

# Analysis and Countermeasures of Urban Rail Transit Safety Problems in China

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**Abstract:** This paper analyzes the typical subway accidents and finds out the causes of common subway accidents. As the main carrier of passenger transportation in cities, urban rail transit has always been the focus of attention, but security incidents still occur. At present, China's urban rail construction has entered a period of high tide, and the safety of urban railroads has become increasingly important. Summarize the treatment plan for a series of common accidents such as subway squeeze stamping, subway fire, subway rear-end collision, and how passengers should save themselves.

## 1. Introduction

In order to meet the living needs of urban residents, the density of urban infrastructure construction is increasing, making traffic congestion a key factor hindering the further development of the city [1]. Due to the limited urban land resources and comprehensive social, economic and development factors, it is not scientific and reasonable to continuously build roads as a solution to traffic congestion problems, which is not in line with the overall goal of sustainable urban development [2]. Compared with other public transportation modes, urban rail transit such as subway and light rail has the characteristics of large passenger capacity, high operational efficiency and low energy consumption. It can save urban resources and meet the goal of sustainable development [3]. The majority of urban residents provide more convenient and efficient travel options. Therefore, in the increasingly mature rail transit technology, the construction of rail transit system has become the first choice for major cities to solve road congestion problems and improve development space [4].

## 2. Methodology

After decades of development, the development of China's large railways has begun to take shape, basically meeting the usual needs, but at the peak period still shows a certain degree of insufficient transportation. The development of urban rail is in the ascendant, and there is still a long way to go to become the main force of urban transportation [5]. In the long run, the speed of existing railways, the construction of important routes and the increase of train frequency will become the main trend of the development of large railways. The impact of traffic on the urban central functional area and the impact on the city's overall economy will prompt the development of urban regulations.

At the end of 2018, the national railway operating mileage reached 153,100 kilometers, an increase of 5,519 kilometers from the end of the previous year. The road network density is 107.4 km / 10,000 square kilometers, an increase of 5.7 km / 10,000 square kilometers. Among them, the double-track mileage was 48,300 kilometers, an increase of 4,538 kilometers, the double-track rate was 46.8%, an increase of 2.0 percentage points; the electrification mileage was 55,800 kilometers, an increase of 4,782 kilometers, and the electrification rate was 54.1%, an increase of 1.8 percentage points [6]. There are 18 cities across the country that have opened rail transit, an increase of 2 from the end of the previous year. There are 81 rail transit lines with a total length of 2,408 kilometers, an increase of 12 and 350 kilometers, of which 67, 2050 and 9, and 290 kilometers are respectively. It has 1,549 rail transit stations, an increase of 174, of which 134 transfer stations, an increase of 18; operating vehicles 14,366, 34415 standard, respectively

increased by 13.9% and 12.2%, of which 12,971 subway vehicles, 1,253 light rail vehicles , respectively, increased by 15.6% and 0.5% [7]. In 2018, the national railway sent 2.11 billion passengers, an increase of 10.8% over the previous year. The passenger turnover was 1,059.56 billion person-kilometers, an increase of 8.0% over the previous year. The national railway transportation goods was 3.97 billion tons, an increase of 1.6% over the previous year. The cargo turnover was 2.9173.9 billion tons, which was the same as the previous year [8]. Urban rail transit completed 10.919 billion passengers and operated 274 million kilometers, up 25.1% and 21.5% respectively, accounting for 8.5% of the annual urban passenger traffic [9].

### 3. Factors Affecting Urban Rail Transit Safety

Analysis of rail transit safety issues from people, vehicles, lines, and laws, as shown in Figure 1, can be analyzed from four factors.

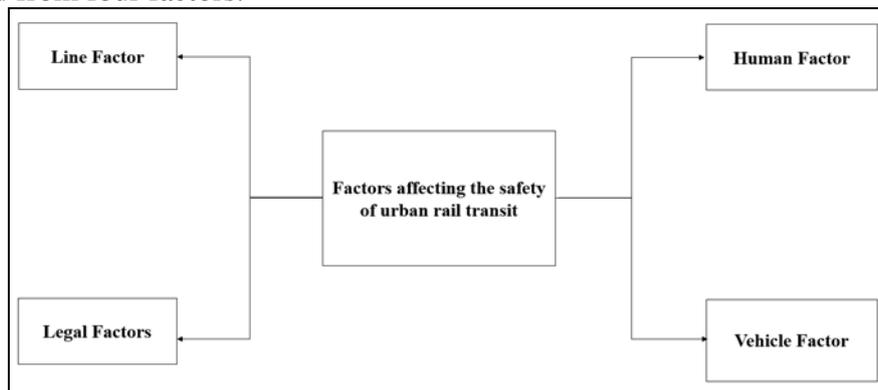


Fig.1. Four factors affecting urban rail transit safety

#### 3.1. Human factor

Urban rail transit should be people-oriented, and rail safety management should also be people-oriented. Passengers should be fully considered to ensure the safety of passengers. Since the quality of passengers has a great impact on the safety of rail transit, many accidents are caused by passengers failing to comply with the rules of travel. Therefore, education on the public's traffic safety awareness should be strengthened to reduce the safety of rail transit due to crowded passengers. Threat. On the other hand, the proportion of accidents caused by the negligence of urban rail transit workers is also large, and the consequences are serious. Almost every major accident is related to the dereliction of duty of the staff. Therefore, it is very necessary and urgent for the staff to carry out legal education, technical education, safety education and professional ethics education.

#### 3.2. Vehicle factor

Although the car is made of flame-resistant materials, it emits a lot of toxic gases after burning. Therefore, whether the flame retardant materials used in the vehicles are qualified and whether the safety devices are sufficient and effective plays an important role in the safe management of rail transit. At the same time, whether the vehicle meets the operational requirements and the technical condition of the vehicle is good or bad will directly affect the operational safety of the rail transit.

#### 3.3. Line factor

Rail transit is a closed traffic system, and the line is an important part of the system. The occurrence of accidents has a certain relationship with the line conditions. For example, the density of the intersection of the ground rail transit plane is large, the lighting conditions in the section tunnel are poor, and the signal sign is lacking. It will affect traffic safety.

#### 3.4. Legal factors

In China's existing rail transit policies and regulations, although there are principled and

qualitative requirements for safety management, there are no specific management provisions and quantitative measurement standards, and there is also a lack of legal policies on traffic safety management.

#### 4. Result Analysis and Discussion

As a fast-moving means of modern cities, rail transit is a comprehensive reflection of its management level and quality. “Safety First” is the fundamental need and primary criterion for passengers. The safety of rail transit includes fire safety, driving safety, and comprehensive management safety. In addition to some sudden accidents, most security incidents have precursors [10]. In order to better avoid accidents, we must start from the following five aspects to do security prevention work, as shown in Figure 2.

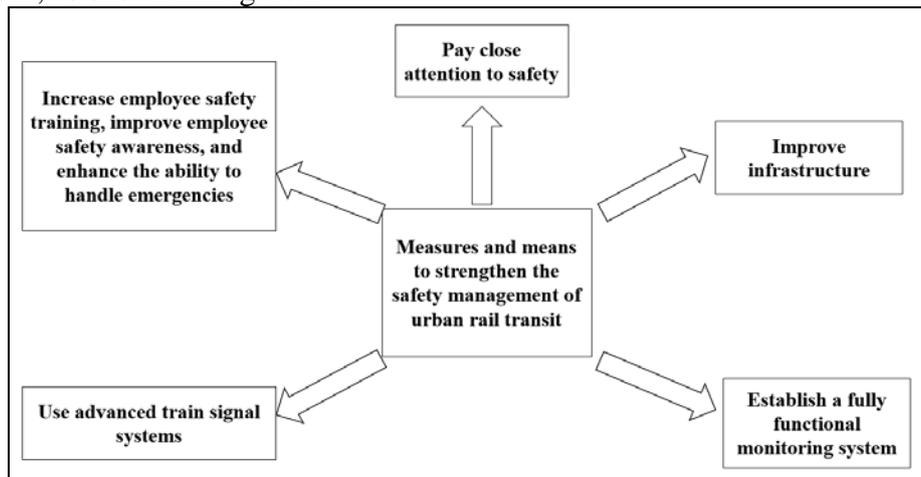


Fig.2. Measures and means to strengthen the safety management of urban rail transit

##### 4.1. Pay close attention to safety precautions

Safety precautions are fundamental to avoiding safety accidents in urban rail transit. The prevention work should focus on two aspects: on the one hand, it is necessary to improve the hardware conditions of existing urban rail transit; on the other hand, it should improve the management organization settings.

##### 4.2. Improve infrastructure

Add urban rail transit protection doors. The isolation door is constructed at the platform and the train line. When the train is not in the station, the isolation door is closed. When the train enters the station, the isolation door is opened to allow the passenger to enter the train. This will prevent passengers from falling over the station due to overcrowding during the waiting process, and at the same time avoid passengers entering the train running line from the station, which can prevent the subway suicide from happening to a considerable extent.

##### 4.3. Establish a fully functional supervision system

The supervision system is mainly responsible for monitoring whether the urban rail transit infrastructure and the running status of the train are normal, and whether the passengers in the station and the train are behaving normally. If an abnormal phenomenon occurs, an alarm can be issued in time. Therefore, the establishment of a comprehensive urban rail transit monitoring system is of great help to improve the safety of urban rail transit. The specific monitoring tasks of the system are as follows: power facility monitoring, monitoring whether the power supply facilities along the substation are operating normally. Monitoring of station infrastructure and in-vehicle equipment status. The monitoring system is mainly responsible for ventilation and air-conditioning system equipment, water supply and drainage equipment, escalators, elevators, public areas of stations, advertising lighting, station accident lighting power supply, screen doors, etc. Comprehensive and effective automatic monitoring of station equipment, train doors, windows and

in-vehicle alarm equipment, such as man-made closed partition doors, ensures that the equipment is in an efficient, energy-saving and reliable optimal operating state. The monitoring of the running status of the train is responsible for monitoring whether the running indicators such as the running speed of the train are normal. Passenger behavior monitoring. It is mainly responsible for monitoring whether passengers in the station and in the train deliberately damage facilities and behave abnormally.

#### **4.4. Using advanced train signal systems**

Due to the short running range and high operating density of urban rail transit, the signal system responsible for commanding the train operation plays an important role in ensuring the safe operation of the train. Therefore, it is of great significance to adopt an advanced train signal system to reduce the safety accident caused by human error. The urban rail transit signal system should be composed of two parts: the train operation automatic control system (ATC) and the vehicle maintenance base signal control system. It is used for train approach control, train interval control, dispatch command, information management, equipment condition monitoring and maintenance. Management, which constitutes an efficient integrated automation system. The operating line ATC system consists of an automatic train protection (ATP) subsystem, an automatic train monitoring (ATS) subsystem, an automatic train operation (ATO) subsystem, and a train number transfer (PTI) subsystem.

#### **4.5. Strengthen the safety training of employees, improve the safety awareness of employees, and enhance the ability to deal with emergencies.**

Employee safety education is common in all industries and is carried out on a regular basis. However, due to the low incidence of accidents, a considerable part of people have not paid attention to it. It is only a formal walk, and training for emergencies is lacking. It is this kind of thinking that caused great losses in the event of an accident. The urban rail transit management department shall establish a comprehensive staff training system, and the safety supervisors of the urban rail transit management department shall directly be responsible for the staff safety training work, and shall truly cause employees to pay attention to safety issues, and at the same time, target the accidents that are prone to occur. Simulation training to improve the ability of employees to deal with problems in the event of an accident. For those who do not pay attention to safety issues, the employees who are not well-thought-out during the training and training process will be given serious treatment and will never be soft.

### **5. Conclusion**

With the development of the city and the continuous updating of transportation, the urban track will give a new attitude to the development of the city. The urban rail transit safety management is an important topic. The rapid development of science and technology, the safety of the urban track will be more the more rationalized, the more secure the urban rail transit. The development of urban rail transit is of great significance to promoting urban construction and economic development, improving the living standards of citizens and improving the environment of the city. As an important public transport vehicle in the city, rail transit is directly related to the safety of the majority of passengers. The safe construction and safe operation of urban rail is the primary goal and basic principle of its transportation.

The urban rail transit system is a huge and complex system engineering, and there are many risk factors from its construction to formal operation. Based on the statistical analysis of past urban rail accidents, this paper analyzes the existing risk factors from people, vehicles, lines and legal aspects, and provides a basis for ensuring the safe operation of the subway.

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