PROCEEDING 6

VIABILITY OF FIRE ESCAPE ROUTES IN THE STUDENT HOSTELS AT SELECTED KATSINA STATE TERTIARY INSTITUTIONS

SHITTU, Abdullateef Adewale[1], IDIAKE, John Ebhohimen[1], OYEWOBI, Luqman Oyekunle[1], TSADO, Abel John[1], BILYAMINU, Badamasi[1], MAC-BARANGO, Dumo O.[2]

[1]Department of Quantity Surveying, Federal University of Technology, Minna, Nigeria.
[2]Department of Quantity Surveying, Rivers State University of Science and Technology, Port Harcourt, Nigeria.

Most of the windows in tertiary institution hostels are usually provided with security bars w hich may help to keep the hostels safe from intruders, but they can also trap students in case of fire outbreak. The tertiary institutions' administration should make windows and doors w ith security bars have quick release devices for easy opening in an emergency. This study a ddressed the problem of the devastating effect of fire which results in loss of lives and prop erties due to the fact that many tertiary institutions in Nigeria have given less attention to th e fire safety programme. To address this problem, the study set out to assess the cost of pro vision of escape routes in the hostels of tertiary institutions in Katsina State in case of fire o ccurrence. Data were collected from the archive of the Works Department of four selected t ertiary institutions in Katsina State and from direct measurement of floor areas, area of esca pe routes and number of escape routes (i.e. doors, corridors and staircases) from three hoste ls from each of the four selected institutions. Analysis of data was done with the use of regr ession analyses. Major findings from the study showed that there exists significant relations hip between: i. the cost of providing escape routes and cost of construction; ii. population o f hostel occupants and number of escape routes; and iii. floor area of hostel and area of esca pe routes. It was concluded that population of hostel occupants, hostel floor area, number of escape routes and area of escape routes have significant influence on the cost of providing e scape routes in tertiary institution buildings. It was recommended that the projected number of hostel occupants and hostel floor area should be considered in estimating the cost and nu mber of escape routes when designing for escape routes in the hostel buildings.

Keywords: *fire escape routes, hostel floor area, population, tertiary institutions*

aishatabdulahi2007@yahoo.com
funsho@futminna.edu.ng

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INTRODUCTION

Fire is an important process that affects ecological systems around the globe. The positive effects of fire include stimulating growth and maintenance of various ecological systems. Fire has been used by humans for cooking, generating heat, light, signalling, and propulsion purposes. The negative effects of fire include hazard to life and property, atmospheric pollution, and water contamination. It can result in conflagration, which has the potential to cause physical damage through burning. According to Umar (2014), achieving an acceptable level of fire safety in University Students" hostel is one of the greatest responsibilities of the University administration. Students" hostel fire can easily cause devastating effect, if appropriate measures are not employed. Even though, the fire occurrence in students" hostel is not frequent but if it occurs may result in loss of lives and properties. Hence it requires a full and continuous devotion from both the University community and the administration to provide adequate escape route in case of fire emergency.

An escape route is a continuous and unobstructed path of exit travel from any point within a workplace to a place of safety (OSHA, 2003). An escape route consists of three parts: the first part is called Exit access – portion of an exit route that leads to an exit; the second part is called Exit – portion of an exit route that is generally separated from other areas to provide a protected way of travel to the exit discharge; and the third part is called Exit discharge – part of the exit route that leads directly outside or to a street, walkway, refuge area, public way, or open space with access to the outside. Most of the tertiary institution hostels windows in Nigeria are usually provided with the security bars (burglary) which may help to keep the hostels and offices safe from intruders, but they can also trap people in a deadly fire because the burglary serves as obstructions to windows that are meant to be fire escape routes. Windows and doors with security bars must have quick release devices to allow them to be immediately opened in an emergency. Occupants of such buildings (students) should understand and practice how to properly operate and open locked or barred doors and windows. The population in a hostel should also be considered when designing escape routes. According to Wikipedia Encyclopedia (2012), population is a term referring to the total number of human inhabitants of a specified area. Fire prevention, protection and escape route are subjects of vital importance and are so linked with the design and construction of buildings that it is essential to have an understanding of the factors which influences the nature, the rate of growth, ultimate severity and nature of risks involved in the event of fire. The nature of risks in the event of fire can depend on the use to which the building is put. Example, hostels in tertiary institutions and lecture halls, because of the large number of people accommodated (population) involves a high life risk even though the combustible contents may be low while a large ware house storing a lot of combustible materials involves a considerable risk to extensive damage to structures and contents but a low risk to occupants because their number is likely to be small. Since the hostels in tertiary institutions involve a high life risk, suitable forms of construction, planning of the building internally and satisfactory planning and construction of the means of escape should be highly considered which will allow occupants to escape without difficulty.

Fire is therefore a leading cause of accidental death because a fire can engulf a structure in a matter of minutes and people get trapped due to lack of escape routes, use of security bars on windows and over population of people in a particular floor area. Fire requires specific conditions to occur through a source of ignition. These conditions are inadvertently present in all buildings, as the by-product of design choices (Patterson, 1993).

The current trend of fire in hostel buildings has become a concern in our society today. There has been a lot of incidence of fire in hostels, where student has lost their lives and valuable properties (Nwabueze, 2012). These issues need to be reconciled with the building codes, fire safety design and cost constraints of the project. Fire safety in students" accommodation cannot be over emphasized, although, many institutions in Nigeria have given less attention to the program; despite its importance and the devastating effect of fire, thus may result in loss of lives and properties (Umar, 2014). It is therefore essential that escape routes are available to enable the occupants to reach a place of safety and that they are adequate and capable of being safely and effectively used at all times. In the light of this, the study set out to assess the cost of provision of escape route in the hostels of tertiary institutions in Katsina State in case of fire occurrence. The objectives of the study are:

i. To determine the relationship between construction cost and cost of providing escape routes in hostels of tertiary institutions in Katsina.

ii. To determine the relationship between population and number of escape routes in the hostels of tertiary institutions in Katsina.

iii. To determine the relationship between the floor area of hostel and area of escape routes in tertiary institutions of Katsina State.

The following null hypotheses were used for the study based on the literature findings:

$H_0$1: There is no significant relationship between construction cost and the cost of provision of escape route in the hostels of tertiary institutions in Katsina

$H_0$2: There is no significant relationship between population and number of escape routes in the hostels of tertiary institutions in Katsina.

$H_0$3: There is no significant relationship between the floor area of hostel and area of escape routes in tertiary institutions of Katsina State.

SURVEY OF PREVIOUS WORKS

An Overview of Fire Incidences

Fire is referred to as the rapid oxidation of combustible material and gases producing heat and light (oxygen, heat and fuel) in the absence of one of these elements there cannot be fire (Oyeyode, 2003). Fire is one of the most destructive hazards which threaten buildings. It has the potential to affect the occupant, the building and its components. Also areas not directly damaged by the flame or heat may be smoked, dirt and falling debris or by the huge volumes of water used in fire fighting. According to Malven (1997), when substantial heat is generated, over 500 – 600 degrees Celsius, flashover occurs and the fire becomes fully

developed, engulfing the whole compartment. Decay follows when all the fuel or oxygen within the compartment is totally consumed. An example often quoted is that a wooden log is difficult to ignite but thin sticks can be ignited easily and will burn fiercely when piled together. According to Patterson (1993), building fire safety in its most simplified form is based on three general strategies; first is to prevent ignition; if it occurs, to prevent spread; and if spread occurs, to minimize damages to the lives and properties, occupants and fire-fighters. Mogbo (1998) researched on the environment and fire incidences in Nigeria and the implications on public policies and politics. Using a critical review of literature and interview, Mogbo (1998) discovered that the incidence of fire outbreak has caused damage to lives, property, the economy and the environment at large. Shittu (2001) studied the incidence of fire outbreak in public and residential buildings of Kwara State from 1990 - 1999. Using a quantitative method of research, Shittu (2001) collected archival data and discovered through an empirical statistical analysis that fire outbreak results into serious losses of lives and property in both residential and public buildings with the highest impact felt in residential buildings. Shittu (2007) researched on a comparative analysis of fire outbreak between the military and civilian era in Niger State in domestic and public buildings. Using archival data collected from Niger State Fire Service which were analysed using T – test, Shittu (2007) discovered that cases of fire outbreak are recorded more during the civilian era than the military and therefore fire outbreak remains on the increase in both domestic and public buildings. Shittu (2010) studied the incidence of fire outbreak in North-Central Nigeria and discovered that there was no significant difference in the number of recorded fire cases in both domestic and public buildings of the States in North-Central Nigeria. Shittu (2010) therefore concluded that the incidence of fire outbreak is still on the hike. Shittu *et al.* (2013) carried out an appraisal of fire safety provisions in tertiary institutions buildings in Minna, Niger State and discovered that most of the tertiary institutions do not follow the required standards in providing for fire preventive measures in their buildings. Nwabueze (2012) also researched on the enhancement of Fire Safety in Hostel Designs and concluded that population of occupants and floor area of rooms are very important factors to be considered when designing for the number of escape routes required to enhance fire safety in hostel buildings designs. These studies have, however failed to assess the viability of fire escape routes n the hostels of tertiary institutions in Nigeria. In the light of this, the study reviewed literature to identify the theory of escape route design, factors influencing escape route design and cases of fire outbreak in tertiary institution buildings in Nigeria among other issues in order to clearly identify the gap in previous researches and how to address the problem left unsolved due to this gap.

Student Housing in Nigerian Tertiary Institutions

The Nigerian higher educational institution was established with the aim of giving students a very sound and qualitative education, so as to be able to function effectively in any environment in which they may find themselves, so as to become more productive, self-fulfilling and attain self- actualization (Saint et al, 2004) .This is because in Nigeria, students are the single most important stakeholders in the University/College System. Similarly, Students' accommodation is among the most important facilities that should be provided in a typical Nigeria University Campus. This is because it offers the students the opportunity to interact amongst their colleagues from faculties other than their own in addition to the unique opportunity for night discussions and social interactions which when put together

will help in shaping the student's social life, appreciation of their roles and responsibilities in the community and society at large (Esenwa, 2003). In the beginning, Nigerian universities were established with the intention of providing comfortable hostel accommodation for all students on campus. Up till the early 1970s there was no problem of students' accommodation in University campuses (Esenwa, 2003). Some Nigerian Universities at that period were planned and designed to accommodate both staff and students on campus, hence their location on a large expanse of land away from the developed areas or towns. Then, not many females were admitted. Therefore, in the universities, the spaces provided for accommodation were more for the male students. However, with current search for parity; equal opportunity for both sexes; the female students' enrolment has increased (Esenwa, 2003).

Following this development, a committee, popularly referred to as Brigadier T. B. Ogundeko Committee, was set up by the National Universities Commission (NUC) in 1977, to look into funding problems in the Nigerian University System and submits recommendations. Esenwa, (2003), noted that the recommendations of the Committee on students' accommodation are as follows:

a) Government policy that only 75% of university students should be housed on campus should be continued and the need for these students to interact with the public is valid.
b) In order to relieve pressure on government finance in the areas of student housing, the older universities should henceforth finance construction of student living accommodation with loans, while government should finance one third of the student accommodation required by newer universities.
c) The latter recommendation should put the newer universities at par with the older ones which have had at least one third of their student accommodation requirements financed by government. The students should contribute a substantial part of the repayment.
d) The universities should employ the services of an Estate Agent to undertake a feasibility survey of the avenues of raising loans from the many mortgage establishments, insurance companies, the provident fund and banks.
e) Design for students' hostels should be more modest, simple and functional, so that they can be within the means of students.
f) Students should be charged N150.00 per session for lodging the subsidy for additional hostel would come from lodging charged on existing buildings in older Universities would government require to pay a subsidy until it has developed one third of the accommodation required."

When it was however realized that even with this new policy, available hostel spaces were still inadequate, a new accommodation policy that guarantees accommodation for fresh students and final year students was then put in place (Esenwa, 2003),. To create more accommodation space, many universities introduced the concept of double bunking (e.g. University of Benin, University of Nigeria, Nsukka) to increase available bed spaces without a corresponding increase in the number of conveniences (such as toilets). This turned to be a sedative measure because it worked for just a short while only as student's enrolment continued to increase without a corresponding increase in hostel facilities. According to Esenwa, (2003), due to the drop in capital allocation to Universities in 1975, when seven new universities (known as second generation universities) were established, a policy which provides for accommodation of about 33% of the total students enrolment in the universities

was formulated and it unfortunately, brought about the problem of squatters in our students' hostels. In the middle of 1980s, the problem became so acute that students had no other choice than to live off campus and grapple with the problem of insecurity, unsteady water and electricity supplies, while some even slept in the classrooms (Esenwa, 2003), thereby, giving rise to so many problems such as female rape cases, abduction of persons, rise in incidences of prostitution and fall in academic quality. This justifies the need for more hostels in Nigerian tertiary institutions which should provide all fire preventive measures.

Theory of Fire Safety Design

Fire safety is defined by Encyclopedia Americana (1993) 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 constructional 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.

In the light of the above there is a strong need for the provision of effective fire detection devices in buildings to bring about effective fire protection for occupants of buildings.

Fire Detection and Alarm Systems

The provision of an appropriate fire detection and alarm system is an essential element of the fire safety measures in a hostel (Malven, 1997). It provides early warning of the occurrence of fire and thereby facilitates the activation of appropriate emergency procedures, including evacuation. Early detection also improves the chances of restricting the growth and spread of fire within the building by the use of first aid fire-fighting equipment, where safe to do so, and by early call-out of the fire services (Herbert, 1998). A fire detection and alarm system should be provided in all hostels. The system should incorporate automatic fire detection (heat or smoke type detectors, as appropriate) throughout the premises and suitably located manual activation facilities. Large buildings should be divided into fire alarm zones, as required by the standard, which will facilitate identification of the alarm source.

In order to make fire detection and alarm system to effectively serve its purpose, there is the need for an adequate provision of escape routes in hostel buildings. This enables the occupants exit the building and seek for help immediately.

General Provisions for Means of Escape

Effective fire safety in buildings goes beyond meeting codes. It requires a systematic and diligent approach on the part of the architect for fire prevention, protection and control in all the aspects of building design, construction and use (Malven, 1997). According to McKay (1975), the means of escape in large buildings should form an integral part of the design of the building and should be such that the occupants can make their way to safety along the escape route' by their own unaided efforts. McKay (1975) also stated that long narrow corridors with several turns and an insufficient number of staircases may lead to overcrowding and panic, which can have more disastrous results than the fire itself. McKay (1975) also reported that when escape routes are being planned the type of person likely to be involved must be considered. Occupants of flats will be familiar with the layout of the premises where as customers in a shop may be completely unfamiliar with their surroundings. In schools the fundamental principle is the provision of an alternative means of escape and in hospitals the main concern is with the adequacy of the means of escape from all parts of the building.

When fire occurs in building, large quantities of smoke and gases are produced. Smoke and hot gases may travel considerable distances within a building and will present a direct threat to life. Visibility also is considerably reduced, thereby affecting the viability of escape routes within and from the building. In examining the means of escape, it is necessary to consider the evacuation process. Herbert (1999) asserted that evacuation can be subdivided into such distinct phases as:

- Phase 1: evacuation from the room or area to a common corridor, a protected stairway or to a final exit;
- Phase 2: evacuation via a common corridor to a protected stairway or a final exit; and
- Phase 3: vertical evacuation via a protected stairway to a final exit and a designated assembly point.

Floor Surfaces on Escape Routes

The floors of corridors, lobbies, landings and stairways forming parts of escape routes should have non-slip even surfaces. Where ramps are provided for use by physically handicapped persons, they should comply with Technical Guidance Access for Disabled People (Herbert, 1998).

Height of Escape Routes

Escape routes should have minimum clear headroom of 2 m and should not have an obstructions or projections except any door frame below this height (Herbert, 1998).

Doors on Escape Routes

All doors on escape routes should generally open in the direction of escape. Doors should not open across stairways, or obstruct the width required for escape of corridors, landings, or lobbies when open. However, doors serving rooms which accommodate less than 50 persons may open into the accommodation (Herbert, 1998). A fire resisting vision panel

should be provided in fire doors which are located on corridors for the purpose of sub-division.

Principles of Escape Route Design

Herbert (1998) reported that in designing for fire escape routes, horizontal and vertical components should be considered. In bungalows, the means of escape will consist of horizontal escape routes only, while multi-storey buildings will require a combination of these two components. For the purposes of escape, the travel distances along an escape route from any point in a building should be restricted to an extent which is dependent on the availability of alternative escape routes. The horizontal escape routes may be sub-divided into the components for travel within rooms and horizontal travel from rooms to a protected stairway or to a final exit. The protection in vertical escape routes should be provided to the enclosure to the stairway at all storeys and additionally by the provision of protected lobbies, where required, between the stairs enclosure and the accommodation. In some limited situations an external escape stairway may be the only practicable way of providing an alternative means of escape from a building.

Herbert (2008) added that the general principles of escape route design recommend a list of factors required for effective means of escape. These are: number of escape routes and width of escape routes. Basically, alternative escape routes should be available so that a person confronted by fire can escape in a direction which is away from the fire. Each storey of the building should be provided with at least two escape routes, except in the case of small premises which under certain conditions may be served by a single escape stairway. Escape routes should be sufficiently wide to enable evacuation of the occupant capacity of the rooms or areas they serve. The width of escape corridors should generally be not less than 900 mm.

The review of previous works in this study has pointed out that for effective fire escape route systems to be designed in buildings; there is a need to consider the size of the building, the floor area of rooms and the population occupants. This forms a basis for the study to use this parameters to assess the viability of fire escape routes in the hostel buildings of tertiary institutions in Katsina State.

Cases of Fire Outbreak in Nigerian Tertiary Institutions

Mogbo (1999) in his paper work written in the journal of the Nigerian Institute of Quantity Surveyors pointed out that the following government educational institutions had faced the trauma of fire outbreak:

(a) the Institute of Management and Technology Enugu, burning down decades old workshops,

(b) Federal Polytechnic at Idah in Kogi state and Bida in Niger state respectively.

(c) University of Nigeria Nsukka where engineering laboratory complex as well as some staff residential quarters were razed to the ground,

(d) Ahmadu Bello University Zaria where the chapel complex was burnt down by students during religious riots and protests. There were also other cases where protesting students in some secondary schools burnt down their school buildings.

Daily independent, August 26, 2010, reported a fire incident that gutted about eight rooms of the G-block of a male hostel at Usman Danfodio University, Sokoto. Christianity Today Magazine, March 12, 2004, again reported the case of a hostel fire that destroyed twenty six lives in Nigeria, because there was only one entrance and exit to the building. 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 (2009) that the major cause of fire outbreak in Nigeria is electrical faults. All these reports have shown that the incidence of fire outbreak is a problem requiring adequate attention.

It has also been revealed from the previous research reviewed that fire outbreak is a disaster that has being a problem to domestic, public and institutional buildings. Previous studies have researched on the causes of fire, financial loss due to fire (Shittu, 2001; Shittu, 2007; Shittu, 2009), analysis of fire safety provision in tertiary institution buildings (Shittu *et al*, 2013), and relationship between fire incidences and capital expenditure (Shittu *et al*, 2015). These studies have however failed to study the factors influencing the cost of providing fire escape routes in buildings which has been identified as a major way capable of mitigating injuries in the case of fire outbreak by Shittu *et al.* (2013). This study fills this gap by carrying out an assessment of the cost of provision of fire escape routes in the hostels of tertiary institutions in Katsina State.

METHODOLOGY

This study adopted the quantitative research approach using archival data collected from Umar Musa Yar'Adua University, Katsina, Alqalam University, Katsina, Hassan Usman Katsina Polytechnic, Katsina and Federal College of Education, Katsina. The study examined three hostel buildings each from the four purposively selected higher institutions in Katsina State. This gives a population of 12 hostel buildings. The criteria for the selection of the higher institutions were age and population of hostel occupants.

Data collection was from both primary and secondary sources. Primary source of data collection was through direct measurement of floor areas, area of escape routes and number of escape routes (i.e. doors, corridors and staircases) from the hostel buildings sampled. Secondary source of data collection was from the archive of the maintenance/works

department of the selected tertiary institutions in Katsina State where data were obtained on the construction cost from 'as built' Bills of Quantities and Working Drawings and population of occupants of the hostel buildings sampled. The data were on construction cost, population of hostel occupants, floor area, area of escape routes and number of escape routes. Thus the source of data collection is a "primary source of data collection".

The data collected were analyzed scientifically using simple regression analysis to determine the relationship between the pair of variables for which the research hypotheses were tested. The regressions were subjected to four functional forms (Linear, logarithmic, square and cubic) of analyses. The strength of the relationships between the variables studied was obtained using the coefficient of determination (R^2) value. An R^2 value below 50% is taken to represent a weak relationship while that above 50% is taken to represent a strong relationship. F-Test was used to test for significance. The study assumes a 5% level of significance.

Below is the decision rule for each of the tools of the regression statistics discussed above:

F test:

The decision rule here states that:

- If $F_{calculated} > F_{tabulated}$ then relationship is significant i.e. reject H_o
- If $F_{calculated} < F_{tabulated}$ then relationship is not significant i.e. accept H_o

Coefficient of determination (R^2):

The decision rule here states that:

- If $R^2 \geq 50\%$ then relationship is strong.
- If $R^2 < 50\%$ then relationship is weak.

DATA PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS

The results of experiments carried out on fire escape routes in hostels of tertiary institutions in Katsina are presented in this section.

Data Presentation

The data collected for the study from the twelve hostels on population, escape routes and construction cost are presented in Table 1.0.

Table 1.0: Data on 12 Hostels in Tertiary Institutions of Katsina State

Hotel No.	Type of Building	Hostel Construction Cost (=N=)	Cost of Escape Route (=N=)	Population	Number of Escape Routes	Hostel Floor Area (M^2)	Area of Escape Routes (M^2)
1	2STOREY	361,396,350.00	72376912	501	178	3441.87	757.21
2	2STOREY	226,141,800.00	44785876	332	178	2380.44	478.96
3	BUNGALOW	122,076,900.00	14549168	236	67	1427.8	269.85
4	BUNGALOW	75,708,000.00	1.00E+08	108	44	757.08	115.08
5	2STOREY	470,862,000.00	70229646	444	122	3139.08	659.21
6	2STOREY	353,667,600.00	56710400	66	76	5441.04	544.1
7	2STOREY	90,787,500.00	28171265	225	84	1815.75	312.31
8	BUNGALOW	29,197,700.00	2926660	106	61	834.22	100.11
9	3STOREY	190,252,320.00	48518100	552	292	5006.64	1251.66
10	3STOREY	80,577,225.00	18219034	265	281	1852.35	244.88
11	2STOREY	201,201,000.00	27960922	201	77	2012.01	325.95
12	2STOREY	82,331,340.00	4378348	102	61	904.74	110.38

Source: Field Survey (2015)

Data Analysis and Discussion of Results

The use of regression analysis was employed to determine the relationship between the variables considered for the study. This was done to achieve the stated objectives and to test the hypothesis of the study. The regression analysis was carried out in four analyses. The results of these analyses are presented and discussed below. Table 2.0 revealed that, from the linear model, there exists a weak, positive and non-significant relationship between the cost of providing escape routes and cost of construction of hostel buildings of tertiary institutions in Katsina State.

Table 2.0 Relationship between Cost of Escape Route and Construction cost

Analysis No.	Variables X	Variables Y	Type of Model	Observations: Regression Equation	R/R^2 (%)	F_{cal}	F_{tab}	P_{value}	Strength of Relationship	Remark
1a	Cost of Escape Route	Construction Cost	Linear (Simple)	$Y = 9x10^7 + 2.487x$	54/29	4.106	4.96	0.070	Weak	NS
1b	Cost of Escape Route	Construction Cost	Cubic (Simple)	$Y = 9x10^7 - 6.334x + 3.5x10^{-7}x^2 - 2.9x10^{-15}x^3$	92.5/85.6	15.902	4.07	0.001	Strong	SS

KEY: NS = Not Significant
SS = Statistically Significant

From Table 2.0, it was observed that the coefficient of correlation (R) value was 54% indicating a strong degree of association, while the observed coefficient of determination (R^2) value was 29% indicating a weak relationship between the variables. The positive correlation observed between the variables shows a tendency that increase in the cost of providing escape routes will be accompanied by an increase in the construction cost and vice versa. The F calculated value of 4.106 observed was less than the value of F tabulated value of 4.96. The probability (P) value of 0.07 observed was greater than 0.05. The relationship between Cost of Escape Route and Construction cost was improved in the logarithmic, quadratic and cubic models where the probability (P) values observed were 0.03, 0.013 and 0.001 respectively. The observed coefficient of determination (R^2) value was improved to 85.6% indicating a strong relationship between the variables in the cubic model. These models show strong and significant relationship between Cost of Escape Route and Construction cost. The null hypothesis was therefore rejected based on these models. Table 2 gives a summary of the results of the linear model when the relationship was not significant and the cubic model when the relationship between the variables was most significant.

Table 3.0 revealed from the linear model that there exists a strong, positive and significant relationship between the population of hostel occupants and number of escape routes in hostel buildings of tertiary institutions in Katsina State.

Table 3.0: Relationship between Number of Escape Routes and Population of Hostel Occupants

Analysis No.	Variables X	Variables Y	Type of Model	Observations: Regression Equation	R/R^2 (%)	F_{cal}	F_{tab}	P_{value}	Strength of Relationship	Remark
2	Population	Number of Escape Routes	Linear (Simple)	Y = 27.29 + 0.38x	72/52	10.924	4.96	0.008	Strong	SS

KEY: SS = Statistically Significant

The observed coefficient of correlation (R) value, from Table 3, was 72% indicating a strong degree of association, while the observed coefficient of determination (R^2) value was 52% indicating a strong relationship between the variables. The positive correlation observed between the variables shows a tendency that increase in the population of hostel occupants will be accompanied by an increase in the number of escape routes and vice versa. The F calculated value of 4.106 observed was greater than the value of F tabulated value of 10.924. The probability (P) value of 0.008 observed was less than 0.05. The null hypothesis was rejected based on this. The logarithmic and quadratic models also show similar results. This agrees with the findings of McKay (1975), Melinek and Brown (1985) and Herbert (1999).

Table 4.0 revealed from the linear model that there exists a strong, positive and significant relationship between the floor area of hostel and area of escape routes in hostel buildings of tertiary institutions in Katsina State.

Table 4.0: Relationship between Hostel Floor Area and Area of Escape Routes

Analysis No.	Variables X	Variables Y	Type of Model	Observations: Regression Equation	R/R^2 (%)	F_{cal}	F_{tab}	P_{value}	Strength of Relationship	Remark
3	Hostel Floor Area	Area of Escape Routes	Linear (Simple)	Y = -9.168+ 0.182x	84/71	24.815	4.96	0.001	Strong	SS

KEY: SS = Statistically Significant

The observed coefficient of correlation (R) value, from Table 4.0, was 84% indicating a strong degree of association, while the observed coefficient of determination (R^2) value was 71% indicating a strong relationship between the variables. The positive correlation observed between the variables shows a tendency that increase in the floor area of hostel will be followed by an increase in the area of escape routes and vice versa. The F calculated value of 24.815 observed was greater than the value of F tabulated value of 4.96. The probability (P) value of 0.001 observed was less than 0.05. This formed a basis for rejecting the null hypothesis. The quadratic, logarithmic and cubic models show similar results but improved the R^2 value to 86.5%. This agrees with the findings of McKay (1975), Herbert (1999) and Shittu *et al.* (2013).

CONCLUSIONS AND RECOMMENDATIONS

The study concludes that the cost of escape routes has a significant influence on the total cost of construction. Population of hostel occupants has a significant influence on the number of escape routes which invariably has an influence on the cost of providing escape routes in hostel buildings. Hostel floor area has a significant influence on the area of escape routes which invariably has an influence on the cost of providing escape routes in hostel buildings.

Finally, population of hostel occupants, hostel floor area, number of escape routes and area of escape routes have significant influence on the cost of providing escape routes in tertiary institution buildings. It was therefore recommended that the projected number of hostel occupants should be considered in estimating the cost and number of escape routes when designing for escape routes in the hostels of tertiary institutions. Floor area of hostel buildings should also be used as a basis for determining the area of escape routes when designing for the area/space to be provided for escape routes in tertiary institution buildings.

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