



---

## The Current Development Status and Trends of Urban Utility Tunnels in China

Chen Suhang

School of Safety Science and Engineering, Henan Polytechnic University, Jiaozuo 454003, China

---

**Abstract:** As an integrated infrastructure project consolidating various utility pipelines, utility tunnels effectively address issues related to pipeline layout and safety, prevent repeated road excavations, and facilitate the intensive development of underground space resources. This aligns with the demands of modern urban infrastructure construction. This study analyzes the current state of utility tunnels in China from three perspectives: the development history, the legal and regulatory framework, and the status of operations and maintenance management. The analysis identifies four major challenges constraining utility tunnel development: inadequate planning in the initial stages of construction, the need for further improvement and refinement of relevant regulations, ongoing debates over the types and quantities of pipelines to be included, and a lack of experience among utility tunnel operators. The study concludes that future development trends include integrating utility tunnels with “green city” and “sponge city” initiatives, as well as advancing intelligent operation and maintenance systems.

**Keywords:** Utility tunnel; development status; development trends

---

### 1. Introduction

The underground utility tunnel, also known as the "common trench" or "utility tunnel," is a modern and efficient urban infrastructure system that integrates two or more types of utility pipelines—such as water supply, drainage, electricity, heating, gas, telecommunications, television, and internet—within a shared tunnel space. These tunnels are equipped with dedicated inspection ports, hoisting entrances, and monitoring systems, and are implemented through unified planning, design, construction, maintenance, and centralized management.

The construction of urban underground utility tunnels offers numerous benefits. It addresses challenges such as repeated road excavations, dense overhead utility networks, and frequent pipeline failures. Additionally, it enhances urban safety, optimizes urban functionality, beautifies cityscapes, and promotes intensive, efficient, and transformative urban development. Utility tunnels also strengthen the sustainability of urban systems, making them a critical component of modern urban infrastructure renewal and transformation, and aligning with trends in urban modernization.

Originating in Europe in 1833, utility tunnels have undergone substantial development globally, becoming a hallmark of modern municipal construction and management in developed cities. For instance, Paris currently has over 100 kilometers of utility tunnels, with increasing capacities. Similarly, Japan had constructed 310 kilometers of utility tunnels by 1992, with an annual growth rate of 15 kilometers. In contrast, the development of utility tunnels in China has been relatively slow. The first utility tunnel was built in 1958 beneath Tiananmen Square in Beijing. However, it was not until late 1994 that the first large-scale utility tunnel was completed in Shanghai's Pudong New Area. Over the past two decades, utility tunnel development in China has remained sluggish, with projects limited to a few developed cities and newly urbanized areas.

This paper analyzes the current state of utility tunnels in China from three perspectives: historical development, the evolution of legal and regulatory frameworks, and the current status of operations and maintenance



management. It identifies the factors constraining the development of utility tunnels and proposes future trends to provide a reference for advancing utility tunnel development in China.

## 2. Current Status of Utility Tunnels in China

### Development history of utility tunnels in China

The construction of urban utility tunnels in China began in 1958 with the completion of the first utility tunnel beneath Tiananmen Square in Beijing. Since then, its development has undergone five distinct phases [1][2].

#### 1. Conceptual Phase (Before 1978)

During this period, advanced practices and experiences related to utility tunnels from abroad were introduced to China. However, due to the unique historical context and limited resources, the development of urban infrastructure stagnated. Only municipal design units in a few major cities, such as Beijing and Shanghai, engaged in exploratory projects. They primarily relied on adapting foreign design principles while conducting small-scale trials in selected areas.

#### 2. Debate Phase (1978–2000)

With the gradual implementation of reform and opening-up policies and the acceleration of urbanization, significant progress was made in improving urban infrastructure. However, conflicts between localized and broader urban interests, coupled with resistance from certain departments, hindered the integration of utility pipelines. Despite strong advocacy from renowned experts, comprehensive pipeline integration faced substantial obstacles. During this period, some developed regions initiated experimental utility tunnel projects, achieving limited scale and some degree of operational success.

#### 3. Rapid Development Phase (2001–2010)

Driven by rapid economic growth and urban population expansion, utility tunnel construction entered a period of significant advancement. This phase witnessed substantial theoretical and practical research efforts by Chinese scientists and technical experts. Building on the knowledge and experience accumulated during the previous phase, comprehensive pipeline planning and design were undertaken in numerous medium and large cities, leading to the implementation of large-scale projects.

#### 4. Catch-Up and Innovation Phase (2011–2017)

During this period, strong governmental support played a pivotal role in driving the rapid development of utility tunnels. The Ministry of Housing and Urban-Rural Development conducted extensive research, and the State Council issued a series of policies encouraging public-private partnerships (PPP) to stimulate private investment in infrastructure, particularly in utility tunnel construction. This marked a transformative phase in China's utility tunnel development, with significant contributions to the national economy. By 2017, China had surpassed developed countries in construction scale and technological advancement, establishing itself as a global leader in utility tunnels.

#### 5. Orderly Advancement Phase (2018–Present)

Since 2018, utility tunnel development in China has entered a phase of systematic and strategic advancement. Cities are now required to develop tailored utility tunnel plans based on local conditions, ensuring that construction aligns with practical and sustainable objectives. This phase emphasizes refining strategies, optimizing resource allocation, and implementing feasible construction plans to achieve more efficient and orderly development of utility tunnels.

### Current status of utility tunnel construction in China

Compared to the development of utility tunnels in other countries, China's progress in this field began later and experienced slow initial growth. However, case studies of operational utility tunnels in several Chinese cities demonstrate their significant benefits. By replacing traditional direct-burial pipelines and overhead cables, utility tunnels enhance urban infrastructure management and urban aesthetics, underscoring the need for greater national attention and investment.

The first urban utility tunnel in China was constructed in 1958 beneath Tiananmen Square in Beijing, spanning approximately 1,076 meters. In 1991, Taipei built the first utility tunnel in Taiwan. Since the 1990s, numerous cities in mainland China have initiated utility tunnel construction plans. Table 1 outlines the development of utility tunnels in selected cities. Recent years have seen an increasing number of cities implement policies



supporting utility tunnel construction, particularly in newly developed urban areas. Notable examples include Tianjin, Dalian, Shenyang, Qingdao, Ningbo, and Harbin.

In August 2015, the General Office of the State Council issued the "Guidelines on Promoting Urban Underground Utility Tunnel Construction", sparking a new wave of utility tunnel development across the country. As part of this initiative, the first batch of 10 pilot cities was designated in 2015, including Baotou, Shenyang, Harbin, Suzhou, Xiamen, Shiyuan, Changsha, Haikou, Liupanshui, and Baiyin. A second batch of 15 pilot cities was announced in 2016, comprising Zhengzhou, Guangzhou, Shijiazhuang, Siping, Qingdao, Weihai, Hangzhou, Baoshan, Nanning, Yinchuan, Pingtan, Jingdezhen, Chengdu, Hefei, and Haidong.

### **Current status of legal and regulatory frameworks for utility tunnels in China**

Based on the different entities responsible for policy and standard formulation, the scope of application and effectiveness of these policies and standards vary. This section summarizes the relevant policies and standards at both the national and local levels.

#### **1. National Policies and Standards**

In recent years, various government bodies, including the State Council, the National Development and Reform Commission, the Ministry of Housing and Urban-Rural Development, and the Ministry of Finance, have issued numerous significant policy documents. These documents have played a critical role in standardizing and guiding the construction of urban underground utility tunnels. In terms of technical standards, in May 2015, the Ministry of Housing and Urban-Rural Development issued the "Technical Code for Urban Utility Tunnel Engineering" (GB50838-2015), which provided explicit requirements for the planning, design, construction, inspection, and maintenance of utility tunnel projects. This standard aimed to enhance the safety, economic efficiency, and technological advancement of utility tunnel construction. On January 22, 2016, the Ministry of Housing and Urban-Rural Development introduced the "National Design Framework for Urban Utility Tunnels" (Document No. [2016] 18), encompassing four key areas: general design, structural design and construction, specialized pipelines, and auxiliary facilities. The framework was intended to guide the development of standardized design practices. In December 2017, the Ministry of Housing and Urban-Rural Development published the "Technical Standards for Urban Utility Tunnel Monitoring and Alarm Systems" (GB/T51274-2017), which outlined specific requirements for the design of monitoring and alarm systems in utility tunnels. These systems include environmental and equipment monitoring, safety protection, and communication systems. The standard was implemented on July 1, 2018. Additionally, other standards, such as the "Investment Estimation Indicators for Urban Utility Tunnel Projects" and the "Comprehensive Planning Standards for Urban Engineering Pipelines", have been issued to further support utility tunnel construction.

#### **2. Local Policies and Standards**

To ensure the smooth planning, construction, and operation of utility tunnels, local governments have developed policies tailored to their specific contexts and requirements, while aligning with national standards. These local regulations effectively standardize the planning, construction, operation, and maintenance of utility tunnels in their respective regions. Examples include the "Management Measures for Urban Underground Utility Tunnels in Xi'an", the "Opinions on Promoting the Construction of Urban Underground Utility Tunnels in Shanghai", the "Fee Standards for the Paid Use of Urban Underground Utility Tunnels in Nanning", the "Shanghai Urban Utility Tunnel Maintenance Technical Regulations", the "Hebei Province Technical Regulations for Urban Underground Utility Tunnel Construction", and the "Shenzhen Technical Regulations for Underground Utility Tunnel Engineering".

### **Current status of utility tunnel operation and maintenance management in China**

Throughout the lifecycle of utility tunnels, various risks are inherent and persist. Domestic scholars have conducted extensive research on risk management during different phases of utility tunnel operation and maintenance. Jin Yafang analyzed the characteristics of utility tunnel projects under public-private partnership (PPP) models and summarized twelve risk factors. Using game theory, the study derived the optimal risk-sharing ratio [3]. Zhou Xianhua et al. developed a five-level hierarchical structure model for risk factors, calculating the driving forces and dependencies of each factor to reveal their interrelationships [4]. Zhao Jia employed the Risk Factor Risk Management (RFRM) method combined with improved analytic hierarchy process, entropy weight method, and Bayesian decision theory to filter financing risks in PPP-mode utility tunnel projects, proposing suggestions for risk prevention and mitigation [5]. Wang Shuhong constructed a



multi-hazard coupling disaster risk assessment model for utility tunnels [6]. Additionally, Li Qian applied the Decision-Making Trial and Evaluation Laboratory (DEMATEL) method to identify critical risk factors in the operation and maintenance management process of utility tunnels and offered specific preventive measures [7]. Despite the growing interest among scholars in studying the operation and maintenance management of utility tunnels, progress in this area remains relatively slow. At present, a mature and comprehensive operational management system for utility tunnels has yet to be established.

### **3. Challenges in the Current Development of Utility Tunnels in China**

#### **1. Insufficient planning prior to construction**

Despite significant progress in utility tunnel development, numerous critical issues persist. Historically, underground engineering projects in China were independently planned and constructed by various units or departments, often operating in silos. These entities prioritized their specific usage and value creation without considering the urban underground space as an integrated resource requiring comprehensive, coordinated planning. This fragmented approach led to the segmentation of underground resources, making subsequent redevelopment and utilization challenging. In severe cases, this lack of coordination created significant obstacles for future underground engineering projects. Moreover, this fragmented development approach resulted in the loss of vital data and documentation related to project surveying and design stages. In many instances, due to prolonged timelines, some cities lack sufficient data on underground engineering, further complicating the advancement of future projects. This underscores the critical need for unified and rigorous planning during the preliminary stages of utility tunnel construction. Comprehensive data collection and standardized planning should be implemented to maximize the efficient use of underground space. By anticipating future projects during the early phases of construction, cities can reduce project costs, minimize resource wastage, and avoid unnecessary increases in expenditures. A forward-looking, holistic approach to planning is essential to ensure the sustainability and functionality of urban underground utility tunnels.

#### **2. The need for further improvement and refinement of regulations related to utility tunnel construction**

Urban underground utility tunnel construction has experienced rapid development, entering a period of significant growth. However, existing regulations and standards remain insufficient and require further improvement. Currently, the primary technical standard for the utility tunnel sector is the "Technical Code for Urban Utility Tunnel Engineering" (GB 50838—2015), supplemented by a limited number of design guides and atlases. While these resources provide a foundational framework, they fail to offer comprehensive guidance, particularly for deep-buried utility tunnels. Additionally, discrepancies exist between different regulations referenced during the structural design of utility tunnels. For instance, standards such as the "Code for Design of Concrete Structures" and the "Code for Structural Design of Water Supply and Drainage Pipelines" sometimes provide conflicting or inconsistent guidance on specific issues. These inconsistencies hinder the development of effective and efficient design practices tailored to the unique needs of urban underground utility tunnels. If design work relies solely on conservative assumptions to address these gaps, it could lead to significant resource wastage and inflated costs.

Furthermore, regulatory gaps persist in the acceptance and inspection processes following the completion of utility tunnel construction projects. At present, there are few or no standardized protocols governing the post-construction inspection and operational acceptance of utility tunnels. This lack of regulatory clarity presents challenges for ensuring the quality, safety, and functionality of completed projects. Addressing these regulatory deficiencies will require the development of more comprehensive and specific standards that align with the unique characteristics of utility tunnels, ensuring that design, construction, and operational practices are both efficient and effective.

#### **3. Disputes regarding the types and quantities of pipelines in utility tunnels**

Currently, the most complex utility tunnel projects in China can accommodate up to nine types of pipelines. For example, the Jiangbei New Area Utility Tunnel in Nanjing includes pipelines for electricity, telecommunications, water supply, reclaimed water, heating and air conditioning, natural gas, stormwater, sewage, and waste management. However, in practical engineering, determining which types and how many pipelines should be incorporated into utility tunnels is influenced by numerous factors, including policy requirements, urban functionality, technical conditions, environmental factors, and construction and operational



costs. Consequently, significant debates remain among experts regarding the types and quantities of pipelines to be included. Pipelines such as electricity, telecommunications, heating, water supply, and reclaimed water face relatively few technical and environmental constraints, resulting in minimal opposition to their inclusion. On the other hand, pipelines for stormwater, sewage, natural gas, and waste management are subject to greater geographical and safety constraints, leading to more significant resistance to their integration into utility tunnels.

#### **4. Lack of experience among utility tunnel operators**

At present, most utility tunnel projects in China have not fully transitioned into the operational management phase. A review of various implementation plans reveals that some government-funded projects have assigned the management responsibilities for utility tunnels to temporary agencies established specifically for this purpose. However, these agencies often lack sufficient consideration for cost recovery and maintenance, resulting in operations that are barely sustainable. In public-private partnership projects, operation and maintenance responsibilities are often handed over to the private entities that were responsible for construction. Some contracts include clauses that allow the private entities to transfer operational rights or require pipeline companies to collaborate with private entities to manage and maintain the utility tunnels. However, most private entities involved in these projects are new to the field of utility tunnels, as tunnel operation is not their primary business. The operation and maintenance of utility tunnels require a high degree of specialization, and the management tasks cannot be adequately handled by a single property management company or municipal service provider. The lack of experienced and specialized operators presents a significant challenge to the sustainable operation of utility tunnels, highlighting the urgent need to cultivate expertise and establish professional management frameworks.

#### **4. Development Trends of Utility Tunnels in China**

##### **Integration of utility tunnels with “Green Cities”**

As national development continues to advance and construction technologies mature, the integration of utility tunnel construction with green city initiatives is becoming increasingly vital in contributing to urban environmental improvements. A critical aspect of green city development is the efficient management of urban waste. In the future, utility tunnels can not only accommodate electricity and communication cables but also provide centralized channels for the transportation of urban waste and sewage to designated treatment facilities. This integration will enhance waste management efficiency and minimize environmental impacts, further aligning with the goals of green cities to promote sustainability and ecological harmony.

##### **Integration of utility tunnels with “Sponge Cities”**

With global warming intensifying, urban flooding has become a pressing issue in China. The construction of sponge cities, which aim to improve urban resilience to flooding by collecting, storing, and utilizing rainwater, offers a promising solution to this challenge. Utility tunnels, which inherently include pipelines for water supply and drainage, can be effectively integrated with sponge city concepts. By combining the two systems, urban utility tunnels can not only address issues related to urban flooding and water resource reuse but also significantly reduce labor and material costs. This synergy enhances the functionality of both infrastructures while promoting sustainable urban water management.

##### **Intelligent operation and maintenance of utility tunnels**

With the rapid advancement of information and intelligent technologies in China, the smart design of utility tunnels is set to become the mainstream direction for their future development. Intelligence will play a pivotal role not only during the construction phase but also throughout the operation and maintenance lifecycle of utility tunnels. In particular, the operation and maintenance phase of utility tunnels, which has long been a challenge, stands to benefit significantly from intelligent systems. Monitoring systems, robotic inspection technologies, and digital platforms for utility tunnel management will simplify operations and improve efficiency. The long length of utility tunnels and the complexity of the pipelines they house, coupled with potential multi-hazard risks, make manual management highly difficult. Intelligent systems, however, can autonomously manage the tunnels, requiring personnel only to analyze monitoring data and issue commands based on inspection results. For example, the inspection of utility tunnels—ranging from a few kilometers to tens of kilometers—currently demands substantial manpower and resources if conducted manually. However, robotic inspection systems can replace human labor, saving time and resources. Once a problem is detected, personnel can issue commands to



address it directly, streamlining the entire maintenance process. Intelligent operation and maintenance systems will thus address key operational challenges, ensuring the long-term sustainability of utility tunnels.

## 5. Conclusion

1. The key constraints on the development of utility tunnels in China include insufficient planning prior to construction, the need for further improvement and refinement of regulations related to utility tunnel construction, ongoing disputes regarding the types and quantities of pipelines to be included, and a lack of experience among utility tunnel operators.
2. The future development of utility tunnels can be integrated with “green city” and “sponge city” initiatives, while the intelligent operation and maintenance of utility tunnels will become a crucial direction for advancing their management.

## References

- [1]. You X H. (2017). Present status and future development trend of urban utility tunnel construction. *Urban Architecture Space*. 24(3): 6.
- [2]. You X H. (2017). China state construction technical center. *Architecture Technology*. 48(9) :902.
- [3]. Jin Y F. (2017). Study on risk allocation and profits distribution of PPP project in underground comprehensive corridor. Zhengzhou University.
- [4]. Zhou X H, Pan H T, Shen Y F. (2017). Risk factor evaluation of underground utility tunnels under the PPP Model: based on the ISM-MICMAC model. *Friends of Accounting*. (13):59-64.
- [5]. Zhao J, Qin Y H, Wang J B. et al. (2018). Research on the risk management of PPP mode financing of utility tunnel [J]. *Chinese Journal of Underground Space and Engineering*. 14(02):315-322.
- [6]. Wang S H, Zhang Z, Hou W S. et al. (2018). Risk assessment method on multi-disaster coupled hazard for urban utility tunnel. *Journal of Northeastern University (Natural Science)*. 39(06):902-906.
- [7]. Li Q, Duan W, Xu G Q. (2019) Research on risk factors of operation and maintenance management of utility tunnel based on DEMATEL. *Tunnel Construction*. 39(01):31-39.

