

# Assessment of Implementation of Fire Safety Procedures and Regulation in Public Buildings

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## Abstract

The research assessed the level of implementation of fire safety procedures and regulations in public buildings, which employed the use of questionnaire to ask questions from a sample of 100 facility managers, 230 workers and 220 visitors from selected public buildings. Mean and standard deviation were used to analyze the data collected from the subjects. The findings of the study showed that there are available and adequate Fire Safety provisions which have satisfied their level of implementation. The study reviewed relevant literature on fire, causes of fire in public buildings, fire safety regulations, control of fire, fire prevention and protection, assessment of fire safety, implementation of fire safety. The structured questionnaire used contained 34 items, which were divided into (4) four sections (A, B, C and D), Section A was designed to elicit information status, name, address and type of the public building, Section B was designed to elicit information on the availability of fire safety provisions in the public buildings and Section C was designed to elicit information on adequacy of fire safety provisions in public buildings while Section D was designed to elicit information on the level of implementation of the fire safety provision by the building authorities. The instrument was validated by experts of building construction in the Department of Science and Technology Education of Bayero University Kano in Nigeria. Its reliability was established using split half method by the use of Guttman split-half coefficient formula to correlate between forms with a coefficient of 0.706. The Research recommended that a permanent fire safety committee in all the public buildings should be constituted to be responsible for given out fire safety provisions guide to building users on periodic bases, Courses on fire safety should be introduced, and made compulsory for student irrespective of his/her cause of study, Fire safety training should be carried out at least annually. The study suggested that there is need for further studies on the attitude of public building users towards fire safety procedures and regulations, An investigation in to the awareness level of public building users towards implementation of Fire Safety procedures and regulations in public buildings, An assessment on the level of adequacy of fire safety equipments in public buildings and The study on the level of satisfaction of Fire Safety provisions and training in public buildings.

## 1. Introduction

Having the awareness of the practical difficulties that may be faced by some building owners in complying with certain fire safety requirements, without compromising fire safety, the Fire Services Department and the Buildings Department are adopting a flexible and pragmatic approach in the implementation of the safety requirements. For instance, for owners facing financial difficulties, or those who have difficulties in complying with certain fire safety requirements due to practical or structural constraints of the buildings, the Fire Service Department and the Building Department will consider extending the deadline for compliance and prescribing alternative fire safety measures (e.g. accepting a water tank of smaller capacity, where appropriate) in light of the actual circumstances of the buildings and the owners/occupiers. Owners may also propose viable alternatives to the required fire service installation and improvement works, and discuss them with the relevant departments.

Despite the provision of building and Fire safety regulation aimed at ensuring life safety, and protection against properties damage, still accidents do happen like fire outbreaks that raze several sections of our public buildings. In most cases the causes are attributed to thing like electrical faults, act of sabotage, and unknown incidence. Fire safety regulations and procedures encompasses the provision of safe system in accordance with current fire safety precaution and guidelines and ensuring that, they are maintained and tested regularly. This means that all fire safety equipments in the buildings must be tested frequently, and maintenance of all healthy and safety records, including staff training and regular drills like fire drills must be carried out regularly. Therefore building users must be adequately aware of the fire safety procedure and regulations so that, they are clear of what to do on discovering a failure like fire so as to carry the correct evacuation procedures. This awareness would undoubtedly have a key role to play in preventing unnecessary and consequence of accidents in the buildings.

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## 2. Fire Safety Procedures and Implementation

There are various approved regulations that give recommendations and guidance of meeting the performance requirements of fire safety of the buildings (residential or non-residential [1].

### 2.1 Causes of Fire in Public Building

The causes of fire in public building can be classified into three groups:

1. Natural cause
2. Accidental cause
3. An incendiary cause

#### 2.1.1 Natural cause:

(i) **Lightening**-This is caused by connective current occurring in the thunder cloud containing a dense cold air at the top, and warm moist air at the bottom.

(ii) **Wind**-The action of wind can blow the buildings apart, shooting out electric wires which may spark to start fire.

(iii) **Animals**-Animals such as bats, rats, etc, can chew the insulation of electrical wires especially those with only one layer of insulation.

(iv) **Settlements of the building**-Differential settlement of the building may cause a pipe carrying gas to crack as a result of which it leak and causes fire.

#### 2.1.2 Accidental causes of fire

**Electrical fire**-Electrical fire can be caused from one of the following conditions

- i. Arcing
- ii. Sparking
- iii. Overheating

**Arcing:** If a short circuit or break in an electrical conductor occurs, the electrical current-tries to continue to flow in the open space, it creates an arc.

**Sparking**-Sparking usually occur as a result of electric welding operation or from the arcing of short circuit.

**Overheating**-Overheating can result from two conditions which are either the fire that heat the conductor from outside or overheating from an internal source like Cooking apparatus, Appliance Malfunction, Explosions, Smoking, Bonfires and Rubbish fires.

**2.1.3 Incendiary fire causes:**

These terms incendiary causes of fire has been coined to cover a number of causes of fire outbreak, which are either malicious, deliberate, or of such gross carelessness as to be equally blameworthy.

- i. Pathological fire setters.
- ii. Emotional fire setters.
- iii. Fraud fires (Arson).

**2.3.4 Causes of fire in public building**

Lack of staff training and regular fire drill are among the reasons of fires in public buildings. It is therefore important that, a Fire Risk Assessment is regularly carried out to identify possible risks and prevent any fire from occurring. There are some causes in

- a. Hospital building.
- b. Academic / Residential building.
- c. Public Assemblies

**2.4.1 Fire Safety Requirements for Office Premises**

The owner or occupier of any building which is used as office accommodation except a high rise building shall provide firefighting equipment's in where the building is four or more story, the owner shall provide it with:

- i. At least two stair cases each built with fire resistant material, terminating at a final exit from the building and with all circulation areas in the building built with fire resistant walls and fitted with fire resistant and smoke doors.
- ii. Dry or wet riser fighting appliance in addition to first aid fire extinguisher
- iii. Sprinkler firefighting system and
- iv. Smoke and heat detection equipment's.

**2.4.2 Fire Safety Requirement for hotel:**

The regulations here apply to any building which is used as a hotel and is of two or more story.

- a. There shall be at least two stair cases, one opposite the other in addition to enclosed stair case.
- b. An alternative power system for emergency lighting shall be provided.
- c. All exit doors shall be illuminated with exit signs.
- d. All circulation areas of the building shall be constructed with fire resistant materials.
- e. Fire extinguishers, fire blankets shall be provided and placed at easily accessible areas in the building for use in the fire event.
- f. Where the building is of five floors above, wet or dry risers, hose reels and sprinkler system shall be provided.
- g. Fire alarm system, manual or automatic for warning guest on fire outbreak shall be provided.
- h. A reasonable space be provided within the building for assembly of all persons in the building in the event of an outbreak of fire.
- i. In the case of high rise building, all doors to the bedrooms in the circulation areas of the hotel shall be fitted with fire resistant doors.

**2.3 Control of Fire**

There are three basic methods for controlling fire hazards in the building, i.e. prohibition, isolation and protection [2].

**2.3.1 Prohibition**

Prohibition is the removal of a hazard from a building. If a material or activity is likely to cause serious fires, it should not be permitted in a building. The dispensing of gasoline, for example, is a considered to be a dangerous operation.

**2.3.2 Isolation**

Of the two remaining methods, hazard isolation is the one more often used. Isolation may take two forms. The first requires cutting off hazard from the remainder of the building to minimize its effects.

**2.3.3 Protection**

Controlling a fire hazard by isolation assumes that its worst effects will be contained. This method of controlling the hazard is to minimize these effects, in to counteract the hazard and thereby protecting the building.

**2.6 Fire Prevention and Protection**

Fire prevention is intended to reduce the source of ignition, and is partially focused on programs to educate people from starting fires. Buildings, especially schools and tall buildings, often conduct fire drills to inform and prepare citizens on how to react to a building fire. As pointed by [1], the precaution which can be taken within building to put off a fire occurring, or it should occur of containing it within the region of the outbreak, providing a means of escape for people in the immediate vicinity and fighting the fire can be considered under structural fire protection, means of escape in case of fire, and firefighting.

Fire Drills, Warning Devices, Smoke Detectors, Fire Alarms, Structural fire protection, Means of Escape, Fire Extinguishers, Hose Reels, Risers, Sprinklers

Prashant and Tharmarajan [10] conducted a research on the essential aspects of fire safety management in high-rise buildings and found out that Fire outbreaks occur as a result of "human factors", such as carelessness, negligence or simply a lack of fire safety awareness. In response to this, fire safety management has become an integral aspect in the daily operations of high-rise buildings. The research presents the results of the investigation on fire safety management in high-rise buildings. The objectives of the study was to identify the aspects of fire safety management that influences fire safety of high-rise building users, to establish the most critical of these aspects and to identify methods to improve fire safety of high-rise building users. Biswadeep Ghosh [3] conducted a research on the Assessment of the benefits of Fire Extinguishers as fire safety precautions in New Zealand Buildings and found out that there was a downward trend in the use of extinguishers. However, the statistics may not reflected the true usage patterns of extinguishers. The report used historical data available from 1990 – 2007 from the New Zealand Fire Safety Fire Service Resource database and used statistics generated from conducting a survey of service agencies for fire extinguishers in New Zealand. The report also evaluated prescriptive requirements existing in New Zealand and compares with prescriptive requirements outside of New Zealand.

Sunusi[4] conducted a research on an investigation into fire safety procedures and regulations in some public buildings in Kano State. The research aimed at investigating the availability, adequacy and awareness of fire safety procedures and regulations in some public buildings within Kano State with the need of contributing to the enhancement of the present state of fire safety of our buildings and found out that the existence, adequacy and awareness of fire safety procedures and regulations are fairly good and in need of further improvement.

**3.0 Research Methodology**

The research design used for this study was survey research design. Questionnaire was used to determine opinions of the facility managers and visitors on Assessment of the level of implementation of fire safety procedures and regulation in public buildings. This study was carried out in the following public buildings in Kano State metropolitan:

- i. Kano Electricity Distribution Company Plc, Kano State Office.
- ii. Murtala Muhammad Library Complex, Kano.
- iii. Grand Central Hotel, Kano.

**Table 1:** Distribution of Respondents by Public Buildings in Kano State, Nigeria

S/N	Buildings	Facility Managers	Workers	Visitors	Total
1	Kano Electricity Distribution Company plc, Kano.	30	70	30	130
2	Murtala Muhammad Library Complex, Kano.	20	60	80	160
3	Grand Central Hotel, Kano.	50	100	110	260
	<b>Total</b>	100	230	220	550

**3.2 Method of Data Analysis**

The data collected was analyzed using mean and standard deviation. Mean and standard deviation was used to answer the three research questions.

#### 4. Data Presentation

This chapter deals with analysis and presentation of data based on the research questions formulated to guide this study.

##### 4.1 Key

$N_1$ ,  $N_2$  and  $N_3$ = Number of Facility managers, Workers and visitors in Office, Library and Hotel Respectively.

$\bar{X}_1$ = Mean score of Facility managers,  $\bar{X}_2$ =Mean score of Workers,  $\bar{X}_3$ = Mean score of Visitors and  $\bar{X}_T$ = Average mean of all Respondents.

Based on the research questions raised for the study and their related findings, Table 4.1 of this study confirmed the availability of fire safety provisions in public buildings in Kano state.

$N_1= 40$   $N_2= 95$   $N_3= 91$

**Table 2** Mean and Standard Deviation of the Responses of Facility Managers, Workers and Visitors on the Availability of Fire Safety Provisions in the Public Buildings in Kano State Nigeria

S/N	ITEMS	$\bar{X}_1$	SD <sub>1</sub>	$\bar{X}_2$	SD <sub>2</sub>	$\bar{X}_3$	SD <sub>3</sub>	$\bar{X}_T$	SD <sub>T</sub>	Remark
1.	Fire extinguisher	3.81	0.56	3.51	0.56	3.57	0.66	3.63	0.59	Available
2.	Sprinkler	2.83	0.83	2.58	0.93	3.18	0.79	2.86	0.85	Available
3.	Hose reels	3.08	0.94	2.83	0.96	3.10	0.89	3.00	0.93	Available
4.	Fire escape	3.29	0.72	2.87	1.04	3.13	0.78	3.10	0.85	Available
5.	Fire assembly point	3.35	0.65	2.87	0.98	2.85	0.94	3.02	0.86	Available
6.	Fire exit signs	3.10	0.66	2.75	1.04	2.84	0.94	2.90	0.88	Available
7.	Exit routes	3.24	0.74	2.91	0.92	2.84	0.98	2.99	0.88	Available
8.	Glow in the dark signage indicating exit routes and location of fire safety equipment	2.90	0.70	2.33	1.08	2.74	0.96	2.66	0.91	Available
9.	Fire doors	3.06	0.73	2.39	0.98	2.79	0.96	2.75	0.89	Available
10.	Atrium fire-detection and alarm system	2.79	0.75	2.85	1.06	2.57	1.09	2.73	0.96	Available

**Table 3:** Mean And Standard Deviation of the Responses of Facility Managers, Workers and Visitors on the Adequacy of fire safety provisions in the public buildings in Kano state Nigeria.

S/N	ITEMS	$\bar{X}_1$	SD <sub>1</sub>	$\bar{X}_2$	SD <sub>2</sub>	$\bar{X}_3$	SD <sub>3</sub>	$\bar{X}_T$	SD <sub>T</sub>	Remark
<b>Means of Escape</b>										
11.	Escape routes are adequate and sufficient for the number of occupants.	3.40	0.73	2.79	0.94	3.21	0.85	3.14	0.84	Adequate
12.	They are protected where necessary	3.04	0.56	2.71	0.76	2.98	0.76	2.91	0.69	Adequate
13.	They are generally free from obstruction	3.27	0.63	2.94	0.83	2.84	0.98	3.02	0.82	Adequate
14.	They are free from hazards	2.94	0.65	2.50	0.86	2.77	1.03	2.74	0.84	Adequate
<b>Fire Compartmentation</b>										
15.	Stairs are fire separated to protect occupants escape to limit the spread of fire within and adjoining building where necessary	2.98	0.80	2.87	0.90	2.94	0.91	2.93	0.87	Adequate
16.	Escape routes are separated to protect occupants escape to limit the spread of fire within and adjoining building where necessary	3.10	0.69	2.84	0.83	3.07	0.75	3.00	0.76	Adequate
17.	Risk areas are separated to protect occupants escape to limit the spread of fire within and adjoining building where necessary	3.28	0.67	2.85	0.95	2.95	0.92	3.03	0.85	Adequate
<b>Fire Alarm System</b>										
18.	Provides adequate warning	2.65	0.74	3.02	0.96	3.01	0.91	2.89	0.87	Adequate
19.	Automatic fire detection is provided where necessary	3.02	0.73	2.71	1.02	2.87	0.92	2.86	0.89	Adequate
20.	Provides unwanted significant alarm	2.85	0.70	2.42	0.94	2.80	0.89	2.69	0.84	Adequate
<b>Emergency Lighting</b>										
21.	Adequate emergency lighting s provided to secure the means of escape	2.90	0.72	2.62	1.00	2.90	1.00	2.81	0.90	Adequate

22.	Maintained adequately	3.13	0.63	2.67	1.00	2.73	0.96	2.84	0.86	Adequate
23.	Highlight any significant deficiencies	2.98	0.66	2.54	0.99	2.70	1.01	2.74	0.89	Adequate
<b>Signage</b>										
24.	Adequate fire safety signage	2.96	0.66	2.97	0.84	2.81	1.00	2.91	0.83	Adequate
25.	Provision of fire safety instructions	3.00	0.71	2.97	0.82	2.77	1.00	2.91	0.84	Adequate
<b>Fire Brigade Contingency Building Plan</b>										
26.	Drawing of fire brigade contingency building plan	2.92	0.65	2.80	0.89	2.92	0.88	2.88	0.81	Adequate
<b>Emergency Plan</b>										
27.	Drawing of a general emergency building plan	2.88	0.76	2.90	0.97	2.74	0.97	2.84	0.90	Adequate

**Table 4** Mean And Standard Deviation of the Responses of Facility Managers, Workers and Visitors on the level of implementation of fire safety provisions in the public buildings in Kano state Nigeria.

S/N	ITEMS	$\bar{X}_1$	SD <sub>1</sub>	$\bar{X}_2$	SD <sub>2</sub>	$\bar{X}_3$	SD <sub>3</sub>	$\bar{X}_T$	SD <sub>T</sub>	Remark
<b>Means of Escape</b>										
28.	Exterior open space around the building	3.19	0.79	3.33	0.71	3.09	0.96	3.20	0.82	Implemented
29.	Compartmentation	3.08	0.63	2.92	0.77	2.98	0.87	2.99	0.76	Implemented
<b>Signage</b>										
30.	Exit signs	2.92	0.57	2.87	0.89	2.95	0.91	2.91	0.79	Implemented
<b>Fire Safety Provisions</b>										
S/N	ITEMS	$\bar{X}_1$	SD <sub>1</sub>	$\bar{X}_2$	SD <sub>2</sub>	$\bar{X}_3$	SD <sub>3</sub>	$\bar{X}_T$	SD <sub>T</sub>	Remark
31.	Extinguishers	3.31	0.80	3.37	0.74	3.18	0.84	3.29	0.79	Implemented
32.	Hose reels	2.98	0.76	2.97	0.94	2.88	0.96	2.94	0.89	Implemented
33.	Automatic sprinkler system	2.86	0.83	2.57	1.09	2.91	0.87	2.78	0.93	Implemented
34.	Over head tank	3.31	0.88	2.75	1.03	3.04	0.98	3.04	0.96	Implemented

## 5. Conclusions

The availability of fire safety provisions in the public buildings in which Overall of the majority of the respondents agreed that all the aspects identified from the literature review are relevant towards Fire Safety procedures and regulations in public buildings. Thus, the aspects of Fire Safety provisions that influences fire safety of public building users were successfully identified and based on the responses obtained from the Overall of the majority of the respondents also agreed that all the aspects identified towards Fire Safety procedures and regulations in public buildings. On identifying the level of implementation of the fire safety provision by the building authorities, based on the responses obtained from the Overall of the majority of the respondents agreed that all the aspects identified from the literature review are relevant towards Fire Safety procedures and regulations in public buildings.

- 1) These are some areas suggested by the researcher for further study in the area of Fire Safety procedures and regulations as listed below:
- 2) The study on the attitude of public building users towards fire safety procedures and regulations.
- 3) An investigation in to the awareness of level of public building users towards implementation of Fire Safety procedures and regulations in public buildings.
- 4) An assessment on the level of adequacy of fire safety equipments in public buildings.
- 5) The study on the level of satisfaction of Fire Safety provisions and training in public buildings.

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