

A study on the spread of fire caused by the stack effects of patio—A computer modeling and a reconstruction of a fire scenario

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Abstract

This study reported an actual building fire incidence for a ten-story building that occurred in Taiwan in 2008. Due to the stack effects the fire occurred on the third floor spread through the patio in a short time to the upper floors and caused three deaths in a tenth floor apartment. This study also attempted to reconstruct the actual fire scenario using computer simulation. The spread of the fire to the combustibles due to hot smoke was accounted for in the simulation. Variation of the fire scenario and the factors causing the fire spread were studied. It was found that an initial fire size below 1.0 MW would not generate sufficient hot smoke to cause fire spread despite the stack effects. However, any obstructions in the patio such as window shading has been found to cause heat accumulation that would aggravate the fire spread problem. The presence of a canopy at the top of the patio can cause higher concentration of smoke for the upper floors. The simulation results are found to be in good agreement with the actual incidence. Moreover the simulation results also show that when the fire spread through the patio the initial fire size of 1.0 MW at the fire site can grow to a building fire of 300 MW.

Keywords

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1 Introduction

Patios are often designed for natural lighting and ventilation. Regulations on the functions of natural lighting and ventilation can be found in many building codes. However, any temperature difference between the ambient and the patio would become the driving force of the airflow in the patio, also known as the stack effects.

In the event of a building fire hot smoke from the fire site would flow into the patio and in consequence the stack effects would turn the patio into a vertical shaft for smoke exhaust. Such a case happened in a building fire that occurred on the 25th of May, 2008 in the outskirts of New Taipei City in Taiwan area. It was a ten-story building with a patio shared by two apartments. The fire occurred in a room on the third floor but instead caused three deaths in a tenth

floor apartment. Fire and smoke spread in a short time to the upper floors through the patio. Besides the casualties as mentioned above, the fire also caused total loss of property to some apartments in the building. The authors visited the residents and the fire site. The survivors mentioned that the smoke spread to all floors above the fire site in times of minutes.

To further understand the mechanisms of fire spread through the patio a reconstruction of the fire using computer modeling was attempted in this study. Important factors related to the growth of fire size and also the fire safety was investigated. The mechanisms of smoke and fire spread through the patio are studied and presented in this study. The effects of the variations of the important factors of fire and smoke spread are also presented.

Some literature related to the spread of smoke through