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POSSIBILITIES OF USING THE UNDERGROUND SPACES IN ROMANIA

Summary. Taking into account the new developments of the modern society, the use of the underground spaces represents an important alternative to the sustainable development, due to the fact that these spaces can help to decrease the pressure on land using, as well as, increasing the value of some mineral deposits, which could be used as hosts for waste disposals. The underground waste disposal represents an alternative to sustainable development.

MOŻLIWOŚCI WYKORZYSTANIA PODZIEMNYCH PRZESTRZENI POEKSPLOATACYJNYCH W RUMUNII

Streszczenie. Z analizy tendencji rozwojowych nowoczesnych społeczności wynika, że wykorzystanie podziemnych przestrzeni poeksploatacyjnych stanowi dla nich ważną alternatywę. Przestrzenie te mogą pomagać w zmniejszaniu naprężeń na powierzchni ziemi, jak również powiększają potencjalną ilość materiałów mineralnych deponowanych, które byłyby lokowane na wysypiskach powierzchniowych. Podziemne lokowanie odpadków stanowi alternatywę dla rozwoju hałd.

1. Introduction

The increasing of the world population and the rapid development of the modern society will have a great impact on the human behaviour into the future, based on the improvement of the quality of life, food, energy and mineral consumptions.

Bearing in mind the above mentioned ideas, we have identified three main development directions as:

- Transformation of the agricultural land into the field of industrial use;
- Increase of the number of the people into the urban areas, and
- Rehabilitation of derelict areas and sustainable development of the environment.

Due to the increasing number of people, urban and economic growth, the surface land should support the intensive development of industry and commerce, housing and transportation systems, so the green spaces from agriculture and forestry are decreasing intensely.

2. Land use pressure

The combinations of various factors, such as: politics, economics and history, have created huge problems in land using, in different countries of the world, taking to high land values (unaffordable for most of the people) in some specific urban areas, as well as creating problems in housing transportation and utilities systems.

Besides the above mentioned problems, we would like to emphasize the necessity to preserve and improve the environment, and the continuous actions of the Non-Governmental Organizations, into the field of environment, in order to maintain a certain quality of surrounding green spaces and unpolluted areas.

Having a lot of pressure on the use of the surface land, the underground spaces became an real alternative to the development of the urban activities. These underground spaces offer the possibility to new developments without a further deterioration of the surface environment and ecosystems. Although costs related to the use of underground spaces are usually low or absent, the general costs (including maintenance) are quite high, respective to the similar surface constructions, and in most of the cases they can't be justified, based on aesthetics and social reasons, related to the environment, in developing countries which can't afford it.

It is very clear that the land pressure will lead to two directions, already present in many countries of the world, which are the construction of tall buildings, or the use, on a large scale, of the underground spaces, alternative which seems to be more beneficial in very good & good rock mass or in the case of the reuse of old mine workings.

Taking into account it, is important to plan new underground spaces very carefully. The planning process should be effectively controlled and used to conserve the natural environment, and the secondary impacts, from the development of the underground projects, should be assessed.

The economic planning on the using of the underground spaces should be used prior to large underground projects. This planning should take into account the necessities on long term, and in the same time it should preserve the environment where people live and work.

A principal force on using the underground spaces is represented by the international preoccupation on preserving the environment, which has led to the re-planning of many urban and industrial areas.

The modern society development and the increasing urban areas, has taken to the diminishing of the agricultural and green spaces, which have been substituted by closed spaces of concrete, glass and steel. A major current task is represented by the development in underground of some facilities, in order to protect the surface, and preserve agricultural land and green spaces.

Environment preservation and the longer use of the natural resources, are difficult tasks for the human kind, within the current economic development and life style.

3. Benefits on using the underground spaces

The use of the underground spaces can help to solve, using a judicious planning, the dilemma environment-resources, due to the many physical and economic benefits these spaces can provide.

Although some physical benefits could be measured using costs, other problems such aesthetics should be taken into account in the decision-making process.

We would like to emphasize the most important direct benefits:

- isolation of the underground spaces, due to the rock mass characteristics, which enables the constant temperatures in such spaces, besides the variable temperatures from the surface, thus offering important advantages in the conservation and energy disposal;
- natural protection against some natural disasters , such as: storms, hurricanes, floods, surface fires;
- possibility of the emplacement some facilities in underground, where it is not feasible on surface due to the environmental and economical constraints;
- protection against noises, vibrations, earthquakes and acid rains & fallouts, bearing in mind the fact that thin strata of soil or rock mass could absorb air noises, very important attribute for facilities placed near to extremely noises places, such as railways, highways and airports;

- emplacement in underground of the industrial high technology systems, which requires limited vibrations, and the rock mass could offer such requirements;
- due to isolation properties and limited number of entries, the underground spaces could offer protection against various contaminants, not strictly related to military uses, many industrial activities having high explosive potential or releasing chemical and toxic substances;
- underground structures are less exposed to destructive surface waves from earthquakes;
- limited access in underground and good surveillance, offer protection against thieves and intruders, through inaccessibility and guarded entries, requiring tunnel or underground excavations for unauthorized access, which are time consuming and could be located easily;
- harmful activities can be placed in underground spaces, in order to avoid the deterioration of the surface environment and to reduce the impacts on local communities;
- less visual impact than similar surface structures which is an important factor in case of facilities placement in urban or residential areas;
- use of the underground spaces could prevent degradation of the environment, through protection of the green lands and natural landscapes.

Combining the use of the underground spaces with mining activities, based on a good planning and management, it could be obtained important economic benefits, or the mineral resources exploitation could become economically feasible in condition which normal mining of these mineral deposits would be at the lower limits of profitability.

Other advantages of the underground spaces are derived from the fact that they can be built without constraints from the surface activities.

Economic benefits are related to initial costs and running costs, thus even if, normally, design and construction of underground structures, cost more in certain geomechanics conditions, depending on type and dimensions, could ensure important savings, which could be combined with low costs of lands used for the underground spaces.

The underground spaces could have low initial costs through adequate design, and if some surface construction requires supplementary works, the underground structures doesn't.

The benefits resulted from the use of the underground spaces, could be found in maintenance costs and the use for energy. Thus, the isolation of the underground structures from the surface effects affecting the exterior of buildings, can have as a result the low costs for maintenance in underground, due to the reduced impact of temperature variations, UV radiation, frost / defrost cycles and the problem of snow.

Beyond the financial impact for the users of underground spaces regarding the specific energy uses, the energy storage in underground, has a lot of benefits, including national interests and safety, the economic development and commercial balance of each country.

The design and construction of the systems of the underground spaces can be organized in such ways that they will have a small impact to the surface.

The presented benefits regarding the use of the underground spaces would not have to give the idea that there are not drawbacks, but using an adequate design, in situ and laboratory investigations, and a future planning, these drawbacks could be considerably diminished, and the underground space would represent the only way to overcome the actual problems generated by the development of the modern society, urban planning, environmental pollution etc.

4. Examples on using the underground spaces

The underground space represents an important natural resource, and its uses started long before the human kind could realized its benefits. In modern times the underground spaces, started to be used on a large scale first in USA, and then it developed in Western and Northern Europe & Japan. This uses is linked with the identification of favourable geomechanics, mining, economics & politics parameters, which then are used to assess the feasibility of the alternative technical proposals.

The problem on using the underground spaces is actual in Romania, due to the multiple advantages on its using, and also due to the complex situation of the environmental protection and the large amount of the mining voids resulted after the mineral deposits deployment. In Romania there are groups of researchers with preoccupations in the field of the reuse of the mining voids, who work on identification-mainly on the hard rock mines voids – and possible reuse of these spaces, to classify the various types of voids which could be used into the near future, and to analyse the local and global stability of these underground structures in order to be integrated into the economic circuit.

Taking into account the possible uses of the underground spaces, resulted as voids on the mining activity of mineral resources in Romania, we can present them shortly, as it follows:

- the use of the underground spaces for recreation, by developing underground of auditorium halls, art galleries, video rooms, restaurants, bars, health and recovery facilities (Salt caverns);

- underground museums and special touristic facilities, which include certain equipped underground spaces;
- labs and education facilities placed underground;
- long-term parking facilities;
- industrial facilities, for at least three reasons; environmental protection, special features and low costs for the use of underground spaces;
- the use of such spaces for deposits of goods;
- civil defence facilities, centres of military command headquarters and security systems, protected to bombing and intruders;
- agricultural and food products deposits within the underground, due to the adequate conditions for disposal, and better combat against mice and insects (the low level of oxygen concentration and increase of dioxide carbon quantities, have roles of anesthetics), increased safety to degradation and intruders, as well as to a low energy consumption in case of freezers;
- natural gas and oil disposal underground, for civil and military use, in order to isolate the internal reserves, from the shock of the international oil crisis, to terrorists attacks and to limit the impacts to environment;
- to store safely movies, films, software & archives etc.
- to store water for industrial or domestic usage;
- mushroom raising at artificial light, which avoid the attack from diseases and natural;
- use of the underground spaces for waste disposal, being one of the most efficient and cheap ways for disposal, taking into account various requirements in order to protect the environment.

5. Conclusions

In the process of using the underground spaces we have to analyze a lot of geological, geomechanical, mining economical factors, and then taking into account the results of the complex analysis, we can take a decision regarding the various uses-social or industrial or industrial-of such spaces, which are usually placed on the surface.

Even if the underground has a negative image into the human culture, history and probably in its mind, involving fear, mystery and unknown it is obvious that underground spaces become more attractive where there is a land pressure, and better use for green areas

and playing fields, thus the sustainable development of the human being could be ensured through the use of the underground spaces.

Also, there is very useful to combine the mining of mineral deposits with the planning and use of the underground spaces, where this alternative is a viable option for mining activities.

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Abstract

New developments of the modern society, the use of the underground spaces represents an important alternative to the sustainable development. These spaces can help to decrease the pressure on land using, as well as, increasing the value of some mineral deposits, which could be used as hosts for waste disposals. There is very useful to combine the mining of mineral deposits with the planning and use of the underground spaces, where this alternative is a viable option for mining activities.

In the process of using the underground spaces we have to analyze a lot of geological, geomechanical, mining economical factors, and then taking into account the results of the complex analysis, we can take a decision regarding the various uses-social or industrial or industrial of such spaces, which are usually placed on the surface.

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and playing fields, thus the sustainable development of the human being could be ensured through the use of the underground spaces. The underground waste disposal represents an alternative to sustainable development.