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Abstract

The present study aims to investigate the characteristics of airflow inside the room through 5-blade square louver face ceiling diffuser using CFD. Several diffuser models are installed inside 3D room model by changing blade angles (60º, 65º and 45º) and lip angles (0º, 5º, 10º and 15º). Besides, the model with 60º blade angle and 0º lip angle is installed inside different room models with various return air inlet positions. The realizable k–ε turbulence model is used in simulation process. The results indicated that the diffuser model with 65º blade angle provide jet and terminal air velocities beside airflow patterns cling with ceiling higher than the models 60º and 45º. Therefore, it is suitable to install in the space with larger size and relatively higher noise level to reaches to the comfort criteria faster than the other models to reduce the energy consumption. On the other hand the model with 45º blade angle is applicable to installed in the spaces with larger height due to airflow patterns out in cone shape. In addition, increasing lip angle to 15º leads to relatively reduce the cling of airflow patterns with room ceiling, and reach to comfort conditions with less energy consumption faster than 0º lip angle. Moreover, the room geometry model with two return air inlets on the ceiling with adequate size is produced ideal design of a fully mixed air distribution system with relatively constant temperature gradient.

Abbreviations

CFD, Computational Fluid Dynamics; RANS, Reynolds Average Navier Stokes; LES, Large Eddy Simulation; RNG, Renormalized k-ε Model; E, Ventilation Effectiveness; PIV, Particle Image Velocimetry; LDA, Laser Doppler Anemometry; SKE, Linear k-ε Turbulence Model; SKE-NL, Linear k-ε Turbulence Model; CRCP, Ceiling Radiant Cooling Panels; PMV, Predicated Mean Vote; EDT, Effective Draft Temperature; ADPI, Air Diffusion Performance Index; DO, Discrete Ordinates Model

Keywords

Ceiling diffusers, Coanda effect, CFD, Blade angle, Comfort criteria, lip angle, Terminal velocity, Fully mixed air distribution system.

Nomenclatures

Symbol	Meaning Unit
k	Turbulent kinetic energy m^2/s^2
V	Velocity m/s