Abstract

False ceiling installations are a popular solution to hide mechanical extraction systems in building spaces. Current guidance suggests a “rule-of-thumb” of a minimum 25% free area so that the smoke can flow through the perforations unhindered, which was based on experimental study. This threshold value is often misused in a wide range of false ceiling designs, although the original experimental work was carried out only for evenly distributed perforations in the false ceiling. To address the effects of the perforated false ceiling on the smoke and heat control system, a Computational Fluid Dynamics study was conducted using a Fire Dynamics Simulator. Firstly, this study examined the effects of the false ceiling with evenly distributed perforations on the gas temperatures and visibility inside the compartment where the smoke and heat control system is installed. Next, numerical simulations were carried out to see how the size and distribution of the openings in the false ceiling would affect the effectiveness of the smoke and heat control system, compared to false ceilings with evenly distributed perforations. The numerical results showed that for a fire as large as 2 MW the minimum of 40% free area will not hinder a significant amount of smoke from flowing through the false ceiling if the false ceiling is at the same level as the downstand. For free areas between 40 and 25%, extending the downstand below the false ceiling should be considered if the criterion is to contain the smoke within the compartment on fire. Evaluation of designs with various degrees of openness showed that the smoke above and below the false ceiling is dependent on the size and distribution of the openings and should be evaluated case by case in real-life applications. The numerical study demonstrated that taking the “rule-of-thumb” for designs that depart from the original experimental results gives rise to an ineffective smoke and heat control system which could result in high temperatures and loss of visibility at the escape routes.