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Architectural design technique for fire safety towards a proposed hostel construction in Taraba State polytechnic, Suntai

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Abstract
Fire safety strategy design plays a significant function in improving the safeness of students' buildings against conflagration outbursts. Persistently, there is an increase in fire-related problems amongst learners' boarding houses which summons the need for architectural design which plays for the safety of thousand students who are occupants of the hostels. In essence, this can provide a ground on which the strategy can play a better role to ensure the thorough safety of lives and properties in the study area. Based on that, this research simples a focus on the Architectural design strategy for fire safety towards a proposed hostel construction in Taraba State, Polytechnic, Suntai. The population of the study are the hostels of the institution under the study. Simple random sampling technique is used and this helped the researchers arrived at 75 instead of the entire frame for simple analyses. This study demonstrates that the results of a questionnaire survey which is designed inform of scales for field observation by the researchers has done a good job. This helps in assessing the conditions of the number of students' hostels in this study. The outcomes showcase some issues such as unsafety of fire outbreaks in the students' hostels around the Taraba State Polytechnic, Suntai, campus. The discoveries from the study disclosed that 'problems with a poor or unprofessional architectural design which is associated to electrical wiring, installations and many more are significant findings because the students' lives in the study are at the risk of fire outbreak. Therefore, finding out the problems and satisfactory designs for fire safety and enforcing the measures to prevent such incidences should help in the management of fire outbreaks in students' hostels and other buildings.

Keywords: Issues, Strategy for fire safety, Students' hostels

Introduction

Accommodation is one of the most essential needs of students in tertiary institutions such as the state polytechnic, Suntai. The necessity of quality housing has been of tremendous interest to humankind precisely from the early years. In a similar opinion, a good accommodation performs several functions such as providing fundamental shelter, useable occupancy, and self-fulfilment. It ensures that the requirement for a good students housing entails the need of adequate boardinghouse and installations for the provision of well-being of the occupant Afolayan (1981) [1]. Similarly, accommodation situations have been pointed out as having noticeable impacts on the quality of healthiness, job efficiency, jovial behaviour, happiness and prevailing welfare of polytechnic community (Onibokun, 1985) [19]. This condition involves not only to metropolitan and pastoral accommodation areas, but also to housing installations within the communities. In tertiary institutions such as the study area need to be systematized to provide a better students' hostels in the school domain for efficacious educational trainings. In a broader note, the hostels have to be habitable with a modern architectural design for safety. It can be in form of rooms, auditoria or flats (Schmerts, 1972). Installations such as toilets, laundry room, nightspot, etc, are also furnished for the comfort of learners.

The condition of these things is typically counseled by set criteria as sufficiently as the integer of learners anticipated to live in the hostels (Nalbantoğlu, 1993) [18].

More to that, a tiny concentration gave by the government and leaders of the educational institutions to accommodation has overseen to nauseous inadequacy in boardinghouse installations, resulting to overcrowding, over-utilization, pollution of installations and higher of risks of conflagration. It has expanded the digit of off-campus learners who cannot see spaces in the functional hostels. The consequence of this condition on educational performance, soundness and sociable behaviour of learners is pessimistic and cannot be overlooked (Onwuka, 1990) [20].

Statement of Problem

The rapid numeral of students in technical educational institution like the state poly technic, Suntau and many more have been experiencing severe accommodation troubles which dissemble students' hostels housing due to improper architectural design. The ratio of occupancy has risen by over thirty percent (30%). This implies that a large number of students are accommodating in rooms which are designed for probably four learners. In essence to that, if eventually disasterious incidence such as fire outbreaks in the hostels, many live and properties of the occupants will go missing for good. Currently, previous literatures showcase that many tertiary institutions in the state failed to account for the safety of fire outbreak through architectural design strategy that will put an end to the trend problem of boardinghouses precisely in the study area as a matter of urgency. This spectacle issue has rendered hostels lose its main objective of delivering conducive environment for academic activities. More to that, academic excellence, sociable integration, safety of lives and properties of students among others are all impeded as a result of unprofessional architectural design strategy for fire safety in the study area and so it is considered worthy of research to provide a lasting solution to the problem.

Aim and Objectives

The research aims at providing strategy design of curtailing chances of fire incidences in students' hostels. This enhances the fire resistance for safe evacuation to a place of safety. This is achieved through the following objectives:

1. To determine the level of fire risk in the hostel under study.
2. To ascertain the effectiveness of accessibility for fire fighters in the hostels under study.

Review of Related Literature

Fire Outbreak in Hostels

The containment of fire outbreak in Nigerian hostels has been a major challenge in the country. This is evident enough from the ongoing crisis in the country where student's lives are at stake as well as their belongings. Ozor (2015) narrated a fire incident which occurred in the University of Nigeria, Nsukka where a female hostel was completed razed by fire as a result of power surge. No lives were lost but the outcome resulted to the loss of property worth millions of naira. The fire could not be contained because the fire fighters ran out of water. There was no provision of water hydrant to control the fire outbreak. This drawback gave the unfortunate chance for the fire to spread to other rooms. Mary (2016) narrated an event of fire that was also caused by power surge. This happened in Bethel female hostel in Abubakar Tafawa Balewa University, Bauchi state. Power surge has always been marked as a source of fire in hostels. However, in most cases, it has always been an assumption. No proper fire risk assessment has been appropriately carried out to determine the possible cause.

In the University of Lagos, fire started as a result of student's carelessness. It was gathered that a student used a hot plate to cook and kept the heated plate under the bed. The heat from the hot plate was the source of the fire. Samson (2014) also narrated the same incidence that was caused by a cooking hot plate which resulted to an inferno in Moremi hall in Obafemi Awolowo University. Cooking strategies can be said to be one of the major problem of students in hostels. This might have emanated from inadequate or no provision of storage utility space, no provision for kitchen facilities or the problem of proper orientation of room activities.

Fire hazards can also be fatal to human lives in hostel accommodations. An unfortunate event occurred in the College of Education Agbor, Delta state, where two female undergraduate siblings were burnt to death following an inferno that razed the entire fabric of the hostel building (Ogwuda, 2014). Nadi (2015) narrated how a whole block that accommodated about 50 students got razed by fire and killed two students while several others were injured. Fire equipment were completely absent to contain the outbreak and the cause could not be determined. A far more dreadful event occurred in Government Girls Secondary School, Kano, where 7 female students died as a result of stampede as they struggled to escape the building through a narrow gate. The hostel was the largest of the 13 hostels in the school but was reduced to rubbles because of the inferno that gutted the entire structure. The possible cause could not be ascertained. Thus, the incident remained a mystery. Fire incidence in hostels keeps going on and on in the society and all over the world.

Architectural Design Strategy for Fire Safety

Fire Compartmentalization

Hong Kong Buildings Department (2011) stated that:

1. Every building should be divided into fire compartments by fire barriers without exceeding the fire compartment area/volume in order to inhibit the spread of fire;
2. A fire compartment should be enclosed by fire barriers. Protection of all openings, joints and penetrations located in a fire barrier should have a Fire Resistance Rating (FRR) not less than that of the fire barrier.

Method for Data Collection

The research design that is adopted for this research work is descriptive research whereby the data generated are documented in their natural setting without manipulation of any variable and seeks information as they exist. A case study as a descriptive research design tool is used to obtain detailed information of each event, one phenomenon at one place over an extended period of time which is clearly defined and quantified in this research work.

Method of Data Presentation and Analyses

The data collected is tallied from the raw questionnaires, organized and computed to percentages. This is done through field observation by the researchers. These were then tabulated and some data presented in tables selection of appropriate graphical presentation in the presentation.

Result and Discussion

In this section, the results of data analysis and the findings were presented. The presentations were made systematically in the order of the research questions of this study, which are presented on tables below.

RQ. 1 What is the level office risks in the hostel buildings under study?

In order to answer the above research question, the mean of the level of fire risk is calculated based on the studied cases and the summary of finding is presented in Table 1.

Tables.1 show the variables of the level of fire risk in regards to sources of fuel applied to the studied buildings, standards as established by literature, field observant at the time of visit, rating scale, mean and remark.

The level of fire risks of sources of fuel showed that highly flammable liquids recorded a very high risk of 100%. Conventional laundry activities (drying of cloths) recorded a high risk of 80%. Combustibility of wall and ceiling linings recorded a medium risk of 66%. Combustible waste recorded a low risk of 56%. Stock of combustible materials recorded a medium risk of 76%. Carpets recorded a medium risk of 66%. Curtains, drapes and blinds recorded a low risk of 56%. Bedding recorded a very high risk of 100%. Upholstery recorded a medium risk of 66%.

RQ. 2 To what extent is the effectiveness of accessibility for fire fighters applied in the hostels under study?

For the of this question to be addressed, the mean of the effectiveness of accessibility for fire fighters is calculated based on the studied cases and the summary of finding which is presented in table. 2 below. The table provides information about the variables such as fire service access and others as well. The effectiveness of accessibity for fire service vehicle access shows that 70% of minimum width of road between kerbs was moderated applied and 70% minimum width of gateways was moderately applied, 35% of minimum turning circle between kerbs was not applied, 20% of minimum turning circle between walls was not applied, 0% of minimum clear height was not applied and 100% of reverse limit was very well applied in the studied hostels. On the other hand, variables like fire fighters, fire mains, and hydrants are found to be 0% in this research.

Table 1: Level of fire risk in regards to sources of fuel in the studied hostel buildings

S/N	Attributes	Standards	Field Observations				Rating Seale			Mean Value		Percentage (%)	Remark
	Sources of Fuel		Hostel 1	Hostel 2	Hostel 3	Hostel 4	Hostel1	Hostel2	Hoste3	Hostel4			
1.0	Highly Flammable Liquids: Gases, Chemicals, Liquids & solvents, Liquid-based products	Prohibition policies on large amount of flammable substances. Keep safe in fire resisting stores.	Store is absent	Store is absent	Store is absent	Store is absent	5	5	5	5	5	100	Very High Risk
2.0	Conventional Laundry Activities(Drying of cloths)	Ensure adequate outdoor drying facilities. Drying areas must be free from fire risk.	Outdoor drying of cloths on clothes line	Outdoor drying of cloths on clothes line	Indiscriminate drying of cloths in high fire risk areas	Indiscriminate drying of cloths in high fire risk areas	1	1	5	5	4	80	High Risk
3.0	Combustibility o Wall& Ceiling Linings	Combustible linings must be FR-treated. Reduce large areas of combustible linings. Use fire resisting linings especially in fire risk areas.	Fire resisting linings. No fire retardant treatment.	Fire resisting linings. No fire retardant treatment.	Moderate areas of hardboard	Large areas of hardboard	2	2	4	,	33	66	Medium Risk
4.0	Combustible Waste: Paper, rags, cardboard, etc.	Ensure good general housekeeping. Waste bins should be located 10m away building.	Adequate waste bins(general good housekeeping).Waste bins located morethan10m away building	Inadequate waste bins(poor general housekeeping)Waste bins located 0-5maway building	Adequate waste bins(general good housekeeping).Waste bins located 5-10maway building	Inadequate waste bins(poor general housekeeping).Waste bins located 0-5maway building	1	3	2	5	2.3	56	Low Risk
5.0	Stock of Combustible Materials: Fabrics, papers, cardboards, wood, etc.	Separate stock of combustible materials from sources of ignition and by fire resisting construction.	Adequate store but non-fire resisting	Inadequate storage facilities	Inadequate storage facilities	Inadequate storage facilities	3	4	4	4	3.3	76	Medium

1=Very Low Risk,2=Low Risk,3-Medium Risk,4=High Risk,5-Very High Risk.

Source: The Regulatory Reform(Fire Safety)Order(2005)/ Field Survey: 2023

Table 2: The effectiveness of accessibility for fire fighters applied in the studied hostel buildings continuation

S/N	Attributes	Variables	Standards		Field Observations				Rating Scale				Anle A ueaMA	A Heauao (1o3a)	Remark
					Hostel 1	Hostel 2	Hostel 3	Hostel 4	1TasoH	21asoH	CI2soH	+ 1a1soH			
2.0	Fire Service Vehicle Access	Minimum Turning Circle Between Kerbs	16.8m Ø	26.0m Ø	Less than10m Ø	Less than10mØ	Less than10mØ	Less than10m Ø	2	2	2	1	1.75	35	Not Applied
		Minimum Turning Circle between Walls	19.2mØ	29.0m Ø	No turning circle between walls	No turning circle between walls	No turning circle between walls	No turning circle between walls	1	1	1	1	1	20	Not Applied
		Minimum Clear Height	3.7m	4.0m	No Height obstruction	No Height obstruction	No Height obstruction	No Height Obstruction	1	1	1	1	1	20	Not Applied
		Reverse Limit	Not more than 20m from an end of an access road		Less than 20m	Less than 20m	Less than 20m	Less than 20m	5	5	5	5	5	100	Very well Applied
3.0	Fire Mains	Buildings Fitted with Fire Mains	Fire mains inlet should be accessible and visible to a pumping appliance within 18m of the main inlet to the connection point.		Absent	Absent	Absent	Absent	1	1	1	I	1	20	Not Applied
		Buildings Not Fitted with Fire Mains	Total Floor Area (㎡)	Provide Vehicle Access (%)	Absent	Absent	Absent	Absent	1	1	1	1	1	20	Not Applied
			2,000-8,000	15 of Perimeter											
			8,000-16,000	50 of Perimeter											
			16,000-24,000	75 of Perimeter											
			Over 24,000	100 of Perimeter											
4.0	Hydrants	Criteria for Providing Hydrant(s)	Provide hydrants where a building is up to 280㎡ or more in area & 100m away from an existing fire-hydrant.		Absent	Absent	Absent	Absent	1	1	1	1	1	20	Not Applied
		Alternate Means of Hydrant(s)	- 45,000 litre of charged static water tank. - 45,000 litre of spring, canal or pond accessible to a pumping appliance		Absent	Absent	Absent	Absent	1	1	1	1	1	20	Not Applied

1=Not App Not Applied, 2 = Fairly Applied, 3 = Moderately Applied, 4 = Well Applied, 5 = Very Well Applied. 4=Well Applied,5= Very
***Source*:** Association for Specialist Fire Protection, (2011) / Field Survey: 2023 11

Discussion

This research sought to ascertain the extents to which fire safety design strategies is applied in the studied hostel buildings where applicable. Therefore the objectives are achieved through addressing the questions below in this work.

RQ.1 What is the level of fire risk in the hostels under study?

In the course of carrying out fire risk assessment in the studied hostel buildings, it clearly showed that little or no attention has been paid on managing potential threats that could cause fire incidences. Sources of ignition and fuel is still a threat in the Nigerian hostels. A common factor is overcrowding, which increases fire hazards by any additional occupant in a space as a result of lack of space. This addition adds to the fuel loads which in turn increases chances of fuel and ignition, creates over loads in electrical points and yields to shortage of storage spaces. Fire resistant storages spaces for storing flammable and combustible were not provided from observation in the course of this risk assessment, therefore the threats can hardly be measured. According to Regulatory Reformed (Fire Safety) Order (2005), there must be prohibition policies of flammable substances and must be kept safe in fire resisting stores in order to check high tendencies of fire risk. School management has a vital role to play in the impact of fire risks in hostels, which is evident from poor prohibition policies to hinder indiscrimination of spaces, especially areas with high potential threats such as cooking with hot plates. According Ebenehi *et al.* (2017), fire safety strategy should be a continuing process such that fire safety systems are regularly checked and maintained. This is because fire takes place without warning allowing building occupants limited time to react either to extinguish the fire or to escape.

RQ.4 To what extent is the effectiveness of accessibility for fire fighters applied in the hostels under study?

From the observation carried out, provision of fire fighter access was completely neglected in all the studied hostel buildings. Rowan (2011) stated that a building having up to 7.5m high must have a firefighting shaft and must consist of firefighting lobby, protected stairway, fire main outlet, valve, self-closing fire doors and a firefighting lift for buildings above 18m.

The minimum turning circle between kerbs was fairly applied with a minimum turning circle of less than 10 meters, which did not meet the minimum requirements of the Rowan (2011), which is 16.8m for pump appliance and 26m for high reach appliance. Fire mains and hydrants were not applied and were completely neglected in all the studied hostel buildings. Rowan (2011) states that fire mains inlet should be accessible and visible to a pumping appliance within 18m of the main inlet to the connection point; provide hydrants for buildings more than 280㎡ and 100m away from an existing fire-hydrant; provide alternate means of hydrants and provide vehicle access to the building.

Conclusion

In conclusion, it is possible to argue that the findings of this study contextualize the title and so the objectives are fully archived. Not only that, the research questions are equally answered in totally. Therefore, this work is worthy of benefits to the to all mentioned in the study area.

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