

Numerical Investigation of Indoor Environmental Quality in a Room Heated with Impinging Jet Ventilation

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Abstract : The indoor environmental quality (IEQ) is increasingly recognized as a significant factor influencing the overall level of building occupants' health, comfort and productivity. An air-conditioning and ventilation system is normally used to create and maintain good thermal comfort and indoor air quality. Providing occupant thermal comfort and well-being with minimized use of energy is the main purpose of heating, ventilating and air conditioning system. Among different types of ventilation systems, the most widely known and used ventilation systems are mixing ventilation (MV) and displacement ventilation (DV). Impinging jet ventilation (IJV) is a promising ventilation strategy developed in the beginning of 2000s. IJV has the advantage of supplying air downwards close to the floor with high momentum and thereby delivering fresh air further out in the room compare to DV. Operating in cooling mode, IJV systems can have higher ventilation effectiveness and heat removal effectiveness compared to MV, and therefore a higher energy efficiency. However, how is the performance of IJV when operating in heating mode? This paper presents the function of IJV in a typical office room for winter conditions (heating mode). In this paper, a validated CFD model, which uses the v2-f model is used for the prediction of air flow pattern, thermal comfort and air change effectiveness. The office room under consideration has the dimensions 4.2×3.6×2.5m, which can be designed like a single-person or two-person office. A number of important factors influencing in the room with IJV are studied. The considered parameters are: heating demand, number of occupants and supplied air conditions. A total of 6 simulation cases are carried out to investigate the effects of the considered parameters. Heat load in the room is contributed by occupants, computer and lighting. The model consists of one external wall including a window. The interaction effects of heat sources, supply air flow and down draught from the window result in a complex flow phenomenon. Preliminary results indicate that IJV can be used for heating of a typical office room. The IEQ seems to be suitable in the occupied region for the studied cases.

Keywords : computation fluid dynamics, impinging jet ventilation, indoor environmental quality, ventilation strategy

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