

Disaster Risk Assessment Methods and Response Plans for Cultural Heritages in Taiwan

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1. Introduction

According to World Bank's "A Global Risk Analysis" in 2005, Taiwan is endangered to more than three types of natural disasters and its ratio of population exposed to disasters is the highest in the world. In addition to high exposure of natural disasters, Taiwan's heritages and historic buildings are also threatened by manmade causes. Fire is the number one cause for heritage damages in Taiwan. As a result, the Taiwanese government and the academic research field have been working together to promote and implement heritage related disaster rescue acts and disaster preventing management. One of the key elements being promoted is "disaster risk analysis", which is now required for all heritages and historic buildings undergoing evaluations for reuse in Taiwan. Recently in Asian countries, disaster risk analysis is the main method used to help harmonize the conflicts between heritage preservation and fire safety objectives. Therefore, as a pilot study we have developed a simple fire risk analysis method to help train the stakeholders to accurately assess the risks and improve heritage management.

2. Objectives

Constructing fire risk analysis for heritages

- The assessment procedures should be simple and corresponds to Taiwan's cultural habits. It should categorize fire safety into different levels and point out where improvements can be made.
- The risk assessment result can reflect a heritage's vulnerability to fire and its key preservation objectives.

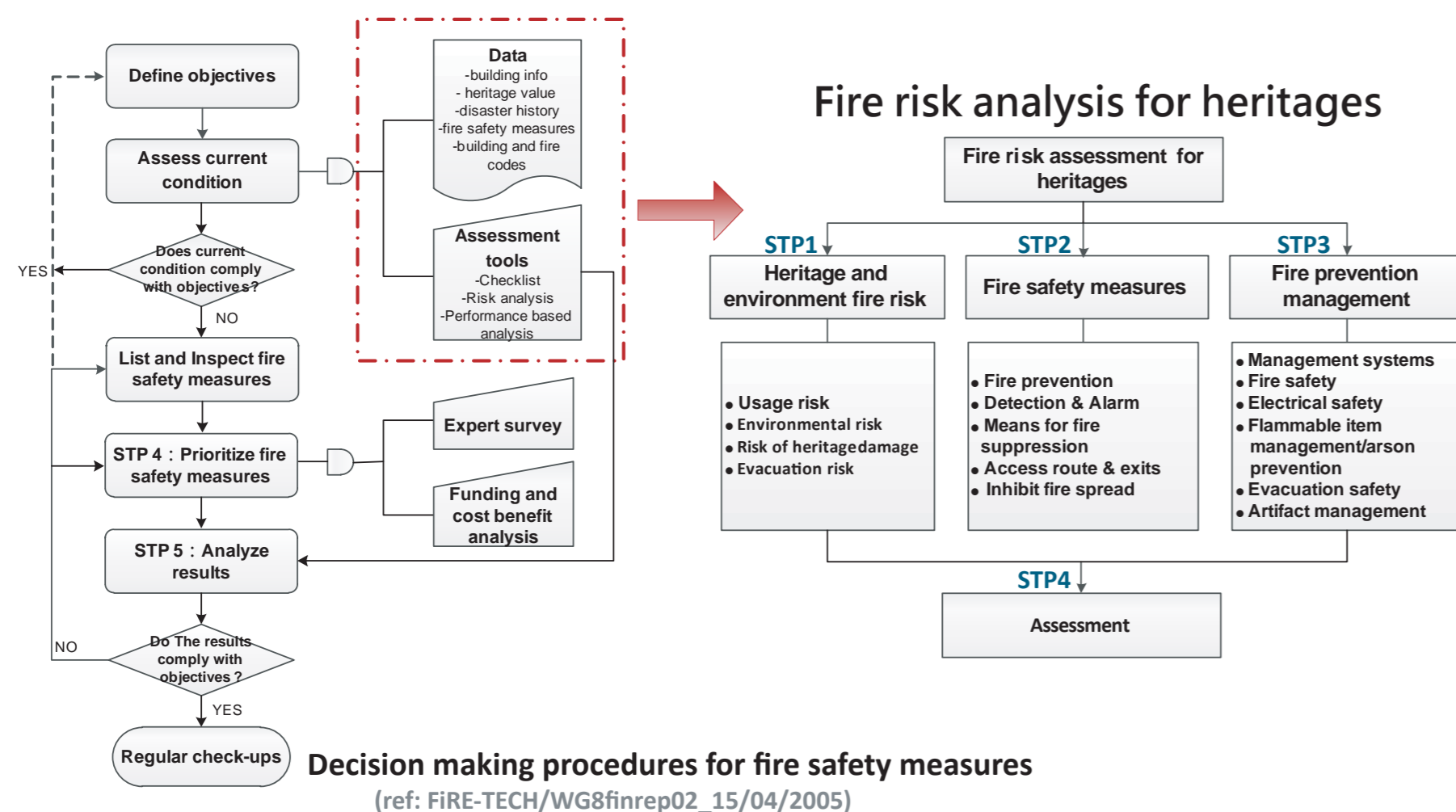
Meet heritage preservation needs and disaster prevention goals

- Comply with the heritage's space image and preservation needs.
- Decrease disaster risks, disaster preventive measures should comply with heritage's disaster situations.

3. Methods

Decision making procedures for fire safety measures

Development and application of fire risk analysis tool for heritages



STP1: Grade fire disaster risk using heritage and environment fire risk assessment form.

STP2: Grade fire protection safety using fire prevention measures assessment form.

STP3: Check if fire safety management checklist complies with fire prevention management items.

STP4: Fire prevention safety grade gives the overall fire safety level.

Heritage and environment fire risk assessment value

Parameter / Sub-parameter	Score (A)-average	Weight(B) (%)	Value R (AxB)
1. Usage risk			
1.1 Use of fire and electricity		25	
1.2 Number of users			
1.3 Usage type			
2. Environmental Risk			
2.1 Risk of fire spread to neighboring buildings		25	
2.1.1 Distance between buildings			
2.1.2 Number of walls facing a neighboring building			
2.1.3 Occupancy			
2.1.3 Building structure			
2.2 Risk on rescue due to traffic or transportation			
2.2.1 Accesses for the firemen			
2.2.2 Fire brigade			
3. Risk of heritage damage			
3.1 Heritage building		35	
3.2 Cultural artifacts			
3.3 Cultural value			
4. Evacuation risk			
4.1 Egress/Evacuation		15	
Total Risk Score			100

Fire safety measures

Parameter / Sub-parameter	Score (A)-average	Weight(B) (%)	Value S (AxB)
1. Fire prevention			
1.1 Security system		25	
1.2 Fire prevention management			
2. Detection & Alarm			
2.1 Automatic fire alarm system		25	
2.1.1 Detector			
2.1.2 Local fire alarm control panel			
2.1.3 Alarm system			
3. Means of fire suppression			
3.1 Manual firefighting equipment		30	
3.2 Automatic fire sprinklers			
4. Access routes & exits			
4.1 Evacuation installations		10	
5. Inhibit fire spread			
5.1 Outdoor sprinkler system		10	
5.2 Water supply			
Total Fire Safety Score			100

Fire safety management checklist

Item	Check
	YES NO
Management systems	
1. Appoint a fire prevention manager and formulate a protection plan.	
2. The protection plan should include daily fire prevention management, equipment checks, emergency response.	
3. Is the protection plan revised regularly (at least half-yearly and before/after large events)?	
4. Was the protection plan reviewed (checked) by professional units or teams?	
5. Performs fire drills and holds education seminar (class) at least once a year.	
6. A written protection plan should be drafted for a heritage building under construction or when setting up an exhibition.	
Fire safety	
1. Avoid using fire, have personnel monitor fire use.	
2. Strengthen initial firefighting response and protection for areas of fire use (increase number of fire extinguishers, easy firefighting tools such as hoses and water buckets).	
3. Flammable items should not be placed near areas of fire use.	
4. Are all fire equipment (gas stoves, gas heaters, lighters) checked regularly?	
Electrical safety	
1. Avoid use of extension cords.	
2. Performs regular check on all electrical equipment, cords, switches, and plugs.	
3. Have professionals check electrical systems and electrical loads regularly?	
4. Avoid using high electricity consumption and heating equipment.	
Flammable item management/arsen prevention	
1. All waste (leaves, garbage) should be cleaned/disposed every day.	
2. Parking of vehicles should not be allowed at the heritage itself and its nearby areas.	
3. Decrease unnecessary flammable items.	
Evacuation safety	
1. Stairway, corridor, doorway, and any entrance/exit should remain clear.	
2. If the entrance/exit needs to be closed/locked, it has to be able to be unlocked immediately for smooth evacuation.	
Artifact management	
1. Regularly check registered artifacts.	
2. Is there an area for temporary storage in the event of an emergency?	

Fire safety level

Heritage and environment fire risk	Risk Score
● Usage risk	
● Environmental risk	
● Risk of heritage damage	
● Evacuation risk	
Total Risk Score (R')	
Fire safety measures	Fire Safety Score
● Fire prevention	
● Detection & Alarm	
● Means of fire suppression	
● Access routes & exits	
● Inhibit fire spread	
Total Fire Safety Score (S')	
Fire safety level : R'+S' =	
Note: the lower the safety/risk value the higher the risk (-5 to +5)	

4. Case Study

Long Shan Temple

Long Shan Temple was constructed very early in history, according to folklore it was commissioned by a Zen Master during the late Ming Dynasty (1653 AD). It is one of the most valuable temple type national heritages in Taiwan.

Fire risk analysis

Fire risk analysis classifies Long Shan Temple at medium risk level. The recommendations are as follows:

- Usage risk:** should avoid using old electrical appliances.
- Environmental risk:** should prohibit nearby parked vehicles.
- Risk of heritage damage:** salvage of artifacts and post disaster recovery are not well planned, asset assessment for interior artifacts has yet been conducted.
- Evacuation risk:** backdoor is locked, should have some unlocking mechanism in case of emergency.



1~2Floors: Brick
1~3Floor: R.C.
4~7Floors: R.C.
1~2Floors: iron sheet roofing, steel construction



Fire safety level

Heritage and environment fire risk	Risk Score
● Usage risk	-0.925
● Environmental risk	-0.675
● Risk of heritage damage	-1.675
● Evacuation risk	-0.15
Total Risk Score (R')	-3.43
Fire safety measures	Fire Safety Score
● Fire prevention	0.75
● Detection & Alarm	0.5
● Means of fire suppression	0.3
● Access routes & exits	0.5
● Inhibit fire spread	0.3
Total Fire Safety Score (S')	2.35
Fire safety level : R'+S' = -1.08	
Note: the lower the safety/risk value the higher the risk (-5 to +5)	

5. Promotion and Implementation of Heritage Disaster Policy

Disaster Prevention Guidelines for Heritages, Council for Cultural Affairs, 2011

Basis

"Program on strengthening disaster prevention and disaster relief for heritages and historic buildings" from Executive Yuan's Disaster Committee, May 15, 1998.

Objectives

To effectively protect important cultural assets such as heritages. To strengthen disaster preventive mechanisms and increase people's adherence to heritage protection. This disaster prevention guideline provides disaster prevention plans as reference for heritage owners, users, and manager when drafting executing plans.

Disaster Prevention Guidelines for Heritages

Council for Cultural Affairs, 2011
SFPE Taiwan Chapter
PI: CHIEN, SHEN-WEN
2011

Construction Management for the Reuse or Renovation of Heritages, Historic Buildings, and Human Settlements Land Use Approach to Fire Safety

Amended provision
2010.10.19 announcement

Article 4

When a difficulty occurs during the construction/planning for the reuse or renovation of heritages, historic buildings, and human settlements, the owner, user or manager should submit its reuse/renovation plan along with its response plan based on its cultural asset preservation goal, environment characteristics, and risk analysis to its authority department for approbation.

Disaster Prevention Guiding Principles for Tainan City's Heritages and Historic Buildings

Implementation period:

Phase I: July 1 to July 31, 2011

Formulate disaster emergency, fire protection and fire rescue plans for heritages and historic buildings

Phase II: July 31 to November 30, 2011

Carryout disaster related exercises/drills for heritages and historic buildings

Phase III: from December 1, 2011

Promotion of installing disaster prevention equipment and facilities within heritages and historic buildings