Introduction of fighting fires formed the basis

Introduction

Fire protection engineering is an important concept that was integrated into the design and construction of the Lowry building which is an arts center that took three years to construct beginning in 1997.

The architects and fire safety engineers of the time knew well the cost of destroying the building by accidental fires. Thus the incorporated fire safety designs solutions for the building as discussed below. The paper discusses in detail about various design strategies, continues to evaluate the difference between prescriptive design and performance based designs. Passive and active fire protection systems are discussed, an evaluation fire fighting installations, building materials and ends with a documents used in the construction of the building. There is need, however, to conduct much research on the behavior of construction materials under different load conditions and associated thermal effects.

Fire safety designs solutions

Fire safety design solutions are critical components in ensuring the integrity of a building in mitigating against hazards due to fires as was detailed by the architect (The Building, n. d). In addition to that, the fire control officer concurred with the architect reinforcing the rationale for fire safety design solutions, typical of the Lowry building (Lowry, n. d).

The architect detailed that fire safety design solutions included considering design aspects such as the provision of adequate means for escape doors in the event of a fire, integrating reliable signage mechanisms to ensure a flexibly high standard systems consistent with fire safety standards. In the building, escape mechanisms that can accommodate disabled persons and children were incorporated into the design. The design provides for lifts and associated communication mechanisms as set out in the design and fire safety standards (The Building Regulations 2000, 2006). In a detailed discussion between the architect and the fire control officer, emergency folders as one of the cost effective approaches of fighting fires formed the basis of designing the building for fire protection. The architect detailed that for a means of escape doors, corridor fire doors have been used to partition adjacent corridors incorporating self closing mechanisms. However, the design allows for fire resisting construction materials that measure up to the standard requirements outlined in building regulations and legal requirements (The Building Regulations 2000, 2006). It is important to fit a ? hrs fire resisting door based on the fundamental principles of designing for performance, besides prescriptive design requirements.

On the other hand, several circumstances allow demand that electromagnetic device integrated into doors and staircases helps to minimize damage to fires. Through the eye of the architect, the fire control, officer could see other fire safety designs solutions to incorporate means of escape stairs. In the design, each step is designed with distinguishing edges that include contrasting nosing with an appropriate slip resistant surface. In line with construction standards, the architect revealed that escape stairs are sustainably maintained to ensure protection from adverse weather effects such as algae and frost among other factors. Typically, the design and construction limits the use of spiral and helix stairs. However, they have been incorporated into the design for their aesthetic appeal and plenty of space (The Building. n.

d). In addition to that, the architect asserted that such stairs were used to accommodate the needs of escaping children and disabled people who could be in the building in the event of a fire. Boarding and lodging areas are installed with fire alarm systems that allow for real time reporting of the incident of a fire. These installations comply with standard architectural provisions and legal requirements.

Any alarm is directly communicated to an alarm receiving office which is continuously manned by well trained and experienced technical fire fighting staff that is made up of a quick response team in the event of a fire (Information Policy Team, 2006). Information about the occurrence of a fire is continuously relayed to the remotely located centre to provide information about the status and progress of any fire. In addition to that, the alarm center is computerize and logs all events of fires in a database for future analysis. The design includes refugee areas that are typically provided with communication systems and staircase enclosures. That allows people who are disabled to communicate with the fire fighting personnel in the event of a fire. At this point it is evident that the architects worked consultatively with fire control officers in informing the design for fire safety protection focusing at the disabled and children.

According to the architect, the fire safety designs solutions focused at direct access to fire fighting equipments specifically including a range of equipments and devices. That was in particular inclusive of height restrictions, the weight capacity of the building according to the building codes and regulations used at the time of construction. On the other hand, fire fighting installations are in accordance with fire fighting regulations and standards discussed later on.

These installations provide solutions in fighting fires by the use of extinguishing agents that are discussed elsewhere in this paper (The Building Regulations 2000, 2006). The design of ducting and ventilation systems incorporates fire fighting equipments that were carefully integrated into the system at the design and construction stages. In addition to that, Intumescent grills were used in the compartmentalization process to attain standard escape ducts as outlined in the fire safety regulations and standards discussed elsewhere. However, the architect agreed with the fact that both prescriptive and performance based designs borrowed from each other to form the basis of the design. Therefore, a brief comparative analysis of both approaches is necessary as discussed below.

Prescriptive and performance based design

A strong distinction between performance based design and prescriptive design could further inform the research process into the fire safety designs solutions specific to the building in question (ABS. 2004). Under the prescriptive approach, designer engineers are more concerned with adhering to the specifications laid down in the building codes and regulations without caring about the ultimate performance of the design. These codes lay stringent restrictions on designers and leave them with little or no flexibility to develop a design that incorporates fire safety elements particularly when buildings on limited space (Galati, Vollintine, Nanni, Dharani, & n.

d). The prescriptive approach relies on escape means, construction of fire resisting structures, and the best means to reach required fire fighting equipments. In addition to that, prescriptive codes prescribe standards for the design of a structure, and provide a preliminary structure due for consideration during the design for fire engineering. On the other hand, performance based design begins without caring about established codes and standards, factors items that may not be compliant in the design, factors a comparative evaluation of alternative designs, creates a fire safety report that is evaluated by a sitting committee, and gradually submits the document for use by the fire protection engineers.

Performance based designs must, however, be quantitatively evaluated before it is adopted and integrated for use in a structure Galati, N. Vollintine, B., Nanni, A., Dharani, L.

R.& V, M., A. n. d).. It is also important to design methods must incorporate tested results, necessary redundant methods, issues related to fire dynamics, and the quantification of the level of safety has to be done by appropriate fire control personnel.

However, both designs must factor both the active and passive fire fighting systems as discussed below.

Passive and active fire protection systems

Active and passive fire protection systems safety typically formed an integral part of the strategy used for fire protection as revealed to the fire safety officer by the architect. In the discussion with the architect, a number of active fire protection systems were identified. The systems identified specific to the building included fire extinguishers, emergency lighting, pressurized stairwells, emergency exits, automatic sprinkler installation to LPC rules – BS 5306 Part 2 1990 / BS EN 12845, and automatic fire detection to BS 5839 Part 1 2002 a fire protection strategy in agreement with the view presented by (Robinson, n. d). These systems were, in the architect's argument, appropriately integrated into the building to optimize their integration in ensuring fire safety standards are adhered to and the risk of a fire are minimal in the event a fire occurring, early action could be taken to minimize the likelihood of any potential destruction. On the other hand, the architect further identified passive fire protection methods as being integral to the fire protection methods used in the building.

These included the use of noncombustible construction typically involving fire barriers, fire resistant cabling, large capacity buildings and fire dampers as discussed below. According to the architect's arguments, the use of active and passive fire protection methods were performance based though a theoretical basis reinforced the prescriptive approach as underlying the performance based approach. The architect continued to indicate that passive forms were reflective of the use of fire resistant electrical cabling. Referring to documents that were available, the architect clarified that appropriate cabling was done to ensure that hazards due to the risk of fire from wrongly done electrical installations could be mitigated. Fire barriers integrated into the building included fire insulations on the roofs and other fire protection linings, dampers particularly built into ducts and other non-structural materials layered in between building elements to curb the possibility of a spreading fire.

Various metal cases used with different board materials cemented with spray materials to prevent the spread of a fire away from its source. It is important to realize that structural steel used in the construction of the building met standard requirements for steel that could maintain its structural strength and other mechanical properties when subjected to intense heat. It is argued in theory and observed in practice that door posts used for the doors are made of fire resisting door sets and doors that incorporate into their designs roller shutters to enhance the resistance and protection from hazards related to the risk of the occurrence of fires. Further importance is attached to the regular maintenance of hardware components that make up the structure and use of self-closing does to curb the spread of a fire from a given source. In addition to that, the structure is critically identifiable with rolling shutters that provide easy escape in the event of a fire.

On the other hand, fire separating elements are used within the fire walls to ensure the risk of fires spreading through the walls is curbed. The architect further argued that the floor areas engineering requirements are met in the use of fire resistant flooring materials. Concrete floors are reinforced with steel and other fire resistant materials and reinforced with composite steel reinforcements. On the other hand fire resistant ceilings are incorporated which meet and satisfy the requirements spelled out in fire protection engineering standards.

These characteristics are also evident in the design and construction materials of cavity barriers particularly for those fires that are spread through smoke and related effects. The architect argues that the design of the building could be complete with the use of active fire protection measures. These include the use of fire extinguishers positioned at strategic points to enable easy access to any source of fire. In addition to that, the use of fire detection mechanisms is a critical component of early sensing of the possibility of the occurrence of a fire and looking for measures to prepare against the likely event of a fire. Fire detection mechanisms integrate smoke detection devices which automatically triggers a fire warning in the event of its occurrence. On the other hand, well provided for lighting provides a clear visibility for escape and with adequate escape routes.

It is important to continuously maintain lighting throughout the building no blockage occurs when escaping in the event of fire. Typically, the fire detection systems are installed in the building to allow early sensing of a fire to allow contingency measures to be employed to curb any occurrence of a fire. They are, according to the architect, at various levels. These include Flammable and Toxic Gas Detection Systems which incorporates an electronic sensor that is able to identify the leaking of gas or smoke and trigger information about the risk of a fire (Robinson, n. d). The architect concludes this part by being categorical that emergency lighting was critical in determining the saving of lives in the event of fire. Thus, an automated mechanism that could trigger the lighting mechanism in the event of a fire was integrated into the structure to address an emergency situation.

However, in theory and practice, it has been identified that the complexity of the building and the occupying population were determinant factors in the design of the lighting system. Other issues integrate into active fire protection measures include emergency exits, smoke ventilation and exit systems, pressurized stair-walls and automatic sprinkler systems (Robinson, n. d).

Appraisal of the different types of fixed fire fighting installations

An appraisal of different fixed fire fighting installations within the building revealed a number of issues. One of the methods involved the use of a sprinkler water system. A critical evaluation of the system indicates that the sprinkler system has been established to be a cost effective fire fighting system and reliability figures indicate up to 99% efficiency in putting off fires, a technique doubtlessly integrated into the Lowry building (Robinson, n. d). The performance design of the sprinkler is meant to reduce the size of a fire by optimizing its design in controlling the spread of smoke hence minimizing the rise in temperature as a likely source of fire.

However, sprinklers have limitations in optimizing their efficiency in tall ceilings and the inability to be functionally efficient in front of obstructions, and inflexibility in the event of electric fire breakouts. Typically, the design mechanism of a sprinkler is characterized by a water source that is reliable, control valves, pressure upping pumps in the face of inefficiently pressurized water, and a piping mechanism. On the other hand, sprinklers fall into the category of wet pipe, dry pipe, wet and dry, tail end, among others. In their design, sprinklers exit pressurized water in the form of deluge water systems where medium capacity nozzles are used, water mist systems that discharges mist at a fire, and foam enhanced systems that use foam that is mixed with water and directed at a fire at either low, medium or high expansion levels (Robinson, n. d).

Building construction materials and impact of heat on the structure

The building materials used to construct the Lowry included 48, 000 tons of concrete giving the building the aesthetics of a ship when viewed from the outside, 2, 466 tons of steel forming a massive investment in steel, and 5, 263 square meters of glass (Teacher's Resource Pack. n. d).

Milke, Kodur and Marrion (n. d) detail the behavior and properties of different materials when subjected to effects of fire. The fire rating of the Lowry building is strongly related to the building codes and materials that were used in its construction (Milke, Kodur, & Marrion, n. d). Typically, steel formed one of the basic construction materials used in the building. Steel, when subjected to heat, the thermal properties and the thermal performance of steel varies proportionally.

In accordance with ASTM E119 provide laboratory results on the analysis of these materials when subjected to heat treatments. The yield strength of steel changes with increasing heat before it yields at 500 ? C, typical of steel frame measuring 11? 10-6 mm/mm ? C. Steel reaches a melting point at 1400 ? C. To mitigate against the effects of fire, fire protection measures were used in protect steel against the effects of heat. These include insulating steel members by use of sprays and use of other mineral fibers such as concrete and other masonry materials as was seen appropriate.

Another method used to protect steel was the captive method. Here, the heat capacity of other protective materials was exploited to conduct away heat from its point of application. Other approaches used included end strain methods, applying appropriate loads, and using connections that could allow flexibility for expansions in the face of heat to minimize the overall effect on the building. Other protective measures included the use of tensile membrane actions, structural interactions, and temperature distributions (Welcome to The Lowry. n. d).

Concrete, as another structural component respond to the application of heat in different ways depending on the type of concrete used. Concrete maintains its strength at high temperatures more profoundly than steel. However, the spalling characteristics of concrete influence its behavior under the conditions of heat. That varies the compressive strength with changes in temperature particularly for the lightweight concrete used in the construction of the Lowry building (Hasija, 2010). In conclusion, therefore, the building is modeled to accommodate every aspect of structural safety and able to withstand the effect of heat on the application of heat. In addition to that, the design assures that to a greater extent, the safety of occupants in the event of a fire is guaranteed.

Appropriate building codes and approved documents used in the design and construction of the premises

In the design and construction process, a number of fire protection codes were used. Typically, the National Fire Protection Association (NFPA) provides standards to be adhered to when designing or procuring water tanks that are used for private fire protection.

These tanks include water tanks, pressure tanks, gravity tanks and a number of others as were seen appropriate during the design and construction process. Each of these tanks has to meet standers inspection requirements typically in relation to the fire resistant materials they are made of. The NFPA 101, Life Safety Code provided a guide in the fire protection equipments used in the building, furnishings, means of egress, building materials, and structure and other constructions. On the other hand, 2003 International Fire Code® (2002) details administrative issues in the design of a structure relating to structures and all other issues related to premises for fire protection. It details requirements for fuel fired installations and appliances, refrigeration systems, ventilations, and a host of other fire protection systems, and means of egress in details (2003 International Fire Code®, 2002). However, appropriate authorities have to approve a specific code to use for a specific building.

Approved documents used in the design and construction of the building

In the construction of the Lowry project, fire protection engineering was based on standard codes that were adopted for use in the construction process. The document details the design of the building such as cavity requirements, ceiling lift in dwelling areas, fixtures, maximum loading conditions, and several other details (Glasroc F fire protection solutions, n.

d). In the Glasroc F fire protection solutions (n. d) document construction details are highlighted while and the performance different materials are detailed.

Other areas of detail include Board fixings, system support components, and other steel ceiling membranes (Glasroc F fire protection solutions, n. d). In addition to that, construction details are shown in the Glasroc F fire protection solutions (n. d) for further informative analysis.

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