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A Path toward Safer Heritage Buildings through Excellent Fire Prevention and Control System in Malaysia

Fire prevention & control system by Fire Rescue Department Malaysia states that protection in the aspects of fire prevention, control and extinguishment for a certain area based on the availability of risks in that area. It is a practice of mitigating the unwanted effects of fires. Besides that, a fire safety system also includes the study of the behaviour, compartmentalisation, suppression and investigation of fire and its related emergencies. In protecting and preserving the historic fabric of the heritage structure there are some major differences which is a challenge for the architect and fire protection engineer in the application of general fire protection principles. The challenge in protecting heritage structure is to maintain their historical fabric while providing a reasonable level of safety for their occupants and contents. In order to avoid harming the building's historic character, the architect and engineer will need to have the sensitivity and ingenuity approaches to provide fire prevention and protection measures that do not damage the historic fabric of the building. This paper focuses on path toward safer heritage buildings through excellent fire prevention and control system in Malaysia.

Keywords: *fire prevention, control system, fire, building, passive protection, active protection*

1. Introduction

It is largely recognized that fire is one of the greatest threats not only to the building's occupants but also to the building's fabric and contents. Fire has long been an adversary of heritage buildings and its structure, with some older structures falling victim several times. There are a few factors that contribute to the fire in this unique yet vulnerable heritage building. Most of the heritage build-

ings are of large scale buildings; flammable priceless contents; large numbers of visitors; and existing structures weak on fire resistance. Therefore, fire risk assessment plays an important role as many historic buildings in Penang are significant of architectural value and historical importance and their destruction by fire is an irreplaceable loss [1].

All these heritage buildings should be well kept and protected from the danger of fire at all time. Every building should have good fire protection and resistance to prevent from fire outbreak. Unfortunately, up to now, there are fairly insufficient legislations or guidelines on fire safety for heritage buildings in Malaysia. In fact, FRDM stressed the safety of life is the ultimate principle of fire safety in a building. Property protection which includes protection to building's fabrics and contents of heritage buildings is not really been prioritised [2]. Efforts should be made to improve fire protection and resistance at historic buildings to make certain that it is safe from the danger of fire with concerned of preserving the building fabric without destroying or changing the features of existing building [3].

Fire prevention and control system by Fire Rescue Department Malaysia states that protection in the aspects of fire prevention, control and extinguishment for a certain area based on the availability of risks in that area. It is a practice of mitigating the unwanted effects of fires. Besides that, a fire safety system also includes the study of the behaviour, compartmentalisation, suppression and investigation of fire and its related emergencies. In protecting and preserving the historic fabric of the heritage structure there are some major differences which is a challenge for the architect and fire protection engineer in the application of general fire protection principles [4]. The challenge in protecting heritage structure is to maintain their historical fabric while providing a reasonable level of safety for their occupants and contents. In order to avoid harming the building's historic character, the architect and engineer will need to have the sensitivity and ingenuity approaches to provide fire prevention and protection measures that do not damage the historic fabric of the building.

In other words, in upgrading any heritage buildings the architects, engineers or conservators should with a concept of balancing fire engineering with conservation aims in their mind. Standard fire protection approaches that normally ideal for new constructions may have adverse impacts on heritage materials and spaces and destroy the very qualities that give a space its historic character. Practically, factors to be considered in determining acceptable levels of fire protection in heritage buildings are [5]:

a. The age of the structure and its type of construction, its uniqueness;
b. Site location and accessibility;
c. Occupancy and use;
d. Means of egress and distances of travel to exits;
e. Size and height of the structure;
f. Qualities of finishes; and
g. Types of building contents.

2. Passive System

Passive Fire Protection System is an integral component of the three components of structural fire protection and fire safety in a building. PFP attempts to contain fires or slow the spread, through use of fire-resistant walls, floors, and doors. PFP systems must comply with the associated Listing and approval use and compliance in order to provide the effectiveness expected by building codes.

2.1. The building on its site

Historic constructions are different from contemporary ones for reasons associated with the old conception of villages or towns, and with the types of materials and constructive solutions used. Those characteristics make it difficult to adopt common fire risk assessment methods in the old areas of towns [6].

2.2. The Use of Premises

The use of the premises can very often affect the fire performance of the building. A shop stocking polystyrene foam or video cassettes would be far more hazardous than one selling fish or jewellery.

The upper floors of some of the premises often have no commercial value and are left vacant. This leads to neglect and sometimes deterioration through the ingress of water, which could cause problems if the services remain live.

Some of these upper floors are used for the dumping of rubbish, which exacerbates the problem. Bringing these upper floors back into use will have the advantages of preventing dereliction and improving the fire protection for life safety purposes to comply with the Building Regulations [6].

Table 1. Common issues and potential solutions in the spreading of fire.

Common issues in historic buildings	Potential solutions
Room geometry can render British Standard recommendations for use of detectors unsuitable. Large windows or ornate ceilings can allow a large flow of air over detectors, preventing them from responding quickly enough.	Careful selection of detectors can greatly improve the chance of detecting a fire before it becomes too large. Beam detectors can cover large areas with relatively few detectors and reflectors, reducing the disruption to the fabric of the building. Wireless systems can be used in areas of a historic building where the installation of wires is not acceptable or possible. The location of the detector must also be considered to avoid environmental conditions, such as air flow, influencing the efficacy of the detector.
Installation of systems disruptive to historic fabric of building.	'Hidden' aspirating detectors have been used in historic buildings whereby the detector head is concealed within a wall or ceiling and therefore minimises aesthetic impact. Aspirating detectors continually sample the air and will decrease the time it takes to detect a smoke signal.

Source: Historic Buildings and Fire Safety Guidelines by Chiltern International Fire

2.3. Means of Escape

According to Historic Building and Fire Safety Guidelines, they provide us information regarding the means of warning and escape during fire outbreak. At the same time, potential solutions are suggested too. The information is shown as Table 1.

2.4. Communication & Safety

Table 2. Common issues and potential solutions in the spreading of fire

Common issues in historic buildings	Potential solutions
Access for fire tender vehicles can be limited. Historic buildings can be remote from nearest fire and rescue service.	Liaise with local fire and rescue service regarding access and facilities to develop and agreed 'planned response'. If access to the building is restricted, it may necessitate attendance by a different type of tender vehicle with specialist equipment. Accurate site plans with access points and other important information need to be supplied to fire and rescue service to maximise efficiency on site. Develop artefact salvage plans in cooperation with the local fire and rescue service.
Limited water resources (no fire mains).	Use local resources such as lakes or rivers, rather than relying on a potential inadequate mains supply.

Source: Historic Buildings and Fire Safety Guidelines by Chiltern International Fire

Historic Building and Fire Safety Guidelines also drawn out issues regarding communications between two involving parties that should be solved in order to have a better fire protective system. Issues on access and facilities for the fire fighters are as shown. Besides, potential solutions are suggested too. The information is shown as Table 2.

3. Active System

Active fire protective system is an integral part of fire protection. AFP is characterised by items and/or systems, which require a certain amount of motion and response in order to work, contrary to passive fire protection.

3.1. Detectors

There are a few types of detectors that can be chosen to install as a fire precaution.

3.1.1. Point Detectors

Point detectors give the most choice of all systems in the method of operation, with heat (fixed temperature and/or rate of rise) smoke (ionisation or optical), combined heat and smoke, or Carbon monoxide detection being readily available. This enables the system to be tailored to the risk being monitored, to give the best coverage whilst avoiding false alarms Detectors that are recessed, or placed above holes in the ceilings, or hidden behind beams and lights are also ineffective.

3.1.2. Smoke Detector

Figure 1. Common type of smoke detector found in the market.

A smoke detector is a device that detects smoke. The smoke detectors send a signal to the fire alarm system. Most smoke detectors work by either optical detection using photoelectric cell or by ionization. The smoke detectors are usually powered by the central fire alarm system which is powered by the building power with a battery backup.

The smoke detectors (Figure 1) will automatically send a signal to the fire alarm control panel whenever smoke is detected at the specific area so that further action can be taken.

3.2. Fire Alarms

Fire alarm system is designed to fulfil the following objectives to notify occupants of a facility to take necessary evasive action to escape the dangers of a hostile fire. It also aimed to summon organize assistance to initiate or to assist in fire control activities besides initiating automatic fire control and suppression systems and to sound an alarm.

A break glass type fire alarm system will need to break the glass panel and the button inside need to be pressed to trigger the fire alarm during fire emergency. Once the button is pressed, the fire alarm on the designated floor will first ring and followed by the fire alarms in other floors after a few seconds. Routine maintenance will be carried out frequently to ensure that all systems are functioning properly. The fire alarm break glass panel is located at the lift lobby of every floor

3.3. Escape and Emergency Lights

Fire exit route is the most simple fire protection system. Occupants are required to escape from the building according to the direction of the fire exit route during fire emergency. Emergency fire drills will be held from time to time to make sure the occupants are familiar with the fire exit route.

3.4. Exit Sign

Exit signs are signs in a building which show location of the emergency exit. The sign is permanently illuminated as visibility may be reduced due to smoke or electrical lighting failure. Figure 2 shows an example of exit sign above the fire door.

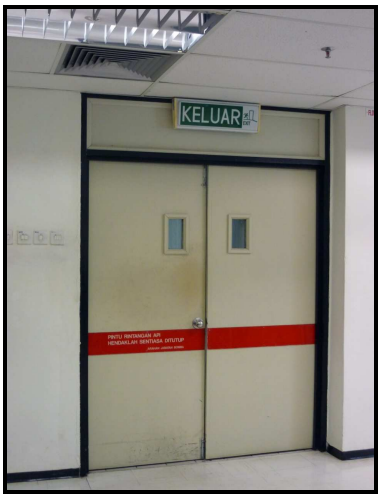

Figure 2. An exit sign above the fire door

3.5. Sprinkle System

A fire sprinkler system is an active fire protection measure, consisting of a water supply system, providing adequate pressure and flow rate to a water distribution piping system, onto which fire sprinklers are connected.
Fire sprinklers function by having its head held close by either a heat-sensitive glass bulb or a two-part metal link held together with fusible alloy. The glass bulb or link applies pressure to a pip cap which acts as a plug which prevents water from flowing until the ambient temperature around the sprinkler reaches the design activation temperature of the individual sprinkler. Due to each sprinkler activates independently when the predetermined heat level is reached, the number of sprinklers that operate is limited to only those near the fire, thereby maximizing the available water pressure over the point of fire origin.

3.6. Staircase Pressurization System

The staircase pressurization system is an important element in the building fire safety system. This objective of this system is to create a safe environment in egress staircases, allowing building occupants to escape the building in a safe manner. The main mechanisms by which the stairs are made safe are by guaranteeing structural protection of the stair enclose and by elevating the pressure within the stairwell to ensure that smoke cannot enter. This can be done by fixing a fan on the top floor of the stairwell. The fan can be controlled from the fire alarm control panel and it will be activated when there is a fire in the building so that the staircase will be free from smoke.

3.7. Fire Lift

Fire lifts are lifts that can be used by fire fighters during emergencies to access to different floors of a building. It is different to a passenger lift as fire lifts have independent power supply. Hence, when there is a fire outbreak, the power to the lobby lifts will be shut down and the fire fighters will use the fire lift to transport themselves and also equipment to the location of the fire.

3.8. Fire Door

A fire door is a door with a fire-resistance rating (sometimes referred to as a fire protection rating for closures) used as part of a passive fire protection system to reduce the spread of fire or smoke between compartments and to enable safe egress from a building. Fire doors are usually made up of a combination of materials such as timber, steel, gypsum, vermiculite boards and glass sections. The construction of the fire door should comply with Malaysian Standards requirements. Fire doors differ from conventional doors as the edges of a fire door requires fire rated seals such as an intumescent strip which expands when exposed to heat. All

the fire doors are supplied with automatic door closers of the hydraulic spring operated type. All fire doors have a fire rating which indicates the fire resistance duration. There is usually a certification nailed on the top right corner of each fire door as shown in Figure 3.

Figure 3. The fire door and the certification of the fire door

3.9. Fire Hose Reel System

A fire hose reel system consists of hose reels normally 30m in length fixed on specific locations on all floors connected to a fire pump set. The hose has a control nozzle to control the water direction and water flow. This system is pressurised with a purpose of fighting any fire that might occur until the Fire & Rescue Services arrive. A hose reel is usually provided near to the lift lobby of every floor enclosed in a door.

3.10. Wet & Dry Risers

3.10.1. Wet Riser System

A wet riser is a main vertical pipe intended to distribute water to multiple levels of a building or structure as a component of the fire suppression systems. It is a system of valves and pipe work which are kept permanently charged with water to be used in the event of fire. Wet riser system shall be provided in every building which the topmost floor is more than 30.5m above fire appliances access level. The centralized wet riser system will serve all floors of the building. The wet riser system will be filled with water under pressure. The water of the wet riser system will be supplied from a main water tank located at the ground floor of the building.

3.10.2. Dry Riser System

A dry rising is a main vertical pipe intended to distribute water to multiple levels of a building or structure as a component of the fire suppression systems. The pipe is maintained empty of water. According to UBBL (230), dry rising system shall be provided in every building in which the topmost floor is more than 18.3m but less than 30.5m above fire appliance access level. A hose connection shall be provided in each fire fighting access lobby. Dry risers shall be of minimum "Class C" pipes with fittings and connections of sufficient strength to withstand 21 bars of water pressure

3.11. Hand Held Extinguishers

There are several types of portable fire extinguishers can be found in the market. The types of fire extinguishers commonly used are the ABC powder fire extinguishers and the Carbon Dioxide fire extinguishers. The ABC powder fire extinguisher is suitable for A, B and C type fire. Type A is common fuels such as wood, B for flammable liquids, and C for charged electrical fires. This type of fire extinguishers is generally located at the office area and also the lift lobby of every floor.

The Carbon Dioxide fire extinguisher is most suitable for electrical equipment fires which as the fire extinguisher will not harm electrical equipments. However, Carbon Dioxide is harmful to our health therefore CO_2 fire extinguishers are not widely used in the office area. This type of fire extinguisher is located in computer rooms, the air handling unit (AHU) room, lift motor room, and the pump room. The location of these fire extinguishers can be found in the fire safety plan at every floor.

3.12. Fire Hydrant

A fire hydrant is an active fire protection measure and a source of water provided in most areas with municipal water service to enable fire fighters to tap into the municipal water supply to assist in extinguishing a fire.

3.13. Carbon Dioxide System

The carbon dioxide system (Figure 4) is a fire fighting system which automatically emits carbon dioxide gas when there is a fire outbreak. This system is usually used in electrical rooms with no human occupancy because carbon dioxide gas is harmful to humans. The heat and smoke detectors will trigger the carbon dioxide system whenever excessive heat or smoke is detected in the room. The carbon dioxide gas is usually stored in large pressurized canisters inside the room.

Figure 4. The Carbon Dioxide system control panel

4. Fire Management

Fire safety management can be defined as the application by a manager of policy, standards, tools, information and practices to the task of analysing, evaluating and controlling fire safety. A fire safety strategy for a specific building needs management policies and procedures to ensure the effective operation of the strategy and it should be on an ongoing basis where fire safety systems need to be regularly checked and maintained.

Normally, fire takes place without warning and may cause building occupants have limited time to react either to distinguish the fire or to escape. When fire is not controlled the following may result:

a. Death and injury of people who cannot escape its smoke, gases and heat;
b. Destruction of buildings, their contents and other tangible property;
c. Building have to close either temporary or permanent which could cause loss of income or possibly bankruptcy; and
d. Destruction of irreplaceable reminders of human heritage.

Therefore, the most effective method to eliminate the risks of fire is to conduct a fire risk assessment regularly with close monitoring and reviewing; i.e. 'prevention is better than cure'. Indeed, a heritage building owner / manager should play an important role in safeguarding their building and must possess a good fire safety management. An efficient fire safety management is essential because the majority of heritage buildings, whether aware or not, are exposing to fire risks due to the following factors:

a. Existing structures weak on fire resistance; aging or decaying building materials and combustible materials e.g. timber;
b. Inadequate fire prevention and protection systems, notably passive fire protection;

c. Poor fire safety awareness among the building owners, managers, staff and public;
d. Low standard of management, housekeeping and maintenance;
e. Few heritage buildings located at busiest area or narrow road where without a good access for fire brigade;
f. Large number of visitors; most open daily to public;
g. The danger from renovation works;
h. Possible danger from nature factors such as lightning, overheating etc.; and
i. The danger of careless and arson.

In this regard, the 'best-practice' management procedures are the steps that are taken when planning the management of fire risk. They are based on the four following criteria: prevention, preparation, response and recovery. Nevertheless, fire safety in a heritage building is the joint responsibility of building owners, occupants (staff and visitors) and related authorities because an authentic heritage fabric and content lost to fire is irreplaceable; no matter how good subsequent restoration may be, the original has been lost forever. All concerned must be aware of their individual duties in ensuring that adequate standards of fire safety and property protection are both provided and maintained.

5. Conclusions

Fire is a one of the subject that is always mistreated and ignored as far as heritage building is concerned. Unlike the newly built buildings which need to undergo some fire protection system test as required under UBBL, people are less likely to accomplish fire protection system test and detailed assessment in heritage building. From past cases, we can conclude that this negligence becomes a huge factor in attributing to the fire in heritage building. Therefore, the most effective method to eliminate the risks of fire is to conduct a fire risk assessment regularly with close monitoring and reviewing; i.e. 'prevention is better than cure'. Indeed, a heritage building owner or manager should play an important role in safeguarding their building and must possess a good fire safety management. In protecting and preserving the historic fabric of the heritage structure there are some major differences which is a challenge for the architect and fire protection engineer in the application of general fire protection principles. The challenge in protecting heritage structure is to maintain their historical fabric while providing a reasonable level of safety for their occupants and contents. In order to avoid harming the building's historic character, the architect and engineer will need to have the sensitivity and ingenuity approaches to provide fire prevention and protection measures that do not damage the historic fabric of the building.

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