

EXAMINATION OF NATURAL LIGHTING IN VERNACULAR ARCHITECTURE IN THE CONTEXT OF SUSTAINABILITY

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ABSTRACT

One of the primary aspects of the concept of sustainability is the reduction in the need for artificial light sources with the natural lighting method often used in vernacular architecture. Artificial light sources are often used in interior spaces as a result of the developments in the lighting technology. Lighting products using modern technology harm the environment during the production stage and following the expiry of their lifecycle and also cause problems as waste. Moreover, most use a technology that is far from being sustainable. They harm the environment as waste after their lifecycle expires. Examining examples of architecture constructed with modern construction methods and where natural lighting is used to the maximum extent, it is observed that daylight is preferred in interior spaces due to being more economic, healthy and environmentally friendly. However, the variety of methods used to receive natural light into interior spaces also sets the architectural character of the building. This study discusses selected examples of vernacular architecture to underline the natural lighting techniques that support the notion of sustainability. The study describes the effect of natural lighting on interior space and then examines the relationship between vernacular architecture and the natural lighting technique. The subject is described under topics such as vertical and horizontal window apertures as the method for receiving light into the interior space and the yard system, and the various modes of architecture observed in various climate regions are interpreted in the context of sustainability.

VERNAKÜLER MİMARİDE DOĞAL IŞIĞIN SÜRDÜRÜLEBİLİRLİK BAĞLAMINDA İNCELENMESİ

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ÖZ

Sürdürülebilirlik kavramının öncelikli konularından biri; vernaküler mimaride sıklıkla kullanılan doğal aydınlatma yönteminin yapay ışık kaynaklarına ihtiyacı azaltmasıdır. Aydınlatma teknolojisinin gelişimi ile birlikte yapay ışık kaynakları iç mekânlarda sıklıkla kullanılmaktadır. Günümüz teknolojisine ait aydınlatma ürünleri ister üretim aşamasında isterse ömrünü tamamladıktan sonra çevreye zarar vermekte ve atık olarak da sorun oluşturmaktadır. Üstelik birçoğu sürdürülebilirlikten uzak bir teknolojiye sahiptir. Kullanım ömrünü tamamladıktan sonra atık olarak çevreye zarar verirler. Doğal aydınlatmanın maksimum düzeyde kullanıldığı, çağdaş yapım yöntemleri ile inşa edilen mimari örneklerde gün ışığı; sürdürülebilirlik açısından değerlendirildiğinde ekonomik, sağlıklı ve çevre dostu olma özellikleri sayesinde iç mekanda tercih edilmektedir. Bununla birlikte doğal ışığın iç mekana alınma yöntemlerinin çeşitliliği binanın mimari karakterini de oluşturmaktadır. Sürdürülebilirlik anlayışını destekleyen doğal aydınlatma tekniklerine dikkat çeken bu çalışma seçilmiş vernaküler mimari örnekleri üzerinden değerlendirilmektedir. Çalışmada doğal ışığın iç mekana etkisi açıklandıktan sonra, vernaküler mimari ile doğal aydınlatma tekniği arasındaki ilişki sorgulanmaktadır. Işığın iç mekana alınma yöntemi olarak dikeyde ve yatayda pencere açıklıkları ile avlu sistemi gibi başlıklar altında açıklanan konu farklı iklim bölgelerinde farklı mimari biçimleri sürdürülebilirlik bağlamında yorumlanmaktadır.

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INTRODUCTION

Daylight emerges as a design issue in interior architecture as much as its necessity for the continuity of human life. Sunlight, which has been used since the earliest times in the illumination of the interior, has become controllable today thanks to the changes and developments in approaches of space design. Architectural solutions tailored to the function of the interior have removed the harmful effects of sunlight. The architectural solutions that were designed for this purpose have increased the aesthetical value of the interior as well as the quality of the sunlight changing at different times of the day.

Daylight has begun to be guided, transmitted, and processed through architecture and technology. Daylight entering through the openings in the building envelope is guided inside with various details on the architectural scale. Technology also meets requirements as artificial light when daylight is not sufficient. However, artificial light produced with the support of technology is far from being a sustainable approach as it plays a major role in the consumption of energy resources. Furthermore, not only energy consumption but also high amounts of energy are consumed for the production of such artificial light sources. For this reason, examples of vernacular architecture where natural sources are used effectively and the use of natural light in the sustainable design concept constitute the subject of this study.

RESEARCH FINDINGS

The Effects of Natural Light on Interior

The correct and purposeful use of natural light in the interior is possible by knowing the nature of the light well. Controlling the sunlight and creating designs towards using it in the interior will lead to healthier interior spaces. Hundreds-year-old vernacular architecture has been shaped by the experiences of those living in that area by living and analyzing the environment correctly. The effects of natural light on the interior are listed below:

- 1- Sunlight has positive effects on humans. It makes them feel good. It is necessary for human health.
- 2- It decreases artificial light use. As a result, it saves energy.
- 3- As the light value changes during the day, its value in the interior also changes. Light degree differences change space perception, too.
- 4- In addition to the perception of the space, it strengthens interior-outdoor relation.
- 5- While artificial light use gives a stable light amount in any space it is used, it is possible to provide different atmospheres to the user with natural sunlight with its quality changing during the day.
- 6- The most effective space is possible with natural light. Natural light is inviting. The natural light amount changing during the day creates a different atmosphere in the interior.

Concept of Vernacular Architecture and Natural Lighting

Vernacular, which means specific to the local people, can be explained as an architectural form that is constructed by using local material, and construction technology, and technique. Another factor that constitutes the definition of vernacular is that it constitutes the structure character which is in accordance with the general architectural character of the area. Sezgin (1984) explains the term in his study as;

The word “vernacular” is not found in foreign dictionaries frequently. Only in French dictionaries; it has a history of 40 years and the meaning is not clear enough. In Latin, “Verna” means slave. And the Word “Vernacular” means “Someone/something from a certain country’s origin” and it is accepted as a synonym for “indigene”. Today, a regional architecture whose value has been understood all over the world, in its French and English definition “Vernaculaire-Vernacular Architecture”, is the direct and unconscious transformation of the culture in which the society is in possession into the material within the context of certain needs (Sezgin, 1984, p.45).

Vernacular architecture materializes through the reflection of the lifestyle and socio-economic structure and culture of the region to interior and architectural mass by the local craftsmen. For that reason, the similarity in dimensions, constructions, materials, colors, and details of structures in vernacular architecture creates integrity and harmony in architectural design. Integrity and harmony in design reveal the architectural character of the region. The interior organization is shaped by climatic and cultural influences. Space construct arising from the region’s way of life, the construction techniques emerged with the construction materials supplied from the immediate environment (stones, wood, soil, etc.), climatic characteristics of the region (warm climate, continental climate, etc.) and its topographic structure determine the space formation, and it also emphasizes the characteristic features of vernacular architecture (Figure 1,2). Thus, an architectural identity is formed in a different character than the vernacular architectural forms in other geographies. Although the construction techniques, materials,

detail, and color are the same, there are examples of architecture that have diversity in themselves. The continuity of the architectural character determines the local architectural character, and it transfers the architectural culture to future generations. Based on the effective use of natural resources, the vernacular architecture supports the notion of sustainable design with this aspect of it.

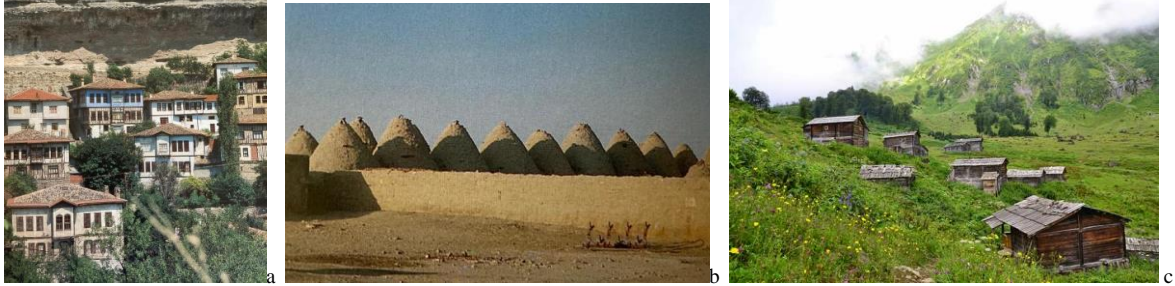


Figure 1. Vernacular Architecture Examples from Safranbolu - Harran – Black Sea
a- (Küçükerman, Güner, 1995, p.23), b- (Bektaş, 1996, p.38), c- (URL 1)

Vernacular architecture shows a sustainable understanding by using sustainable materials, replaceable and recycled materials, ensuring the continuity of the construction technique. It has been a tradition for hundreds of years to use natural resources such as water and sunlight effectively. Rainwater flowing from the roof is accumulated and used for various purposes, and sunlight is controlled and taken into the interior. Thus, natural resources are used effectively. It can be said that vernacular architecture which is also known as architecture without an architect is a tool to sustain architectural culture.

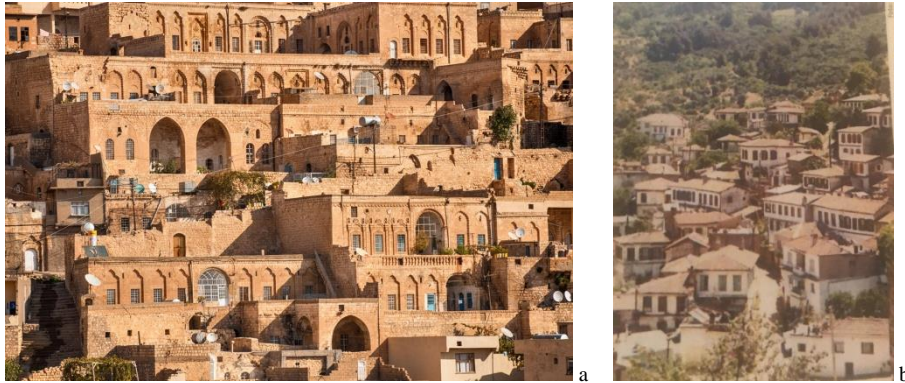


Figure 2. a- Mardin Vernacular Architecture Example; They Peek Over Each Other in the Sloping Topography and Make Use of Daylight This Way. Depending on the Size of the Rooms, Windows of Different Sizes and Semi-open Shaded Spaces (Iwans) Allow the Sunlight to be Taken Indoors (URL 2).

b- Vernacular Architecture of Şirince (Üstünel and others, 2002, p.85)

The Ways of Taking Daylight Indoors

Considering the direction in which natural light comes from and taking the requirements in the interior and the climatic characteristics into consideration, openings are left in the structure in vernacular architecture. In this process, the construction material and construction determine the quality of the openings.

There are 3 different methods of taking daylight indoors in vernacular architecture:

- A. From vertical openings on the facade; windows
- B. From horizontal openings in the space; openings constructed on the roof, roof windows
- C. Atrium

A. Vertical Openings are constructed onto the wall's surface to take daylight indoors. In addition to creating an illuminated space, it also helps to heat the indoors. The arrangement of windows on the building's facade creates an architectural language with the region's construction technique, materials, details, and structural system. This language is a symbolic language that belongs to the region. Characteristic construction elements are identities of vernacular architecture. The roles of topography, climate, and culture are undeniable in the creation of this identity.

The vertical openings called windows are defined as “openings or holes constructed to provide light and air to an interior” (Sözen, Tanyeli, 1994, p.188). Another definition is “Opening made on the walls with chops and glass, constructed to see outside, take light and air inside.” (Hasol, 1993, p.351).

“The window arrays, becoming one of the important items of the identity of the Turkish Houses and providing a wide angle of view to the place, have turned into the form of two series, bottom and top... the bottom windows are collapsible, and the top windows are fixed glass skylights that only illuminate the place.” (Küçükerman, Güner, 1995, p.143).

The high side openings in vernacular architecture are effective when the weather is cloudy, there is indirect light and the sun is above. Generally, the skylights are situated to heights where people cannot reach. The skylights are arranged to increase the spatial value of that space and to customize it in line with the other rooms. Since the glasses at this height are usually colored, the colorful reflection of the sunlight in the interior increases the importance of the room. Skylights are constructed on the inner and outer surfaces of the wall. The glass in the inner part is colorful while the outer glass is colorless. The outer glass protects the inner colorful glass from the outside effects. The daylight reflecting through the bottom vertical openings is effective in the interior. The impact level of the light can be softened by making the surfaces surrounding the opening curvilinear or angled (Figure 3).

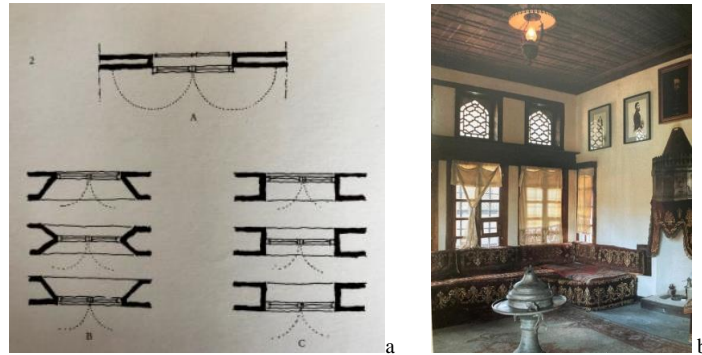


Figure 3. Window-wall Relation and a Room in Bursa
a- (Küçükerman, Güner, 1995, p.146), b- (Küçükerman, Güner, 1995, p.112)

The openings constructed in the architectural shell are the determining elements of vernacular architecture. Through these openings, daylight is taken into interior space. However, the hours when the sunlight comes intensively can be disturbing in the interior. In this case, architectural solutions that can control the natural light in the interior can make it possible to take daylight indirectly with the eaves and lattices indoors (Figure 4).

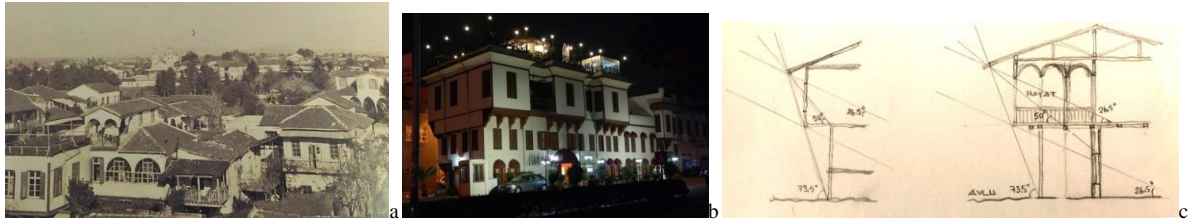


Figure 4. The Eave Designed to Take Daylight into the Interior in a Controlled Way (Mersin and Adana)
a- (Anonymus, 1995, p.24) b- personal archive c- (Bektaş, 1996, p.33) reorganized

B. Horizontal Openings

While it is difficult to construct openings on a horizontal surface in terms of construction materials, techniques and technology; in Turkish baths, daylight is taken into the interior through the small openings in the dome (Figure 5).



Figure 5. On The Left, the Skylights of the Historical Turkish Bath in Unye, in the Middle, and on the Right Sille Turkish Bath, Konya. The Glasses in the Bath are Made Concave to Increase the Endurance to High Temperatures. a-(URL 3) b- (URL 4) c- (URL 5)

In addition, in cone-shaped architecture examples, daylight spreads through the opening in the domes to the interior in Harran. In this region, the opening in the dome allows evacuating the warming air because of hot climate conditions. The small openings constructed on the plinths of the cone help taking the sunlight inside (Figure 6). Vernacular Erzurum houses have a cooking area which is called tandoor. The opening above the tandoor in the house of Hacı Kazım Bey in Erzurum is shown in Figure 7.

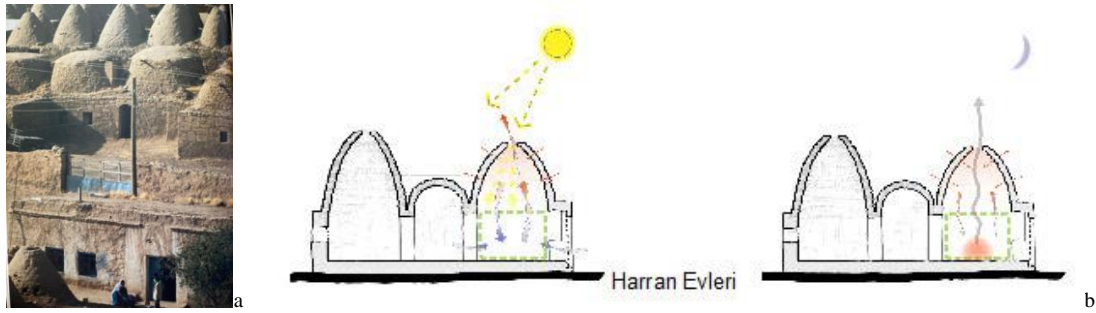


Figure 6. Vernacular Domed Houses of Harran, Turkey
a- (Küçükerman, Güner, 1995, p.32), b- (URL 6)

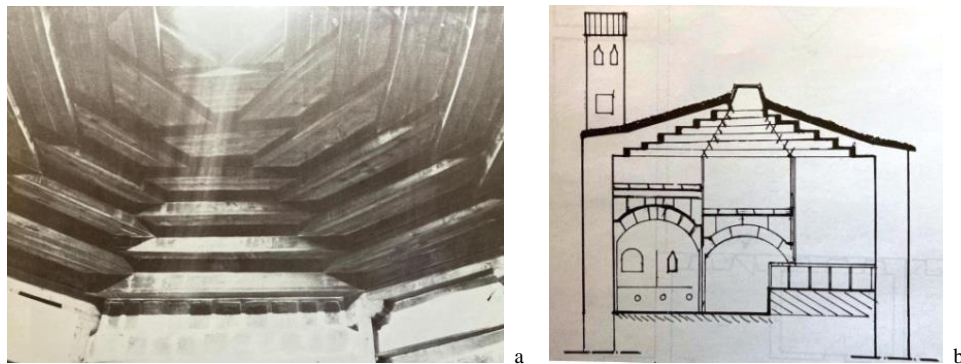


Figure 7. Opening Above the Tandoor in the House of Hacı Kazım Bey in Erzurum and Section
a- (Karpuz, Haşim. 1993, p.143) b- (Karpuz, Haşim. 1993, p.84)

C. Atrium

It is a method that has been used frequently in architecture since the earliest civilizations because of climatic reasons. Atrium is defined as “the cloister in the middle of the old Roman houses to that all the sections of the house are opened to” (Hasol, 1993, p.351). “These are central and daylight-taking interiors which organize a building” (Bednar, 1986, p.87). It is used in buildings with an inward plan type intended to create shade spaces, especially in hot climate regions. Atrium or courtyard is a space that is open-air and surrounded by rooms on four sides. It is a free space arranged in the middle of the structure in order to illuminate the interior of large constructions. The daylight illuminates the rooms from this open-air courtyard space. The courtyard is the place where many functions are carried out as well as it provides natural light to the rooms surrounding it; it is used

versatile as a living room, also for hosting the guests, preparing food, eating, etc. (Figure 8). It is even a playground for the children. The changing angle of the sun during the day creates various shadow spaces in the courtyard. Since the walls surrounding the courtyard do not warm up on hot days, it also creates a cool environment in interiors. In vernacular architecture, it is characteristic to have small openings on the street facade. And these small window openings limit the entrance of sunlight into the interior. On the other hand, the large openings in the courtyard where the necessary privacy is provided make it easier for the sunlight to enter the interior. In other words, the courtyard or atrium creates an outdoor space inside the building.



Figure 8. Houses with Atrium from Gaziantep- Kilis- Antakya
a- (Bednar, Michael J, 1986, p.87) b- (URL 7) c- (URL 8)

Evaluation of Vernacular Architecture and the Use of Daylight in the Context of Sustainability

World Commission on Environment and Development, WCED, (1987, p.16) defines sustainability as “the principle of meeting today's needs without compromising the right and the ability of future generations to meet their own needs”. On the other hand, Avcı, explains sustainable architecture as a human and nature-oriented housing approach (Avcı, 2016, p.45). In this context, correct interpretation of the vernacular architecture examples which are reflections of human-construct-environment interaction is the vital requirement of the future.

The aspects of vernacular architecture and natural lighting that support sustainable understanding can be listed as follows;

- **The Use of Natural Sources:** Vernacular architecture examples are built with the materials supplied from the immediate environment. The constructions attain an aesthetic value with the color and texture of the local materials. The sunlight used for interior lighting supports a sustainable design concept for the reason that it is a natural energy source.

Whether the building material is stone or wood, window apertures are left to the extent allowed by the construction technology. Except for the glass windows arranged in the architectural shell, wooden shutters keep out the unwanted rays of daylight. When shutters are not used, wooden cages also help the daylight to enter in a controlled manner. The wood and window joinery used in the construction of the cages are obtained from the forests of the region. For functional and technical reasons, concave glass materials are used in the small circular lighting openings located in the domes of the Turkish baths shown as an example in this study. This glass material is also environmentally friendly and natural.

- **Effective Use of Energy:** It contributes to the heating of the interior as well as reducing the electricity consumption in illumination. These buildings, which are built according to the climatic conditions in the region, benefit from the positive effect of the sunlight (heating and lighting). Thus, the effective use of solar energy is provided.

High ceilings in traditional houses allow for a system where one window can be built on top of another. Thanks to the windows of different sizes, maximum illumination is provided in the interior. Moreover, the visual effect in the interior is increased by using colored glasses in some of these windows on vertical surfaces. In cases where daylight and sunlight are insufficient despite such large openings, oil lamps burning kerosene or electric lamps were used depending on the period. Thanks to the large dimensions of the windows, energy consumption is reduced.

- **The Understanding of Design for Humans:** Natural light is necessary for psychological and physiological well-being of the humans. At the same time, it increases the aesthetics value of the space as it increases the visual comfort of the space. It makes people feel good. While constructing the buildings, respect for neighborhood relations and neighbor rights is valued.

- **The Sustainability of Architectural Sustainability:** Openings that increase the relationship of people to the environment, shading elements that control the sunlight constitute the architectural character. Thus, it contributes

to the transfer of architectural culture to future generations. Vernacular architecture examples reflect the region's cultural characteristics (art, traditions, belief... etc.).

The architectural character prevailing in the region stems from construction materials and construction technology. In addition, the fact that construction elements such as vertical openings (windows), roofs, and eaves are built with the same detail ensures the continuity of architectural sustainability.

• **Protection of Natural Conditions – The Harmony with Environment:** Vernacular architectural examples meet sustainability criteria because they are topographically compatible structures. The buildings in vernacular architecture maintain the balance between natural and built environments (it harmonizes with nature and thus supports sustainable design understanding).

Window systems, roof openings, and courtyards that provide a characteristic order in these buildings define the silhouette of the region. The resulting silhouette and architectural texture bring originality to the region. Although each opening on the façade is different from the other, harmony stands out among the variety. Architectural identity becomes evident.

• **Effective Use of Materials – The Use of Environmentally-Friendly Materials:** These architectural examples built with construction materials obtained from the immediate environment are recyclable, healthy, and economical.

Glass, wood, and stone materials that are close to the human spirit are used as often as necessary. As evident in many examples, they are free of ornaments. Even if ornaments are used around the window and door openings, they are at a level that reminds the principle of "less is more" in their minimal material and plain form.

• **Changeable, Convertible, Flexible Design:** The sizes of the buildings are flexible. The construction system formed by vernacular architecture can enlarge according to user requirements. The spatial relationship of the constructions is shaped according to the lifestyle of the region. The sunlight entering through the openings affects space perception.

According to the seasons and the changing needs of people, vertical openings, windows, and shutters can be opened and closed. In buildings with courtyards, people sit in different areas of the courtyard during the day, depending on the direction of sunlight. The courtyard can be used for many different functions in line with the needs of the residents, such as hosting guests, eating meals, and sometimes washing laundry. The courtyard becomes a flexible space that changes and transforms throughout the day.

• **Social Sustainability:** The construction of the vernacular buildings takes place through the cooperation process. This cooperation contributes to social unity and integrity.

Within the scope of this study, the traditional architecture ensures social sustainability and in terms of concepts such as equality, diversity, and quality of life, despite families of different economic classes in the society, the modest details on the façades of buildings evoke harmony and equality. Even the diversity created by the openings in the architectural shell is in harmony. The amount of daylight and sunlight entering the interior improves the quality of life of the residents. The resulting architectural character is associated with a sense of belonging.

CONCLUSION

Although artificial light sources have brought the lighting design to a very different point since the end of the 19th century, what natural light brings to the interior and its dynamism is indisputable. As the sustainable understanding of space design becomes more important, the effort of using the natural light interior design will increase. Vertical or horizontal openings in vernacular architecture and arrangements such as the atrium, courtyard providing natural light to the interior are suitable solutions for functional and sustainable design approaches in today's spaces. Space designers should utilize these solutions which will decrease the consumption of energy for artificial lighting. In the spaces which are designed with the positive and uplifting effects of sunlight, healthy individuals can live. For this reason; in space organization, designers should interpret the design concept of the vernacular architecture which is compatible with nature according to today's conditions. In this study, the contribution of natural lighting to sustainable design was attempted to emphasize through examples of vernacular architecture. Today, the conscious use of natural energy resources can be possible in this way.

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