FIRE SAFETY MANAGEMENT IN HERITAGE BUILDINGS: A CASE STUDY IN MALAYSIA

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ABSTRACT:

In Malaysia, there are few heritage buildings with an architectural and historical significance that may classified into several categories, namely traditional timber Malay houses, pre-world war shop-houses, colonial office buildings, institutional buildings and religious buildings. Many of them are worthy to be listed as Heritage Buildings or National Heritage buildings under the National Heritage Act 2005 (Act 645). However due to poor fire safety management, many priceless heritage buildings were badly damaged or burnt down by fire e.g. Muzium Rakyat, Melaka (2001), Rumah Pak Ali, Gombak (2003) and Sarawak Club, Kuching (2006).It is widely accepted that fire is one of the greatest threats not only to the building's occupants but also to the building's fabric and contents. Nevertheless, in term of fire safety approach, a heritage building requires relatively more sensitive approach compare to a new building; a high standard of fire safety management is required, not only to protect people but as well as to protect historical contents, fabrics and structures of the building. This paper suggests some recommendations to provide a satisfactory level of fire safety management in a heritage building.

Keywords: Fire safety management, fire safety, building fire safety, heritage buildings in Malaysia, heritage buildings conservation.

(a) 1. INTRODUCTION

In Malaysia, there are few old buildings with architectural and historical significance that may classified into several categories, namely traditional timber Malay houses, pre-world war shop-houses, colonial office buildings, institutional buildings and religious buildings. Many of them are worthy to be listed or gazetted as a Heritage Building or National Heritage Building under the National Heritage Act 2005 (Act 645). Currently, in order to preserve the buildings, most of them have been changing to different functions from its original (adaptive-reuse) such as museums, libraries, offices and hotels. However due to poor standard of fire safety management and inadequate fire protection, many priceless historic buildings were badly damaged or burnt down by fire (*Table 1)*. In fact, fire damaging heritage building is also an international crisis; for example in the UK a rate of more than one heritage buildings of national and international importance have been seriously damaged by fire per year (Kidd,1995, p.12).

In term of fire safety approach, practically, a heritage building requires relatively more sensitive approach compare to a new building; a high standard of fire safety management is required for heritage buildings, not only to protect people but as well as to protect historical contents, fabrics and structures of the building. Heritage buildings are irreplaceable but vulnerable to fire as there is a combination of several factors: large scale buildings; flammable priceless contents; large numbers of visitors; and existing structures weak on fire resistance.

Table 1: Fire statistic for heritage buildings in Malaysia from 1992 – 2008

Date	Building	Year of Built	Function	Estimated Loss (MYR)	Cause
17 Sept. 1992	**National Museum Malaysia**, Kuala Lumpur	1959	Museum	100,000	Smoking / water heater
Mac & Dec. 1992	**High Court Building**, Kuala Lumpur	1896 / 1904	Court		Short-circuit
12 Sept. 1996	**Sultan Abu Bakar Royal Museum**, Johor	1864/ 66	Museum	Undisclosed	Arson (Molotov cocktail)
15 Mac. 1997	**Sultan Abu Bakar Royal Museum**, Johor	1864/ 66	Museum	Undisclosed	Undisclosed
02 Dec. 2001	**People's Museum**, Melaka		Museum		Short-circuit
20 Oct. 2003	**Rumah Pak Ali,** Gombak, Kuala Lumpur	1876	Private museum	> 1 mil.	Short-circuit
27 June 2005	**23 Shop-houses pre-World War**, Meru, Klang, Selangor	1920 - 1930	Shop house	5 mil.	
27 June	**13 Shop-houses**	1920 - 1930	Shop house	> 500,000	

2005	**pre-World War**, Kampung Sentosa, Kuala Lumpur				
17 July 2006	**Shop house**, Jalan Laksamana, Bandar Hilir, Melaka	> 1806	Shop house		
27 July 2006	**Sarawak Club**, Kuching	1876	Club house		
24 July 2007	**Ipoh Police Volunteer Mess Hall** Ipoh, Perak	1910	Club house		Faulty electrical wiring
30 Sept. 2007	**PULAPOL Senior Police Quarters,** Jalan Semarak, Kuala Lumpur	1940	Quarters	300,000	Short-circuit
19 Mac. 2008	**6 units of Old Shop-houses,** Taiping, Perak	1895	Shop	> 300,000	
05 May 2008	**38 units of Punan Bah longhouse,** Belaga, Sarawak		House	> 500,000	

2.0 FIRE AND HERITAGE BUILDINGS

2.1 Introduction

It is widely accepted 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 enemy of heritage structures, with some older structures falling victim many times. One example is the LaFenice Theatre (Venice Opera House) that first opened in 1792 on the site of a theater that burned down in 1773 was again

extensively damaged by fire in 1836 and 1996 (Bukowski, Nuzzolese and Bindo, 2001). The Windsor Castle (UK) also was badly damaged by fire in 1992; it was probably caused by curtain being ignited by a wall-mounted spotlight which was too close behind it and resulted total loss at least USD 90 million.

Figure 1: The 98-year old wooden building of Ipoh Volunteer Police Mess Hall was destroyed by fire on 24 July 2007.

In fact, history shows that fire was recognised as a threat to great civilizations as early as 2000 years ago. The Roman Empire devised a system of corps vigilante whose sole task was to be on watch for the outbreak of fire. The Great Fire of London in 1666 became the catalyst for the modern day building codes. The fire broke out in a baker's shop and destroyed half of London. The buildings in London at that time were not fire separated and so the fire spread easily. Analysis of how the fire spread led to the creation of the first building regulations (Spadaccini, 1998).

2.2 Fire in Malaysia

The Fire and Rescue Department of Malaysia (FRDM) reported that from 2005 to 2007 fire was caused total loss of more than MYR 2.4 billion that claimed 221 lives and injured 268 people (*Table 2*); the highest total death and total lost is recorded in year 2007 (*Figure 2*). Furthermore, 3,447 (17%) from the total of 20,225 fire cases in 2007 were involved building fires, in fact it was gradually increased from 2000 to 2007.In the context of heritage buildings, until today, fire was damaged and destroyed many heritage buildings in Malaysia which given total loss approximately up to MYR 5 million *(Table 1)*. It is believed

that the main reason of the problem is due to fire safety awareness among the public is still very low.

Table 2: Fire statistic in Malaysia for 2005 -2007

	Fire call	Affect of Fire		Estimated loss (MYR)
		Death	Injured	
2005	31,138	70	115	794,662,089.85
2006	18,913	71	86	760,682,593.45
2007	20,225	80	67	865,289,376.62
TOTAL	70,276	221	268	2,420,634,059.92

(Source: Fire and Rescue Department of Malaysia)

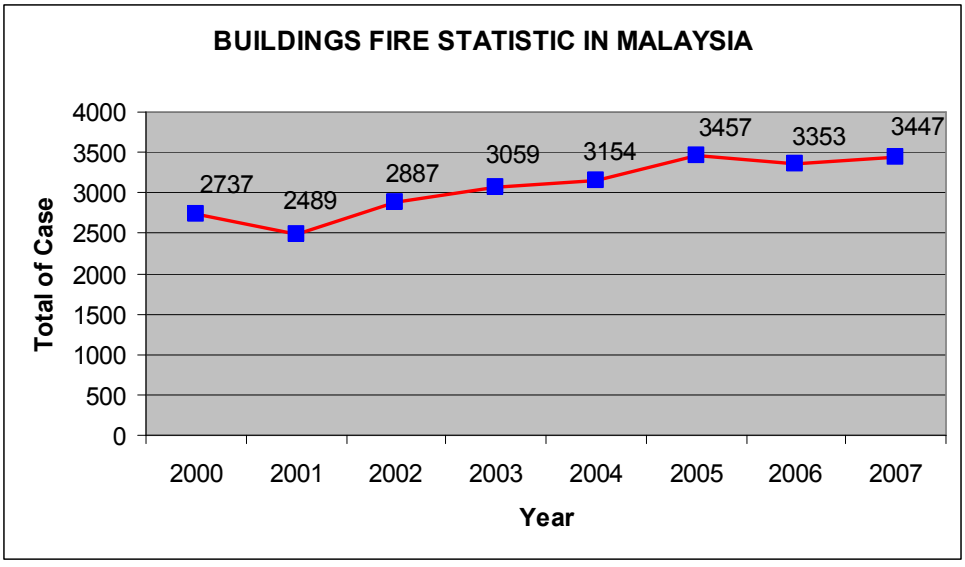

Figure 2: Buildings fire statistic in Malaysia for 2000 -2007
(Source: Fire and Rescue Department of Malaysia)

3.0 FIRE SAFETY AND FIRE PROTECTION STRATEGY

3.1 Fire Safety Objectives

In general, there is little or no difference between heritage buildings and 'new' buildings in term of fire safety objectives regarding protection from fire, namely:

a) **Life safety:** in buildings in which there are normally occupants, they will require adequate time and appropriate facilities to enable a safe escape.

b) **Prevention of conflagrations:** preventing the spread of fire from buildings to buildings.

c) **Property protection:** this includes protection to contents such as furnishings, fittings, objects of value, as well as the property itself.

However, in many countries, only the first two objectives above have been more emphasised. For example in Malaysia, the Fire and Rescue Department of Malaysia (FRDM) stressed the safety of life is ultimate principle of fire safety in a building (Hamzah, 2006, p.2). In England and Ireland, the relevant building and fire regulations have traditionally placed the greatest emphasis on two fire protection objectives: life safety protection and prevention of conflagrations. Property protection which includes protection to building's fabrics and contents is not really been prioritised (Pickard, 1993/4, p.27). Indeed, in case of heritage buildings these should not be happened since any heritage structure, authentic fabric or heritage content lost to fire is relatively irreplaceable.

3.2 Fire Protection Strategy

Commonly, there are two types of fire protection for a building, namely passive fire protection and active fire protection. Passive fire protection comprises all fire safety concepts which embrace the passive measures in fire containment design (e.g. means of escape, fire exit and compartmentalisation). It is a proactive approach taken at the building design stage, aimed at addressing a comprehensive solution to the fire problem. In the simple words, these systems do not require power or water to operate in case of fire. In contrast, active fire protection is an installed fire protection system (manual or automatic) that detects and/or suppresses structural fires such as: fire alarms, detectors (heat & smoke), hose reels, fire telephones, automatic sprinklers and etc. The main purpose of this protection is to give a warning of an outbreak of

fire and the containment and extinguishment of a fire. It is highly advisable that in selecting which active fire protection systems to be installed there are three main factors to be considered, which are:

a) whether the systems are adequate that could provide at least satisfactory protection;
b) the systems must be appropriate and efficient to the building's scale, usage and contents (for example, sprinkler could be the best system to distinguish fire but may damage heritage artefacts); and
c) the system should be cost-effective in long-term e.g. easy/low maintenance.

In most cases, the combination of these protection types could provide an optimum protection. The relationship between fire, passive systems, active systems and people (occupant movement) in the event of fire is illustrated in Figure 4.

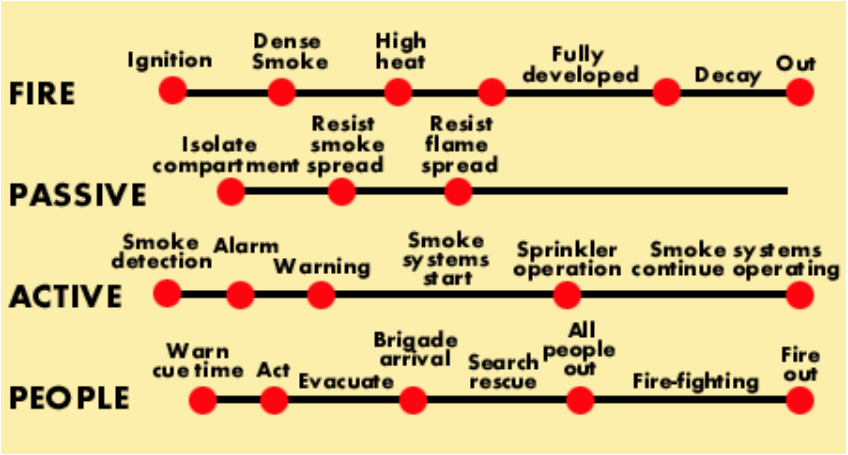

Figure 4: The relationship between fire, passive systems, active systems and people (occupant movement) in the event of fire.
Source: Spadaccini, D. (1998)

3.3 Fire Protection for Heritage Buildings

In protecting and preserving the historic fabric of the heritage structure, Escape Consult (2006) stressed that 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. 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 (Watt Jr. and Solomon, 2002, p. 302). Practically, factors to be considered in determining acceptable levels of fire protection in heritage buildings are:

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.

In this regard, Kidd (2001, 2005) suggested that all fire protection improvements for heritage buildings should follow the following principles:

- **Minimal Intervention:** Any changes to a listed or heritage building must cause as little impact on the building and its fabric as possible. Any work undertaken to improve compartmentation, or to provide fire detection or suppression, should not cause unnecessary disruption or damage during installation, maintenance or eventual removal.
- **Reversibility:** Any changes to a heritage or listed building should wherever possible be reversible, i.e. adopting a 'plug in, plug out philosophy'.
- **Essential:** Only the minimum amount of work necessary to achieve the stated objective(s) should be undertaken and all the work should be justified and informed by a detailed fire risk assessment.

- **Sensitive:** Fire protection devices, equipment and systems should be installed with due consideration to the overall appearance of the building as well as having the minimum impact on the fabric of the building which they are intended to protect.
- **Appropriate:** The fire protection measures adopted must be appropriate to the level of risk- for example there may be little point in providing a full automatic sprinkler system for a location which is sparsely furnished and where there is little or no fuel load.
- **Legal Compliance:** The fact that certain fire protection measures are required by law does not overrule the need to comply with other legal requirements (listed building consent, planning permission, building standards, fire regulations and certification procedures).

4.0 LEGISLATIONS AND GUIDES ON BUILDING FIRE SAFETY AND HERITAGE BUILDING IN MALAYSIA

There are seven main legislations in Malaysia that may directly and indirectly relates to design and manage fire safety for heritage buildings in Malaysia. Those legislations may divide into two key aspects: building fire safety and heritage building *(Table 3)*. Even though, each legislation may consists different scopes and requirements; however, in practice, they must be concurrently referred in order to ensure all the related legislations have been complied at satisfactory level.

Table 3: List of legislations related to building fire safety and heritage building in Malaysia

Building Fire Safety	Heritage Building
1) Street, Drainage and Building Act 1974 (Act 133) 2) Uniform Building By-laws 1984 (UBBL 1984)- *Peninsular Malaysia* 3) Building Ordinance - *Sarawak & Sabah* 4) Fire Services Act 1988 (Act 341) 5) Occupational Safety and Health Act 1994 (Act 514)	1) National Heritage Act 2005 (Act 645) 2) Sarawak Cultural Heritage Ordinance (1993)- *Sarawak only*

At state level, all local authorities in Malaysia historic city (e.g. Kuala Lumpur, Penang, Malacca and Taiping) have formulated an individual conservation guideline for their own historical areas. Most heritage buildings are statutorily listed under the conservation legislation and any alterations, external or internal, affecting their character as buildings of special interest must be the subject of an application for Listed Building Consent to the local planning authority. Nevertheless, in the context of fire safety, none of the state conservation guidelines provides a comprehensive guide to architects, conservators and managers. This is believed due to poor awareness on fire safety among the local authorities and therefore, gives less priority to the fire safety needs. Alternatively, few international codes and guides that published by a non governmental body such as National Fire Protection Association (NFPA), Historic Scotland and Fire Protection Association which are useful for reference (*Table 4*).

Table 4: List of international fire protection and fire safety codes and guides for heritage buildings.

No	Description	Publisher
1	NFPA 909: Code for the Protection of Cultural Resource Properties—Museums, Libraries, and Places of Worship	NFPA
2	NFPA 914: Code for Fire Protection in Historic Structures	NFPA
3	TAN 11: Fire Protection Measures in Scottish Historic Buildings	Historic Scotland
4	TAN 28: Fire Safety Management in Heritage Buildings	Historic Scotland
5	TAN 22: Fire Risk Management in Heritage Buildings	Historic Scotland
6	TAN 14: The Installation of Sprinkler Systems in Historic Buildings.	Historic Scotland
7	Heritage Under Fire: A Guide to the Protection of Historic Buildings	Fire Protection Association

5.0 FIRE SAFETY MANAGEMENT FOR HERITAGE BUILDINGS

5.1 Introduction

Howard and Kara-Zaitri (1999,p.364) has described that 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 view supported by Pickard (1994, p.8) who stated that “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. Spadaccini (1998) highlighted that when fire is not controlled the following may result:

1) Death and injury of people who cannot escape its smoke, gases and heat;
2) Destruction of buildings, their contents and other tangible property;
3) Building have to close either temporary or permanent which could cause loss of income or possibly bankruptcy; and
4) 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 in Malaysia, 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; building built before the UBBL.
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) existing electrical wiring not been upgraded or replaced accordingly; few heritage buildings are still using old electrical wiring that may cause faulty electrical.
g) storage for many flammable artifacts or heritage collections such as old books, manuscripts, traditional costumes and antique furniture;
h) large number of visitors; most open daily to public;

i) the danger from renovation works;
j) possible danger from nature factors such as lightning, overheating etc.; and
k) the danger of careless and arson.

In this regard, Opus Consulting (2004, p.3) recommended that 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 (*Figure 5*).

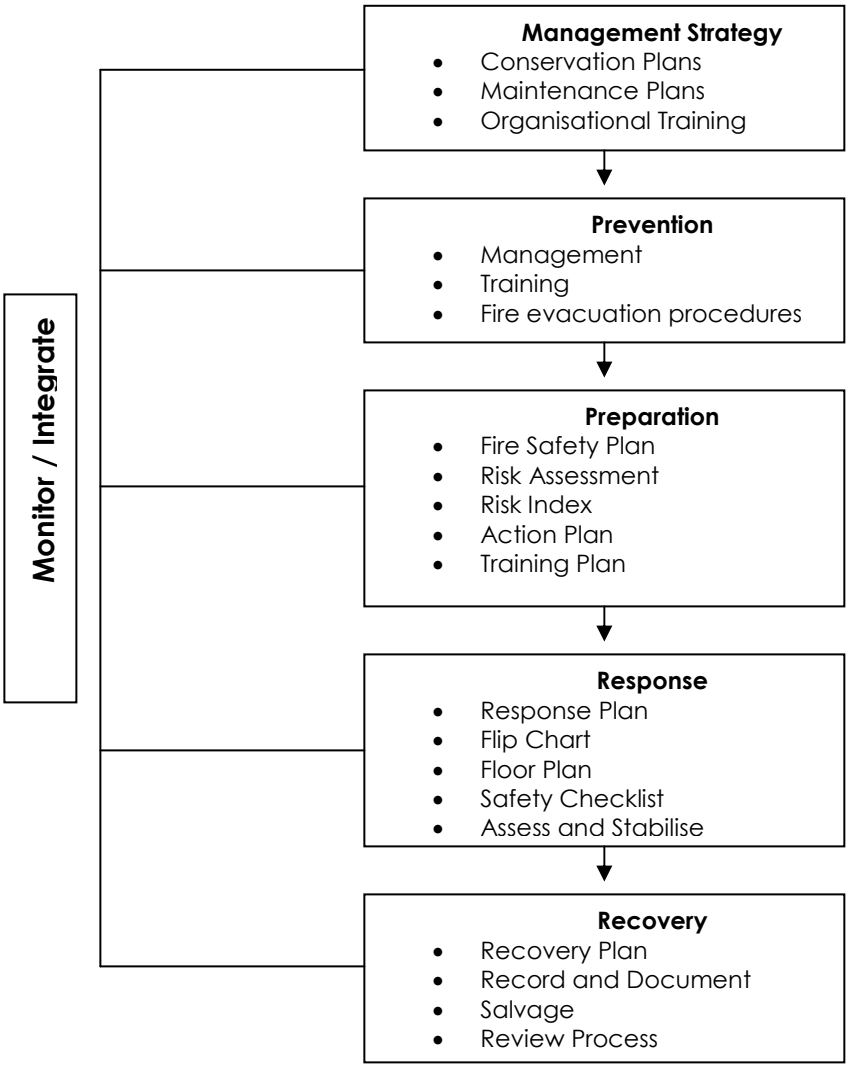

Figure 5: Steps in fire safety planning and management.
Source: Opus Consulting (2004)

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.

6.0 RECOMMENDATIONS TO IMPROVE FIRE SAFETY MANAGEMENT

As mentioned earlier, in order to ensure the high standard of fire safety in heritage buildings three main parties should be closely cooperated, namely the building owners or administrators, building occupants/users and authority bodies. Therefore, it is essential that all of them must have a good awareness on fire safety. They should play their roles accordingly to safeguarding the safety of occupants, historic fabrics and contents in heritage buildings. Some of pro-active actions could to be taken are summarised as follows:

6.1 The Building Owners/Administrators:

a) Consult regularly with local fire brigades on risk management, fire fighting and salvage;
b) Where legally required, fire certificates should be obtained and their requirements fully complied with;
c) Formulate a written fire safety policy statement that to be informed or distributed to all staff. Effective internal mechanisms should exist to ensure that the policy is properly implemented and annually reviewed;
d) Appoint a fire safety manager with specific responsibility to implement the fire safety policy;
e) Form a central fire safety committee, meeting at least once a year to review fire risk management and ensure that the fire safety policy statement is implemented;
f) Ensure that all signage on fire safety and procedures are sufficient and should be properly displayed and located;
g) Inspect that no obstacle at all times to fire exits, hose reel, evacuation routes, etc;
h) All fire prevention and protection measures should be inspected and maintained periodically; to ensure all systems are in working order;

i) Provide a comprehensive fire action plan. Exercises should be arranged periodically;
j) Appoint a reliable consultant to carry out a detail fire risk assessment annually;
k) Identify important risks and danger of fire spread, and eliminate unnecessary hazards;
l) Fire drills should be organised at least six-monthly intervals under the supervision of the local fire brigade;
m) All staff should undergo a basic fire safety training annually, to ensure all staff knows how to minimise fire risks and how to react in the event of a fire;
n) The installation of a reliable fire detection and protection system should be seen as a high priority;
o) Apply an insurance coverage for building and contents (if classified as a high heritage value);
p) Each heritage building that containing many historical contents (e.g. museum) should have a trained salvage team, with regular exercises in co-operation with the local fire brigade; and detailed plans for the salvage of contents;
q) Clear fire safety requirements should be included in all contracts for building, maintenance, renovation and for special events. Management must check to ensure that the requirements are being carried out; and
r) A proper programme of preparation and safe storage (possibly off-site) of architectural, photographic and other information should be put in place.

6.2 The Building Occupants / Users:

a) Comply all requirements in the fire safety policy that formulated by the building administrator;
b) Cooperate with the building administrator to ensure the building and contents are safe at all times;
c) Continuously enhance personal awareness and knowledge on fire safety;
d) Not smoking in the building;
e) Immediately inform the building administrator if encounter any sign of fire risks;
f) Fully participate in fire training and drills that organised by the administrator; and
g) Report to the related authority if spot the building is not complying any legal fire safety requirements.

6.3 The Authority Bodies (Government, Fire Brigade) :

a) Ensure all heritage buildings are complying the current fire safety requirements;
b) Carry out an effective and efficient enforcement; spot-check to be conducted regularly;
c) Formulate a comprehensive fire safety guidelines specifically for heritage buildings;
d) Make compulsory to all heritage buildings to install a reliable fire detection and protection systems;
e) Regularly conduct fire safety campaigns to increase awareness among the public;
f) If necessary, review or/and amend legislations or acts that related to building fire safety and heritage buildings (e.g. increase penalty).

7.0 CONCLUSIONS

Heritage buildings are exposed to the same fire threats as other buildings, including arson, lightning, construction operations, faulty equipment, and inadequate maintenance. In the case of fire safety objective for heritage buildings, life safety and property safety (heritage contents and buildings) should be considered accordingly. It is widely accepted that standard fire protection approaches, based on ideal (new construction) conditions are relatively inappropriate to be applied in heritage buildings. Therefore, for heritage buildings, it is highly advisable that the architect or engineer will need to have the sensitivity and ingenuity fire protection approaches that do not damage the historic fabric of the building. An individually designed package of fire protection measures should also include management policies and procedures for particular buildings. By this approach it may be possible to achieve the impossible- a sufficient standard of fire safety with minimum irreversible disturbance to the character of heritage buildings. In addition, fire disasters could have been prevented if there had been an adequate level of fire safety management before, during, and after the incident.

Effectively, management of fire safety in heritage buildings should be on an ongoing basis. Fire safety systems need to be regularly checked and maintained. Furthermore, where a fire safety engineering approach has been

utilised, there is a need for auditing. In other words, every decision which has been made needs to be recorded and periodically re-evaluated to ensure the effectiveness of arrangements.

Obviously, protecting heritage buildings from fire is important and a selected fire prevention and protection system must conform to all appropriate codes of practice and legislation. In Malaysia, there is still a long way to go before fire protection regulations specifically for heritage buildings will be endorsed and implemented. However, there is increasing awareness amongst local authority conservation units, NGOs and public in line with the desired aim of the National Heritage Act 2005 to ensure the long-term preservation and use of heritage buildings in Malaysia.

8.0 REFERENCES

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