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TITLE OF THE THESIS THREE DIMENSIONAL FLOW OF RECIRCULATING AIR WITHIN A ROOM WITH INTERNAL OBSTRUCTION

ABSRTACT

Numerical and experimental studies of recirculating air within a room with internal obstruction for mixing ventilation (MV) and displacement ventilation (DV) have been investigated. The studies involve solution of partial differential equations for the conservation of mass, momentum, energy, concentration, turbulent energy and its dissipation rate. The experimental data were used to validate numerical solutions by using three turbulent models: the standard k- ε (SKE), realizable k- ε (RKE) and renormalizations-group k- ε (RNG). The renormalizations-group k-ε (RNG) turbulence model provided the best agreement as presented here. Firstly, statistical analysis for three models, have been computed. Secondly, smoke visualization image obtained has been compared with the three models. Thirdly, velocity and temperature distribution are compared. The decay coefficient of the jet for mixing ventilation on five reference lines covering the studied room have been determined. The uncertainties in the measurements of temperature, velocity, volumetric flow rate and convective flux and film coefficients have been investigated and reported. The ventilation effectiveness for heat removal has been investigated for (MV) and (DV). The selection of velocity as correlating parameter for convective heat transfer coefficient has been done in such a way that it matches to the ASHRAE results. Convective coefficients in mixing ventilation (MV) were considerably lower than those estimated from ASHRAE while in displacement ventilation (DV) they were higher than those from ASHRAE. The CFD code ANSYS FLUENT 6.3 is convenient for investigating the effect of other parameters on the characteristics of the recirculating air flow in the room. Two parameters have been investigated: firstly the three different sizes of heated obstruction and secondly the change of air flow rate to study the effect of these parameters on air flow characteristics inside the room in the presence of heated obstruction. On the basis of the investigations done as reported above it can be concluded that the displacement ventilation is the best suited system for a room depending on the ventilation effectiveness (temperature).