The Development of Common Duct in Taiwan and Its Enlightenment to China

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Abstract: Utility tunnel built in the urban underground is used to hold two or more urban pipeline engineering structures and ancillary facilities, that is also known as the common duct in Taiwan. The construction of utility tunnel can effectively eliminate the "zipper of the road" and reasonably use underground space, which is the important direction of modern smart city in sustainable development. This paper summarizes the development course of common duct in Taiwan area and discusses its accomplishments from construction achievements, the legal system, funding sources, system planning and public pipeline database. On this basis, according to the existing problems in the development of utility tunnel in China, this paper points out some enlightenments that China gets from the development of common duct in Taiwan, so as to provide positive enlightenments for large-scale construction of utility tunnel in our country.

Introduction

The urbanization rate in our country has reached 56.1% by 2015, with the urbanization process is accelerating, the pressure for maintaining normal operation of the city municipal pipeline keeps increasing, the lack of scale of underground pipeline and low management level were exposed. For example, some cities have storm flooding, pipeline leak explosion, road surface collapse events, etc. In addition, the traditional way of directly buried pipeline leads to the frequent road excavation, brings inconvenience to residents and operation maintenance, which results in higher social costs. With the development of urbanization in our country, the traditional way of directly buried pipeline has exposed many shortcomings, which can't meet the needs of the modern urban life. The introduction of urban infrastructure construction and development of new pattern is the key to solve bottleneck of the urban infrastructure development. In this case, the utility tunnel as an intensive municipal infrastructure can effectively solve these problems. The concept of utility tunnel originated in Europe in the nineteenth century, its technical level has been fully mature and got great development in many cities. Utility tunnel has become a modern symbol of city municipal construction management in some developed countries and regions after one hundred years of exploration, research, improvement and practice \cite{1}. However, the construction of utility tunnel in China starts late and develops slowly; the main reason is the question of construction funds and operating management. The development time of common duct in Taiwan is the same as China, but the construction of common duct in Taiwan has made great achievements. This paper summarizes the development of common duct in Taiwan to provide enlightenments for construction of utility tunnel in China.

The Development of Common Duct in Taiwan

Taiwan brought in the concept of common duct from Japan in 1989, enacted the common duct law in June 2000, and made a variety of ways to promote the construction of common duct, which has made great achievements, such as the administrative regulations, engineering technology and
coordination during the time of development in Taiwan. The construction of common duct in Taiwan has experienced three stages, as shown in figure 1[2].

![Figure 1. Three stages of common duct development in Taiwan.](image)

The First Stage (before 1991): Starting Stage

Affected by Japan in early 1970s, Taiwan has produced the idea of constructing common duct, due to various conditions which had not yet been mature, the construction of common duct failed to make substantial progress. Until 1989, in the early construction of the Taipei MRT, the problems of digging the livelihood of the people such as telecommunications, gas pipeline and traffic jams had appeared, which caused the general discontent. To solve this problem, the mayor of Taipei led the delegation to visit Japan, they were affected by the concept of “common ditch-once and for all from digging up roads” and brought the idea of constructing common duct back to Taiwan that is why common duct began development in Taiwan.

On July 17, 1990, Taipei government in works of new industry sets common duct department, which was officially approved on February 15, 1991, that is the first dedicated institution about common duct in Taiwan. At the same time, Construction and Planning Agency started formulating relevant legal provisions, and Kaohsiung government also established pipeline department to comply with relevant business of common duct, which marks the common duct into a new era in Taiwan.


Taipei government set up Nt$2.5 billion as common duct fund to promote common duct engineering in July 1991, then the interior ministry also raised Nt$2.5 billion as common duct fund to provide loans and cyclic utilization for all levels of government and common duct department.

At the same period, the related laws and regulations that were formulated and modified gradually started involving common duct. For example, Taipei increased the provision of common duct in the Taipei urban road management rules in 1993, in order to make the construction of common duct be based on the laws and regulations. On June 14, 2000, the interior ministry enacted the common duct law, then the common duct implementation rules and other relevant laws were published.

Taiwan announced the announcement of common duct network for the first time in 2000. Now, Taipei, New Taipei, Taichung, Tainan, Kaohsiung, Keelung, Hsinchu and Chiayi, a total of eight cities, have completed the overall planning and established systematic planning of common duct.

In addition, Taiwan’s government established “public facilities pipeline database grouping” to make related policy and system of pipeline database in 1990. Making all kinds of line standard system and public facilities planning, will integrate all kings of pipeline information of Taiwan and establish public facilities pipeline database, for all kinds of pipeline unit query.

The Third Stage (2003-present): Perfecting Stage

In 2000, the interior ministry enacted the common duct law, also, the implementing rules and related method of the common duct law developed during the next two years. As of May 2003, the implementation of the common duct engineering design standard showed that the central level of the regulation system in Taiwan had been completed, which marked that the common duct was entirely based in Taiwan.
On April 22, 2010, the interior ministry promulgated the interior supervision about the government of municipalities and countries promoting the common duct project, which was to promote construction of common duct and understand the construction state of common duct. Between May and July each year, Construction and Planning Agency shall invite 5~7 persons to supervise the previous year’s results, including Directorate General of Budget, Accounting and Statistics, Council for Economic Planning and Development(CEPD) and specialists and scholars, and understand problems in the course of construction. The supervision team shall respectively check each project, hoping give positive guidance in promoting the construction of common duct at all levels of government through using the monitoring system for assessment.

The Development Achievements of Common Duct in Taiwan

Construction Achievements

As shown in table 1, that is the construction status of common duct in Taiwan as of April 2015. The accumulative length of construction completed is 392.818 km; all the planning length of construction will reach 908.181km. Seen from the distribution, the construction of common duct is mainly concentrated in the densely populated and economically developed cities, such as Taipei, New Taipei, Taichung and Kaohsiung [3].

<table>
<thead>
<tr>
<th>Project</th>
<th>Completed</th>
<th>Instruction</th>
<th>Design</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main(km)</td>
<td>53.344</td>
<td>13.292</td>
<td>9.560</td>
<td>76.196</td>
</tr>
<tr>
<td>Branch(km)</td>
<td>61.660</td>
<td>109.302</td>
<td>16.380</td>
<td>187.342</td>
</tr>
<tr>
<td>Raceway(km)</td>
<td>47.249</td>
<td>13.337</td>
<td>0.000</td>
<td>60.586</td>
</tr>
<tr>
<td>Cable line(km)</td>
<td>230.565</td>
<td>279.626</td>
<td>73.866</td>
<td>584.057</td>
</tr>
<tr>
<td>Total(km)</td>
<td>392.818</td>
<td>415.557</td>
<td>99.806</td>
<td>908.181</td>
</tr>
</tbody>
</table>

Legal System

Since the 1990s, various local governments have vigorously promoted the construction of common duct after the concept of common duct introduced. In order to facilitate planning and implementation of common duct, solve various problems in the construction, legislation became the inevitable demand at that time. The interior ministry promulgated the common duct law in 2000 as a turning point, which indicated that legislative work of common duct had entered the rapid development of new stage. Then the related laws of the common duct law developed, these laws and regulations systematically made a specification about the planning, construction, operation, funding and other issues of common duct, which indicated that a common duct legal system had been established. After that, the local governments started formulating laws and regulations at the local level, making laws and regulations system of common duct continuously detailed at the local level [4].

System Planning

The common duct prescribes that the competent authority shall consult with the pipeline business organs at all levels to plan common duct system within their respective jurisdictions. The system planning of common duct is gradually completed by country in Taiwan, combining with the development and utilization of urban underground space at the same time and constructing with the MRT and underground railway engineering. Now, 8 counties and cities have completed the overall planning. At the same time, the laws and regulations prescribe that the completion of common duct system planning shall be announced after approved by the interior ministry, and the system shall be
thoroughly reviewed every three to five years after announced. Also, the planning shall be reviewed from time to time in order to cope with national important policies or the implementation of major projects.

Public Pipeline Database

In 1992, Construction and Planning Agency called to establish prophase planning study of public pipeline database. They would gradually build public pipeline database in various counties by making public pipeline database system of overall planning and all kinds of line standard data interchange formats and exchange and building all kinds of pipeline testing platform. There are 8 counties and cities have established pipeline database by 2014, other counties will continually promote the construction plan. After the whole pipeline database is completed in Taiwan, it’s achievement and benefit will appear. The database will provide better information of disaster prevention and mitigation, engineering design and business management, which can provide the basis for planning and construction of common duct and greatly promote the development of common duct.

The Construction Status and Existing Problems of Utility Tunnel

Development Course

China built the first utility tunnel under Tiananmen Square in 1958, then built the same cross section of utility tunnel when chairman Mao memorial hall was built. However, the construction of utility tunnel in the true sense began in Zhang Yang road in 1994, which has been more than 20 years of history so far, and the utility tunnel had not been valued and large-scale development [5]. Along with the accelerating urbanization, city problem appeared continuously, utility tunnel as an intensification of the municipal infrastructure can effectively solve these problems. In the past two years, utility tunnel walks into public view, the construction of utility tunnel starts booming in the country. In April 2015, the ministry of finance and ministry of housing and urban-rural confirmed Baotou and other 9 cities as pilot cities of utility tunnel and planned to build 398 km utility tunnel underground in 3 years, with a total investment of 35.1 billion Yuan. According to statistics, there are 69 cities building utility tunnel in China, which reach 1000km and the total investment of 88 billion Yuan [6].

Existing Problems

a. Source of Fund Mainly Raised by Government Investment is Single

Utility tunnel has many advantages and can make a significant benefit, but its prophase construction investment is higher than the traditional pipeline directly buried underground and it also requires high operation and maintenance cost, which make it hard to take part in investment for the social capital. The money of constructing utility tunnel in China is essentially raised by a variety of government financial means, which has an important role in supporting for the development of utility tunnel. However, as the construction of utility tunnel and operation scale constantly expanding around the country, the huge construction investment with no money paid will make the single mode of government financial supporting more and more unsustainable. The stable source of funding will become the key to develop utility tunnel on a large scale [7].

b. There is Lack of Corresponding Legal Security System

The construction and management of utility tunnel must be carried out by the law. At present, China has not legislated for utility tunnel, only relying on the relevant policy guidance and technical specification. The behavior originally regulated by law is carried out by administrative means, which makes the enforcement and is difficult to achieve the desired effect. In recent years, the central government is also constantly exploring and has established the specification of the national level. And the laws and regulations of construction, operation and management of utility tunnel should be established as soon as possible.

c. Pipeline Units are Influenced by Traditional Concept of Directly Buried Pipeline
The construction of utility tunnel is to break the traditional model that pipeline unit is individual to establish a new mechanism of coordination and management. It’s a big difficulty to change the past management system and idea and make each pipeline unit follow the same construction specification. In addition, the construction investment of utility tunnel in the early stage is much higher than the traditional buried cost; pipeline unit is reluctant to participate in constructing utility tunnel for the immediate interests.

**d. Unified Cost-sharing Mechanism has not been Established**

The relationships between different types of pipeline lying in the utility tunnel are mainly manifested in the distribution of the limited space. According to the space factor that pipeline takes up and income factor, we can share construction cost of utility tunnel to ensure a stable income latterly and sustainable construction of utility tunnel. Different pipeline units have responsibility to pay for use and operation maintenance when they enter into utility tunnel. But there has not established unified cost-sharing mechanism in China, which leads to the lack of basis in the operation of the actual cost allocation and makes the cost of utility tunnel recovery be a problem [8].

**Enlightenments to the Construction of Utility Tunnel**

**Establishing Regional Network System as a Whole**

Utility tunnel as a comprehensive project is about the people’s livelihood, involves numerous units and complex construction, which cannot be easily changed once completed. So it should be planned by considering the urban development at present and in future before constructed. China should draw lessons from Taiwan to establish a system of network about utility tunnel in various counties or provinces, which can reasonably use underground space, combine with the city planning in the region, and build with the construction of the urban subway and underground space development. At last, it should build up the whole area of planning system of utility tunnel, which is constantly being revised as urban development.

**Establishing Laws and Regulations System**

Laws and regulations as the basic constraint behavior standard, is the key to promote the development of utility tunnel. There is no special legislation in the construction of utility tunnel in our country, mainly relying on the government’s administrative means to dominate, which will be discounted. China should draw lessons from Taiwan and other regions about laws and regulations system and combine with the experience of the utility tunnel that has been built to establish legislation from two aspects of technology and policy at the national level, which makes a basis on constructing utility tunnel in all regions.

**Setting up Specialized Department**

Municipal pipeline accommodated in the utility tunnel was built by different competent authorities that were no unified coordination mechanism. Constructing utility tunnel makes lines in the same space, which requires coordination between various pipeline units before starting planning. Constructing utility tunnel involves many units, which must have a unified organization of the department be in charge at this time. At the beginning of the construction of common duct, Taiwan established common duct department in Taipei, then established in Kaohsiung, which is responsible for the construction of utility tunnel. China should change the present management system that various pipeline units are responsible for their construction, and establish the competent authorities of utility tunnel from central to local, they are specifically responsible for the coordination between various pipeline units and unified planning and construction.

**Guaranteeing the Stable Source of Funding**

Now, the construction of utility tunnel in China mainly relies on the government investment, pipeline units rent or use it in free. Because the construction of utility tunnel requires a lot of money, the government cannot afford when built in a large scale. To explore diversified financing
model is the precondition for the development of utility tunnel. Taiwan raises money by establishing common duct funds, and the government joins investment with the pipeline units to ensure the sustainable development. China should adopt diversified investment and financing mode, such as setting up funds, bringing in social capital, issuing bonds, etc., to ensure a stable source of funding in construction of utility tunnel.

**Establishing Information System Platform of Utility Tunnel**

Pipeline data is respectively kept by each unit and doesn’t make public because the units of each line have their own authority, which will hinder the coordination between the various units and be not conducive to planning and construction of utility tunnel. China should take advantage of modern information technology to establish information database of underground space development and utilization to provide information for each unit. Information system platform of utility tunnel can be established on the basis of underground space utilization and pipeline construction to realize the intelligent management of underground utility tunnel.

**Conclusion**

Utility tunnel, as urban infrastructure service product, plays an important role to the development of the whole city and residents’ daily life. Strongly constructing utility tunnel in city, can improve the urban environment, save urban land, and avoid affecting traffic and people’s life when the pipeline is constructed and maintenance in a traditional mode, which is the important measure to realize urban sustainable development. In the past two years, the country has vigorously promoted construction of utility tunnel; the region should take this opportunity to promote the development of utility tunnel. Aiming at the problems existing in the construction of utility tunnel, we should sum up experiences of development at home and abroad and combine with domestic pilot project construction to explore the construction of utility tunnel in law, financing, operation, maintenance and cost allocation. At last, we should establish perfect development pattern and improve the management level of utility tunnel on the basis of the level of urban development in our country.

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