Preliminary Study on Fire Risk Assessment Index System of Detention Center

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Abstract. According to the basic theory of fire safety management, combined with the particularity of supervision function of detention center, the factors affecting fire risk of detention center were analyzed. The fire risk evaluation index system of detention center was established from six aspects: fire hazard control, fire prevention ability, fire extinguishing ability, safety evacuation ability, fire safety management and personnel characteristics. The weight of each index in the evaluation system was determined by AHP, the analysis results showed that the safety evacuation ability affected the fire risk of detention center.

1. Introduction

Detention center is an institution that detains criminal suspects and defendants who have been arrested and criminally detained according to law, its main task is to guard the detained criminal suspects with armed vigilance according to national laws to ensure their safety and prevent them from escaping [1]. The function of detention center is to supervise criminal suspects and defendants, to ensure their safety, prevent escape and ensure the smooth development of criminal litigation activities. Therefore, the detention center adopts closed management and the safety exit is locked, but this conflicts with the task of fire safety management, once a fire breaks out, it is difficult to escape and rescue, which can easily lead to serious consequences of mass casualties of detainees. Therefore, it is necessary to establish a scientific and systematic index system of fire risk assessment in detention center, which can be used to assess the fire risk of detention center, find out the hidden danger of fire safety in detention center, and take control measures to reduce the fire risk and ensure the fire safety of detention center. Based on this, this paper studies the fire risk of detention center, aiming at establishing a systematic, scientific, perfect and practical index system for fire risk assessment of detention center.

2. Detention Center Fire Risk Analysis of Influencing Factors

2.1. Fire Hazard Source Control

Fire hazards are mainly the dangerous sources that may produce combustion and then cause fire [2]. A large number of monitoring and monitoring equipment, communication equipment, heating and cooling equipment and other electrical equipment are installed in the detention center, which are in working condition 24 hours a day, and the equipment is prone to failure or even spontaneous combustion. At the same time, a large number of wires need to be laid for the installation of electrical equipment, and there are many prison rooms in the detention center, the laid wires are
very complex, and the wires are seriously aging, which is easy to cause fire. Cooking in the kitchen of the detention center is an open fire operation, which easily leads to fire due to negligence. Police in detention center have a high smoking rate due to high work pressure, and improper handling of cigarette butts may lead to ignition of other articles, resulting in great fire risks.

2.2. Fire Prevention Capability

Most of the large buildings in detention center were built in the early stage, and the setting of fire zone, fire spacing design and fire resistance rating cannot meet the requirements of modern fire protection code, which are congenital fire hazards\(^3\). Enhancing fire prevention awareness is the fundamental measure to prevent fire, only by paying attention to fire prevention ideologically can we cultivate good fire prevention habits and prevent problems before they happen. The detention center is mainly composed of detainees and supervising policemen, it is necessary to enhance the awareness of fire prevention of detainees while enhancing the awareness of fire prevention of policemen. Fire prevention knowledge is the foundation of fire prevention work, and professional fire prevention knowledge can make fire prevention work achieve twice the result with half the effort. Both the police and the detainees need to master the basic knowledge of fire prevention in order to achieve correct fire prevention and improve the efficiency of fire prevention behavior.

2.3. Fire Extinguishing Capacity

Extinguishing ability is the key to control fire influence and reduce fire risk. Automatic fire alarm system can remind people of the occurrence of fire at the first time\(^4\), automatic fire extinguishing system can automatically take fire extinguishing measures, fire hydrant system provides water for fire extinguishing, smoke control and exhaust system can discharge toxic smoke at fire scene, and fire emergency communication system provides convenience for fire emergency communication. The distance between the detention center and the nearest fire station directly affects the arrival time of fire rescuers, reduces the waste of gold rescue time, controls the fire in time, and prevents a larger scale of burning. Mastering basic fire fighting knowledge and skills can help people take correct fire fighting measures when they find a fire, put out the fire at the best time, and prevent a small fire from causing a big disaster. Whether it is police or detainees, mastering the basic knowledge and skills of fire fighting can improve the efficiency of fire fighting and reduce fire losses.

2.4. Safety Evacuation Capability

Safe evacuation ability is the ability to organize people to evacuate to a safe place in case of fire, which directly affects the casualties caused by fire. The ability of safe evacuation depends not only on the setting of safe passage and exit\(^5\), but also on the effect of emergency evacuation drill. Because of the special functions of the detention center, the fire exits in the detention center are locked at different levels, which directly restricts the smoothness of the fire exits, opening the fire exits requires unlocking at different levels, which takes a certain amount of time in an emergency. At the same time, the particularity of the detainees in detention centers determines that reasonable safe shelters must be chosen for evacuation to prevent the rescued persons from escaping. Emergency evacuation facilities can guide people to escape quickly and efficiently, and improve the efficiency of safe evacuation. Detainees in detention center can't freely enter and leave the prison room, and master the basic ability of escape and self-rescue, which can make them fight for the time to be evacuated and save themselves after the fire, and improve the probability of being safely evacuated. Police need to organize the safe evacuation of detainees after the fire broke out, and need
to have the ability to organize emergency safe evacuation, the level of emergency safe evacuation ability will directly determine the probability of successful evacuation of detainees, which is of great significance to ensure the safety of detainees.

2.5. Fire Safety Management

The fire safety management of detention center is relatively backward, and the fire safety management system is imperfect and formalized seriously; Fire safety inspection is a mere formality, and hidden danger investigation is not in place; The fire emergency plan is not carefully formulated, and it is difficult to play a role at a critical time; The implementation of fire safety operation regulations is not in place, and illegal operation behaviors are widespread. The fire management department is ineffective or even absent, and the management personnel lack professional knowledge of fire protection and the management level is low. The detention center pays low attention to fire safety education and training, which is carried out with low frequency and serious formalization; the education of detainees is generally that the police collect information on the internet, which lacks pertinence and is not suitable for the special place of detention center.

2.6. Group Characteristics

The number of detainees in detention centers accounts for the vast majority, and the distribution is relatively concentrated, the density of personnel is large, and emergency evacuation is difficult. After the fire broke out, the detainees' escape is limited, and their psychology will be directly pulled by the development of the fire, those with poor psychological quality may take excessive reaction behavior, which will affect the psychology of other detainees, destroy the order of emergency evacuation, and cause stampede in the process of crowding, which will increase the difficulty of evacuation, and then lead to lower efficiency of safe evacuation and increase casualties.

3. Construction of Fire Risk Assessment Index System in Detention Center

3.1. Establishment of Fire Risk Assessment Index System in Detention Center

According to the actual fire situation of detention center, through field investigation, combining the suggestions and opinions of fire management personnel, fire safety experts and fire prevention experts in detention center, and according to the principle of index construction \[6\], the index system of fire risk assessment in detention center is preliminarily established and optimized by using grey system theory. The index system is shown in Table 1.

| Target layer               | Criterion layer            | Index layer                                      |
|----------------------------|----------------------------|-------------------------------------------------|
| Fire risk in Detention Center | Fire hazard source $C_1$ | Electrical equipment failure $C_{11}$           |
|                            | Careless use of fire $C_{13}$ | line fault $C_{12}$                             |
|                            | Fire prevention capability $C_2$ | Careless use of fire $C_{13}$                   |
|                            | Fire protection characteristics of buildings $C_{21}$ | Inadvertent smoking $C_{14}$                  |
|                            | Fire prevention awareness of detainees $C_{22}$ | Fire prevention awareness of detainees $C_{22}$ |

Table 1. Fire risk assessment index system of detention center.
| Group characteristics $C_6$ | Fire safety management $C_5$ | Safe evacuation capability $C_4$ | Extinguishing ability $C_3$ |
|---------------------------|-----------------------------|---------------------------------|-----------------------------|
|                           | Fire safety management system $C_{51}$ | Width and number of safe passages $C_{41}$ | Police awareness of fire prevention $C_{23}$ |
|                           | Fire safety education and training $C_{52}$ | Locking rate of safe passage $C_{42}$ | The mastery of fire prevention knowledge of detainees $C_{24}$ |
|                           | Fire safety inspection and hidden danger rectification $C_{53}$ | When to open the safe passage $C_{43}$ | The mastery of police fire prevention knowledge $C_{25}$ |
|                           | Fire emergency plan $C_{54}$ | When to open the safe passage $C_{44}$ | |
|                           | Fire safety operation procedures $C_{55}$ | Supporting facilities for emergency evacuation $C_{45}$ | |
|                           | Fire management organization and level $C_{56}$ | Emergency evacuation drill $C_{46}$ | |
|                           | Number and distribution of detainees $C_{61}$ | The ability of prisoners to escape and save themselves $C_{47}$ | |
|                           | Density of detainees $C_{62}$ | Emergency evacuation ability of civilian police $C_{48}$ | |
|                           | Stress psychology of detainees $C_{63}$ |                           | |
|                           | Stress behavior of detainees $C_{64}$ |                           | |
3.2. Detention Center Fire Risk Assessment Index System Index Weight Determination

In this paper, AHP is used to determine the weight of each index in the index system of fire risk assessment in detention center. Let the established judgment matrix be $A$, then

\[
A = \begin{bmatrix}
a_{11} & a_{12} & \cdots & a_{1n} \\
a_{21} & a_{22} & \cdots & a_{2n} \\
\vdots & \vdots & \ddots & \vdots \\
a_{n1} & a_{n2} & \cdots & a_{nn}
\end{bmatrix}
\]

In the formula $a_{ij}$, the factors $i$ and $j$, their importance to the factors of the previous layer \cite{7}, and the importance comparison judgment matrix constructed through expert investigation is as follows:

\[
A = \begin{bmatrix}
1 & 2 & 3 & \frac{1}{2} & 1 & 3 \\
\frac{1}{2} & 1 & 2 & \frac{1}{3} & 1 & 1 \\
\frac{1}{3} & \frac{1}{2} & 1 & \frac{1}{3} & 1 & 1 \\
\frac{1}{2} & 3 & 3 & 1 & 2 & 3 \\
1 & 1 & 1 & \frac{1}{2} & 1 & 2 \\
\frac{1}{3} & 1 & 1 & \frac{1}{3} & \frac{1}{2} & 1
\end{bmatrix}
\]

Calculate the index weight \cite{8} according to the calculation steps of sum:

Feature vector $W = [0.2158, 0.1254, 0.0950, 0.3211, 0.1507, 0.0920]^T$, $CR = \frac{CI}{RI} = 0.0271 < 0.10$.

It can be concluded that the judgment matrix has satisfactory consistency, $A = (0.2158, 0.1254, 0.0950, 0.3211, 0.1507, 0.0920)$.

Solve in the same way:

$C_1 = (0.2695, 0.4168, 0.1928, 0.1209)$,

$C_2 = (0.3341, 0.1256, 0.2909, 0.0948, 0.1546)$,

$C_3 = (0.2541, 0.1237, 0.0755, 0.2356, 0.0755, 0.2356)$,

$C_4 = (0.1406, 0.0234, 0.2346, 0.0511, 0.0980, 0.0511, 0.1162)$,

$C_5 = (0.1983, 0.1844, 0.3213, 0.0876, 0.1259, 0.0824)$,

$C_6 = (0.1739, 0.3862, 0.3165, 0.1234)$.

The weight of each index in the index layer to the target layer is equal to the weight of the index to the criterion layer multiplied by the weight of the index of the criterion layer to which it belongs to the target layer \cite{9}.
C_{11} = 0.2158 \times 0.2695 = 0.0582 \\
C_{12} = 0.2158 \times 0.0659 = 0.125 \\
C_{13} = 0.2158 \times 0.0416 = 0.0416 \\
C_{14} = 0.2158 \times 0.1209 = 0.0261 \\
C_{21} = 0.1254 \times 0.3341 = 0.0419 \\
C_{22} = 0.1254 \times 0.1256 = 0.0158 \\
C_{23} = 0.1254 \times 0.2909 = 0.0194 \\
C_{24} = 0.1254 \times 0.0948 = 0.0119 \\
C_{25} = 0.1254 \times 0.1546 = 0.0194 \\
C_{31} = 0.0950 \times 0.2541 = 0.0241 \\
C_{32} = 0.0950 \times 0.1237 = 0.0117 \\
C_{33} = 0.0950 \times 0.0755 = 0.0068 \\
C_{34} = 0.0950 \times 0.2356 = 0.0224 \\
C_{41} = 0.3211 \times 0.1406 = 0.0451 \\
C_{42} = 0.3211 \times 0.2346 = 0.0753 \\
C_{43} = 0.3211 \times 0.2346 = 0.0753 \\
C_{44} = 0.3211 \times 0.0697 = 0.0224 \\
C_{45} = 0.3211 \times 0.0697 = 0.0178 \\
C_{46} = 0.3211 \times 0.0980 = 0.0315 \\
C_{47} = 0.3211 \times 0.0511 = 0.0164 \\
C_{48} = 0.3211 \times 0.1162 = 0.0373 \\
C_{51} = 0.1507 \times 0.1983 = 0.0299 \\
C_{52} = 0.1507 \times 0.1844 = 0.0278 \\
C_{53} = 0.1507 \times 0.3213 = 0.0484 \\
C_{54} = 0.1507 \times 0.0876 = 0.0132 \\
C_{55} = 0.1507 \times 0.1259 = 0.0190 \\
C_{56} = 0.1507 \times 0.0824 = 0.0124 \\
C_{61} = 0.0920 \times 0.1739 = 0.0160 \\
C_{62} = 0.0920 \times 0.3862 = 0.0355 \\
C_{63} = 0.0920 \times 0.3165 = 0.0291 \\
C_{64} = 0.0920 \times 0.1234 = 0.0210 \\

4. Analysis of Fire Risk Assessment Index System of Detention Center

By analyzing the weight of criterion layer A=(0.2158, 0.1254, 0.0950, 0.3211, 0.1507, 0.0920), it can be concluded that the ability of safe evacuation is the primary factor affecting the fire risk of detention center, which accords with the characteristic that detention center is closed because of its special function. There is a negative correlation between safety evacuation ability and nursing ability of detention center. Strong nursing ability means that the detention center is closed, and the safety evacuation ability will be weakened. It is difficult to reconcile the conflict between them. Therefore, safety evacuation ability is the most important factor affecting the fire risk of detention center.

5. Conclusion

From the analysis of this paper, it can be seen that the ability of safe evacuation is the main factor affecting the fire risk of detention center, which is consistent with the particularity of detention center function. Regularly organize emergency evacuation drills to improve emergency evacuation ability and replace intelligent locks to shorten the time of opening safe passages have practical guiding value for fire risk management and control in detention centers. The index system of fire risk assessment in detention center has certain reference significance for fire prevention and control and fire safety management in detention center.

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