Development and Utilization of Urban Underground Space

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Abstract. As the human society constantly develops, people have started to study the development and utilization of urban underground space. Compared with the past, great changes have happened in the contemporary era when it comes to the use of resources in urban underground space and related technologies. The development of urban underground space is susceptible to many factors, and unreasonable utilization leads to serious consequences. The vigorous development of urban underground space is not only a very important criterion for measuring the level of urban modernization, but also an inevitable trend of urban development. This paper analyzes the current development and utilization of urban underground space, describes the significance of development and utilization, and studies the problems in development and utilization of urban underground space and corresponding countermeasures.

1. Introduction
For a planning area of a city, the part beneath the ground surface is the underground space of the city. With the improvement of people's living standard, more and more people swarm into the city, resulting in an increasingly higher demand of the floor space. To better adapt to the continuous development of modern society, the three-dimensional space should be fully utilized, and underground space is one of the most important directions to expansion. As an important part of urban space, urban underground space has huge development potential. Nowadays, many cities lack enough awareness of the importance of underground space. They either rarely exploit underground space or lack the planned development and utilization of underground space. Even though some cities have used underground space, they utilize it in a disorder manner because of lacking specific laws. In order to better promote the faster and better development of the city, it is necessary to rationally plan and utilize urban underground space, continuously expand the utilization scale of the urban underground space, and develop it in a planned way.

2. Current Development and Utilization of Urban Underground Space
Internationally, issues on the development and utilization of urban underground space were put forward as early as in the 1980s. Some scientists once predicted that one third of the world's population will live underground in the 21st century, indicating that the development and utilization of urban underground space has become an important indicator of whether a city is developed or not. Currently, cities around the world that have effectively developed and utilized underground space are Paris in France, Tokyo in Japan, New York in the US and Montreal in Canada, etc. With forward thinking, these cities have efficiently constructed and utilized their underground space through continuous development. For example, building facilities such as underground downtown streets, cinemas, large reservoirs and large urban complexes are quite complete in these cities, with areas of...
development and utilization reaching a certain scale. With the continuous economic development in recent years, China’s scale of urban construction has been constantly expanded and the level of urbanization has been continuously improved. Nevertheless, as construction land decrease, traffic is becoming increasingly congested, and the environmental quality is declining. China is facing increasingly huge pressure in various aspects. Thus, more attention has been paid to the development and utilization of urban underground space. Through the continuous development in recent years, first-tier cities in China have made gradual progresses in the utilization of underground space. For instance, China takes its place in the front ranks of the world when it comes to the construction of subways. Facilities like underground parking lots, shopping centers, entertainment venues, reservoirs and various pipelines have also been put into use. Since China started late in the utilization of urban underground space, it has not yet formed a certain scale in developing underground space. So we still need to learn from developed foreign cities in terms of urban planning and design.

3. **Significance of Development and Utilization of Urban Underground Space**

3.1. *It is conducive to alleviating the shortage of urban construction land.*
With the continuous deepening of urbanization, the scale of the city is constantly expanding, and the contradiction between the lack of construction land and urban development is becoming increasingly severe. Nevertheless, thanks to the development and utilization of urban underground space, the parking lots, shopping centers and entertainment originally built on the ground are transferred to the underground, which not only saves land resources, but also alleviates the contradiction between people and land, while maintaining the high-standard construction of buildings, keeping the good points of both from the perspective of urban development.

3.2. *It helps relieve traffic congestion and improve environmental quality.*
The economic development will inevitably lead to the improvement of people’s living standards. As the demand for vehicles increases day by day, the cities nowadays are filled with countless vehicles. Although the number of vehicles has increased, the construction of roads and parking lots is far from enough to meet the demand, which will inevitably lead to congestion. Besides, the excessive discharge of exhaust gas has caused great pollution to the air. However, by making use of urban underground space to build parking lots or develop public transportation such as subways, urban congestion has been eased, exhaust gas emission has been reduced, and air pollution has been alleviated. In addition, the original construction land is used to build parks, which can increase the greening area, build up environmental quality and improve people’s quality of life, playing a huge role in promoting the construction of livable cities.

3.3. *It is beneficial to the construction of urban air defense systems.*
Urban underground space in China was first developed for air defense and evacuation, and the transfer of personnel and materials during wartime. Nowadays, urban underground space is comprehensively utilized for the laying of hydropower pipelines as well as the construction of facilities for supplying food and medical supplies, which has greatly improved the security of urban air defense.

3.4. *It contributes to reducing energy consumption.*
Compared with the above-ground buildings, the urban underground space is poorly ventilated because it is a relatively closed space. Therefore, without a big temperature difference, it is warm in winter and cool in summer underground, which saves power resources and to some extent alleviates the power shortage during the peak period.
4. Problems and Countermeasures of Development and Utilization of Urban Underground Space

4.1. The development and utilization of urban underground space lacks scientific and comprehensive planning.
Currently, the underground space in most Chinese cities is developed for both air defense and urban construction. This policy has certain limitations, for it does not classify underground space as a resource for urban development and construction, which cannot adapt to the need of the currently comprehensive development and utilization of urban underground space for policy. The use of underground space is irreversible and the underground space will not be restored once it is developed and utilized. In view of this situation, the development and utilization of urban underground space must be incorporated into the overall planning for the long-term development of the city, so as to carry out scientific development and utilization, and avoid destroying and wasting land resources.

4.2. There are no specific laws and regulations to regulate the development of urban underground space.
In the current stage, the state’s laws and regulations on the development and utilization of urban underground space have not clearly defined the ownership of urban underground building facilities, especially when it comes to the underground buildings that have been transferred. Therefore, it is extremely urgent to complete laws and regulations on development and utilization of urban underground space. Based on the specific national conditions as well as the laws and regulations of developed foreign countries, China should formulate laws and regulations to match the development and utilization of urban underground space, and especially define the ownership of underground space, so that the development and utilization of urban underground space can have laws and regulations to go by.

5. Conclusion
By reasonably developing and utilizing urban underground space, land resources can be rationally saved, the utilization efficiency of the land can be effectively improved, and the traffic pressure can be alleviated. Efficient development and utilization of urban underground space can improve the ecological environment of the city, greatly reduce urban pollution, maintain the historical and cultural landscape of the city, effectively increase the green area of the city, and expand the capacity of the infrastructure to some extent. A reasonable planning of urban underground space can not only accelerate the development process of the city, but also improve the economic and social benefits of the city. Hence, urban underground space must be well developed and utilized so that the city can achieve faster and better development.

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