Incorporating Underground Space in Urban Planning

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ABSTRACT

The general spirit of sustainable development that determines modern world’s choices gives an impulse to the development of underground structures and calls for a different kind of urban development that will be away from every horizontal sprawl or multi-storey construction. Within the bounds of that kind of planning it is very important to notice the value of compact city which is combined with numerous anticipations for the upgrading of urban environment, and as a result, underground space which is introduced in urban planning comes into sight as the most sustainable solution. Successful incorporation of Athens’ underground space into urban planning depends on successful correspondence between the current analysis of the latest developments and the alternative perspectives of development as well as between different sections of strategic issues and the general guidelines for coping with the upcoming problems. What is called for is the creation of new standards that will reverse the priorities from the structured environment to the unstructured one and from the highly exploited aboveground space to the limitedly exploited subsurface.

1. INTRODUCTION

In the past years, the majority of conceptions concerning urban planning were based on the idea of city and nature being in harmonious co-existence. These ideas were highly approved but their implementations contributed to the creation of the current urban problems. Thus, in the 21st century, the gigantism of urban complexes and their shapeless expansion towards the suburban and rural space (megacities), the intensity of the environmental and social problems as well as the downgrading of life’s quality and productivity demonstrate that the standard methods of urban planning are not sufficient enough. The contradiction between the intentions and their results establish that there are too many obstacles concerning both the model of economic growth, which is unrelated to the protection of the environment, and the difficulty in foreseeing the consequences of different activities taking place in the urban environment. The acknowledgement and the confrontation of these obstacles create the necessity of a different kind of planning.

Sustainable development came to the fore as a global wish in order to deal with the continuous environmental downgrading and the exhaustion of natural resources, two facts that constitute the contemporary environmental problem. The cities’ functions are combined with the rational usage of natural and anthropogenic resources, while the cities’ dysfunctions are combined with the overuse and unfair distribution of these resources, one of which is the space itself. Space is a natural resource of great value, which is indispensable to human activities. However, it can be easily introduced to the consumption policy through the procedure of urbanization and for this reason a very careful management is demanded. It is very important to notice that the average urban population of the 100 biggest cities in the world, together, increased from 200,000 in the year 1800 to 5.1 million in 1990 and in 7.2 million in 2002. (Besner, 2002). The United Nations Organization (UNO) and all the other global Organizations lay peculiar emphasis on the cities where more than 10 million people live and are known as Megacities. Even though there were only 19 Megacities in the year 2001, it is estimated
that there will be about 60 in 2015 and that most of them will emerge in the developing countries. This current trend is expected to be continued in the future. Thus, it is estimated that in the year 2030 more than 4.9 billion people will live in cities and this number corresponds to the 60% of the total estimated population in earth. (Parker, 2004). This new type of urbanization which is called “metropolisation” is the most powerful driving force for the development of underground structures. During the next decades a huge urban expansion will be observed in the developing countries, so it is clear that the underground space will become essential to their sustainable development. Unfortunately, this perception is the corollary of the serious problems that the Megacities (like Tokyo, Bombay, Delhi, Mexico, Sao Paolo, etc) face today and not a result of valuating certain policies of development being continuously followed. Moreover, it is already understood that the previous efforts at supporting rural regions, mainly through subsidizing rural activities, are not right because they do not give a complete answer to the perspective of rural space development. Nowadays, rural space must be faced as a part of the whole society and not as a part of the non real “rural society”. Its future must be combined with that of urban space and it is obvious that cities must be transformed into a “circular ecological system” which will restore the balance between the inflow of environmental resources and the urban outflows.

![Fig. 1. The model of “circular city”.](image)

2. UNDERGROUND DEVELOPMENT, THE CORNER-STONE OF PLANNING COMPACT CITIES

Contrary to what city planners believed in the early 20th century, the sparsely structured city which was proposed as the answer to the problems created by the intensive multi-storey construction (traffic jams, illegal parking, limited space for public use and most of all the non functional planning of different urban factors) is responsible to a great extent for many other problems with those of the natural environment overshadowing all. The gigantism of urban complexes leads to an uncontrolled urban expansion without any traces of planning. Moreover, it increases transportation time, infrastructure expenses and energy consumption, while at the same time suburban space is rapidly consumed.

The continuously increasing demands for the development of structures together with the necessity of keeping the environment to high standards call for a successful incorporating of underground space in urban planning. This planning is extremely important because the degree of freedom offered by the third dimension upward has already been exploited to the highest degree, whereas the third dimension downwards has not received the attention it should have. The principal goal to rapidly solve a problem on the surface was moving it underground under the best financial conditions, fact that demonstrates the lack of substantial planning and a problematic long-standing management. (Parriaux et al, 2004)

Moreover, there are many potentials of using underground space which are not as promoted as tunnels and underground car parks. However, the high density of underground structures coupled with their unplanned placement leads to the overuse of space and their unfair distribution in it results to obligatory construction in greater depths.

Within the bounds of that kind of planning it is very important to notice the value of compact city, the recent so-called connected city which is the current vision of urban planning for many cities, one of
which is Athens. The policy of managing urban planning in Netherlands was based on the concept of compact city with the intention to strengthen the development in the western part of the country, the so-called Randstad, where the larger cities are situated (Amsterdam, Rotterdam, The Hague and Utrecht). In particular, protection of its “Green Heart” against further urbanization has been the main topic. In 1998 a study was conducted examining the possibilities of a more large-scale and systematic use of its underground space and it proved that gains in available space up to 50% in specific areas were feasible. (Monnikhof et al, 1999)

3. THE PROCESS OF INCORPORATING UNDERGROUND SPACE OF A GREAT URBAN COMPLEX LIKE ATHENS IN URBAN PLANNING

The morphology of Athens’ urban complex is a result of certain historical conditions in combination with a lack of ability to implement a local urban planning on account of the already existent chaotic development. As a result it must be understood that any effort to approach Athens’ urban planning must take into account space itself because its availability is limited. The proposed assessment of the existent model of development and the ideas of incorporating Athens’ underground space in urban planning is formulated as follows (Figure 2):

3.1 Preliminary recognition and problem diagnosis

The most significant procedure that must be followed is the recording of all surface and underground land uses, their detailed analysis and the valuation of their special distribution. For this reason, it is very important for the urban standards concerning the essential proportional participation of each function in the city (areas of circulation, habitation, occupation, social functions, public and green areas, utilities) to become opportune. Moreover, new standards must be enacted in cases that they do not exist. The faced difficulties are focused on the fact of limited surface space because the necessary space for each land use per person increases together with the population growth. As a result making exploitation of underground space feasible depends on systematic planning in order to be able to cover all the future needs.

3.2 Decision of taking action and determination of the planning

One first step towards the decision of underground construction is the estimation of all the urban and suburban functions that can be transferred in the underground and their division according to the percentage of surface space gained with their materialization. Furthermore, it is essential to study the interaction between the underground structures and their adjacent ones in order to ensure their harmonious co-existence through satisfying certain qualitative and quantitative criteria.

3.3 Data gathering, analysis and expectations

In this step, the factors of urban planning that are really determinant should be separated from those that aren’t. To this end it is very important to gather all data concerning population as well as the legal regime of construction and ownership. Moreover, the urban complex must be subdivided into unities according to the existent population density and the feasible densities after the systematic use of underground space. As much as transportations are concerned they compose (together with utilities) the land use with the greater possibility of being transferred underground. So, it is essential to study the existent connections between urban areas in their interior as well as with their environs. It is equally important to valuate the existent transportation net based on the prediction of future expected traffic. The problem of parking must be immediately solved through determining the necessary number of parking spaces per region or more precisely per user. Moreover, it is proposed to establish data bases which will record the geological and geotechnical information being obtained in a flexible
and accessible system. Particular attention must be paid on the existence of underground water which may render the construction problematic.

3.4 Intentions and obligations

Preventing the destruction of the natural and anthropogenic environment is the main objective when planning the construction of underground structures. It is clear that their circle of life is of great length and as a result their consequences are permanent. Within the bounds of a general diagnosis of Athens’ problems it is important to notice possible restrictions on construction as regards certain areas. This issue is relative to people’s daily routine and has to do with the determination of influence and safety belts around the installations servicing different urban functions.

3.5 Forming a plan of action or alternative plans

Every plan should be based on the controlled and gradual development of well-matched underground land uses. The idea of an underground structure arises from the combination of certain social needs with technical and environmental data as well as the pursuing targets. It is important to notice that the desirable success of the plan is based on its inventiveness because there are no ready-made solutions and simple transferring of successful patterns demands great attention.

3.6 Examining the alternative plans and evaluating the most suitable plan

The result of examining alternative plans leads to choosing the best one. However, in many cases the proposed solutions presuppose modifications to the principal data through a circular procedure of feedback and the conclusions must be in accordance with the initial construction targets.

3.7 Decision making, implementation of the plan and long-term inspection

After having examined all the previous mentioned factors, the decision maker must end up in feasible proposals based on the effective use of underground structures. A main impediment that underground development must overcome is that of construction cost. Although it may appear increased in accordance with that of surface structures, counting in the external environmental cost in a cost-benefit analysis demonstrates that adopting underground solutions can lead in competitive alternative choices. The implementation of the plan is based on enacted laws and its long-term inspection lies on the fact that preventing the crisis in urban environment requires spherical solutions which correspond to complete planning.
Fig. 2. The process of incorporating underground space in urban planning.

4. CONCLUSIONS

The main driving forces that lead to the solution of underground space are all the estimated improvements in the quality of natural and anthropogenic environment as well as the possibilities of
combining variable functions inside more efficient structures. However, a piecemeal approach to its use does not allow these benefits to be realized and it is evident that underground space will be not able to cover future needs. As a result, variable procedures of incorporating underground space in urban planning should be discussed in detail by urban planners and researchers so that the one integrating both everyday convenience and long-term environmental preservation is followed.

REFERENCES

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