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Evaluation Of Fire Management Practices In Selected Restaurant Buildings In Osogbo, Nigeria

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***Abstract*— The incidence of fire in buildings is a major threat to safety of occupants and properties therein, particularly, where inflammable materials are commonly used. Hence, its occurrence has been a major source of concern to stakeholders in the built environment. This study, therefore investigated sources of fire in selected restaurant buildings in Osogbo and examined fire management practices in use. The eight modern restaurant buildings in the study area were sampled. Data was collected through primary and secondary sources by administering questionnaires on the selected respondents, conducting interviews and site visits. The data collected was analysed with the use of appropriate statistical techniques. The study indicated that gas-related activity was the most potent source of fire outbreak in the restaurant buildings with a mean index of 3.98 followed by electrical energy (3.51) while textile-related material was the least with a mean index of 0.53. It was found that dry chemical extinguisher and sprinkler/hose reels were the most commonly provided fire-fighting facilities in the restaurant buildings while dry chemical extinguisher was the most ranked fighting facility that they had understanding of its usage and handling with a mean index of 3.00. The study concludes that fire management practices should be an integral part of daily operations in the restaurant buildings in order to evolve proactive measures in managing any likely occurrence of fire outbreaks because of its vulnerability. Its exit design features, doors, should also be properly dimensioned and located in order to serve as a passive measure of ensuring safety of occupants during any occurrence of fire outbreak.**

Keywords—Buildings, Fire, Hazards, Management Practices, Facilities

I. INTRODUCTION

The world has in the past three decades experienced a succession of disasters such as floods, fires, storms, earthquakes, volcanic eruptions and landslides. Such incidents include the worst fire disaster that occurred in 1984 in Mexico [1]), the Mozambican floods of the year 2000 [2] and the 2010 Chilean earthquake [3]. The disasters have claimed many thousands of lives, caused material losses and inflicted a terrible toll on developing countries in particular, where disasters divert attention and resources from development needed desperately to escape poverty [4]. As quoted by [5], there is fast growth in urban places of all sizes from small market centres to mega-cities. The increased developments and interactions increase the potentiality of fire occurrences as well. Fire outbreaks that carry the danger of causing disasters have been a concern both in urban and rural areas.

Fire is a potentially life altering threat in any building and can create an even worse situation if there is no prior preparation for such an event [6]. By conforming to the codes and requirements from the authorities, following sensible preventive actions and adequately training building occupants, security personnel and facility staff in proper response to fire emergencies, the overall threat of fire and fire related damages can be greatly reduced [7]. Absolute protection of life and property from fire in the built environment is unattainable, and, even if attainable, it is prohibitively expensive. However, too little expenditure on fire safety could result in levels of life loss that would be unacceptable to the community [8]. Between these extremes will exist a set of cost-effective solutions, in which it is feasible to minimize the total cost associated with fire and consistent with achieving levels of life safety which are acceptable to the community [9].

Fire is the rapid oxidation of a material in the exothermic chemical process of combustion process involving release of heat, light and reactive products [10]. Fire starts in different ways and it can serve as potentially destructive force in people's lives [11]. The frequent occurrence of major fire accidents in buildings has become a major threat to the nation's fragile economy [12]. Many major markets and office buildings have been gutted by fires destroying lives and properties worth several billions of naira [13]. These market fires have continued to render many jobless, damage the environment, disrupt economic activities and worsen problem of poverty [14]. Buildings as infrastructure along with people's lives need protection against fire outbreaks. Knowledge on the use of installed facilities is essential in tackling fire

emergencies. Otherwise, their installations become worthless as lack of knowledge could hamper escape from fire hazards and thwart attempts to contain fire outbreaks at its preliminary stage [15].

A. Problem

Fire outbreaks occur as a result of human factors such as carelessness, negligence or simply due to lack of fire safety awareness. As mentioned by [16], all parties, being owners, tenants, occupants, cleaners, security, maintenance and operations personnel are equally responsible for the safety and security in any building. In response to this, fire safety management has become an integral aspect in the daily operations of buildings. Few studies have been done on fire management practices in buildings. A survey on high-rise building safety, emergencies and evacuation procedures conducted in Chicago, USA in 2006 indicated that almost all occupants knew where fire exits were located. The findings supported the need for continued public education about emergency evacuation procedures in high-rise buildings [17]. Limited research has been done in Nigeria on the availability and use of fire-fighting equipment in buildings, particularly in restaurant buildings, where cooking activities that depend on different types of fuel that may cause fire occurrences take place frequently.

B. Aim

This study was designed to assess sources of fire outbreaks and evaluate fire management practices in the selected modern restaurant buildings in Osogbo.

II. THE STUDY AREA

The study area for this research is Osogbo. Osogbo is the capital city of Osun State in the South-western warm humid region of Nigeria. It is located on latitude 7.7667˚N and longitude 4.5667˚E. The average annual rainfall is 1241mm. The driest month is January with 9mm. precipitation fall while highest precipitation fall is recorded in September with an average of 202mm. Osogbo's annual mean relative humidity in the afternoon is 60% while in the morning, it is 82.4%. The annual mean minimum and maximum temperature are 21.98˚C and 31.4˚C respectively [18].

III. METHODOLOGY

The increasing rate of commercial and industrial activities in Osogbo, being the capital of Osun State which impact on the rise of modern restaurants informed its selection. According to [19], data collection is a systematic approach to gathering information from a variety of sources to get a complete and accurate picture of an area of interest. The research design of the study was done with recourse to Kothari [20] by considering peculiarity of outline of the framework and the data needed. Data collection for this research was through primary and secondary data sources. The primary data was conducted by administering questionnaires on the targeted respondents which included management and staffers of the restaurant buildings who were involved in the procurement, installation and use of fire fighting facilities. The multi-choice questions in the questionnaires focussed on the occurrence and management practices of fire in the restaurant buildings in line with the objectives of the study. The primary data was complemented by using site visits and interviews conducted on the respondents. The data collected were analysed by using both descriptive and inferential statistical techniques. The rate and occurrence of fire in the restaurant buildings were analysed by using appropriate descriptive methods while responses on the fire fighting facilities installed, level of handling and management practices and exit characteristics of the restaurant buildings were analysed by using relative importance index method. The sample frame consisted of the eight modern restaurant outlets in operation in Osogbo during the course of the study [21]. A total number of seventy (70) questionnaires were administered on the identified respondents working in the selected restaurant buildings.

IV. RESULTS AND DISCUSSIONS

As shown in Table 1, out of a total number of seventy (70) questionnaires administered on the identified respondents in the selected restaurant buildings in the study area, a total number of fifty four (54) were retrieved. This indicated that a response rate of seventy seven percent (77.14%) was found useful for data analysis.

Table 1: Percentage of Questionnaires Administered and Retrieved

Number of Questionnaires Administered	Number of Questionnaires Retrieved	Percentage of Questionnaires Retrieved
70	54	77.14

V. CHARACTERISTICS OF THE RESPONDENTS

The respondents sampled were contained in Table 2. It is shown that majority of respondents were service attendants in the restaurant (52.9%). Others were supervisors (17.6%) and general managers (9.8%). The highest percentage of respondents were male (66.7%), female (33.3%) and their marital status were single (70.6%) and married (29.4%) respectively. As shown in Table 3, majority of the respondents (43.1%) were less than 25 years in age followed by those between 25 and 35 (33.3%) while those between 35-45 years and above 45 years respectively were 11.18% each. The academic qualifications of the respondents varied, as 54% of them had SSCE, 21.6% had OND, 9.8% had HND and 14.6% had B.Sc.

Table 2: Respondents Sampled in the Restaurant Buildings

Respondent	Frequency (%)
Service Attendants	52.9
Supervisors	17.6
General Managers	9.8
Barmen	7.8
Customer Service	3.9
Chief Cook	2.1
Purchasers	5.9
Total`	100.0

Table 3: Profile of the Respondents Sampled in the Restaurant Buildings

Respondent	Frequency (%)
Age (Years)	
< 25	43.1
25-35	33.3
35-45	11.8
> 45	11.8
Total	100.0
Sex	
Male	66.7
Female	33.3
Total	100.0
Marital Status	
Single	70.6
Married	29.4
Total	100.0
Academic Qualification	
SSCE	54.0
OND	21.6
HND	9.8
BSc	14.6
Total	100.0

VI. SOURCES OF FIRE OUTBREAK IN THE RESTAURANT BUILDINGS

The likely sources of fire in buildings were classified based on the causative agents as materials causing fire, oxidants causing fire and heat energy causing fire respectively. The study also considered how fire may occur in the restaurant buildings based on the activities carried out and on the type of class of the fire incident. Table 4 shows that the most predominant and ranked source of fire outbreak in restaurant buildings was gas with a mean score of 3.98. It was closely followed by electrical heat energy (3.57), wood and wood-based products (1.33) and chemical heat energy (1.14) while it was found that textile material with a mean score was the least source of fire with a mean score of 0.53. This then shows that gases-based materials have the highest percentage as the source of fire outbreak in restaurant buildings.

However, amongst the activities that caused fire occurrence in the restaurant buildings, it was found that the most predominant source of fire outbreak was cooking activity with a mean score of 3.51. It was followed by faulty electricity and smoking with a mean score of 3.41 and 2.98 respectively. Whilst renovation (0.71), arson (0.69) and remodelling with a mean score of 0.63 were found to be the least activities that cause fire events in the buildings (Table 5).

Table 4: Sources of Fire in Restaurant Buildings

Sources	1	2	3	4	5	SWV	RII	RANK
Materials Causing Fire								
1. Wood and wood-based products	6	3	3	8	3	68	1.33	3
2. Plastics	2	3	9	1	0	39	0.76	6
3. Textiles	3	10	0	1	0	27	0.53	10
4. Liquids	2	5	3	0	3	36	0.71	7
5. Gases	2	5	4	6	31	203	3.98	1
Oxidants Causing Fire								
1. Oxygen in air	4	6	0	0	3	31	0.61	8
2. Chemically Bound in Oxygen	3	7	1	0	2	30	0.59	9
Heat Energy Causing Fire								
1. Electrical Heat Energy	1	6	11	14	16	182	3.57	2
2. Chemical Heat Energy	2	4	1	0	9	58	1.14	4
3. Mechanical Heat Energy	1	2	7	0	3	41	0.80	5

Table 5: Activities that Cause Fire Outbreak in Restaurant Buildings

Causes	1	2	3	4	5	SWV	RII	RANK
1. Cooking	5	2	13	9	19	179	3.51	1
2. Faulty Electricity	6	1	7	10	21	174	3.41	2
3. Smoking	4	5	1	5	23	152	2.98	3
4. Fire ignition	0	8	5	13	11	138	2.71	4
5. Renovations	5	0	9	1	0	36	0.71	5
6. Arson	3	1	6	3	0	35	0.69	6
7. Remodeling	4	6	4	1	0	32	0.63	**7**

Similarly, based on the classification of fire in the buildings, Table 6 shows that Class C type of fire is

the most predominant source of fire with a response rate of 62.50%, followed by Class A and B with a response rate of 18.75% each. However, Class D type of fire likely to be caused by magnesium was recorded not to be a probable cause of fire in the restaurant buildings. This can be traced to the non-use of magnesium based materials in the restaurant buildings.

Table 6: Classes of Fire in the Restaurant Buildings

Classes of Fire	Frequency	%
Class A due to material of an ordinary nature e.g. paper and wood	12	18.75
Class B due to flammable material and combustible liquid	12	18.75
Class C due to energized electrical equipment	40	62.50
Class D due to combustible metals e.g. magnesium	0	0
Total	64	100.00

VII. FIRE MANAGEMENT PRACTICES EMPLOYED IN THE RESTAURANT BUILDINGS

The study assessed availability of fire fighting facilities in the sampled restaurant buildings in the study area. As shown in Table 7, the dry chemical extinguisher was mostly available with a response rate of 50% (Plate 1). It was closely followed by the installation of sprinklers/hose reels (18.5%), carbondioxide fire extinguisher (12.96%), wet chemicals (5.57%), fire blanket (7.41%), and foam extinguisher (5.56 %) respectively. However, the Table also reveals that the use of halon extinguisher was not so much in use in the restaurant buildings.

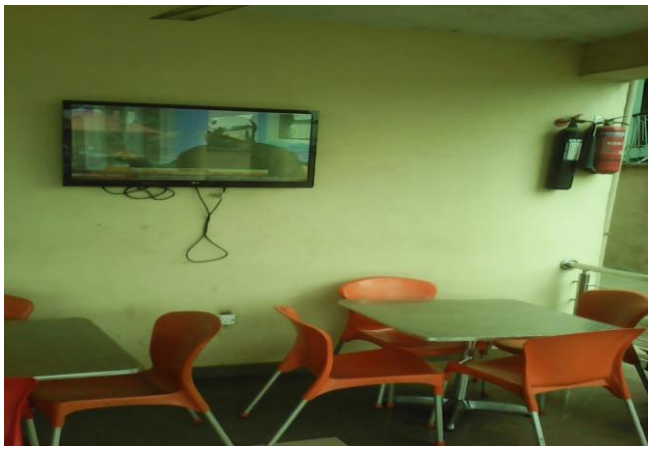

Plate 1: Installation of a Fire Fighting Facility in the Restaurant Building

Table 7: Availability of Fire Fighting Facilities in the Sampled Restaurant Buildings

Fire Fighting Facilities	Exist (Yes) F	%	Does not exist (No) F	%
Dry chemical extinguisher	27	50	5	9.62
Halon extinguisher	0	0	11	21.15
Foam extinguisher	3	5.56	10	19.23
Carbon dioxide extinguisher	7	12.96	6	11.53
Sprinklers/hose reels	10	18.5	8	15.39
Wet chemicals	3	5.57	7	13.46
Fire blankets	4	7.41	5	9.62
Total	54	100.00	52	100.00

The respondents working in the restaurant buildings were requested to provide data on the level of performance and their knowledge of use and handling of the installed fire fighting facilities by employing a likert scale of 1 to 5, and these were determined by their respective Relative Performance Index (RPI) and Relative Knowledge Index (RKI). As shown in Table 8, the dry chemical extinguisher was ranked first to have the highest level of performance amongst the installed fire fighting facilities with a performance index score of 3.12. It was followed by sprinkler/hose reels, carbon dioxide extinguisher, fire blanket, foam extinguisher and wet chemicals with mean scores of 1.55, 1.22, 0.76, 0.53 and 0.43 respectively. However, the halogen extinguisher that was not available in the restaurant buildings had the least performance rating with a mean score of 0.

Table 8: Performance Level of the Installed Fire Fighting Facilities

Fire Fighting Facilities	5	4	3	2	1	SWV	RPI	Rank
Dry chemical extinguisher	27	5	1	0	1	159	3.12	1
Sprinklers/hose reels	12	4	1	0	0	79	1.55	2
Carbon dioxide extinguisher	9	2	3	0	0	62	1.22	3
Fire blankets	5	2	2	0	0	39	0.76	4
Foam extinguisher	3	0	4	0	0	27	0.53	5
Wet chemicals	3	1	1	0	1	22	0.43	6
Halon extinguisher	0	0	0	0	0	0	0	7

C. Level of Knowledge of the Personnel in the Handling of Fire Fighting Facilities

Table 9 shows the level of knowledge of the respondents working in the restaurant buildings in the use and handling of the installed fire fighting facilities

in the sampled restaurant buildings. As indicated in the Table, dry chemical extinguisher was rated as the type they could handle and use most proficiently with an index score of 3.00. It was followed by sprinkler/hose reels, carbon dioxide extinguisher, fire blankets, foam extinguisher and wet chemicals with index score of 1.49, 1.04, 0.75 and 0.43 respectively.

Table 9: Level of Knowledge in the Handling of the Installed Fire Fighting Facilities

Fire Fighting Facilities	5	4	3	2	1	SWV	RII	Rank
Dry chemical extinguisher	25	3	5	0	1	153	3.00	1
Sprinklers/hose reels	10	5	2	0	0	76	1.49	2
Carbon dioxide extinguisher	8	1	3	0	0	53	1.04	3
Fire blankets	5	1	3	0	0	38	0.75	4
Foam extinguisher	3	0	3	0	0	24	0.47	5
Wet chemicals	3	0	2	0	1	22	0.43	6
Halon extinguisher	0	0	0	0	0	0	0	7

As shown in Table 10, it is revealed that safety boots were mostly provided by the management of the restaurant buildings with 17.3% response rate, followed by the portable water tanks (16.35%), alert system (15.42%), leather gloves (14.5%) helmet (8.41%), rain coat/overall (7.93%), goggles (7.01%), flame retardant (5.61%), face masks (4.67%) and self-contained breathing apparatus (2.8%).

Table 10: Availability of Safety Kits for Personnel in the Restaurant Buildings

Safety Kits Provided	Yes (F)	%	No (F)	%
Safety boot	37	17.3	5	4.95
Leather gloves	31	14.5	13	12.87
Helmet	18	8.41	11	10.89
Face masks	10	4.67	15	14.85
Rain coat/ overall	17	7.93	10	9.90
Goggles	15	7.01	16	15.84
Portable water tanks	35	16.35	9	8.91
Self-contained breathing apparatus	6	2.80	10	9.90
Personal alert system	33	15.42	3	2.97
Flame retardant	12	5.61	9	8.92
Total	214	100.00	101	100.00

VIII. CONCLUSION AND RECOMMENDATIONS

This study has investigated the likely sources and classes of fire outbreaks in restaurant buildings. Based on the findings of the study, most of the restaurant buildings sampled installed dry chemical extinguisher, sprinklers/hose reels and carbon dioxide extinguisher in order to manage occurrence of fire outbreaks. It was found that an appreciable number of the personnel had knowledge in the handling and use of the fire-fighting facilities installed and underwent training periodically. Hence, the study hereby recommends that in order to achieve efficient fire management practices in restaurant buildings, its proper design from the design stage should be carried out which will make provision for properly sized and well-located exit features (doors) to allow movement of occupants during any outbreak of fire. Management of restaurant buildings should employ competent and skilled fire personnel that should undergo training periodically. Also, the installation, use and maintenance of contemporary fire-fighting facilities should be done according to manufacturer's specification. Lastly, the locations of the fire-fighting facilities should be easily accessible and complemented with sign aids.

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