

University for Business and Technology in Kosovo

UBT Knowledge Center

UBT International Conference

2021 UBT International Conference

Oct 30th, 9:00 AM - 10:30 AM

Daylight in underground houses as a new form of housing

Zana Prelvukaj

University for Business and Technology, zana.prelvukaj@ubt-uni.net

Fjolla Abazi

University for Business and Technology, fa31474@ubt-uni.net

Follow this and additional works at: <https://knowledgecenter.ubt-uni.net/conference>



Part of the [Architecture Commons](#)

Recommended Citation

Prelvukaj, Zana and Abazi, Fjolla, "Daylight in underground houses as a new form of housing" (2021). *UBT International Conference*. 12.

<https://knowledgecenter.ubt-uni.net/conference/2021UBTIC/all-events/12>

This Event is brought to you for free and open access by the Publication and Journals at UBT Knowledge Center. It has been accepted for inclusion in UBT International Conference by an authorized administrator of UBT Knowledge Center. For more information, please contact knowledge.center@ubt-uni.net.

Daylight in underground houses as a new form of housing

Zana Prelvukaj¹, Fjolla Abazi²

UBT College ; Pristina, Republic of Kosovo
zana.prelvukaj@ubt-uni.net¹ fa31474@ubt-uni.net²

Natural light is very important and direct role in the process of human life. Since the creation of caves used for living, natural light has played an important role in informing the time and changing the time between day and night. It is also of great importance in the creation and use of living spaces. This paper will analyze the application and forms of providing natural light in underground houses as a new form of housing. Underground houses, are considered as ecological building, which contribute to the protection of the environment. The application and provision of natural light is quite limited based on the construction site, the typology of the underground house and the orientation as well as the geographical terrain of the construction space. The development of technology of light refraction and creation of openings helps in the application of openings and enables to illuminate the living spaces in a natural way.

Keywords: Daylight, Underground houses, living, types of openings

Underground Houses

Underground houses a new future of construction can be considered as ecological construction in the context of environmental protection. Based on the form of construction of these houses providing lighting can be one of the biggest difficulties in residential comfort. The research is based on the type and typology of the underground house and the forms of application of natural light. Providing lighting in residential areas occupies an important place in comfort and life process. As we know, light is a key to human visual perception of the world as an understanding of issues, colors, patterns and spaces depends on the quality and quantity of light. (F.Ahani, 2011). On the other hand, multidimensional aspects of the functioning of light which include psychological and aesthetic roles in addition to climate and spiritual ones. One of the most famous assertions about the importance of light was also made by the renowned architect of modern architecture Le Corbusier (F.Ahani, 2011) "The architecture is neatly, correctly and a magnificent game of masses gathered in the light" (Le Corbusier). Important in the use of underground spaces plays the role of study and analysis which land offers us benefits in comfort and use of living space compared to above ground housing. There are a large number of different benefits to choosing underground construction which have been verified worldwide and at different times through current experiences of using underground space. (F.Ahani, 2011). The focus of the research is closely related to the natural process of light, from natural light to the needs of the use of artificial light sources. Creating openings in the construction of living spaces called "windows" allow us to introduce natural light inside the created spaces. (Carmody, 1993)



Figure 1 -Underground House (Sources Author)

Natural light in residential buildings

A well thought out and designed building with light provision where there can be a range of significant benefits for residential building occupants (Philips, 2004).

Health - Daylight is one of the many important factors of environmental health. As a result, medical research continues to explore the tangible and intangible effects of daylight on the human body and mind (Philips, 2004).

Visibility comfort - Lighting quality refers to visual performance, visual comfort and ease of viewing. Natural light provides the highest quality light source for visual tasks because it is a complete source of visible light spectrum. Residents of buildings generally prefer a well-lit space, provided that attention is paid to brightness and heat problems. (M. Angélica Ruiz*, 2014)

Visibility

Daylight provides a connection to the natural world. Based on changes in atmospheric conditions, seasons, light allows us access (Carmody, 1993, p. 12).

Window

A window is an opening in a wall or side of a building that accepts light and air into the interior.. Windows since ancient times have been created only as openings without any restrictions until the technological development where the use of glass material began which in accessible form enabled the entry of natural light into the space as well as protection from natural conditions. Among the most important points that should be considered in the application of windows inside a building are:

- Orientation of the building
- The effect of sunbathing on the construction site
- Ventilation
- Isolation of pollution and noise
- Aesthetics of the building
- Use of glass color
- The quality of the glass

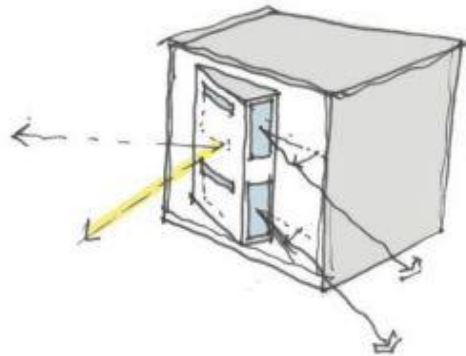


Figure 2 - Window in Building

(<https://www.eaststaffsbc.gov.uk/sites/default/files/docs/planning/planningpolicy/spd/Design%20Guide%20Appendix%20%28Amended%20Oct19%29.pdf>)

Application of natural light to underground houses

In order to ensure the lighting of residential areas in underground houses in the most efficient way, it is important to analyze the reception of natural light in direct form or in the distributed form. Direct light is light that comes from the sun without being reflected from other surfaces. (S. Amara, 2011). It means that light travels from a straight path from the sun to the collector. (S. Amara, 2011). Direct sunlight is easy to focus on. Diffuse light, on the contrary, has many directions and comes from all over the country. It is therefore much more difficult to focus on it. Concentration of sunlight is necessary if one is to distribute it in areas where lighting is needed. (S. Amara, 2011).



Figure 3 - Daylight in Underground House, Atrium typology (Sources Author)

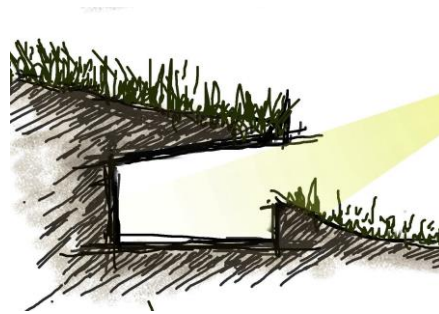


Figure 4 - Lighting in underground houses with side openings (Sources Author)

According to studies, there are several types of underground houses that are based on the construction site, the layout of the construction site. The typologies of underground and underground houses on flat terrains can be considered as the most problematic for the possibility of creating lighting in all living spaces. If underground spaces are designed to be a healthy environment for humans, and then natural light will play an important role. Methods for lighting underground space include traditional and innovative daylight systems. Traditional methods include courtyards, atriums, and overhead lighting concepts. (Philips, 2004)

In these cases, the use of lighting in the form of "Atrium" would help solve the lighting of residential areas. The word atrium started as the central courtyard of a Roman house, accepting light and air into the surrounding living space, the word has taken on a broader meaning as described in the CIBSE LG10 daylight and window design (F.Ahani, 2011). With the development of architecture and the use of attractions in buildings, the atriums began to be covered with glass windows, which enabled the monitoring of atmospheric conditions in the atrium area, as well as enabled the entry of light inside the designed space. Underground spaces are divided into shallow and deep spaces. Shallow spaces are covered by soil or protected by soil, semi-underground and underground. Deep spaces include underground spaces. Yard and overhead lighting concepts are used to illuminate shallow underground spaces, while the atrium is considered one of the innovative systems used for daytime lighting mainly in deep spaces, but they can also be used to illuminate shallow daytime spaces (Philips, 2004).

High lighting concepts are those in which daylight penetrates into an underground space through openings located above the ceiling line and usually form part of the roof of the building (Robbins, 1985). The use of this type of lighting can most often be found in the typologies of underground houses underground and ansor lighting is not enabled. There are four concepts of using zenith lighting. Dritare horizontale

- Saw-shaped windows
- Monitor window
- Clerestories
- Skylights

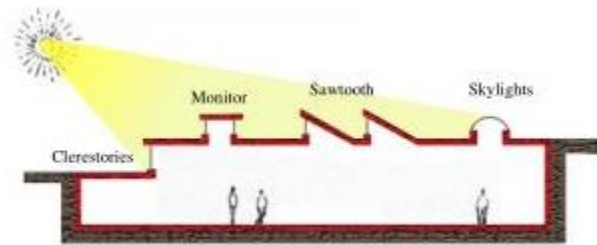


Figure 5 - Lighting concepts to daylight underground spaces (Lechner, N.; "Heating, Cooling, Lighting: Design Methods for Architects", P.320)

The underground house from the Korean firm BCHO has designed the underground house with atrium Jedong Ranch on the island of Jeju in South Korea, which through the stairs has created access and open atrium to provide lighting in residential areas. (Lobell, 1985)



Figure 6 - Underground Meditation Space on Jeju Island (<https://www.dwell.com/article/13-subterranean-homes-that-are-out-of-this-world-c64819ed-fd90b32c>)

The example of architecture has revealed that the land on which we use today for walking can also offer us a settlement with comfort and efficiency in energy conservation. In cases when it is not possible to design and build atriums, natural lighting in the living spaces of underground houses (Lobell, 1985)



Figure 7 - Zenital Lighting
(<https://64.media.tumblr.com/a0f371bda9918c358a681ad3239693d5/98172756b668275a-94/s1280x1920/159a602b15237e2d6ca3c4189f702e487af83559.jpg>)

The type of openings in underground houses are determined based on the area and depth of the designed and designed building. Designing openings and providing lighting in residential areas is always easier in cases where we do not have depth in the building. In cases where the design of the building is designed in depth and wider underground area, the provision of lighting can be achieved by using lighting pipes with devices that enable the introduction of natural light into the depths of the earth. Of the various methods none can be said to have achieved a universal application, but each has a specific use and is worth mentioning. There are many ways in which the interaction of light or sunlight with a mirrored surface can be used for reflection through mirrors. These tend to be specialist solutions that require the mirror to be controlled by a motorized tracking system or heliostat (Studios Architecture – Washington, 2001). Light tubes. Of all the innovative daylight lighting methods, the light tube has had the universal application. It is a method of lighting the roof, which by associating it with reflective tubes, directs the light to a lower level (Studios Architecture – Washington, 2001). Light tube installations can be accompanied by a ventilation device, also with artificial light sources which are obtained after dark or when daylight outside is insufficient, using a light control system (Studios Architecture – Washington, 2001). A particularly useful application has been in residential buildings, where a light tube can be directed to an area in the property, such as the downstairs floor, which might otherwise not receive daylight (Studios Architecture – Washington, 2001).



Figure 8 - Forms of lighting in underground spaces
(https://carpenterlowings.com/portfolio_page/solar-light-pipe/)

Conclusion

Natural light plays a very important role in human health and psychology during life. Underground houses as a new form of housing are considered as ecological construction, which contribute to the protection of the environment. The application and provision of natural light is quite limited based on the construction site, the typology of the underground house, the orientation as well as the geographical terrain of the construction space. Based on studies on the possibilities of providing lighting in residential areas to underground houses as a new form of housing, underground houses can be considered as houses that provide comfort and full lighting in residential areas. By specifying the type of flat ground house type that are considered to be among the most difficult types to provide lighting, an adequate solution would be the use of closed or open atriums which allow natural light to enter through openings in atrium area. In cases where the design of the underground house is projected in the depths of the earth, the introduction of natural light would be difficult, in such cases additional technological equipment such as mirrors or lighting tubes should be used which enable light to penetrate and penetrate to a depth of set.

References

- Carmody, J. S. (1993). Underground Space Design. In J. C. Sterling, *Underground Space Design* (p. P. 27). New York: Van Nostrand Reinhold; 1st edition.
- F.Ahani. (2011). Natural light in traditional architecture of Iran. Iran: WIT Press, Transactions on the Build Environment, Vol 121.
- Lobell, J. (1985). *Between Silence and Light*. Boston: SHamhala Publications INC .
- M. Angélica Ruiz*, E. N. (2014). Developing a Thermal Comfort Index for Vegetated Open. *ScienceDirect*, 47.
- Philips, D. (2004). *Daylighting - Natural Light in Architecture*. Burlington: Architectural Press, An imprint of Elsevier.
- Robbins, C. L. (1985). *Daylighting. Design and analysis*. United States.
- S. Amara, B. N. (2011). Energy Procedia. In B. N. S. Amara, *Concentration Heating System with Optical Fiber Supply*. Sweden: Published by Elsevier Ltd.
- Studios Architecture – Washington, D. U. (2001). *Solar Light Pipe*. From Carpenter | Lowings Architecture & Design:
https://carpenterlowings.com/portfolio_page/solar-light-pipe/