The Impact of Historical Building Environmental Hazard Rescue Exercises on the Concept of Firemen

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Abstract. In this experiment, the firefighters perform the cultural assets disaster rescue drills before and after the cognitive differences as the core of the experiment. Firefighters develop education in the face of various types of building rescue training, but they lack the type of historical and historical buildings, which are fundamental in nature. The difference between the rescue target and the rescue tactics, and other types of building rescue methods can hardly be applied. The subject of this experiment is to introduce fire rescue resources (public assistance) after the failure of self-disaster prevention (self-help, co-help), and the research object is based on historical building. After many field surveys, knowledge training and actual exercises, the comparison is performed. The fire extinguishing education and training research on historical monuments can improve the effectiveness of historical monument fire extinguishing and preserve the current status of historical monuments, can list the number of cultural relics rescue personnel from 30% to 60%, can increase the number of cultural relics from 20% to 50%, can answer the answer to the room rescue from 20% to 100%, can answer the perimeter protection focus from 40% increase to 100%, can say that the focus of the water is increased from 30% to 100%. From the data, through the drills, the correct rescue concept can be greatly improved, and the secondary damage of historical sites can be avoided, but the focus of the rescue is on the cultural relics. It still needs to be strengthened, so the drills still need to be handled with perseverance in order to be more implemented and popularized.

1. Introduction
Historic sites have their characteristics as follows due to factors such as the background of the age and the construction technology: fragile structure: mostly timber structure or brick-wood mixed buildings, poor fire performance, high ceiling and terms of fire and electricity. The characteristics of the above buildings lead to the following characteristics structural instability when the fire occurs, the fire spread quickly, fire load is huge and smoke and heat accumulation are easy.

These hazard factors can also be promoted through human management mechanisms, hardware disaster prevention performance and government-civil cooperation, reducing the possibility of fire damage to monuments. This study is expected to achieve the following objectives by handling historic sites and historical building rescue drills.

(1) Through realistic training, the actual situation will be adjusted to enhance the crisis awareness and professional knowledge of the monument management personnel, the public and the fire department, so that people can understand the assistance that can be provided under different roles, reduce the losses caused by disasters, and even avoid disasters. The fire extinguishing education and
training research on historical monuments can improve the effectiveness of historical monument fire extinguishing and preserve the current status of historical monuments.

(2) On May 30, 2019, Changhua County Fire Department Yuanlin Branch, the historical building rescue drills handled by Singsian Academy, was used as a research case. According to the situation set in advance, the actual operation of the process of assessment and the subsequent discussions to explore the feasibility of the program of improvement, to draw conclusions to reduce the occurrence of similar disasters reference.

Gabriele (2016)[1] Fire risk in Architectural Heritage represents a fundamental problem for occupants' safety. Italian-style historical theatres are one of the most interesting examples because of their historic and artistic value, high fire vulnerability, fire sources and occupants’ features (many people are not familiar with the architectural spaces). Lin (2016)[2] restoration and management of historic buildings and historic sites pointed out that the historical disasters of historical sites can be divided into natural disasters and man-made disasters. It also proposes a cultural asset disaster prevention and protection program, including the establishment of short-term goals, medium-term goals and long-term goals, strengthening its own management and maintenance capabilities, building protection plans, combined with scientific and technological applications to enhance warning functions, preservation monitoring, structural analysis and evaluation, etc. It will deepen the horizontal connection between various units, and promote the close exchanges between culture, fire control, construction management units and historic sites, historical building managers, and protect the country's irreplaceable important cultural assets. Chen (2009)[3] historic sites and historical buildings have been seriously damaged by fire. There are three aspects of lack: 1. lack of disaster prevention equipment, 2. lack of management maintenance, 3. improper firefighting; In addition to the practice of fire prevention drills in historic buildings, the main focus should be on two aspects: 1. daily fire prevention management inspection drills to identify potential factors that may cause fire. 2. the correct way to save fire should be adjusted to "water wall" or "water mist" depending on the size of the fire. To achieve effective fire suppression without causing damage to the building structure. If the fire is raging, a "water wall" should be formed from top to bottom to isolate the oxygen and quickly extinguish the fire. In addition, it should be avoided to set fire extinguishing agents such as foam and dry powder. Because the powder is easily attached to the historical sites, its chemical substances will be corrosive and cause damage to the historic materials.

2. Methods
This study uses experimentation method, which explore the causal relationship between independent variables and dependent variables in a properly controlled context. The core of this experiment is the cognitive differences between firefighters before and after performing a cultural asset disaster rescue drill. The experimental target is to introduce fire rescue resources after the failure of autonomous disaster prevention. Combined with prior knowledge training, firefighters can understand the characteristics and value of historical buildings after the drill, and be familiar with the rescue focus and rescue tactics to avoid secondary damage to historical buildings during the rescue process.

2.1. Experimental spindles
This experiment takes the firefighters' cognitive differences before and after the execution of cultural asset disaster rescue drills as the core of the experiment. The experimental target is introduced into the fire rescue resource (Public assistance) after the self-rescue disaster prevention (Self-help) failure. The research object is Sing-sian Academy. Through proper planning of situation setting and matching with prior knowledge training, firefighters can understand the historical characteristics and value of historical buildings after the drills and be familiar with rescue key and rescue tactics to avoid secondary damage to historic buildings during the rescue process.
2.2. Building basic information

The field of this experiment was established in 1807. Artificial arson is the main cause of the fire in Table 1. The seven rescue phases introduced in the experiment are shown in Table 2. And collect experimental data.

### Table 1. Experiment setting

| Drill situation | Contextual basis | Fire position | Fire time       | Walkthrough process                                                                 |
|-----------------|------------------|---------------|----------------|-------------------------------------------------------------------------------------|
| The corridor between the right wing and the worship hall was arson | Strengthening the Guiding Principles for Self-management of Fire Prevention in Historic Sites and Historical Buildings - Arson Disaster Factors | The corridor between the right wing and the worship hall | May 30, 2019, 15:00 PM | At 14:00 of May 30, 2019. The gangsters set fire to the Sing Sian Academy during this period. Due to the brick-wood mixed structure on site, the fire rapidly expanded and spread from the corridors, which would affect the cultural relics room, the worship hall and the right wing (study room). The historical building management quickly launched an emergency contingency plan after discovering the fire and notified the fire department and the Cultural Bureau for emergency rescue. |

### Table 2. Seven-stage setup of the drill

| Section | Script | Execution content | Executive staff |
|---------|--------|-------------------|-----------------|
| 1       | Prisoner arson caused fire | Use oil pan to set up fire | Equipment company |
| 2       | Start emergency response grouping | Firefighting / notification / guidance | Administrator |
| 3       | Situation handover: fire, personnel, cultural relics | Guide the location of fire and cultural relics, whether there are people trapped | Administrator and Fire brigade |
| 4       | Situation 1: Fire suppression | Perimeter protection Entering the attack | Fire brigade |
| 5       | Situation 2: The cultural relics room is extended burning | Cultural relics rescue | Fire brigade |
| 6       | Situation 3: life search | Protection and search parallel | Fire brigade |
| 7       | Field blockade and inventory the Cultural relics | Inventory the Cultural relics | Administrator and Cultural bureau |

3. Results

3.1. Before the experiment: Experimental field survey

- Current situation: The maintenance status is excellent. The pattern is simple and equipment is regularly maintained, but the use of fire and electricity need to be strengthened.
  - Challenge: Self-defense firefighting team is less effective; although Yunlin University of Science and Technology is entrusted to arrange self-defense firefighting, but the maximum number of people is only 3, plus the administrator's age is already high, in addition to calling the report and using the
broadcast, the administrator admits that themselves inflexible actions, the use of fire extinguishers and
the evacuation may be difficult to implement.

- Electricity management: The electric part of the lamp is used throughout the year. The light is
  only closed for about 7 days a year, but the power consumption of the above items is extremely low. If
  the electricity management and maintenance are implemented, it is still within the controllable risk
  range; in the socket plug and wire, Some of the old, burnt, bare and other situations are in urgent need
  of improvement. The temple has been reminded that it should be improved as soon as possible
  (updating equipment, fixing and covering, etc.)

3.2. Experimental project

Historic sites and Historical buildings are different from other buildings. In addition to human life
priority, not only protection the buildings but also the cultural relics preserved inside are needed.
Therefore, there should be different tactics and practices in the rescue. The correct fire rescue
principles for such buildings are as follows:

- Outside the building: Spraying water mist into the air to create a water wall sprinkling method to
  extinguish fire and perimeter protection without destroying the monuments and historical buildings.
- Inside the building: Execution of indoor firefighting work, in addition to the need to enter the
  room for rescue, the use of water jets may cause falling objects, should avoid direct damage caused by
  water injection; High-pressure water mist or knapsack high-pressure sprinklers shall be used to avoid
direct impact on the structural body and important cultural relics, reducing water damage, structural
damage and cultural relics.

- Water jet technique(Fig 1): Avoid using foam extinguishers such as foam and dry powder.
  Indirect attack method: spray a water mist with a width of about 30 to 60 degrees, shoot above and
  around the fire source, and spray back and forth to the hot air below the ceiling, and continuously
  move the position of the water jet to seek the maximum coverage to produce the maximum amount the
  water vapor; In addition, the water mist should not be directed to the wall, the fire control effect is not
  large.

- Relics rescue: Set up a cultural rescue squad, meet the historic site and historical buildings
  management personnel, perform the task, and confirm that the project and quantity are correct.

- Residual fire treatment: The execution of the residual fire treatment will be accompanied by the
  historic sites and historical building management personnel. To implement relevant protective
  measures against the cultural assets affected, to avoid unnecessary damage.

Figure 1. Use water mist manufacture water wall protection

The results of the interviews before and after the experiment. After many field surveys, knowledge
training and actual exercises, the comparison is performed. Can list the number of cultural relics
rescue personnel from 30% to 60%, can increase the number of cultural relics from 20% to 50%, can
answer the answer to the room rescue from 20% to 100%, can answer the perimeter protection focus
from 40% increase to 100%, can say that the focus of the water is increased from 30% to 100% in
Table 3 and Fig.2.
Table 3. Description of the drills results

| Topic                                      | Subject                              | Result                   |
|--------------------------------------------|--------------------------------------|--------------------------|
| Rescue work function group.                | Answer: Cultural Rescue Team.         | 30% increased to 60%     |
| Handover contents with the relationship person | Fire, people, cultural relics        | 30% increased to 50%     |
| Precautions of indoor fire point attack.   | Answer: Whether to use high pressure water mist | 20% increased to 100%    |
| Precautions of perimeter protection.       | Answer: Do you understand the manufacturing of water wall? | 40% increased to 100%    |
| The way of water jet should be avoided.    | Answer: water column, foam, dry powder | 20% increased to 80%     |

Figure 2. Comparison of results before and after the drills.

4. Conclusion
This study is mainly aimed at the rescue of historic sites and historical buildings. If the pre-existing education and training, appropriate situation setting and the arrangement of the drills process, the impact on the firefighters’ disaster relief concept is evaluated. After selecting the drills targets, whether the secondary hazard of those buildings can be significantly reduced before and after the analysis of the knowledge training and actual simulation drills, the two results are compared. The conclusions obtained for the case are as follows:

The effect on cultural relics protection is poor: whether the first question is whether to organize the cultural relics rescue team, and whether the second question asks the relationship person's cultural relics information, understand the number of people is only increased from 30% to 60%, and 30% to 50% (increased personnel are the drill immediately sees the rescue process on the front, or serves as the colleague of the cultural relics rescue personnel. However, the staff and the leader of the brigade can understand the need for the cultural relics rescue team. The effectiveness of this question is relatively poor. The analysis should be:

Assignment of tasks is leader's work: Rescue non-automated units at the disaster site, needs to let leader to analyze the situation of the disaster site and then assign tasks. Therefore, the attendance of the colleagues generally does not understand the whole scene of the fire and the division of tasks. This
aspect is easier for the colleagues to ignore, while the cultural rescue team is indeed a less used grouping, not familiar with the commonly used fire rescue tactics.

Habitual targeting disaster rescue: Regardless of the fire of the building, although there are differences in tactics, in principle, it is derived from "fire source" or "human life". Therefore, it is relatively unfamiliar to "relics rescue" in addition to fire and human life. And, besides the actual operators or seeing colleagues with their own eyes, it is hard to remember.

High understanding of tactical execution: The third is question is precautions of indoor fire point attack, whether to understand the use of water mist or high pressure water mist equipment to extinguish fire, The fourth question of perimeter protection precautions, whether water can be used to spray water into the air to create a water wall. The fifth question is to understand whether the water injection method should be avoided, and the degree of improvement is 100%. It is obvious that the colleagues have a more conceptual view of the actual tactics, and the non-actual operators can understand after the knowledge training and show the training results in the actual exercise.

It can be seen from the case study that through good situation planning, knowledge training and practical training, the colleagues can greatly improve the correct disaster relief work for historic sites and prevent the second hazard in the rescue process, but the functional grouping (relics rescue group) it is impossible to make all colleagues understand at a time, so the historic sites rescue drill can actually improve the rescue concept of firefighters, and it needs to be handled regularly to achieve popularization and proficiency.

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