



Construction and Management of Emergency Shelter from the Perspective of Modernization—Taking Shenzhen as an Example

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Abstract. Emergency shelters are used to protect the public from typhoons, torrential rains, floods, earthquakes, epidemics and other major emergencies. As an important part of disaster prevention, reduction and relief work, the construction and management of emergency shelter places put forward higher requirements in the development of modern cities. This paper analyzes the new ideas of the development of the new era on the planning principles of emergency shelters, the new requirements of the rapid urbanization process on the management of emergency shelters, and the new challenges of the complexity of disasters and accidents to the construction of emergency shelters, taking Shenzhen City as an example, the paper comprehensively and systematically introduces the characteristics of disasters in Shenzhen City, construction contents and management experiences of indoor and outdoor emergency shelters, etc. This paper summarizes important construction contents and the management mechanism of indoor and outdoor emergency shelters in Shenzhen, in order to provide useful reference for the planning, construction and management of modern urban emergency shelters.

Keywords: Emergency shelter · Modern city · Complexity of disaster and accident · Disaster prevention and mitigation

1 Introduction

Emergency shelters are used to protect the public from typhoons, torrential rains, floods, earthquakes, epidemics and other major emergencies [1–3].

The construction of emergency shelters has a longer history abroad [4, 5]. From the 14th to the 16th century, European cities such as Catania in Italy and Lisbon in Portugal fully absorbed the experience of historical natural disaster response and gradually built emergency shelters. During post-disaster recovery and reconstruction, they transformed narrow, complex road networks into straight and spacious city roads connected to urban squares to enable all neighborhoods to be interconnected [6]. In the 1950s, the construction of emergency shelters entered a new phase [7]: Japan built parks with an area of

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more than one hectare into emergency response parks (Teng Wuxiao et al., 2003; Lei Yun, 2007); 60% of American urban homes has basements, there are 50,000 “emergency operation centers” used by state and local governments, and 200,000 other types of public shelters [8]; the largest civil defense shelter in New Orleans can accommodate up to 100,000 people at the same time and is equipped with various functional venues and facilities, as well as blast-resistant doors that can withstand shock waves and earthquake shocks; Switzerland divides its civil defense shelters by region, connects them to each other, sets up various functional areas, and provides enough food to last half a month or longer.

The construction of emergency shelters in China started relatively late [9–11]. “The ‘Urban Planning Compilation Methods’ (Ministry of Construction, 2006) first proposed the principle and construction policy of establishing a comprehensive disaster prevention system. Article 17 of the ‘Urban and Rural Planning Law of the People’s Republic of China’ (10th National People’s Congress Standing Committee, 2007) clearly states that ‘... Content such as disaster prevention and reduction should be included as mandatory in the overall planning of cities and towns’, and Article 25 specifies that ‘When formulating urban and rural planning, basic data such as investigation, surveying and mapping, meteorology, earthquakes, hydrology, and environment as required by the state’. In the same year, the ‘Eleventh Five-Year Plan for Urban Construction Comprehensive Disaster Prevention’ (Ministry of Housing and Urban-Rural Development, 2007) proposed the goal of ‘basic formation of a regulatory system for urban construction comprehensive disaster prevention and a framework for comprehensive disaster prevention and defense system, and significantly enhancing the comprehensive ability of urban disaster resistance’. “The ‘Site Selection and Supporting Facilities for Earthquake Emergency Shelters’ (GB 21734-2008; General Administration of Quality Supervision, Inspection and Quarantine, etc. 2008) [12] specifically stipulates the classification, site selection and facility configuration requirements for earthquake emergency shelters. The ‘Management Specification for Natural Disaster Evacuation Points’ (MZ/T 052–2014, Ministry of Civil Affairs, 2014) specifies specific requirements for evacuation point sites and buildings, basic facilities, daily management, safety management, emergency management, etc. The ‘Standard for Construction of Urban Community Emergency Shelters’ (Ministry of Housing and Urban-Rural Development, etc. 2017) clarifies the construction scale, site selection and planning layout, area, buildings, and facilities requirements for community-based emergency shelters. China’s emergency shelters have gradually improved, and urban comprehensive disaster prevention planning has gradually shifted towards “combining peace and war, combining peace and disaster, focusing on prevention, responding quickly, and effective strategies.” Enhancing the capacity for disaster prevention, reduction and relief has become the main goal of comprehensive disaster reduction work in the new era.

2 Modern Cities Demand New Requirements for Emergency Shelter Construction

As urbanization accelerates, the impacts of natural disasters on cities have become increasingly severe. Despite the important roles that various engineering and non-engineering measures play in urban disaster prevention and mitigation work, recent

frequent disaster responses have revealed that overall urban disaster resistance capacity is still insufficient. For example, in 2018, Typhoon “Mangkhut” caused nearly 3 million people to be affected across 5 provinces (autonomous regions) in Guangdong, Guangxi, Hainan, Hunan, and Guizhou, resulting in 5 deaths, 1 missing person, 1.601 million emergency shelter and resettlement cases (as of September 18, 2018 at 17: 00). In 2020, floods in the south affected a total of 30.2 million people in 27 provinces (regions, cities), including Anhui, Jiangxi, Hubei, Hunan, Guangdong, Guangxi, Chongqing, Sichuan, and Guizhou, leading to 140 deaths or missing persons, 1.721 million emergency relocation and resettlement cases, and 601,000 people in urgent need of living assistance (as of July 9, 2020 at 14: 00). The construction and management of emergency shelters are integral parts of disaster prevention, reduction, and relief work, and modern urban development demands higher requirements of them.

2.1 New Development in the New Era Proposes New Principles for Emergency Shelter Planning

The “14th Five-Year Plan for National Economic and Social Development and the Long-Term Goals Through the Year 2035 of the People’s Republic of China” proposes to “establish a unified command, be proficient and permanent, react quickly, and link up and down the emergency management system; optimize the construction of the national emergency management system and improve disaster prevention, reduction, and relief capabilities,” and “enhance public facilities’ ability to respond to storms, droughts, and geological disasters, and improve the emergency shelter functions of public facilities and buildings.” “Emergency shelters provide service guarantees for resettling victims of major disasters in cities. It is the core of urban disaster prevention, reduction, and relief systems and urban safety. Its planning and construction should fully consider the influence of multiple types of disasters and start from different scenarios such as concurrent and chain disasters, fully considering the degree of impact of disaster events. It should make full use of existing facilities, combined with the assessment of disaster-causing factors and the vulnerability analysis of carrying bodies, consider the distribution of sheltered populations, and be targeted. Emergency shelters of various types should be built in stages and batches in conjunction with urban renewal and existing land use. Emergency shelters should be constructed with fully relying on intelligent, digital, and technological means to make their use more convenient and efficient.

2.2 Rapid Urbanization Proposes New Requirements for Emergency Shelter Management

With the advancement of urbanization in our country, the impact of natural disasters on cities and towns is becoming more and more obvious, especially, the large and medium-sized cities, small and medium-sized towns with dense population and developed economy in the eastern region are frequently affected by urban waterlogging, typhoons and torrential rain, etc.. According to statistics, from 2016 to 2019, every year, 31 provinces (autonomous regions and municipalities directly under the central

government) are affected to varying degrees by disasters such as droughts, floods, landslides, debris flows, typhoons, hail, freezing and snowstorms, of the 606,726,000 people affected, 18 percent were in eastern China such as Beijing, Shanghai and Tianjin, with Hebei, Shandong, Guangdong and Zhejiang provinces leading the list. With the development of urbanization and the increase of city size, the population and buildings are becoming more and more dense, which puts forward higher requirements for the management of modern the emergency shelters, how to effectively provide emergency shelter for a large number of people in a short time is also a problem that can not be ignored in the process of modern cities. The management of emergency shelters should run through the whole cycle after junior high school, and the initial planning should fully take into account the development speed, population distribution, building density and historical disaster characteristics of the urban modernization process, during the medium-term construction, the actual needs of the region should be combined with the post-maintenance of the equipment to be constantly updated and improved to ensure that the emergency shelter can always start up efficiently and quickly.

2.3 Complexity of Disasters and Accidents Pose New Challenges for Emergency Shelter Construction

After many natural disasters, a series of secondary disasters is often triggered, such as landslides, mudslides, floods, droughts, environmental damage, and structural damage that occurs after earthquakes, resulting in serious harm. According to statistics, 60% of the economic losses caused by natural disasters in China are caused by compounded chain-type disasters. Among them, earthquakes and typhoons combined with chain disasters have resulted in more than 80% of casualties [13]. The complexity of disasters and accidents poses higher requirements for the construction of modern emergency shelters in cities. How to efficiently and quickly help citizens evacuate from disasters and avoiding secondary disasters is an unavoidable issue in the process of urban modernization. The construction of emergency shelters should fully consider factors such as spatial layout, functional area requirements, equipment facilities, response to disaster types, and capacity, ensuring accessible paths and clear identification, and providing refuge spaces that can meet the needs of disaster victims in case of extreme emergencies.

3 Experience in the Construction and Management of Emergency Shelters in Shenzhen

3.1 Characteristics of Disasters in Shenzhen

Shenzhen City has a subtropical maritime monsoon climate and is frequently affected by tropical cyclones and heavy rainstorms. Influenced by the complex coastal terrain, rivers in Shenzhen experience sudden rises and drops in water levels, while the low-lying areas in the western coastal region are prone to flooding. The diverse bedrock types on land and the complex geological environment make it susceptible to geological hazards such as landslides, mudslides, and karst collapse. Shenzhen is located in the southeastern coastal earthquake zone and has a structural background that is prone to moderate

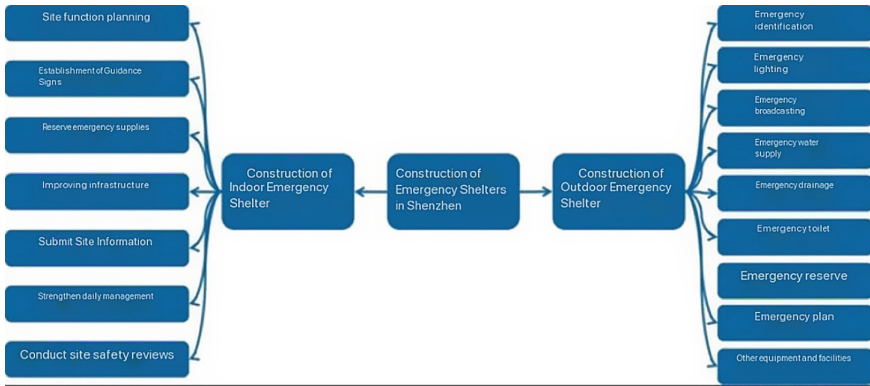


Fig. 1. Key Contents of Shenzhen’s Emergency Shelter Construction

earthquakes [14]. Meanwhile, Shenzhen is highly developed with a large population and dense buildings. As of the end of 2019, the city had a permanent population of 13.4388 million, resulting in 6,730 people per square kilometer (Shenzhen’s total area is 1,996.85 square kilometers). In the event of a sudden incident, the impact would be particularly significant. In recent years, Shenzhen has been experiencing more frequent and severe extreme weather conditions, resulting in an increase in natural disasters. According to statistics, during just four typhoons, “Severe Tropical Storm Merbok,” “Typhoon Hato,” “Typhoon Pakhar,” and “Super Typhoon Mangkhut,” from 2017 to 2018, emergency shelters throughout Shenzhen opened 2,099 times, accommodating over 225,800 people.

3.2 Content of Emergency Shelter Construction

In 2012, Shenzhen formulated the “Plan for Implementation of Shenzhen Outdoor Emergency Shelter Planning” and “Plan for Implementation of Shenzhen Indoor Emergency Shelter Planning (2010–2020),” which clearly defines the key content of indoor and outdoor emergency shelter construction. Relevant departments throughout the city were organized to use existing parks, green spaces, schools, community centers, street centers, cultural venues, sports facilities, welfare facilities, and other places simultaneously promote the construction of indoor and outdoor emergency shelters (Fig. 1).

3.3 Experience in Emergency Shelter Management

Standardized Management Through New Regulations and Systems

In order to comprehensively review the current management of emergency shelters, strengthen disaster preparedness in these areas, and improve the efficiency of sheltering and relief services, Shenzhen launched a city-wide investigation into the state of emergency shelter construction in 2019. Through grassroots research, it was discovered that there were issues with the management of emergency shelters due to overlapping functions between departments and unclear responsibilities among stakeholders. This

ambiguity led to difficulties in determining duties related to maintenance, management, operation, and closure of emergency shelters, with different departments often employing a “coordinate as you go” approach, which to some extent hindered the effectiveness of relevant work.

In response, Shenzhen initiated the revision of the “Shenzhen Emergency Shelter Management Measures” and the “Guideline for Indoor Emergency Shelter Operation Management during Typhoons and Heavy Rainstorms”, which clearly defines the responsibilities of various levels and departments, work requirements for daily maintenance, operation and closure of emergency shelters and further improve the organization and the support mechanism of emergency shelter management in Shenzhen. At the same time, in order to promote the effective implementation of emergency shelter work, the various districts of Shenzhen city on the basis of practical experience, effectively undertake the rules and regulations at the municipal level, to study and compile supporting management documents that meet the work needs of the jurisdiction. For example, Longhua District and Pingshan District formulated and issued the “Emergency Shelter Management Procedure,” while Bao’an District developed and issued the “Shenzhen Bao’an District Indoor Emergency Shelter Management Standard Guidelines” Implementing Details, and Yantian District drafted and issued the “Guidance Manual for Indoor Emergency Shelters in Yantian District.”

Standardized Construction Through New Standards and Requirements

In order to enhance the disaster prevention, reduction, and relief capabilities of grass-roots communities and comprehensively construct a comprehensive disaster reduction community with Shenzhen characteristics to address the “last mile” problem of disaster prevention, reduction, and relief, Shenzhen has begun formulating the “Shenzhen Comprehensive Disaster Reduction Community Creation Standard.” This document clearly outlines new standards and requirements for the construction of emergency shelters, functional zoning, signage, evacuation routes, and other aspects, in order to promote standardized construction of emergency shelters citywide (Fig. 2).

Building a “One-Click” Search Through New Methods and Technologies

To facilitate rapid, convenient, and efficient search for emergency shelters by citizens, Shenzhen launched the indoor emergency shelter information on Tencent Maps in July

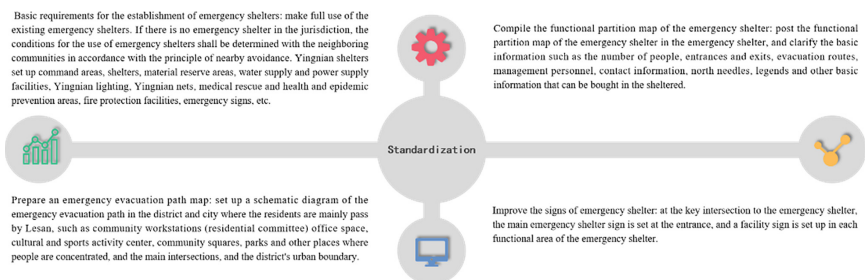


Fig. 2. The standard requirements for the construction of emergency shelters in the Shenzhen Comprehensive Disaster Reduction Community Creation Standard.

2019, allowing real-time querying and navigation. Citizens can search for “indoor emergency shelters” in the “Emergency Prevention and Mitigation” column of the Shenzhen Emergency Management Administration WeChat public account or the Tencent Maps app/WeChat mini-program named “Tencent Maps+ “ to obtain information such as the nearby indoor emergency shelter’s name, address, emergency contact phone number, etc. Meanwhile, they can navigate with one click, making it easier and faster to reach the nearest indoor emergency shelter and achieve effective disaster avoidance. Currently, popular maps like Tencent, Baidu, Amap, etc. Have all launched the indoor emergency shelter query and the navigation function for Shenzhen.

4 Conclusion

The construction of emergency shelter is an important strategy of disaster prevention, reduction and relief to enhance the safety of modern cities. Shenzhen has formed a set of closed-loop management system in the process of promoting the construction of emergency shelters in modern cities. Next, Shenzhen should closely integrate the work arrangements of the national comprehensive disaster reduction demonstration communities, the National Comprehensive Disaster Reduction Demonstration Counties, and the National Security Development Model Cities, we will improve the weak links and weak points in the planning, construction and management of emergency shelters, update urban planning, upgrade construction standards and strengthen management, strive to fully construct the regional model for the construction of the emergency shelter system in the pilot demonstration zone, so as to achieve reasonable layout of the site, complete supporting facilities, functional division is comprehensive, accessible evacuation routes and public awareness is high, the overall capacity of cities to prevent, reduce and respond to disasters have significantly increased.

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