

Fire Safety Protection and Prevention Measures in Nigeria Office Buildings



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Abstract office buildings are generally known to have high-rise of fire due to its complexity, combustible materials, and its economic value. The primary aim of this study is to investigate the fire safety protection and prevention system installed in six randomly selected office buildings. The method adopted in achieving the study objective includes literature review, interview, and physical inspection/observation. Thus, a multiattribute evaluation approach was adopted to establish adequate, inadequate, and no fire safety systems, used the pre-designed checklist from NFPA, 2008, NBC, 2006, and NFSC, 2013. The analysis of the result shows that some of the fire safety systems are mainly provided in the buildings. Thus, inadequate maintenance affect their performance greatly; the result shows that fire extinguisher has the highest performance among the fire safety system provided with 66.6% of the buildings have adequate, good working condition, properly position, etc., while 33.4% of the building does not have adequate fire extinguisher in term of performance, are not maintenance the system display lack in term of total compliance to the standard fire regulation. The results of the other systems were as follows: place of safety (33.4%); inadequate, (66.4%) no fire safety system, (0.00%) adequate, Escape Stair (0.00%), adequate, (33.4%) inadequate, (66.6%), no fire safety system, Fire Door (17%) adequate, (83%) inadequate (0.00%) no fire safety system, Travel distance (0.00%) adequate, (83%) inadequate, (17%) no fire system, Emergency lighting (0.00%) adequate, (100%) inadequate, (0.00%) no fire safety system, Fire Alarm (16.6%) adequate (66.6%) inadequate, (16.6%) no fire safety system. The firefighters access (0.00%) adequate, (100%) inadequate, (0.00%) no fire safety system, Artificial lighting (17%) adequate, (83%) inadequate and (0.00%) no fire safety system. Judging from the findings, the study recommended that, regular maintenance of fire safety system should be done to enhance effective functionality of the systems, effective fire safety management system should be developed to enhance continuous functions of the installed system and construction of any office building should be made to comply strictly with existing fire safety regulation, standard, and code.

KEYWORD: Office Buildings, Fire Safety Protection, Fire Safety Prevention, Observation/Inspection

I. INTRODUCTION

Fire safety issue in buildings has of recent a matter of urgent attention because of frequent fire outbreak in several

buildings across the globe. Fire can cause severe damages to buildings, destroy the contents, kill the occupants if possible.

Therefore, such a significant threat to humanity requires the urgent attention of all concern stakeholders in order to reduce the rate at which it occurred to the barest minimum. (Thomas, 2014)

Although fire is known to have numerous advantages to a man in several ways, the numerous benefit of fire is often overshadowed by the enormous destruction ability of fire. Thus, just as it was generally believed in our today society, that fire risk cannot be eradicated despite the modern system of fire protection approach. Fire is a potential life threat in any buildings, and it is capable of creating the worse scenario if adequate fire systems control is not in place to prevent fire occurrences. (Adam Cowlard, 2013)

Fire safety measures in the building are one aspect of fire safety management with the purpose of fire disaster prevention and protection in order to reduce the fire risk to an acceptable level. It has to do with the installation of passive and active measures to ensure that the risk to life, destruction of property and its effect on the environment are minimized (FEMA, 2007)

However, several authors disapproving office-building occupants in diverse backgrounds have suggested various points of view. According to Rahad(2015), revealed that, occupants of office buildings are usually exposed to psychological problems, such as fear of isolation in personalized space, causing loneliness that could lead to depression, stress, anxiety, and lowering interest in community affairs concerning fire risk inclusive. In a fire, disaster involving an office building (Ebenechi, 2017), the researchers highlighted that the fire risk to occupant's life is quite huge with respects to an office building, which are mostly low-rise buildings. This could be attributed to multiple floors in most of the buildings that generally created an increasing effect, requiring a more significant number of people traveling via vertical distances on the stair. (Roh, 2009) further revealed that effect of fire is very high in low or high-rise buildings, in which different pressure between the floors are created, that could result in natural air movement within the buildings capable of moving a massive volume of heat and smoking during a fire outbreak.

In a similar study, author Yayun (2016) revealed that fire effects in low-high rise buildings are associated with fire protection systems installed in the building that lead to extensive fire and smoke spread or reduction in ease people exist. Equally (low office building or high rise buildings, as means of escape deadly under a large number of persons occupied by the buildings

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Office buildings in Nigeria are faced with numerous challenges and experiencing fire disaster that endangered the lives of its occupants, destruction of property and equipment within the building and often time affect other neighboring buildings (Joo, 2011). The dreaded risk of an office building around the world is fire. According to Tan (2004), fire disaster in buildings results in occupant's deaths, property destructions, and disruption of daily business activities. Studied had revealed that many fire incidence occurs in an office building (Rahadi, 2015). The effect of the incidents on Nigeria's economic from both financial and public image viewpoints could be considerable (Roslan, 2017). These incidents happen particularly among the occupants and visitors to buildings, while they visit or carrying out their daily activities. Several fire incidents primarily of small scale occur in office buildings without being reported. Because of the happening, this paper aims to audit fire safety measures in Nigeria office building and methods in the realm of fire protection challenges essential to office buildings. The findings of the study will enormously contribute to developing a sound fire safety management for an office building in Nigeria. low office building or high rise buildings, as means of escape deadly under a large number of persons occupied by the buildings

II. LITERATURE REVIEW

The conceptually, maximum fire safety can only be achieved via a combination of the three most essential components, such as active fire measure, passive measure, and fire safety management. An active and passive fire measures in a building are concerned with regulating the fire from occurring and extinguishing the fire, respectively (The institute of engineers, 2004). Fire safety involves protection system has to do with fire prevention system and suppression at both design/ construction and post-construction stage, consequently, each of the three fire safety components displays three critical functions, i.e., active control, management control, and passive control in achieving effective management of fire in buildings

Fire safety code, 2013, National buildings code 2006 and NFPA, 2008 guide to fire safety regulation, provides that effort should be made to avoid fire risk in buildings. The fire risk that could, not be avoided, should be investigated and evaluated, and once identified, it should be fought at the point of ignition. Adequate fire safety management programs should be adopted with comprehensive fire safety management components, such as compliance with safety regulation, fire safety training, emergency plan, and procedure and robust fire safety policy, etc.

Generally, passive fire safety measure includes the provision of fixed fire protection systems during buildings constructions, while active fire safety measure is the mechanical components installed in buildings to efficient means of controlling fire and provide warning in building a fire (NFPA, 2018 edition). However, in most cases, active fire protection systems installed in buildings seized to functions because of several factors, such as spoiled, vandalism, negligence, interfere, or change of occupants (Woon, 2016). However, all installed active fire protection in buildings require to be tested, maintenance, replaced the damaged one, upgrade and adequately train the building occupants on how to operate the system. Besides, the arrangement should also be made to regularly inspect all the

installed fire safety systems through an effective fire safety management program (wang, 2015).

The selected committee drafted the Nigeria national building code 2006 comprises of professionals in the field of fire safety, practicing in Nigeria, besides, to other stakeholders at various stages of the draft (NNBC, 2006). Thus, the drafted copied did not address the pertinent aspect of fire safety, such as effective fire safety management implementation, the primary focused of the draft was the provision of active and active measures, this, however, cannot give an acceptable level of fire safety. Despite the insufficient, weak fire, regulation and strike policy framework for fire safety management in Nigeria, there still exist scattered statues relevant to generate fire safety in users of buildings

A regulation set up for fire protection in low-high rise buildings is not existent. The adopted occupation health and safety act (2007) from the UK and recently enacted fire safety code 2013, where the primary legislation governing general safety and health at workplaces. The original provision in this act associated with fire protections includes section 77-access and safe place of employment, section 78-fire prevention, section 81- safety prevention in case of fire, and section 82-evacuation procedures. The factories and others place of work, fire risk regulation notice, 2007 and national building code which provide for adequate safety management of building at the post-construction stage, ensure that adequate life safety, property, and economic activities in building are not under threat and enhances convenient and comfortability for the building occupants. The regulations for fire protection systems provided in the section.

Passive fire safety in buildings: the legal provision for place of safety, escape stairs, fire doors, protected lobbies, travel distance, story exist, fire barrier, fireman access and exist signage are contained in the National Fire Protection Agency 2008, Nigeria Fire Safety Code 2013, and drafted Nigeria National Building Code 2006. The fire safety regulations require that public buildings should provide emergency vehicle access and a place of safety to enable occupant's assembly for safety and create access for firefighting equipment to the building at any time without any hindrances (White, 2002)

The escape stairs are an emergency route provided to ease the buildings users' early evacuation in building a fire, similarly (Nachtigall, 2017). An emergency escape stair should have sufficient width that is capable of enhancing safe evacuation of the building users, and it shall be free from any hindrances includes luck up, obstructions.

That could hinder the users of the building from quick evacuation in building a fire, particularly during a fire emergency. Hence, loss of lives, injuries, property loss may occur. In fire emergency evacuation of buildings, users in office buildings tend to go through the escape stair, which they are more conversant with, and if the escape stair is blocked, stamped, may occur and possibly result in loss of life, injuries and property destructions.

Therefore, a sufficient width of escape stairs should be provided in public buildings to prevent death and injuries during the fire outbreak, NNBC, 2006, NFSC 2013, and NFPA 2008.

Passive fire protection can be categorized into different classes ranging from resistance construction, means of escape, and compartmentation (NFSC, 2013). Thus, the aspects of the passive fire protection system investigation in the study area.

Active fire protection measure: active fire system in buildings is an act of installing mechanical components in buildings to provide means of regulating building fire and provided warning during fire occurrence (NFPA, 2018 Edition). Fire safety prevention against ignition at the point of sources before its spread is significant in fire safety. The provision of passive measures in buildings may not be adequate to provide fire safety required in the building. However, the provision of active firefighting equipment would be able to assist buildings occupants in containing the fire before fire respond squared arrive at the scene (NFSC, 2013). The provision of this active fire system was designed to complement the passive system and vice-versa. Hence, the qualities of fire safety equipment assessed in this studied are as follows fire alarm, firefighting, natural ventilation, artificial lighting, emergency lighting

III. METHODOLOGY

Research design: A questionnaire survey was developed using a mixed-methods approach. A quantitative and qualitative approach was conducted on randomly selected office-low-rise buildings in the Nigeria a mandatory sample was developed by the use of random tables where all the selected office buildings (low-rise) in the Northern Nigeria were listed and involved in the sampling procedure (Mugenda, 2003). Record from the urban development control and planning department across the selected metropolis in the north-central region of Nigeria shows that 95% of an office building in that locations are low-rise buildings ranging from three to four-story buildings (

NBC,2006), therefore, using random tables, the research selected six numbers of buildings. Hence, the requests to conduct research was granted. Individual interview participants were selected via a suitable and snowball sampling technique (C.R, 2014)

The professionals in the field of fire safety include fire safety directors of a state, directors of work and maintenance or their representative, directorate of occupational health and safety, building manager, Architect and Builders in all the buildings selected for the research . The physical observation of the selected building was done using with prepared checklist from National fire protection Agency 2008, National Building Code of Nigeria 2006, NFSC, 2013 and interview was also conducted on the selected professionals in the field of fire safety: include Architect, Builder, Building manager, Engineer, and Fire Safety directors were used in data collection. All the fire safety systems, both active and passive, were inspected against the requirements of the prepared fire regulation checklist to determine its suitability. The NFPA 2008, a regulation was referred to where the local regulation that has a deficiency.

Because of the multiplicity of fire safety systems, in building and existing methods for fire protection, a multi-attribute evaluation model was adopted in determining the collective performance of an individual building. An ordinal scale demonstrating the grade levels, X, Y, and Z were used in classifying the performance of an individual approach in separate buildings where X stand for adequate, Y inadequate and Z represented No fire safety system.

Analysis And Results

The results of the buildings inspected are analyzed and presented in this section; the fire safety system in the analysis are shown in Table 1. As designated in the above section, X stands for adequate, Y inadequate, and Z no fire system

Buildings	Place of safety	Escape stairs	Fire door	Travel distance	Emergency lighting	Fire alarm	Fire extinguishers	Exit signage	Fire access	Artificial lighting	
Kogi State Secretariat Building Lokoja	Z	Y	Y	Y	Y	Y	X	Y	Y	Y	
Nigeria National Library Building	Z	Z	Y	Z	Y	Y	X	Y	Y	Y	
Niger State Water Board buildings	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Edo State University Senate Building Iyamo	Y	Z	X	Y	Y	X	Y	X	Y	X	
Alex Ekweme University Office Building Ebonyi State	Z	Z	Y	Y	Y	Y	X	Y	Y	Y	
Power holding company of Nigeria building	Z	Z	Y	Y	Y	Z	X	Y	Y	Y	
No of Buildings	X	0	0	1	0	0	1	4	1	0	1
	Y	2	2	5	5	6	4	2	5	6	5
	Z	4	4	0	1	0	1	0	0	0	0

Fire Safety System Position Of The Inspected Buildings; Table 2

IRE SAFETY SYSTEMS	ADEQUATE FIRE SAFETY SYSTEM		INADEQUATE FIRE SAFETY SYSTEM		NO FIRE SAFETY SYSTEM	
	No of Buildings	Percentage (%)	No of Buildings	Percentage (%)	No of Buildings	Percentage (%)
Place of safety	0	0.00	2	33.4	4	66.6
Escape Stairs	0	0.00	2	33.4	4	66.6
Fire door	1	17	5	83	0	0.00
Travel distance	0	0.00	5	83	1	17
Emergency lightening	0	0.00	6	100	0	0.00
Fire Alarm	1	16.6	4	66.6	1	16.6
Fire extinguishers	4	66.6	2	33.4	0	0.00
Exit signage	1	17	5	83	0	0.00
Fire men access	0	0.00	6	100	0	0.00
Artificial lightening	1	17	5	83	0	0.00

IV. FINDINGS AND DISCUSSION

Analysis and Results:

The finding from the buildings inspected are analyzed and presented in this section. The fire safety system in the analysis is shown in Table 2. As indicated in the above section, X represented adequate, Y inadequate, and Z No fire safety system.

Place of Safety:

From the results shown on the table 2, however, shows that 0% of building inspected does not make adequate provisions for place of safety, while 33.3% exhibited inadequate place of safety and 66.6% percentages of building inspected do not have a place of safety for the occupants during fire emergency as specified by National Fire Protection Association, 2008, Nigeria National Building Code, 2006 and Nigeria National Fire Safety Code, 2013 respectively. However, the significant issues concerning a place of safety were insufficient space and abused of the designated area for fire safety in the building inspected. Hence, making used car parks and other spaces as a place of safety. As shown in figure (1) below



Figure 1: Place of Safety

Escape Stair:

In the buildings inspected, the result revealed that none of the buildings have adequate escape stair as stipulated by the relevant fire safety regulations, which, 33.3% of the buildings comply with the specification, but not adequate and 66.6% of the buildings inspected do not have escape stair or means of escape. As shown in the figure (2) below



Figure 2: Estate Stair

Emergency Lighting:

The results from the buildings inspected, showing that there was no adequate emergency lighting amongst the buildings investigated, 100% inadequate emergency lighting exhibited in that buildings, was. As a result, improper maintenance or negligence. The power generating system in the place visited is either damaged or not maintained, and some are hardly replaced when damaged after they are commissioning. As shown in figure (3) below

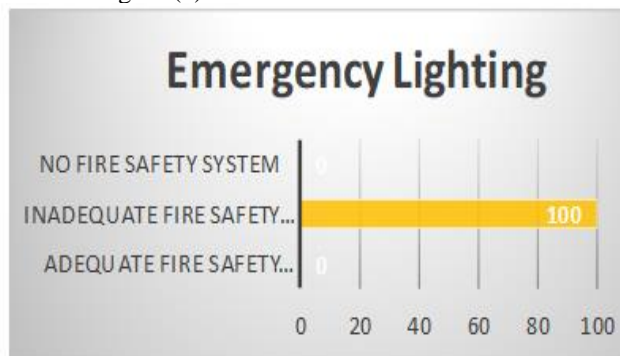


Figure 3: Emergency Lighting

Fire Door:

The fire safety regulations require that buildings are installed with effective fire doors, it should be identified through the exit signs, and the door should be free from obstruction of any object so that occupants can quickly evacuate the buildings during a fire emergency.



Thus, from the inspected buildings, it has shown that 17% of the buildings investigated have adequate fire doors as stipulated by fire safety regulation. 83 % percentage of the buildings have inadequate fire doors. Besides, the inadequacy of fire doors exhibited by the majority of the buildings can results in several challenges during the occupant’s evacuation in the fire emergency. As shown the figure (4) below



Figure 4: Fire Door.

Travel Distance:

The requirements for travel distance in high-rise buildings is provided in fire safety regulation the regulation expected every building to have a specific distance within buildings to enable occupants movement during a fire emergency. The survey shows that 83% had inadequate travel distance, 17% do not have a place designated as travel distance. The main challenges with travel distance among the investigated buildings included absents of travel distance, inadequate where it exists, and abuse of usage where it was provided. As shown in figure (5) below

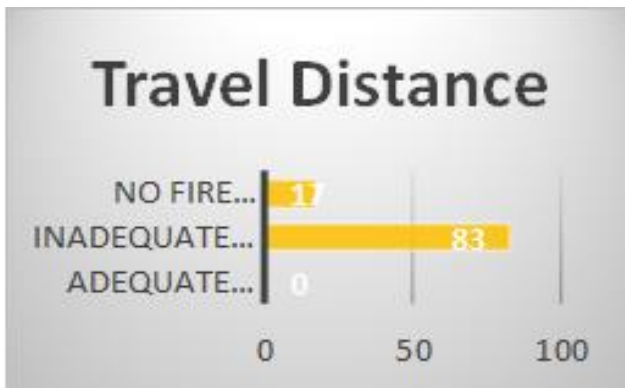


Figure 5: Travel Distance

Fire Alarm:

The primary purpose of the fire alarm system in buildings is to detect smoke or fire in order to keep the building occupants alert to enhance quick evacuation during fire emergencies. However, in the study conducted, it was revealed that 16.6% of the building investigated had adequate fire alarms system installed, 66.6% of the buildings were inadequate, and 16.6% of the buildings do not have fire alarm systems installed in buildings. It is, however, an indication that the majority of the building investigated do not comply with the fire safety regulations. the figure (6) below

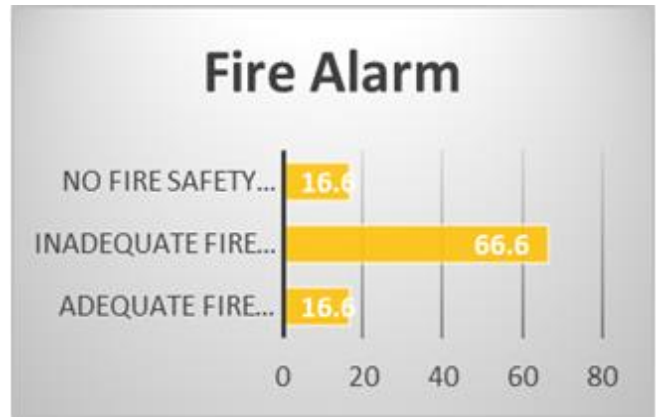


Figure 6: Fire Alarm

Fire Extinguishers:

Fire extinguishers are an active fire safety system installed in buildings for fighting a fire during an emergency. The regulations provide for specifications for appropriate fire extinguishers, and the fire extinguisher should be maintained appropriately, and keep functions. From the buildings inspected, 66.6% of the buildings had adequate fire extinguishers, 33.4% had adequate fire extinguishers installed in buildings. However, the finding indicated that most of the buildings had adequate active fire safety systems installed.

As shown in figure (7) below



Figure 7: Fire Extinguisher

Fire Men Access:

The fire safety regulation requires that buildings should have adequate firefighters access to enable quick intervention of fire to response squared. The survey conducted had inadequate firefighter’s access from the observed buildings; the researcher found out that there are no facilities to access the internal aspect of building especially, firefighting lift, reel hose, and protected lobbies. However, it was initially marked out for firefighters access facilities that were converted to the car park and garage. Hence, it is an indication that the entire buildings investigated in the case study area do not comply with fire safety regulations. As shown in figure (8) below



Figure 8: Fire Men Acces

Artificial Lighting:

The purpose of artificial lighting is to give light to the building's occupants whenever, the natural light goes off, especially in the peak time, from the buildings observed it was found out that 17% of the buildings had adequate artificial lighting system, 83% were inadequate. However, the buildings from the case study exhibited non-compliance with the relevant fire safety regulation. As shown in figure (9) below

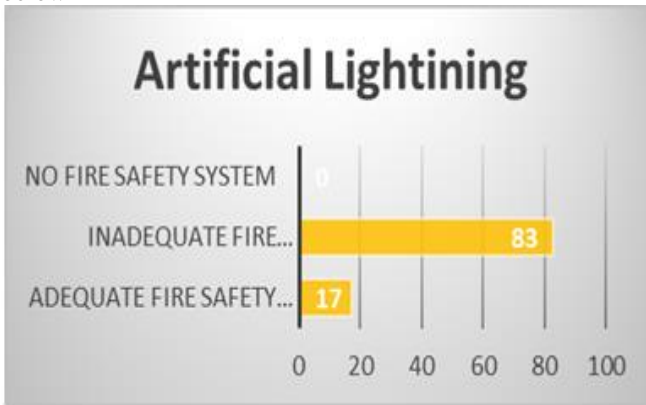


Figure 9: Artificial Lightining

V. CONCLUSION

Office buildings are generally known to be high-risk types of building in terms of fire because of combustible materials, the construction, imported combustible materials by the occupants, the nature of operation in the building, and its ability to accommodate different kinds of people during business activities. The fire safety system in office buildings should be effectively maintained and manage to provide an acceptable level of safety for occupants and protection of the properties

This study investigates the fire safety protection and prevention system installed in some selected office buildings in the Nigeria, asses the existing fire safety system installed in office buildings. The observation was conducted with a pre-designed checklist from the National Fire Protection Association, 2013, National Building Code of Nigeria, 2006, and National Fire Safety Code of Nigeria, 2013. The major setback revealed from the provision of fire safety systems was the lack of implementation of the standard fire regulation as stipulated in the guideline. Besides, study shows that all the buildings inspected do not have critical fire safety systems, such as firefighters access, emergency lighting.

In order to achieve an acceptable fire safety in office buildings in Nigeria, this paper, therefore, recommended that, Adequate places of safety should be made to enhance

compliance with fire safety regulations. There should be adequate provision of firefighting equipment's position at an appropriate location to enhance quick intervention of fire safety respond squard during a fire emergency. Fire safety protection systems should be regularly maintained to enhance effective functionality of installed system, an effective fire safety system management should be developed to enhance continuous functions of installed system, comprehensive fire safety inspection, regular fire risk assessment, investigating and reporting, and mitigating action be undertake, and construction of any office building should be made to adhere strictly to fire safety regulation standard and code

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