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Discussion on the development of underground utility tunnels in China

Chao Yang^{a,*}, Fang-Le Peng^a

^a *Research Center for Underground Space & Department of Geotechnical Engineering, Tongji University, Shanghai 200092, China*

Abstract

This paper mainly reviews the history of the construction of the underground utility tunnel in China, and points out the existing problems. Based on the analysis of several construction cases, some practical experience on the large-scale promotion and construction of urban underground utility tunnels in China are given from the decision-making, planning, construction, management and other aspects, which may be helpful to the development of underground utility tunnels in other countries.

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1. Introduction

Today, most of urban utilities in China are directly buried under the roads. This approach illustrates a lack of long-term governance of underground space, leading to congestion of the urban utilities installed in the shallow underground level. Allied to this, the operation of urban utilities such as repair, renewal, maintenance, upgrading and decommissioning results in frequent excavation and reinstatement of the roads in our cities, seriously obstructing the traffic. Moreover, damages to the surrounding environment and buildings caused by utility operations are also recognized as potential city security problems. Accidents of utilities like leakage, rupture, explosion, frequently happening in China, have drawn considerable attention of the government and citizens. Under

* Corresponding author. Tel.: +862165987532.
E-mail address: pengfangle@tongji.edu.cn

this situation, underground utility tunnel which has widely been discussed and adopted by different countries are becoming an alternative way to solve the problems of urban utility placement. Since the construction of Zhangyang underground utility tunnel in Shanghai (1994), Beijing, Guangzhou, Shenzhen and other major cities in China has carried out a number of pilot projects of urban underground utility tunnels. Especially in 2015, a series of policies to promote the construction of utility tunnels are issued by the central government, heralding an explosive growth trend in the next 10 years.

With the process of reform opening up, China was going through the world's largest and fastest urbanization process ever in the history, spending only 60 years improving the urbanization rate from 10% to 50%. To achieve the same process, Europe spent 150 years and Latin America spent 210 years [1]. By 2015, the rate of urbanization has reached 56.1%, which means there are 770 million people living in the cities, equal to the population of Europe. The rapid growth of urbanization brings challenges to environmental protection and supply capacity of public resources. Therefore, the Chinese government has always been exploring a more intensive and ecological way of urbanization.

Recent years, backward infrastructural facilities are found to be one of the main limiting factors in improving the quality of urbanization. For a long time, most of China's water supply, electricity, communications, gas, drainage and other urban utilities are directly buried beneath the road, which leads to a number of problems such as frequent street cutting for utility installation, maintenance, renewal and the associated problems of traffic congestion, noise and damage to other utilities. Moreover, lack of current underground utilities data and the low efficiency of traditional management method often lead to fire, leakage, or even explosion disasters during construction. Consequently, experts and government officials in China turned to promoting the underground utility tunnel as an alternative solution for sustainable utility placement. An underground utility tunnel can be defined as "any system of underground structure containing one or more utility service which permits the placement, renewal, maintenance, repair or revision of the service without the necessity of making excavations"[2]. In this paper, statistics and analysis on the development status of urban underground utility tunnel are firstly given. Then, some key points and practical experience for promoting utility tunnels in China's urban areas are discussed. Finally, an example is given to better understand the basic principle for the development of urban underground utility tunnel.

2. Development status

In 1994, the first utility tunnel was built at Zhangyang Road, Pudong District, Shanghai. The tunnel was about 11.125 km long, using rectangular cross-section form consisting of two compartments. Four kinds of urban utilities (electricity, telecommunication, water supply and gas line) were combined into the tunnel. After that some cities also carried out a few number of pilot projects of utility tunnels. (Figure 1)

So far, the total length of utility tunnels built in China's major cities is about 500km, close to other cities in the world. However considering average length per capita, the number is only 0.24 km per one thousand people which is far below the average level (Figure 2). On the other hand, if choosing the average number (2km/1000people) of other developed cities to calculate China's potential space for utility tunnels, the total number can be approximately close to 27000km. This suggests that the construction scale of underground utility tunnels in China's major cities is far from enough.

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