

FIRE SAFETY IN RESIDENTIAL APARTMENT BUILDINGS FOR LOW INCOME RESIDENTS IN SRI LANKA

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ABSTRACT

Fire risk is a critical matter to be considered in apartment buildings constructed for low income residents. Accordingly, management of fire safety carries a big role. However, it become a challenging task in these types of buildings due to residents' low income, educational level and social backgrounds. Hence, it is vital to evaluate the fire safety in such apartment buildings and to identify their issues. The research is focused to analyze gaps in the fire safety management. Thirty apartment buildings located in Colombo metropolis were selected for the study. Members of the management corporations were interviewed to gather data.

Finding showed that lack of knowledge and awareness, not having a proper fire safety system, lack of resources, less commitment of residents, lack of support from relevant authorities and poor maintenance practices are the most critical issues in fire safety management. Enhancing the fire regulation, increasing the awareness, implementation of proper fire safety management systems and construction technologies were identified as required improvements to fill the gap in fire safety.

Findings of the research can be considered to enhance the fire safety of apartments constructed for low income families.

Keywords: *Apartment Buildings; Fire Safety; Fire Safety Management; High-rise Buildings; Low Income Families.*

1. INTRODUCTION

1.1. BACKGROUND

Fire is high vulnerable and unpredictable disaster which consumes life and property, and thus preparation for prevention is paramount important (Waziri, 2012). Moreover, fire safety is one of the major considerable areas in high rise buildings (Chen, *et al.*, 2013). Further, residential buildings have shown the highest potential to fire risk due to various household activities (Hall, 2013) and are recorded more fatalities (Stephen *et al.*, 1998; Xin and Huang, 2013). Fire Service Bureau in Beijing identified that 347 civilian injuries and 853 civilian deaths from 52661 residential fire incidents (Fire Service Bureau, 2011). Further, 52,661 fires or 39.7% of all fires occurred in residential buildings in China, which results in 853 civilian deaths, 347 civilian injuries and indirect property damage of approximately 309 million were recorded in a study by Xin and Huang (2013). The USA fire department was responded to a fire every 23 seconds, one structural fire was reported every 63 seconds, one home structure fire was reported every 86 seconds, and one civilian fire injury was reported every 34 minutes (NFPA, 2015).

These fire incidents can be occurred in numerous ways. According to Waziri (2012), most of the fires are initiated as a result of household action such as, cooking, electrical system, heating equipment, smoking, candles, cloth driers, child play, lightning, kitchen equipment, fireworks and outdoor grills. Further, open flame and natural causes are contributors of the fire outbreaks (Subramaniam, 2004). According to the Palazzi, Curro and Fabiano (2015), fire can have both direct and indirect impacts on buildings and occupants. Direct damages are injuries to occupants and damages to properties. Further, Burn and suffocation can be considered as primary

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damages caused by fire and death or personal injury can be considered as serious effects (Wong *et al.*, 2006). Indirect damages affect the business continuity, goodwill of the building, building operation and maintenance cost increases (Corcoran, Zahnow, & Higgs, 2016).

The last few years, residential buildings faced various types of fire accidents which caused damages to the building properties and injured residencies (Liu and Chow, 2014). To control the residential fires, mainly fire extinguishers, hose reels, fire hydrants, fire doors, etc., are recommended in the literature. The objective of fire safety systems are to prevent flashover and provide clear exit to rescue the occupants (Daniel, 2002). Further, Fitzgerald (2004) indicated, that occupants must aware the escape routes and they must be in adequate number and size to avoid blocking and queuing. Furness and Muckett (2007) indicated, when the occupancy load is high, the travel time to escape from the building depends on the flow capacity of the escape routes. Fire management is important to reduce the risk of fire deaths and injuries (Woon and Suleiman, 2015). Moreover, effective fire safety management in any facility depends on understanding of the roles and responsibilities of individuals who runs the building facility (Furness and Muckett, 2007). Fire service of Sri Lanka cannot achieve the requirement level due to many reason such as, lack of financial resources, lack of equipment and qualified fire fighters, inadequate fire safety regulation (The Sunday Times, 2016, November 13).

Fire damage in a residential apartment can be higher than in other types of buildings as occupants are unfamiliar with the use of fire safety equipment, occupants being asleep or being affected by alcohol, tenants are unfamiliar with building layout if the building has rented out for short term period and due to clothing and other ignitions materials. With a growing demand for residential apartment buildings where population density is high, concerns towards fire safety is important. However, managing fire safety in residential apartments for low income residents is at a poor level due to various limitation caused by their high population density, low income, knowledge and social background. Therefore, the research was focused to study the shortfalls in the current fire safety management in those residential apartment buildings. Two objectives were set for the research as to (a) identify the issues in fire safety management and (b) propose recommendations to overcome the issues in fire safety management.

2. LITERATURE REVIEW

2.1. FIRE SAFETY IN RESIDENTIAL APARTMENT BUILDINGS

According to Miller (2006), buildings have classified as high, normal, and low risk types of buildings in terms of fire risks. Generally residential buildings considered as high vulnerable facility for fire due to many reasons (Hassanain, 2009).

Having large quantity of combustible materials such as, mattresses, bedding and pillows, papers or magazines, clothes, upholstered furniture, boxes or bags, curtains or drapes, interior wall covering, floor covering, cabinetry, linen, and ceiling covering can increase the risk of fire (Rohr (2001). According to Waziri (2012), fire will occur as a result of an action of a domestic activity. The existence of kitchen, fuel storage, electrical equipment, and air conditioning units in residential building creates high risk of fire (Roberts and Chan, 2000). Furthermore, when occupants are asleep, there is chance for fires to grow and develop before being discovered and unconscious occupants may be less alert and also be slower to react to the situation (Stollard and Abrahams, 1999). Yang and Bin (2013) mentioned that, not having a responsible person for fire safety management, insufficient facilities with poor design especially poor investment of fire protection services, no funds for fire safety management, improper or lack fire safety systems and lack of rules and regulations are common factors in poor fire safety. Further, Furness and Muckett (2007) mentioned that panic during the fire could increase the possibility of fatalities and injuries in fire emergencies.

Fire prevention through active and passive fire protection measures can control or reduce the fire risk (Soja, 2011; Hassanain and Hafeez, 2005; Fitzgerald, 2004; Ramachandran, 1999). Features embedded in the building structure or envelop to resist the fire, occurrence of fire, smoke control and spreading the smoke throughout the building are examples for passive fire protection. Fire detection system, fire alarm system, emergency lighting, automatic sprinkler system, stand pipe and hose reel system and portable fire extinguishers are considered as active fire protection systems.

2.2. FIRE SAFETY MANAGEMENT

Fire safety management is the process of analyzing, evaluating, and controlling fire safety by standards, tools, policies, practices and information (Howarth and Kara, 1999). Fire safety management plays a greater role to prevent Fire disaster and minimize fatalities and property damages (Rubaratuka, 2013; Argueta *et al.*, 2009; Spadaccini, 2009). Fire safety management consists of coordination of some programs towards the prevention of devastation of fire, such as fire prevention management, fire drill and other training, maintenance of equipment, and development of emergency procedure (Nadzim and Taib, 2014).

Good fire safety management can lower the probability of fire occurrence and mitigate the consequence when a fire does occur (Sun and Luo, 2014). Fire events can be managed with proper collaboration of responsible parties including guardian, manager and fire handler and management is the major party to handle fire safety in buildings (Corcoran *et al.*, 2016). Further attitudes of building owners, occupants and management staff have a greater impact in order to implement proper fire safety management (Tsui and Chow, 2004). Wang *et al.* (2011) point out that, a number of parties need to be given their contribution to achieve fire safety of the building including professional designers, fire authority and building users. Further, management policy is a significant factor in this regard (Marchant, 2000).

3. RESEARCH METHODOLOGY

Qualitative research approach was used for this study. Thirty apartment buildings for low income residents located in Colombo metropolis were selected for the study. The selected apartment buildings contain four to eight floors and the number of unit in those buildings vary from eight to two hundred and twenty two. Thirty three (33) respondents were interviewed for this research. Face to face interviews were conducted with members of the Management Corporation (MC) of those selected thirty apartment buildings. An interview guideline, which consisted with major five sections to identify issues in the fire safety management systems and probable suggestion to overcome the issues was used for data collection. Further, three experts in the apartment management field were interviewed to identify recommendations to overcome the issues in fire safety management in apartment buildings for low income people. Content analysis was used to analyze responses of interviewees using NVivo software tool.

4. ANALYSIS AND DISCUSSION

Data analysis was done using qualitative method. The findings of the interviews were analyzed using content analysis and NVivo (NUD*IST Vivo Version 11.0) was used.

4.1. FIRE RISK

Most of the respondents emphasized that, apartment buildings having high risk in the event of fire due to large amount of combustible materials available at residential buildings, poor condition or unsafe kitchen equipment, candles, electrical shortages, papers, and electrical equipment, children playing with matches box, lighters, and candles, lamps used for religious purposes and usage of fireworks in festival seasons. Further there were three major fire incidents identified (Table 1).

Table 1: Previous Fire Incidents

Source of Fire	Damage	
	Property	Human
Electrical shortage in an oven	Entire household was destroyed	No reported damage
Left over a switch-on iron on the table	Entire household was destroyed	No reported damage
Illegal cooking as a business using firewood	Entire household was destroyed	No reported damage

Moreover, respondents elaborated that non-availability of fire safety systems, non-compliance of regulation and illegal construction also increase risk of fire in apartment buildings. Further, low income people generally use low quality electrical equipment, aging of electrical wiring and poor maintenance of electrical system has a huge potential for a fire. One mentioned, '*extensive use of portable multi sockets has high potential for fire by overloading*'.

4.2. FIRE SAFETY MEASURES

Fire safety in apartment buildings constructed for low income people is at poor condition. *“There are many apartment buildings without having fire safety certificate”* revealed a respondent. It was identified that fire safety systems such as extinguishers, detectors, and sprinklers were not installed in the apartments that are constructed long years ago. Further, these fire safety systems are not installed in apartments which have been constructed recently also due to large installation cost which is in turn increased the cost of a unit. Management corporations are also not in position to invest for fire safety systems.

Moreover, passive fire safety features are not built to enhance the fire safety. Only 16 apartments have ventilated lobbies as the only fire safety feature. As a result, some of the newly constructed apartments have no fire certificates. Under these circumstances, fire safety management in apartment buildings for low income people is at a poor level. Following section discusses critical issues in fire safety management in those apartments.

4.3. FIRE ACCESSIBILITY

It was identified that some of the roads have been blocked by unauthorized construction and thus, the fire brigade has no access to the building in case of a fire. Placing material on the passage may cause other accidents than fire to the residents and visitors who are in the residency when fire breakout. Further, vertical accessibility through balconies also blocked by fixing of grills. It was observed that few of the buildings have fire staircase. Unfortunately, most of them can not utilized in case of an emergency as they were blocked by unauthorized construction and MCs are not in a position to take any action again those illegal activities.

One of the members in a MC mentioned *“if a fire occurs, the only solution we have is to evacuate the people to main road through main entrance of this apartment building because we do not have an assembling point within the premises.”* Further, another member mentioned that *“we can get the fire truck up to the main entrance of the apartment.”*

4.4. FIRE SAFETY MANAGEMENT AND EMERGENCY MANAGEMENT PROCEDURES

Results showed that there was no any standard procedures and policies regarding the fire safety management in those apartment buildings. Getting assistance from Condominium Management Authority (CMA) as the liaison party was not sought in developing such procedures.

Further, none of the building have fire evacuation procedures. Moreover, MCs have no skills or knowledge to develop such procedures. Further, members of the management corporation mentioned that *“maintaining an emergency response team is also complicated as it is difficult to find persons who can take the responsibility”*. Further, they added *“We cannot appoint an outsourcing management company including for fire safety management, as residents can’t bear the cost”*.

All the respondents mentioned that they were not trained or having any experience in managing fire. Thus, *“we do not know how to control residents getting panic during the event of a fire. Evacuating children and old people will be very difficult”*. All MCs are accepted to have fire drills to train residents for a fire emergency. However, incurred cost is the main issue.

4.5. AWARENESS OF FIRE SAFETY MANAGEMENT

The success of fire safety management heavily depends on the awareness of fire safety among the residents and their support. Most of the respondents emphasized that, the level of awareness of fire safety among the apartment residents is very low. Some residents even do not have the contact numbers of fire brigade. Most of residents in those apartments are not educated and engaged in *“street business”*. Therefore, they do not have knowledge about the fire safety and no skills in operating fire safety systems (even they are installed) in an emergency. Thus, there is a huge need for training and awareness programmes.

5. MECHANISMS TO IMPROVE FIRE SAFETY

Views from experts in the field of management of apartment buildings, developers, and fire safety management were obtained to establish strategic measures in terms of system improvement, improvements in regulations, emergency preparedness and new technologies. The findings are shown in Table 2.

Table 2: Mechanisms to Improve Fire Safety

System Improvements
<ul style="list-style-type: none"> • Installation of fire safety systems and further their maintenance is required to be checked by the relevant authorities • Developers have to concern about fire safety and the building should be designed in appropriate manner by considering the fire safety standard • Construction of separate worshipping area for residents can be considered.
Improvements in Regulations
<ul style="list-style-type: none"> • National fire regulation should be implemented with the section of action taken against the non-followers of fire regulations including developers • Proper housekeeping and waste management policies are need to be developed • Amend the Apartment Ownership Law (Amendment) No.39 of 2003 with a special provision for fire safety
Emergency Preparedness
<ul style="list-style-type: none"> • Safety first procedure should be followed by everyone • Emergency preparedness plans and procedures should be developed. Fire department can assist MCs • As an immediate retrofit, conducting awareness programs for residents is identified. As a long solution, safety awareness can be addressed even at the school level giving knowledge on fire safety • Properly scheduled fire drills can get a good participation of the residents and it will make sure that each resident is well trained to act accordingly during a real fire breakout • Support from the Non-Governmental Organizations (NGO) can be obtained to conduct fire training programs
New technologies
<ul style="list-style-type: none"> • Introduce the fire trolley for residencies, since it is a package consist an axe, knife and fire extinguishers including large CO², dry powder, water and foam. • Apply new technologies for upcoming apartments, specially refuge floor, sky-bridge and firefighting shaft

6. CONCLUSIONS

There is the increasing trend towards the development of apartment buildings for low income people in Sri Lanka due to the scarcity of land. It is important to consider the safety needs of residents and to provide safe residential environment to all the occupants. Most importantly, fire risk has to be eliminated.

However, it was identified that apartment buildings are having high fire risks due to availability of combustible materials within confined spaces, poor condition of kitchen equipment, candles, electrical shortages, papers, and electrical equipment, children playing with matches box, lighters, and candles used for religious purposes and usage of fireworks in festival seasons. Further, heavy use of extension codes, ageing of electrical wiring and overall due to heavy use are critical fire risk causing factors.

Lack of fire safety systems, lack of awareness, lack of accessibility for fire trucks, lack of emergency management procedures, lack of knowledge and resources are inherent factors for poor fire safety management. As strategic measures to eliminate those issues, apply new technologies for upcoming apartments, introduce fire trolley for residencies, properly scheduled fire drills, Support from the Non-Governmental Organizations, amend the Apartment ownership law and fire regulation were identified. However, implementation mechanism of those strategies is needed to be sought through further studies.

7. REFERENCES

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