

## THE ROLE OF DESIGN AND CONSTRUCTION IN MITIGATING FIRE DISASTERS IN HOUSING IN NIGERIA

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### ABSTRACT

*Fire occurrence in and around human living spaces is inevitable due to the twin inescapable human errors of commission and omission. Fire disaster could render a whole family homeless in a blink of a moment, a government building totally inhabitable and vital document completely burnt, and even sustainable private and public housing effort might be threatened by unexpected fire disasters. According to NEMA (2012), “ A disaster describes the situation where the occurrence of abnormal or infrequent hazardous event has impact on the communities, causing substantial damages, disruption and possible casualties and leaving the affected communities unable to function normally without external assistance”. Nothing could be sustainably done to stop fire occurrence but the concern is how the spread could be mitigated. The paper examined fire disaster, the hazards, destruction of property and loss of lives. It focused on fire spread and ways of curtailing it through design and construction management. It also determined measures that could be taken to mitigate the impacts. The research methodology made use of primary and secondary data for its data. The primary sources were made up of field surveys, use of questionnaires randomly administered to relevant professionals and stakeholders in housing provisions. Secondary sources were used encompassing extracts from related literatures, journals, magazines and articles from the internet. The data were analysed using discreet statistics and presented in tables and graphs. The results showed that fire occurrence could not be humanly stopped but the spread through material specifications, using fire rated doors and windows, compartmentalising building spaces and treating them with materials resistant to fire, and avoiding fire fuels in housing environment vulnerable to fires. The paper concluded that through design and construction management the impact of fire disaster could be minimised.*

**Keywords:** Designs, Construction management, Fire disaster, Housing.

### Introduction

In recent years they have been cases of fire disasters leaving behind irreparable loses of lives and property. The result of most fire disasters leaves behind unforgettable experiences in the

minds of victims. Sometimes when fire occurred, could lead to death of hundreds of persons and sometimes up to thousands. Sometimes a whole life time investment either in property or humans could be razed down in a moment by fire. Of recent a final year medical student in a room along with other students were burnt to death due to gas explosion. Such experiences happen frequently as noted by Richman (2015), in his lecture titled Nigerian fire disasters, identifying bottlenecks in the planning of burn care, stated that “victims of fire accidents come in various sizes and complexities”. He further stated that “most devastating of the fire disasters in the nation’s history, was the pipe line explosion which occurred in Jesse in Delta state on October 18, 1998 which accounted for the highest number of casualties with 1082 persons dead and hundreds injured”.

The complexity about fire is that the occurrence is most of the time inevitable due to inherent human complexity especially his attitude to handling things. Also fire disaster like every other disaster is complex. As noted by NEMA (2012), “disasters are complex events with multi-faceted causes and hence disaster management needs comprehensive, multi-disciplinary to deal with both the complexity and change”. It further stated “man’s major effort at survival and self-preservation is directed towards the mastery of his environments. Unfortunately there are limitations to his effort when any disruptive or harmful sudden event occurred. The condition which create these accidents are called hazards while the impacts especially if the scale is large are called disasters”.

Fire disaster could have psychological effect and death on people who only even heard about it. Some years back, a man’s only son was returning to school after holidays, was involved in an accident and all in the motor were burnt to death. The news psychologically affected the father and later became paralytic. He eventually died later.

Others have also corroborated the fact that the possibility of fire disasters are not preventable but technical measures could be adduced to abate the spread. According to Issah and Aliyu (2012), “the natural disaster is likely to happen any time and cannot be prevented, but measures could be taken to reduce the possibility regardless of the many forms that a disaster may take”. On the issue of public enlightenment and education on the enormous impacts of fire, Osaro (2013), said that “the nation has not been properly enlightened on the enormous impact of fire on lives and property”. He further stated “fire outbreak is an emergency which requires a well-coordinated and effective response to reduce injuries, protect assets, and prepare the organization for a smooth and rapid recovery”. He further stated that, “the impacts of fire on families, organizations, society are enormous. Many business organizations that have had major fire incidents never recover. They were forced to go out of business for good due to vital loss of business infrastructures and records”.

The effect of fire on man is generally terrible and immeasurable. Fire result is a major cause of accident or untimely death. Injuries and burns from fires could disfigure their victims permanently for life. Sometimes they could become reclusive and do not want to be seen in public.

In spite of the above, nothing could be sustainably done to stop the occurrence but something could be done to mitigate the spread, which is the substance of this study.

### **Aim and objectives**

The paper is aimed at enlightening housing developers and users about fire, the occurrence, spread, hazards and havocs, and motivating them that through users’ prudence, efficient designs, specification and construction management, the impacts of fire on lives and property could be minimised. The objectives are:

- i. To detect hazard and havoc due to fire.
- ii. To identify causes and sources of fire
- iii. To find out design and construction measures for curtailing fire spread.
- iv. To determine fire safety measures for security of people and property against fire.

### **Scope and limitation**

The scope of the paper is limited to identifying fire, the causes, sources, hazards and identifying design and construction measures that could be adopted to reduce the spread of fire in housing, in order to mitigate the havocs on lives and property.

### **Theoretical analysis**

“Fire is the rapid oxidation of a material in the **exothermic** chemical process of combustion, releasing heat, light and various reaction products. At a certain point in the combustion reaction called the ignition point, flames are produced. The flame is the visible portion of fire”.  
Wikipedia (2015)

“The risk of fire is one of the greatest threats to health and safety, property and the delivery of essential services in any community. The loss of lives or property as a result of fire is a tragedy. Industry and government and indeed every one share in the responsibility of protecting lives and property from the consequences of fire” (An extract from Northern Aboriginal Affairs and development, Canada.) From the above, the response of every one should be proactive as fire disaster could render a whole family homeless in a blink of a moment, a government building totally inhabitable and vital documents completely burnt, and even sustainable private and public housing efforts might be threatened by unexpected fire disasters.

Fire protection is linked up with mitigating the spread. Once the spread is localised, lives and property would have been protected against fire hazards. Foster and Harrington (1980), define fire protection as, “the protection of occupants, contents and structure of building from the risks associated with fire”. It takes coordinated effort of users, developers, designers and construction crews to ensure this. Due to the effects of fire on man if allowed to spread, Barry (1982) posits that practical measures should be adopted to localise the effect of fire. One of such measures is the provision of fire breaks or stops on openings. He defines fire breaks or stops as “solid or incombustible up stand or projections to windows that serve as a barrier to the spread of fire from one window to an adjacent window”.

Fire occurrence could take place any time and usually occupants are unprepared hence building components must be designed and constructed to be fire resistant so that in the event of any occurrence they could resist fire for some time before external interventions. To achieve this, we could have fire doors fixed along means of escape. According to Barry (1982), “fire doors are fixed to walls that act as fire barriers to maintain the effectiveness of walls as barriers to the spread of fire and along means of escape routes in building, as a barrier to the product of combustion. Such doors might also be designated some times ashalf hour or one hour fire resistant, which means that the door will give protection against fire for the period required”.

Seely (1982), corroborates above stance on measures to mitigate fire spread. According to him “the spread of fire over a surface could be restricted by the provisions for such materials to have low rates of surface spread of flame, and in some cases restrict the rate of heat produced”.

Substantiating above views, Punmia and Jain (2008), said that “No building material is perfectly fire proof. Every building contains some materials such as furniture, clothing, eatables which can easily catch fires or which are vulnerable to fire. However, the endeavour of the Architects and engineers should be to plan, design and construct the building in such a way that

safety of the occupant may be ensured to the maximum possible extent in the event of fire outbreak in the building due to any reason whatever". The technical interpretation of fire safety of building is to convey the fire resistant of a building in terms of hours when subjected to fire of known intensity. Punmia and Jain (2008) further opined that "The building should have adequate time interval so that the adequate protection for the occupants could be afforded".

### **Sources of Fire in Housing**

Sources of fire could be many and even innumerable. According to Issah and Aliyu (2012), "fire could originate from both external and or internal sources. External sources include the risk of bush burnings, and lightning strikes. Internal risks of fire are ever present with our wide spread reliance on the use of electrical appliances such as desk lamps, heaters, computers, power boards and other equipment within the collection building". In general, the sources are surmised under error of omission and commission that is human inherent tendency to evade his responsibility and the attempt at hiding his heinous activities through fragrant ignition of fires.

For further enlightenment and understanding, some other potential ignition sources of fires are outlined as follow:

- Smokers' materials such as cigarettes, matches and lighters.
- Naked flames such as gas open flame equipment.
- Electrical, gas, oil- fired heaters ( could be fixed or portable)
- Cooking and lighting equipment
- Deliberate fire raising
- Faulty or unused electrical equipment
- Sparks and frictional heat such as from over heating
- Interaction of reactive chemicals

### **A brief review of some selected havocs in Nigeria selected fires Disasters**

**The NECOM House fire outbreak in 1983:** The building was a 37 storey structure housing the then NITEL in Lagos. The fire started mysteriously and the havoc was tremendous. The loss was mostly on the property as it was learnt fire started in one of the nights of the year. It cost the Federal government colossal amount of money to renovate the building, not to talk of the vital document lost in the inferno.

**Pipe line explosion in Jesse, Delta State:** This occurred according to NEMA in october18, 1998 which accounted for the highest number of casualties with 1082 person's dead and hundreds injured. The impact on property could be much.

**Multiple bomb explosions at the Nigerian military cantonment, Lagos:** This occurred on January 27, 2002, which left up to 800 persons dead and thousands homeless.

**Pipe line explosion, Abule Egba (Lagos):** This occurred in December 26, 2006. Up to 700 persons lost their lives and several undefined persons injured.

**Frequent fire accidents in the year 2012, in Abuja, the Federal capital:** Not fewer than 69 persons were killed in the fire incidents and property worth 765 million naira was also destroyed during the period (**extract** from the Federal fire service magazine).

**Various fire accidents in Rivers State:** these occurred in 2012, and no fewer than 230 persons died while 73 others received various degrees of injuries in 222 recorded fire incidents that occurred in Port Harcourt and other parts of the state.

**Numerous fire accidents in Osun and Gombe States:** in Osun State fire incidents claimed 31 lives and destroyed property worth 227 million naira in 2012. Also the same year in Gombe State, fire killed about 60 persons and damaged property worth 790 million naira.

**Innumerable bombing activities in Nigeria particularly in the north East:** Bombings in several parts of the North East and some other parts of the country since 2009, has left uncountable number of persons dead and property worth billions of naira destroyed.

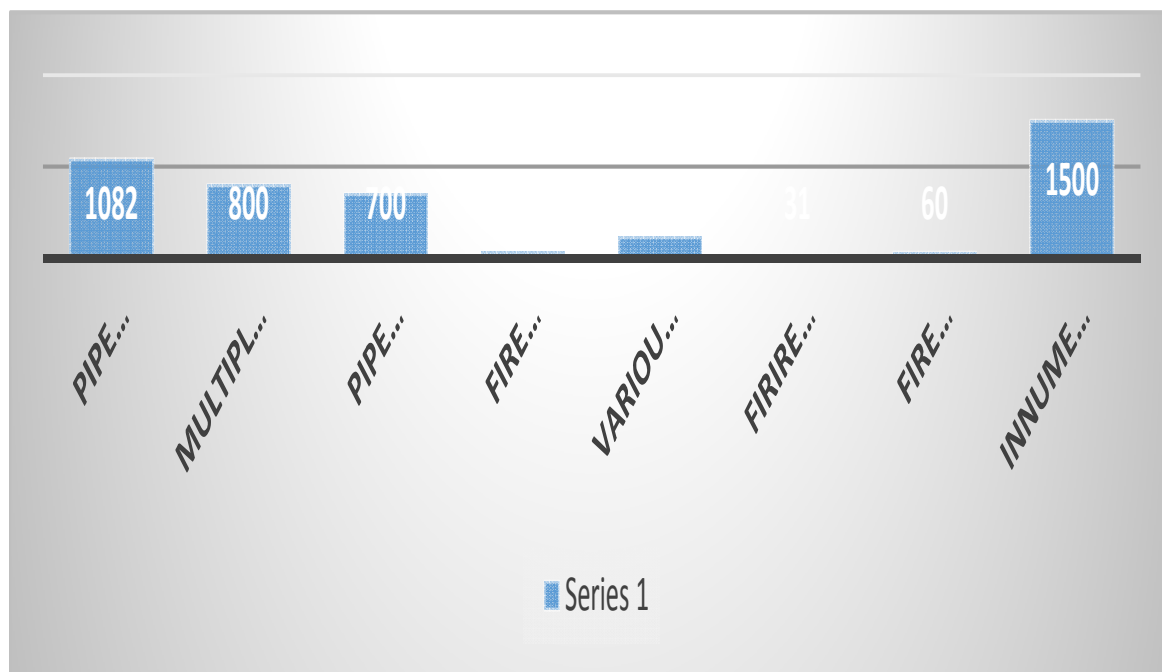
Above data is further presented on table for easier understanding

Table I: Some selected fire havocs in Nigeria.

S/N	Type of fire	Estimated number of lives lost	Value of property	State/Town	Year of occurrence
1	NECOM House fire outbreak	Un defined	Multi million naira	Lagos	1983
2	Pipe line fire explosion	1082	Un defined	Jesse, Delta	1998
3	Multiple bomb explosion at military cantonment	800	"	Lagos	2002
4	Pipe line fire explosion	700	Un defined	Lagos	2006
5	Frequent fire accidents	69	765 million naira	Abuja	2012
6	Various fire accidents	230	Un defined	rivers	2012
7	Numerous fire accidents	31	227 million naira	Osun	2012
	Numerous fire accidents	60	790 million naira	Gombe	2012
8	Innumerable bombing	Thousands of lives	Un defined		Since 2009 till date.

Source: Extracts from NEMA (National Emergency Management Agency), Publication.

Fig I. Graphical representation of loss of lives due to fires



## Methodology of Research

The research methodology made use of primary and secondary data for its data. The primary sources were made up of field surveys, use of questionnaires randomly administered to relevant professionals and stakeholders in housing provision. Secondary sources were used encompassing extracts from related literatures, journals, magazines and articles from the internet. Data collected from these sources were analysed with the intent to finding out the causes and sources of fire, and what could be done professionally to curtail the spread of fire and ensure the security of people and property.

## Results

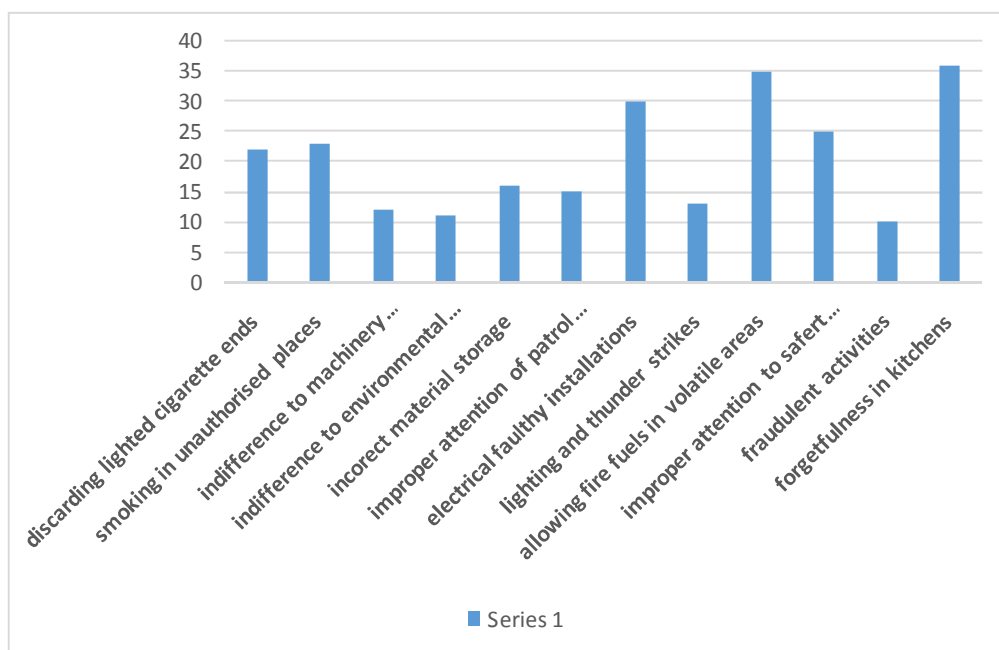
The data generated from the questionnaires, field observations, extracts from literatures and journals are presented below:

**Table 2: Questionnaires format and responses**

S/N	CAUSES	VIM	FIM	NIM
1	Careless discarding of lighted ends of cigarette , matches	22	14	3
2	Smoking in unauthorised places	23	11	4
3	Indifference to maintenance of machinery including overloading of bearings	12	19	7
4	General indifference to environmental cleanness	11	20	8
5	Incorrect storage of materials	16	16	2
6	Faulty workmanship in electrical installations	30	4	2
7	Improper attention of persons concerned with inspection and patrol of premises	15	19	2
8	Natural means through lightning and thunder strikes	13	21	5
9	Allowing fire fuels in areas vulnerable to fire hazards	35	2	1
10	Improper attention to fire safety regulations	25	11	1
11	Desire to cover up fraudulent activities	10	23	4
12	Forgetfulness especially in kitchens using gas cookers	36	1	1

Note please: VIM: Very important. FIM: Fairly Important. NIM: Not Important.

Fig. 2. Graphical representation of the ranking in table 2



## Findings and discussions

Table 3 shows that among the varying parameters that cause fires in buildings, forgetfulness ranks the first. The reasons amongst others are that forgetfulness is part of human nature. He tends to forget vital responsibilities because of multitude of activities in the course of the day.

**Table 3: Ranking Of the Causes of Fire in Housing**

S/N	CAUSES	VIM 5	FIM 3	NIM 2	MEAN	RANKING
1	Forgetfulness especially in kitchens using gas cookers	36	1	1	4.84	1
2	Allowing fire fuels in areas vulnerable to fire hazards	35	2	1	4.82	2
3	Faulty workmanship in electrical installations	30	4	4	4.47	3
4	Improper attention to fire safety regulations	25	11	2	4.26	4
5	Smoking in unauthorised places	23	11	4	4.11	5
6	Careless discarding of lighted ends of cigarette , matches	22	13	3	4.07	6
7	Incorrect storage of materials	16	16	6	3.68	7
8	Improper attention of persons concerned with inspection and patrol of premises	15	17	6	3.63	8
9	Natural means through lightning and thunder strikes	13	20	5	3.55	9
10	Indifference to maintenance of machinery including overloading of bearings	12	19	7	3.45	10
11	General indifference to environmental cleanness	11	20	7	3.40	11
12	Desire to cover up fraudulent activities	10	22	6	3.37	12

**Note please: VIM: Very important. FIM: Fairly Important. NIM: Not Important**

Number of questionnaires collated = 38

Consequent upon the analysis of the questionnaires administered, field surveys, observations, extracts from related journals, the following were identified as the probable causes of fires in buildings: Forgetfulness especially in kitchens using gas cookers, Allowing fire fuels in areas vulnerable to fire hazards, Faulty workmanship in electrical installations, Improper attention to fire safety regulations, Smoking in unauthorised places, Careless discarding of lighted ends of cigarette and matches, Incorrect storage of materials, Improper attention of persons concerned with inspection and patrol of premises, Natural means through lightning and thunder strikes, Indifference to maintenance of machinery including overloading of bearings, General indifference to environmental cleanness, Desire to cover up fraudulent activities:

- a. Forgetfulness especially in kitchens using gas cookers: This is one of the identified causes of fires in buildings as this hovers around human nature. This is further explained thus:
  - i. Gas is usually in vapour form and so escapes or circulates with air. When it is left to leak out for some times, it fills the air and any scratch of flame could submerge the whole building with fire.
  - ii. Procrastinating at fixing identified gas leakages: In line with the above, if gas leakage is detected and not immediately fixed, it could lead to unexpected fire outbreak.
  - iii. Storage of fire fuels in kitchen pending convenient time: Fire fuels are subtle sources of fire and when in kitchen could lead to easy spread of fire when ignited.

- iv. Due to multitude of activities: where the family is large and a woman has to attend to many responsibilities, food being cook could be left on fire unattended to. This has caused fires several times in the past.
- v. Lack of the required skill for applying or using fire extinguishers: Fire occurrence could be unexpected so housing users should be acquainted with the use of extinguishers, and where this is forgotten when fire starts could spread unabated.
- vi. Forgetting flammable fluid in the room: Fluid like flammable oil should not be kept in rooms susceptible to fires but be kept far away from sleeping spaces. Where this is not done, unexpected fire could occur.
- b. Allowing fire fuels in areas vulnerable to fire hazards: Fire fuels such as rugs, PVC tiles, and carpets are means of easy spread of fires. Floors of rooms should be left bare instead of being finished with such materials. Where there is money floors should be finished with ceramic tiles or marble as means of averting fire spread.
- c. Faulty workmanship in electrical installations: When the electrical connection of a house is properly done, there might not be any fire threat through it. However regular maintenance and checking are required after some years. Where this is neglected could lead to fire sparks and spread. As the construction of a house is in progress, well trained and experience electrical experts should be called to do the installations as electrical works should never be managed due the negative effect of it.
- d. Improper attention to fire safety regulations: house or building users should acquaint themselves with the available safety regulations and strive to apply them. When such regulations are neglected, could lead to fire spread.
- e. Smoking in unauthorised places: Smoking has caused avoidable fires in the time past and so it should be outlawed especially in public places even where not vulnerable to fire hazards as the effect of any fire outbreak could be tremendous. Smoking should be avoided in critical places such as filling stations, gas stations, kitchens where gas burners are used and provision should be made for cigarette tubs in places smoking is allowed.
- f. Incorrect storage of materials: Materials should be properly stored in the appropriate spaces for orderliness and in order to evade any probable fires. Where materials both flammable and non-flammable are not appropriately kept, they could be sources of fire spread and actual outbreak.
- g. Improper attention of persons concerned with inspection and patrol of premises: If those concerned with such responsibilities do not live up to their call, fire could also occur. Avoidable fires have occurred in the past where such people neglected their responsibilities. Security, fire and police men should not neglect their duty to avoid fire occurrences in such places.
- h. Natural means through lightning and thunder strikes: unprotected buildings could be struck by lightning or thunder storms and that could lead to fire outbreak. Construction specifications require that buildings especially tall ones should be protected against thunder storms with the use of lightning rods normally placed at the highest point of a building. If building developers do not comply with such specifications, avoidable fires could occur.
- i. Indifference to maintenance of machinery including overloading of bearings: Although this is not a major cause of fire in buildings however if expected maintenance is persistently neglected, it could lead to fire outbreak. Where machinery needs to be lubricated it should be immediately done to avoid fire problems.
- j. General indifference to environmental cleanness: Cases of fire occurring due to indifference to environmental cleanness took place in the time past. They are also cases of bush burning that had encroached into human living spaces and have resulted in fire outbreak that led to the destruction of lives and property.



- k. Desire to cover up fraudulent activities: this is mostly prevalent in public buildings where people in a bid to cover shady activities snap up a whole building with fire. A particular case was the NECOM house fire in Lagos in 1983. Over one of the nights in that particular year fire just started in the house. It cost government fortunes to renovate the house. Way out in this case is the installation of water sprinklers in strategic areas of such buildings.

**General Tips on how to prevent fire in homes:** The following are some technical tips on how to prevent fire occurrence in homes if prudently applied:

**To prevent fire from electrical faults:** You must never over load electrical outlets or sockets. Also do not replace a fuse wire with cable, according to Akomolede (2015), “if the fuse wire got burnt and cut off your light, ask a qualified electrician to find out why it cut off and find out the cause before putting another fuse”. The fuse is there to cut off light when there is a danger but when you replace it with a cable of higher melting point, it will cut off light but may result to fire outbreak.

**Always turn off all electrical appliances when not in use even for very short moment:** The appliances include air conditioning system, fans, pressing iron, boiling rigs or kettle, electric cookers, computers, televisions etc.

**Check your gas cylinder regularly for leakages especially before striking a match:** to prevent any probable fire out break through this medium, Akomolede (2015), opined that “it is advisable to let your gas cylinder to be outside the kitchen so that any leakage can flow into the air outside the house with less risk of fire”. Also avoid turning on the gas before looking for a match to light it.

**Do not store petrol in your house:** If you must use petrol generator, keep petrol far from the kitchen and the generator itself. Do not use lantern or candle near the generator. Also when you want to turn it on, also do not refuel while the generator is on.

**Reduce the amount of combustible materials to the minimum in the house:** Do not use rug or rubber carpets. They aid fire spread quickly. Leave your floor bear with tiles or marble or terrazzo finish.

Whenever you use insecticide, do not bring naked fire into the room until the insecticide in the air is no longer potent.

**Installation of fire extinguishers at strategic part of the house:** it is important to have fire extinguishers in the house and should be located in conspicuous places where they could be assessed without hindrances in case of fire.

**Always use qualified electrical engineers when building a new house:** You could save money by using a semi illiterate electrician but the cost of the risk could be very high.

**Children also could be sources of fire ignition in homes:** In his technical advice on how to keep fire occurrence under check, Osaro (2013), advised that “all matches, lighters and candles should be kept out of the reach of small children, and that young children should be taught to bring matches or lighters they find to the adults”. Children should be taught that lighters or matches are tools to be used only in the presence of adults.

## **Design, specification and construction measures for mitigating fire spread in housing**

They could be so many of them. Below are some of them as extracted from books, journals, related literatures and observations?

**Fire detection alarm system:** According to the new encyclopaedia Britannica (16<sup>th</sup> Edition), “It is the means of warning in case of fire. Today they are automatic fire alarm systems consisting of thermostat activated devices that at a certain temperature that either sound an alarm or report to a central fire office for further action”. The thermostat is usually placed at or near the ceiling where it will be most immediately affected by increase in temperature. Fire alarm system reduces the time in notifying occupants, security personnel and emergency respondents.

**Ignition sources:** reducing the probability of ignition is a critical factor in abating fire and its spread. Ignition sources exist in various forms including electrical wiring. They should be good housekeeping, fire prevention plans, regular inspection and maintenance programme.

**Compartmentalization:** This prevents fire from spreading through a building. Fire rated compartmentalization meant to limit the horizontal and vertical spread of fire, smoke and heat, including protection on door openings help limit fire consuming large areas.

**Maintaining structural integrity:** A building structural fabric needs to continue to support its load during a fire. However fire has an adverse effect on the performance of the structural elements. Fire proofing, inbuilt fire ratings and proper interconnection of the structural elements help to increase building structural integrity.

**Suppression:** Fire should be suppressed either manually or automatically before it gets larger. Water, gaseous materials, foam as well as sand and other natural materials available at home could be used

**Use of fire fighters:** emergency responders should be notified to come to a site and assess to begin the fight against fire immediately. Activity directed at limiting the spread of fire and extinguishing it particularly as performed by the department of fire services trained for the purpose are of immense importance in curtailing the spread of fires. Sometimes if possible fire fighters rescue persons endangered by the fire if necessary before turning their attention to putting it out.

**Egress/ fire escape:** Means of rapid egress from a building primarily for use in case of fire. Occupants need to travel safely to a place of safety with the earliest possible time. The evacuation is based on being notified in a timely manner having exits marked and nearby, and providing sufficient capacity and allowing occupants to use the exit systems unhindered and without obstructions. Currently they are examples of means of escape as shown thus:

- A knotted rope or rope ladder secured to an inside wall.
- An open iron stair way on the building exterior
- An iron balcony
- A chute
- An enclosed fire and smoke proof stair ways.

**Hazards:** They need to be removed, limited or controlled especially buildings containing significant quantities of combustible materials, furnishings, interior finishes, construction materials and storage. These could result in fast fire growths, fire of extended duration that could limit time to react to it.

**Fire extinguishers:** This is a portable or movable apparatus used to put out fire by directing on to it a substance that cools the burning materials, deprives the flame of oxygen or interferes with the chemical reactions occurring in the flame.

### **Conclusion and recommendations**

Successive governments, corporate bodies, individuals and international communities have made concerted efforts to prevent fire occurrence but most failed. Effort is then stepped up to curtail the spread. The complexity about fire is that the occurrence is most of the time inevitable due to amongst other things the inherent human complexity especially his attitude to handling vital issues. The paper concludes that fire occurrence in buildings may not be sustainably prevented but the spread. However with the use of fire rated doors and windows, compartmentalising designed spaces and treating them with fire retardant materials, the impacts of fire could be greatly minimised to the bearable level. Building developers and users could then have to relax their nerves from the threats of fires. The following are the recommendations:

- i. There should be coordinated effort made by government, corporate bodies, and individuals on the fight against fire. These could cost them their treasures, talents and time.
- ii. There should be public enlightenment, orientation, and education on the hazards usually caused by fires in order to sensitise all to wake for sustainable combat against fire.
- iii. Building materials manufacturers should be encouraged to go into mass production of building components that are fire rated, and selling them to prospective developers at affordable prices.
- iv. Qualified professional stake holders in building developments especially electrical installation crews should be motivated to be part of electrical installation processes when new buildings are in construction.
- v. Parts of a building vulnerable to fires should be properly monitored in the course of construction. Kitchen area could 'be built to have dual roof that is, it is decked first and later roofed over with other parts of the building.
- vi. Final building users should live up to their responsibilities by being circumspect in keeping house hold materials so as to keep away fire fuels and other sources of fire ignitions from areas vulnerable to fire, and keep them in such areas free from hazards.
- vii. Government should expedite action to outlaw smoking in restricted places especially in filling stations and other areas susceptible to fire outbreak. The law should attach repressive punishment for every offenders.
- viii. Government should compel installation of water sprinklers in all critical areas of public buildings to automatically intervene in the event of fire when people are not in the neighbourhood to raise alarm.
- ix. Users and developers 'opinion should be sought in the course of planning, design and construction activities. They should be carried along so as to feel as part of the construction team or processes so as to make constructive criticisms or suggestions on how to manage unexpected fires.
- x. Government should make the edict outlawing reckless bush burning sustainable both in the country side and urban centres.
- xi. Services of fire men should be accessible to people immediately when the needs arises. The materials needed for their intervention exercises should be readily available to avoid failures.

- xii. Users in the residential housing should be caution to prioritise their domestic activities especially women in kitchens to avoid the tendency to forget vital responsibility in the kitchens.
- xiii. In planning a site, to avoid fires spreading or jumping from one building unit to another, adequate horizontal and vertical spaces should be allowed in between buildings sufficient enough to hinder such fire spreads.

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