**Design And Analysis Of Ceiling Fan Blade Performance Using Flow Simulation**

**ABSTRACT**

This study pertains to the design optimization of a four-blade ceiling fan to enhance air circulation and energy efficiency. The sweep angle of the blade profile is nonlinear. The design of experiment (DOE) computational fluid dynamics (CFD) and response surface method (RSM) methods were used in parallel to find the optimal design solution. The design variables considered were inboard angle of attack, outboard angle of attack, blade sweep, and tip-chord length. Numerical simulations were conducted using steady state Reynolds-averaged Navier–Stokes (RANS) equations and the Spalart–Allmaras turbulence model. The baseline results were validated through experimental data. Subsequently, the DOE method was employed to generate the blade design which reduce the number of simulations without losing the influence of different geometric parameter interactions. The response variables studied were volume flow rate, mass flow rate, torque, and energy efficiency. The simulations exhibited that flow pattern has a distinct feature and is further classified into three groups. In the end, the optimal blade design was identified using response surface methodology (RSM).

Keywords: Nonlinear sweep; Design of experiments; Blade design; Computational fluid dynamics; Response surface method.