Probe into Control and Guidance System of Underground Space Planning for New Urban Center - An Example of Underground Space Planning for the New District Airport in TangShan

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ABSTRACT

With China entering an acceleration period of underground space development, the utilization of underground space becomes an important field for government to control. It is urgently to resolve the problem that how to control and guide of underground space development. In this article, control system of underground space planning for new urban center is discussed. This article takes example for underground space planning of Tangshan airport new district to conclude the content and features of underground space planning control system for new urban center. Based on some problems and phenomenon of construction process in new urban center, this article further explores the establishment method of various controlling contents, the implementation strategy of planning compilation, so as to increasing the enforceability of underground space planning.

1. INTRODUCTION

With the acceleration of China's urbanization process, the large-scaled underground space development can be seen throughout the country. Due to the use of underground space to resolving "City Syndrome", such as shortage of land, congestion, deterioration of ecological environment; the development of underground space shows us different way for the intensive development of urban land. It can improve the quality of its development is of great significance.

In recent years the development and utilization of underground space activities have become more and more rational and mature. Some cities have started urban underground space exploration and effective planning. The level of construction and management has been greatly improved. Along with the constant development of new urban centers, many new centers in megapolis take the overall planning and development of large-scale underground space. The planning compilation requirements of underground space referred to a certain height, but in reality, its content, inwardness and index is lack of unified control system bound by the norms. There was also a lack of planning and management strategy suited to the characteristics of underground space for new urban center. Therefore, the new urban center will explore ways to improve the control functions of underground space planning, to establish and improve the planning control system. It is very necessary.

2. LAND-USE CONTROL IN NEW URBAN CENTER

Land-use planning is an important element of underground space. The land-use controlling of underground space makes such provisions as the construction of underground space, location, size, boundaries, the development capacity and etc.
2.1 Plot division

The plot division of underground space rests with the function of the land and its ground land division. The free style layout of commercial architecture in the new urban center, leads to the different levels of land development conflicts between the land demarcation and the actual construction of the site. The government should not invest in the development of an exhausted land, and if the plot divided several times, it’s not easier to use. If the land is too small, it is inconvenient to use up, and its connectivity with surrounding land creates a bottleneck in future. Thus the planning must delineate the minimum plot size and enable greater flexibility of the land division, preventing the reduction of land efficiency and land quality resulting by small-scale land development, so as to a greater extent in the function of the need to adapt to the new urban center.

The plot division of underground space relates with the function and development mode. The land which has a single character, unified development (such as underground public garage), could be divided larger, and the control index also be relatively brief. In principle, the development of underground space under buildings in the plot division could follow the ground, but the development of underground space underneath such place as the road, open space, public green space or a particular use of the public facilities must be independent plot division. Therefore, in regulatory detailed planning of underground space for Tangshan airport new district, the land for commerce, housing in function is usually controlled within 0.5-4.0ha. But the land for urban green space in function is usually controlled within 2.0-6.0ha. The division of green space should consider the ground demarcation, keeping its integrity. The roads and rivers does not account into a plot, preserving a separate unit plot. Given the complexity of the construction rights of underground space, plot division should give attention to its ownership, administrative jurisdiction and the unitary nature of boundaries land use, civil engineering facilities and vertical facilities.

2.2 Development capacity control

The development capacity control of underground space in New Urban Center mainly considers the minimum equipment, to make use of underground space efficiently. In fact, the capacity control is mainly related to parking facilities, air defense facilities and commercial facilities in the area. Urban underground space development intensity relates with the demand of underground space. Therefore, according to the development intensity of regional planning on the ground, and combining with the layout of underground space planning, underground space development capacity infers different plot. It is a more comprehensive method that can be considered with various factors.

In new urban center, the value of commercial land, or land along the subway is larger different from the land of surrounding areas. It has directly impact on the function of the use-land for construction, the size of plot division, the rate of capacity on the ground and the actual benefit of input and output. So the development intensity of underground space should be differently decided according to their location and the level of land tax. When forecasting the development capacity of underground parking in airport new district for Tangshan, the proportion of the vehicles in underground is adjusted to the proportion of vehicles in the ground according to the principles of urban planning. It is suggested that 80% to 85% vehicles on the ground placed in underground. According to the function and actual circumstance around the plot, at least 70% parking on the ground will be solved in the underground in the specific implementation. This has been the development of underground parking capacity, as shown in Table 1.

3. CONSTRUCTION CONTROL IN NEW URBAN CENTER

3.1 Vertical control

New urban center planning always carries on planning for a new land in city, or changes the function of the land in the original plan. As the result of underground historical cultural relics, the original
underground structures optionally or improper planning of new underground structures, the new
underground structures will conflict with old underground structures when carrying on the
underground space planning. As the underground structure is not easy to change, and the developed
underground space is difficult to come back to their original level, we should pay particular attention
to the underground structures planning for hierarchical setup when carrying on the development and
utilization of underground space. It can avoid the conflict between the underground structures and the
wastage of resources to achieve harmony and rational development of underground space.

Table 1. Underground Parking Capacity of Airport New District in Tangshan.

<table>
<thead>
<tr>
<th>The Function of Architecture</th>
<th>Floor Area (m²)</th>
<th>Ratio of Parking (vehicle / 100m²)</th>
<th>Number of Parking (vehicle)</th>
<th>Percent of Underground Parking</th>
<th>Number of Underground Parking (vehicle)</th>
<th>Area of Underground Parking (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commerce</td>
<td>1745232</td>
<td>0.4</td>
<td>6981</td>
<td>85%</td>
<td>5934</td>
<td>296700</td>
</tr>
<tr>
<td>Culture and Entertainment</td>
<td>470693</td>
<td>0.4</td>
<td>1883</td>
<td>85%</td>
<td>1601</td>
<td>80050</td>
</tr>
<tr>
<td>Executive</td>
<td>144978</td>
<td>0.35</td>
<td>508</td>
<td>80%</td>
<td>407</td>
<td>20350</td>
</tr>
<tr>
<td>Housing</td>
<td>1696376</td>
<td>0.5</td>
<td>8482</td>
<td>80%</td>
<td>6786</td>
<td>339300</td>
</tr>
<tr>
<td>Total</td>
<td>4057279</td>
<td></td>
<td>17854</td>
<td></td>
<td>14728</td>
<td>736400</td>
</tr>
</tbody>
</table>

In the underground space planning of Tangshan airport new district, the vertical control of the various
types of underground facilities abide by the following principles in order to ensure the construction
and operation smoothly: ① B1th is mainly the public activity level, and the height is 6.5m–7.5m. A
vertical clearance of the ground to the ceiling is 4.0m–4.5m. It is mainly for pedestrian, motorized and
non-motorized vehicles parking, commerce and cultural entertainment, and other public facilities.
Taking into account the layer which attached to vegetation or equipment, the covered soil layer should
be reserved the space for synthesis duct. ② B2th is mainly the vehicle parking and the connected
motor vehicle lane. Take into account it can be changed to mechanical parking mode in future or
possibly transformed to the functions of public activity level, its height is been controlled in 5.0m. ③
B3th is mainly for motor vehicles, equipment and etc. The height is 4.0m around. The vertical
clearance of underground pedestrian passage is not less than 3.5m (Fig. 1).

3.2 Underground Boundary control

The planning and design of underground space in new urban center must focus on the
factors of underground structures, underground pipes and plant roots. The
development of underground space should coordinate the distance between existing
buildings and underground pipelines, and other concessions from the plant root.
In underground space planning of Tangshan airport new district, the boundary control of
underground structures does not allow to beyond the road line generally. In the case of the land-use boundary coincides with the road line because of the badly shortage of the land, underground roads are not allowed to extend beyond the red line. Meanwhile the distance between underground construction and road line may provide the space for the growth of some large trees. Taking into account the space reserved for the pipeline commuting to internal construction, underground construction boundary backs off the land-use boundary of the ground at least 5m according to the requirement of engineering pipeline department (Figure 2). Based on Chinese current level of construction technology, adjacent underground construction each backs 1.5m off the line of land-use, which creates the possibility for the future of connectivity between plots. For the consistency and flexibility planning, the new underground construction backs at least 3m off pipeline; when the planning projects is at the side of green belt, the underground development backs 3m off green belt; when the planning projects is at the side of the river, the development boundary of underground is the same with the ground.

3.3 Disaster prevention in underground construction

Through analyzing the various risk factors involved in the underground space, we found that the fire disaster is first of all. As the result of the relatively denseness of commercial facilities and population, underground public buildings should be designed to meet current fire protection standards, including adequate width of safety evacuation, convenient route of fire protection, smoke control device and division of fire compartment.

It is mentioned that the underground public space should be designed in units in the planning of Tangshan airport new district, to confine the disaster to a minimum, and protect other underground space. Above all units have two exits towards the ground. The distance between passageway to any evacuation must be less than 40m, and a clear indication system must be setup. The planning and construction of subway, tunnels, underground streets, and underground parking facilities should be combined with other facilities. They should reasonably setup separate fire compartment, evacuation routes, safety exit, security alarm, fire extinguisher and other facilities in strictly accordance with the standards.

4. UNDERGROUND TRANSPORT NETWORK PLANNING GUIDANCE

With the rapid development of urban track transportation and urban space development in the three-dimensional direction, most of cities make use of underground space to alleviate local traffic conflicts in new urban center, particularly mainly to solve the dynamic and static transportation. underground transportation are generally divided into three kinds, such as subway, parking and pedestrian. Therefore the planning and design should follow the following three principles:

- Security zones and development zones should be set up along the subway, according to traffic demand in future, the subway stations should be reserved the space for transfer station, parking, underground pedestrian crossing and other facilities to make connectivity in the future.
- Underground pedestrian crossing should link with near major stations, and turn into the transport system, so as to form a network of underground pedestrian.
- Underground garage are suitable to construct together with underground street, subway station and other underground facilities, moreover connected with the adjacent underground garage.

Fig. 3. Concept of Underground Parking System.
Take the underground transportation planning of Tangshan airport new district as an example, there is no subway in the region, so the underground transportation planning gives priority to underground parking. The accessorial parking space of various buildings should adopt the form that ground parking combine with underground parking, conforming to the relevant provisions of Tangshan. A high proportion of accessorial underground parking should be built, and they also be required opening to public. Underground public parking will be distributed at the areas where is more intensive construction on the ground, or surrounding the transfer hubs of private and public transportation, or surrounding landscape nodes. In order to improve the efficiency of parking and coordinate underground static traffic with ground dynamic traffic, adjacent underground garage should be linked together in the large developed plot to form underground parking system, so as to realize the static and dynamic traffic connecting flexibly (Fig. 3).

5. CONTROL AND GUIDANCE OF UNDERGROUND SUPPORTING FACILITIES IN NEW URBAN CENTER

The requirements of the various allocated facilities should be proposed in control and guidance of underground supporting facilities. It includes the control and distribution of all kinds of underground public facilities, civil air defence facilities, and such underground facilities as business services, administrative office, health, cultural and entertainment facilities and etc.

Take the planning of Tangshan airport new district as an example again, as a new urban center, its facilities will generally be divided into three categories. Firstly, commercial services facilities; secondly, public facilities; thirdly, civil air defence facilities. Now, commercial service facilities will be mostly analyzed. This kind of facilities is to meet the demand of people for business affairs or living. Its location generally corresponds with the ground public services center, and it always locates in surface and underground transportation hub. How to configure this facility refers to Japan provision. The scale of the underground commercial space is not less than 5,000 m², but for disaster prevention, not more than 20000 m², while the internal part of the area for underground streets should be maintain in a reasonable ratio, commonly total area of commercial facilities is less than the area of underground passage.

6. CONTROL AND GUIDANCE OF PUBLIC POLICY

In addition to several types of control index in common use, public policy control is also one of the essential elements for the healthy development of the new urban central. The experience of the developed countries shows that policy formulation often more important than the plan itself in the development of underground space. Therefore, in order to make the implementation of operational control policy of the underground space planning, public policy of underground space should refer to domestic and foreign investment and financing, choose different mode of development according to different underground projects; define the land-value of the underground public domain; establish more workable policy of the technical specifications and planning compilation of underground space as soon as possible.

In the underground space planning of Tangshan airport new district, it is suggested that the underground space will be sold openly and developed independently step by step. Or the underground space will be unified invested, operated and managed by the developer through the way of compensation. The underground space underneath square or greenbelt can not only be sold openly to attract developers to invest in the transfer, but also be leased out by the civil defense department and other public sector after investment. According to the experience of the domestic underground space development and construction, the mode of Public-Private-Partnerships is suitable for public facilities; In particular, it is more suitable for the development and operation of state-owned assets. Therefore, the project of underground transportation, civil pipeline can use this mode by the cooperation between
government for the public sector and private sector, to encourage negotiations and preferential policies, and realize the investment and proposals.

7. CONCLUSION

The planning and design is one of the controlling factors that influence the development of the new urban center through. Also, the management and implementation of planning is a key factor which lead the underground space to the healthy development direction. Due to its practicality, and extensity, it will need all the professionals work together to deepen and improve it. In practice, the control system includes both the construction of the spatial entities and the establishment of an invisible policy management. As the underground space planning is a new thing, the planning control system is still in the exploratory stage, it requires more study and practice.

REFERENCE