Analysis and Suggestions on Current Situation of Fire-fighting Facilities for Urban Rail Transit

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Abstract

Fire-fighting facilities are important components to ensure the fire safety in public facilities. However, with the increasing service time of major urban subways, serious fire safety issues are raised in more and more urban rail transit facilities. In this study, the current situation of urban rail transit fire-fighting facilities is investigated through field research and information searching. The common problems concerning the urban rail transit fire-fighting facilities is summarized, including the aging of equipment, improper maintenance, divorcement of design, construction and operation, and improper operation of equipment. Some suggestions for improvements are offered in the end.

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Keywords: rail transit, subway, fire-fighting facilities

1. Introduction

China's rail transit shows a booming development trend. Taking Shanghai as an example, the city's rail transit carried 5% of passengers choosing public transport in 2000. This proportion increased to 41% in 2013. In 2015, the average daily passenger traffic was around 7.93 million (the average traffic on workdays was 8.75 million and the highest single-day traffic was 10.287 million), accounting for about 53% of the city's total public transport volume. The overall passenger flow intensity was about 18,000 passengers/km, and the average travelling distance was about 15 km. Rail transit has become the most common means of transportation for urban residents. Shanghai rail transit passenger flow is shown in Figure 1.

Fire-fighting facilities are important components to ensure the fire safety of building facilities. The investigation and research of fire-fighting facilities in ordinary buildings have attracted a lot of attention from fire protection technicians and researchers [1-4]. However, there are few researches on fire-fighting facilities used for urban rail transit. Only Tian Juanrong and Cai Yun[5,6] conducted studies on subway fire-fighting facilities and passengers' awareness of fire-fighting facilities. However, with the increasing service time of major urban subways, serious fire safety problems are found at more and more urban rail transit facilities. For example, some cables used in tunnels of Beijing Subway Line 1 and Line 2 had been put into operation for 46 years since 1969. Due to the national and historical conditions at that time, both the technical level and quality standards were relatively low. There are still fire safety risks though the cables have been upgraded. Railway stations of Shanghai Metro Line 1, Line 2 and Chongqing Metro Line 2 are seeing the stability of their fire alarm controllers and gas fire-extinguisher controllers deteriorate year by year and failures increase significantly. Hence, it is necessary for the current urban rail transit facilities to carry out a more comprehensive study on fire-fighting facilities used for existing urban rail transit.

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In this study status of urban rail transit fire-fighting facilities is investigated through field research and data collecting. Suggestions for improving are also offered.

Fig.1. Whole-day passenger flow distribution on rail transit network in Shanghai

2. Status of fire-fighting facilities of urban rail transit

According to the current technical standards of the subway design, platforms and halls, the subway line sections, car depots and train dispatching and control centers of subway stations are mainly equipped with automatic fire alarm system, fire hydrant system, smoke prevention and exhausting system, gas fire extinguishing system, emergency lighting and evacuation guide signs, fire extinguishers and other fire-fighting facilities. Configuration of subway fire-fighting facilities in major Chinese cities is shown in Table 1. In some cities, according to the actual situations, the configuration of fire-fighting facilities on subway platforms is intensified. In Chongqing, automatic fire sprinkler systems have been set up on the underground subway platform. In Shanghai, automatic fire sprinkler systems have been also equipped the platform for some subway lines. the subway train control rooms in Beijing, Shanghai and Guangzhou have been equipped with respirators. In terms of finishing materials, interior trims of subway trains (including the part within the train shell to the inner wall panels, inner roof panels, floor and other decorative components, as well as seats) are made from incombustible materials or halogen-free, less-smoke and flame-retardant materials.

Due to the special nature of the subway system, there are following differences between subway and single building fire-fighting facilities. Firstly, they have different protection areas. Subway fire-fighting facilities are used to protect areas of trains, stations, section tunnels, car depots and parking areas, of which the stations and section tunnels are the major areas to be protected while buildings don’t. Secondly, they have different system compositions. The subway fire-fighting system consists of subway train fire control system, automatic ticket gate system, escalator and PSD system, and drainage system while single buildings don’t have. Thirdly, they have different operation modes. For conventional building fire-fighting facilities, except for automatic fire alarm and automatic fire sprinkler system which are in the routine monitoring state, other facilities are all in reserve or standby state. Many sub-systems of subway fire-fighting facilities, such as environmental control smoke control system, automatic ticket gate system, escalators and PSD system and communication system, are all in a standing state.

<table>
<thead>
<tr>
<th>City</th>
<th>Basic system configuration</th>
<th>Automatic fire sprinkler system</th>
<th>Water spray system</th>
<th>Electric fire monitoring system</th>
<th>Distributed optical fiber fire detection</th>
<th>Intelligent evacuation lighting system</th>
<th>Fire protection water pump house system</th>
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