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Fire Protection Measures in Buildings: The Architect's Design Role

ARC. N. I. OBI (MSc) (MNIA/ARCON, MNES, MAARCHES
Department of Architecture, University of Nigeria, Enugu Campus.

Abstract
The key elements of any fire protection system involve prevention, retardations, detection, extinguishments as well as rescue. Major advances have been made in all these elements and are continually improved and made increasingly effective by improvement in technology advancement. Advancement in Building design and construction can have significant improvement in fire safety, therefore, architects, need to adapt new techniques and new materials and incorporate them in their designs. They also need to liaise with fire professionals and engineers across the globe in order to update their knowledge in fire safety. In many countries, safety standards and laws were made as a guide to prevent fire conflagration, loss of assets or buildings, as well as protection of individual life, and architects follow such regulations during design. The fire protection codes, laws and standards are as such effectively implemented in advanced countries. Here in Nigeria there seem to be no adequate statutes in place, except the draft National fire Code. Architects in the country have to rely a lot on their personal fire protection knowledge and design dexterity to provide in building fire prevention and protection measures. Statutory Fire Safety Provisions should be established and administered by the 3 tiers of our government and such document must serve as a guideline in all architectural designs. This paper therefore tries to give an insight into the role of architects as it relates to fire protection during design of buildings.
Keywords: buildings, fires, prevention, safety, standards.

INTRODUCTION

During the design process of a building, the architect takes various factors into consideration. The primary factors that need to be considered are: the design layout of building; the functional requirements or purpose of the building; the position of various building elements and components, the use or specification of building materials. These are necessary measures required to minimize the risk of incidences of fire, which can occur either by negligence, accident or by deliberate actions. Other factors that need to be put into consideration by the architect are to ensure that the spread of fire is minimized, that provision is made for adequate means of escape in the event of fire, and the protection of structural elements of the building. The architect is required to bring together all relevant information in form of acts, byelaws, standards, codes of practice and regulations appertaining to the fire safety of buildings. He needs to consult the local chief officer or local fire control officer in their locality during the design stage.

Insurance of buildings is a necessary step in administration of buildings. For the locality where they practice insurance the architect will need to consult the building owner's insurance company who is required to follow a set down rules for the calculation of insurance premiums (British Standard Code of Practice; The Aqua Group 1984). The regulations, standards and code of practice are only minimum requirements; individual clients of buildings at high risk may require special fire safety measures depending on the level of risk. (Doe and Fire Officers Committee, 1973,). In Nigeria, fire fitness of building is one of the requirements for granting of building approval. The Chief Fire Officer of the locality also usually issues fire performance certificate at post construction stage before the end users take up the building. This is based on the provision of the Draft National Fire Safety Code published by Federal Ministry of Works & Housing, Lagos dated 21st October, 1993 page 1: (i-iii) "RESPOSIBILITIES OF BUILDING OWNERS: *Any developer, owner or occupier of a building shall have responsibility for-(i) obtain a Development Permit prior to the Commencement of building works; (ii) secure a Fire Safety Certificate on completion and prior to the occupation of all building types , except single and two-family dwellings etc. thereafter, the Fire Service shall carry out regular fire safety inspection and renew the Fire Safety Certificate annually; (iv) provide for and maintain fire safety in his building or structure annually."* Echono S.T (1993)

CAUSES OF FIRE OUTBREAK IN BUILDINGS

Generally the likely causes of fire outbreak range from an intentional act by arsonists or by sabotage, accident, carelessness or negligence. Other causes arise as a result of faculty design of electrical installations, absence of safety measures during design of buildings and safety precaution during the construction stage.

FIRE PROTECTION MEASURES AT DESIGN STAGE OF BUILDINGS:-

Generally, five major components of fire protection measures are:

- Prevention of fire initiation (precautions taken at design stage)

- Restriction of the growth and spread of fire (retardation).
- Containing fire within specified boundaries (compartmentation)
- Provision of means of escape for occupants (rescue)
- Controlling fire by automatic sprinklers, that is, by active means, (extinguishments).

During preliminary design/sketches the fire regulations according to Chandler, must be considered because of their influence on design and on layout of buildings and the impact they make on overall cost, Chandler, I (1989: Building Technology; London), and the architect should ensure:

- A thorough understanding of how fires commence, develop and spread in buildings.
- Overcrowding and traffic obstruction are avoided around circulation spaces and escape routes.
- There should be adequate spacing of buildings in relation to their site boundaries in order to avoid fire penetration through the roof and opening from adjacent buildings.
- Within the buildings, circulation spaces such as corridors staircase walls must be designed in order to meet fire safety requirements.
- The co-ordination of all services drawings: Mechanical and Electrical, and specialists drawings pertaining to fire, to ensure of adequate provision location of fire hydrant points.
- Also that insurance premium is taken out.Reznik, (2006)

To achieve the above stated measures, the architect, at design stage must involve:

- Fire Engineers or fire professionals in order to ensure a reasonable design provisions for protection of life and property.
- In planning for fire protection in and around a building involves an integrated system approach that enables the architect to analyze all the building components as a total building fire system package.
- Creative and efficient integration of well-articulated design strategies in order to achieve a balanced design that will provide desirable levels of safety.

For a structural elements in a building, the Architect must ensure that a continuity of fire resistance is maintained throughout the load bearing elements floor to floor and also address the following structural requirements factors:

- Construction type, its allowable height and area.
- Separation requirements.
- Fire rating for materials and specification.
- Occupancy type
- Exit stairway enclosure and remoteness.
- Exit discharge points to be clear and unobstructed.
- Accessibility of exit must be clear.
- Door locking arrangement in terms of security and acess must be clear.

For a Good Site Layout, the Architect needs to integrate in his design, fire service access, suppression and separation distances and their positions relative to adjacent structure and site boundaries.
This is to ensure that the layouts are uncomplicated to enable fire fighters to locate an area quickly.

- The architect therefore ensures that the design is provided with rapid and unobstructed access to various key elements specified in the building such as hose valves elevators and stairs, key boxes etc.
- Ensure easy access to other fire apparatus into and around the building.

Material Specification: For material specification, the architect ensures that all specified materials must satisfy fire resistance provision. The use of bricks, blocks and concrete according to Chandler, will enhance thermal and acoustic properties and at the same time withstand fire because of their structural thickness. Retardant paints are sometimes specified by the Architect to reduce fire spread.
For Service Provision in Design; the Architect's involvement of Services Engineers right from onset is necessary in view of the fact that services installation such as pipes and central mechanical ventilation can be a potential source of fire and smoke spread. The Architect to coordinates the input of these engineers at design stage. The Architect also ensures that the specified materials are tested and covered with test certificate at this stage. In case of high-rise buildings the Architect ensures that adequate water supply to the optimum pressure is specified including additional water storage which must meet the demands of active fire fighting provisions such as sprinklers, hydrants, dry risers and wet risers.
Wet and Dry Risers are further explained, as in built mechanical components made with pipes running vertical up a high-rise building with valves on every floor where fire fighting hoses can be attached for fighting fire. When the hoses are not connected to any valve floor to floor but only on the ground floor sources of water it is called dry riser. When it is connected to water source for example at high level roof tanks or other sources it is called wet riser. The architect must be familiar with all these installation by co-coordinating the inputs of Services Engineers. Majekodumi (N. I. A. Journal 1989).
Design of Walls: Load bearing walls are known to provide adequate fire resistance due to their structural

strength. Fire resisting walls should be designed to enclose stairways, lift shafts, service ducts and other floor-to-floor ducts.

Columns and beams: These are reinforced structures that contribute to the general stability of a building when subjected to fire. The Architect ensures that these elements are provided with adequate reinforcing bars and adequate concrete spacing. The involvement of the structural Engineer's input is white necessary at this stage.

Fire Detection Requirements in Design:

The Architect will address all issues pertaining to:

- Detection and notification potentials in and around the building.

For Fire Suppression Requirement, he ensures that;

- Water supply capacity is adequately specified for water-based fire extinguishing systems.
- Type of specified automatic fire extinguishing system is known to end-users.
- Pipes and hose reel outlets is clearly stated in the drawing.Bartkowiak, N (2006).

For Emergency Power, Lighting, Exit Signage and Smoke Control Potentials, the Architect ensures that;

- Energy distribution potentials are adequately specified
- Artificial lighting through an emergency power sources are provided in all corridors, stairways, exit or escape route
- Smoke control system that works with detection and alarm are specified in high sensitive areas.
- Fireproofing and fire stopping devices such as fire proof or fire stop doors are specified at the right locations.
- The emergency power sources are provided for egress in the case where, the main electricity power source is cut off in times of fire.
- Natural lighting through glass windows are specified around exit stairs ways, corridors, lobbies, which may become potential escape route during fire because artificial lighting will need to be switched off or when emergency power lighting is unavailable. Baldassara, C F (2007).

Building Height: Building height has influence on compartmentation, escape routes and fire ratings of the structure. The positioning of doors, staircases and distances between doors and places of occupation will to a large extent determine the level of safety with which people escape in the event of fire. The role of the architect therefore is to address the incorporation of escape routes, the specification of the right materials for walls, floors, doors and staircases during his design. Aiello, et al (2002).

RECOMMENDATIONS

- Statutory fire safety provisions must be established by the 3 tiers of Government Federals, State and Local Government for all designs and must be made mandatory before the issuance of development permit.
- Part of the process of statutory approval of building plans should include approval by chief fire officer of the state or locality. This must be backed by relevant laws, bylaws, regulations and codes as done in other countries.
- Adequate funding system is necessary for local authority and fire services to cope with increasing number of emergency situations.
- Fire precaution regulations should be put into law and promoted by setting up a Fire Safety Panel which acts as an advisory body and should include the representatives from local authorities, fire service, and governments departments.
- Compulsory fire insurance cover should be made for public buildings.
- Fire engineering to be included in school curriculum so as to encourage people to consider a career in fire service.

CONCLUSION

The general fire safety of a building will need a combination of passive fire protection and active fire precautions which will together provide a structure the ability to withstand fire and provide means of escape for building occupants.

Advancement in building design and construction can have significant improvement of fire safety, therefore our fire service has to understand and adapt to the demands of those emerging technologies by periodic review of new techniques and new materials incorporated in modern buildings.

Architects need to communicate with fire professionals and engineers across the world to update their knowledge in fire safety. If we must improve safety of our buildings and environment, we must learn of initiatives, safety schemes, new products and strategies that have been adopted throughout the global village.

REFERENCES

Aiello and Rella, M (2002): Fire Safety Measures in Historic Buildings for University Use.

Baldassara, C.F (2007): Fire Protection, Engineering, Energy and New Fire Protection Challenges .Round Table Discussion of Energy- Related Fire Engineering, Challenges and Solutions.

Bartokowiak, N (2006): Technical Measures of Fire Protection: Automatic Fire Protection Systems and Safety Management Systems.

Building Technology Special,(1971): Fire and Security Buildings Chandler, I (1989): Building Technology 2, Mitchell London, in association with the Chattered Institute of Building CIOB. London.

Doe and Fire Officers Committee, (1971): Fire Resistance Requirement for Buildings, a New Approach. Proceedings of symposium held in London 28th September, 1971.

Echeno, S.T. (1993): Draft National Fire Safety Code, Federal Ministry of Works and Housing, Lagos.

Majekodunmi, O. (1987): High Rise Building and Fire Prevention. Nigerian Institute of Architects (NIA) Journal March, 1987.

Obafemi Awolowo University, (1979): Newsletter Vol. 1x16. Dec. 1979:

Rezeznik, M.J (2006): Fire protection Performance Evaluation for Historic Buildings Technical Advice Notes for Scottish Historic Buildings.

The Aqua Group, (1984): Fire and Building. London.

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