Şimşek, Onur. "Sustainability Aspects in Mosque Architecture: From the Beginning to the Present". *Diyanet İlmî Dergi* 60/3 (Eylül 2024), 1175-1206. https://doi.org/10.61304/did.1459221

Sustainability Aspects in Mosque Architecture: From the Beginning to the Present

Araştırma Makalesi

Geliş Tarihi: 26 Mart 2024 Kabul Tarihi: 19 Eylül 2024

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Öz

1970'lerde sürdürülebilir mimarinin öncüleri, uluslararası modernizm tarzını ekolojik nitelikleri açısından incelemeye başladı. Bunu takip eden on yıllarda çevre konusu bir kriz olarak ele alındı. Günümüzde, iklim değişikliği konusunda önemli bir dönüm noktası yaşandığına şüphe yoktur. Dünya genelinde insanlar tarafından kullanılan enerjinin önemli bir yüzdesi binalarda tüketildiğinden, yeşil mimari konusu tartışmasız dikkate alınmak durumundadır. Mimarlık tarihinde, bugünün sorunlarına yönelik çözümler için ilham kaynağı olabilecek çok sayıda örnek bulmaktayız. Bu makale, başlangıcından günümüze cami mimarisindeki sürdürülebilirlik unsurlarını analiz etmeyi amaçlamaktadır. Giriş bölümünde, İslâm mimarisinin çevre bilinci ile ilgili gelişimi tematik olarak ele alınmaktadır. Bunu, aşağıdaki başlıklar çarçevesinde analiz edilen örnekler takip etmektedir: Çok işlevlilik, doğal malzemeler, doğal aydınlatma ve havalandırma, sürdürülebilir tasarım stratejileri, kültürel sürdürülebilirlik ve son olarak modern çağda çevre dostu ve enerji bilinçli tasarım.

Anahtar Kelimeler: İslâm Mimarisi, Mimari Kültür, Camiler, Yeşil Bina, Sürdürülebilirlik, Kerpiç, Ahşap.

Sustainability Aspects in Mosque Architecture: From the Beginning to the Present

Research Article

Received: 26 March 2024 Accepted: 19 September 2024

Abstract

The pioneers of sustainable architecture began to question the international style of modernity with regard to its ecological qualities in the 1970s. In the decades that followed, the environmental issue was treated as a crisis. Today, there is no doubt about understanding our time as a major turning point in climate change. Since half of the energy used by humans worldwide is consumed in buildings, the topic of green architecture is essential. In the history of architecture, we find numerous examples that can be inspiring for solutions to today's problems. This work intends to investigate the sustainability aspects of mosque architecture from its beginning to the present day. In the introduction, the development of Islamic architecture in relation to environmental awareness is discussed. This is followed by supraregional aspects of sustainable Islamic architecture, which are analyzed under the following focal points: multifunctionality, natural materials, natural lighting and ventilation, sustainable design strategies, cultural sustainability, and finally, environmentally friendly and energy-conscious design in modern times.

Keywords: Islamic Architecture, Architectural Culture, Mosques, Green Building, Sustainability, Adobe, Wood.

Summary

As the damage caused by industrialisation to nature was documented, the criticism about modernism raised in society evolved into legislated measures. As a matter of fact, there is no doubt that there is an important turning point in the issue of climate change today. Since a significant percentage of energy consumption, one of the most important data, takes place in buildings, ecological architecture is one of the most important topics among today's researches. In this respect, sustainability researches have started in the context of Islamic thought and Islamic architectural tradition as well as in different geographies and cultures. Along with the studies on the place of ecology and sustainability in Islamic thought and philosophy, examples from many different geographies and climates in the Islamic architectural tradition dating from the 7th century to the present day are examined under this title.

However, the fact that the limited number of studies are mainly in the Far and Middle East clearly shows that more studies should be carried out in different geographies, including our country.

Materials constitute an important issue in contemporary architecture. The materials used today have a high environmental impact during their production and require complex recycling processes. This problem was not present in the natural materials used in traditional architecture. In addition, most of the materials were obtained from local sources. Adobe, wood and natural stone have been the main materials of mosque architecture for centuries. The Great Mosque of Paradise in Mali is one of the most famous examples of adobe architecture. Despite frequent repairs, it has survived to the present day. In the 20th century, Egyptian architect Hassan Fathy utilised the advantages of mudbrick to create an architecture that attracted worldwide attention. From the 13th century to the present day, Seljukid wooden mosques defy time with all their splendour; their structural and covering systems inspire contemporary buildings such as the Cambridge Mosque.

The courtyard culture, which has continued from the Masjid-i Nabawi to the present day, has been an indispensable element of our mosques. Interior courtyards have numerous advantages for the surrounding spaces. In terms of sustainability, an inner courtyard provides natural lighting and ventilation for all surrounding rooms. Cool air is stored at night and delivered to the rooms during the day. Refreshing water from the fountain enhances the cooling effect.

One of the main topics of mosque architecture is the minarets. Since minarets are no longer considered necessary for acoustic purposes, they are a much debated topic in modern mosque architecture. Some new concepts try to use the height of the minaret for natural ventilation, so that the minaret can be functionally justified again. Since architectural forms can retain their meaning independently of a specific function, these new initiatives also represent a desire to preserve the symbolic significance of the minaret in Islamic architecture.

The soot chamber integrated into the ventilation system of Mimar Sinan's Süleymaniye complex and the ink produced from it is one of the special inspiring examples of recycling, while ostrich eggs used to repel spiders are also worth mentioning in the context of green architectural solutions.

Water is a subject of great importance in Islamic civilisation. The mud drain in the courtyard of the Qayrevan Mosque is a seminal design solution that combines aesthetics and function, not only in terms of rainwater utilisation but also in terms of design.

The reuse of buildings and materials is an important method of sustainability. Building monumental places of worship requires energy and financial resources on a macro scale. Therefore, it is important to utilise monumental structures for as long as possible. The Ottomans attached great importance to preserving the great mosques built before their time. For this reason, they used the mosques in large Anatolian cities and did not build new ones. Pre-Ottoman buildings in cities such as Konya, Kayseri, Sivas and Erzurum are still the most important architectural monuments today. Hagia Sophia, which survived after being built for the third time in the 6th century, is the most famous religious building among the examples of reuse.

As a result, sustainability and environmentally sensitive construction has become an important issue in all cultures. In the last two centuries, resource and energy intensive construction has become a global problem. Therefore, reading the pre-industrial building tradition from the perspective of sustainability can offer solutions for today's problems. Indeed, as our study shows, there is a source of inspiration for new solutions in various areas of green buildings. Sustainable materials, natural lighting and ventilation in hot regions, active and effective use of the existing architectural heritage beyond its preservation, the philosophy of ecological coexistence with other living beings are just some of the many possible solutions. Current projects in various countries show that holistic environmental concepts are becoming increasingly important in mosque architecture.

Cami Mimarisinin Başlangıcından Günümüze Sürdürülebilirlik Unsurları

Geniş Özet

20. yüzyılın ilk yarısında hâkim olan modernist mimari, 1950'lerden itibaren farklı açılardan eleştirilmeye başlanmıştır. Makinelerden ilham alınarak inşa edilen konutlar, otomobillerin domine ettiği ulaşıma göre planlanan şehirler yeni yaşamın ideal çözümleri olarak sunulmuş olsalar da, zamanla insan ve çevre dostu çözümler olmadığı ortaya çıkmıştır. Endüstriyelleşmenin doğaya verdiği zarar belgelendikçe, toplumda yükselen eleştiriler zamanla kanunlaşan önlemlere evrildiler. Nitekim günümüzde artık iklim değişikliği konusunda önemli bir dönüm noktası yaşandığına şüphe yoktur. En önemli verilerden birisi olan enerji tüketiminin önemli bir yüzdesi binalarda gerçekleştiğinden, ekolojik mimari günümüzün araştırmaları arasındaki en önemli başlıklardan birisidir. Bu minvalde farklı coğrafya ve kültürlerde olduğu gibi İslâm düşüncesi ve mimari geleneği bağlamında da sürdürülebilirlik araştırmaları başlamıştır. Ekoloji ve sürdürülebilirlik konularının İslâm düşüncesi ve felsefesindeki yeri üzerine yapılan çalışmalarla birlikte 7. yüzyıldan günümüze kadar uzanan İslâm mimari geleneğinde birçok farklı coğrafya ve iklimdeki örnekler bu başlık altında incelenmektedir. Ancak yapılan sınırlı sayıdaki çalışmanın ağırlıklı olarak Uzak ve Orta Doğu'da olması, ülkemiz de dâhil olmak üzere farklı coğrafyalarda daha çok çalışma yapılması gerektiğini açıkça göstermektedir.

Çağdaş mimarinin önemli bir sorununu malzeme konusu teşkil etmektedir. Günümüzde kullanılan malzemeler üretimleri sırasında yüksek çevresel etkiye sahiptir ve karmaşık geri dönüşüm süreçleri gerektirirler. Bu sorun geleneksel mimaride kullanılan doğal malzemelerde mevcut değildi. Ayrıca malzemelerin çoğu yerel kaynaklardan elde edilirdi. Kerpiç, ahşap ve doğal taş yüzyıllarca cami mimarisinin başlıca malzemeleri olmuştur. Mali'deki Cennet Ulu Camii kerpiç mimarisinin en meşhur örneklerindendir. Sıklıkla onarım gerektirmesine rağmen günümüze ulaşması mümkün olmuştur. Mısırlı Mimar Hassan Fathy 20. yüzyılda kerpiçin avantajlarını kullanarak tüm dünyada ilgi gören bir mimari oluşturmayı başarmıştır. 13. yüzyıldan günümüze ulaşan Selçuklu Ahşap camileri tüm ihtişamlarıyla adeta zamana meydan okumakta; taşıyıcı ve örtü sistemleri günümüzde Cambridge Camii gibi çağdaş yapılara ilham olmaktadırlar.

Mescid-i Nebevî'den günümüze dek devam eden avlu kültürü camilerimizin vazgeçilmez öğesi olmuştur. İç avluların çevresindeki mekânlar için sayısız avantajları bulunmaktadır. Sürdürülebilirlik açısından, bir iç avlu çevredeki tüm odalar için doğal aydınlatma ve havalandırma sağlar. Geceleri serin hava depolanır ve gün boyunca odalara ulaştırılır. Çeşmeden gelen ferahlatıcı su soğutma etkisini artırır.

Cami mimarisinin gündemde olan başlıca konularından birisi de minarelerdir. Minareler artık akustik amaçlar için gerekli görünmediğinden, modern cami mimarisinde çok tartışılan bir konudur. Bazı yeni konseptler, minarenin yüksekliğini doğal havalandırma için kullanmaya çalışmakta, böylece minare yeniden işlevsel olarak gerekçelendirilebilmektedir. Mimari formlar anlamlarını belirli bir işlevden bağımsız olarak koruyabildiğinden, bu yeni girişimler aynı zamanda minarenin İslâm mimarisindeki sembolik önemini koruma arzusunu da temsil etmektedir.

Mimar Sinan'ın Süleymaniye külliyesinde havalandırma sistemine entegre ettiği is odası ve oradan üretilen mürekkep, geri dönüşüm için ilham verici özel örneklerden birisiyken, örümcekleri uzaklaştırmak için kullanılan deve kuşu yumurtaları da yeşil mimari çözümleri bağlamında zikretmeye değerdir.

Su, İslâm medeniyetinin büyük önem verdiği bir konudur. Kayrevan Camii avlusundaki çamur süzgeci, estetik ile fonksiyonun birleştiği, sadece yağmur suyunun değerlendirmesi bakımından değil, tasarım açısından da ufuk açıcıdır.

Binaların ve malzemelerin yeniden kullanımı sürdürülebilirliğin önemli bir metodudur. Anıtsal ibadet yerleri inşa etmek için makro ölçekte enerji ve mali kaynak gerekmektedir. Bu nedenle abidevî yapıların mümkün olduğunca uzun süre kullanılması önemlidir. Osmanlılar, kendi dönemlerinden önce yapılan ulu camileri korumaya büyük önem vermişlerdir. Bu nedenle büyük Anadolu şehirlerindeki camileri kullanmışlar ve yerlerine yenilerini yapmamışlardır. Konya, Kayseri, Sivas ve Erzurum gibi şehirlerde Osmanlı öncesi yapılar bugün hala en önemli mimari eserlerdir. 6. yüzyılda 3. kez inşa edildikten sonra günümüze ulaşan Ayasofya, yeniden kullanım örnekleri içindeki en ünlü dînî yapıdır.

Sonuç olarak sürdürülebilirlik ve çevreye duyarlı yapılaşma artık tüm kültürlerde önemli bir konu haline gelmiştir. Son iki yüzyılda kaynak ve enerji ağırlıklı inşaat, küresel bir sorun haline gelmiştir. Dolayısıyla endüstri öncesi yapı geleneğini sürdürebilirlik perspektifinden okumak, günümüz sorunları için çözüm önerileri sunabilir. Nitekim yaptığımız çalışmanın da gösterdiği üzere, yeşil binaların çeşitli alanlarında yeni çözümler için ilham kaynağı bulunmaktadır. Sürdürülebilir malzemeler, sıcak bölgelerde doğal aydınlatma ve havalandırma, mevcut mimari mirasın korunmasının ötesinde aktif ve etkin kullanımı, diğer canlılarla ekolojik bir arada yaşama felsefesi pek çok olası çözümden sadece bazılarıdır. Çeşitli ülkelerdeki güncel projeler, bütüncül çevre kavramlarının cami mimarisinde giderek daha önemli hale geldiğini göstermektedir.

Introduction

The creation of man is based on different levels. From a philosophical point of view, he is considered a bio-psychosocial being endowed with spirit. New psychological works also mention a transcendental side of man.[1] With his physical levels, man is bound to the earth and, moreover, dependent on it. Due to his characteristics, he is, on one hand forced to adapt to earthly circumstances, on the other hand, he is constantly in search of an even safer and more comfortable habitat. The first steps in this direction include caves and simple huts. The 45,000-year-old cave paintings discovered on the Indonesian island of Sulawesi are the oldest artistic evidence of this type of dwelling.[2] Among the simple huts, we can cite the yurt as an example that is still used today.[3]

In the history of mankind, architecture has always been regarded as an important yardstick for the development of a civilization. In this sense, cities symbolize not only economic and political power but also cultural and scientific standards. Numerous buildings were also constructed for presentation purposes. The Dome of Rock in Jerusalem[4], the Selimiye Mosque in Edirne, the masterpiece of architect Mimar Sinan and Ottoman architecture, which was commissioned by Sultan Selim II to surpass all existing mosques, should be mentioned here. Today, skyscrapers, for example, are seen as symbols of modernity, development and, above all, power. However, architectural development did not only bring advantages. As industrial developments in the twentieth century led to an environmental crisis, architecture was also scrutinized in terms of its sustainability. This is because an important part of the energy used by people worldwide is consumed in buildings.[5] Today, there is no doubt that our time should be seen as an important turning point in climate change.

In the 1970s, the pioneers of sustainable architecture began to question the international style of modernism with regard to its ecological qualities.[6]

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1 Doğan Cüceloglu, *Var mısın*? (İstanbul: Kronik, 2021),15.

2 A. Brumm, et al. "Oldest cave art found in Sulawesi", *Science Advance*s Vol. 7/3 (2021), 1.

3 Onur Şimşek, *Courtyard Culture, A Comparative Analysis of the Seljukid Courtyards* (Vienna: TU Wien, Institute of History of Art, Building Archaeology and Restoration, Phd Thesis, 2014), 46.

4 Markus Hattstein, Peter Delius, *İslam Sanatı ve Mimarisi* (İstanbul: Literatür, 2007):41.

5 Sofia Behling, Stefan Behling, *Sol Power: Die Evolution der solaren Architektur*. (München, New York: Prestel Verlag, 1996):20.

6 Onur Şimşek, "Friedensreich Hundertwasser, A Visionary of Ecological Design". *Design Communication European Conference*. Ed. Uddin, M. Saleh et al. (İstanbul:

Glass is now regarded as a symbol of modern architecture. The desire for more transparency in the material results in higher heating and cooling costs. Another disadvantage of the materials used today is their environmental impact during their production and disposal. Concrete, another dominant material of modernity, has many disadvantages: Compared to existing monumental buildings, concrete buildings have a shorter lifespan (approx. 100 years). In addition, the production of cement is one of the most emission-intensive industrial processes. 5% of the global waste belongs to concrete.[7] As many of these problems are related to the industrial revolution, the focus will be turned back to pre-industrial times in this article and to the Islamic architectural tradition.

1. Literature Review:

We can say that the research on sustainability in the context of Islamic thought and Islamic architectural tradition is still in its early stages. With the studies on the place of ecology and sustainability issues in Islamic thought and philosophy,[8] examples in the Islamic architectural tradition dating from the 7th century to the present day in many different geographies and climates have started to be examined under this title. Especially in the Far East and the Middle East[9], there are more studies on this subject. The courtyard, which has a long tradition[10], constitutes one of the important topics in this field. Minarets, which have recently been discussed politically and functionally, are also the subject of ecological suggestions. One of

Özyeğin Universiy Publications, 2016), 1/448-456.; Joachim Radkau, *Die Ära der Ökologie - eine Weltgeschichte* (München: C.H. Beck Verlag, 2011), 197.

7 Jianzhuang Xiao et al. "Durability of Recycled Aggregate Concrete: An Overview", *Journal of Advanced Concrete Technology* 11/12, (2013), 347.

8 Omer Spahic, "A Conceptual Framework for Sustainability in Islamic Architecture" *Conference on Technology & Sustainability in the Built Environment (King Saud University, 2012), 119.* Ursula Kowanda-Yassin, *Naturnähe und Naturverständnis in den Grundlagen des sunnitischen Islams - Ein Beitrag zum aktuellen Umweltdiskurs* (Vienna: Uni Wien Phd Thesis, 2010), 113, A. El-Sabbagh Bagder et al., *Environmental Protection in Islam* (Cambridge: IUCN, 1994)", Labeeb Bsoul. et al. "Islam's Perspective on Environmental Sustainability: A Conceptual Analysis," *Social Sciences MDPI*, 11/6 (May 2022), 1-11.

9 Nurjayanti, Widyastuti et al., "Sustainable Islamic Architecture in Settlements and Their Environment In Surakarta", *Journal of Islamic Architecture* 7/4 (June 2023) 750-759. ; Imriyanti Imriyanti, "Mosque Architecture As A Sustainable Building in Urban (Case Study: Al Markas Al Islamic Mosque Makassar", *Journal of Islamic Architecture* 2/4 (December 2013), R. Al-Mohammed, *Examining The Sustainable Mosque Design in Qatar Through the Global Sustainability Assessment Sytem (GSAS)* (Doha: Hamad Bin Khalifa University, The College of Islamic Studies, Master Thesis, 2017).

10 John Reynolds, *Courtyards: Aesthetic, Social, and Thermal Delight* (New York: John Wiley & Sons, INC, 2002).

the most important of these is the proposal to use minarets as ventilation, especially in hot climates.[11] While there are studies in the field focusing on today's mosques[12] and smart cities,[13] the majority of the studies focus on energy efficiency.[14]

The fact that the limited number of studies on sustainability in Islamic architecture are predominantly in the Far East and Middle East clearly shows that many more studies need to be carried out in different geographies, including our country. Therefore, our research includes examples that have not been mentioned in other studies and covers different topics, such as cultural sustainability. We begin to analyze these examples on the basis of their material characteristics. In contrast to the disadvantages of modern materials mentioned above, wood and clay, for example, have economic and ecological advantages.

2. Sustainable Materials of Traditional Mosques

As already mentioned, materials play a very important role nowadays when it comes to sustainability. Many of the materials used today have a high environmental impact during their production and require complex recycling processes.[15] This problem did not exist in traditional architecture. Most materials came from natural, local sources. Only for monumental buildings' prestige objects, such as columns, or decorative materials such as mosaics were transported from other cities or even countries. Although the old buildings were all constructed from natural materials such as clay, wood, stone, or brick, this article will focus exclusively on clay and timber

[11] Jamal Abed Al Wahid Jassim,. "A New Design of the Minaret as a Two-Sided Wind Catcher Integrated with the Wing Wall for Passive Evaporative Cooling in Hot Climates", *Journal of Engineering Science and Technology* 13/11 (2018) 3856 - 3873; Najmul Imam, S. M. "Ventilation in a Mosque- An Additional Purpose the Minarets May Serve", *Healthy Buildings 2003 Proceedings 7th International Conference* (7th-11th December 2003) – (Singapore: National University of Singapore, 2003) – 3/746-751

[12] Ayşe Arslantaş - İdil Ayçam, "A Study On Examining Present Mosque Archıtecture Within The Scope Of Sustainability Principles," *2.Uluslararası Akdeniz Bilimsel Araştırmalar Ve İnovasyon Kongresi* (Girne, Cyprus Kktc, 2022).

[13] C. Papa and N. Rossi, "Smart Cities and Sustainable Finance: The Islamic Perspective", *European Journal of Islamic Finance* 9/2 (2022) 18-26.

[14] Numan, M., Y., Almaziad, F.A. "Enhanced Design Features For Energy Saving Of Mosque Buildings In The Maritime Desert" *The First International Conference on Mosque Architecture University of Dammam*, (2016). Mawed, M., "Smart, Sustainable and Healthy Cities", *International Conference of the CIB Middle East and North Africa Research Network* (CIB-MENA 2014) 307-324.; Al Touma, A. And Quahrani, D. "Enhanced Thermal Performance of Mosques in Qatar", *IOP Conference Series: Earth and Environmental Science* 104/1, (2017) 012012.

[15] Gastón Sanglier Contreras, et al. "Building Materials and Their Impact on the Environment", *Contemporary Engineering Sciences* 15/1 (2022) 51–61.

buildings, which are once again gaining importance as sustainable building materials in today's architecture.

2.1. Adobe

The history of mosques begins with the emigration (Hijra) of the Prophet from Mecca to Medina in 622. A small mosque was first built in Quba.[16] This was followed by the first large mosque in the city of Medina, which formed the center of the new Muslim city as the Prophet's Mosque (Masjid-i Nabawi).[17] It was built in the traditional style of the city at the time. The entire mosque was made from simple and regional materials. The foundations were made of stone, followed by walls made of clay. The simple roof construction made of branches and leaves from date trees protected the private rooms of the Islamic prophet and a small part of the prayer room from rain and sun.[18] Clay as an inexpensive, locally accessible material has been used from the Prophet's mosque to the present day. Two very famous examples are given below.

2.1.1. The Djenné Mosque in Mali

One of the most famous mosques and also the largest clay sacred building in the world is the Great Mosque of Djenné in Mali[19] It has been a UNESCO World Heritage Site since 1988. The history of this building, which was converted from a luxurious palace into a mosque, dates back to 1240. However, after being destroyed, most of it had to be rebuilt at the end of the 19th century and the beginning of the 20th century. In keeping with tradition, there is a school (madrasa) next to the mosque, also made of clay. Clay buildings are very inexpensive, but on average, they do not have a long lifespan and require constant maintenance. Heavy rain can cause considerable damage, as was the case with this mosque in 2009, when the southern tower of the east facade collapsed due to the rain. The wall consists of sun-dried clay bricks, clay-based mortar, and clay plaster. The clay plaster ensures an even surface and protects the masonry against water. Palm trunks are built into the 40-60 cm-thick walls. The palm trunks prevent cracks that would be caused by fluctuations in temperature or humidity. They can also be used as scaffolding during repair work. Simple ceramic pipes serve as rain gutters.

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[16] Hüseyin Algül, "Mescid-i Kubâ". *Türkiye Diyanet Vakfı İslâm Ansiklopedisi* (Ankara: TDV Yayınları, 2004), 29/279

[17] Hattstein – Delius, *İslam Sanatı ve Mimarisi,* 41-42.

[18] Nebi Bozkurt - Mustafa Sabri Küçükaşçı, "Mescid-i Nebevî", *Türkiye Diyanet Vakfı İslâm Ansiklopedisi* (Ankara: TDV Yayınları, 2004) 29/282

[19] Erich Lehner, Roots of Architecture - Building Traditions in Non-European Cultures. (Wien: IVA-ICRA Publishing, 2016), 87

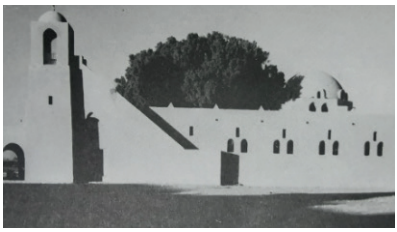

Figure 1. The Djenné Mosque in Mali (Erich Lehner:45)

Figure 2. Mosque in New Gourna (Fathy,1973:302)

2.1.2. Gourna[20] / A Modern Village out of Earth:

Hassan Fathy is a world-famous architect and author from Egypt. With his philosophy and sustainable architecture, he inspired simple ecological and economical architecture. He gained a reputation for his local solutions to global problems of modern architecture and developed an architectural language and construction method that is coherent with Egyptian culture by confidently following the centuries-old local building method with clay. Clay was convincing not only because of its environmental friendliness, but also because of its low purchase and production costs. Hassan Fathy was so fascinated by this construction method that he dedicated the largest part of his work to this material. Using traditional techniques, craftsmen were able to construct arches and domes without much effort and without any formwork.[21] This meant fast construction times and low manufacturing costs. Hassan Fathy's virtuosity created aesthetically pleasing buildings from this simple material.

Fathy began to develop the New Gourna project in 1948 with traditional clay masters. The project with a traditional Egyptian identity could be built easily and very cheaply without the need for large construction equipment.[22]

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[20] The New Gourna project by Hassan Fathy (1900-1989) became a world-renowned example of alternative, sustainable materials in the twentieth century. Between 1945 and 1950, a new village was built for the poor inhabitants of ancient Gourna to keep them away from grave robbing and to protect the archaeological artefacts. Due to the tight budget, Hassan Fathy proposed the new village including a mosque, theatre and school made of sun-dried mud bricks. By using traditional building techniques, the construction costs could be reduced even further. (For example, the domes and arches could be built without scaffolding.) With this project, which Hassan Fathy presents in detail in his book "Architecture for the Poor - an experiment in rural Egypt", Hassan Fathy became a pioneer of ecological aesthetics decades before the green movement in architecture.

[21] EI-shorbagy Abdel - moniem M., *The Architecture of Hassan Fathy: Between Western and Non-western Perspectives* (Christchurch: University of Canterbury, PhD Thesis, 2001), 138

[22] Hassan Fathy, *Architecture for the Poor*: *An Experiment in Rural Egypt* (Chicago: University of Chicago Press, 1973), 113

The aim was to create an economical and ecological village for 7,000 inhabitants. The future inhabitants had the opportunity to participate in the construction. This meant that the construction costs could be reduced even further. The new village of Gourna became a worldwide landmark for clay construction.

The mosque is located on New Gourna's main square. The dome, with which Fathy wanted to symbolize the vault of heaven, stands out in the rich composition of the outer facade. The dome sits on an octagon and, according to Fathy, another symbol is at play here, namely that of the eight angels who carry the throne of God. The dome above the prayer room sits on trumpets and was built without scaffolding. As scaffolding costs time and money, a technique was used for the construction in which each row of clay bricks is supported by the one below. The revitalization of traditional adobe construction and the creativity of Hassan Fathy have resulted in a village that offers high-quality and aesthetically pleasing architecture for residents in need.

2.1.3. Earth Building as a New Trend

Finally, on the subject of clay, a winning project will show the current trend and the return of the importance of clay as a natural material. In 2019, an ideas competition for mosques was organized in Turkey by the Ministry of Environment and Urbanism. Projects were submitted in two categories. In the first category, designs were submitted for a mosque with a capacity of 200 people in the city of Gaziantep, Turkiye. The winning project stands out not only for its simplicity but also for its bold choice of materials. The mosque and the surrounding buildings were proposed in clay construction with load-bearing wooden elements.[23]

Figure 3 Winner of the idea compatition for Mosque design (https://www.arkitera.com/proje/1-odul-2-kategori-cami-tasarimi-fikir-yarismasi/

[23] In order to draw attention to the change in awareness and architectural education with regard to natural materials, it should also be mentioned that the winner of this category had only completed his bachelor's degree one year before the competition.

2.2. Timber Constructions:

From Central Asia to Khorasan and Anatolia, wooden constructions form an important part of the Islamic architectural heritage. In Central Anatolia, many Seljuk buildings have been preserved. In many cities such as Sivas, Erzurum, Konya and Kayseri, the large mosques from the Seljuk period are used for Friday prayers and daily prayers. Some of these mosques stand out due to their impressive wooden construction. Two mosques, among many others from Anatolia and one from Uzbekistan, are presented here as examples.

2.2.1. Aslanhane (Ahi Şerafeddin) Mosque in Ankara:

The Aslanhane Mosque in the Turkish capital Ankara was built in the 13th century, and the original wooden structures, including wooden columns, ceilings and minbers have been preserved. The wooden ceiling was constructed using the kündekari technique without nails or glue. The richly decorated ceiling is supported by 24 wooden walnut pillars in four rows. The minbar (pulpit), also made of walnut wood, was assembled using the elaborate Kündekari technique without nails. The mosque, which is more than 700 years old, shows how sustainable wood can be as a building material and motivates its use in contemporary designs. The ornamentation of the mihrab (prayer niche) with plaster, ceramics, and bricks can also inspire new interpretations and uses of materials in ornamentation.[24]

Figure 4 Timber ceiling, coloumns and the minber in Aslanhane Mosque (Onur Şimşek)

Figure 5 Detail of wooden coloumns in **Eşrefoğlu** Mosque (Onur Şimşek)

2.2.2. Eşrefoglu Mosque in Konya:

Konya was the first capital of the Anatolian Seljuks. The city has numerous buildings from the Seljuk period. The Eşrefoğlu Mosque is

[24] Semavi Eyice, "Ahî Şerafeddin Camii", *Türkiye Diyanet Vakfı İslâm Ansiklopedisi* (Ankara: TDV Yayınları, 1988), 1/531

located next to Beyşehir Lake and is therefore also known as the Beysehir Mosque. The mosque was commissioned by the ruler Süleyman Beg between 1296 and 1299 and forms a complex together with a tomb, a caravanserai, and a hamam. Compared to the Aslanhane Mosque, this mosque has some differences. Here the wooden columns stand on stone plinths, everything above is made of wood. Instead of the ancient spolia in the Aslanhane Mosque, the Esrefoglu Mosque has impressive column capitals made of local wood. In the center is a small atrium through which daylight can enter the interior. This opening also allows the columns to equalize moisture and prevent cracks. In addition to the roof construction and the pillars, two special areas have also been preserved in their original condition: a gallery for the muezzin and a second as a ruler's lodge. The minber in the Kündekari technique is also preserved in original walnut wood. The Eschrefoglu Mosque was added to the tentative list of Unesco World Heritage Sites in 2012. [25]

2.2.3. Khiva Great Mosque:

Friday-Mosque of Khiva in the historical Ichan Qala of Khiva in Uzbekistan, dates back to the 10th century, when today's Juma Mosque was rebuilt and expanded with spoilers in the years 1788-89. The hypostyle mosque, with its rectangular shape and size of 55 x 46 meters and historical wooden contruction, is a unique example of the rare multicolumn mosques in central Asia. 213 wooden columns with a height of 4.5m support the flat roof structure, which has two lightwells in the center of the mosque, providing light and ventilation. The roof is divided into fields of 3x3m defined by the distance of the columns. Untypical for Uzbekistan, these sqaure fields of the roof are not decorated. Four columns have carved inscriptions in different calligraphy styles, for example, kufi. In one of the columns, the hadith: "Praying is a duty for Muslims" is written.[26] Other inscriptions in kufic lettering praise the donors and give some information. In 2008, one of the four inscribed columns was removed. Some pillars show inscriptions from the 10th century, and others from the 10th – 12th century with Arabic inscriptions in kufic style with geometric patterns. Later examples with floral patterns show types from the 18th and 19th."[27]

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[25] Doğan Yavaş, "Eşrefoğlu Camii", *Türkiye Diyanet Vakfı İslâm Ansiklopedisi* (Ankara: TDV Yayınları, 1995) 11/479-480; Onur Şimşek, "The Timber Construction Of Friday - Mosque In Khiva"*, International From Tradition To The Future Conference: Timber in Architecture* 9-10 (March 2022) (İstanbul: Fatih Sultan Mehmet Vakif University Publications, 2022), 70-80.

[26] Şimşek, "The Timber Construction Of Friday - Mosque In Khiva", 77.

[27] Şimşek, "The Timber Construction Of Friday - Mosque In Khiva", 77.

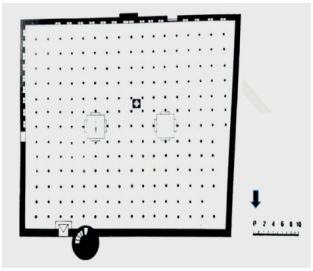

Figure 6 Plan of the Friday Mosque in Khiva (Polat, 2019: 342)

Figure 7 Details of column carvings in the Friday Mosque in Khiva (Şimşek, 2022:77)

2.2.4. Wood for Modern Design: Cambridge Mosque

In the light of environmental discussions, natural materials are being used more and more often. With this in mind, modern mosques in the western world are also being built from wood.

In 2009, an architectural competition for a mosque in Oxford, England, was held. In Oxford, the first green mosque in Europe was to be planned by Marks Barfield Architects. The basic idea was to create an atmosphere for a thousand people among trees that resembles a pleasant oasis, which seems to have grown naturally out of the ground with all its beauty. According to Abdal Hakim Murad, an Islamic scholar, co-initiator, and director of the mosque, the aim of the project was to combine a historic, timeless form with the latest technologies to create a British mosque for the 21st century. After ten years of patient work, a group of experts managed to synthesize Islamic art, geometry, natural materials, and British building traditions. The Cambridge Mosque's load-bearing structure of curved and laminated wooden beams gives the mosque its main character. The complex geometry used as tree abstractions was inspired by both the Islamic building tradition and the Gothic ceiling construction of the nearby King's College Chapel.[28]

Figure 8 Praying Hall of the Cambridge Mosque (https://www.keithcritchlowlegacy.org/work/cambridge-mosque)

[28] https://marksbarfield.com/projects/cambridge-mosque/ 25.01.2022]

2. Sustainable Design Strategies

3.1. Ventilation

The temperature control of mosques has always been a topical issue. Nowadays, this topic is dealt with from an energy technology perspective.[29] Various solutions for the air conditioning of prayer rooms can be found in the architectural tradition.

3.1.1. Inner courtyard:

Inner courtyards have numerous advantages for the surrounding spaces. In terms of sustainability, an inner courtyard provides natural lighting and ventilation for all surrounding rooms.[30] The cool air at night is stored and brought into the rooms during the day. The refreshing water from the fountain enhances the cooling effect.

Figure 9 Agha Bozorg mosque with sunken courtyard and iwan with minarets (Onur Şimşek)

Figure 10 Wind towers of the Agha Bozorg Mosque (Onur Şimşek)

One of the most interesting courtyards of Islamic architecture in Iran can be found in the Agha Bozorg complex, which consists of a mosque and madrasa. The sunken courtyard of the Agha Bozorg complex is not visible at the entrance. Only after taking a few steps does it suddenly appear with a surprise effect, emphasizing the monumentality of the symmetrical facade. The rooms of the madrasa are arranged around the sunken inner courtyard. The fountain in the center is used for cooling and, together with the plants, provides a natural vista within the building. This means that the courtyard facade, very different from an external building facade, becomes an experience for the residents themselves and not for the neighbours, as is the case with external facades. If the inner courtyards of mosques are not needed for prayers, they can also be planted with greenery. This

[29] Al Touma - Quahrani "Enhanced Thermal Performance of Mosques in Qatar", 104/1, 012012

[30] John Reynolds, *Courtyards*: *Aesthetic, Social, and Thermal Delight*, 182.

reduces the proportion of sealed surfaces, and the water can seep into the groundwater. In addition to the aesthetic enhancement of the space, the plants have a calming psychological effect on visitors. On the one hand, they increase the spatial quality for people and provide a habitat for small animals and plants.

Urban fabrics with inner courtyards offer dense building structures within a city without having to forego private open space with all its advantages. They not only provide privacy, but also wind and noise protection for residents.[31]

In the Iranian city of Kashan, the inner courtyards lead through steep staircases into underground rooms. These underground living spaces offer a cool atmosphere in the hot summer months. Contrary to what we understand today, they can be richly decorated and reach monumental dimensions. Kashan is famous for large domed underground parlors such as those in the Broujerdi and Tabatabaya houses.

3.1.2. Wind tower / Badgir / Malqaf

Badgirs are centuries-old architectural elements for the natural ventilation of buildings in hot countries such as Iran, Afghanistan, and the Arab world.[32]

A badgir is a massive tower with two to four ducts from the lowest room to the roof. The wind or cool night air is captured via the openings and channeled downward. As a result, the wind cools wall and floor surfaces and leaves the building again via the second channel of the tower. Containers with cool water are positioned inside the towers, or damp cloths are hung up so that the air can sweep over the cool water and be cooled further. Underground channels (so-called qanat) can generate further cooling. The strength of the flow can be controlled by flaps inside the tower. The aesthetics of Badgire also have a strong positive effect on the silhouette of the city.

3.1.3. Sustainability Proposals for the Minaret

As minarets no longer seem to be necessary for acoustic purposes, they are a much-discussed topic in modern mosque architecture. Some new concepts try to utilize the height of the minaret for natural ventilation so that the minaret can be functionally justified again. Since architectural forms can retain their meaning independently of a specific function, these new attempts also represent the desire to preserve the symbolic significance of

[31] John Reynolds, *Courtyards: Aesthetic, Social, and Thermal Delight*, 182.

[32] Movahed Khosro, "Badgir (wind catcher) an example of traditional sustainable architecture for clean energy", *2016 IEEE Smart Energy Grid Engineering (SEGE)* (Oshawa, ON, Canada: 2016), 79-83.

the minaret within Islamic architecture. It is now impossible to imagine an Islamic city skyline without minarets. Jamal Abed Al Wahid Jassim from the Middle Technical University in Iraq proposes a minaret that catches the wind from two sides and helps to keep rooms at a pleasant temperature in hot seasons through passive evaporative cooling. With his project, Najmul İmam from the Bangladesh University of Engineering & Technology shows that architects from the Far East are developing similar concepts for the minaret. This project argues that the loudspeakers mean that the muezzin no longer needs to climb up to the sharafa, i.e. the balcony of the minaret. Therefore, a complicated staircase is no longer necessary; a simple vertical ladder is sufficient. This means that the entire volume of the minaret can be used for the air ducts. According to Najmul Imam's proposal, the minaret would gain an additional function without losing the first one.

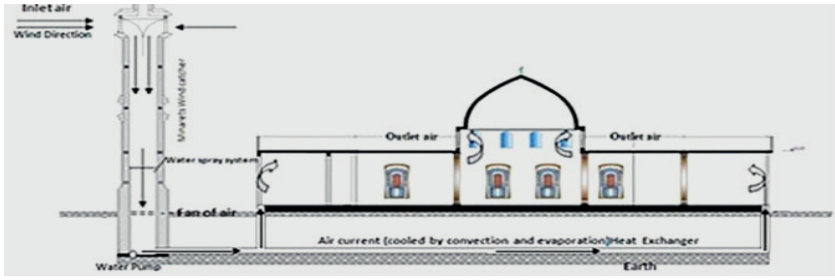

Figure 11 Design of a minaret as a windtower in Irak (Jassim, 2018: 3864)

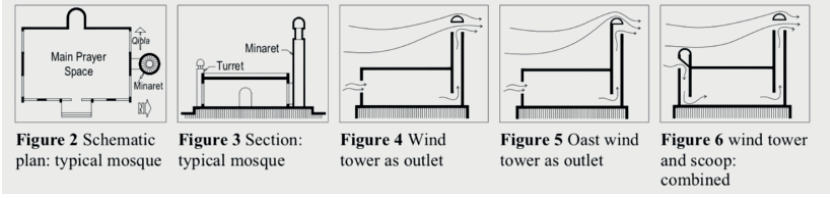

Figure 2 Schematic plan: typical mosque **Figure 3** Section: typical mosque **Figure 4** Wind tower as outlet **Figure 5** Oast wind tower as outlet **Figure 6** wind tower and scoop: combined

Figure 12 Design of a minaret as a windtower in Bangladesch (S M Najmul Imam, 2003:3)

3.1.4. Underground Rooms for Cold Seasons

Many mosques in the Middle East and the Arab world consist largely of semi-open rooms. In cold winter times, as is the case in Iran, heating this room concept is very difficult or only possible to a limited extent. This is why many Friday mosques have closed, underground winter prayer rooms. These rooms are smaller and lower than the spacious prayer rooms above and have hardly any monumental elements or ornamentation. They are kept plain white. This emphasizes the brightness of the scarcely lit room. Instead of ornamentation, the identity of the winter prayer rooms is created by architectural elements, e.g. the rows of pointed arches in the Friday Mosque in Isfahan.

3.2. Sustainability as a Design Philosophy

3.2.1. Aesthetic Mud Filter in Kairuan:

In North Africa and Andalusia, Islamic buildings have highly developed water infrastructures. The highly complex water supply system in Alhambra and the irrigation systems in Kordoba are just two examples. The inner courtyards in particular are equipped with fountains, basins, or cisterns as required.

In some courtyards, rainwater was collected on the surface and channeled into cisterns below. In the courtyard of the great mosque of Kairuan, Tunisia, the rainwater is filtered through this mud filter[33] This marble filter has small steps that increase the friction surfaces for the water flowing through. Dust and dirt stick to these steps. The filtered water flows through the center of the small inlet, opening into the cistern below. The pure water is scooped up again and used for ritual ablution.

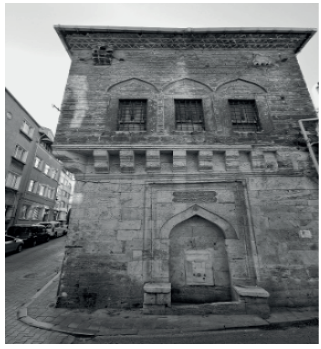

Figure 13 Mudfilter in the great Mosque of Kairuan: (Hattstein, Delius 2007:136)

Figure 14 Facade with fountain and Bird house (Onur Şimşek)

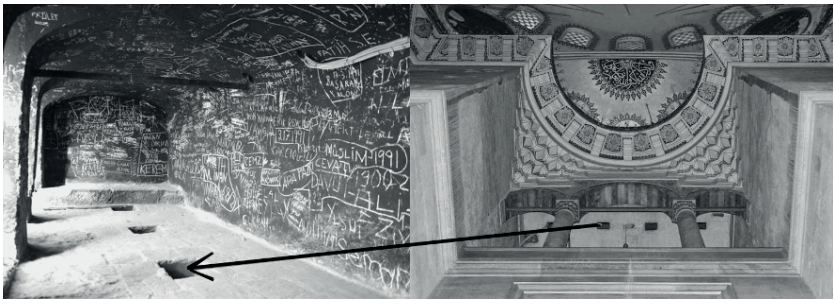

Figure 15: Soot cell in the Süleymaniye Mosque (Onur Şimşek)

Figure 16: Ventilation openings above the main entrance to the soot cell (Onur Şimşek)

[33] Hattstein - Delius, *İslam Sanatı ve Mimarisi,* 136.

3.2.2. Sinan's Genius: Ink Production through Ventilation

An interesting concept for sustainability can be found in the Süleymaniye Mosque in Istanbul. The Süleymaniye Mosque was built between 1550-1557 and forms the center of the largest complex in the Ottoman Empire. The famous court architect Mimar Sinan also endeavored to create amazing details for acoustics, ventilation, and water pressure in the largest mosque of the empire. The Süleymaniye Mosque was illuminated with 275 gas lamps in the 16th century. For the ventilation of the interior and smoke extraction, the architect Sinan arranged channels for the necessary draught. (Figure 15-16) Two of these channels lead through a chamber above the main entrance. The air passes through this chamber, and the smoke from the gas lamps remains on the wall surfaces as soot. This soot is subsequently removed and used for the calligraphers' ink. It is also known that Sinan was able to keep the spiders away from the steel construction of the gas lamps by hanging ostrich eggs. This is also one of the simple, sustainable, and aesthetic solutions for the maintenance of the mosque.

3.2.3. Building for All Living Beings

The Turkish-Islamic building tradition attached great importance to usefulness for all living beings. Even before rich facade compositions had begun to be designed, fountains were integrated on the street side to provide passers-by with washing or drinking facilities. In the Ottoman mosques and buildings, this culture is extended by a sensitive detail. In many mosques, very detailed birdhouses were built on the facade. Some of these birdhouses are so large that they are referred to as bird palaces. The facade of an Ottoman school in Fatih/Istanbul shows a fountain on the street level and a birdhouse on the roof. This example clearly illustrates the environmental awareness mentioned above. The fountain serves the people on the pavement, and the birdhouse serves the birds on the roof. (Figure 14)

4. Cultural Sustainability:

4.1. Appropriation and Reinterpretation of Local Architecture and Artistic Tradition

The Umayyad Mosque, which was opened in 714, is one of the first large mosques in the history of Islamic development. After the conquests, churches were initially used as common places of worship[34] The ancient Temple of Jupiter[35] and the Church of St John[36] used to exist on the site of today's mosque. Later In the Umayyad period, it was decided to build

[34] Burckhardt Titus, *İslam Sanatı Dil ve Anlam* (İstanbul: Klasik, 2012), 44.

[35] Hattstein - Delius, *İslam Sanatı ve Mimarisi,* 69.

[36] Talib Yazıcı, "Emeviyye Camii", *Türkiye Diyanet Vakfı İslâm Ansiklopedisi* (Ankara: TDV Yayınları, 1989), 11/109.

an independent mosque. Khalif Walid I brought in Byzantine masters and artists. The Byzantine influences can still be seen today, not only in the basilical structure but also in the decoration. At one time, 4000 square meters of the walls of the great mosque in Damascus were covered with mosaics.[37] At the beginning of the seventh century, mosque construction was enriched by the existing building techniques, materials, and ornamentation of Byzantine culture.

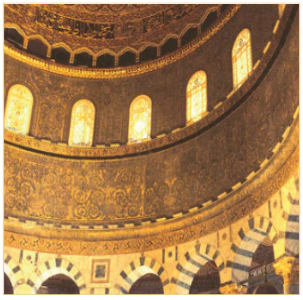
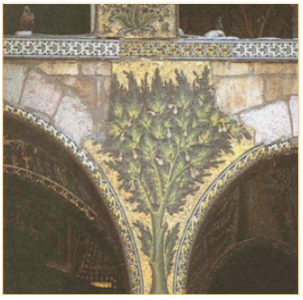


Figure 17: Mosaics and ancient coloumns at the dome of the rock in Jerusalem (Hattstein, Delius 2007:66)

Figure 18: Mosaics at the Great Mosque in Damascus (Hattstein, Delius 2007:66)

Figure 19: Ancient coloumns at the Alaeddin Mosque in Konya (Onur Şimşek)

4.2. Syntheses of Intercultural Forms and Planning Schemes

The courtyard has a long tradition in Asian architectural history. Excavations show that courtyards already existed in today's Turkmenistan in the 3rd century of the Christian era. These examples also show schematic axes that intersect in the center and accentuate the four directions in the form of niches. For numerous experts such as Akin, Kuran and Mirbabayev, Asian building culture had a lasting influence on the 4-Iwan type of madrasas and mosques. The Great Seljuks continued this 4-Iwan scheme from the Asian building tradition and used it for other monuments in the great mosque of the new capital in Esfahan in the 11th century[38] This gave rise to a new mosque layout that is still used in Iran and Central Asia today. In addition to its prayer function, the inner courtyard also has the role of a town square.

At the Masjid-i Juma in Isfahan, the inner courtyard is temporarily covered with carpets during peak visitor times on Fridays and feast days and used for prayers. On the other days, it serves as a town square with all its

[37] Hattstein - Delius, *İslam Sanatı ve Mimarisi,* 80.

[38] Onur Şimşek, *Courtyard Culture - A Comparative Analysis of the Seljukid Courtyards*, 46.

monumentality or as a shortcut in the urban fabric with the side entrances. The identity of the inner courtyard is also reinterpreted here within the mosque architecture in favour of the courtyard. The new monumentality exceeds the dimensions of an atrium of an Abbasid mosque, but also the atrium of an Ottoman mosque, and dominates the building due to its central location.

The iwans were designed with different room depths according to the cardinal points. The iwan facing south is the longest and therefore offers longer shade for visitors.


Abb. 20-21 Iwans at the Mascid-i Juma in Isfahan (Onur Şimşek)

4.3 Deliberate Integration of Ancient Spolia

The use of ancient spolia has a long tradition in Islamic architecture. The Dome of the Rock in Jerusalem is supported by ancient columns with gilded Corinthian capitals (the end of a column, note). Another example of the use of spolia in the Umayyad period is the Great Mosque of Damascus. Magnificent antique columns divide the prayer hall into three naves. The treasury in the inner courtyard is also supported by ancient columns. In Anatolia, the Seljuks used many spolias in the mosques. In the Aslanhane Mosque mentioned above, the weight of the wooden ceiling was transferred to the wooden columns via antique capitals of different heights. Spolia were also built into the walls of the facade. Ancient columns can also be seen in the interior of the Alaeddin Mosque in Konya. In the prayer hall of the above-mentioned Kairuan Mosque in Tunisia, the round arches of the arcades sit on Roman or Byzantine columns.

4.4. Reuse of Former Places of Worship

The reuse of buildings and materials is an important part of sustainability. A macro-scale amount of energy and financial resources are required to build monumental places of worship. It is therefore important to use these buildings for as long as possible.

The Ottomans attached great importance to protecting the great mosques

before their time with their significance as Friday mosques. That is why they used the mosques in the large Anatolian cities and did not replace them with new ones. In cities such as Konya, Kayseri, Sivas and Erzurum, the pre-Ottoman buildings are still the most important architectural monuments today.

The Hagia Sophia which was rebuilt in the 6th century after the previus two buildings from the 4th and 5th century[39] is the most famous monument within the reuse examples. The continued use of the building as a mosque has ensured that extensive maintenance has been carried out regularly in every century[40] and that the building has survived to the present day.[41] Next to the Hagia Sophia, there are many other buildings that were previously churches have been used as mosques without changing their external appearance. Minarets were added on the outside and only the necessary elements such as the mihrab and minbar were added on the inside.

The Kalenderhane Mosque, with its original exterior facade and fully preserved interior, is another famous example.

Figure 22 Elevation Hagia Sophia Mosque (Onur Şimşek)
Figure 23 Interior Hagia Sophia Mosque (Onur Şimşek)

5. Real Nature Instead of Abstraction

5.1. Tree Instead of Minaret

The architect Behruz Çinici designed the parliament mosque in the Turkish capital Ankara in 1986. The architect cites the simplicity of the first Prophet's Mosque and the hill on which Bilal, the faithful companion of the Islamic prophet, called the faithful community to prayer, as the

[39] H. Fırat Diker, *Ayasofya ve Onarımları* (İstanbul: Fatih Sultan Mehmet Vakıf Üniversitesi Yayınları, 2016), 7.

[40] Diker, *Ayasofya ve Onarımları*, 341.

[41] Suphi Saatçi, "Ayasofya ve Osmanlı Mimarisi", *Fetih ve Ayasofya Sempoyzumu Bildiriler Kitabı*, ed. Zekeriya Kurşun - Ali İhsan Aydın (İstanbul: Fatih Sultan Mehmet Vakıf Üniversitesi Yayınları, 2022), 33.

source of inspiration for his modern design. A detail in the silhouette of the mosque, which received the Agahan award in 1995, draws attention. On the right of the portal of the mosque, where the minaret is located in traditional mosques, a tree was placed as a vertical element, instead of a minaret.[42] The cypress tree, which replaced the minaret was dismantled in 2018 when it became ill and dried up, and a poplar tree was planted in its place.[43]

Although the mosque actually has a very low, in fact a horizontal minaret, it remains unrecognisable in the silouhette and is even overshadowed by the tree to the trained eye. Furthermore, the reinterpretation of the mihrab wall creates a strong connection to nature. The mihrab niche is made entirely of glass and opens up the interior to the rear courtyard with its fountain and greenery. The rich plant abstractions that visitors usually find on the mihrab wall of mosques are replaced here by the sight of real nature. Instead of the usual abstract tiles on the mihrab wall, the architects Behruz and Can Çinici use this rear courtyard as a symbol for the paradise garden.[44]

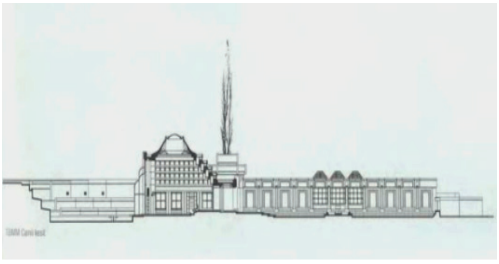

Figure 24 Section of the TBMM Mosque with tree as vertical element (Çinici, Bilgin, 1996: 20)

Figure 25 Paradise garden behind the transparent mihrab (https://www.cinicimimarlik.com/tr/tbmm-camii/)

5.2. Green Roof and Adaptation to the Site

The architect Emre Arolat also based his plans on the simplicity of the Prophet's Mosque. As there is no prescribed form for the mosque in the religious sources, the architect of the Sancaklar Mosque tries to avoid any formalistic discussion and concentrates on the essence of the prayer room. The main concept of the design was to adapt the shape to the terrain and create space using local materials. A green roof unites the building with the terrain and provides natural insulation. Local plants and materials decorate

[42] Çinici, C. - Bilgin, Z., "Bir Cami Dosyası", *Ege Mimarlık* (1996), 3/20; F. İbiş, "Türkiye Büyük Millet Meclisi Camii ve Sanatsal İmgeleri", *Yasama Dergisi* 46 (2022), 147-174.

[43] İbiş, "Türkiye Büyük Millet Meclisi Camii ve Sanatsal İmgeleri", 163.

[44] İbiş, "Türkiye Büyük Millet Meclisi Camii ve Sanatsal İmgeleri", 164.

the walls and the inner courtyard of the mosque. Inside the energy-saving building, a teahouse and a library act as social centers of attraction.

Another interesting concept of this mosque is the use of sunlight instead of ornamentation on the mihrab wall. The widespread mosaics are not used at all in this mosque. The gray color of the concrete is structured by the traces of the formwork. The traditionally rich composition of plant abstractions is replaced in the Sancaklar mosque by the play of light, which constantly changes during the day and is indirectly channeled into the prayer room from above.[45]

Figure 26 Sancaklarmosque elevation (https://emrearolat.com/project/sancaklar-mosque/#gallery-4)

Figure 27 Sancaklarmosque interior (https://emrearolat.com/project/sancaklar-mosque/#gallery-15)

5.3. Sustainable Mosques in Oxford, Dubai and Istanbul

In June 2014, Dubai's Awqaf and Minors Affairs Foundation celebrated the opening of an environmentally friendly mosque in Dubai. It was built entirely from sustainable materials. Solar panels provide light and hot water. Thermal insulation systems reduce energy costs, especially for cooling.

Another contemporary project with sustainable strategies is the Cambridge Mosque in England, as already mentioned in the text above. Strong insulation and a high degree of airtightness ensure an ideal climate without major energy expenditure. Maximizing natural ventilation reduces energy costs and ensures an ideal oxygen supply. The entire energy balance of the mosque benefits from the solar systems. The green roof acts as additional insulation and helps to reduce CO2 emissions. A green roof also provides a habitat for smaller creatures. The fountain in the inner courtyard refers to the traditional cooling of mosques. Trees and greenery provide sufficient green space. Water is systematically conserved, as rainwater is

[45] https://emrearolat.com/project/sancaklar-mosque/[13.03.2022]

collected and reused. An efficient heating, cooling and ventilation system ensures an economical energy balance.

The use of bricks from regional production creates a uniform relationship between Islamic architecture and local building tradition. On the one hand, the mosque blends into its surroundings thanks to the material, while on the other hand, it stands out thanks to its Kufic geometry and bright color.

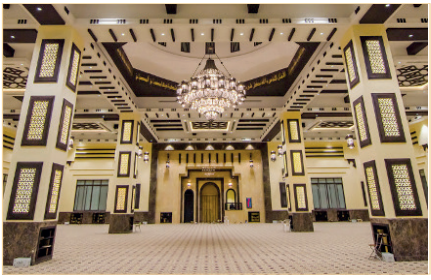

Figure 28 Sustainable Mosque in Duabi (https://mosqpedia.org/en/mosque/135)

Figure 29 Brickwall of the Cambridge Mosque next to the brick Facades of the neighbours (https://marksbarfield.com/projects/cambridge-mosque/)

Finally, the Ali Kuşçu Mosque built at Istanbul airport is an important indicator of how much the issue of sustainability has been taken into consideration in mosques recently. Because Ali Kuşçu Mosque, along with the Istanbul airport structure, was awarded the Leed GoldV4 Certificate by the US Green Building Council after being examined under headings such as system, sustainable land, water efficiency, energy and atmosphere, materials and resources, indoor quality of life, and innovation in design. Having successfully passed criteria such as energy efficiency in lighting and mechanical systems, utilization of daylight, water saving, use of recyclable materials in the construction process, and carbon footprint, the Ali Kuşçu Mosque is worth to be shown as an important example for 21st century mosques in terms of sustainability.

Figure 30 Ali Kuşçu Mosque at İstanbul Airport (https://www.istairport.com/hizmetler/deneyim/ortak-ihtiyaclar/ibadethaneler/)

Conclusion

In parallel with the world's environmental problems, studies in the context of Islamic thought and architectural tradition have participated in the growing research on sustainability. From the 7th century to the present day, examples of the Islamic architectural tradition from many different geographies and climates are examined under the headings of ecology, sustainability and green design.[46] However, the fact that the limited number of studies are predominantly in the Far East and the Middle East clearly shows that more studies should be carried out in different geographies, including our country.

Materials constitute an important problem in contemporary architecture. The materials used today have a high environmental impact during their production and require complex recycling processes.[47] This problem was not present in the natural materials used in traditional architecture. Moreover, most of the materials were obtained from local sources. Adobe, wood and natural stone have been the main materials of mosque architecture for centuries. The Great Mosque of Djenne in Mali is today one of the most important representatives of adobe architecture, although it requires regular repairs. In the 20th century, the Egyptian architect Hassan Fathy emphasized the economic and practical building techniques of mudbrick and succeeded in creating an architecture that attracted worldwide attention.[48] The fact that a mosque made of clay has been awarded first prize in Turkey's 2019 Mosque Ideas Competition is a recent example of the value placed on proposals using natural materials.

Another material that should be put back on the agenda in terms of sustainability is wood. The 13th-century Seljuk wooden mosques that have survived to the present day stand the test of time in all their splendor, inspiring contemporary buildings such as the Cambridge Mosque with their structural and roofing systems. Today, there are significant developments in timber construction techniques in areas such as fire resistance and wide spans. Increasing the use of timber in mosque construction should therefore be a priority in regions where the material is readily available.

The courtyard culture, which has continued from the Masjid-i Nabawî to the present day, is an indispensable element of our mosques. Courtyards

[46] Hailane Salam - Nik Lukman Nik Ibrahim, "Aspects Of Sustainable Architecture: An Islamic Perspective", *Alam Cipta* 11/2 (December 2018), 8; N. Utaberta, et al., "Evaluating Possible Innovative and Sustainanble Approach of Mosque in Contemporary World", *Journal of Design + Built* 9 (2016), 56-61.

[47] Maziar Asefi - Zahra Afzali, "Environmentally Sustainable Architecture: Material-Based Technological Design Approach", *Current World Environment* 11 (2016), 29.

[48] Simone Swan, "Hassan Fathy Demonstrates Ancient Construction Methods in New Mexico", *Architectural Record* 168 (December 1980), 39.

have many advantages for the surrounding spaces. Therefore, the courtyard architecture, which has provided solutions in different plan schemes, can be used with all its advantages in today's mosques and complexes. One of the main issues on the agenda of mosque architecture is the minaret.[49] New functions are being proposed for minarets that no longer seem necessary for acoustic purposes. Minarets play a crucial role not only in the identity of mosque architecture, but also in the silhouette of Islamic cities. Since architectural forms can retain their meaning independently of a specific function, the proposed new functions for minarets also represent a desire to preserve the symbolic importance of the minaret in Islamic architecture. In Islamic architecture, examples where sustainability and aesthetics are valued together draw attention. The soot chamber that Mimar Sinan integrated into the ventilation system in the Süleymaniye complex and the use of the ink produced from it in calligraphy are inspiring examples of recycling, while the aesthetic ostrich eggs used to repel spiders are worth mentioning in the context of green architectural solutions. Another example of a combination of aesthetics and function is the mud drain in the courtyard of the Kayrevan Mosque. This design not only removes rainwater dust but also adds an aesthetic element to the courtyard.

The reuse of buildings and materials is an important method of sustainability. An enormous amount of energy and financial resources are required to build monumental places of worship. It is therefore important to utilize monumental structures for as long as possible. The Ottomans attached great importance to preserving the great mosques built before their time. For this reason, they used the mosques in major Anatolian cities and did not build new ones. Hagia Sophia, preserved to the present day after it was re-functionalized as a mosque during the Ottoman period

Sustainability and environmentally conscious building are now important issues in all cultures. Resource and energy-intensive construction over the last two centuries has become a global problem. It can therefore be helpful to take a look at the pre-industrial building tradition. As this work shows, there is inspiration for new solutions in various areas of green building. Sustainable materials, natural lighting and ventilation in hot zones, dealing with existing architectural heritage, and ecological coexistence with other living beings are just some of the many possible solutions. This work also shows that projects were already being developed and built in the twentieth century with eco-sustainable aspects in mind. The latest projects in various countries illustrate that holistic environmental concepts are becoming increasingly important in mosque architecture.

[49] Kemal Kutgün Eyüpgiller, "Türkiye'de 20. Yüzyıl Cami Mimarisi", *Mimarlık* 331 (2006), 20-27.

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