International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 9 Sep. 2022, pp: 1342-1349 www.ijaem.net ISSN: 2395-5252

Cost Implication of Fire Prevention Installations on Selected Buildings in the Federal Polytechnic Idah

Bello, H.A & Kupoluyi, T. O

Department of Quantity Surveying, School of Environmental Studies, Federal Polytechnic Idah, Kogi State, Nigeria

----

Date of Submission: 20-09-2022 Date of Acceptance: 30-09-2022

ABSTRACT: The aim of this research work is to recommend and value appropriate firefighting equipment and installations for buildings not older than five years on the Federal Polytechnic Idah campus. The appropriate fire prevention and firefighting equipment, the size and quantity and the cost implication of recommended firefighting equipment for each selected building was determined. The study observed that the six buildings being investigated have not been 100% completed before they were released for occupation and use, and no appropriate fire prevention and firefighting equipment have been installed on them. The research work recommended that Management should ensure full completion of these projects and likewise put in place mechanisms to procure and install appropriate fire prevention and firefighting equipment on the buildings. 46 units of 20kg dry powder fire extinguishers to be procured and installed at the sum of ₦ 4,750,650:00 only are recommended for installation in these buildings.

I. INTRODUCTION

Disaster is a common phenomenon that can and will happen when least expected, in fact it very often comes unannounced and uninvited with disastrous consequences. Reitz (2017) defines a disaster, as an event whose timing is unexpected and whose consequences are seriously destructive. A very common example of disasters typically occurring in Nigeria is fire outbreaks. Fire plays two important roles in Society; it can be a very good servant, and at the same time, it can be a very bad master. While at work as a master, Kulkarni, et. Al. (2016) observed that incidence of fire can happen at any time and in any place, and usually result in huge financial loss, injury and death.Incidences of fire disaster are not new to the Federal Polytechnic, Idah, it has been reported that entire buildings housing infrastructure and instructional materials worth millions of Naira have been lost to fire disaster. In presenting the chronology of some disasters in Nigeria from July 2000 to May 2007, Abareh (2014) reported the burning, in 2004, of the Federal Polytechnic Idah Library, as a result of students' unrest. The same report was contained in the work of Ugwuanyi, et. al. (2015). Since the famous fire incidence on the Federal Polytechnic Idah Library in 2004, the campus has witnessed significant infrastructural development resulting in the development of several new buildings and other infrastructure.It is reasonable to understand and expect that an incidence of fire outbreak can happen again.Obi (2015) reiterated that statutory regulations require that all public buildings are to be equipped with fire prevention facilities of adequate quantity and in good functional condition, however most new buildings constructed on the campus do not have fire prevention and firefighting equipment provided for them. In the event of any fire outbreak, significant loses would have been incurred before the Central Fire Station would arrive the scene of incidence.

The aim of this research work is to recommend and value appropriate firefighting equipment and installations for selected buildings on the Federal Polytechnic Idah campus.The study shall determine appropriate fire prevention and firefighting equipment on the selected buildingsand alsodetermine the cost implication of recommended firefighting equipment for each selected building.The research work shall endeavor to prepare the cost implications of providing recommended firefighting equipment for all buildings not older than five years in the Polytechnic. A holistic fire prevention and firefighting system in a building of the size being investigated would consist of equipment such as sprinkler systems, smoke detectors, fire alarms, fire

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 9 Sep. 2022, pp: 1342-1349 www.ijaem.net ISSN: 2395-5252

extinguishers, hose reels, a water reservoir supplying adequate amount of water, water piping systems and regular supply of electricity. However, due to the peculiarities of the buildings being investigated, the research work will focus attention on the provision of fire extinguishers only as an urgent measure to curtail any incidence of fire.

What Is Fire?

Fire is a chemical reaction in which energy in the form of heat is produced. The chemical reaction is known as combustion. Combustion occurs when fuel or other material reacts rapidly with oxygen, giving off light, heat, and flame. A flame is produced during the ignition point in the combustion reaction and is the visible, gaseous part of a fire. Flames consist primarily of carbon dioxide, water vapor, oxygen, and nitrogen. (Pausas and Keeley, 2009). The fire triangle is an illustration symbolizing the three components that must be present for a fire to burn. These components are fuel, oxygen, and a heat/ignition source. If any one of these components is absent, fire cannot exist.For a fire to ignite there must be an initial and continued heat source—this is called a chain reaction and is part of what makes up the fire tetrahedron. Heat allows fire to spread by removing the moisture from nearby fuel, warming surrounding air, and preheating the fuel in its path. When the fire becomes either fuel-controlled (i.e., there is no more fuel to burn) or ventilation-controlled (i.e., there is not enough oxygen to sustain combustion), the fire decays to a smoldering state and is finally extinguished.

Classification of Fires

Voelkert (2015) summarized the classes of fire. They are:

I. **Class “A” Fires:** A class “A” fire can involve any material that has a burning ember or leaves an ash. Common examples of class “A” fires would be wood, paper, or pulp. The preferred method for extinguishing class “A” fires is to remove the heat. Water is the most common agent, but others such as dry chemical, halon, halogenated agents and foam can be used effectively.

II. **Class “B” Fires:** A class “B” fire involves flammable liquid or gas. Familiar examples would be gasoline, oil, propane, and natural gas. A variety of fire extinguishing agents are used on flammable liquid fires employing all theories of fire extinguishment. Which agent is best to use is dependent upon the circumstances involved. Flammable liquids do not ignite in their liquid state; rather it is the vapors being generated by these liquids that ignite.The mixture of oxygen and flammable vapors in proper proportion needs only an ignition source to start the combustion process.

III. **Class “C” Fires:** Class “C” fires involve live electrical equipment and require the use of an extinguishing agent and/or extinguisher that will not conduct electricity back to the fire fighter(s). Electricity is an energy source and an ignition source, but by itself will not burn. Instead, the live electrical equipment may serve as a source of ignition for a class “A “fire such as insulation or packing, or a class “B” fire.

IV. **Class “D” Fires:**Class “D” fires involve exotic metals such as titanium, zirconium, magnesium, and sodium. These fires require special agents such as dry powders and special application techniques. The extinguishing agents and techniques used on “A”, “B”, or “C” fires will not work on class “D” fires, nor will the agents and techniques used for class “D” fires work on any other classification of fire. Many common agents like water will actually react to burning metals and increase the intensity of the fire in a violent manner.

V. **Class “K” Fires:**Class “K” fires involve cooking media. These can be any animal or vegetable-based fats or oils. These fires require special agents such as wet chemical extinguishers and systems that are alkaline in nature and have superior cooling capabilities. The entire mass of the cooking medium in a deep fat fryer must be secured and cooled below its auto ignition point in order to achieve complete extinguishment.

Impact of Fire in Modern Society

Fire has been known to serve many useful purposes, both industrially and domestically. Every home is equipped with different forms of fire source for the purpose of generating heat, cooking, lighting and cleaning among others. In the corporate world and industrial settings, fire has contributed significantly to the successes recorded in the production of various essential goods and services. When fire is deliberately ignited and controlled, it can prove to be a good servant. However, when fire incidences occur due to careless handling of the three fire components, or careless handling of existing fire, it can be a very dangerous and lethal master. Ilori, et. al. (2019) and Odaudu (2017) observed that human factors such as carelessness, negligence and lack of fire safety awareness are some of the leading causes of fire outbreaks. Despite the technological advancement in fire safety, Tan (2004) note that fire remains the leading cause of lives and property loss at commercial and industrial facilities worldwide and fire could lead to the premature winding up of an organization no matter the size of the organization.

Nigeria has a vast history of fire incidences. Adekunle, et. al. (2016) reported several cases of domestic fires resulting to loss of lives and property in different parts of Lagos State between 2012 and 2013. Ilori et.al. (2019) documented several cases of fire incidents affecting secondary schools in Northern Nigeria and leading to loss of lives and property. Obasa, et. al. (2020) reported 18 documented cases of fire incidents affecting various buildings and infrastructure between 2010 and 2019 in Imo State. Similar reports are contained in the works of Duniya (2015), Iyaji, et. al. (2016), and Odaudu (2017).The Federal Polytechnic, Idah is not left out in this incident. Abareh (2014) stated that in 2004, arsonists set ablaze the Central Library of the institution, destroying learning resources worth millions of Naira.The economic losses resulting from fire incidents is huge, coupled with loss of material assets, some of which may not be recovered permanently, and more often than not, human lives are lost to these occurrences.

Policy Provisions for Fire Disaster in Buildings in Nigeria

In Nigeria, the major fire safety regulations for buildings are provided in the Nigerian National Building Code of 2006, NNBC, 2006. The safety provisions contained in Building Code includes among others the following: safety measures such as structural fire resistance, detection, alarm, and extinguishing apparatus; measures of egress encompassing configuration features and support characteristics and general safety such as safety and means of egress parameters. Some of the other provisions in the Code include smoke detector installation at elevator lobby, provision of designated main floor level for emergency personnel for firefighting or rescue purpose (Nigerian National Building Code, 2006). Expressing its unambiguous understanding of the significance of fire safety awareness, the code highlighted the need for fire safety awareness campaign and life safety education to the general public within the jurisdiction of the Nigeria NBC scope.However, Adeleye, et. al. (2020) observed that the deficiencies in this Code lie in the technicalities of the law and in the apparatus of its enforcement. The report explained that even though Nigerian federal laws police safety practices in the country, every so often, the effects of these laws are not felt, and this is due largely to poor enforcement. Consequently, this sets in motion a practice of pseudo-adherence to the provisions of the law at the expense of people's safety. Ogbonna and Nwaogazie (2015) further highlighted that developing nations often adopt standards modeled after technologically advanced countries, thus, making the standards complex and difficult for the developing nations like Nigeria to implement. Consequently, there is need for strict adherence with safety provisions especially fire safety in buildings by owners and users.Fire safety measures in the building are one aspect of fire safety management with the purpose of fire disaster prevention and protection in order to reduce the fire risk to an acceptable level. It has to do with the installation of passive and active measures to ensure that the risk to life, destruction of property and its effect on the environment are minimized (Alao, et.al., 2020).

Conceptually, maximum fire safety can only be achieved via a combination of the three most essential components, such as active fire measure, passive measure, and fire safety management. Active and passive fire measures in a building are concerned with regulating the fire from occurring and extinguishing the fire, respectively (The institute of engineers, 2004). Fire safety involves protection system has to do with fire prevention system and suppression at both design/ construction and post-construction stage, consequently, each of the three fire safety components displays three critical functions, i.e., active control, management control, and passive control in achieving effective management of fire in buildings. Fire Safety Code (2013), National Building Code (2006) and NFPA (2018) guide to fire safety regulation, provides that effort should be made to avoid fire risk in buildings. The fire risk that could not be avoided, should be investigated, and evaluated, and once identified, it should be fought at the point of ignition. Adequate fire safety management programs should be adopted with comprehensive fire safety management components, such as compliance with safety regulation, fire safety training, emergency plan, and procedure and robust fire safety policy, etc.

Generally, passive fire safety measure includes the provision of fixed fire protection systems during building construction, while active

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 9 Sep. 2022, pp: 1342-1349 www.ijaem.net ISSN: 2395-5252

fire safety measure is the mechanical components installed in buildings to provide warning in buildings in the event of a fire (NFPA, 2018). However, in most cases, active fire protection systems installed in buildings seized to functions because of several factors, such as damage, vandalism, negligence, interference, or change of occupants (Woon, 2016). However, all installed active fire protection in buildings requires to be tested, maintained, replaced the damaged one, upgrade and adequately train the building occupants on how to operate the system. Besides, the arrangement should also be made to regularly inspect all the installed fire safety systems through an effective fire safety management program (Wang, 2015).

Infrastructural Developments in theFederal Polytechnic, Idah (2016 to Date)

Kupoluyi and Kolawole (2018) stated that the Federal Polytehnic, Idah, established in 1977, occupies a land area of about 1,230 hectares on the Idah-Ajaka Highway in Igalamela/Odolu Local Government Area of Kogi State. It had 193 structures existing on the campus out of which 9 were under construction.Many more buildings and infrastructural facilities have since been developed and are already put to use on the campus, among these are the Quantity Surveying/Building Technology Department building, Architectural Studio and the 500 capacity Lecture Theatre all in the School of Environmental Studies. Several other new projects in other Schools and Divisions of the Polytechnic have either been completed or are presently ongoing, notably, the new Central Administration Building, other 500 capacity Lecture Theatres, the OTM Building and the SLT Building.Generally, in the last five years (2016 to date), the Polytechnic has witnessed significant emergence of several new buildings and infrastructural development. Significantly, none of these developments are equipped with appropriate fire prevention and firefighting installations. The Polytechnic depend entirely on the remotely located Fire Department which has only one Fire Truck at its disposal. One is left to imagine the experience in the event of a major fire outbreak in any of these new developments.

Research Methodology

The study is exploratory in nature in which case studies were selected for investigation and data obtained from the case studies, and a combination of analytical and descriptive research strategies were adopted in reporting the results of the research.The data for this research work are from two sources, primary and secondary. Primary data consisted of information obtained from site visits, market survey data and informal interviews. Secondary data included working drawings of case studies, Codes of Practice and Standards documents and review of related literature.All the buildings in the Federal Polytechnic campus constitute the population for this study, while buildings not older than 5 years in the Polytechnic constitute the samples for this study. Six buildings meet this requirement, and they are;

i. Architectural Technology Studio
ii. Science Laboratory Technology building.
iii. Office Technology and Management building
iv. Building Technology/Quantity Surveying building
v. 500 capacity Lecture Theatre (School of Environmental Studies)
vi. 500 capacity Lecture Theatre (School of General and Administrative Studies)

Project drawings from the Physical Planning Unit, sketches obtained from site visits, schedules of fire protection and firefighting equipment and a schedule of current market survey are the instruments used to obtain data in the course of the research work.The data obtained shall be used to prepare the cost implication of installing recommended fire prevention and fire protection equipment in the selected buildings. Hence, the quantities of equipment for each of the spaces contained in the buildings are obtained by dividing the floor areas by the equipment's minimum range of operation, and the installation costs are obtained by determining the unit rate of each equipment and multiplying same with the number required.The results obtained are presented in tables and bill of quantities templates for necessary interpretations and inferences.

Analysis of Data

The Samples: Basic Information

6 samples were selected for investigation. Each of the samples was constructed within the last 5 years. All the samples were taken from the Federal Polytechnic, Idah campus.3 sample designs were identified from the 6 buildings. All the buildings have been officially declared completed, and some are already being put to use. However, certain basic infrastructure still remains to be available on these buildings. Table 1 below describes the specimen sample designs and status of the buildings.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 9 Sep. 2022, pp: 1342-1349 www.ijaem.net ISSN: 2395-5252

Table 1: Specimen Sample Designs and Status of Buildings

Building Sample	Building(s) in each type	Status
Type I	- New Architectural Technology Studio	- already put to use - no electricity supply - no fire prevention/firefighting equipments installed - no water supply
Type II	- 500 capacity Lecture Theatre (SES) - 500 capacity Lecture Theatre (SOGAS)	- not yet put to use - no electricity supply - no fire prevention/firefighting equipments installed - no water supply
Type III	- Science Laboratory Technology building - Office Tech. and Management building - Bldg Tech./Quantity Surveying building	- already put to use - no electricity supply - no fire prevention/firefighting equipments installed - no water supply

Source: Field Survey (2022)

It should be noted that the absence of electricity and water supply to these buildings constitute serious constraints to the installation of some vital fire prevention and firefighting equipment. This is because many of these equipment depends on the availability and regularity of water and power supply to function effectively. In view of the fact that these buildings have already been put to use, it is important to provide basic equipment as emergency measures to control any occurrence of fire. Hence, a mechanism that does not depend on the supply of water and electricity will be useful to install on these buildings.

Selection of Fire Fighting Installations

During interviews conducted on the personnel of the Central Fire Station, it was recommended that in view of the peculiarities of the buildings, units of 20kg portable fire extinguishers be installed at strategic points within and around the buildings.IS 2190:2010 provided useful information to guide decision on the suitability, size and placement of fire extinguishers for the various classes of fire.Table 2 below highlights the requirements for choice of fireextinguishers for different classes of fire. It should be noted that, according to IS 2019:2010 specifications, the class of fire to expect on these buildings is Class A. Class A fires are fires involving solid combustible materials of organic nature such as wood, paper, rubber, plastics, etc, where the cooling effect of water is essential for extinction of fires; these are the predominant materials available in these buildings, hence the focus for this research work is on Class A. As shown on Table 2, any of the 10 listed fire extinguishers with the exception of the Dry powder type for metal fires (IS 11833) and Carbon dioxide type (IS 2878 and IS 8149), can be installed in the buildings under investigation. IS 2109:2010 further recommends the maximum range of coverage for each fire extinguisher as shown on Table 3.Table 3 above shows that there should be a maximum travel distance of 15m to any mounted extinguisher; hence it means that the maximum distance between 2 extinguishers must be 30m. On the basis of this spacing, the number of fire extinguishers per building can be calculated. Table 4 shows the recommended quantity of fire extinguishers per building. As shown on Table 4, a total of 46 units of 20kg fire extinguishers will be required on the 6 buildings under investigation.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 9 Sep. 2022, pp: 1342-1349 www.ijaem.net ISSN: 2395-5252

Table 2: Suitability of Different Types of Fire Extinguishers for Different Classes of Fire

Type of extinguisher	Type/Class of fire			
	A	**B**	**C**	**D**
Water type (gas cartridge), IS 940 and IS 13385	S	NS	NS	NS
Water type (stored pressure), IS 6234	S	NS	NS	NS
Mechanical foam type (gas cartridge), IS 10204 and IS 13386 S	S	NS	NS	
Mechanical foam type (stored pressure), IS 14951 and IS 15397	S	S	NS	NS
Dry powder type (stored pressure), IS 13849	S	S	S	NS
Dry powder type (gas cartridge), IS 2171 and IS 10658	S	S	S	NS
Dry powder type for metal fires, IS 11833	NS	NS	NS	S
Carbon dioxide type, IS 2878 and IS 8149	NS	S	S	NS
Clean agent gas type, IS 15683	S	S	S	NS
Halon 1211 type, IS 4862 (Part 1) and IS 11108	S	S	S	NS

NOTE: S – Suitable, NS – Not Suitable: Source: IS 2109:2010

Table 3: Fire Extinguisher Size and Placement for Class A Hazards

Criteria	Hazard		
	Low	Medium	High
Maximum floor area per unit (m^2)	280	140	90
Maximum travel distance to extinguisher (m)	15	15	15

Source: IS 2109:2010

Table 4: Quantity of Fire Extinguishers per Building

Building Type	Part of Building	Recommended Quantity	Total Number
Type I (1 building)	Studio 1	2	2
	Studio 2	2	2
Type II (2 buildings)	Ground Floor	7	14
	First Floor	2	4
Type III (3 buildings)	Ground Floor	4	12
	First Floor	4	12
		Total	**46**

Source: Field Survey (2021)

4.2.3 Cost Implication

A market survey revealed that the cost of a single unit of dry powder fire extinguisher is ₦ 75,000:00. Other cost implications are computed as follows,

Cost of 1 unit delivered to site		76,000:00
Set of hanging brackets, including fasteners		5,000:00
Total		81,000:00
Add	10% contingency works	8,100:00
	10% builder's work	8,100:00
	7.5% VAT	6,075:00
Proposed unit rate		103,275:00

The proposed rate for 1 unit of 20kg dry powder fire extinguisher is ₦ 103,275:00. The cost of 46 units of the equipment is 103,275 x 46 = ₦ 4,750,650:00.

II. FINDINGS

The 6 buildings being investigated are of 3 types; **Type I** has only the New Architectural Technology Studio, **Type II** has the 500 capacity Lecture Theatre for the School of Environmental Studies and the 500 capacity Lecture Theatre for the School of General and Administrative Studies whilst **Type III** has the New Science Laboratory Technology building, the New Office Technology and Management building and the New Building Technology/Quantity Surveying buildings. All the buildings, except Type II are already being put to use and none of the buildings have power and water supply services. This necessitated the recommendation of the dry powder fire extinguisher in the buildings.A total of 46 units of the equipment will be required on these buildings at the rate of ₦ 103,275:00.The total estimate for the entire installation works is ₦ 4,750,650:00

III. CONCLUSION

The research work concluded thus;

i. The 6 buildings being investigated have not been 100% completed before they were released for occupation and use.
ii. The management of the Federal Polytechnic Idah is subjecting these buildings to risk for not installing appropriate fire prevention and firefighting equipment on them, more so, similar incidence has been reported on campus before.
iii. As a precautionary measure, 46 units of 20kg dry powder fire extinguishers need to be procured and installed in these buildings to avert any incidence of fire.
iv. It will cost the Management of the institution ₦ 4,750,650:00 only to procure and install the 46 equipment on the buildings being investigated.

Recommendations

The research work recommends the following;

i. Management of the Federal Polytechnic Idah should put all mechanisms in place to ensure the full completion of these projects in the shortest possible time, as the services currently not in place are essential for the wellbeing of the users.
ii. Management should likewise put in place mechanisms to procure and install appropriate fire prevention and firefighting equipment on these buildings.
iii. 46 units of 20kg dry powder fire extinguishers are recommended to be procured and installed in these buildings.
iv. The Polytechnic Management is advised to provide the sum of ₦ 4,750,650:00 only to procure and install the 46 equipment on the buildings being investigated.

REFERENCES

[1]. Abareh, H. M., 2014: "Survey of Disaster Preparedness by Heads of Academic Libraries in North-Eastern Nigeria". Global Journal of Academic Librarianship. 3(1), pp. 45-57
[2]. Adeleye O. I., Ajobiewe T. O., Shaibu S. V. and Oladipo T. O.: Fire Disaster Preparedness of Public Buildings in Ibadan Metropolis, Nigeria. Open Science Journal 5(2)
[3]. Adekunle, A., Asuquo, A., Essang, N., Umanah, I. I., Ibe, K. E., and Alo A. B. (2016): Statistical Analysis of Electrical Fire Outbreaks in Buildings: Case Study of Lagos State, Nigeria. Journal of Sustainable Development Studies. 9(1), pp. 76-92
[4]. Alao, M. K., Yahya, B. M., Wan, Y. B., Aliu I. U. (2020): Fire Safety Protection and Prevention Measures in Nigeria Office Buildings. International Journal of Management and Humanities 4(5), pp. 109-115
[5]. Duniya S. D. (2015): An Evaluation of Fire Prevention and Control Strategies in the Design of A Multi-Level Market, Kafanchan. Unpublished MSc. Thesis submitted to the School of Postgraduate Studies, Ahmadu Bello University, Zaria
[6]. Ilori, A. E., Sawa B. A. and Gobir A. A. (2019): Application of Cause-and-Effect-Analysis for Evaluating Causes of Fire Disasters in Public and Private Secondary Schools in Ilorin Metropolis, Nigeria. Archives of Current Research International 19(2), pp. 1-11
[7]. Iyaji S. O., Kolawole, O. B. and Tinufa A. A. (2016): The Role Of Design and Construction in Mitigating Fire Disasters in Housing in Nigeria. Journal of Good Governance and Sustainable Development in Africa 3(1) pp. 73-84
[8]. Kulkarni, R. S., Giri, P. A. & Gangwa, P. R. (2016): Knowledge and Practices Regarding Fire Safety Amongst Health Care Workers in Tertiary Care Teaching Hospital in Marathwada Region of Maharashthra, India. International Journal of Community Medicine and Public Health. 3(7), pp. 1900 - 1904

[9]. Kupoluyi T. O. and Kolawole O. B. (2018): A Review Of The State Of Infrastructure On The Federal Polytechnic, Idah Campus. International Journal of Innovative Research and Advanced Studies 5(11). pp. 7-12
[10]. NFPA. (2018). Standard For Portable Fire Extinguishers.
[11]. NNBC. (2006). Nigeria National Building Code
[12]. Obi N. I. (2015): Fire Protection Measures in Buildings: The Architect's Design Role. Civil and Environmental Research (www.iiste.org) 7(7) pp. 27-30
[13]. Odaudu U. S. (2017): Analysi of the Overview of the Causes of Fire Outbreaks in Nigerian Markets. International Journal of Environmental Studies and Safety Research. 2(2), pp. 1-9
[14]. Ogbonna C. I. and Nwaogazie I. L. (2015): Fire Safety Preparedness in Workplaces in Port Harcourt, Nigeria. International Research Journal of Public and Environmental Health 2(8), pp. 112-121
[15]. Pausas, J.G. and J.E. Keeley. 2009. A Burning Story: The Role of Fire in the History of Life. BioScience59(7):593.
[16]. Reitz, J. M. (2017): Online Dictionary for Library and Information Science. CA: Libraries Unlimited.
[17]. Tan, C. A. (2004). Effective management of fire safety in a high rise building. BuletinIngenieur, 12-19
[18]. Ugwuanyi, R. N. C, Ugwu M. E. &Ezema, K. C. (2015): Managing Disasters in University Libraries in South East Nigeria: Preventive, Technological and Coping Measures. Library Philosophy and Practice (e-journal). 1289. Viewed at http://digitalcommons.unl.edu/libphilprac/1289
[19]. Voelkert J. C. (2015): Fire and Fire Extinguishment: A Brief Guide To Fire Chemistry and Extinguishment Theory for Fire Equipment Service Technicians
[20]. Wang, S. Y. (2015): Applying Building Information Modelling To Support Fire Safety Management. Automation InConstruction. pp. 158-167.
[21]. Woon, H. S. (2016): A study on the perception of institutional environment in fire safety management- focused on fire – fighting officers and fire safety managers in Chonnam Province. wCrisisonomy. pp. 33-52.