

Minimization of Fire Outbreaks in Nigerian Buildings Via Fire Safety Education in Architecture in the Universities

Odaudu Ugbede Sunday^{1*}, Abdullahi Aminu Lawan², Abbas Ibrahim Mu'azu³

Abstract

Frequent fire outbreak in buildings is a problem in Nigeria which has led to the loss of many human lives and the destruction of substantial properties. To minimize this menace in Nigeria, it therefore became extremely important to carry a research work to recap the architecture curriculum of study with respect to fire safety education in the universities in Nigeria, to provide guidelines for its improvement. Desktop study was considered as the instrument for the research data collection. Data were gathered from the National Universities Commission (NUC) in Nigeria with regard to the Core Curriculum and Minimum Academic Standards (CCMAS) in architecture for 2022, and other secondary sources. Consequently, they were subjected to analysis and checked by using the contents analysis technique, to get the validation of the results. Among the findings are: there is no fire safety education as a single entity architecture course in Nigerian universities through the CCMAS to fully address the frequent fire outbreaks in buildings; in pages 44 and 45 under the caption of "ARC 405: Building Services II" of the CCMAS, the required fire safety topics to be studied are not well detailed for clarity and direction; prevention of fire is found in the CCMAS but causes of fire in buildings were omitted. Among the recommended guidelines are: fire safety education as a single entity architecture course should be integrated into the CCMAS because of the frequent fire outbreaks in Nigerian buildings and every fire safety topic in architecture that should be studied in Nigerian universities must be well detailed for clarity and direction; causes of fire in buildings should be incorporated into the CCMAS in addition to the fire prevention that is already in it, to know the reasons behind fire outbreaks in buildings before their prevention measures can be proffered.

Keywords: Architecture curriculum, education, fire safety, Nigeria, universities

*Author for Correspondence

Odaudu Ugbede Sunday

E-mail: arcodauduugbede@yahoo.com

¹Lecturer, Department of Architecture, Aliko Dangote University of Science and Technology, Wudil, Kano State of Nigeria

²Lecturer, Department of Architecture, Aliko Dangote University of Science and Technology, Wudil, Kano State of Nigeria

³Lecturer, Department of Architecture, Baze University, Abuja, Nigeria

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INTRODUCTION

Fire is an exothermic and self-perpetuation reaction that occurs when a liquid, solid, or gas-phase fuel undergoes rapid oxidation; it is also called combustion in which the reaction releases light, heat, and further chemical reactions [1]. While allowing other reactions to occur, combustion is predominantly characterized as the combination of combustible materials with an agent of oxidation. When fuel and agent of oxidation are heated beyond a certain temperature, exothermic chemical reactions take place and are maintained via the additional heat energy that will be continually generated [1]. Thus, fire is produced from combustion with the required elements.

Fire safety is a set of practices with a plan to minimize the destruction emanating from fire; measures for fire safety comprise those with the intention to disallow the starting of an uncontrolled fire and the ones that are employed for limiting the development and effects of a fire after its ignition [2, 3]. Fire safety education offers a full-line of pamphlets, coloring and activity books, stickers, badges, videos, hats, promotional items, and more with regard to practical information on the dangers of fires and ways to avoid them and it is crucial for remaining calm and reacting appropriately during fires to minimize risks and damages [4–6]. It was revealed by Ibrahim et al. [7] that research showed that the design of buildings contributes very well to fire magnitude in buildings with serious implications on the safety of lives plus properties; thus, fire safety is a crucial consideration in the design of buildings to be fulfilled by architects at the design early stages, and the knowing how of safety of fire amidst architects can result to safer building designs with regards to fire prevention.

Fire prevention management is putting into use disciplined plans to make sure that the fire risks are curtailed [8, 9]. Fire prevention is made up of activities to reduce ignition sources; it focuses on fire reduction programs to the level of educating people against the things that start fires. Passive fire prevention measures are ways in which fire is prevented with maximum possibility via the design of buildings and making use of appropriate building materials [10–13]. These include the provision of areas or places of refuge, fire escapes stairs and doors, and fire training for educating occupants of buildings on protection equipment against fire and ways of exit [14–17]. In this regard, it is stated [18] that the properties and lives of people can be saved via readiness before the fire incident; they can also be saved through good management of fire. Thus, it became important that lessons should be learned from the fire management processes for building design, construction, and post-construction for optimum fire safety. There is a necessity to ensure fire safety in the planning of buildings; through it, the impacts of outbreaks of fire will be minimized [19–23]. Optimum protection and prevention against fire are enhanced with the incorporation of fire safety from the stages of design to the stages of completion of buildings which in turn curtail the risks from fire.



Figure 1. Nigeria showing its 36 States and the Federal Capital Territory, Abuja
Source: Nigeria Map – Cities and Roads. GIS Geography, 2022.

Frequent fire outbreaks in buildings, especially market buildings are a problem in Nigeria which have led to the loss of many human lives, substantial goods, and properties [24–26]. This problem is very severe in the northern part of Nigeria. For example, a huge fire over the night ravaged Muhammadu Abubakar Rimi market in Sabon Gari Area of Kano in Kano State of Nigeria and many shops and properties worth millions of Naira were badly affected; this is the second time in five months that the same market was gutted by fire [27]. Also, the Director of the Kaduna State Fire Service reported that a total of 30 people died in 716 fire incidents in buildings in Kaduna State of Nigeria in 2021 [28]. Additionally, there was a report of an outbreak of fire that occurred on 2nd March 2022 at Muna El Badawy Camp, Jere Local Government Area in Borno State of Nigeria and it was just two weeks after the last fire incident that brought damage and destruction to shelters in this state [29]. To solve this problem, it, therefore, became very necessary to overview the architecture curriculum of study with regards to fire safety education in Nigerian universities, to generate guidelines to improve it for reducing frequent fire outbreaks in Nigeria. The study area is the entire Nigeria where universities are offering architecture as a course. Figure 1 shows the map of Nigeria its 36 States and the Federal Capital Territory, Abuja.

METHODS AND PROCEDURES

A descriptive method of survey was adopted in this research, and it generated qualitative data. It was opined [30, 31] that Nigeria is made up of 36 states plus the Federal Capital Territory (FCT). The research data was obtained by desktop study. The research reviewed the architecture curriculum of study in Nigerian universities with regard to fire safety education because of the severity of fire outbreaks in Nigerian buildings [27–29]. To accomplish this, a study was conducted on the Core Curriculum and Minimum Academic Standards (CCMAS) for the Nigerian University System in Architecture for 2022 which was established by the National Universities Commission (NUC) in Nigeria in 2022, to extract relevant data regarding this research because all the universities in Nigeria directly develop their curriculum of study from it. Other secondary sources of data were obtained from reports, journals, books, theses, fire codes, guides, blogs, manuals, conference proceedings, and media. The analysis of the data of this research was done and checked via content analysis technique through the comparison of the extracted data with the raw desktop (secondary) data, to get the validation of the results. The analysis results were employed to improve the architecture curriculum of study.

DATA PRESENTATION AND DISCUSSIONS

Core Curriculum and Minimum Academic Standards for the Nigerian University System in Architecture for 2022

According to the information obtained from Joseph et al. [32] beneath the caption of “Preamble” on page 16, the reason for having the CCMAS Statement is to assist the university system in Nigeria in the planning, approval, and accreditation of programs of learning; assist the professional bodies in the accreditation program and programs review having a relationship with professional competence and others. This information is similar to the one obtained from the Buildings Department of Hong Kong [33] which indicated that the establishment of universities is for knowledge impartation and the development of several skills to ensure the productivity of students and to make students gain a living in addition to contributing towards the development of nation, and the university system is thus saddled with three main responsibilities which are: teaching, research plus servicing communities; it is appropriate to take note that quality is of utmost crucial for education in the university.

Similarly, Joseph et al. [34] revealed that degree accreditation plus the rest of academic programs are the processes of acknowledgment to evaluate standards, guidelines plus procedures, to determine a particular program quality by authorities in charge of accreditation which can be agencies of government or professional bodies. Likewise, Ibijola et al. [35] show that accreditation is the core component of quality assurance as it can be seen as a measure of the quality of academic programs or as a yes or no decision. Therefore, it can be presumed to be an assessment of whether institutions or programs meet a certain academic standard and qualities in their minimum for a particular status. Ibijola et al. [35] further revealed that accreditation in the Nigerian university system has three stated objectives

of which the first objective is to ensure that at least the provision of the documents of Minimum Academic Standard (MAS) are guaranteed, maintained, and enhanced. The number two objective is to ensure that labor employers and the rest community members who graduate in Nigeria from all academic programs have reached a minimum competence level in their specialization areas, while the number three objective is to certify to nations that the programs offered in the universities in Nigeria have high standards and the Nigerian university graduates are adequate to be employed and to go for further studies.

Also, the Council on Social Work Education [36] revealed that accreditation is a system to recognize educational schools and programs of professions connected with those schools as acquiring a performance level, quality plus integrity that qualifies them to the educational community confidence plus the public under their services. The Council for Higher Education Authority recognized the Commission on Accreditation (COA) of the Council on Social Work Education (CSWE) to accredit baccalaureate plus the programs of a degree of Master's in Education of Social Work in the United States plus its territories. The COA has the responsibility to formulate, promulgate, and implement the standards of accreditation for baccalaureate and programs of the degree of Master's in Social Work to ensure the standards show competent preparation plus to confirm that accredited programs of social work are up to the standards. Consequently, the COA of CSWE gives a multistep process of accreditation that brings into consideration self-study programs plus benchmarks, visiting of sites, and reviews of COA. Having reviewed different studies on accreditation of programs similarly related to this study, thus, the need to fully integrate fire safety education as a single entity architecture course into this purpose cannot be over-emphasized because of the frequent fire outbreaks in Nigerian buildings [25], and since Nigerian university system and professional bodies feed directly from CCMAS as their root of assistance.

In addition, page 24 under the caption "Overview" of the CCMAS shows that the program is designed to account for the changing needs of architectural education arising from the changing social, economic, psychological, and technological environment. In this regard, fully accounting for the psychological traumas from fire outbreaks in Nigerian buildings is of paramount importance. This is because frequent outbreaks of fires in Nigeria are a challenge that has resulted in the loss of human life and valuable properties and goods. From the National Association of Nigerian Traders [26], every year, there are always outbreaks of fire in Nigerian markets. An example can be taken from the statement of the Federal Fire Service of Nigeria [25] that in the space of January 2015 and March 2016, outbreaks of fire in Nigerian markets destroyed goods plus properties worth over 5.3 trillion Naira as worth and 600 lives of people.

Literature shows that the National Fire Safety Code of Nigeria (NFSCN) lacks enforcement to effectively reduce the frequent fire outbreaks in Nigeria despite the engagement of different building professional bodies in its preparation [37]. According to the acknowledgment page of the NFSCN, the Nigerian Institute of Architects, the Architects Registration Council of Nigeria, the Department of Architectural Services in the Nigerian Federal Ministry of Works and Housing, and other bodies of Nigerian building professionals were engaged in the preparation of the 2013 (first) edition of the NFSCN that is currently (2023) in use. Yet, it gives little consideration to the use of building design for reducing outbreaks of fire and the spread of fires in buildings (passive prevention and protection measures against fire) in just five pages with fire resistance constructions in only seven pages which are building engineering aspect, and this is a serious weakness.

From the information obtained from the National Universities Commission [32], beneath the caption of "Preface" on page 10 of the CCMAS, the documents of CCMAS are structured in a unique way to give 70% of core courses for every program, while giving allowance for universities to utilize the remaining 30% for other innovative courses in their peculiar areas of focus. The consideration of full attention to fire safety education in architecture should be among the key factors to consider in this regard. Nevertheless, CCMAS must also share from this remaining 30% for other innovative courses to be utilized by universities, to reduce this huge percentage allocated to universities.

Giving full attention to fire safety education in architecture cannot be over-emphasized because there is a necessity to ensure fire safety in the planning of buildings; through it, the impacts of fire outbreaks will be minimized [19–23]. There is a need to design buildings to give an acceptable fire safety level with the reduction of heat and smoke risks; the main objective is to have minimization within the limits of acceptance of death or injury potential to the building occupants plus others who may be part of the involvement like the fire plus rescue services [38]. Also, crucial are protecting contents and ensuring that as much as possible of a building can continue to function after a fire and that it can be repaired; the risk to adjoining properties also needs to be considered as well as possible environmental pollution [38].

Page 24 under the caption “Overview” of the CCMAS shows that the architecture program is designed as a two-tier degree structure. The first-degree results in the award of the Degree of Bachelor’s in architecture and the second-tier results in the award of the Degree of Master’s in architecture. Yet, fire safety education as a single entity architecture course is not captured in the program. Likewise, the study conducted by Ibrahim et al. [7] showed that architects undergo education in fire safety in different modules, but they are not as a distinct course even though education in fire safety gives them a basic understanding of the principles of fire safety plus gives a determination of when to have consultation with the experts of fire. Among the recommendations of this study are the creation of a separate course on the safety of fire and if they are taught among other modules, there should be allocation of additional time/depth to their contents. This is because studies showed that the design of buildings contributes much to fire magnitude buildings with serious consequences on life plus property safety; thus, the safety of fire is a crucial consideration in the design of buildings which architects seek to achieve at the initial stage of design because the knowledge of safety of fire by architects can support the design of safer buildings with regards to fire protection [7].

Pages 26 to 27 under the caption of “Global Course Structure” of the CCMAS reveal first year (100 level) to final year: fourth year (400 level) courses as graduation requirements for undergraduate architecture programs in all Nigerian universities but there is no fire safety education as a single entity architecture course in Nigerian universities through this CCMAS to fully address the severity of fire cases in buildings even though in Nigeria, fire outbreak is a perennial problem with about 7,000 incidents annually; the extensive loss of lives and properties from continuous outbreaks of fire indicate the obvious need to solve the problem of incidences of fire as reported by Daramola et al. [39]. However, it was observed that on pages 44 and 45 under the caption of “ARC 405: Building Services II” of the CCMAS, the required fire safety topics to be studied are not detailed enough for clarity and direction in these pages and they include:

1. Fire systems are mainly in domestic buildings.
2. Fire prevention.
3. Fire codes.
4. Fire equipment in buildings.

Providing more details regarding fire systems mainly in domestic buildings, fire prevention, fire codes, and fire equipment in buildings cannot be over-emphasized because the Health and Safety Authority and the Department of Developmental Services [40, 41] supported that the strategy of fire prevention plus the assessment of fire risk should consider detail plus a complete consideration of all issues including those resulting from heat, oxygen plus fuel and followed by advice on these three elements.

FIRE SYSTEMS MAINLY IN DOMESTIC BUILDINGS

The CCMAS emphasized fire system consideration mainly in domestic buildings. However, frequent fire outbreaks in commercial buildings like markets are significantly rated high in Nigeria [24–26]. Yet, in the CCMAS, emphasis was not given to the need to significantly consider other buildings like markets that are vulnerable to fire. Thus, addressing this issue cannot be over-emphasized as Ibrahim et al. [7] also pointed out that for any building design to be effective in terms of satisfying both architectural and

technical objectives, fire safety must be integrated early in the building design process as most of the passive fire protection design for structural framing remains within the responsibility of project Architect with little if any input from a fire protection or structural engineer.

Nevertheless, Ibrahim et al. [7] further stated that although architects are not fire scientists by training; it is crucial for them to have awareness of the fundamental principles of fire safety because of their roles as principal designers of all buildings. Therefore, it should be ensured by architects to be familiar with specific issues of safety of all buildings being designed including getting relevant advice plus information from the specialists of fire at the initial stage of building design. Thus, all this knowledge must be addressed in the CCMAS.

FIRE PREVENTION

Fire prevention management is putting into use disciplined plans to make sure that the fire risks are curtailed [9, 41]. The prevention plans are not stated in the CCMAS with regard to the distances between buildings and fire resistivity of building materials and other prevention measures. According to Neufert and Botma [42, 43], the spaces between buildings or the spaces between the buildings and boundaries are truly very important factors to consider as they are the severity of the outbreaks of fire that are ascertained via the fire loads of buildings. Hence, fire safety will be enhanced in buildings. In addition, Studies [44–46] indicated that the combustibility of materials of buildings is a key factor for consideration during the design of buildings against fires. The consideration of these prevention plans in the CCMAS is of paramount importance.

In addition, prevention of fire is one of the topics to be studied in the CCMAS but how can fire prevention be studied without knowing what causes fire in buildings? From the information obtained from Sikazwe [47], fire causes are the factors or factors resulting in a fire and the factor for the cause can be but has no limitation to the outcome of intentional or unintentional action, failure due to mechanical issues, or act of nature. Nwaogu [48] revealed that outbreaks of fire in markets in Nigeria always occur in different places and they are rated significantly. Most of these fires are a result of factors like electric sparks, cookers plus storing of fuel that is adulterated [48]. It has been established that whether from the crackers of fire or faults from electricity plus other ways of fire outbreaks in Nigerian markets, lives of people plus properties worth millions of Naira are usually lost in such fires [25, 26]. Considering the above causes of fire, they must receive attention in the CCMAS.

FIRE CODES

Fire safety codes are regulations or guidelines enforced under the act of fire prevention plus the protection of a country that is made up of a set of minimum standards that provide respect to the safety of fire within plus around the existing facilities or buildings [20, 49–52]. What kind of fire codes with regard to the particular countries are expected to be studied in this regard? This has resulted in a vague statement that should be addressed in the CCMAS.

FIRE EQUIPMENT IN BUILDINGS

There are different types of fire equipment in buildings; among them are emergency lighting systems, street fire hydrants, sprinklers, Argonite automatic fire suppression equipment, fire hose reels, fire alarm systems, and portable fire extinguishers [53–57]. The types of fire equipment in buildings to study were not stated in the CCMAS and the details of what to be studied about them like their spacing between each other were not provided. Therefore, these issues must be properly addressed in the CCMAS.

CONCLUSION AND RECOMMENDATIONS

The research overviewed the architecture curriculum of study with regard to fire safety education in universities as an avenue to generate guidelines to improve it for reducing frequent fire outbreaks in Nigeria. The research findings revealed that: there is a need to fully integrate fire safety education as a single entity architecture course into the CCMAS provided by the NUC because of the frequent fire

outbreaks in Nigerian buildings; there is a need to fully integrate fire safety education as a single entity architecture course into the Nigerian university system to address problems of frequent fire outbreaks in Nigerian buildings since Nigerian university system feeds directly from the CCMAS as their assistance base for designing, approving and accrediting programs of learning and since the documents of CCMAS are structured in a unique way to provide 70% of major courses for every program while giving allowance to universities to make use of the remaining 30% for the rest of innovative courses in their specific areas of emphasis.

In addition, it is needed to completely integrate education of fire safety as a single entity architecture course into the programme of architecture professional bodies to address the problem of frequent fire outbreaks in Nigerian buildings, since professional bodies feed directly from the CCMAS as their assistance base in accrediting and reviewing their programmes with regards to competence of professions; there is a need for CCMAS to fully account for the psychological traumas from fire outbreaks in Nigerian buildings, since it is designed to account for the changing needs of the architectural education arising from changing psychological environment; the required fire safety topics to be studied under the caption of “ARC 405: Building Services II” in CCMAS are not well detailed for clarity and direction; emphasis was given to fire system mainly in domestic buildings, while other vulnerable buildings to fire in Nigeria like market buildings were not emphasized in the CCMAS, in order to drastically reduce the frequent fire outbreaks in Nigerian buildings; prevention of fire is found in the CCMAS but causes of fire in buildings were omitted in it. Having considered the findings of this research, the following guidelines are therefore recommended:

Guidelines to Improve Architecture Curriculum of Study for Reducing Frequent Fire Outbreaks in Nigeria

1. The National Universities Commission (NUC) in Nigeria should integrate fire safety education as a single entity architecture course into the CCMAS.
2. Fire safety education as a single entity architecture course should be integrated into the university system in Nigeria, since the university system in Nigeria directly feeds from the CCMAS as their assistance base to design, approve, and accredit the programs of learning and since the documents of CCMAS are structured in a unique way to give 70% of major courses for every program, while giving allowance to universities to make use of the remaining 30% for the rest of innovative courses in their specific areas of emphasis.
3. Fire safety education as a single entity architecture course should be integrated into the program of architecture professional bodies: Architects Registration Council of Nigeria, and the Nigerian Institute of Architects, since professional bodies feed directly from the CCMAS as their root of assistance in their accreditation and review of programs relating to professional competence.
4. CCMAS should fully account for the psychological traumas from fire outbreaks in Nigerian buildings since it is designed to account for the changing needs of architectural education arising from the changing psychological environment.
5. The required fire safety topics to be studied under the caption of “ARC 405: Building Services II” in CCMAS should be well detailed for clarity and direction, especially with regards to the minimum distances between buildings that can stop fire spread from buildings to buildings.
6. Emphasis should not only be given to the fire system mainly in domestic buildings in the CCMAS, but it should also be given to other vulnerable buildings to fire like market buildings.
7. Causes of fire in buildings should be incorporated into the CCMAS in addition to the fire prevention that is already in it, to know the reasons behind fire outbreaks in buildings before their prevention measures can be proffered.

RESEARCH GAP

This research relied absolutely on the secondary sources of data without a direct visit to the universities, to obtain physical or primary data relating to the current architecture curriculum of study with regards to fire safety education and this is a knowledge gap. Therefore, in subsequent research of this nature, this gap should be filled.

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