence, Froude number, Particulate emissions.