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The Improvisation Strategy of Escape Route Design in High Rise Residential Buildings in Malaysia

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Abstract

Unexpected fires may occur at any moment and in any location. There is a chance that a fire may break out in a high-rise residential building. Studies on fire safety in Malaysia is very recent, especially research on escape route in high-rise residential buildings. When compared to other building types, the number of fire incidents involving residential buildings is much higher. The main objective of this paper is to suggest the strategy to improvised escape route design for future development of high-rise residential buildings in Malaysia. The quantitative method of a self-completion questionnaire online survey was conducted among 992 residents of high-rise residential buildings in Gombak, Selangor who experienced with the existing escape routes in their building. The findings provide a basis for design team to improve the design of escape route in high residential building. Thus, this research can provide as implications related to social and proposed the guidelines to the enhance the fire safety escape route in design and specification for tenants or residents or developers to achieve the conducive, safety and good environment in the high-rise residential building. As a result, escape routes in high-rise residential buildings should be designed and constructed to allow occupants to escape the building as soon as a fire is spotted.

Keyword: Escape Route Design, Fire Emergency Exit, High Rise Residential Building

Introduction

The basic requirements of fire safety regulations is creating conditions for safe evacuation from burning buildings. For this purpose, escape routes are proposed for designing the fire safety standards and other applicable regulations governing fire safety requirements of buildings. An escape route is defined as a route that allows safe evacuation of persons from the building or its part threatened by fire, evacuation into the open air, the access of fire brigades (Greena, 2022). If fire breaks out in high-rise residential buildings, it is expected that the occupants will evacuate the building using normal escape routes provided in the building unless they have caught fire. If fire and

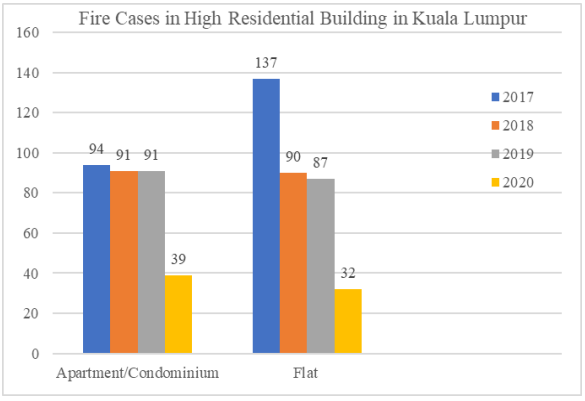
smoke conditions in the affected building are worse and threaten the occupants, then they may have no choice but to return to their respective apartments or seek refuge in other apartments and wait to be rescued by the fire fighter (Yung et. al., 2001). Therefore, escape routes in high-rise residential buildings are supposed to provide a safe egress for the building occupants to reach at the safe designated area. Elements of escape route such as steps, handrail, balustrade, and staircase slope should have been designed and installed in such a way that they are safe to use.

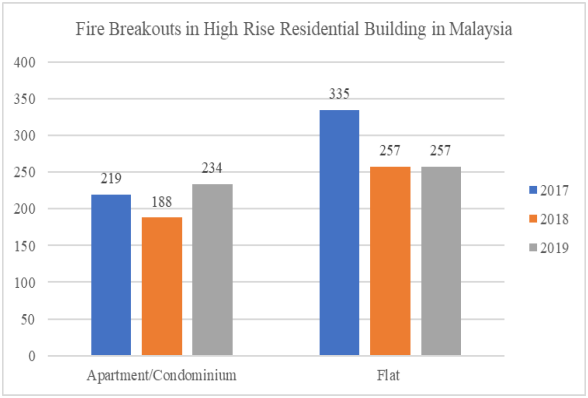
Overview of Fire in High-Residential Building

In comparison with other types of disaster, fire poses a crucial threat to life and property (Aziz et al., 2020). Fire and Rescue Department of Malaysia (FRDM) attended to 51,458 fire cases in 2019 all over the country, or an average of 140 cases per day. This figure was the highest annual figure recorded, with the percentage increasing by 24.1 percent compared to 2015. The Department of Statistics Malaysia (through the Public Safety statistics) reported that the total number building fire breakout in 2019 was 5439 cases, showing an increase of 125 cases compared to 2018.

According to FRDM, the total numbers of fire cases in high rise residential building in Malaysia from year 2017 to 2019 were captured 1490 numbers. As for Wilayah Persekutuan Kuala Lumpur, the fire cases for high rise residential building are 661 numbers were highlighted by Public Safety Statistic Malaysia from year 2017 to year 2020.

Table 1
Fire Breakouts in High Rise Residential Building in Kuala Lumpur and Malaysia





Design Escape Route for High Rise Residential Building

The Malaysian Uniform Construction By-Law 1984 establishes the essential guidelines for developing an escape route in a structure. Total travel width, availability of a fire hydrant and hose reel, alternate escape, and number of staircases are all examples of construction codes for public multi-story residential buildings. Stairs, handrails, balustrades, and the slope of the staircase should have been planned and constructed in such a manner that they are comfortable to use.

Table 2
Derived the criteria of design escape route for high-rise residential building based on uniform building by-law 1984

No	Design criteria by UBBL 1984	Specification
1.	Dimensions of stair risers and treads	Any staircase must have a riser of no more than 180mm and a tread of no less than 255mm, with riser and tread proportions that are similar and compatible throughout the staircase The depth of the landings must be equal to or less than the width of the staircases. In high- rise residential buildings, a landing of not less than 1.80 meters in depth must be provided in staircases at vertical intervals of not more than 4.25 meters, and there must be no more than sixteen risers between any such landing in all other buildings (UBBL, 108:1),
2.	Handrail	Both handrails must be situated not less than 825 mm and not more than 900 mm measured from the nosing of the treads, except that handrail to landings must be positioned not less than 900 mm from the level of the landing
3.	Obstruction and projection on staircase	Other than railings in stairs, there should be no obstruction in any staircase between the topmost landing and the exit discharge on the ground floor, and no projection in any corridor, walkway, or staircase at a level lower than 2 meters above the floor or above any stair.
4.	Measurement of travel distance to exits	On the floor or similar walking surface, measure the distance to an exit following the natural direction of travel's centre line. It starts 0.300 meter from the farthest point of occupancy, bends around any corners or obstacles with 0.300-meter clearance and ends at the storey exit. Where stair measurements are needed, they must be taken in the plane of the pattern nosing.
5.	Lighting and ventilation system in staircase	All staircases must be fully lit and ventilated in accordance with municipal government standards.

	Fire Fighting Access Lobbies	Any structure taller than 18.3 meters must have firefighting entry lobbies. Every floor level should have a lobby, and the lobbies should be placed such that the level gap does not exceed 45.75m. Aside from that, all firefighting entry lobbies should have a firefighting staircase on the exterior.
6.	Fire Door	Suitable fire-resistance rating (FRP) fire doors should be provided for compartment walls and separate walls
7.	Horizontal exits	the total number of exit widths provided is not less than half of what may be required for the entire building
8.	Emergency exit signs	Storey exits and connections to those exits must be identified with clearly identifiable signage and not blocked by any decorations, furnishings, or other devices, two electric bulbs with a combined power of not less than fifteen watts must be installed.
9.	Ventilation of Staircase Enclosures	each floor or landing must have a minimum one square meter opening for ventilation. For structures above 18 meters in height, any level or landing shall be mechanically or naturally ventilated to eliminate smoke infiltration into the staircase enclosure

Any resident can conceive of a safe escape route as soon as a fire starts in their home. To accomplish this, it would be crucial to protect a well-defined exit route, also known as a "escape route" or "evacuation route," which is referred to as a safe route (horizontally and vertically) for people to move from any location within the building or system to a safe location without such outside assistance. Not only do escape routes provide those in risk of being burned alive with a way out. Additionally, the route would make it possible for fire agencies to enter the structure swiftly and efficiently to put out the fire or look for any trapped individuals.

Problems In Design Escape Route for High-Rise Residential Building

Current practice for security harness (iron grill)

The current practice whereby many building owners were inspired to harness security measures by putting an iron grill or an extra safety precaution such as double locked iron gates at the main entrance and other exit routes of their property, has increased the risk of being trapped if fire breaks out (Yatim, 2012). Furthermore, the research reveals that the biggest challenge for firefighters is in this region. This is due to the fixed grill window styles, which made it impossible for firefighters to free victims after a burn. This type of case demonstrated the value of window grill construction in assisting building occupants in quickly exiting as an emergency escape during a burn. In September 2017, a tragic fire erupted at the Islamic school Darul Quran Ittifaqiyah in Kampung Datuk Keramat, Klang Valley, frightening the nation. After the fire, the students attempted to escape the building

but were blocked because the windows were fitted with grills that could not be opened from the inside.

Lack of Emergency Escape Route for People with Disabilities

Once a fire breaks out, getting out of a building safely can be difficult. The appearance of fire or thick smoke in the home will lead many people to feel disoriented and frightened. When attempting to escape a house, people with disabilities face additional obstacles (Daimantes, 2003). It can be very difficult to find an escape path if a person is seriously ill, needs a wheelchair or uses another medical device to get about, such as crutches. A physical condition can also limit an individual's time to respond fast enough to avoid a possible fire. Mobility disabled wheelchair, mobility impaired but not using a wheelchair, hearing impaired, and visually impaired are the four categories of disabilities. This kind of individual can be seen in almost every high-rise apartment building, but the building is not fitted for people with disabilities holding points, such as smoke-stop or fire-fighting lobby, handrails, wheelchair stairlifts, and other amenities.

Lack of Emergency Lighting and Exit Signage

During fires, haze causes low visibility and irritates people by making it impossible to navigate their way (Jeon and Hong, 2009). The electricity can go out if a fire or other event occurs in an apartment building. Tenants must be able to think exactly to leave the building if the electricity goes out. In an emergency, the disruption of these services may have serious consequences for people's lives, property, and enforcement. Failure of emergency lighting and exit signs may obstruct occupants' ability to safely evacuate a building, increasing the likelihood of trauma, illness, or death, as well as the efficacy of the emergency management team in assisting rescue, locating the cause of the incident, and mitigating property harm. Fire evacuation routes in modern buildings vary, affecting tenant egress in the event of a fire. House residents are at a high risk of failing to self-evacuate due to the building's long and complicated evacuation paths, as well as low visibility caused by smoke and fire.

Poor of Final Exit Doors

Final exit doors are either locked and unable to be opened for security purposes, or they are twisted or swollen to the point that they may not open or require a great deal of force to open. The ultimate objective in the event of a fire is to guarantee the complete and timely evacuation of all people inside the building, as is required by UK fire-safety legislation. Other problems involve occupants blocking final exit doors by storing items in front of them, which is all too common and prohibits anyone from exiting the building (Yatim, 2009).

Research methodology

This research involved a quantitative research technique where the perceptions of respondents were based on their experience in using escape route. The quantitative method of a self-completion questionnaire survey was conducted among 992 residents of high-rise residential buildings who experienced with the existing escape routes. Within 3 months, the researcher managed to assess the responses from 228 residents due to MCO limitations. There were asked about their opinion, view and experiences on the existing escape route design and helping them in increase the evacuation process time in Malaysia scenario.

Analysis and Discussion of Results

The elements for improvisations the escape route design that include refer guidelines for window grilles, provide emergency escape route for persons with disabilities, emergency lighting and exit sign, final exit doors, sliding or revolving doors must not be used for exits and external escape directions must not be blocked. Table 3 shows the mean score for each element in improvisations the escape route design and Table 4 represent the ranking for each element.

Table 3

Mean score for improvisation element

Q1		Q2	Q3	Q4	Q5	Q6
N	Valid	228	228	228	228	228	228
	Missing	0	0	0	0	0	0
Mean		4.69	4.55	4.55	4.67	4.60	4.78
Minimum		1	1	1	1	1	2
Maximum		5	5	5	5	5	5

Table 4

Ranking on improvisations the escape route design

IMPROVISATIONS THE ESCAPE ROUTE DESIGN	MEAN SCORE	RANKING
External escape directions must not be blocked	4.78	1
Refer guidelines for window grilles	4.69	2
Final exit doors	4.67	3
Sliding or revolving doors must not be used for exits	4.60	4
Provide emergency escape route for persons with disabilities	4.55	5
Emergency lighting and exit sign	4.55	5
Total average	4.64	High

The highest mean score and ranking is 4.78 for external escape directions must not be blocked and the lowest mean score and ranking are provided emergency escape route for persons with disabilities and emergency lighting and exit sign which is 4.55. The total average mean for the improvisations the escape route design is 4.64 that indicate the level is high. Therefore, it shows the majority respondents suggested to improve the external escape directions must not be blocked. This is based on the real situation that always happened in high-rise residential building.

The highest mean score for item improvisation is external escape directions must not be blocked. This support by Yatim (2009) that emphasize that all escape routes should be cleared from any form of obstacles or any obstructions that can delay the evacuation process. Hence those components must be clear from any form of obstruction such as iron grills, items stored in passageway or corridors, dumping rubbish, etc. If these things happen, it will significantly impede the evacuation process. In addition, installing extra safety precautions in the form of an iron grill, which, besides providing security against intruders, created an additional

obstacle for occupants in the event of fire (Yatim,2009). Therefore, the occupants of the building must refer guidelines for installation window grilles.

Conclusion

As a conclusion, the above analysis provides the key element of improvisations the escape route design that are external escape directions must not be blocked. Regular maintenance is recommended to ensure the external pathway are clear from any hindrance to achieve the conducive, safety and good environment in the high-rise residential building. In the event of a fire emergency, well planned escape routes in high-rise residential buildings could save many lives. An effective circulation system for the building will typically be provided by well-designed ways of escape, and vice versa.

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