A Probe into the Development and Utilization of Underground Space of New Towns in Beijing

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ABSTRACT

Beijing is an international metropolis and its new towns bear the functions of relaxing the pressure of population and employment in its central city and bringing along the development of the surrounding areas. The recent large-scale planning and construction of the urban rail transit will improve the contact between new towns and central city. It has become a topic of great concern how to bring along the new towns through TOD (transit-oriented development) and particularly, how to construct a sound urban environment while maintaining the intensive development of the central areas of the new towns.

By analyzing the opportunities and conditions for the development and utilization of the underground space of the new towns in Beijing, this paper probes into the possible patterns of the said development and utilization, and in combination with the case of the underground space planning of the comprehensive area in front of the station of Yizhuang New Town, it attempts to promote the comprehensive utilization and coordinated development of ground and underground space by developing and utilizing the underground space so as to provide a choice for the intensive, efficient and sound development of the new towns.

1. INTRODUCTION

In accordance with Beijing General Urban Planning (2004-2020) (hereinafter referred to “BJGUP”), a total of 11 new towns will be planned in Beijing and they will play the roles in relaxing the pressure of population and employment in the central city, congregating new industries and driving the regional development. According to China’s division of cities based on the size of population, except Yanqing, 4 of the 11 new towns of Beijing are up to the size of population of the medium-sized cities (with a population of 0.2-0.5 million) and 6 up to that of the large cities (0.5-1 million). This means that, in the next 10-20 years, a number of large urban regions will be gradually developed and constructed around the central city of Beijing. The three key new towns, Shunyi, Tongzhou and Yizhuang, are planned to have a population of 0.7-0.9 million and the urban development space for a population of one million has been reserved for them.

The enhanced functions and the expanded population and land area of new towns require the compact construction and intensive development of new towns. In the meantime, the objective of building the “healthy new towns” needs the provision of favorable ecological environment and moderate open space. Therefore, it is imperative to explore a way suitable for the development and construction of the new towns in Beijing.
2. ANALYSIS ON TOD FUNCTIONS OF RAIL TRANSIT IN NEW TOWNS

2.1 A Theoretic Overview of TOD

The theory of TOD is originated in the United States (after the 1980s) and usually refers to the mixed-use communities with an average radius of 2000 feet (ca. 600 meters) and centered around transit stops and core commercial areas. TOD arranges the residence, retailing, offices, public space and public building facilities within walking distance, enabling the residents to conveniently choose their means of traveling, such as bus, walking, bicycle or car. TOD emphasizes the compact urban space patterns near the stations, the mixed use of land, the higher intensity of development, the convenient and friendly regional streets and POD (pedestrian-oriented development) environment.

2.2 An Overview of TOD Functions of Rail Transit

As a large-capacity method of public traffic and transportation, rail transit can guide the high-intensity use of the surrounding land to realize its TOD functions by greatly increasing the supply of traffic. Generally, the process of rail transit-oriented urban structural development is in four stages: ball-shaped development---wave-shaped development---belt-shaped development---surface-shaped development.

![Fig.1. Process of Rail Transit Oriented Urban Structural Development.](image)

The preconditions for rail transit to function in the new towns are as follows:
First, it connects the central city and the new towns and the latter should be large enough; and its final development can bring about the passenger flow demand that can adequately bring into play its advantages;Next, it needs the coordination of road systems and satisfies the arbitrary and diversified choices for traveling; and it shouldn’t be the only way of public traffic;Finally, no stations should be set at the separating belts between new towns so as to avoid inducing the development of such belts.

2.3 Planning of Rail Transit for New Towns in Beijing

To promote the coordinated development of urban spatial layout, land use and traffic, it has been clearly pointed out the “BJGUP”: the construction of traffic facilities will not be considered as the follow-up projects after the land layout takes shape, instead, the traffic development patterns that correspond with the land use layout will first be determined so as to fully play the pioneering role of traffic and make the traffic construction as the important means of TOD. Priority will be given to the construction of the large-capacity rapid public passenger transportation corridor connecting the new towns; and along the corridor, the new towns are developed to accomplish the rational urban growth. Priority will be given to the development of public traffic that can meet most of the traffic needs and centered on rail transit.

There are two line networks in the urban rail transit planning of Beijing. One is the subway line network serving the central city and its lines and stations are mainly distributed inside the central city; the other is the suburban railway line network serving the new towns outside the central city and its lines and stations connect the central city and the new towns and between new towns. In terms of planning, the functions of the two networks are clearly specified. The subway line network serve the central city, but considering that Tongzhou, Yizhuang and Daxing New Towns are rather near the central city, some of the subway lines extend toward them. The planning of rail transit networks has laid the foundation for displaying the TOD functions of rail transit for the new towns.
2.4 Concept on TOD Construction of Rail Transit for New Towns in Beijing

Within each of the TOD functions of rail transit inside the new towns will congregate many urban functions and demand large-scale construction and higher intensity of land development, which inevitably requires the compact space layout. But what we intend to explore is how to construct an efficient and agreeable space environment while maintaining the compact layout. In the following, by attempting the development and utilization of underground space within the TOD function scope in the new towns, particularly their central areas, we shall construct the dimensional space environment with the ground and underground development as a whole so as to create the sound and sustainable new towns.

3. OPPORTUNITIES AND PROSPECTS FOR THE DEVELOPMENT AND UTILIZATION OF UNDERGROUND SPACE OF THE NEW TOWNS IN BEIJING

3.1 Motives for Utilization of Underground Space

According to the “BJGUP”, the development objectives of the new towns are “two axes---two belts---multiple centers”. The new towns are the important nodes on the two development belts in the urban space structure and also the political, economic and cultural center of the local regions. They should fully rely on the existing satellite towns and major infrastructure facilities to construct themselves into the sound and relatively independent new towns with perfect functions, beautiful environment, convenient traffic and developed public service facilities. According to this objective, in the construction of new towns, the land use efficiency and the intensive use of land for construction will inevitably be increased, and the development and utilization of underground space is just one of the effective approaches for realizing the intensive use of land for construction.

3.2 Economic Development Level of the New Towns

In 2005, the per capita GDP of Beijing was about US$ 5,680, which was tantamount to the level of middle income countries in the world; and the per capita GDP of most new towns exceeded US$2,000. According to the large-scale development and utilization of the underground space in the developed countries, the stage of rapid development of industrialization is the stage at which the per capita GDP is US$ 1,000-3000 and also the primary stage of large-scale development and utilization of underground space. From the level of economic development, most of the new towns in Beijing have been economically qualified for the primary development and utilization of underground space.

3.3 Planning and Construction of Rail Transit

Beijing is being engaged in a large-scale planning and construction of rail transit. In 2006, Beijing constructed and put into operation 4 urban rail transit lines, (including subway, light rail transit, and Suburb Railway) one of which connects Tongzhou New Town; 5 lines are under construction and will be open to traffic before the 2008 Olympic Games, and one of them connects the Capital International Airport located within Shunyi New Town; it is estimated that 6 lines may be completed in the near future (before 2010) and two of them will connect two new towns, Yizhuang and Daxing; and it is estimated that about 19 lines will be constructed by the year 2020, and more than 10 lines can reach all the 11 new towns. Three or more urban rail transit lines will run through three major new towns. More efforts will be made for the large-scale planning and construction of urban rail transit particularly after the 2008 Olympic Games. In the mid-and long-term periods, the connection between the central city and the new towns will be reinforced and the rail transit will be made the corridor for relaxing the pressure of population in the central city and for driving the development of new towns.
3.4 Advantages in the Development and Utilization of Underground Space of New Towns

Currently, the land use in the new towns of Beijing shows remarkable extensive characteristics. The development and construction are lower in density and smaller in intensity; a great deal of land inside some new towns remains to be the ordinary villages and towns and even the land for non-construction use; the cost for renewing the urban construction is small and the amount of follow-up urban construction caused by urban rail transit is large; within the scope of TOD functions, it is more likely to implement the development of underground space and rail transit lines and stations during the same period; and there is stronger initiative during the initial period of development and utilization of underground space. Besides, there is less amount of building demolish in the railway construction within the new towns; the engineering exerts less influence; and as most of the construction can be conducted on the ground, the price of urban rail projects is low. When the development and utilization of underground space is combined with the construction of rail transit, its own cost of construction will also drop by great margins.

3.5 Possible Patterns of Development and Utilization of Underground Space of New Towns

(1) Patterns of Development and Utilization of Underground Space

According to the foreign experience in the development and construction of underground space, there are mainly four types of development patterns, namely, the “central connection” pattern, the “axis rolling” pattern, the “overall network” pattern and the “sub-focal point” pattern. In accordance with the status quo and planning of the land and traffic in the new towns of Beijing, the “central connection” and “axis rolling” patterns may be copied for reference. The “central connection” pattern refers to the construction of overall run-through underground space in the urban central area and its radiation to all the urban areas through the rapid rail transit. Montreal and Toronto in Canada are most representative of this pattern; the “axis rolling” pattern mainly refers to the construction of the crisscross urban underground complex which develops along the subway lines in a rolling manner. The development and utilization of urban underground space in Japan is most representative of this pattern.

(2) Prospects of Development and Utilization of Underground Space of New Towns in Beijing

With the economic development level, population size and land use scale of the new towns as the basic conditions, in combination with the distribution of rail transit line networks and by taking into consideration the restrictive conditions for construction, the central areas of the new towns in Beijing fall into three categories in terms of their patterns of underground space development and utilization. Category I: within the planning period (by 2020), it is mainly the “axis rolling” pattern; and in the long-term period (after 2020), the “central connection” pattern will be adopted in the public core functional areas of the new towns. This is mainly for three major new towns---Yizhuang, Shunyi, Tongzhou and Daxing besides. The contents of underground space construction may include the underground space development and utilization in the central areas, the main functional areas and the land for construction use within the scope of TOD functions, the construction of comprehensive underground pipe corridor, underground parking lots and the large underground municipal engineering facilities such as water plants and rubbish treatment facilities.

Category II: Through the “axis rolling” pattern, the underground space is developed and constructed along the rail transit line network and stations connecting the new towns. This is mainly for the three new towns with certain construction basis on the plain---Changping and Fangshan. The contents of underground construction may include the underground space development and utilization in the central areas, the main functional areas and the land for construction use within the scope of TOD functions, as well as some large underground municipal engineering infrastructure facilities.

Category III: Through the point-shaped pattern of development and utilization of underground space in some areas, the underground space is moderately developed and utilized. This is mainly for the five
small new towns-Huairou, Miyun, Pinggu, Yanqing and Mentougou, which shoulder the ecological preservation and water source protection. The main contents of underground construction may include the underground space development and utilization in the central areas within the scope of TOD functions.

4. TENTATIVE RESEARCH ON DEVELOPMENT AND UTILIZATION OF THE UNDERGROUND SPACE OF THE COMPREHENSIVE AREA IN FRONT OF THE STATION OF YIZHUANG NEW TOWN

Currently, the detailed regulatory planning of the comprehensive area in front of the Station of Yizhuang New Town is at the stage of discussing the mid-term scheme for land use; and the scheme for the three stops on light railway L2 and its surrounding areas is being collected from all over the world. The authors are participating in the research on the development and utilization of the underground space of this area and have made some preliminary results from analysis and research. In this paper, through the analysis of the case, i.e. the comprehensive area in front of the Station of Yizhuang New Town and in combination with the TOD functions of rail transit, we seek to tentatively probe into the patterns of developing and utilizing the underground space of the new town in Beijing, particularly their central areas.

4.1 The Importance of Development and Utilization of the Underground Space of the Comprehensive Area in front of the Station

As one of the key new towns to be developed in Beijing, Yizhuang is an important node on the Beijing-Tianjin urban corridor and industrial belt. With its solid foundation for high-technology industry and advanced manufacturing, Yizhuang will be the regional industrial center for radiating and driving the industrial development of Beijing-Tianjin urban corridor in the future. The hub station of Yizhuang represents the comprehensive change hub for Beijing-Tianjin inter-city railway, light railway Line 2 (connecting the central city with Yizhuang), suburban railway Line S6 (connecting 8 new towns to the east and south) and the ground public traffic. As the gateway of the new town oriented to the regional and eastern development belt, the comprehensive area (ca. 18 km²) in front of the hub station is the most important image area of the new towns and will be important area for accomplishing the objectives set for the new towns. During the planning period, with the rapid economic and social development, the development and construction of ground space and the operation of light railway L2 will certainly bring along the development and construction of the underground space around the subway stops. To avoid the isolation of underground space and disorderly development, we should lay down the rational planning of underground space and promote the coordinated development of ground and underground space so as to lay a sound foundation for the sustainable development and construction of this area.

4.2 Research on the Patterns of Development and Utilization of Underground Space of the Comprehensive Area in front of the Station

Through the comparison and analysis of the characteristics of the underground space development and utilization patterns and the advanced domestic and foreign cases, it is primarily assumed that, within the period of planning (by 2020) for the underground space of the comprehensive area in front of the station, the pattern will be mainly the “axis rolling” pattern, and in the long-term period (after 2020), the “central connection” pattern will be adopted in the core areas for public buildings. The underground space system will cover lots of function patterns such as business, culture and entertainment, office, catering, service and parking. Within the planning period, it is assumed that, in combination with the construction of overall municipal pipe corridor and the running rail lines, the underground space complex (underground vehicle-free street) is planned and set to connect the Yizhuang Station and the Ciqu Station, and the
three main-body structures are constructed as a whole during the same period. With the underground vehicle-free street as the axis and with the areas surrounding Yizhuang Station and Ciqu Station as the key areas, the plane layout of underground space featuring “two areas and one axis” is formulated.

During the long-term period, the underground space may form the plane layout featuring “one core, two areas and one axis”, that is, with the underground space for comprehensive development of multiple functions at the local public central area, with the underground space surrounding Yizhuang Station as the area for bringing along development and that surrounding Faqu Station as the area for supplementing development (two areas), and with the underground space extending along light railway L2 as the development axis (one axis), the system of development and utilization of underground space at the comprehensive area in front of the station can take shape by connecting “one axis” with “one core” and “two areas”.

5. CONCLUSION

The development and utilization of the new towns in Beijing, particularly the underground space of their central areas is mainly distributed within the scope of TOD functions. Its great dependence on TOD, the uncertainty of TOD implementation, the sufficient land supply within a short period and the lack of guidance of relevant regulations and policies and other factors will all result in inadequate motive for development and utilization of underground space. If the development and utilization of the underground space of the new towns fully rely on the spontaneous market activities, the construction will certainly lag behind and also make it less possible to launch the compound development of the land along the rails and the compact development of ground and underground space, which, to a certain extent, will impact the accomplishment of the objective of sound and sustainable development of the new towns. However, if the government imposes too much interference and the underground space is excessive developed, there may cause huge waste and management burden. Therefore, it is of crucial importance to reasonably control the time and order of the development and utilization of underground space of the new towns.

REFERENCES