Assessment of Fire Escape Routes in Commercial High-Rise Buildings in the Nairobi CBD, Kenya

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Abstract- Due to the inherent fire risk in occupancies, it necessary that they are provided with suitable and sufficient escape route in case of fire emergency. This will ensure that occupants can get to a place of relative safety within the shortest period of time without travelling excessive distances or encountering hindrances. This paper is resultant of a study conducted on fourteen commercial highrise buildings in Nairobi CBD. It assesses essential fire escape route elements in the light of the requirements of the national regulations, laws and standards. Inspections, questionnaire survey, document review and interviews were used in the research. One hundred and nine (109) occupants responded to the questions poised to capture their perception, attitude and opinion on the escape route/s at their workstations. In the assessment 85.71% of the surveyed escape routes exhibited insufficient or unsuitable fire elements while only 7.14% of the buildings had sufficient and/or suitable and 7.14% had no escape stairs at all. Further, the results of the study show that, although fire escape routes are required as an integral part of the fire safety strategy, there still exist deficiencies in their provision. Unclear or no exit signage, obstruction and locking; poor escape route planning, lack of alternative escape route and the condition of fire doors are some of the challenges found with escape routes in the buildings. In view of the results, escape routes should be adequate, easily accessible, properly marked, well lit and have in place requisite facilities to enable easy movement and safety of the people. The escape route should also be routinely inspected to ensure no inhibitions are found to prevent people from using the route effectively. Lastly, the responsible authorities and persons should make sure that inspections are done and records made on remedial actions undertaken to correct present hazardous situation/s.

Index Terms- Fire escape route, means of escape, relative safety, highrise buildings

I. Introduction

Provision of escape route in any occupancy emanates from the need to ensure that all persons in buildings can easily and quickly get to a place of relative safety in the event of fire or other dangers without obstructions. A fire escape route in highrise buildings, unlike low-rise buildings, is more critical in the event of fire due to the height factor and the number of occupants at any one particular time. Insufficient or absence of an elaborate fire escape route is likely to cause a calamitous situation in the event of fire in such occupancies. At a minimum a fire escape route should be easily accessible and identifiable by the occupants and adequate enough to accommodate all the persons in the shortest time possible. It should also be well lit, properly ventilated, and free of any hindrances or blockages and protected from spread of fire and smoke by use of fire doors. Further, escape routes should be fitted with such facilities as balustrades, rails and means for communication to the outside.

The principal legislation that relate to fire safety in Kenya, namely, Factories and Other Places of Work (Fire Risk Reduction) rules require that all workplaces are provided with adequate means of escape while the Life Safety Code 101 (2000) developed by National Fire Protection Association (NFPA), provides that in circumstances where a disabled person is unable to escape unaided and might need to find a place of relative safety a refuge should be provided. According to a survey carried out by Nairobi Central Business District Association (NCBDA) in 2009**,** more than half (50%) of highrise buildings in the City have no adequate fire escape routes. The report cited obstruction of the staircases along the escape, lack of emergency lighting and compromised fire doors i.e. hinged, blocked or completely removed, as key setbacks in provision of escape routes. In view of the preceding, this study aims at examining the provision, in terms of sufficiency and suitability of safety elements, of fire escape routes in fourteen commercial highrise buildings in the Nairobi Central Business District (CBD). The findings of the research will assist the occupiers, designers and the authorities realize the shortfalls in provision of fire escape route in commercial highrise buildings, thus improve on the safety of the occupants.

II. Review of Literature

Conceptually, a good management of fire safety is essential to ensure that fires are unlikely to occur; that if they do occur they are likely to be controlled or contained quickly, effectively and safely; or that, if a fire does occur and grow, everyone in the premises is able to escape to a place of total safety easily and quickly (Furness and Muckett, 2007). The principal objective of provision of an escape route in occupancies is to ensure that people can get to a place of relative safety within the shortest period of time without travelling excessive distances or being delayed by 'bottlenecks'(FPA, 2007). . The route should at all points, be wide enough to allow the persons using such route to move rapidly along it and it must not, at any time, be obstructed in any way. The regulations also provide for the specifications for appropriate lighting and ventilation of such escape routes and stairways. 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 (Yatim, 2009).

Yatim, 2009 (pg 168) notes that ' 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 and that 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'.

Yatim, 2009, also identifies other critical elements of fire escape routes such as means of escape routes for disabled such as provision of means of warning, consideration of escape time and vertical escape. As regards the means of escape he recommends that buildings should have additional measures for aiding the evacuation of disabled people. These include such measures as visual alarms and personal vibrating pagers linked to the alarm system. He also recommends that disabled persons be escorted or even carried to a safe place since they may need to rest for a while as they make their escape. In order to minimize the amount of time taken to escape, he notes, the following matters should be considered: clear signage indicating escape routes which are maintained and that escape routes should be kept clear of obstacles. Likewise, Life Safety Code 101 (2000) developed by National Fire Protection Association (NFPA), provides that in circumstances where a disabled person is unable to escape unaided and might need to find a place of relative safety a refuge should be provided. A refuge in a protected stairway is an internal stairway intended for use as escape route, it may also be used for everyday use. The protection use enclosing elements of fire resistant walling and doors (NFPA, 2007).

In Kenya, the legislative, policy and standards requirements for fire protection systems in buildings emphasize the need for maintenance, monitoring through inspections and reporting for effective protection of lives, property and /or environment. Despite lack of sufficient and solid legislation and policy framework for fire protection in Kenya, there still exist scattered statutes relevant to general fire safety in occupancies. A law specially formulated for the purposes of fire protection in highrise buildings is not there. The Occupational Safety and Health Act (2007) is the main legislation governing general safety and health in workplaces. The key provisions in the Act related to fire protection include section 77-Access and safe place of employment, Section 78-Fire prevention, Section 81-Safety provisions in case of fire and Section 82-Evacuation procedures. Other legislative instruments include the Factories and Other Places of Work (Fire Risk Reduction) rules Legal Notice 59, 2007 and the National Buildings Maintenance Policy which provides for effective maintenance that ensures adequate health, safety and environmental standards, return on investment, convenience and comfort for the building users.

III. Materials and Methods

3.1 Case studies

The project boundary is defined by the core Nairobi City (62 Km Sq) found in the larger Nairobi Metropolitan. Most of the high-rise buildings in the Nairobi Metropolitan are found within the Nairobi Metropolis, especially the CBD. High-rise are building structures with over 7 storeys or 23 meters high measured from the sidewalk to the highest occupiable level, NFPA (2000). A request letter accompanied by an introduction letter from the Institute of Energy and Environmental Technology was used to get the permission to conduct the research in their buildings. The buildings involved in the survey exhibited mixed-use character with varied types of businesses such as schools, health centers, retail shops, especially clothing and office blocks, salons, cash transfer outlets, cyber cafes and restaurants among others. Others have some floors partitioned to create space for establishment of stalls commonly referred to as exhibitions. Registry records from the the department of city planning and architecture showed that the CBD has over 150 commercial highrise buildings (the CBD encompasses areas within Wetland's, Upper Hill, Community, Parklands and the section bordered by Uhuru highway, Haile Selassie, Kirinyaga road, Globe Cinema, Kijabe Road back to Uhuru highway). By use of random tables, the researcher selected 25No. buildings, however, in only 14No (9.3 %) of the buildings the request to conduct research in these premises was accepted. The situations of the buildings are as contained in the table below:

Table 1: The buildings involved in the study

No	Name of the building	Date of Construction	No of floors	Location within the CBD
	Re-insurance plaza	1982	20	Harambee Avenue
	Anniversary Towers	1992	26	The University Way
	KICC	1973	31	Between Harambee Avenue City Hall Way
	Electr. House	1974	18	Harambee Avenue
	Eco bank	1983	19	Muindi Mbingu
	Tembo House	1985	7	Moi Avenue
	Rahim. Tower	1999	18	Upper Hill
	Afya center	1987	17	Tom Mboya Street
	Lonrho House	1990	20	Standard Street
	Stanbank House	1970	10	Moi Avenue
	Bandari Plaza	1985	14	Westlands
	Fedha	2008	10	Westlands
	ICEA	1981	19	Kenyatta Avenue
	I&M	2001	18	Loita Street

3.2 Methods

a) Sampling

The methodological approach was a synergy of quantitative and qualitative methods subjected to fourteen commercial high-rise buildings. Data was collected through a) a pre-designed

checklist where the researcher accessed the escape routes and noted the shortfalls; b) document reviews and c) interviews of building managers and the occupants. The requisite sample was generated by use of random tables where all the 154 commercial high-rise buildings in the CBD were listed and involved in the sampling process. Individuals to participate in the interviews were selected through convenience and snow-ball sampling techniques. A pre-set questionnaire was administered to 109 respondents (occupants) to capture their perception, opinions, knowledge and attitude of on such elements as distance to the escape route, marking and lighting, maintenance, stairway protection and adequacy of the escape route. The responses were measured by use of Likert scale with varying responses range, that is, Agree/Yes, Partly Agree, Disagree/No, Totally Agree and Not applicable/I don't know.

IV. Analysis and Results

The analysis of the adequacy of the escape route was done based on NFPA (2007) adequacy criterion, i.e., sufficiency and suitability. As indicated above, several sources of data or research methods were employed in the survey. These are observations, interviews and the questionnaire survey. The sections provide the analysis and results in each tool.

a) Inspection of the escape route

A predesigned checklist (adopted from NFPA, 2007) was used in inspecting the situation/s of the various requisite elements for an escape route such as size, slope, lighting, signage, and distance. The adequacy of the route was checked against its sufficiency and/or suitability in the light of the national legislation (the building regulations) and standards. Through observations it was found that only 7.14% of the buildings had sufficient and/or suitable escape routes, 85.71% exhibited insufficiency or unsuitability while 7.14% had no escape routes at all. The results are illustrated in the figure 1 below.

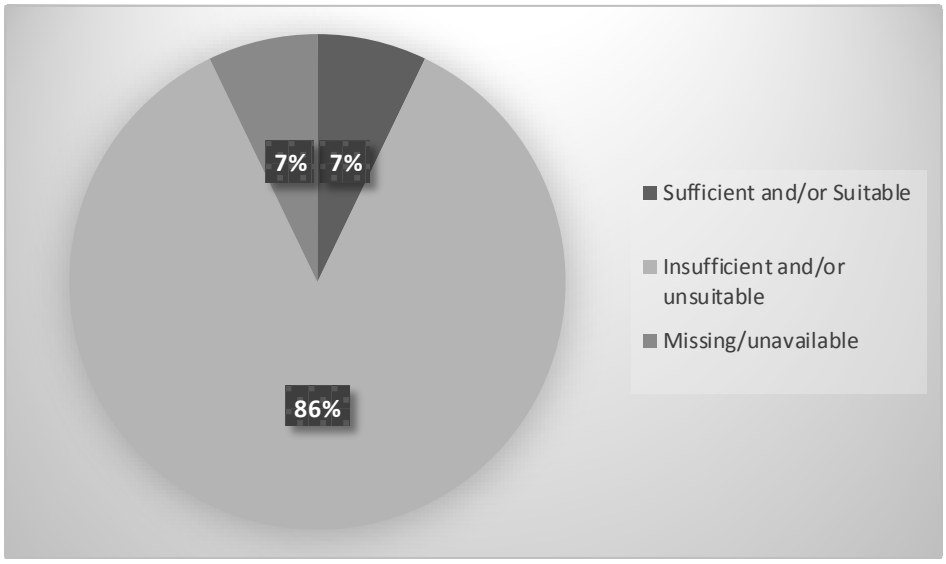

Figure 1: Observations on provision of means of escape in buildings

The survey found that only 7.14% of the buildings had sufficient or suitable means of escape to safety, 85.71% had exhibited insufficiency while 7.14% had no escape stairs. . The deficiencies noted are wide ranging and cumulatively define the fire safety performance of a building. The key shortfalls in escape route include unclear or no exit signage, obstruction and locking; to poor escape route planning, hence prone to entry of smoke; the number of people occupying the building at one particular time exceeding the design factor; lack of facilities for disabled people, lack of alternative escape route; and the condition of fire doors, that is broken, padlocked and not self-locking.

b) Questionnaire analysis

The occupants were interrogated on several aspects of a suitable fire escape route such as distance, marking and lighting, stairway protection etc. as discussed in the sections below.

i) **Distance to the place of relative safety**

Normally, distance from the position of the occupants to the nearest escape route and thereafter should be short enough to allow respondents to reach a place of relative safety in the shortest time possible. In the survey, the responses were as illustrated in the figure below.

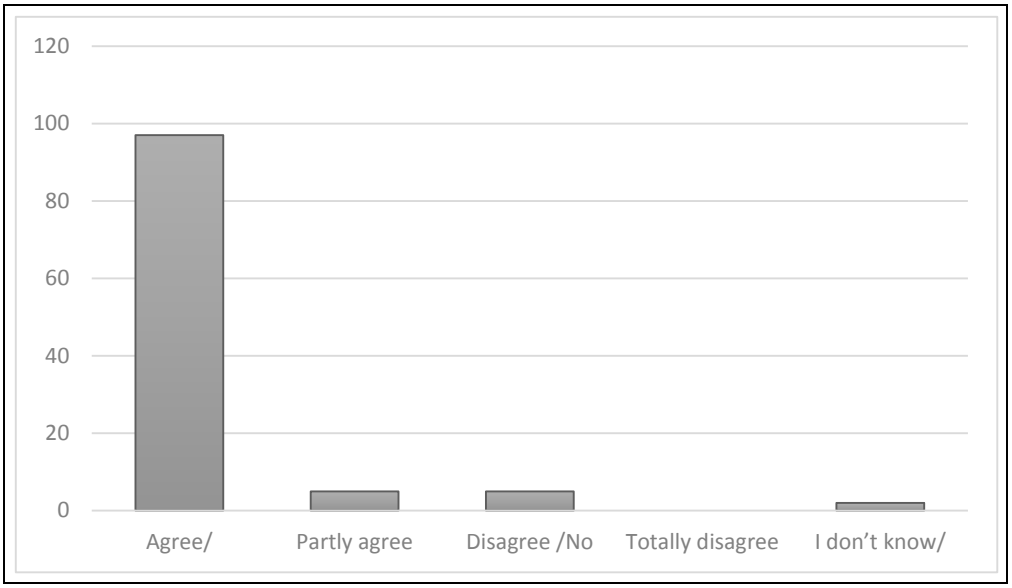

Figure 2: The level of agreement of the distance to the escape route

The results above indicate that majority (89%) of the respondent were contented with the distance of travel to place of relative safety. The means, in most of the buildings, the occupants would be able to identify and reach the escape route in time to safety.

ii) **Marking and lighting of the escape route**

Marking of the escape route is important to offer an opportunity to the occupants to identify the route easily. The building codes requires that any building having emergency routes be clearly marked and signposted to indicate the direction to be travelled in the case of any emergency. The Occupational Safety and Health Act, 2007, Part VIII, Section 8, subsection (7), requires that every, window, door or other exit affording means of escape in case of fire or giving access thereto, other than the means of exit in ordinary use, be distinctively and conspicuously marked by a notice printed in red letters of an adequate size . The escape route should also be provided with emergency lighting in times of darkness lasting for duration adequate to facilitate evacuation of all the persons. It also requires that the escape routes are well illuminated to allow person using the route be able to see clearly. Tactile floors and braille inscriptions are also necessary to persons with visual problems. In the survey the buildings were found to perform differently in terms of provision of such elements. The results are as presented in the figure 2 below.

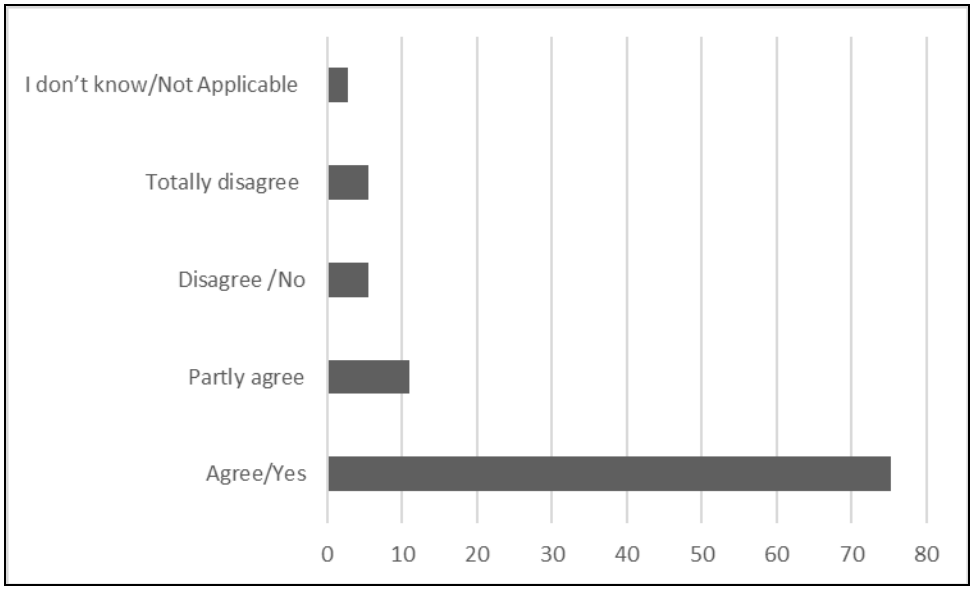

Figure 3: The Marking and lighting of the escape route

As shown above, the 75% of the respondents agreed that the escape routes are well marked and lit while 11% of the respondents partly agreed.

iii) Maintenance of escape route

The escape route should be well maintained, free of any obstructions, well light and provided with essential furniture to aid in movement and visibility of the route. This will make the escape usable during emergencies. Maintenance will also allow remove of unwanted materials or obstructions along the route. The responses are illustrated in the figure below.

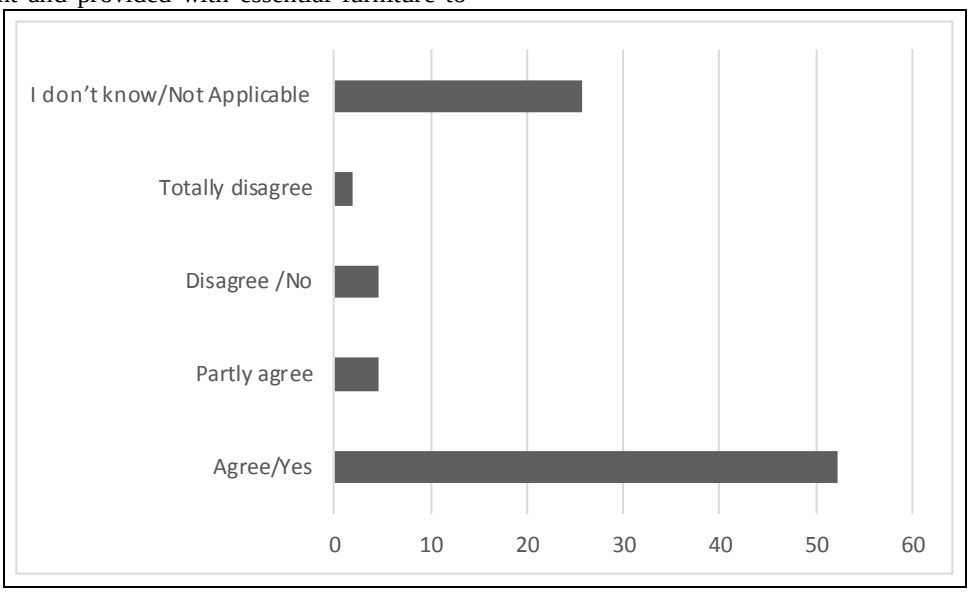

Figure 4: Level of agreement with maintenance of the escape route

The responses show that 52% of the respondents were satisfied with maintenance of fire escape route in their premises, 30.28% had reservations while the rest variously not satisfied (constituting 17% of the respondents).

iv) Stairway protection

The building regulations, regulation SS25.6, provides that where any stairway forms part of an emergency route such stairway shall, throughout its length, be provided with a handrail on each side. Regulation SS26 requires that a stairway is provided with ventilation to the outside of the building at each storey level or ventilated by means of a roof ventilator and such ventilator be permanently open. The stairways are also supposed to be protected from intrusion and spread of smoke and heat through provision of fire-rated. Smoke and smoke products, if not stopped from entering the escape route may lead to deaths through asphyxiation.

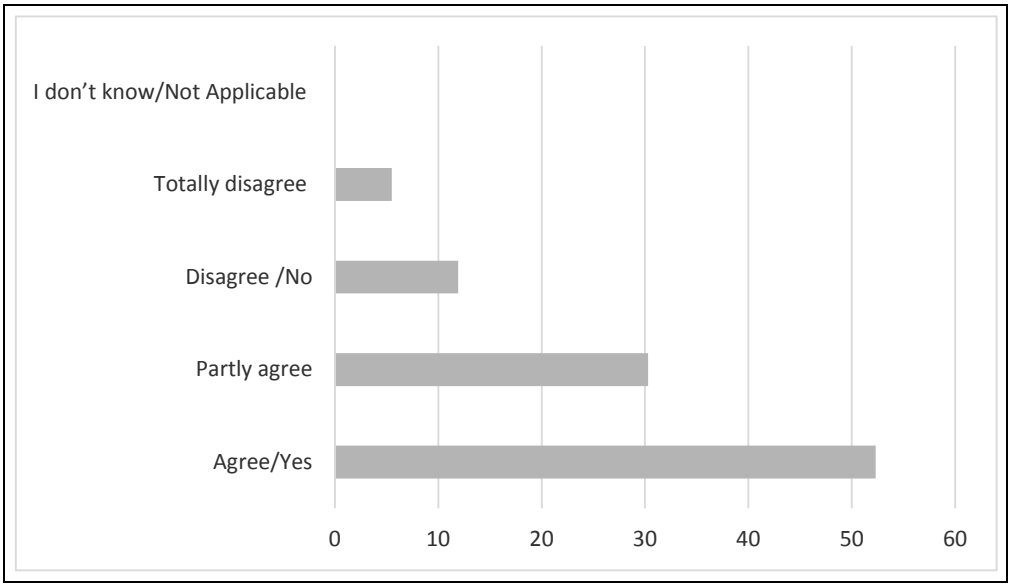

Figure 5: Level of agreement by occupants on fire escape protection

As indicated in the analysis above, 52.30% of the respondents were comfortable that the escape route is well protected, 4.59% were partially contented while the 17.42% were not. The proportion of the respondents who had no idea (25.69%) could be associated with persons who have never used the escape routes/ staircases or are likely to have not participated in fire drills. The results are indicative that protection of escape stairway protection needs to be improved.

v) Need for an additional escape route

The investigations showed that over 70% of the respondents expressed a need for an extra escape route. This could be associated by the high number of occupants in the premises. Also, the respondents could have experienced the confusion, congestion and struggle that emerge after an alarm is set off during trials or after a false alarm.

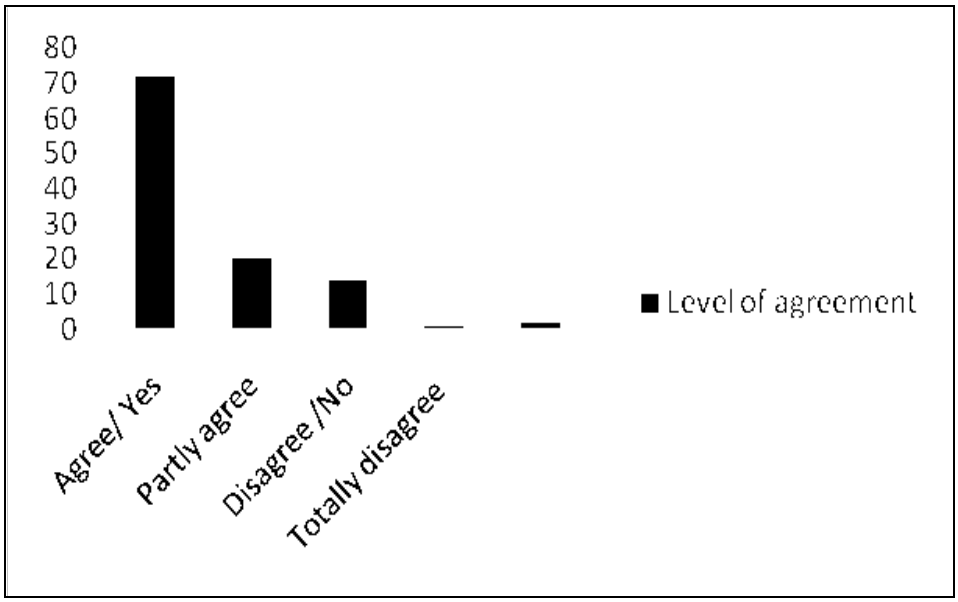

Figure 6: Level of agreement on the provision of additional fire escape route

The results show that there is a need for more than one fire escape routes in commercial high-rise buildings especially where the user surpass the number of occupants**.**

V. Conclusions and Recommendations

As indicated in the methodology, physical observations, literature review, interviews and questionnaires were the key tools for data collection. Data analyzed from literature review, observations and interviews made during the survey it was clear that; a) unclear or no exit signage, obstruction, locking, etc.; b) poor escape route planning and lighting ; c) the number of people occupying the building at one particular time exceeding the design factor; d) lack of facilities for disabled people to evacuate from the building; e) lack of alternative escape route provided in the building; f) the condition of fire doors, that is, broken, locked, not self-locking etc. and; g) lack of smoke control/removal mechanism as key challenges in provision of escape routes. The occupants variously expressed their opinions and perceptions in regard to the provision of the escape routes. The analysis has showed that majority of the occupants (respondents) agreed that the distance to the place of relative safety is adequate (89%), 52% agreed that maintenance and stairway protection are adequate while 80% felt a need for an extra escape route at their respective premises.

To this end, it's recommended that, to enhance use and safety of escape routes in commercial high-rise buildings, there is a need to correct the shortfalls such as unclear exit signs, obstructions in the access and stairway and provide for adequate escape route that can accommodate all the occupants at the shortest time possible and provide facilities for the persons with disabilities. New buildings should install fire fighting/evacuation lifts to defeat the challenges due the height of the building.

References

[1] Abdulla, Jelani, (2001), "Fire in tall building: Occupants safety and owners' liability" Kuala Lumpar, International Law Book Services

[2] C.R Kothari (2014), "Research Methodology: Methods and Techniques', 3rd Ed, New Age International Publishers

[3] FPA, (2007), Fire Prevention, Fire Engineers Journal: The international journal for fire professionals, FPA

[4] Furness and Muckett (2010), "Introduction to Fire Safety Management", Elsevier Ltd, Burlington, UK

[5] Government of Kenya (2007), "Factories and Other Places Work (Fire Risk Reduction) Rules, L.N 59, 2007", Government Press, Nairobi

[6] Government of Kenya, (2010), "National Planning and Building Regulations, 2010", Government Press, Nairobi

[7] FPA, (2003), "Design guide for the Fire Protection of Buildings: Essential Principles", Fire Protection Association, London

[8] Mugenda and Mugenda, (2003), "Research Methods (Quantitative and Qualitative Approaches)" 2nd Ed. ACTS, Nairobi

[9] R. Kumar (2005). Research Methodology 2nd Ed. (A step-by step- guide for beginners), Sage Publications, and London

[10] Ranjit Kumar, (2005), "Research Methodology – A step-by step guide for beginners", Sage Publications, London.

[11] Yatim, Y.M. and Harris, D.J., (2007a), 'An Evaluation of Provision of Escape Routes in High-Rise Residential Buildings – Malaysian Experience', Journal Alam Bina, Universiti Teknologi Malaysia, Jld, 09 No.04, pp.67 - 81.

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