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# Development of urban public spaces using urban underground spaces: a new method to improve quality of life (QOL) in Tehran metropolis

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**Abstract.** Once Tehran was an enchanting city garden with abundant green lands at Alborz mountain range. Now it has changed into a metropolis with many problems as a result of losing a lot of gardens, farms, and green spaces. Tehran is the capital of Iran with a population around 13 million people daytime and 8.5 million people night-time. Its area is about 730 square kilometres and in terms of population density, it is ranked 25th in the list of most populous cities. Due to the lack of public spaces required, Tehran metropolis has faced serious challenges to create a sense of life satisfaction in the residents. Due to population density and numerous amount of mass housing and high land prices, the development of public spaces required by the city has become more difficult. Therefore, one of the ways to develop such spaces is to use underground surfaces and combine them with existing surfaces on the ground. How to properly correlate and interact between the development of urban public spaces, urban underground spaces and improving Tehran metropolis citizens' quality of life and provide solutions for it, is the main issue of this research.

## 1. Introduction

Most of the settlements chosen by humans were in fertile areas. Then, with the population growth and need of more diverse spaces, cities were formed with the maximum combination with natural spaces. It seems that this stage of population growth and urbanization has been the best combination of urban spaces and urban life. But afterwards, due to the need for more spaces, most of these cities are affected by their residents and encountered with increasing the density and removing or reducing natural elements. This rapid growth trend, especially in recent decades, has led many residents of metropolises in the world to feel totally exhausted to continue their lives in cities and many of them have fled to the suburbs to escape from those conditions or spend their lives commuting between the city and the suburbs. In recent decades, Tehran city has uncontrollably become one of the metropolises that has lost its Bagh-shahr (city garden) identity by turning green spaces and gardens into office and residential towers. Now the appropriate quality of space for an urban life with the correct interaction between man and urban nature can be found only in some neighbourhoods of Tehran.

According to such a critical situation, these questions then arise, "what will be the future of this metropolis and its inhabitants?", "Is it possible to hope for a bright future to a good life in this city by



ignoring the mistakes that had been made in the development of this metropolis?”, “Is it possible to imagine that there are still solutions to improve urban living conditions?”

Although urban management in Tehran has had significant achievements, such as the construction of highways, the development of underground roads, the construction of grade-separated intersections and the development of public transportations, but the measures taken and the rapid development of the city have created serious restrictions on urban public spaces, and also have significantly reduced the environmental indicators of human habitats. This crisis which often occurs due to factors such as inter-organizational incompatibilities, policies related to neighbouring geographical territories, political attitudes and incoherent management programs, severely reduces the Citizens' quality of life and sense of life satisfaction in metropolises [1].

How to properly correlate and interact between the development of urban public spaces, urban underground spaces and improving Tehran metropolis citizens' quality of life and provide solutions for it, is the main issue of this research.

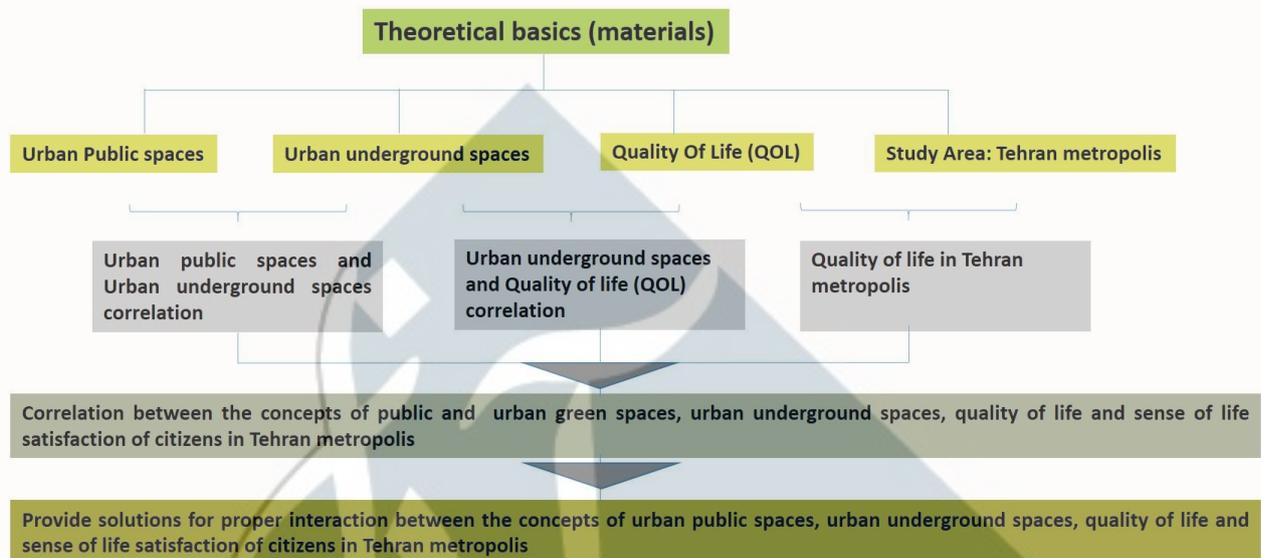
In this paper, the descriptive-analytical research method is used. Observation method (primary data collection method) and Library research method (secondary data collection method) have been used as data collection methods.

## **2. Theoretical Framework and Research Hypotheses**

The simplest hypothesis for the development of public green spaces is the demolition of some buildings and their conversion into green spaces, but in practice this premise can create the most complex problems of urban management. With the increase in property prices in Tehran, the purchase and seizure of personal properties by the municipality is an issue that can only be considered in very specific circumstances and the huge costs of this method prevent its realization. On the other hand, the metropolis of greater Tehran has been developed in an unbridled manner and has been considered as one of the most important metropolises in the world only in recent decades. Therefore, in addition to proper planning for the development of urban spaces, urban management officials must take effective actions to improve the quantity and quality of the construction of existing urban public spaces. In this regard, it is important to find appropriate solutions that are coordinated with the structure of the city and the lifestyle of citizens. Due to the increase in the number of public parks and open urban spaces in recent years in Iran, more attention has been paid to the expansion of urban public spaces, but still the impact of measures taken in this direction has not been sufficient, for instance, Tehran metropolitan squares have become places for vehicular traffic. The most important factors that hinder the development of urban public spaces replacing existing buildings include high population density, high land prices, the officials' concern about changes in local contexts and managing the settlements of displaced residents due to these changes [2].

Another hypothesis for the development of urban public spaces is the use of lower levels of land in combination with existing spaces on the ground, which seems to be an efficient method without the need to destroy large parts of public spaces in the city.

In the following, the relationship between the theoretical parts of the article and the process of reaching the solutions are shown in figure 1.



**Figure 1.** Theoretical sections correlation diagram  
The process of achieving research results based on theoretical concepts

### 3. Materials and Methods

In this paper, the descriptive-analytical research method is used. Observation method (primary data collection method) and Library research method (secondary data collection method) have been used as data collection methods. In the following, the explanation of basic concepts, their development and their relationship with each other have been studied and reviewed.

#### 4. Urban Public spaces

Urban public spaces, in addition to affecting the quality of life of residents, are considered to be the important infrastructures in democratic societies that affect their social, political and cultural arenas [3]. In Tehran metropolis some efforts have been made to develop such spaces. Some positive results of these efforts include increasing people's interactions through the development of public cultural and recreational places, the development of universities and educational environments, the expansion of industries and factories, creating job opportunities and also facilitating traffic through the construction of highways and tunnels [2].

In figure 2, the development of urban public spaces in Tehran metropolis streets is shown, which occurred from 1926 until now. In this picture, the photos in hand display the situation of places in old Tehran that are signs of urban development in this metropolis.



**Figure 2.** Development of urban public spaces in Tehran metropolis streets from 1926 until now

However, many areas of Tehran still don't have sufficient urban facilities and public spaces needed by citizens [4].

In the field of green space management and urban public spaces, the study of experiences and environmental management strategies of other countries at the international level is important. In this regard, the study of the principles of urban environmental management, integrated urban management systems in accordance with successful management models in successful metropolises in this field, including New York, Toronto, Amsterdam, Johannesburg, Istanbul and Dubai, which won the special award "Safe City" can be very efficient and useful. One of the main reasons for the success of these metropolises in this field is the integrated management of all matters related to the protection of public spaces and the urban environment in the form of government duties and under the direct supervision of the government. Major strategies and planning in the field of urban environmental protection are carried out according to the highest organ of urban management's opinion, namely the city council. In this regard, the important action of mayors is to pay attention to improve the education of citizens and encourage them to participate in urban environmental protection programs [1].

## 5. Urban underground spaces

From the past to the present, the native architects of Iran in different regions of the country with different climates, have had many innovations with different goals such as compatibility with nature, facilitation of travel, providing security goals, storage of food needed in different seasons and managing and supplying the water needed to improve the quality of life of residents. Parts of these spaces are built underground if needed. The use of depth of earth in the native underground architecture of Iran has many examples and applications. These include underground spaces in the hot and dry regions of Iran, glaciers, aqueducts, Qanats<sup>1</sup>, reservoirs, various underground tunnels and sunken courtyards.

Other efficient underground spaces that are used to facilitate intra-city communication and transportation in different parts of Iran are various types of underground tunnels. Among the underground structures in Tehran metropolis, which have been constructed with the aim of facilitating the communication needs and the mobility of citizens, we can mention the Tohid intercity tunnel. Tohid Tunnel, which is an important underground communication structure in Tehran metropolis, includes several tunnels and entrance ramps. This space has provided an acceptable environmental space for

<sup>1</sup> Qanat: Iranian underground aqueducts to supply water

Tehran metropolis by facilitating the movement of vehicles, smoothing traffic in the area, creating a proper communication space between different parts of the area, facilitating and accelerating daily affairs by providing easier access to the places needed by residents, and reducing private cars traffic in the area which all result into fuel saving. The construction of this intercity tunnel since 2009 has made Tehran metropolis as one of the 5 cities with fast bus transportation service in the world [5].

Other important urban underground spaces include subway stations and Transit-oriented development (TOD)<sup>2</sup>. The transit-oriented development, which is located within a quarter to 1.5 mile from train or tram stations or subway entrances, is in fact a mixed-use commercial-residential area. By exploiting the underground potentials of cities, such spaces help to solve public urban problems such as lack of urban public spaces, inefficient transportation problems, and increase of surface air pollution caused by the passage of vehicles [4].

Some examples of the most widely used urban underground spaces in Tehran Province (from the past until present) are shown in figure 3.



**Figure 3.** Some examples of the most widely used urban underground spaces in Tehran city from the past until present (Figures from left to right: Haji mirza aqasi Qanat (old Tehran underground aqueduct), Seyed Esmaeal Ab anbar (water reservoirs), Tohid intercity tunnel, Valiasr subway system (public transportation), urban plaza in Valiasr square).

## 6. Urban public spaces and urban underground spaces correlation

In recent decades, urban underground spaces and structures have been created for public use with the aim of facilitating communication and transportation needs in Tehran metropolis. In addition to facilitating urban travels, development of urban spaces based on public transportation such as metro and TOD system, can improve the quality of life of citizens in metropolitans by creating opportunities for interaction in public spaces and meeting some daily needs through commercial spaces in stations.

The development of such spaces provides a good opportunity to organize and integrate communication between different parts of the city. In this case, in addition to meeting this basic need, open spaces can also be used for other public facilities with the aim of preserving the urban environment. In fact, with this action, safe and suitable commercial and cultural spaces are provided underground and public urban green spaces for the use of pedestrians are located on the ground [2].

## 7. Improving quality of life (QOL)<sup>3</sup>

Quality Of life (QOL), which refers to people's awareness of their living conditions, has received more attention in urban studies in recent years. Given the multidimensional nature of QOL, this issue has recently been carefully studied in various fields of sociology, geography, economics and environment. To study the quality of life parameter, objective and subjective approaches have been used, which are called objective and perceptual perspectives. According to some sources, there is no uniform standard for selecting quality of life indicators, but all selected indicators should be common to the following: Assist officials and planners in assessing current issues and future urban development; Be valid, Simple,

<sup>2</sup> TOD (Transit-Oriented Development): A type of urban development that maximizes the amount of residential, business and leisure space within walking distance of public transport

<sup>3</sup> QOL (Quality Of Life): The general well-being of individuals and societies, outlining negative and positive features of life that consists of the expectations of an individual or society for a good life

tangible and practical; Have a clear, practical and functional purpose; Be relevant and consistent with the chosen neighbourhood [6]. To determine the quality of life indicators in each neighbourhood, it is helpful to assess the factors related to the citizens' sense of life satisfaction [7]. Life satisfaction reflects a person's overall assessment of living conditions and includes various dimensions, including socio-demographic characteristics, psychological contexts, and life experience [7].

In addition, the results of previous studies show that there is a direct relationship between feeling safe and life satisfaction [8]. In this regard, in recent years, a new approach to "Crime Prevention through Environmental Design" called CPTED<sup>4</sup>, focusing on urban design, controls and evaluates the development of urban construction. According to this new approach, space engineering factors and their impact on reducing the amount of urbanization, and also, the impact of spaces on the incidence of crime in them have been considered in urban management and planning [9]. Although crime is more likely to occur in underground spaces, with some precautions, this problem can be prevented. Obviously, by determining the design criteria for each subject and plan, reducing or eliminating the occurrence of crime can be predicted and prevented.

The importance of examining the quality of life in different communities stems from the lack of proper understanding of the real needs of citizens by planners and urban management officials. In fact, measuring the level of support of community leaders for the welfare and sense of satisfaction of citizens is the main issue of studying the quality of life in cities. Therefore, according to the results of measuring this parameter in any society, the correct allocation of budgets and urban development programs by the authorities can be evaluated. In order to accurately understand and evaluate the various aspects of this parameter, it is very important for the authorities to recognize the various factors related to the citizens' sense of satisfaction of life [6].

## **8. Urban underground spaces and Quality of life (QOL) correlation**

The relationship between the concept of quality of life and its relationship with the development of urban and underground public spaces in Tehran metropolis is one of the most important issues, which is one of the main concerns of city managers in developed metropolises. Environmental pollution, air pollution, noise pollution, and spending many hours of the day in heavy traffic are among the tensions in metropolitan areas. In addition to these daily urban tensions, some factors including social problems and family conflicts, increasing urban delinquency, increasing mortality rates, and youth problems can reduce life satisfaction, and due to imposing heavy costs on citizens of metropolitan areas, their quality of life is severely reduced [5]. In recent decades, rapid population growth and consequently the need for rapid development of urban public spaces in the metropolis of Tehran, leads to increased daily traffic, increased costs, energy loss, increased environmental pollution and other issues mentioned above. In these critical conditions, the development of part of public spaces in the form of underground spaces will improve the qualitative and quantitative level of urban development by controlling the order, reducing congestion and environmental pollution, and facilitating urban transportation especially in crowded areas of Tehran. Thus, in addition to creating environmental order and peace of mind, the quality of life will improve by maintaining and developing green spaces in open urban spaces.

## **9. Study Area: Tehran metropolitan**

### **Tehran Structural and Environmental Development**

Tehran is the capital of Iran, in the province of Tehran, which is located in the northern part of Iran and in the southern foothills of the Alborz Mountains. Tehran metropolis with a population of more than 8 million people in the central part of Tehran province, is the twenty-fifth most populous city in the world. The area of Tehran is 730 km<sup>2</sup> and it is one of the largest cities in West Asia, which is ranked 27th in the ranking of major cities in the world. Tehran's population density is estimated between 10,700 and

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<sup>4</sup> CPTED (Crime Prevention through Environmental Design): The Impact of Environmental Design on Predicting and Preventing Crime

11,000 people per square metre. The results of studies on environmental sustainability and the ecological footprint index, which is the most efficient tool for measuring the progress of communities, show that the population growth of the metropolis of Tehran and the ecological footprint index are increasing. During five years (for example, from 2006 to 2011), the population of Tehran has increased by 5% and the ecological footprint index has increased by 22% [10].

The city of Tehran has 22 municipal districts, each of which has its own socio-economic characteristics [6]. Despite the development of facilities in the metropolis of Tehran, due to lack of coherent urban management, citizens cannot establish a deep connection with these facilities. Unbalanced population dispersion in some areas and difficult access to some needed places, high costs and heavy traffic in the city, prevent the full use of the existing potentials in this metropolis [2]. Lack of city officials' accurate and continuous knowledge about citizens' requirements in each area, will prevent the proper provision and optimal use of urban development facilities. In recent decades, due to the changes in the lifestyle of citizens and as a result of changes in their needs, it is very important to investigate the possible damage caused by these changes in order to complete and adjust the urban development system. In this regard, paying attention to the preservation of some historical and valuable urban contexts is one of the important points that should not be ignored or damaged by urban development programs [9].

According to the reports on "Tehran environment situation", using the DPSIR<sup>5</sup> model (Driving forces, Pressures, States, Impacts and Responses) - which shows the correlation of environmental components and their interactions - this metropolis is one of the leading cities in the preparation of SoE<sup>6</sup> (State of the Environment) [1]. Some examples of the view of Tehran and its structure from 1865 to 2020 are shown in figure 4.



**Figure 4.** Tehran city from 1865 to 2020

### 10. Quality of life in Tehran metropolis

Tehran metropolis has 22 districts and different functions of these areas are under supervision of several government organizations. This diversity of supervision makes it difficult to create a coherent management plan in the metropolis of Tehran. Also, the lack of proper and coordinated interactions between city managers and citizens, has prevented foresight in accurately identifying and planning the

<sup>5</sup> DPSIR (Driving forces, Pressures, States, Impacts and Responses): A model shows the correlation of environmental components and their interactions

<sup>6</sup> SoE (State of the Environment): The term normally relates to an analysis of trends in the environment of a particular place which can encompass aspects such as water quality, air quality, land use, ecosystem health and function, along with social and cultural matters

basic and long-term needs and sub-needs of residents. Furthermore, deficiency of a fixed budget allocated to municipalities leads to irrational actions by this organization to provide the desired budget, including the issuance of permits for unauthorized congestion and construction in restricted areas, all of which will lead to the destruction of the natural environment [1]. As a result of such measures, despite the development of urban facilities in recent decades, the sense of life satisfaction of citizens has decreased with a reduction in quality of life. Creating a sense of security, peace and belonging to the citizens is effective and it helps to strengthen the components of improving the quality of life in society.

### **11. The concepts of public and urban green spaces, urban underground spaces, quality of life and sense of life satisfaction of citizens in Tehran metropolis correlation**

Now, Tehran city is seriously facing with deficiency of green space, which leads to a shortage of adequate oxygen, air pollution and reduced quality of life, adverse results that will affect the mind and body of the citizen. Environmental pollution has a great and significant effect on increasing mortality due to respiratory diseases in the metropolis of Tehran. In this regard, the development of urban green spaces will have a great impact on reducing air pollution and consequently reducing physical, respiratory and mental diseases. Green spaces are among the important elements of providing public comfort in urban environments and creating green ecosystems in metropolises can greatly help to promote mental and physical health and ultimately improve the quality of life [11]. Therefore, in addition to developing the required urban public spaces, including commercial spaces, service spaces (such as cinemas, parking lots and sidewalks), urban management planners should also develop urban green spaces in the form of parks and open spaces for training including aerobics, outdoor playgrounds, and urban green landscapes. As a result, such measures will be provided for the citizens of Tehran metropolis by expanding social relations and making daily life more dynamic, sustainable urban life and development along with high quality of life [2].

To achieve these positive consequences and due to the growth of population density and the growing need for the development of other urban spaces in the metropolis of Tehran, the development of underground spaces is an effective modern solution in urban development. Adequate attention to this issue can help improving the quality of life, especially in dense and crowded areas of Tehran. High land prices, vertical development of cities, abundance of harmful environmental pollutants on the ground; All of these influential factors prove the importance of creating underground spaces through proper urban planning and management, and acts as an untapped and very efficient potential in improving the quality of life of citizens in the metropolis of Tehran [4].

### **12. Discussion**

According to the results of this research and based on the hypotheses presented in it, some solutions for correct and efficient interaction between maintaining and developing urban public spaces, urban underground spaces and improving the quality of life index are presented as follows:

- Combine the lower levels of the earth with surfaces on the ground to develop urban public spaces
- Due to no restrictions on use of depth and dimension of underground spaces and also no allocation of municipal taxes to such spaces, contrary to the very heavy municipal fees allocated to the construction of buildings on the ground, urban development and construction of public spaces in underground spaces should be preferred to urban spaces on the ground
- Land price control, proper monitoring of vertical development of cities, controlling environmental pollutants and improving the protection of the urban environment, which, together with the planning and psychological management of citizens, act as key measures in improving the quality of life.
- Accurate and coherent regulation of goals and macro-plans of urban management in controlling the development of public urban spaces and underground urban spaces.
- Purposeful and continuous interaction of urban management officials and citizens with the aim of correctly identifying the main and secondary needs of life and improving the quality of urban life and the sense of public satisfaction of citizens.

- Attention of urban managers in metropolises to the development of efficient underground urban spaces such as TOD system, car and pedestrian communication tunnels, and underground recreational-cultural spaces with high attractiveness and good ventilation, can improve the quality of life and urban environmental protection by addressing basic or everyday needs and shortcomings.

In line with the above extraction and inferential solutions, It should be noted that the government of Iran in the sixth development plan of the country has put some actions on its agenda during the years 2016 to 2021, which can also help to advance some of the above solutions. This program includes several main areas. The discussion between the government and the UN country group on development opportunities and challenges in the context of Iran's development priorities focuses on these areas: Development of resistance economy, advancement of science and technology, cultural promotion, protection of urban environment and health.

The state of the environment is a global concern. Economic development has often come at a high environmental cost and the world today has come to the conclusion that sustainable economic development is highly dependent on the protection of key environmental assets. Iran faces acute environmental challenges due to its arid climate, rapid urbanization, and widespread economic reliance on oil and gas production. Current climate change is expected to exacerbate many of Iran's challenges. In addition, the current volume of energy consumption in the country and per capita levels of carbon dioxide emissions are among the highest in the world that the widespread use of urban outdoor vehicles is an important factor in increasing it; especially the metropolis of Tehran has suffered from high environmental pollution. This factor ultimately leads to an increase in the destruction of urban green spaces, or at least, higher costs for its maintenance. In this regard, the government's strategy is to make the country's economy independent of carbon products and reduce the use of carbon in order to improve energy efficiency in residential, industrial and urban transportation systems. Also, the transfer of a large part of the transportation system to the underground and the creation of standard and principled arrangements related to the design of such underground spaces have been considered very useful in this regard. In addition, the country is interested in continuing to develop and implement basic programs and policies for adaptation to climate changes, which will help it to reduce the negative effects of such changes on the economy and social welfare, as well as taking the advantages of new opportunities.

Moreover, in the field of promoting physical and mental health and as a result of improving the quality of life in metropolitan areas, with regard to the population of the elderly and people with disabilities in the country and the priority of fair use of all segments of urban public services, the optimal response to the healthy living needs of these special groups is also one of the main concerns of the government. In this regard, actions have been taken to facilitate the movement and use of urban facilities by this group in open and underground public spaces. Preparation of some solutions for standardization of spaces for this group, including changing floor materials in high-risk areas, braille lines, ramps and escalators has been done, but still there is a need for progress and development of these measures on a larger scale.

### **13. Conclusion**

The urban environment consists of conditions that should provide the bedrock of mental health, physical comfort and ultimately improving the quality of life of its residents. Protecting the urban environment and observing sustainability indicators in urban development are some of the most basic needs of urban society and, consequently, the most important tasks of urban managers. Any lack of planning in any part of the development of urban management, especially in metropolitan areas, will cause confusion and a decline in the citizens' quality of life [1].

Due to the high population density in the metropolis of Tehran and the definite need for the development of urban spaces, attention to the preservation of public green spaces and its non-destruction due to the development of urban construction is considered a very important issue. Further destruction of public green space over time will reduce the mood of citizens and will not meet their basic needs and can lead to a decline in the quality of urban life. Some part of the required urban public spaces (such as communication spaces and pedestrian crossings, some gathering spaces, metro and TOD spaces,

intercity tunnels, public parking, warehouses and some low-consumption spaces) should be created underground.

In addition, in order to increase the sense of life satisfaction in citizens and facilitate their daily communication and travel, and create a suitable mood and psychological atmosphere for them, quality of life improvement (QOL) factors should be considered and evaluated by urban management officials with higher priority. Therefore, feasibility studies and accurate urban planning to identify and determine appropriate and efficient underground applications in each area should be done under the close supervision and control of urban management officials. Especially in strategic urban areas, the importance of selecting and creating efficient and proportionate underground spaces increases significantly due to the high population density in such areas and the importance of stability of security and public order in them.

Also, it is possible to develop urban public spaces underground and public and open urban green spaces on the ground by developing underground spaces which have lower costs compare to constructing on the ground in the metropolis of Tehran. In addition, in order to implement any efficient development plan in each region, in the first step, local and regional studies should be done separately and specifically according to that plan; In the next step, with a wider perspective, studies should be done on the relationship between underground development plans in different urban areas, and in the final step, by using a comprehensive plan, the coherence and integration of the plans of all areas should be done, in order to achieve an accurate and efficient urban development plan in the metropolis.

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