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FOREWORD

This edition of the journal contains papers covering a wide variety but highly inter-related issues to do with human settlements and management. A few of the papers are related to housing development and the use of renewable materials in the construction industry, policy issues to do with urban development in Nigeria, application of GIS in monitoring urban development, and effects of climate change on the development of cities.

The hope and expectation is that the papers will further our understanding of challenges and opportunities of the development and management aspects of our human settlements.

Prof. Mustapha Zubairu
Editor-In- Chief
CHSUD Journal

APPRAISAL OF FIRE SAFETY PROVISIONS IN TERTIARY INSTITUTIONS BUILDINGS IN MINNA

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Abstract:
This paper was aimed at examining the adequacy of fire safety practices in some selected tertiary institution buildings with a view of determining the differences between the UK standard fire safety requirements and the actual fire safety provisions in the selected buildings. To achieve this, well structured questionnaires and physical assessment of fire fighting equipment were carried out. Primary and secondary data were collected. The target respondents were the student representatives and school authority. The data collected were analyzed using both T-test and linear regression analyses. Major findings from the study showed that no significant difference existed between the standard number of escape routesprescribed by the UK Building Regulation and Federal Fire Safety Code and actual number of escape routes provided in the buildings selected. However UK standard number of fire alarms and actual number of fire alarms as well as UK standard number of fire extinguishers and actual number of fire extinguishers observed showed significant difference respectively. It was therefore concluded that number of firefighting/prevention equipment provided in the sampled buildings do not comply with the number prescribed by the UK Building Regulation and Federal Fire Safety Code. Recommendations from the study included that the tertiary institutions' authorities should follow the prescribed standard by the UK Building Regulations and Federal Fire Safety Code when making provisions for fire alarm systems and fire escape routes with the use of projected population of occupants and other physical factors.

Keywords: *Fire safety, Tertiary institution, Population, Escape routes, Firefighting equipment, Fire alarm.*

Introduction

According to Oyeyode (2003) fire is the result of flammable material being combusted and the essential ingredient for the propagation of fire is air, which is sufficient to start ignition or means of ignition and oxidation. The University of Gulph (2003) also described fire as the oxidation of substances often with the evolution of heat and light in varying degrees of intensities. Benjamin (1986) explained that fire has a triangle which includes fuel, high temperature and oxygen. This fuel in the triangle and oxygen will rapidly ignite once in contact with heat. This is supported by Adeleke (1993) that the slightest contact of highly inflammable liquid contents, such as gasoline (petrol), paraffin (kerosene), or gas with fire brings explosive services of destruction, inferno and loss of lives and property. In the light of the above there is a great need for any building design to incorporate fire safety measures to serve as preventive and protective precautionary measures to safeguard lives and property.

Fire safety is defined by Encyclopedia Americana (1992) as the precautions that are taken to prevent or reduce the likelihood of fire that may result in death, injury or loss of property. Passive Fire Protection Federation (2013) viewed fire safety from three perspectives of passive protective measures as given below:

i. Passive fire protection is the primary measure integrated within the construction fabric of a building to provide inherent fire safety and protection by responding against flame, heat and smoke to maintain the fundamental requirements of building compartmentation, structural stability, fire separation and safe means of escape.

ii. Passive fire protection measures achieve their intended purpose by raising the fire resistance of the structure, protecting the structure against the effects of fire, reducing fire spread through secondary ignition, limiting the movement of flame and smoke, and minimizing the danger of fire-induced collapse or structural distortion.

iii. Passive fire protection design, incorporating passive fire protection materials, systems and assemblies, serves by fire containment to protect life, safeguard the building structure, protect assets, maintain building serviceability after fire, minimize rebuild costs, and facilitate quick business recovery and continuity.

Virginia Tech (2013) reported that tertiary institution buildings in Virginia are required to comply with the Virginia Statewide Fire Prevention Code (especially Section F-604.1 and Section F-606.1). In the light of this, Virginia Tech has policies relating to misuse of fire equipment, arson, disregard of fire alarm signals, and tampering with fire alarm and smoke detection equipment. Compliance with the directives of emergency personnel, Division of Student Affairs personnel, and the fire Marshall is required. Students are therefore responsible for familiarizing themselves with the material on the web pages as well as policies found in the Hokie Handbook. Nigerian tertiary institutions should also adopt such policies in order to reduce the incidence of fire outbreak (especially in classrooms and hostel blocks) which increases annually all over the country.

Safety is often considered an issue supported by everyone. Unfortunately, when it comes to spending money on safety, many people do not feel it is vital to the success of projects. Thus, it is not normally a cost code item, and it is subject to cutbacks if budgetary constraints develop. This stems from the failure of many to recognize that an effective safety practice can reduce job accidents and directly or indirectly reduce project costs. Fire outbreak has led to immeasurable loss and many lives and property have been destroyed in our educational institutions in Nigeria. In the light of these, Hassan (1999) reported that the safety of occupants in the buildings should be the main concern for all professional bodies involved in both the design and construction of buildings. Nevertheless, the design and safety in building will not be enough if adequate preparation is not put in place by the occupants and users of constructed facilities.

Mogbo (1998) opines that some government educational institutions have faced trauma of fire outbreak between 1975 and 1995 and these have been analyzed as thus:

i. The institute of management and technology, burning down decades of old workshops.
ii. Federal polytechnics, Idah, Kogi state and in Bida, Niger state respectively.
iii. University of Nigeria Nsukka.

In addition, in 2005, fire incident occurred in the female hostel of the Federal University of Technology, Minna, Niger State which destroyed property and another incidence also occurred in 2009 and at the Bosso campus (temporary site) of the same institution. A recent incidence of fire outbreak was reported by Voice of

the Nigerian Tertiary Institutions (2013) that the Community Campus Radio Station of the Federal University of Technology, Minna, popularly referred to as Search FM 92.3 was gutted by a mid-night inferno on Wednesday 16, January, 2013 destroying property worth over =N= 50 million. The fire outbreak which occurred around 12:00 a.m. as a result of electric spark gutted the whole studio and other offices of the station. This is in line with the discoveries of Shittu (2001), Shittu (2007) and Shittu (2010) that the major cause of fire outbreak in Nigeria is electrical faults.

Fire safety provisions in tertiary institution buildings in Nigeria needs a thorough appraisal because reports have shown that causes of fire can be linked to negligence, carelessness, ineffective use of firefighting equipment, insufficient provision of fire escape route in the buildings and lack of provision for such during their design. Shittu (2001) discovered that the amount of financial loss due to fire on the average in Kwara State for the period 1990 to 1999 was 4% of the Capital Expenditure (N 14, 548, 694.00), implying that fire disaster is a serious menace which is also a threat to the economy and this is also applicable to institutional buildings. It is obvious therefore that this negligence leads to loss of lives and property.

According to Oludare (2000), there has been emphasis on the provision of firefighting equipment for the fire service offices in the Nigeria. Millions of Naira are being spent to train fire-men in fire-men combat, but little has been done to look at fire safety practices in the buildings where there is likely to be occurrence of fire. In most times, fire-fighters are been blamed for fire incidents in institutional and other types of buildings, and all their possible loopholes seriously explored. But little has been said or explored about the activity of the other stakeholders in the construction and uses of buildings, which in often times are responsible for the causes of fire outbreak (Makanjuola et al., 2009).

From the above background it has been seen that the action of fire has caused injury, loss of lives and property. In addition its smoke and gases has caused loss of sensitivity, vision impairment and loss of consciousness. Mogbo (1998) researched on the environment and fire incidences in Nigeria and the implications on public policies. Shittu (2001) studied the incidence of fire outbreak in public and residential buildings of Kwara State from 1990 -1999. Shittu (2007) researched on a comparative analysis of fire outbreak between the military and civilian era in Niger State in domestic and public buildings and Shittu (2010) studied the incidence of fire outbreak in North-Central Nigeria. The result of these studies are majorly on the trend of fire cases and the losses due to fire incidences in relation to the causes, without much emphasis on analyzing fire safety practices in buildings by the occupants and the client in Nigeria. Against this backdrop, the need for this study is to assess the level of fire safety provisions in tertiary institutions buildings in Minna, Niger State, Nigeria.

Purpose of the study

Aim

To examine the adequacy of fire safety provisions in some selected tertiary institutions buildings in Minna, Nigeria, with a view to suggest ways of reducing the occurrence of fire hazard.

Objectives

i. To determine the difference between the standard number fire escape routes prescribed by the UK Building Regulation and Federal Fire Safety Code and the number of available fire escape routes in the buildings sampled.

ii. To determine the difference between the standard number of firefighting equipments prescribed by the UK Building Regulation and Federal Fire Safety Code and the number of available firefighting equipments in the buildings sampled.

iii. To determine the relationship between number of occupants and the number of fire escape routes.

Statement of Hypothesis

1. There is no significant difference between the standard number of fire escape routes prescribed by the UK Building Regulation and Federal Fire Safety Code and the number of available fire escape routes in the buildings sampled.
2. There is no significant difference between the standard number of firefighting equipments prescribed by the UK Building Regulation and Federal Fire Safety Code and the number of available firefighting equipments in the buildings sampled.
3. There is no significant relationship between the number of occupants and the number of fire escape routes.

Scope of Study and Assumption

The study covers some selected tertiary institutions in Minna, Niger State which are Federal University of Technology, Minna, School of Health Technology, Minna and School of Midwifery, Minna, Niger State. The institutions were selected based on the relevance of information they have to offer to the course of study. The research is limited to Hostels, classrooms and offices in the institutions.

The data collected covered standard number of fire escape routes based on the UK Building Regulation and Federal Fire Safety Code and actual number of fire escape routes provided in the buildings sampled, standard number of firefighting equipment based on the UK Building Regulation and Federal Fire Safety Code and the actual number of firefighting equipments provided in the sampled buildings and the number of occupants in each of these buildings. All buildings of one-storey design are regarded as medium buildings and those of two-storey design are regarded as high buildings.

Methodology

Since this study deals with analysis of fire safety provisions in some selected tertiary institutions, the target respondents are school authority and hostel and class representatives (students) whom the researchers believed had first-hand information of the things happening in the institution buildings.

The list comprising the total number of students and staff in the selected tertiary institutions in the areas of study constitute the sampling frame for this study. These are provided for clusters in the study area below:

Table 1: Number of Occupant in the Institutions

Federal University of Technology Minna Population	15000
School of Health Technology Minna Population	1300
School of Midwifery Minna Population	1 400
Total Number	**17700**

The research instrument used for this study was from both primary data (questionnaires and physical measurement) and secondary data (already compiled information on number of occupants) in order to obtain information for the purpose of accuracy. The research questionnaire was divided into sections as given thus - Section A was based on the number of people, Section B was based on number of escape routes and Section C was based on the firefighting equipment. This was accompanied by physical measurement to obtain accuracy and sincerity.

The data collected for this research work was analyzed using T- test for determining statistical difference between the pair of variables tested (i.e standard fire escape routes & actual fire escape routes and standard number of firefighting equipment & actual number of firefighting equipment) and linear regression analysis for determining the statistical relationship

between the pair of variables tested (i.e. number of occupants & number of fire escape routes). This paper assures a 5% level of significance for the Probability (P) test, T – test and F – test respectively. The calculated P value must be less than 0.05 (i.e. 5%) for the relationship between the pair of variables tested to be significant, otherwise the relationship will not be significant. T and F values calculated must be greater than their respective corresponding statistical table value for the relationship between the pair of variables tested to be significant, otherwise the relationship will not be significant. The results of the analyzed data were presented using tables.

Data presentation

All data collected were found to be suitable for analysis so that conclusions may be drawn and these are presented in Table 2 below:

Table 2: Data on Actual Fire Safety Provision and UK Standard Fire Safety Requirements

Types of structure	Name of Institution	UK Standard number of escape route	Actual number escape route	UK Standard number of fire alarm	Actual number of fire alarm	UK Standard number of fire extinguisher	Actual number of fire extinguisher	Population in the building	No. of Escape routes in the building
Hig.bldg	FUTMin	2	1	24	10	17	0	480	1
Mid.bldg	SHTech	1	2	5	0	32	0	50	2
Bug.bldg	FUTMin	2	1	9	7	15	0	607	1
Bug.bldg	FUTMin	1	2	20	0	26	0	70	2
Mid.bldg	SHTech	1	1	14	0	2	0	30	1
Bug.bldg	FUTMin	2	2	15	0	14	0	200	2
Mid.bldg	FUTMin	1	1	35	0	1	0	19	1
Hig.bldg	FUTMin	2	1	15	0	8	0	262	1
Mid.bldg	SHTech	2	2	10	0	82	0	300	2
Hig.bldg	FUTMin	2	1	35	0	43	11	450	1
Mid.bldg	SHTech	5	4	59	23	16	6	1010	4
Mid.bldg	SMidWif	2	3	35	0	35	14	300	3
Bug.bldg	SHTech	2	7	16	0	59	32	328	7
Bug.bldg	SMidWif	1	2	43	0	35	4	89	2
Bug.bldg	SMidWif	2	1	82	0	10	1	284	1
Mid.bldg	SHTech	1	2	8	17	15	0	91	2
Mid.bldg	SMidWif	2	2	1	0	35	0	500	2
Hig.bldg	FUTMin	2	2	14	2	15	0	400	2
Mid.bldg	SMidWif	2	2	2	4	14	0	490	2
Bug.bldg	FUTMin	2	4	26	1	20	0	510	4
Bug.bldg	SMidWif	2	1	15	1	9	0	300	1
Mid.bldg	SHTech	1	4	32	0	5	0	50	4
Bug.bldg	SMidWif	1	4	10	0	24	0	140	4
Mid.bldg	SMidWif	2	2	17	1	90	30	525	2
Hig.bldg	SHTech	2	2	90	0	10	6	490	3

Source: Authors' field work (2012)

Key:
Bung = bungalow building
Mid bldg = medium building (1-Storey)
High bldg = high building (2-Storey)
FUTMin = Federal University of Technology, Minna
SHTech = School of Health Technology, Minna
SMidWif = School of Midwifery, Minna

Results and Discussion

The results of the T – Test analyses are presented and discussed in Tables 3 and 4 below.

Table 3: T - Test Analysis between Standard Escape Routes and Actual Escape Route

Analysis No	Variables		Observations					Inferences	
	X_1	X_2	Type of Model	Mean Values	T_{cal}	T_{tab}	P_{value}	Remark	Action on H_o
1	Standard Escape Route	Actual Escape Route	Independent Sample Test	$X_1 = 1.80$ $X_2 = 2.20$	-1.265	2.04	0.212	NSD	Accept H_o

Key: NSD = No Significant Difference

Table 3shows the relationship between the UK standard number of fire escape routes and actual number of fire escape routes in the buildings measured. It was observed that standard number of fire escape routes had an average mean value of 1.8000 and actual number of fire escape routes had an average mean value of 2.2000. The T-calculated value of -1.265 observed was lower than the T-tabulated of 2.021 while the P-value of 0.212 observed was greater than 0.05 and based on these the null hypothesis was accepted, indicating the existence of a non-significant difference between the number of actual fire escape routes and the number of escape routes prescribed by UK Building Regulation.

Table 4: T - Test Analyses between Standard Fire Alarm and Actual Fire Alarm & between Standard Fire Extinguisher and Actual Fire Extinguisher

Analysis No	Variables		Observations					Inferences	
	X_1	X_2	Type of Model	Mean Values	T_{cal}	T_{tab}	P_{value}	Remark	Action on H_o
2a	Standard Fire Alarm	Actual Fire Alarm	Independent Sample Test	$X_1 =$ 25.280 $X_2 =$ 3.040	4.69	2.04	0.000	SSD	Reject H_o
2b	Standard Fire Extinguisher	Actual Fire Extinguisher	Independent Sample Test	$X_1 =$ 25.280 $X_2 =$ 4.160	4.309	2.04	0.000	SSD	Reject H_o

Key:
SSD = Statistically Significant Difference

From Analysis 2a, in Table 4, it was shown that the relationship between the UK standard number of fire alarm and the actual number of fire alarm measured from the sampled buildings respectively had average mean values of 25.2800 and 3.0400 respectively. The statistical difference between standard number of fire alarm and actual number of fire alarm was, therefore, observed to be significant because the T-calculated value of 4.690 observed was greater than the T-tabulated value of 2.040 while the P-value of 0.000 observed was lower than 0.05 and based on these the null hypothesis was rejected.

The results of the T-Test of Analysis 2b from Table 4, shows the relationship between the UK standard number of fire extinguisher and actual number of fire extinguisher measured from the buildings sampled. It was observed that the standard number of fire extinguisher had an average mean value of 25.2800 and actual number of fire extinguisher had an average mean value of 4.1600. The T-calculated value (4.309) was observed to be greater than the T-tabulated value (2.040) while the P-value observed (0.000) was lower than 0.05 and based on these the null hypothesis was rejected, and it implies that there exists a significant difference between the number of standard fire extinguishers and the prescribed number of fire extinguishers by UK Building Regulation.

Table 5:Summary of Results for Regression Analysis

Analysis No.	Variables		Observations					Inferences		
	X	Y	Type of Model	Regression Equation	F_{cal}	F_{tab}	P_{value}	Strength of Relationship	Remark	Action on H_o
3	Population	Available Escape Route	Linear	Y=1.994 + 0.001x	1.8	4.26	0.43	Very Weak	NS	Accep H_o

Key
NS = Not significant

The results of the third analysis (regression), summarized in Table 5, shows the relationship between population (number of occupants) and number of available escape routes in the buildings sampled. The result of this analysis shows a positive, linear, relatively weak and non-significant relationship between population and number of available escape routes. A relatively low coefficient of determination (R^2) value of 18% was observed. The regression equation by having a positive correlation indicates that there is a tendency for the two variables to move in the same direction. That is an increase in the population has a tendency to be accompanied by a corresponding increase in the number of fire escape routes. The linear relationship between the two variables is not significant, since the value of F-calculated of 1.800 observed was less than 4.261at 5% level of significance and the P-value of 0.43 observed was greater than 0.05. Therefore the null hypothesis was accepted.

Conclusion

The fact was found out that incidence of fire outbreak has affected government buildings, organization buildings and institutional buildings which has led to

loss of lives, property, time, money and productivity

The result of the difference between UK standard number of fire escape routes required in buildings and the actual number of fire escape routes in the selected buildings in Minna tertiary institutions shows that there is no much deviation from prescribed standard. Therefore the available number of fire escape routes, to a great extent, is in compliance with standard prescribed by the UK Building Regulation and Federal Fire Safety Code.

The result of the difference between fire alarm standard prescribed by the UK Building Regulation and Federal Fire Safety Code and the actual number of fire alarm in the selected buildings shows that there is no compliance with the number prescribed by the UK Building Regulation and Federal Fire Safety Code. Therefore the available number of fire alarm is below the prescribed that is the difference between standard and the actual fire alarm is highly significant.

It was also shown from the analysis that there is great deviation between the standard number of fire extinguishers prescribed by the UK Building Regulation and Federal Fire Safety Code and the actual number of fire extinguisher measured in the selected buildings. Therefore the actual number of fire extinguishers provided in the selected buildings is not in compliance with the number prescribed by the UK Building Regulation and Federal Fire Safety Code, implying that is there is significant difference between the standard and actual number of fire extinguishers provided. It was also shown that the relationship between population and fire escape routes was not significant, which implies that population should not be the only factor to be taken into consideration while making provisions for the number of fire escape routes but it is also an important factor because it correlated positively with the number of fire escape routes.

Recommendations

- The tertiary institutions should follow the prescribed standard by the UK Building Regulations and Federal Fire Safety Regulations when making provisions for fire alarm systems, firefighting equipment and fire escape routes.
- Projected population of occupants with some other physical factors should be considered as a determining factor for fire escape routes.

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