



The 5th Conference on Performance-based Fire and Fire Protection Engineering

Experiment and Simulation Study on High-rise Student Apartment Fire Personal Evacuation in the Campus

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Abstract

The paper sets an evacuation scene and evacuation parameters at the actual situation in case of high-rise student apartment fire, applied BuildingExodus Evacuation Model software, and calculated the dynamic changes of evacuation time and evacuation amounts of people in each access of the building, which accords with the result of fire evacuation drill. It is concluded that it is reasonable and practicable using model software to simulate evacuation time for each floor, and the result can be a substantial reference for actual evacuation time in case of fire.

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Keywords: personal evacuation model; building fire; numerical simulation; evacuation time

1. Introduction

With the rapid development of economic construction and sharp increases of material wealth, large-scale and ultra large buildings have emerged unceasingly, therefore the potential safety hazards are increasing constantly. Fire is one of the most common hazards which seriously harm people's lives and property and directly influences economic development and social stability. High-rise fire evacuation is directly related with people's life safety, and how to effectively prevent and reduce the casualties, especially group casualties, in case of fire has become an emphasis and hotspot of domestic and overseas public safety study at present. However, high-rise student apartment fire, with features of large student amounts, living centralization and big chances of fire, therefore is likely to cause great economic loss, significant casualties and substantial social influences^[1]. For this purpose, this paper addresses actual situation of campus and student apartments of some university in Beijing and develops the experimental and numerical simulation study of safety evacuation.

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2. Evacuation model and building simulation

2.1. BuildingExodus evacuation model

This paper applies BuildingExodus model software to simulate people evacuation in case of high-rise student apartment fire. This software is developed by Galea of the University of Greenwich and has fine grid model for evacuation simulation^{[2][3]}. The model is designed for large space and large amounts of people to escape, and it is applicable for simulation of supermarkets, hospitals, cinemas, stations, airport terminals, dangerous buildings, schools and so on. It can present more practical evacuation simulation results by inputting evacuation factors including various behavior characteristics (such as physical, psychological, behavior attributes of evacuation people), and fire hazardous features (such as hazardous attributes of heavy smoke, temperature, poison gas). Therefore, the evacuation simulation results by using BuildingExodus model with evacuation situation analysis and factors setting can be an important reference for actual evacuation time in case of fire, and has a high value of development and popularization.

2.2 Basic layout of the building for numerical simulation

The building is located in Student Apartment 5# of some university in Beijing. The total area is about 20247.64m² (excluding second basement), in which the above ground GFA accounts for 18836.30m², the below ground GFA accounts for 1411.34m²; The height is 38.20m, each floor is 2.8m, the rise of stair is 14cm, and the run of stair is 30cm. This project is in type II civil architecture, 12 floors above the ground, 2 levels of basement. Above the ground is student apartment with the roof as the lift motor room; the first basement is bicycle garage and the second basement is bicycle garage and equipment room. The fire-resistive grade of buildings is Grade 2 for the above and Grade 1 for the below. The architecture is in type of reinforced concrete shear wall, and the base is foundation settlement. Each floor and stair hall is a fire zone, the first basement is divided into 3 fire zones and the second basement is divided into 4 fire zones. The plane structure of ground floor is as shown in Fig. 1(a), and the plane structures of 2-12 floors are the same as shown in Fig. 1(b). There are 3 staircases in the building for students to use including the left (Staircase 1), the right (Staircase 2) and the middle (Staircase 3); and accordingly there are 3 emergency exits on the ground floor including the left (South Exit), the right (North Exit) and the middle (Central Exit).

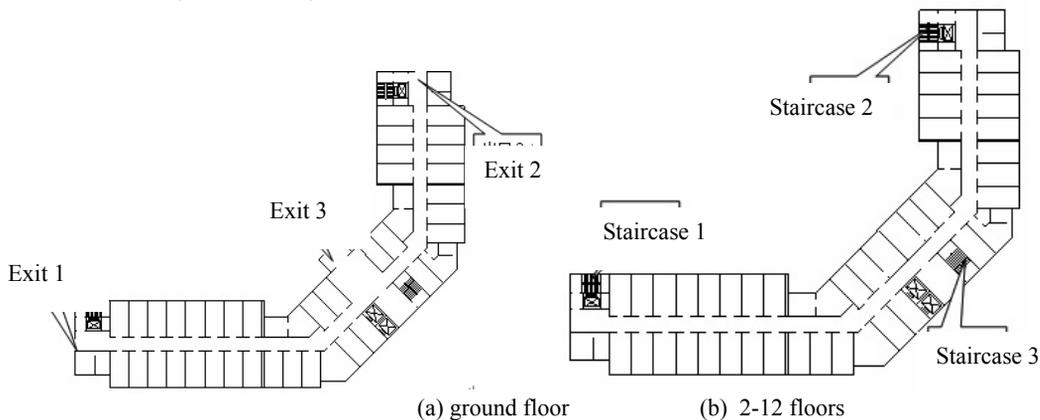


Fig. 1 Plane structure layout of the building

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