kerpic'2019

Earthen Heritage
New Technology, Management
7th International Conference

5-7 September 2019
Köyceğiz, Muğla, Turkey

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II

Proceedings for the
Seventh International Conference
Kerpiç'19
Earthen Heritage, New Technology, Management

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Themes of The Conference:
Proposed Main Theme Earthen Architecture: Lessons from Past to Future Proposed topics: All studies on movable and immovable cultural assets and tangible and intangible earthen heritage as:

- Historical, Architectural and Archaeological researches
- Studies on Information and documentation Systems
- Traditional construction techniques
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- Intervention, restoration and prevention techniques
- Heritage site planning and management
- Case studies
- Cultural heritage education, skill development and communication by innovative systems
- Sustainability in building materials
- Sustainable architecture

DEAR COLLEAGUES;

7. International Conference www.kerpic.org/2019 will take place at Köyceğiz, Muğla/Turkey, will follow the www.kerpic.org/2005 “Living in Earthen cities” at Istanbul Technical University; www.kerpic.org/2008 “Learning from earthen architecture in climate change” at Cyprus International University, TRNC; www.kerpic.org/2013 “New Generation Earthen Architecture: Learning from Heritage” Istanbul Aydin University, www.kerpic.org/2015 “Built Environment on Silk road” Istanbul Aydin University, Istanbul; www.kerpic.org/2016 “Cultural landscape, rebuilding after decay”, Istanbul Aydin University, Istanbul; www.kerpic.org/2018 “Back to earthen architecture: industrialized, injected, rammed, stabilized”, Hasan Kalyoncu University, Gaziantep.

Over thirty years, Kerpiç–network is carrying researches on durability, seismic response and production techniques on earthen construction material. Durability researches are based on gypsum & lime stabilization of earth, called “alker”; seismic response researches are based on horizontal energy dissipating surfaces in the load bearing walls and production techniques are based on shotcrete and compacting production of earthen walls. www.kerpic.org, info@kerpic.org We are pleased to announce the Call for the 7. international conference on kerpiç’19 “Earthen Heritage, New Technology, Management” and the workshop on production: 5,6,7 September 2019 Organized by Kerpic Akademi and Kerpic Network.

The conference scope will focus on using earth for housing, “Earthen Heritage, New Technology, Management”, The study will range from the graduate programs, together with the academics and professionals to exchange results and experience. It will be an opportunity to understand the strategy and the advances how to use the contemporary construction technology, using earth-based material.

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Examples of Religious Structures in Traditional Adobe Architecture: Bayat and Savranşah Mosque in Denizli Çivril Architectural Characteristics and Conservation Issues

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ABSTRACT

Civril; It is located within the boundaries of the Denizli Province, in the Upper Menderes Basin, in the Aegean Region. 6 km away from the district, Beycesultan Mound, base the history of the region upon BC 5000s.

The archaeological history of Çivril, the architectural feature of the Bayat and Savranşah mosques are main reason for choosing these buildings as the subject of the study.

Bayat and Savranşah mosques in the Bayat and Savran quarters of Çivril are separated from the other mosques in the region by their construction techniques and interior decorations. These buildings are similar to construction technique, material, plan type and their construction dates are very close to each other.

Both mosques were built with adobe construction technique and it is used carving ornaments decoration method. The adobe wall elevates up to the ceiling after the alternating wall technique that exists in several rows.

Within the scope of this declaration; It is planned to make in-situ inspection and photographic documentation regarding both buildings and to determine the conservation problems by examining the current situation and deterioration of the buildings. The aim of the study is to reveal architectural features and conservation problems of buildings.

Keywords: Adobe, Earth Architecture, Adobe Mosque, Bayat Mosque, Savranşah Mosque.

1 INTRODUCTION

Çivril is located in the inner Aegean Region and is 95 km away from Denizli 'Fig. 1'. Agriculture is the main source of income in the district with a population of approximately 60 thousand. Beycesultan Mound and Eumania Antique City which is in Işıklı neighborhood are located. Bayat and Savranşah Mosques which are in Bayat and Savran districts attract similar attention with their similar architectural features.

Period mosques with similar architectural features are common in and around Denizli. As a result of the literature research, in the study conducted by Nilgün Çevrimli within the Directorate General of Foundations, it was found that Bayat and Savranşah Mosques were included in the inventory of 71 buildings identified as Flat Ceiling Wooden Mosques in Denizli [1].

The aim of this study is to examine the architectural features of the Bayat and Savranşah mosques and to determine the conservation problems and studies were carried out in this context.

Within the scope of the study, architectural features and conservation problems were determined in both mosques. In this context, the spatial definitions were made and the approximate measurements of the interior spaces of the buildings were taken and the structure, structural elements, construction techniques and material properties were examined. Structural and material deteriorations in the interior and exterior of the buildings were detected within the visible areas. In addition, photographic documentation was carried out in the buildings.

A literature search was conducted and articles, a publication of the Denizli Metropolitan Municipality[1] and a master thesis on Savranşah Mosque[2] were prepared was seen.

Figure 1. Civril's location on the map of Turkey [2].

2 BAYAT MOSQUE

2.1 Location and History

Bayat neighborhood where the mosque is located is 17 km away from Çivril district center and the population of the neighborhood is 103 according to 2018 data.

Bayat Mosque; according to an inscription on the beams in the roof system, it was built in 1872-1873 [3]. Mosque; it has been registered as a cultural asset to be protected by the decision of the Regional Council for the Conservation of Cultural Property Izmir II in resolution 1825 of 13/02/1991 [4].

This building with wooden poles and hand-drawn; is exist with the portico for late comers and place of worship. The mosque, which is located at the entrance of the neighborhood, is being used instead of the mosque which cannot be used today.

2.2 Architectural Features

The building is accessed through a garden whose walls were built of mudbrick blocks on rubble stones.

The mosque was built with adobe blocks on rubble stone. The roof system of this mosque without a minaret is originally dirt and nowadays it consists of wooden beams, bond timber and mats 'Fig. 2'.

[1] "Denizli Cultural Invertory", Denizli Metropolitan Municipality Cultural Publishing, Publishing Number: 80.

[2] Mavuşoğlu, N. İ., Restoration Project of Savranşah Village Mosque, Master Thesis, Istanbul Technical University, Institute of Science , Istanbul, 2008.

Building; has a single indoor space of approximately 7,60x7,70 m, which is reached through the portico for late comers 'Fig. 3'. The height of this place is around 4,30 m.

There is a profiled cushion in the section where the main beams sit on the supports. With the beams in the east-west direction over the main beams, the load of the top cover was transferred from the walls to the supports and a stepped ceiling was made [1].

Some of the bond timbers seen in the space have geometric motifs at the end. Ground covered with dirt.

Indoor walls are covered with plant motifs on limewash, geometric decorations and religious depictions.

In the color printing technique, depictions such as servants, tulips, oranges and pomegranates and Kaaba depiction are seen. Allah, Muhammad, Abu Bakr, Omar, Osman and Ali are written in the panels at the top of the walls. The scriptures also include verses from the Qur'an [5].

The wooden mimbar is located on the right side at the entrance to the interior 'Fig. 4', pulpit on the left. Islamic motifs continue in the mihrab section. Rag-stone wall can be seen at the bottom of the mihrab.

Figure 2. Bayat Mosque Entrance Facade View, 06 June 2019.

Figure 3. Bayat Mosque Interior View, 06 June 2019.

Figure 4. Bayat Mosque Interior View, 06 June 2019.

2.3 Conservation Issues

There are losses in the adobe blocks forming the garden walls. The entrance door of the garden which is used today is not original and an entrance opening was created from the concrete section connected to adobe blocks.

A large part of the roof of the portico for late comers is ruined at the entrance to the building. In the collapsed section, adobe blocks belonging to the original structure can be seen 'Fig. 5 '.

Disturbances in the structural system of the structure; deformation of adobe material on walls, plaster losses, there are cracks in the existing plasters and deterioration of the carving 'Fig. 6'. The building receives water from the roof and there are deteriorations in the wall system and carving. The masonry section housing the facade wall is plastered with cement. In addition, the building receives water from the ground and there is subsidence at the base.

The mosque is not used due to existing deterioration and damages.

There are no emergency protection measures in the structure, some of which is demolished, and the rest is in danger of collapse.

Figure 5. Bayat Mosque Interior View, 06 June 2019.

Figure 6. Bayat Mosque Interior View, 06 June 2019.

3 SAVRANŞAH MOSQUE

3.1 Location and History

Savran neighborhood is 9 km from Çivril city center and its population is 479 according to 2018 data. Savranşah Mosque was built in 1882 and the inscription on the gate of the mosque contains the person who built the mosque [3]. Building was registered as a cultural asset to be protected with the decision of High Council for the Conservation of Cultural Property numbered 882 dated 12/04/1985 [6].

Savranşah Mosque is shown as an example of the flat roofed mosque architecture with wooden posts [7].

Structure consists of three places; the portico for late comers, the place of worship and women's loge.

There is a reinforced concrete mosque built in 1983 about three meters to the southwest of Savranşah Mosque [7].

3.2 Architectural Features

The building was built on rubble stone and cut-stone material with adobe construction technique. There is dirt on the wooden beams and bond timber. Today, there is a protective shelter made of space frame system on the building. The steel columns of this roof fit into the concrete supports 'Fig. 7'.

Figure 7. View of Savranşah Mosque Entrance Facade, 06 June 2019.

The interior of the mosque, which has two graves in front of it, is reached by the portico for late comers, access to the space with 4 risers. There are pedestals made of travertine under the wooden columns at the portico for late comers. The floor of this section is travertine coating on original rubble stone material which is nowadays application. In the portico for late comers there are floral and geometric motifs on limewash. The staircase in this section leads to the women's loge 'Fig. 7'. The entrance door to the building is original and the interior wall where the door is located is painted with stone imitation paint 'Fig. 8'. There are two spaces at the entrance on both sides approximately 13 cm high from the floor. The interior, which measures approximately 9,90x10,80 m, is divided into three sections with wooden bearing arranged in two rows.

These bearings are approximately 105 cm in diameter. The interior height is close to 6 m and all walls are decorated with geometric, floral or Islamic motifs 'Fig. 9'. Particularly the motifs in the mihrab section attract attention. On the left side of the mihrab is the pulpit, and on the right is the mimbar. The mimbar is made of wood and features geometric motifs 'Fig. 10'. These motifs continue on the ceiling indoors.

Figure 8. Savranşah Mosque Entrance Gate, 06 June 2019.

Figure 9. Savranşah Mosque Interior View, 06 June 2019.

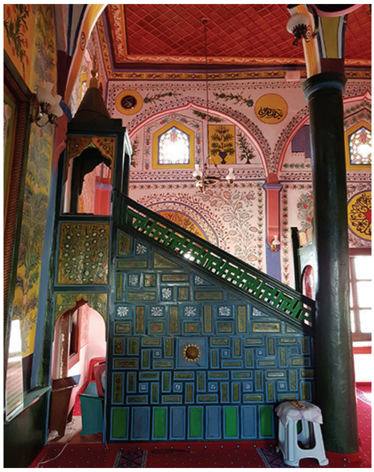

Figure 10. View of the mimbar, 06 June 2019.

3.3 Conservation Issues

The mosque, which underwent restoration in 2011, is now open for use. The building, which was ruined and unusable before this date, was re-usable within the scope of conservation and restoration. Its structure, walls, floors, roof and architectural decorations have been repaired considering the original state of the building addition, a roof with a space frame surrounding the structure was added during these works.

The mosque, known to be flat roofed in its original state when compared with similar period structures, disrupts the originality of the roof frame with space truss system added on the repaired roof after the restoration works.

The protective shelter constructed with the space frame system is hinders the visibility of the building.

Corrosion in the steel columns of the roof and deterioration of the reinforced concrete supports are observed 'Fig. 11'.

Figure 11. Savranşah Mosque Entrance Facade View, 06 June 2019.

4 CONCLUSION AND EVALUATION

The conservation and restoration work of Bayat Mosque cannot be carried out due to bureaucratic processes until today. The building is in danger of collapse and there is not even an existing survey. In recent years, there have been reports in the media that the building is about to be demolished and official institutions have requested conservation and restoration work. These demands, which have been continuing for many years, have recently come to a conclusion and the project process for the conservation and restoration of the structure is about to begin. The structure is in danger of collapse. Emergency protection measures should be taken at the mosque until the conservation and restoration process begins.

Savranşah Mosque maintained its original function as a result of conservation and restoration works carried out in 2011. Although these studies are positive, the conservation framework contradicts the value of originality. Although the original flat roof was preserved and repaired, a steel form was added.

The protective shelter is closing the building and a heavy and sustainability controversial element has emerged. It is recommended to remove this roof, which contradicts the originality of the building and negatively affects its visibility.

The master thesis, which was made in 2008, includes the identification of conservation problems and conservation proposals of the structure, and the applied conservation framework was realized independently of this scientific study.

Bayat and Savranşah mosques are the architectural heritage that must be preserved with their original architectural features.

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Stability of Earthen Structure in Earthquake (Case Study: Earthen Domes in Bam, Iran)

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ABSTRACT

The devastating earthquake 0f 26 December 2003 in the historic desert city of Bam caused the destruction of vast part of city and its citadel Arg-e Bam. This natural disaster had learnt lessons from earthen architecture. Although the earthquake caused major structural damage to new and old buildings, some structures like earthen domes had remarkable resistance.

This article intends to review the events of earthquake and so study the stability of earthen domes, and finally introduce the plastic (p.v.c.) mesh and bar materials in reconstruction and restoration of that domes.

Keywords: Earthen architecture, earthquake, stability, Domes

1. INTRODUCTION

The earthquake on December 26, 2003 caused a lot of damage. A great part of these damages was due to collapsed structures falling on people who were sleeping. In addition to the damages done to a great part of Bam city, there are some buildings which were not destroyed but have suffered small damages.

Round parts and Domes had remarkable stability among the collapses and underwent less damage.

This paper is based on the observations and documentations of writers during the first days after the earthquake, starting with a review of those days; it then describes the damages of the buildings. Afterwards, some of the stable buildings including Domes are introduced; at the end of this part the reasons why the Domes are more stable are stated. In conclusion this paper talks about the maintenance of one of the Domes in the center of the earthquake, Arg-e-bam.

2. BAM AND ITS HISTORICAL BACKGROUND

"Bam is located in the south of Iran and had a population of eighty thousand people (at the time of the earthquake). The studies show that the city dates back to the Ashkaninan era (250 BC to 226 AD)" (Karimian , 2004 , p.58).

"The constructions remaining in the Arg is mostly from the Islamic period about which geographers of that period have extensively written " (Mehreyar, 2004,p 41).

"In the old stories and legends there are historical backgrounds for Bam but about its urbanism there is information in the Islamic Period which mentions the presence of urban elements, architecture and some of the Arg features. Bam city, great mosques, Bazar and the four gates of the city and their names were mentioned" (Mehreyar, 2004,p 43).

Figure1. the location of bam's region (authors).

3. MAJOR IRANIAN EARTHQUAKES OF THE 20th CENTURY

Iran is one of the most seismically active countries in the world, as more than 90% of the country falls within an active seismic zone, the Alpine-Himalayan belt. This earthquake–prone country has experienced more than 130 quakes with a magnitude of 7.5 or higher in the last seven decades; in the 20th century alone, more than 126,000 people have died in earthquakes.

The country's high seismicity, structural vulnerability, and low-level preparedness have resulted in devastating earthquakes killing thousands, leaving tens of thousands homeless, and disrupting agricultural and industrial services, critical components of the citizens' livelihoods. Most recently, the Bam earthquake of 2003 killed more than 40,000 people, leveled the ancient citadel of Arg-e Bam, and left thousands homeless.

4. THE DECEMBER 2003 EARTHQUAKE IN BAM

"In the morning of December 26, 2003 a strong earthquake with a center near the city with a magnitude of 6.3 devastated the city and caused the death of half of its citizens"(Croci , 2003,p37). "The first reports from buildings' status of Bam indicated a great number of destruction.

Adobe buildings with Domes were damaged but not destroyed since in earthquakes their function is their shape. Adobe buildings with Roman ceilings, had buoyancy in the place of the curve and the group of buildings with the cylindrical cover had a desire to stay, since they had clef, but just the parts that were separated collapsed. The buildings that were made of cement were more stable than buildings that were made of mud and adobe. There were seven or eight building made of concrete that stood very well. There was a school made in 1936 which stood well although it was made of bricks. The walls around the roof faced more danger and damage. The walls that have the weight of the ceiling and don't have a hasp weren't destroyed. The walls that didn't have any weight on them were destroyed if they didn't have a hasp. The ridge is dangerous and vulnerable. The buildings that had a vertical and horizontal hasp and their connections were made correctly, are stable" (Mehreyar, 2004,p 49).



Figure 2, 3. Above left and middle: the demolition of urban fabric in Bam after earthquake (authors).
Figure 4. Above right: the demolition of Arg-e Bam after earthquake (authors).

5. DAMAGES AND DEMOLITION

A great mass of buildings, infrastructures of the city, the historic region of Arg-e Bam and water canals (Qanats) were destroyed, and as a result the human life of the city was endangered. These damages are mainly divided into two major parts:

5.1. Human and social damages

The death of forty thousand people in this earthquake is a human disaster that caused lots of people's lives to suffer. In this situation lots of children became orphans and old people and injured people got into trouble. The social structure ruptured due to family relationships.


Figure 5,6. Human and social damages caused by earthquke in Bam (authors).

5.2. Body destroys

A great remarkable part of the city, both in the old part and in the new part of the city, had serious damages that rendered these parts unusable.



Figure7. (above right): The view of damaged Arg after earthquake (authors).
Figure 8. (above left and middle): Body destroys caused by earthquke in Bam (authors).

6. RESCUE PROCESS

Immediately after the news was announced, a lot of Iranian people and rescue groups from all over the world came to help the injured. The presence of Iranian experts and their knowledge about modern rescue activity and the necessity of educating experts on this field caused to establish a Master of Science in the field of reconstruction after crash.



Figure 9,10. (above left and middle): The rescue process after earthquake in Bam (authors).
Figure 11. (above right): The presence of red cresent for rescue process after earthquake (authors).

7. REMAINED BUILDINGS

Among the masses of destruction, some of the buildings suffered less damage and have remained. The structures with Bad band and hasp, and some of Dome and light structures are included.
The following pictures show the remained building from both historic and new parts of the city which resisted in earthquake.



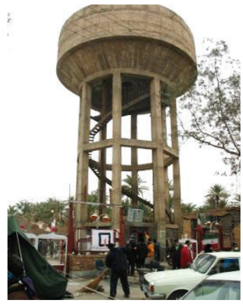
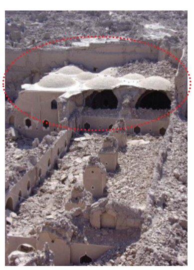



Figure 12,13. (below): The stability of Bam's jame mosque in earthquake (authors).
Figure 14,15,16. (above): Remained buildings in bam's earthquake (authors).

8. DOMES

Some of the Dome structures and earthen structures among the wrecked buildings have attracted us. These Domes are made with different methods and are scattered in the old city.
"The impact of the earthquake on the built heritage of Bam and its infrastructures demonstrated that it was the lack of quality of construction and engineering of the buildings that was the main cause of damage rather than the construction materials themselves. This also demonstrates the need to document and understand building and material performance properly. This is particularly important in the development of seismic earthen architecture technology for future use in Bam and elsewhere in Iran" (The Bam Declaration and Recommendations, 2004).



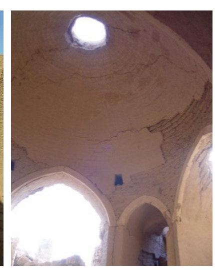



Figure 17,18,19,20. Remained earthen Domes in bam after earthquake (authors).

The existences of pressure forces on the top of Dome will due to compress the materials. In base parts with existing tension forces the parts are separating. When an earth quick is happening the walls that have the weight of dome because of same distribution of lateral forces caused by dome weight will get the weight together. This issue will cause that domes be more stable facing earthquake.

If some parts of the wall and dome fall down the existence of tension forces in the stem will cause that the internal forces of materials shift to the near parts and the remaining parts of the dome stands. Any how this fall down will stop at the neutral and a great part of the dome will stand.

Decrease of the dome's thickness at the top will cause to become light and decrease the mass at the top. So the gravity center of the forces goes toward down and it will cause that the structure move less in an earthquake.

9.STABILITY OF DOMES

"From the stresses produced in domes which has resulted excessive cracks, which could be seen easily, and from the form of construction at the base of the domes, and due to the fact that masonry domes with double curvatures cannot resist bending and can only undergo compressive stresses, there is a very close similarity between the behavior of masonry domes with the behavior of concrete shell domes which are designed following the membrane theory. To get to conclusion it is necessary to refer to the membrane theory in shel

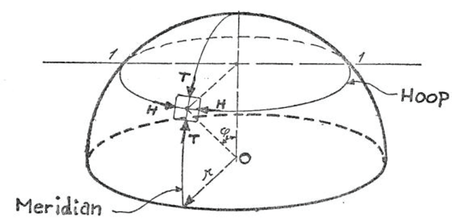


Figure 21. shell membrane theory applied to masonary domes (Gregorian,1974).

We can investigate the variation of the T and H forces at different points of the dome, it is enough to vary, Φ1 from zero to 90 degrees. The following will be the result:

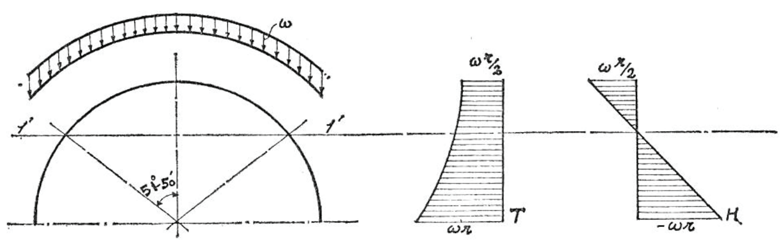


Figure 22. The stress chart in masonary domes (Gregorian,1974).

It could be easily seen that the amount of T is always positive which means always compressive as could have been predicted from the beginning , though increasing from a minimum of $\frac{wr}{2}$ at the top to a maximum of wr to the base. The force H is compressive from the top of the dome to plane 1'-1' which has a centeral angle of 51'-50" , from whereto the lower parts of the dome the hoop force becomes tensile increasing from a value of zero to a maximum of wr at the base of the dome.

Thus the following conclution are obtained:

A-along the meridians there is always ocmpression which increases with the angle Φ1

B- the forces H acting on horizontal circle produce compression at the upper horizontal circle of plane O'-O' but tension in horizontal circles in lower planes of 1'-1' increasing from zero tension at 1'-1' to a maximum at the planes of 0-0 causing cracks as shown on sketch below.

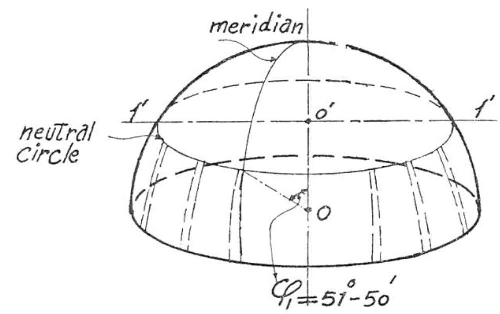


Figure 23. shell membrane theory applied to masonary domes (Gregorian,1974).

Observing the cross section of masonry domes it could be easily seen that the thickness «t» increases from top to the base to overcome the increasing compressive stress T and tensile stress H, and cracks seen on this type of domes are mostly resulting from forces H and at the lower parts of the neutral circle along the meridians this could be easily seen on the following existing buildings:

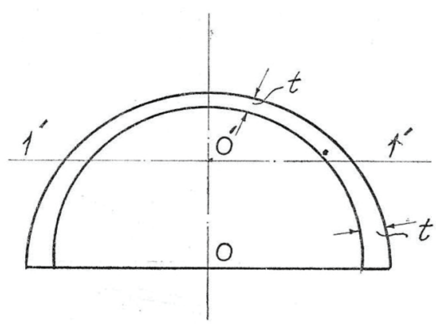


Figure 24 : the cross section of a masonary domes (Gregorian,1974).

To resist the tensile H force, provisions has been made to increase the thickness of the dome where tensional hoop force exists or providing heavy hexagonal or octagonal bond-beams around the periphery of the dome-thus increasing the area to get less tensile stresses.

In several cases the H stresses have been calculated by the writer which has resulted small tensile stresses which though is not acceptable theoretically, but small tensile stresses could be resisted by masonry by means of mechanical anchorage and bond between bricks and adhesion of mortar to bricks ,(or by means of wooden bond beams) such investigation has been made and special type of bricks laying has been observed in the lower parts of domes which resistance to tension has to be investigated by means of making small size models and putting them under loading" (Gregorian,1974).

10.THE STRENGTHENING METHOD FOR STRUCTURES AND BASES IN DOMES WITH PLASTIC MESHES

So from what is given in previous part, the stability of domes mostly relies on the stability of Containment structures which are the built walls and vaults in the base of the Domes. Considering the gained expriences from the bam's earthquake, the Based research center in Arg-e-bam initiated studies related to the methods for strengthen the walls and vaults with different materials.

One of these methods is the use of plastic bars in walls and strengthens walls, vaults and arcs with plastic meshes which the following pictures show the use of this method.

In this method the bases firstly strength with plastic meshes to increase the resistance to earthquake forces and then the dome will build on the bases.

Figure 24,25,26 : the vaults and walls are strengthen with plastic meshes (Archives of bam's research center,1997).

Figure 27,28,29 the bases are strengthen with plastic bars (Archives of bam's research center,1997).

11.CONCLUTION

Although the bam earthquake had extensive destruction, it gave us informative lessons. Collapsing of roof and debris had mainly cause the casualties. The light structures such as domes had remarkably resisted because of the monotonous distribution of forces. If the lateral walls tolerated the earthquake forces, the appropriate weight and the monotonous distribution of forces prevent it to collapse. Strengthening the bases and walls for increasing the stability of domes with using the plastic meshes is one of the issues that considered in this article.

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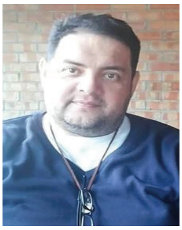
Earthen Construction as New Architectural Life Style City of the Orient Suakin – Africa



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ABSTRACT

Speaking about the "City of the orient" SUAKIN in the state of Sudan which can be presented as a sample of a Historical city built by Earthen construction which most of the existing buildings needs preservation, Suakin is the primary significance of this paper, where we should take into consideration of Earthen Architecture is a feasible, affordable, durable, cost-effective, environmentally friendly construction method which can be promoted as new architecture Life style for an Orient city which this study will re-purposing the function of each restorted building in a way to make it more modernized as today life style. After restoring this building, we can use the them as the following:

Education (nurseries, schools, institutes, and universities), **C**ulture (theaters, museums, libraries, and cultural centers), Health (hospitals, clinics, health centers or labs), **P**ublic Administration (municipalities, governorates, courts of Justice, ministries), **T**ourism (hotels, resorts, youth hostels, etc.), **T**rade (bazaar or souq area constructions), **R**esidential (residential districts, Houses, Villas).

Suakin is a port city on the Red sea coast of the Sudan state built between the 16th and 20th centuries under both the Ottoman and the Egyptian influence, Suakin is located nearly opposite Jeddah – Saudi Arabia and many of its architects were Hedjaz's, who emulated the Jeddah style. Suakin had two districts, Geif (alongside the coat) and the Gezira (the island) which is a flat oval-shaped island, about 750m long and less than 500m.

Suakin as a city which can be presented as a new life style method, where its Earthen Architecture reflects a 500 years of architectural tradition identified **E**gyptian- **O**ttoman and Hijazi's Architecture and used in either primitive cultures since 1500 AD, the among all the important historical civilizations across African eastern coast. Examining historical paradigms (use of wood, stone, thatch and earth as architectural material) offers us therefore an insight into how we can re-employ the architectural know how in a way that is fully adapted to the particularities of each locality and habitat, while facilitating and improving the construction process thanks to modern technologies.

Furthermore, Studying Old city of **SUAKIN** - Africa as an example of Earthen Architecture- New life style in project of restoration the entire city that have been carried out in different aspects and provides us with the most convincing argument as regards the need for an extensive use of Earthen Architecture- new life style as an environmentally friendly, sustainable and cost-efficient alternative.

Keywords: Historical city, Earthen building, Restoration, Suakin, re-purposing, modernization.

1 INTRODUCTION

Suakin as a city was considered as one of the most important PORTs in all the eastern cost of Africa in general and the most important port in the western coast of the red sea, because of:

- Its location opposite to city of Jeddah, where millions of the Africans Muslim go to Mecca to participate in pilgrimage where they come to Jeddah from Suakin then mecca and Medina and then Jerusalem once a life as a most.

- Many of Mecca's ASHRAF settled in Suakin, This gave the city more important.

- Its Topographical location as an ISLAND lies in a lake on a short river coming from a sea, Which is a very magnification combination in Topography takes tourists to be interested in staying there for a time.

Starting by the name of Suakin, where there are many interpretations for the name:

- Some are depending on the word (sakin ساكن) which means (Habitant), where suakin is the plural of (Sakin ساكن).

- Others are depending on the word (wasa- jin / سواه- جن) till it became Suakin / which means Made by the jinn.

- Others also thought that the word suakin came from the Arabic word (suk – سوق) which means also Market.

2 LOCATION

Suakin is located on latitude 19.5 degrees north of the equator and 37.5 degrees east longitude. And was famous for the old and was passing by the trips after crossing the ports adjacent to him such as the port of Qunfudah and the port of Jeddah and the port of Laith and the port of Yanbu in Saudi Arabia and the port of the short and Safaga port in Egypt. It was originally an island and then expanded to the coast and then reached the city of Suakin comprising the island and the coast. *(See Figure: 1)*

Figure 1. Location of city of Suakin on the west coast of the Red sea.

3 TOPOGRAPHY

Suakin is built on a flat, oval-shaped island of about 750 meters in length and less than 500 meters wide, in a narrow, red sea-rimmed lagoon connected by a paved road. The coast consists of swamps, coral reefs and plains bordered by hills covered by sprawling shrubs and seasonal valleys Autumn Rain provides amounts of water. (See Figure: 2)

Figure 2. Suakin Island.

4 THE CLIMATE

In the winter, seasonal winds produce a cold breeze and rain, but in the summer the weather changes and is closer to the warm summer atmosphere of the Indian Ocean and the wind is accompanied by dust storms from the desert.

5 HISTORY OF SUAKIN

To understand Suakin Architecture and who all these heritage mix came from we need to study the history, social life, Weather.

It is known that Suakin was inhabited since ancient times, and became known after the emergence of Islam and became more famous after it was able to replace the affliction as a commercial outlet for the kingdoms of ancient Sudan and the first port of Africa for pilgrims.*1*[**]

5.1 Antiqui

Some historians point to the synchronization of Suakin's discovery with the maritime and commercial activity practiced by the Greeks and the Ptolemaist during the Ptolemaic period. It is also believed that the ancient Egyptians since the time of the Fifth Dynasty were passing through Suakin and used as a station on their way to Somalia in the Horn of Africa to bring gold and milk.

5.2 Umayyad's times

During the eighth century AD, Suakin was first mentioned in the writings of travelers and geographers and Arab historians as a city through which some members of the Umayyad family of the Quraysh tribe migrated to Egypt to escape the Abbasids after the death of the Umayyad caliph Marwan bin Muhammad in 750 AD. Al-Maqrizi said: "In the book of preaching and consideration of the plans and effects," there is a "road from the Nile to Suakin, Baad, Dahlak and other Red Sea islands where the Umayyads escaped when the Abbasid followers pursued them." This means that

Suakin moved both of my cities in abundance and affinity during a period of five centuries: from the eighth century to the nineteenth century. Other ancient Arabic sources confirm that Suakin received groups of Arab families during the ninth, tenth and eleventh centuries for the purpose of settling them. It seems that from the beginning of the Arab migrations to the year 1255, it was a small village inhabited by barbaric groups engaged in limited maritime activity, which is to serve the north and central Sudan trade routes to foreign markets. According to al-Muqrizi and Ibn Salim al-Aswani, Suakin was connected to the trade centers on the Nile and constituted a sea port for the Christian communities in Sudan through which they trade with the outside world and through which the Christian pilgrims passed on their way to the Holy Land in Jerusalem until the early sixteenth century.

5.3 Abbasid times

The collapse of the Abbasid state in Iraq and the growth of the Fatimid state in Egypt led to a change in this situation, and the short ports and ports became the main centers of trade with India. Suakin was mentioned in the Hamdani writings of the 10th century, which referred to the existence of an ancient town that originated as a small settlement of Beja and then expanded after the port of Baa'a (Massawa in present Eritrea) was abandoned in its south. The Crusades and the Mongol invasion in the Near East led to the transformation and prosperity of trade into the region. In the twelfth century AD, the Crusaders invaded the Red Sea coasts and destroyed and looted the towns and coasts surrounding it, including Suakin, and several battles took place between them and the inhabitants of those areas.

5.4 Ottoman administration

5.4.1. Selim I

In the year 1517 AD, the Ottoman Sultan Selim I conquered the city of Suakin after a short occupation by al-Fung. The city became the seat of the governor of the Ottoman administration of Abyssinia. Including the cities of Hargeeko and Massawa in the current Eritrea. During the reign of Sultan Selim Al Othmani, Suakin was included in the Ottoman province of Hejaz. Saukin traders continued to deal with the Blue Sultanate, where they assembled goods and products from central Sudan and directed commercial convoys to Suakin via Sennar and Kassala to be marketed and exchanged there with foreign merchants and then shipped under But the city deteriorated significantly under the Ottoman rule because of the policy of restrictions exercised by the Ottomans later on European traders to reduce their business through the Red Sea in an attempt to fight European ambitions in the region.

In 1540, there was a dispute between the commander of the Portuguese fleet Stefano da Gama and the Governor of Suakin. The Portuguese ships were en route from the Portuguese enclave of Goa to the Gulf of Suez for the purpose of attacking and seizing it. When they reached Suakin, they destroyed the city buildings and looted them, With the Portuguese.

5.4.2. In 1629, Suakin became a military base for the Ottoman campaign:

Against Yemen. And the arrival of the family of Muhammad Ali Pasha to power in Egypt a few years after the beginning of the nineteenth century AD and the subsequent expansionist ambitions that included the borders of southern Egypt and the occupation of Sudan in 1821, Suakin entered a new phase in its history did not recognize the Ottoman Empire Mohammed Ali joined Suakin to his property and rented it to him for a sum of money he paid annually. After the death of Muhammad Ali in 1849, Suakin returned to the Ottoman Empire.

The Egyptian Turks tried to develop Suakin to serve as a sea port for Sudan. However, Mohammed Ali Pasha's commercial policy towards Sudan did not help much. He directed the Sudanese trade towards Egypt and the Sudanese goods required by European markets pass through Egypt and its ports on the coast of the White Sea But the opening of the Suez Canal for international navigation in 1869, on the other hand, revived the sea route through the Red Sea, which was crowded with the movement of commercial vessels, which led to the revitalization of the ports of the region, including Suakin.

5.4.3. Bilateral governance:

Kachner Gate and part of the remains of the old wall Lord Kitchener of Suakin took over his forces and survived the long siege imposed by the armies of Mahdia under the leadership of Prince Osman Dukna, after the success of the campaign to recover the Sudan in 1899. *2*[**]

Figure 3. Kachner Gate- Suakin

The British began to study the idea of building a new seaport in Sudan after the English governor of eastern Sudan pointed out that Suakin was not suitable for large ships. He suggested searching for another site on the Sudanese coast where ships could enter the night in the light of a nearby light.*3*[**]

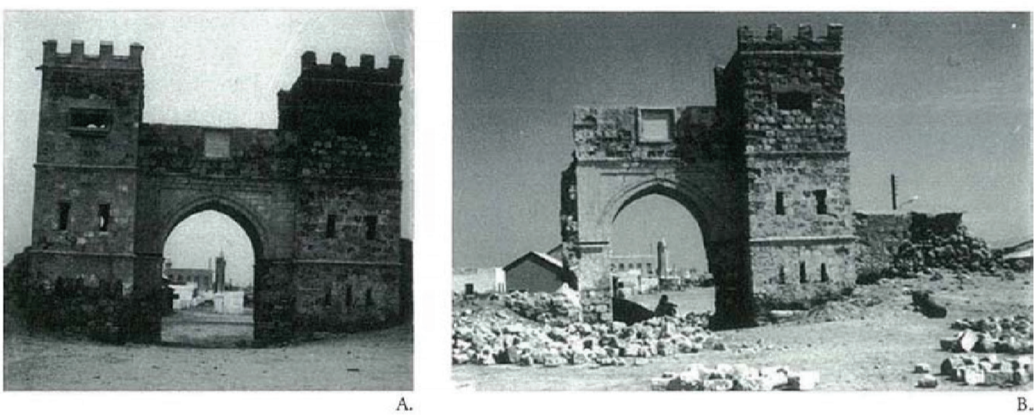

Figure 4. The rapid deterioration of buildings, Kitchener gate in I993.

5.4.4 Suakin after independence:

The role of Suakin as a seaport has been reduced to Port Sudan after most of its inhabitants abandoned it to the new city and destroyed most of its old Islamic and Arab architectural houses and became a site of ancient archaeological sites in Sudan.*4*[**]

6. ARCHITECTURE IN SUAKIN

The Phong's helped transform Suakin from a small village into a port city during their short reign, building Wall's for defense purposes, Made closed warehouses and stores around the port, and well's to provide fresh water. Phong introduced new types of **mud** and **straw housing**, completely different from the houses of the local residents and their oval tents, which were made of a kind of local rug made of straw and mats and installed on short pegs hammering on the ground. All that remains of the reign of Phong is the royal cemetery, which includes four tombs.

In 1517, The Ottoman Empire was able to take out the Phong from Suakin and began to implement a large-scale urban program. The laws stipulating that all the buildings should be built of stone, especially on the island, Where the Earthen buildings are severely damaged by moisture, the government then wants to make the buildings in the island of stone to reduce the maintenance work of the wall structure, and allowed the earthen buildings on the coast and inland for the lightness of moisture impact on buildings.

Most of the buildings in Suakin consisted of two floors, three floors with vertical walls and prominent balconies known as Roshan. They were about two meters long. They had closed window, windows decorated with interlocking, interlocking strips of teakwood that protruded from the façade and overlooking the street called **Mashrabiya.** (See figure: 5)Tea is consumed. The buildings were built with white-painted coral reefs from inside and outside. The house has a Diwan known as a wide dining room, as a reception room.*5*[**]

Figure 5. Old picture for Suakin in 1928, showing the **Mashrabiya's** in the city.

Most buildings can be divided in terms of architectural style into two categories:

6.1 Buildings built before 1860 and derived their architectural style mainly from the architecture that was prevalent in the city of Jeddah on the opposite side of the Red Sea coast is a distinctive Ottoman, style Mashrabiya is closed from only three sides with a window shutter.(see fig.5)

6.2 The buildings are inspired by the Egyptian Mamluk architectural style and features closed and covered marshes on all sides and have recently been added to the touches of British colonial architecture.6[**]

There are some buildings that show a mixture of Ottoman styles in the lower part of the building and the Egyptian style on top of the building in the added parts. The tall white buildings were built in the style of urban architecture, with residential squares separated by narrow streets and small courtyards. The number of houses consisting of three or four floors in the nineteenth century about 200 houses, including the oldest Basha House history and is located in the center of the city and dates back to 1518, the seat of the first Turkish governor of the inhabitants and has no impact amid the ruins of the city today.

The buildings of the government authorities are located overlooking the sea in the northern part of the island, including the customs office marked by the arched gate next to it is the building of the province was a formal break built in 1866 as a government guesthouse (the second floor was added by the Egyptians). Along the beach there is the telegraph office and Khurshid Effendi's house, which is built in the middle of a large courtyard and a garden with a large yuan. On the other side is the building of the National Bank of Egypt, the latest history in its construction and is characterized by the walls overlooking the sea directly represents a sharp architectural style angles and the walls of the first floor in good condition.

The famous Chinawi Bey Palace, which consists of rooms with a number of days of the year and extends along the central market, was built in the middle of the 18th century. There are two mosques:

6.2.1 Hanafi mosque:
This mosque location was in the island and the structure of the mosque was better than the shafii mosque where it was still used up to 1985. 7[**]

Figure 6. Hanefi mosque & the school on the right of the picture

6.2.1.1 Plan:
The Hanefi Mosque, which is planned as a single storey, sits on an area of approximately:

20.00 x 22.30 meters. There is a rectangular courtyard measuring 11.00 x 19.60 meters in front of the rectangular place of worship *(Figure: 7).* the place of worship is separated from the courtyard by piers. Two rows of four columns, parallel to each other The piers carry wide pointed arches. Among the front row pillars, there is a parapet wall 60 cm in height (Figure 7). At the same time in the middle of this row muezzin housing is located. This cloak, made entirely of wood, is the most worn element of the mosque (Figure 8). Laying of the place of worship, 13 cm from the courtyard. More low and smooth rectangular natural stone pavement is laid on the ground. The floor of the courtyard is covered with natural stone in amorphous form with unequal dimensions. 75-80 cm. thick, 230 cm. high garden walls surrounding the height of worship unites with the walls of the mosque gives integrity to the mosque. 8[**]

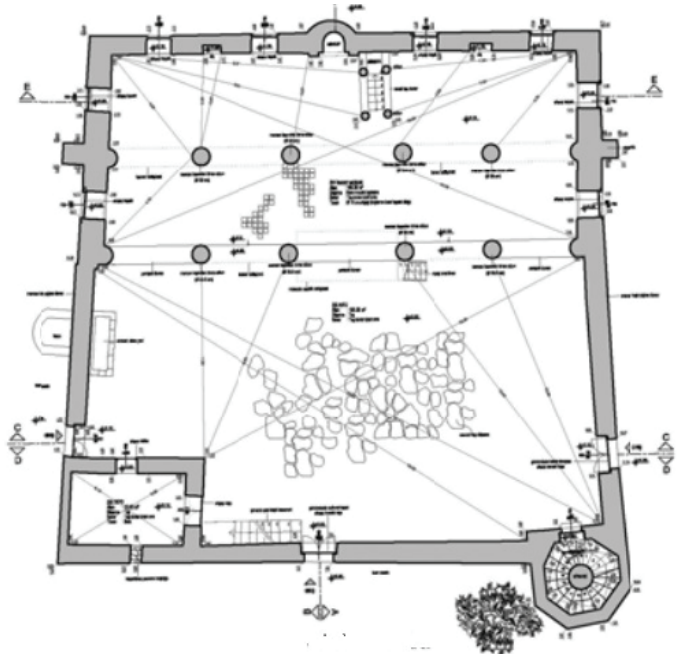

Figure 7. Hanefi mMsque Plan

6.2.1.2. Facade

The element that gives architectural features to the facades is the wooden window covers with flat lintel. These windows, which do not have a glazed joinery, are designed with doors to prevent sandstorms occurring on the island. The upper and lower parts of these covers are opened independently of each other. Middle of the covers at the upper level (approximately 2.80 m height from the ground).

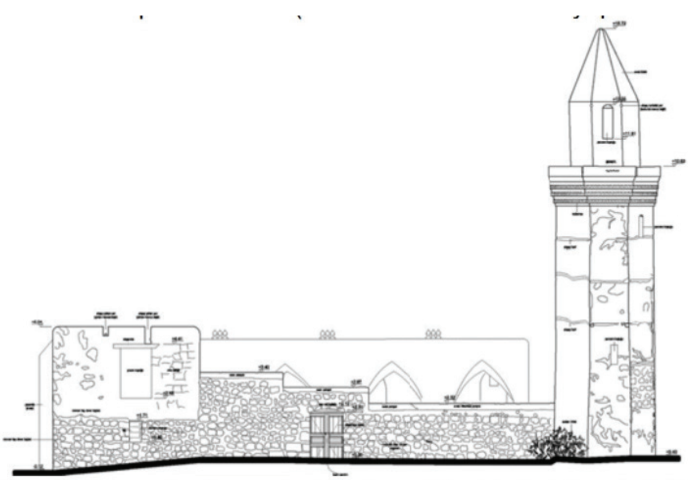

Figure 8. Hanefi mosque South west elevation

There is a fixed wooden grid in the skylights (Fig. 8). The stone cherts coming out of the Northeast façade at the roof level add a special feature to the façade. In general, there is no problem with the carrier system, but there are breakages in all plasters.

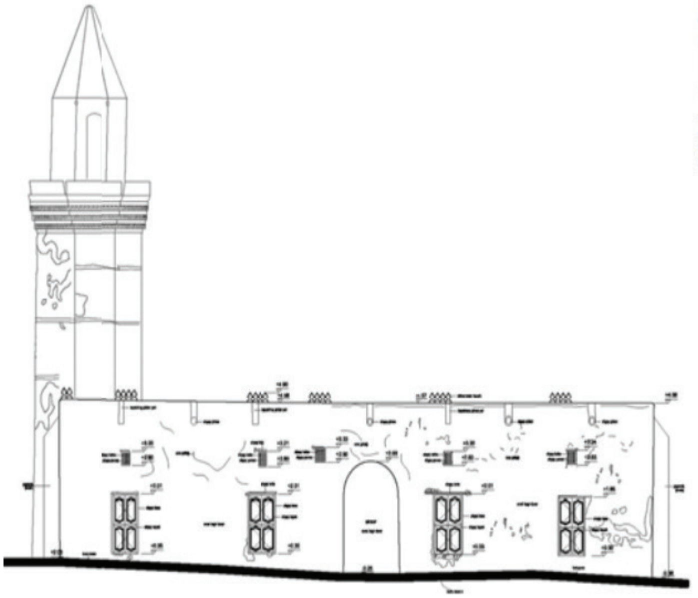

Figure 9. Hanefi mosque North east elevation

6.2.2.3 School (medrese):

There is a two-storey primary school located west of the courtyard and adjacent to the garden wall. The ground floor is accessed by a single-leaf wooden door and the upper floor is reached by a staircase with 9 stone steps. Although there are window gaps in the structure, never before It is noteworthy.

6.2.1.4 Minaret

The minaret is located in the south of the mosque and has an octagonal plan and adjacent to the mosque. in height. There are profiled moldings on the part where the facade protruding from the façade joins the body of the minaret. The wooden beams on the main body walls of the minaret, which also has a stone cone, add emphasis to the facade in a horizontal plane.

6.2.2 The Shafi'i, mosque

This mosque location was in the island and the structure of the mosque destroyed because of lock of maintenance.

6.2.2.1 Plan

The shafii Mosque, which is planned as a single storey, sits on an area of approximately:
36 x 22.5 meters. The elevation of the mihrap (north east) is the only elevation having no entrance. Where the other 3 elevations are having entrances. There is a rectangular courtyard measuring 12.00 x 18.00 meters. Three rows of four columns, parallel to each other towards the Mihrap.

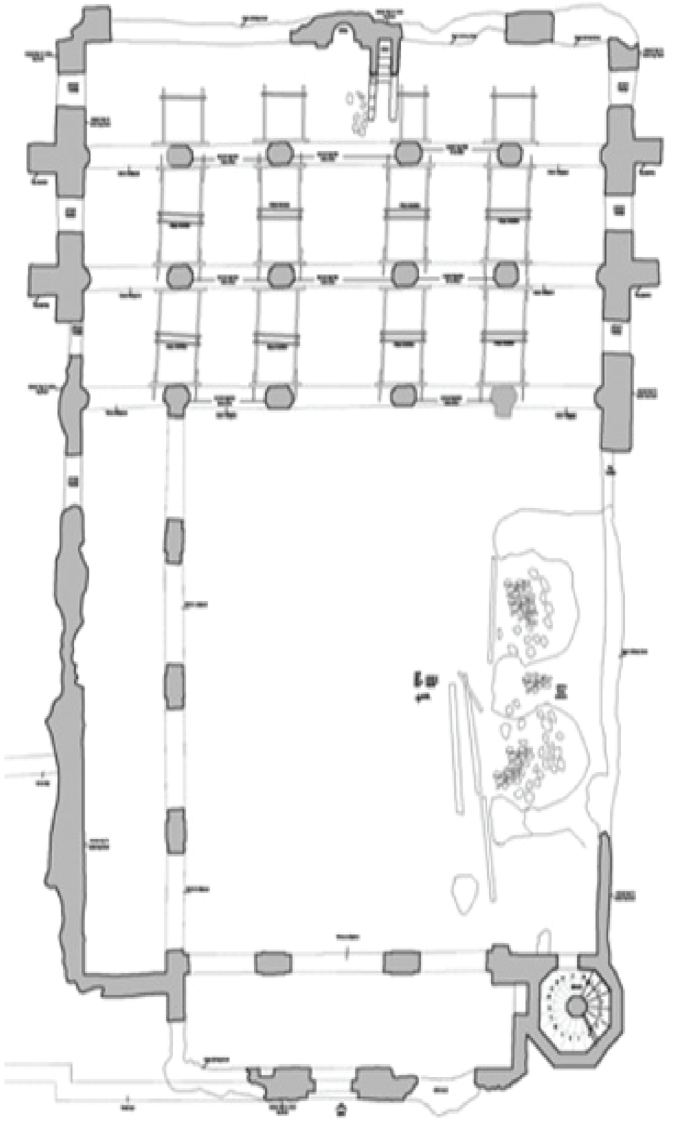

Figure 9. Shafii Mosque Plan

6.2.2.2 Elevation:

Since the large walls of the mosque were destroyed, the window arrangement on the façade could not be seen clearly. When you look at the courtyard of the mosque prayer section Riwaq façade gives the most ideas from the architect. (See figure :10)

6.2.2.3 Minaret

The minaret is located in the south west of the mosque with 17 m hieght. İn better shap than the external walls. (see figure :11)

Figure 10. Shafii Mosque Mineret

Figure 11. Shafii mosque main elevation

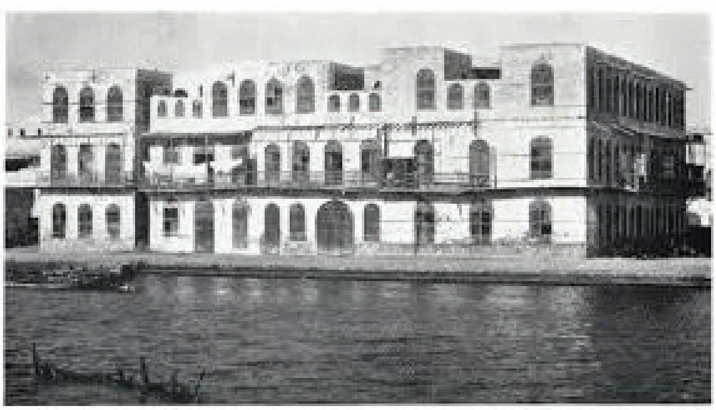

Figure 12. Chinawi Bey Palace

The inauguration of the Suez Canal in 1869 opened the first cotton mill and the first boys' school that sent its students to Cairo to sit for the primary certificate exams, a hospital, a post office, a customs building and a telegraph office. 9**

During the Mahdia revolution in the early 1880s, the British took over the city and built a 3-mile-long stone wall supported by 12-foot-high fortifications around the city in the Qayif area. The main entrance was the Kutchner Gate. 10[**]

«This is the gateway to eastern Sudan. Peace be upon everyone who enters or leaves through it » General Gordon Pasha built a short paved passageway from Bar al-Qayif to the island in 1877 and the buildings of Qayef are still mainly built of wood.

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A study on the earthen houses located in Chikan village of Iran in terms of material and construction techniques

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ABSTRACT

Human beings always need a space as shelter in the form of natural environment and artificial space (man made). Vernacular heritage in spite of all of its values and harmonies are in decline. These heritage also exist in small villages and studying them can be helpful in preserving them.

The village of Chikan is located in a cold and dry climate in the southern splopes of the Zagros Mountains, and dates back to 70 years ago. The indigenous people of this village were nomads before that time. Due to the conversion of nomads into farmers, they were permanently settled in their summer-quarters. It led to the creation of houses with indigenous materials which had low cost, high build speed and no need for non-local human resources.

All building materials and tools in these houses were indigenous and made by the people themselves. In current paper, in order to better understand the aforementioned heritage, the materials and structure of buildings are carefully studied. Regarding the climatic condition, available materials and local construction techniques, the following materials have been used in chikan houses: stone (in foundation and bottom half of the walls), walnut and Poplar wood (for construction of ceilings and openings), Clay (in the top half of the walls), straw and foliage of the trees.

The data for this article was collected through field research and interviews with the indigenous people of the village. The importance of addressing this issue is introduce and analyze this type of architecture. The main goal of this paper is to preserve and document this valuable architecture for future generations.

Keywords: Vernacular architecture, Iran, Earthen architecture, Material and structure

1 INTRODUTION

A comprehensive look at rural housing suggests that housing is a social, economical, and physical locus which is built to provide suitable living conditions. Villages were the first permanent settlements in Iran. With the formation of the first permanent settlements and agricultural prevalence, Significant changes occurred in the livelihood and social process, and from the same time farming and livestock there have been the impact as a source of food and clothing and use of ability of domesticated animals in the shape and build of housing. In this environment, the necessary space for work and life, Storage space for agricultural tools and gardening and their products, breeding and keeping livestock and… is provided, for this reason, housing has a variety

of patterns. In all of these patterns is visible that attention is paid to place and use of the possibilities and limitations that exist in nature. (Final statement of the First International Conference on Rural. 1390 Settlements)
The purpose of this article is understand the dimensions of the native architecture of this cold and dry climate with a constructive and material responsiveness approach. To get useful results, we will study materials (Including how to supply and use materials), The structure of buildings (includes details of the structure and its relationship with climate, materials used and how to build buildings), and construction tools, more precisely.

2 GEOGRAPHIC AND ARCHITECTURAL FEATURES OF VILLAGE

'Figure 1.' The village of Chikan is a subunit of the central part of Ardakan city in Fars province, from southern slopes of Zagros mountains in Iran. The warmest month of the year in this area is July, with an average temperature of 24.4 °C. The lowest average temperatures in the year occur in January, when it is around 0.0 °C. The difference in precipitation between the driest month and the wettest month is 64 mm. (climatedata.org /asia/iran/fars/ardakan. At 2019/june/05 . 15:58 pm)
The old age of this village is 70 years old. The reason for choosing this area was to stay in its strategic position, namely to be surrounded by mountains to escape from the thieves, and As well as the beautiful nature of the area and the presence of lush valleys and natural amenities like a river and a waterfall and fertile land for farming.

a) **b)**

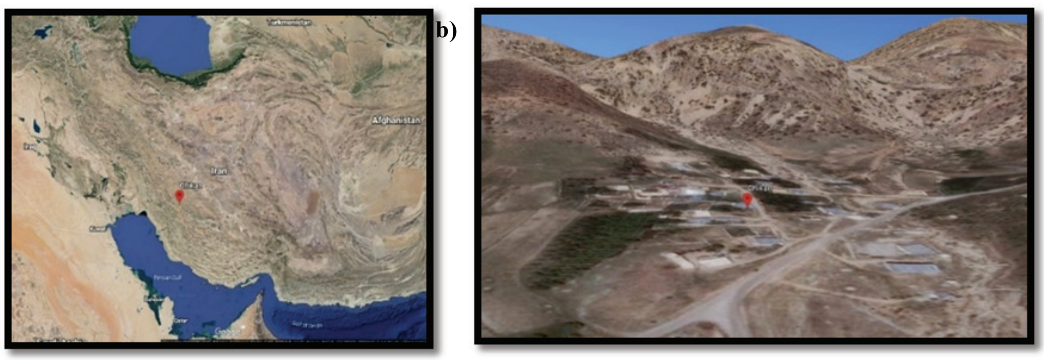


Figure 1. The strategic position of the village; google earth, 06May2019

In this village buildings are built in one floor because of the high build-up speed and heavy climate conditions. And the form of the plan of houses is made either linearly or in form of L 'Figure 2.'.

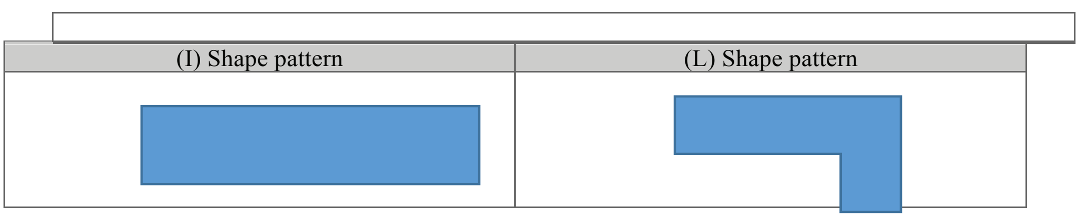


Figure 2. Examining common patterns in the villages historical texture

'Figure 3.' During the time and acquaintance of villagers with non-indigenous and industrial materials, the new fabric of village was shaped by modern materials and methods of construction.

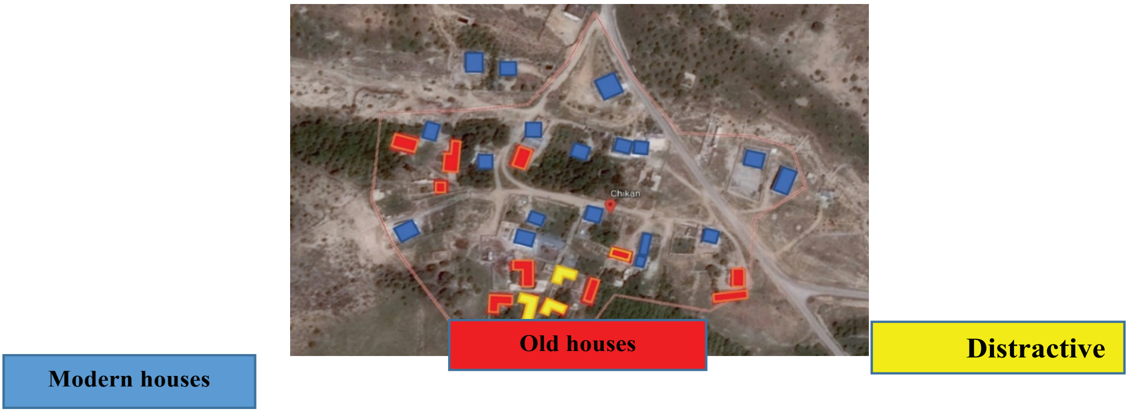


Figure 3. Plan types for houses in the village; Credit: Abdshahi, 2019

'Figure 4.' Designed spaces in the residential area included: The room that they call the guest house is the largest room in the house, a living room, a depot, a vernads in the front of the guest house and a semi-open kitchen that looks like a hut. And entrance, coral and w.c are also located in the southern part of the courtyard.

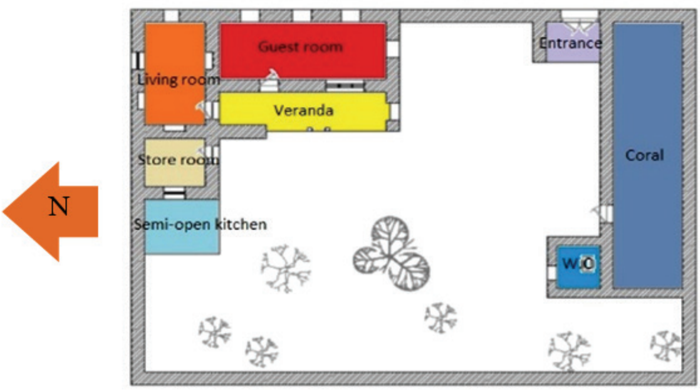


Figure 4. Schematic plan of case study; Credit: Abdshahi, 2019

3 MATERIALS

Due to the climatic conditions of the mountainous village of Chikan the materials used should be of good thermal capacity and strength. Therefore, materials in the same climate can be appropriately respond to this need, on the other hand the villagers did not have access to materials outside of their area, due to economic and temporal reasons, for these reasons, they used indigenous materials, which include the following:

1.3 Stone materials

Because of the mountainous region Stones were found abundantly, and it is at the forefront of materials in this houses, For this reasons stone is the main material of building. Materials used in building walls were stones that were extracted from the surrounding mountains, and those were carried to the construction site by a tool called Lahr. Another tool called Cenefter was used to carry materials by the pack animals. The rocks that were carried to the site were used for foundation and walls of courtyard.

2.3 Wooden materials

'Figure 5' Walnut and poplar woods were originally produced from wildling trees in the area and the waterfall. But the villagers began to plant poplar by increasing their construction and agriculture, because it had high growth rate. The use of poplar wood is seen in a large part of the structure like the structure of ceiling, doorways, door and windows of the building.

a)

b)

Figure 5. Woods worked in structures; Credit: Abdshahi, 2019

3.3 Filler materials

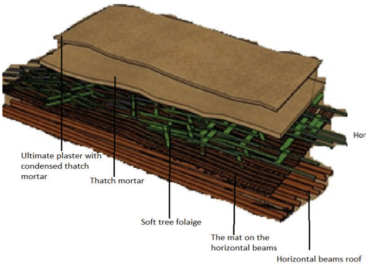
Soils are the main materials used in the villages. In general, one of the particles that affect the quality of soil is clay particles whatever the amount of these particles in soil go higher, soils have a higher quality. The use of soil has different species, due to the mountainous nature of this area the amount of clay particles in the soil is low. for this reason, to increase soil particles adhesion, they added straw to it. Soil use in this village is seen in the materials of barrier, filler, mortar and coating, which is most used in filler materials.

4 CONSTRUCTION TECHNIQUES

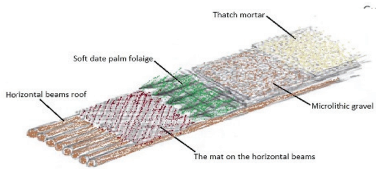
Construction techniques in this type of villages are largely impressible from its nature patterns. For building strengths such as structures of caves, they can require materials of high capacity and high strength such as stones, light materials for the roof structure, flexible and compact materials for openings.

1.4 Roof structure

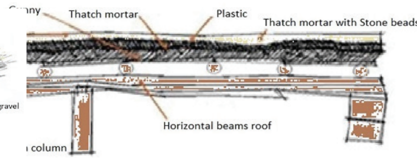
'a) Figure 6' The roofs of this village are flat which makes snowmaking easier and the possibility of more solar radiation. Low ceiling height and also a house floor, to less vulnerability to wind and lose heat. In the roof construction system, first, they placed woods on the walls, which ejected about 50cm from the edge of the wall, and put on them mortar,(To protect the wall in situations of rain where water does not penetrate the wall), after this stage, the wood was placed in parallel with the width of the ceiling on the walls and they covered it by mat which was made from the city of Zarghan (It is located 180 km from Chikan village) because of the quality and abundance of mat in this city. Then they covered this mat with soft tree foliage until the mortar that covers it does not wound mat, after this stage, they made a solid mortar that they called (Gareku) and knotted all over the ceiling and then they were flattened with a roller device called Bumgard. Then they poured thatch mortar, straw and salt on it. Below Can be seen the similarity of this structural system with two cold and mountainous climates: 'c) Figure 6' Roof houses in the village of Creek in Kohgiluyeh and Boyer Ahmad province. And warm and humid: 'b) Figure 6.' Roof houses of old texture of Bushehr city.



a) Figure 6. Roof houses of chikan village; Credit: Abdshahi, 2019



b) Figure 6. Roof houses of old texture of Bushehr city; Credit: Abdshahi, 2019



c) Figure 6. Roof houses of creek village; Habibi, 1989

2.4 Floor structure

In most buildings, the direct connection of the floor with the surface of the earth has been avoided. The use of a platform in substructure helps to do not penetrate the earths surface moisture into the house. The floors of houses were high on the ground (To prevent water penetration into the house, this level difference was filled with rock and mortar to tighten the foundation) and first it was mortar and then mud and finally plated it. Over time, and the village people access to cement, they cement the floors. The sand of this work was collected from the nearby river.

3.4 Wall structure

'Figure 7.' In the upper half of the walls of house they used clay, The clays were built in the same place by using mud and straw, so that each worker was molding 500 to 700 clays a day. The size of these clays was 20 * 30, and after two days, when the clay was tight, they put them in a standing position to dry completely. 150 cm below the wall were built with stone because of moisture and then they built up 2.75 meters high with clay. A large diameter of the walls, which is an average of 70 cm, It prevents the heat exchange between the interior and exterior of the building. Therefore, during the day, sun shines and warms up the wall and saves this heat. And it keeps heat at night and cause the home air balance.

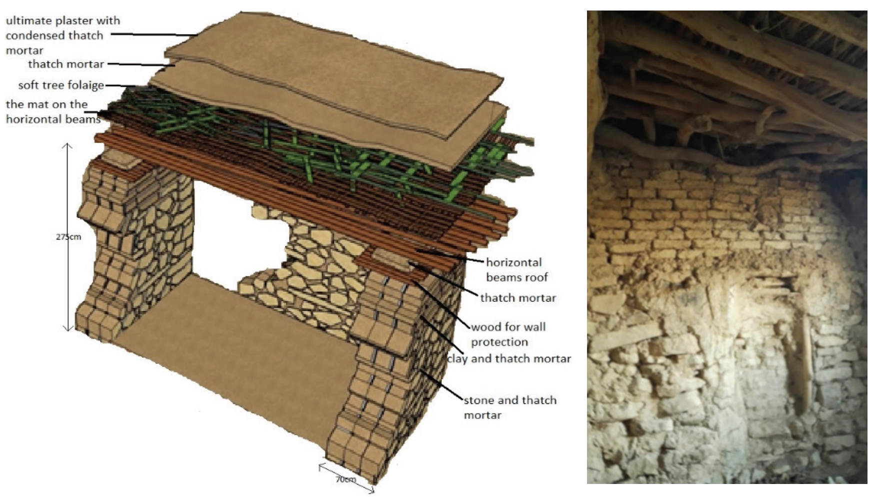


Figure 7. Wall houses structures; Credit: Abdshahi,

4.4 Opening structure

For construction of openings they put the woods 'Figure 8.' as a lintel which was made of poplar and walnut, on the two sides of gap. Walnut wood columns were used in the veranda, because the barrier wall was not in the open area. Both inside and outside of the house walls, were plated with mortar and straw, which has both a beautiful aspect and a good insulation for cold and warmth.

Figure 8. Opening structures; Credit: Abdshahi,

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5 TOOLS

The villagers needed tools to extraction of materials and their use in building houses. They made all the tools with the same materials available, including stone, wood and metal. And with the help of these tools, they made houses. These tools incude: axe, Lahr, Kenefter, Bumgard and …

1.5 Lahr

A wooden device with two tall wooden axes filled in the middle with wooden boards, It was used to shift the burden to humans, which the villagers themselves built.

2.5 Kenefter

A wooden device used for carrying loads by pack animals. This device consists of two wooden structures connected by a rope, To put materials on it and carry it to construction site. 'A) Figure 9.'

3.5 Bumgard

A cylindrical device with an approximate diameter about 25 centimeters, which was made in two kinds of wooden and rocky in the village. This device used to compact and flatten the roofs of houses, especially in the winter, The wooden type of this device 'C) Figure 9.' is the trunk of the tree that shaved it in the form of a cylinder. And its rocky type 'B) Figure 9.' is also a large stone piece that shaved it in the form of a cylinder. And there was a gap inside of this cylinder, by approximate diameter about 5 cm, to pass the timber and rotate the cylinder around the tree axis by connecting two ropes to its sides.

A)Figure 9. Wooden Kenefter; Credit: Abdshahi, 2019
B)Figure 9. Rocky Bumgard; Credit: Abdshahi, 2019
C)Figure 9. Wooden Bumgard; Credit: Abdshahi, 2019

6 CONCLUTION

Indigenous architecture patterns in the border of the Zagros mountains has a variety of unique features. According to conducted studies, some of the factors affecting the formation of the architecture of these villages can be described as follows: subsistence economy of villagers, Climatic factors, community culture of rural people, the reasons for the need to provide housing, culture and social conditions of the villagers, and the topography of the Earth. The results show that the village of Chikan has its own unique characteristics. These features include: compact fabric, a climate compatible structure, strategic position and security aspect of the village's location due to being located in the valley and surrounded from the sides by mountains.

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Analytical Correlation of Mechanical Properties of Masonry Bricks and Adobe With Pull-Off Tests

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ABSTRACT

Researchers and heritage specialists have been undertaking studies to decrease the use of destructive test methods, substituting them with non- destructive tests (NDT), minor destructive tests, or competitively low destructive test.

Specifically, by obtaining a large variety of results on the mechanical properties on various types of bricks and adobes one can more easily predict mechanical properties of similar masonry units.
The work consists of performing different mechanical tests on various types of bricks. In this experimental program two different soft mud bricks (adobe) and two different extruded bricks were collected to perform test on them.

The main purpose of this experimental activity is given by the possibility to obtain an analytical correlation from a direct measurement, three values for these mechanical properties that are related to the same masonry unit with its pull-off strength. On the basis of the results, the possible relationship between the pull-off strength and each of the other parameters (flexural, compressive and splitting tensile strength), have been investigated, taking into account the variation of the type of bricks.

Significantly, function of soft mud bricks in all correlations of pull-off strength and other mechanical properties were linear and this function was exponential for extruded bricks. These correlations will contribute to formulations able to predict the strength of units from the simple application of pull-off tests.

Keywords: Pull-off test – Masonry brick – Non-destructive test – minor destructive test

1. INTRODUCTION

Masonry is one of the oldest and most widely used construction materials in the world. Masonry`s high durability, resistance and their simple process in manufacturing, are some of the main reasons that using this material for construction contributed. Masonry constructions paly a great role in the existing constructions including historical structures and monuments and architectural buildings.

They must withstand in all different influences and loads for centuries, and must not get into a condition that may threaten their users, visitors or admires. The safety and reliability of existing and historical structures are evaluated according to criteria that established in standards and codes accepted by society in order to achieve a reasonable level of risk. Assessments of buildings according to these standards require knowledge of the conditions and characteristics of the materials and structures that have been used.

Compression, flexural and splitting tensile tests are destructive laboratory tests and in order to perform these tests on historical buildings, the units need to be removed from the structure in order to be tested in the laboratory. Moreover after all the tests, the units will collapse and they cannot be put back in the building anymore.

The work consists of performing various mechanical tests on different series of bricks. In particular, three types of tests will be carried out on each unit: i) three-point bending on the whole brick, ii) a compressive or a splitting tensile test on one of the two portions produced by the flexural failure, iii) two pull-off tests on the other portion produced by the flexural test.

To provide a large variety of results, four different types of bricks were tested: historic soft mud bricks coming from an existing structures, manufactured soft mud bricks, and two extruded bricks coming from two different manufacturers.

The main purpose of this experimental activity is given by the possibility to obtain analytical correlation from a direct measurement, three values for these mechanical properties that are related to the same masonry unit with its pull-off strength.

Furthermore to remove the influence of the geometry from the measured mechanical properties, all the result have been normalized to obtain the "pure" mechanical properties. Significantly, function of soft mud bricks in all correlations of pull-off strength and other mechanical properties were linear and this function was exponential for extruded bricks.

These correlations will contribute to formulations able to predict the strength of units from the simple application of pull-off tests.

2. EXPERIMENTAL TEST

Based on compression strength behaviour of bricks four different type of bricks were chosen to apply tests on them. Historic soft mud bricks from an existing structure, manufacturing strong Soft mud bricks with product code of A001LOF that provided from ***S.*****ASNSELMO** company, Extruded brick with product code of 601that were provided from **IBLl** ***SPA*** Company and second extruded brick with product code of M50200 that were provided from **UNIPOR** company.

Soft mud bricks that were sub divided to two category. Historical ones that has less compressive strength and contain 25 samples and they were collected from one existing structure. Industrial ones with higher compressive strength that were brought from manufactory and encompass 14 individual units. Extruded one (hard bricks) that were subdivided to two category from two different company that each group contains 14 units of bricks.

Figure 1. Visual view of different type of bricks for experimental test from left to right historic brick, soft mud brick (LOF), extruded No 1 (IBL) and extruded No 2 (UNIPOR).

2.1 Specimen Preparation and Procedure

According to ASTM C67 [1] about selection and preparation of test specimens full size bricks were selected .it was tried to choose specimens that were representative of the complete range colors, textures and sizes. Also all samples were brushed to remove dirt, mud and other foreign materials un-associated with the manufacturing process. [2]

The experimental program procedure consists in performing three types of mechanical test on the same brick: more precisely, a three-points bending on the intact brick, a compressive test or a splitting tensile test on one of the two portion produced by the flexural failure, and two pull-off tests on two bed surface on the other portion of bricks.

2.1.1 Pull of Test

Pull of test is a method to measure surface tensile strength of brittle material like bricks and concrete. This test originally were done on concrete surfaces to measure bond strength or tensile strength of concrete repair or overlay materials by direct tension [3].

This test method is suitable for both field and laboratory to determine first, near surface tensile strength of the substrate before application of repaired layer to assure of surface adequate preparation and Bond strength of repaired material to the substrate and The tensile strength of a repaired or overlay material after application of material [3].

In this test there are four different type of failure (A) failure in substance, (B) at the bond line between the substrate and the repair material, (C) in the repair or overlay material, or (D) at the bond line between the repair or overlay material and the epoxy adhesive used to bond the steel disk. If failure occurs at the bond line between the steel disk and the epoxy adhesive, discard the test result and perform another test. [4]

Figure 2. process of pull off test. Before (left) during (center) and after (right)

3 ANALYSIS AND INTERPRETATION OF RESULTS

3.1 Analysis of Experimental Results

Summary of result and coefficient of variation for each properties shows that as it was expected historical bricks were the weakest series and result were scattered in all properties. In term of homogeneity and comparability of results soft mud bricks (LOF) was best series. Result from extruded bricks showed that they react in compression force were least scattered.

In all series failure mode due to pull-off test were A (substrate failure) and results that lead to failure in bending were removed from analysis sections.

Table 1 Summary of Result of all mechanical properties on experimental tests

Specimen	*Mean value f_f N/mm2*	*C. of V.*	*Mean value of f_s N/mm2*	*C. of V.*	*Mean value of f_c N/mm2*	*C. of V.*	*Mean value of σ_{p-o} N/mm2*	*C. of V.*
Historic bricks	3.59	35%	1.986	35%	16.814	27%	0.891	49%
Soft mud bricks (LOF)	8.830	10%	5.126	16%	54.520	17%	3.0346	17%
Extruded No 1 (IBL)	4.325	30%	3.817	19%	47.808	8%	2.552	17%
Extruded No 2 (UNIPOR)	6.962	25%	6.243	32%	66.532	16%	3.183	29%

3.2 Review of Previous Experimental Program

In this experimental program because of shortage of time and finance, limited type of brick And limited amount of samples were tested and result only covers a short span of strength of bricks. For finding a correlation between mechanical properties and to be more precise and accurate and covering larger span of strength , results of previous experimental test that were done in the Department of Structural and Transportation Engineering of the University of Padua were combined with results of this experimental program and graphs were plotted.

In the previous experimental program that were done in University of Padua 51sample of extruded and 47 soft mud brick were tested. Extruded bricks coming from four different sets that three of the are from the same manufacturer and facing ones coming from four different set that each two set produced by one manufacturers.
the possible relations among the average properties of the bricks, flexural, compressive and splitting tensile strength among this tests were investigated. The flexural strength is not influenced by the compressive and the splitting tensile strength variations, while the splitting tensile strength reveals a slightly increasing correlation with the compressive strength. [5]

3.3 Analysis of Experimental Program

In order to analysis results, combination of previous results and new results were plotted in graphs and soft mud and extruded bricks were distinguished in different legends. Subsequently, this combination of all experimental programs lead to study a large amount of samples in both type of soft mud bricks and extruded bricks and finally covering a wide range of result from low to high strength.

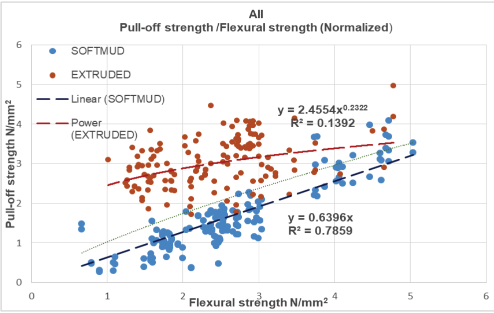

Figure 3 Pull-off strength plotted versus normalized flexural tensile strength in both soft mud and extruded bricks

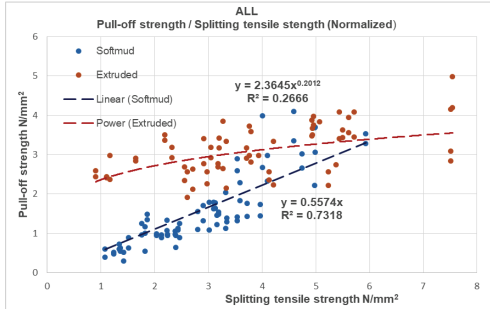

Figure 4 Pull-off strength plotted versus splitting tensile strength in both extruded and soft mud bricks

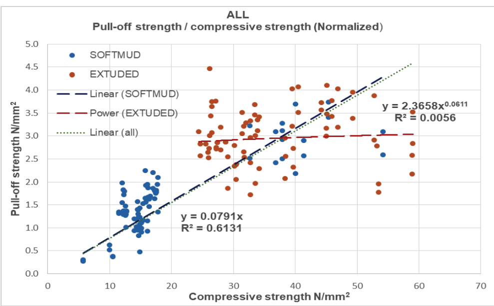

Figure 5 Pull-off strength plotted versus compressive strength in bot extruded and soft mud bricks

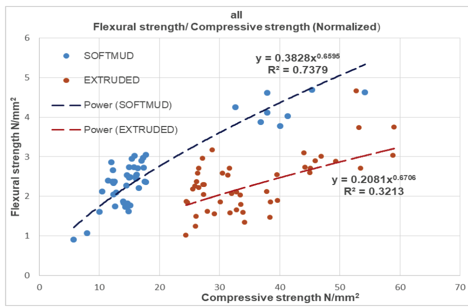

Figure 6 Flexural strength plotted versus compressive strength in all bricks

3.4 Summary of all result

In the following all the possible correlation between mechanical properties (flexural tensile strength, splitting tensile strength and compressive strength) and pull-off strength of all bricks and also possible relations among the average properties of the bricks, flexural, compressive and splitting tensile strength, that were investigated presented.

Comparison of all result shows that generally each type of bricks has different behaviour in the correlations; significantly this correlation is mostly linear for soft mud bricks and power law for extruded bricks. Also results shows that in all correlation, normalized outcomes are more accurate by referring to "R squared" fitting values.

Consequently, comparing correlation that developed for each type of group indicate that providing total correlation for each relation of mechanical properties with pull-off strength is not correct.

Experimental results	Normalized results
$\sigma_{pull-off} = 0.3144\, f_{flexural}$ (Soft mud) $\sigma_{pull-off} = 2.1533 f_{flexural}^{0.2131}$ (Extruded)	$\sigma_{pull-off} = 0.6396_{Normalized\ flexural}$ (Soft mud) $\sigma_{pull-off} = 2.4554^{0.2322}_{normalized\ flexural}$ (Extruded)
$\sigma_{pull-off} = 0.5016_{f splitting}$ (Soft mud) $\sigma_{pull-off} = 2.3149^{0,2013}_{f\ splitting}$ (Extruded)	$\sigma_{pull-off} = 0.5574_{f\ normalized\ splitting}$ (Soft mud) $\sigma_{pull-off} = 2.3645^{0,2012}_{f\ Normalized\ splitting}$ (Extruded)
$\boldsymbol{\sigma_{pull-off} = 0.0593_{f\ compressive}}$ (Soft mud) $\boldsymbol{\sigma_{pull-off} = 2.4936^{0.0432}_{f\ compressive}}$ (Extruded)	$\boldsymbol{\sigma_{pull-off} = 0.0791_{f\ Normalized\ compressive}}$ (Soft mud) $\boldsymbol{\sigma_{pull-off} = 2.3658^{0.0430.06112}_{f\ Normalized\ compressive}}$ (Extruded)
$f_{flexural} = 0.6377^{0.662}_{f\ compressive}$ (Soft mud) $f_{flexural} = 0.3524^{0.6675}_{f\ compressive}$ (Extruded)	$f_{flexural} = 0.3828\ ^{0.6595}_{f\ Normalized\ compressive}$ (Soft mud) $f_{flexural} = 0.2081^{0.6706}_{f\ Normlized\ compressive}$ (Extruded)
$f_{flexural} = 1.547_{f\ splitting}$ (Soft mud) $f_{flexural} = 1.1018_{f\ splitting}$ (Extruded)	$\boldsymbol{f_{flexural} = 0.8397_{f\ normalized\ splitting}}$ (Soft mud) $f_{flexural} = 0.6049_{f\ normalized\ splitting}$ (Extruded)

4.CONCLUSION AND FUTURE STEPS

The present Article deals with investigating the analytical correlation between pull-off tests and mechanical properties of masonry bricks taking into account various type of units and consequently reducing destructive test to minor destructive tests by finding correlation. It was found that the pull-off tensile strength could be correlated to the flexural, splitting and compressive strength of the bricks by means of power-based regressions and single functions depending on the type of bricks.

A significant relationship between the brick's pull-off strength and it compressive strength has emerged. As the compressive strength of masonry bricks increase, pull-off strength also increases, this correlation is a single function for soft mud bricks and power law for extruded bricks. This relationship is likely attributed to the behaviour of soft mud bricks and extruded bricks in compression and tension; extruded bricks are stronger in compression and the range in this property is so much larger than the range of the tensile pull-off strength of bricks. Subsequently, as the range in the tensile pull-off strength is smaller, it provides for more constant values in comparison to the compressive strength values.

In these experimental results, by increasing compressive strength and splitting tensile strength, the flexural tensile strength improves and where the ratio between the flexural tensile strength and the splitting tensile strength is close to 1.

Normalizing all the experimental results with reducing the influence of geometry and developing new outcomes show that although correlations maintain in the same shape but results are more precisely and fitting function for each graph seem to be sufficiently appropriate to describe it. In the end for the future steps, due to shortage of time for the experimental tests, lateral pull-off test were not performed on samples. Therefore, in order to be more accurate, have more data for comparison, and to find a more precise correlation, lateral pull-off test should be performed on samples.
It is anticipated that result from lateral pull-off test should be close to result of pull-off tests on two bed surfaces of bricks.

Also, in the series of tests performed there were some outliers (scattered results) that were not removed from the graphs; however, there are some different methods for experimental tests that guide which data can be considered as outliers. This step needs to be undertaken however it wasn't fit in the scope of this experimental tests.

Furthermore, continuing this series of test with a larger variation in bricks can provide a more accurate estimation of mechanical properties of masonry from similar masonry units that were tested in experimental programs. Subsequently application of any destructive and non-destructive tests to investigate masonry unit's mechanical properties could be avoid.

It should be noted that all tests were done on sound bricks and results should not refer to degraded bricks. Future steps could include an investigation an analytical correlations on degraded and damaged bricks.

5. ACKNOWLEDGMENTS

I would like to express my deep gratitude to my supervisors, Professor Maria Rosa Valluzzi and Professor Pere Roca and Dr. Enrico Garbin for their patient guidance, knowledge and useful critiques of this research and experimental work. I would like also to extend my thanks to the technicians and all the staff of the laboratory of the Department of Structural and Transportation Engineering of the University of Padova.

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Rural Regeneration through a Bilateral Cooperation (Case Study: "Workshop on REGENRATION: Project TAAR")

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ABSTRACT

Nowadays, in which the environmental crisis has dominated the lives of people, villages of Iran which mostly based on vernacular earthen construction and adobe are forgetting their wise and sustainable methods of living. They are transforming from main producers to mass consumers. Neglecting the value of their vernacular heritages, they replaced this traditional building with incompatible constructions and gradually the rural population is leaving to the cities. As a consequence, villages left abandoned for the sake of unbalanced development.

Trying to overcome the issue, a team work procedure called "Workshop on REGENERATION" has been designed by a group of young architects in Iran. The workshop aims to frame the problems in the contexts of conservation, sustainability, indigenous fabrication, and resiliency. In addition, it will investigate the possible solutions through discussions, surveying and hands-on work.

This case study not only point to sustainable architecture and building material and regenerating the valuable earthen heritage. , but also tried to educate people about earthen vernacular construction (students and locals) through real experience and understanding and hands-on works.

Bilateral cooperation between professionals and locals in the restoration and conservation process, and use of traditional methods of earthen construction can lead to a new system of rehabilitation on rural neighborhoods spontaneously.

The whole Idea is a try to conceive how we can globally think and locally act, with a respect to traditional heritages and modern achievements. It would be practical through an educational process which could inspire local population and future professionals to take action.

Keywords: Hands-on work – bottom-up approach – bilateral cooperation – vernacular heritage – Rural Regeneration

1 INTRODUCTION

Today, regarding to the sustainable development goal which has been provided by UN-UNESCO all the organizations and institutions endeavor to achieve this goal. Even though, accomplish the sustainable development in developing countries encounter different levels of challenges.

This also became more complicated in countries and specifically regions with rich tangible and intangible heritage and historical buildings.

Iran is home to one of the world's oldest continuous major civilizations, with historical and urban settlements dating back to 7000 BC.[1]

Rather than 21 major archaeological sites in Iran that have been globally registered by UNESCO as World Heritage sites.[2] The country contains thousands of historical villages and towns which regarding to lack of awareness and infrastructure their tangible and intangible heritage values are neglected.

Villages are so fragile to the changes in process of developments and modernity. This changes influence not only body and physical aspects and infrastructures but also lifestyle and culture.

On the other hand, busy and stressful urban life and lack of quiet and calm environment persuade people spend their holidays and free time in small towns and villages far from chaotic and noisy mega cities.

Specifically in Iran, shortage of proper eco-tourism and accommodation facilities like hostels together with affordable price for buying a land and build a property in small towns and villages resulted in building new and modern houses and villas in villages to overcome their requests.

Subsequence of the issues mentioned above create an unbalanced circumstance in small towns and villages.

Furthermore, The enormous and increasing number of immigration from rural neighborhood to cities not only threats tangible heritage and historical building in rural neighborhood, but also results in deterioration of intangible cultural heritage and social disintegration both in cities and villages, and could be a consequential reason for growing marginalization and urban poverty.

Regarding to conserving all the tangible and intangible heritage of Iran "Cultural Heritage, Handicrafts and Tourism Organization of Iran" legislated different regulations and laws. Unfortunately most of these laws and legislations are implemented only on important listed monuments and they are not targeting small historical towns and earthen heritages.[3]

This organization tries to works well but they don't have enough power, budget and support to improve education, protection and conservation of cultural heritage and earn very small amount of all budget of country (less than 1%) per year [4] which is not really enough and they cannot take care of everything properly. So mostly their budget goes to maintain and protect all monuments which were listed in national and international levels.

Regarding to that it is necessary to build up more NGO and institutions to help this organization overcome all the issues.

Governments and organizations endeavor to face the problem by various procedures. They may impose their solutions in a top-down method by implementation of specific law or try to reach a participatory and bottom-up approach.

Amongst all possible answers to overcome the aforementioned issues, "Workshop on REGENERATION" has been designed and held in a village in center of Iran to develop skills, education and communication through bilateral cooperation.

This study and workshop were lunch from small towns in small scale regarding to be more persuasive and impressive.

2. SCHEME OF THE WORKSHOP

"Workshop on REGENERATION" is a team work procedure which aims to frame the problem in the contexts of conservation, sustainability, indigenous fabrication, social facilitation and resiliency. Trying to spread the Regeneration discourse among the professionals and locals, "Workshop on Regeneration" will investigate the possible solutions through interdisciplinary dialogues and hands-on work for a mutual collaboration and practical effectiveness.

The *workshop* is planned to be a continuous program in villages aimed to launch a bottom- up approach in the field of regeneration and reconstruction, and target to improve living condition of all resident to stay in their rural neighborhood and be proud of their cultural heritages through education, communication and raising awareness. It makes different groups of people work together and let them being involved in an issue, which is vital in sustainable development. It has been designed to make a link between professionals, academicians and locals to form a bond of mutual respect and perception. One will find an alternative influential context by working in rural areas and the other will revive their relevance with their valuable properties.

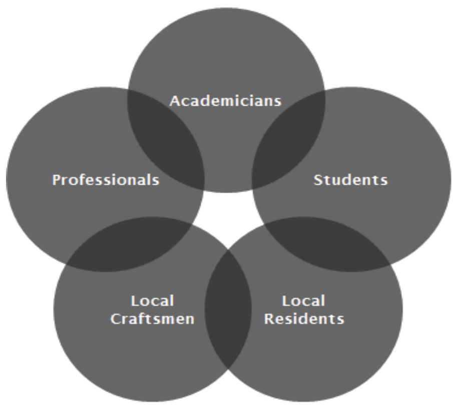

Figure 1. Different association of the workshop

The framework of workshop consists of two different phases:

2.1 Theory
In which the notion of rural development is being discussed from different points of view. The team focused on various field by concentrating on case studies and participating in lectures and talk sessions with the experts. A combination of architects, urban and rural planners, agriculture experts, social facilitators, rural entrepreneurs would share their experiences with the team.

This part aimed to bring different professions in a same platform to illustrate their relation and how they can work together and build up an interdisciplinary program. Moreover that, reviewing and discussing different project and case studies from all around the world focusing on different subjects in this filed has given people the opportunity to think broaden and be more creative in the process of workshop and dealing with the main project.

2.2 Hands-on work
In this workshop, we had a special approach toward making; the Phenomenological way of making. Phenomenology considers a difference between the experience of whoever is doing physical work and whoever is watching the work from outside [5] Experience is the keyword for this doctrine that relies on, and is directly in relation with, memory, imagination, and unconscious [6]

Phenomenology suggests a complicated personal experience for architects; that is the experience of making; a pure experience that rejects all the modern thinking of using technology. Hand is not only an organ that executes the intentions of the brain; rather the hand has its own intentionality, knowledge, and skills [6]. Phenomenology asks the architect to go one step back, and once again look for the origins of architecture beyond the cultural and historical perceptions. [6] Here we willed to live the life of local craftsmen that their craft is mostly faded in the contemporary society.

Bilateral cooperation

This process is not only a physical improvement for the village but also a trigger for social awareness, especially for the locals. The main goal of this stage is to influence the society through an architectural implementation.

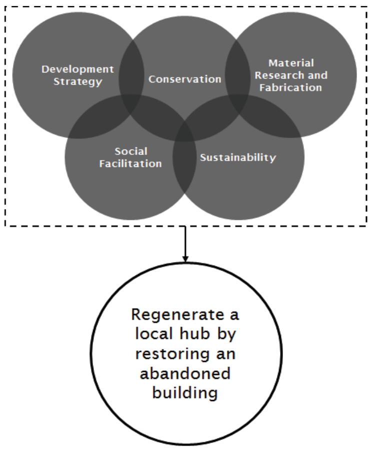

Figure 2. The interdisciplinary context

Bilateral cooperation between professionals and locals in both phases can lead to a new system of rehabilitation on rural neighborhoods spontaneously. Each phase has a construction, by which the main idea of the procedure would be followed.

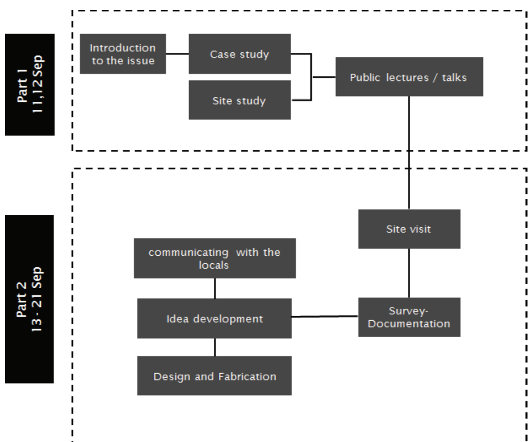

Figure 3. The structure of the workshop

The procedure is planned to be continued periodically in a pilot village (TAAR, Isfahan province, Iran) and in the other rural neighborhood in different parts of Iran. (based on the local demands and collaboration.)

3. SUMMARY OF THE WORKSHOP

The first workshop held in "Taar", a mountainous village in the central part of Iran.
This continues programs aimed to launch a bottom- up approach in the field of regeneration and sustainable development, and target to improve living condition of all resident to stay in their villages and be proud of their tangible and intangible cultural heritages through education and communication and raising people`s awareness.
The first "Workshop on REGERATION" has been held from 17 to 27 September 2018 in Tehran, Natanz and Taar village (Isfahan Province). Two days in Tehran (lectures and discussion), one day in Natanz (sight-seeing) and 8 days in Taar village (hands-on). School of Architecture (University of Tehran), INTBAU organization and Terrachidia supported the workshop scientifically and local partners took part in execution.
Almost 50 people participated in it, as lecturers, tutors, local tutors, local assistant, students, local sponsors, etc. They all gave the event a holistic perspective.

Figure 4 Inside of the Cottage ©Soniya Beigi

In the first two days professionals and students from around the world gave lectures about their experiences and points of view about the notion of REGENERATION. Meanwhile the students and participants discussed about the issue and the numerous case studies.

The next two days were dedicated to observation and conception of the contexts, surveying the buildings and communicating with the local population in Natanz and Taar. During these two days the team got closer to the problem step by step

Figure 5. Regeneration of the cottage ©Soniya Beigi

Getting to know "what does a bottom-up approach mean", the group introduced to one of the local residents. They were supposed to regenerate a cottage belongs to him, by answering his demands and needs. The main condition in the process was regarding the indigenous heritages of the village as they discovered, from the cultural issues to the architectural features. The team cooperated to regenerate the cottage.

Talking with the main stakeholder, discussing and brain-storming about the cottage and its role in the context and simultaneous planning and construction formed a participatory regeneration method. After a hard-working week, the team has finished by regenerating the cottage, extending the actual building with a new room (made by stone, adobe and wooden roof), redesigning the landscape and repairing the route, all with the traditional methods of construction. The regenerated cottage became a start point in the village, and a change in the viewpoints of the participants and locals.

Figure 6 A collaboration! ©Soniya Beigi

Figure 7 A collaboration! ©Soniya Beigi

Figure 8 cottage before starting the workshop

Figure 9 finall result of the conservation

4. CONCLUSION

The whole Idea is a try to conceive how we can globally think and locally act, with a respect to traditional cultural heritages and modern achievements. It would be practical through an educational process which could inspire local population and toady and future professionals to take action.

Continuity of the procedure of *workshop on REGENERATION* would make an improvement of social awareness and contribution in recovery and regeneration of the rural neighborhood. Forming a collaborative context for bilateral cooperation of professionals and locals would result in balanced relation between villages and cities and enhance rural and urban resilience indirectly.

5. ACKNOWLEDGMENTS

We would like to thank all the residents of Taar village, its Mayor and local Craftsman who helped us during our survey and workshop in the village.

We also would like to thank, University of Tehran and INTBAU organization for all their supports. Finally we would like to thank all of the participant of workshop and all their delightful efforts and enthusiasm.

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An Investigation of Iran Bazaars, Specimen Zone; Kazvin Bazaar

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ABSTRACT

The Silk Road was one of the oldest and perhaps the most significant institutional structures in human and economic history. The Silk Road was the reason for the development of culture, architecture, commerce and economy and many issues.

Goods carried over the Silk Road were bought and sold in the center of the city, and these areas were occasionally purchased and developed on behalf of the bazaar. Bazaars have led to the development of architectural through, trade and economy since antiquity. These commercial zones were situated outside residential areas, and consisted of one or more streets, lined with shops and workshops. Depending on the region, bazaars have different architectural order. This difference has created different bazaar architecture over time.

As the Silk Road was the most important East - West route, it passed through many countries.
In this study, the development and classification of the bazaars in Iran are examined first, followed by a scrutiny of the historical, spatial and functional aspects of the Kazvin Bazaar (Grand Bazaar) along the Silk Road.

Keywords: Silk Road, Iran, Spatial and functional, Kazvin, Grand Bazaar.

1 INTRODUCTION

Linking Central Asia with Europe, the historical Silk Road served as a bridge between civilizations for centuries. Commercial goods, as well as science, art, culture and religious beliefs were carried along this path (Al yılmaz, C.,)

The establishment of Iranian bazaars dates back before Christ. One of the main reasons for the development of these bazaars was the passage of the Silk Road and its link between the East and West. Physically, Iran is a large country, covering a large land area with various regions and climates. Its variable climate gave rise to various architectural works and culture. As a result of different works and construction techniques in various periods, structures have been created particular to the region, among which bazaars express themselves in terms of special exterior visuals. These Bazaar convey art, culture and architecture.

As one of the oldest cities in Iran, Kazvin was a city which served as the capital of the Safavid State. Situated at a junction along the Silk Road, the city of Kazvin was founded in 250 AD by one of the Sassanid rulers, either Shahpur I or Shahpur II and the reason it was founded was so that the empire's northern borders would be secured against activist raids.

The aforementioned Iranian bazaars and the historical process of the Kazvin Bazaar were examined in this study.

The area covered by the study was studied in terms of reviewing Iranian bazaars, and taking up the historical process of Kazvin Bazaar situated along the Silk Road, from its spatial and functional aspects.

2 PROBLEM NOTIFICATION

Due to its peculiar design, the Kazvin Bazaar is said to be one of the areas a discussable thread in this bazaar city. There are very few remnants from the historical bazaar that exist today. Today's bazaar is an artifact from the Safavid decade. This bazaar has featured with high brick arches which in particular had a special style leading to an exclusive remnant.

Reasons for forming the study;
1. The reason of the bazaar's distinct design,
2. The bazaar is situated at a junction of the Silk Road,
3. The Silk Road's contribution to the bazaar,
4. Kazvin served a period as the capital of Iran in ancient times,
5. This bazaar has currently has depreciated and is currently undergoing renovation.

3 HISTORICAL DEVELOPMENT OF THE BAZAAR IN IRAN

The word 'bazaar derives from the Farsi words 'Cahar' '(four) and' 'Su' (side, street), meaning 'four streets.' Located in the center of a city, this commercial area is integrated with squares and streets, which are covered or open, and surrounded by shops on either side. It's call 'çarşıy' in Farsi.

The first shopping activity in history and the space utilization of shopping was seen in Roman and Greek civilizations. The first commerce gave rise to the formation of a variable and expedient trading community in venues that had efficient public spaces and low populated. The covering of structures differed according to the traditional materials and construction styles (Soltanzade, H, 2014).

In the places where shopping was the first place to the Salles, portable stalls brought about an expedient, variable shopping pattern in places of low populations and efficient public spaces. Light materials were utilized in building the top covers that surrounded the goods with the purpose of protecting the vendors, customers and products to be sold in the stalls from external influences.

For this purpose, the structures of the covers differed according to the traditional materials and construction styles. These coverings were peculiar to the region, and sometimes their compositions symbolized the bazaars.

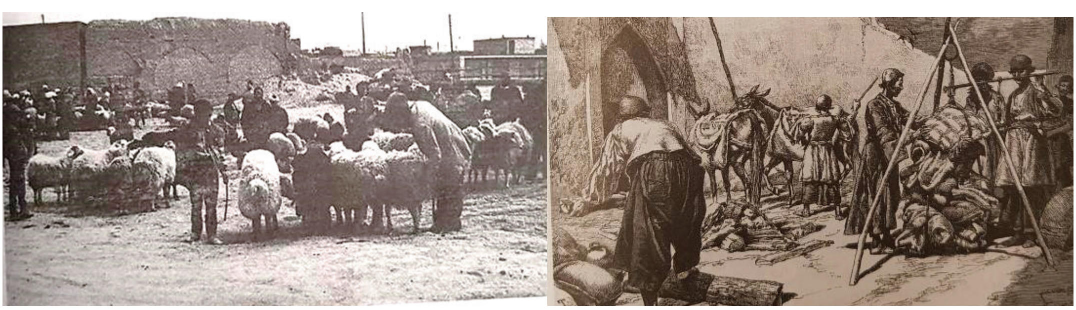


Figure 1. The formation of the Bazaar in Iran [1]

3.1 Reasons for the Formation of Historical Bazaars

The reasons that lead to the formation of old and historical bazaars are listed as follows (Pirniya, M. K, 2007).

Easy public access in the city center,
Near central structures,
Convenient for meet daily needs
Easy to safeguard

Though bazaars located within Iran and Turkey bear close similarities, they are quite different names and even functions have been defined.

3.2 Similarities of Historical Turkish and Iranian Bazaars

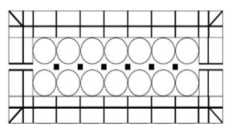
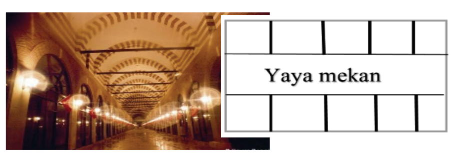
While each country had become unique not only in terms of their social makeup, but also in terms of their physical structures, the structure types and styles bearing unique characteristics had begun to emerge in commercial structures. For instance, the 'bedestan' and 'arasta' in Turkey are commercial structures unique to Turks. As for Iran, venues such as the 'Timçe' 'Geysariye' and 'Dalan' are completely unique to the country. A significant portion of Turkish and Iranian commercial structures is comprised of caravanserais within the city and adjacent to the bazaars.

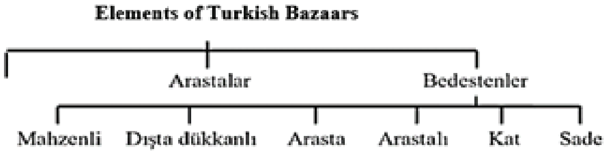
Similarities of Historical Turkish and Iranian Bazaars are listed;
They were constructed in close proximity to the fortress and pedestrian traffic
They are located in city centers,
They developed like an organic line,
They take their place next to Islamic works (Pirniya M.K., 2016)

3.3 Elements of Turkish and Iranian Bazaars

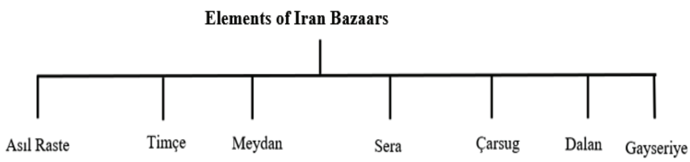
Formation elements of bazaars in Turkey are given in the following Table (Öncel, F., 2016)

Table 1. Elements of Turkish Bazaars

Elements of Turkish Bazaars	
Bedestan; Are Covered Bazaars dedicated to buying and selling precious goods and antiques.	 
Commercial Inns; are defined as stone masonry or wooden buildings called 'Hans,' otherwise known as 'caravanserai,' which were situated along trade routes and in towns for the accommodation of travellers, comprised of rooms, courtyards, storage spaces and stables (Hasol, 1995)	
Arasta; From the second half of the 15th century onwards, the Ottomans built structures comprised of shops lined up along an axis, calling them 'arasta.'	



Elements of Iran's bazaars are shown in the Table;



Brief elements of Iran's bazaars;
1) Storage and maintenance areas, Sara, Caravanserai
2) Production areas, Dalan (corridor)
3) Commercial venues, Timçe, Han, Arasta (Raste)
4)Religious venues, Mosque, Madrasah
5)Service provider venues, Turkish bath, Water storage
6)Venues that meet communication and social needs, Çarsug, Meydan (Dehkhoda, L., 2011).

- **Asıl Raste (Main Axis);**

As bazaars were formed mostly along linear axis, the most important element of the bazaar is the axis. Shops were located facing each other on the edges of the main axis. Concurrently, the main axis developed organically as people used them. In short, the 'Raste' is known as the main road and the busiest spot in the bazaar (URL 1).

Figure 2. A Raste specimen in an Iranian bazaar [2]

- **Timche**

As an octagonal planned, two-or three-story enclosed venue, the 'timche' is an important venue of traditional covered bazaars that emerged during the development of the bazaar. (Moazemi, S., 2013).. Shops were built in the middle as well as in the vicinity, and muqarnas, dome, and solid wood panels were used in the roof. There are a total of 19 'timche' in the bazaars of Gom, Emini, in the city of Kaşan, as well as that of Tabriz.
There are two types of 'Timche' in Iran; Single-story, two-story.

The storage and wholesale of goods on a large scale were generally carried out in these 'timche.' Goods were generally displayed on the ground floor of these shops, whereby rest areas of the large mercantile establishments were found upstairs.
The Timche Amir in the city of Tabriz, as well as the one of the Amin-o-Döle in the city of Kaşan are recognized as important 'timches.'
The most important outdoor two-storey 'timches' are the Melek Timche found in the city of Isfahan, as well as the one found the north entrance of the Kazvin Bazaar (Sultanzade, H., 2001).

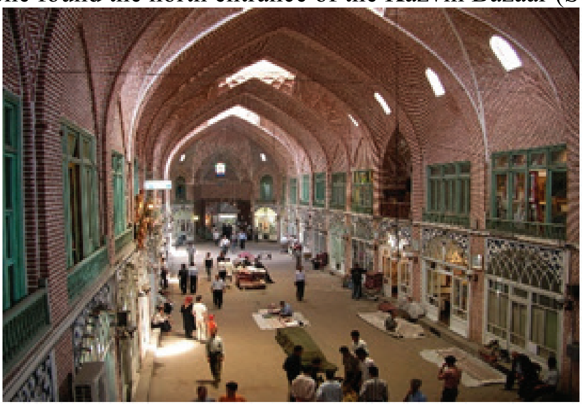


Figure 3. View of the Timche Amir in the Tabriz Bazaar [3]

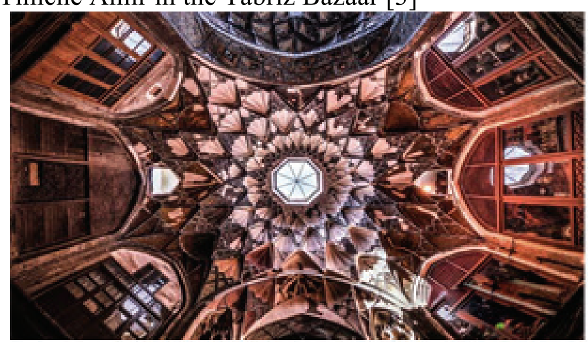


Figure 4. View of the Amin-o-Döle Timche in the Kaşan Bazaar [4]

- **Sara (Commercial Inn)**

The Farsi word 'Sara' means 'a small caravansaray.' The price of goods at a 'sara' was more expensive than those found at caravanserai and these were not used to supply cheap goods.

Commercial inns function as the passages of today and help to expand commercial spaces, increasing the limited possibilities of arastas. 'Sara' are complemented by a central courtyard and surrounding single- or two-story shops. Two types of 'sara' were constructed.

Sara (Commercial Inn)	Enclosed 'Sara'
	Open Saras; • Single- or Two-Storey 'Sara' • Saras with or without courtyards

Figure 5. View of the Hac Rıza Sara at Kazvin Bazaar [5]

- **Gayseriye**

The word 'gayseriye' means 'long sara' and was the venue where guildsmen and artists would work. Fine jewelers, goldsmiths and textile makers would tend to their crafts there. Since the 'gayseriye' had gates, they were generally empty and quiet, thus providing suitable working environments. The most notable and finest 'gayseriye' are the İbrahim Khan ve Gazvin in the city of Kerman, as well as the Siran in İsfahan (Moazemi, S., 2013).

- **Meydan (Square)**

There was a city or regional square next to the bazaar or in the continuation of its axis. As the bazaar was the city's most important passageway, it was integrated with a square.
Some bazaar operations were conducted from outdoor spaces situated either partially within its structure or else the immediate vicinity. The most spectacular of these squares are the Negsh-i-Jahan Square in Isfahan as well as the Ganj Ali Khan Square in Kerman (Figure 6, Figure 7). These squares were integrated with the bazaars and have become an indispensable part of the bazaar. Due to the lack of free space in cities such as Tabriz, Gazvin and Shiraz, the bazaar installations were positioned in these spaces (Asgari N; 2014).

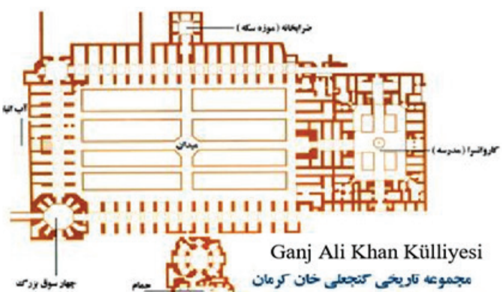


Figure 6. Ganj Ali Khan Square [6]

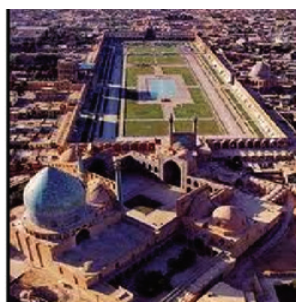


Figure 7. Negsh-i-Jahan Square [7]

- **Charsug**

Comprised of two main *Arastas*, the venue that presented magnificent commercial opportunities was known as the *charsug*. *Charsug* architecture was different from other bazaar elements as it was designed with finer embellishments, with shops positioned on all edges. Rather than connecting different arastas, the *charsug* in the bazaar complex arranged the appearance, size and natural illumination of the arastas. Besides the *charsug* / *arasta* portions, a *dede* was positioned in front of the entrance gate of important venues such as the *sara*, mosque and madrasah with the most important *arasta* of another bazaar. The *çarsug* at Isfahan (Figure 8) and Kerman (Figure 9) are the finest specimens (Asgari N; 2014).

Figure 8. View of the Charsug in the city of Isfahan [8]

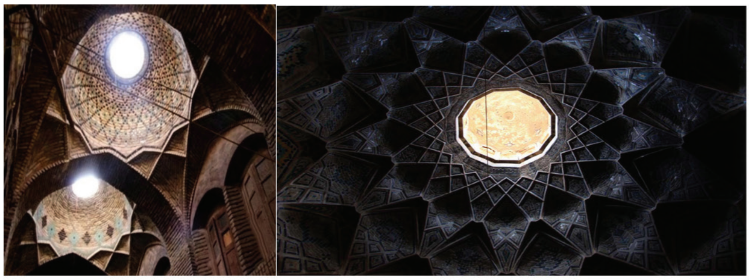


Figure 9. View of the Charsug in the city of Kerman [8]

- **Dalan**

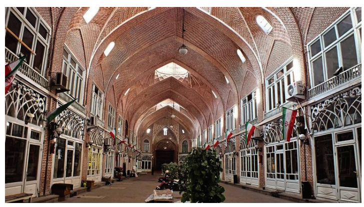
Meaning 'corridor,' the *dalan* is an intermediate type of *arasta* and is differentiated from the other arastas by two gates and closes in the evening. *Dalan* are usually located at the entrance of a *sara* (commercial inn) or caravansaray (Dehkhoda, L., 2011).

Figure 10. The old and new Tehran bazaar [9]

4 CONFIGURING THE BAZAARS IN IRAN

The bazaars of Iran are configured in various groups in regards to space and function.

4.1The Spatial Configuring of Bazaars in Iran
Spatial configuration is shown in the following Table;

Configuration	Linear-Planned Bazaars (to Length)	Multi-Axis Bazaars	Diagonal Bazaars
Characteristics:	• Most Iranian bazaars, and particularly permanent bazaars are generally linear. • Linear bazaars extend lengthwise along the main axis and feature commercial inns on either side.	• Multi-axial bazaars encompass a wide space, both length-wise and width-wise. • Generally, these bazaars were already planned and developed later on. • The characteristic of these bazaars is their easy movement and convenience from a traffic standpoint.	• These types of bazaars are comprised of two main intersecting axis. • These bazaars feature a main entrance and exit, whereas these entrances and exits in some small bazaars determine the start and end of the borders of the city.
Example	ZANJAN BAZAAR	TABRIZ BAZAAR	LAR BAZAAR
Appearance and plan	 	 	

4.2 Climatic Configuration of Bazaars in Iran
Iran is a country with very different climatic regions. The parts overlooking the Caspian Sea are very humid and always rainy. except this region, all other Iranian territory is found in subtropical arid regions. The north-facing slopes of the Elbrus Mountains, which turn the northern edges of the Caspian Sea, are covered with rich forests, with an median 1000-1500 mm of annual precipitation. The narrow coastal plains at the foot of these mountains are very humid (URL 2.)
Each city in Iran has a uniquely designed bazaar, according to its climate.
Climate Types : 1. Desert Climate (Hot and Dry)
2. Cold and Dry
3. Moderate and Humid
4. Hot and Humid

1. Desert Climate (Hot and Dry); this type of climate determines the absence of precipitation. There are times when the daily temperature differences reach 50° C.
Due to the climate, the bazaar ceilings were built using hot-zone construction techniques (Mansori, A, Javadi, SH, 2017).

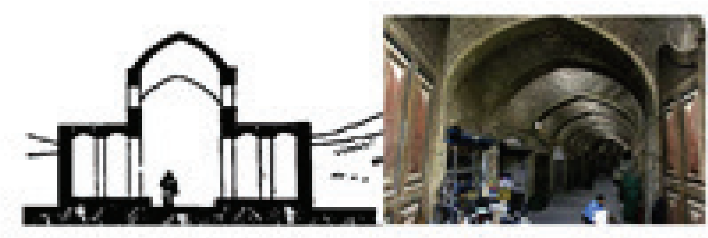


Figure 11. View of the Yazd Bazaar [10]

2. Cold climates; Determined feature of this region is extreme cold in winter and temperate weather in summer. Snowfall is very high.

Figure 12. View of Kazvin Bazaar [11]

3. Moderate and Humid; The southern coastal region of the Caspian Sea receives the most precipitation in Iran.

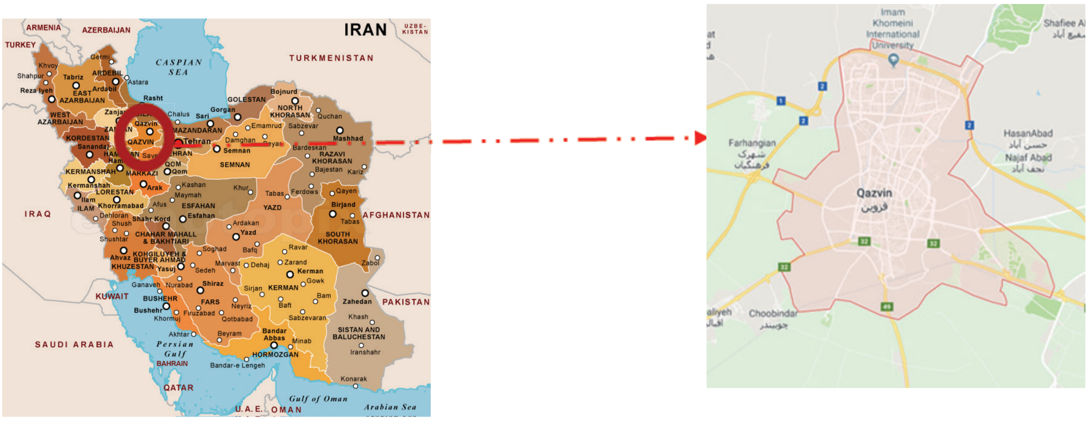
Figure 13. View of the Rasht Bazaar [12]

4. Hot and Humid Zone; Because of the extreme heat and high humidity, the roof is made as follows.

Figure 13. View of the Bastak Bazaar [13]

5 HISTORY OF THE ENCLOSED KAZVIN BAZAAR

As one of the oldest cities in Iran, Kazvin was the capital of the Safavid State. Situated 150 km northwest of Tehran and at the southern foot of the Elburz Mountains, it was founded by Shahpur I in 250 AD. As host of various civilizations throughout its history, as well as a stopover along the Silk Road, Kazvin has various historical and embellished works. One of these historical areas is Kazvin's commercial covered bazaar.



The Kazvin Bazaar had a certain development during the Safavid era, but its length increased during the Kachar era. The bazaar we see today is comprised of changes left from the Safavid era. Kazvin became the capital of Iran during a period of the Safavid State, so architectural changes began in the city and this change expanded its texture even further. Today's covered bazaar is a restored building with fine engravings and specially designed illumination (Mansori, A, Dizani, E, Aghabozorg, N, 2017).

5.1 Architectural Features of the Grand Bazaar in Kazvin

The history of Kazvin bazaar dates back approximately 1000 years. This bazaar encompasses 14,000 m^3 and has three main entrances. Two main entrances are from Imam Homeini Street in the south, and the other main entrance is from Molavi Street in the west, with porticoes beneath all the entrances. The bazaar developed along the north-south axis, and these entrances are still in use (Figure 14) (Dabir, M, (2003).

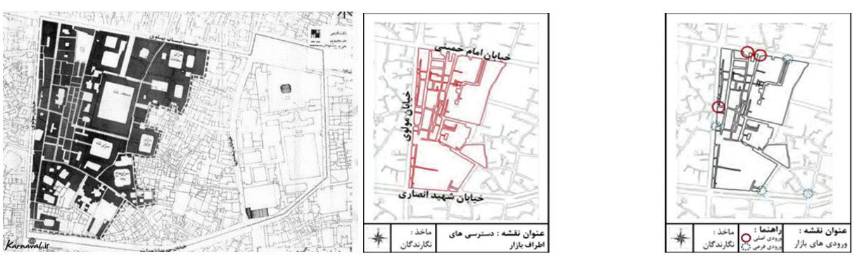


Figure 14. Plan and Entrance of Kazvin Bazaar [14].

The Kazvin Bazaar had various branches and shops in the old days, but gradually began to deteriorate and depreciate over time. The architecture of the bazaar we see today resembles the Isfahan and Shiraz bazaars and dates back to the Safavid era. The bazaar has its own unique ceiling architecture. Comprised of brick material, the ceiling of the bazaar has remained intact for many years (Figure 15).

Figure 15. Bricked arches are seen in the bazaar [15]

Another element of the bazaar is its illuminated section dating back hundreds of years ago. While light entered through the ceiling during the day, a candle burning area was applied on the walls for illumination at night.

Figure 16. Nowadays, electric light is used in Roshandan [16]

5.2. Spatial Property and Measured Elements of Kazvin Bazaar

According to written sources, various guildsmen worked in the Kazvin Bazaar; blacksmiths, cotton workers, saddlers, coppersmiths, handicrafts, jewelers, second-hand peddlers, goldsmiths, dressmakers, etc. Today, the volume of coppersmiths, 'halebiciler' and blacksmith work has slackened considerably and they work much less these days.

Important stalls in the Kazvin Bazaar include; Agha, the Grand Agha, Masum, Hadji İdris, Hadji Hasan Ali, Hadji Sheikh, Hadji Muhammed Ebrihim, HacdjiMuhammed Rahim, Hadji Mir Hasan, Zaferaniye, Saîd-ol- Saltane bazaars, the Bedestan, as well as the Hac Rıza and Vezir commercial inns (Stierlin, H. (2012).

In terms of architecture and engineering, the Bazaar's Sultani Mosque is regarded as a unique mosque among Kazvin mosques.

This bazaar features important *sara* (Commercial Inns) and caravanserai. The reason for this is that this region received more economically support, i.e., more shopping was done in these areas, while architectural characteristics of this region is even more distinctive.

- **Saraye Sad-ol-Saltane**; This *sara* was built during the Kachar era. The most valuable area of this *sara* is two Rasten junctions and the hand-painted ceiling. Tile and ceiling skylights were applied in the ceiling processes (Haji Gasemi, K., 2001).

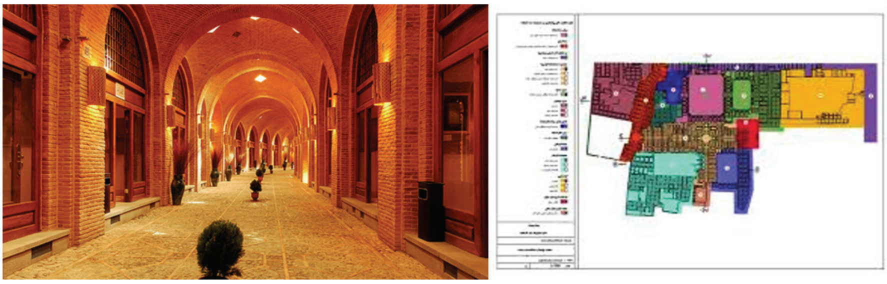


Figure 17. The view and plan of the Saraye Sad-ol-Saltane [16]

- **Saraye Vazir:** An arched *sara* with porcelain tiles and a haşti entrance is situated to the east of the Gayseriye. The central dome is approximately one meter wide with a skylight in the middle. These sara have a large garden and is encircled by shops [30].
- **Saraye Hac Rıza;** Constructed during the Kachar era, this *sara* features a large garden and surrounding shops, which were usually built on two floors.

Figure 18. View of the Saray Hac Rıza [16]

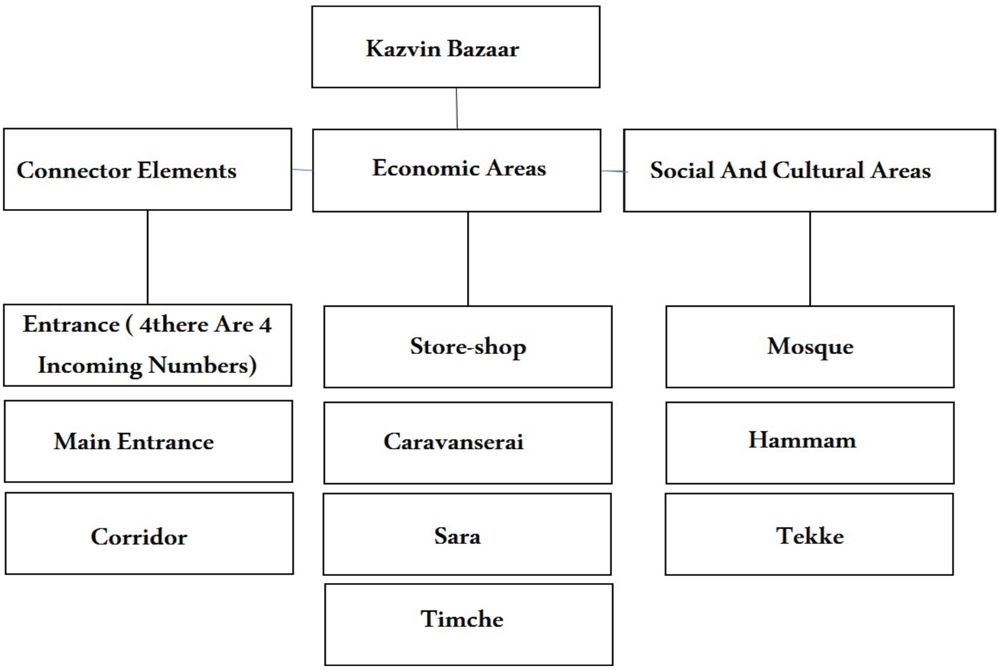
The Razavi: Caravansaray; Dating back to the Safavid era, this caravansaray features two iwans and a square plan.

Figure 19. View of the Razavi Caravansaray [16]

6 CONCLUSIONS

The social life and communication of the people that began in the ancient Egyptian squares more than 20 centuries ago and continued in the Greek Agora, Stoa and Roman forums formed the beginning of the construction of the earliest shopping centers. Later on, outdoor and enclosed markets had emerged where commercial life continued in oriental culture.

The Kazvin Bazaar is a combination of fine, encompassing structures, the architecture of which was shaped by commercial activities and pertinent needs in the fields that created an integrated multi-functional city complex. The main reason for the development of this bazaar is that it was a stopover along the Silk Road. Though the history of the bazaar goes back 1000 years, it was renovated during the Safavid and Kachar eras as it witnessed changes from time to time. The bazaar we see today are what remains from the Kachar era. The characteristics of the bazaar are the ceiling construction, the tilework in the ceiling, as well as its history and length. A summary of the venues that comprise of the Kazvin Bazaar is as follows;



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Traditional Construction Techniques of Karahüyük Houses

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ABSTRACT

Karahuyuk is a small village located in Aksehir district, Konya Province. It is a second-degree archeological site, a home of many civilizations. Vernacular houses in Karahuyuk were built using adobe brick masonry and timber-framed structures filled with adobe bricks. This building culture dates back to the period when the first civilization inhabited this region. Since the 1950s, the building culture shifted from traditional adobe brick and timber frame structure to reinforced concrete for the construction of new buildings and rehabilitation of old ones. However, most of the traditional buildings were damaged by the 2002 Afyon earthquake. Only 12 timber-framed adobe brick buildings remained intact during the earthquake and were later registered under the Konya Conservation Council of Cultural Assets.

In this paper, the unique features of the construction techniques of these 12 houses will be explained via comparison of the typology of plan and façade, building materials, and construction methods. Research methods include survey, in situ assessments, and interview surveys with the house owners about the local building traditions, the construction system, purchase of materials, the craftsmen. These 12 buildings carry the mix of Central Anatolia and Mediterranean housing features, due to the location of the village. The use of concrete and cement with traditional buildings methods, make these buildings unique as they carry the 19th-century building styles although they were built in the 1950s.

In conclusion, this paper introduces earthen vernacular structures in Karahuyuk for the first time, and the recommendations are given for their repairs and rehabilitation.

Keywords: Karahuyuk Houses, Timber-framed structures filled with adobe bricks (hımış), Traditional construction techniques

1 INTRODUCTION

The Karahuyuk region is an area that has been inhabited since the Bronze Age. There are not many examples of civic buildings that reflect the old life habits as a result of the changes in time and building culture. The existing buildings were built mostly during the Republican period and especially in the 1950s. Most of these structures were either destroyed or damaged due to earthquakes with a magnitude of 6 in Afyon Province on 3rd of February 2002. The remaining 12 houses are registered as to be protected cultural heritage. Karahuyuk houses have great importance in terms of local architecture and its periodic features.

2 PLAN TYPOLOGY

The types of planes seen in Karahuyuk houses are observed as four types as *Mabeyn* plan, plan with gallery (*dış sofa*), plan with hall (*iç sofa*), and the ground floor is a plan with the gallery, while the upper floor is a plan with hall [Table 1]. Hall and gallery have the duty of circulation of all the rooms. Coşkun House is the only house in *Mabeyn* plan style. While Karadeniz house, Yilmaz house, Eren house, Alp house, Vural house, and Acarman house are in the style of the plan with gallery (*dış sofa*); Çimen House, Yıldız House, and Başeğmez House are a plan with hall (*iç sofa*). Aydoğdu house and Korkmaz house are the examples of ground floor with the gallery, upper floor with the hall.

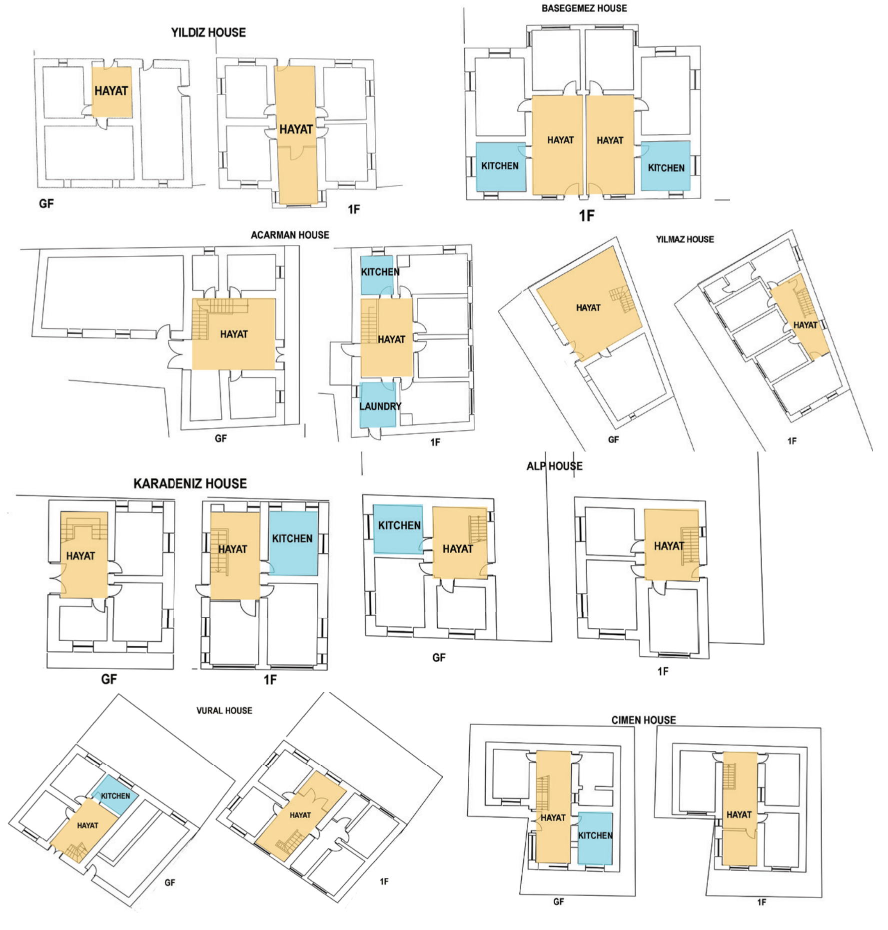
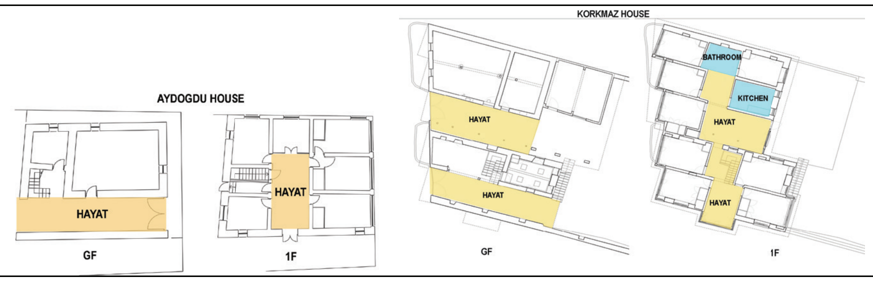
Although Karahüyük is a settlement which is connected to Akşehir for a long time, house formations of these two regions vary. The most significant difference of the Karahüyük houses from the Akşehir houses is the extensive and long-term use of the *dış sofa* in Akşehir, while the *dış sofa* in Karahüyük houses are closed and they are preferred to use L form near the square. While Akşehir houses are entirely adorned both for interior and façade features, Karahüyük houses are quite dull. In addition to different tastes, the income level of the region and the family also affects the ornamentations on the buildings.

While the ground floors undertake functions such as a barn, warehouse, and haystack, the first floor contains the main living units. The upper floor has a hall (*sofa, hayat)* and rooms. However, in some houses, the barn, warehouse, haystack are located in the outbuildings in the garden, and the lower floor rooms have the function of living. The lower-floor rooms undertook the function of living in Karadeniz house, Vural house, Çimen house, and Alp house. In these types, one of the rooms on the lower floors undertakes the kitchen function, while the other rooms include functions in the Turkish room, such as sitting, sleeping, and eating. The reason why the lower floors are used as living space in these houses is mainly due to the crowded family members and the small size of the parcel. The room at the Eren house, which is different from the others, has a guest room.

In general, the windows in the rooms are located opposite of the entrance door of the room. If the room is located in the corner, there might be windows on the right or the left depending on the location. There is a closet or bathing cubicle on the wall where the door is located. Each room has a cupboard or niche. The doors, closet, and bathing cubicle used in the buildings are made of wood and have similar features in terms of size and ornamentation. The floors of the rooms are soil flooring or wooden flooring, and wooden beams are observed on the ceilings. The inner and outer walls were lime whitewashed on the mud plaster in the original case, and now all were plastered with cement mortar.

Table 1. Plan Typology of Karahuyuk Houses [1]

<table>
<tr><td>Plan with hall
(iç sofa)

Plan with hall
(iç sofa)</td><td>
</td></tr>
<tr><td>Ground floor with gallery (dış sofa)
Upper floor with hall (iç sofa)</td><td>
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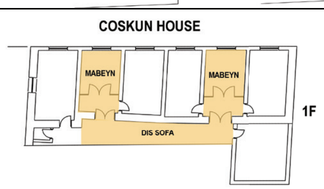
<tr><td>Mabeyn Plan</td><td>
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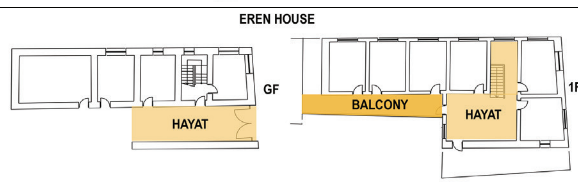
<tr><td>Plan with gallery
(dış sofa)</td><td>
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</table>

*The yellow color represents the hall (*sofa, hayat*). The blue color represents the kitchen, store and laundry room where concrete is used for flooring.

3 FACADE FEATURES

In Karahüyük houses, usually the lower floors are massive, and the upper floors have a frontal layout with lots of windows. On the lower floors, there are small windows only in the upper part of the doors and the warehouses. However, in the houses where the lower floor has living units, there are windows on the lower floors at the same line of upper floor windows. While the upper floor facades have a symmetrical effect, but with the combination of lower floor facades features, it becomes the asymmetrical one. However, in some buildings, facades have a symmetrical layout, as well. The original windows are made of wood, and they are formed by multiplying together the same basic unit with different dimensions. However, most of the original windows have been replaced with PVC windows, so it is difficult to observe the original windows.

The cantilever, the indispensable part of the Turkish house, has an essential place in Karahüyük houses, as well. While the cantilevers in the buildings are usually located in the halls (*sofa*), there are also some cantilevers continue along with façade extent in the Karahüyük houses. These cantilevers are one-way, room-wide consoles. The cantilevers are plain-looking appearances that consist of elongation of the first floor. The underlays are also covered with wood; in some cases, those with floor beams can also be seen. While the cantilevers are located in the hall (*sofa)* of Başeğmez, Yıldız and Alp houses; in Acarman house, Aydoğdu house, Eren house, Coşkun house, Yılmaz house, and Karadeniz house, the cantilevers are located in rooms along with façade length. Only in Korkmaz House, it has a triangle shape. There is no cantilever in Vural house and Çimen house [Table 2].

Table 2. Façade Typology of Karahuyuk Houses [1] [2] [3]

Cantilevers located at rooms along with façade length	
Cantilevers located at the hall (sofa)	

<table>
<tr><td>Without cantilevers</td><td>


</td></tr>
<tr><td>Cantilevers located at rooms along with façade length in a triangle shape</td><td>
</td></tr>
</table>

4 CONSTRUCTION TECHNIQUE AND MATERIAL

It is observed that the old houses, which were ruined in the region, were built in the traditional Konya house type, adjoining, adobe, flat-roofed houses. However, the buildings, which are currently standing, are built according to the conditions of that time, considering the parceling and the use of new materials and old materials together. The construction techniques in the region are observed in the adobe blocked masonry technique and adobe block filler, which is observed in traditional Konya and Akşehir houses. In the whole structure, masonry system was dominant, while the timber-framed technique was used in the cantilevers.

On the basement of these buildings, the stone was used up to the plinth level. Above it, wooden girder was put, and adobe bricks started to be bond the wall. Wooden beams were used at floor level. While wall thicknesses are around 60-70 cm, the main mudbrick sizes are around 27x27x10 cm. The flooring details are the same as traditional adobe making technique, and they differ in terms of using concrete in the wet areas. Instead of using two layers of compressed soil, this building used one layer of compressed soil, and a maximum of 10 cm thick concrete is poured above it (Fig. 1). In the same period, the houses in the town of Gözlük in Sarayönü were built entirely with traditional technique and with no use of the concrete material. In the upper cover of the structures, flat roof or roof tiles with Marseille tile were used. Instead of laying stones or grooves on the edges of the flat terraces, it used straws which were long and dense. In this way, the structure is protected from the harmful effects of water.

Many of the materials which were used in those building constructions came from their land. When a child was born, about 20-50 poplar trees were planted together, when the child grew up, the poplar grown as well. When the child reached the marriage age, he built his own house with those poplar trees. The soils used in the adobe were brought about 3-5 km far from the village, only from the land in that area, called the soil of the plaster (*zıva*). The straw used in the making of adobe was one's production. Straw and reed were brought from Doğrugöz village which was almost 6 km away from Karahuyuk. The stone was purchased from the quarry. Those who would like to have a roof with a roof covering also obtained the Eskişehir Develi tile from Akşehir by purchasing. Again, the concrete material used in the construction was also purchased from the supply.

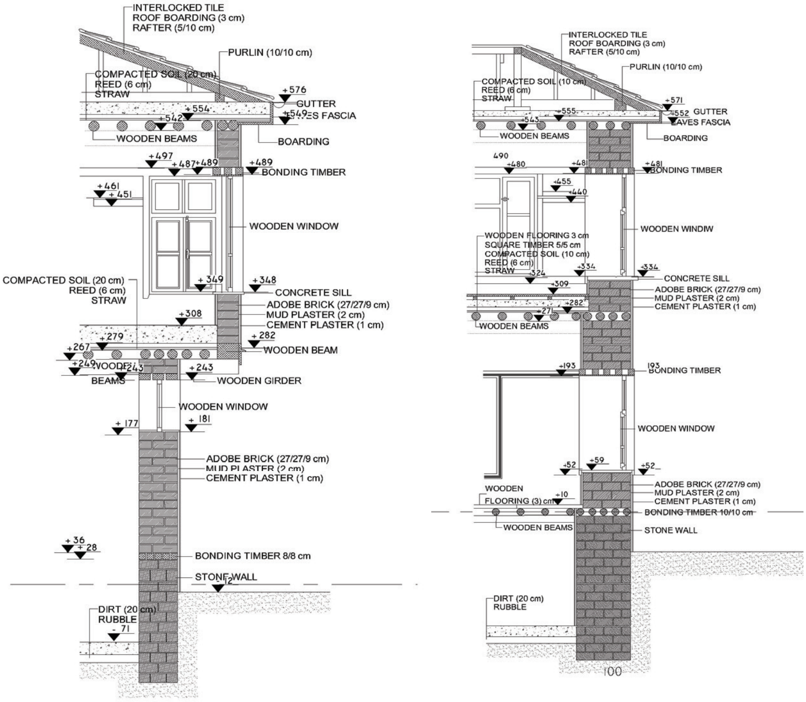

Figure 1. The detail of the construction system, Korkmaz House [1]

5 CONCLUSION

The experts of the board registered the old structures in Karahuyuk region due to the similar construction techniques of 100-150 years old style considering them as much old. However, as a result of the research, it was determined by the interviews with landlords individually that the buildings were built approximately in the 1950s. As a construction technique, different details can be applied depending on whether the land is flat or inclined, but they follow a similar construction system in general which is a combination of stone masonry in the basement, adobe masonry in the ground floor and timber frame structure with adobe filling in the cantilevers (Fig 1). The unique feature of this technique is the use of concrete only on the floor of wet areas, like kitchen, laundry, storeroom, and window sills on purpose. The use of a flat roof or hipped roof might be related to the economic conditions of the owner. Purchasing necessary materials for a flat roof is cheaper than the hipped tile roof.

The situations of these buildings are getting worse day by day. There are some implementations, mostly including the change of roof system to the hipped tile roof, changing original windows with PVC ones and using cement as the mortar and plaster which causes damage in the structure, without the permission of the board due to the desire of the house owners to have the new comfort features in their home. The origin of the problem is the economic situation of the landlords. Mostly they are old farmers, and their children migrate to cities, and families do not have enough budgets for proper restorations.

The lack of knowledge about preservation of adobe structures is another reason. Because of that, the Soil-water content, Sieve analysis, Atterberg limits, USCS, and Proctor tests made on the adobe brick samples of Korkmaz House to classify the type of the soil and its features, later to determine the appropriate adobe bricks for using in preservation works. According to the results of the tests, a mix of 10% gypsum and 30% aggregate was suggested to be optimal for the repairs of the adobe bricks, and to use the clay and straw plaster, which contains 15% lime, is suggested for the interior and facades with regular maintenance every year.

The social awareness about the value of these vernacular houses should be the priority. These buildings show the era of development of modern materials, most importantly, the use of modern materials along with traditional ones. The budget problem can be solved with holistic projects where locals, government, academia, and NGOs involved. With this approach, the technique which was still known in the 1950s can live longer and might be used in the future for the conservation of earthen vernacular heritage.

6 ACKNOWLEDGMENTS

This paper, which is a part of the master thesis of Süheyla Koç, is written in dedication to the late thesis advisor Prof. Dr. Ahmet Ersen.

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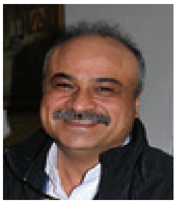
Documentation Studies and Material Researches of Ramazan Semseddin Mosque in Ankara

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ABSTRACT

Adobe has been used by the human being as a building material since the first settling ages in Anatolia. It was preferred as an economical building material that could easily be found in the immediate surroundings. Especially in the inner parts of the country, mudbrick was used in the construction of many historical buildings. In this context, it can be said that adobe was a preferred building material for a period of time in Ankara.

If the development of Ankara is examined in the historical process, it is understood that Ankara is a city which covers the urban spaces and structures belonging to the previous periods. In and around the citadel, which is the center of the city throughout history, the structures of the Roman Period, as well as Seljuk, Ottoman, and Republican Periods can be seen together.

After the city became a Turkish land, many buildings with commercial, social and religious functions were built. Some of these structures couldn't survive and some survived by losing their architectural properties and historical value. A large number of mosques were built in the city during the construction activities carried out in the Ottoman period.

Ramazan Şemseddin Mosque, which is located in the inner citadel in Ankara, is one of those religious buildings constructed during the Ottoman period. According to the researches, it is estimated that the mosque was built in the early 17th century. It is understood that stone was used in the construction of the wall foundations of the mosque and the upper parts were built by using mud bricks and its supported by wooden beams.

In this study, some part of documentation studies of Ramazan Şemseddin Mosque, its conservation problems, material researches and results of the analysis are presented.

Keywords: Mudbrick, adobe, Ramazan Şemseddin mosque, conservation, material analysis.

1 INTRODUCTION

Ramazan Şemseddin Mosque, located in the Inner Citadel/ İç Kale district was registered as an immovable cultural asset with the decision dated 14.10.1972 and numbered 6691 of the High Council of Real Estate Antiquities and Monuments. In 2008, the structure was documented within the scope of the conservation project and the change of the structure in the historical process was researched. Besides, material research was conducted to understand better the structure.

During the project period, the publications of the authors who made researches about the structure were also examined and that valuable information was used. İbrahim Hakkı Konyalı included Ramazan Şemseddin mosque in his book on Ankara Mosques. One of the structures that Gönül Öney evaluated among the religious and social structures of Turkish age in Ankara is the mosque which is the subject of this study. Ali Kılcı, the researcher, examined the mosques built in the city in different periods and recorded the repairs implemented to those structures in his book, Altındağ's Spiritual Geography.

While Emine Erdoğan examining the settlement of historical Ankara according to Tahrir books in her research, Seyit Ali Kahraman and Yücel Dağlı translated the travelogue of Evliya Çelebi into today's Turkish.

In this study, documentation studies, monument's conservation problems and the results of the material researches are summarized and shared with researchers.

2 ARCHITECTURAL FEATURES OF THE MOSQUE

2.1 Plan Features

The triangular-shaped entrance section was added to the east side of the building. This space hasn't any historical value in terms of materials and design. A double-winged door leads to the original part of the mosque. In the right and left sides of this door, there are sets about 40 cm high, covered with wood, while the floor of the entrance hole, covered with modern tiles. The dimensions of the harim, which is the main gathering place of the mosque, are approximately 7.25 m x 7.75 m and the floor is covered with wood and carpet. The walls and wooden ceiling are plastered and painted in white. In the center of the ceiling, there is a wooden hexagonal shaped and profiled core which is painted brown color. There are gilded leaf motifs which are oriented to four sides inside the core.

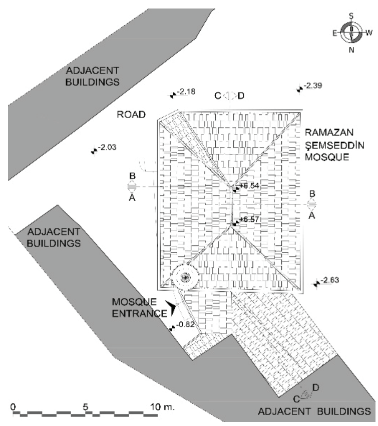
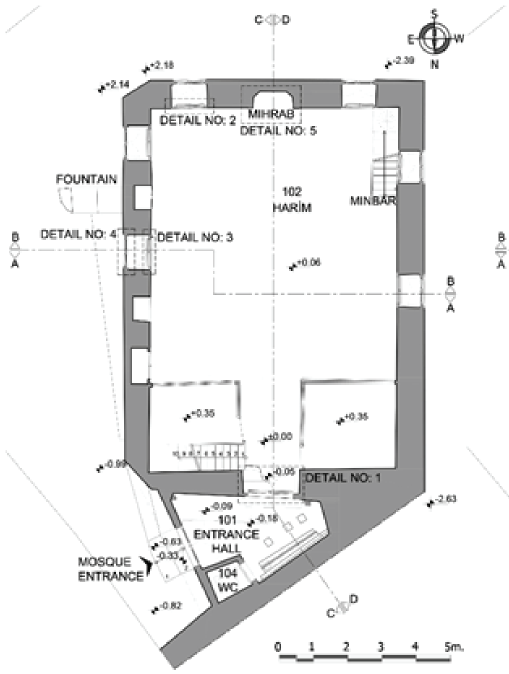


Figure 1. The location of the mosque and the entrance of the castle.
Figure 2. Site plan.

In the south (qibla) wall, there are 2 rectangular-shaped windows at the bottom and 3 rectangular windows at the top. This wall also has mosque elements such as mihrab and minbar. In the eastern wall, there are 2 windows and 2 niches at the lower level. The 3 top windows are smaller than the lower windows.

In the western wall, there are 2 windows at the lower level and 1 window at the top. All the windows in this wall have wooden frames and painted with oil paint. Some of the original window shutters on this facade do not exist in their original place.

The lower level windows in the south and east walls are decorated by using mural paintings. Ornamentation elements weren't used around the upper windows. Also, there isn't this type of decoration around the windows of the western wall.



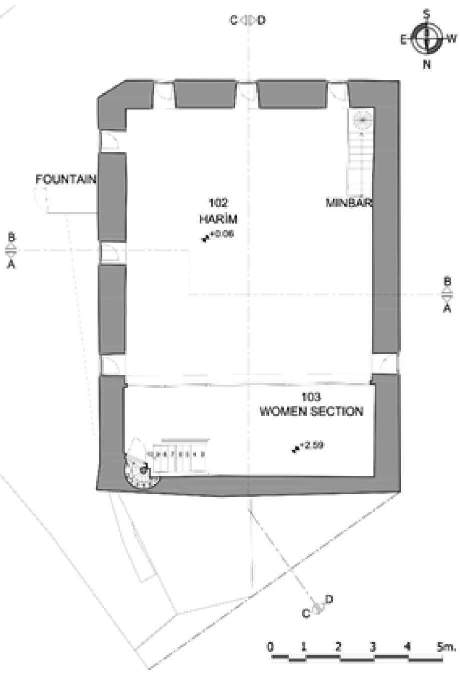


Figure 3. +1.20 level plan.
Figure 4. +3.30 level plan.

In the east wall, carnations, pomegranate flowers, and hatayi motifs are observed in the frames of the windows, while the southern wall windows have rose blossom, pomegranate flower, and leaf motifs. Motifs are dominated by red and green colors. Kelime-i tevhid "Lâ ilâhe illallah Muhammedün resûlullah" from the Koran is written on the top part of all windows.

The door which provides entrance to the harim is arched and the door sill is made of stone. Wooden door wings have three-table and are painted in white and brown. The door is mounted to the frame with ring-shaped interlocking hinges.

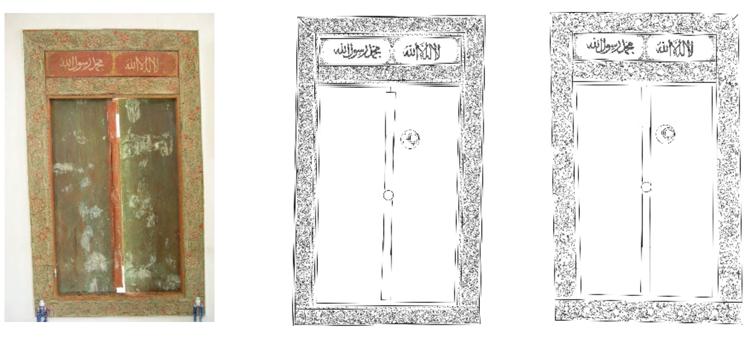
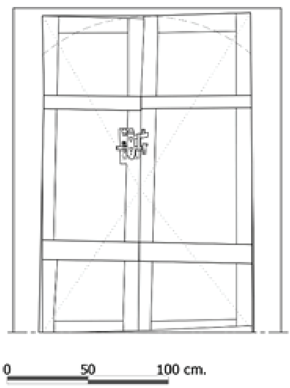
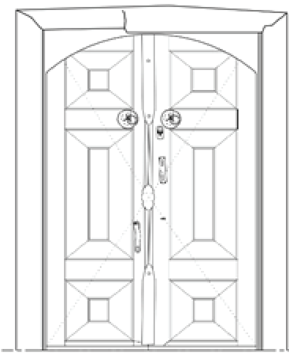
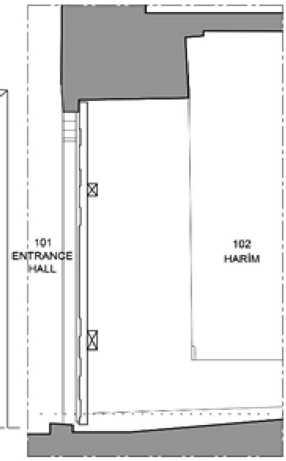


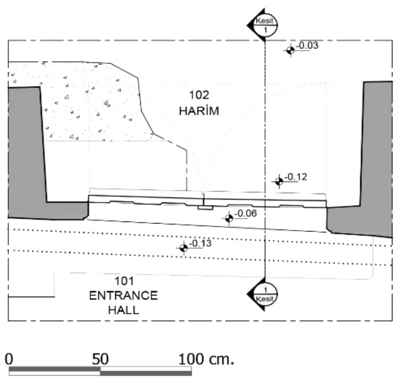
Figure 5. Decoration of the windows on the eastern wall (Detail no: 2, 3).







Back elevation Front elevation Section



Back elevation photo Plan Front elevation photo

Figure 6. Detail of the entrance door (Detail no: 1)

The women section is located in the north direction of the harim and is carried by four wooden posts. There is a wooden staircase on the east side of the entrance, adjacent to the north wall to reach to the women section. The gallery overlooking the harim has plain wooden railings. There is also a gate to the minaret on the northeast corner of the place.

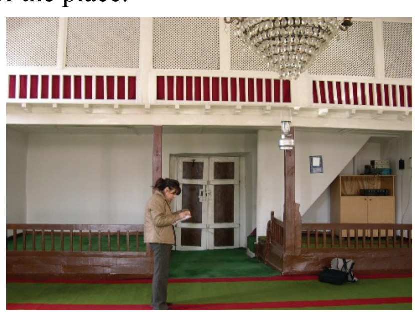
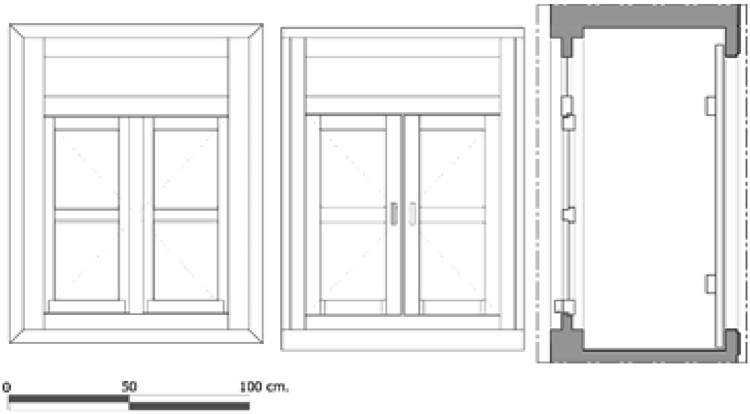
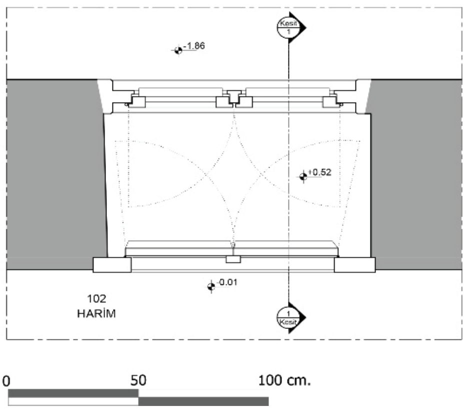


Figure 7. Ceiling decoration.
Figure 8. View of the north wall of the Harim.



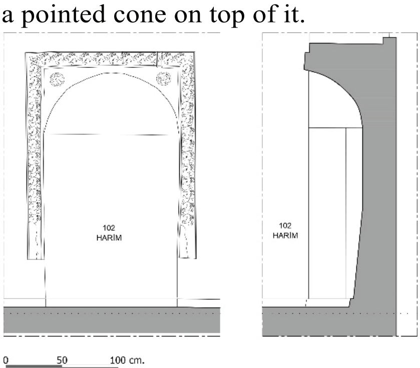
Back elevation Front elevation Section



Plan

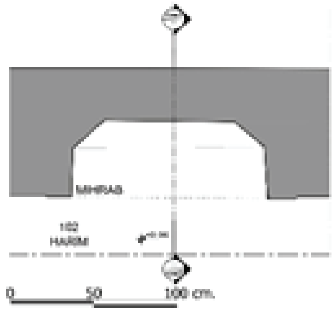
Figure 9. Window detail (Detail no: 4)
Figure 10. East elevation and fountain.

The rounded arched mihrab in the qibla wall was decorated with herbal-style embossed motifs and painted with gilding paint. The side panels of the minbar were made of wood in a rectangular shape. The same arrangement can be seen on the side surfaces of the kiosk. The kiosk has a pointed cone on top of it.



Elevation Section

Figure 11. View of the south wall of the Harim



Plan

Figure 12. Mihrab detail (Detail no: 5)

2.2 Exterior Features of the Mosque

The foundation of the building was built with rubble stone while the mudbricks were used for the upper part of the structure. The building is supported by wooden beams used at certain levels. The roof is covered with tiles. A wooden minaret rises through the roof, in the northeast corner of the structure.

The mosque hasn't the last prayer hall. On the eastern facade, the left and right corners of the original walls are chamfered. The windows are located on two different levels, as bottom and top. The rubble stone wall at the bottom of the facade was grouted using cement.

Figure 13. South elevation of the fountain
Figure 14. South and east elevation

A corner of the southern facade is orthogonal, but the other corner is chamfered. There are 2 windows in the lower part and 3 windows in the upper part and these windows have the same characteristics as the windows on the east and west facades. The western facade of the building has 2 windows at the upper part and 1 window at the bottom part.

An additional entrance section with no windows was added to the north facade of the building. The wooden minaret on the northeast corner of the building is quite plain without decoration. There is a stone fountain adjacent to the building. Although it does not have an inscription, it can be dated to the end of the 19th century and early 20th century according to the construction style [1]

3 BRIEF HISTORY OF THE BUILDING

There isn't a historical document such as an inscription or written document which gives full information about the construction date of Ramazan Şemseddin Mosque.

In a survey conducted based on Şer'iye registers that Ramazan Şemseddin district was set up inside the inner castle of Ankara at the end of the 16th century. In that period, the neighborhoods in Ankara either arose around a religious building or arose as a result of the wishes of some of the occupational groups or those gathered around the same religious belief and tradition [2]. This perspective strengthens the thesis that the mosque was built in the name of Şemseddin at the end of the 16th century or more probably early in the 17th century.

In the study of Ceylan and Aydın, "When the 17th century period of the Ottoman Classical Period came to an end, two buildings of Şerefeli (Resul Efendi) Mosque (1674-75) and Ramazan Şemseddin Mosque (Kale Pazarı) were built in the 17th century. It is possible to say that this period mosques continue the style of Ankara [3].

Gönül Öney also states that the building was built in the 17th century by Ramazan Şemseddin. Another information given by Öney about the mosque is the complete renovation of the building on the old foundations in 1954-56 [4]. However, the original elements existing in some parts of the structure and an old photograph suggest that the structure was renovated but not completely demolished in that period.

Researches show that most of the mosques in Ankara Castle and its surroundings were built without a minbar and minaret [4]. In this respect, it is considered that Ramazan Şemseddin Mosque had no minbar and minaret originally. Evliya Çelebi gives information about Ankara mosques in the travelogue. "Mosques covered lead are a few. Mosques are covered with clean earth. The rest are neighborhood masjids." [5]. The Kurşunlu Mosque, located on the Anafartalar Street in Ankara, next to the Altındağ City Hall and the Cenabi Ahmet Paşa Mosque in Ulucanlar Street are examples of mosques with domes covered lead in the 16th century [1]. It is also an indication that the soil roof is not used in all the buildings and different systems and materials were applied. The use of earth roofs in mosques and masjids in Ankara decreased after the 15th-16th century. The wooden roofs of the mosques and masjids built in the 17th and 18th centuries were carried by wooden constructions and walls [4].

The examples of ornamented wooden ceilings with hexagonal cores appear in the Hacıbayram Mosque and Hacı Musa Mosque in the 15th century [1]. Increase number of this type of examples in 16th-17th century indicate that the change in the ceiling systems of the mosques in Ankara. Comparative studies suggest that the minaret and minbar of the mosque were added in the 18th century. According to the existing fountain construction style, it was built in the late 19th or early 20th centuries.

It is known that the mosque was repaired in 1956 and 1984 [1]. The unqualified applications and the entrance section of the mosque must have been implemented during these repair works. A book on Ankara Foundation Works was published by Ankara Development Agency and short descriptions concerning the current situation of the structure were made in that publication [6].

4. DOCUMENTATION METHOD AND GENERAL EVALUATION OF DETERIORATION ANALYSIS

4.1 Documentation Method

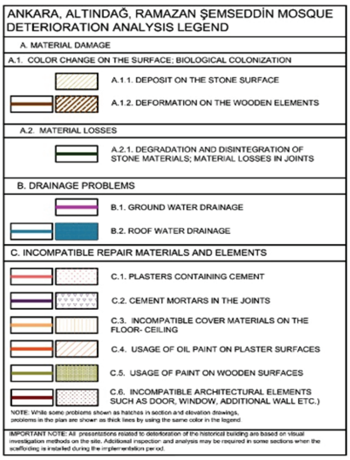
Within the scope of the survey, topographic measurement system (TPS) was used. Where the TPS system was not available, the manual triangulation measurement method was preferred for the measurement. The mural paintings around mihrab and lower level windows of the structure were drawn by using the photogrammetric data.

4.2 General Evaluation of Deterioration Analysis

In the process of detecting the damages occurring in the building, analytical drawings were prepared as a result of the two-stage work performed on-site and in the office. The building was

examined by visual methods on-site and the information obtained was processed with hatches and notes on analytical drawings. Problematic areas of the structure were photographed in detail.
The damages detected during the fieldwork were transferred to the analytical drawings using the 'Mapping Method' in the office. Each problem and damage was indicated by hatching in a different color and these hatches were identified by a legend. Thus, it was aimed to identify similar and different problems in various parts of the structure.

Damage Assessment Analysis Legend was created under 3 main headings as; * Material Damages, * Drainage Problems, and * Incompatible Interventions.



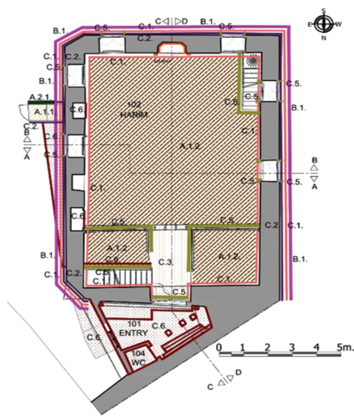
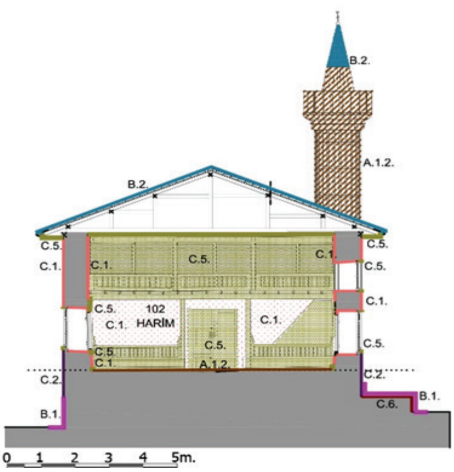


Figure 15. Deterioration analysis legend
Figure 16. +1.20 level plan



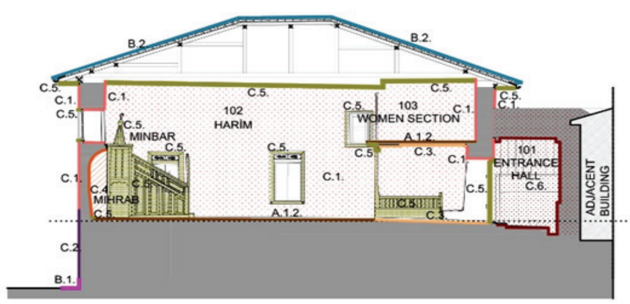
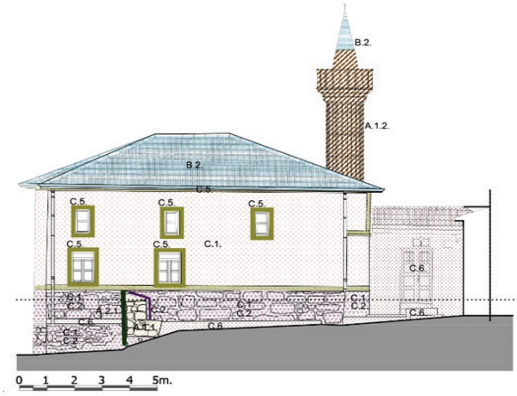


Figure 17. A- A section.
Figure 18. D- D section.



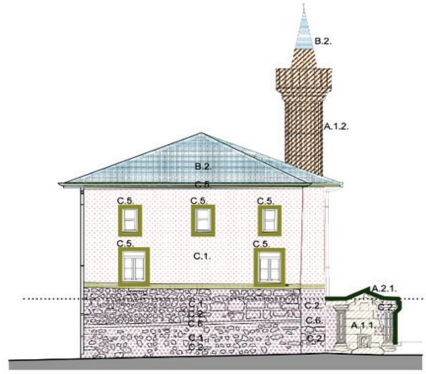


Figure 19. South elevation
Figure 20. East elevation

4.3 Explanations of Methods Used for Material Analysis

To investigate the properties of the mud brick and plaster used in the construction of the mosque, attention was paid to the selection of the samples from the departments with the least material degradation. Both visual analysis and experimental analyses were carried out during the studies and the results were evaluated. Soil Texture, XRD, and WD-XRF Analyses were performed by using the facilities of Turkish Atomic Energy Authority, Sarayköy Nuclear Research and Training Center in Ankara.

Figure 21. The appearance of mud plaster and painted layer on lime plaster
Figure 22. Close-up view of the lime plaster

Figure 23. Scaled photo of mud plaster and lime plaster as two layers
Figure 24. The appearance of mud plaster

4.3.1 Texture Analysis Method
Texture analysis is defined as the relative amount or distribution of the mineral groups of various sizes in the soil. Migrometer method is used in the texture analysis of soil material. In this method, the soil sample is sieved to a particle size of 2 mm, solution is prepared and then the measurement is made by hydrometer. According to the measurement results, the material is classified as follows;
* If the particle size is <0.002 mm, "Clay soil",
* If the particle size is in the range of 0.02 - 0.002 mm "Silt soil",

* If the particle size is between 2-0.02 mm, it is called "Sandy soil".

4.3.2 X-Ray Diffraction Diffractometer (XRD)

X-Ray Diffractometer (XRD) is one of the most important methods used in the structure analysis of powder and solid materials. X-ray powder diffraction analysis is performed using Bruker D8 Advance model.

With the copper-targeted X-ray tube, phase analysis and crystal structure analysis of materials are carried out in a temperature range of -180 ° C to + 1600 ° C and information is given about the main minerals in the material.

4.3.3 Wavelength Distributed X-Rays Fluorescence Spectrometer (WD-XRF)

- Geological, environmental, biological and archaeological samples in solid, powder, liquid form from Boron to Uranium are analyzed simultaneously (up to 50), accurate, sensitive, reliable and non-destructive.

4.3.4 Moisture and Organic Material Ratio

The samples which were pounded in a pestle and purged in a drying oven were dehumidified and weighed. In a crucible, it was heated up to 500 ºC in the oven and the organic substances were destroyed, the mixture was weighed by cooling above room temperature and the ratio of organic matter in the sample was calculated from the difference.

4.4 Results

4.4.1 Texture Analysis Method

Table 1. Texture analyses results of the samples of Mud Brick and Mud Plaster

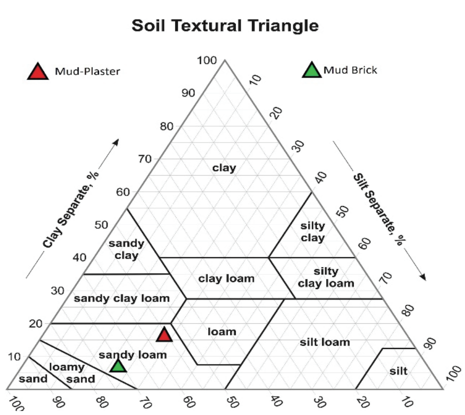
SAMPLE	SAND %	SİLT* %	CLAY %	STRUCTURE CLASS
Mudbrickk□	76,6	13,8	9,6	SL**
Mud Plaster	53,4	28,7	17,9	SL

Definitions

* Silt: Non-organic, granular and highly fine (coarse than clay, but smaller than sand) material classified by grain size separation. According to the distinction accepted by the International Society of Soil Science, Silt grain size is given as 0.02 - 0.002 mm diameter.

** SL: Sandy Loam (Qualified soil type with sand, shaft, and clay.)

Table 2. Texture Triangle Diagram of Samples.



According to the triangle diagram, the samples both mud brick and mud plaster are in the area of "SANDY LOAM".

4.4.2 Ramazan Semseddin Mosque X-Ray Diffraction Diffractometer (XRD)

Table 3. XRD Result of Mud Brick sample.

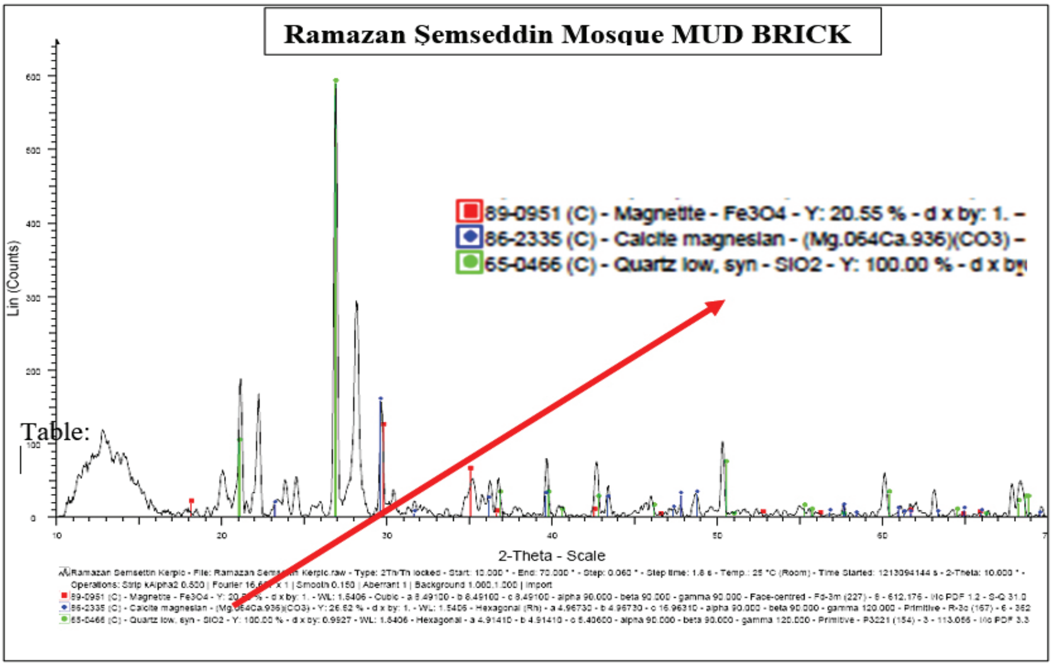


Table 4. XRD Result of Mud Plaster Sample.

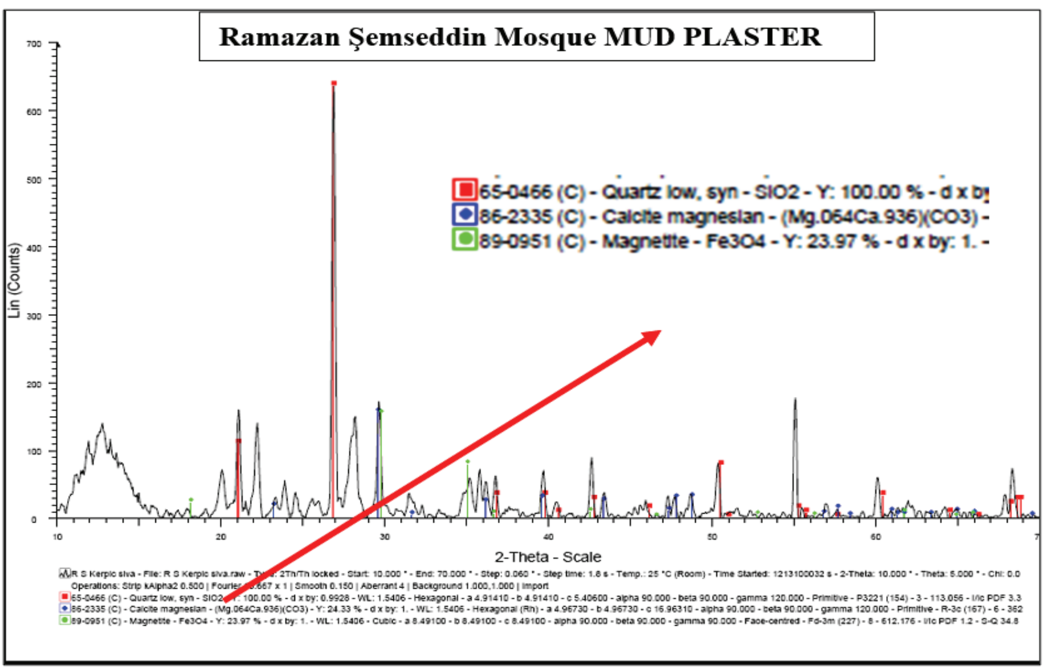
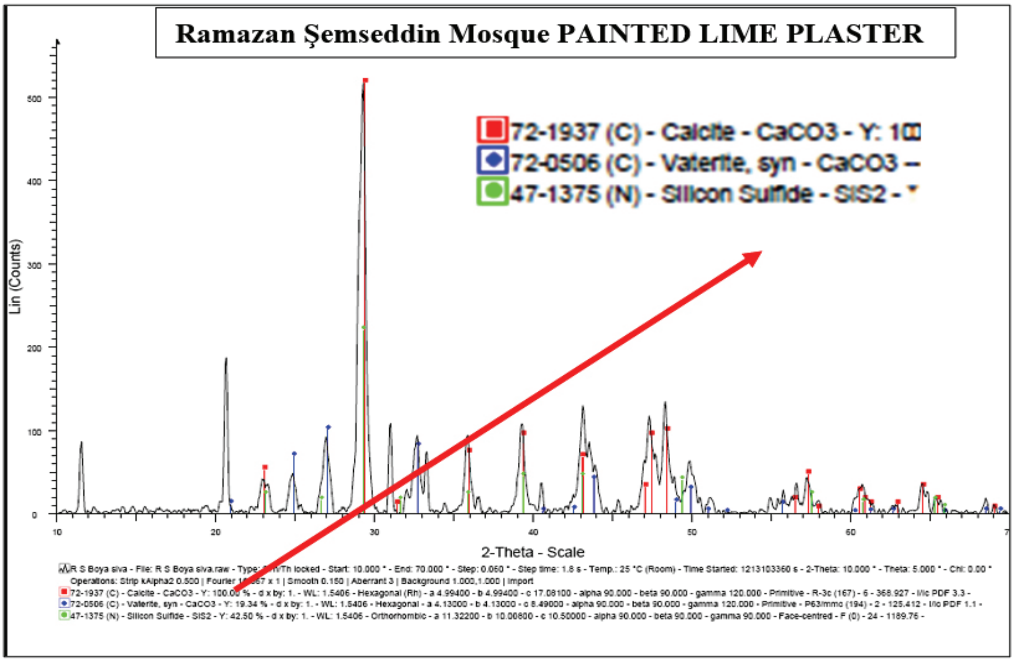


Table 5. XRD Result of Painted Lime Plaster Sample.



4.4.3 Ramazan Semseddin Mosque XRF (X-Ray Fluorescence)

MUD BRICK

Compound	Concentration (%)
Na2O	1.07
MgO	2.258
Al2O3	20.211
SiO2	50.595
P2O5	2.219
Cl	0.453
K2O	2.737
CaO	8.92
Ti	0.419
Cr	0.018
Fe2O3	9.611
Ni	0.005
Cu	0.019
Zn	0.017
Ga	0.003
Br	0.002
Rb	0.01
Sr	0.05
Y	0.003
Zr	0.016
Nb	0.002
Ba	0.137
Pb	0.01
SO3	1.215

MUD PLASTER

Compound	Concentration (%)
Na2O	0.902
MgO	2.222
Al2O3	19.774
SiO2	50.438
P2O5	2.617
Cl	0.329
K2O	2.707
CaO	9.554
Ti	0.44
Cr	0.013
MnO	0.019
Fe2O3	9.523
Ni	0.006
Cu	0.023
Zn	0.027
Ga	0.001
As	0.003
Rb	0.008
Sr	0.054
Y	0.003
Zr	0.02
Nb	0.002
Sn	0.005
Ba	0.136
Pb	0.016
SO3	1.156

PAINTED LIME PLASTER

Compound	Concentration (%)
Mg	0
O	0
Na2O	0.848
Al2O3	1.011
SiO2	1.635
P2O5	0.081
Cl	0.808
K2O	0.082
CaO	80.048
Ti	0.018
MnO	0.024
Fe2O3	0.775
Zn	0.044
As	0.002
Sr	0.174
Pb	0.003
SO3	14.446

4.4.4 Results

When the samples taken from the Ramazan Şemseddin Mosque are examined, it is thought that the same type of soil may have been used in the production of adobe and adobe plaster since the XRF analysis results contain similar values.

Table 6. Comparison Graph of the XRF Results on Mud Brick and Mud Plaster samples

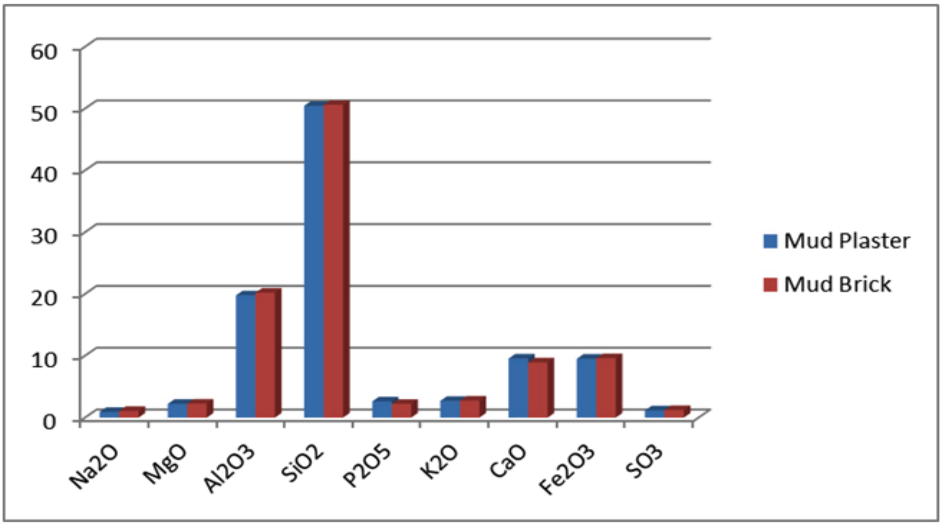
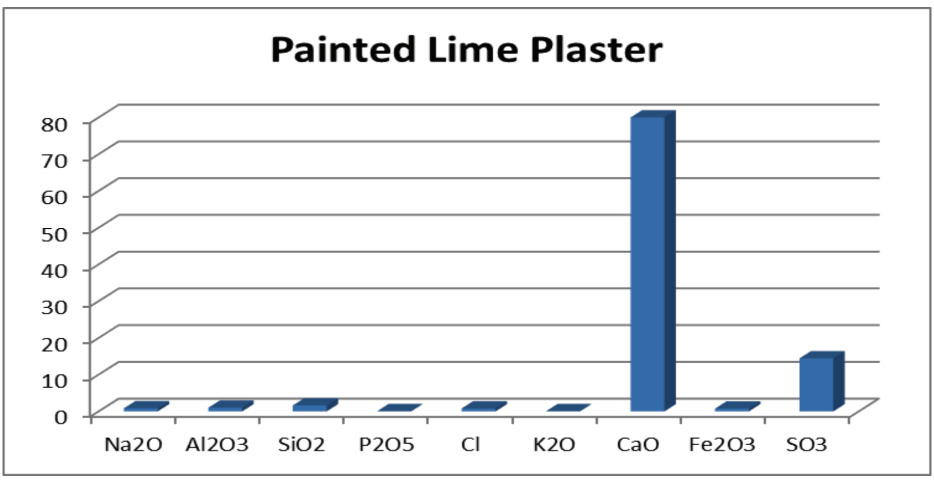


Table 7. XRF Result Graph of Painted Lime Plaster.



When the plaster sample is examined under the stereomicroscope, a layer of mud plaster is seen on the mud brick and two layers of lime plaster are seen on it. The outermost plaster is thinner than the other. The paint on the surface of the plaster is silicone-based and it is thought that the paint may have been used during repairs.

5 CONCLUSION

Today, the approach of the protection of cultural assets requires to follow a scientific procedure within its own ethical rules. This protection approach consists of studies such as documentation, analysis of material's features, diagnosis of its problems and development of preservation interventions. During the restoration works, it is important to use repair materials that is compatible with the original materials of the historical buildings.

It is known that Ramazan Şemseddin Mosque lost some of its originality due to the repairs made in the historical process. Due to the limited written resources of the building, it was difficult to access information and documents regarding the original condition of the building. However, the main approach adopted in the restoration project was to propose interventions aimed at preserving the original values of the building in terms of design, architectural features, construction system, material quality, and usage. Therefore, in all interventions to the material, it is aimed to protect the original material in place and minimum intervention principle is adopted. However, if this is not possible for structural reasons, it may be possible to replace the original material which has deteriorated with the new material.

In this research, as well as documentation of the structure, also detailed material researches about mud brick, mud plaster, and lime plaster were conducted. Then, material proposals were developed for the production of mud brick and mud plaster for the restoration implementation. According to the results of the research given above sandy loam was used for the production of both mud brick and mud plaster.

Mud Brick Production Proposal
It is recommended to use soil containing values as the mixture of 76% Sand, 14% Silt (Loam), Clay 10% for the production of mud brick. Also, since the mud brick contains approximately 9% organic material found in the analyzes, it is recommended to add 9% organic material (straw) into the mortar during the new mud brick production.

Mud Plaster Production Proposal
Likewise, for producing mud plaster, it is proposed to use 53% Sand, 29% Silt and 18% Clay. Additionally, since it is determined that the plaster material contained about 12.6% organic material in the analyzes, it is recommended to add 13% organic material (straw) into the mortar during the new mud plaster production.

6 ACKNOWLEDGMENTS

We would like to thank the Turkish Atomic Energy Authority for performing *Soil Texture, *XRD, and *WD-XRF Analyses and scientific help during our research concerning the mosque's materials. We also thank Ankara Regional Foundations Directorate for their contributions related to the preparation of the conservation project.

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Mapping the Earthen Building Material Ingredients of Ancient Anatolia

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ABSTRACT

The use of earthen building material in Anatolia dates back to ancient times. The differences in earthen material production and application techniques in different periods and geographies of Anatolian cultures indicate the diversity of soil types and local stabilization methods of Anatolia. Despite the rich cultural and technical heritage, the economic prosperity in many geographical regions brings the collapse of the earthen structures and the rapid transition to the concrete structures, are linked to a developing prejudice that represents the social underdevelopment of earthen material and poverty. However, as a result of the increasing tendency of the building oriented illnesses deriving from synthetic building materials and the studies carried out by the Institute of Building Biology + Sustainability (IBN), the earthen building material has begun to gain value again. The compliance of materials with man and nature is scored by IBN through assesment criterias. Material evaluation results show that earthen building material is the most compatible building material with human and environmental health.

In the near future, it is expected that the earthen building material will have a 'Renaissance period' due to its unique properties that can guarantee human and environmental health. It is thought that people will want to have a clean earthen wall instead of smelling the paint, glue, disturbing chemicals coming from insulation and other elements. It is not enough for the birth of earthen structure renaissance to be able to fulfill the consciousness, it is necessary to know the material well in order to make progress in the development of earthen building material and construction methods. The interruption of the transfer of local knowledge and experience since ancient times, does not prepare the ground for the progression and technical progress of the earthen material, which is expected to be a solution to human and environmental health problems.

In recent years, the synthetic materials used as additives in the studies to improve the properties of the earthen building material by stabilizing. Using synthetics causes the material to lose its valuable properties at the level of the building system. For this reason, this study aims to compile the results of earthen material analysis collected from ancient settlements in Anatolia and to be indexed/mapped. Thus, it will document the knowledge of ancient masters who know the local soil types and use stabilization methods with the addition of natural matter in the preparation of earthen building material. It is thought that this study will provide a guide to the studies aiming the new soil material mixtures and production techniques.

Keywords: Earthen Building Material, Ancient Anatolia, Ancient Masters

1 INTRODUCTION

The earthen structure gains architectural features in the Aceramic Neolithic Period settlements such as Boncuklu Höyük, Pınarbaşı and Aşıklıhöyük, where the first examples of the use of earthen building material located in Anatolia. More advanced examples of buildings made of earthen material appeared in the Ceramic Neolithic Period, with the settlement of Çatalhöyük the most prominant example [1]. The differences of the earthen material production and application techniques used in different periods and regional Anatolian cultures, indicate the diversity of soil types and local stabilization methods in Anatolia. Further, due to the different geological formations present in Anatolia, different soil types were available [2]. Generally, if there is cohesive soil as a building material, it should be used as the first choice. If not, the soil should be given the quality of building material, that is, an 'improvement and stabilization method' appropriate to the type of soil should be applied [3]. In 1948, Bekir Postacıoğlu examined the soil blocks[1] brought from 77 different settlements of Anatolia through physical and mechanical experiments in the material laboratory of ITU. It has been determined that the ratio of straw additive material in soil blocks varied, and in some regions even production without straw has been identified [3]. The recognition of local soil material and the use of appropriate stabilization methods have been the result of an accumulation of knowledge in Anatolia since ancient times. Despite the rich cultural and technical heritage, the economic prosperity in many geographical regions has brought the demise of mudbrick buildings and the rapid transition to concrete structures. One reason for this situation is the developing prejudice that associates mudbrick buildings with social underdevelopment and poverty [4, 5]. Eres (2010), encountered this problem of abandoned settlements and forgotten knowledge of soil materials in a study on the adobe domed structures in and around Urfa. The fact that no one knows the construction of the dome anymore except for a few old craftsmen today poses the danger that the long tradition of adobe domed building will be lost for future generations and like many old traditions it must be rediscovered from the beginning [6].

However, in recent years, as a result of research[2] on building material related to diseases and due to studies carried out by the Institute of Building Biology+Sustainability (IBN)[3], earthen building material has started to become appreciated again. Building Biology is defined as a holistic study of the artificial environment, human health and the natural environment. The study covers the effects of the structure on both human health and natural environment health, and the building material is at the center of the relationship between the human-structure-nature trilogy [8, 9]. The compatibility of materials with human and nature is scored by IBN in accordance with the criteria. According to the results of the material evaluation, the earthen building material, which received 2.6 points out of 3, was found to be the most compatible building material for human and natural health [10, 11].

According to Bruce King (2010), there will be a Renaissance Period for the earthen building material in the future due to its unique properties that can guarantee the health of human and environment. It is believed that people will prefer a clean earthen wall instead of smelling the paint, glue, disturbing chemicals coming from insulation and other elements [12]. For the renaissance of the earthen structure it is not enough to satisfy the consciousness, it is also necessary to know the material well in order to make progress in the development of earthen building material and construction methods. The interruption of the transfer of local knowledge and experience between ancient times and today does not prepare the ground for the technical progress in earthen material building techniques, although earth is expected to be a solution to human and environmental health problems.

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[1] In the original text it is described as 'adobe'.
[2] In a study conducted by Yıldız and Sezer in 2015, 46 articles were examined while questioning the relationship between building materials and human health and it was concluded that material selection has direct effects on user health. In the research, diseases caused by indoor pollutants originating from materials are listed as; chronic lung disorders, cancer, blood and bone marrow diseases, respiratory and mucosal disorders, infections, allergic and psychological effects [7].
[3] The Institute of Building Biology and Ecology (IBN), in service since 1983, has been carrying out important studies for the development and dissemination of Building Biology Science, and the results of these studies are published as standards, principles and material evaluations [8].

2 SOIL IMPROVEMENT AND STABILIZATION METHODS

Improvement and stabilization are the processes that are used to give the soil the qualities required by the place and purpose of use of the structure. When these processes are completed, the building soil becomes soil building material and is ready for use in the building [3].

Özcan (2005) determined the points to be considered in the selection of the correct stabilization method as follows: the characteristics of the soil to be improved, the economic efficiency of the project (cost and time spent in the improvement of adobe), the production technique of adobe and the construction system in which the adobe material will be used [13]. The methods of soil improvement are shown in Table 2.1. [13]

Table 2.1 Improvement-Stabilization Methods

Mechanical Stabilization	Increasing the properties of soil such as density, mechanical strength, porosity, compressive strength.
Physical Stabilization	Improving the properties of soil by changing the texture. Ex: Changing the granulometric structure of the soil, soaking the soil, drying, etc.
Chemical Stabilization	Addition of different substances or chemicals to the soil. Chemical reactions result in a new material. The most common of these are the incorporation of vegetable fibers into the soil, the addition of binder cement, gypsum, and bitumen.

In recent years, academic studies in Turkey have been carried out in order to improve soil properties by stabilizing earthen construction material. Stabilization studies for strengthening the weak compressive strength and water resistance of the earthen construction materials are summarized in Table 2.2. [14, 15, 16, 17, 18]

Table 2.2 Soil Material Stabilization Experiments

Year	Researcher	Additives
1964	Postacıoğlu	Cement
1969	Alkan	1/10-1/18 volume ratio of cement
1980	Eriç, Anıl ve Çorapçıoğlu	15% plaster and lime
1985	Kafescioğlu ve Gürdal	22 lt. water, 2 kg. lime and 10 kg. plaster for 100 kg. soil[4]
1990, 1995	Baradan	Milled brick and tile waste, lime and fly ash
1998	Durmuş	Paddy husk and cement
2000	Erol	Fly ash
2005	Değirmenci	Phospho-gypsum and fly ash
2007	Kıvrak	Silica fume and straw in different proportions between 0-25%
2008	Can	Ferrochrome slag
2010	Çakır	Natural pozzolan and lime
2011	Gül	Air entraining and fiber additives

Apart from chemical stabilization studies, Prof. Dr. Bilge Işık is working on spraying technique of soil material and this technique which is fast and rational is developed with soil stabilization studies [19]. Aside from academic studies, Aşanlı (2017), who creates his own mixtures, lists the materials of his traditional mudbrick recipe as follows: 1 m³ soil, 12 kg coarse rock salt, 30 kg wood ash, 20-25 kg of straw. Rock salt is added to increase water resistance in order to prevent

[4] The mixture was named as 'Alker'.

plant seeds from sprouting in the spring. Wood ash gives elasticity, water and moisture repellency, resistance to compressive and bending forces. Straw, bristle or feather material that has been damp, dried, at least one-year, increase the strength of adherence and act as binding force. Aşanlı stated that each region has its own recipe for soil materials due to the different clay quality in the soil and asserted that Anatolia has unlimited successful recipes. He further encourages the formation of new mixtures, but warns of the necessity of the addition of natural ingredients when preparing mixtures: 'Your own body will be the first place where your house, barn or any building you build will waste' [20].

3 THE USE OF EARTHEN BUILDING MATERIALS IN ANATOLIAN ANTIQUE SETTLEMENTS

In recent years, studies carried out with the aim of improving the properties of soil by stabilizing the earthen construction material, as seen in Table 2.2, have shown that the use of the synthetic additives generally causes the soil material to lose its valuable properties at the level of the construction system. For this reason, in this section, the results of soil material analysis collected from ancient[5] settlements in Anatolia were compiled and indexed. It is thought that it can form a basis for studies aiming at new mixtures and production techniques by documenting the knowledge of the ancient craftsmen who knew the local soil types and useed natural material as added stabilization methods during the preparation of earthen construction materials.

It is possible, although only to some extant, to collect information from the works of ancient authors about the techniques of earthen construction. Vitruvius gives the most extensive information on the subject by writing about periodical production and application techniques in his book[6]. He recommends not to use sandy, gravel clay or fine gravel for soil block mixture. If this is done, blocks are heavy and when the building element forms a wall, it gets wet with rain, crumbles and shreds, and the straw in it breaks down. White and calcareous, even coarse-grained pebble clay is recommended in his book [21].

Thanks to the material culture that emerged through archaeological excavations, information about the production and application of building materials in ancient times is also being transferred to the present day. Van Beek (2007), in the 'Archaeological Character' section of his book on soil building material, states how sensitive it is due to the moisture penetrating the antique soil blocks, which have remained under the soil for a long time. He further states that it is very difficult to remove the adobe blocks without breaking. It is even difficult to notice them during the excavation [22]. Therefore, all of the scientific studies that enable the transfer of information by initiating this challenging process are very valuable. As a result of the literature survey an 'Antique Soil Building Material Usage Index' was created (see Table 3.1). In this present study I included only ancient sites, for which the necessary data of the soil construction material were available, and which met my criteria set out in the index above. The descriptions of the ancient settlements included in the index are given below.

Aktopraklık Höyük: It is located within the borders of Bursa province. It is believed that it was continuously settled from second half of the 7th millennium B.C. until the first half of the 6th millennium B.C. [23]. According to the research results, the people of the period had knowledge about lime mortar making technology and lime reaction against water. Although they were well aware of lime technology, they used a clay soil mixture in mud brick. As a result of the investigation of the soil construction materials of the mound, it was concluded that the aggregates used were of local soil origin and the phosphorus content in the samples was high due to the use of animal fertilizers. There is no evidence for the use of organic additives (hay, straw etc.) in the samples. Additionally, in some instances debris of the previous layer was used in succeeding

[5] The period was limited until the end of antiquity, by authors.
[6] The Ten Books on Architecture.

phases. The studies also found out that in some layersthese layers pottery fractures were consciously added to the mortar mixtures [24].


Figure 1. Aktopraklık Höyük [Url-1] **Figure 2. Güvercinkayası** [Url-2]

Güvercinkayası: This site is located on the waterfront Melendiz, near Çatalsu Village. It dates back to 5200-4750 B.C. (Url-3). Soil building material has been used since the construction of the houses from the Neolithic period. Pisé technique is seen in the earliest examples. The main building materials of the settlement are soil, stone, wood and reed. Soil was used as the mortar of the stone masonry. The uprights and door moldings are made of wood and the roof cover is reeds and compacted soil. In addition to the floor and wall facades, the surfaces of silos, ovens were plastered with mud mortars. In the last layer a terrace structure made of mudbrick was found. An important feature of the adobe brick terrace structure is that the colors of the bricks and mud mortar that hold the full and half bricks together, are different. As far as can be said, full bricks are very light-gray, half-bricks are yellowish and the mortar turns bluish. As a result of the investigation, tuff minerals and high lime levels were detected in mudbrick blocks, roofs and floor plasters and montmorillonite and chlorite clay minerals were found in mud mortars used only in wall plasters [25].

Tepecik-Çiftlik: The settlement, which is located within the boundaries of the Çiftlik District of Niğde Province, is dated between 7500-5800 B.C. (Url-4). Due to its location, it was possible to obtain clay soil easily, which could be used as building material. Soil building material in Tepecik-Çiftlik was used in the construction of building walls, plastering of the floor and interior walls. Further, as binding mortar in the stone subbasement walls and in the construction of building equipment (such as furnace or honeycomb). According to the data obtained from the studies, stone additives were used more in the grayish adobe mixture and the organic (straw) additive was used less. The adobe used as a binding mortar on stone sub-walls is generally not an admixture. Adobe sludge, which was used as plaster in interior spaces and furnace floors, has more dense clay, straw-stone added and an 'oily' consistency. The result of the examination of the building elements showed that the contribution to the soil of the building walls contained abundant straw and little stone. The soil material used as plaster is always yellow/yellowish, orange colored and has a homogeneous structure containing dense clay. Because of this structure, it is easy to apply as plaster. Clay soil was used in order to reduce the permeability of the top cover of the roofing element [26, 27].


Figure 3. Tepecik-Çiftlik Höyük [Url-5] **Figure 4. Aşıklı Höyük** [Url-6]

Aşıklı Höyük: It is located between Hasandağ and the Melandiz Mountains in Central Anatolia. It was settled from ca. 8500-7300 B.C. (Url-7). Although it is a rocky settlement, soil has been used as the basic building material. Earthen construction techniques have changed throughout its history, from its beginning to the date the settlement was abandoned. According to the results of the analyses, gypsum, basalt, feldspart, quartz, tuff, volcanic glass and species of volcanic origin were found in the soil structure of the Aşıklıhöyük samples. Materials used as additive or binder such as hackberry, coal, ash, dung, bark, large plants, some organic materials and small plant residues have been identified as additive or binder. The additives used in the improvement-stabilization method in Aşıklıhöyük have a variety of content and composition. This diversity shows that the Aşıklı people of the period had various soil material mixture prescriptions they created themselves. In addition, periodic changes in additives were determined. For example, the dung, which was used as an additive in the life of the 9th millennium, was replaced by plant contribution in the 8th millennium. The mudbricks of the 9th millennium are of similar characteristics as the 8th millennium mortars. In the second half of the 8th millennium, when the settlement pattern was tightened and neighborhood groups were formed, there was a diversity in resource use and a tendency to move out of the settlement. In the 8th millennium, mortars contain more aggregate than soil blocks. This suggests that the building materials of the previous building in mortars are considered as recycling material and reused in the newly constructed building [28].

Arslantepe: A site located in the town of Orduzu in Malatya. It was settled from 5000 BC on until the 11th century AD (Url-8). Liberotti et al. (2011) stated that as a result of the XRD test carried out on the soil forming of the Arslantepe building material, all samples had the same mineral composition, albeit at different rates: calcite, quartz, plagioclase, filosilicate, gypsum and/or dolomite.The results of the study conducted by Liberotti (2010) demonstrate that to the Arslantepe soil structure material inclusions were added as part of the improvement-stabilization method, among them pottery fractures, animal bone fragments and plants. It was Also different sizes and proportions of plant contributions were observed, especially in the plaster. The size and proportion changed according to the purpose, in which it was used in the structure. This proves that the soil building material properties were recognized during the Arslantepe Chalcolithic Period [29, 30].


Figure 5. Arslantepe Höyüğü [Url-9]


Figure 6. Çatalhöyük [Url-10]

Çatalhöyük: It is located within the borders of Çumra District of Konya. The earliest settlement level dates back to ca. 5500 B.C. [Url-11]. Çatalhöyük houses were built in a rectangular plan by systematically stacking the adobe blocks on top of each other without using stone foundations. The wooden beams placed inside the mudbrick walls helped to carry the roof. The roofs of the houses were covered with clay and reed. The interior walls of the houses were plastered with mud and painted with white paint. Red, yellow and brown paintings were drawn on the white paint [31]. Love (2011), analysed eighteen mudbricks and found out that minerals such as quartz, feldspar, calcite, chert, basalt, gypsum, and granite aggregates characterize the sand fraction, including traces of mica, hornblende, garnet and pumice, and cultural material such as bone and charcoal fragments [32].

Table 3.1 Ancient Soil Building Material Usage Index [In the preparation of the index, the references used for the information concerning the ancient settlements given above are valid].

Ancient Settlement	Geographic Location	Sampling Period	Structural Function	Content	
				Soil Mineralogy	Additives
Aktopraklık	Bursa	Around 6th millenia BC	Earth Block	Lime-rich clay soil	Animal manure, pottery fractures
Güvercinkayası	Aksaray	Middle Chalcolithic Age	Earth Block, Roof, Floor Plaster	Tuff minerals and high levels of lime	-
			Wall Plaster	Montmorillonite, chlorite clay minerals	-
Tepecik-Çiftlik	Niğde	Late Neolithic Period	Wall Structure	Clay soil	Abundant straw, less stone
			Plaster	Clay-rich soil	Straw-stone
			Mortar (Sub-wall)	Clay soil	No additives
			Roof (top cover)	Clay soil	-
Aşıklıhöyük	Aksaray	8th and 9th millennia BC	Earth Block	Gypsum, basalt, feldspar, quartz, tuff, volcanic glass	Hackberry, coal, ash, dung, bark, large plants, some organic materials and small plant residues
			Mortar	-	More aggregate than soil blocks, recycled building materials
Arslantepe	Malatya	Chalcolithic Period	Earth Block	Calcite, quartz, plagioclase, filosilicate, gypsum and/or dolomite	Pottery fractures, animal bone fragments and plants
Çatalhöyük	Konya	Neolithic Period	Earth Block	Quartz, feldspar, calcite, chert, basalt, gypsum, and granite aggregates	Mica, hornblende, garnet and pumice, and cultural material such as bone and charcoal fragments

4 CONCLUSION

As a result of the literature study and the analysis of soil material of ancient places in Anatolia, it can be said that the ancient craftsmen knew the local soil types and used different stabilization methods for their soil materials. Therefore, for the pre-renaissance preparation for adobe building material, it is important, from the technical point of view, to take into consideration the wisdom of the ancient masters, who know the soil and who constructed soil structures by using natural additives in their stabilization methods, in today's studies. Recognition of the soil types of our country in the light of the prescriptions of soil building materials that have existed in Anatolia since ancient times and technical development of the soil material, providing the stabilization methods with natural substances without losing the healthy properties of the material are important for the continuity of human and environmental health.

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Limitations, Barriers and Opportunities for Providing Sustainable Low-income Housing in Turkey

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ABSTRACT

While the developed world is adapting to the consequences of climate changes, global warming will adversely affect the quality of life and economic structure in developing countries. The low-income populations from low, medium and high Human Development Index (HDI) countries would suffer even more from climate changes because of their vulnerable living conditions and the lack of appropriate and sufficient infrastructure.

Particular attention should therefore be paid to the low-income housing conditions not only to address the environmental concerns but also to improve the living standards and health and wellbeing of low-income populations. This paper reviews the Turkish housing conditions in order to state the opportunities and challenges for delivering sustainable energy efficient low-income housing in Turkey. Some of the issues which have been reviewed and discussed are urbanization; slums; housing costs, types and sizes; construction methods and materials and renewable energy sources. The findings demonstrate some critical areas such as informal settlement, overcrowding and access to housing facilities as well as embodied energy of construction methods and materials which require immediate attention.

Housing affordability; slums and informal settlements; unacceptable living conditions and standards in terms of overcrowding and access to basic facilities; and low quality, environmentally deleterious construction methods and materials were identified as the major issues which should be addressed in Turkey. Besides, short-term, medium-term and long-term actions are suggested in order to improve the current housing conditions in Turkey. It should be noted that reducing embodied energy is currently the key factor in reducing the CO_2 emissions and environmental impacts of Turkish housing industry. Yet, improving living standards may transform the running/in-use energy from negligible to a major issue in the near future. This should be considered by all stakeholders including planners, designers and policymakers to achieve a truly sustainable low-income housing in Turkey.

Keywords: Low-income Housing, Sustainability, Climate Change, Energy Efficiency, Turkey.

1 INTRODUCTION

In Turkey as a developing country, housing for low-income groups has always been an important issue that must be carefully investigated under the evolving social, economic and demographic changes in the country's urban habitat. Accommodation is the basic need of the urban crowd and this subject affects the urban poor the most.

The Republic of Turkey is a transcontinental Eurasian nation located between Europe and Asia, neighbored by Greece, Bulgaria, Iraq, Georgia, Armenia, Iran and Syria. Poverty, a complex, multidimensional, and universal problem, has been conceptualized as income and material deprivation. In 1990 the World Bank first reported that there were 1.3 billion poor people out of 6.7 billion people in the world, 70% of them in rural areas. Because of the unstable economy and an inflation rate of 20,30% in 2018, Turkey suffers from high poverty rates. In 2018, Turkey was ranked 64 out of 187 countries with moderate human development in HDI (Human Development Index) ranking. The highest poverty rate was among agricultural workers (46.6%) and in Eastern and Southeastern Anatolia [1]. Factors related to poverty were crowded households, unemployment, immigration, working for a daily wage in the agricultural and construction sector, low educational status, lacking social insurance, and living in rural areas or in Eastern and Southeastern Anatolia.

Poverty headcount ratio at national poverty line (% of population) in Turkey was reported at 1.6 % in 2014, according to the World Bank collection of development indicators. The Rural Poverty Portal notes that, in 2014, the majority of people in poverty in Turkey lived in rural areas, where the rate was over 35 percent below the poverty threshold to merely 22 percent in urban areas. This rural-urban inequality stems from several factors:

•Average rural family size is nearly double that of urban families
•Environmental issues like climate change, soil erosion and continued issues with overgrazing livestock all of which greatly affect agriculture, which is the livelihood of the vast majority of rural families
•Low literacy rates and limited education
•A continued lack of welfare and social security for the rural poor.

Turkey has an area of 783.562 km² and an average altitude of 1131 m above the sea level. Mountain ranges extend in an east-west direction parallel to the north and south coasts, and these are a principal factor in determining ecological conditions.

Turkey's diverse regions have different climates, with the weather system on the coasts contrasting with that prevailing in the interior. The Aegean and Mediterranean coasts have cool, rainy winters and hot, moderately dry summers. Annual precipitation in those areas varies from 580 to 1,300 millimeters, depending on location.

Generally, rainfall is less to the east. The Black Sea coast receives the greatest amount of rainfall. The eastern part of that coast averages 1,400 millimeters annually and is the only region of Turkey that receives rainfall throughout the year. Because of Turkey's geographical conditions, one can not speak about a general overall climate. In Istanbul and around the sea of Marmara the climate is moderate (winter 4 deg.C and summer 27 deg.C); in winter the temperature can drop below zero. In Western Anatolia there is a mild Mediterranean climate with average temperatures of 9 deg.C in winter and 29 deg.C in summer. On the southern coast of Anatolia, the same climate can be found. The climate of the Anatolian Plateau is a steppe climate (there is a great temperature difference between day and night). Rainfall is low and there is more snow. The average temperature is 23 deg.C in summer and -2 deg.C in winter. The climate in the Black Sea area is wet, warm and humid (summer 23 deg.C, winter 7 deg.C). In Eastern Anatolia and South-Eastern Anatolia there is a long hard winter, where year after year snow lies on the ground from November until the end of April (the average temperature in winter is -13 deg.C and in summer 17 deg.C).

2 METHODOLOGY AND LIMITATIONS OF THE STUDY

Analyzing the statistical data obtained from various national and international institutions within the framework of urbanism principles is the main methodological approach. Literature review, site visits and photographic surveys are carried out to collect relevant information.

3 POPULATION GROWTH, URBANISATION AND SLUMS

In recent decades, the world has been urbanizing rapidly. In 1950, only 30 per cent of the world's population lived in urban areas, a proportion that grew to 55 per cent by 2018. The global urbanization rate masks important differences in urbanization levels across geographic regions. Northern America is the most urbanized region, with 82 per cent of its population residing in urban areas, whereas Asia is approximately 50 per cent urban, and Africa remains mostly rural with 43 per cent of its population living in urban areas in 2018 [2].

The current population of Turkey is 82,704,874 and equivalent to 1.08% of the total world population based on the latest United Nations estimates. Turkey ranks number 17 in the list of countries by population. The population density in Turkey is 108 per Km^2 and 72.2 % of the population is urban.

The number of households in Turkey is 19,842,850 and average size of households is 3.7 persons, according to family statistics of Turkish Statistical Institution. Population living in slums (% of urban population) in Turkey was reported at 11.9 % in 2014, according to the World Bank collection of development indicators, compiled from officially recognized sources. Since the 1960s, cities in developing countries like in Turkey have faced an unprecedented rate of urbanization and poverty.

Fig. 1 explains the increasing of urbanization rate in Turkey due to the fast changes of globalization, industrialization and economic in the world caused unplanned and high urbanization process that led to create cities with un-legalized area. Besides the social transformation following the Second World War has a great effect on the urbanizations. The enormous rate of immigration to the metropolises in a short time period resulted by the industrialization, caused a construction of illegal settlements in all over the world and in Turkey [3].

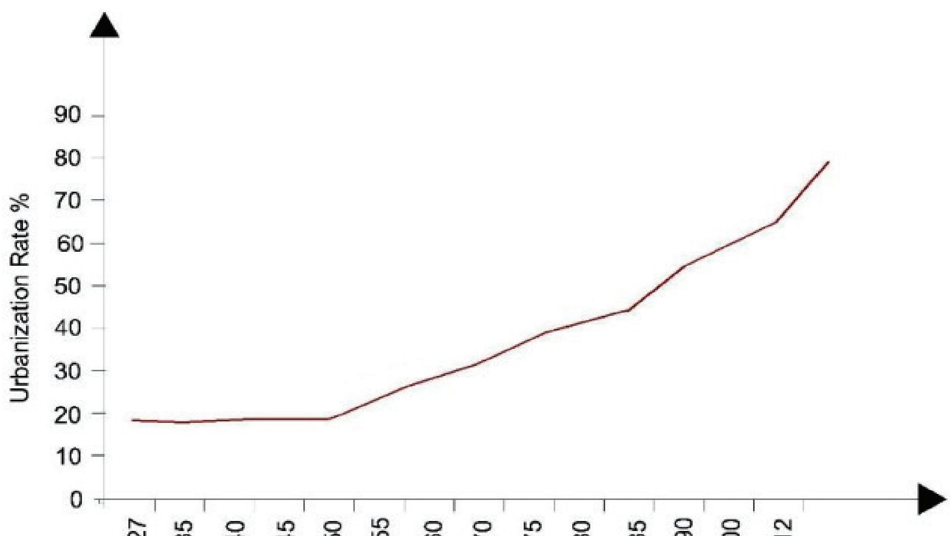

Figure 1. Urbanization rate in Turkey (1927-2012) [4]

According to statistics the average rate of urbanization in Turkey was 17% since the foundation of Turkey Republic in 1923 until the early 1950s, and it increased up 62% in 2000s [5]. According to United Nations, urbanization rates in Turkey was ranked third in the world between the years 1980 and 2000. On the other hand, the insufficient abodes during same periods prompted immigrants to make their own solution and create illegal settlements, which is called now gecekondu [6]. Slums are not only without a legal status, but also built by a second-hand material with very low standards [7]. Because slums build without any coordination with municipalities that caused mostly an environmental degradation, drain of clean water, improper waste disposal, and a damage of existing infrastructure. When we look at the urbanization history in Turkish Republic, we can classify four reasons for urban transformation plans. The illegally constructed settlements, obsolescence in existing building stock, inner-city slums problems, and finally the risk of natural disasters [8].

4 HOUSING CONDITIONS

According to the early studies conducted for the Ministry of Reconstruction and Settlement [9,10,11], in the first half of the 1960s 59% of the population in Ankara, 45% in Istanbul and 33% in Izmir lived in irregular settlements. In the 1980s, these percentages were, respectively, 55%, 70% and 50%. In 1991 the total number of "gecekondu" in Turkey was estimated to be 1,585,455, nearly half of them being located in the three most populated cities of the country, Istanbul, Ankara and Izmir [12]. Squatter and low-income housing are defined in a variety of ways: The main ones are based on their physical appearance or legal status.

Common features of slums:
•That it is against the law
•Lack of health and technical conditions
•Have been made in the place of someone else
•Lack of permission of the landowner
•Having been unlicensed
•Substantially made
•Having been hidden.

5 HOUSING CONDITIONS

Low quality, high waste, and energy intensive production methods, as well as excessive soil extraction and deforestation, are identified as the main environmental damage of the current construction methods and materials in Turkey. Slums are not only without a legal status, but also built by a second-hand material with very low standards. Because slums build without any coordination with municipalities that caused mostly an environmental degradation, drain of clean water, improper waste disposal, and a damage of existing infrastructure.

There are specialized "gecekondu" dwellers that build and sell dwellings to migrants; In some cases, settlements may be established as the consequence of an organized mass invasion by dwellers already living elsewhere in an over-populated city. Election times seem to be preferred for such intra-city migration because politicians do not want to be embroiled in the controversy of confronting migrants for fear of losing votes. The decision to invade a vacant lot is often made after it has been surveyed in advance. Then, thousands of people move onto the lot overnight, divide and name it. They begin to build dwellings with the assistance of friends and relatives using paperboard, sheets of tin, planks of wood, and other useful makeshift materials. They erect the houses in a matter of hours. By morning, previously empty land appears dotted with one room shacks. Later, if successfully defended against the police, the shacks may gradually be expanded to become permanent houses by replacing the original construction materials with brick and cement [13].

Figure 2. Antalya, Kepez, Gülveren District

6 RENEWABLE ENERGY

The World Summit on Sustainable Development in Johannesburg in 2002 committed itself to ''encourage and promote the development of renewable energy sources to accelerate the shift towards sustainable consumption and production''. Accordingly, it aimed at breaking the link between resource use and productivity. This can be achieved by the following:

• Trying to ensure economic growth does not cause environmental pollution.
• Improving resource efficiency.
• Examining the whole life-cycle of a product.
• Enabling consumers to receive more information on products and services.
• Examining how taxes, voluntary agreements, subsidies, regulation and information campaigns, can best stimulate innovation and investment to provide cleaner technology.

Renewable energy is highlighted as the key area which should be addressed to reduce the CO_2 emissions of low-income housing. In today's low energy buildings, the operational energy needs are reduced to a fraction, often less than a quarter, of conventional buildings. This means that the energy/carbon required to produce the building itself, mainly the materials, becomes far more important. The largest carbon items in a building life cycle analysis (LCA) are often cement products and steel – often over 70% of the total lifetime EC and the embodied part will increase as operational energy decreases drastically in future low energy buildings. The other, minor components of the embodied impacts of buildings are the energy for transport of materials, and on-site energy use. The post-use impacts of dismantling and disposing of or recycling buildings has been less studied. This phase requires more attention. Recycling aluminum saves roughly 85% of the energy needed for virgin aluminum; and recycling steel saves over 50%. However, recycling concrete requires 5% more energy than new concrete, and recycling plasterboard is 48% more energy intensive than using virgin material [14].

7 CONCLUSIONS

This paper aimed to study the current Turkey's housing conditions in order to highlight the limitations, barriers and opportunities for providing sustainable low-income housing in Turkey. Housing affordability; slums and informal settlements; unacceptable living conditions and standards in terms of overcrowding and access to basic amenities; and low quality, environmentally harmful construction methods and materials were identified as the major issues which should be addressed in Turkey. The following short, mid and long-term actions are recommended in order to improve the current housing conditions in Turkey. Increasing access to renewable energy sources, raising public awareness, educating local manufacturers and builders, and gradual long-term introduction of innovative construction methods and materials which are adapted to local needs and conditions are some of the recommended actions to improve the current conditions.

It is believed that the research will bring new architectural perspectives, innovative ideas in the future regarding housing needs of low-income groups in Turkey.

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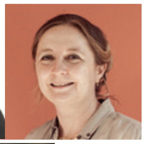
The Use of Mud and Mudbrick in Architecture at the Iron Age City of Kerkenes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ABSTRACT

This paper presents the state of research into the use of mudbrick construction at the Iron Age city at Kerkenes Dağ, Yozgat. Extensive geophysical surveys at the site, coupled with excavations, have allowed archaeologists to gain a rather clear picture of the range of construction techniques and materials used at this ancient site. Most, if not all, of the structures so far investigated were built on several courses of dry-stone masonry foundations. However, the superstructure appears to have been composed of mudbrick walls, topped with a timber-boxed mud and rubble-stone fill. Most of the walls would have been protected by a coat of mud plaster as well. The roofs were also most probably composed of timber floor beams covered with earth; utilizing timber columns resting on stone bases for larger-spanning structures.

Twenty-seven years of excavations and surveys have shed remarkable light on the urban fabric and material culture at Kerkenes, and we are expanding our focus on construction methods and materials. Early on in the project, building material remains were collected when deemed interesting enough. This has changed over time. The current excavation program, which aims to unearth an entire urban block in the northern portion of the city, includes a specific sub-project investigating and modeling architectural construction and its destruction. In order to help us better visualise the ancient buildings, all excavated architecture is being recorded using photogrammetry, and key structures and features are reconstructed using 3D modeling. These models will eventually be used with simulation software to create a model of the city and its eventual destruction by fire.

Keywords: Archaeology, Kerkenes, Iron Age, building materials

1 INTRODUCTION

The use of mud in architecture dates back to times immemorial. Mud always represented a sturdy yet versatile building material that could adapt to any level of technological development. The Neolithic site of Çatalhöyük, which flourished over 9000 years ago, is a famous example of early use of mud in architecture, where a complex settlement was erected with mudbricks and timber. This trend continued for thousands of years, giving rise to structures as simple as Chalcolithic houses and as complex as royal Bronze Age palaces. Given the wealth of resources found throughout Anatolia, mud and mudbrick only represents one of many available construction materials, and the history of architecture in the region reflects this variety. Wood, stone, and reed, alongside mud are the four essential building materials, which are still used in construction in various combinations according to their availability in different regions of Anatolia. Their combined incorporation in individual structures changed as technological advances broadened the scope of architectural forms. During the Bronze and Iron Ages, all four of these main construction materials were routinely used in a wide variety of structures, not just the most imposing of them, as had previously often been the case.

A good example of the fruitful marriage of mud, stone, and wood is the mountaintop city on the Kerkenes Dağı, near the village of Şahmuratlı in Sorgun, Yozgat. Although most of the remains visible today are of surviving stone foundations, ongoing excavations are revealing the importance mud took in the building techniques employed at the site. Evidence for the use of mud is found not only in the walls, but in the floors and roofs as well, be it in the form of mudbrick, mud plaster, or mud fill. This paper presents the state of current knowledge concerning construction techniques and materials, more specifically as it pertains to mud in all its forms.

2 THE IRON AGE CITY AT KERKENES DAĞI

The ancient city on the Kerkenes Dağı (fig. 1) dates to the late Iron Age, *ca*. 2,500 years ago. The short-lived city was built as a single foundation around 620 BCE, presumably by a Phrygian ruler, and was destroyed with fire around 550 BCE, most likely by either Croesus of Lydia or Cyrus the Great of Persia in the course of their war against each other.

Scholarly work at the site aimed at developing a better understanding of the ancient city at Kerkenes began almost a century ago. From 1926 through 1928, surveys and a brief campaign of

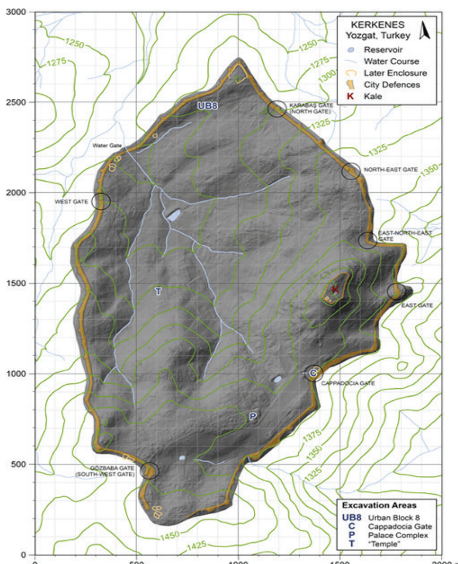

Figure 1. Plan of the archaeological site on the Kerkenes Dağı. The excavated city gate – the Cappadocia Gate – (center right; C), the Palatial Complex (lower right; P), as well as Urban Block 8 (top; UB8) are identified. The large bread oven was located in the vicinity of the Gözbaba Gate (bottom left).

excavations were completed by Hans Henning von der Osten and Erich Schmidt of the Oriental Institute of the University of Chicago (1, 2, 3). Although limited, this work was sufficient to date the unknown city to a broad period now defined as the Iron Age and to allow a hypothetical identification of the city with ancient Pteria, a city mentioned briefly by Herodotus in his *Histories* (I.76) (4, 5).

While this work was foundational to our understanding of Kerkenes, the city's mysteries were left aside after these short campaigns in favour of then much more fashionable research on the Hittite Empire, and 65 years went by before archaeologists returned to work in the city. In 1993, Geoffrey and Françoise Summers, using a range of new technologies including aerial remote sensing and geophysical surveys, started modern archaeological work at the site (6). Three years later, excavations came to complement this uniquely vast and varied corpus of remote sensing data. For more than 25 years, work at Kerkenes has allowed scholars to explore the 271ha city. In, perhaps, an attempt to adapt to the ridges and valleys defining the topography of the walled mountaintop settlement, most of the space suitable for building was divided up by the city's planners into over 750 urban blocks, that is to say walled areas that potentially demarcated different households, social groups, or functions. While one of the seven city gates as well as a portion of the so-called Palatial Complex and Urban Block 8 have been the focus of long-term excavations (7, 8, 9), work in other areas of the site have yielded insights into all aspects of life in the city.[1]

3 BUILDING MATERIALS

Since 1996, a series of trenches have been opened across the site, revealing a variety of building practices. Through large-scale excavations as well as test trenches, the project has exposed structures from several urban sectors, yielding important clues as to building materials and construction techniques. The last two decades of excavation at Kerkenes have allowed us to determine the basic practices in use during the construction of the Iron Age city. It appears that the city was built using four main materials: granite from local bedrock, wood, mud, and reed. Other materials such as lime plaster and sandstone are also present, but they appear to have played a secondary role. Sandstone appears to have been used mostly in specialised or elite contexts for decorative purposes as it is easier to carve and shape, while lime plaster covered the walls and/or floors of only a few select structures excavated so far.

Granite

Unworked granite represents the primary building material retrieved during excavations at Kerkenes. Its somewhat unusual prominence is easily explained by its abundance on top of the Kerkenes Dağı, where it protrudes as bedrock from the ground in the form of outcrops of varying sizes. Upon construction of the city, those outcrops were levelled and the stone used in the erection of the city walls and the gates as well as the foundations of every known structure on site, buildings and enclosures alike. Due do its natural tendency to break along relatively flat planes, the granite was usually not hewn or shaped, and walls were built with minimal modifications to the stones. The largest and flattest pieces were typically used to create the faces of the walls and *glacis*, while rubble was used to fill the core. The one known exception to this practice is the Ashlar Building, located inside the Palatial Complex. The lower portion and part of the floor of this unusual structure were constructed using granite cut and smoothed into rectangular blocks, an endeavour that would have required significant labour (10).

In most cases, the stones were unevenly coursed and typically formed the footing for a superstructure made of lighter material, such as mudbrick and possibly something akin to wattle and daub. The height of these footings varied from a few decimetres to over a metre, although monumental structures such as the city wall and city gates featured stone walls rising up to 6m (11).

[1] For more information about the project, visit http://kerkenesproject.org.

Wood

Wooden beams provided structural support and reinforcement from wall to roof. In the Cappadocia Gate and elsewhere in the city wall, horizontal beams, possibly of black pine, positioned every metre or so supported and stabilised the impressive stone edifice (12). Excavations in Urban Block 8, which have unearthed a wide variety of structures from the monumental columned building to the modest storage room, have uncovered evidence for vertical wooden beams being either incorporated in the core of walls, or recessed within their face (13) (fig. 2). Ten wooden columns also supported the roof of the columned building, which would otherwise have been impossible to cover due to its width, which exceeded the maximum length of available timber threefold. The remains of carbonised beams found within walls and the size of column bases and beam slots allowed archaeologist to estimate the diameter of these structural elements to ca. 20-30cm, although the columns and main beams that

Figure 2. Vertical wooden beam slots from Trench 31 (TR31). The beams occurred at regular intervals along the wall's face, into which they were recessed. It is unclear if the lime plaster which otherwise covered the walls and floor of this room also covered the beams, or if they were left exposed.

supported the roof may have been larger; beams reaching 50cm in section may still be seen in old houses in the village. However, evidence for much smaller wooden elements has also been recovered in the form of metal brackets and mud impressions, as well as much smaller wooden remains. These would suggest that wood was present in the superstructure of walls as well, possibly framing a core of mud and small stones.

Mud

Due to its very versatile nature, mud was used in many aspects of building practices. Since preservation conditions at the site have caused severe degradation of mud and mudbrick features over the 2,500 years since the destruction of the city, their presence in the excavations is not as ubiquitous as that of stone, although they probably represented the bulk of building materials. In a number of buildings, mudbricks were found directly on top of the stone footing, suggesting that they represented the upper layer in the structure of the walls. While most mudbricks are recovered in a very burnt and fragmentary state, some complete examples have shown that although all are roughly square in shape, the size of individual bricks was not uniform. Examples from the antechamber of the columned structure in Urban Block 8 were approximately 35x35cm and between 8 and 10cm in thickness. Mudbricks tended to be rather crude, with a high content of chaff temper and sizeable stone aggregate, although the exact composition of the mud used varied significantly from one studied brick to another. All the recovered mudbrick fragments were fired to some extent, but this firing must have occurred during the city's destruction and the conflagration that ravaged it rather than during production. Due to the size of the city and the amount of resources required to fire such a large quantity of bricks, it is reasonable to assume that mudbricks were originally sun-dried and not kiln fired. Moreover, properly fired bricks would likely have survived intact in much larger quantities.

Despite their preponderance in many Anatolian and Near Eastern sites, mudbricks appear to have been used for only a few courses since their remains are sparse and typically limited to the lower level of the collapse, indicating that another type of building material was used for the uppermost portion of the walls. The most likely candidate is mud, in this case in a form of wattle and daub or *hımış*, where mud, small stones, wood, and possibly reed formed the structure and fill of the walls. Unfortunately, since walls at Kerkenes are rarely preserved beyond their stone footings, evidence for the use of mud in the superstructure is purely indirect. Since the city was destroyed in a fire which in certain areas reached temperatures high enough to fire and even vitrify mud, fragments of mud used as wall filling were preserved. Although simple mud fragments are of little interest, a non-negligible number bore impressions of the structures they were pressed against, often wood or reed.

Wall plaster was also used to cover the interior – and perhaps occasionally the exterior – surface of some walls. Thick coats of the substance have been retrieved from the stone footings of many structures across the site, including those in Urban Block 8. The plaster tended to be rather crude, with a high concentration of chaff temper and stone aggregate, much like the mudbricks themselves. Different qualities of mud plaster, some finer than others, appear to have been used, sometimes layered one on top of the other: the coarser plaster was applied directly onto the stone to provide an even surface, while a finer plaster was used as a finishing coat. Although it is much less common, lime plaster is also attested. Like its fine mud equivalent, the lime plaster was also applied to a coarser coat of mud plaster. Because of the short life of the city and the generally poor preservation condition of the plaster layers, it is difficult to tell whether plaster was reapplied on a regular basis, or if the original coats were intended to last for long periods of time. In either case, no evidence for paint was ever found, suggesting that the plaster retained its natural colour, a reddish brown for the mud, and a very light grey for the lime.

The exact origin of the vast quantities of mud required to build Kerkenes remains uncertain. No mud quarries have been identified in the city's vicinity, although nearby streams as well as the bed of the Eğri Öz Stream could have been exploited during the Iron Age without leaving much evidence behind. Whether mudbricks were formed at the site or arrived already shaped from the surrounding villages is still the subject of research.

Reed

Evidence for the use of reed is limited to a few carbonised examples, as well as impressions preserved in mud (fig. 3). The reed appears to have been fairly uniform in size, ca. 5-10mm in diameter, which is consistent with reed still found today in the valleys surrounding Kerkenes. The current hypothesis is that reed may have been used along with wood to create a frame in which mud was packed to form the superstructure of the walls. Reed was also likely used as a roofing material. Even today, Turkish water reed is still considered one of the best thatching materials and is imported in large quantities by countries with long thatching tradition (14).

4 CONSTRUCTION TECHNIQUES

Study of building materials and techniques at Kerkenes is still in a preliminary stage. Nevertheless, current excavations in areas such as Urban Block 8 as well as older excavations across the site have yielded important clues relating to construction techniques and architecture.

The most informative excavations when it comes to common building practices took place in Urban

Figure 3. Example of water reeds impressed on mud. The coarse stone inclusions present in the mud can be seen where the fragment broke (top), while the uneven colour of the mud – going from brownish-grey to dark grey – is evidence of differential burning that occurred during the fire that destroyed the city.

Block 8, at the northern edge of the city, specifically in the large columned structure located within Trench 40 (TR40) (fig. 4).[2] Excavation of the external walls of the columned structure in 2017 offered clues as to what may have stood above the stone footings. In the antechamber, up to two courses of thin squarish mudbricks were partially preserved directly on top of the dry-stone masonry foundations. The stone footings themselves were constructed in the same manner as has been observed elsewhere on the site; namely, large flat stones were used for the faces, while the core was filled with much smaller rubble. Wall thickness varies from structure to structure but averages at just under one metre. At the back of the main room, the stone footing of the western wall was removed to reveal the presence of pairs of large vertical wooden beams. The 1.5m thick wall investigated in this instance contained two rows of ca. 30cm-wide pine beams[3], a pattern that was repeated in the eastern wall as well. Pairs of beams were located 40-50cm apart, only a few centimetres from the wall face, while the pairs themselves were 75cm to 1m apart. The fill between the beams was composed of loose stone rubble and mudbrick fragments. Although no mudbricks were recovered directly on top of those walls, a large pile of collapsed – yet still coursed – bricks were recovered at the back of the building.

[2] Excavations at the Cappadocia Gate and Palatial Complex have yielded their fair share of building materials, but those areas are monumental in nature and unlikely to reflect techniques used in more conventional structures elsewhere in the city.
[3] Tomasz Wazny, personal communication, 2017

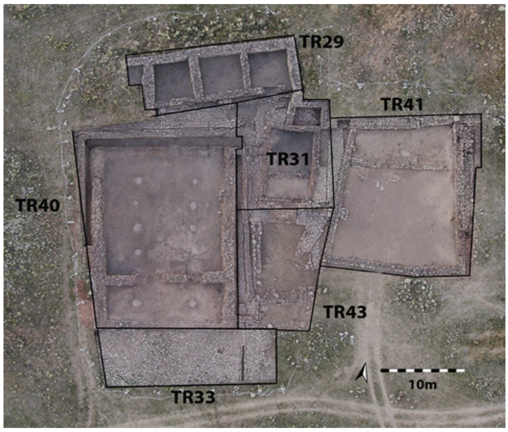

Figure 4. View of the current excavations in Urban Block 8, with the different trenches highlighted.

The front and back walls of the columned structure appear to have been of a different construction than what is typically found, since only minimal stone footings were found. The relative absence of stone and the evidence for heavy burning recovered in the vicinity of these two walls suggest that they may have had a much higher wood content, possibly in the form of an elaborately decorated wooden façade like the ones carved into the living rock of the Phrygian Highlands (see 15). The large mudbrick collapse from the back of the structure may thus be the remnants of a mudbrick pier incorporated into the back wall for additional support.

The large wooden beams embedded in the side walls likely rose beyond the level of the stone footings, supporting a superstructure made of materials less rigid than stone and mudbricks. The unusual fill of the eastern and western walls – stone rubble, mudbrick fragments, and loose dirt, all potentially held in place by a wooden façade given the absence of any obvious facing stones – might reflect the composition of the upper wall. This particular mix is relatively common in traditional architecture and is found, among others, in wattle and daub structures. A wattle and daub upper structure, in which the wattle would be replaced or complemented with large water reed stems, is consistent with the material remains found in excavations of domestic structures throughout the site. The mud on which the reed and wooden impressions were found was always very coarse and comprised of rather large inclusions of stone fragments and chaff, indicating that the mud was not finely levigated and may have been mixed with tempers and aggregate to increase its structural properties. Another possibility would be something akin to the traditional Turkish *hımış* construction, where a wooden frame is infilled with masonry elements such as stones and mud. This particular type of construction, variations of which exist through much of the ancient world, would explain the presence of stone rubble throughout the archaeological collapse layers as well as the large proportions of small charcoal fragments routinely recovered. In this case too, coarse un-fired mud would have played a preponderant role and would have been pressed against wooden elements, which would explain the presence of the wood impressions. Since mud, stone rubble, and relatively small wooden planks were rather abundant and easily obtained in Kerkenes's vicinity during the Iron Age, such a construction technique would have been both efficient and affordable, and would have allowed for the rapid construction of a large city.

In addition to wall fill, mud was also used as a finishing material in the form of mud plaster. In the case of the columned building, remnants of it were found on the interior face of both the eastern and western walls. If a coat of mud plaster was ever applied to the front and back walls however, none of it survived. The opposite face of the eastern wall, which faced into an adjacent narrow space that may have been roofed, was likewise covered by a thick, relatively well-preserved coating of mud plaster. The plaster itself is rather crude and brittle, with a somewhat finer finishing layer. It was applied directly to the stones and may have been used to prevent water from entering the structure's foundations, since a drain is located nearby. Mud plaster covered with a thin layer of lime plaster was recovered from two rooms adjacent to the columned structure, both of which are at present believed to have been used for food preparation (16, 13).

Mud may also have been used in roofing. Although nothing remains of the original roof structures, monumental façades carved into cliff sides in the Phrygian Highlands (15) as well as doodles found on the Gordion mound (17) indicate that at least some Phrygian buildings were topped with double-pitched roofs. Given the cold and snowy central Anatolian winters and the rainy springs, pitched roofs would have been a logical solution to counter any snow or water accumulations. In the absence of roof tiles at Kerkenes, the most likely candidate for primary roofing material is therefore a form of thatch. Impressions in mud as well as carbonised remains suggest water reed as the most likely candidate. As is the case in other traditional thatching techniques, mud could have been used to secure the different reed bundles into place, while providing an additional waterproofing layer (18). The other possibility is the use of flat earth roofs, which are still seen in traditional and vernacular architecture in the Anatolian highlands.

Beyond structural elements, mud was also used in indoor features. The structure located directly behind the columned building included a food preparation area in its easternmost room, where a small hearth was built directly onto the clay floor. The relatively simple feature was composed of three narrow mudbricks standing on their sides, with one portion of the hearth left open. If the bricks were used merely to contain the cooking fire or if they were used as a stand for cooking pots is currently unknown. Instances of mud used in cooking installations is further attested in the southern portion of the city, where a large hemispherical bread oven and a secondary smaller squared oven constructed of mud were partially unearthed (19, 20).

5 CONCLUSION

Despite not being as archaeologically visible as at other ancient sites which could not rely on more permanent materials such as stone, mud was an important part of architectural practices at Kerkenes. Mixed in with the pervasive stone collapse and heavily degraded through 2,500 years of weathering and erosion, mudbricks and other mud elements can be difficult to identify, but excavation methods adapted to those particular conditions as well as properly trained excavators have allowed the collection of crucial information concerning the building materials and techniques employed throughout the Iron Age city. Current evidence points towards mud in one form or other having been used in walls, floors, and roofs as well as installations such as ovens. Many gaps in our knowledge of construction practices at Kerkenes still remain to be filled, but continued research on the topic is underway and already shedding light on some long-unanswered questions.

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Traditional Earth Construction Systems in Colombia

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ABSTRACT

Historical records show that earth construction systems have always been present in the development of civilizations. Since the inception, mankind has learned how to build homes with earth and other materials obtained from nature. Nowadays, this constructive heritage and its continuity over time can be verified in different parts of the world.

This document will address the geographical, historical and socio-demographic characteristics from a land located far away from Turkey, known as Colombia. A South American country with particular seismic hazard conditions and a sloping topography, which has developed a rich earth architecture over the years that fits and responds to those factors. This paper will address the constructive principles of three of the most traditional earth construction systems applied in Colombia: *Bahareque, Tapia pisada and Adobe - kerpiç.*

Bahareque, (*also known as bajareque, quincha or fajina in other locations of Latin America*) a mixed "guadua" (local kind of bamboo), timber and mud wall constructions; and the two earthen construction systems of inheritance the Spanish colonization, ***Tapia pisada***, *(also known as tapial)* constructions of rammed earth without using other kind of structural materials, and ***Adobe** (kerpiç)*, constructions based on manually produced mud blocks. The paper will approach their characteristics, variations as well as the current application of those earth construction systems in the actual local context of Colombia.

Keywords: Adobe, bamboo, earth, mudbrick, bahareque.

1 INTRODUCTION

Colombia is a country strategically located in the north of South America, where Central and South America meet. It has land borders with Venezuela, Panama, Brazil, Ecuador and Peru. Additionally, it has coasts on the Caribbean Sea (Atlantic Ocean) and the Pacific Ocean. Colombia is divided into three parts according to the division of the Andean mountain range: West, Central and East. [11]

Earth construction techniques in Colombia were shaped and developed according to the conditions of each region in the three systems: **bahareque**, **tapia pisada** (rammed earth) and **adobe** (kerpiç*)*.

Bahareque is a construction technique that mixes timber, bamboo or earth. This system is also known in other parts of the world, where different kinds of plants are used instead of bamboo. With the emergence of new construction materials, the traditional bahareque construction technique was developed and renovated and started to be implemented in four different ways: Earth bahareque, Wooden bahareque, Metal bahareque and Cement bahareque. [7]

Adobe, a construction technique with solid pieces or units of uncooked mud. The dimensions of the pieces are very variable and respond to both tradition and constructive criteria. [1]

Tapia Pisada, in this procedure the walls are built just with earth and supported on stone or concrete foundations, without being held by wood or other support materials. This method consists of tamping prepared earth layer by layer, in the middle of two planks with the normal thickness of the stone walls. [5]

The earth construction systems used in Colombia are located as follows: **Bahareque** is used along the Andes mountain range with a big predominance in the Coffee Triangle, one of the most seismic zones in the country. **Adobe** is used in the southwest and northeast of the Andes mountain range; and, **Tapia pisada**, in the northwest and northeast of the Andes mountain range. [9]

1.1 Historical Development

Colombia's territory has witnessed the emergence of indigenous cultures from 500 BC. One of them, and the most important in the country, is undoubtedly the Muisca culture[1]. Very little architecture from this culture has survived, and since the Muisca architecture is generally made of perishable materials, no archeological findings have been discovered, except for some stone foundations. According to historians, Muisca houses were structures built with a straw roof and bahareque walls. These structures are the first earth construction examples in Colombia. [9]

In the colonial period (1550-1810), after the arrival of the Spanish, those existent earth construction techniques were adapted and reused. This is how, construction techniques and systems such as bahareque, adobe and tapia pisada started to be implemented in the 16th century. In the 17th and 18th centuries, the tapia pisada became a traditional technique used on the walls of monumental and civil buildings. Also in this period, structures were built with a mixture of adobe and tapia pisada. In the residential architecture, only low-cost materials such as earth were used; but in the formal and monumental architecture, high-cost materials such as stone and brick were preferred along with earth. [9]

At the end of the 19th and early 20th centuries, the bahareque architecture experienced a further century of magnificence, becoming the preferred technique used in the construction of large multi-story houses. This is how, the housing architecture in Colombia was developed over four hundred years using earth as a main material. According to the list of the Heritage Directorate of the Ministry of Culture, 1,133 National Monuments and 47 Historical Centers have been declared in the country, of which 80% are built with earth. [9]

2 BAHAREQUE

Bahareque is an adaptation of the English word **Bajareque**, which means walls made with bamboo and earth. Bahareque has been named in different ways among Latin American countries: **Bahareque** in Colombia and Venezuela; **Bajareque** in Cuba, Guatemala and Honduras; **Quincha** in Peru, Bolivia, Ecuador and Chile, and **fajina** in Uruguay. Bahareque is mainly used in the construction of walls and it is formed by connecting timber, reed and earth elements with vegetable fibers and leathers. Bahareque has been used in Colombia for centuries even before the discovery of America by Spain. In colonial times, the Spanish found about 300 hamlets around the Andes region built with bahareque by the Muisca indigenous tribes. By renewing this technique, churches and houses were built and the bahareque became the most common construction system in that period. [8]

[1] Indigenous group that inhabits the center of Colombia

On the other hand, the occupation process of the Colombian coffee region began at the early 19th century, called the Antioqueña colonization[2]. During this period in Colombia, the bahareque was rediscovered and the villages, small or medium-sized cities were systematically constructed by using this earth construction technique. [7] The earth, timber and bamboo were used in the construction of these new cities and villages, since timber and bamboo can be easily repaired and are more effective than masonry and concrete in seismic zones.

Today, bahareque architecture is based on wooden frame structures. These frames may vary from timber and bamboo to just bamboo, according to the economic possibilities of the builders. Four types of bahareque have been defined according to the wall finishes: Earth Bahareque, Wooden Bahareque, Metal Bahareque and Cement Bahareque. [7]

In the Earth Bahareque construction system, timber is generally used as the first structural element and bamboo is used as the second one. In this system, the adobe is used as a coating and filling material. The earth filled bahareque is generally used for the external building walls and between constructions to separate them and prevent the spread of fire in the event of a fire; and the earth coated bahareque is generally used for the non-structural walls. [7] In order stick together the mud and the bamboo and timber, the earth needs to be in a **plastic** state.[3]

Timber is used in the upper and lower plates and main studs in the corners. Other studs and supports are generally made with bamboo. The wall structure consists of: upper and lower timber plates of 4x4", timber corner studs of 4x4" and bamboo studs of 5"/12 cm in diameter. The studs are placed 90 cm apart and attached to the lower plate and other studs with the help of nails. The timber diagonal supports are placed between the studs to reinforce and strengthen the structure and between the main studs, bamboo studs are placed 30 cm apart without interfering with the continuity of the diagonal supports. [7]

Figure 1. Traditional bahareque constructions in Colombia [6]

2.1 Earth Filled Bahareque

After installing the timber/bamboo frame, bamboo strips are placed on the internal and external faces of the wall to support the filling mud. These bamboo strips are bonded to the studs with wicker fibers or anchored with iron nails every 15 cm. After this process, adobe is used to fill the wall. Earth and animal feces mixture is used for wall plastering, and the walls are subsequently painted with lime. [7]

[2] Colonialism process between 1770-1874 in the non-populated areas of Western Colombia

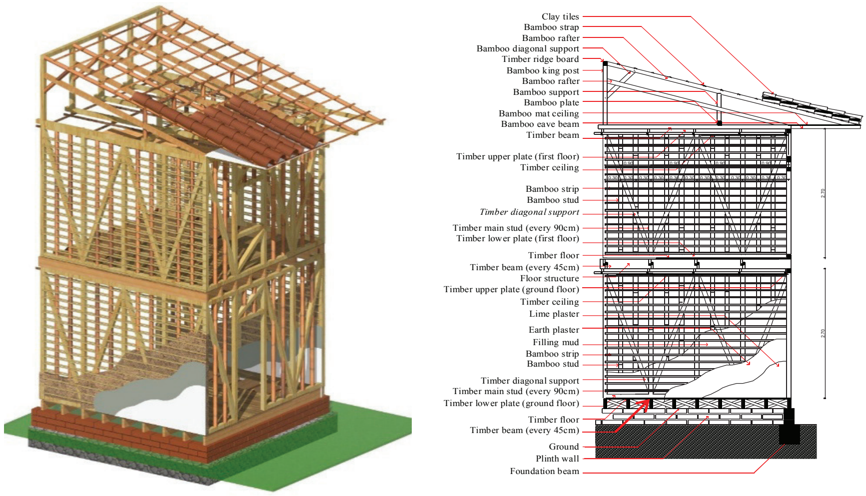

Figure 2. Earth filled bahareque structure [7]

2.2 Earth Coated Bahareque

This system evolved from the previous one. In this system, bamboo mat is used instead of the bamboo strips. This mat is installed on both sides of the wall frame. In this system, adobe is not used as filler element and the walls are left empty. [2] This type of bahareque is used especially on interior non-structural walls. [7] As for the previous bahareque, a mixture of adobe and animal feces is used for wall plastering; and as a final step, the walls are painted with lime as well. [2]

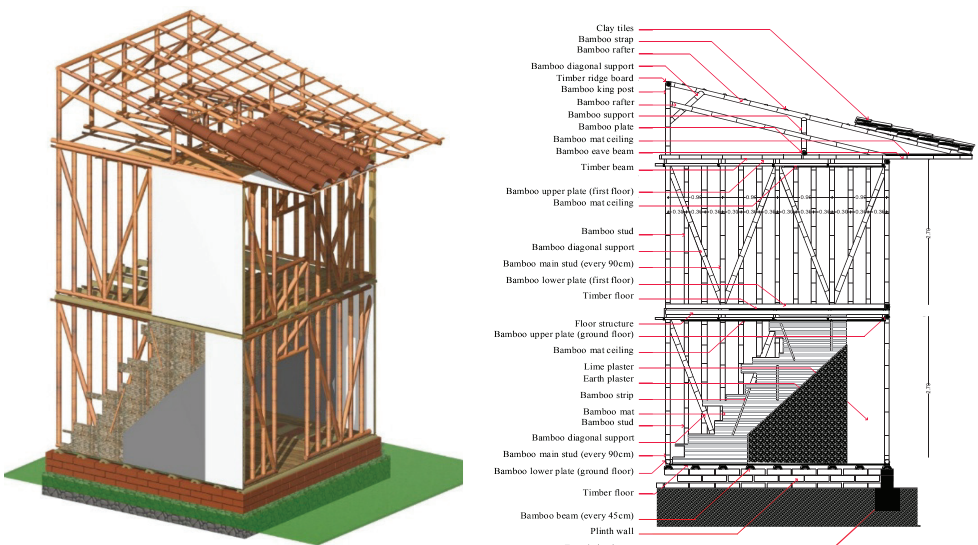

Figure 3. Earth coated bahareque structure [7]

3 TAPIA PISADA / RAMMED EARTH

From the beginning of the history of civilization mankind has used earth as a building material. The first traces of rammed earth on the planet were located in the Neolithic Age in Mesopotamia, between the Tigris and Euphrates rivers. In addition, the rammed earth system was also used in the first cities of Iran, Syria and Palestine and in the archaeological sites of Yang Shao and Longshan cultures in China. [12]

Since ancient times, indigenous cultures have used materials from nature for the construction of their homes and thus, the earth became the most used one. After the discovery of America, the Spanish brought construction techniques in rammed earth and adobe to different parts of Colombia, using these techniques in their own constructions. During the colonial period in Colombia, earth was used to build houses and temple walls, making it the most popular construction technique of the time. [12]

Rammed earth is a traditional system from the colonial period, called **tapial** in Spain and **tapia pisada** in Latin America. Tapia pisada buildings are constructed with earth, without the support of any wood or structural material. This method consists on laying the earth mortar prepared in the middle of the two molds, pounding it after each layer. The earth is stacked in this way and the structure is built to reach the desired height. [5] During the colonial period, in Colombia, the tapia pisada was used as a construction system in civil and monumental buildings. [12] Nowadays in Colombia, Santander region towns, such as Barichara, are built entirely with tapia pisada.

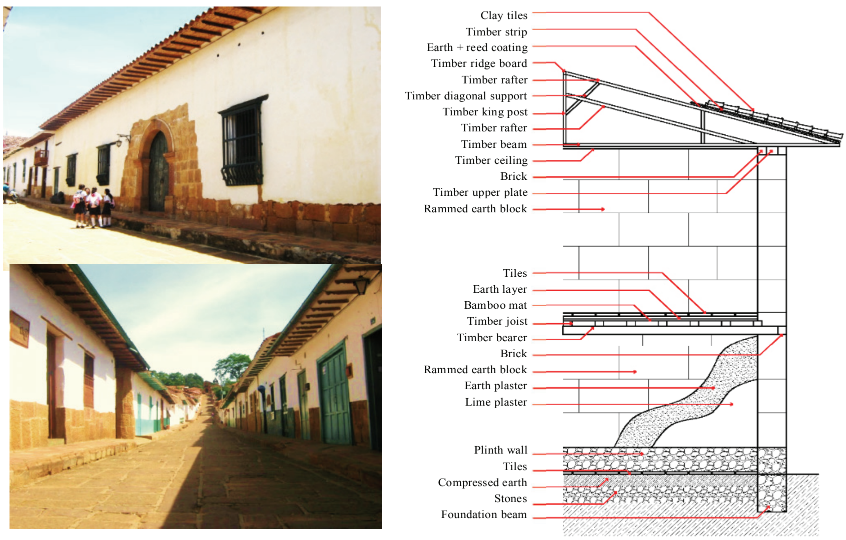

Figure 4. Tapia pisada structure and examples

3.1 Material Properties

In the tapia pisada, the most important material is earth. During the procedure the moist earth is compressed inside two molds to form the walls. With this material a block of earth is created: 60-80 cm wide, 80-120 cm high and 200-240 cm long and the molds are lifted upwards until the building is finished. The constructions are built especially between June and July at the harvest time. [5]

Not every type of earth is suitable for construction. It has to be a balanced mixture between gravel, sand, mud and clay. After the best earth for construction is found and removed, it is covered and stored to protect it from water rain. A formula to create the most suitable earth cannot be defined in weight or volume, since it depends on the quality of the earth used and its possible aggregates. As the finer the earth, the better the quality. It is estimated that the best earth should be composed of: around 0 to 15% of gravel, 40 to 50% of sand, 20 to 35% of limo and 15 to 25% of clay. In terms of quality the earth has to be cleaned and all the organic material parts, such as roots, grass, straw and wood need to be removed. [5] The mortar used for the construction of the Tapia Pisada walls must be in a **wet** state in order to facilitate the handling and molding operations. [3]

4 ADOBE

Since ancient times, raw earth has been used for construction. In Mesopotamia and Egypt for more than 10,000 years, earth has been used to build monuments that show both the prestige and the material and spiritual development of the communities. [4] On the other hand, in the 15th and 16th centuries when the Spanish started their conquest of the America, they brought with them the knowledge of the construction with **adobe** and **tapia pisada**. This is how the construction of the main capital cities of the New Kingdom of Granada[3] began and the urban houses of the common people were built on one or two floors in adobe and tapia pisada. [12]

The word adobe comes from the Egyptian "**thobe**" (brick) translated in Arabic "**ottob**", converted "**adobe**" in Spanish and English and sometimes called "**toub**" in French. The adobe is a term with several meanings, the first and most common is "sun-dried mud brick", the second, "mud formation", and the third is "raw mud bricks". One of the greatest advantages of adobe is the flexibility of production and its easy transportation to the site. Adobe bricks are perhaps the oldest manufactured material in the construction area. This technique is based on solid pieces or units of uncooked mud and variable dimensions that respond to both tradition and constructive criteria. [4]

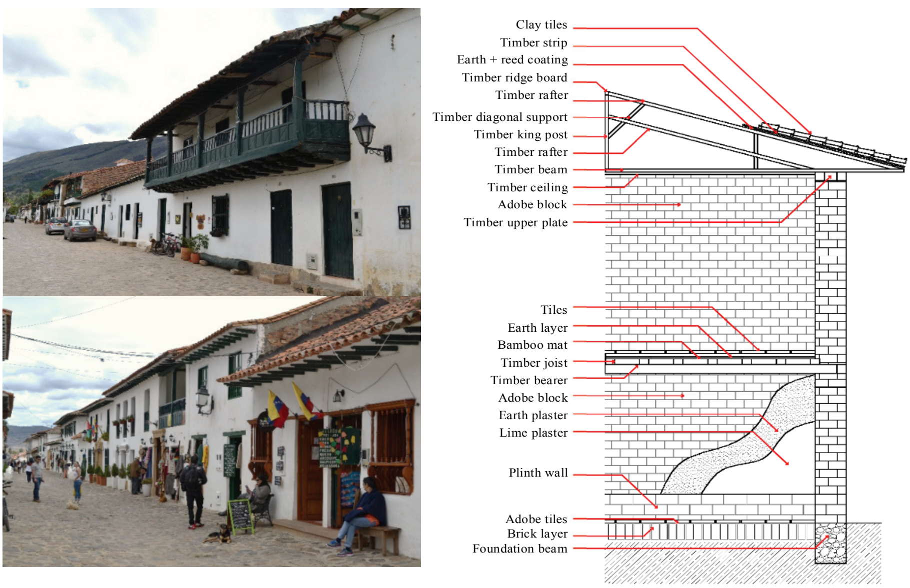

Figure 5. Adobe constructions structure

4.1 Material Properties

The size of the adobe brick is usually 30-40 cm length, 15-20 cm width and 7-10 cm height; generally, the length, width and height of the brick has a ratio of 1, 1, ¼ or 1, ½, ¼. The adobes are made by placing the mud moistened in wooden molds with the desired dimensions. [1] The earth used must be in **plastic** state, as in the case of bahareque. [3] Few days after the adobe mud is poured into the molds, it is removed from them and dried in the shade for 15 days in the open air. If the earth used for the mudbricks has a good cohesion, the same one can be used as mortar to paste the bricks. In case the cohesion of the earth is insufficient, lime can be added to the mortar to increase the cohesion. In some cases, other materials such as natural fibers (straw), horse manure, lime and even bull blood can be added to increase the tensile strength and stretch of the earth. The thickness of the mortar used between adobe bricks is approximately 2 cm. [1]

[3] The New Kingdom of Granada (Spanish: Nuevo Reino de Granada) is a colonial state founded in the 16th century on the territory of present-day Colombia and Venezuela.

5 EARTH CONSTRUCTION TECHNIQUES APPLIED TODAY

5.1 Contemporary Concrete Bahareque

Bahareque buildings have proved over the years to be more seismic resistant than concrete and mansory buildings. The combination and properties of the materials used in the bahareque structures provide better resistance to the seismic loads. The seismic-resistant properties of bahareque are one of the most important reasons for the continuity of this technique over time and its acceptance as a traditional technique. Around 45-50% of the Colombian territory is located in the seismic zone and a large part of the population is located in these regions. Being a light and flexible construction system, the contemporary concrete bahareque is used in these seismic and mountainous regions with volcanic soils in the country. According to the current earthquake regulations in Colombia and the residencial construction law[4]; bahareque can only be used in the construction of one or two-storey buildings.

The contemporary concrete bahareque system is the same as the bahareque system used in the past. However, the structural problems caused by the bahareque system used in previous periods are being solved in the contemporary system. Reinforced cement was not used in the foundations of the buildings constructed in the past, and the connections between timber and bamboo elements were not often sufficient or not solved correctly.

In the contemporary bahareque, timber and bamboo construction techniques were developed, and metal connections and joining elements are used to provide strength. In addition, cement is now used to reinforce the joints of bamboo. On the other hand, the contemporary bahareque resolves the problems of foundations used in the past with seismic resistant foundations in reinforced concrete.

These modern arrangements in the construction technique increase the seismic resistance of the system and make the structure suitable for the geographical conditions of Colombia. For this reason, nowadays bahareque construction systems are re-interpreted in a contemporary way and this technique is called contemporary bahareque. [7] Currently in Colombia, bahareque is used in many buildings with different functions and it is seen as an alternative architecture for the physical development of the region.

Sometimes the bahareque is used in hybrid constructions where the structural elements of the building are made with reinforced concrete or masonry, while the bahareque remains just in the non-structural dividing walls. The purpose of this type of hybrid is to create contemporary buildings of greater dimension with modern materials that contribute to the resistance of the construction in the case of an earthquake, incorporating at the same time the use of traditional construction techniques.

5.2 Tapia pisada and Adobe

Nowadays, the use of reinforced concrete support elements or iron internal reinforcement is observed in tapia pisada or adobe constructions. The tapia pisada and the adobe, by themselves, do not meet the seismic standards in large size edifications, so those systems had to merge with a concrete and iron structure that technically binds them up. In addition, the dilation between both materials is carried out with natural fibers to allow an adequate response to a seismic movement. The purpose of using this type of construction is to provide a more durable structure while using at the same time traditional materials, such as earth. In addition, a trend has developed in the low-cost constructions in tapia pisada and adobe walls. This trend rescues the traditional housing concept and the use of materials and construction techniques. The aim of this trend is to maintain traditional construction techniques without using contemporary materials in modern architecture.

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Vernacular Architecture of Ghurtan Castle, Iran: Planning and Construction

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ABSTRACT

Vernacular architecture of every territory is a manifestation of inhabitants' experience, intellect and their technical, cultural and living knowledge which is responsive to the land's demands and requirements throughout time. Moreover, due to being coordinated, domestic, adaptable to region's context and geography it led to peace and tranquility for dwellers. Consequently , considering Iran's huge desert areas and soil, which has become the most essential element in its earthen architecture, the present study focuses on this kind of architecture.

Ghurtan adobe castle is one of the most important residential regions of Zayanderoud riverside, which dates back to 1000 years ago(Deylamian period). The earthen vernacular houses of Ghurtan castle in Iran were studied regarding their historical origin. Due to the location, it introduces different types of deployment, livelihood, structure and social structure.

Factors such as climate, social and urban structure, spatial organization, construction techniques and materials were considered which affected the form of the buildings. The goal of this research is to illuminate and analyze the most important techniques and methods in planning and construction of Ghurtan castle; and how these methods could achieve maximum passive cooling, thermal comfort, and the least energy consumption.

Keywords: Vernacular architecture, Ghurtan castle, construction technique, earthen architecture

INTRODUCTION

Ghourtan is a village in Varzaneh city in east of Isfahan, located in the northern margin of zayanderoud river. At the center of the village -in the margin of river- there is a castle that used in recently 30 years (few people still use it), it has 43000meter area.

Because of proximity to desert, Varzane has a large amount of air dryness and the average rainfall is 80 mm. The average maximum temperature in this section in July is 42 degrees and the average minimum temperature is 5.6 degrees in the middle of December and the average temperature is 14.1 degrees Celsius.

The village is made up of vernacular materials and techniques are mostly Forgotten.
This article is intended to preserve the national heritage that is subject to destruction.

Figure 1. Landscape of Ghourtan castle, Nasim Mantashi
Figure 2. Plan, Cultural Heritage Organization

Architcture Aspect of Houses

Due to hot and dry climate and culture of region, the areas formed compressed with central yard, this yard has important role in locating the other areas so that main areas (living room) in north and south side (In order to getting light) and service areas like storerooms and stalls located in east and west sides. most of the houses of this castle according to Confidentiality subject, connection of inside with outside formed in two ways, first with communication corridor (caped or free) that make indirect connection with inside. Other way is creating octagonal area (called: Hashti) after of head of entrance.

Windows are constructed close to inner surface to prevent daylight from entering directly. (called it TABESHBAND)

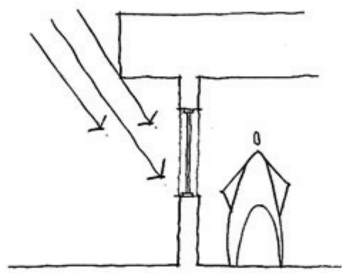


Figure 3. TABESHBAND, Nasim Mantashi

Figure 4. TABESHBAND, Drawing by Nasim Mantashi

Construction Materials and Building Elements

Local materials and construction systems have been applied with local knowledge and experience of the urbanities in relation to the function, cultural characteristics and also religious choices (kukaract.Aktemur, 2003)

Briefly, materials are chosen under the impact of the climate, cultural and habitual specialty effects the formation of Gurtan houses.

The main materials in the traditional houses are adobe, wood, brick which are the most accessible material in this area. adobe walls and wooden beams have been used in order to increase the flexibility of the wall against tensile forces. Adobe is a material with high thermal capacity. High thermal capacity is suitable for hot and dry climates. Similar to construction materials, structural elements are also affected by the local weather conditions.

In order to prevent heat loss and protect from the cold weather, walls are built 50-80 cm thickness, and are covered with stucco and plaster of clay and straw. Furthermore, in order to reduce the ground load and decorated indoor, unload some parts of walls.

In the hinges of the doors and windows, and also in the knockers, sashes and locks, wood and metal materials are used.

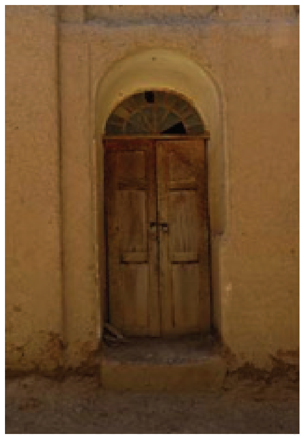


Figure 5. -6. Internal space, Nasim Mantashi

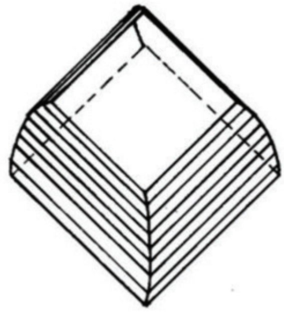
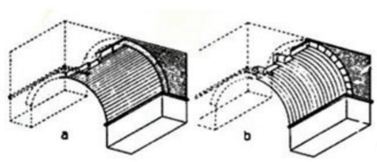
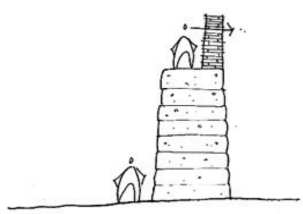
According to adjacent of castle with Zayandehroud River and fertile agricultural land which affects the household economy, castle has 3 essential layers, A. residential spaces B. Storerooms and C. public spaces that limited with cab fance that each layers having a structure . Layers are interconnected and eventually reach the outer layer of the castle fence.

A. Houses have vaulted roofs and it has different advantages such as: covering of longer spans in compared with flat roofs and it helps to create thermal comfort; warm air rising and cold air descending that make air circulation

B. Storerooms are divided to two group: 1. Domed ceiling 2. Vaulted ceiling and it depends on the span and the plan. Small span with nearly square plan covered by dome.

C.The castle has a main fence (battlement), which is made of cab wall that in some places, the thickness of the wall is 4 meters in order to strengthen the wall. Furthermore, in order to reduce the ground load, walls are built being narrowing from the below.

Table A,B,C: A. residential spaces B. Storerooms and C. public spaces that limited with cab fance that each layers having a structure

A	  
B	  
C	   

CONCLUSIONS

The Ghourtan castle is a valuable heritage which is in danger of being destroyed. Studies about this castle presented, demonstrate of the intimate close relationship between vernacular construction, environmental resources and human needs. Materials, construction techniques, and native structures are able to adapt to different conditions.

Meanwhile, the basic human needs and economic activities, in particular the agricultural way of life, represented a key role.

The widespread use of adobe as structural masonry material for all kinds of buildings and infrastructure, led to the adaptation of a construction techniques and solutions to its natural capabilities, demonstrating its potential as construction resource . By examining the materials and techniques used, we divided the castle into three layers, including 1. residential spaces 2.

Storerooms , 3-public spaces limited by cob fence. The structures in each are not separate from each other and make a mega structure.

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Investigation of Energy Consumption in Adobe Buildings Through Edirne Sample

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ABSTRACT

Adobe buildings, which have a fairly old in the history of world, have been on of the main materials that meet humanity's need. The ease of production of adobe building material has been preferred throughout the history due to its low cost. In the production of adobe, known as traditional building material, it is considered as an energy-efficient ecological material with features that are less energy consuming, non-polluting, easy to recycle and sustainable with its suitable features for climatic comfort conditions. Nowadays, buildings are responsible for about 40% of energy consumption. Depending on the ratio, environmental impacts of the buildings are also increasing. It is necessary to consider these impacts in the selection of building material that forms the shell of structure. Within the scope of the study to investigate the impact of building materials on the total energy consumption of buildings, the features of the single-storey mudbrick housing properties and energy consumption in the village of Trakya Region Edirne Province are examined. Archicad Eco Designer Program is used for energy simulation. With the low cost and low energy consumption on low-rise rural housing, cost, ease of production and contribution to thermal comfort of the adobe, its availability as a sustainable building material is seen.

Keywords: Mudbrick material, Adobe buildings, Energy consumption, Archicad Eco Designer

1 INTRODUCTION

It is known that traditional construction systems and materials are used in easy, rational frugality to suit life, nature, environmental conditions and climate. Adobe is a building material that human produces depending on soil and forms as desired. The adobe, which dates back to very old periods, still maintains its validity and use because it brings rational and sensible solutions. Today, Anatolian people are still able to create this efficient appliance with simple and easy production methods of adobe [1]. In the principles of sustainability, it should be assessed in the scope of resource effectiveness of building material, effect on indoor air quality, affordability and the aesthetics. Sustainable building materials are the materials that is sensitive to the environment and to the resources in its production and uses raw materials actively. It should be recyclable, without damaging human and environmental health [2]. The adobe can fulfill it with its features.

An important part of natural resources is used in building production and reveals the impact on energy consumption of buildings. 20% of the energy consumed in the world [3] and 22% of the energy consumed in Turkey are spent in building production [4]. To meet the growing needs of building across the world; supply of raw materials, processing of materials and the energy consumed in the construction area cause large large scale pollution. Use of materials in the area of building production reduce the 215% of energy usage and impacts that is created by transportation by 453% when compared to reinforced buildings. Studies indicate that the energy consumed for the production of walls and floorings and the amount of material transported to the construction site account for the %50 of the embedded energy of a house. While the energy consumption of a reinforced concrete housing was determined as 239 GJ, it was found that a concrete house consume [97GJ] 246% more energy when compared to a stone-dweled house [5].

Mishra and Usmani indicate that, in their work, in a building that has 100 m^2 construction area, built of cooked brick energy consumption is 581 GJ, in a hollow concrete masonry 509 GJ and in an adobe structure it is 370 GJ. When adobe is used in production instead of cooked bricks, it has been determined that energy consumption decreases by 36.22%. Therefore, it is possible to reduce the buried energy of a structure by approximately 37% by using the materials in the region in construction production [6]. In a study on Britain, every year, for construction of earth buildings 24 million tonnes of soil was assessed by reusing and in case of only 5% of the concrete structures in Britain were replaced with soil structures, the CO_2 emissions would reduce 100.000 tons [5].

Although the structuring in the rural areas in the Trakya Region heads towards to reinforced concrete over the time, there are examples of mudbrick that have survived. İner and Erdoğan assessed houses according to the plan types and parcel usage, in their examination of Uzunköprü Yeniköy Village, and they indicated that materials that were used are limestone and mudbrick. They have indicated that users have produced the building materials themselves and they are still using the hay and sunflowers that they harvested from their fields, clay soil found around the village in order to repair their buildings [7]. In this study, the example of rural area (Havsa/Arpaç village) that was produced based on earth based production in The Trakya Region is examined in terms of energy consumption.

2 PROPORTIES OF MUDBRICK MATERIAL

The most common architectural material of Central Anatolia is the earth and earth made adobe. The adobe that is made by mixing additive materials such as clay soil, straw or sawdust with water, is used after molded and sundried [1]. Adobe, an easy-to-produce material, is suitable for use today. In terms of building physics, adobe absorbs the moisture in the air quickly in the comfort conditions of the environment and releases the moisture in its structure quickly and keeps the moisture in the air by attracting the excess moisture. There are many studies in the literature regarding adobe features. While material is examined regionally [8] in some of these studies, experimental [9] and laboratory [10] studies are found in some other studies.

In an experiment that is conducted in a study regarded hygrothermal features of adobe, three scales mud-walls were built and measurements were made. Temperature and humidity variations on the outer and inner walls are continuously recorded with dynamic behaviour using vibration in the environment. During the 240 daily monitoring period, the minimum internal temperature of the walls was found to be higher than the outside temperature. This situation has shown that the adobe walls have the ability to storage heat. In addition, due to the combined effect of maximum internal temperature, air temperature, wind, solar radiation and wall orientation, it has been observed that the wall retains this temperature for a long time, as it reaches higher values than external ambient temperatures [11].

In study of mechanical characteristics of adobe, they sought to make reliable static tests of 50×300×450 mm adobe blocks they produced with experimental methods and to formulate a founding model explaining the full tensile-strain response of adobes under compression. They have determined that the founding model developed to define stress-strain behavior under the pressure of adobe blocks is very well suited to the experimental data obtained from cylindrical samples [9].

Yardımlı, Işık, Balık also proposed an adobe production technique can be produced with fast technology in Çanakkale/Ayvacık after the earthquake in this study area to meet the need of emergency shelter in the severely damaged villages of region. The proposal was fulfilled with the participation of Ayvacık mayor and its staff with the rapid adobe production technique. The study includes the materials used in production of adobe buildings, the type of mold to be applied and production technology. A sample building was also built for municipal staff [12].

3 CASE STUDY

3.1 Edirne/ Havsa/ Arpaç Village Mudbrick Housing Review

In this study, Arpaç Village of Edirne Province was choosed. Arpaç Village connected to the Havsa District of Edirne has 110 digits and 284 inhabitants. It is located 32 km distance from the city centre, 17 km from Havsa (Figure 1) [13]. Despite the renovation of reinforced concrete buildings throughout the village, it is observed that adobe buildings are still being used.

Figure 1. Study area Edirne Arpaç Village [14]

The examined adobe building was built with masonry system between 1955-1960, and the housing consists of 4 rooms and 1 sofa (Figure 2-8). There is no *hayat* part in the housing, it reflects the middle-sofed Turkish house type of plan. The entrance is as high as 30 cm above the garden level however the housing has remained at the road quota. One of the rooms of the housing was partially demolished to make room for reinforced garage in addition to the housing, and a doorway was opened to provide passage to the sofa. The outer walls were boned of 70 cm, 1.5 row adobe and inner walls were bonded of a single row of adobe. In 1986, the walls were raised with 2 briquette bricks and the roof was renovated. And the upper flooring is solid plaster over plasterboard. Doors and windows are wooden joinery and single glazing. Land and housing entrance is provided from the side garden. In the backyard there is a toilet and a small barn. The barn is currently being used as a storage.

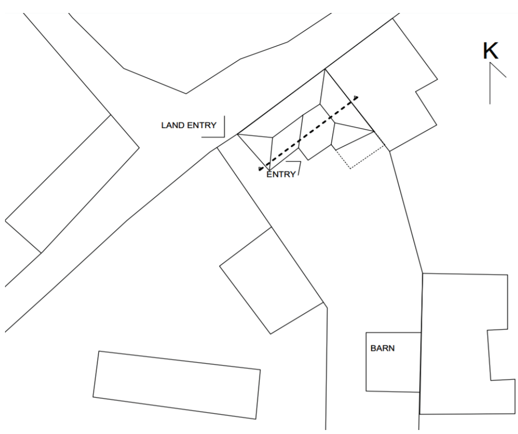

Figure 2. Sample mudbrick housing location plan

Figure 3. Sample mudbrick housing road frontal*

Figure 4. Sample mudbrick housing garden entrance

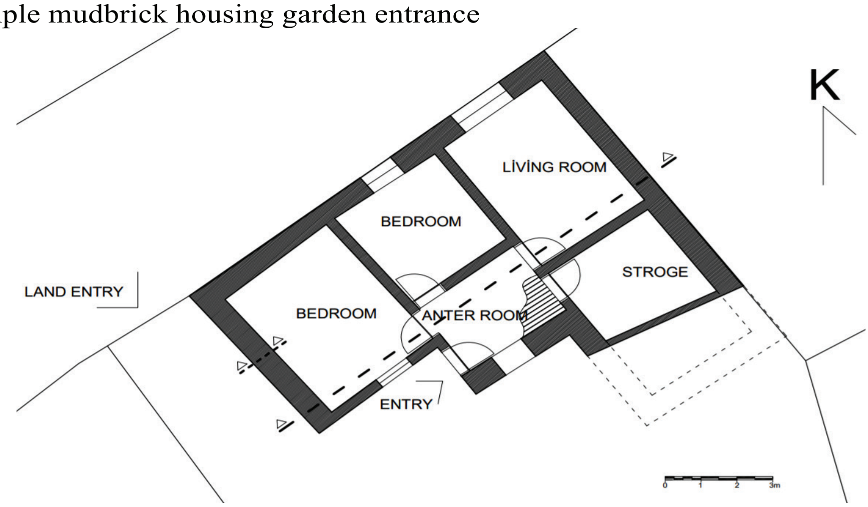

Figure 5. Sample mudbrick housing space distributions.

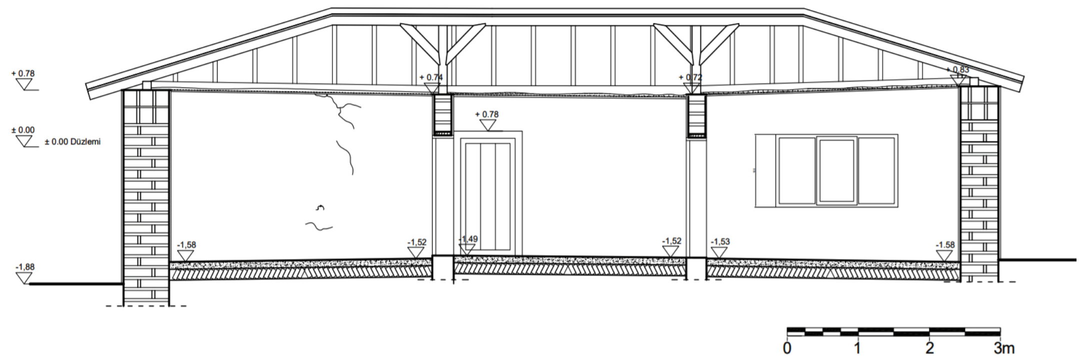

Figure 6. Section and structural elements of mudbrick housing features

Since the economic conditions of the family living in the housing the roof maintenance is not carried out. In the bedroom located in the outer corner of housing, effect of water leaks is seen. Taking off in the plaster and cracks in the wall junction were observed.

Figure 7. Mudbrick housing entrance and interior ceiling

Figure 8. Mudbrick housing plasterboard ceiling and wooden interior doors.

3.2 Methods and Findings

In this study Archicad Eco Designer program was used to obtain the energy consumption results of selected as a sample mudbrick housing. In program model of the building was created with entering climate data [14] (Figure 9-10) and features of materials of elements of building (wall, flooring, roof, window, etc.). According to TS 825 (Thermal Insulation Requirements for Buildings) Standard, Edirne is in the 2. Degree Day Region [15] and has temperate-humid climate characteristics. Summers are mild and winters are cold [16]. The average annual outdoor temperature in Edirne is given in Table 1[17]. Eco Designer STAR uses StruSoft's VIPcore computation engine, which complies with ANSI/ASHRAE 140, the Standard Test Method for the Assessment of Building Energy Analysis Computer Programs. Then depending on the building features, energy analysis result values and graphs of program are obtained (Table 2, Fig. 11-13) [18]. The features of building elements obtained with the help of the Archicad program and their thermal transmittance and net energy consumption values are also given in Figure 12-13. The external envelope temperature and heat flow distributions are shown in Figure 14.

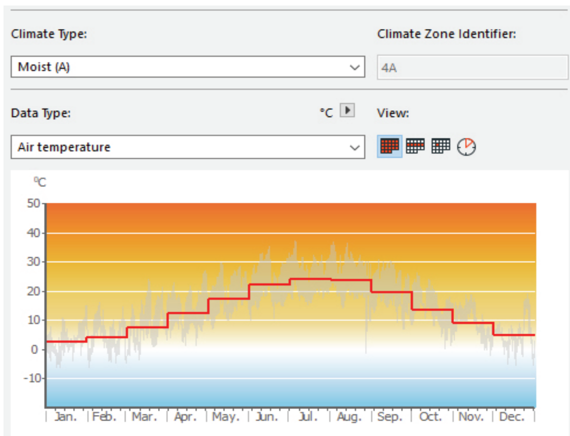

Figure 9. Climate data of study area (Edirne)

Table 1. Average for many years' annual temperatures of study area (Edirne)

Temperature (°C)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct	Nov	Dec.	Annual
Average temperature,	2.7	4.6	7.7	13.0	18.2	22.4	24.8	24.4	19.9	14.2	9.1	4.6	13.8
Average min. Temperature,	-0.6	0.4	2.8	7.1	11.7	15.4	17.3	17.1	13.4	9.2	5.1	1.2	8.3
Average max. Temperature,	6.5	9.2	13.2	19.3	24.7	29.1	31.8	31.8	27.3	20.6	14.0	8.4	19.7

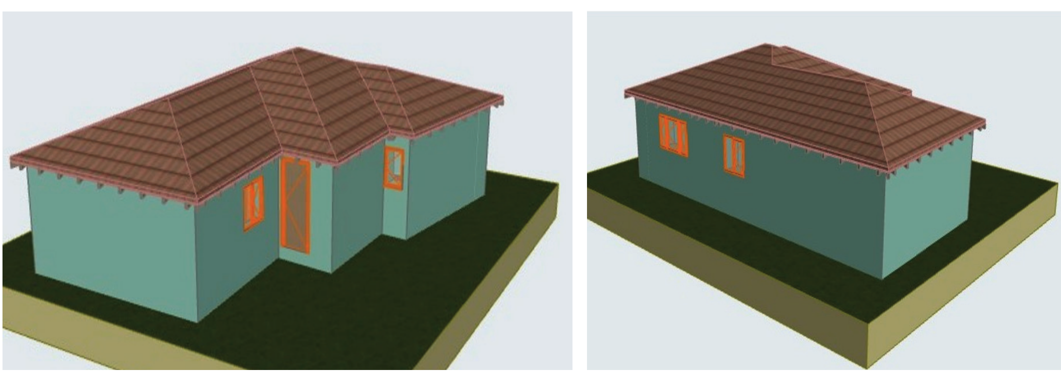

Figure 10. Model of mudbrick housing

Table 2. Properties of mudbrick housing elements

Building elements	*Thickness, d (cm)*	*Density δ (kg/m³)*	*Thermal conductivity coefficient, λ (W/mK)*
External adobe wal	70	1250	0,40
Ceiling (wood)	12	700	0,16
Flooring (soil)	10	1700	0,50

The floor area of adobe housing is 88,48 m^2, the external shell area is 73,02 m^2, the ventilated volume is 129, 12 m^3 and glass ratio of the building is 4% (Figure 11).

Thermal Blocks

Thermal Block	Zones Assigned	Operation Profile	Gross Floor Area m²	Volume m³
001 Sample Thermal Block	5	Residential	88,48	129,12
Total:	**5**		**88,48**	**129,12**

Figure 11. Properties of sample mudbrick housing

Depending upon structural elements, in the adobe buildings, U-value thermal transmittance varies between 0.53 W/m^2K – 1.11 W/m^2K. Building shell average is 0,86 W/m^2K. Openings are 2,11-3,44 W/m^2K. The annual energy consumption of the building was calculated as 70,34 kWh/m^2, net heating energy as 52,82 kW/m^2, used primary energy as 115,94 kWh/m^2. The CO_2 emission corresponding to this energy consumption is 5.10 kg/m^2. Solid fuel is used as fuel type in the building. When the annual energy consumption distribution of building is examined, there is a consumption of 3354.6 kWh depending on the heating requirement in the winter period (Figure 12). Heating load increases in winter period (heating season) and solar gains increase in summer period (Figure 13).

Key Values

General Project Data		
Project Name:	Sample building	
City Location:		
Latitude:	41° 41' 25" N	
Longitude:	26° 52' 59" E	
Altitude:	0,00	m
Climate Data Source:	TUR_ED_Ed..._TMYx.epw	
Evaluation Date:	30.06.2019 23:12:25	
Building Geometry Data		
Gross Floor Area:	**88,48**	m²
Treated Floor Area:	**63,51**	m²
External Envelope Area:	**73,02**	m²
Ventilated Volume:	**129,12**	m³
Glazing Ratio:	**4**	%
Building Shell Performance Data		
Infiltration at 50Pa:	**2,86**	ACH

Heat Transfer Coefficients	U value	[W/m²K]
Building Shell Average:	**0,86**	
Floors:	--	
External:	**0,53 - 1,11**	
Underground:	--	
Openings:	**2,11 - 3,44**	
Specific Annual Values		
Net Heating Energy:	**52,82**	kWh/m²a
Net Cooling Energy:	**0,00**	kWh/m²a
Total Net Energy:	**52,82**	kWh/m²a
Energy Consumption:	**70,34**	kWh/m²a
Fuel Consumption:	**70,34**	kWh/m²a
Primary Energy:	**115,94**	kWh/m²a
Fuel Cost:	--	GBP/m²a
CO_2 Emission:	**5,10**	kg/m²a
Degree Days		
Heating (HDD):	**3421,00**	
Cooling (CDD):	**1712,25**	

Figure 12. Energy consumption values of sample mudbrick housing

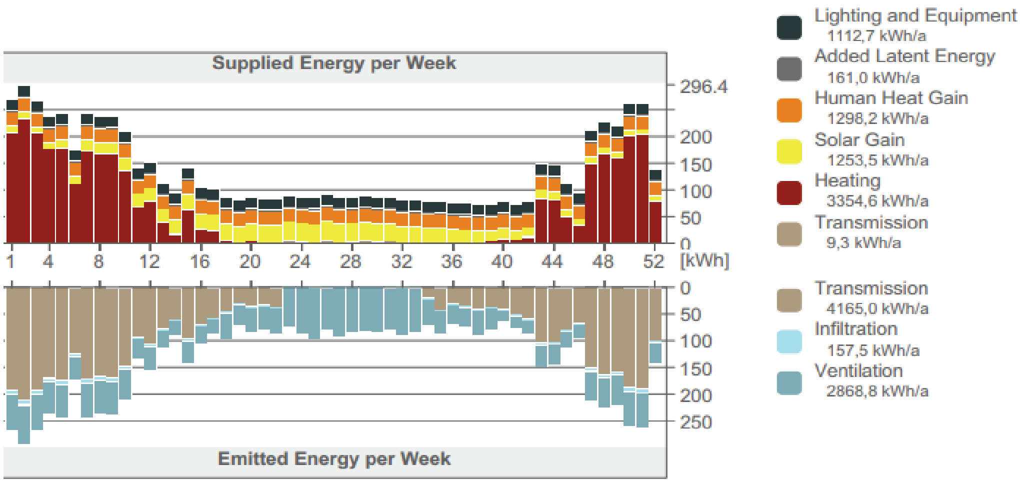

Figure 13. Annual distribution of energy consumption of sample mudbrick housing

During the winter period, the temperature distributions in the outer shell 70 cm of the adobe wall near the internal environment high temperatures are seen and near the external environment, a fall in the temperature distributions is seen. A certain amount of heat is preserved within the mudbrick walls (Figure 14).

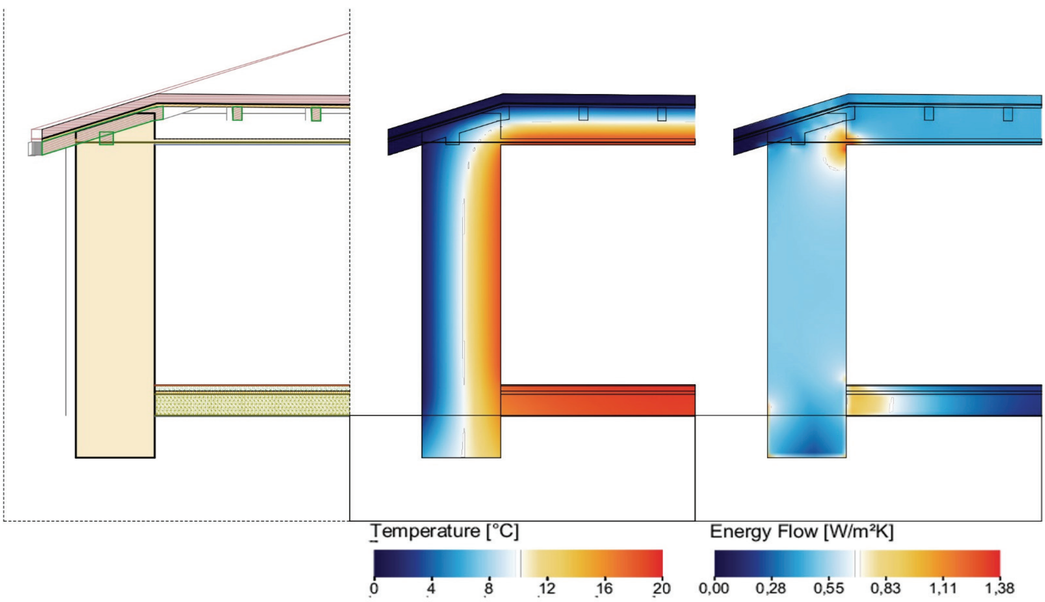

Figure 14. Temperature and heat flow distributions in the outer shell of mudbrick housing

Seasonal 24-hour indoor and outdoor ambient temperature values are shown in Figure 15. During the winter period (heating season), in March and December, the internal ambient temperature is within the 20°C comfort limit. In summer and autumn, it changes parallel to the outside temperature.

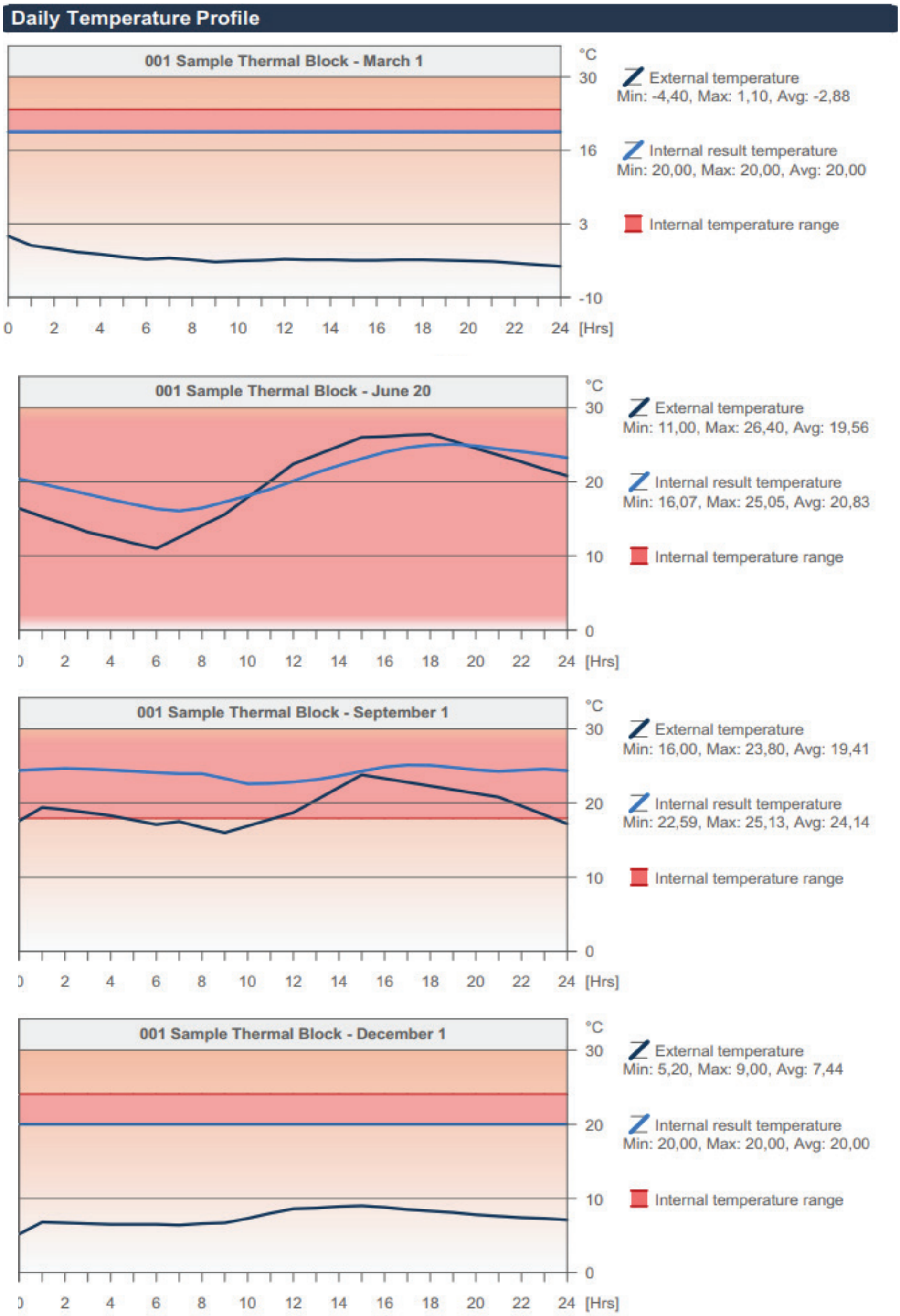

Figure 15. Daily temperature profile of mudbrick housing

4 RESULTS AND EVALUATION

Adobe is worldwide preferred for its ease of production and its low cost, especially when examined in the rural settlements. The production costs of the building materials used today, their impacts to the environment during production and their energy performances should be taken into consideration and the overuse of limited sources should be avoided. In the selection of building material, adobe maintains its importance with its positive features. In energy analysis in the sample housing building it is seen that mudbrick material provides a well thermal resistance due to the low thermal conductivity value and the thickness required for its structure. It is also seen that comfort temperatures are provided for different seasons in terms of indoor ambient temperature. The mudbrick housing assessed as part of the field study provided a very good result in energy efficiency, considering it was a single glazed, heat-insulated and ground-seated village house. The adobe building is close to the low-energy building class with annual heating energy values of 50 kWh/m^2. The adobe, which has become an even more improved building material with contribution of plaster and lime, is unfortunately a material that has been forgotten in today's Turkey. In the village where the field study was conducted, unfortunately there is no wall master who knows these traditional techniques. The solution of the maintenance and repair problem of these buildings that occurs in the course of time, becomes difficult and originality of adobe buildings are increasingly lost. The use of traditional materials and construction techniques before forgotten, in conjunction with new techniques and materials today will be beneficial in every aspect.

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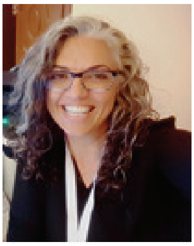
Review of the Shrinkage Behavior of Earthen Construction

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ABSTRACT

The growing shortage and cost of housing in both developing and developed countries continues to make the use of earth as an alternative building material relevant in recent times. There have been limitations such as shrinkage which leads to excessive cracking. The soil used to fabricate the adobe blocks and the mud mortar must contain clay, since it provides strength to the dry materials. Unfortunately, clay shrinks during drying; therefore, an excessive amount of clay will cause cracking of the blocks and mortar due to shrinkage, and loss of strength in the adobe masonry. Straw, wheat husk, and to a lesser extent, coarse sand can be used as additives to control this cracking and thus to improve the strength of adobe masonry. This paper presents a review on the behavior of adobe during its drying stages. The addition of traditional binders such as gypsum and lime have been found to be effective in reducing shrinkage but in recent studies, further improvements have been observed in the addition of 0.25% of zinc stearate, 2% of pig hair (natural fiber) with fiber length of 30mm, 2% of Grewia optiva and 1% pinus Roxburghii fibres (natural fiber), 0.5% polypropylene fiber (synthetic fiber) respectively. Previous studies also showed that by adding the fibrous materials in the mixture, the amount of fibers and the fiber length affected the shrinkage of clay. Alker is gypsum- and lime-stabilized earth and is characterized by its quick setting time (approximately 20 minutes), hence preventing clay shrinkage and eliminating the need for curing and drying processes. Alker has around 1-1.5% shrinkage which is very low. Gypsum reduces the level of shrinkage in the building material while alker possesses durability required for load-bearing wall construction.

Keywords: Alker, shrinkage, fibers, clay content

1 INTRODUCTION

Earthen materials used for the production of adobe is as old as mankind and it's a universally used construction material. A third of the world population and 50% of the population in developing countries lives in earthen constructed structures. This meets housing needs by creating low cost alternatives, availability of raw materials and simple technologies been employed in the construction [1]. The behavior of structures constructed using earthen materials have been documented since the 19th century and the most commonly used is the handmade brick from clay, loam and sand. The shortcomings associated with this method of construction in terms of mechanical properties have been minimized by using thick walls but this leads to other problems such as the high risk of crack propagation during drying and also significant axial shrinkages [2]. In most cases, small amounts of hydrated lime or fibers (natural or synthetic) are included in the soil matrix to improve its properties.

Alker is earth containing a high content of clay stabilized with lime and calcined gypsum. It is an abbreviation of Turkish words for gypsum and adobe, meaning gypsum-stabilized adobe. Structures constructed with Alker have been in existence since 1983 and shows improved physical properties [3]. It is composed of 8-10% gypsum, 2-5% lime, and 15–22% water with regards to the weight of dry soil as a construction material [3] [4] [5] [6]. Figure 1 shows an Alker building under construction in 1995.

Figure 1 Alker building under construction[3]

2 TRADITIONAL ADOBE

Traditional adobe mixtures are mostly composed of soil and sand [7]. They are handmade, which is produced by mainly mixing earth and water, thereafter drying the mixture under the sun. The mineralogical composition of the earth content varies most times according to local traditions and availability of materials [8]. The construction of traditional adobe requires clay as the major binder and the earth used contains approximately 30% clay. This large amount of clay content required as a binder in the production increases the risk of shrinkage that would occur during the drying phase [3]. The earth mixture is adjusted by reproportioning the soil fractions or by introducing stabilizers (organic or inorganic) to improve the adobe strength properties and reduce cracking in the drying phase [8]. The properties of adobe depends largely on the physical, chemical and mineralogical charateristics of the soil, and also the water content, drying, type of stabilization and production procedures [9]. Figure 2 shows the a flow diagram depicting the procedure for the production of traditional adobe bricks.

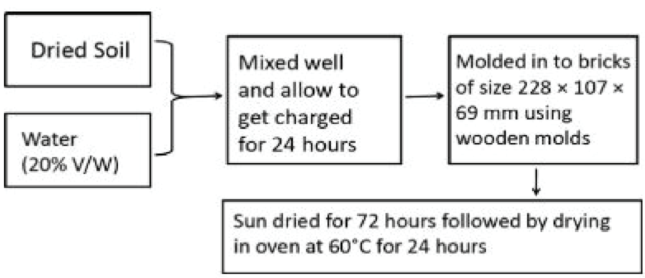

Figure 2 Procedure for the production of Traditional adobe bricks[10]

2.1 Shrinkage Properties of Adobe

Adobe is highly prone to wind and water erosion which facilitates its degradation. The prolonged circulation of water in the adobe pores promotes swelling-shrinkage cycles of the clay fraction [8]. The frequent exposure of adobe bricks to moisture leads to absorption of water in the bricks which results in their swelling and when evaporation occurs during drying, shrinkage occurs [11]. The production process of adobe has a huge impact on its shrinkage process and suggestions have been made concerning the seasons in which they are produced. The earth blocks produced during the spring or autumn seasons experience a less rapid drying process that can produce cracks because of the low intensity of the heat from the sun compared to those produced in summer with higher heat intensity. The Romans have also been known to add coarse sand into the adobe mixture to reduce the fraction of clay relative to the other components which would allow a lower shrinkage to occur [12]. Table 1 shows the volumetric shrinkage properties of Pressed Adobe Bricks with different moulding water content.

Table 1 Volumetric shrinkage of Pressed Abobe Bricks [13]

Moulding water content (%)	Volumetric shrinkage (%)
14.7	6.4
16.4	9.4
17.4	12.7
20.7	14.6

It was observed that the increase in the moulding water content increased the tendency for volumetric shrinkage to occur as a result of the delay in the evaporation of the portion of the moulding water during drying [13].

The cracking that occur on the surface of adobe can be directly correlated with the linear shrinkage of the soil used for its production, and as a result with the percentage of fines in the soil. The soil used for earthen building construction should not have a linear shrinkage which is greater than 2% [14].

2.2 Shrinkage Properties of Stabilized/Reinforced Adobe

Clay material is the most important component of adobe, however coarse sand or straw is usually added to soil and water mixture for producing adobe bricks to control drying shrinkage [15]. To improve the mechanical properties especially shrinkage properties of adobe, small amounts of hydrated lime or natural fibers are added to the soil matrix. The differential shrinkage of adobe during the drying process could be high depending on the mixture of the soil. Fibers are added to prevent the shrinkage cracks from developing. The higher the resistance of fibers with high bonds, less shrinkage cracks occur in the Pressed Adobe Bricks [16]. Table 2 shows the mechanical properties of adobe stabilized with different percentages of straw and the adobe bricks prepared with 33.3% straw showed less shrinkage observed from the reduced possibility of cracks which appeared [1].

Table 2 Mechanical properties of adobe stabilized with straw [1]

		Mix ratio: straw = 33.3% of total volume		Mix ratio: straw = 25% of total volume	
		Upper face	Lateral face	Upper face	Lateral face
Shrinkage during drying (%)		15.6		18.14	
Mean density (g/cm^3)		1.65		1.82	
Compressive strength (N/mm^2)		3.99	1.43	3.69	2.19
Flexural strength under concentrated loads	1st crack (KN)	1.81	2.45	2.53	1.75
	Rupture (KN)	1.91	2.53	2.53	1.75
	Max. Stress rupture (N/mm^2)	0.54	0.65	0.82	0.49

There are other studies which includes the use of Zinc stearate doses between 0.25 – 2% in stabilizing adobe and this showed little influence on some physical properties of earthen materials which include ultrasonic speed propagation and density but low shrinkage and the absence of cracks was observed in the samples which suggests that it can be used to stabilize adobe bricks [7]. More recent studies have utilized the use of pig hair for improving the shrinkage properties of adobe and Figure 3 shows the restrained drying shrinkage results of adobe stabilized with different content and length of pig hair respectively.

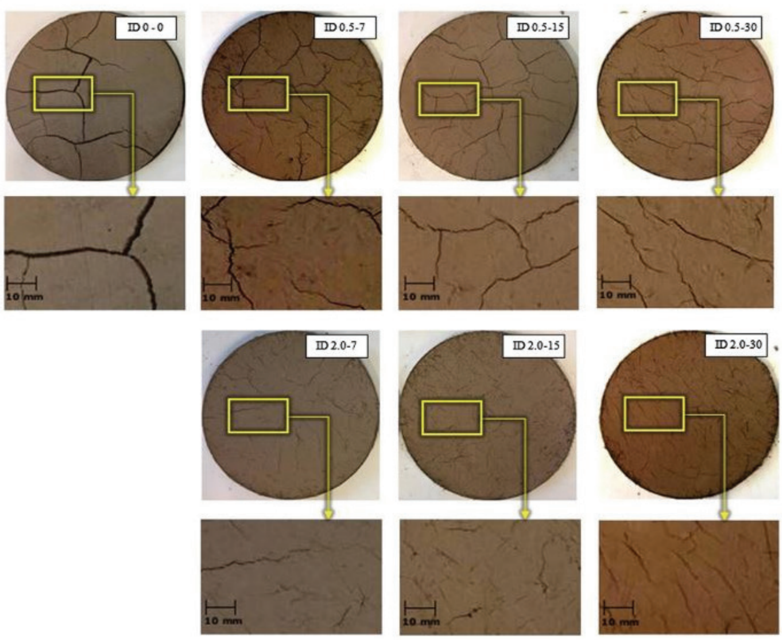

Figure 3 Results of restrained drying shrinkage [17]

The addition of the pig hair especially for dosages of fiber of 2% and fiber lengths of up to 30mm reduced the distributed cracking as a result of the restrained drying shrinkage. This shows that the expected maximum pullout loads is directly proportional to the length of the fiber. The increase in the dosage of fibers would result in the location of more fibers in the cross sections which increases the chances of reducing the crack widths and crack density [17]. Recommended proportion of natural fibers such as 2% Grewia Optiva and Pinus 1% Roxburghii fibers have been observed to be advantageous in the production of improved and durable adobe bricks [11]. The interaction between soil, bamboo particles and synthetic termite saliva has been studied and found to reduce linear shrinkage. Figure 4 shows the average and standard deviation values of the linear shrinkage and the typical behavior of samples. The scaffold created by the 6% bamboo particles content and the cohesive characteristics of the synthetic termite saliva reduced the linear shrinkage up to 54% compared to the control sample (S) [9].

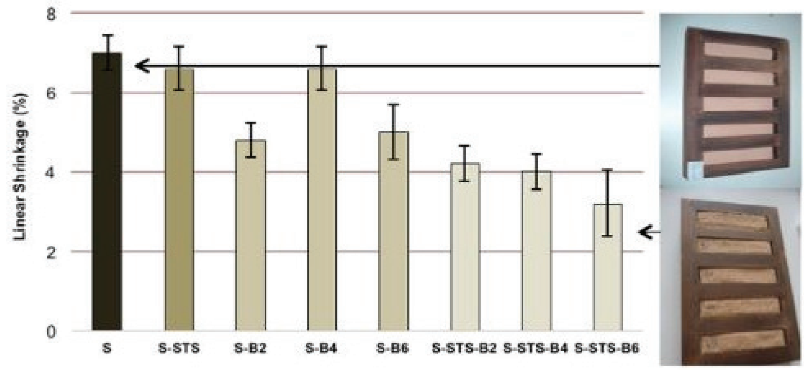

Figure 4 Average and standard deviation values of the linear shrinkage and behavior of samples [9]

Adobe reinforced with Polypropylene fiber (synthetic fiber) was observed to have produced less voids around the fiber independent of the type of soil in the matrix hence minimizing shrinkage. The mixes reinforced with wool fiber showed similar shrinkage properties of the matrix but was dependent on the soil types[18].

3 ALKER COMPOSITE TECHNOLOGY

The combination of earth and gypsum is called Alker. This is an abbreviated form of the Turkish words for gypsum and adobe, meaning gypsum-stabilized adobe [3]. Alker is an earthen construction material which can be used as load bearing walls in buildings which can be built with blocks or earth material compressed, rammed or injected into a wall formwork [4]. Alker technology utilizes earth containing only about 8% clay content, and to improve the mechanical properties, water resistance, workability of this earth material, which is stabilized with gypsum ($CaSO4\ 1/2\ H2O$). Alker as construction material is composed of 10% gypsum, 2% lime and 20-22% water with respect to the dry weight of soil [5]. The gysum content of Alker diminishes shrinkage even in wetting and drying cycles [19]. The production of gypsum-stabilized adobe tends to be faster because of fewer man-hours required and smaller preparation area compared to that of traditional adobe. The low clay content of earth required in the production of Alker makes the earth material more readily available than the earth required for traditional earthen construction [4]. The use of Alker which requires low energy consumption can ensure sustainable indoor and outdoor construction life cycle [5].

3.1 Shrinkage Properties of Alker

The inclusion of gypsum and lime into the alker mixture enables it to complete setting and attain rigidity within 20mins hence preventing clay. Gypsum reduces the amount of shrinkage in the building material [5]. The relationship between shrinkage and time for different mixes of gypsum and lime in Alker is shown in Figure 5. The plain earth samples showed the highest shrinkage value compared to the stabilized samples. It shows that the maximum shrinkage value after 28 days of the plain earth mix is 4 times higher than that of the "Gypsum (10%)/Lime (5%) mix. The addition of lime which showed lower shrinkage values is due to the binding pozzolanic products and calcite crystals formed on the gypsum structure and earth particles [6].

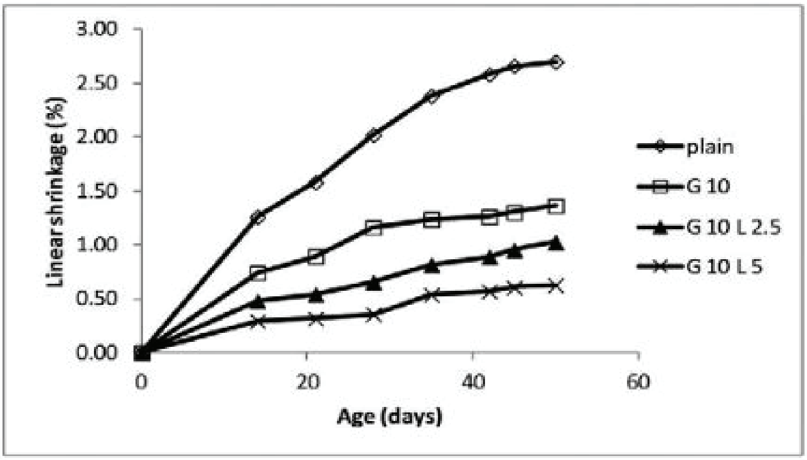

Figure 5 Alker shrinkage with respect to age [6]

Some of the physical properties of Alker as compared to earthen wall are shown in Table 3. The shrinkage property is shown to be higher in plain earthen wall than in Alker wall. The low shrinkage values of Alker (1%) can be attributed to a rigid skeleton formed by a hardening of gypsum and lime in the structure due to the calcite crystals and binding gels formed as a result of the pozzolanic reaction [6]. Other authors have observed a linear shrinkage value of 1-1.5% [4].

Table 3 Physical properties of Alker

Alker properties	Alker	Earthen wall
Lower heat transmission, λ (W/m K)	0.4	1.13
Reduced shrinkage (%)	1	2
Specific, c (KJ/kgK)	1.0	1.0

The addition of reinforment to Alker in the form of natural fiber (straw) or synthetic fiber (polypropylene fiber) in the mixture will further minimize the shrinkage [3].

4 CONCLUSION

The research discussed in this paper was on the review of shrinkage behaviour of earthen construction and the following conclusions can be summarized as follows:

- The high clay content (30%) of traditional adobe which increases its binding properties also increases its shrinkage properties. The production process of adobe and the seasons in which they are produced has been observed to affect the shrinkage process
- The volumetric shrinkage of adobe has been observed to increase with an increase in the moulding water content. This was as a result of the delay in the evaporation of the moulding water during.
- Traditional adobe stabilized with 33.3% straw showed 15.6% shrinkage during drying.
- The reinforcement of Adobe using synthetic fiber such as Polypropylene fiber was observed to have minimized shrinkage independent of the soil type. However, the reinforcement with wool fiber showed similar shrinkage properties of the matrix but was dependent on the soil types.
- The reduction of the clay content, and the presence of gypsum and lime in alker makes it a better adobe for eathern construction. Alker content of 10% gypsum and 2-5% lime showed linear shrinkage below 1%. In general, the linear shrinkage of alker have been observed to be 1-1.5% which is lower than the recommended linear shrinkage for soil used for eathern building construction.

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Mud Brick Structures in Armenia and Preservation Methods Proposal

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ABSTRACT

There are many brick structures in Armenia, they were built in different periods from the 6th min. B.C. until the 20th century. These structures have different functions. At the first they were built like settlements. When civilization was developed, they built by residential houses, churches, public buildings and others.

Shengavit Settlement is the oldest one in Yerevan which was built in 6 min.B.C.. These structures can be pointed out in Karmir Blur and Erebuni in the capital and in other provinces, Artashat, Armavir and Dvin. Residential houses and religious buildings are also built from mud brick. Most of these structures are located in the Ararat valley. The use of mud brick was also used in the 20th century where Alexander Tamanyan's design a club was built in the village of Getazat, in Ararat province.

Today, this type of monuments preservation is a major problem in Armenia, as they are rapidly decaying. Due to the climatic conditions of the Republic of Armenia, mud bricks are destroyed by precipitation and freezing process. Then we need to pay great attention to the problem and try to find methods to preservation these structures.

Based on international experience, there are several ways in which they have been approved and passed a probation period for the maintenance of earthen and mud brick structures. One of these methods is the use of wooden frames for reinforcement, liquid glass covering and application of water-resistant material with clay plaster for facing. There are also unsupported methods for using our property for the preservation of our monuments, such as the bio-water-resistant bricks. Which are made from dried leaves and plasmas cans. There are similar solutions in the world that have been used in artificial glass bricks or blocks. This option is also applicable in Armenia because they are water-resistant and resist the high temperature fluctuations.

Keywords: Mud brick, earthen architecture, preservation, Armenia

1 INTRODUCTION

A human's "friendship" with clay from natural construction materials is very old. It was a special cult material in Mesopotamia, according to the Babylonian tradition, man was created from clay [1]. This is the substance that provides the most harmonious link between human-nature and its resources richly provided the planet in general. It contains an extremely powerful emotional force in its simplest and most purely materialistic expression, which has caused the interest in the modern construction to increase that interest. This "friendship" is in the Armenian highland for millennia.

In the article various types of structures will be presented in the towns of the Republic of Armenia, with a general description of the method of their preservation.

2 MAIN PART

One of the oldest settlement in the capital of the Republic of Armenia is Shengavit. Shengavit settlement is located in the south-western part of Yerevan, on the left side of the Hrazdan River, now on the eastern side of Lake Yerevan. It is one of the well-studied monuments of the early stage of the Bronze Age and occupies about 6.0 ha. It is distinguished by its developed architecture and represents the Shengavit archeological culture of the IV millennium in the Ararat Valley [2]. Shengavit settlement belongs to the type of hill-towns located on the natural apical 'Fig. 1'.

Figure 1. Shengavit Settlement (3D) restructuring from Artak Movsisyan, "millenniers' traveler, Yerevan" movie.

Residential and defensive, religious and economic structures have been found.

Building materials, clay, were the most common of the mud bricks made from the top of the walls of residential houses, temporal and religious monumental buildings, the floors of the same structures. The walls were covered with clay. The clay was mixed with straw, which gave him the required strength. The base layer was laid on mud bricks, the second layer of which was the size of the brick double the first row. Here we also see 12 cm thick bricks and walls, which were laid from the bottom of the brick, without a stone base [Table 1]. The wall thickness was 0.8-1.0 m, and the height of the preserved part was up to 2.0 m [3].

Table1. The size of the mud bricks used in Shengavit (size in cm)

Width	Length	High
20	28	10
29	40	10
28	38	10
22	52	10
30	30	10

The walls of the rectangular rooms were made of two-layer rubble masonry and mud bricks. But there are also rooms that have two walls built entirely of mud brick. Both the walls of the round shelters and the quadrangle rooms were covered with clay from inside and outside, often without the aid of a tool. Housing floor was covered with cobbles or small gravel, which then stacked with a clay paste of 1.0-1.5 cm. During the renovation it was covered with a new clay plaster.

The same technique and principle were built in the capital by Teishebaini (Karmir blur) and Erebuni and in other region of Armenia Dvin, Artashat, Armavir and more Houses with brick and mud have been built primarily in the Ararat valley, in the Sisian region. In Western Armenia built in the villages of Alishkert, Shatakh, Msho province and in the villages in general, where the main building material was clay 'Fig. 2'. The rooms were covered with a horizontal flat roof or with a two sloped roof and sometimes covered with arches like dome. In case of covering the two sloped roof, one or more pillars were cut from the inside of the room, dividing the room into two parts. In the case of a dome, a few wooden pillars were inserted from the inside of these weak walls, which were joined together from top to bottom and forming a constructive skeleton that saved the cover [4].

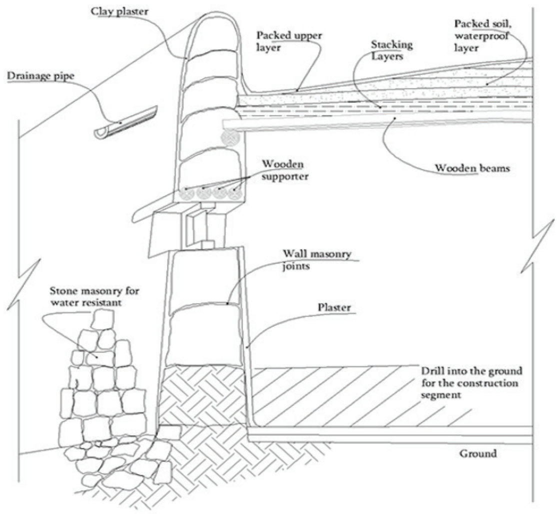

Figure 2. Earthen wall structure which use in Armenia.

Most of the houses were built with mud brick, relatively rich people were built with brick, even with stone. Sometimes, some of the outer facades of mixed brick or stone and mud blocks the intermediate belts of the walls, the windows and the doorways, the braces and the cornices to make the accent, they put the bricks or stones. Ashtarak, Oshakan, Voskevaz, Etchmiadzin and other villages of these districts are also rich in these types of houses 'Fig. 3' [4].

Figure 3. Residential building, build in mud brick and stone.

Some of the old people's residential homes, there is a clear influence of the late Iranian architecture. Chopin, head of the Revenue and Property Authority of the "Armenian province", writes in his study of the newly occupied Armenia "…The facade of homes of Yerevan put a very unpleasant impression on the first time, but inside it is booming.

Houses are generally constructed of mud brick and stone but partition walls are made of bricks and lime mortar. Inside the walls used the wooden beams which keep the building from earthquakes. The first floor of the building usually covered with stones, sometimes covering the whole front of the house with semi decorative brick…" [5].

Today, very few of these types of building have been left, since most of them have been demolished for new and modern high-rise structures have been built on their site.

There are still religions earthen structures such as churches in the Republic of Armenia, mostly in the Ararat valley. This church has a simple rectangular plan, a simple basilica type. They were covered with a flat roof, but nowadays the residents were added thin metal sheets for save it from rain and snow.

These type of churches can be pointed out that Norashen, St. Mariam, Hayatagh and Hovtamej St. Astvatsatsin Churches 'Fig. 4'.

The ruined walls of these churches are marked by the remains of clay jugs placed on the wall for two main reasons. The reason for this is the low utilization of wall building materials and their lightweight and the second reason for the acoustic sounds.

Figure 4. Earthen church in Norashen and Hovtamej

In all the churches, entrance and windows frame are arranged with a stone or brick. The use of this two building materials has also been decorative. The main entrance is from the west and the secondary entrance is open from the southern facade. On both sides of the main altar, there are depositories where mainly church-related items were kept 'Fig. 5'.

The degradation and destruction of the brick structures are mainly due to erosion, changes in weather condition and temperature, perforation of underground water, plant growth on the structure, and natural disasters. The main challenges are the absence of preservation/conservation techniques and financial difficulties. This research looks into the preservation techniques for adobe and brick structures.

Figure 5. Church door frame built with stone and clay jar inside of the wall masonry.

Degradation causes can be divided into two main groups: natural and anthropogenic. Natural degradation are result of weather condition and temperature changes, earthquakes, floods, landslides, erosion, fire, plant growth on structures, air pollution, and flood of underground waters.

Anthropogenic degradations are consequences of factors such as wars, urban development projects, demolishing buildings, inappropriate intervention, or simply abandoning the structure. Figure 1 illustrates structure degradation factors.

One of the preferred techniques for reinforcing the structures to earth is coating with reinforced cement mortars. Gypsum and lime are compatible materials within earth-based mortars. They create softer plasters than cement, and produce a chemical bond with earth, especially slaked lime or hydrated lime. These advantages provide interest for several research projects and theses that advocate their use [4]. The insertion of a ring beam and the use of tie rods or buttresses can be justified in some cases. Generally speaking, it is always best to develop constructive solutions using wood, a material that works well in combination with earth, comparing to steel or concrete. However, every solution must be carefully considered before being implemented. Transversal ties bind two opposite facades of building allow reconnection of a structure that has been divided into two parts or when one part is deformed. The insertion of a tie rods can prevent the collapse of severely deformed walls 'Fig. 6'.

Paving of alleys and lanes using flat stones makes it possible to:

- Make lanes available for pedestrians when it rains, particularly in the case of narrow and steep lanes.
- Guarantee a proper water drainage while slowing down the erosion process of the ground surface.
- Avoid water infiltration on lateral walls.
  However, some precautions should be taken for implementation:

Degradation of brickwork structures can also be as a result of landslides, with the formation of underground waters. These cause high moisture, which is harmful for adobe structures. In the winter a snow layer sits on the building walls, as it melts later the water is absorbed in the walls and bases. Thus, it becomes an opportunity for frostbite and decay. The common and valid method for solving the problem is the creation of drainage systems. Today, Knapen drainage pipes are very popular. They are made of different materials and are intended to be used in different environments. Placement of pipes in the walls is done through certain calculation by taking into account the volume of the water. They are placed 20 cm above the base, which does not disturb the historical appearance of the monument. Figure 6 shows Knapen drainage pipes installation types and position [7-10].

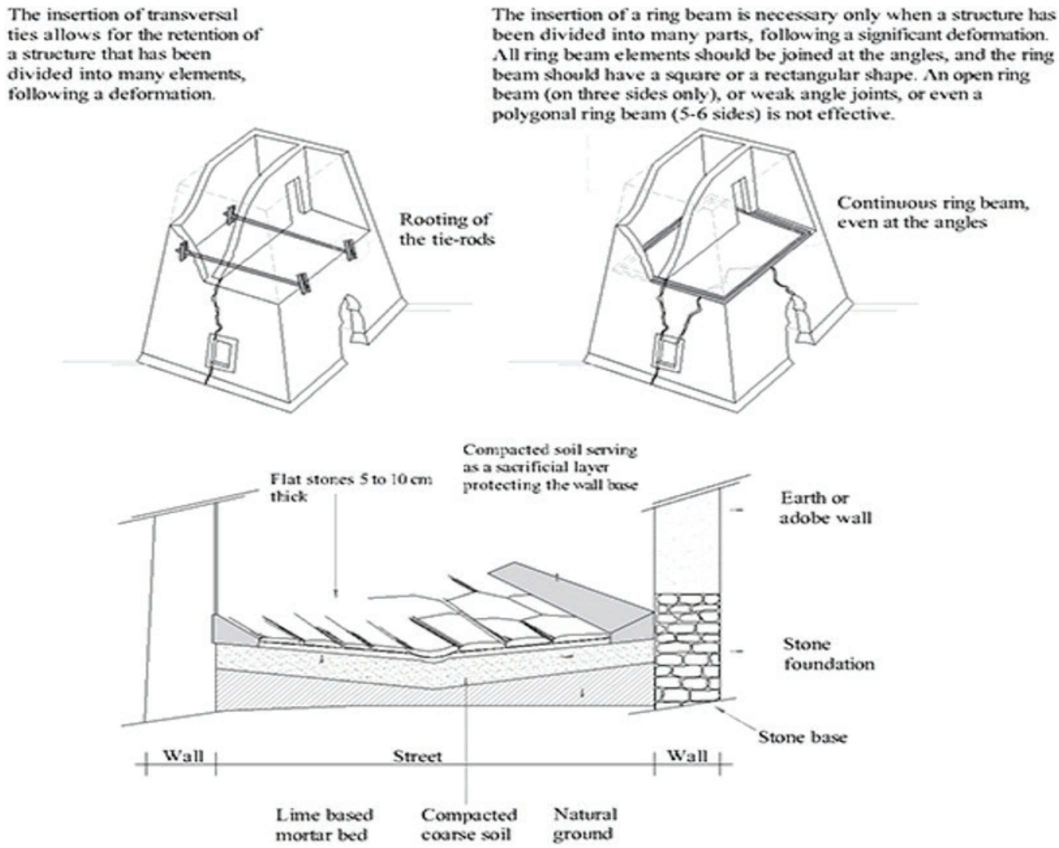

Figure 6. Adobe structure strengthening and drainage technique

After drying the bases, it is necessary to strengthening the building, a way of strengthening is use of reinforced concrete. This material is not compatible with the brick, but its strength, stability, and high inflexibility allow it to be used in the form of diaphragms in the structure to ensure the structure durability and inflexibility. European researchers have joined archaeologists and conservation workers to look for solutions for the Protection of Cultural Monuments (PCM).

They developed a new material, a new kind of coating, to specifically protect these old bricks in an environmentally friendly way. This further helps to develop new 'green' products to protect cultural heritage sites damaged by frost, organic agents, chemical corrosion and other 'weathering' processes. This preservation material does have photocatalytic properties. It is also self-cleaning and anti-microbial - it destroys any organic materials that could alter the surface of the bricks. It is also transparent - it does not change the aesthetic appearance of the building that needs preservation 'Fig. 7' [6].

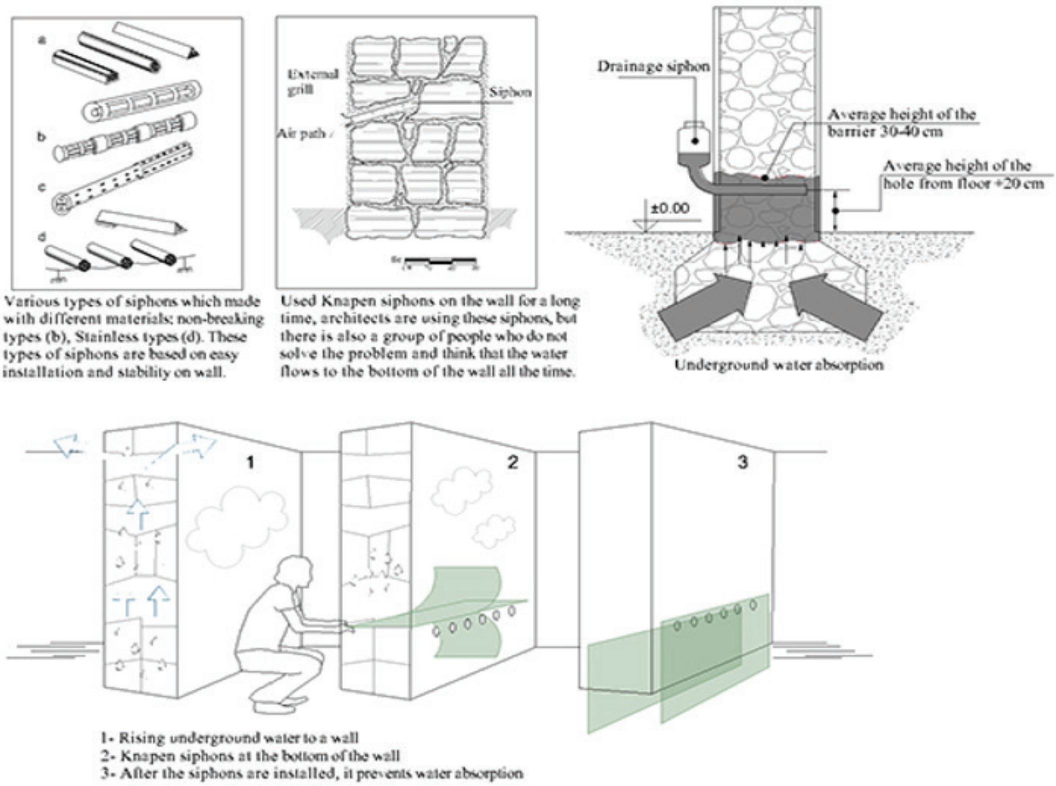

Figure 7. Various types of knapen siphons using on wall

3 CONCLUSION

The earthen and mud bricks structures in the territory of the Republic of Armenia are periodically covered from the fourth millennium to the 20th century with time interruptions.

Houses, fortresses, churches, residential houses and public buildings have been built in the Republic of Armenia.

The proposed techniques for reinforcing the earth and adobe structures are strengthening with wooden frames and reinforced cement plaster. There are many brick buildings in Armenia, mostly parts of archaeological excavations (Bronze century, Urartian and Antique Roman fortifications, church, residential and industrial buildings), and their conservation and restoration problems can be solved by the wooden frames and Knapen pipes for drainage.

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The Destruction of Cultural Heritage in Conflict Zones: Timbuktu

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ABSTRACT

Conflict is one of the significant factors which has increasingly become a threat of damage and/or destruction of cultural heritage all over the world. Mali is one of the countries whose cultural heritage including UNESCO World Heritage Site in Timbuktu were damaged and destroyed by armed rebel groups due to the conflict in 2012. In Timbuktu, fourteen mausoleums on a total of sixteen inscribed on the World Heritage List was destructed by armed rebel groups. It followed by a fire of a library containing valuable manuscripts dating back to the 13th century. The last disaster was the destruction of the door of the mosque of Sidi Yahia which is also insribed on the World Heritage list. The restoration was mandatory to help people who lost their identity to come out of that conflict. After Timbuktu was liberated, UNESCO began mausoleum restoration works with local people, who helped masons with a good knowledge of the local construction techniques. The person responsible for the destruction of nine mausoleums and the door of the mosque was charged by the international criminal court which was a first of its type in the history of this court. In this study, firstly, Timbuktu is taken under the scope with its history, location, its status of World Heritage Site and ancient manuscripts collection. This followed by conflict analysis which is used as the main research method. Last but not least, the restoration works of UNESCO is mentioned aiming to underline rebuilding destructed identity of Mali.

Keywords: Timbuktu, manuscript, mausoleum, destruction, conflict zone

1. INTRODUCTION

Timbuktu is one of the 8 administrative regions of Mali in West Africa. It is located on the south coast of the Sahara, 15 km north of the Niger River. The name of the city of Timbuktu is said to have originated from the word of 'imashagan' meaning free people (Rasmussen, 2014, p.12). It was one of the most important commercial and intellectual centers of West Africa in the Middle Ages. Especially from the mid-14th century to the 17th century, it was a respected city in the West and North Africa and the Middle East and the center of Islamic education. According to the census conducted in 2009, the population of the city was 54,893.

1.1. History of Timbuktu

The city, which was founded in the fifth century, reached the peak in terms of economy and culture during the15th and 16th centuries. It was one of the important trade points in history because of its location where the trade routes crossed in North Africa. It was also the center of the Sahara trade route where trade was managed and the product was sent to Europe especially gold and grain. For this reason, the city has been known as the Golden City, which is the source of wealth and difficult to reach for centuries in Europe. It was also an important centre for the Islamic education having several universities with 25,000 students. As seen from the timeline below, the most important milestones of the city in its history are summarised.

Figure 1. The milestones in history of Timbuktu

1.2. World Heritage Site of Timbuktu

Timbuktu was inscribed to the World Heritage Site with three large mosques and sixteen cemeteries and mausoleums in 1988. Timbuktu was selected as a World Heritage Site with the criterias of (ii), (iv), (v) explained below;

> ***Criterion (ii):*** *The mosques and holy places of Timbuktu have played an essential role in the spread of Islam in Africa at an early period.*
> ***Criterion (iv):*** *The three great mosques of Timbuktu, restored by the Qadi Al Aqib in the 16th century, bear witness to the golden age of the intellectual and spiritual capital at the end of the Askia dynasty.*
> ***Criterion (v):*** *The three mosques and mausoleums are outstanding witnesses to the urban establishment of Timbuktu, its important role of commercial, spiritual and cultural centre on the southern trans-Saharan trading route, and its traditional characteristic construction techniques. Their environment has now become very vulnerable under the impact of irreversible change*

In addition, authenticity which can explain as the three mosques (Fig 2) with great value in terms of architecture, traditional construction techniques, daily maintenance and use; and integrity which is three mosques and sixteen tombs reflecting Timbuktu in the 16th century are the other significant factors for selection.

Djingareyber Mosque, which is one of three mosques in world heritage site, is located in the center of the historical core in the south of the city of Timbuktu. It is known that it was built by Andalusian architect Abu Ishak in 1325 by King Moussa. The mosque, which is one of the most important examples of soil architecture and wooden workshop in Africa, has been restored in 2009 by AKTC. (AKTC, 2010) Sankore Mosque, Sankore University or Sankore Madrasa, also known as King Mansa Musa (1307-1332), known to have been established before the period and especially during the Askia Dynasty (1493-1591) 25,000 students from various parts of Africa in the city of Timbuktu being one of the most important islamic learning centers for the world. (Khair, 2013) The Sidi Yahya Mosque was built to the south of the Sankore Mosque in the 15th century and restored in the 17th century. The mosque was also used as a madrasa, along with the Sankore madrasa, which became the centers of islamic education in the 16th century. (Khair, 2013)

Figure 2. Djingareyber Mosque (left), Sankore Mosque, Sidi Yahya Mosque minaret (right), UNESCO, 2005

1.3. Ancient Manuscripts of Timbuktu

Salt comes from the north, gold from the south, and silver from the country of the White men, but the word of God and the treasures of wisdom are only to be found in Timbuktu.
An old West African proverb

Timbuktu has become the symbol of the region's manuscript heritage because of providing insight on Africa's history much earlier than European colonialism. According to the manuscripts in Timbuktu, students who had studied here between the 14th and 16th centuries received education in many different fields such as law, technology, linguistics, politics, astronomy, medicine, music, history, literature, philosophy, mysticism, as well as Qur'anic education. This education was equal to the doctorate level of today's system of education. (Mathe, 2012) The archives of Timbuktu consist of approximately 400,000 works while the oldest known manuscript date to 1204. These include books as well as invoices and sale contracts offering an insight into the trade network of their periods. (Rasmussen, 2014)

2. CONFLICT ANALYSIS

2.1. Profile

Political, economic and socio-cultural environment in Mali should be analysed in terms of gaining better insight into Mali conflict in 2012. According to UNDP human development index data in 2011, It ranks 178th out of 187 countries in the world and is considered one of the least developed countries. Half of the approximately 14 million people in Mali live below the hunger limit of $ 1.25 per day. Education is unstable due to the lack of adequate number of teachers and structures. The majority of students leave school at the end of 3 or 4 years, this leads to the capture of children by various terrorist groups to raise child-soldiers. In the Sahel region, Mali was severely affected by the drought in 2011 and brought millions of people at risk of starvation. Tuaregs rebelled twice since the independence of Mali, the first of which was 1963 and the second was 1990. After the second nomadic uprising, the government signed a contract to provide infrastructure for the infrequently populated northern part of the country, but this could not be achieved due to the country's economic situation. At the timeline below, the history of conflict is explained with significant events. (Badale and Isvoranu, 2013)

August 2011	Many armed Tuaregs returned to Mali fighting for Gaddafi
October 16, 2011	The National Movement for the Liberation of Azawad (MNLA) was established by the Tuareg minority
December 20, 2011	Algerian troops entered the country to help the Mali government to fight with Al-Qaeda groups
January 2012	MNLA launched its attacks in Menaka. It followed by Ageul-hoc, Tessalit, Léré, Andéramboukane and Nianfunké.
February 2012	MNLA attacked Hombori. Protests have begun against the government's inability to combat attacks in the north.
March 13, 2012	Iyad Ag Ghali explained that the Ansar Dine was the organization for the implementation of the Sharia Law
March 22, 2012	The National Committee for the Establishment of Democracy siezed power.
March 31, 2012	MNLA took control of the city of Gao.
April 2012	MNLA sized power of Northern Mali and declared its independence.
May 2012	Ansar Dine and MNLA united in Timbuktu to implement the Sharia Law.
June 7, 2012	An armed group was formed in Timbuktu for those who objected to the implementation of the Sharia law.
June 8, 2012	Tension between Ansar Dine and MNLA began.

June 27, 2012	Ansar Dine betrays MNLA, joins AQIM, MUJAO, takes control Gao, the sharia law begins to be strictly enforced.
July 1, 2012	Mali apply to United Nation
November 11, 2012	ECOWOS emplaced the troops.
December 20, 2012	UN approved the deployment of land forces to Africa to take back Mali. The extremists invaded the city of Konna and headed south to the capital. Mali asked France for help.
January 11-12, 2013	France launched an airstrike and recaptured the city of Konna.
January 18, 2013	United States sent 100 military instructors to Mali to support.
January 21-28, 2013	France and Mali's troops took back the control of Diabaly, Douentza, Gao, and finally Timbuktu.
February 2013	Al-Qaeda started a guerrilla war against Mali and French troops and US deployed the drone for exploration.
March 4, 2013	It was confirmed that Abdelhamid Abou Zeid, the leader of the AQIM, was killed.
April 2013	French troops began to withdraw.

Table 1. History of Mali conflict in 2012, BADALE and ISVORANU, 2013

The conflict adversely affected people in terms of not only shelter, education, economy but also cultural heritage. In 2012, 149,943 people from conflict zones, approximately 1% of the population, had to relocate to other countries. Even though the conflict was ended in 2013 and the control of the region was taken back, only 43.000 of the refugees returned due to the insecure environment in the country. As regards education, according to the statements of the Ministry of Financial Education, 10,000 students, who had to relocate in 2012, could not receive education. In addition, many schools in Timbuktu and Gao have been destroyed. In terms of economic condition of country, farmers' migration to other countries, power cuts due to conflict, lack of access to adequate resources for agriculture and animal husbandry brought the country's pre-conflict poor economy to a halt. Last but not least, Timbuktu's cultural heritage was significantly affected. 14 tombs were completely destroyed along with the gate of Sidi Yahya Mosque as well as 4000 historical manuscripts were burned.

2.2. Causes

Structural causes which underlie conflict can be listed as the emergence of nationalism in the period between World War I and World War II and the spread of radical Islamic thought in the region since the end of the 19th century. As regards proximate causes, Tuaregs' negative attitude towards modernization and their accusing the Mali government of forcing nomadic people for modernization can be at the top of the list of causes. In addition, the idea that the nomadic people will have their own independent states in Azawad Region and the establishment of MNLA and Al-Qaeda's provocation the people against the current government as well as the enmity between the nomads and the settled people which arose in the period of the French Colony are also the reasons of conflict. Famine, drought, the instability of the economy, the spread of Al-Qaeda are also the other reasons which cause the conflict in 2012. Lastly, with the fall of Gaddafi, a considerable number of unemployed and military-based nomads who fought in Libya returned to Mali with desire to declare independence in Northern Mali, which they called Azawad can be accepted as trigger cause. (Oluwadare, 2014)

2.3. Actors

The actors of conflict are tried to analyze in terms of interests, goals, positions, capacities and relationship at the table below in the light of recent searches about conflict that stated at bibliography.

	Interests	**Goals**	**Positions**	**Capacities**	**Relationship**
The National Movement for the Liberation of Azawad (MNLA)	Tuaregs who received military training in Libya	It was founded in 2011 for the independence of the Azawad region	It has as military power, war strategy and political power	Military war strategy due to their education in Libya	It was allied with Ansar Dine. No international institution recognized
Ansar Dine	Under the leadership of Tuareg, who is willing to implement the Sharia Laws	To implement the Sharia Law in 2012 first in the Azawad region and then in the whole of Mali.	The most powerful rebel group with multiple resources	-Getting children to military camps with propaganda -Man and weapon capacity	-Founder of the former Al'Qaeda members -The founder is Tuareg Ag Ghaley
Al-Qaeda in the Islamic Maghreb(AQIM)	Due the unstable situation in Mali declare its center as northern Mali	In 2007, it was founded radical Islamists in Algeria	Kidnapping foreigners in the region and blackmailing	Effect to unstable countries in Africa	-In cooperation with MNLA through Ansar Dine and MOJWA
Movement for Oneness and Jihad	Black people leaving AQIM was also benefit from	Founded in 2011 by Africans who left AQIM to	It has over 1000 fighters but this figure is not stable	According to OCHA reports, the terrorist group	It is connected to AQIM as an ideology

in West Africa (MOJWA)	the unstable situation in Mali	introduce Sharia in West Africa		of the highest number of foreign	
The Boko Haram	The radical Islamic terrorist group in Nigeria came to Timbuktu in 2012	Taking advantage of the conflict to continue its activities in Mali	Established a military training camp in Timbuktu,	Military training camp with increasing participants	Return to Nigeria. after the intervention of France
Malian Governmental Forces	Mali government troops	To regain management in the region	Especially in the first period of the conflict suffered heavy losses	6000-7000 military units, air force, limited navy	Call for assistance to the United Nations and ECOWAS
Malian Militians	It is composed of volunteers living in the country	Resisting to radical Islamic fighters	Capacity of hundreds of volunteer fighters	Successful attacks against radical Islamists	Receiving military training from troops
The Economic Community of West African States (ECOWAS)	Mali is a member of ECOWAS	Founded in 1975 with the participation of 15 countries	Control and improve the economic activities of 15 countries in the region	ECOWAS members worry about extending of conflict	Mali and 8000 troops sent to the northern border to aid French troops
The Europen Union	Acceptance of the crisis in Africa	Providing logistic and economic assistance and training military	One of the main actors as an economic supporter	Economic capacity	-Sending of military instructor -Financial support to ECOWAS
France	Invasion of strategic cities such as Gao and Konna	Stabilizing Mali	One of the most important actors to restore control in the region	Military power	Formation of a military unit with Mali, EU, ECOWAS
The United States of America	Potential for international terrorist attacks	Stabilizing Mali	To have superior technology and resources	International terrorist attacks	Working with France
Algeria	The proximity of radical Islamist fighters	Sending troops to the border	strong economic and military power in the region	Nomadic population	Neighboring country

Table 2. Actors of Mali conflict in 2012

2.4. Dynamics

The tendency of conflict and factors ensuring continuity are tried to analyse in this section. In 2013, MNLA and the Islamic Terrorist Groups retreated to the northern Ifhogas mountains without continuing the conflict after two months of French intervention. Following the conflict in the region, 2000 French soldiers stay to maintain peace stability, but the debate over whether this solution was permanent carried on. In terms of human right, it was considered that the worst period of of Mali was the peripd of conflict in 2012 because of rapes, child soldiers. The unresolved issues of conflict and abuse of civilians and the current economic problems caused civilian displacement. The attacks on cultural heritage sites in Timbuktu have reacted internationally. (Badale and Isvoranu, 2013)

3. THE EFFECTS OF MALI'S CONFLICT ON CULTURAL HERITAGE IN TIMBUKTU

In Timbuktu, 14 of the 16 mausoleums on the World Heritage List were destroyed together with the El Farouk independence monument, only the mausoleum of Cheick Al Imam Saïd survived although with significant damage to its roof and walls. The door of the Sidi Yahia mosque, considered sacred by local residents, was torn down and 4,203 manuscripts in the Ahmed Baba Institute for Islamic Graduate Studies and Research were burned or stolen (UNESCO,2017).

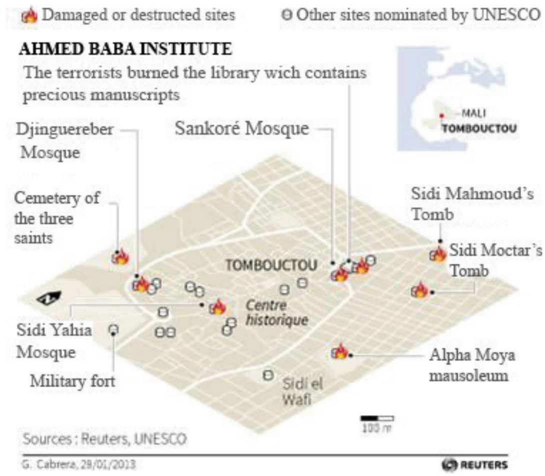

Figure 3: Damaged sites in Timbuktu, UNESCO, REUTERS 2013

3.1. The Destruction of the saints mausoleums

Fourteen of the sixteen mausoleums inscribed on the World Heritage List were completely destroyed during the period of conflict in north of Mali. Built from the thirteenth century, these mausoleums represent the prestigious past of Timbuktu. The mausoleums were destructed by a group of extremists who considered the veneration of saints as "idolatry". What happened in the region was described by Chirfi Moulaye Haïdara, a writer born in Timbuktu, as "the paroxysm of barbarism". According to the French News Agency, the leader of Ansar Dine Abu Dardar declared: "There will not be a single mausoleum"

3.2. The burning of manuscripts

The manuscripts of Timbuktu had survived for centuries. They were kept by the residents and held preserved in private libraries during the French colonial rule. They were after that collected for restoration and kept in two different buildings, an ageing library and the Ahmad Baba Institute.
The armed groups retreating from Timbuktu set fire to a library containing thousands of priceless historic manuscripts, according to the Saharan town's mayor, in an incident he described as a "devastating blow" to world heritage. Hallé Ousmani Cissé told the Guardian that al-Qaida-allied fighters on Saturday, January 26th, 2013 torched two buildings that held the manuscripts, some of which dated back to the 13th century. French troops and the Malian army reached the gates of Timbuktu on Saturday and secured the town's airport. But they appear to have got there too late to rescue the leather-bound manuscripts that were a unique record of sub-Saharan Africa's rich medieval history (Smith, 2013).

3.3. The destruction of Sidi Yahia mosque's door

The destruction of religious properties in Timbuktu continued. The extremists broked the door of Sidi Yahia mosque located in the south of the city. According to a local legend, once this door is opened,it would be the end of the world. Clearly the aim of this act was to prove that this belief was wrong.

4. THE RESTORATION WORKS CARRIED OUT BY UNESCO IN TIMBUKTU

After a year from the beginning of Mali's conflict, the cultural heritage in Timbuktu has suffered serious damage. The Malian government launches a call for help to UNESCO. To respond to Mali's call, UNESCO initiated the following major actions:

- Mobilization of the international community by launching an awareness campaign. A Malian "Heritage passport" was also published, showing the location of all the most important cultural sites in Timbuktu, and distributed to nearly 8000 French, Malian and African soldiers.

- Informations were regularly sent to the United Nations Security Council. He adopted resolutions strongly condemning the destruction of cultural and religious sites in Mali. These efforts led to the adoption of Resolution 2100 in April 2013. The Peacekeeping Mission in Mali (MINUSMA) was established, and for the first time in history, it collaborated with UNESCO to protect cultural sites.
- Inscription by the World Heritage Committee of the sites of Timbuktu and the Tomb of Askia on the list of World Heritage in Danger in July 2012, during its 36th session in Saint Petersburg,
- Support of the Government of Mali to finalize its accession in November 2012 to the 1999 Second Protocol to the Hague Convention of 1954 for the Protection of Cultural Property in the Event of Armed Conflict,
- Visit of the former Director-General of UNESCO to Timbuktu with French President François Hollande, to see the damage to cultural heritage.
- Organization of an international Meeting of Experts (18 February 2013), in collaboration with the French Ministry of Culture, for the safeguarding of Malian cultural heritage, This meeting led to the adoption of a 11 million US$ million action plan to restore cultural heritage and safeguard ancient manuscripts in Mali (Eloundou, Cissé, 2018).

4.1. Reconstruction of the mausoleums

After the end of the conflict, the local population was the first to urge UNESCO to rebuild the mausoleums that were a major pillar of their social life, it was impossible for them to overcome the difficult times they experienced during the war without the existence of these symbolic tombs. The first damage assessment mission was carried out in June 2013 by a team of international and Malian experts. Beyond material damage, they concluded that psychological damage was equally important. To mitigate these impacts, UNESCO, the Malian Ministry of Culture and their technical partners adopted an approach in three stages:

- In the firt place, there were both a photographic and planimetric documentations of the damage.
- After that, archives, historical information, architectural surveys and archaeological excavation records as well as compiling traditional building practices and techniques, were collected, in consultation with the guild of Timbuktu masons, who alone possess the ancestral know-how needed to undertake this type of reconstruction. The construction choices that were agreed upon with the same traditional techniques, in order to preserve Timbuktu's World Heritage status.
- By the end, the collected data was organized into a reconstruction and restoration strategy paper, to act as a guide for all stages of reconstruction.

At the same time, a long and slow process of strategic planning enabled raising the necessary initial funds for the construction projects launched in March 2014 (Ibidem).

Figure 4. Malian Masons reconstructing the mausoleums, AFP PHOTO / SEBASTIEN

4.2. Rescue of the manuscripts

The manuscripts belonged to families in Timbuktu. They were handed over to the Institute for Restoration and Conservation.When Timbuktu fell into the hands of the armed groups, Abdel Kader Haïdara who controlled the city's largest private archive library knew that the manuscripts were in danger, and he began to communicate with families to get them back from the institute. Thus, the manuscripts were placed in wooden trunks and brought back to the families' homes. After the situation deteriorated, it became a necessity to remove them from Timbuktu. Thousands of trunks containing

400,000 manuscripts were secretly moved to Bamako, by desert and sea. None of the manuscripts were lost during the transportation, but some remained in Timbuktu. Fortunately, about 10,000 of them were kept underground in rooms that were really well hidden, so they survived the burning. So, when the mayor of the Sahara municipality Hallé Ousmane Cissé declared that the city's precious archive had been burned, he didn't know that they destroyed only several thousand manuscripts, and hundreds of thousands of them had been moved to a safe place in Bamako for their restoration.

4.3. Restoration of Sidi Yahia mosque's door

The "secret door" of Sidi Yahia, the only one facing the sunset, was restored by local carpenters between April and August 2016, under the auspices of UNESCO. The resettlement was made on 19 September 2016 in front of many notables and inhabitants of the city. Also The UNESCO representative Lazare Eloundou, the deputy head of the UN Mission in Mali Mbaranga Gasarabwe and the ambassador of the European Union, Alain Holleville, deputy Mayor Drawi Assékou Maïga were present at the ceremony.

4.4. The Offender's trail

The Touareg Ahmad al Faqi al-Mahdi was arrested in October 2014 in Niger. He wass tried , a year later, by the International Criminal Court for the destruction of mausoleums in Timbuktu. This trial a first in front of the ICC. The 40-year-old man has been sentenced to nine years in prison for "intentionally directing attacks" in 2012 against the door of the Sidi Yahia mosque and nine of the mausoleums. The ICC also ordered individual, collective and symbolic reparations for the Timbuktu community and estimated Mr. Mahdi responsible for the repairs to 2,7 million euros.

5. CONCLUSION

The effects of the 16-month conflict that took place in Mali in 2012 on the cultural heritage can be sum up as 14 of the 16 tombs of Timbuktu's World Heritage Site in the Mali Conflict were completely deliberately destroyed by Ansar Dine, one of the radical Islamic organizations, and 4,000 of the 400,000 manuscripts were irreversibly destroyed. Approximately 145,000 people were refugees and 50,000 people had to be relocated to the south of the country. More than 50,000 refugees have returned, while others have not returned, fearing that the country is still unsafe. The tombs, which were damaged during the conflict, were restored by UNESCO with public participation and willing. The manuscripts which were recovered by being sent to Bamako in cooperation with UNESCO and the Mali Government were restored and put under protection. Ahmed al-Faqi al-Mahdi, which is accepted as responsible for the targeted destruction of fourteen tombs, Sidi Yahya Mosque's gate, and approximately 4000 burned manustirpts were tried at the International Criminal Court in La Hague and sentenced to 9 years in prison. It shoul be noted that with this decision, conscious damage to cultural heritage was seen in the war crime category fot the first time in the history of this court. Although the conflict, which was started in 2012, ended with the interference of French army in May 2013, the tension and insecure environment in the country still continues.

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Branding The Kerpic Architecture as a Cultural Identity in Çelemli Mansion in Adana

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ABSTRACT

The research focuses on the architectural culture of the Çelemli district of Adana, which has been the home of many cultures and human lives dating back to 6000 BC in Anatolia. It is a study of the structures of the mudbrick material, which was built by the technique and method, which was created by the migrants who needed a living space in order to continue their life. The scope of the research is the adobe of Çelemli village, which is 55 km away from the city center of Adana.

In the research, the general information of the village of Çelemli; The information about the working subjects such as location, the definition of the area are taken from the necessary centers and the information about the plan, the facade, the material properties and the construction techniques are recorded in an oral form from the owners and their current situations are documented with the photographs and necessary drawings.

The documented findings showed how a structure of mudbrick material was made and what were the necessary steps for it. As a result of the research, suggestions have been made on how to ensure the awareness of adobe houses and branding of adobe architecture as cultural identity.

Key words: Çelemli village, immigrant architectural heritage, Adana, adobe house, brand architecture

1. INTRODUCTION

The climate, geography, sociocultural structure and most importantly after the war of 93 (1877-1878), the population migrating from the Balkans were given agricultural and residential lands. They built mudbrick village houses with information based on their culture. It is preferred because the adobe material is easily available and is practically prepared at the construction site. The heat insulation value of adobe material provides comfort to the user with advantages. It is a building material which is obtained by pouring clay, containing clay in suitable proportions and pouring into the molds by blending and kneading with the necessary additives. It is a building material which is obtained by pouring clay, containing clay in suitable proportions and pouring into the molds by blending and kneading with the necessary additives. In the examples of adobe building, there is widespread application of earth plaster on the facades and flat roof on the roofs. Although the houses are single-storey in the early period, the growth of the population and economic growth accelerated after the 20th century. After the war of 93 (1877-1878) the mudbrick structures of the immigrants from the Balkans were the architectural heritage identity of Çelemli Village. Today, unlike learning from local masters in history, global education has failed to teach the necessity of preservation of heritage. Local efforts and communication are important to provide cultural identity to architects. In this section, the branding and sustainability of the soil architecture in Çelemli neighborhood are aimed at human cultural values.

2. ÇELEMLİ NEIGHBORHOOD IN ADANA

It is a village of Yüreğir district of Adana province. It is located 55 km from Adana and 30 km from Yüreğir district. (Figure 1)

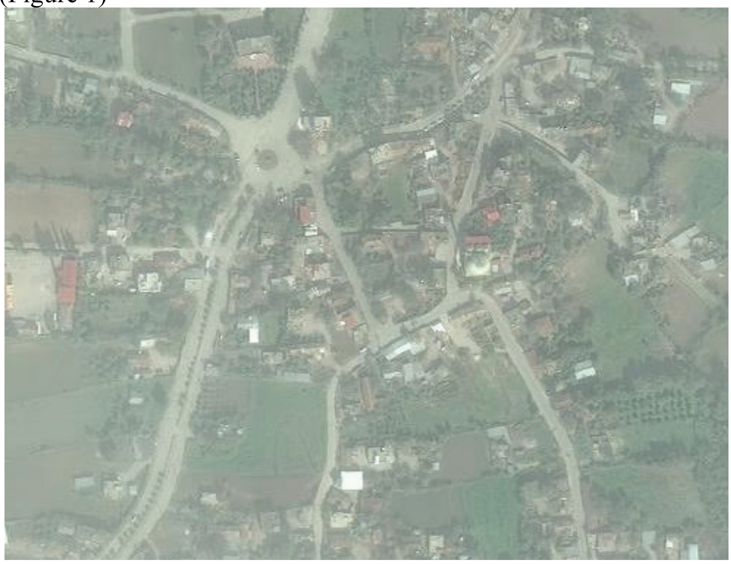

Figure 1: Çelemli Mahallesi Yandex Map Satellite Image [1]

2.1 Date and Location

Living in Çelemli Borough Deliormanlı Balkan Turks, 93 in the war of 1877-1878, the Republic of Turkey without the establishment half a century ago left their Balkan homeland (previously Konya and separated from Haymana region and present Bulgaria rest of the state border, but at that time the Danube province of the Ottoman Empire Ruse, Shumen, Hazergrad-Razgrad, Old Friday, Silistra, Pravada and others) have returned to different parts of Anatolia with their previous homeland. (Figure 2)

Figure 2: Adana Province and Yuregir District Map [2]

2.2. Culture

The history of the establishment of Çelemli town, the history of thousands of villages, towns and neighborhoods established by Balkan Turks in Anatolia and Thrace after the Turkish-Russian War of 1877-1878 is very similar. Deliormanlı Balkan Turks living in Çelemli Municipality, in 1877-1878, before the Republic of Turkey founded and brought in half a century before the former homeland of the Balkan homeland lands they left with hundreds of years of technological and professional knowledge to Anatolia and them, to ensure their livelihood, environment and where they live they have used the region to build and beautify.

The most well-known handicrafts of these professions or accumulations are blacksmiths-metalworking-knife-making, carpentry-woodworking-production of agricultural tools, nozzle-pipe construction, home-made construction of pillows-quilts and socks, socks-booties production, tailoring, lace-knitting-needle embroidery, garden-flower arrangements, flower cultivation, seed bakery-bread and some other crafts. The ovens they use in the bakery area have a unique architecture and adobe material. (Figure 3)

Figure 3: Local Bakery Furnace [2]

2.3. Architectural Features

Deliormanlı as the construction method specific to the Balkan Turks, masonry brick and light wood materials were constructed using structures. Today, these structures are still in use (Figure 4).

Figure 4: The Preserving House [2]

2.3.1. Typology

As a construction method specific to the Balkan Turks, the plan types of the pavement are called mudbrick and brick. 3 types of plan types have been formed in the region.
Type 1; Each room has a separate bathroom (bathhouse), less than 2 rooms, outside with a special earth oven (emissary furnace), durable and insulated house plan in the form (Figure 5.6).

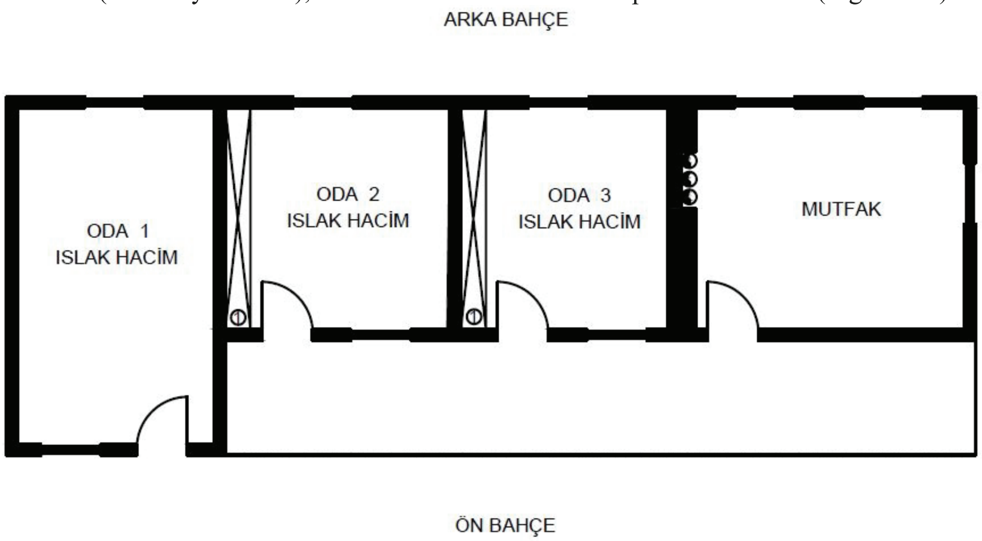

Figure 5: Example Immigrant Home Plan Type 1 [2]

Figure 6: Example Muhacir House Plan Type 1 Photograph [2]

Type 2; The entrance of the house from the blind facade and the entrance to the summer will be able to provide 1 shop with 2 doors, in each room, so-called cabinets, at least 2 rooms, kitchen and wet area (bathhouse) is solved in the same space and outside the special earth oven (immigrant oven) is a type of plan with a durable and insulated house plan. (Figure 7,8)

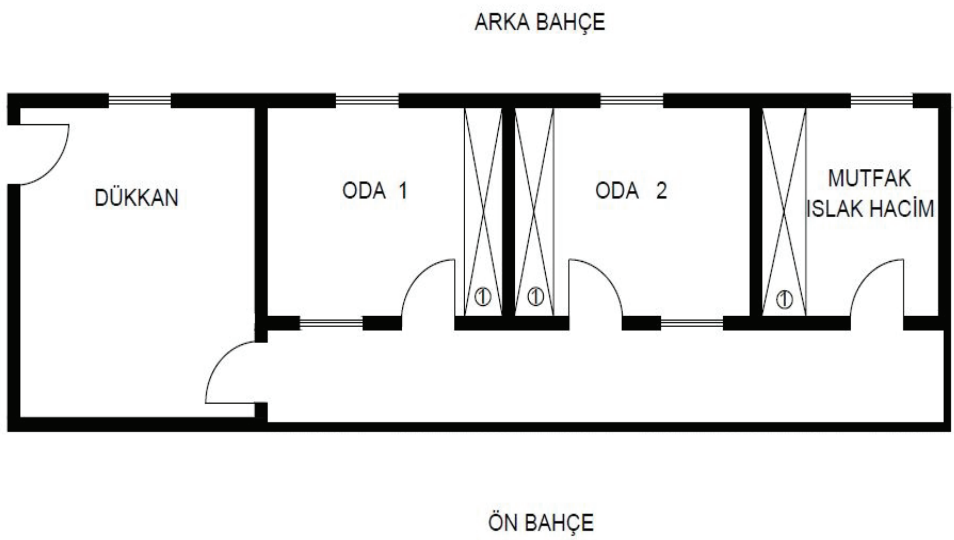

Figure 7: Example Immigrant Home Plan Type 2 [2]

Figure 8: Example Muhacir House Plan Type 2 Photography [2]

Type 3; In each room, the so-called load-bearing cabinets, with a minimum of 3 rooms, a warehouse, kitchen and wet space (bathhouse) to provide the material needs of the outside kitchen are solved in the same space, and there is a special soil furnace (emissary furnace) outside and the plan type is in the form of a durable and insulated house plan. . (Figure 9,10)

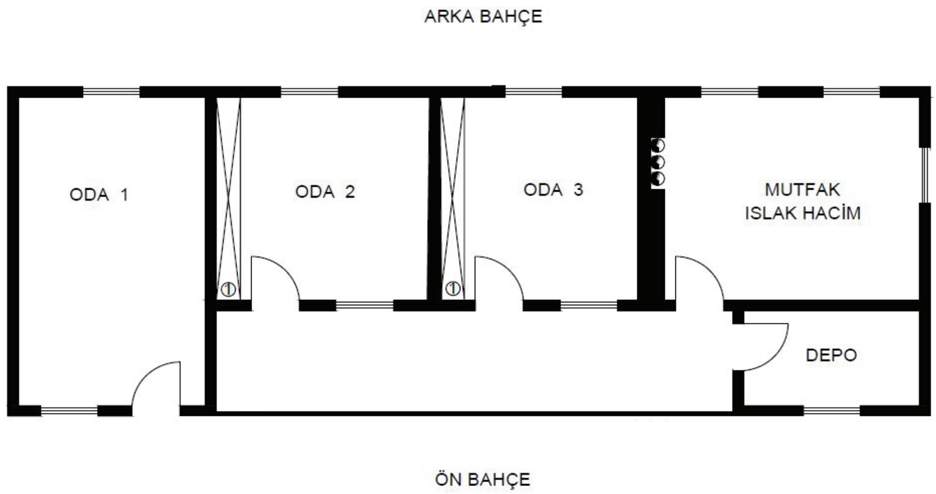

Figure 9: Example Immigrant House Plan Type 3 [2]

Figure 10: Example Immigrant House Plan Type 3 Photography [2]

2.3.2. Decoration Items

In the examples of traditional civil architecture in the region, exterior ornamental elements have not been used; Different color paints are used in windows to give character to the structures.

In the architectural elements of the building, there is no niche and no ornamentation on the ceiling in the rooms where the wall thickness is of the appropriate thickness. Functionality is considered as the main objective in architectural elements. (Figure 11)

Figure 11: Sample Immigrant House Plan Type 1 Door Window Photograph [2]

2.3.3. Slabs

In the field of planning, the traditional civil architecture example is the original roofing of the buildings.

2.3.4. Roof Form and Roof Cover

The example of civil architecture in the region is traditional roof terrace (dam). Tree trunks are placed on adobe blocks to be made of dam. Wooden poles to support the tree trunks are erected to reduce the dam load. Then the tree trunks are covered with reed. The reed is covered with earth and the roof is partially completed. To prevent the flow of water in the rain, the soil is compressed as a method of primitive waterproofing. (Figure 12,13)

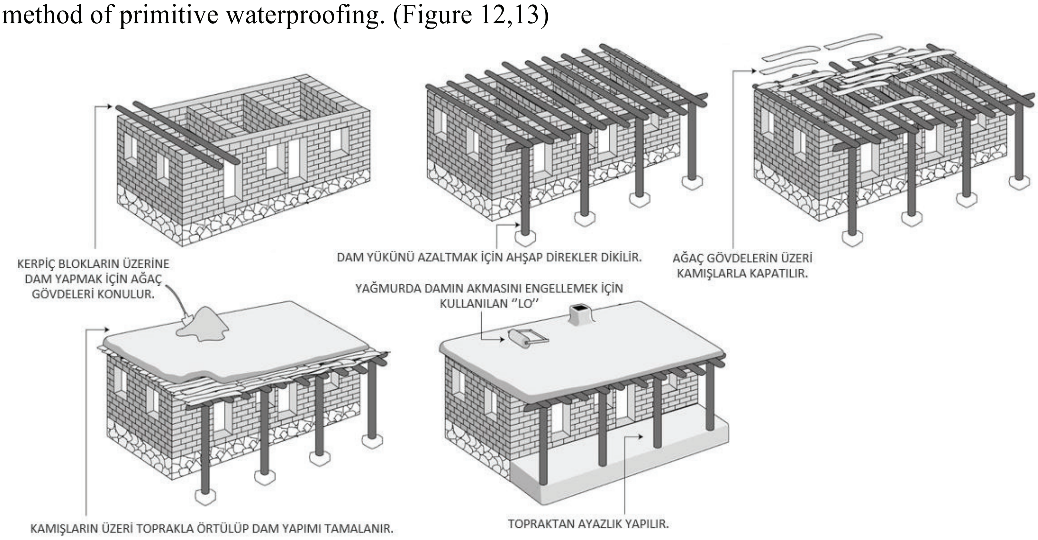

Figure 12: Muhacir Houses Progressive Dam Construction Method [2]

Figure 13: Muhacir Houses Dam Interior View [2]

However, due to the increase in the age of the users and the abandonment of the terraced roofs caused by the abandonment of the young users, the existing roof roofs (flat roofs) were demolished to protect the structures. As roofs, terrace roofs are flat. (Figure 14)

Figure 14: View of Muhacir Houses Roof [2]

2.3.5. Construction Technique and Material

As a construction method specific to the Balkan Turks, the plan types of the construction are called mudbrick and brick. Constructions of this type were used in the traditional construction technique. When digging the foundation pit, only the walls to be made are excavated. Stones are placed in the pit to serve as the basis for the pit. On this prepared foundation, adobe blocks are knitted by knitting method. A muddy dung was used as a mortar in the wall. (Figure 15)

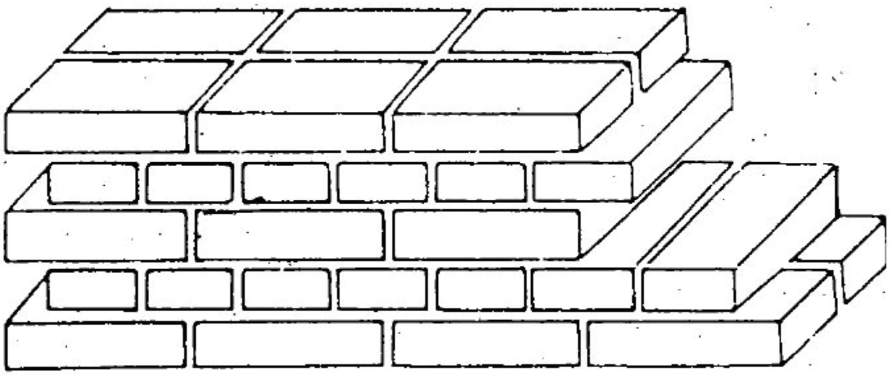

Figure 15: Method of Spreading Knitting [2]

Tree trunks are placed on the wall prepared from mudbrick blocks to be made of dam. Wooden poles are erected to support the tree trunks and to form the eaves in the summer section. Then the tree trunks are covered with reed. The reed is covered with earth and the roof is partially completed. In order to prevent the flow of the dam in the rain, it is compressed by means of soil lo as the primitive waterproofing method. To form the section of the summer, the soil is raised to the level of flooding and compressed with the help of lo. Window and door frames are placed and the house is made of interior and exterior plasters. The buildings are plastered with straw and mud. (Figure 16)

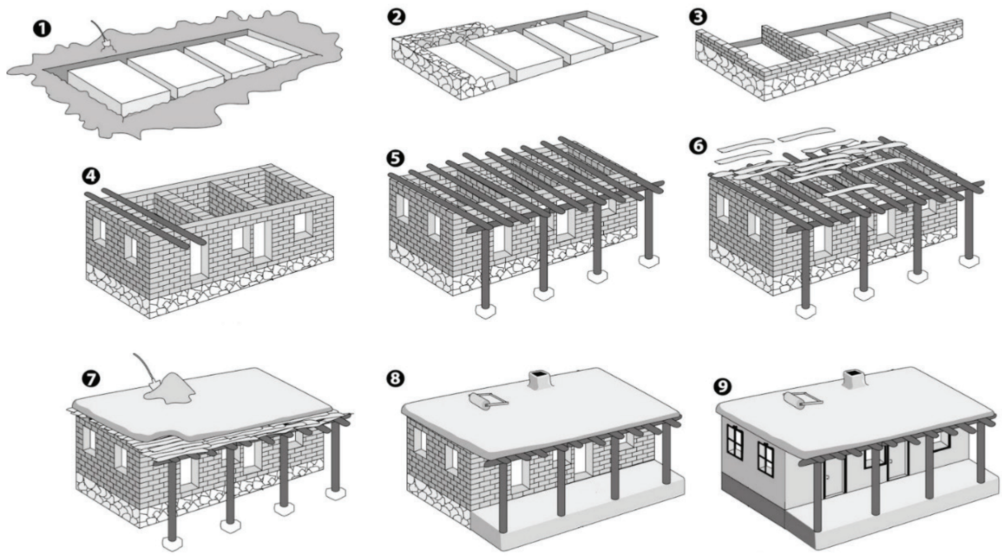

Figure 16: Muhacir Kerpiç Houses Construction Stages [2]

3. CONCLUSION

Heritage to be branded, to understand and continue the legacy (kerpiç) architecture, ,n 1877-1878 years Balkan Deliormanlı Turks, came back to their mainland Anadolu and To forfit their living space they applied there own (kerpiç) building technicques in the Adana,Çelemli rigion. Which its materyal and technique is differant than its used in this vigion (Turkey's Çukurova rigion). That ezcecds 140 years continusly used, we can say its a good building technique, by using this traditional materials within new techniques to be applied in our buildings.

The task is to understand the real value on the soil architecture in Çelemli and call it cultural capital. And as a result of this research, it is known that the construction period of the hay used in traditional is long. Nowadays, it is suitable to use algebrous adobe which is called alker as a faster building method than adobe technology.

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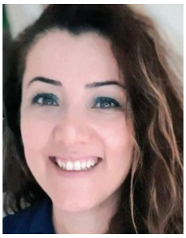
Kerpic'19 – Earthen Heritage, New Technology, Management
7th International Conference
Köycegiz, Muğla Turkey, 05-07 September 2019
No:94

Modern Earth Building: Women Education and Production Center in Keban



Özgül ÖZTÜRK

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ABSTRACT

In the villages will be an example to the local architecture, healthy, ecological, energy-efficient and modern construction techniques will be used in combination with natural materials in Turkey, for example RURAL TOURISM ECOLOGY-structure, we are building multipurpose and an alternative Modern Earth Building. It will be used as “Women Education and Production Center” when the population is dense and it will be used with the purpose of “ Ecotourism ”, income will be used for the scholarship for female students when the population is out of the center.

Studies like to increase the representation of women, to ensure their participation in social and economic life and to take part in the production process by training will be done in Earth Building. Strengthening women's economic status and social gender equality are among the main criteria of the project.

With the sustainability of the project, increased participation by touching more women, population density and accessibility, we are implementing the project in the central district of Keban, which includes 30 villages in total includig my ancestor's village.

Key Words: local architecture, earthen architecture, earth building, ecotourism, women empowerment, women production.

CONTENTS // GENERAL PROCESS

1. WHO ARE WE?

1.1 What does A Architecture?

A Architecture, with seasoned architects having more than 25 years of experience in the profession, makes "Circular Design" (Architecture- Sustainability oriented) that will awaken the feelings of freshness and prosperity of today's people who feel a deprivation of nature in chaotic city environment. A Architecture, Interior – Outside is an architectural firm that provides counseling services and designs for the future in the fields of:

- Decoration - Interior Design
- Green - Ecological Architecture
- Project Design - Implementation

A Architecture designs, produces and derives with a focus on people, nature, values, originality, social impact, culture of collaboration and transformation.
Working with passion and creating difference combining the wisdom of the old and knowledge of the present A Architecture is now 20 years old.

Figure 1. A Architecture Logo

1.2 Who is Özgül Öztürk?

Özgül Öztürk, graduated from Besiktas Atatürk Anatolian High School , Istanbul Technical University Architecture Faculty in 1992 , and Marmara University Business Administration MBA.

Özgül Öztürk is one of the climate change leaders who participating in active works towards sustainability, community building and has played an active part in numerous voluntary projects in the fields of Green Architecture, Ecological Architecture, Sustainable Living and Social Transformation. She is participating in interviews with universities and institutions. She is Speaker-Facilitator-Trainer and Dreamer.
She is Bilgi University Faculty of Architecture design group consultant of POT + (under the supervision of Fulya Özsel Akipek-Tuğrul Yazar) in 2017 and a consultant at the post-graduate school of Architecture of Bilgi University «ROBOTIC EARTH CRAFTS» and participant of the Architectural Project Jury in 2018.
She is doing an architectural mentor about ''EARTH STRUCTURE'' for the "SOLAR DECATHLON AFRICA" student competition in MOROCCO in 2019. She is one of the instructors of 'Sustainability' at ITU Corporate Academy.
She has been a member of the Women Entrepreneurs Association (KAGIDER) since 2004, a member of the Board of Directors of 2015-2017.
She has ITU Foundation Earth Structures Group and professional memberships. She is participant of MIT - Otto Scharmer "Transforming Business,''Society and Self". Özgül Öztürk works on "Circular Design" (focused on Architecture-Sustainability) in Turkey and has been working as an architect in A Mimarlık (A Architecture) company which she has founded in 1998.

1.3 Awards.

- **International S-ARCH 2018 PROJECT AWARDS "Sustainable Architecture" Honorable Mention Award 2018, Completed / Small Projects Category**
  POT+ Design Group ''Rammed Earth Wall Consulting''
- **Rotary ''Outstanding Service in Profession'' 2018**
- **"Common Action Walls" among the projects selected in yearbook of 2017 Turkish Architectural Yearbook of Arkitera**
  POT+ Design Group ''Rammed Earth Wall Consulting''
- **"Experimental Works of Architecture" Balkan Architectural Biennial Works | IABA 2017 Grand Prix Urbanism Prize**
  POT+ Design Group ''Rammed Earth Wall Consulting''
- **''Women of the Earth'' in Sustainable Development category**

International Grand Jury Award, 2016 World Winner
International Public Vote, 2016 World Winner
Turkey National Jury Prize, 2016 Turkey Winner

2. WOMEN EDUCATION AND PRODUCTION CENTER IN KEBAN

2.1 Project Content

All of the activities we target within the extent of the project include the issues of Sustainable Development, one of the United Nations Millennium Development Goals.
Instead of doing one in the village; in terms of population density, accessibility and scaling, it will be more beneficial to make it in Keban, the central district where 30 villages are connected.

Short term :

- Supporting natural life,
- Transform the rural area as attraction area in Elazığ,
- To provide women to participate in social and economic life and to participate in the production process by training.
- Strengthening the economic position of women,
- Ensuring gender equality,
- To create ecological mindfulness,
- With the eco-architectural criteria of the almost extinct architecture:
- Using today's modern building techniques, regional and natural materials, compatible with regional architecture,
- Breathing, healthy, strong, providing the best level of comfort in life,
- Consume less energy, providing positively to climate change, to be fuel-efficient, it intends to leadership in the countryside and in Turkey.

Medium term :

- Creating attraction area and economy with ECOTURISM-RURAL TOURISM for local and foreign tourists,
- Provide economical growing and founding Women's Cooperative with women work and production.

Long term :

- Increasing women entrepreneurship,
- Be a model for all of Turkey with the same sample in each district,
- To increase the number of our citizen living in the big cities by returning to production and economy in the countryside and living in districts and villages.

2.2 Within the context of Project BM Sustainable Development Goals

Figure 2. Within the context of Project BM Sustainable Development Goals

2.3 First Stage of Project

"CONSTRUCTION OF A GREEN BUILDING WITH ECOLOGICAL ARCHITECTURE"

What are the properties and advantages of the building?
Green Building model with ECOLOGICAL ARCHITECTURE,

- Where rain water harwesting
- Water is recovered and used in reservoir and garden watering,
- Green roof implementation with heat preservation, structure and environmentally friendly ecological roof,
- Electricity supplied by solar energy,
- Organic wastes are recycled with compost to make clean fertilizer.,
- Modern construction technology implementation with natural material,
- A healthy structure to structure and human biology,
- Walls are thermal mass, heating-cooling requirement is low,
- Thick walls provide noise control,
- It has strong construction and long life,
- Low cost,
- Walls do not require plaster, paint.It is free of charge,
- Fire resistant,
- Buildings can breathe with this technique
- Moisture balance is ideal (%40-60),
- Built very fast,
- Saves money and energy,
- Aesthetic visuals are provided with different earth types,
- Healty and environmentally friendly !

2.4 Process

According to modern construction technology today in Turkey, project,which rammed earth building techniques with two world championship in France in 2016,and championship in Turkey will be implemented, as promised in Elazığ

2.5 Purpose

With this project, respectful to nature, local culture that emphasizes, healthy, ecological, energy efficient and modern structure together to use natural materials, with techniques in Turkey, it will be an example to forward ECOLOGICAL-RURAL TOURISM structure multipurpose aims to build an alternative structure. When the project is completed, the place is planned to be a place where schools, students or interested people visit, where ecological structure principles are learned, resources related to earth structure implementation can be found and implementations can be seen.

2.6 Function of Structure

It is a single floor building of 85 m2 in total. Multi-purpose training hall, learning and sharing area, library and women's handmade production display and sales department, gift sales department, workshop area, outdoor children's playground, community garden ecological agriculture area, workshop area in nature, open-air cinema area , designed exhibition space, toilets designed in this building.

2.7 Project Awards

In the category of Sustainable Development organized by ''Women of the earth Yves Rocher & France Institute''

- International Grand Jury Award,2016 World Winner
- International Public Vote, 2016 World Winner
- 2016 Turkey Winner

2.8 Institutions and Organizations Cooperated in the Project
Yves Rocher & France Institute, ITU Foundation Earth Structures Group, KAGİDER Women Entrepreneurs Association, Elazig Governorship, Elazig Special Provincial Administration, Elazig Chamber of Commerce, Elazig Municipality, Keban Municipality, Keban District Governorate, TUROYD Tourism Hotel Managers Association, Historical Environment and Building Protection Association, Elazig Firat University, Istanbul Bilgi University, Keban Newspaper, Narköy Ecological Hotel and Education Center, Çekül, Sustainability Steps Association, Sustainable Life Film Festival, Environmental Events Platform, Yeşilist Sustainable Life Platform

2.9 Project Visuals
In the photos below, our earth structure project is seen with the earth structure technique we plan to implement.

Figure 3. Front facade perspective [Author]

Figure 4. Front facade perspective [Author]

Figure 5. Right facade perspective [Author]

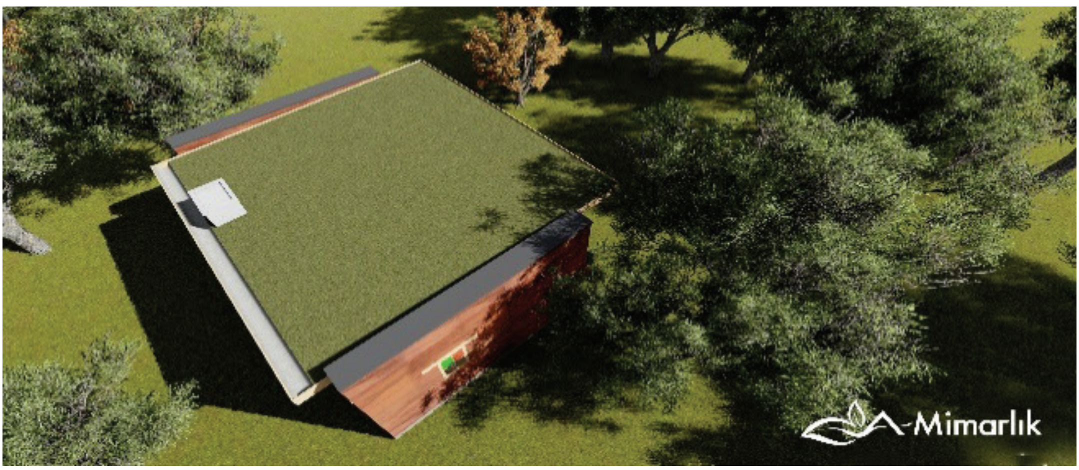

Figure 6. Green roof perspective [Author]

Figure 7. Interior perspectives [Author]

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No:1

An Excavation, Survey, Restitution and Restoration Project For Abbas Ağa Mosque, a Mud-Brıck Religious Building in Old Van City

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ABSTRACT

Abbas Aga Mosque which is located in the northwestern part of the Old Van City is in a ruinous condition currently. It is not known for certain when and by whom Abbas Aga Mosque was built. Considering the building's construction materials, technique and the form, it is assumed that it was built at the end of the XIXth century.

Flat roof covering system of the building which was used until the year of 1915 was ruined after 1918 and other parts are tried to survive in spite of the nature's and treasure hunters' negative effects. Interior space of the building was built in approximately 9.10x18.75 m. sizes, cross planned. Entrance of the mosque is through a door of 1.58 m. width from the north. Approximately 2 m of the frames forming the building are rubble stoned and other parts are completed with using mud-brick materials thoroughly.

The building's floor level, gathering place story, two pedestals where abutments settle, altar niche, pulpit base and settling styles have been observed during the scientific excavation works in 2013. Yard components and the street pattern were appeared after excavations which were done in suroundingareas of the mosque. Application projects of survey, restitution and were prepared upon all new data coming out of the excavations. Renovation works are continued by Foundations Directory's Bitlis Regional Office.

Abbas Aga Mosque varies in terms of architectural qualities from other religious buildings in the region from the aspects of aks-i seda küpleri (echo cubes) which were put in the inside parts of the frame walls which were made out of mud-brick materials and clay and flat soil roof system and construction techniques.

Keywords: Mud-brick, Bat, Clay, Timber, Settling Styles, Aks-i Seda Küpleri (Echo Cubes)

1 INTRODUCTION

Old City of Van that is located in south of Van Castle is founded on approximately 365.000 m^2 area and is used by many civilizations since Urartians. East, south and west of the city is surrounded by historical walls and the northern side has sharp rocks of Van Castle. Entrance to the city is enabled through four gates on the walls. They are: the one on the northern corner of the east walls is Tebriz Gate, the one on the northern corner of the west walls is Yalı *(İskele =*

Pier) Gate. Other two portals are the one on the southern walls is Orta Kapı = Central Gate *(Yeni Kapı = New Gate) and* Saray = Palace *(Uğrun)* Gate (Öztürk and Mızrak 2001: 32-34), (Figure 1).

Figure 1. Layout Plan for Old City of Van *(Ş. Öztürk)*

The city walls were renovated in the year 1245 A.H. after the city had risen in the importance because of transferring balls and ammunition in Ahlat Castle to Van Castle by ships. Renovation inscription is on the Central (New) Gate. Topographically Old City of Van has a slight sloping land. In the city, Turks and Armenians used to live side by side in good neighbourhood relations four years (Fig.1).

Figure 2. Old City of Van, General View *(Ş. Öztürk)*

A miniature from XVII. Century in Topkapi Palace Archives *(E.9487)* gives information about general and almost real scenery of Van Castle and the city. As seen in old photos and etchings, City of Van had a structure where architectures of any nature and religion were intimated. Evliya Çelebi who had traveled through the region in mid-XVIIs *(1655)* narrated that the city had 10 neighbourhoods; 3 of those neighbourhoods where muslims consist majority, had also Armenian residents. The map which Lynch prepared in the last quarter of the XIX. century shows that the city consists of twelve neighbourhoods and nine of them has muslim and three of them has non-muslim residents (Günel, 41-48: 1993).

Nationalist movements that had started in Europe also influenced Armenians by 1914, in the beginning of WWI. 4th Army Corps under the command of Ali Sinan *(Sabis)* Pasha entered into Van on 2nd April 1918 and three years' occupation ended. Some part of the local people who had migrated from Van came back later. Van is one of the cities where Armenian gangs organized in especially after the Ottoman-Russian war of 1877–1878 *(War of '93)*. On 17th March 1915, Armenian Tashnak gang which had 4.000 members, had seized City of Van alongside Russian troops.

When Tsarist regime collapsed in 1917 and Bolshevik Party that replaced that regime withdrew the Russian Troops from Eastern Anatolia in compliance with the agreement that had signed in Erzincan on 18th December 1918.

Figure 3 Old City of Van, General View *(Ş. Öztürk)*

People settled in the cottages and wine estates at outskirts of the city because the city's position was not available for reconstruction. These settlements formed some kind of today's foundation of Van City. Old City of Van turned out to be almost a dead city after the year 1918 losing her former liveliness and mobility (Öztürk, Ş. 2004: 52-54).

Figure 4. Abbas Agha Mosque General View *(Ş. Öztürk)*

Existing architectural constructions in Old City of Van have been estraping and collapsing flagrantly day to day as a result of neglect, disrepair and disrespect to the past. Abbas Agha Mosque is one of those registered historical religious buildings that survive in spite of all these negative process (Figure 1; 1-3). Entire architectural conservation project and reports about the building is done by Dr. Şahabettin Öztürk, Instructor and director of Restoration Programme at Van Yüzüncü Yıl University, Faculty of Architecture and Design's Department of Architecture.

2 LOCATION

Abbas Agha Mosque that is located in the historical Old City of Van is founded on a rectangular, moderately sloping land through east-west direction on the northwest part of the city.

Abbas Agha Mosque has Horhor Mosque in the west, Van Ulu (Great) Mosque in the east, and, historical Van Castle in the north. Excavation and cleaning works done by expert staff from Foundations Directory's Bitlis Regional Office and inspected by The Project's Author and The Directory's technical staff in the year 2013 and all architectural traces and data about the historical building have been discovered.

Today many architectural elements of the building such as entire covering system, main outer walls, courtyard and water well in the north entrance are nonexist.

3 HISTORY

Abbas Agha Mosque's foundation date and builder are not known entirely. Considering the building's construction material, technique and architectural form, it is thought that it was built at the end of the XIXth century (Öztürk, 8: 1996).

Existing knowledge about the building is discussed by Ministry of Culture and Tourism, Directory of Diyarbakır Regional Protection Board for Cultural and Natural Heritage in the meeting dated 08.06.1979/A-1673 and a registration decreed under the laws numbered 2863 and 3386 because of carrying the features of the cultural heritage in need of protection.

The conservation project is evaluated by Provincial Culture and Tourism Directory of the Van Governorship within the scope of suggested project investment studies of Provincial Special Administration for 2008.

In this direction, projects of building survey, restitution and restoration project have been prepared and have been approved by Regional Protection Board for Van's Cultural Heritage in the year 2010.

Abbas Agha Mosque property is transferred to Bitlis Regional Directory of Foundations after a protocol had signed between Bitlis Regional Directory of Foundations and Van Governorship in the year 2010. During related construction company's excavation works, new data were ascertained and included in the projects by Bitlis Foundations Regional Directory after revision on the building's restoration works in the year 2013.

4 EXCAVATION AND CLEANING WORKS

Abbas Agha Mosque's, excavation, cleaning and renovation works are put out to tender by Bitlis Regional Directory of Foundations in the year 2013 and works started immediately. Surveying excavation and cleaning works applied in and around of the Mosque are completed in approximately two months by skilled workers and builders under the technical inspection of project author, constractor company's technical staff and Bitlis Regional Directory of Foundations.

Figure 5, 6. Interior Excavation and Cleaning Work View *(Ş. Öztürk)*

The building's interior ground level, abutments, wooden gathering place piers, floor covering, pulpit, altar, sitting berms, door jambs and window jambs are ascertained during excavation and cleaning works. And southern road ground level and architectural covering pattern, northern entrance's mortar stones, water well, courtyard floor ground level and many other architectural elements' places and their architectural features are ascertained and recorded during excavation and cleaning works outside of the building.

Figure 7, 8. Interior and Courtyard Excavation and Cleaning Work View *(Ş. Öztürk)*

During excavation and cleaning works many pots and pans, tiles, ceramics, metal elements, wooden amorphous pieces in the excavation are classified separately. Also architectural construction materials like brick, mud-brick and freestone are recorded taking their inventories.

The building's surveying, restitution and restoration projects prepared again after excavation and cleaning works.

Figure 9, 10. Pipe Views Observed During the Excavation Works *(Ş. Öztürk)*


Figure 11, 12. Pipe Views Observed During the Excavation Works *(Ş. Öztürk)*


Figure 13, 14. Ceramics and Pottery Views Observed During the Excavation Works *(Ş. Öztürk)*


Figure 15, 16. Ceramics and Pottery Views Observed During the Excavation Works *(Ş. Öztürk)*

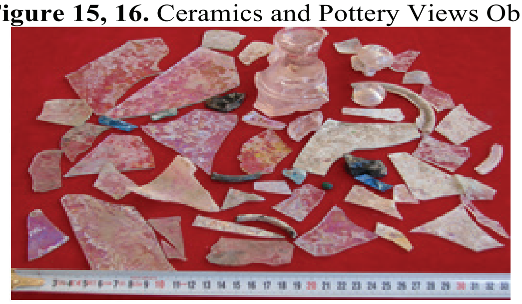


Figure 17, 18. Glassware and Metalware Views Observed During the Excavation Works *(Ş. Öztürk)*

Figure 19, 20. Ceramic Piece Views Observed During the Excavation Works *(Ş. Öztürk)*

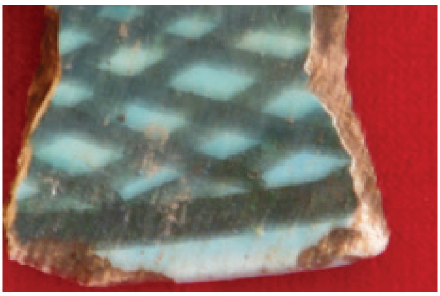

Figure 21,22. Ceramic Piece Views Observed During the Excavation Works *(Ş. Öztürk)*

Figure 23,24. Ceramic Piece Views Observed During the Excavation Works *(Ş. Öztürk)*

Figure 25,26. Ceramic Piece Views Observed During the Excavation Works *(Ş. Öztürk)*


Figure 27,28. Ceramic Piece Views Observed During the Excavation Works *(Ş. Öztürk)*

5 BUILDING SURVEY

5.1- Plan

Abbas Agha Mosque is accessed through a 1.40 m wide double leaf wooden door in an ogee arch alcove in the middle of the north main outer wall. Entrance door *(Shoe Rack Section)* is 1.86x2.22 m. sized and built lower than the 0.12 m inner ground level.

Interior consists of 9.23x18.69 m. sized, rectangular layout plan developed to east-west direction. The altar aclove in the middle of the south main outer wall on the entry door line is 0.64. m long, 1.12 m. wide and of rounded layout. Altar's limestone coloumns are on the corners and shaped with a rounded arch.

Altar alcove is surrounded by a line of rounded brick arches outside. Pulpit platform that is located at west of the altar was built three steps (0.68 m.) higher than the ground level (Figure 2-5).

The mosque is separated as two sections in the east-west directions from the center by two square-shaped freestone, similar architectural featured abutments of 1.10x1.10 m. size and three ogee arches which are put on the abudments. 0.45 m. high and 0.48 m. wide lime freestone sitting berms proceed the south, east, west and north outer walls of the mosque.

The building has six rectangular windows of 0.80 m. wide as four on the south main outer wall and two on the north main outer wall. They are made out of freestone and in similar architectural features. In gathering place level, there are nine *kuşkanat* loopholes of 0.60 m wide and in similar architectural features.

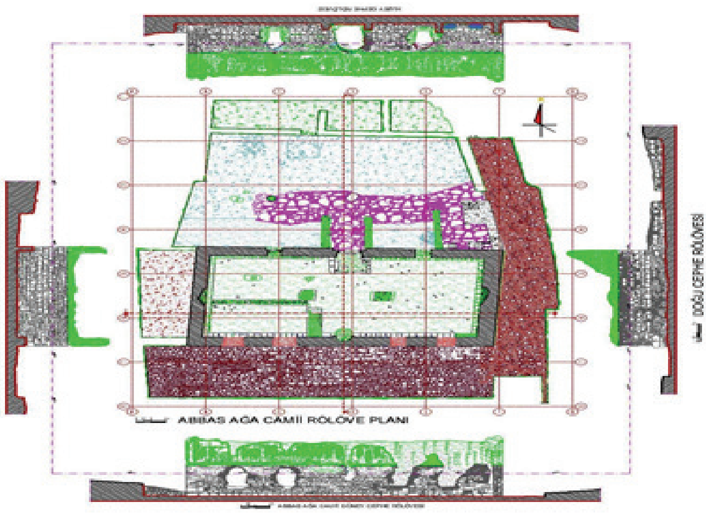

Figure 29. Abbas Agha Mosque Surveying Layout Plan *(Ş. Öztürk)*

Five of them are in the south main outer wall; two each of them are on the east and west outer walls oppositely. Access is enabled to the gathering place level with a 1.00 m wide one handle wooden stairs adjacent and parallel built to the north main outer wall in the east of entrance gate (Figure 29).

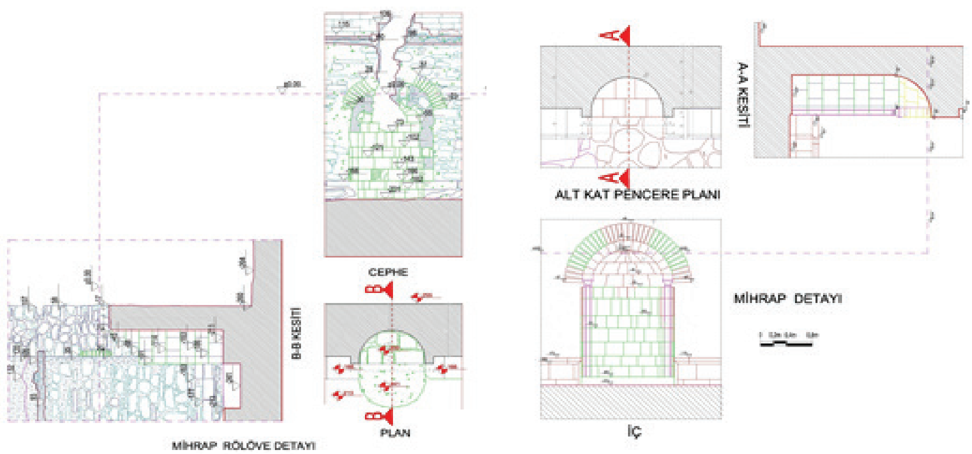

Figure 30,31. Abbas Agha Mosque Altar Restoration and Surveying *(Ş. Öztürk)*

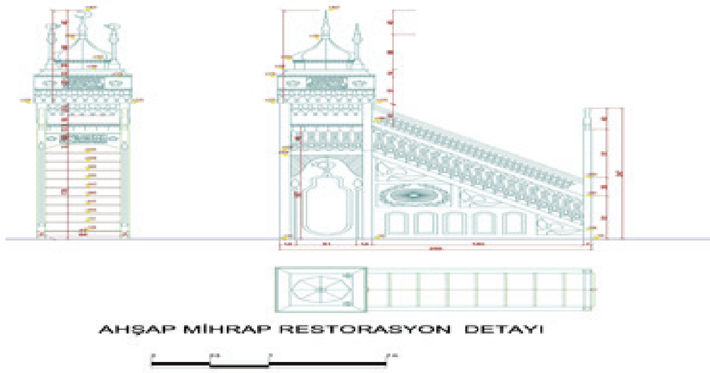

Figure 32. Abbas Agha Mosque Wood Pulpit Restoration *(Ş. Öztürk)*

2.70 m. wide wooden gathering place floor proceeds on north main outer wall. Gathering place is supported by four studs on the decorative stone abudment on the floor.

In order to arrange the sound inside the mosque, 22 *aks-i seda küpü (echo cubes)* are placed inside of the outer walls as seven each on the north and south outer walls, four each on the east and west outer walls.

Figure 33, 34. Mortar Stone Views Observed On Excavation *Works (Ş. Öztürk)*

Figure 35. Mosque General Views Discovered After Excavation *(Ş. Öztürk)*

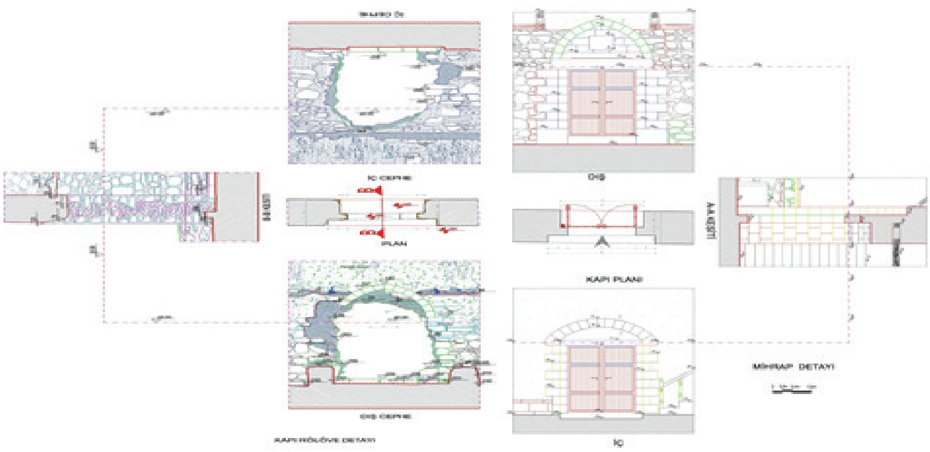

Figure 36, 37. Abbas Agha Mosque, Gates' Restoration And Surveying *(Ş. Öztürk)*

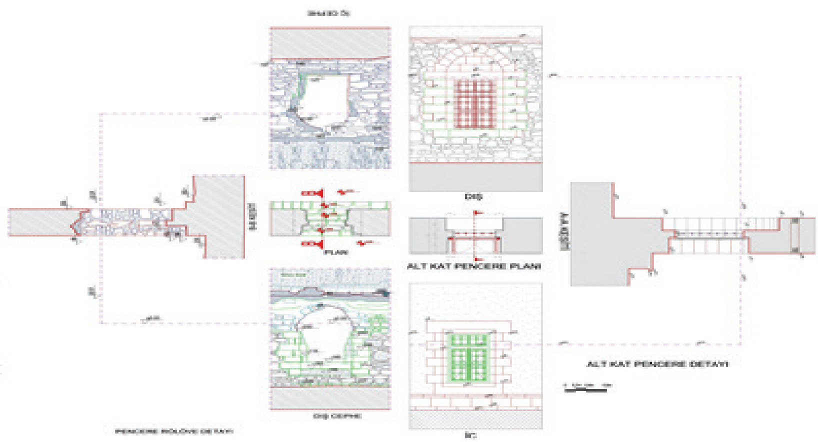

Figure 38, 39. Abbas Agha Mosque, Windows' Restoration And Surveying *(Ş. Öztürk)*

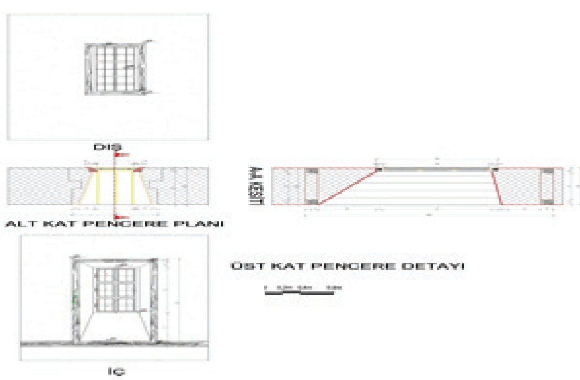

Figure 40. Abbas Agha Mosque, Upper Window Restoration *(Ş. Öztürk)*

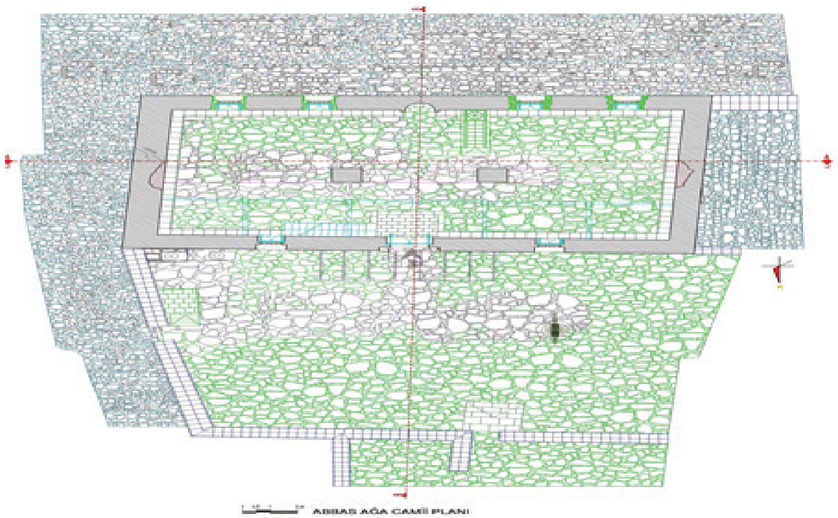

Figure 41. Abbas Agha Mosque's Restoration Plan *(Ş. Öztürk)*

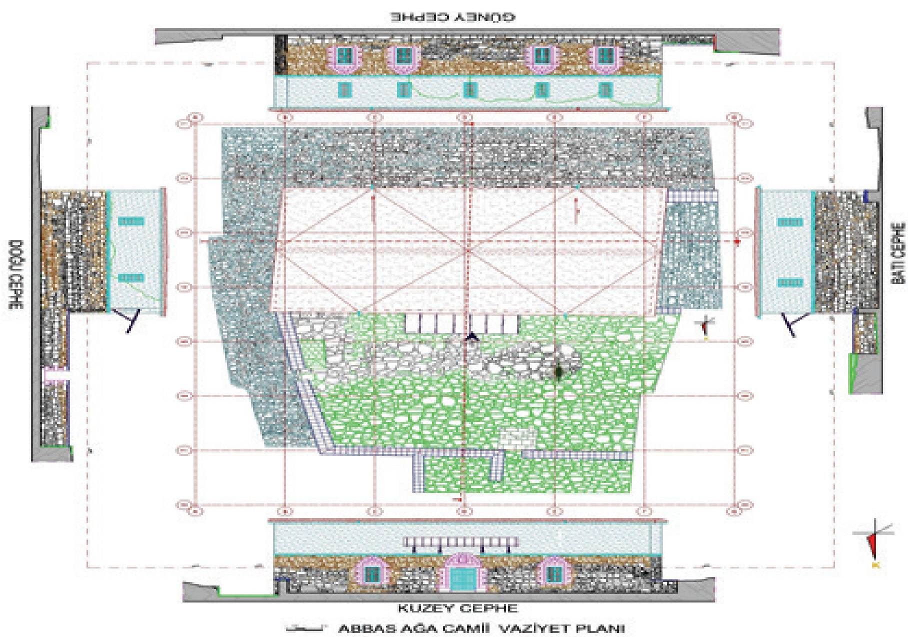

Figure 42. Abbas Agha Mosque's Restoration Layout Plan *(Ş. Öztürk)*

Of the outer walls which consist the building, south and north walls' thicknesses are 1.00 m. each, east wall is 1.20 m. and western wall is 0.95 m thick. All of the outer walls are 3.70 m. high from the floor level as rubble stone and then surrounded by 0.15 m. bonding timber by in and outside. Finally outer walls go through mud-brick and then pass to the flat soil roof. Surfaces of the three freestone arches in the inside of the building are uncoated, insides of the other outer walls are coated with chaff, wood ash and rock salt added clay plaster.

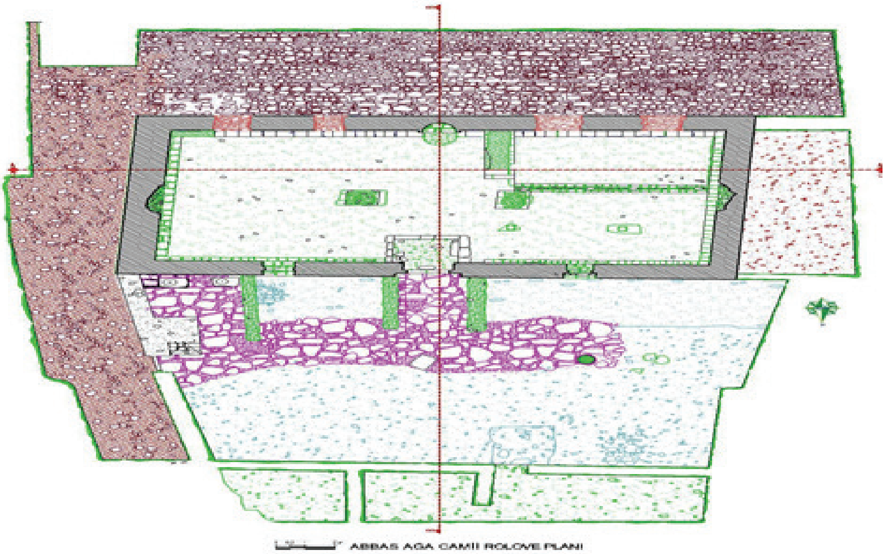

Figure 43. Abbas Agha Mosque's Surveying Plan *(Ş. Öztürk)*

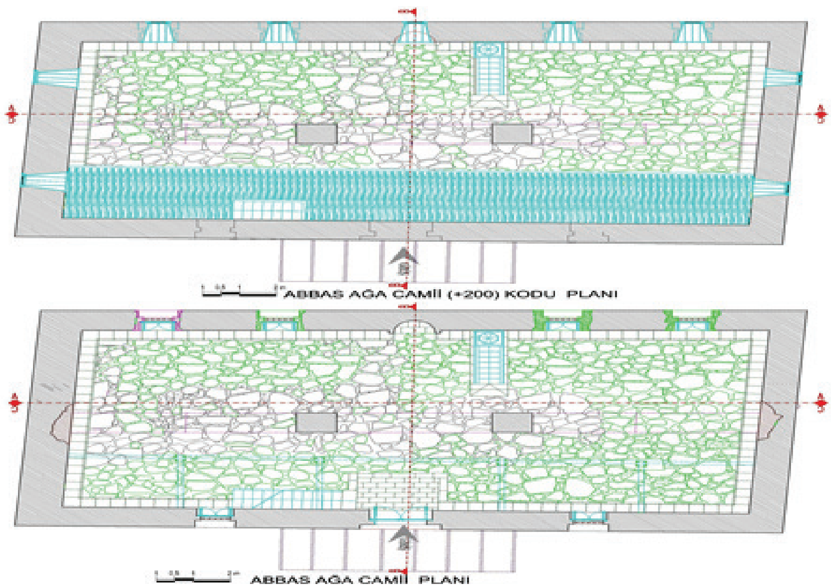

Figure 44, 45. Abbas Agha Mosque, Ground Floor and Gathering Place Floor Restoration Plan *(Ş. Öztürk)*

Streets at the east and south of Abbas Agha Mosque are rubble paved. Southern road is 5.78 m. wide in a regular course. The street at the east of the building is an irregular course and width of the road changes from place to place. Main outer wall at the east of the building goes through on lower level and the ground floor between two walls is designed as rubble stone paved.

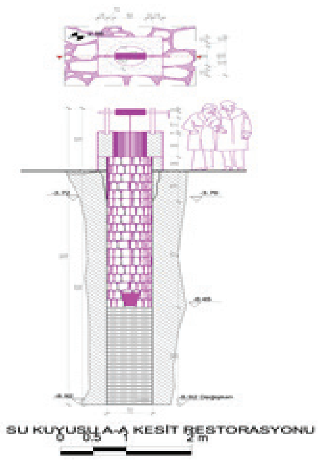

Figure 46. Abbas Agha Mosque Water Well Restoration *(Ş. Öztürk)*

Access to the slate paved courtyard of the mosque is provided from a 1.00 m. wide door on the east side. The quite wide courtyard of the building located at north is planned as two steps, 16.54x19.92 m. The platform located at immediately south of the entrance gate is 1.51x1.87 m. sized and approximately 0.89 m. higher than the courtyard floor level. This platform is used for a place where wheat sacks that were brought for animals are kept. Southeast corner of the building has two monolithic limestone mortar stones.

There is a face stone water well in the area close to the west part of the courtyard. Water well is built for ablution, cleaning up and regulating groundwater purposes.

Access to the upper level is enabled by three steps on the north of the courtyard. East and north outer walls of the building are protected by 0.80 m. wide freestone coping (Figure 6-16; Photo:26-29).

5.2 Facades

Northern facade is 6,75 m. wide and 20.93 m. high. Entire facade of the building is surrounded by 3.40 m. high rubble structured main outer wall and 0.15 m. wide bonding timber from ground floor level. Walls are hightened by 2.81 m. mud-brick structured outer walls and flat soil roof is accessed by a 0.30 m. protruded wood flat eaves.

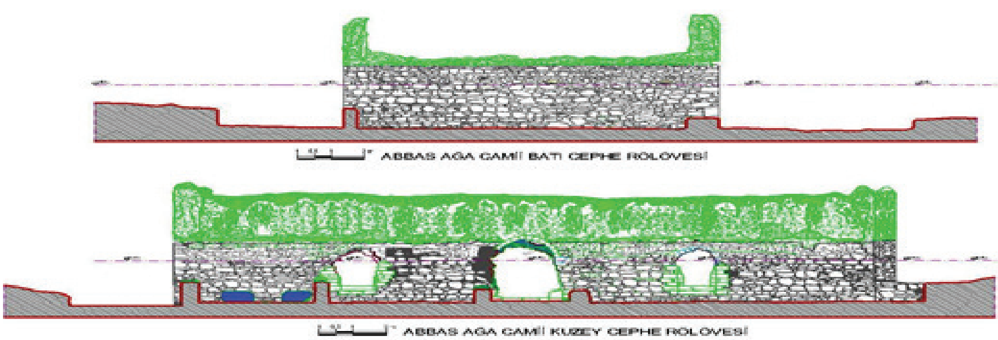

Figure 47, 48. Abbas Agha Mosque North And West Front Survey *(Ş. Öztürk)*

Double leaf wooden door of entrance in the middle of the northern facade is formed in an ogee arch. Four pewter coated marquee which are supported by wooden buttresses are placed over the entrance door for the purpose of protection against snow and rainwaters (Figure 17-19).

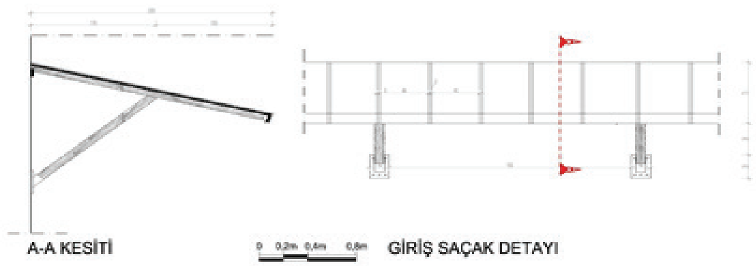

Figure 49. Abbas Agha Mosque Giriş marquee Restoration *(Ş. Öztürk)*

Two windows placed symmetrically in the ogee arches are located on two sides of the entrance door. Also two wooden gargoyle *(Şöratan)* are located in the facade (Figure 20-22).

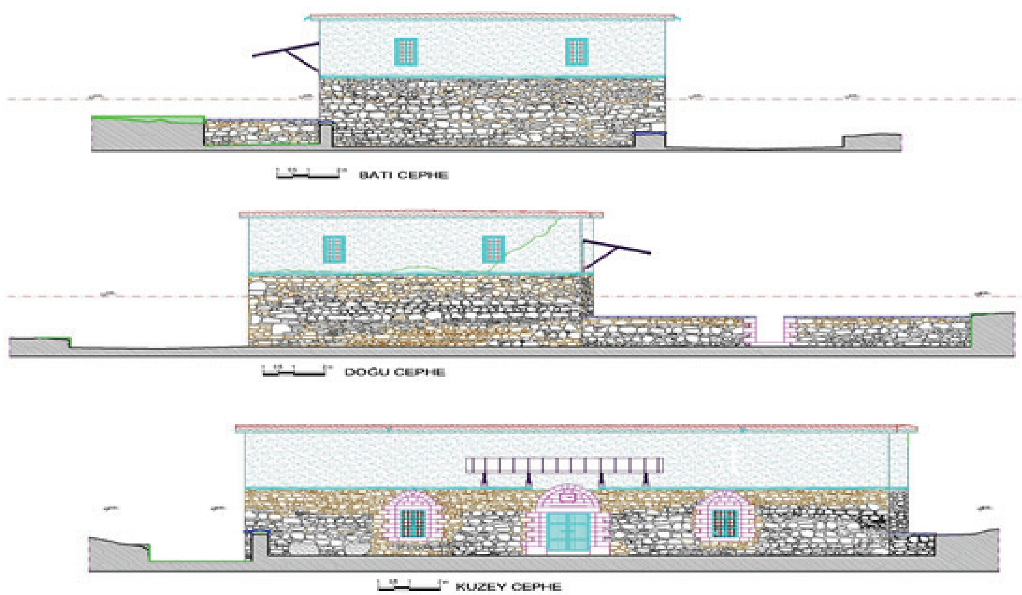

Figure 50, 51. Abbas Agha Mosque North, East And West Facade Restoration *(Ş. Öztürk)*

Southern facade is 7.02 m. high and 20.85 m. long. Nine windows on the lower and upper parts of the south facade are located on the same line providing mobility to the facade. Upper parts of the windows on the lower part are formed as ogee arches. Upper level windows are designed as interlocked flat arches. Also, two wooden gargoyle *(Şöratan)* are located in the facade.

Eastern facade is 7.07 m. high and 10.81 m. long. Upper windows of the eastern facade are two and are located on the same line providing mobility to the facade, Upper level windows are designed as interlocked flat arches.

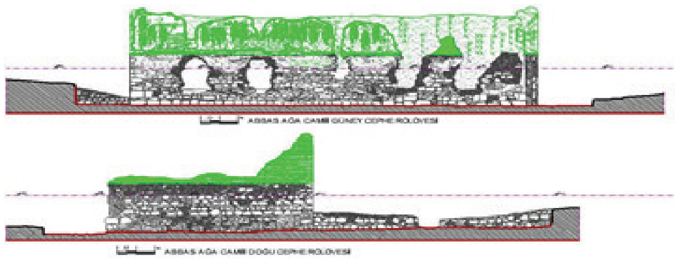

Figure 52, 53. Abbas Agha Mosque East And South Front Survey (Ş. Öztürk)

Western facade is 6.91 m. high and 11.23 m. long. Upper two windows of the western facade are located on the same line providing mobility to the facade. Upper level windows are designed as interlocked flat arches.

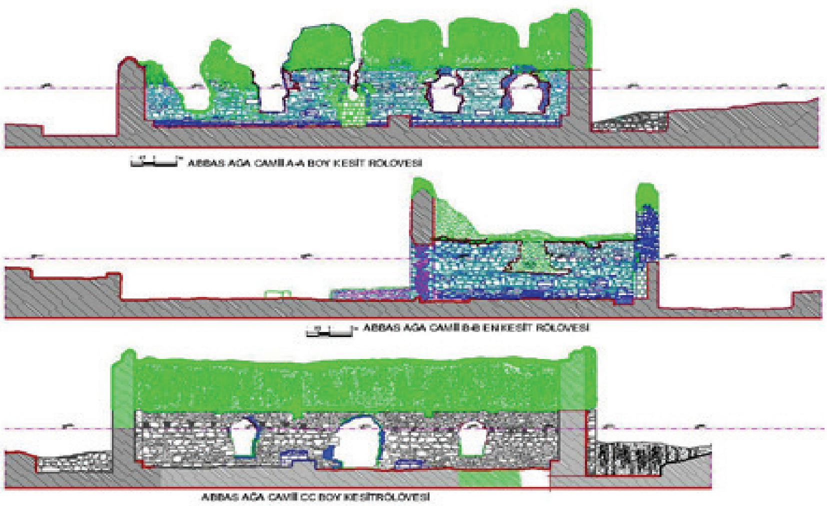

Figure 54, 55. Abbas Agha Mosque A-A, B-B and C-C Section Survey *(Ş. Öztürk)*

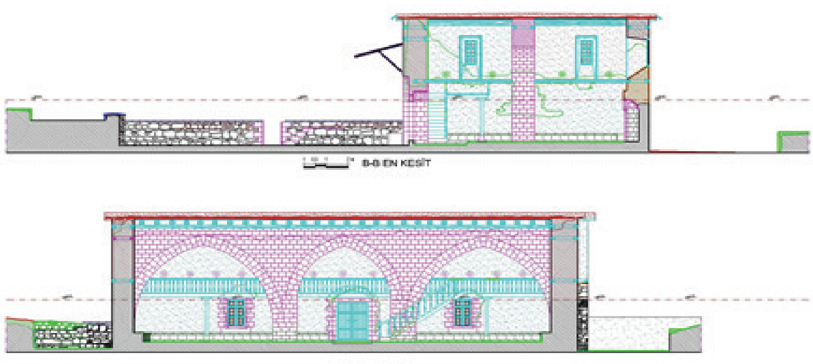

Figure 55, 56. Abbas Agha Mosque B-B and C-C Section Restoration *(Ş. Öztürk)*

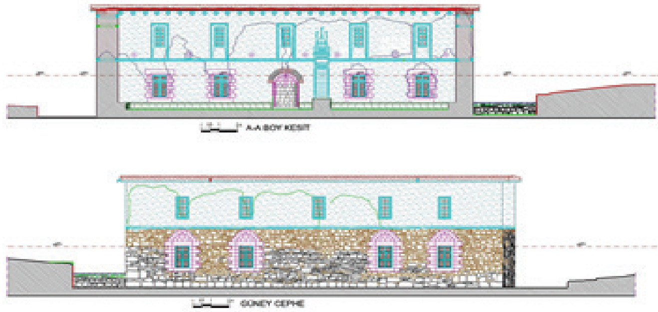

Figure 57, 58. Abbas Agha Mosque A-A Section and South Facade Restoration *(Ş. Öztürk)*

5.3- Flat Soil Roof

Size of Abbas Agha Mosque's flat soil roof is 11.43x21.45 m. Flat soil roof is 4 % slopping in the direction of north and south. Four gargoyles are placed as two each directions and snow and rain waters are drained from flat soil roof.

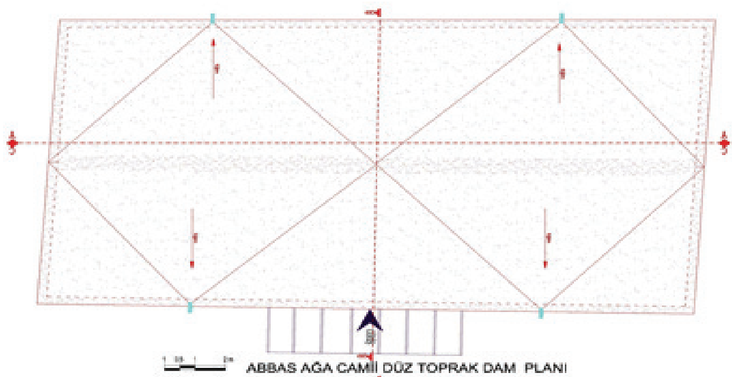

Figure 59. Abbas Agha Mosque Restoration Flat Soil Roof Plan *(Ş. Öztürk)*

Upper part of the mud-brick outer walls are surrounded by 0.15 m. thick bonding timber. 0.25 m. rounded section wooden beams *(keran)* are placed over in short direction *(north-south) approximately* 0.40 m. distances regularly.

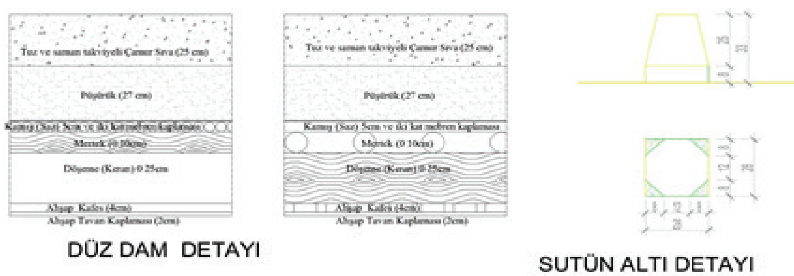

Figure 60. Abbas Agha Mosque Flat Roof Details From Column's Underside *(Ş. Öztürk)*

Heads of wooden beams in mud-brick main outer wall over bonding timbers are pitched and preserved by this way. Wooden beams are covered by 0.04 m. thick wood rafter. Rafters are covered by 0.04 m. thick thatch (*saz*), 0.20 m. thick more solid mud-brick (*püşürük*) and finished by 0.20 m. thick clay plaster.

6 MATERIAL AND BUILDING TECHNIQUE

Abbas Agha Mosque's outer walls are built by masonry construction technique. Three different construction techniques are applied on outer walls. Until approximately 3.40 m. from ground are built with rubble masonry rock fill technique. Traditional mud-brick arrangement technique is applied until flat soil roof level. Inside of the arches are built by using coursed smooth face stone.

Rubble, freestone, slate, mud-brick, brick, metal and wood are used for Abbas Agha Mosque's construction. Rubble is used for the construction of outer walls and road floor covering. Freestone is used for the mosque's interior sitting berms, for door and window arches and jambs, for construction of inner arch, altar and covering for courtyard's coping.

During the research, it is found out that mud-brick is used for upper parts of the mosque outer walls. Wall thicknesses are 0.90, 0.96 and 1.20 m. and three full, two full, two half mud-bricks are used. Full mud-brick sizes are (0.8x0.29x0.29), (0.8x0.34x0.34) and (0.8x0.37x0.37).
Used half mud-brick sizes are (0.8x0.10x0.29), (0.8x0.10x0.34) and (0.8x0.10x0.37), (Figure 35).

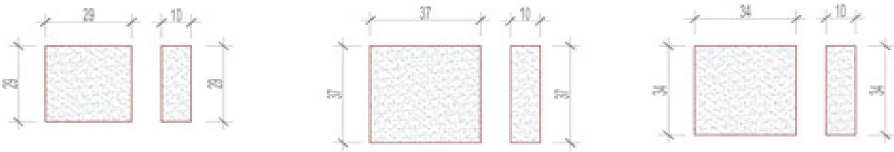

Figure 61. Abbas Agha Mosque, Used Mud-Brick Sizes *(Ş. Öztürk)*

Wood is used for door and window joineries, for outer wall's bonding timbers, for stairs, wood gathering place's construction and for flat soil roof covering joist and rafters. Brick is used for construction of altar's arches. Metal is used for accessories of doors and windows and window rails.

6.1 Mortar and Parget Analysis Results

Lime mortar is used as binding material for Abbas Agha Mosque's stone wall construction. Wood ash, chaff and rock salt added clay parget are used as binding materials in mud-brick walls. Lime Mortar and parget samples which used for rubble manufacturing are taken from two different places and chemical analysis has been done in the laboratory.

 

Figure 62, 63. Mortar and Parget Sampling Views *(Ş. Öztürk)*

Analysis report result dd. 28.06.2014 and no 703 for Van Abbas Agha Mosque's Pargets and Mortars have been done and completed by Ministry of Culture and Tourism, Istanbul Restoration and Conservation Center and Regional Laboratory Directory. Two parget samples that were taken from Abbas Agha Mosque are in quality of: creamy colour, soft patterned and nonporous look, fine grained thin clay layer, having less dispersivity, easily shatterable manually. Strength of material: **dispersable, easily shatterable manually.**

Two mortar samples that were taken from Abbas Agha Mosque are in quality of: grey colour, soft patternd and partly porous, consisting lime lumps in patches, fine grained look mortar quality. It has quality of firmness and solidness, manually breakable but nondispersible quality.

6.2 Chemical Analysis
They are the analysis with the purpose of observing lime (calcium carbonate), organic substance and humidity amounts in the material. Ignition loss *(calcination)* and acid test *(Loss in HGI2)* analysis are done in order to determine proportion of lime in the material. Values found by ignition loss analysis give organic substance and calcium carbonate amount. And acid test result gives calcium carbonate amount in the material.

Ignition loss, acid test, sieve analysis and spot test results are provided below:
- Suggested parget analysis mixture proportions: %33-35 Slack and soaked lime, %33-35 stone powder, %28-30 Jigged fine stream sand
- **Suggested Mortar analysis mixing ratios;** %32-33 Slack and soaked lime, %28-30 stone powder, %35-37 Jigged fine stream sand

7 DECORATION

Abbas Agha Mosque is a highly plain building from the aspects of internal and external architectural elements and any architectural decoration are not used.

8 PROJECT APPLICATIONS

Before Abbas Agha Mosque excavation and cleaning works started, Van Cultural Heritage Regional Directory had approved of surveying, restitution and restoration studies done by Van Governorship's Secretary General Of Special Provincial Administration in the year 2008.

New Application Projects have been prepared after excavation and cleaning works under the tender done by Directorate General of Foundations, Bitlis Foundations Regional Directory in the year 2012. Projects are prepared by Dr. Lecturer *(Architect-Art Historian)* Şahabettin Öztürk Yüzüncü Yıl University, Faculty of Engineering-Architecture, Architecture Department, Restoration Programme Director. Projects;

1-Surveying
1.1-Surveying Damage Analysis Project
1.2-Surveying Material Analysis Project
1.3-Analitik Analysis Project

2-Restitution
2.1-Existing Building Parts *(Original Structural Pattern)*
2.2-Building Parts That Completed with Existing Constructional Traces
2.3-Building Parts That Completed with Comparing Buildings in The Region
2.4-Building Parts That Completed with Architectural Necessities

3-Restoration
3.1- Restoration Project
3.2- Restoration Response Project

4- Report and Photo
4.1- Response
4.2- Photo Album

9 CONCLUSION

Old City of Van and Van Castle used by many civilizations since the early ages because of its location and strategical position. Each civilization so to speak decorated the city with religious, military and civil architectural works. Undoubtedly roles of the religious architectural buildings vitalizing this important city are quite big.

Abbas Agha Mosque is not only a mosque, it is a building that was used as a medressah at the same time. Especially freestone sitting berms in the mosque come out as an exceptional architectural element. They proove that the mosque was not used for only to worship, by contrast it is also used for social activities. Abbas Agha Mosque has a quite different architectural features than other religious architectural buildings in the region considering mud-brick material, echo tubes (*aks-i seda küpü*) that placed in the inner parts of the outer walls with clay plaster, flat soil roof system and structure techniques.

Recently scientific excavation works in the Old City of Van and north Van Castle which is done only once in a year, for one month, have been disappearing under the negative impact of nature and treasure hunters. Today, there are religious buildings like Kaya Çelebi Mosque, Hüsrev Pasha Complex, Horhor Mosque, Süleyman Han Mosque that are renovated by Directorate General of Foundations, Bitlis Foundations Regional Directory and are used by domestic and international tourists.

It is a fact that when renovation works are completed, buildings whose renovation works have been conducted, predominantly Abbas Agha Mosque, Ulu (Great) Mosque, Kızıl (Red) Mosque, are going to provide vitality to the Old City of Van, almost a dead city for approximately one century. This case will provide important gains to the region's culture and tourism.

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No:2

Comparation on Mud-Brick and Bat Construction Materials and Building Methods and Techniques in Van

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ABSTRACT

From the aspects of materials, construction technique, form and functionality, Seljuks Period Religious and Civil Architecture templates in Van Region have a major similarity with architectural buildings in West Azerbaijan, State of Islamic Republic of Iran in the east of our country. It is a reality that this similarities are cultural, geographical and vastly effected by migrations besides being neighbouring border provinces.

Today, "Bat" and "Mud-brick" materials' usage is frequently seen in the Military, Religious and Civil Architectural Constructions which were built in various periods in the Van province and around. Researches and application samples on mud- brick material in the region are abundantly met. However, samples or scientific researches are not seen about the "Bat" construction material except a limited amount of researches. And many researchers define architectural buildings they study as of mud-brick material although they were built by "Bat" construction materials and construction technique.

"Bat" is used as a construction material with various names in the Central Asian countries such as Turkmenistan, Uzbekistan and Afghanistan, Azerbaijan, Iran and others. This "Bat" construction material is named after "Batman", a unit of measure in the Ottoman period and used in construction works. It has quite different qualities than the regular mud-brick material from the aspects of both being construction material and application technique.
Mud-brick is used as a construction material for civil and religious buildings in Van Region. However bat construction material is used more of in walls, towers, bastions, castles, fortification and decoys (Surroundings and Yards) which are Military Buildings.

Keywords: Mud-brick, Bat, Clay, Timber, Brick Mesh

1 INTRODUCTION

Mud-brick and Bat are used as parent or auxiliary construction materials for many architectural buildings in Van Architecture, whether in religious or military, especially in civic buildings from early ages to modern times. Ashlar, rubble stone, slate, gritstone, travertine, limestone, wood, metal and partially clinker are used in constructions as auxiliary materials (Öztürk and Bingöl, 2011: 362-372).


Photo 1, 2. Bat and Mud-Brick Wall View from Van, Urartu Anzaf-Ayanis Castles *(Ş. Öztürk)*

All over-the-plinth-level walls are constructed as mud-brick in the Traditional Van civil architecture. Special soil that is used in mud-brick, clay and flat soil roof flooring has been brought from Van's Central, *Yumrutepe Village*. The clay paste that is prepared by chaff, rock salt, wood ash and water is used after soaked three or four days, and then being moulded into prepared wood chambers and sundried. After laboratory tests it is observed that compression strengths of mud-bricks that are used in the traditional buildings in this country are between 6 and 15 kg/cm^2 in general. (Öztürk, 2018:605-610).



Photo 3, 5. Bat and Mud-Brick Tower Wall View from Van, Tuşba Castle *(Ş. Öztürk)*

Mud-brick and bat, most basic construction materials of the Van Region have been used in every kind of architecture in the region for almost 3.000 years. Bat and mud-brick materials have been met in the scientific archaeological excavations at Van Castle, Ayanis Castle, Yoncatepe civil settlement, Southern Anzaf and Northern Anzaf Castles. It is possible to meet architectural constructions which had built by mud-brick and bat building materials from Urartu period till today incessantly *(Photo:1-5)*. [3]. [4].

The soil-based construction material that come out during scientific excavations in the region has been described as mud-brick by all scientists. During scientific studies and practices in Van Region and countries like Iran, Uzbekstan, Afghanistan, Turkmenistan since the year of 2002 it is observed that soil based mud-brick and bat construction materials are entirely various from the aspects of preparation, application and architectural buildings where they are used in.

2 MUD-BRICK

Ker+pich: *"Ker"* syllable means carrier in Persian and Kurdish. And "pich" syllable may have meanings such as empty, useless, formless etc.

Ker+pich = mud-brick: "mud-brick" means a construction material which is made out of a special clay consisting ash, rock salt, chaff and water molded into special chambers and sundried.

Keran: The naming for roof covering systems with approximately 0.25 m. thick, rounded section wood joists' being set among 0.40 m. gaps in Van and Bitlis Architecture. Meaning of the word keran is: (*"Ker":* carrier and "*-an*": plural suffix) carriers. Its term meaning is: a carrier between two bearings.

Photo 6, 8. Mud-Brick-Keran and Kerme Views *(Ş. Öztürk)*

Kerme; A peat fuel made out of excrements of small cattle such as goat or sheep in Van and Bitlis Region. In barns, animal excrements are squeezed under animals' feet and cut in 0.30x0.30 m. square shape sizes with plough after reaching 0.20 m. thickness and then sundried. This fuel is used in stoves, ovens and furnaces. Temperature calory of the kerme is quite higher than turf. (Öztürk, 2013:103-113).

Word origins of Kerpiç (mud-brick), Keran and Kerme are derived from *"ker"* that is carrier *(Photo:6-8).*

The soil that used for mud-brick manufacturing in the region is provided from Yumrutepe Village *(Tırneşin)* which is located in Van-Erciş highway's 25th km, besides Kurubaş, Bardakçı neighbourhoods. The most important quality of the soil used for mud-brick manufacturing is being barren, impermeable and having an ideal propoption of sand and clay. Today the soil is brought from the village to the area where clay is made at by tractor-trailer trails or trucks. Before the soil used for clay, it is screened by sieves with 0.07-0.10 mm diameter rounded pores. Local master builders perform a simple experiment before turning soils into clay.

Soil to be used in mud-brick manufacturing is soaked with water and turn into clay. Then it is squeezed between hands and laid down onto ground. If the laid clay part is torn before 0.05 m. it means it has excessive sand in it; if it is torn between 0.05-0.10 m. it means it is an ideal clay; if it is torn longer than 0.10 m. it means its sand is inadequate. After being experimented by master builders, mud-brick is used on clay manufacturing. The screened soil is prepared by mixing 10 kg. coarse rock salt, 10 kg. wood ash and 25 kg. yearly chaff for approximately 1 cubic meter size *(Photo:9,10).*

Photo 9, 10. Clay Preparation Views *(Ş. Öztürk)*

2.1 Preparation of Mud-brick Material

A mixture of certain amount of soil, wood ash and chaff is blended homogenously in dry conditions and after clear water added, it is kept at least one day. Soil mixture absorbs water and is stomped under the naked foot. Stomped clay is gathered with a shovel and soaked over soil ground almost two days. By this way, coarse rock salts, chaffs and wood ashes in the clay spreads homogenously. This process is called clay's *"fermentation" (Photo:9,10).*

After a reddish liquid extracted from soaked clay flows and is removed, this phase means the clay has been fermented and eligible to soak or be used in mud-brick manufacturing, therefore shrinkage is going to be minimum in the application *(Photo:9,10).*

Photo 11, 12. Mud-Brick Preparation Views *(Ş. Öztürk)*

2 MUD-BRICK

Carefully prepared clay material is used either as plaster in flat soil roof building or brought into the mud-brick form after soaked in special wood chambers. Among mud-brick chambers used in the region 0.08x0.30x0.30 m. sized ones are called *"Full mud-brick"* or *"parent mud-brick"*, 0.08x0.15x0.30 m. sized ones *"Half mud-brick"* or *"Child mud-brick"*, smaller mud-brick pieces are called *"Kret"*.

Summer time is preferred in order mud-brick to sundry for being eligible to use, because it is rainless. The area where mud-bricks are to be manufactured is levelled grading. A thin thatch should be laid on the surface for mud-bricks' being removed easily unbroken. Wooden mud-brick chambers should be scourged with a rug after each usage for mud-bricks to take shape properly.

Clay positioned in the chamber is squeezed in the hands of mud-brick master builders and upper surface is levelled with a wood trowel or sleeked with a metal stick. Then the chamber is pulled up carefully. It is sundried three or five days depending on the climate conditions *(Photo:13,14)*.


Photo 13, 14. Mud-Brick Drying Views *(Ş. Öztürk)*

Following three or five days of sundrying, mud-bricks are raised vertically and kept in this position a couple of days and separated as parent and child ones. Then they are stacked in triangle forms and be ready for usage *(Photo:15,16)*.

If they are to be used next year, triangle-form-stacked mud-bricks are covered by liberally chaffed clay and placed acide.


Photo 15, 16. Mud-Brick Stack And Packaging Views *(Ş. Öztürk)*

The reason for using coarse rock salt in mud manufacturing is to prevent clay's absorbing water and seeds' coming into leaves in the clay. Also this prevents mud-brick and plaster's being inhabited by pests like scorpions, insects, mouses etc... ***The reason for using wood ash in mud manufacturing is material*** to be having elastic properties, higher compression strength and being repellent against humiditiy, water and damp. ***The reason for using chaff and "kırcom" in mud manufacturing is*** clay to be having higher adherence and fastening quality. To be able to get desired result from used chaff and kırcom, it is betted to be careful it to be one-year old (Öztürk, 2016: 99-104).

3 NATURAL MUD-BRICK

Natural lawns or meadows occupy various settlements *(districts, counties, villages and arable fields)* which were established in the Gevaş, Erciş, Muradiye, Edremit districts whose have coasts at Lake Van and wetlands because of being close to streams. Meadows and lawn fields renew itself continuously because of being wet. A layer of natural mud-brick is used in construction of various architectural buildings each year after being cut with plows *(Photo:17,18)*.


Photo 17, 18. Natural Mud-Brick Lawn Views *(Ş. Öztürk)*

Natural mud-bricks are provided in two different sizes. Full natural mud-brick sizes are approximately 0.15x0.30x0.30 m. and half ones are approximately 0.15x0.15x0.15 m. sizes. This construction material that local people call "doğal kerpiç" (natural mud-brick) has lesser possibility of dismantling and being lost in the usage because of its close texture. Grasses for this mud-brick are provided cutting with special cutter shovels in each year's spring and fall seasons.

Because providing natural clay is relatively easier than bat and mud-brick, it is preferred by local people in rural areas. Natural mud-brick is a material mostly used for buildings for walls in vineyards, gardens, stables, and furnice barns in rural areas.

3.1 Construction Techniques of Natural Mud-Brick
While natural mud-brick is being used in architecture, the same as mud-brick wall construction techniques are applied. Any bonding clay material is not used in the wall construction.

Parent walls of buildings are constructed out of ashlar or rubble stone from ground to the plinth level first *(Photo:19,20).*

Walls are surrounded by 0.15 m. square sectioned bonding timbers from outside and inside correlatively in the sub basement level. Bonding timbers are used in openings for doors and windows and flat soil roof beams. For flat soil roof covering system, the technique for mud-brick walls is used as well. Outer surfaces of the walls and stable, chaff barn, furnace barn etc. buildings are made out of fair-faced brickwork. Internal walls are coated with clay. And houses' walls are entirely coated and painted both inside and outside.

Natural mud-bricks that are cut and prepared in lawns and meadows should be used in at least five days. Otherwise binding mud should be used.


Photo 19, 20. Natural Mud-Brick Wall Views *(Ş. Öztürk)*

4. BAT

"Bat" construction material is used in Van civil architecture for especially yard walls (cob walls), for military architecture, castle, tower and outer walls.*"Bat",* which is also a construction and preparation technique, is essentially an Ottoman weight measurement unit. Bat is a clay amount which a mason can remove from the floor and spread to the wall in one attempt (Pektaş, 2013: 120).

Bat is an abbreviation of *"Batman" in* the regional architecture's vocabulary. A Batman= 6 Oka = 6,69767 kg as a unit. In rural Van, this construction material is called *"pi"*.

Bat, is a construction material varied from mud-brick from both manufacturing process and technique. The clay for using in bat manufacturing is mixed in the same way with mixtures used in mud-brick manufacturing. However, plantal materials which are called *"kırcom"* are used instead of chaff as longer than chaffs.

Before using prepared clay material in construction it should be kept over the soil ground at least ten days. By this way, the water in the clay will go and the mud-brick becomes more solid *(püşürük)* than clay.

4.1 Castle, Wall and Tower Building Techniques With Bat Construction Material

Military buildings had been built with bat technique in constructions of historical castles and walls in the region. Although wall thicknesses and hights are varied in the construction of outer walls and towers, it is remarkable that double facade wood bonding timbers were used especially on bastions *(Photo:21-23)*.

Photo 21, 23. Views of Wall and Tower with Bat Technique from Van Castle *(Ş. Öztürk)*

Regarding bat technique wall height vary depending on the bastion, tower and castle walls to be built besides it is different than cob wall. Because bastions are higher buildings than towers, they are bonded by rubbles or ashes until certain levels from the ground.

For outer walls, in order to unite 0.20x0.20 m. sectioned wood bonding timbers, wood rounded section elements are bonded as approximately 0.50 and 0.75 m. protrusive from the wall surface. The wall that heightened with bat is retracted with a certain bevel. Castle wall construction is completed after using double facade again on approximately one meter height each *(Photo:24-35).*
Debarked elm that sundried at least two years is preferred for wood materials in bat technique-constructed walls.

Photo 24, 26. Views of Walls and Towers with Bat Technique from Van-Hoşap Castle *(Ş. Öztürk)*

Elms are soaked in linseed oil pools at least for 15 days before being used in the wall construction or all surfaces of the wood is pitched with tar in two layers before usage. Taking these preventive measures, wood bonding timbers to be used, gain strength against bad climate conditions, moisture, humiditiy, excessive hot and cold temperatures and some pests.

Photo 27, 29. Views of Ateşgeda (Fire Temple) and Walls with Bat Technique, Iran-İsfahan *(Ş. Öztürk)*

Photo 30, 32. Views of Wall And Tower With Bat Technique, Uzbekstan-Bukhara Castle *(Ş. Öztürk)*

Photo 33,35. Views of Walls with Bat Technique, Uzbekstan-Bukhara Castle *(Ş. Öztürk)*

4.1 Decoy *(yard Wall)* Wall Building Technique With Bat Construction Material

In Van civil Architecture, neighbouring yard borders that are located in the backside of the houses are separated with cob wall *(yard wall)* walls from each other. An approximately 0.50-0.75 m. deep foundation is digged. This foundation is levelled from inside with approximately 0.05 m. thick wood ash. Then the wall is constructed using wood-ash blended mud binding material with one metre high rubble or slate.


Photo 36, 38. Old Van City, Horhor Gardens' Cob Wall Views *(Ş. Öztürk)*

Bat wall that is built on 0.50 m. height stone wall over the ground level is 0.50 m. wide and approximately 2.00-3.00 m. height. Upper surface of the cob walls are built as half bullnose form or as pinnacle shape. Middle part of the cob walls are completed aligning embedded small coursed rubble stones. Coursed rubble stones' appearance to a certain extent because of the snow and rain impact means cob walls are in need of maintenance and repair. Maintenance and repair is made once in every 10 years almost *(Illustration: 1; photo:36-38).*



Photo 39,41. Views Of Cob wall Walls With Bat Technique, Iran, Kashhan And Shiraz Provinces, *(Ş. Öztürk)*
Cob walls are met in Van Province as a reflection from the architectural culture of Iran's noted historical cities such as Urumieh, Tebriz, Kashhan, Isfahan, Shiraz etc., Seljuk Empire's prominent centers *(Photo:39-41).*

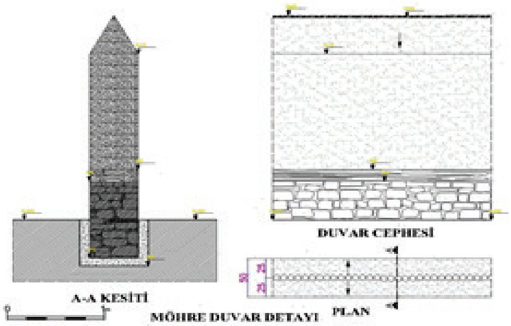

Illustration 1. Decoy Wall Detail *(Ş. Öztürk)*

5. CONCLUSION

Architectural samples that were built with mud-brick and bat construction material as Anonymus Architecture in the Van Region are made by uneducated, even illiterate local master builders.

Each region's Architecture vary regarding material, climate, economy, religion, culture etc. features. Material and non-material values like tools, form, function, ration and proportion are imparted to the architecture as a fond of knowledge over centuries.
Until approximately 1970, commonly used construction material in this country's rural and urban areas is mud-brick as a traditional construction material compatible with nature and environment and easily recyclable. It is a reality that mud-brick is the most convenient construction material from the aspects of manufacturing, physical and chemical qualities for helping survival of the all kind of living being, particularly human. When it is used together with wood, it has superiority over concrete material regarding health, isolation, economy, visuality, duration etc. qualities as currently proved scientifically.

Without a doubt, bat and mud-brick are construction materials that have been used from early ages till today in every kind of architecture incessantly.
It is a fact that there is not an adequate amount of inventory and research about mud-brick manufacturings which we scrutinized latest samples. As for me, modern mixtures made out of clay directly molded in chambers blending with gypsum, lime, cement etc. after being mixed in concrete mixer are not mud-brick, neither those materials are the clay which is used in mud-brick manufacturing. This causes a terminological contradiction to come out. This kind of researches are favourable though. There is not a direct relationship between the mud-brick and bat that was used for every kind of architecture in this country, Central Asia and various parts of the world and traditional material.

Mud-brick manufacturing which is an important construction material process in our traditional architectural culture is disappearing rapidly under a vertical architecture in expanding cities where humanistic values extinct. In this respect, we do not have necessary education given by concerned ministry, trade chambers *(Chamber of Architect, Civil Engineers' Chamber)* and faculties of architecture adequately. Preserving mud-brick manufacturing from various regions of this country and transfer it to the next generations is the permanent duty of all architects. Because it is not possible us to be having a voice both nationally and internationally without learning and preserving traditional architecture.

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The Role of Migration and Movement in Creating Environmental Comfort in the Native Houses in the Central Plateau of Iran (Case Study: The House of Ardakanian, Yazd, Iran)

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ABSTRACT

Migration evokes a specific type of movement in which humans move toward better conditions with changes in their location and facilities. This definition not only originates from the real world, but also is rooted in the human nature. In other words, the essence of migration and its marrow is fixated in every human.

The house, as the immediate artificial environment, is influenced by climatic factors, native culture, and social factors. This is where people find their lives. Therefore, in this study, the house is chosen as an example for recognizing and evaluating the importance of migration.

In this field study, by performing analytical evaluations of native houses in the Central Plateau of Iran, the cycle of migration in the house is identified, regarding the type of architecture and their unique styles.

This cycle, consisting of seasonal migration consistent with nature and seasonal migration consistent with dynamics and fluidity of space, is a set of horizontal and vertical movements in the house, which provides the themes of environmental comfort for residents in the hot and arid climate of this region.

Keywords: Migration Cycle, Seasonal Migration, Occasional Migration, Ardakanian's House.

1 INTRODUCTION

1.1 Climate Condition

Hard and cold winters, warm and dry summers, very low rate of rain, air humidity, herbal cover, so much difference between day and night temperature and in salt desert and salt-desert border regions, the dusty winds are the outstanding climatic specifications in this region. (Maleki, 2011)

1.2 Morphology and Urban Texture

The villages and cities of hot-arid regions can be compared to cactus bushes or desert plants. Because the life spaces of these regions consisted of urban spaces, pathways, yards and buildings are completely protected against undesirable winds and at the same time desirable winds and sun radiation are used with special arrangements. The urban texture is condensed and compressed to each other in these regions. Houses have merged or combined walls and the border between them cannot be identified. The compression and combination of buildings has leaded the external surface of each building to the least and as a result each home can conserve the needed energy inside of it for a long time. It is also an answer for the crowdedness. The narrow serrated lanes which sometimes have high walls and are roofed by arches cast a shadow on the surrounding houses and control the wind speed of Kavir. The structure of city is planned in a way, which arteries are open in the direction of desirable winds and closed in the direction of undesirable winds and sand storms. (Maleki, 2011) Fig.1

Figure 1. Yazd urban Texture

Figure 1. Yazd urban Texture

1.3 Introduction of Ardakanian's House

1.3.1 Location

The Qajar house of Ardakanians is located in the historical texture inYazd butchers' neighbourhood, one hundred and forty years old. Fig.2

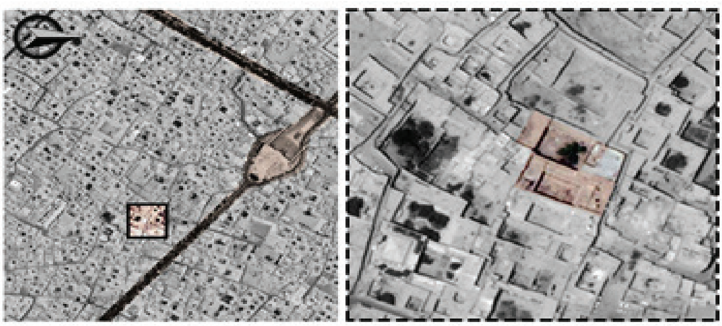

Figure 2. Site Plan and Location of Ardakanian house

1.3.2 The layout of the house

Like many other houses in Yazd, the Ardakanian House ensemble consists of two separate parts, each with a courtyard of its own. Both courtyards are rectangular and oriented along a north-south axis. The main built areas of both courtyards, or houses, stand above ground level, in a single story. The basement floor areas are small and, on the second floor, built areas exist only on the southern side. The main entrance of the house is located on its northern side. In the eastern courtyard, walls are deeper and resemble eivanchehs. At a short distance past the door, the entrance corridor splits into two hallways, one leading to the eastern courtyard and the other to the western. In both parts of the house, the spatial order of the built areas surrounding the courtyards follows the model prevailing in other houses in Yazd.

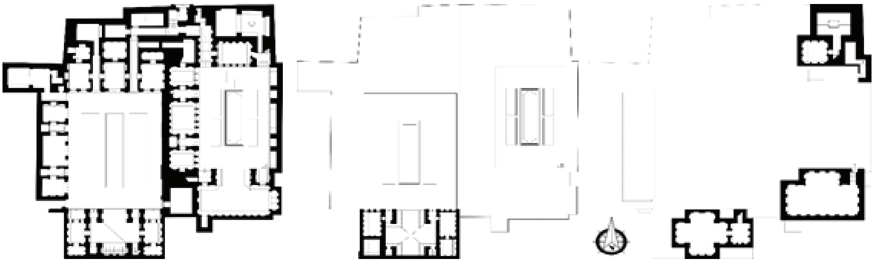

Figure 3. Left to right: Ground Floor Plan, First Floor plan, Basement Floor Plan (plus deep basement plan)

A notable point here is the highly regular spatial order of the southern side of the larger (western) house, in which a cross-shaped central Tallar is flanked by two rooms. This Tallar is accessed from the courtyard via two short lateral corridors. Each room is fronted by an eivancheh, which connects it to the courtyard. The existence of eivanchehs on either side of the Tallar emphasizes the presence of semi-open spaces in the facade of this side. This facade, therefore, appears very porous and shaded, to the extent that the sashed windows of the rooms adjoining the eivan appear as it's only closed surfaces. An important feature of this courtyard's southern side is the proportion between its eivan's width and height. In comparison with that of other houses in Yazd, this eivan is taller and more elongated in height. Interestingly, this house is known as Ardakanian House, and we know that proportions similar to those of this eivan are visible in the houses of the city of Ardakan. Thus, one may perhaps conclude that the founder of this house, who probably came from Ardakan, had it built by a fellow citizen architect. (Ganjname, 2004) Fig.3

It should be noted, this article only deals with the study of the western part of the house.

Figure 4. Tallar, Orientation north, Create hot air flow suction by vertical alignment.

1.3.3 Introduction of climate spaces

A. Tallar: Large room or lounge, In Yazd, Tallar is said to rooms or large porches that are open in front of it. In this house, Tallar is cross shaped, which is called Shekam daride. Fig.4

B. Eivan/Eivancheh: Part of the building with a roof that is open in front and there is no door and window. The small Eivan is called Eivancheh. Fig.5

C. Three/Five Door Room: The rooms are faced with three or five doors, separated by blades. The divider blades play the role of vertical and horizontal shading. Fig.6

D. Central Court Yard: In general, the Court yard refers to areas where four sides are walls or buildings. Sometimes it's called the open-air building.


Figure 1. Eivan, Shading using dent, Inlet air filter
Figure 2. Five door room, Failure and daylight adjustment by using vertical blades and window divisions

E. Basement: A basement space is used to adjust the summer heat using the heat capacity of the land in a warm and dry area.

F. Sardab: The Sardab is a space built deep into the ground to take shelter in the heat, and water and food are kept there to keep it cool. Sardab are usually cooled with wind catcher and Qanat. Fig.7

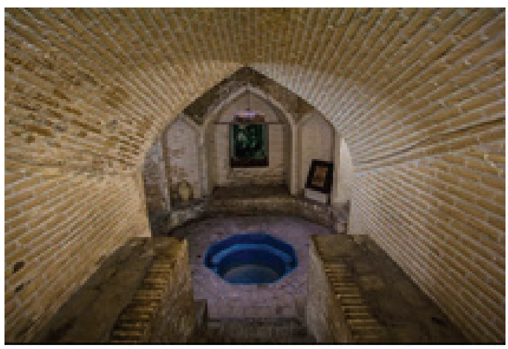

Figure 7. Sardab, Creation of evaporative cooling with the help of Qanat in Sardab. Generate thermal balance throughout the day using the Earth's thermal capacity.

J. Bahar Khab: Usually on the roof and at height, there is a space that is used to sleep at night. Fig.8

Figure 8. Bahar Khab, Creating spatial quality and mental relaxation. The use of fresh air at night.

H. Wind-catcher: A tower that catch cool air and wind from the high ground and enters the building and It evacuates the warm air inside the building in the opposite direction of the wind blowing through suction.

In addition to the ones that are physically effective on environmental comfort, there are non-physical factors that affect mental comfort and, consequently, environmental comfort. (Ghezelbash, 1985)

1.4 The Life Styles

The last subject, which also needs more consideration, is the different ways and styles of living for using the maximum of environment potentially. It seems that the culture particularities according to people's view to the world and their environment characteristics, which help to adapt and respect the nature laws. The most important requirement for life in desert is to have personal particularities in compatibility with natural environment as much as which of social. We can find them clearly in the people everyday life in this region. The first is having the working mentality for to defeat the hard conditions and transforming the environmental limits into possibility. The second is to be sufficient to what the nature gives him though little. The third is forethought, a characteristic imposed by limits of hard nature for earning one's living that ensure him and future generation without fright of future. These three characters help the person for sustain the life at least in the good conditions. The attempt must continue the generation by generation. (Maleki, 2011)

1.4.1 Definition of Migration

In this area, migration at home is a harmony of nature that has been part of the lives of people.

At the first glance, the term "migration" means "moving away from home" to another's home with tribe, relatives and home appliance or "immigration", and the transfer of "tribe" or "population" from one place to another. This action can be done on the basis of volition or on coercion; however, the migration and movement as the essence can be identified in two dimensions: external migration and internal migration. External migration is objective and apparent and the basis of migration is internal. External migration done at home, in the city, or in the world and cause human growth and relaxation, which is, consequently the same internal and external migration. In the architectural arena, migrating around in spaces at different times causes the comfort of the inhabitants and users. The shape of a house on the central plateau of Iran is typically the central courtyard. In other words, the mass is defined in three levels of the basement, aligned with a yard and a second floor, or a yard roof around in the center. This form of architecture provides them with the most desirable space when technology does not interfere with the environmental comfort of the inhabitants. In addition to the physical and climatic reasons, the lifestyle of the inhabitants has also contributed to this environmental comfort. In other words, the concept of migration and migrating action have been the main pillar of the lifestyle of the inhabitants.

2 METHODOLOGY

The present study was conducted using a descriptive-analytical method based on library studies as well as field observations. It is a case study, which includes methods whose purpose is to describe the circumstances or phenomena under investigation and is analytical because using the research methodology studies to investigate role of migration and movement in achieving environmental comfort. In the first step, theoretical foundations and components that affect the environmental comfort are extracted through library studies and based on valid sources.

In the following, using a field survey in a case study (Ardakanian house), the two-way relationship between the lifestyle of residents and climatic zones and elements in the study area was formulated and in the final step, through analyzing the qualitative data, the effects of different types of migration on environmental comfort, Was evaluated.

3 DISCUSSION

3.1 Migration Cycle at Ardakanian's House:

In the definition of internal and external migration, it was noted that there is a close connection between these two categories and achieving internal migration is not possible without the nature migration and the universe cycle. In this home, the climate migration and nature-based movement are so clear we will continue to review it.

3.1.1 Seasonal Migration

One of the main features of this house and such houses is the constant between the seasons, which creates a very interesting harmony between inhabitants and nature. With the arrival of a new season (albeit almost algebraic), furniture is moved from one space to another, and performance and activities take place in a new space. The remarkable note of seasonal migration is that; the spaces are designed in the way that in winter season and some autumn (the Yazd climate has almost two main seasons, winter and summer, and the spring and autumn weather is weather Moderate, which does not require heating and cooling and is very short). In addition, approximately include five months from the year, the distance between the essential spaces, such as the building, the living room and the living dining room will be short. This makes it more likely to move and migrate in different seasons than when it creates an unfortunate memory due to the cold.

However, these movements are not tricky, and the migration is very smooth and over time. Because nature itself will never become occasional. That is, there cannot be a special connection between winter and spring. (Although this is the calendar's separation). Continuing to move on to a specific season, living in the first space was less and more in the destination space. Fig.9

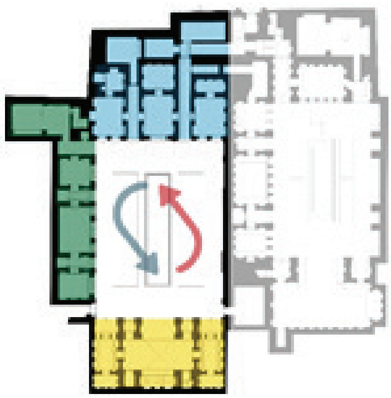

Figure 9: Seasonal Migration

A. Summer

This season includes about half a year and the space behind due to the warmth of the sun. (Migrating of nature) The cooling technology of this house is to use natural elements such as wind and water, which is why most of the open and semi-open spaces of this season. The centrality of this season is the Tallar.

B. Spring and autumn

In this season, the light of the first half of the day will require more than light in the sunset and the second half of the day, which is very nasty in Yazd. The rooms of the northwest front belong to the centre of the Panjdari room in this season. Both the spring and autumn air temperatures are moderate (one to heat and the other to cold). For this reason, in this house and most of such houses, the spring and autumn front are aligned.

C. Winter

Due to the desert climate, winter in Yazd is cold and dry and the sun's direct light warm the room in the day and some hours of the night. The Northeastern Front, the Panjdari room and the surrounding three-door rooms are the main spaces of winter yard.

3.1.2 Occasional Migration

Establishment will not take place in the Occasional Migration for a long time in each of the fronts and spaces mentioned earlier. In fact, in each of the locations listed, there is some microclimates, which cause minor and Occasional Migration. (The migration in nature). So, movement and migration continues inside each total migration. In other words, in an Occasional Migration, without changing the overall position of a person, movement will have a more limited in a smaller process.

A. Summer (Horizontal and Vertical Movement)

a. Tanabi-Tallar (Room under the Wind catcher): During the hours of the day, early in the morning and evening, the movement between the two spaces was used to escape the heat and shelter the shadows and winds. In addition, local moves also took place in the Tallar in changing the furniture between the edge of the Tallar, due to the greater visibility at the beginning and the end of the Tallar, by the escape from the luminous sunlight of the first morning of the summer. Fig.10

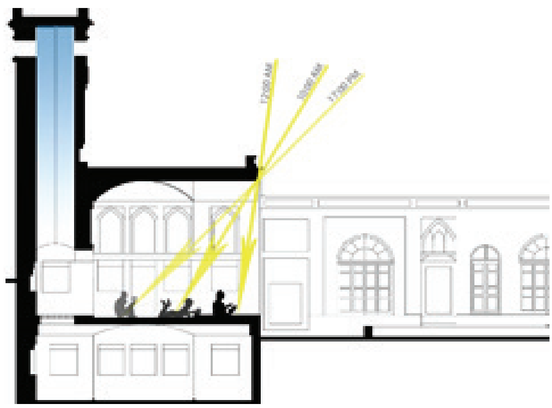

Figure 10. Horizontal Movement during the day in summer

b. Tallar-Basement: In addition to moving in the horizontal cycle, the movement is also carried out in the vertical direction, and when the Tallar and the room below the wind catcher is not responsive to heat, the movement is done between the Tallar and the basement means moving to the basement and vice versa around Noon.

c. Basement-Underground: occasionally, especially the July season, the heat of Yazd is tumultuous, and in this case there is a connection between the basement and the basement, which, although it does not have an optimal optical quality, but make the heat of Yazd very tolerant.

d. Tallar-Roof: In the process of vertical movement that happens in this house, human communication with the sky, the moon and the stars is very interesting, and from the sunset, the habitants move to the roof, because it has been enclosed with appropriate walls. However, this is a migration from the earth to the sky, and in addition to the very desirable weather of the night in the desert, habitants watch the beautiful night sky.

In addition, in this season, the capabilities of nature, such as moisture, shade, sound of water, etc, are provided by moving and settling in the courtyard (i.e, a wooden bed placed on the dock or next to it). Fig.11

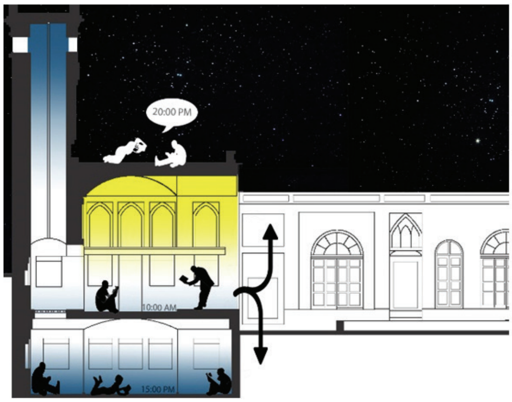

Figure 11. Vertical Movement during the day in summer

Figure 12. Horizontal Movement during the year in autumn
Figure 13. Horizontal Movement during the year in spring

Figure 14. Horizontal Movement during the day in winter:

B. Spring and autumn

Tallar is also active at the beginning of the autumn and the end of the spring because of the heat of noon and afternoon. However, at night and in the morning, the Panjdari Room of the Northwest Front is active and seasonal migration is done between Tallar and Panjdari spaces. In the middle of these seasons, the rotational movement is not as wide as the other, and is between the Panjdari and the surrounding three-door rooms. Although in the beginning of spring and end of the fall, the winter-oriented front three-door rooms is active more. Fig.12,13

C. Winter

In winter, most of the day and night passes through Panjdari room. In this room, due to the extent of the room, if the need or lack of light is required, the interior situation changes. However, the heating of Panjdari room with a fairly large size with fossil fuels, such as coal, is hard, so the night and morning (which brings up the light of the east) has been in the three-door room which has less and smaller opening for warming up.

4 CONCLUSION

Based on the previous statements, the motion cycle is carried out horizontally and vertically in a space or within a few spaces during one day and one year.

Table 1: Final analyses of vertical movement

Winter		*Spring & Autumn*		*Summer*		*Vertical movement*
Seasonal	Occasional	Seasonal	Occasional	Seasonal	Occasional	
-	-	-	-	-	-	*One space*
-	-	-	-	-	*	*Several spaces*

Table 2: Final analyses of Horizontal movement

Winter		*Spring & Autumn*		*Summer*		*Vertical movement*
Seasonal	Occasional	Seasonal	Occasional	Seasonal	Occasional	
-	-	-	-	-	*	*One space*
-	*	*	*	-	*	*Several spaces*

The results of the analysis of the two above-mentioned tables

1- The movement throughout the day is more than during the year, which is often done in the summer. The reason for this, is to achieve thermal comfort in hot and dry climate conditions in Yazd.

2- Typically, vertical movements between several spaces in difficult summer conditions occur during a day.

3- Horizontal moves exist between several spaces throughout the day and throughout the year.

4- Horizontal movement within a space is done throughout the day only in the summer. While vertical movements inside a space are dim during one day or throughout the year.

5- The extreme temperature difference between night and day in the summer and winter season exacerbates movement throughout the day. In contrast, in the spring and autumn, when the weather is moderate and the temperature difference at the beginning and the end of the season is evident, the movement during the season is more intense.

6- Case five indicates that the design and arrangement of spaces in hot and cold climate should be more on the occasional migration than moderate regions, which should be considered more on seasonal migration.

It may seem a bit unreasonable, but always in the same location, one kind of nature is not useful and does not cause human comfort. For example, sunlight which in winter provides a source of energy and heat, and the comfort of a human being, may be annoying and unbearable in the summer, and in this season, escaping from the light and sheltering the shadow, the lack of light, will provide the right conditions. Joining or escaping to the nature by human beings may not create a disadvantage in the movement and migration of nature, and this cycle is permanent. But joining and, at least, the effectiveness of it will bring many benefits to humans such as optimizing energy and reducing fuel consumption, the same issue that has emerged in the present era of the energy crisis has created many concerns. Moving on the orbit of nature and using endless energy of the sun (clean energy), leads to significant savings in society many times of the day and year, and the ability to shadow, night etc.

Other factors affecting on migration cycle to complete this cycle to achieve environmental comfort are as follows:

1. Dense and compact plan
2. Minimum external surface Relative to the size of the building Creates maximum shadow and reduces heat exchange in summer and winter
3. At least openings at the outer surface of the building to the passageways
4. Create the highest levels of opening to the protected area of the central courtyard
5. Use of clay and mud due to high thermal capacity in the walls and roofs of houses
6. Use of arches and domes in roofs of houses due to the property of native materials (mud and clay)
7. The dome roof also creates shadow over half of the body of the dome and the surrounding area, causing a difference in pressure and air flow in the space below the dome. More reflection due to curve and arched arch
8. Creating dome roofs in two shells plays the role of thermal insulation
9. Dome ceilings are more exposed to the wind
10. Use of land heat capacity in critical situations
11. The use of bright and polished colours for surfaces and facades to absorb less heat from sunlight and more reflections of the sun's rays.
12. The use of the central courtyard and the layout of the surrounding rooms will protect the building from the heat of the summer and the cold of winter and the currents and desert dust.
13. Placing the winter chambers with large openings for sunbathing the space to the south and on the northern front of the building
14. Use of plant, water pond and fountain in the central courtyard to create moisture in the central courtyard by evaporation method
15. Save the cold during the night inside the yard and walls, and modifying the air in the yard and building throughout the day
16. Creation of wind catcher with openings to the wind desirable to direct the wind in order to ventilate and modify the air inside the building
17. Reuse rain water and waste water as much as possible
18. It can be concluded that all the basic principles of implementation include: the use of windows, windbreaks, thermal insulation, water and plants/canopies, internal and external rooms, natural ventilation and underground protection, building mass and type of plan in order Achievement of thermal insulation in these houses has been respected.
19. Providing psychological comfort: The central courtyard in the native Yazd houses, in addition to the sense of security, with the natural elements of water and vegetation, create a microclimate on the scale of a home that offers a mental health for the residents. Understanding the passage of time due to falling and growing leaves of trees, seeing the

sky at night with Attendance at the roof, The companion of man with nature as part of the ecosystem are One of the most effective factors on mental health.

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Yazd Faculty of Art and Architecture; An Opportunity to Realize Economic Sustainability

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ABSTRACT

The historical district of Yazd city is more than 700 hectares, and over the history it has been experienced different developments. The development of education cores was one of them, and it has been occurred along others developments. Yazd art and architecture school is the first architectural education place that it was established outside the capital. It is the turning point in the history of art, architecture and urban education in Iran, because not only the location of this faculty is appropriate, but also the education system that it is being used has a close communication with the surrounding texture. The allocation of some valuable historic houses to this faculty illustrates the trend and development of Yazd art and architecture school that it focuses on the new concept "The University and The City" while the most of education places in Iran are separated with their surrounds society.

It is considerable that one of the best achievement of this subject is the increase of the faculty's economic benefit and city. So this paper aims to show the analysis of the Yazd Art and Architecture faculty and it surrounds that they can be used in the strategic decision to reach the economic sustainability by others universities. The economic sustainability referees to the concept that a university can make a mutual communication with city and protect the human capital and upgrade it. New school development proposals will consider the importance of the two – way interrelationship of the university and the city. This research is done by the descriptive-analysis method and it uses the review of documentary and library studies.

Keywords; The University and The City, Yazd Faculty of Art and Architecture, Sustainable Architecture, Economic Sustainability.

1 INTRODUCTION

The historical texture is the part of unrepeatable heritage that we did not play for making them, but we can have a play by keeping or destroying them. In the historic texture of Yazd, buildings are been that each of them has a specific identity and character.

Nowadays, the sustainable development of cities is focused by urban planner and architects, but it is not only a quantitative concept, but also it has a close connection to the quality of living level. The Universities are one of the focal point in cities which they effect on the living of citizens, and they have the important role on the development and sustainability of cities. So, the universities can offer the logical development plan and program to upgrade the level of sustainability in the surround cities.

One of the main concern of science ministry in Iran is the quality of educational spaces. These spaces are attended from two point view, one they are the places for nurturing the professional work forces and the other they should respond to the quantitative and qualitative educational needs in the other words these spaces are the patterns of architecture that they can be kept and saved in citizens' minds, so they should be considered the architectural values (Rakhshani Mehr, 1395).

Nowadays, the focus and demand of urban planner, architects, economist, sociologist, universities head, and also citizens realize the university-city concept. Yazd city has had the strategic role over the history and it has experienced the different development. One of those is the development of education that it is connected to its surround texture as the agent of city texture. The amazing ancient schools which they were established around the Bazaar is the real sample like: Khan School that is located surround the Khan Bazaar, and Shahzadeh School that is located near the jameh mosque of YAZD and Chahar Souq Bazzar. (Fig. 1)

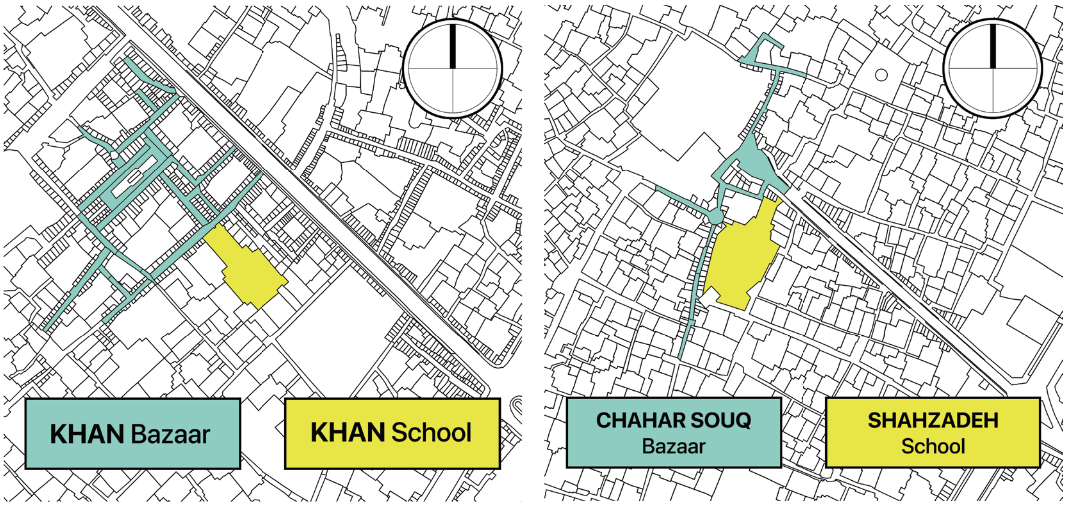


Figure 1. The relation of these schools with Bazar and Yazd city (Authors).

Unfortunately, although a functional relation between universities and its surround blocks causes to benefit both of them and upgrade their quality (Yumi Lee et al, 2014), universities most are being in city not the component of cities (Cunningham, 2012:1) and this type of relation was destroyed in Iran completely until Yazd art and architecture school was established in the old part of Yazd city and it was the first step of making connection with the surround environment. (Fig. 2)

Figure 2. The goals of the formation of the Yazd Faculty of Art and Architecture (Authors with adapted from Mirjani, 2003).

Therefore, the refereed goals and desires show that the Yazd art and architecture school has tried to effect on its surround environment as the city agent over the years and this relation shows the importance of the university-city concept, so this article surveys the importance of sustainability, sustainable development, economic, economic development, and sustainable economic; finally Yazd art and architecture school is described as the successful sample and its economic impact on surround environment is assessed.

2 SUSTAINABILITY

Nowadays, the sustainability concept has a significant importance insofar as each new aspect about the environment and development is not wrapped up until this idea is not taken part them. This concept relates to the time, place, and different societies conditions, so the one description cannot be achieved (Eftekhari, 2003: 26).

The "Sustain" word in Oxford dictionary means that the ability, durability, or keep a work evermore. At this time, the meaning of this word everything that will continue at future. (Table 1)

The "sustain" word which its Latin root is "subtinere" is formed two component "Sub"(from down to up) and "Tenere" (keep, save) and it refers to two idea:

- keeping and continuity value and validity of a thing
- cause to the object continuity in the different condition

Table 1. Definition of The Term Sustainability in the Encyclopedias (Authors).

No.	*Writer*	*The title of book, article and encyclopedia*	*Sustainability Definition and Meaning*
1	Dehkhoda, Ali Akbar	Dehkhoda's Encyclopedia	Durable, Permanent.
2	Moein, Mohammad	Moein's Encyclopedia	This word means durable and the gerund of it "Sustaining" means strengthen or undergo.
3	Oxford	Oxford Dictionary	The 'sustain' word which its Latin root is "Sustinere" is formed two component "Sub" (from down to up) and "Tenere" (keep, save). After 1920, this word was used more than past. The meaning of this verb is mixed with some different concepts like: support, protection and continuity, and the 'sustainable' adjective is used about the condition and state of a thing that it is protected or continued.
4	Azerbaijani, Mona	Sustainable architecture concept	Sustain: protect, keep alive, continue continuously. Sustenance: the durable living process. Sustainable: this adjective describes a thing that causes the peace, store and supply of something that causes finally to extend the living and continuity.
5	Habib	-	Sustainability means stable and durable. The sustainability of sustainable phenomenon is derived by the durable pattern, method or systems of this phenomenon over the long time. The continuity of phenomenon is occurred by the stable patterns which they always are taken, and in this repetitive process they are matched and adapted with new condition which they affect in the specific time.
6	Soflayie, Farzaneh	An investigate about the experience and concept of sustainable architecture	The 'sustainable' word root is the subtinere and it means keeping in high level or keeping from the foundation of something. In each society, the future foundation should be protected by this time citizens. Some places encourage people to protect and support the society by the meaningful composition of physical, cultural and spiritual specification.

2.1 The Sustaınable Development

The sustainable development focuses on the importance of continuous growth and development. The development is not achieved when this trend causes to destroy the environment. This definition about the development certifies this idea: "If it is true that each society should respond about the demand and welfare of members, the 'development' word includes all of the necessary changes for achieving this goal. These changes are caused to go to the better condition by a social system which it recognizes the undesirable conditions of living." (Laqaei, HasanAli, 2008: 22). (Table 2)

One of the new idea in architecture and urban aspect is the sustainable development theory. This aspect of development responds to present human needs with considering the ability and needs of the future society (The world environment and future development commission statement; Oxford university, New York: 1987). The sustainable development is the qualitative development and its goal increase the quality level of living for future societies. This development has a deep themes in three aspects: 1. The environment sustainability, 2. The economic sustainability, 3. The social sustainability (Keaumarsi and others, 2001: 49). (Fig. 3)

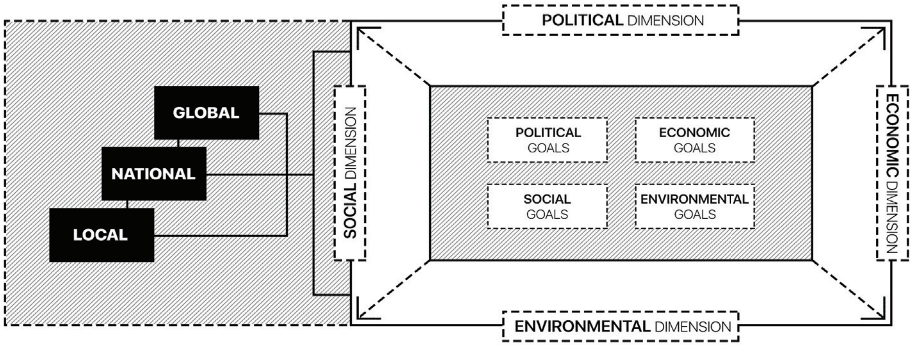


Figure 3. Levels of sustainable development (Authors with adapted from UN, 2005)

Table 2. Definition of Sustainable Development from Different Perspectives (Authors).

No.	*writer*	***The definition of sustainable development***
1	The global commission of environment	The sustainable development is a changed process which it includes the use of sources, the guidance of investment, the tendency of technology development, and the change of subject that they are adapted with the future people needs. The sustainable development is the development that responds to the present needs without any damaging to the futures abilities.
2	The global commission NGO	A development which it responds to the present needs without any damaging to the environment and the futures abilities is the sustainable development. By the former definition, each society can take the sustainability and the justice between the different societies can be provided. The social and economic development should be realized in a way that if the future generation should be tolerated costs, the effects of economic action should be limited for the futures generations. So, the sustainable development is the economic development which it continues continuously. In this view, the sustainability is divided into two kind of powerful and weak development (WCED, 1987).
3	21 Urban Conference	Improving the quality living in one society from the different dimensions (Ecological, Cultural, Political, Institutional, social, and Economical) without any pinch creation for the futures generations.
4	The Bruntland Report	The sustainable development is the development that responds to the present needs without any damaging to the futures abilities for responding to their needs. In this view, the goal of sustainable development is the keeping of human societies from a kind of development that it does not destroy the environment (Matin,…).
5	MACED Forum	The sustainable development of urban communities can provide the selecting of the different kinds of development with considering the relation between Ecological, Economical, and Equality dimensions. Economic: providing the general benefit in the Economic, Self-reliance, Self-promotion, and Native wealth. Ecology: creating the natural capitals and responsibility of human communities for the nature and environment with considering the nature's limitations. Equality: providing the opportunities of taking part in the all of actions, benefits and decision of community
6	The global bank	In the global bank view, the sustainable and healthy environment cannot be occurred when the poor is being in the society. The continuity of development has a problem when the society does not have the social justice.

2.2 Economıc

One of the meaning of economic is the golden mean in any work. The economic activity is an activity which it pays attention to the necessity of thrift and goods and sources rational using especially the scarce goods (Shwald, 1999: 13). The economic also is the science and method for the optimum using of sources with taking on the maximum benefit and minimum cost. It is the best and most possible way to reach to the welfare. So paying attention to the economic problems in the historic textures is a suitable way to prevent these texture from stagnating, so with motivating the economic and economic activity in these neighborhoods can hinder the inactivity of them and imposing the costs on city and finally, they can take the life again.

Finally, this statement can be said the economics of a society has a close relation with its architecture and also the architecture can effect dramatically on the society's economic, so with recognizing this relation, the architecture design can match with the optimal economic condition, increasing the proficiency, and sustainability.

2.3 The Economıc Development

The general goal of the human development plans is the improvement of social, economic condition, living quality, and their inhabitants' activities. The development and improvement of living condition in the human institutional rely on the technical cooperation and the participation of different local people in the different level of decision of development's plans. This approach should consider as the strategy and principles of human institutional development. The sustainable development can impose an approach which it is formed with the economic and environment growth. This trend should perform in the different time and place and also it pays attention to the historical and cultural qualities (Worsley, 1998: 259).

The two concepts 'economic growth' and 'economic development' should be distinguished. The economic growth is the quantitative concept while the economic development is the qualitative one. The later concept is a growth with the increase of production capacity and also physical, human, and social capacity. The economic development relies on the economic aspect of development which it provides the facilities for the human growth and excellence. (Table 3)

The sustainability of economic activities can explain from different views:

1- *A situation is called the sustainability which the society's desirability is not limited or gone down.*
2- *A situation is called the sustainability which the management of sources provides the opportunities for production and economic growth at future.*
3- *A situation is called the sustainability which the resources of natural investment is not reduced in the way of economic growth and development.*
4- *A situation is called the sustainability which the management of natural resources does not reduce the operation of using resources over the time.*

Table 3. Defining the Components and Criteria of Economic Sustainability (Authors).

No.	***Dimension***	***Qualities***
1	Economic	One of the economic meaning is the golden mean in any work. In Moein's mind, the economic is one of the social sciences which it refers to the quality of the financial subjects, how do the free financial relation, the rules and principles survey these matters, and the equipment should be used with considering the time and place to cause the society welfare (Moein, …). The moderation is one of matters that the economic refers to it and the customary meaning of economic is the moderation. The different definitions of economic in the economist and philosophies minds are: Aristotle: the economic meaning is the management of house Adam Smith: the economic meaning is the science review of the nature and reasons of nations wealth Estoart Mill: the economic is the surveying of nature wealth from the rules of production and distribution. Ricardo: the economic is the science. Alfred Marshall: the economic is the study of human in their professional life.

		In the other definition, the economic is the surveying of humans character in the current life, in other words it is the making money and using them for living (http://daneshnameh.roshd.ir).
2	The sustainability of economic system	It means the improvement of economic foundation and accessing to the economic security, sustainable livelihoods, useful employment, safe financial sources, and finally the adapted technology with environment for using the sources (the committee of changeable, supplementary, and rural development industrial management, …).
3	The economic justice	The 'poverty removing' and 'adapting with the environment' are the main dimensions about the economic justice. The poverty has the different definitions that these difference refer to the view of definition like: the philosophy of human being, the role of human in society, the perception of social justice, attention to individuality and plurality, and the condition of life. Generally, we can say the poverty is the social, economic, and cultural phenomenon that it derives from the lack of main supply for living. The poverty is the relative meaning and it has different definitions in different places and times, but the poor are some body which they cannot provide the minimum possible facilities for living (Sameti, …).
4	The economic stability	The economic diversity refers to the number and draws of energy flow routes in economic system. It can count with the multiple different types of economic activities in system and how their energy draws and distribution. The economic diversity can get the chance for growth, development, and the stable future (Farahani, …).
5	The economic efficiency	The relation between the used data and taken data is efficiency. The data include labor force, wealth, and soureces. The efficiency is reduced by the scarcity or the low quality of environment function, it causes that the more wealth and labor forces are used to produce the equal output. The relation between the real output and expected one is efficiency (Farahani, …).
6	Proficiency	The proficiency is the benchmark for activities. All of the human activities are occurred to reach to specified goals, when we talk about the proficiency, we should evaluate any activity with its specified goal (Masum and partner, …). The sustainable development is the balanced development which it considers the systematic insight in all of the branches. On the other hand, the sustainable development is the complete form of development management which its holistic view and also implying on systematic insight try to follow the balanced approach (Latifi, …). The sustainable development which it has the justice concept in the different occasion can be the final goal and desire of criteria and regulations (Salehi, …).

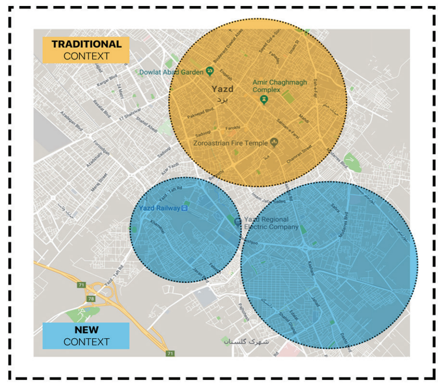
3 YAZD FACULTY OF ART AND ARCHİTECTURE; AN OPPORTUNITY TO REALIZE ECONOMIC SUSTAINABILITY

The university as an urban subsystem can make a relation with the outer system (city) to reach to the mentioned goals. The universities' spaces is not independent with their environment. So for correction the present position, we need to describe the three general aspects which they connect and work together and parallel, first of all, the inner correction of university system which it includes two parts: education and research, the improvement of outer factors, and correction the relation between two later aspects (Noghrekar, 2014).

Really, the different type of relation (software and hardware) with city is occurred by the three aspects. In the software scope, the correction about the managerial, organizational, the change of subjects headlines and others are needed, but in the hardware scope, one of the main strategy is architecture (Rahimi, …),because the architecture of universities can transfer the elements of academic culture and the fundamental values of it to the minds and souls of people (Fazeli, …). Although the goal is the realization of a general management for the buildings' body, paying attention to body is not the only possible way for reaching to desires and goals, because this process includes other aspects.

After 30 years, Yazd art and architecture school has an important role for the social sustainability admission and apply and almost economic sustainability in its located texture. This school has an invaluable collection which it includes some Qajarian and Safavian traditional houses. In the recent years, a lot of traditional houses are added to the primitive core of this school. This school can divide to two blocks: Rasoulian which it is started by the rasoulian house's devotion and Mortaz blocks which Mortaz house has a simple background. (Fig. 4)

1. YAZD CITY
(The city map)



2. DIFFRERENT PARTS OF YAZD CONTEXT
(Traditional context position in comparison to the new context)

3. UNIVERSITIES LOCATION
(Yazd Univercity is "in the city" but not "of the city".)

1. THE RADIUS OF ECONOMIC IMPACT
(The location of the Faculty of Arts and Architecture and its close relationship with the city has had a greater economic impact in comparison to Yazd University.)

Figure 4. The importance of location the YAZD Faculty of Art and Architecture in historic context and the YAZD University in new context (Authors).

The endowments have a lot of effect on the establishment and continuity of cultural, economic, and social institutions and centers. They can affect amazingly on them over the history. The devotion is one of the reason which it causes to form, order, and develop Iranian cities and their economic over the time. The primitive core of this school which it was established by the devotion (Waqf) of Rasoulian house has the economic effect on its environment automatically. (Table 4)

Table 4. Definition of Sustainable Development from Different Perspectives (Authors).

dimension	*The effect of devotion on the economic sustainable development*
the effect of devotion on the employment	The devotion causes to shape the new job opportunity The effect of devotion on the land and houses proficiency for commercial, educational, religious using The effect of devotion on decrease the unemployment especially in the low class level of society
the effect of devotion on the social justice	Decrease the class differences Prohibition the wealth focusing
the effect of devotion on the economic security	the production the vital goods like wheat, defensive weapons causes the tax, governmental, and general income security
the effect of devotion on the compensation of governmental services	Providing the sufficient financial credit for responding to the lack of fund Taking part the private sector for providing the sufficient fund Increase the service for the deprived group of people
the effect of devotion on the adjusting the money and goods on economic	Improve the effect factors on the increase of goods' production

This aspect has a close relation to the definition about the Iranian vernacular architecture and urban. The vernacular architecture is derived by the environmental qualities for responding to human needs in environment. The economic, cultural, social, weather condition have effect on this architecture which it was done by masons and architects. Generally, the vernacular architecture responds to the important condition and qualities of environment and human needs. All of the traditional architecture form were built for responding to the specific needs, living qualities, economic, and way of living (Falamaki, 2005). The establishment of Yazd art and architecture school in Rasoulian house and the development of it in the near houses by devotion and buying them are shaped by some factors like: the economic condition, the politics of management, the condition of buying or house devotion. This school has changed its environment economic condition which they have a relation with this school. The following table shows the economic impact of this school in its environment and it is surveyed in the different scale. (Table 5)

Table 5. Economic Impact of Faculty on Different Scales (Authors).

No.	
1	The location of this school in the historic texture causes to make the relation between students and local people and increase the function activities are located in the bazaar like: bakery, café, deli, etc. all of mentioned items cause to promote the economic beneficiary for the neighborhood.
2	The location of school in the Gowdal-Mosalla neighborhood causes that students can hire or buy some houses which they are near to school for living. These houses have high cost in compared other houses are located in others neighborhoods. This factor is one of item which it promote and help the economic sustainability in Gowdal-Mosalla neighborhood.
3	The meaningful presence of school and its combination with the architectural and urban spaces can create the special place which it can attract tourists and visitors in the specific period in the year. For example, the number of visitors in Newroz 1394 was 835 while it increased to 968 in the next year. In Newroz 1396, 968 tourists visited this place and in the next period it records to 983. This visiting has the income for school, on the other hand the economic beneficiary can increase in this neighborhood.
4	The relation between the school and bazaar was almost made recently by buying and devotion of Timche building which it is located near to Mortaz house. The next step is the caravansary owning which it is located between the Timche and Bazaar, it causes to make the clear relation between school and bazaar and art students can purchase their handworks, subsequently it causes the promote Bazaar boom.
5	The site of faculty may cause the government to rely on this faculty staff for giving the research project about the Yazd historic texture to them. The research agreements which they were contracted between The Wind Catcher International Research Center or Vernacular Architecture and the different organs present the mentioned items. These project have the benefit for the school and historic texture.
6	The location of this school in the traditional houses causes to make and increase the hidden economic added values of these houses. This item can achieve by differing the cost of these houses with Yazd university building in Safaeieh.
7	The conferences about the art, architecture, and urban were hold by this school cause that other universities student and neighborhood's people took part them. This kind of conferences in the Yazd historic texture increase the social information about the value of historic texrure.

4 CONCLUSION

This article discusses about the sustainable development, criterion of it, and especially the economic sustainability, and its aim to introduce the factors of economic sustainability and hidden economic added value in Yazd art and architecture school building and its impact in the its surround environment. Over the 30 years after this school was established, it has the hidden economic added value for its students, adjacent buildings, neighborhood, Yazd University, and even Yazd city. Although the placement of this school in the historic texture has some positive point, it has some negative point in the physical, spatial, cultural, and social parameters which they are the outside of this paper scope, and they do not mention.

The following table illustrates the dimension of sustainability in Yazd art and architecture school and their effect on reaching to the economic sustainability. The placement of this school and its effect on its surround environments can observe accurately and it also is taken by other universities as the pattern for increasing the economic sustainability. (Table 6)

Table 6. Economic Impact of Faculty on Different Scales (Authors).

No.	***The criterion of economic sustainability and the hidden economic added values in Yazd art and architecture school***
1	Locating in the good location (the Yazd historic texture)
2	The existence of different function (social, cultural, educational, religious, and economic) and they make a relation with historic texture
3	The historic background of school buildings
4	The development and new activity in the contemporary time
5	Making the security in the surround environment
6	Making the trust between the local people and students and staff
7	The existence of social capital
8	Adding the attractive function

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The Inter-disciplinary Significance of Traditional Recipes Used In Earthen Dwellings of the Indian Malabar Region.

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ABSTRACT

The Malabar region of ancient India presently known as Kerala is a land rich in traditional know-how and is renowned in the field of Ayurveda (traditional medicine), Taccushastra (science of carpentry) and Chuvar chitra kala (mural Painting).This knowledge also spreads into traditional architecture wherein the structures built with stone, lime, mud and wood used natural ingredients to form organic stabilisers to increase the durability of the structure particularly in that of earthen and lime plasters/mortars.

The paper follows a bi-partite approach to understand the use of traditonal recipes in earthen constructions of the region and its inter-disciplinary linkages. It will give a brief overview on ayurveda, mural art and architecture and the unique natural ingredients that ties these practices together. The use of these natural stabilisers in earthen construction will be seen through a case study of existing earth dwellings in the Wayanad region of Kerala. This paper aims to go beyond the boundaries of architecture and look into how these traditional practices surpass their realms to imbibe and learn from the other.

The main objective of the paper is to throw light on the simplicity and complexity of ancient know-how. Simplicity in the natural ingredients used and complexity in the varied applications of the same ingredient spanning across various fields. It gives insight on the richness of knowledge concerning natural resources during ancient times and sets a precedent to how a truly sustainable lifestyle could be practised. The paper will also discuss future possibilities of reviving the use of these natural ingredients as stablisers in earthen construction through mutualism and stronger collaborations with the more popular traditional practices that have survived globalisation and urbanisation in the Malabar region.

Keywords: Natural Stabilisers, Earthen Plasters, Ancient Know-how, Traditional Practices

1 INTRODUCTION

The south western coast of Ancient India was popularly known as the malabar region. The malabar region consisted of present Kerala, the western coast of Karnataka and southern Goa.Kerala is a narrow coastal strip on the south western tip of India 'Fig 1'. The state is spread over 38,863 square km, stretching 580 km in length and 30-130 km in breadth, with Thiruvananthapuram as its capital. It is bordered by the states of Karnataka and Tamil Nadu on the east and the Arabian sea to the west [1]. Kerala's rich and layered history is one of the main reasons for it being a land rich in traditional know-how and multi cutlural influences. Fortunately, not all of these influences and traditions have been lost to modernisation and rapid urbanisation which is often the case in developing India.For example, the way of life of certain hill tribes in Kerala still partially preserve that of their ancestors from the neolithic era. Kerala also was home to many powerful dynasties the Chera empire in the 9th and 10th century being one of the most famous, durng which there was great emphasis art,culture and science [2]. The first trading port in India Muziris located in present Kerala had distinct bearings on the commercial and cultural linkages with lands afar. Through these commercial relations which led to the establishment of extensive cultural contacts with foreign countries, Kerala made long-distance political and economic relations with other civilizations. All of this had an influence in shaping the unique and composite culture of the land [3]. These are the few factors that helped the rich and diverse traditional know-how across various disciplines.

Figure 1. Map of State of Kerala and geographical location of the State w.r.t India.

1.1 Methodology

This paper is a biproduct of a primary study conducted on the use of natural stabilisers in earthen plasters. During the course of this research the authors found co-relations between the organic additives used in construction and other traditonal practices. This paper covers their findings on the research carried out on the same. The information given in the paper is a result of literature and field studies carried out by the authors.

2 TRADITIONAL PRACTICES AND ITS LINKAGES TO EARTHEN ARCHITECTURE

It is not very often that architecture finds overlaps in other fields in terms of material and technique, however when it comes to traditonal practices the covergences were more of a way of life. This paper looks into the field of medicine, art and into architecture at a macro level with focus on the unique natural ingredients used for varied applications 'Figs 2a,2b and 2c'. These ingredients are later seen in their usage as natural stabilisers in lime and earthen mortars.

Figure 2a,2b,2c. Images showing traditional medicine(2a), art(2b) and architecture of Kerala (2c) respectively [4][5].

2.1 Ayurveda – Traditional Natural Medicine

Ayurveda is a system of traditional medicine that originated in India. It is a system of medicine which does not separate the body and the mind, and takes into consideration the environment - oneness of body, mind and spirit. *Ayur* means life and *Veda* means the science of knowledge.

2.1.1 Origins of Ayurveda

It was brought to Kerala between the 6th and 7th century CE by Vagbhata, a Buddhist from Sind(north India) which developed into a dynamic medical culture. It made significant progress between the 13th and the 17th centuries, thanks to generous royal and individual patronage. The knowledge of this science was initially given to 18 upper caste families and they were called the Astavaidyas, later students outside the family were accepted as disciples. This helped disseminate their knowledge beyond the family circle and create new lineages of transmission [6]. In the present day, Ayurveda in Kerala is still widely popular both inside and outside of Kerala. There are many formal colleges that teach ayurvedic medicine. Tourism being an important source of economy in Kerala, ayurveda is one of the prominent sciences on which tourism is promoted. There are many *Ayurvaidya Shalas* (Ayurvedic centres) that are set up all over Kerala that practise this alternative medicine.

2.1.2 Common Ingredients and Varied Uses

The ingredients used in Ayurveda include herbs, spices, animal products, alcohol, metals in small quantities. Plant-based treatments in Ayurveda may be derived from roots, leaves, fruits, bark, or seeds, hence it requires an in-depth understanding of regional herbs and its varied benefits. As part of this research interactions with an ayurvedic *vaidyan* (ayurvedic doctor) brought to light that almost all of the natural additives added to mud constructions seem to find a place in ayurvedic medicine as well. For example *Kadduka* or gall nut is a popular natural stabiliser added into mud plasters for its water resistive properties. *Kadukka* plays a very important role in ayurvedic medicine as it is used as an ingredient in 80% of the ayurvedic medicines due to its numerous benefits 'Fig.3'. It is referred to as *Haritaki* in Ayurveda and treats many illnesses from digestive disorders to skin conditions and improves immunity. Another example would be the *Avanakka maram*(castor) whose vegetal gel from leaves is used as a protective external coating in mud plasters. In Ayurveda, the roots and seeds of the tree are used in the treatment from rheumatism.

Figure 3. Image showing gall nut, locally known as *Kadukka*.

2.2 Chuvar Chitra Kala – Traditional Mural Art

Mural paintings in Kerala are referred to as Chuvar Chitrakala . The mural paintings of Kerala are famous for its richness of colours 'Fig.2b'. Murals in Kerala are painted with basic five colours: ochre-yellow, ochre-red, blue, green and black and their desirable combinations. Traditionally they were done using completely natural pigments over lime plastered walls.

2.2.1 History

The earliest mural paintings can be dated back to the rock cut caves of Ajanta and Ellora which are more than a milennia old. In Kerala, mural art can be traced back to the 7th and 8th century [7].
The base wall is prepared with lime very carefully as it plays an important role in the vibrancy of the painting. Different natural additives are added to lime from the first layer to the last. Murals were painted on granite or mud walls (laterite).

2.2.2 Common Ingredients and Varied Uses

The steps in creating a Mural painting can be broadly divided into 4 processes – Preparation of the wall, sketching of the outline, and application of natural colour and the addition of decorative details. In the topic of natural additives to natural plasters - it is steps 1 and 3 that are of interest to us.
Layer 1 – Lime and sand (1:2) was mixed with *Kadukka (Terminalia chebula)* or *Oonjalvalli (Cissus glauca Roxb.*) 'Fig.4'.
Layer 2 - The base mix of lime and sand is added with cotton fibres (*Gossypium herbaceum*) in 2mm thickness giving brightness to the wall.
Final Layer – This is a more fluid mix where lime is mixed with the milk of an immature coconut (*Cocos nucifera*) and the wall is coated 20-25 times maintaining the thickness to be 1mm or less. After this step the walls will attain a gleaming white colour ready to take the natural pigments of the painting.
Preparation of Pigments - Pigments are all got from natural herbs and the gum of the Neem tree (*Azadirachta indica*) is used as a basic adhesive for the paints. Apart from this many other natural herbs are used in Mural paintings for the brush, the wooden handle etc [7].

The fruits and leaves of the *Oonjalvalli* plant used in mural art is also used to plasters. This, as an additive in mud when studied showed increased water resistance. In lime, it has been proven to slow down drying process, thereby reducing shrinkage cracks and has higher compressive strength to a pure lime mix [8]. In Ayurveda it helps to treat skin and respiratory disorders.

Figure 4. Image showing the cut stem of the *Oonjalvalli* plant.

2.3 Traditional Architecture

Indian traditional architecture, has been found to construct with mud and lime since 4000 years ago[9] - the Indus valley civilisation of Mohenjedaro and Harappa, presently located in Pakistan [10]. The Charminar in Hyderabad, Andhra Pradesh built in 1591 was the first public monument in the world built using lime mortar and stone [11]. In Kerala the primary building materials used in vernacular constructions were timber and laterite blocks [12]. Other common building materials included mud, lime mortar, wood, bamboo, clay roofing tile and coconut palm leaves. Mud was used in walling, bricks, as mud mortar for laterite masonry and as filler for timber floors. Laterite blocks are usually bonded and plastered with lime mortar [13].

2.3.1 Common Ingredients and Varied Uses

The Padbhanabhapuram Palace presently a UNESCO World heritage site, was built in the 16th century in the capital of the old travancore state. The Palace is known for its shiny black flooring, which is made from jaggery lime, a combination of egg white, charcoal, burnt coconut, and river sand, buttermilk and curd 'Fig.5'.This flooring is well known for its mirror finish and durability[14]. It is clear that lime was a preferred construction material of ancient times and there is a lot of traditional know how around lime constructions and the natural additives added to it. On examination, it was found that often similar additives were added to both mud and lime constructions.

Figure 5. Image showing the flooring of Padbhanabhapuram Palace [14].

The restoration work of the Vadakkunnathan temple in Thrissur was chosen as the case study to understand the natural additives that were added to the restoration of external lime plasters to the temple 'Fig.2c'. The temple is a marvel made out of wood and stone where most of the walls are lime plastered. The restoration work was awarded the UNESCO Asia-Pacific Heritage Award for Cultural Heritage Conservation. The 1200 year old temple restoration work was carried out by a team of archaeologists, artisans and others with architect Vinod Kumar from DD architects as the project co-ordinator. The lime plasters and the wood work was restored using only the original materials – the wood was repaired and coated with a special oil made up of eight natural ingredients to protect against termites [15]. The lime plaster was done using powdered shells with jaggery and nine different herbs which include *Kadukka*, *Oonjalvalli* and *Pananchikaya (Cochlospermum religiosum)* 'Fig.6'. The whole preparation, which took 40 days and the mix and plastering was done using skilled traditional craftsmen. Details regarding the restoration process of the exterior lime plasters were given by the conservation architect and the mason who was involved in the restoration process. This work which has been documented to great detail in the research paper- "The study on performance enhancement of lime mortar used in ancient temples and monuments of India" by T.Thirumalini was particularly useful.

Figure 6. Image showing the *Pananchikaya* fruit.

The same gel of the *Pananchikaya* fruit which was used in the lime plaster is also used to dip fishing nets to render them resistant to the wear and tear of sea water. The benefits of using *Kadukka* and *Oonjalvalli* in construction have been mentioned earlier in this paper.

3 USE OF NATURAL STABILISERS IN TRADITIONAL EARTHEN DWELLINGS

India being a country with a tropical climate the mud at times requires stabilisation to render it resistant to the heavy rains of the monsoons. Additives of plant and animal base have also been added to the earth to improve its qualities- hardness, workability and water resistance. The attraction of these additives is that they are locally available, often the efficiency of these additives are largely based on traditional skill. This research paper covers the local knowledge of the indigenous people of villages of Manathavadi, Koyileri, Koottyoor, Kaatikulum, Aravanazhy and Thirunelli in the Wayanad district of Kerala who continue to practice traditions passed on from their ancestors and live in mud homes built using their traditional know-how. The data was collected from the local inhabitants of the mud dwellings which were built by them or their ancestors. In the case of the latter the traditional knowledge concerning these structures have been passed onto them from past generations and practiced by them through maintenance and repairs of their houses.

3.1 Earthen dwellings in Wayanad

Wayanad is located on an elevated plateau (700-2100m above MSL) in the Western Ghats of India. Most part of Wayanad is encircled in forests with rich cultural and bio diversity. This region was ideal for conducting field visits as Wayanad is home to many indigenous populations.The areas studied saw mud structures made of mainly *Alagu* (wattle and daub) in the Thirunelly district and *Mannu kata* meaning adobe blocks were found in places near Manathavadi namely Koyileri and Kootyoor near Thirunelly. Both these techniques were plastered with mud in the final layers with additives used that were found in the forest. The knowledge on natural stabilisers shared by these indigenous communities has greatly helped in better understanding of their traditions, culture and future aspirations.

3.1.1 Natural additives used in dwelling 1

The earthen dwelling is situated in Thirunelly, Wayanad. The house is about 100 years old and is built of adobe blocks and fired bricks. The walls were plastered using a mix of soil, cow dung, ash and hibiscus extract 'Figs 7a and 7b'.
Layer 1: Soil, sand and rice husk are mixed together, kneaded by foot and applied on the wall.
Layer 2: Soil and sand without rice husk are mixed together and applied over Layer 1.
Layer 3: Dung, soil and ash are mixed together and applied over the wall after letting it rest for a minimumof 24 hours.
Layer 4: After application of the third layer, the Hibiscus Thalli is coated over the layer once the 3rd layer has set for an hour or two.

Figure 7a,7b. Image of dwelling 1 showing the structure(7a) and the plaster pattern (7b).

3.1.2 Natural additives used in dwelling 2

The earthen dwelling is situated in Koyileri, Wayanad. The inhabitant is a farmer and is famous for his preservation of of a variety of indigenouse paddy seeds which were at a risk of extinction due to the green revolution in India. This sensibility extends to his home which is a wattle and daub structure estimated to be built 70 years ago. The walls were plastered using a mix of soil, rice husk and herbal extracts 'Figs 8a and 8b'.

Layer 1: Soil and rice husk are mixed together by adding *Kulamavu* water instead of plain water. The mix is left to rest for 24 hours and applied over the wall. This layer is repeated if necessary.

Layer 2: Ash and *Kulamavu* are mixed together and coated over the first layer. While it is applied, interesting patterns are created with the motion of the fingers.

Figure 8a,8b. Image of dwelling 2 showing the structure(8a) and the plaster pattern (8b).

Curd, dung and Urine mentioned have always been used as natural stabilisers to mud constructions all over the world. In India it is more common to use Dung and Urine in constrcution. The derivatives from the cow in India is referred to as *Panchagavya* meaning 5 elements of the cow which include – Milk, Curd, Ghee, Urine and Dung. In ayurvedic medicine the use of *Panchagavya* is of great importance as each ingredient has specific healing properties. Hence each of these ingredients are used individually too for different ailments. It is said to improve mental health, strengthen immune system and helps in de-toxification.

4 CONCLUSION AND FUTURE POSSIBILITIES

The inter-disciplinary linkages between the traditional practices prove that our ancestors understood the balance of nature and had an in depth knowledge of the natural resources around them that permitted its varied use. It is for this reason that most of the ingredients listed is used not only in mud constructions but also for medicinal and other purposes. Unfortunately this traditional knowledge database is at the risk of disappearance. In the areas visited it was noted that the local building culture was under threat due to urbanisation and government housing schemes that do not incorporate the local building techniques.The individuals who live or aspire to continue to live in earthen homes are diminishing. There is hence an urgent need to focus on not only documentation of these techniques but also look into its revival.

It is here where we can look into possibilities of reviving the use of these natural ingredients as stablisers in earthen construction through mutualism and stronger collaborations with the more popular traditional practices that have survived globalisation and urbanisation. An advantage in Kerala that could help promote the revival of natural stabilisers in construction is the gaining popularity of Ayurveda in healthcare. As most of the herbal ingredients used as a natural additive are also used for medicinal purposes, a possible collaboration with ayurvedic practitioners can be envisaged for supply of these ingredients. The success of this objective lies in the collaborative efforts towards bringing this know-how across disciplines onto one common platform. Increasing the demand for the resources and skill by encouraging all practitioners in the field of earthen construction to promote traditonal practices will help make these applications feasible and economically viable.

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Culture Led Regeneration, Sample of Yazd Heritage Site

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ABSTRACT

Different approaches for upgrading deteriorated districts run in last decades. These approaches are affected by transformation from industrial economy to service economy. One of them is Urban Sustainable Regeneration via culture. This paper aimed to introduce this new approach and one of the projects based on it. Its Content include: reviewing literature, for achieving a framework in culture led urban regeneration and one of its project that newly done in Yazd, historic site. Results shows that culture led regeneration approach has lots of potential in upgrading and flourishing of heritage and deteriorated sites. It seems that the situation is ready for operating this approach in Yazd, Iran, historic site, and Tourist Library is one of the best samples of Urban Sustainable Regeneration.

Keywords: Culture Led Regeneration Approach, Tourist Library, Rafieian's House, Yazd, Iran.

1 INTRODUCTION

A strategy for applying culture With the goal of achieving an economic mechanism can include not only the development goals, but also the cultural forms for Cities (UNESCO Havana, 2016) (UNESCO,2016) (UNESCO,2018). Regeneration of the basic culture with the basic concepts such as using of innovative economic sections and what is called creative industries(Hughes, 1998)(Rafieian, Mohsen, Bemanian, Rafieian,2011), shows that we can use of cultural approach and its positive aspects in the inner part and the central of the cities.(Yani Said, et al. , 2013) This approach respects to the old structures, while it adds new one to it and offers a function which has been led to the cultural and social currents with economical and productive infrastructures(IWAMOTO,2008). In addition, having a kind of convergence in the purpose and urban regeneration, confronting to the dual dominance thought of hotel-restaurant which has a major role of land use changes in historical textures, and finally diversification of activities to recreate the life of cities will be done. This article is divided into three sections: theoretical basis, introduction of the tourist library and the Rafieian old House Renovation Project(Ifko, 2016)(Bahreini, Ezadi, Mofidi,2013).

2 CULTURE LED REGENERATION

2.1 Culture And Regeneration

Culture and its representation is considered as an impartible part of every city's relationships; it means that every city is known for its culture and its appearance(Hong Hwang, 2014). New urban conditions bring up culture as a factor for development in current years. In fact, the economic development based on the culture(Vickery, 2007). The culture and its role on urban development has instability in consept during decades. Between the 1940-1960s, culture was apart from economics and productions. This is the time that in some opinions, urban restoration is still revitalizing and still influenced by global wars (Bianchini, 2007). During the 1970-1980s, culture plays a role on social and political purposes, but since the 1990s, when some people have called it the "era of partnership", culture is used as a tool for economic and physical regeneration of the city and also used in urban policy (Kong, 2000)(Brown, Alsalloum, 2018). In this way, over the past three decades, efforts to transform the past cities by focusing on industrial and productive activities's centered, to today's cities with the focus on service activities, done by culture led regeneration (Garcia, 2004). In other words, the main goal of the regeneration is to bring convergence of the two processes of culture and economy (Bianchini, 2007). Then after, various analyzes of the role and importance of the cultural approach to urban regeneration are done and it can be said that "urban regeneration of culture-based" has become a fundamental approach in urban restoration and protection field(Local Government Association, 2019).

2.2 The History Of The Culture Led Regeneration

Since the 1970s, many European cities witnessed an unintended restructuring due to the relocation of industries and consequently, employment, the migration of the urban middle class to the suburbs, the changing pattern of employment, the development of shopping centers outside the cities and the increase of ownership and dependency on the personal car (Binns, 2005: 1)(Malikova, L. & Sirak, 2008). The consequences were poverty, delinquency and unemployment in urban centers, so we can seek the motive for the emergence of urban regeneration with cultural approach to it (Bianchini, 1993). Soon after, urban planners, urban managers and those who involved in, understood that constructing of office towers, commercial complexes, passages and stores are not applicable to regenerate on their own (Hannigan, 1998) (Lotfi, 2011). In such circumstances, an analysis of urban conditions, the potentialities of the cultural mechanism of cities, and new economic ideas caused a redefinition of development for cities. Eventually, despite the changes in many economic mechanisms, and cosidering cities have been long the areas for producing culture and innovation and according to artistic tastes, preferences and tendency to all kinds of fashion that have been evolved in cities, cities would survive if they used them as a fundamental strategies (Harvey, 1982)(Liu, 2019).

3 USING CULTURE LED REGENERATION IN IRAN

The process of defining activities and uses in historical contextures of Iran is usually slow, and also unilateral without economic risk in some cases. Therefore, more changes have been made to creating more tourist centers such as hotels and restaurants, and less workshops, handicrafts and cultural-economic uses and only in a few cases, there are a variety of culture led regeneration and creative industries(Rafieian, Mohsen, Bemanian, Rafieian, 2010). However, there are international, national, institutional and legal conditions for the comprehensive uses of this approach. In recent years, the cities of Shiraz, Isfahan and Tabriz have joined the network of creative cities and Yazd has also been the candidate for the creative city in 2017. It is also a good cooperation from responsible institutions for creative industries and base culture in historical contextures (Shabani & Ezadi, 2013) (Rafieian, 2010), so The Rafieian Historic House Renovation Project and turn it into a tourist library that began in 2014, has been successfull so far and also been exploited its first phases.

4 COMMON PROCEDURES IN REGENERATING THE HISTORICAL CONTEXTURE OF YAZD

In recent years, the historical contexture of Yazd has been the subject of many interventions to restore and improve. Some of these interventions is just formal and done through the decorative approaches that we can mention the growing trend of access to pavement by using washbeton technology to prove it. Some parts also based on improvement and renovation field. Locating some administrative, educational, commercial and tourist services are in pursuit of this goal. Faculty of Art and Architecture of Yazd University, Restoring of 22 Historic Houses, Imam Javad Yazd University Restoration of 4 Historic Houses, The Administration of Cultural Heritage, Municipal Construction and Improvement Company, Housing Comoany, Tourism Institutions, and the most important thing is that, there is a huge amount of traditional hotels and restaurants in the historical contextures. These activities are in three categories of cultural-educational, administrative and commercial activities. A brief overview of these activities shows that the first two were more directly supported by the government budget or the "oil budget" and the third category has been developed by the private investors support. In recent years, due to inadequate government budget, the activities of the first two categories have been declining and the dominant thought of regenerating, just bacome the "Hotel-restaurant". Folowing this procedure has slowly led to local protests ,and tourists cosidering it to be overwhelming and irritating in the historical contextures. It seems if there is no solution for new regenerational activities in changing of historical contexture to become just commercial and services use, it would be a serious threat to sustainability in its development. In recent decades, there have been many policies in dealing with issues of historical contextures, environmental quality increas, social status, liveliness that the culture led regeneration has lots of potential for improving the condition and thriving of old contextures among them and the conditions is also prepared to accomplish.

5 YAZD HERITAGE SITE

The historical contexture of Yazd city is one of the unique examples of Iranian architecture that belongs to the historical periods of the Ilkhani, Safavid, and Qajar that UNESCO registered it as one of the historical city at the forty-first conferences of the UNESCO World Heritage Committee in Krakow, Poland. The area of the heritage is approximately 700 hectares which 195 hectares is district and 500 hectares remaining is called margin.

6 INTERNATIONAL TOURIST LIBRARY

In the investment of historical contexture development, the major share in changing of uses, belongs to the dominant thought of "Hotel-restaurant", although the tourism industry needs to have a diverse range of uses. The need to develop the culture of reading and the information centers is becoming increasingly felt today. Todays. Historic cities of Iran are the destination for lots of tourists who care about learning and research, though it is a glimpse. Some tourists also make the plan to know Iran's culture, art and civilization. The tourist library is a must-see place for this matter. There are several tourism libraries in the country which none of them could have been a tourist library.The library of tourists focuses on serving tourists, however it has never claimed to be a specialized tourist information center, and with minimal resources trying to provide a fast and comprehensive service to the tourists.

The tourist library based on the tourism economy; it means while it is seeking specialized information service for tourists, it manages his economy with the definition of the membership fee, and by utilizing the attractions of its historical contexture and position trying to promote economic self-esteem and stimulate development in the field of geography and culture in combining culture and economy.

Figure 1. This picture shows one a calm and traditional reading hall and also the bookshelf around it. As we can see, tourists can find the book easily and read them there.

7 MAİN PARTS OF TOURİST LİBRARY

The library activities are mainly carried out in two scientific and cultural fields, so that, some parts is dedicated to activities such as holding lectures and scientific and cultural seminars ,and some other parts is for keeping book and reading hall. On the sidelines, tourism-related services and catering activities are presented.

7.1 Tourist Library

This project is a collection of many books on various cultural, artistic, historical, architectural, religious subejects realated to live languages of the world.

7.2 Scientific And Cultural Lectures And Seminars

With a timetable that has already been informed by tourists in various ways**,** seminars will be held with cultural, artistic and historical issues by experts and university professors at the library in English, German, Italian, French, Espanyol and Chinese.

8 INTRODUCING THE LOCATION OF THE PROJECT

The Tourist Library that is known as the Rafieian Historic House, located in northeastern side of Boostan Shah Abul Qasem of Yazd city. Shah Abul Qasem surrounded by four neighborhoods: Koosheke no in north, Darvazeh Shahi and Chahar Suq in south, Fahadan, Bazare no and Vaght o Saat in east ,and Lord-e Keyvan and Seyed Goleorkh street in west. Its name was taken after Shahabuddin Qasem Traz. Also there is a mosque and a school as the same names that became costomary as Shah Abul Qasem during times.

8.1 Rafieian House

Rafieian House has been registered in No. 31285 in the national heritage list of IRAN. This family collection consists of three inner, outer and Narenjestan courtyards. Since 1955, each courtyard is separated in Separate registration numbers by the form of a separate document. Rafieian House is the outer courtyard of main property.This building is dating back to the Zandieh and earlier Qajar era(250 years ago). Since Qajar era, many extensions have been added to the building, so this house registered as Qajar date. Pahlavi's extensions also strongly influenced Qajar architecture of the house that for example include removing the 5 doors and bladeing the facade and blade out of the hall. Perhaps the reason is the modernism paying attention to the functionalism in recent century which caused all the home decorations disappeared underneath the gypsum plasters.

9 A REVIEW OF RAFIEIAN HOUSE RESTORATION

Since the House date, back to Qajar era, it is considered that all desructive extensions will be removed due to heritage value. It makes a re-connection among the collection and neighbors.

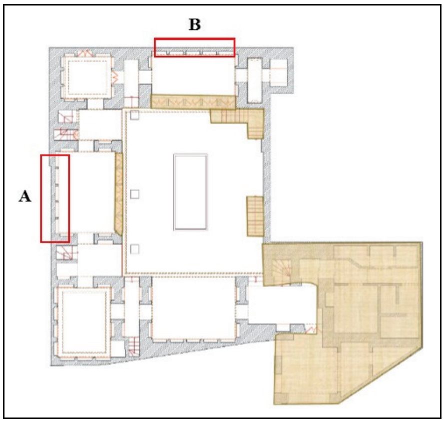

Figure 2. This is a plan of Rafieian House site. In part A, based on the probability, the blade wall was connected to western courtyard and had own hall and separate space for both winter and summer. Part B shows a bale wall which was originally connected to the neighbor's house or the Narenjestan courtyard.

The repair began removing the extentions from the northern part of the building. According to the old age, it was anticipated that added walls on the northern part, have been in the last decade. When removing these extensions, the sharp arches of Qajar era emerged. In the sequel, they showed two doors on the right and left side of the north that their forms were protected and just filled with brick. This indicates the presence of 5 doors that were left 2 (1 & 5). Therefore, during the project, it was decided that the 5 doors would be restored.

According to the decorations appearing on the north front of Rafieian House, it is not far from the poit that may there are also the similar decorations on the western front. So with more precision and safty, the wall of the west front was also removed, but there were no 5 doors there. Regarding the cracks drawn on the wall and the assumption of existance some shelves under the plastered gypsum, the overlying layers were carefully picked and it showed the rows of shelves that were filled with bricks. According to the symmetrical and regular rhythm of the shelves, it was assumed that there are 5 doors also in this hall, so they were re-built there.

The Southern Hall which became the storage space, had 2 metal doors. Supposed having shelf in North and West Halls, South Hall was removed from the extensions. There were no doors, but shelves shaped like a horn and square and rectangle that were completely different from the Northern and Western Halls, emerged. So The Southern Hall was preserved and restored in the same way.

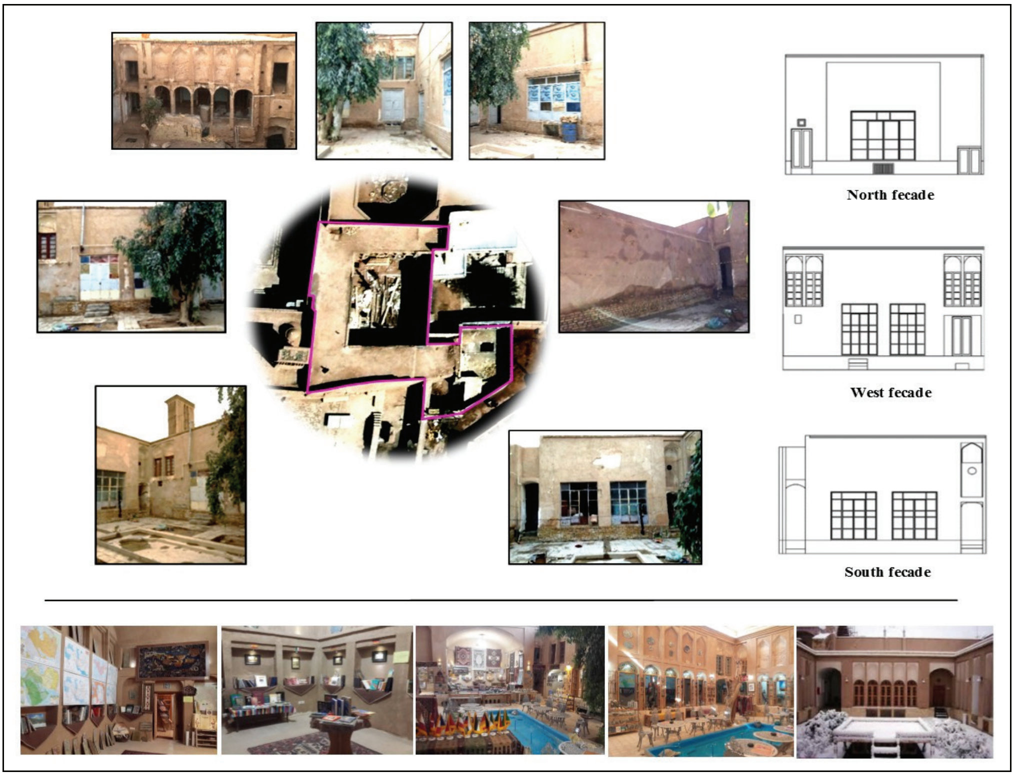

Figure 3. This picture displays some forms of the house before and after restoration. The house repaired in the best possible faces. North, west and south fecades are clearly illustrated.

10 SUBSEQUENT EFFECTS OF THE PROJECT

The Yazd International Library Project has a good relationship with the center of "Shah Abul Qasem" neighborhood, and connection between the garden next to the project and adjacent to the library has been considered. In the beginning, "Shah Abul Qasem" was a cozy place for the gathering of delinquents, the adjacent registered number became a place for trash due to demolition and vacillation of the contexture and also "Alaqeh Band" mosque that was without a trustee, had been plumb. The project went on the neighborhood liveliness into two soft and hard parts. In soft: Strengthened social monitoring by defining a long working day from morning to night, and use of the indigenous and local volunteer or paid employee to manage the library. In hard: make the neighborhood center upgraded by improving the neighborhood landscape, change the place of garbage to the mosque's toiletry facility, activate "Alaqeh Band" mosque and installing CCTV.

11 CONCLUSION

Todays, the combination of culture and the economy is one of the most common approaches to sustainable development. Although, the investments were aloccated to build hotel-restaurant in the past, it redirected to the new development ideas that are rising now. One example is Rafieian Historic House renovation project With the aim of upgrading part of Shah Abul Qasem neighborhood in Yazd historical Contexture that could be successful according to being in one of the bases of creative development. The multi-dimensional goals are being implemented in this project. On the one hand, surrounding contexture has been upgrading, and on the other hand tourists are increasing. The point is, though it has been a little over the start of the project, similar projects have begun, such as the Painting House Gallery.

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Reviving Place Identity and Extracting Rural Housing Pattern for Sustainable Development of villages Case Study: Tooran-Posht Village

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ABSTRACT

Villages are one of the social human gatherings, which have had a direct connection with dwelling since the beginning of time. The main element in the making of rural texture is its housing and how this element can have a significant impact on the rural community. Iran's rural housing architecture has had many deep splits for many reasons in the last half century and has lost its graduate path to sustainable development. In order to better comprehend the rural housing quality, recognition and analysis of its strength and weakness points should be emphasized. In most villages nowadays, the abundance of interference has led to undermining the role of place identity in the sustainable development of villages. The houses are the main element that make the rural texture and space organization; how it is settled and built specifies the quality of the environment, its identity through the years, the influence of economy, tradition, and the norms that oversee the society.

In order to recognize the concept of place identity, its formation process needs to be studied and extracted. Village identity is derived from culture and the unwritten rules of the village's society. In this paper, by studying three houses from the authentic and historic texture of Tooran-Posht village in Yazd, and acknowledging the essential factors of place identity such as: structural body, space and function, the main elements of the Tooran-Posht village identity has been recognized. Using the recognized identity, a proportionate housing pattern with the modern needs of the villagers is extracted. The design and planning process of sustainable rural housing should present patterns in which on one hand can help preserve the native architecture and identity elements of the village and on the other hand, it can be a guideline for future sustainable development. In this regard, going through this path can lead to a suggested solution for maintaining the vernacular housing and texture of a village.

Keywords: Place Identity, Rural Housing, Sustainable Development, Tooran-Posht Village, Yazd

1 INTRODUCTION

The rural environment, which is the space of manifestation of pure place, owes its integrity to the potential of the environment. These are the potentials that come about as a result of human interaction with their environment and to respond to an accepted level of their comfort needs. Hence, the spaces created have spatial characteristics that are unique to the characteristics of the human interaction environment, and given the diversity and differences in the characteristics of each environment, spatial spaces with unique spatial qualities will represent the phenomenal nature of villages [1]. Therefore, the village cannot be called only a few buildings, but the village originates from the type of human interaction with the context in which it is inhabited and it forms the beliefs and behaviors of human beings.

The village, as the first phenomenon of sedentary, has always played an important role in the economic cycle of cities and countries throughout history. If the city is considered as the product of the industrial revolution, the village is undoubtedly also stemming from the agricultural revolution [2]. What is already known as the distinct difference between the city and the village is the tendency towards agriculture in the villages. The natural causes and effects of the earth have been neglected in their sustainable development, and the pursuit of nature does not play a role in space designing, the texture of villages is in harmony with natural factors, and in this respect, more organic texture is formed. The village body is a place where rural activities can be formed. To provide an overview of the physical condition of villages, recognizing the internal organization, component analysis, and strengths and weaknesses is crucial. Since the physical shape and texture of the village is the result of human interaction with the environment, one of the best ways to know the extent to which physical spaces respond to the needs of people is environmental research. In most of the big villages, due to the large volume of physical interference, the sustainable development of the new texture is without unity and integrity. This has led to the loss of the original identity of the newly developed parts of the village and the village has lost its prominent feature, identity.

2 PLACE AND VILLAGE IDENTITY

Some theorists consider identity to be essentially a cultural creation. Culture is the most important and richest source of identity. When we speak of culture, we refer to ways in which humans individually and collectively give meaning to their lives by communication with others. Of course, this connection will be meaningful if it is established within the framework of identity boundaries, while at the same time helping to strengthen and consolidate such borders [3]. Beyond culture and tradition, it is sometimes necessary to recreate something that can be activated and revived [4].

One of the issues facing the inhabitants of today is the lack of identity and sense of belonging in the place of residence; residence means a significant bond between man and the world [5]. Place identity is a part of personal identity and reflects the social and cultural aspects of a place that will play a central role in the richness of individual personality. Place without identity reduces the social presence of the residents and leads to their sense of loneliness in potential threats and lack of belonging to the place [6]. The problem of architectural identity is a global issue. This is the result of the phenomenon of globalization [7].

The place is the bedrock of the culture, architecture, and the place of life of the people who created it during its time. Place identity changes occur in the lifetime of a person. This infrastructure of personal identity involves understanding the environment [8]. The village's body is influenced by the various relationships and factors that surround a village and the people that make up the village. Factors such as geography, construction materials, social and psychological security, economics, the public landscape and religious factor. The complex relationship between these factors all affects the body of the village. The current cultural spirit in the building is influenced by all the spiritual factors connected with the original culture of the land. This cultural spirit is one of the factors shaping the identity and main characteristics of the village that the village is known for.

It has been proven that architecture is always associated with human beings, and architecture is a kind of container for its own, human beings. This close relationship between the human body and the architectural body makes it possible for both of them to interact, in such a way that human behavior and values can be seen on the architectural object. Traditions, local customs and unwritten laws among the villagers all affect the traditional and native texture. From the psychological and physical point of view, security is the basic human need. For this reason, for example, the entrances of the houses are close together and the texture is concentrated in order to protect them from the enemy attack. Given the political and cultural conditions of the present day, it can be predicted that in the future, human identities will be more likely to be subjected to change and danger. Considering the above-mentioned issues, it is necessary that the identity of the village be reshaped in such a way that it is adapted to the needs of its inhabitants today, and that this method of identification and revival will be used in Iran and even the world.

3 TOORAN-POSHT VILLAGE

In this paper, we tried to study the village of Tooran-Posht as a village in a warm and dry region to extract the appropriate housing pattern in order to provide the current inhabitants with the spiritual and material resources, as well as to restore the past identity of the village. It will cause other people to return to the village and choose it for permanent residence. This village is considered to be a good example because of its historical importance and because it is located in a warm and dry area in a mountainous setting. The village of Tooran-Posht is located in the central part of Taft city, Yazd province, Iran. The village dates back to about 1,500 years, although the inhabitants of the village estimate its history goes back to about 2500 years ago. Over the hills overlooking the village, four domed monuments are build, such as Gonbad Ali, in Abraqoo, which all went into ruin and recently thought to be restored and renovated [9].

Figure 1. Aerial photo of Tooran-Posht village behind

4 TOORAN-POSHT HOUSING CASE STUDIES

To investigate the identity of the Tooran-Posht village, it is necessary to first analyze some of the housing. The criteria for this work are factors such as body, space, and function. According to these criteria, it is possible to extract the behavioral pattern of Tooran-Posht, and, based on that, recognize the past identity of the village and derive patterns according to the residential needs of the inhabitants. Extracting a new pattern causes the physical and behavioral identity of the village to be restored. In this paper, it has been tried to find the appropriate pattern by examining the cases mentioned in the residential buildings of the village in organic texture. Each of these factors includes subsets.

1) The body includes climate, orientation, light and wind, open, semi-open and closed spaces.
2) Space includes hierarchies, module elements.
3) Function includes livelihoods, open and semi-open spaces function, and structural behavior.

The process of extracting the identity of the village of Tooran-Posht and extracting its housing pattern is shown below.

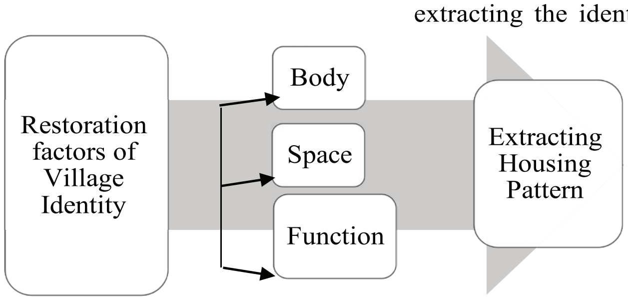


Chart 1. The process of extracting the housing pattern of Tooran-Posht

4.1 Case Study I

4.1.1 Body

The first case study is located behind the Tooran-Posht castle and has a special style. This house has a vestibule and is divided into two parts and, unlike other houses; the main part of the building is not in the main view. It has two separate yards, one for animals and one for residents. The main feature is the presence of a vestibule entrance that has two main accesses from one side to the courtyard and, the other, a walkway that leads to a stairway to the first floor above the stable. From the second vestibule, we have access to two rooms, one of which is a kitchen (Matbakh) and the other is the Talar. To reach the first floor of the residential wing, there is an exclusive, semi-open staircase, which leads to the first floor and has access to two upper rooms. (Figures 2 and 3).

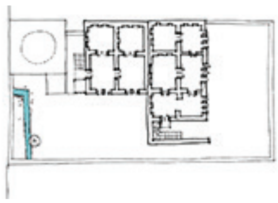
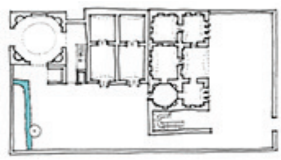



Figure 2 and 3. Ground and first floor plan

The building is "L" shaped, which follows the pattern of most houses of the old texture. The presence of a vestibule has added to the area of the building, but more space is still reserved for outdoor space (Figures 4 and 5).


Figure 4 and 5. From left to right: the corridor near the entrance - first floor rooms

The orientation of the house is two-way: the first courtyard is facing the west and the main building is facing the south and has an eastern-western orientation. Because of the mountainous weather, the house is not in the wind direction. The courtyard is completely shaded and water passes through it for the water mill (Figures 6 and 7).

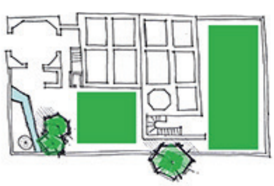
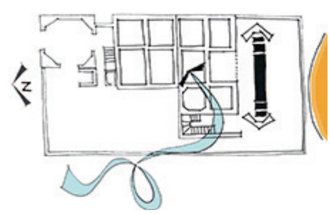



Figure 6 and 7. From left to right: Vegetation – Orientation, wind, sun

4.1.2. Space

The two first floors do not have access to each other and access to each room is only through the previous room. Each stable also has its own eating area, which acts as a side room for stable. Each wing has its own stairway. The main point of this house is the presence of two vestibules as the prefaces of the entrance, each assigned to one wing (Figures 8 and 9).

Figure 8 and 9. Hierarchy of the ground and first floor

The components that are repeated in the house are the stairs of the building as well as wooden doors facing the courtyards. The presence of the Talar and the two lateral rooms can also be considered as motifs. The presence of wooden beams of the ceiling can also be motifs. Each room has a side room that has been replicated throughout the house. The presence of the vestibule for each wing is also the main attribute of this home (Figures 10 and 11).

Figure 10 and 11. The façade of the two wings of the building

4.1.3. Function

The two courtyards are the two main open spaces of this house, the first courtyard (outer) is for keeping animals and the second courtyard (internal) for the residents. The presence of the Talar in the main awing is also a major feature of the semi-open space. In the main wing, through the corridor and stairs, they have access to the first floor, each with separate side rooms (Figures 12 and 13).

Figure 12 and 13. The open and semi-open spaces of the ground and first floor

As mentioned above, in contrast to other houses, it has two wings. The two wings of this house are unrelated and their structures work like two separate houses. The presence of a vestibule in its first wing is a separate structure that is covered with a dome. The ground floor has a stone structure. On the first floor, only an adobe structure is used. (Figures 14 and 15).

Figure 14 and 15. From left to right: the point where the two wings meet – structural function

4.2. Case Study II

This unoccupied house is located near the castle of Tooran-Posht. Because the reconstruction has not been done, it can be a good example of the original texture of Tooran-Posht. This case study can be considered as a native example of Tooran-Posht residential houses.

4.2.1. Body

The house is divided into two wings, which one is dedicated to the animals on the ground floor, and the other wing is for the owners. At the ground floor, three other rooms are located next to the bathroom. A staircase accesses the first floor where there are four rooms. The first floor of the other wing also has access to the balcony. The land of this house is almost square-shaped (Figures 16 and 17).

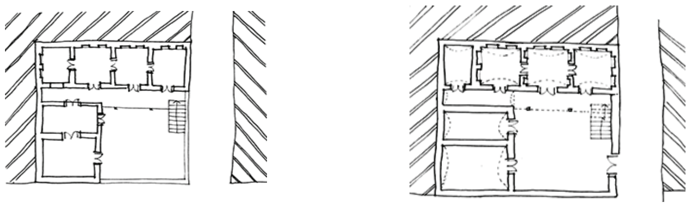


Figure 16 and 17. Ground and first floor

The main building has an east-west orientation and receives southern light. The animal holding area is eastward and has north-south orientation. The presence of water in the yard has enriched the vegetation of the house (Figures 18 to 20).

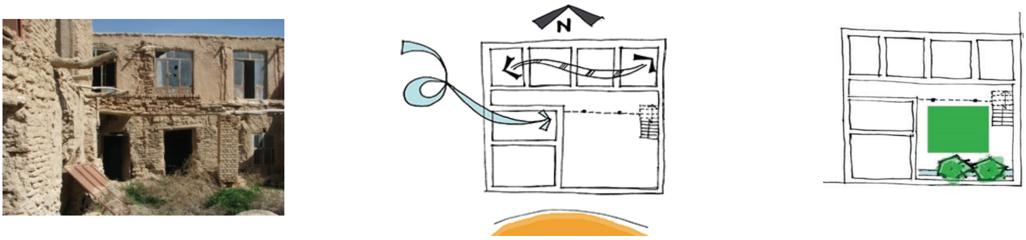


Figure 18 to 20. From left to right: façade - Orientation, wind, sun – Vegetation

4.2.2. Space

When entering the building, it is visible that the main wing is facing the south, and all the rooms open to outside. The first floor is accessed through the stairs and the balcony, which has separate access to each room and runs through the corridor between the two wings (Figures 21 and 22).

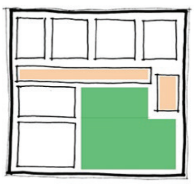
Figure 21 and 22. Hierarchy of the ground and first floor

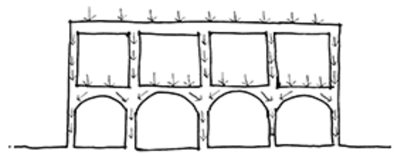
Factors that are repeated in this house are the presence of exterior stairs, as well as doors that all open to the outside. The presence of beams and wooden columns for the first floor balcony are all components that can be used as motifs. The connecting corridor between the two buildings on the ground floor, as well as the balcony on the first floor can be considered as main points (Figures 23 and 24).

Figures 23 and 24. The façade of the two wings of the building

4.2.3. Function

Open spaces are related to the courtyard and balcony. The semi-open space, which includes the space below the balcony, is the entrance used to enter the rooms. Closed spaces include spaces facing south and east that the eastern wing is for animals, and the south wing is for the inhabitants. The ground floor structure is made of stone and adobe, and the arches are used for its roof. For the first floor, an adobe structure and a wooden beam have been used. There are four closed spaces on the first floor, unlike most of the villages in Tooran-Posht. The absence of the Talar and the two side rooms are one of the features of this house (Figures 25 to 27).





Figures 25 to 27. From left to right: The open and semi-open spaces of the ground and first floor - structural function

Allotment of a whole wing to stable shows that livestock was the main source of livelihood for its inhabitants, and a significant portion of the house was dedicated to this. Using the yard to plant vegetables and walnuts and almonds trees, is a clear sign of the impact of livelihood on home construction.

5 EXTRACTED PATTERNS

According to the case studies, the common patterns of housing construction in the village of Tooran-Posht are:

In the historical texture of the village, they often use indigenous materials -use of clay in its combination with wood or stone- and due to the mountainous topography of the village, the inhabitants have had a limited ability to create regular geometric parts for their land. In this regard, most lands in this area are formed only based on the shape of the earth and the direction of its slope, and many of them have irregular shape and form. The village, which is located on the bed of stone, has affected the size of buildings and segments. In some cases, the size of residential units is very small and even below 100 square meters (Figures 28 and 30).


Figures 28 and 30. View of the village's texture

The basic principles of the native architecture of these areas are as follows:
1) Use of dense and compact texture
2) Use open plan to maximize the use of landscape views
3) Use of materials that have good thermal insulation and insulation
4) Settling residents on the top floor of the building and the stable below it

6 SUGGESTIONS BASED ON PATTERNS

The suggestions made to restore the identity of the village of Tooran-Posht are as follows:

1) The use of indigenous materials: the use of building materials and mines in the region, which, in addition to reducing the costs of transporting materials from the surrounding areas to the village, also provides the opportunity for the villagers to work in construction. Thus, due to the existence of marble and marble mines, as well as the use of these rocks in the walls and texture of the village, this material was considered as indigenous materials. Adobe materials, such as clay, are also easily available in Tooran-Posht. In addition to the economic benefits of utilizing indigenous materials of the region, achieving coordination and integration of different parts of Tooran-Posht is another result of this.

2) Climate design: Due to the warm and dry climate of the open forms or the shape of which the north-south orientation are longer than the east-west orientation, it is better not to have the building in compacted form and square in plan. Two-story buildings with a cube-like shape are the best type of building for controlling indoor air temperatures in the winter. In hot areas, closed and compact forms and cubic buildings or buildings that are clustered back to back in the direction of the north-south axis are better. The building should also be in a direction that receives the most sunlight in the winter and the lowest radiation in the summer. Because of the cold weather in winter, these open forms with their northern-southern sides longer than their eastern-western sides are not suitable and past architects have best resolved this issue.

3) Construction system: In residential units of the village, one can refer to a type of construction and architecture system, which is the same as the load-bearing wall and the beam covered roof. Meanwhile, in village houses, the roofs of the lower spaces that are dedicated to the stable are made out of adobe and have arch vaults. Large and thick walls are seen in older homes. In all types of residential buildings, the wall thickness is considered acceptable.

From the above, one can consider an appropriate housing pattern with regard to the identity of the Tooran-Posht; the extracted pattern is as follows:

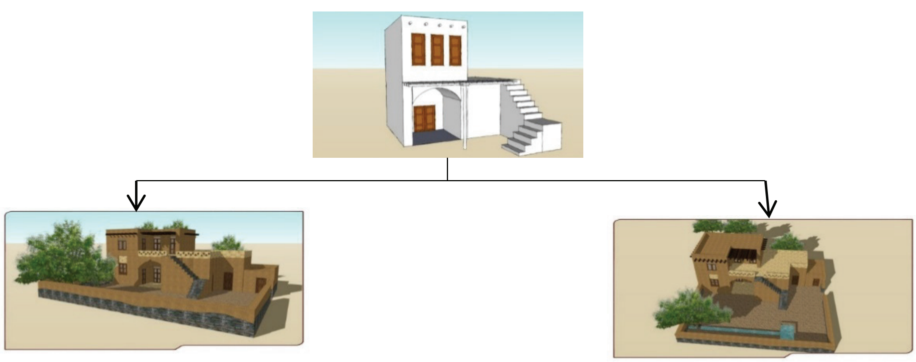


Chart 2. Simple extracted pattern to a complex extracted pattern

7 CONCLUSION

Village identity is the pillar of the main housing patterns of the village of Tooran-Posht, and village identity analysis is necessary to determine the proper pattern for Tooran-Posht. Considering the factors used to restore village identity, patterns can be derived based on the case studies, and, taking into account the conditions of the region and the needs of today, the villagers can reach a texture appropriate to the native architecture. This process can help save the cost of construction that will lose its effectiveness after a while. The large budgets spent on sustainable rural development, if not programmed right, are not useful, but if sustainable rural development is based on the identity of the village, the defined patterns derived from the houses of the village can be used in future houses.

This method is not specific to a village with special conditions, but it can be extended to all villages in the country and used in the design and planning of rural development. It is hoped that the extracted patterns for the village of Tooran-Posht will gradually be used by the villagers and incorporated into native architecture and will also be used for new construction.

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Antoine Predock: The Master of Adobe Contemporary Architecture


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ABSTRACT

Adobe architecture is one of the technics of the local and traditional architectural styles since the very early ages, which is seen in a wide geography and used by many civilisations, the examples of this technic can be seen in such as ancient Egypt, ancient Greece, or in civilisations of Middle East, etc. Although Predock rejects the notion that he is an adobe architect, it is clearly seen that there are references of detailly worked adobe technic in his projects.

In 1967 Antoine Predock established his first office in Albuquerque, New Mexico, on where he could find possibilities to understand the fine details of making adobe construction. During his career he has been honoured with more than 100 national and regional design awards in addition to the American Institute of Architects Gold Medal since his career and in 2007, he received the Lifetime Achievement Award from the Smithsonian Cooper-Hewitt National Design Museum and he was a Rome Prize Fellow at the American Academy in Rome, and is a Fellow of the AIA, RIBA, and RAIC, and was a William Kline Fellow at Columbia University.

The references to southwestern American national and traditional adobe architecture can be seen on his works, on which he designs blunt, windowless forms as if they are pieces of local adobe building examples and it is seen that the muted earthen colours he employs also seem typical of a desert climate, although he has made a group of examples as under the abandoning of these colours on his Santa Fe based or Californian designs. Thus, it can be said that he is a master of adobe contemporary architecture, who loves to design contemporary architectural examples in use of national materials and local and traditional techniques, such as on The Institute of American Indian Arts Museum, in Santa Fe or on Euro Disney's Hotel Santa Fe in Paris, and etc.

Keywords: Antoine Predock, Adobe Architecture, California, Santa Fe

1 INTRODUCTION

Antoine Predock is Lebanon, Missouri in 1936, and he founded his office in 1967 which is located in Albuquerque, New Mexico. By April 2019 the second base of his office has been founded in Taipei. Without doubt he gained attention at first with La Luz Community, which is located in Albuquerque, New Mexico. During the years of it's foundation LA Luz Community has been announced as the most important cluster development in New Mexico, which is a planned area development project. La Luz offers privacy and security to the community and is self governed by the community, as well. Not only by the project but also by the administrational model La Luz has been known as the most well-known and one of the best example of home situated unique community (1,2,4).

His glorious story has been continued by the award gaining project of the limestone material based Turtle Creek House for avid bird watchers in Dallas, Texas in 1987, whereas the construction of the house has been finished in 1993 (4,2).

But maybe Predock's architectural synthesis of local materials and traditional techniques has been clearly seen on the New Mexico Museum of Art Expansion building that was completed in 1999 in Santa Fe. During the process he also made renovation of the old museum building as well. One another important early design of Predock is The Tang project that was opened in 2000, includes two major gallery wings (the Wachenheim Gallery and the Malloy Wing), two smaller galleries (the State Farm Mezzanine and the Winter Gallery), digitally equipped classrooms, and several event spaces (1,2).

With more than 50 completed projects Predock's architectural style can be described as a synthesis of local architectural formation schemas in a global visibility by an artistic wisdom.

2 "INGREDIENTS" OF PREDOCK'S ARCHITECTURAL WISDOM

The process and the product of constructing is known as architecture in general view; with another words it is also known as the art or practice of designing and building structures and especially habitable ones, which can be defined as a unifying or coherent form or structure (6). If the history of architecture is put under a zoom it is known that the chronological explanation is started from the definition of the first habitats. A habitat is a housing for a controlled physical environment in which people can live under surrounding inhospitable conditions or the typical place of residence of a person or a group in a general point of view, on which the environmental factors are important on its' foundation that are known as context on architectural field (6).

Context, by a simple definition, is environmental factors that influences the construction of building. By a general point of view, contextual factors include the nature of the surroundings, which consists of both natural and built elements. Basically, the context has a promote continuity between the building and local circumstances (6).
In a vide view the architectural equation among choosing of local materials by using of traditional techniques and content of the context gives the vernacular architecture as a result. Vernacular architecture has the following specialities;

- The availability of resources
- The skilled workforce
- Climate
- Historical influence
- Local culture
- Environment
- Natural and local skills
- Local technology

These are also the important points of Predock's architectural fiction which is named as portable regionalism. It is defined as local material and techniques touch on universal perception.
It is a general belief that for designers to create any good building design, it is important to understand the local context which can broadly be classified as:

1. Micro-climate,
2. Topography, and
3. Natural habitat of a site

All above criteria directly or indirectly influence design decisions in the design process. It seems that the architectural choice of Predock is build up on local material using by traditional techniques even if on big size public buildings as on small size vernacular architecture.

The philosophy of his work consists of 4 basic issues;

1.Clay
2.Body/ Motion
3.Roadcut
4.Desert beginnings
(2,3,4)

The localisation of New Mexico and it's constructional possibilities along with the socio-cultural background of the region formalised the outlines of Predock's personal style. With his words it is understood that the experience of him working on a region like New Mexico makes a wake up call on his architectural style formalisation as a pusher force, a force that has entered his system of designing and composing of many things on a wide view. According to Predock;

"…Here (New Mexico), one is aimed toward the sky and at the same time remains rooted in the earth with a geological and cultural past. The lessons I have learned about responding to the forces of a place can be implemented anywhere. I don't have to invent a new methodology for new contexts. It is as if New Mexico has already prepared me" (2)**.**

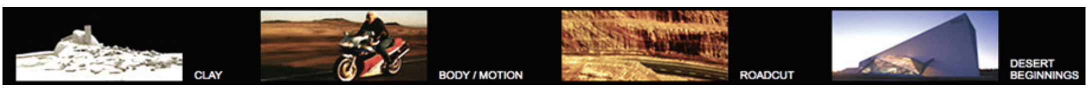

Figure 1. For basic issues of Predock's architectural philosophy.

This web of methodology is named as a philosophy of architectural point of view that has 4 basic issues as it is given above. These 4 issues are acting as the trivet of his architectural style.

2.1. Clay
" When a project is formative or embryonic the drawings are often terse and immediate, a kind of encoding or DNA that will inform the making of the building" says Predock. When his projects are encoding it seems that the DNA of his projects consists of the adobe, clay and local materials based actual regionalism in an universal point of view says Sagdic (4).

He likes to work with adobe material in reality and in three-dimensional model making with clay material to design the final form. He uses tiny - three-by-five inches like Cal Poly, or very large, like the one for Agadir which is five feet long and three feet wide. He says that "I am still exploring as I work with the clay but I am working toward a finality. Compared to a drawing on paper the models are very real; they are the building. They are not 'massing models,' they rationally address section and plan.. So I don't do an architectural concept sketch and see if the program has anything to do with it.". It can be understood that as the ancestors of these lands Predock is using local material, clay even on the very preliminary step of designing. It seems that this is an approach of spreading the principle of working with natural materials to the whole of the design process.

He says that, "It is embedded in the work from the very beginning and the discussions with clients with respect to the performance life of the building are very exciting and lead off into many interesting directions in terms of the programmatic intensities in the work. So the program figures continually with the different ingredients of energies that go into the first moves or gestures toward making the piece that becomes a building" (7). He thinks that this is a disclaimer with respect to the program that would be what is known buildings through the history change their program and this ephemeral notion of program has to do with political overlays, cultural norms or evolutionary change in what was functional content, just like the Pantheon changes from a pagan temple to a Christian church overnight. Therefore, it is clear that he sees these kinds of tremendous reversals are also part of the possibility of life where the architecture should follow. Here he says that "this means that any building must have a life of its own, in a way independent of program, but of course accommodating the original program" (7). So, in his point of view, when architecture becomes solely program-driven and is merely a functional diagram, without other admixtures, it becomes a rather empty determined condition, just like a body without a soul, in his words. Therefore, it can be understood that he prefers to work on the form possibilities of architectural programs by clay models to generate the most accurate forms for the different possibilities of the life.

2.2. Body/ Motion

"Architecture is a fascinating journey toward the unexpected" says Predock (7). As a rider who loves the speed, he thinks that architecture is a ride including both physical ride and intellectual fragments of a ride. According to him landscape and architecture in relation to machines and technology. Thus, the idea of a motorcycle in the landscape confirms a kind of a technological and an experiential closure in his point of view.

During the whole life he says that his architectural point of view was influenced profoundly by music and dance. He says that "When I was a student at Columbia University I became very involved in dance and with the body in space through the work of Jennifer Masley, Merce Cunningham, Yvonne Ranier and, later, Anna Halprin…I think of my buildings as processional events, as choreographic events; they are an accumulation of vantage points both perceptual and experiential" (7). If his projects are researched it is clearly seen that his architectural style is a music during which the forms are dancing especially as a part of the land by the choice of the adobe material and as a part of the nature by the interiority of oscillation of forms.

2.3. Roadcut

During he is living in New Mexico he has been affected a lot about the serenity of the desert, whereas his architectural point of view had turned into a mature personal style. He says that "Critical to the spirit in my work is the enigmatic quality of the desert". According to him desert has inside more that what it is seen over the landlevel, rocks and many life forms, and etc. he says that "In a highway roadcut (in New Mexico), for example, a sectional diagram of the earth is revealed through man's intervention. At the bottom of a roadcut in the southwest is pre-cambrian granite, overlaid by limestone. In geologic time, other sedimentary strata like sandstone and ocean bottom fossils begin to turn up - brachiopods, chrinoid stems" (7). Just like the different levels on cultural artifacts, he adds. It is clearly understood from the important projects of him that the idea of the roadcut is a poetic diagram of an investigative process for the making of architecture in his style.

2.4. Desert Beginnings - Portable Regionalism

He describes the relationship in between the desert and his architectural style as desert beginnings and thus he gives a name to his style as a portable regionalism, inside which it is understood that the maturity of an architectural formation should have shortcuts inside to create different possibilities to the users, even unexpected ones, to give a chance to differ into a new function, it should have a poetic diagram of roadcuts inside as if it has direct relation to different cultural artifacts. Portable regionalism thus has local material and traditional technique possibilities on a contemporary international background (4,2).

As he is always noticed that New Mexico has formed his experience in an all-pervasive sense. He does not sees New Mexico as a region, but it is understood from his speeches that he is so determined to describe it as a force that has entered to his system as a force that is composed of many things (4,2,3).

According to him in New Mexico a person is aimed toward the sky and at the same time remains rooted in the earth with a geological and cultural past. He says that the lessons he has learned here about responding to the forces of a place can be implemented anywhere and he adds that he does not have to invent a new methodology for new contexts. It is as if New Mexico has already prepared him to his future. According to him, "Rather than being a highly rational methodology, my process remains connected to spirit through the body and to the personal space that the body defines. The trick is getting through the thicket of what Kahn called "the measurable" in the making of a building, to come out the other side with the original content, the original aura intact, for the built work to express that initial physical and spiritual impulse". Therefore it is understood that recreated a design process description to him in a mature direction and formulated "the ingredients" of his architectural style as it is for many long years (1,4,3).
He says that "Lessons learned in the American Southwest apply anywhere in the world - my "regionalism" is portable"(7) .

Figure 2. The digital collage made by Predock himself to define the basic issues of his architectural philosophy.

3. PROJECTS IN ADOBE

3.1. Preliminary Projects and La Luz

La Luz is a special place offering privacy and a sense of community which has ninety-six adobe homes that are located in east of North Coors Road along the Rio Grande River on the western edges of the West Mesa. As the architect of La Luz Predock envisioned as an initial spirit on the architectural design of the community, with respect to the site to control it but not to change it at all (4).

The adobe buildings with their patterns of rhythm and repetition, create a landscape of their own, a landscape imagery attuned to the mesa, the expansive river valley, the bosque and mountains of New Mexico. La Luz responds to the natural setting on which it was built. At La Luz you are a part of a symbiotic relationship between the man-made part and the natural part of the land. It accommodates people's desires for the views, for privacy and use of the open space. There are not many places left where such views exist. It has been protected for over forty years, and still enhances peoples' lives today (2,3).Several organising principles of design and development govern the aesthetic of La Luz. One is the preservation of the spectacular view to the East. A second principle of design is to separate people from cars and to provide walking and bicycle paths between houses and open space. The third principle is to cluster homes around plazas, using common walls to eliminate side yards and to reduce individual landscape maintenance for each homeowner (1,4).La Luz is an icon of everything that conservation-minded, bio-regionally sensitive and culturally concerned urbanists in New Mexico have hoped to achieve in residential architecture. The La Luz Landowners Association along with its landscape and architectural committees have made sure, through their award-winning stewardship, that La Luz remains in virtually pristine condition on the outside. Interior renovations have been undertaken almost continually, often with the resale of homes. La Luz has been included on the National Register of Historic Places and continues to be a dynamic place for aesthetic living in New Mexico.

Figure 3. La Luz.

At the **Mandell Weiss Forum** one comes though a eucalyptus grove and there, in a clearing, stands a two hundred and seventy foot long mirror. One is suddenly part of an expectant crowd, a building of tension that has to do with the arrival of the audience and the anticipated arrival of the performers. It is a ritual - the encounter with this giant mirror, the collective straightening of the tie, and the passage through the looking glass to what lies beyond (7; 2).

The **Nelson Fine Arts Center** seems initially to be a single event, but it is actually a processional route that is open-ended. Visitors can create their own paths to unexpected destinations that provide respite from the sun while, simultaneously, a celebration of the sun. The building offers an array of sensory possibilities throughout the day and the night. Its nocturnal life is very different from its sun-drenched daytime life (7,4).

3.2. New Mexico Museum of Art Rennovation and Expansion

The project was planned in association with Edward Larrabee Barnes and it was completed in 1979. The 1917 Museum of Fine Arts graces a strategic site in the heart of Santa Fe's historic district. By 1980, the original quality of the structure had seriously deteriorated through neglect and improper alterations. Administrative, service, and exhibition areas were all inadequate to meet the needs of a modern museum (1,3,2,4). The program mandated extensive renovation and preservation of the existing 47,000 square foot structure, addition of http://www.predock.com/FineArtsMuseum/MusFineArtsSF1.jpg 13,000 square feet of gallery and storage, and integration of 13,000 square feet of exterior spaces. Restoration of the museum entailed both exterior and interior interventions. Through careful research and excavations, the polychrome chip carvings, vigas and stucco have been refurbished to match historical conditions. Thermally sound, operable wood windows replace and replicate the original fenestration. On the interior, the original skylighting was uncovered and screened to permit filtered natural light to enter galleries (1,3,2,4). This meticulous restoration is complemented by the new gallery which represents the first phase in a four gallery master plan and provides the facility with a modern, climate-controlled space. These new and renovated spaces have permitted the exhibition of traveling shows of works by major artists including Robert Rauschenberg, Georgia O'Keefe, Paul Sarkisian, Agnes Martin, and Bruce Nauman (7,4).

3.3. The Institute of American Indian Arts Museum

The museum is in adobe material was completed in 1992. There is a statue museum at the back side of the institute inside the park which was named after Allan Houser, the famous statue artist. The welcoming hall of the museum is like a Kiva as a space which is planned as a little bit down than the entrance of the museum. The building is designed as Spanish Pueblo style in adobe material and coloured as the local traditional way (5).

Figure 4. New Mexico Museum of Art Rennovation and Expansion

4. CONCLUSION

When the Predock's architectural style is on agenda it is for sure that his stylistic touch to the local materials and traditional techniques can be named as an actual synthesis as once Barbaros Sagdic indicated; it is also named by Predock himself as a portable regionalism; it can be also thought that his effort on contemporary architectural praxis can be described as a local touch on universal background. He uses national planimetric schemas on an international point of view whereas he uses traditional techniques on universal contemporary architectural praxis. Thus he makes a synthesis of local-traditional and contemporary as kneading them, as kneading the regionalism on a global world's incomes.

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Restoration Process of Arif Pasha Mansion

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ABSTRACT

The former Eminonu Municipality Building (Arif Pasha Mansion), in which the survey, restitution and restoration projects and works are carried out, is a 4-floor stone structure built with masonry system, which is located on the south of Koprulu Library just in the middle of Hagia Sophia and Cemberlitas in Divan Yolu extending to the west by passing next to Hagia Sophia in the county of Fatih. The structure is located at the 237th square, 6th parcel and is seen that it was built on Theodosius Cistern, which is thought to be 1500 years old.

The structure has a scheme plan in a classical style reflecting the characteristics of its period of building. Simplicity is preferred for the ornament of the external walls and intense ornament is avoided on stones, jambs and moldings. In connection with the construction system, the window gaps on the wall are formed by rounding the upper sides and integrity is created by ensuring the continuation in order.

This presentation is prepared to explain the methods used in the project work. With the modification performed in 1911, the structure was expanded by adding an arm to the south and a floor was added with such expanded part. The roof of the building was rebuilt at the same time. It is understood that the arm on Serefiye Cistern was added in this period. When the historical maps prepared for Istanbul are examined, it is seen that the municipality service building was marked as Municipality Building in ''Alman Mavileri ''(German BLUE's) Map dated 1913-1914 and it was used as a hotel according to the Pervititch Map dated 1923. It is understood from such maps prepared after the period, when the building was converted into the Municipality Building, that there is no change in the external architecture.

Keywords: Arif Pasha Mansion, Eminönü Belediye Binası, Thedosius Cistern

HISTORY AND FEATURES OF THE BUILDING

The old Eminönü Municipality building (Arif Pasha Mansion) where relief, restitution and restoration works are conducted, is located on the Divan road extending from the side of Hagia Sophia to the western direction as a four-storey and stone-masonry system building in the southern side of Köprülü Library in the middle of the with Hagia Sophia and Çemberlitas. The building is located on the section numbered 237 and parcel numbered 6 and built on is Theodosius cistern considered to be about 1500 years old.

The building has a blueprint scheme that reflects the characteristics of the period in which the building was constructed. The simplicity was preferred in the exterior decorations and the stone jams and silts were avoided. In connection with the construction system, the façade window gaps were created by rounding up the upper parts and ensuring a continuation within the order of integrity. Figure 1.

Figure 1. The building covered by the work located in Istanbul

The building covered by the work located in Istanbul, Fatih, section numbered 237 and parcel numbered 6 has given different kinds of services in the past. As a result of the researches carried out, the date of the construction of the Arif Pasha Mansion, the very first date of construction of the building, was not determined despite all research. Although there are statements that this mansion was a wooden building in historical sources, there was no trace of any evidence to verify this fact based on observations carried out on the current building and the removal of the paint and plaster with the furnishing during the application phase. It is also possible that the wooden mansion had suffered massive destruction during the fire of Hodja Pasha in 1850.

This region surrounded by historical buildings and squares such as Mahmud II. tomb, Cevri Kalfa Children School, Firuz Aga Mosque, Kaygusuz Tekkesi,, Press Museum, Köprülü Library, Çemberlitas Square, Atik Ali Pasha Mosque, Koca Sinan Pasha Complex, Çorlulu Ali Pasha Complex, Merzifonlu Kara Mustafa Pasha Complex, Gedik Ahmet Pasha Mosque and Hamam, Million stone, 1001 Direk cistern and Çemberlitaş hamam, has been used as a settlement area for Ulema and government rulers throughout history. Figure 2.

Figure 2.

This presentation is prepared to clarify the method applied in project works for the building used as Şehremaneti for a period of time and to specify its relation with historical environment and offer architectural solution proposals to meet the needs of our day ant to summarize the process performed.

The building covered by the work located in Istanbul, Fatih, section numbered 237 and parcel numbered 6 has given different kinds of services in the past. As a result of the researches carried out, the date of the construction of the Arif Pasha Mansion, the very first date of construction of the building, was not determined despite all research. Figure 3.

Although there are statements that this mansion was a wooden building in historical sources, there was no trace of any evidence to verify this fact based on observations carried out on the current building and the removal of the paint and plaster with the furnishing during the application phase. It is also possible that the wooden mansion had suffered massive destruction during the fire of Hodja Pasha in 1850.

Figure 3.

As it is understood from the historical sources, after the announcement of the second Mesrutiyet Arif Pasha Mansion was used as Istanbul Şehremaneti building after purchased and undergone a thorough renovation by the Şehremaneti as of January 31, 1912. It is thought that the wooden mansion that is mentioned either was not really wooden building or that it is completely demolished and built a masonry building. As a result of the position of building elements on the building and the tests conducted on them, it is understood that the first building boundaries were half level of boundaries of our day.

With the renovation performed in 1911, building was expanded by adding a curtilage to the building in the south direction and adding one more floor. The roof of the building was also rebuilt. It is understood that the curtilage located above the Şerefiye cistern was added during this period.

When the historical maps prepared for Istanbul were examined, the municipal service building was marked as the Şehremaneti building on the map of the German blues dated 1913-1914, and was used as a hotel according to the Pervititich map dated 1923. Based on these maps, which were prepared after the period when the building was transformed into Şehremaneti, it is understood that the building didn't undergo any change in the exterior architecture.
Figure 4.

Figure 4.

When Istanbul was occupied by the Allied Force at the end of the Mondros Armistice Agreement dated 30 October 1918, building was used by the French occupation forces under the command of General Charphy until October 1, 1923 as a military headquarters despite the opposition of Cemil Topuzlu period the mayor of that time. After the establishment of the peace, the building, which was used as a conservatory building in the late 1920's, was unused for some time after the conservatory moved. Figure 5.

Since 1984, it has been used as Eminönü Municipality Building and has served for this purpose until 2009. The building used as a municipal building in 1990 underwent the second comprehensive renovation and new additional service building built on the Şerefiye cistern, was demolished to remove unnecessary loads applied to the cistern on 8 March 2010.
Figure 6.

Figure 5. Arif Pasha Mansion period 1-2

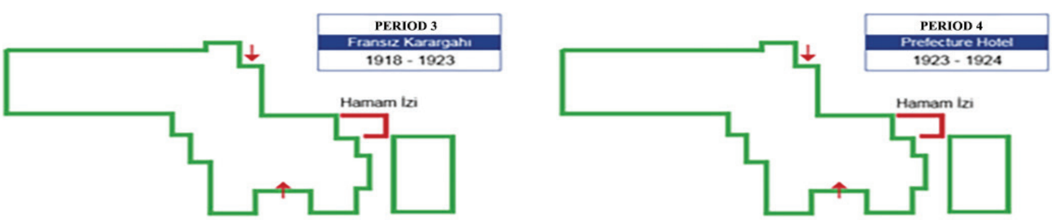

Figure 6. Arif Pasha Mansion period 3-4

When historical researches of the building are completed, typological works for the period when building was used as mansion were conducted and it is aimed to create the plan scheme. Typological researches were concentrated on the masonry mansions, which were built in the similar period with similar construction method and the approximations in terms of style. The buildings located in and around Divanyolu have also been subjected to examination due to their spatial proximity. Figure 7.

Figure 7.

Typological research to shed light on the plan solution of the building was limited to the masonry or wooden mansions built in Istanbul in the early 19th and 20th centuries. In the Ottoman traditional housing architecture, the plan and spatial solutions did not differ greatly in time, as the lifestyle of the society did not undergo very radical changes. The main novelty in the 19th century is in the use of construction technique and materials. Because 1850 Hodja Pasha Fire caused losses in a very wide area, it is known that after this date masonry system and the construction of iron-door mansions became widespread in Divanyolu. Figure 8. Figure 9.

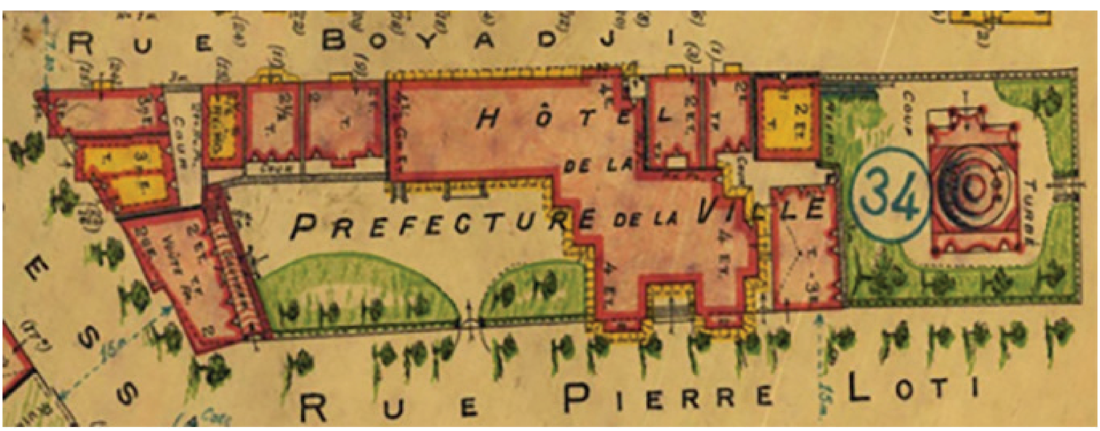

Figure 8.

Figure 9.

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A Survey of Relationship between Perceived Ease of Use and Acceptance of Earthen Architecture Technology (A Case Study of Young Educated Couples in the City of Yazd, Iran)

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ABSTRACT

The acceptance of earthen architecture as a modernized tradition is influenced by several factors including perceived ease of use. The main objective of this research is defining the relationship of this factor and acceptance of newly built earthen houses. This perceived ease of use comprises "ease of learning construction skills", "accessibility to materials", "building construction speed" and "ease of restoration and maintenance". This research has a survey method, and in terms of time criterion, is cross-sectional. The statistical population was young educated couples in Yazd among which 145 people were chosen based on the Cochran formula and with a multi-stage cluster sampling procedure. The research tool was a researcher-made questionnaire whose reliability was measured through Cronbach's alpha and had content validity. Among all of the ease of use dimensions, the results showed that there was just a positive and significant correlation between "ease of restoration and maintenance" and the acceptance of earthen houses. In conclusion, it seems that architectural solutions in terms of ease of restoration and maintenance would pave the way for increasing the acceptance of these houses.

Keywords: Earthen houses, Ease of use, Technology acceptance, Yazd, Young educated couples

1 INTRODUCTION

With identification of the distinct existing technologies, as well as an in-depth survey of their features, merits and demerits, and adapting them to the technical, operational and economic climate of a country regarding the architectural designing criteria, it is feasible to use methods and materials with attributes such as lightness, easy installation and high-speed execution in the residential sector. In this case, needless to use various manufacturing tools and machines, the residential sector would benefit from acceleration in the construction process and improvement in its quality alongside cost reduction [1].

Contrary to popular belief that building with earth is not efficient, it is a useful type of building in which almost one-third of the world's population live [2]. It is thought that earthen architecture is not durable and requires regular maintenance. Although if the necessities are observed well in such buildings, they can be hard-wearing even in sultry conditions. The evidence for this claim is the ancient earthen buildings such as the Great Wall of China [3].

Nowadays, Earth materials are introduced to the world for their high efficiency as a kind of modern technology in the field of architecture. The world is about to turn to this architecture. Earth has been used as a building material in every continent and at all times due to its availability and versatility. In fact, it is one of the oldest building materials. Recent excavations show that earth architecture in

Iran dates back to 6000 BC. For example , the Choghazanbil remnants are some of the evidence of building with earth in ancient times.

Dethier (1981) pointed out that earthen architecture as a "compatible, light and intermediate technology" goes far beyond the concept of a material. Furthermore, due to its ease of use, it shares a philosophical and multilateral affinity with human. In Ivan Illich's opinion, "Tools foster conviviality to the extent to which they can be easily used, by anybody, as often or as seldom as desired, for the accomplishment of a purpose chosen by the user" (P. 22).

So far, few researches have been carried out on the acceptance of earth architecture and its relationship with perceived ease of use. Therefore, we can say that this research is novel. Acceptance can be defined as the lack of hindrance and opposition to the implementation of a system. It is associated with several causes and factors, including ease of use. This research makes an attempt to realize this factor in earthen houses. The fundamental question of this research is "what is the relationship of perceived ease of use and the acceptance of newly built earthen houses in the city of Yazd?"

2 LITERATURE REVIEW

In a study in South Africa, Bosman (2015) showed that there was negative opinions about the maintenance of earthen buildings. In addition, location and area type would affect the choice of preferable building, especially whether materials are available in that location. Owino et al. (2014) found that the fast speed of erection was one of the advantages of using interlocking stabilized soil blocks in northern Uganda. Danso (2013) showed that the abundance and availibility of earthen materials in Ghana were their benefits. On the other hand, requiring ongoing maintenance and large workforce were among their underlying problems. Zami & Lee (2007) stated that flexibility and simplicity of earthen building technology could be conducive to the spread of knowledge among the stakeholders of building industry and the participation of the public in building their houses. Ferrigni (2005) stated that some cultures perceived earthquake as a different phenomenon and accepted the demolition of their buildings by it because they could be easily restored and the materials are reusable. On Lefkas Island; for example, walls are constructed with stone, and there is a second structure made of wood that is completely independent of the first structure. During the earthquake, masonry walls demolish; however, the wooden structure remains. Therefore, walls can be restored easily and quickly. This makes the demolition of buildings acceptable among the public. Ngowi (1997) stated that vernacular construction methods could be transferred easily from one generation to another while the modern methods are so complicated. As per this research results, Bosman (2015) concluded that if earthen architecture technology were less complicated and could be easily understandable, the design cooperation of the beneficiaries due to sharing knowledge and consulting would be promoted. Frescura (1981) showed that the environment and accessibilty to materials are the major factors for deciding which material to use for wall construction. Combs (1985) conducted a research among house builders so as to assess the acceptance of solar and earth-sheltered houses. Results showed, in order to make these building acceptable, there should be constructions of this type in building industry. Further, builders who considered these construction methods easy were more willing to use them. Although the majority of them compromise about the difficulty of building with them, he stated that there should be more studies on the reasons of this hardship and whether it is about the unawareness of builders or the problems confronting designing these buildings.

3 THEORETICAL FRAMEWORK

Davis (1989) stated that two factors of perceived ease of use (PEU) and perceived usefulness (PU) cause the acceptance of a technology (Fig.1). According to the technology acceptance model (TAM) the perceived ease of use can lead to the perceived usefulness of the technology [4, 5]. This means that when people easily perceive the use of a system, a clear perception of the usefulness of that system is gained. In fact, the technology acceptance model (TAM) is the first model in this field outlining the acceptance of a technology.

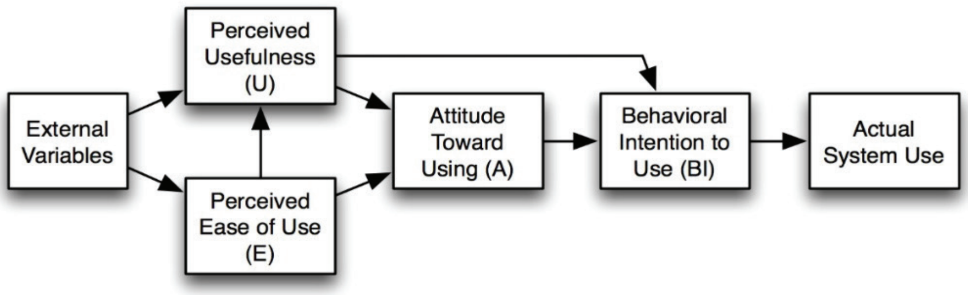

Figure 1. Technology acceptance model, Davis, 1986 *[6]*

Contrary to the increasing number of technology acceptance theories, they are rarely used in architecture and building industry research, although some studies have recently been conducted in this regard [7, 8, 9]. The TAM is presented in Fig. 2 to define the acceptance of earthen architecture technology and the perceived ease of use.

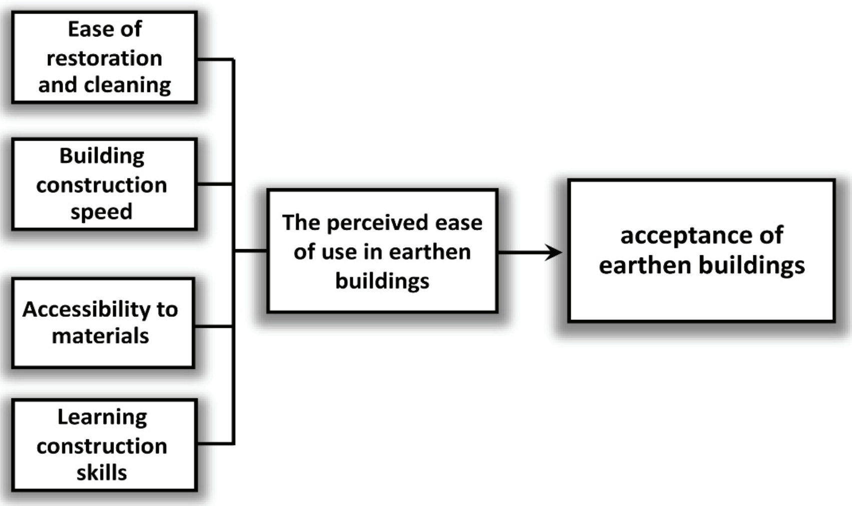

Figure 2. A model for the acceptance of earthen architecture technology and the perceived ease of use

In fact, various factors such as the previous experience of habitation, the perceived ease of use, the perceived usage compatibility and perceived usefulness can be linked to the acceptance of earthen architecture [10], but in this paper, only the perceived ease of use in earthen buildings is examined.

4 METHODOLOGY

This study ia quantitative and a survey method is used to assess the acceptibility of earthen houses among the statistical population of the study consisted of young educated couples between the ages of 19 and 39 in Yazd. As it is indicated in a related article [11], the sample size was estimated to be

145 individuals, and the content-validated questionnaires were filled with a multi-stage cluster sampling procedure. The Cronbach's alpha coefficient of variables were also of enough relaiability, higher than .6 (Table 1).

Table 1. Reliability coefficient of variables

Variable	*Attributes*	*Number of indices*	*Cronbach's alpha for each index*	*Cronbach's alpha in total*
Perceived ease of use	Ease of restoration and maintenance	2	.684	.821
	Building Construction speed	3	.801	
	Accessibility to materials	2	.606	
	Learning construction skills	2	.665	
Acceptance of earthen houses		12	.753	

5 RESULTS

Out of the total sample, women stood at a high of 58.2%. On average, the participants were thirty years of age. In fact, a vast majority of 31.4% was in the 30-34 age bracket. In the case of education level, the percentage of people with associate degree was 29.7%, a master's or doctorate degree was common for 28.3% of them, and a hefty 42% held a bachelor's degree. As regards salary, a mere 16.7% earned less than 10 million IRR[1] a month. The monthly earnings of between 10 million and 15 million IRR were paid to 29.4% of respondents. Moreover, 23.8% of whom tended to be on the salary band of 15-20 million IRR, and a massive 30.2% received an income of over 20 million IRR per month.

Table 2. Pearson correlation between research variables

	Ease of restoration and maintenance	*Building Construction speed*	*Accessibility to materials*	*Learning construction skills*	*Perceived ease of use*
Acceptance of earthen houses	.231	.152	.044	.061	.163
	.002	.109	.6	.5	.09
Perceived ease of use	.624	.859	.725	.636	1
	.000	.000	.000	.000	
Learning construction skills	.203	.329	.296	1	
	.02	.000	.001		
Accessibility to materials	.217	.523	1		
	.011	.000			
Building Construction speed	.489	1			
	.000				
Ease of restoration and maintenance	1				

As per the above table (Table 2), there is a positive and significant correlation between the ease of restoration and maintenance and the acceptance of earthen architecture ($P \leq .05$); in other words, as

[1] 1 US Dollar ($) = 42,000 Iranian Rials (IRR)

restoration and maintenance can be carried out more easily, the acceptance of earthen houses increases. However, no meaningful relatinship was observed between the acceptance of earthen houses and other attributes of ease of use, including "learning construction skills", "accessibility to materials" and "building construction speed".

Table 3. The results of normality test and one sample t-test for the main research variables

Variable	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*	*theoretical average*	*T*	*P-value*
Learning construction skills	2	10	6.1	1.9	6	1.09	.2
Accessibility to materials	2	10	6.8	1.9	6	4.9	.000
Building Construction speed	3	15	9.5	2.7	9	2.1	.036
Ease of restoration and maintenance	2	10	6.4	1.7	6	2.9	.004
Perceived ease of use	12	42	29.01	6.04	27	3.6	.000
Acceptance of earthen houses	14	60	42.3	9.8	37	7.1	.000

As can be seen in the table 3, the average level of the ease of use was 29.01, which was higher than the average theoretical mean (27) and this difference was statistically significant ($P \leq .001$). Moreover, "accessibility to materials", "building construction speed" and "ease of restoration and cleaning" had an average of 6.8, 9.5, 6.4 respectively, which were meaningful ($P \leq .05$), showing that the majority of people had positive opinion about these factors.

Table 4. The result of multivariate regression analysis to estimate the determinants of accepting newly built earthen houses

Independent variables	*B*	*Std. Error*	*Standardized coefficients*	*t*	*P-value*	*Collinearity Statistics*	
			Beta			*Tolerance*	*VIF*
Constant	33.176	3.721		8.915	.000		
Ease of restoration and maintenance	1.481	.563	.251	2.628	.010	1.000	1.000

R	*R Square*	*Adjusted R Square*	*f*	*P-value*	*Durbin-Watson*
.251	.063	.054	6.908	.010	1.687

In order to determine the contribution of each independent variable to the dependent variable, regression analysis was used (Table 4). Among the variables entered into the regression equation, only "ease of restoration and cleaning" with the beta value of .251 remained in the model. According to this Table, the correlation coefficient between these variables and acceptance is .063. The adjusted R Square equals .054, indicating that 5.4 percent of the variations in the dependent variable are explained by "ease of restoration and cleaning". Furthermore, this regression model is linear and significant. The value of f-test for explaining the meaningful effect of the independent variables on acceptance is almost 6.908, and the significance level is .010.

6 DISCUSSION AND CONCLUSION

Earthen architecture with its numerous advantages such as availability and versatility of its materials can play an important role in making a house user-friendly. In this research, an attempt was made to survey the relationship between the acceptance of newly built earthen houses and the perceived ease of use. This study was conducted on the basis of Davis's technology acceptance model and with the participation of young educated couples in the city of Yazd, Iran.

The research findings showed that the acceptance of newly built earthen houses was higher than the average score. There was a significant and positive relationship between the perceived ease of use in terms of restoration and maintenance and the acceptance of this architecture. While 53 percent of the sample believed restoration could be carried out easily, only about one-fourth of them thought of maintenance and cleaning of these buildings as an easy work. Therefore, it means that improving the ease of maintenance and cleaning can increase the acceptance of earthen houses. Solutions as follows is suggested making the maintenance and cleaning of such houses easier.

Paying attention to ease of cleaning in designing earthen floors, on which furniture is placed and people move, is important. To protect such floors against erosion and water, using stabilized compressed earth blocks, covering earthen surface with brick, wooden or stone blocks, laying carpet or moquette on it [12], putting pads under furniture legs and avoiding walking on it putting shoes on can be effective [13].

"Such solutions as installing door/window shades to deviate dust, designing simple forms for windows without acute angles, reducing window/opening surfaces outside the house and door/window sealing can partially lessen the ill effects of sand and dust on earthen architecture. It is also possible to prevent the penetration of sand and dirt by producing moisture to absorb dust, locating the house entrance against the wind and in a recessed area, using tall walls and parapets, and creating green space. One of the problems of old adobe houses, which caused troubles in the past, was wall destruction especially in lower parts. To eliminate this defect, it is helpful to use stabilized and compressed blocks, moisture- and erosion-resistant coatings" [11, p. 11] and to protect earth wall corners by using lippings such as wooden profiles or backed bricks [12].

There is not a significant relationship between ""ease of learning construction skills", "accessibility to materials", "construction speed" and acceptance of earthen architecture. Meanwhile, the majority of people approved of the accessibility of earthen materials although they did not consider other items suitably provided.

As regression analysis showed, just ease of restoration and maintenance among all dimensions of perceived ease of use can, to a small extent, explain the acceptance of earthen houses. That is consistent with Davis's theory (1989) explaining that a system's ease of use cannot lead to use of people by itself. The technology acceptance model claims that to accept a technology, two factors of perceived ease of use and perceived usefulness should exist simultaneously. In fact, as people perceive the use of a system easier, their perception of the usefulness of it increases. The correlation between construction speed and restoration and maintenance of earthen buildings and the dimensions of perceived usefulness confirms the TAM. This means that the faster the construction and the easier the restoration and maintenance of earthen architecture is, the more the public perception of its usefulness becomes, and consequently, a greater acceptance it gains.

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The Importance of Geographic Information Systems (Gis) in Preservation of Architectural Monuments and Structures

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ABSTRACT

All over the world can be found building that has local, national, regional or global value of that territory. There are thousands of this kind of buildings. These monuments are richness for humanity. It is important to save that monument and use to right way of benefit of humanity.

Only in the territory of the Republic of Armenia the number of monuments exceeds 3000. All these structures need protection and maintenance. As well as having great potential to become tourist target.

Restorative architects have a great contribution to the preservation of monuments, but their potential is not enough to achieve full results. It is necessary to involve different specialties which can help architects, as well as cartographers, specialists in geographical information systems, constructors, building materials specialists, tourism specialists and so on.

Specialists in the preservation of monuments have a same target "Save the monuments", but it is impossible to preserve the monument whose location is unknown. To solve this problem, it is essential to create one common geographic information system, where there will be a wide range of monuments, as well as a wide variety of information collected. According to this data, it will be possible to organize work on the restoration of monuments, protection and publicity projects.

The main and first part of making geo-information system is creating the infrastructure. Each monument is unique, so for classify we need to find specific characteristic elements. After this step we can classify data and use it. After development of the infrastructure, is possible to insert information about monuments. Present information stored in one place in different formats like text, pictures, drawings, etc. The existence of this system we will allow not only unite all the information but also make analyzes and discover inaccuracies.

In the paper we study about geo-information systems for how to apply them in the field of monuments restoration and preservation. As an example, taken the monuments of the territory of the Republic of Armenia. Done a proposal on the development of geographic information system for monuments preservation in the RA territory.

Keywords: GIS, cartography, geodatabase, electronic map

1 INTRODUCTION

The collection of data on the surrounding world, the combination and coordination on major issues in modern science. The collected data are of value only if they are presented in the proper form [2].

The first question that may arise with unknown people in geographical information systems is why we need it? Geo-information systems typically associate with maps. But we do not use maps and atlases at every moment of our lives.

According to some data, in 1854, John Snow in London pointed out the parts of the city where cholera infections are present. This was the first case of using of geo-information method [3,4].

The USA Bureau of Registration is one of the organizations that have an important role in the development of GIS. At the end of the 1960s, the GBF-DIME (Dual Independent Map Encoding) forum was started. This forum was first implemented in the spatial relationship between objects, which is called topology. It describes how the objects on the map are connected to each other.

Harvard University's Graphics Laboratory, which was called Computer Graphics and Spatial Analysis Laboratory in 1968, has started many innovations with modern GIS tools. In the laboratory in 1960-1970 the terrain model was developed in an electronic form, which was a big step in the GIS area.

2 THE ESSENCE OF GEOGRAPHICAL INFORMATION SYSTEMS

GIS includes three technologies: technical, information analysis and economic [5,6,7].

GIS lets you get a lot of information as it has a large database of data and is richer than an electronic map. GIS- provides various types of data, textual and graphical analysis complex possibility.

Graphic databases are composed of:

- Raster layers
- Vector layers

Maps created in this system can be represented in any coordinate system and transferred to any map projection.

GIS consists of 5 main parts:

- Equipment
- Software
- Data
- Workers
- Methods

In GIS systems, it was possible to combine different types of information, which, in its turn, enabled to make more extensive and perfect analytical activities. Over time, these systems have started to invest in various sectors of the economy, which has contributed to increasing the governance of the sectors.

3 UTILIZATION OF THE SYSTEM IN THE FIELD OF HISTORICAL ARCHITECTURE

As it has already been mentioned, it is extremely important for the preservation of historic-architectural monuments that the data coordination and accessible to them are extremely important. For this reason, a proposal was made to create a geographic information system for historic-architectural monuments.

At first, it is necessary to define a list of characteristics that best describe these objects. As an example have been observed such characteristics as: Name of monument, the number of monument in the State register list, construction period, location, current situation, construction material, have a restoration or reconstruction intervention, etc. [Table 1].

Table 1

no	Name of monument	Location	the number of the monument in the	Type	Construction period	Significa nce		Current situation					Construction material	Archival material		Buffer zone radiuses	Architectural style
						Govern	Privet	Ruins	Distress	Standin	Restore	Historic al form		Drawin	Photos		

An example of a GIS system developed for the Armenian Residential Areas or settlements (Fig.1)

Figure 1. model e-map of settlements of Republic of Armenia

This system can help you to create digital and print maps as well as electronic databases.

The GIS system is based on data gathered from residential areas that describe the location of residential areas and their substance, the type of basic employment, economic product, etc.

The data contained in the database are trilingual and allow for analyzes in different fields. For example, using the old names of settlements and the date of creation are made historic analyzes. Here you can enter the data of the monuments and get all the information in the final form, which is necessary to provide a preliminary approach for the restoration, preservation and reconstruction of the historical monument.

Figure 2 presents a small section of the database that covers a wide range of information.

An architectural monument base is created with the resemblance of the GIS database.

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OBJEC	Shape *	Marz_eng	Name_Eng	Type_eng	Height	Community_eng	Old_name_e
158	Polygon	Ararat	Abovyan	village	960	Abovyan	-
417	Polygon	Kotayq	Abovyan	city	1400	Abovyan	Elar
76	Polygon	Aragatsotn	Agarak	village	1100	Agarak	Akerak, Akeran
564	Polygon	Lori	Agarak	village	1370	Lori Berd	-
760	Polygon	Syuniq	Agarak	city	650	Kapan	-
849	Polygon	Syuniq	Agarak	village	1025	Meghri	-
986	Polygon	Vayoc Dzor	Agarakadzor	village	1160	Areni	-
85	Polygon	Aragatsotn	Agarakavan	village	1450	Agarakavan	Agarak Talishi, Agarak Kharaba, Agarak
375	Polygon	Gegharquniq	Azat	village	2050	Geghamasar	-
908	Polygon	Tavush	Azatamut	village	580	Azatamut	Bentonitayin kaveri gortsaranin kic
655	Polygon	Shirak	Azatan	village	1490	Azatan	-
128	Polygon	Ararat	Azatashen	village	855	Azatashen	-
166	Polygon	Ararat	Azatavan	village	830	Azatavan	-
952	Polygon	Vayoc Dzor	Azatek	village	1625	Vayq	Azatak
515	Polygon	Lori	Aznvadzor	village	1675	Aznvadzor	Gyozaldara
590	Polygon	Lori	Atan	village	1650	Tumanyan	-
6	Polygon	Aragatsotn	Alagyaz	village	2050	Alagyaz	Alagyoz, Jamshlu Mets
273	Polygon	Armavir	Alashkert	village	855	Alashkert	Sovetakan
613	Polygon	Lori	Alaverdi	city	770	Alaverdi	Manes
465	Polygon	Kotayq	Alapars	village	1500	Charencavan	Aylaberq
812	Polygon	Syuniq	Alvanq	village	600	Meghri	Aldara
736	Polygon	Shirak	Alvar	village	1980	Arpi	Duzqend

Figure 1. A part of database

4 CONCLUSION

Have the one or more areas of information in one place and get a complete picture of the wide variety of tools. GIS database application in the field of data storage of architectural monuments to help avoid confusion. The integrated database will be included subject to various authorities, as well as objects belonging to different legal entities and individuals. Important indicators for the collection and regular updating of proper facilities will be monitored and will chronologically follow the changes.

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The Jenni Canyon Ecohotel

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ABSTRACT

In recent years, the advantages of ecotourism have been considerable in Iran. Located in Tabas, the largest county of Iran, an ecohotel is designed beside a million years old canyon called, The Jenni Canyon. The principles are to introduce and protect this magnificent attraction while creating a space for the tourism industry.

The site is in a big, flat area with good accessibilities to the city and other landmarks of Tabas. The ecohotel is designed by considering earth architecture technologies. In the hot and dry climate of Tabas, Soil is the main local material which is also suitable for interior thermal comfort. This feature is considered in the architectural design process.

Super Adobe structure is chosen for this ecohotel units, due to the climatic, anti-earthquake form of the dome and also, this form is common among local historical architectural monuments. The contexture of the hotel is designed compressively, same as other local villages, around a centered-spiral geometry. For energy saving, the lower half of the domes are designed to be built in the ground, due to the ground proper insulation against fluctuation of temperature. This ecohotel is designed by considering the theoretical foundation of Persian architecture, like a variety of spaces at different levels, multi-functional areas and space hierarchy of entrances, bathrooms, and corridors.

This hotel supplies its own energy sources by using solar power and biogas. It helps job creating for people especially youth in villages around Tabas, who are migrating to cities every day due to unemployment issues, by employing them in the construction process, managing the hotel, local food supplying and using their handicrafts in the interior design. Right now, a prototype of the hotel units is testing for construction, with the collaboration of Yazd Local Architecture Institute.

Keywords: Ecohotel; SuperAdobe; Earth architecture; Tabas; Jenni Canyon

1 INTRODUCTION

Tabas is the widest county of Iran. Located in South Khorasan province, Iran, this county has a hot and dry climate.

Every day, the population of Tabas is decreasing due to lack of job and income for people, especially youth, and their migration from villages to big cities. [1]

There are 313 desolate villages in this county and the unemployment rate in Tabas is higher than other counties of South Khorasan. [2]

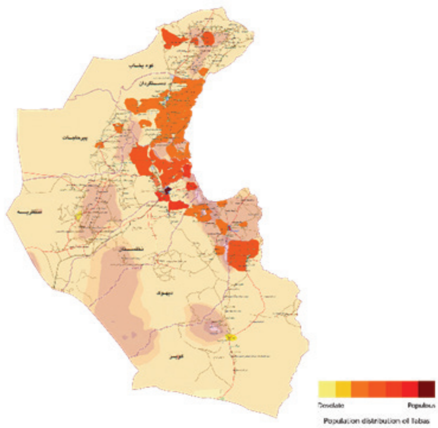


Fig. 1. Population distribution of Tabas

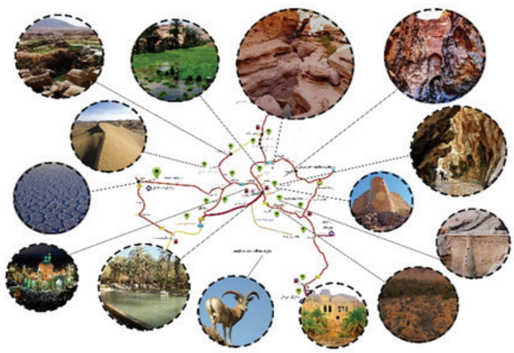


Fig. 2. Tabas Tourism Attractions

Tabas has many tourist attractions that even few Iranians have ever seen. [1] By reviewing the benefits of the ecotourism industry, which is a high-profit low-cost business, in the present study, an attempt was made to investigate attracting tourists to these magnificent attractions and job creation for people.

By examining different attractions of this area, The Jenni Canyon was selected as the case study. This tourist attraction is newly registered in the Iran national heritage list in fall 2016. [5]

Fig. 3. The Jenni Canyon

The Jenni Canyon is a million years old canyon with different land erosions. [1] Some holes are observed in the walls of this valley that are signs of an old qanat that takes the water from the upstream village (Azmighan) to the downstream village (Atashkanan) [4].

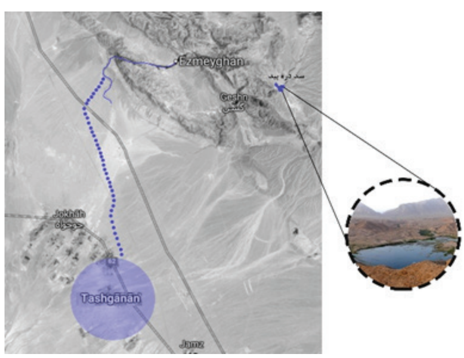
There are some other holes in these walls that are named Gabr houses. [fig.4] Gabrs are ancient people of Tabas who used to cherish sun and water and believed that the universe consists of two elements: light and darkness [1]. There are little rooms in the walls of the valley that were worshiping places of Gabrs like Mithraism temple . [1] Native people believe that Jinnis live in this Canyon. They assume Gabrs Houses as Jinnis homes. Due to water sound inside walls and the height of canyon, it feels scary to walk in this valley.
Every year, thousands of tourists visit this place without any accommodation services. There is a big flat site next to this canyon that is located in the center of population and other landmarks of Tabas with good accessibilities from city, airport, and train station. In this site, construction is allowed with a suitable distance from the canyon. [4]

Based on the mentioned points, the idea of designing an Ecohotel (i.e., a nature-friendly hotel) is under consideration.

Fig. 4. The Jenni Canyon – Mithraism temple – Gabrs Houses [4]

2 SITE ANALYSIS

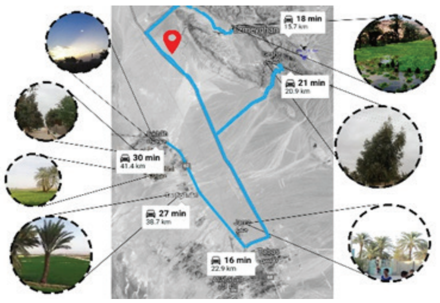
2.1 Fig. 5 .Water



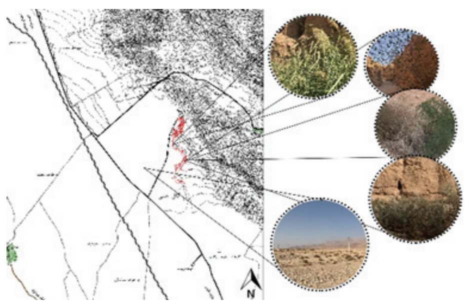
The Jenni Canyon is located in the downstream river of Azmighan Village, where abundant water is found and rice and palms are cultivated in the same area . The water of this river enters the canyon, from which it flows to the old qanat and finally to the downstream village, Atashkanan. [4]

Due to the goal of job creation for local people, agreed by the villagers and farmers, river water can be supplied to this hotel. Also, the water need of the hotel can be purchased from Darebid dam located in the upstream of Azmighan.

2.2 Fig . 6 .Accessibilities
The project site is near the villages around Tabas City and thus transportation is easy for the people of Job creation target. Also, it is close to the train station and Tabas airport.



2.3 Fig. 7. Plants
Almond, Hayzeh Grass, thyme, and some other spices grow in the project site scarcely.
[4]



3 DESIGN PROCESS

3.1 Professional tourists
By considering the potentials of the site and location, 4 types of professional tourists were defined for this Ecohotel:

3.1.1 Ecotourists . Fig 8 .

Ecotourists are the first group of professional tourists that may be attracted to this hotel due to the variety of tourism attraction of Tabas.

3.1.2 Astrotourists . Fig 9 .

Astrotourists are the second group of professional tourists that may choose this hotel for their accommodation because of the full star , beautiful sky of this desert area and low light pollution.

3.1.3 Geotourists . Fig 10 .

Geotourists are the third group of professional tourists that may choose this ecohotel for their accommodation because of Jenni Canyon and other geotourism attractions around Tabas (e.g., Halvan desert, Jahanam Cave, and Salt Lake). [7]

3.1.4 Meditation Tourists . Fig 11 .
Meditation Tourism is a new trend in professional tourism that started up from Jordan. [6] Through this practice, people travel around the world to meditate and worship the mother of nature.

Meditation tourists are the fourth group of professional tourists that may choose this ecohotel for their accommodation because of the nature and atmosphere of the location.

3.2 Contexture Design

Fig. 12 . The villages around this have hot and dry climate region and have formed with a compact contexture over the years. [7] Also, there is no element in the site of the project to limit the geometry of the hotel contexture. Fibonacci geometry was chosen for the compact contexture of the hotel because of its centralized geometry, as well as its repeated pattern in the galaxy and nature. Also, changing the size of units was possible using this geometry.

3.3 Structure

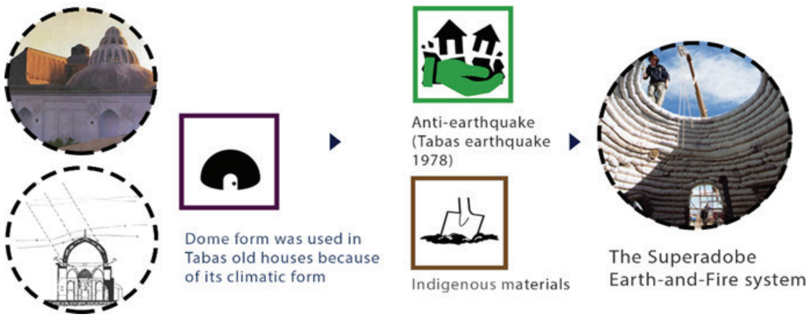


Fig.13 . Dome form has a climatic function in a hot and dry climate. Historical monuments of Tabas were used to be built with domes. [7] Soil is the main local material of Tabas. Owing to the anti-earthquake form of the domes, Superadobe system was adopted for the structure of hotel units. Vault soil structure was chosen for closed corridors of the hotel.

3.4 Installation

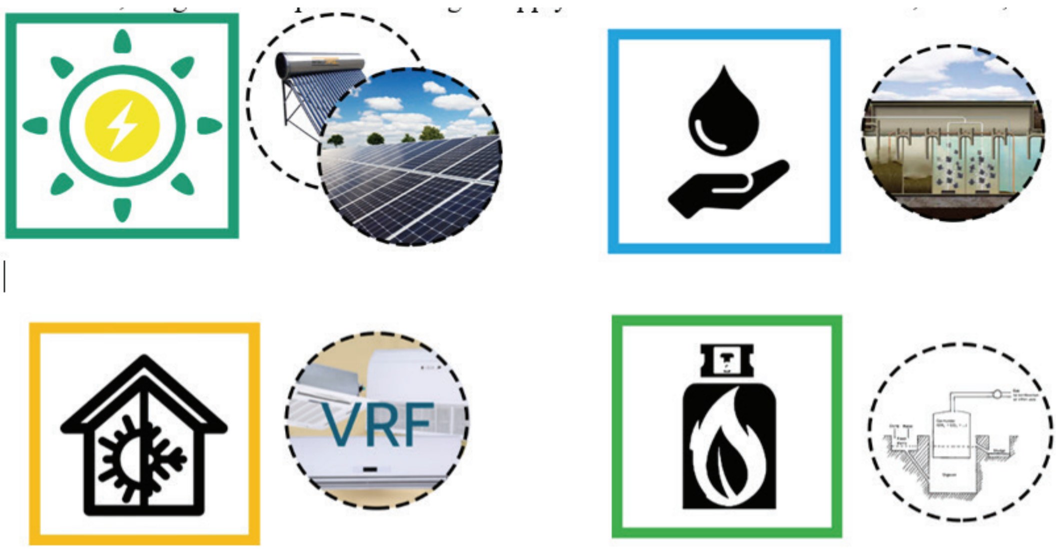


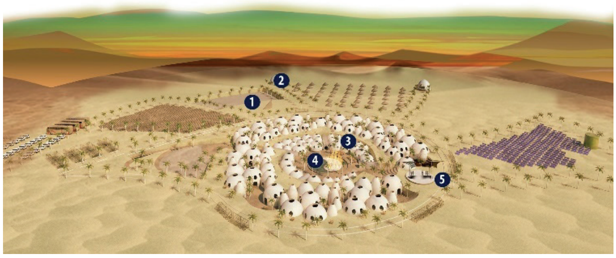
Fig .14 .

Due to the abundance of sunny hours in Tabas, [7] solar panels are used for producing electricity in the hotel. Electricity is not used for exterior lighting due to the light pollution for location sky. Also, solar water heaters are used like villages around the site. Septic tank is used for recycling wastewater. Moreover, Biogas can be produced for gas supply of the hotel from camel stools, wastes, and garbage.

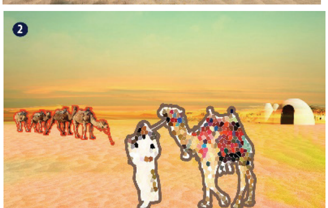
For energy saving, the lower halves of the domes are built in the ground because of the proper insulation of the ground against fluctuation of temperature.
Due to the haze in the atmosphere, a package system of installation was chosen. In addition, water evaporative coolers and Windcatcher do not provide enough thermal comfort and need a large space for channeling. So, variable refrigerant flow (VRF) system was chosen for the heating and cooling of hotel units with narrow pipes and green gas inside.

4. DESIGN EXPRESSION

4.1 Site plan spaces

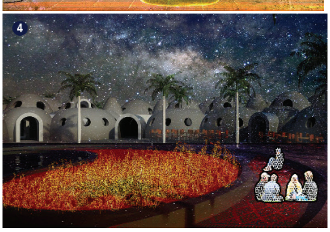


4.1.1 Playground . Fig 15 .
Playground of the hotel is a place for children to be directly in touch with the soil.
it is a multipurpose ground for playing sports and having fun. People can use stairs to access the grounds or to sit on them to watch their kids and those playing in the ground.



4.1.2 Camel stalls. Fig 16
There are several Milch camels in Tabas County.
This stall is provided for six camels so that tourists can see them and have fun with riding them in the desert.

4.1.3 Restaurant. Fig 17 .
The restaurant has three salons for tourists and it is furnished by Persian elements. People also can use outside space to sit on chairs next to the fire and water central space.

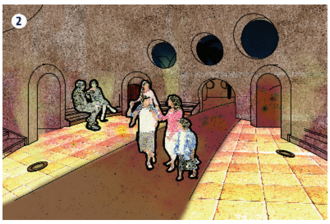


4.1.4 Fire and Water Central Space . Fig 18
This place is in the center of the hotel where water and fire (two opposite elements) are designed to be next to each other. People can sit in the space provided next to them: in the daytime, next to the water to cool, at night, next to the fire to warm because of hot days and cool nights of the hot and dry climate of Tabas.

4.1.5 A Place for Worship. Fig 19
This is a place for anyone with any belief who wants to pray and worship God or who needs to meditate in nature. This place is designed as simple as possible:
A round platform with a tensile structure on it, as a sunshade with a view to fire and water central space

4.2 Residential Phase

4.2.1 Residential Units. Fig 20
There are 36 residential units in this hotel that are designed in different sizes for 1, 2, 3, and 5 people. Every unit is designed in two levels (i.e., lower and upper levels). The upper level has access to the balcony.
Parapet design was inspired by triangles used in buildings in Nayband, Tabas. Tabas white stone is used for flooring the units. The space of the unit is designed multi-functionally, like Persian old houses, and is furnished by Tabas Persian carpet.



4.2.2 Pre-Entrance Space **,** *Fig 21*
Every 4 residential units opens to a pre-entrance space. It is a pause space and there are little platforms to sit on. This pre-entrance is a space that avoids entering dust and desert soils into the units.

4.2.2 Bathrooms , Fig 22
All residential units have a bathroom that has two parts: A WC and a bathroom that is inspired by space hierarchy in traditional Persian bathrooms. The shower is designed under the ceiling void light.

5. CONCLUSION

Fig .23. The following job opportunities are planned to be created by establishing this ecohotel:

There will be job opportunities for workers in the process of building superadobe units. Also, the workforce is needed for managing the hotel and tourists.

In the villages around the project site, various fruits and vegetables, rice, chicken, fish, and meat are produced by rural farmers. Supplying hotel food from the local community will create job opportunities for rural people around.
There will be job opportunities also by using Tabasian women handcrafts, especially handwoven carpets, in the interior design of the hotel units, and creating a space for introducing and selling their products in the central yard.

6 ACKNOWLEDGMENTS

I thank my dear parents who supported me lifelong .
Special thanks to professor Iradj Moeini who guided me during the design process.
And Dr. Farahza who helped me in designing the prototype and introduced this conference to me.

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The narrative of adobe as a sustainable material in Anatolia: The use of adobe in housing from prehistoric times to today

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ABSTRACT

When the settlements in Anatolia in prehistoric ages are investigated in terms of construction materials, it is seen that primary material used in the construction of shelter and housing is adobe. The human who has acquired a sheltered place has used earth as the construction material because of its high-rate reachability on earth, easy obtaining and sustainability during the shelter and housing production.

In this study, from prehistoric times to today, the use of adobe in different Anatolian regions with different settlement characteristics and interior organizations, is discussed. In this context, settlements of Çayönü in Southeastern Anatolia, Aşıklı Höyük and Çatalhöyük in Central Anatolia, Aktopraklık in Northwestern Anatolia were selected.

As a result, it is seen that technologies used in housing in prehistoric times have developed considerably and this practice is still continuing in some region without any significant change. Both the development of adobe production and application technologies and properties of the adobe in terms of sustainability has made the using of adobe to become increasingly widespread today.

Keywords: Adobe, Prehistoric Settlements, Sustainability

1 INTRODUCTION

When it is examined from prehistoric times to today, it is seen that adobe has used intensively in construction process. Humanity has used earth, which is obtainable, solid, healthy and sustainable as building material. It is thought that the earliest earth structures in Anatolia occurred in BC 10.000 and later (Kafescioğlu, 2017: 10).

In this study, usage of adobe and it's sustainability is examined on housing which have Anatolia's variety of settlement texture and indoor organization.

Parallel with, places such as Southeastern Anatolia; Çayönü, İn Central Anatolia; Aşıklı Höyük and Çatalhöyük, in Northern Anatolia; Aktopraklık is examined. It is seen that today, the usage of adobe still continues at Aksaray - Kızılkaya Köyü and Malatya Balaban.

2 SHELTERS AND HOUSING IN PREHISTORIC TIME

Humans sustain their life through hunting and foraging over one million years they don't live in so that they could not build a durable shelter. Thus, they had the necessity for sheltering and nourishment from the very early times. For that, they benefit from nature's ready form as caves or they found temporary solutions as using stones, animal bones and skins to make themselves shelters, many times to protect themselves, they dig a hole in to the earth (Özdoğan, 1996: 19).

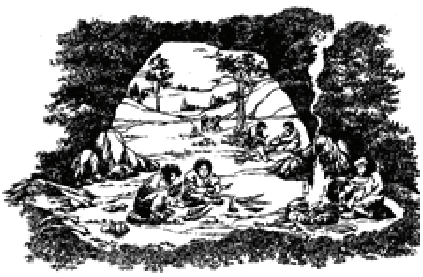

Figure 1. Caves, Drawing: M.Keskin (Acar, 1996: 380)
Figure 2. Shelters, Drawing: M.Keskin (Acar, 1996: 381)

Earth has been widely known element in the entire world from early times to now to build a shelter. From the very early times, both the closeness to water resources and production of adobe is important in choosing the right settlement place (Kafescioğlu, 2017: 4-10). Adobe is known with it's waxy form and being a material produced by human.

It is considered that the oldest adobe shelters came to existence in Neolithic era (Kafescioğlu, 2017: 10). Adobe has used as main material in permanent settlement. Adobe mud comes into existance with the mixture of organic and inorganic admixture of materials in earth which includes clay. It has used in wall making, as brick in wattle and daub architecture or covering the support system in trees.

Perminant shelter and settled life go by the name of housing exist when they find a way to obtain nourishment and food lastingly (Özdoğan, 1996: 20).

2.1 Çayönü (Diyarbakır)

Primordium of the settlement in Çayönü which goes back to 10.200 - 4.200 B.C begins with the round settlements just for the purpose of sheltering. Settlements comprise of a single place without the differentiation of wall and housetop. In this period, widely known technique was to covering walls with light materials as branches, reeds also with skins and plastering it with clay (Özdoğan, 2010: 143).

With the development of agriculture, new functions and as an answer to these functions need for new settlements arise. Rounded settlements did not correspond to these functions. As a result, settlements in squad forms existed (Acar, 1996: 382).

Rounded settlements in Çayönü has transformed into stone based grid structures which has 11 meter length and 6 metre width. These settlements exist in a form where they put faggot over the grid structure and surface covered up with clay (Özdoğan, 2010: 143).

During the process, structure has gain a square shape outer wall, and the grid system under the based turns into stone floor and adobe wall. Çayönü is a great example to show how it transforms from round plan to square plan step by step. Next process shows how corner connections appear and walls carry the weight of the roof (Özdoğan, 2010: 143).


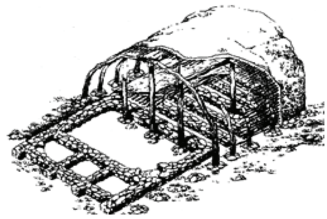
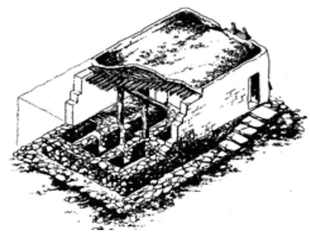

Figure 3. Çayönü Round planned housing Drawing: M. Keskin (Acar, 1996: 382)
Figure 4. Çayönü Grid planned housing Drawing: M. Keskin (Acar, 1996: 383)
Figure 5. Çayönü Stone paved planned housing Drawing: M. Keskin(Acar, 1996: 383)


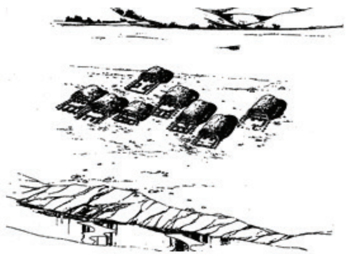
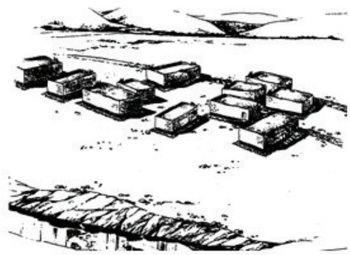

Figure 6. Çayönü Adobe House model (Acar, 1996: 21)
Figure 7. Çayönü Grid planned housing settlement Drawing: M. Keskin (Acar, 1996: 384)
Figure 8. Çayönü Stone paved planned housing settlement Drawing: M. Keskin (Acar, 1996: 384)

2.2 Aşıklı Höyük (Aksaray)

The oldest form of Aşıklı Höyük settlement in B.C. 8.200 – 7.500, consist of round planned building. From the very beginning, people of Aşıklı were living in shelters which were half buried into the earth, rounded planned adobe wall structures.

Figure 9. Aşıklı Höyük Pit shelters Photo: Burcu Akgün

After that, the structure and the technology behind the settlements had changed. It had turn into a square planned, flush seamed, aggregate, closely spaced buildings. Dwellings had single, double or three roomed. They were square shaped, contiguous but had a detachad walls which separate them from each other (Esin, 1994: 30-31).

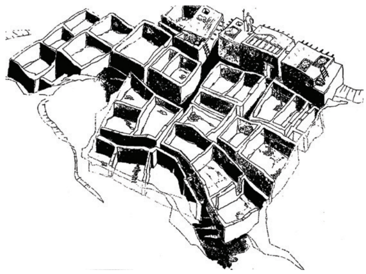

Figure 10. Aşıklı Höyük Settlement
Drawing: H.Güray (Acar, 1996: 385)

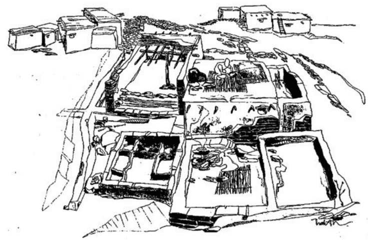

Figure 11. Aşıklı Höyük Housing
Drawing: H.Güray (Acar, 1996: 386)

There is no door which provides the entarence to the rooms. They were able to enter from the flat roofs dwellings through backyards and gateways, also by using ladders. Many of the daily works and house chore were done in this flat roof (Esin, 1996: 38).

Every dwellings wall were made from adobe which was mixed with a bit of straw. Also, as a earth another kind of adobe mud were used (Esin, Harmankaya, 1992). There were not any kind of stone used. However volcanic stones such as tuff and lime stone under the walls was used in some parts (Esin, 1996: 39).

Figure 12. Aşıklı Höyük
Square planned houses
Photo: Burcu Akgün

Figure 13. Aşıklı Höyük
Entrance of square planned houses
Photo: Burcu Akgün

2.3 Çatalhöyük (Konya)

Çatalhöyük which goes back to 7.400-6.000 B.C, consists of square shape dwellings. The texture of dwelling resembles to Aşıklı Höyük. The enterance of the dwellings from the roof with a hole and they were contiguous. Walls of these dwellings were common (Hodder, 1996; 43). There is no street between these dwellings. Transportation is made over the roofs and these dwellings was enclosed. The houses around the yards creates neighborhood.

Dwellings made from earth and adobe which were sun dried. Because there is a marsh on that area, adobe and reed can easily be found. There were wooden sewings in between walls of Çatalhöyük houses. These sewings carry the flat roof. Roof is covered with white, thin and sticky adobe compressed onto the reed (Akurgal, 2002).

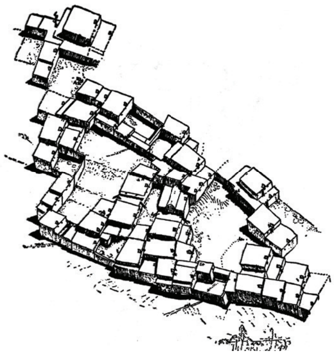

Figure 14. Çatalhöyük
Settlement Plan
Drawing: Melaart, 1966 (Naumann, 2007: 229)

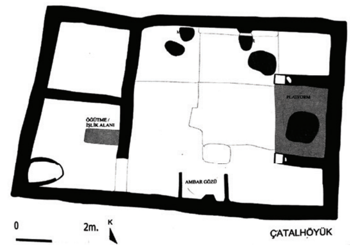

Figure 15. Çatalhöyük
Adobe house plan
(Karul, 2017: 49)

2.4 Aktopraklık (Bursa)

The Neolithic Age settlement in Aktopraklık Höyük which dates back to 6.350 - 5.500 B.C is consists of round planned cottages where the first farmers of Aktopraklık lived. Structure texture is irregular but situated closely. The space among them is used as yard where daily things are done (Karul, 2017: 69).

The structures between them are 3to 6 meter all across. Walls of round or oval 20-30 cm with sunken floored structures is made with reed and wattle-and-daub, also covered with adobe. Roof are covered conically (Karul, 2017: 90).

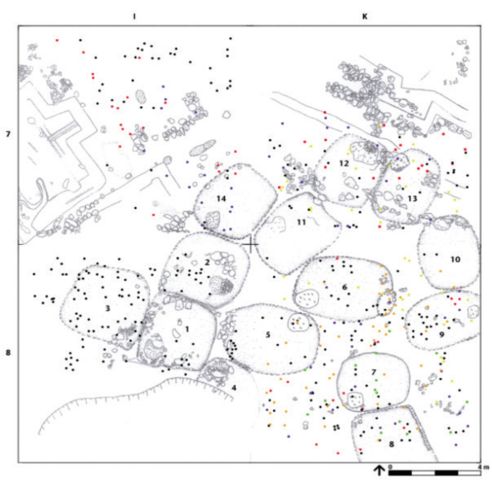

Figure 16. Aktopraklık
Neolithic Period Settlement
(Karul, 2017: 113)

Figure 17. Aktopraklık
Round planned shelters
Photo: Barancan Şahin

Inhabitants of Aktopraklık had encountered with a community who had different traditions in times between last Neolithic and first Chalcolithic. Structures were transform into surrounded by ditch, sqaure form and stone baseless adobe structures (Karul, 2017: 37).

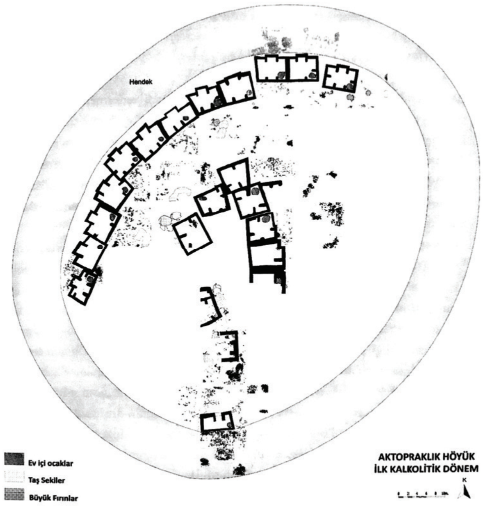

Figure 18. Aktopraklık
Settlement plan
(Karul, 2017: 165)

Figure 19. Aktopraklık
Entrance of adobe houses
Photo: Barancan Şahin

Figure 20. Aktopraklık
Exterior walls of the houses
Photo: Barancan Şahin

First Chalcolithic Age dwellings had single room, square form and were 35 to 40 square meter. Walls which were built witth adobe bricks bond with brick were directly build on the floor. Buildings consructed in a circular direction adjent to each other probably have flat roofs. Walls of the structures were backed up by buttress which rich out 1 meter towards indoor. Niches caueses outer walls to look like ditch (Karul, 2017: 130).

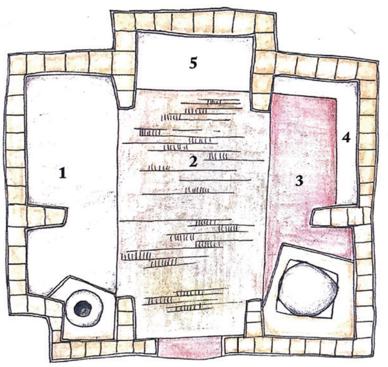

Figure 21. Aktopraklık
Adobe house plan
(Karul, 2017: 137)

Figure 22. Aktopraklık
Adobe house
Photo: Barancan Şahin

In wall mortar and plaster limestone and earth is used. In first architecture of Aktopraklık in Chacoilitic Age adobe bricks were used in wall consruction, roof and also floor covering and oven build (Karul, 2017: 101).

Walls are 40x40x8 centimetres. When it was walls were layyed the half of this measurement with a special technique (Karul, 2017: 133).

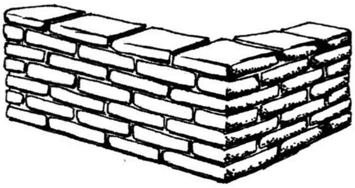

Figure 23. Aktopraklık
Adobe walls used in housing (Karul, 2017: 131)

3 RESULT

When stages of Anatolia's civilization is examined and datas that is resulted from excavation is reviewed, adobe is like symbol of continuity which was used as a primary material. Humanity transforms what he takes from earth into an answer to all his needs. However, adobe becomes a key material for Anatolian civilization with it's easy to give form quality. It also provides many ways to examine the civilization of Anatolia (Sözen, 2017: 7).

In Neolithic and Chalcolithic Era architechture, while making shelter and dwelling, easly found variety of stones, woods and clays were used (Karul, 2017: 125). Technology that were applied to use buildings was advenced and seems to reach our date without a big transformation. Parallel with it, it is emphasized that the technology that were used in Çatalhöyük, continues in today's world (Kafescioğlu, 2017: 10).

In Kızılkaya dewellings near Aşıklı Höyük adobe is still used with stones with adobe.

Figure 25. Village of Kızılkaya, Aksaray
Photo: Burcu Akgün

Figure 24. Village of Kızılkaya, Aksaray
Photo: Burcu Akgün

The dwellings İn Malatya, Balaban consist of single storey and two storey houses. As material stones is used. In walls, adobe and wood is used. Stone is risened with adobe walls which are 70-80 centimeter. Adobe duration increased by adding bonding timber. Generally, Balaban house roof's covered with wooden beam, layed out straw and reed, over the top of it a dark mud mixed with straw layered (Eyüpgiller, 2017: 26-104-142-143).

Figure 26.
Balaban adobe houses
Photo: İlknur Kolay archive
(Eyüpgiller, 2017: 143)

Figure 27.
Adobe housing in Balaban
Photo: İlknur Kolay archive
(Eyüpgiller, 2017: 142)

Adobe is a metarial which is easy to use, reusable and does not produce any waste. Usage of adobe provides indoors to have healthy microclimate. In that way, it provides any place to keep cold in summer and warm in winter. Besides being defined as ecologic element, it absorbes solar energy from the sun which means it provides energy conservation. The usage of adobe become widespread in modern days thanks to it's sustainability and the development in it's production and application technology.

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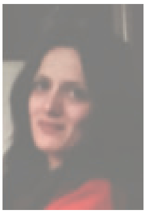
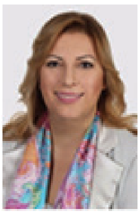
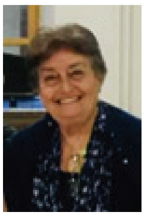
Examining the Cladding Materials of the Rural Architectural Asset Historic Balekoğlu Mansion, in terms of Sustainability

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ABSTRACT

Today, our provincial architectural heritage does not only receive the attention it deserves, also faces a rapid depredation. In rural areas of every other geographical region of Turkey, there are many different types of traditional houses each built with materials abundant in and construction techniques unique to the region.

The objective of this study is to examine the cladding materials used in Balekoğlu Mansion, a traditional architectural asset built in Karadeniz region, Trabzon province, Of district, Bölümlü neighborhood in 19th century and preserved its originality to this day, in terms of sustainability.

It has been established that sustainable and natural materials such as wood, stone, lime, clay embankment and Turkish tiles were used at Balekoğlu Mansion, a surviving example of rural architecture where utilization of local materials is important. It has come into sight that the materials used have been utilized harmoniously with the topography of the residential area and the function and orientation of the building floors.

Keywords: Traditional architecture, sustainable material, ecological architecture, adobe, stone, wood, rural heritage

1. BALEKOĞLU MANSION LOCATION, HISTORY, SETTLEMENT PROPERTIES

The historic mansion was built by a family member, Mehmet Sabri Balek, built in Karadeniz region, Trabzon province, Of district, Bölümlü neighborhood in 19th century. The subject of this study, the Balekoğlu Mansion, is a living historical building where the Balekoğlu family still resides.

Figure 1. Balekoğlu Mansion Location, Of, Trabzon / Turkey [1]

With its great 4000-year history, Trabzon is prominent city of the Roman and Byzantine times, conquered by Fatih Sultan Mehmet, governed by Yavuz Sultan Selim, where Suleyman the Magnificent was born and was visited by our Republic's founding father Mustafa Kemal Atatürk three times [2].

The city center is founded on Boztepe (the ancient Minthrion hill) behind a narrow coastline between the Black Sea and a mountain range running perpendicular to the sea. The province consists of 22,4% highlands and 77,6% hills and mountains. The city has a mild climate unique to the Black Sea shores with a temperature changing between 7,4-23,5 °C, 22,3 °C being the highest average during summer and 4,4 °C being the lowest average in winter [3].

Of is a coastal town founded in XIXth century. Although the region has been ruled under many countries throughout history and housed many diverse communities, it is said that no prior settlement was established on where Of stands today until XIXth century [4].

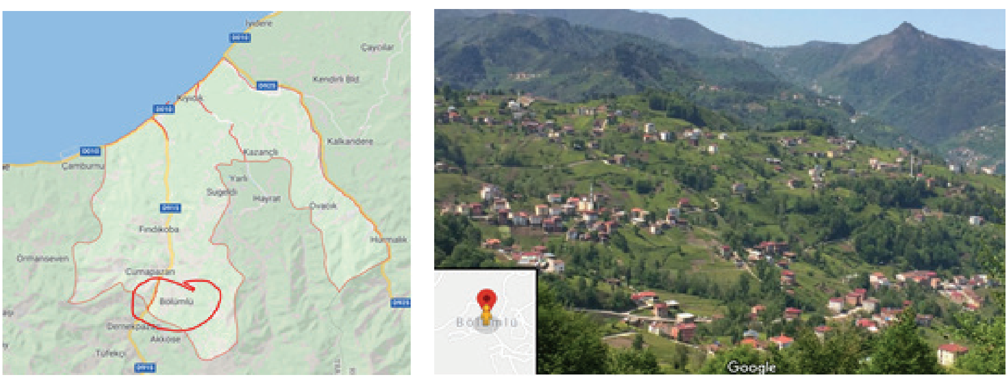


Figure 2. Balekoğlu MAnsion Location, Bölümlü Neighborhood, Of, Trabzon / Turkey [5]

Bölümlü neighborhood, with a population of 1967 [6] based on data from 2018, has a rough terrain. The neighborhood houses many historic 19th century structures such as a mosque, a bridge, a traditional granary called the serander, houses and a mansion. Although many of these structures still stand today, most have suffered from inefficient and insensible preservation methods. Below are pictures of a wooden bridge and an example of a serander (Fig.3).

Figure 3. Bölümlü Neighborhood Habsiyas Historic Bridge ve a Wooden Serander [F: Ö. Balık, 2018]

2. BALEKOĞLU MANSION ARCHITECURAL FACADE ELEMENTS AND USE OF CLADDING MATERIALS

In this part of the study, materials used on the facade, architectural elements of the facade such as the door and the windows, the roof, the eaves and the chimney will be analyzed.

Figure 4. Balekoğlu Mansion[F: E. Balık, 2019]

The mansion is a 2-storey building that covers an area of 100 m² with an almost square base of 10x10m. The structure has two main entrances, one on the northern and one on the southern façade. In addition to these main entrances, there is an entrance to the first floor accessible with an exterior stairway and another small entrance to a common area space on the ground floor. Two other doors on the northern façade opens to the same common area.

Building's ground floor walls are 90 cm thick load-bearing masonry walls. On the first floor, however, the walls are partially timber frame with decorative triangular wall infill (muska) and partially masonry walls (fig.5).

Muska wall infill system: Crushed rocks are used as the filling material in the muska system due to the irregular results of triangular framing. Triangular gaps are filled with crushed rocks and lime plaster. The infill is rendered then coated with limewash. There are examples of both rendered and unrendered muska examples [7].

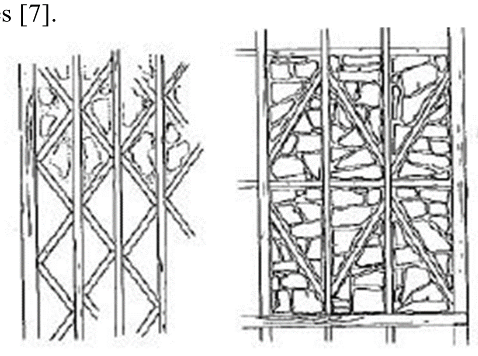


Figure 5. Muska Infill System [7].

2.1 Konak Façade Properties

Balekoğlu Mansion has four facades available for use: east, west, north and south.

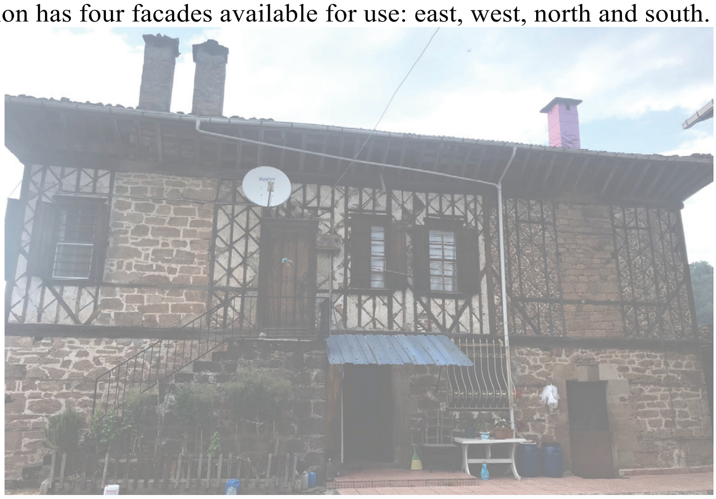


Figure 6. Balekoğlu Mansion Southern Façade Elevation [F: E. Balık, 2019]

On the southern façade of the Balekoğlu Mansion there is a genuine main entrance door and a genuine smaller wooden door right next to it. There is also one window on the ground level of this façade.

In all directions of the structure, the ground floor outer wall is a masonry wall partially supported with horizontal timber bonds. Partly, the gaps between the stone is filled with clay and lime.

First floor is accessible through a genuine stone stairway built on the southern façade at the same time as the building itself. There is one genuine wooden door and 3 windows on first floor's southern façade.

First floor outer wall is one of timber frame with muska infill system. Muska is a wall infilling system where the gaps of the timber frame are filled with rubble stone and lime plaster. Diagonal structural wooden planks are placed in between timber posts to help bear the load. Horizontal wooden bonds are placed in several places to make the building earthquake resistant.

On the first-floor façade, the walls by the chimney are built with masonry instead of timber frame since they are used for heating and cooking purposes.

The floors are separated with wooden girders. All doors, window frames and shutters are all made of wood. There are two inauthentic windows on the entrance floor façade. There is no information on the original state of the windows and there are two inauthentic cast iron railings.

Figure 7. Balekoğlu Mansion Northern Façade Elevation [F: E. Balık, 2019]

There is one genuine main entrance gate (on the right) and right next to it two small inauthentic wooden doors that open to the common area on Balekoğlu Mansion's ground floor northern façade. Right to the main entrance door's left are two windows.

The entire first floor northern façade is a timber frame wall with muska infill. There is a total of nine genuine wooden frame windows with wooden shutters on the first floor.

Again, on this façade, the ground floor wall is made of masonry and divided with horizontal bonds that support against horizontal forces. These bonds effectively help making the building more earthquake resistant.

Figure 8. Balekoğlu Mansion Western Façade Elevation [F: E. Balık, 2019]

There are three genuine windows on the ground floor western façade of the mansion.

Just like the first floor's northern façade, the western façade is completely made of timber frame with muska infill system. Again, on this façade, diagonal wooden planks are utilized against vertical forces and horizontal wooden bonds are utilized against horizontal forces.

There are seven genuine wooden frame windows with wooden shutters on the first-floor western façade.

Figure 9. Balekoğlu Mansion Eastern Façade Elevation [F: E. Balık, 2019]

Attached to the ground floor eastern façade main load bearing walls is a horizontal wooden piece that goes up to the first-floor window opening that was added later on. Unlike the other façades on this floor, on the eastern façade there are two small window openings that open to a storage area.

Exactly like the northern and the western façades, first-floor eastern façade outer wall is fully made of timber frame with muska infill system. Again, on this façade, diagonal wooden planks are utilized against vertical forces and horizontal wooden bonds are utilized against horizontal forces.

There are eight genuine wooden frame windows with wooden shutters on the first-floor eastern façade.

2.2 Mansion Roof, Eaves and Chimney Properties

The roof of the 19th century Balekoğlu Mansion is a hipped roof fitting to the square plan of the house and the traditional fabric of the region, and it has successfully preserved its genuineness.

Figure 10. Balekoğlu Mansion's Roof [8]

Turkish (milled) slates are used on this four-faced hipped roof, a common material for its era (fig.10, fig.11).

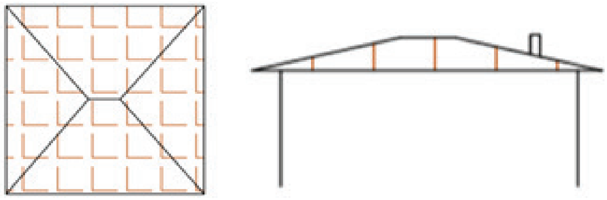


Figure 11. Four-Faced Hipped Roof Detail [Ç: A. Tarım, 2019]

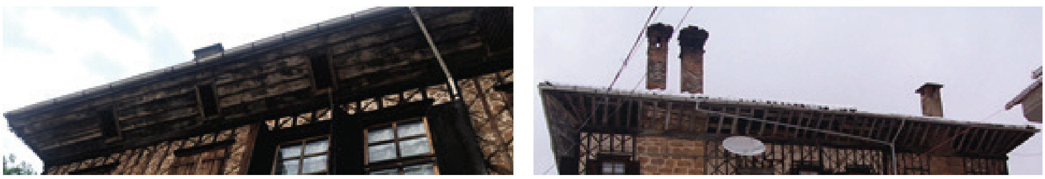


Figure 12. Balekoğlu Mansion Eaves Detail [F: E. Balık, 2019]

A wide and angled eave system is utilized on the building, a common feature of the traditional Turkish house. On the facades, the eaves are enclosed using a grillage or a horizontal wooden cladding. There are three small ventilation windows where wooden cladding is used. Plastic drainage pipes are used to collect and drain water to protect the joint where the wooden eave meets the slates.

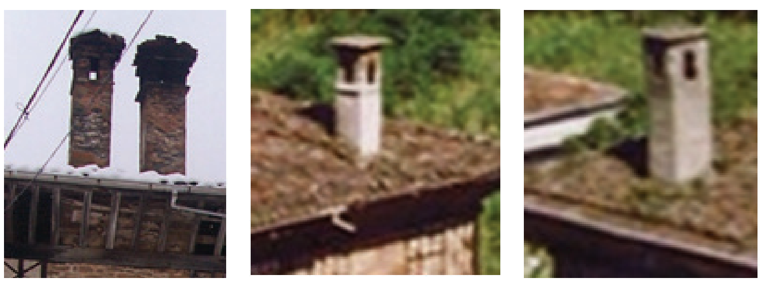


Figure 13. Balekoğlu Mansion Chimney Detail [F: E. Balık, 2019]

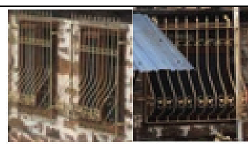
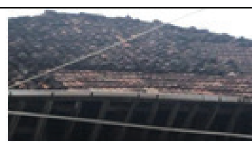
There are a total of four chimneys on the roof, three on the southern slope and one on the western slope.

Two out of the total four chimneys are genuine and are made of stone and rubble slate pieces, whereas the other two are inauthentic and are made of briquettes.

3. CONCLUSION and EVALUATION

Evaluating the materials used on the façade and the roof of the Balekoğlu Mansion and their properties on a table (Table 1);

Table 1. Balekoğlu Mansion Architectural Component and Material Analysis

Location	Component	Photograph	Material
1.1 Southern, Northern, Western and Eastern Facades Ground Floor	Main Wall		Masonry Wall, part plaster cladded with limewash and supported with wooden bonds.
1.2 Southern, Northern, Western and Eastern Facades First Floor	Muska System		Timber frame, gaps between posts filled with rubble stone and plaster, cladded with limewash.
1.3 Southern Façade First Floor	Masonry Wall		Masonry Wall, part plaster cladded with limewash and supported with wooden bonds.
1.4 Southern Façade Ground and First Floors	Main Entrance Door and others		Door frame and the wing are made of natural wood. Door accessories are cast-iron.
1.5 Southern, Northern, Western and Eastern Facades	Genuine Windows		Window frames and shutters are made of natural wood.
1.6 Southern, Northern, Western and Eastern Facades	Inauthentic Windows		Aluminum profiled frames are used for windows. Steel railings are used instead of wooden shutters.
1.7 Southern, Northern, Western and Eastern Facades	Bonds		All horizontal bonds used on the ground and first floors are solid wood.
1.8 Mansion Roof	Roofing		The original roofing material is the Turkish slate. On the southern slope some inauthentic Marseille slate is used.
1.9 Mansion Roof	Chimneys		Two of the chimneys are genuine and are made of stone and rubble slate pieces, whereas the other two are inauthentic and are made of briquettes.
1.10 Mansion Roof	Eaves		On the facades, the eaves are enclosed using a grillage or a horizontal wooden cladding. There are three small ventilation windows where wooden cladding is used.

It is seen that old and natural materials of wood and stone are utilized harmoniously in the 19th century Balekoğlu Mansion.

Wood has been commonly used in Eastern Black Sea region until the 19th century. The fact that wood is the only sustainable, natural and renewable material available and that it is durable against the climate conditions in the region are two of the reasons it was used in Balekoğlu Mansion in abundance.

The stone used in the building is the major structural element and is a natural and local material.

Balekoğlu Mansion is an important proof for the use of local materials especially in rural architecture in previous times. Today, regardless of the climate of the region, its settlement properties and the sustainability of the material, concrete structures are preferred.

In order for the architectural culture to continue, buildings must not only receive the necessary restoration and repair but also meet modern day standards. However, the restoration and repair should not harm the buildings genuineness [12]. Only after these conditions are met will the building be suitable for living. Also, periodic maintenance must be implemented. Awareness in rural areas housing our cultural assets must be raised, people should be taught how to maintain their houses, informed on the means and sustainability of local materials and how to be utilized in construction.

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Evaluation of the Energy Efficiency of the Mudbrick Building Material in the Building Envelope at Traditional Rural Architecture; Case Study of Tongurlar Village in Golpazarı


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ABSTRACT

Building envelope is one of the main component of the building system, that separates the interior space from the external environment and protects the building from the external physical factors in order to provide the required comfort conditions for the users in the interior environment. Main factors used building materials on building envelope in traditional architecture are the raw material of materials, climate data and topography of the regions. The performance requirements of the building envelope to be met by using local materials and construction systems of the region.

Many features should be discovered from climate, material and construction technology of traditional architecture. This features should be used today's existing architectural knowledge for healthier, more comfortable and sustainable buildings to be built. In this study, the material properties of the mud-brick building material which constitutes the building envelope of the residential settlements are examine which are from Bilecik Golpazari Tongurlar district in 2013 within the scope of the "Koyunu Yasat" Project. In this project building envelope and mud-brick building material of selected residential buildings are improved. As a result of these improvements, 2 different building envelopes (exist building envelope and renewed building envelope) compared with using the energy simulation method and annual heating and cooling energy demands are calculated based on the annual and monthly climate data of the region. The results evaluate with energy efficiency. The technical aim of the study is to protect traditional architectural texture in the Tongurlar Village and transfer material and construction knowledge of this rural architecture to the future.

Keywords: Building Envelope, Energy Efficiency, Rural Architecture

1 INTRODUCTION

It is estimated that buildings consume about 25%-30% of the total energy use worldwide. The majority of such energy consumption is utilized to ensure thermal comfort in buildings through heating and cooling applications [1]. It is evident that reducing energy consumption of buildings has become vital, taking into considerations the limitation of conventional energy resources and the adverse effects associated with the use of such type of energy on the environment [2]. Energy efficient buildings has emerged as a new approach to encourage using natural resources and reduce the energy requirements to maintain indoor comfortable conditions [3]. Buildings, in this case, are designed, as a prerequisite, in a way that to ensure minimum heat gain in summer and heat loss in winter in order to reduce heating and cooling loads. Therefore, selecting the proper thermal properties of a building envelope play a major role in determining the energy consumption patterns and comfort conditions in enclosed spaces [4]. As part of the buildings envelope, walls account for a significant proportion of heat loss and gain [5]. Almujahid, et al. (2013) reported that about one third of heat loss occurs through walls in the case of un-insulated brick veneer dwellings [6]. Windows are the weakest link in a building envelope for heat gain in the summer and heat loss in the winter. The solar gain entering through a window represents the largest source of heat gain through greenhouse effect when the radiant heat is trapped inside the building by window glasses [7]. Windows also are responsible for about 25-30% of the heat loss in a building because window glazing is a poor insulator [8]. Therefore, it is critically important to determine properly walls material and windows area when designing buildings.

The thermal performance of a building refers to the process in which the building interact with the internal and external influential conditions. The main aim of investigating the thermal performance is to estimate the energy required to achieve thermal comfort in enclosed spaces, and consequently to size the equipment required for such purpose. There are various factors that affect the thermal performance of a building including geometrical parameters, thermal properties of materials, climatic conditions and the building usage [9]. This research concentrates mainly on the effect of wall thermal properties and windows area on the required heating and cooling loads. It investigates the energy performance of a traditional building in Bilecik Golpazarı Tongurlar Village (Turkey) with different wall components and various windows area before and after the restoration process. The study was carried out using Design Builder program to estimate the energy consumption of the building in summer and winter in terms of the local climatic conditions of Bilecik Golpazarı Tongurlar . The study aims to explore the potential of saving energy in the building through improving the thermal resistance of walls and selecting the proper windows area.

2.BİLECİK GÖLPAZARI TONGURLAR VİLLAGE

2.1 Climatic Conditions

Gölpazarı district is located in the transition area between Central Anatolia Region , Marmara and Black Sea climate types., Marmara semi-humid climate feature is more effective in the area Gölpazarı. The characteristic of this climate: the average annual rainfall amount is between 600-750 mm. maximum precipitation occurs in winter and minimum precipitation occurs in summer. Precipication and is higher in the northern part of the region than in the southern part. Cloudy days are higher than Aegean and Mediterranean Regions , lower than Black Sea Region. [10].

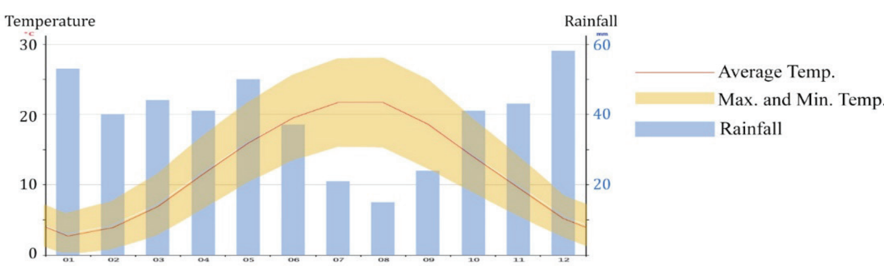


Figure 1: Climatic Data of Bilecik between 1982-2012 [7].

2.2. Settlement

Tongurlar village has developed around the axis of the main transportation road which is the typical rural village development scheme in Anatolia.The geographic ridge followed by the road determines intensity of settlement within the boundaries of the property opened to agricultural areas. The building entrances open directly to the street in buildings adjacent to the main development axis; secondary path and side connections are formed indirectly through the garden.[14].

Figure 2. Location Plan of Tongurlar Village [19].

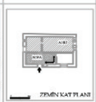
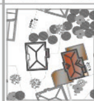
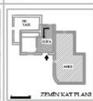
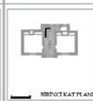
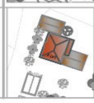
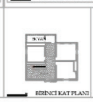
2.3 Tongurlar Village Building Plan Organization

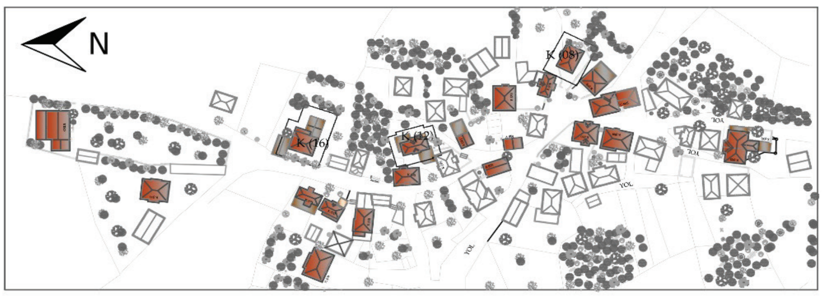
The location of the buildings in the building parcel relationship is organized for using the garden area effectively. Topographical data have been used effectively in building approach. Buildings are organized consistent schemes for building-building scale depending on the settlement patterns and functional relationships determined by the slope and the location. Tongurlar village houses doesn't contain courtyard house examples.

The residential buildings in the village of Tongurlar consist of houses with a typical Turkish house plan scheme and construction system. The traditional Turkish house, which has existed and evolved within the territory of the Ottoman Empire, is a type of house that has its own characteristics and is based on 500 years of history. It first formed its identity in Anatolia, later spread to the Balkans and elsewhere in Europe, within the borders of the Ottoman lands. From the 15th and 16th centuries it began to take its place in other settlements. The 17th and 18th centuries were the most prolific periods of the Turkish house. [11].

As a plan scheme of Turkish House consist plan type without anteroom(sofa); plan type with external anteroom, plan type with interior anteroom and plan type with central anteroom. The rooms become separate spaces with the extension of the anteroom and at the same time the connecting to each other is the most important and unique features of the plan types of Turkish house.(Eldem,1968). According to the location or shape of the antre-room(sofa), Tongurlar village has examples of front, central, exterior, interior(front) and L antre-room(sofa) [12].

Table-1. Some Antre-room Plan Scheme Houses in Tongurlar Village

House Name	Site Plan	Ground Floor Plan	First Floor Plan	External Antreroom	İnternal (Front) Antreroom	Central Antreroom	L Type Antreroom
K(08)				●		●	
K(12)					●	●	
K(16)						●	●



2.4 Using Material in Buildings

One of the most important structural elements of rural houses in the rural area is the building envelope Tongurlar village shows a homogeneous character in material usage which used in the entire settlement texture is mud brick(adobe). Tongurlar houses have mud brick filled half timbering structural system Houses are generally need to restoration for today's comfort needs.

Figure 3. Material Usage on Buildings , Tongurlar Village [14].

3. COMPARATİVE STUDY of ENERGY EFFİCİENCY MUDBRİCK BUİLDİNG ENVELOPE, CASE STUDY BILECIK TONGURLAR VİLLAGE

The building selected as "K16 House" s located at the end of the north-south axis of the Tongurlar village was restored within the scope of the Koyunu Yasat project. The plans of the housing structure before and after the restoration are given in Fıgure 4. Building has undergone structural and functional changes during restoration.

Figure 4. a: First Floor Plan before restoration, b: Second Floor Plan before restoration [14].

3.1 İnformation about Building

Traditional buildings was examined either before or after restoration to find out the effect of changing thermal properties of building walls and windows area on the required heating and cooling loads. It is a two-stories building: the first story with an area of 150 m^2 contains guest room, one bedroom, living room, kitchen, wc and two baths, and the second story with an area of 90 m^2 contains three bedrooms, sitting space, kitchen and bath[14]. .

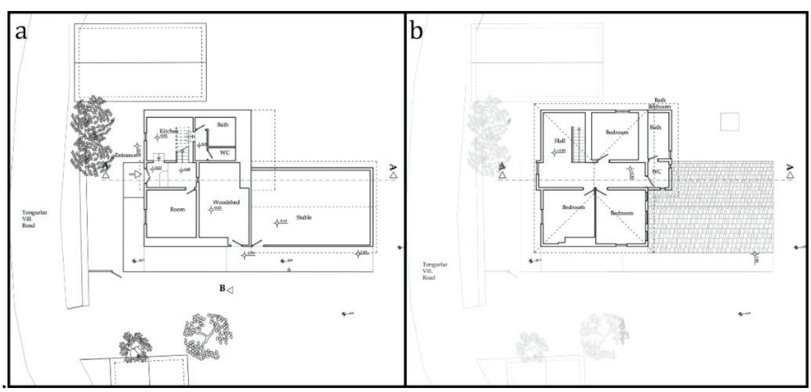


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Figure 5. a: First Floor Plan before restoration, b: Second Floor Plan before restoration[14].

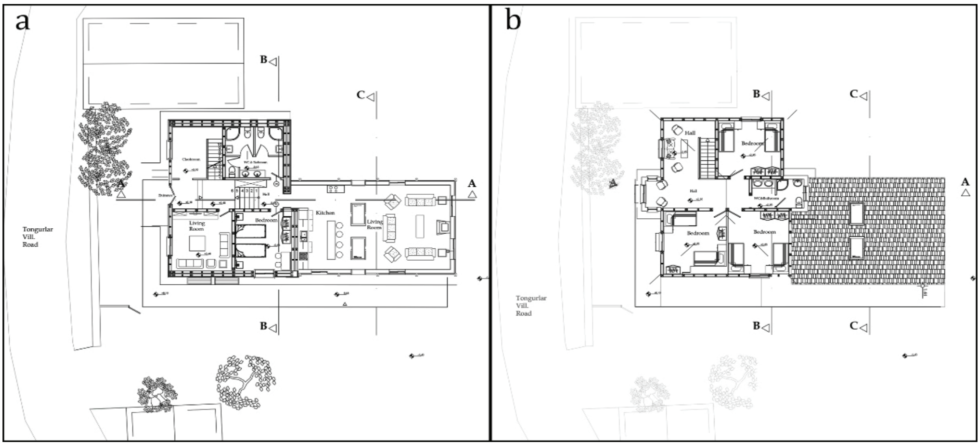

Figure 6. a: First Floor Plan after restoration, b: Second Floor Plan after restoration[14].

3.2 Energy Modelling and Energy İnput Parameters

Energy modelling of building made with Design Builder program and Energy Plus interface.[15]. Design Builder program is used in this study to simulate how the building will perform from an energy and daylight perspective over a whole year. This program offers several simulation applications during the earliest stages of design including. To use the program, some data have to be entered first to specify the design conditions, the building parameters, thermal properties of the building fabric, and climactic conditions. Simulation weather data selecting Bilecik weather data which obtained from Meteonorm Program. [16]

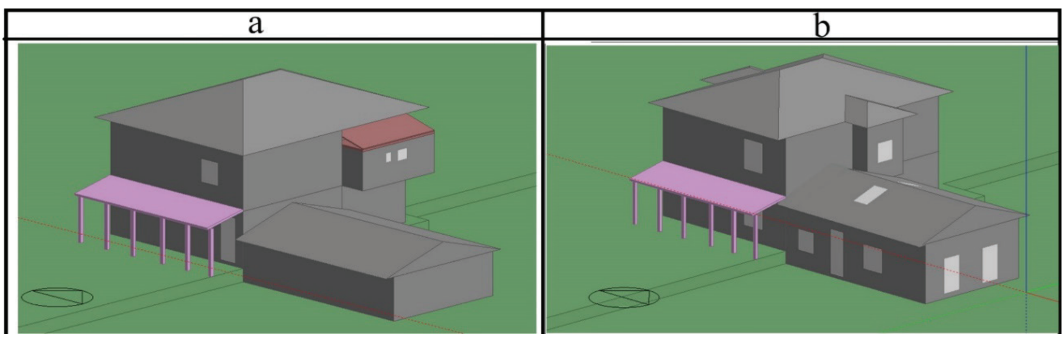

Figure 7 : Energy Models: a: After Restoration b: Before Restoration

The main factors affecting energy consumption of buildings are heating, cooling and lighting energy loads Heating and cooling energy loads are directly related to human thermal comfort. Main factors of effecting thermal comfort also effect energy demands. Factors of affecting thermal comfort are indoor air , building envelope and outdoor air. External weather conditions are influenced by parameters such as temperature, humidity, air movements and solar radiation depending on orientation and location. Beside these parameters, the activity type of the person and the insulation values of the clothes he / she wears are measurable, that objective factors affecting thermal comfort. [13]

In simulation model, heating set point selected 21 ^{o}C and cooling set point selected 25 ^{o}C. Airtightness of building given 3 ac/h before restoration model and airtightness give 0.5 ac/h after restoration model. In activity section, occupancy given 5 people / 150 m^2, metabolic rate given 0.90 met and clothing rate given 1 clo.

3.3 Building Envelope

Thermal transmittance (U-value) was taken primariluuy to describe the thermal performance of wall components. U-value is the rate of steady-state heat flow; it describes the ability of wall components to conduct heat, measured in (W/m².K). It depends on the thermal conductivity and thickness of wall building materials [18]. In this research, walls of the old part of the building is mud brick, with different wall thickness range from 20 cm to 120 cm. Mud brick(Adobe) is one of the oldest building materials in use with affordable cost. It is basically just dirt that has been moistened with water, sometimes with chopped straw or other fibers added for strength. In addition, mud bricks are fireproof, durable, non-toxic, possess low sound transmission levels through walls and provide sufficient thermal mass to buildings. There is structural deterioration in building envelope before the restoration.

The restoration process includes: changing walls material, removing and replacing some of internal and external walls, and changing windows area. The simulation was carried to study the impact these three factors together on heating and cooling loads of the new and the old status. Building envelope structural components layers are given Table 2 and Table 3.

Table 2: K16 Layering of structural components used in the models before restoration[17]

Structural Components	*Material*	*Thermal Conductivity* [W/m°K]	*Specific Heat* [J/kg°K]	*Density* [kg/m³]	*Thickness* [m]	*U-Value* [W/m2°K]
Exterior Wall (22cm-50cm)	cement lime plaster	0.8	840	1600	0,03	**1.46-0.75**
	mudbrick block	0.40	880	1700	0,45-0,17	
	gypsum plaster	0.72	800	1400	0,02	
Interior Floor	wooden flooring	0.14	1200	650	0,03	1.669
	wooden panel	0.13	2000	900	0,02	
	wooden beam	0.13	896	2800	0,15	
	wooden panel	0.13	2000	900	0,05	
Roof	clay tile	1	800	1200	0,03	**0.486**
	particle board	0.12	1700	600	0,03	
	wooden panel	0.13	2000	900	0,05	
	wooden beam	0.13	896	2800	0,15	
Window(Frame)	Wooden frame	0.13	900	2400	0,05	**3.85**
Window(Glazing)	Single Glazing	0.9			0.03	

Table 3: K16 Layering of structural components used in the models after restoration[17]

Structural Components	*Material*	*Thermal Conductivity* [W/m°K]	*Specific Heat* [J/kg°K]	*Density* [kg/m³]	*Thickness* [m]	*U-Value* [W/m2°K]
Exterior Wall (22cm-50cm)	mudbrick plaster	0.8	840	1600	0,03	**1.38-0.71**
	mudbrick block	0.40	880	1700	0,45-0.17	
	mudbrick plaster	0.72	800	1400	0,02	
Interior Floor	wooden flooring	0.14	1200	650	0,03	1.669
	wooden panel	0.13	2000	900	0,02	
	wooden beam	0.13	896	2800	0,15	
	wooden panel	0.13	2000	900	0,05	
Roof	clay tile	1	800	1200	0,03	**0.317**
	particle board	0.12	1700	600	0,03	
	wooden panel	0.13	2000	900	0,05	
	wooden beam	0.13	896	2800	0,15	
Window (Frame)	Wooden frame	0.13	900	2400	0,05	**2.65**
Window (Glazing)	Double Glazing	0.9			0.03	

In the old building windows area (22.42 m^2) is about 6.5% of the total area of external walls, while in the new one (8.49 m^2) is about 2.5%. Table 2. presents the overall windows area from façade area in each case. (Table 4)

Table 4. Total windows area from façade area

The case	Façade Direction	Total Windows Area
Before Restoration K16	South	0.8%
	West	1.4%
	North	1.4%
	East	7.8%
After Restoration K16	South	4.7%
	West	10.6%
	North	3%
	East	11.1%

3.4 Energy Simulation Results

Total annual energy demands of K16 Building after restoration gives lower values in total annual energy consumption than K16 Building before restoration. When the heating load is considered, it is seen that K16 Building before the restoration of K16 house consumes 28,305 kWh and K16 Building restoration consumes 11,340 kWh.(Figure 9)

It is obvious that the estimated annual heating energy before restoration is (171 kWh/m^2) while it increases to (81 kWh/m^2) after restoration This means that decreasing U value of wall(0.75 to 0.71) and increasing of airtightness(3 ac/h to 0.50 ac/h) leads to increase heating energy demand.(Figure 8)

It is obvious that the estimated annual cooling energy before restoration is (48 kWh/m^2) while it increases to (51 kWh/m^2) after restoration. This means that increasing windows area in the restoration process by using the windows to wall area ratio (WWAR) of 6.5% instead of 2.5% leads to increase the annual cooling demand by 6.3% with an average energy (3 kWh/m^2). (Figure 8)

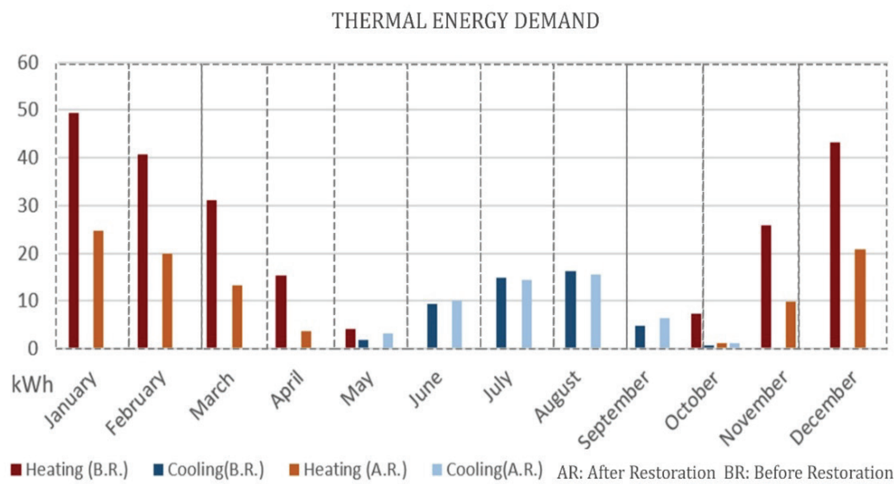

Figure 8 : Mountly Energy Consumption

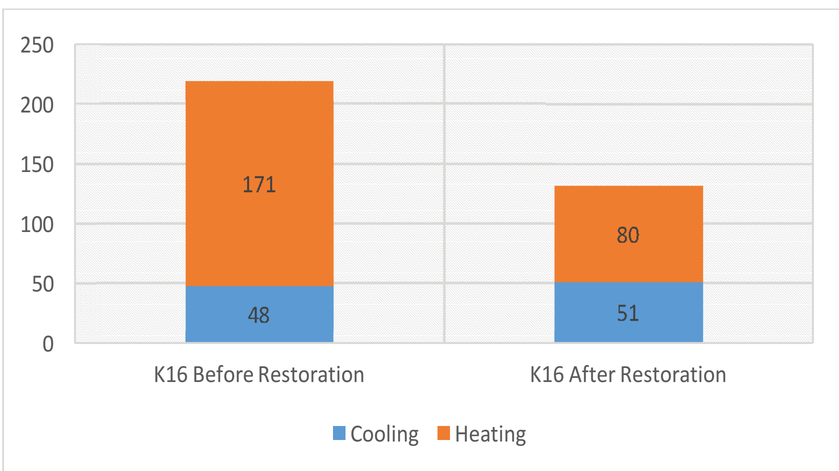

Figure 9: Annual Energy Consumption (kW/h)

3.5 Daylight Anaylsis

Besides thermal performance factor, daylight provision also should be taken into account when examining the impact of windows area. For this purpose, five spaces at ground level and four spaces at 1 level are studied using Design Builder program to investigate the impact of windows area on the average of natural daylight level, Figure 10 and Figure 11. The appropriate illuminance level is not absolute value, but it is differed depending on the type of activity. In this study, the acceptable level is chosen as a range of (100 to 300 lux) to match the residential buildings activities.

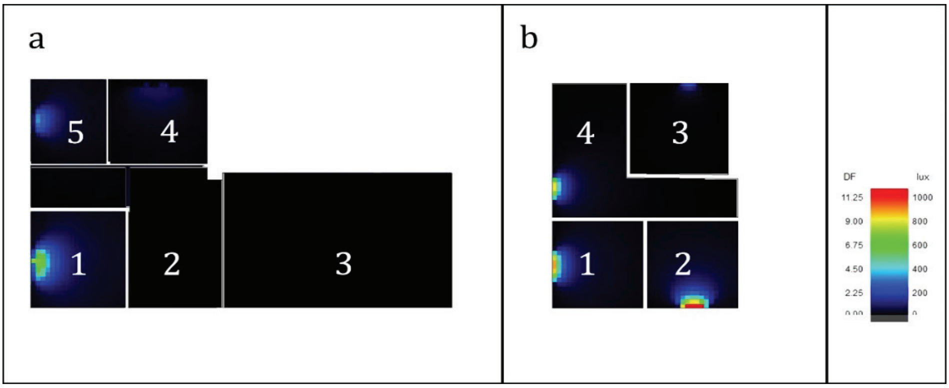

Figure 10. Daylight illumination levels

a: First Floor Plan before restoration, b: Second Floor Plan before restoration

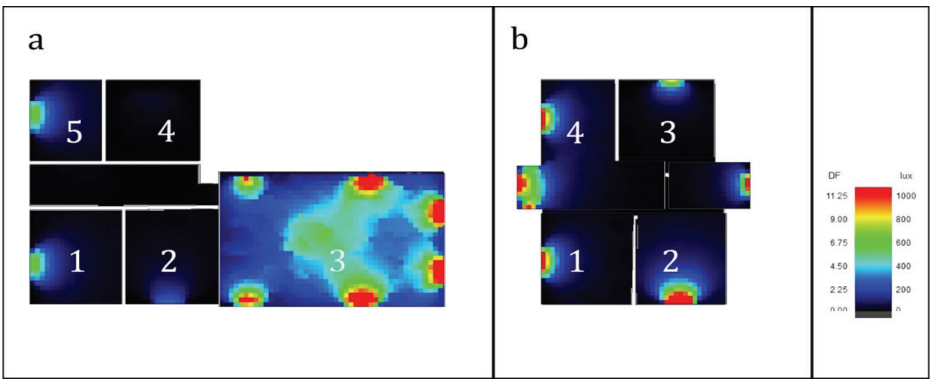

Figure 11. Daylight illumination levels

a: First Floor Plan after restoration, b: Second Floor Plan after restoration

Based on previous table 4. which presents the overall windows area from façade area, It can be concluded that less windows area of old building offers visual comfort for all spaces excepting (No. 2 , 4) in the ground floor and (No. 1 , 3) in the first floor. While, using large percentage of windows area in the all spaces of new building excepting space (No. 4) in the ground floor offers over acceptable daylight level, and it should be avoided because it causes glare that affects visual comfort.

Table 5: The average of daylight illuminance (Lux)

The Case	The Floor	Space No.	Daylight Illuminance Average (Lux)	Low	Optimum	High
Before Restoration	First	1	248		●	
		2	0	●		
		3	0	●		
		4	91		●	
		5	177		●	
	Second	1	348			●
		2	235		●	
		3	304			●
		4	250		●	
After Restoration	First	1	372			●
		2	314			●
		3	1280			●
		4	128		●	
		5	331			●
	Second	1	413			●
		2	372			●
		3	364			●
		4	354			●

4.CONCLUSİON

The thermal properties of wall building materials has a significant role in determining the thermal behavior of buildings. Therefore, selecting the proper wall components is of a considerable importance in creating energy efficient buildings that consume less energy to maintain comfortable conditions in enclosed spaces. It is evident that this approach of building design contributes significantly to create more sustainable built environment, with minimum adverse effect on the environment. It was concluded that, the heating and cooling loads of buildings are gradually reduced, as the wall U-value is lowered.

K16 house, the building envelope was renovated with Koyunu Yasat Project. Through restoration, thermophysical properties of building envelope components window to wall ratio(WWAR) improved. In this context, before and after the restoration of the structure, two different energy models have been made, energy consumption differences and daylight factors between them have been examined. As a result of the simulation, it was determined that energy consumption decreased after restoration. Heating energy demand is decreased because of improvement of wall thermal properties, but cooling demand %4 increased because of increasing of window-wall ratio(WWAR). Visual comfort conditions was improved with window wall ratio.

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A New Approach to Sustainable Design in the Future "The Example of Science-Fiction Movies"




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ABSTRACT

The concept of sustainability, which has been used various fields since 1980s, is a participatory process which provides the moderate use of cultural, scientific, natural and human resources and promotes a social stance on the basis of respect for these issues. The main themes of sustainability as a widely used concept are about the future of humankind and the protection of related resources. In this context, the sustainability in the design appears as not a merely stylistic approach, but also as a tool for systematic thinking, which comprehends the all environmental factors in the making of the built environment.

However, when we shed light upon the rapid environment changes, despite their increasing importance the sustainable design solutions may not hold the potential to be efficient or convenient in the future. Therefore, this study aims to discuss the sustainable design from a hypothetical perspective by examining the selected science-fiction movies with the analysis of the space and the other design elements within the related framework. Since the emphasis of narrative in science fiction is profoundly on the advanced technologies and the progress of humanity, while integrating the fundamentals of science; this genre can hint the glimpse of the future sustainability scenarios also can expand the horizons in terms of design outcomes. This interdisciplinary study, aims to make a contribution in raising awareness about the different sustainable design approaches while developing a new perspective upon them.

Keywords: Sustainability, Sustainable Design, Sustainable Architecture, Science-Fiction Movies, Star Wars movies.

1. INTRODUCTION

The word "sustainability", derives from the Latin "sustinere", basically means to "sustain, to provide, to maintain, to support, and to exist" although it has been used in various ways. The concept of sustainability, which has been used in a larger scope since the 1980s, is a participatory process that provides the moderate use of all social, cultural, scientific, natural and human resources of society and constitutes a social perspective on the basis of respect. In the early 19th century, the sustainability started to appear as a concept in the literature. It can be said that it has emerged in terms of renewable resources such as agriculture, forestry and fisheries. Briefly, the main focus of the sustainability concept are the future of the humankind and the protection of the sources in its application areas [1,2]. Nowadays, construction industry appears as a business sector which directly related to humans and consumes the resources in largest amount. When this taken into consideration, the importance of sustainability in architecture and design approach strikes again.

First of all, the conceptual definition of sustainability and sustainable design is covered in this study. Secondly, the relationship between the cinema and architecture and the impact of design preferences in movies are analyzed. Afterwards, the film visuals from two Star Wars movies, selected within the framework of certain criteria, will be evaluated by doing a literature review and utilizing the digital archives. In the conclusion part, a general evaluation of the study along with the demonstration of the sustainability and Star Wars visual chart is done.

2. THE CONCEPT OF SUSTAINABILITY IN THE FIELD OF ARCHITECTURE & DESIGN

Environment and life which consist of the physical, biological, social, economic and cultural environment and the natural environment in which people and living beings maintain their relationships, interact with each other; are two concepts directly which are related to each other. [1-3] A healthier environment maintains the higher quality of life of the living organisms. In this sense, sustainable, in other words, ecological architecture is not a style but a systematic of thinking that all environmental factors should be considered.

Within the scope of this systematic thinking; 1-Ecological interest in design, ecological view and ecological approach principles, 2-Protection of the environmental systems, designing and living in harmony with nature, 3-Respect for nature and human, 4-Using recyclable materials in planning and implementation stages, 5-Minimizing the energy required during the construction and usage phases of the building, 6-Conscious use of limited resources and making productions useful to each other, 7-Giving priority to renewable systems such as solar, water and wind, 8-Taking measures to prevent environmental pollution due to garbage and wastes, 9-Preservation and dissemination of green areas in order to improve climatic characteristics, 10-In addition to the newly constructed buildings, the improvement of the existing buildings within the scope of energy and ecological principles should be considered. [2-4]

As societies evolve economically, the need for resources such as construction land and materials for buildings or especially energy increases. As a result of this increase the impact of architectural activities on the global ecosystem is growing. The goal of sustainable designs and sustainable architecture in this respect is to ensure that our global ecosystem of living organism, inanimate substenances, and artificial elements continues to coexist. For this purpose, it is possible to create a table that architects can use as a guide for sustainable building designs they want to create. (Table 1.) [1-5] The sustainable architectural design scheme consists of three stages: principles, strategies and methods. These three stages guide the creation of environmental awareness about architecture and environmental education, understanding building ecosystems and how to design sustainable buildings. In summary, the three sustainable architecture principles seen in the table are listed below:

Table 1. The Design Scheme of Sustainable Architecture [5]

THE PRINCIPLES OF SUSTAINABLE ARCHITECTURE		
Resource Management	Life Cycle Design	Respectful Design Approach towards Humans and Nature
STRATEGIES		
Efficient Use of Energy	Pre-construction Phase	Protection of Natural Conditions
Effective Use of Water	Construction Phase	Urban Design and Land Planning
Effective Use of Material	Post-construction Phase	Design for Human Comfort
Effective Use of Building Areas	Pre-construction Phase	Urban Design and Land Planning

Resource Management: This principle deals with the extraction, utilization and recycling of natural resources used in building construction. Some measurements should be taken to protect the energy, water and the other natural resources used in construction stage. In this respect, the natural resources used during the construction of one structure should be able to be re-used in the construction of another structure after the end of the life of the primary building.

Life Cycle Design: This design process carried out with analysis of building construction phases and their effects on the environment. Starting from the first design steps of a building, it aims to integrate a method that causes the minimum environmental damage by considering the relationship of the building with the environment during the process which comprises the usage phase and and the destruction of the buildings.

Respectful Design Approach towards Humans and Nature: This approach addresses the interactions between human and environment. In this respect, while constructing the buildings which provides the maximum level of comfort, especially for its residents, the aim is to create designs that will increase the environmental quality of other living creatures. [1-5]

In the context of product design and sustainability, the suggested considerations for prominent design features are: 1- designing products with exchangeable parts, therefore, the product itself can be repaired when one of the components are broken. 2- usage of raw materials to provide longevity 3- an innovative and efficient means of energy sources in manufacturing process 3- utilizing eco-friendly and recycled materials 4- obtaining the sources from local suppliers 5- designing in such fashion which enables the repurposing 5 – developing products which are suitable for shared or circulatory use 6- utilizing the components of a product when the lifecycle of the product itself ends [6–7]

3. SCIENCE FICTION MOVIES IN THE CONTEXT OF ARCHITECTURE & DESIGN

In this chapter, the relationship between the cinema and architectural design is investigated in aspects of the influence of specific set of design preferences featured in the movies. Later, the reason why the science fiction genre is selected in this study is explained through the reciprocal relationship among the future of the humankind considering the role of sustainability in the future and the genre's envision for these possible future scenarios is revealed.

3.1 The Relationship between the Cinema and Architecture and the Impact of Design Preferences in Movies

To spark discussions about built environment and its perception through a narrative, films are one of the most accessible and prolific media platforms. In cinema, the aesthetic qualities of the surroundings directly impact the story and generates an experiential perception for the observer. [8] As Jadoon states, both film and architecture enable people to travel through space as they require movement for experience. [9]

Cinematic architecture conjures specific mental states such as horror, alienation, sadness or happiness and joy through the architectural imagery and design preferences. [10] This significant imagery embodies the manifestations of current socio-cultural and socio-economic climate while providing a virtual space to inhabit for viewers. [11]

3.2 The Correspondence between the Paradigms of Science Fiction Genre and Sustainability

Science fiction as a genre in film in mid-20th century; nonetheless, the futuristic images on film dates back to early 1900's. Science fiction movies may seem representing the formidable aspect of the future surroundings; however; this representation is mostly an amplified version of the problems in our current reality. Science fiction movies sustains the best examples to analyze the architectural imagery because this genre generates the most provocative, engaging, and even alarming glimpses of future. [12] Therefore, it would be wise to consider this disturbance both as a warning and an inspiration for the problems that may occur in the future due to integration of contemporary paradigms of our society. [13] Science fiction term heavily implies visions from future, technological advancements, the issues of a society of future in terms of political, social or environmental circumstances. Some movies of that genre have inspired some invention and technological progress. Even though science fiction will not be providing a literal vision of future, it still represent new means of perception and a mental projection of future.

Technological developments and innovative, energy efficient design approaches are the key factors in terms of sustainability to compromise with the needs of both recent and future generations. The danger of extinction of natural resources due to reckless consumption and non-ecological implementations remarks the sustainability as a vital issue. When this taken into consideration, science fiction movies can indicate visionary hints to predict future scenarios to find compatible design solutions.

4. VIRTUAL AND SPATIAL ANALYSIS OF CASE STUDIES: STAR WARS: THE PHANTOM MENACE & STAR WARS: THE FORCE AWAKENS

The case studies offer examples of how the sustainable design examples in terms of Architecture and Design. Several methods and practices to implement and maintain sustainability such as use natural light, local selection of construction and production materials, recycling and upcycling methods, ecological approach to urban design.

In this study, Star Wars by George Lucas was chosen as the case study. The aim of this case selection is to determine how a science fiction film, which has been so widely adopted by society, as a result of its fiction brings sustainable architectural and design solutions in other world scenarios and to raise awareness of sustainability with the assistance of popular culture.

Table 2. Star Wars Movie Series

STARWARS SERIES		
Trilogy	Movie	Release Date
Prequel Trilogy	Star Wars 1: A Phantom Menace	1999
	Star Wars 2: Attack of the Clones	2002
	Star Wars 3: Revenge of the Sith	2005
Standalone Movies	Rougue One: A Star Wars Story	2016
	Solo: A Star Wars Story	2018
Original Trilogy	Star Wars 4: A New Hope	1977
	Star Wars 5: The Empire Strikes Back	1980
	Star Wars 6: Return of the Jedi	1983
Sequel Trilogy	Star Wars 7: The Force Awakens	2015
	Star Wars 8: The Last Jedi	2017
	Star Wars 9: The Rise of Skywalker	2019 (coming soon)

The first film of the series, in which George Lucas wrote the script, was shot in 1977. The series was initially published in three episodes with three year intervals; but from 1999 onwards, a prequel trilogy met with the audience. Finally, the sequel movies were released in 2015 and 2017. [14] Due to the prolific use of architectural fiction and spatial richness, especially the A Phantom Menace and The Force Awakens episodes of the series will be analyzed according to sustainable architecture and design criteria.

4.1. The Phantom Menace (1999)

This episode centered around the Jedi helping Queen Amanda as the Federation cuts out all of Naboo's liaison channels, and the discovery of Skywalker child. Meanwhile, the most notable architectural sites are Otoh Gunga,Naboo underwater city, the repair shop in Tatooine and Tatooine vernacular houses.

Naboo Underwater City (Otoh Gunga): When the design of Otoh Gunga is addressed, it is estimated that the units that make up the city massively were inspired by jellyfish. As jellyfish move in water without being attached to the ground, these units are also suspended in water. In addition, the transparency of jellyfish, the fact that a large part of their bodies consist of water and the adhesiveness of the outer tissue are interpreted in the interior and shell of the units.

In addition, fish bone-like elements were used indoors. This is related to the biomimicry approach, in which an indigenous system in nature is used as an inspiration to solve complex design problems and it coincides with the principle of sustainable design focusing on "to design and to live in harmony with nature". (Figure 1)

Figure 1. Some visuals from Otoh Gunga

The Repair Shop in Tatooine: Tatooine is a desert planet in the binary solar system. [15] The film was shot in Ong Jmal in Tunus, not in a fictional space. Traditional mudbrick structures of the city were used in the shooting. [16]

Adobe structures are widely used in desert climates due to their insulation properties. The construction of soil from local soil material and its contribution to energy saving make these structures sustainable. In addition, due to the extreme heat, the establishment of market places in semi-sheltered spaces and the fact that the buildings have wind chimneys for passive ventilation are the general characteristics of the city. At the building scale, the courtyard of the repair shop is surrounded by mudbrick walls higher than the human height, there are small openings in the building, and the use of interior equipment (reception desk, stairs etc.) made of mudbrick material is remarkable. (Figure 2)

Figure 2. Visuals from Tatooine and the Repair Shop

Tatooine houses: The scenes of Tatooine houses in the film were shot in traditional adobe buildings in Medinine, Tunisia. The insulation property of the adobe material was also processed in the dialogues in the film. Certain parts of the facades of the buildings are probably calcified because of the reflection of the sun's rays without being absorbed by the surface as an effort to cool the environment. In addition, the purpose of the inward shifting of the door entrances, particularly at the upper elevations, suggests the idea of forming a heat corridor between the exterior and the interior. These situations coincide with the principles of sustainable design such as respect for nature and people, designing and living in harmony with nature. The interior features small windows, skylight, niches and movable and built-in furniture. (Figure 3)

Figure 3. Visuals from a Tatooin house

4.2. The Force Awakens (2017)

This episode centered around a Rey, an undiscovered Jedi, and her adventures and her realization of her emerging powers beside the villain's efforts to build a more technological and guarded weapon than Death Star to destroy the resistance just like in the former movie, A New Hope. The most striking places in the film are Rey's house in Jakku (desert planet), different tents used as public spaces and the castle of Maz Kanata.

Figure 4. Planet of Jakku and Rey's House

Jakku: The Desert Planet- Rey's House: The scenes of the film in Jakku were shot in the Rubulhali Desert of the United Arab Emirates. [15-16] Generally crashed or damaged vehicles that have lost their function (eg airplanes, spaceships, etc.) are repurposed with different functions such as housing or vehicle. The building Rey used as a residence is a re-functioned spaceship. (Figure 4) In terms of resource management, the effective use of existing elements in a topography where it is difficult to construct like the desert, the efficient use of available elements, the conscious use of limited resources are sustainable in terms of productions that will be beneficial for each other. This has also contributed to the utilizing of metal wastes that will not disappear for years and to prevent environmental pollution.

Jakku: The Desert Planet - Tents: The similarity of the tents used in the scenes to the Arab Bedouin tents and the use of the holistic space here are striking. The tent is designed in a semi-open space with a half-open roof covering, similar to the leaves of the date palm tree, inspired by plants that can grow under the harsh conditions of the present hot desert climate. (Figure 5) The tents used as public spaces in the film coincide with today's sustainable architectural design approach in respect of nature. In addition, it is seen that local materials and idle tools and spaceship parts are brought together and used as different interior architectural elements in the construction of tents and thus the energy consumpiton is reduced to a minimum level.

Figure 5. Planet of Jakku, Tents

Maz Kanata's Castle: The scenes around the building were shot in the UK's Puzzlewood forests. [15] In terms of form and material, the building is a fictional space that brings to mind the temples of Old American Civilizations. When the overall fiction of the building is considered, it is seen that it is an inward-facing settlement surrounded by high walls. A sculpture is used as the focal point in the spacious inner courtyard that forms the public space.

However, the interior, which lacks natural light, is quite dark and gloomy, unlike the courtyard. The use of natural stones suitable for nature and climate in the structure and the untouched appearance of the surrounding green areas are positive aspects of the design. As a matter of fact, the excessively large mass of the castle renders the building out of context in terms of design principles which in harmony with nature. (Figure 6)

Figure 6. Maz Kanata's Castle on the planet of Takodana

5. CONCLUSION

After examining the visual and textual documents, it was seen that the films The Phantom Menace and The Force Awakens, which we have chosen to analyz, have such scripts which only one of the climatic species that exist in the world today dominates the entire planet like in the case of desert planet Jakku.

Naboo Underwater City: Otoh Gunga in The Phantom Menace shows a city which consists of life units suspended in water. Although these units seem to coincide with the biomimicry approach in architecture, the space is inspiring due its solely fictional but genuine design features and it suggests a different approach to designing and living in a harmony with nature.

The scenes in the repair shop in Tatooine were shot not in a fictional place, but in Ong Jmal in Tunisia, so in a science fiction film, traditional mudbrick architecture appears, which we can see in many cities outside Tunisia today. Similarly, the scenes of the Tattoine houses in the movie were also shot in Tunisia and this time the examples of adobe architecture in Medinin were demonstrated. The buildings are very important in terms of introducing the usage of adobe which has an important place in sustainable architectural design to the audience. Despite this natural material is not given enough importance in the present day, its demonstration in the movie is significant in terms of raising the awareness.

The scenes of Rey's House on the Planet of Jakku in The Force Awakens show that a spaceship that lost its function by crashing into the desert was now repurposed as a home. Since the the idea of using spaceships in science fiction movies have been out there for many years, it is open to discussion whether if it can contribute to our perspective on sustainable design or not. As a matter of fact, the use of the ship as a shelter and a home, shows refunctioning which is a common practice in today's architecture and design practices.

In the scenes that tents on the Jakku planet are displayed in the same movie, the local tents that we can easily see in any country where the desert climate is dominant are enriched with sci-fi elements. In the scenes of the film in Maz Kanata's castle, the castle reminds audience of the temples of the ancient American civilizations where the Monsoon climate prevails.

In this context, the notion that cinema and architecture are two art forms which nourish each other is accepted. However, utilization of the the buildings which still can exists in today's world but represented with their more enriched version with fictional features in science fiction movies instead of the utilization of fictional spaces as a product of a creative imagination, proves more fruitful to expand our perspective in terms of sustainable design. Therefore, this study led us to state that the architecture holds a bigger share compared to the cinema in this interaction.

When the the sustainable design principles obtained within the framework of literature review taken into consideration, the sustainability of the buildings which are both fictional and existing structures in the movies are examined in Table 3.

Table 3. The Sustainability-Star Wars chart

The Sustainable Design Principles and Star Wars Movies: The Phantom Menace and The Force Awakens

	The Phantom Menace			The Force Awakens		
	Naboo Underwater City (Otoh Gunga), Figure 1	The Repair Shop in Tatooine, Figure 2	Tatooin Houses, Figure 3	Rey's House in Jakku Figure 4	Tents on the Planet of Jakku Figure 5	Maz Kanaa's Castle on the Planet of Takodona Figure 6
1-Ecological interest in design, ecological view and ecological approach principles		x	x		x	
2-Protection of the environmental systems, designing and living in harmony with nature	x	x	x		x	
3-Respect for nature and human	x	x	x		x	
4-Using recyclable materials in planning and implementation stages		x	x		x	
5-Minimizing the energy required during the construction and usage phases of the building		x	x	x	x	x
6-Conscious use of limited resources and making productions useful to each other				x	x	
7-Giving priority to renewable systems such as solar, water and wind		x				

8-Taking measures to prevent environmental pollution due to garbage and wastes		x x
9-Preservation and dissemination of green areas in order to improve climatic characteristics		
10-the improvement of the existing buildings within the scope of energy and ecological principles	X	

Science fiction writers foresee the inevitable, and although problems and catastrophes may be inevitable, solutions are not."
Isaac Asimov (Holdstock, 1978)

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Adobe Built Heritage in Turkey Examination of Harran Culture House

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ABSTRACT

Northern Mesopotamia and settlement prior to the start of the Christ " Fertile Crescent " region, an important residential area of the cone-roofed structures in the county of Harran in Turkey's Sanliurfa province has been the subject of many studies. Sustainability of buildings, plan typologies, natural materials, construction techniques and Harran group houses are among the important structures of cultural heritage in the region. In these conical roof structures; stone, brick materials, wall and roof; The adobe material was also used as plaster on walls, roofs and floors. When the traces of the first building areas were followed, people constructed their structures by using / converting materials such as stone, soil in nature. In this context, adobe material is a legacy of cultural material because it has soil content. Although adobe is a natural material, it is easy to find the material used in the construction of the materials that make the caster to be an important building material. Moisture and heat balance in buildings is also one of the natural air conditioning factors in the use of adobe material. In order to investigate the mudbrick heritage, the general characteristics of the Harran Culture House, which is one of the clustered structures using the adobe material and kerpic, were used in Harran's cluster houses.

Keywords: Adobe, plaster, mesopotamia, harran conical house, sustainability

1. INTRODUCTION

Adobe material has been used as natural building material since ancient times. It is a sustainable building material with different usage areas and application techniques. Adobe having in common usage in Turkey's geography; It has been used as a building material in certain parts of the buildings located in the Harran district of Şanlıurfa. In the research area, adobe material is used as interior and exterior plaster. With the use of adobe plaster on the plasters of houses made of stone and brick, the sustainability of the natural system of the buildings has been maintained. With this study, information is given about the adobe material used in the cone roofs of Harran and the sustainability of these structures. The study consists of five chapters. In the first chapter; the aim of the study, the scope and the method used to prepare the study are given information. In the second part; Harran's location, history, architectural structure and socioeconomic status of the public are given. In the third chapter; information on Harran Culture House, which is described as mud-brick heritage. In the fourth chapter; information about the construction, material, physical condition and internal climate related to the sustainability of the building are given. In the last section, as a result of these researches, suggestions for the sustainability of evaluation and use of adobe material were presented.

Harran's conglomerate structures date back to the 3000s. Although the buildings that have survived to date date back 250 years ago, they have the property of cultural heritage in terms of construction techniques and materials used. Migration from rural to urban life, the development of technology, as well as the changing materials and application techniques, have reduced the number of users of grouped structures. The cultural value of the buildings is emphasized together with the conservation studies and the preservation of the study area in the region, which is now designated as the urban site. The use of adobe in Harran cumulative structures and the cultural heritage of these structures are gaining importance for the mudbrick heritage. With this research, the effect of Harran cluster houses on regional architecture and the characteristics of the structure were investigated.

Harran district where the use of adobe material was used was chosen as the research area. In this study, investigations were carried out in Harran. Information on the current studies and the studies that are being carried out has been investigated. Observation study of the existing texture in the area and the structure given in the study was carried out and the scientific studies related to the Harran houses and adobe material were examined. Harran'ta mud-brick structures while doing research on one of the structures; The reasons of the building materials, the reasons for the selection of materials, the characteristics of the plan, the relationships between the open and closed spaces and the climatic conditions were evaluated. The user information related to the structure has also been consulted. The construction technique and plan typology as well as the sustainability of the structure were also examined.

2.HARRAN

2.1 Location

Harran district of Şanlıurfa is located in Turkey's Southeastern Anatolia Region. It is located in the 'Mesopotamia li inde which is located between the Euphrates and the Tigris and the' Fertile Crescent 'in which the first agricultural activities were carried out. It is located 44 km from Sanliurfa. Its area is approximately 900 km^2. Around Akçakale and Harran where the Ceylanpınar district, in the south of Turkey is located close to Syria. Harran city; It was established between the Deysan and Cüllab rivers. It has fertile soil. Harran is located on an axis where the important old trade routes on the northwest and west intersect.

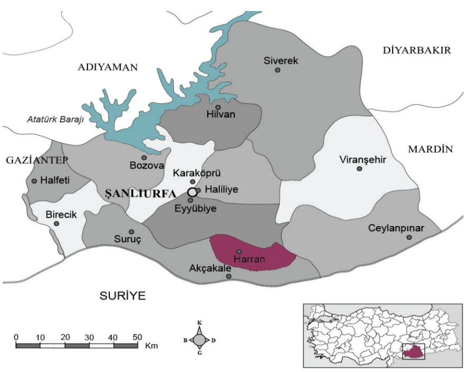

Figure 1: Location of Harran [1]

Figure 2: Cupola Houses of Harran [4]

2.2 History

Harran, which was connected to Urfa with a history dating back 11,000 years before Christ, hosted many civilizations. Urfa, which was built 11 million years ago in Urfa and known as the megalithic structure, has a variety in terms of historical structure and historical area. It has led to the construction of important buildings in architectural development with its religious diversity and the influence of different cultures. The settlement in Harran began before the millennium. Ebla, Assyria, Hittite, Hellenistic, Persian, Babylonian, Roman kingdoms and Umayyad, Abbasid, Eyyubi, Seljuk, Ottoman states were settlements. Harran was the capital during the Assyrians and Umayyads. In the 1200s, the city was damaged by the Mongols in an attempt to occupy the city. This city on the Silk Road in history has a cultural background.

Like Urfa, known as the city of prophets, many prophets lived in Harran. Hz. Abraham, his father, wife and Prophet. Lut and Harran stayed for a period; Hz. He writes that Yakup was married in Harran. In the same holy book, Harran's name is Hz. [2] writes that Abraham came from his brother Haran. The name Harran comes from the word Haranu in the Sumerian. Harran, which is connected to Akçakale district of Şanlıurfa province, became the county of Şanlıurfa in 1987.

2.3 Socioeconomic Structure

Harran, which is thought to be a settlement since the historical ages, has an economic structure based on agriculture and fattening. It is an important economic activity of the city because of the climatic conditions and the structure of the land. The highest yields of wheat and grape crops have been cultivated in old times [3].

Today, cotton and vegetable cultivation is carried out with the effect of irrigation systems. The people of the region, who have strong communication with the land due to agriculture, transferred the land to architectural culture. In Harran, which has a population of 85,000, agriculture is an important source of livelihood.

2.4 Architectural Structure

In the 13th century, it is mentioned that there are 4 madrasah (university), 1 nursing home, 1 hospital and 14 baths. When the architectural structures in Harran are examined, many civil architectural structures, religious buildings, educational structure, military structures are found. The majority of these structures form stone structures. The adobe structures were mainly used in civil architectural structures.

Islamic works were built in architecture with the transition of Islam to Islam in the year of Harran. Han El Barür Caravanserai, Hz. There are important areas in terms of archeology such as Şuayp Peygamberin City, Soğmatar Ancient Ruins, Mecma Gate, Azerbaijani Statues and Harran Höyük. In 1983, archaeological field studies were resumed. Many works belonging to the old age, middle ages and bronze ages were also found in the Umayyad State, Ayyubid State, Seljuk State and Babylon. Many works such as glazed and painted ceramics, stone works, terracotta artifacts, bronze artifacts were found in archaeological excavations. The narrow streets were built and the remains of the city with adjacent courtyard houses were reached. Water wells, sewerage systems, stepped toilets in wet areas and bath, mills, storage areas were found in these structures.

Archaeological researches are continuing in the area where the ruins of Harran Ulu Mosque were built during the Umayyad period. In this area, the fountain courtyard and 32 hela were found. There are also the first baths of Anatolia in the area.

Harran City Circle, which has 187 signs and 6 gates with a length of approx. Harran Castle was built next to the city walls and restored by the Fatimid State in 1059. The castle, which was built in three floors, has been destroyed. Harran Ulu Mosque; It is known as the oldest, biggest and richest stone ornamented mosque in Anatolia. The minaret and the foundations of the building have reached today. The Great Mosque is known to be the Temple of the Moon (Ay Shrine). In 640 it was converted into a mosque. When the land properties of the city of Sanliurfa are examined, cut limestone is used as a local material. In Harran, the stone as well as brick and adobe were used as building materials.

2.5 Climate

Harran is a plain formed by tectonic collapses. The plain with alluvial soils has gained importance in terms of agriculture. Due to the decrease of water resources in Harran where the continental climate is dominant, water tunnels have been created by GAP project and agricultural diversity has been obtained. The average temperature of the Harran plain is 180 ° C. In summer, the average temperature is 40 ° C and in winter the average temperature is 5 ° C. The average annual rainfall is between 300 mm and 400 mm. Rainfall increases in spring and winter seasons.

3. HARRAN CULTURE HOUSE EXAMINATION

The properties of the building, which was transformed from the conical roofs in Harran district into a culture house function, were investigated.

3.1 Location of Harran Culture House

The Harran culture house in Harran district center is located on the parcel no. 227 in Harran city walls. To the north of the Harran fortress is the ruins of Harran Ulucami and the university to the northwest. This area is located in Harran city walls. While there are conglomerate structures around the building, it is possible to see reinforced concrete structures. It is found in the area of organic street tissues compared to the newly opened settlements in Harran.

3.2 History of Harran Culture House

The construction techniques of mudbrick structures with conical domes in Harran date back to 3000 BC. In 1979, these houses were protected by archaeological and urban sites. There are approximately 1000 tombs in the region. These structures, which have survived in Harran, have a history of about 250 years. One of these structures, which was taken under protection, was restored in 1999 and was brought into tourism as Harran Culture House. It has a different plan typology and a morphologically different system over adobe structures on the world. These conical roofs, which are one of the symbolic structures of Harran which was included in the UNESCO temporary heritage list in 2000, are natural materials with sustainability.

3.3 Plan Features

When we examine the plan typology of the building, open and closed spaces are found. Indoor and outdoor spaces are examined as indoor and outdoor spaces. No semi-open spaces are found in these buildings. The settlement area is located on the plain and the slope value is very low. In order to facilitate the construction of the building, the buildings were built in a single storey. In addition, conical roof structures have been preferred as one-storey since air circulation is provided. There are 19 tombs in the structure. 17 of them constitute a single mass, and 2 of them form another mass in the courtyard apart from the main mass. The structures in the structure have a prismatic planning close to the square. The dimensions of the caverns differ. A dormitory room covers an area of 8 m^2 - 9 m^2.

3.3.1 Internal volumes

The closed spaces of the building are conic roofed areas. In this building model where the flat roofed part is not much, each cluster determines a place. The number of dome structures gives information about the economic status of the user of the structure [5]. The places where the graves are located are connected to each other by arches. According to the dimensions of the space intended to be formed in the main mass, the chamber is arranged in the desired size with intermediate dividing walls from the carriage parts of the dams. Living areas, bathroom, workshop, kitchen spaces are located in the main body. Hela was built as a separate building outside the group structure and flat roofed adjacent to the northeast of the main mass. In the structure, it is foreseen that 17 dwelling buildings were used as a barn and the eastern part as a living area. The building, which is located on the left side of the courtyard door with two tombs, was used as the accommodation area for the guests.

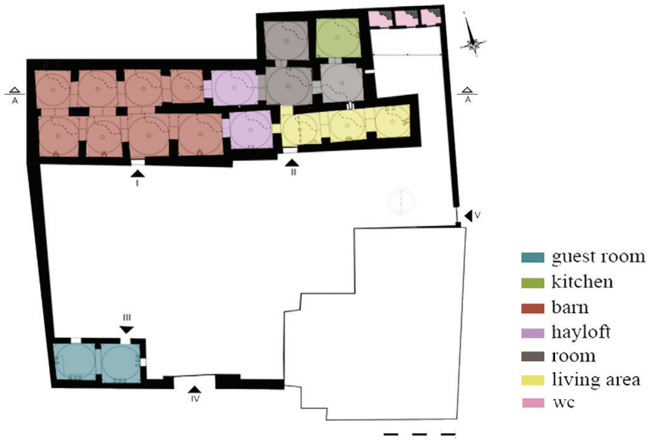

Figure 3: Ground floor plan of the building [7]

Today, this building is used as a kitchen structure serving the outdoor café in the courtyard. While some of the existing structures used in the region are used in warehouses and barns, the living areas continue in the new reinforced concrete structures and in some others these buildings continue to be used as living spaces.

3.3.2 External Volumes

The open space of the building is the courtyard. 2 m walls and building mass form the courtyard. The courtyard was used as an area where daily activities were performed. The user meets the water requirement from the water well located in the courtyard.

3.3.3 Construction

Most of the materials used in the building are stone and bricks, which are the remains of Harran University, which is considered to be one of the oldest universities in the world. The main part of the building was built with stone material. The walls of the building were built with stone and conical roof with brick. The vaults are connected with arches. In each corner of the walls of the cupola forming each room is the corner stone where the conical roof is sitting. When one of the corner stones is removed, a collapse occurs in the structure.
When the building was demolished, the users did not build the structure on the ruins and built the new structure in a different area. Therefore, it can be seen that the old plan and aerial photographs show that the houses are constantly changing.

Figure 4. A view from the courtyard of Harran Culture House [6]

The single-storey tiled structures are made of paving stones. Adobe plaster was applied to the stones. While the stones form a distinct surface, the soil surface used in the interior stands out. In order to determine the boundary between the room and the transition area in the interior volumes of the building, triangular shaped stones parallel to the vertical plane were used. The basement level of the building is 5 cm.

Wooden doors are used in the transition from the exterior to the interior of the building. In the openings for the transition between spaces, the fabric covers instead of the wooden doors were used to cut the visual communication between the spaces. The height of these gaps in the interior is made in some rooms at low height. The door openings for entrance to the building from outside areas are 2 m high. The height of the door gaps in the interior varies between 2 m and 1.6 m. In the sociocultural context, the low value means that the door is passed through the door in order to make people feel respected.

The walls made of stones from the ruins of the University of Harran were built with a masonry system. The wall thickness of the building varies between 50 cm and 100 cm. Adhesive plaster is applied to the interior and exterior walls. In order to ensure the sustainability of the structure, every year, slurry adobe plaster is applied from the interior and exterior parts of the walls. In this way, the structure is protected from internal and external factors.

One of the most important features of Harran cumulus structures is conical roofs. The building has gained a different architectural identity. The inner height of the conical roofs is between 4 mt and 5 mt. The opening in the upper elevations serves as an air chimney. These domes built with 30-40 bricks were covered with triangular bricks on these gaps, which provided both light and air flow. In rainy weather, this space is completely closed.

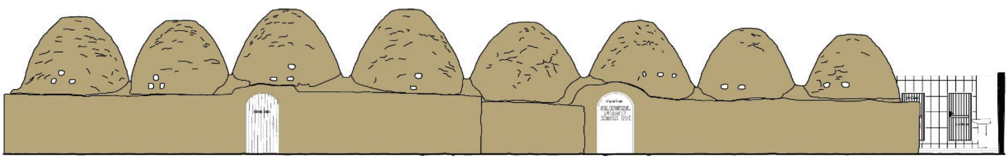

Figure 5: Front of the building [7]

These conic roofs, which are important in terms of sustainability, provide air circulation in the interior and remove the hot air inside the structure in the summer months and remove them from the space. The same operation causes the stove and hearth heat to be kept indoors in the winter. The stove and the stove smoke emerge from the space in the conical roof. Some bricks were placed on the outer surface while conical roofs were being constructed. When the conical roof is needed, the conical roof is being renovated by climbing to these bricks.

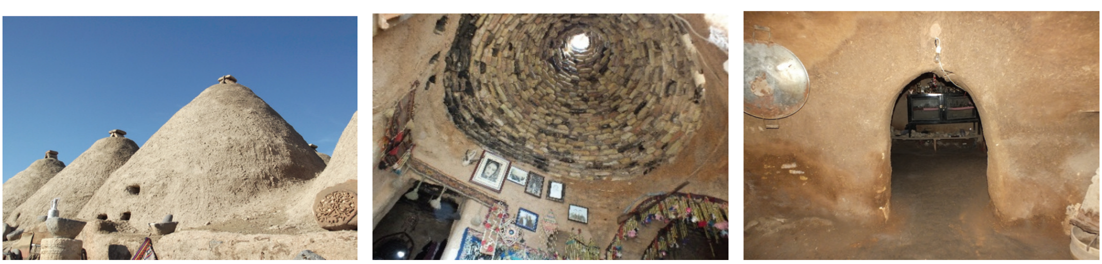

Figure 6-7-8: Conical roof exterior view, Conical roof interior view, Interior wall [6]

The window gaps of the structure are usually small spaces in the upper part of the wall or on the surfaces of the conical roofs. These gaps are approximately 16 * 20 cm. The two spaces or three spaces are approximately 30 cm apart. The space left in the wall is approximately 30 * 40 cm. The number of cavities left on the wall is very low compared to the gaps in the conical roof.

3.4 Physical State and Use of the Structure

In 1979, the urban area was designated as the urban area. The structure was improved by the interventions in 1999. The structure used as a residence has been used as a function of the Culture

House as a result of the works carried out by the relevant administrations. The new function of the structure includes the sociocultural and socioeconomic aspects of the city; exhibiting the lifestyles and the tools they use in their daily life and taking people who visit this structure to a small tour of history.

Users live in single-storey reinforced concrete structures built on the corner of the shed house. They use mechanical systems in their interior buildings with artificial air conditioning. The 2 conical roofs on the parcel and the wet roofs with flat roofs were built on the blanket wall and demolished building areas. Cement plaster was used on the inner surfaces of the walls.

4. CONCLUSION AND RECOMMENDATION

The dormitory houses in Harran are based on an ancient history in terms of traditional construction methods as well as being the legacy of adobe building. These structures, which are the result of local materials, experience and cultural accumulation, are a cultural heritage of the world. These structures will be protected, transferred to the next generations, and will be an important cultural heritage and memory transfer.

With the differentiation of the construction methods and the materials used, the users in the region have turned to reinforced concrete structures. In these buildings where mechanical systems and artificial air-conditioning are used, the number of those who want to continue their lives is increasing.

Harran has also started to decrease in population due to differentiation of economic, sociocultural structure situations and migrations to metropolitan cities. With the abandonment of adobe structures indirectly, the structure is no longer a living organism. Destruction of unused structures causes the loss of cultural heritage.

Known for its unique architectural structure, Harran houses offer an ecological design that is respectful to nature and integrated into nature as a result of its structure biology. In order to ensure the cultural sustainability of adobe structures, the socio-economic conditions should be improved and the users should be encouraged to live in the structures to be constructed with the local materials and the current construction techniques. The old materials used in the current materials should be cleaned, the original structures should be restored.

Inventory remains as a legacy for many civilizations. The life of mudbrick structures, which are living organisms, should be maintained with the users and transferred to the next generations. In recent years, with the help of urban scale projects prepared by the relevant administrations in the region, the conservation works have started for the buildings with historical value in the region. Apart from the local adobe buildings, which are on the UNESCO heritage list, they also have an important wealth of cultural heritage. Archaeological research studies are still ongoing.

With industrialization, materials used in buildings are differentiated and artificial air conditioning systems have been used to regulate the internal climate values. One of the areas where the most energy loss, building air conditioning artificial systems despite; incentives should be made to increase the use of natural energy-efficient adobe material with high humidity and heat balance. In terms of energy storage, the soil material comes after the water material. The soil that has the property of storing heat creates a stable environment by returning the heat energy it stores to its place in time [8]. The adobe offers a healthy life by protecting the place from external weather conditions. Increasing the use of adobe material, more sustainable living spaces can be obtained.
As part of the research carried out during the Harran Culture House survey, mudbrick plaster samples taken from the building are examined. Previous studies on mudbrick plaster, which have higher durability and did not lose its properties, have been investigated in this context. It is aimed to increase the working life of the adobe material by means of stabilizing the adobe building

material with gypsum [8].

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Mudbrick Architecture: Is It Sustainable?

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ABSTRACT

Adobe is one of the leading building materials used since the Neolithic Age. Considering many factors such as supply of materials, production and transportation of desired sizes, construction of the building that meets the shelter needs requires time, labor and energy. However, adobe is a material that provides ease of application in place, is 100% recyclable and does not contain any waste, and can be obtained with healthy, economical, local facilities and simple tools. The use of materials in the region when constructing the structure significantly reduces energy use and transport impacts for material transport compared to reinforced concrete structures. However, countries are not given due importance to mud, causing it being built faceless buildings with existing structures of adobe structures demolished instead of brick-like material and that of historical masonry structure which has an important place in Turkey do not have day to day.

In this study, it is aimed to examine the adobe structures by giving examples from our country and the world and to introduce their properties. Within the scope of this research, historical development of adobe usage, definition and principles of sustainability and how these principles are integrated into adobe structures are demonstrated with examples of sustainable adobe structures worldwide.

Keywords: Mud brick, Sustainable, Material, Vernacular architecture

1.INTRODUCTION

Adobe and bricks; It is the most widely used building material in regions where trees and stones are not easily found. The reason for this is that the adobe is easy to supply and does not require skilled workmanship. The mudbrick, made of clay, has been used in building construction for thousands of years, and about 30% of the world's population still lives in shelters made of clay [1]. Most of the monuments that have survived to date are made of mudbrick. Especially, monuments made of mudbrick, which contributes to cultural heritage in areas with high earthquake risk, are being preserved and preserved. Because these buildings are transferred to future generations as an architectural heritage from the recent past and give important information about the architectural language of the country.


Figure 1,2. Çatalhöyük was built by mudbrick approximately 9000 years ago.

Adobe architecture is very common in many parts of the world, especially in the middle generation. In ancient times, mudbrick was produced in Mesopotamia, Central Asia and Ireland very intensively and was used as a building material which was used due to necessity and left its place to reinforced concrete as the prosperity of society increased. The main reason for this was not the fact that the concrete structure was produced and constructed more healthily or easier. On the contrary, the adobe structure has superior properties in most respects than the reinforced concrete structure.

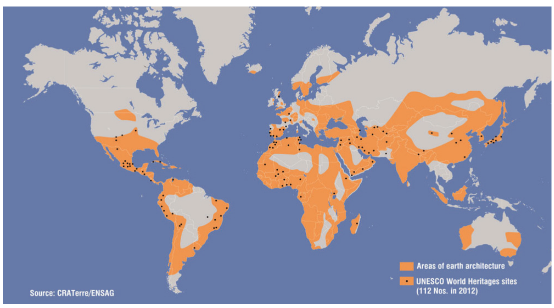

Figure 3. World Mudbrick map

The thickness of the mudbrick structures varies depending on the region where the building elements such as walls and roofs are located and the climate conditions of that region. In Eastern Anatolia, where the winters are very cold, wall thickness is between 70-80 cm. Thermal transitions also increase when the window door openings are opened. In other regions where the winter does not pass so hard, there are also buildings with 50cm wall thickness. Is In terms of knitting technique, mudbrick walls are divided into three walls, the walls made with mudbricks of the same size, the walls made of mudbrick, one of which is called the mother and the lamb, half of the other, and the inner and outer walls are mudbrick. It is the most common type of wall created by mother-lamb bricks [2].


Figure 4,5. Examples of mudbrick walls of different thicknesses.

2.HISTORICAL BACKGROUND OF MUD BRİCK

The first building materials of the first people were soil, forest products, reeds and straw plants and collecting stones which are local materials around them. The use of soil as building material dates back to ancient times, and the first known examples were the Zhoukoudian caves built in the 1920s to meet the housing needs of 600,000, 780,000 years ago, discovered in the southwest of South Beijing [3]. The first evidence of soil formation was seen in the Tigris basin, and this apparent example was built in BC. It dates back to 7500 [4]. Since then, Chinese bricks, Ramses II temples and Ishtar gate have been widely used to build bricks [3].


Figure 6,7. Example of the Great Wall of China and the Gate of Hearings made of clay bricks.

With the migrations, some societies could not find any collection stones in their regions and produced artificial stones and invented adobe. For example, as there is no natural stone in Çatalhöyük, which is a neolithic settlement, people dried the adobe blocks in the sun and obtained artificial stones. Later, during the Jericho excavations in Jordan, mudbrick blocks and carrier wall were found [5,6,7]. Adobe, which requires only soil and water, is one of the simplest construction materials. Through trial and error over time, it was understood that 10-22% clay should be added to make the soil water mixture sticky [8]. In later experiments, new additions were made in order to change the specific properties of mud brick and to have improved mechanical and chemical properties. Animal hair, animal manure, various plant fibers are some of these additions. For example, fiber adobe was obtained by adding 5-10% gypsum and fiber to the appropriate adobe soil. Thanks to the added gypsum, the adobe was set faster and had good strength when removed from the mold. Thus, labor, time and drying area are reserved for drying [9].

3. SUSTAINABILITY

Many sources are threatened by future environmental pollution and the deterioration of natural balance. This situation brings the concept of minimum sustainable architecture day to the agenda. The concept of sustainable architecture; is an approach that produces its own energy, has systems that use natural and renewable energy sources, recovers the materials it uses, protects the green environment, and makes even rainwater ready to be reused.

AIA (American Institute of Architects) concept of sustainability; He explained that the continuity of the society towards the future, without compromising the balance of the system in the direction of depletion or overloading of the basic resources needed [10]. Sustainable architecture; socio-economic, cultural, environmental and societal sense of the future, the problems that will create in the future and plans to solve the design aims to design. When it comes to sustainability, the energy consumed by the building comes to mind first. in buildings; The energy used in the design, implementation and demolition process should be minimized, the presence of systems such as HVAC and artificial lighting should be reduced and the climatic conditions of the region where the structure is located should be taken into consideration [11].

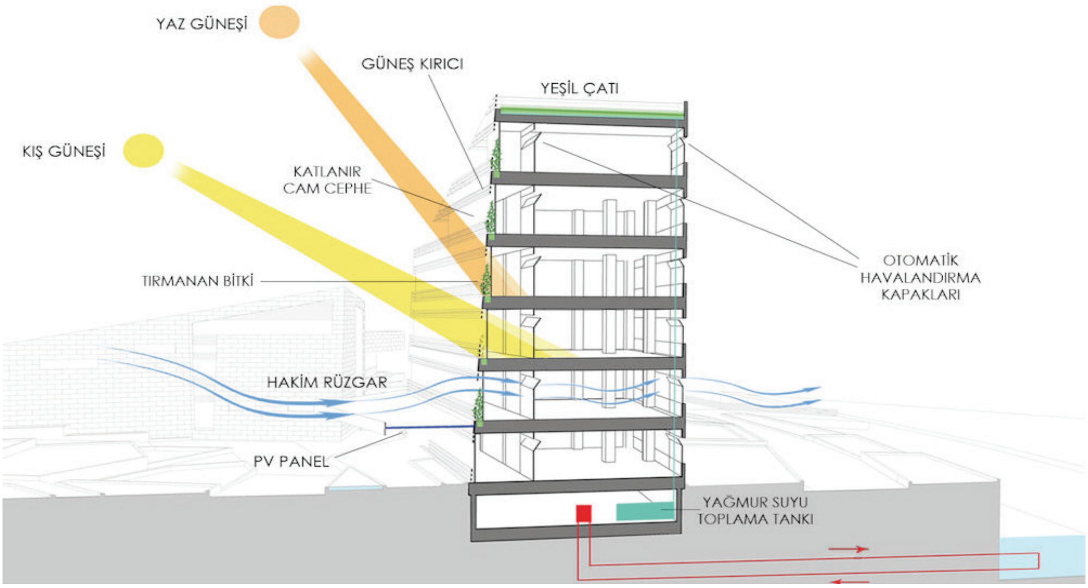

Figure 8. Sustainable building example.

The aim of sustainable building is; to improve the quality of life of the people in the settlements, to create an environment that respects the social, cultural and aesthetic needs of the people and to create an architecture that people value [12].

The concept of sustainability is composed of economic growth, social development and environmental protection. However, the most important factor among them is the environment. Because sustainability arises from the sensitivity of negative changes in the environment. Most of the universities in the United States have a separate department working on sustainable design where environmental design education is provided. The school opened on this subject in the course of architectural education in Turkey is very low. This shows that there is no knowledge and interest in sustainability.

4. THE EFFECT OF MUD BRICK BUILDINGS ON SUSTAINABILITY

Adobe is a building material that has been used since the first settlements on the earth to date, obtained by mixing the soil with straw and water, then pouring it into molds and then drying it in the shade and then in the sun. [13].

Since adobe does not use baking energy in the production of building materials, it is quite environmentally friendly. If mud brick are used as wall materials, the world's energy resources will be conserved and gas and solid wastes will be reduced. It is not wise to use the increasingly narrowing energy resources in the world for the production of building materials. Because the building material is produced to a large extent to meet the growing demand of the growing population. For our country, which imports its energy from foreign currency, it will be meaningful to reduce the production energy of building material on the one hand and the heating and cooling energy of the building material on the other hand. Besides being an environmentalist, the most important advantage of mud brick is that it is suitable for human health. What is necessary for health is the absence of large temperature differences in the space and the building elements that make up the space. Soil, which is one of the best energy storage materials after water, forms the walls surrounding the space as a building material and stores its heating energy in its structure. After the heating is stopped, it keeps the energy stored for a long time and keeps the temperature in balance. On the other hand, because of its high insulation capacity, it protects the structure from unwanted heat or cold outside the structure. The homogeneity of the wall section ensures that the adobe wall behaves in terms of structural physics. In many climatic zones, there is no condensation inside the alkaline wall. If there is no condensation in the wall section, the wall is protected from chemical and physical aging. Mold and micro-organisms do not grow on the section and surface of the wall. Mold and microorganisms in the wall are the source of many diseases including respiration and skin [14].

Since the first settlement ages in Anatolia, mudbrick material, plaster and sometimes stone and block mudbrick in the formation of our local architecture has always been a traditional building material which has been chosen and preferred since it can be produced easily in masonry structure system [15].

This traditional mudbrick building culture, which has been the result of a long tradition in Anatolia, has started to disappear due to many negative factors. In addition, the differences in system of wood and stone adobe culture in the local architectural researches have not been examined sufficiently. An important area to spread the traditional mud housing material to be adapted to contemporary conditions in Turkey, strengthening the structural system carriage and their environment in respect thereto and to be strengthened by suitable intervention to local conditions. When these conditions are met, the continuity of the mudbrick material in Anatolia will be maintained today [16].

5. SUSTAINABLE MUDBRICK BUILDING EXAMPLES

It is a known fact that traditional architecture in Anatolia has not been investigated sufficiently yet. The determination and documentation of our cultural values is mostly done in regions where conservation problems have reached the current and popular status. However, in order to adequately define the regional architectural traditions, extensive screening and documentation studies are needed. According to our knowledge, the first settled settlement in Anatolia is Çayönü Tumulus [17].

Northwest of the city of Diyarbakir, 7 km. southwest of the mound. The pottery Neolithic settlement is located in the northern part of the mound. Here, a multi-roomed building complex with thick walls and courtyards was uncovered starting with stone and raised with mudbrick.

The Çayönü excavation, which completed 12 periods with the 1987 excavation season, continues to be the most well-known, the most widely opened First Neolotic settlement of the Near East with its 4900 mi excavation area. With such a surprisingly advanced architecture and settlement order for such an ancient period, Çayönü reflects a deep-rooted architectural tradition and differs from its well-known Eastern Mediterranean, Syria and Mesopotamian contemporaries. Located on the threshold of the mountainous region of Anatolia, the settlement has given results that will completely change many of our knowledge about the early period of village communities and continues to do so [18].


Figure 9.10. Çayönü Tumulus

In the following period, Çatalhöyük is a very large Neolithic and Chalcolithic settlements in Central Anatolia, which was settled 9,000 years ago. It consists of two mounds side by side in the east and west directions. Today, the city of Konya 52 km. southeast. According to the settlement information obtained as a result of the excavations, mudbrick walls and rectangular plan walls were plastered with a greenish yellow plaster [19].

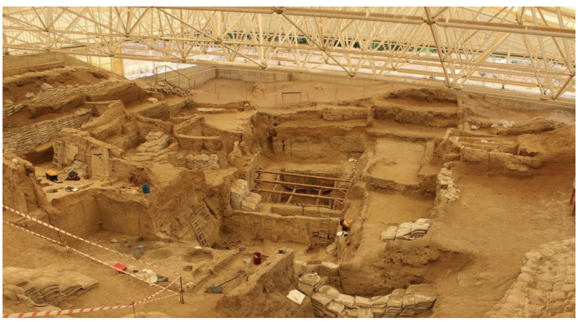


Figure 11,12. Çatalhöyük

The settlement of Çatalhöyük consists of adjoining neighborhoods of houses and temples built with mudbrick adobe in the form of a fully enclosed honeycomb. Similar to the plan, the houses were built with adobe bricks without using stone foundations [19].


Figure 13,14. Sibam, Hadramut

Sanaa, a UNESCO World Heritage site, is located in a 2,200-meter valley and is partly surrounded by mudbrick walls. The religious and political heritage of the city can be seen in numerous mosques, baths and magnificent multi-storey mud-brick houses built before the 10th century. In the city of Sanaa, these houses have a complex mud architecture and clay 6-7-storey buildings. Decorated with extraordinary stained glass and tinted windows, the buildings are replaced by 5-11 storey mud-brick skyscrapers in Shibam and Hadramut.

Shibam is a town of 7,000 people in Yemen where Asia, Africa and Europe meet. UNESCO's World Cultural Heritage list, the city owes its fame to its unique architectural texture. All buildings in Shibam are made of mudbrick, 500 of which are multi-storey houses ranging from 5 to 11 floors. Although Shibam is thought to be a 1700-year-old city, most of the buildings in the city date back to the 16th century. The highest adobe structures in the world are in Shibam, which exceed 30 meters in height [19].

The city of Bem, which was added to the UNESCO World Heritage List in 1993, was built by the Persian Empire. Founded in the 2nd century. On the other hand, Iran has a large agricultural area and the most important problem of Iranian residents. Although Bem City was established in the middle of the desert, it was transformed into an agricultural center with irrigation canals [20].


Figure 15, 16. City of Bem

6. CONCLUSION

Today, with the development of construction technology and the creation of new production line of construction materials, traditional construction materials take second place. Traditional building materials, such as mud brick, consume much more energy than today's building materials and provide indoor conditions. In the days when we are in danger of running out of scarce resources, it becomes inevitable to choose green building materials that use less energy, consume less water and use less natural resources in their production and use. Constructed with traditional methods, these structures can be designed and applied not only on single floors but also on multiple floors. Therefore, the use of materials such as adobe in the construction sector should be encouraged, at least by regulations, in order to further utilize all these practices.

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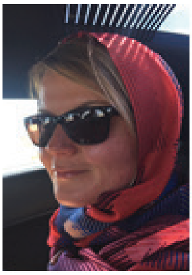
Preservation of the Iraqi Archaeological Architectural Heritage – Current conservation projects in Uruk (southern Iraq)



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ABSTRACT

The archaeological cities of Uruk and Ur and the Tell Eridu archaeological site form part of the remains of the Sumerian cities and settlements that developed in southern Mesopotamia between the 4th and the 3rd millennium BC in the marshy delta of the Tigris and Euphrates rivers. They became part of the UNESCO World Heritage List in 2016.

Uruk is considered to be the first metropolis of mankind. Founded at the end of the 5th millennium BC, about 40000 people lived and worked here as early as 3000 BC. Key achievements of civilization such as writing, or the development of sophisticated administrative and social structures originated in Uruk. Uruk was only eclipsed in size by Babylon at around 600 BC.

The German Oriental Society and later the German Archaeological Institute (DAI) have been excavating monumental as well as residential and commercial buildings on the site of Uruk since 1912. A large part of these building remains consists of earth blocks. With the awarding of World Heritage status, came an obligation to establish a conservation strategy for the archaeological site. This task is managed by the DAI and planned and implemented by Klessing Architekten, Berlin, and ZRS Ingenieure, Berlin, together with local colleagues from the State Board of Antiquities and Heritage Iraq (SBAH).

In autumn 2018, the first measures for preservative conservation were implemented. Among other things, 10 m³ of new earth block masonry was built in an endangered area at the so-called Eanna Ziqqurrat. In autumn 2019, work is to begin on the protective conservation of the so-called White Temple. These are the last, more than 5000 years old remains of the only high temple preserved on a ziqqurrat. This building also consists of earth blocks.

Keywords: Archaeological site, conservation, intervention, world heritage, earth blocks

1 HISTORICAL BACKGROUND OF ARCHITECTURE AT URUK

Located 300 km south of Baghdad and about 15 km east of the provincial town of Samawa, the ancient metropolis of Uruk lay on the western fringe of the Sumerian heartland in the alluvial lowlands between the Euphrates and Tigris rivers. Uruk was inhabited almost continuously from the 5th millennium BC to the 3rd and perhaps even the 4th century AD, i.e. for a time span of around 5000 years.

The metropolis of Uruk probably evolved from two larger or several smaller, closely situated settlements on both sides of the Euphrates that can first be attested in the 5th millennium BC, in the late Ubaid period. These communities expanded rapidly, and by the turn of the 3rd millennium BC they had grown into an integrated urban area of huge size, covering approx. 5.5 km² and rising up to 19 m above the original ground level. At that time, a city wall of 9.5 km length was erected, which already in the 3rd millennium BC was commemorated as a heroic deed of the famous king Gilgamesh. As such, the enclosed city of Uruk was the largest known city in the ancient world, and it retained that renown until the 6th century BC, when the city of Babylon grew to occupy an even larger area.

Already some time earlier, at the end of the "Late Uruk period" (second half of the 4th millennium BC) the city encompassed an area of 2.5 km² and, after more than 1000 years of habitation at the same site, was considerably higher than the surrounding alluvial plain. The city now comprised a centre in the middle of the nearly round agglomaration of mounds and lower areas surrounding it. Excavations were able to reveal buildings from this period at different locations in the immediate centre of the city. Insight into daily activities and crafts were gained from investigations at the fringe of the central area.

The architecture of that period consisted of an early ziggurat, a temple on top of a high terrace as well as several representational structures of considerable size. The ziqqurrat, perhaps the sanctuary of Anu, god of the heavens, stood at the southwestern boundary of the city centre while the representational structures were erected in its northeastern part. The latter buildings were distinguished by their remarkable size, a precise architectural plan and an elaborate division of the external façade. The long rectangular structures consisted of an arrangement of rooms that focussed on a central hall, occasionally ending with a T-shaped head, or they comprised simple yet impressively ordered halls. The façades either exhibited a marked division into decorative niches or were covered with ornamental mosaics of clay or stone cones in various colours.

Several remarkable developments were noted during that period: Following the invention of the rapidly revolving potter's wheel, pottery was made almost exclusively in mass production, which would thus require a well-organised social structure. On the other hand, fragments of large sculpture and stone reliefs, small animals made of stone, elaborately sculpted stone vessels and exquisitely carved cylinder seals found in Uruk are not only a manifestation of the wealth and power of the contractors; they also demonstrate the astounding craftsmanship of the artisans. A further innovative development took place in Uruk, which was to have far-reaching effects in the history of civilisation: the invention of writing. First evidenced around 3300/3200 BC, this script was initially employed to record administrative matters. Uruk at that time obviously played a major political and, most probably, economic role in southern Mesopotamia and beyond.

Figure 1. Uruk, Remains of the Eanna Ziggurat in 2016

Around 3000 BC buildings and settlement layers from the Late Uruk period were levelled, filled in and rebuilt with new structures. Now, a sacred precinct formed the city's centre, where since the 3rd millennium BC at the latest, the Eanna sanctuary of Inanna/Ishtar, goddess of love and war, stood. During the 3rd Dynasty in Ur (22nd/21st century BC), this sanctuary underwent major re-building that eventually led to the canonical form of central sanctuary in southern Mesopotamia which comprised a ziggurat in a central courtyard, surrounded by further courtyards and which was in use in southern Mesopotamia for a long time. As can best be observed in the ziggurats in Ur and Uruk, the resumed ziqqurrat form constitutes two rectangular high terraces, one above the other, upon which a temple is located. Access to the lowest terrace (more than 11 m in height) is provided by an external, T-shaped staircase, which is comprised of an axially arranged central staircase, adjoined by two side stairs, each linked to the terrace. At the beginning of the 2nd millennium BC Uruk became the capital of a local dynasty of kings who erected one of the largest palaces unearthed in Mesopotamia. Cuneiform texts inform us about their restricted political influence and at the same time about their economic ties with different regions as well as the care the kings applied to the existing sanctuaries in Uruk. At the end of the 18th century BC, drier climatic conditions as well as, perhaps, the shift of interregional waterways forced most inhabitants to leave the city and it was only in the 15th century BC, the Kassite period, that major building activities and settlement on the old mounds can be observed. Again, the major focus was the care for the Eanna sanctuary where king Karaindash added a peculiar, little temple building. Uruk during the following centuries played a considerable economic role for the southern marshlands and was part of the so-called sealand until the first half of the 1st millennium BC. The city was strategically important during the Assyrian conquests in southern Mesopotamia (9/8th century BC), and it experienced several enlargements and alterations under the Chaldean rulers (7/6th century BC), the Achaemenid (6-4th century BC) and the Seleucid periods (3rd-2nd Century BC). Still, construction measures are evidenced especially in the Eanna sanctuary and also in the expansive residential area in the immediate vicinity of the sanctuary. Especially during these periods, thousands of clay cuneiform tablets elucidate the economical foundations and activities of the times, revealing the intermittent close relationship between Uruk and the capital city Babylon in a political and – above all – economical aspect.

Yet, during Achaemenid domination there was also a profound change in cult in Uruk. While the Eanna sanctuary continued to serve as a place of cult, under Artaxerxes I or II there was a vigorous renaissance of the cult of Anu, god of the heavens, and his place of worship was re-built next to the Anu ziqqurrat at the northwestern part of the city centre that was so important during the 4th millennium BC.

With the monumental enlargement of this Anu sanctuary "Bit Resh" (approx. 36,000 m²) and the erection of a new Anu ziqqurrat (approx. 12,000 m²) during the Seleucid period as well as the installation of the Inanna/Ishtar cult in a new temple complex "Irigal", likewise a monumental building, the ancient sacred centre of the city lost its importance. The major places of cult were now situated on the southern fringe of the city's centre. Central parts of both the Bit Resh and the Irigal have been excavated. Despite their construction in Seleucid times, they exhibit a typical Babylonian ground plan. Both building complexes encompass a temple complex with the long-known room arrangement: a central, closed cella on a lateral axis with an ante-cella, and the adjoinment of several courtyards which also offer access to further cellae. The accompanying economic and administrative units also had a place within these complexes.

After 141 BC Parthian rulers assumed power in Mesopotamia. Uruk lay on one of the important trade routes between the Arabian-Persian gulf and Syria, and, consequently, the city flourished economically once again in its long history of settlement. Nearly all areas of the city were inhabited. Nonetheless, the ancient temple complexes were given secular purposes. To date, two new temples built in Parthian times have been attested. Their architecture clearly derives from Hellenistic-Roman temples. Similarly, the adaptation of western styles becomes increasingly distinct in the sphere of daily activities. Uruk was still densely settled, when conquered by the

Sasanians in the middle of the 3rd century AD. Nonetheless, a sudden shift of settlement to the eastern suburbs is archaeologically perceptible. Thereafter, in the 4th/5th AD the population in the region gradually decreased and the city of Uruk was ultimately abandoned.

2 ARCHAEOLOGICAL BACKGROUND

Excavations have been conducted systematically in Uruk since 1912. At first the two sanctuaries in the centre of the city stood in the foreground. After World War II investigations also took place in a palace of the Old-Babylonian period at the western margin of the city and in residential sections from Neo-Babylonian and Seleucid-Parthian times. Yet, due to the exceptional size of the city, in more than 40 field expeditions less than 5% of the entire urban expanse could be investigated through excavations. Nevertheless, excavations have resulted in a relatively comprehensive picture of this renowned city.

The excavations in Uruk gained scientific significance through a particular circumstance: the expansive Eanna sanctuary of Inanna/Ishtar in the city's centre took on a form in the 22nd century BC that was retained throughout the following 2500 years, despite numerous substantial modifications. A ziggurat was erected in the centre, surrounded by several courtyards of various functions. The courtyards remained in use for hundreds of years without any greater changes. Their enclosure walls were renewed from time to time, but the construction within the walls was limited. Thus, only few architectural remnants which would have been particularly worth preserving were found below the surface of courtyards dated to the 1st and 2nd millennia BC.

Consequently, excavations reached settlement layers of the 3rd and – above all – the end of the 4th millennium BC relatively quickly. It was in the latter level, "the Late Uruk period", that remains of monumental buildings were found over a large surface, which became known as the typical architecture of this period. Thus far, no architectural rests have been recovered in such an expanse at any other site. Therefore, essential information on these historical periods can be gained solely from the excavations in Uruk. However, the walls of the Uruk period structures were usually preserved at a height of only a few centimetres. While their ground plan and the particularities of their architecture could still be well documented, backfilling of the excavation area was the only possible way to preserve the structures. Larger buildings, on the other hand, were excavated and studied and kept open for the information of visitors. After more than 100 years of field research most of them suffer from erosion and urgently need conservation interventions.

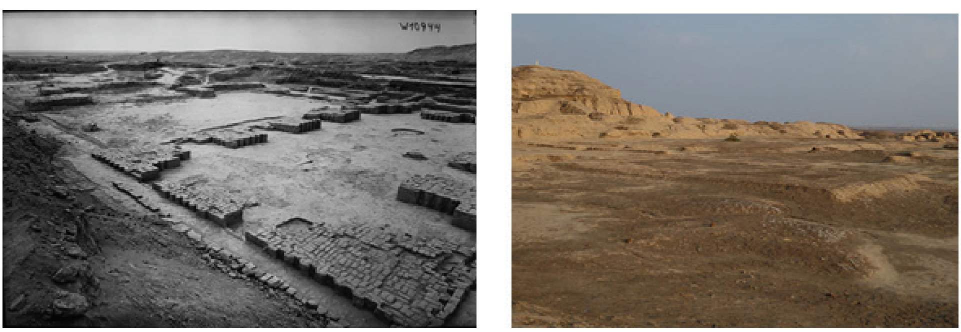

Figure 2a and b. So called "pillar hall" after excavation (a) and current situation after back-filling (b)

Excavated building remains mainly consist of bricks, rarely of natural or artificial stones and, above all, massive earth structures; some are made of rammed earth but mainly of earth blocks.

3 DEVELOPMENT AND IMPLEMENTATION OF A CONSERVATION AND TRAINING STRATEGY

With the awarding of World Heritage status in 2016, an obligation arose to establish a coordinated conservation strategy for the archaeological site. This task is managed by the DAI and planned and implemented by Klessing Architekten, Berlin, and ZRS Ingenieure, Berlin, together with local colleagues from the State Board of Antiquities and Heritage Iraq (SBAH).

A system was developed and implemented for the following tasks:
– Investigation of the damage mechanisms in general and in detail
– Investigation of individual buildings or its remains
– Implementation of a monitoring system
– Development and management of a priority list
– Development and implementation of emergency conservation and conservation measures
– Development and implementation of maintenance plans and manuals.

As expected, the high moisture and salt content in the soil, combined with the typical climatic conditions of hot arid climate zones, has led to a strong accumulation of salts harmful to buildings in the evaporation zone. The delamination of materials associated with salt crystallisation results in the loss of substance from high-quality surfaces such as glazes to the partial collapse of parts of buildings. This process was greatly accelerated in the winter of 2018/2019 by above-average rainfall. It is worth noting that many of the remains of buildings are still covered with historical functional horizontal bitumen mortar waterproofing, which still limits this damage pattern today. Further damage phenomena are above all direct surface erosion by direct wetting with rain or rinsing out of concentrated draining water as well as wind abrasion. Unconscious and deliberate damage by tourist groups in the still insufficiently prepared ruin landscape is also a major problem.

A monitoring system was introduced for areas with particularly critical conservation status or high cultural-historical significance. For this purpose, forms were developed, which are filled in by colleagues of the local antiquities authority at regular intervals or after special climatic events (e.g. heavy rain). These forms make it possible to compare the respective condition with the condition at the beginning of the records. If necessary, measures can be derived from the changes. The local staff of SBAH took part in a one-year programme in Germany on documentation and preventive conservation of architecture developed by the DAI, and the application of this knowledge has been implemented together on site. A priority list for emergency safety and conservation measures is updated constantly, taking into account the current state of preservation, which is recorded by the monitoring system, the cultural value, the location on the future visitor route and the financial and human resources available. Based on the detailed investigation, emergency conservation and conservation strategies are being developed for the individual objects and worked out down to the last detail. The strategies are drawn up in accordance with the UNESCO statutes and discussed with the relevant bodies. Part of the conservation strategy must always be the subsequent maintanance strategy. It is already clear that the huge area of ruins requires constant conservation and maintenance work.

4 CONSERVATION MEASURES ALREADY CARRIED OUT

In the area of the archaeological site of Uruk there are currently no fixed visitor paths but only informative paths, which run partly directly over valuable findings. An interim circulation path for visitors was developed by blocking traditional paths and preparing dump dams of previous excavations to assist the movement of visitors.

Figure 3a and b. The railway during excavations (a) (1923) and during reactivation (b) in 2018

In order to be able to transport building materials on the site with as little damage as possible to the historical features, the historic narrow-gauge raised railway was reactivated, which was used during the time of the large-scale excavations up to the late 1960s. It turned out that the technology is so robust that it could be reactivated some 50 years later without major problems. The transport of building materials could take place as planned with the help of the railway.

The first major protective conservation measure was carried out at the western corner of the Eanna-Ziggurat. The Eanna-Ziggurat, the high temple of the goddess Ishtar, is a huge construction of two massive platforms and consisted of approx. 3.5 million earth blocks. The ziggurat is reinforced by regular reed mat layers and ropes in such a way that a relatively steep formation was possible. The reed mat layers still help reduce surface erosion today. Since the reed mats represent a tensile reinforcement, the erosion causes the formation of partly steep edges. At the western corner considerable masonry masses had already broken off and further areas threatened to fall.

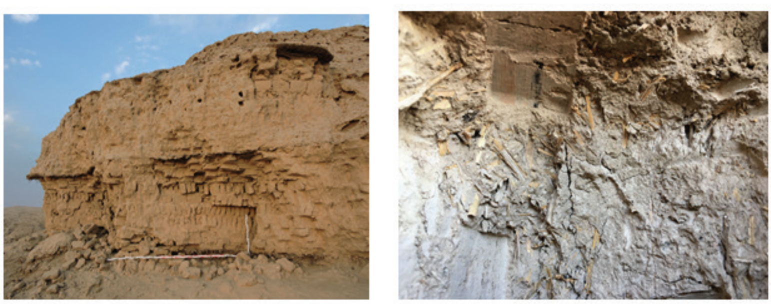

Figure 4a and b. Uruk, Eanna Ziggurat west corner before conservation work (a) and yellow straw in the mortar of the existing fabric (b)

In order to prevent further loss of original masonry, approx. 10 m³ of new masonry was underlaid at the overhanging areas. The composition and properties of the earth blocks are similar to the historical ones. The masonry mortar was additionally mixed with sand to achieve a lower degree of shrinkage than the historical mixture which was necessary to prevent the new masonry from tearing off from the existing masonry. In a few places where this happened, a thin mortar was injected into the resulting crack in the following campaign, i.e. after completion of shrinkage.

Figure 5a and b. Making earth blocks in the traditional method (a) and a view of the western corner of Eanna Ziggurat after completion of conservation work (b) in 2019

The Anu Ziggurat was erected in several building layers during the 4th millennium BC, each consisting of a high platform and a temple on top. Each platform was strengthened with bands of pottery pegs in the form of bottles. For this, double or triple rows of such clay bottles were embedded into the massive earth block core of the Ziqqurrat platform as well as into a freestanding earth block wall, which represented a staircase parapet. Thus, by forming decorative friezes, they at the same time improved the weather stability of the construction. In the excavated areas, remains of these friezes exist only in a few places in stretches of about 50 to 100 cm length, and these are in danger of breaking out. As an interim measure the decision was taken to secure them in their actual position, and to focus on the preservation of the clay bottles themselves at a later date. The position of the clay bottles was secured with earth mortar of various consistencies. While larger areas were repaired with normal mortar consistency, cracks and small-particle findings were applied with fine earth mortar in a pulpy consistency using a syringe and brush. Before applying the mortar, corresponding areas of loose earth particles and crusts were carefully removed and the surfaces were sprayed with water.

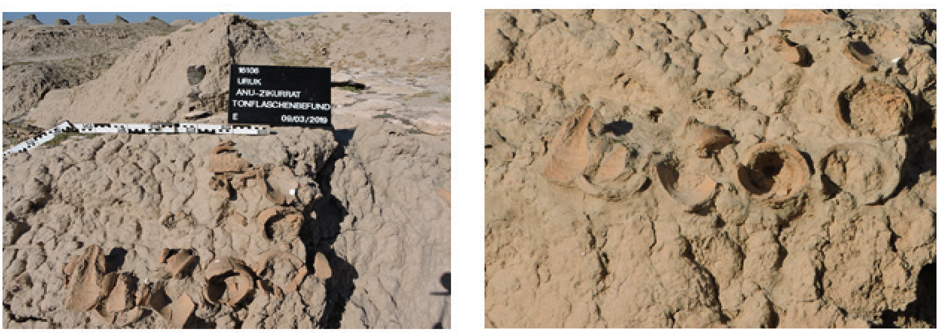

Figure 6a and b. Uruk, Anu Ziggurat, The clay bottles before (a) and after (b) securing measures

A further emergency conservation measure that was undertaken to stabilise the architectural structures was carried out at the so-called stone building and at the Gareus temple made of baked bricks. Different materials for the planned walkway were also tested in small areas.

5 OUTLOOK

In autumn 2019, work will begin on the protective conservation of the so-called White Temple. These are the last, more than 5000-year-old remains of the last existing Mesopotamian temple. This building is also made of earth blocks.

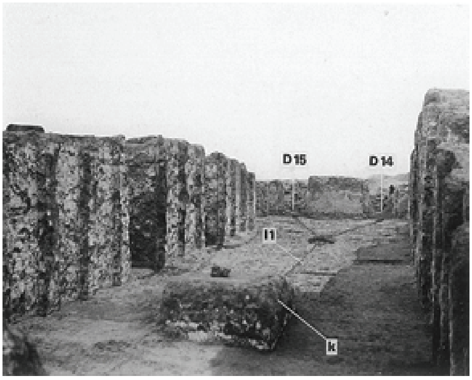

Figure 7a and b. The White Temple after excavation (a) and its present condition (b) in similar direction of view

In the phase of securing conservation, the proposal is to bond a layer of earth blocks to the healthy core of the masonry remains. In all cases, this additional brickwork will lie behind the historical edge of the respective component. After careful consideration of the desirability of such measures, this protective brickwork can be supplemented as a partial reconstruction. While the conservation measures can only be determined by technical expertise, the actual conservation measures and in particular the partial reconstructions must be coordinated with the UNESCO committees.

6 ACKNOWLEDGMENTS

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Conservation Problems of Traditional Adobe Brick Houses in Mesudiye Village, Eskişehir

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ABSTRACT

Soil is one of the most basic building materials used at ancient times and adobe buildings have been seen in Anatolia since the prehistoric period.

Mesudiye is one of the rural settlements in Eskişehir where traditional houses are made of adobe bricks was founded in 1898 by a group of immigrants who came from Rumelia and in the following 40 years, it continued to allow immigrants from Crimea.

There are 132 traditional adobe brick houses in Mesudiye and within the context of the master thesis, 22 of them were examined in detail in terms of their architectural features and conservation problems.

Mesudiye has a grid plan based on three long axes and three short axes. Seydisuyu River is located about 1 km northwest of the village where people supplied materials to build houses such as arid soil and straws. The single-storey adobe houses and service units have linear plan and they are situated in large courtyards due to the agriculture and livestock activities of the village people.

It is seen that repairs are still done in some houses by using soil by the reason of short time of making, being economical, easily accessible and sustainable material with adequate and necessary maintenance.

The conservation problems observed in traditional houses of Mesudiye usually depend on the construction techniques, unqualified repairs, abandonment and earthquake.
This paper aims to pay attention to preserving the village by conserving its architectural and cultural values and to focus on the possibility of future repairs by using traditional construction techniques and materials.

Keywords: adobe brick, traditional houses, Crimean Tatars, Mesudiye, Eskişehir.

1 INTRODUCTION

This paper is about a master thesis which is based on architectural features and conservation problems of Mesudiye Village in Eskişehir, Turkey. Eskişehir rural is one of the Anatolian Regions where earthen architecture can be seen. Mesudiye Village which is situated 45 km far from the city center was founded in 1898 by a group of immigrants who came from Rumelia and in the following 40 years, it continued to allow immigrants from Crimea.

There are 132 traditional adobe brick houses in Mesudiye and within the context of the master thesis, 22 of them were examined in detail in terms of their architectural features and conservation problems. With this paper, it is aimed to raise an awareness on preserving the village as to conserve its architectural and cultural values using traditional construction techniques and materials. Therefore, the architectural features of traditional adobe brick houses in Mesudiye and the conservation problems of traditional adobe brick houses such as nature caused problems and traditional workmanship caused problems are stated below. The conclusion contains the suggestions about future repairs by using traditional construction techniques and materials.

2 ARCHITECRURAL FEATURES OF TRADITIONAL HOUSES

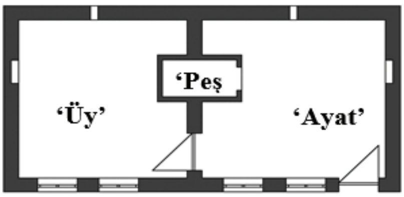
The village is a developed settlement on a flat terrain with a grid plan based on three long axes in the northwest-southeast direction and three short axes in the northeast-southwest direction. Agricultural and livestock activities play an effective role on the location of the buildings in the parcel and their architectural features. Therefore, the houses and service units are built on a large courtyard. The courtyards are entered by adobe brick walls and the entrances of the houses are from the courtyard on the qibla direction. The living areas of the houses are located near the courtyard entrance and at the border of the parcel. The single-storey houses were enlarged linearly with the addition of new units linearly related to the increasing number of family members.

Figure 1. Site plan of Mesudiye Village

Plan:

The living spaces are generally constructed on a linear arrangement of two types of plans, namely '1 'Üy' (room) + 1 'Ayat' (entrance) and '1'Karidor' (entrance) + 2 'Üy' (rooms). 'Ayat' ('Hayat') (Entrance) is the first space of the traditional Crimean Tatar houses, cooking and eating activities are realized. 'Üy' is a living place, room and bedroom of the houses. On the centered wall of 'ayat' and 'üy' there is an authentic fireplace called 'Peş'.

The entrance to the second plan type ('Ekî Başlı Üy') is from the courtyard, by corridor ('Karidor') space. On the opposite wall of the entrance there are 2 gates of the 'Üy's (rooms). 'Peş' is located between the rooms in this plan type.



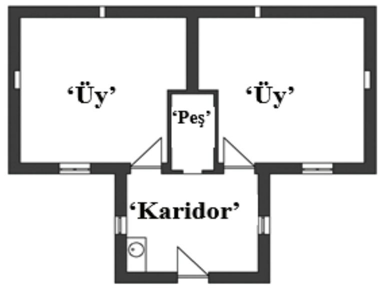


Figure 2. 1 'Ayat' (room) + 1'üy' (room) plan type.
Figure 3 .1 'Karidor' (entrance) + 2 'üy' (rooms) plan type.

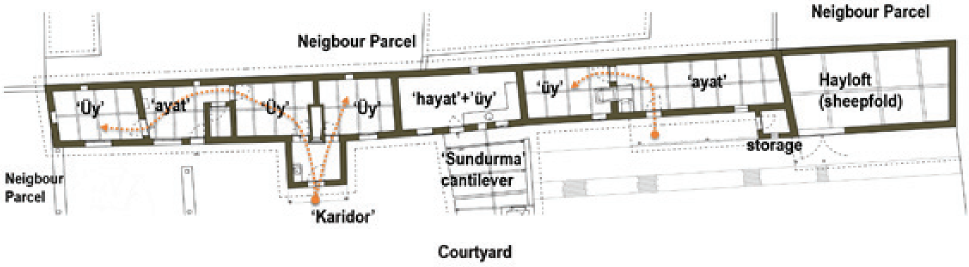


Figure 4 Traditional house plan at 8-9 parcels.

Construction Techniques and Materials:
The foundations of the traditional buildings in the village were built with stone and their widths are between 40-55 cm. It is observed that the stone foundation walls rise 1 m sub-base in some buildings, while it reaches only the ground level in others. In case second case the low stone foundation walls cause the water problems from the ground. The floors of the interiors are covered with mud - straw mixture. During the construction phase, the floors are plastered with a sludge mortar approximately 15 cm thick and compacted with a rammer. Periodic maintenance is done twice in a year.

Figure 5 Stone foundation wall height level and wall width (2019).
Figure 6. Gavel and soil ground used in ground compaction (2019).


Figure 7. Sludge made of 'barren soil', fine straw and water mixture (2018).
Figure 8, 9. Adobe outen brick walls widths (2019).

The inner and outer walls of the buildings were built with adobe bricks. Two types of adobe molds were found in the village. The main outer walls were built in a single row with adobe brick blocks that their dimensions ranged from 38x21x12 cm to 38x18x12 cm. The interior and exterior surfaces of the walls plastered with mud continue to be plastered with lime. However, in some repairs, it is seen that the authentic plaster layer is removed, as to apply cement plaster.

Figure 10. Adobe brick mold – type 1 and type 2

The original roof structure of the adobe brick buildings in the village a sloping side and the most important wooden element is 'tartma'(beam). 'Tartma' beams placed generally between 120-140 cm in distance on the short side of the space. Their cross-sections are 10x10 cm, 15x15 cm square or round. Depending on the dimensions of the room, the 'tartma' beam numbers change between 3 or 4. The wooden truss system that consist of 'tartma' beams carry the wooden rafters covered by plant materials such as sunflower straw, reed, straw and roof tiles. The 'çorak' ('barren soil') used to prepare mud mortar and adobe brick and the reeds used on the roof covering are still supplied from the river near the village. It is known that the stones collected from the foothills of the Kırk Kız Mountains, located a few km southwest of the village, also were used for the foundation wall.



Figure 11 Interior view of wooden roof structure with 'tartma' beams and rafters (2018).
Figure 12 'Tartma' beam detail (2018).
Figure 13 Plant materials of roof covering (2018).

3 CONSERVATIOAN PROBLEMS OF TRADITIONAL HOUSES

Mesudiye Village with its traditional texture might be considered a rural landscape as heritage. However, the basic conservation problems seen at most rural settlements are also observed in the village. Due to its location, the settlement is in the earthquake zone. At the same time, the village, which is located in the continental climate zone, receives heavy snow fall in winters and rain fall in spring. Especially in March, winds called 'Perdalez', blow strongly from all directions for a week and bring snow and cold air. With the winds blowing, the water in the adobe material evaporates and abrades the surfaces such as sand and soil, causing the mud mortar and mud plaster on the wall surface to erode [1]. Nature based problems cause melting of mud mortars and mud plaster on the wall surfaces, joint discharges, structural cracks and the separations of the wall with the weight of the roof. The majority of the structural problems are identified in abandoned and neglected buildings. Consequently, lack of maintenance and repairs, lack of wooden tie beams, disorientated adobe brick walls and the insufficient level of stone basement destroy the buildings.

In the adobe brick houses, it is seen that there is no tie beam on the stone foundation, between the adobe brick wall rows at the eaves level or under the windowsill level. Wooden is used only as lintel element for windows and doors. The presence of tie beams allows the vertical loads to be spread evenly and to stop any structural cracks on the wall. It's already observed that the absence of tie beams has damaged the structural system of the buildings due to the earthquake effect.

Figure 9 Earthquake structural cracks and lack of wooden tie beams (2018).

Another conservation problem due to the traditional workmanship error is that the mudbrick blocks were placed in the same vertical line. In time, joint gaps and separations formed between the adobe bricks caused the structural cracks. Users interventions such as to fill the gaps with small pieces of stone or mortar (mostly slurry mortar, but also cement-based mortars) also caused structural deformations of adobe brick walls.

Figure 10 Traditional workmanship errors seen at adobe brick walls (2019).

One of the common problems is the thickness of the walls. The insufficient wall thickness of the units constructed with single row adobe bricks reduces the earthquake resistance of the building due to the loads coming from the roof.

The buildings in the courtyard have expanded in linear plan due to needs of the users. When the number of the family members increased, a new unit was added to the existing living spaces and the new unit the fourth wall was common with neighboring unit. Therefore, it is observed that the newly unit walls have been separated during the earthquake, due to the lack of 'box behavior'.

In some of the adobe brick buildings in the village, it is seen that, the corner blocks joints were not made in a recessed manner and the connections were opened, the displacements have happened due to earthquake.

Figure 11 Workmanship errors at corner joints (2019).

The linear planning and the existence of window and door only at courtyard facades also have reduced, the earthquake resistance of the buildings.

Another common and constant conservation problem is unqualified repairs such as: increasing the size of the original window and door gaps; replacing window woodwork with pvc and replacing wooden courtyard doors with metal doors; closing the 'tartma' ceiling with wooden slat, plywood, wood veneer materials etc. as to obtain a flat ceiling; covering or cancelling 'peş' and 'oşaklık'(fire place) systems, reconstruction of destroyed chimneys with perforated bricks; plastering cracks or small voids with cement mortar and reconstruction of the destroyed walls by using perforated bricks, briquettes or aerated concrete are the main ones. Thus, the authenticity and the integrity of the rural landscape have been lost due to the repairs that are not made with traditional materials, struts, metal belts and wooden elements.

Figure 12 Unqualified wall repairs done with struts, metal belts and wooden elements (2018).

4 CONCLUSION AND PROPOSALS

In addition to its sustainability, adobe is still preferred to be healthy and economical material. The other advantages of the adobes are easy and quick manufacturing harmonious maintenance with nature, heat and moisture balance of the interior due to its heat retention property [2]. Although its advantages there are various conservation problems in the traditional houses of Mesudiye but the use of traditional materials for repairs still continue. The main reasons of conservation problems are traditional workmanship errors, design concept and the earthquake.

It is possible to repair some temporary cracks and minor deformations by using coop wire which is easy to find and apply. The coop wire placed on the damaged wall completely is fixed to the wall surface which should be covered with mud mortar soil and lime added soil [3].

Another proposal for structural problems is using bamboos to reinforce the damaged walls. This is an intervention which was improved to increase the strength of the walls against the earthquake at Sydney Technology University. For this experiment, the bricks on the wall surface were drilled and a ring was formed through a polypropylene material, then the holes were filled with mud mortar. After the mud mortar had dried, the strings were fixed. The bamboo poles which were placed at 50 cm intervals were connected to the rings and then attached to each other with horizontal wires. Thus, the structure is reinforced by strapping. Bamboo was preferred for being a natural material which is flexible and durable against earthquakes [4]. As a research project the same method can be applied to one house in Mesudiye Village and instead of bamboos, reeds that can be obtained from Seydi Suyu Creek with the sunflower stalk can be used.

The adobe brick houses in Mesudiye Village have usage, technical, historical, originality and aesthetic values and the village is a rural landscape to preserve as a heritage [5]. For these reasons, it is thought that these buildings should be conserved without losing their architectural features in the context of the related ICOMOS's charters such as Charter on the Built Vernacular Heritage (1999) and Charter on the Interpretation and Presentation of Cultural Heritage Sites (2008). However, there are legal gaps in the laws regarding the conservation of traditional rural settlements and new zoning activities in our country [6], [7]. The preservation of rural landscapes for future generations and the continuation of culture can be achieved by meeting with locals on a common aim. Communication, questioning, developing new approaches and creative ideas are important for the sustainability of cultural heritage [8]. It is necessary to create legal amendments and to prepare village design guidelines in order to protect traditional rural settlements in Turkey. Mesudiye Village deserves to be preserved as a cultural landscape without losing its architectural features and cultural values.

5 ACKNOWLEDGMENTS

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Structure Specimens in Thrace: Ahievren Village Houses

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ABSTRACT

Many types of construction, such as timber framework, stone masonry or mudbrick can be seen in the Thracian region. Amongst these traditional construction types, the mudbrick construction has been widely used, particularly in rural areas. However, with the spread of reinforced concrete system, these structures were abandoned and left to their fate.

In fact, although mudbrick structures are healthy, inexpensive and eco-friendly, they have lost their value with the widespread use of reinforced concrete systems. The aim of this study is to emphasize these important environmental and healthy properties of mudbrick structures, to determine the type of housing that bear regional characteristics, and have them attain their necessary value once again.

For this purpose, three mudbrick houses situated in a village in the Thracian region were studied. These were researched in terms of construction technology and materials. During the research process, the construction technology and material were first examined, then the wall properties, window door cavities and finally the top covering element. In order to obtain regional information about the subject at hand, construction and utilization processes of the mudbrick houses were assessed by talking with the village citizens.

Keywords: Mudbrick structures in Thrace, traditional construction, mudbrick building techniques, construction systems, traditional building materials

1 INTRODUCTION

When the construction technique and materials of Thracian village houses are examined, it is seen they developed in accordance with the region. Materials found nearby and climatic conditions shaped the structures. Generally, while stone wall construction is more prevalent in the higher mountainous regions, wood-over-stone two-storey structures are seen in the lower regions or in the city centers, and mudbrick structures are observed in more temperate areas. Concurrently, the region's communities, which were exposed to many wars and migrations, built adobe houses in order to own more economical structures in a shorter time.

The specimen structures selected for this research are located in the village of Ahieren, in the provincial district of Malkara, in the province of Tekirdağ, a region with rich agricultural lands, not very mountainous, with an average elevation of 207 m, and having a large number of streams [1]. The village of 308 inhabitants experiences hot, dry summers and cold, rainy winters [2]. In fact, it can be said this village has a harsh climate with temperatures dropping to -13° C and snowdrifts reaching 44 cm. [3]. However, the hot and prolonged summers have also influenced the plan types. Of course, there is a variety of house plan types in Thrace. One of theis is an example of a single-storey building with open antechambers. Three structures exhibiting differences, two of which fit the open-antechamber category, as well as another, are taken up in this study.

2 THE SUSTAINABLE CHARACTERISTICS OF BUILDINGS

A tendency towards concretization and the abandoning of old traditional buildings has occurred with the development of industrialization and technology. When the relationship between heat and humidity living comfort in traditional mudbrick structures was examined, relative humidity (RH) and thermal comfort in mudbrick structures were found to be more positive than masonry wall [4].

It is suggested that the relative humidity (RH) should be between 30 and 60 % and the temperature should be between 18-24 °C for people's comfort in office spaces. In a study, it was determined that a 30 cm. earthen wall can quickly absorb significant amounts of moisture vapor and also cause a thermal delay of 6-8 hours. In other words, it protects the thermal comfort in the indoor environment. Thus, it has been shown that earthen walls improve indoor air quality and thermal comfort. While these properties are also valid for stone structures, thermal and moisture comfort in almost all traditional structures is more easily provided than reinforced concrete structures. Consequently, by providing these thermal comfort conditions and moisture balancing, these buildings demand less energy [5]. Moreover, since adobe structures are produced on site, there is no transport expense and they are produced using very little energy [6]. These are structures that are recyclable, have durable walls, are low cost, provide heat and sound insulation, and are suitable in hot and cold climates [7] [8].

Despite these superior features, these structures that needed to be preserved were not. Traditionally produced structures in Ahievren village were abandoned as a result of the widespread use of the reinforced concrete construction system. Consequently, just as many çivil architecture structure specimens were destroyed in natural disasters, the abandoning of these cultural heritage housing units caused them to fall into a state of disrepair. As with all cultural assets, necessary precautions should be taken for the preservation of these structures and the citizens of the region should be made aware of this matter [9].

Due to the environmental pollution and energy problems experienced today, the production of environmentally sensitive buildings has become very important for all societies. At this point, mudbrick structures have made it back onto the agenda and their usage with modern methods has gradually began to increase [8]. Adobe structures are now being used in our country in modern architecture as well as traditional architecture with their ease of construction, accessibility, and the ability to produce them in the desired color and pattern with new techniques [10]. We encounter this approach in housing, ecological villages, towns or different types of buildings. For example, a bus stop structure designed for the Büyükkonuk ecological village in Northern Cyprus has constituted a specimen of the utilization of the adobe structure in all areas [11].

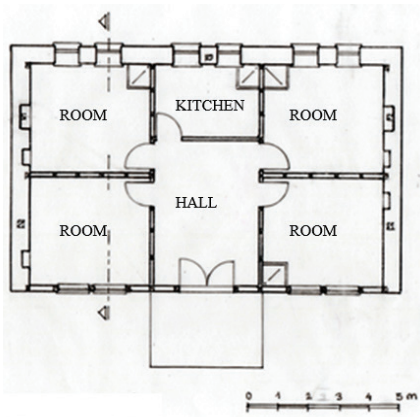
3 TRADITIONAL BUILDING SPECIMENS IN THE VILLAGE OF AHİEVREN

Three houses were selected in the village of Ahievren of the Malkara provincial district of Tekirdağ province. These structures were taken up and examined from the standpoint of both plan type and construction technologies. soil with high clay content and found nearby, and reused stones were used for the stone walls of the structures. Since the region is suitable for growing trees, the supply of wood was made from the region. Tile covered roofs were used in all the houses of the region. The reason for this is because the region is rainy. Stone foundations, stone walls, mudbrick walls and wooden framework wall techniques (hımış) filled with brick or mudbrick were applied in these buildings.

3.1 The Osman Ayvaz House

Constructed in 1966, this single storey house is comprised of a hall, four rooms and a kitchen. The house began to collapse shortly after it was abandoned (Figure 1). There are stoves in two rooms and stove chimneys in the other two rooms. All rooms have built-in cabinets with two shelves next to the stove or on the wall with the stove chimneys. In addition, three rooms feature a babinet that was used as closets and bathrooms. The floor plan and cutaway is shown in Figure 2a and 2b.

Figure 1. Front view of the remnants of the Osman Ayvaz House



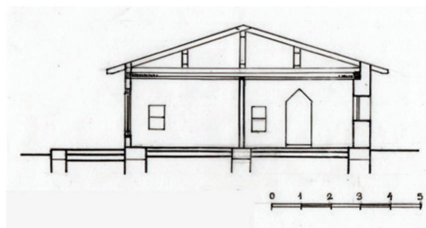


Figure 2 a. Plan of Osman Ayvaz House
Figure 2 b. Section

3.1.1 Wall Construction, Door Window and Plaster Works
The northern wall of the building is a 60-70 cm thick stone wall. This wall constitutes the rear façade of the building and features 80 x 80 cm windows (Figure 3a). The walls of the two sides of the house were built from 60 cm thick mudbrick material (Figure 3b).

Figure 3 a. Rear wall made from stone
Figure 3 b. Side wall made from mudbrick

The internal partition walls of the buildings are comprised of wooden framework with mudbrick filling. The wood in the internal partition walls was used only in the horizontal and vertical directions

(Figure 4a). The front façade wall was also constructed with a wooden framework, but brick was used as a filler (Figure 4b).

Figure 4 a. Mudbrick filled inner walls
Figure 4 b. Outer walls filled with brick

While window and door spaces were formed in the structure, the horizontal wooden beams which were used in the upper and lower window titles were continued on the wall. Moreover, horizontal and vertical wooden beams are provided mid-level to the window (Figure 5a). For the outer door, wooden posts were used on the sides and wooden beams were incorporated on the top lintel (Figure 5b).

Figure 5 a. Beams and posts used in the window frame
Figure 5 b. Upper door lintel and side post use

Earthen plaster was used on the walls throughout the building. However, it was observed some cement had been mixed in the front façade. Plaster wire was used on the surface of the entire building in order to hold straw-mixed plaster material on wood and brick surfaces in particular (Figure 6a, b). Soda pop caps were used as nail heads for nailing plaster wire to the wall with nails (Figure 7a, b).

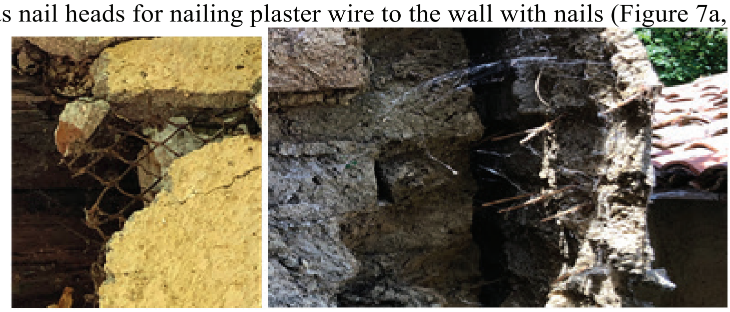


Figure 6 a. Plaster wire
Figure 6 b. Nails used in nailing the plaster wire

Figure 7 a, b. Soda pop caps used in nailing the plaster wire to the surface

3.1.2 Roof and Ceiling Panelling

Purlin and poles were used as supports on the roof (Figure 8). The roof was sealed with rafters and tile boards.

Sunflower stems were used for the rool panelling. The sunflower stems were supported by wooden beams. Figure 9a. Moreover, earth was spread at the thickness of plaster over the stems in order to increase the insulation property (Figure 9b). Wood siding was used in the roof panelling of the room used as a guest room (Figure 9c).

Figure 8. Purlin and poles related to the roof structure

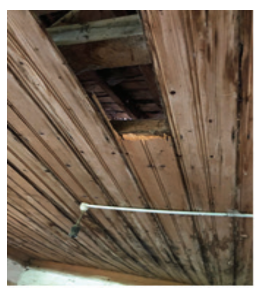


Figure 9 a. Roof panelling crafted from sunflower stems

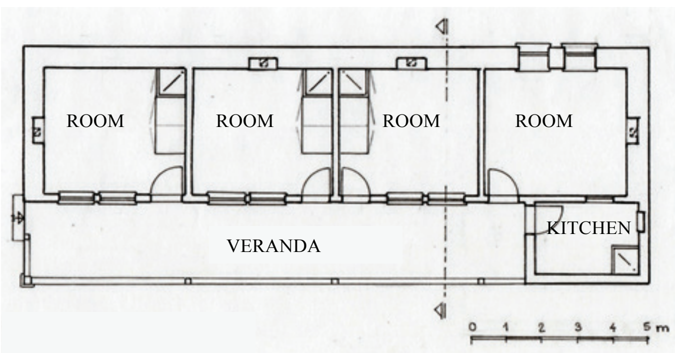
Figure 9 b. Earthen layer spread over sunflower stems

Figure 9 c. Wood siding

3.2 The Ali Öztürk House

Though the exact construction date is unknown, the house is thought to be over a century old. The plan type is an open antechamber (veranda) (Figure 10). The kitchen in the building provided in the Plan and Section Figure 11a, b is located at the end of the open veranda. Outside the daily living rooms, there is a place to take a shower in the cupboard called the 'yüklük'.

Figure 10. The Ali Öztürk House



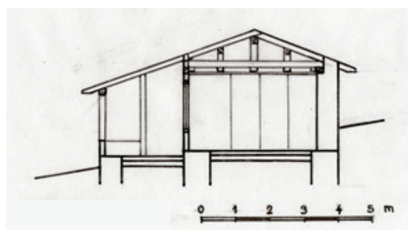


Figure 11 a. Plan of Ali Öztürk House
Figure 11b. Section

3.2.1 Wall Construction, Door Window and Plaster Works

The rear and side façade walls of this building were paved with stone (Figure 12 a, b). Abundant earth was used as a binder in stone wall masonry.

Figure 12 a. The stone wall of the building's rear façade

Figure 12 b. Stone masonry remnants of the side wall

From the remnants of the front façade, it is thought that a brick-filled timber framework system was used in the wall. From the wooden poles in the line of the room walls seen in the veranda, it can be said that the timber framework system was also used in the room walls.

3.2.2 Roof and Ceiling Panelling

Ali Öztürk continued the roof of his house so it would also cover the veranda. From the veranda in the photographs, it is seen the element dimensions used in the roof covering here were quite thick and were made to provide needed rigidity. However, the roof cover, which took on water and was not maintained due to the house being vacated long ago, had since decayed and collapsed. Used in the construction of the veranda as well as supporting the roof, wooden posts were positioned over a thick stone at the bottom (Figure 13 a,b). This post is reinforced by supports placed on the sides of the upper hood (Figure 13 a, b).

Figure 13 a. Linkage of the roof post to the foundation

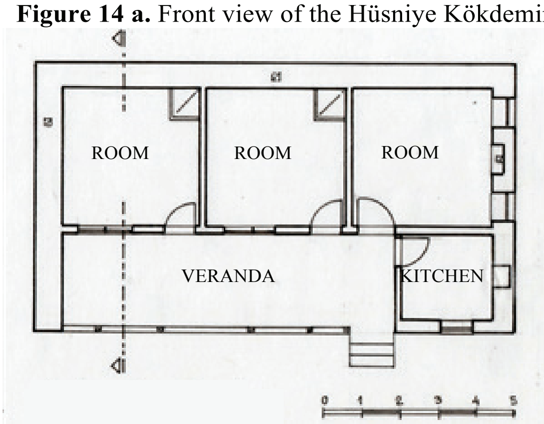
Figure 13 b. Linkage of the roof post to the upper purlin

3.3 The Hüsniye Kökdemir House

Said to have been built in the 1950's, the front and side views of this house still in use are provided in Figure 14a, b. The house is of the open antechamber (veranda) plan type, three rooms and a kitchen (Figure 15 a, b). The veranda of the house is enclosed with a railing made of wooden slats and covered with a transparent plastic cover (Figure 16).

Figure 14 a. Front view of the Hüsniye Kökdemir House

Figure 14 b. Side view



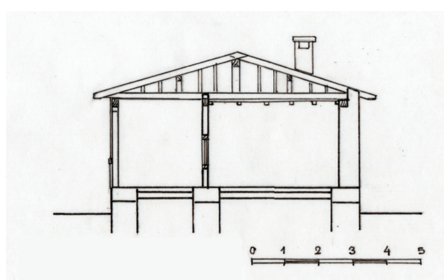


Figure 15 a. Plan of Hüsniye Kökdemir House **Figure 15 b.** Section

Figure 16. Wooden partition encircling the veranda

3.3.1 Wall Construction, Door Window and Plaster Works

From the inner window dimensions, it is assumed this house had exterior walls of either stone or mudbrick of about 60 cm thick. The posts in line with the room walls of the support structure that continues in the veranda indicate it is a building with its inner walls of a timber framework structure. From its door and window elements, it may be said that the inner walls are about 15 cm thick, including plaster. The walls are plastered with earthen plaster. In the use of the door, since each one is opened to the veranda, an insulation threshold was used of an external door quality (Figure 17).

Figure 17. Room doors with threshold like external doors

3.3.2 Roof and Ceiling Panelling

Roof supports are comprised of purlins and posts. The purlins were positioned on rafters and under-tile board. It is observed that some beams and posts were made in pairs to increase rigidity (Figure 18 a). The roof covering on the veranda is not covered by the floor covering, but rather provides an exit to the attic from here. Thus, the attic is used for storage (Figure 18 b).

Figure 18 a. Roof support elements

Figure 18 b. Link between the veranda and attic

Also in this building the ceiling cladding was made of sunflower stems and beams were used to support these stems (Figure 19).

Figure 19. Ceiling cladding

4 ANALYSES

The buildings were assessed in terms of both their architectural features as well as their materials and construction technologies.

4.1 Architectural Features

The houses with external antechambers, which are said to be a second Turkish house plan type, were used particularly in rural areas. In this type of such buildings, the relations between the rooms are provided from the antechamber. In temperate climatic zones, the antechamber and the courtyard or the garden form the common living space. Rooms were used during the winter [12].

This typology was used in the great majority of Ahievren village houses. While the verandas, which are also known as outer antechambers, integrate with the garden environment during the summer and spring, they are covered with various covers in winter season and protected from cold weather.

Moreover, the attic is accessible via the veranda. Thus, the attic can be used to store and dry foodstuffs. Entering from the antechamber, each of the rooms used has architectural features that meet basic needs. Almost every room has a chimney suitable for the use of either a stove or hearth whereas each room has cupboards called 'yüklük' (Figure 20 a, b). A small shower is also found in these cupboards. Hüsniye Kökdemir house is an example in which a shower was installed without a cupboard (Figure 21a) whereas the cabinet in the Osman Ayvaz House (Figure 21b) is no longer extant, but vertical and horizontal wooden element remnants of a shower basin are seen in line with the cabinet in the wall.

Figure 20 a. Osman Ayvaz House fire place

Figure 20 b. Hüsniye Kökdemir House stove chimney

Figure 21 a. Shower unit in a room of the Hüsniye Kökdemir House

Figure 21 b. Remnants of a cabinet and shower unit in the Osman Ayvaz House

4.2 Construction Technology

We observe complex material and construction techniques such as masonry, timber framework, stone, mudbrick, brick and even sunflower stalks in the village houses of Ahievren.

While the side walls are made from stone, and sometimes mudbrick, depending on the material supply, masonry walls are for the rear facade, situated mostly on the north side. The timber frame technique was used in the front façade and partition walls inside the building. In this usage, brick was preferred in the wooden frame for the exterior wall. No cross-linkages were encountered in the wooden structures that were used in these houses.
A second horizontal wooden beam was imbedded to facilitate convenient utilization of materials such as covers, etc. in the use of the veranda (Figure 22a, b).

Figure 22 a. The Ali Öztürk House **Figure 22 b.** The Hüsniye Kökdemir House

Support elements were used in the upper and lower headings of the wooden posts. An example of this is seen in the Osman Ayvaz House (Figure 23 a, b). While these elements provide structure reinforcement against earthquakes, they eliminate the single point stapling effect of the load.

(a)  **(b)** 

Figure 23 a, b. Lower and upper headings of support elements in wooden posts

The building was encircled by a solid frame by positioning supports that increased the rigidity of both the upper and lower heading elements of the wooden posts in the corners in the Ali Öztürk House, as is seen in Figure 17a and b.
The timber used in the building was cut to the required dimensions, though it was generally rough craftsmanship, and was not used as logs.
It is seen that timber beams of very large dimensions were used in terms of rendering a rigid roof structure.

3 CONCLUSIONS

According to the findings obtained in the study conducted;
- The majority of the houses in Ahievren village utilized the outer antechamber (veranda) plan type.
- An extremely economic and ecological system has been created by creating a combined system. Providing thermal comfort of the structure, recyclability of materials, which are obtained from the closest distance, with no need for things such as road expenses and fuel consumption
- The materials, utilization aspects and positioning of the building walls were implemented very advantageously and consciously. The north sides of the buildings were covered with thick and deaf walls as much as possible whereas measures were taken against the cold.
-The south, southeast and southwest sides comprised of the front facade of the house. Large windows that illuminate the house opened out in this direction. Concurrently, the veranda was utilized in this aspect, benefitting from both the heat and natural light.
- The cool air is taken advantage of during the summer with the veranda. In winter, the veranda was covered with a curtain, wooden panels or transparent plastic covers, and this section actually created a sheltered volume in the transition to the heated spaces.
- While the roof elements do not feature fine craftsmanship, belt and breasting, which is a more developed roof element utilized in larger sizes for rigidity, was not used. This indicates these roofs were still not fully developed and were in the midst of a transition process from a historical point of view.
- Sunflower stalks were used as ceiling planking in the buildings, ensuring both lightweight planking and heat insulation is provided via the plant fiber and hollow structure. This material can be obtained from the immediate vicinity and is extremely eco-friendly with its characteristics.

When the wall thicknesses, materials and construction technologies of the buildings are examined, these houses were produced with a combined system, and in considering the economic approaches from all the environmental conditions, construction and utilization aspects, a special construction system was created. Highly sustainable solutions were produced. With these approaches, solutions suitable for both the land and climate were developed. This construction and orientation feature ensures the thermal comfort of the buildings with extremely little energy consumption. Therefore, it is only proper that emphasis should be made in giving these structures the importance they rightfully deserve.

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The Unique Vilkovo Man-made Habitat in the Danube Delta

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ABSTRACT

At the end of the 17th century, inaccessible wetlands of the Danube Delta became a haven for Old Believers during Nikon's church reform in the Russian Empire. The Danube Delta is a unique ecosystem with a high concentration of animals, birds, fish. This is the only place in the world where the land is steadily moving along the sea and growing thanks to the natural leaching of river silt. Wetlands provide a wide range of ecosystem services, including water filtration, protection from storms, flood control and rest.

Habitat Vilkovo consists of the mainland and 72 artificial islands. 45% of the total area of the city falls on water, and the length of the canals reaches almost 100 km. More than 8 thousand inhabitants of Vilkovo have 5 thousand boats. For the formation of islands, the preparation of mounds for the construction of houses and gardens, the citizens manually extracted fertile silt from the marshes, from which they literally "molded", created reality.

The idea of the place and role of man in this unusual environment has been forming for centuries at the junction of almost wild nature, free water surface, and artificial objects. The preservation of such natural areas as the unique habitat of Vilkovo in the Danube Delta is important not only from an ecological, scientific, cultural and aesthetic point of view, but also from an economic point of view with the development of tourism.

Keywords: Marsh silt, wetlands, unique habitat, Danube Delta.

1 INTRODUCTION

The coastal zones of seas, rivers, lakes have always been the most favorable for living, building various settlements. Wetlands, by contrast, very often served as places of forced isolation, shelters, and preservation of their identity. This is a type of wetland ecosystem, which is considered either as lakes with bound water or as land areas containing less than 10% dry matter. For two and a half centuries, the Danube Delta formed due to millions of tons of river sediments formed almost 19 kilometers of land. Even now, the lower reaches of the Danube is the only place in Europe where a new land is being formed 'Fig. 1'.

The extreme nature of the impact of the hydrological environment - ebbs, flows, floods - determines the specifics, traditions, lifestyle of a person. In this case, the basis of the material habitat is water, and the means of shaping - reed, clay, marsh silt, of which literally "molded", created reality.

The peculiarities of construction on water, on difficult grounds (marshes, peat bogs, etc.) are considered in works on the history of culture and archeology Kupriyanov V., Rauschenbakh V., Salnikova K. Methods of forming residential houses in areas with unstable hydrological situation are devoted to the study of Economov I., Shumskaia O., as well as Subbotina O., Thyong L., Koen Olthuis, Faletti Rina, and others.

The man-made system "Vilkovo" in the Danube Delta (hydrologically unstable territory - an architectural object - a man) is perfectly adapted to both complex natural and socio-demographic factors. This paper analyzes the characteristics of the development and formation of the unique habitat of the Vilkovo settlement, taking into account historical, cultural, and climatic factors.

Figure 1. Danube Delta wetlands.

2 PREREQUISITES OF FOUNDATION OF MAN-MADE HABITAT

2.1 Historical and cultural factors of preserving the identity of the Old Believers

Innovations and church reform of Patriarch Nikon met with strong opposition from supporters of the old rites, provoked uprisings in Russia from 1676 to 1681. Supporters of the old rites were declared schismatics and heretics. They refused to pray for the king, rejected the rituals of the official Orthodox religion.

Despite persecution by the authorities and the official church, the Old Believers (up to a third of the entire population) persevered and maintained their faith. Old Believer communities have shown the ability to adapt to the most difficult conditions on the outskirts of the Russian Empire, including the Danube. They played a significant role in the development and strengthening of economic relations in their places of residence, proved to be hardworking and enterprising people. Old Believers made great efforts in preserving ancient manuscripts and old printed books, ancient icons and church plates.

In the middle of the 18th century, Old Believers, and later Zaporozhye Cossacks, persecuted by the authorities, found their refuge in the Danube Delta in impassable mounds. First, the village of Lipovanskoe arose, which in 1746 was renamed Vilkovo. The books of the well-known local historian A. D. Bachinsky, archival materials are the works of the Vilkovo Posad government, 1879-1918, the historical and statistical essay of G. P. Bakhtalovsky "Posad Vilkov", 1881 and many others are documentary sources of the development of inaccessible wetlands the Danube Delta [1].

The golden domes of the churches of Vilkovo clearly demonstrate the tremendous power of faith, the desire to preserve identity for several centuries in the conditions of multinational Bessarabia.

2.2 Climatic factors

Most of the Danube Biosphere Reserve ("Danube Floods" until 1998) is located in the northeastern part of the Danube Delta within Ukraine in the vicinity of the town of Vilkovo, Kiliya district, Odessa region. By the decision of the International Coordinating Committee of the UNESCO program "Man and the Biosphere" in 1998, the Danube Reserve was included in the global network of biosphere protected areas - the Danish Delta Reserve in Romania and Ukraine [2].

At 47 thousand hectares of protected area there are 65% of bird species registered in Ukraine. The Danube, branching out, creates a large, cut through a dense network of arms and lakes, a swampy delta about 75 km long from west to east and 65 km wide from north to south. The pearl of the Danube lower reaches - Vilkovo - is located right by the sea on the border with Romania 'Fig. 2'.

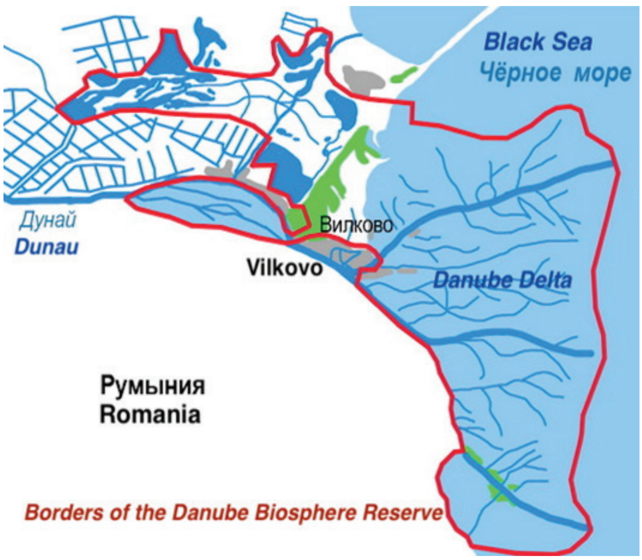

Figure 2. Scheme of the Danube Biosphere Reserve

For delta lands, poorly drained mineral soils (marsh and salt marshes) and the predominance of rich flora (meadow, meadow-marsh grasses) are most characteristic. The wetland environment is a huge natural reservoir of fresh water. Marshes play a large role in maintaining the level of rivers, the chemical composition of water; microclimate formation and natural vegetation restoration process. Significant arrays of marsh grasses slow down the flow of water and contribute to the sedimentation of nutrient-rich sediments (sludge), thereby creating conditions for further biogenesis.

The silt fraction contains clay minerals (layered and layered tape silicates), which concentrate a significant amount (about 30 g/kg) of oil products and other organic and inorganic pollutants entering the water. Bog biocenoses create significant amounts of biomass, which in one form or another is used in the national economy. The role of marshes in nature and human life is enormous.

The unstable natural character of the hydrological situation of the Danube Delta became the decisive factor in the formation of the planning structure of the Vilkovo settlement and the architectural and technological methods of building construction 'Fig. 3'.

Figure 3. Planning structure settlement of Vilkovo

3 FEATURES OF THE FORMATION OF THE SETTLEMENT VİLKOVO

3.1 Planning characteristics of the Ukrainian "Venice"

The settlement, 45% of the territory of which is water and 72 man-made islands, is often called the "Ukrainian Venice". People were forced to come to this region, not on their own, but they did wonders with the few that nature gave them. Initially, the town was practically on the very seashore.

The city is divided in two by the Belgorod Arm, which is now almost dead. Until the 1990s, the wide Ochakov arm was the main navigable channel from the Danube to the sea. Together with the natural channels of the delta, the man-made canals of Vilkovo form a single water system of "eriks" canals (*from the Turkish* ayrak). A longitudinal-transverse grid of channels connects the two arms of the Danube. The overlapping of one channel leads to the smoldering of all adjacent channels. Through the maze of channels, like blood vessels, in the days of high water, water flows from a large river.

The 100 km length of man-made canals serve as convenient communications, the boundary between land and a shelter for boats. Along the canals, 45 km of wooden pavements ("masonry") were laid, and 76 arched drawbridges and passages were arranged through the canals.

'Fig. 4'. You can get to any part of the city through canals on motorboats and peculiar local "gondolas", which are also controlled by a single standing oar. Even livestock are taken to pastures and returned home by boat.

Figure 4. Man-made canals of Vilkovo, wooden pavements, bridges and passages.

The historical part of the city is located on the mainland on the low alluvial shores that were flooded with strong winds and floods. Unfavorable hydrological conditions determined the need to strengthen the sites, conquering them from the water. The soil was taken here, around the captured areas. The height of the embankment of artificial islands ensured the free development of plant roots above the groundwater level. This is a distinctive and colorful region of fishermen and winemakers, settlements with an amazing dialect. Fishing, picking strawberries, apples and grapes, working in apiaries determine the rhythm and flow of life in Vilkovo.

3.2 Architectural and technological features of the development of wetlands

The mainland parts of Vilkovo resemble any other small town with private houses, small local centers of social life. Flooded areas are extended residential buildings along the canals.

The cultural and genetic continuity of a small city founded by Old Believers can be traced to the active role of the magnificent temples in the social life of the city. The first settlers built small churches "from dowser, reeds, clay and silt" on the bank of the Danube, not far from the plains. Then on these places wooden churches were laid with bell towers on stone foundations, which were also rebuilt in the late 19th and early 20th centuries.

Despite all the complex challenges of the 20th century, the dominant feature of Vilkovo - St. Nicholas Church, the Temples of St. Nicholas the Wonderworker and the Nativity of the Most Holy Theotokos - have been preserved and are currently operational. The bright elements of the composite solution of the ensemble of the natural and artificial environment evoke special sensations close to the inspired ones 'Fig. 5'.

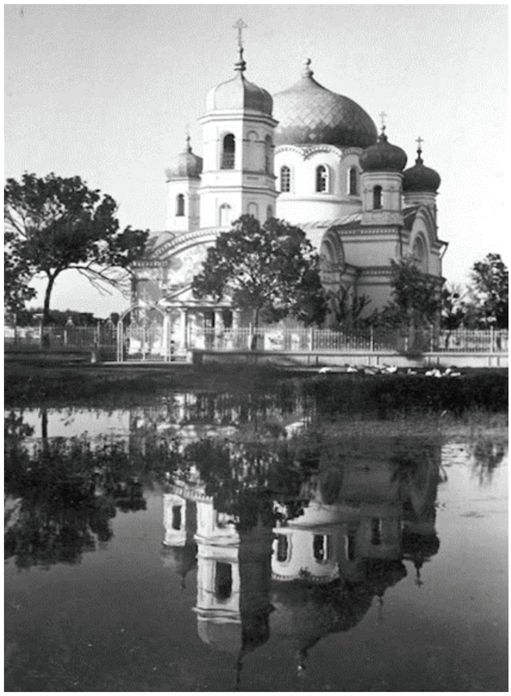

Figure 5. St. Nicholas Church, Vilkovo

The skeleton of the Vilkovo house was constructed from willow trunks, which immediately grew, intertwined with reeds and ropes, then coated with clay and silt. Inside and outside the walls were coated with a mixture of swamp silt with chopped reeds, straw and sawdust. To protect the walls from dampness and mildew, they made a kind of waterproofing of the foundations of houses from a layer of local shells, which absorb excess moisture well. Most homes are raised half a meter from ground level to avoid flooding. For the formation of islands and the construction of houses, marsh silt was manually extracted standing in the water, laid on the shore, then the dried mass was delivered by wheelbarrows and stretchers'Fig. 6'

Figure 6. Manual extraction of swamp silt

To cover the roofs of houses effectively served durable, perfectly retaining heat and giving the houses a peculiar look of reeds from the smooth. 30 centimeters of such reeds does not require additional insulation, the roof does not overheat, does not get wet and does not start rodents. Such thermos houses retain heat well in winter and cool in summer.

Of course, extreme climatic conditions reduce the life of residential buildings to 20-25 years. The ruins of houses that have lost their safety margin are tamped down and used as a foundation for new construction. According to the temporary factor - the houses are new, recently built, but according to the mentality they are historically traditional with preservation of the form, plan, genetic code. Marsh silt-House-Ashes-Silt-New House is the circulation of actual life in Vilkovo. The man-made settlement of Vilkovo is a monument to the titanic possibilities of civilization, as is the cultivated Danube delta itself.

4 ACKNOWLEDGMENTS

The idea of the place and role of man in this unusual environment has been forming for centuries at the junction of almost wild nature, free water surface, and artificial objects.

Life on the water in Vilkovo is a reflection of a complex of interrelated national-ethnic, geographical and climatic features. The scarce collection of materials - fertile silt, clay, willow, reed cane - became the basis and means of forming Vilkovo's habitat in harmony with nature.

Analysis of the unique habitat of the Vilkovo settlement showed that its formation was based on the principles of cultural and environmental compliance; interpenetration; rationalism and minimalism. The preservation of such natural areas as the unique habitat of Vilkovo, its identity is important not only from an ecological, scientific, cultural and aesthetic point of view, but also from an economic point of view of tourism development.

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Figure 2. Scheme of the Danube Biosphere Reserve
Source: https://www.photoukraine.com/i/articles/Dunaiskiy%20Zapovednik%20Photos/001-Dunaiskiy%20Zapovednik%20Map.jpg
Figure 3. Planning structure settlement of Vilkovo
Source: https://uc.od.ua/news/region/1202886
Figure 4. Man-made canals of Vilkovo, wooden pavements, bridges and passages.
Source: ©Yuriy Buriak http://www.pizzatravel.com.ua/rus/Ukraina/2/vylkove
Figure 5. St. Nicholas Church, Vilkovo
Source: http://sobory.ru/photo/312796
Figure 6. Manual extraction of swamp silt
Source: https://www.tgavan.com.ua/o-wilkowo/photo/

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Contemporary Structure in Historical Environment

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ABSTRACT

Architectural cultural heritage is the most concrete document that conveys the socio-cultural identity values of societies in the rapidly changing world of the physical environment, which is the main objective of conservation. The protectorate was developed in the historical process. The physical formations that make up the components of the historical environment are located in the social memory of the city and constitute the identity of the city.

It is an undeniable fact that modern society and deep-time living will also increase the quality of life. Conservation, as a part of the philosophy of contemporary life, is important in the theoretical framework of today. In our historical architectural values, it is envisaged that new additions may be designed in the process of change which will not be left to coincidence in practice. New functions in this transformation process of cultural heritage contain unique or differences.

The article deals with the transfer of historical architectural structures to the present and the future, redesigning the structure and changing its function, and providing theoretical and practical information. To discuss the concept of design criteria of contemporary additional applications to be added to historical structures and historical structures in the context of conservation and reuse problems of architectural heritage;

The aim of this course is to provide infrastructure for the conservation and arrangement of historical architectural areas in the historical process, and to ensure the transformation of living spaces into contemporary living spaces that meet the needs of today's space by integrating contemporary additional-volume / structures.

For this purpose, unique alternative design works that are carried out in reversible and not harmful to the historical identity of the historical buildings in cities in Turkey whose production and stories lead to very different perceptions were discussed as a subject of the course "Modern Settlement in the Historical Environment" that was offered in the Fall-Spring semesters of the academic years of 2017-2018-2019 for Master's Students of the Department of Architecture at Hasan Kalyoncu University. In the renovation processes of these buildings in the historical texture both singly and on the level of the entirety of the texture, examples with forms that reflect the architectural characteristics of the period of annexes that were made, were modern materials and construction systems were used, were discussed in the context of protection and identity.

Keywords: Cultural Heritage, Conservation, Architecture, Architectural Continuity, Contemporary Approaches, Contemporary Structure-Appendices

1 INTRODUCTION

The reason for of protection of historical urban spaces is that they are spatial formations that explain the evolution of a society and its cultural identity. Today, the effects of the reflections in the globalization process after 1980s also include localizations, and therefore, historical urban spaces. Changes in production methods, emergence of new settlements and conditions and efforts to strengthen social identity constitute a significant protection phenomenon. The change that especially carries importance for rapidly growing cities is the large-scale design problems that affect the traditionality which helps definition of the morphology of the historical city.

The approaches to protection of the historical environment and the increased level of responsibility in the architectural approach of the 21st have provided momentum for studies on protection of historical and cultural values; while today's architectural approach is shaped by advancement in material and structure systems and diversity with the development of technology. The protection approach that considers these issues in terms of only building stocks has been replaced by a value-based phenomenon that aims to protect historical environments with the entirety of the values they host. The issue of protection of the topography of the general appearance of the city along with its skyline is more important today. It includes activities needed for protection and improvement of historical cities, urban spaces and their surroundings, as well as their development and adaptation into modern life. The speed of change in periods is a parameter that affects the integrity of a historical city negatively. As historical cities and urban spaces are open to constant change as living entities, these changes affect transformation in all elements of the city. It is needed to take the precautions that are necessary for structures or parts of cities that have historical or artistic value to survive.

In terms of the concept of reclamation in the historical environment, changes in the environment in time, transformation of the lifestyles of local communities and abandonment of traditional functions cause negative effects in historical cities and urban spaces. This situation leads to disappearance of cultural traditions and loss of identity and characters. It is important to know that failure to inspect destruction of historical urban spaces may lead to transformation of the space into an unlivable one, and eventually, it may even end in annihilating its character. This situation, in turn, may result in loss of unique characteristics and cultural heritage values.

In this sense, cultural heritage is an important resource which is a part of the urban ecosystem, and for protection of urban heritage, main approaches regarding architecture, planning and interventions, restrictions and the concept of sustainable development in policies towards protection of cultural heritage gain importance.

The principles that are applicable for all forms of interventions to be made in historical urban spaces are directed towards not only protection of both historical cities and their surroundings but also integration of these with today's social, cultural and economic life. Interventions to be made need to respect the tangible and intangible cultural heritage values of the environment that are to be made in, as well as the quality of life of the inhabitants.

Depending on new practices that are observed in societies, the approach of protection by pausing is now being abandoned, and the idea of sustaining by complying with the necessities of the era is becoming prevalent. The correct protection approach today is to adapt historical values to today's usage and transfer them to the future. In this context, reusage of historical buildings or constructing new buildings is necessary, and annexes may be made in relation to current needs.

In terms of urban continuity in the historical environment, being able to create a new design also constitutes a difficult design problem. The city is at the intersection of architectural character, memory, the zeitgeist and the phenomena of new design technologies. Processes of evolution as a result of new dynamics reveal a new transformation of the city. The legal statute that is practiced in the historical environment is also a topic of debate in association with contemporary annexes made in this environment and new buildings. The practices that are carried out and especially historical environment design approaches are examined, the data that are collected based on the theoretical framework of these approaches are analyzed, and in the modern building/annex practices in the historical environment, new designs and the "design criteria" of adding a new thing onto the old urban texture involve diversity.

New interventions in the historical fabric should also reflect the difference and the zeitgeist of existing values in terms of protecting and sustaining these values. "Imitations" that will affect the artistic and historical values of the historical building should be avoided. The addition to be made to the historical texture should be noticeable, express its own character and not be an imitation. It should be interpreted with the reference it takes from the historical building. These annexes should be compatible with the historical building based on the Main Elements That Affect Settlement in the Historical Environment: Environmental Location (settlement texture, parcel sizes, location inside the parcel), Mass (width, height) and Façade (ratio, material, color, continuity of the façade). The modern annex should be ensured to have a connection to its surroundings, and the historical context in which it will be constructed should be kept in mind. There should be a balance in the composition of the old and the new [1].

The modern annex should have the quality to highlight the historical building, and elements that will create harmony should be selected without overwhelming the identity of the historical building. It should be designed in a "fitting" was without affecting the structural and aesthetical qualities of the historical building, and it should integrate, not dominate [1].

It should be ensured that the modern annex is connected to historical data. It should be "respectful" to a scale and rate suitable for the historical texture. The modern annex should be respectful for the qualities of the historical building and should not undermine its historical uniqueness. Even if annexes emphasize their own period plainly, they should not shadow the historical building, and understatement should be the main issue [1].

The historical annex should be appreciative of the historical building and distinguishable from the uniqueness of the historical building. Selection of a form that does not undermine the identity of the historical building may be applicable for the annex building. Elements that will create "contrast" may be selected. Annexes should be completed in a way that is noticeably distinguishable from the texture for its contrast and independence to reflect its own period [1].

Contemporary annexes made on cultural heritage should be "flexible" and "portable" and not trivialize the building of the heritage and its traditional spaces. In the context of sustainable/ecological goals, the contemporary annex should be recyclable, and the interventions in usage of materials and structures should be reversible to preserve the continuity and integrity of cultural and historical heritage [1].

2 STUDENT DESIGN WORKS (2017-2018-2019/FALL-SPRING SEMESTERS)

2.1 Gaziantep Şahinbey District Public Library / Café Top Cover Design

The District Public Library in the Şahinbey district of the province of Gaziantep in Turkey was built around 1915, and it was used for military purposes in those times. It was used in 1920 by the French as a warehouse and special administration building and in the period of 1927-1928 as a special administration building. The building later became a property of the Ministry of National Education and served as the General İsmet Primary and Secondary School. In 1952, it was named the Şehit Kamil Primary School. In 1977, it was registered with the high commission decision coded A-275, and it is now being used as the Şahinbey District Public Library (Figure 1) [2].

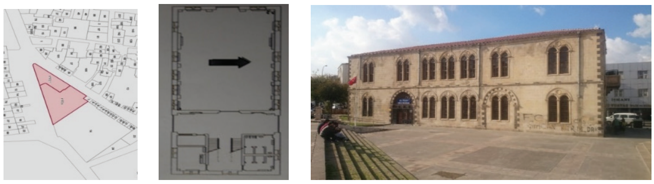


Figure 1. Şahinbey District Public Library, Layout Plan, Blueprint and Image

There was a need for an annex building for the Şahinbey District Public Library for users, and a café design was proposed. By considering the location of the land, it was aimed to bring the District Public Library to the forefront and use it in the most effective way without disrupting its function. Shaping of the designed café was organized as a result of the analyses that were carried out in the field, and the top cover of the load bearing systems was inspired from nature. A modular and light material was chosen for the café. There was also a need to landscape the close surroundings of the Şahinbey District Public Library, and it was planned to remove the unqualified structures found in the historical texture. In urban design, the landscaping and the rose garden previously used in the land were used. Additionally, the designs emphasized the public sphere (Figure 2).

Figure 2. Şahinbey District Public Library Café Top Cover Design and Landscaping (Sinan Talha ÖZCAN, HKU Architecture Department, Master's Student)

2.2 Gaziantep Şirehan Hotel and Old Learning Lodge / Bridge Connection and Modern Annex Design

Şirehan belongs to the category of two-story inns, and it was built out of cut stones with taxes collected from the public with the order of General Cemil, who was the governor of Halep, in 1885, and it is an example of the Ottoman Architecture. It consists of shops built adjacent to the walls of the inn which has a square plan. A part of the shops was destroyed by a large fire in 1994. It is being used as a hotel today (Figure 3) [3].

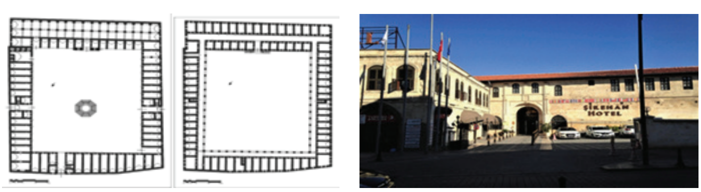


Figure 3. Şirehan's Floor Plans and Image

Next to Şirehan, there is the Old Learning (Yemiş) Lodge, which is known to be constructed in 1900. It is an Ottoman-era inn with one floor it its southern wing and two floors in its northern wing. The closed area of the inn has two sections [4]. The rooms have a rectangular plan and covered with tunnel vaults. The top cover of the upper floor is a hipped roof. The Learning Lodge was restored in 2004 (Figure 4).

Figure 4. Figure 18: Learning Lodge Plan and Images

As a result of the analysis on the inns, as Şirehan did not have suitable physical conditions in the basement floors when it was transformed into a hotel, it was decided to connect it to the Learning Lodge. The main point of the design was connecting the two inns with the help of a bridge (Figure 5).

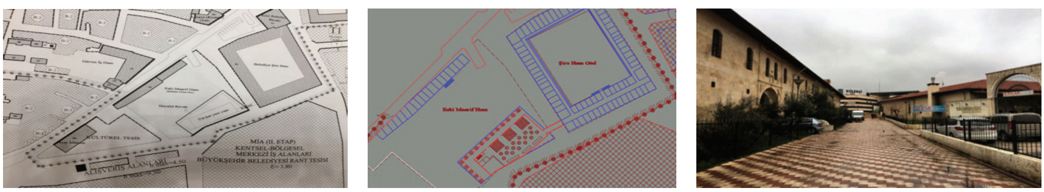


Figure 5. Şirehan Hotel and Old Learning Lodge, Layout Plan, Bridge Proposal and Image of the Road to Be Used for Construction

It was designed to connect a transparent mass to be constructed at the Learning Lodge to the upper floor corridor on the western façade of Şirehan Hotel with a bridge. For the terrace of the new annex transparent building, the cloister design formed by the Italian sculptor named Edoardo Tresoldi with thin wires was planned as the top cover of a restaurant (Figure 6).

Figure 6. Edoardo Tresoldi's Architectural Structure [5] and Gaziantep Şirehan Hotel and Old Learning Lodge / Bridge Connection and Modern Annex Design (Akşen ZİNCİRCİOĞLU, HKU, Architecture Department, Doctoral Student)

2.3 Istanbul Sirkeci Train Station / Workshop Arrangements and Eaves Top Cover Design
The Sirkeci Train Station was designed in the year 1890 by the German architect and engineer A. Jasmund. It is a train station that was built on the European side of Istanbul in the period of Sultan Abdulhamid II [6]. It has a rectangular plan, and there are two towers on the two sides of the entrance. The entrance is symmetrical in reference to its axis. There are rounded windows on the frames with sharp horseshoe arches, and it was shaped with Classical Ottoman period domes, ornamentations and wide eaves (Figure 7) [7].

Figure 7. Sirkeci Train Station, Plan, Façade and Visuals [8]

In the analysis of the Sirkeci Train Station, it was determined that it has turned into an urban transition corridor after its connection with MARMARAY (intercontinental underground tunnel system), and there were spaces that did not reflect its artistic and architectural style or its historical texture. As circulation was high, and semi-open areas were not organized, the existing market is not preferred by users (Figure 8). Additionally, the area that is used as a museum in the Sirkeci Train Station is also insufficient.

Figure 8. Sirkeci Train Station Current State [9]

For the Sirkeci Train Station, annexes that fit the functions in the area that would support it in historical and artistic aspects were recommended. It was aimed to preserve the texture of its rear façade by covering the semi-open historical area with glass. The functionless waiting corridors were transformed into workshops and working areas. Workshop areas were organized by considering different users and age groups. The museum at the train station which was inadequate was enriched with workshop areas. Moreover, glass eaves were added to emphasize the entrances of the building (Figure 9).

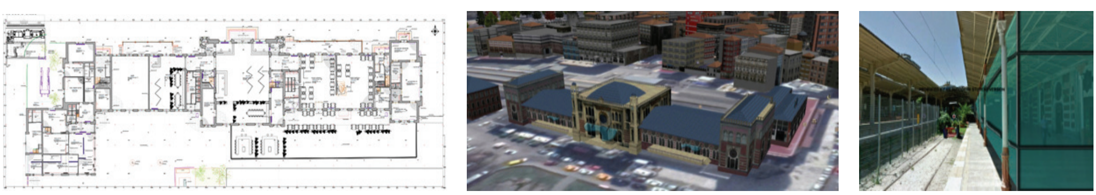


Figure 9. Sirkeci Train Station, Workshop Arrangements and Eaves Top Cover Design (Şeyma İNCESAKAL, HKU Interior Architecture Department, Instructor)

2.4 Kayseri Tavukçu Neighborhood / Public Space Proposal and Top Cover Design

The province of Kayseri is one of the settlement areas with historical accumulation due to its location that is accepted to be an intersection point among the cities in Anatolia. It has a history of about 6000 years between 4000 BCE and today [10]. In the Tavukçu Neighborhood, usually Christian communities had lived until the end of the 19th century. Settlements in Traditional Turkish residences in the form of asymmetric one-story buildings around yards corresponded to regular and two-story buildings in this neighborhood (Figure 10) [11].

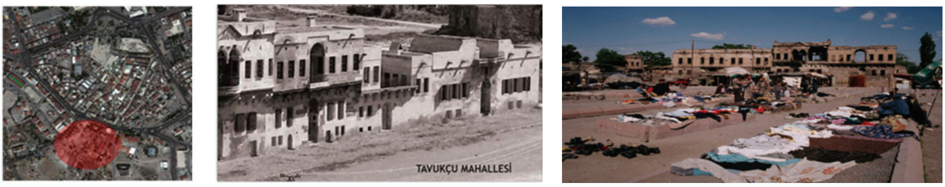
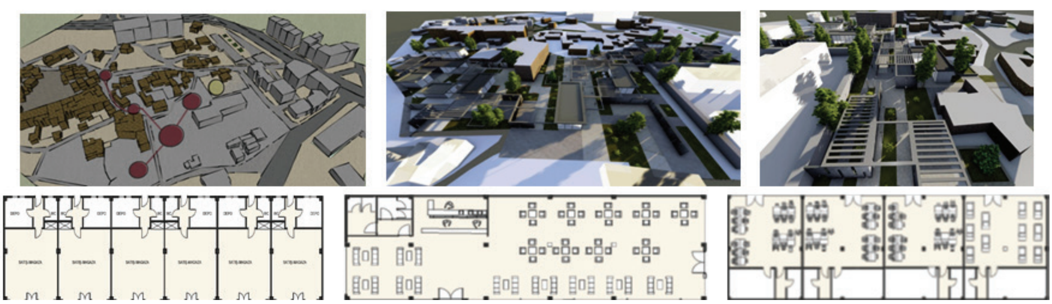


Figure 10. Tavukçu Neighborhood Location and Visuals [10]

In the protected area of the Tavukçu Neighborhood, there are 429 houses a part of which belonged to the rich Christian families of the 19th century. 20 of the houses in the protected area were listed among the Kayseri Houses as examples to civilian architecture to be protected [10]. As a result of the analysis, problems on the urban level were determined, and it was found that the neighborhood, which was evacuated in the process of nationalization in 1996, is in the position of a ghetto in the city (Figure 11).

Figure 11. Tavukçu Neighborhood Current State

As a result of environment analyses in the Tavukçu Neighborhood, the axes that connected boulevards and streets were determined, and a language of form that reflects the existing typology was developed. Memory walls, terraces and gardens that express history to be experienced through the axes by combining different focuses were designed, and the public space was planned by using green spaces. By taking the buildings in the project area as a basis, the design plan was developed by designing the functions of cafés, workshops and sale units (Figure 12).



Sale Unit Plan | Café Type Plan | Workshop Plan

Figure 12. Kayseri Tavukçu Neighborhood, Public Space Proposal and Top Cover Design (Burca ARAR, HKU Architecture Department, Master's Student)

2.5 Tokat Sulu Sokak Neighborhood / Public Space Proposal and Top Cover Design
In the Anatolian Seljuk period, Tokat was a city where economic and commercial life was advanced, and caravanserais where trade caravans in the east-west direction stayed, inns and regular roads and bridges were constructed [12]. The oldest commercial center of the province of Tokat is the Sulu Sokak Neighborhood and its surroundings found in the south of the castle (Figure 13) [13].

Figure 13. Historical Sulu Sokak Neighborhood Current State

The analysis for the Sulu Sokak Neighborhood revealed the urban-level problems of neglect and abandonment. For this area to be regained and made a living part of the city, its historical identity needs to be revealed by providing its surroundings and buildings with different functions. In this context, annex buildings were planned for the settlement area which also contains the Deveci Inn and the Tokenizer Mosque (Figure 14).

Figure 14. Tokat Sulu Sokak Settlement, Visuals of the Deveci Inn and the Takyeciler Mosque

For the modern annex building design, an amorphous structural design with the appearance of rocks was completely planned with translucent and steel structures so that the glass would keep the heat inside. For the retaining wall found in the modern annex building area, by using different arcades and mirrors between the arcades, it was aimed to reflect the buildings in the historical area (Figure 15).

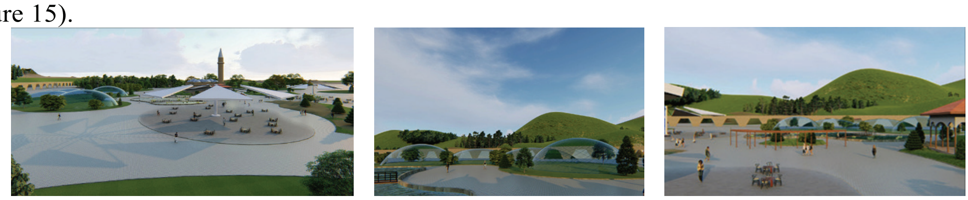


Figure 15. Sulu Sokak Neighborhood, Public Space Proposal and Top Cover Design (Esra Gözde TALU, HKU, Architecture Department, Master's Student)

2.6 Adıyaman Keleş Mansion (Mill House) / Café Design

The mansion located towards the southeast of the castle in the central district of Adıyaman was built out of regularly cut stones from the 19th century with two floors, while the lower floor was organized as a mill. This is why it is also known as "the Mill House." The building that was restored is now being used as social facilities for the Adıyaman Municipality. Alternative activities and arrangements were created for the Keleş Mansion to become a place of attraction for the public in addition to protecting its traditional structural form (Figure 16) [14].

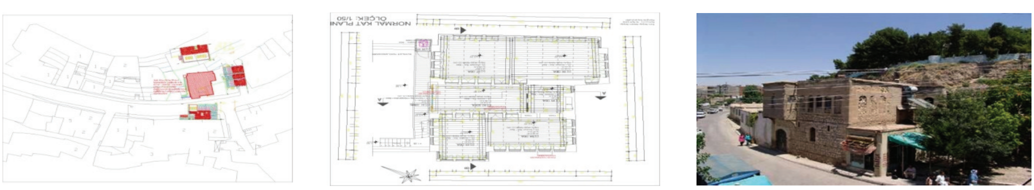


Figure 16. Adıyaman Keleş Mansion, Layout Plan, Blueprint and Image

As a result of the analyses of the Keleş Mansion, it was determined that the café that is found in the mansion was inadequate for 'harfene' nights, painting exhibitions and user groups due to the fact that it is on a busy street, it was planned to create an annex design. With the addition of a modern café designed for the upper floor of the mansion, it was aimed for it to become a center of attraction (Figure 17).

Figure 17. Keleş Mansion (Mill House), Café Design (Fatma GÜVENÇ, HKU, Architecture Department, Master's Student)

2.7 Nevşehir Mehmet Şakir Paşa Madrasah / Activity Area Modern Annex Design

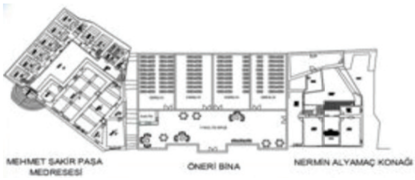
The Mehmet Şakir Paşa Madrasah is located in the Sinasos Square in the town of Mustafa Paşa in Ürgüp. It has an asymmetric U-shaped plan [15]. It is a significant Ottoman work that was constructed in 1900 and used as a madrasah at the time, as a mansion and carpet shop later, and as the Cappadocia Vocational School of Higher Education today (Figure 18) [16].

Figure 18. Nevşehir Mehmet Şakir Paşa Madrasah and Surroundings

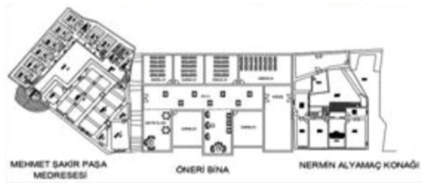
The Mehmet Şakir Paşa Madrasah is adjoined by the Cangut Bagana Building and the Nermin Alvamaç Mansion. The transition between the buildings is achieved by yards, there are reading areas and classrooms for students, and the analyses revealed the inadequacy of the social spaces (Figure 19). Instead of the Cangut Bagana Building that was constructed later, a proposal of a modern building suitable for our period was organized. It was designed by keeping in mind the historical texture and skyline.

Figure 19. Nevşehir Mehmet Şakir Paşa Madrasah Ground Floor and 1st Floor Plants [17]

The façades of the madrasah structure appear in two forms as one-story and two-story due to elevation differences. The annex building that was proposed was designed as flat from the front façade and with an obfuscating conduction, and the façade was covered with tempered glass. It was planned to illuminate the interior space with the glass façade, and the top part of the yard was covered with different heights of glass material for both illumination and sun blockage. By using wood and glass details with the traditional cut stones, a building proposal was brought up in a way that is both respectful for the texture and suitable for inclusion of cafés and social activity areas with a contemporary approach (Figure 20).



Ground Floor Plan



1st Floor Plan

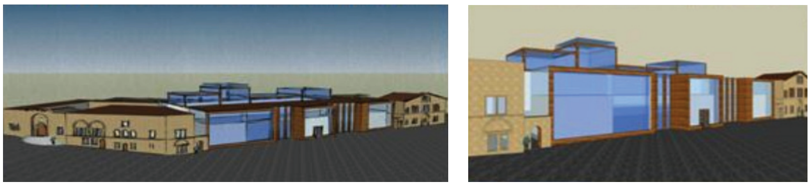


Figure 20. Mehmet Şakir Paşa Madrassah, Activity Area Modern Annex Design (Tülay SÖNMEZ, HKU, Architecture Department, Master's Student)

2.8 Diyarbakır İçkale Old Prison / Visitor Reception Modern Annex Design in the Open Yard
İçkale, located at the northeastern corner of the Diyarbakır fortresses, gained a special significance by construction of the current city fortresses by Romans, and it has been a center of administration. The Old Prison is located in İçkale. The prison building that was constructed as a caravanserai in the Artuqid period was transformed into a prison by repairs in the Ottoman period. The Old Prison Building is being used as the Laboratory for the Restoration and Conservation Region of Diyarbakır (Figure 21) [18].

Figure 21. Diyarbakır İçkale Old Prison Layout, Blueprint and Images [19]

The Old Prison in Diyarbakır witnessed the political events of the period, while it is not open to visits at the time. An annex building was proposed with the purpose of constructing a reception area for visitors who are planned to arrive at the building by using steel and glass materials in the open yard part of the building. In this context, it was primarily aimed to protect the historical structure by completely covering the jail rooms facing the yard with glass. By preserving the historical texture, the integrity of the old and the new was emphasized via the annex design in the entrance of the yard (Figure 22).

Figure 22. Diyarbakır İçkale Old Prison, Visitor Reception Modern Annex Design in the Open Yard (Ayşe Dijle DURMUŞ, Sevgi Nur CEVİZ, Begüm BARLAS, HKU, Architecture Department, Master's students)

3 CONCLUSIONS

Transformation historical city centers are not only in the form, but urban space productions, spatial organizations and functionalizing buildings also carry a separate value for the city, as well as being the product of qualified works for cities. In addition to making associations with the traditional organic texture of the city and sustain its existence today, it is important in terms of transferring the existing heritage values to the future to preserve the historical area, which includes annex buildings in addition to memorial structures, as a whole.

While physically protecting the traditional characteristics of examples of cultural heritage that were built in the historical city centers of Turkey, user needs and comfort conditions suitable for today's conditions were also considered and presented. It is inevitable to improve the qualities of historical cities and urban areas by taking their historical characteristics into account. It should be considered that spatial variables also form significant designs that are influential on human behaviors.

Improvement of awareness on issues of architectural protection and repurposing cultural heritage is a process of designing a new and modern annex structure within the protected area in the context of regaining urban memory and identity. The debates on the phenomena of design criteria for new annexes to be brought to a historical building and new annex practices to be applied on the historical texture involves compliance with legislative principles and learning existing methods.

The modern architectural elements that join the historical environment should be in harmony with the spatial order of the historical area, respectful of its traditional formation and the actual expression of the architectural trends of the time and space. In the narrative style for new designs, negative effects that would lead to disintegration or interruption of the urban fabric and space should be avoided. Architectural interventions should mainly be respectful of historical values and layers and suitable in terms of their spatial, visual, intangible and functional aspects. A continuity of design that allows prevention of negative effects of the soul of the space and distinguishable designs should be prioritized. The adaptation process of historical texture and buildings to the zeitgeist and the contemporary architecture requires usages that offer solutions to today's needs. In this context, secondary implementations that are added to textures and buildings should aim to look for ways of creating a new building without damaging identity values and by protecting what is being reborn in a settlement containing an urban memory without undermining the historical structure.

Consequently, for the modern annex/settlement designs of our students for historical buildings in different cities in Anatolia, each example was designed and evaluated within its specific conditions based on main principles. In the integration processes of historical buildings suitable for today's conditions, usage of contemporary construction techniques and materials allowed designs that emphasize the periodical identity of the historical texture-building. By completing building designs to the extent allowed by the data in hand without harming the originality and integrity values that have reached our time, one of the most important objectives should be to provide the user with information regarding general spatial organization and usage of the spaces located inside the old building. Interventions that fit new needs by preserving existing qualities shaped by the historical and cultural meanings carried by the skylines of historical buildings and forms of perception and vision will provide more qualified visions and acts of transformation.

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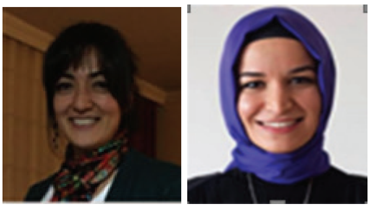
Evaluation of Unregistered Rural Dwellings in Sociocultural Sustainability: The Case of Kırşehir Ahi Evran District



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ABSTRACT

Ecological, economic, social and cultural aspects of the sustainability of the issues identified in the scope of various determined strategies and policies. Sociocultural sustainability, which aims to sustain the concept of sustainability with the cultural values and accumulations and to be transferred to the next generations, can be realized by carrying the traces, signs and symbols of the past to the next generations.

Within the scope of this study, unregistered(Out of inventory in other words Non-Registeres by Protection Board) the mudbrick structures of Ahi Evran District which are the rural architectural examples of the city were discussed in the context of sociocultural sustainability. The mudbrick structures in the streets mentioned in the Ahi Evran District do not form a certain texture in terms of number and density. Other examples of rural architecture in different parts of the city have been destroyed during the development process of the city. For this reason, within the scope of this study, it has been tried to determine the necessary measures to be taken and the measures to be taken in order to protect and maintain these structures in the context of sociocultural sustainability by making documentation studies of the mudbrick structures in the said area and making important contributions to the city's memory in addition to the other monumental and traditional structures of the city. The importance of these structures, which are important in carrying the footprints of the past to the present and future generations, is emphasized as contributing to the historical and cultural history of the city, and suggestions for reducing or eliminating the damages caused by reasons such as neglect and not being used are presented.

Keywords: Sociocultural Sustainability, Mudbrick Structure, Unregistered(Out of inventory in other words Non-Registeres by Protection Board) Rural Dwellings, Sustainability, Architectural Heritage, Kırşehir.

1 INTRODUCTION

The concept of sustainability has been the subject of research in many disciplines in recent years. Such as developing and changing living conditions and technology, unplanned population growth, causes the existing resources to decrease. Within the framework of the concept of sustainability, the discipline of architecture along with many disciplines, such as minimum energy usage in the construction, use and re-use processes of the buildings, the use of renewable energy sources, the long life of the building and the low energy expenditure during the usage process and the completion of the life of the building without damaging the nature is important in this context.

The historical areas and structures that witness the past of the cities are important assets of the settlement in terms of social, cultural and historical values. The protection and survival of these assets can be regarded as the responsibility of the present generations to the next generations. In this context, the historical structures of the cities as well as products that are examples of rural architecture are important architectural values that should be evaluated, preserved and maintained in the context of sociocultural sustainability. The protection and survival of architectural elements, which are an important tool in transferring the cultural footprint to future generations, are defined as the determinants of the culture level of the society.

In this study, the mudbrick dwellings in Kırşehir Ahi Evran District were evaluated as the structures that constitute the examples of rural architectural heritage of the settlement. Within the scope of the study, the structures and spatial relations of houses and outbuildings, facade shaping, structural system and cultural contribution to the city were tried to be examined and the measures and protection decisions to be taken within the scope of protection of these buildings were tried to be evaluated. It was tried to raise awareness about rural architectural heritage which is a part of the historical values of the cities.

2 RURAL ARCHITECTURAL AND SOCIO CULTURAL SUSTAINABILITY

Rural architecture can be defined as the whole of the values shaped as a continuation of the sociocultural life and physical structure characteristics of the settlement. These values are the texture integrity that takes the form of concrete cultural heritage shaped by the topography and geographical features of the traditional production and living activities of the settlement [1, 2, 3, 9].

Within the framework of the concept of conservation, the monumental structures worth preserving as well as the examples of civil architecture and rural settlements are worth preserving date to the second half of the 20th century. In this context, the fact that the settlements exhibiting rural features are among the values that should be preserved and maintained, increase the qualities worth preserving in cities and increase the understanding of holistic protection. The Venice Regulation of 1964 emphasizes that rural settlements and simple monuments that have gained cultural significance can be considered within the concept of historical monuments. The Declaration of Amsterdam, published in 1975: The idea that rural architecture can be regarded as a heritage, which began with the European Congress of Architectural Heritage, has continued to increase with the definition as much as urban heritage in the 1977 Granada Document. In addition to the Traditional Architectural Heritage Regulation of 1999 and the Venice Regulation, it has been deemed appropriate to include rural buildings as worth protection [1, 2, 3, 9].

The concept of conservation, which enlarges the physical scope in accordance with the declarations and regulations that considers rural architecture to be handled within the scope of heritage, is evaluated in the context of sustainability which is the field of study of many disciplines and evaluated on a wide platform. The foundation of sociocultural sustainability can be defined as the existence of cultural values as cultural footprints that can be defined as the formation of social structure and lifestyle and transfer to future generations. In this context, in addition to urban settlements, rural living spaces are cultural and architectural values that must be preserved. Kırşehir Ahi Evran District, which is the subject of the study, consists of mudbrick dwelling structures and has a rural character in terms of land settlement decisions and usage. While the difficulty of urban life and the tiring effect of concrete density cause the demand of the user to the rural areas to increase, the weakness of social relations in urban life strengthens the longing for rural areas. In this context, these dwellings are used as the second dwelling which is part of the user's permanent dwellings and the other dwellings are used in certain periods due to the rural qualities that are not registered, and the reasons that the user meets the demand to escape from urban life. It is believed that these houses are recognized by the next generations and the preservation and preservation of these houses without losing their originality in the context of sociocultural sustainability is a social duty and responsibility. In addition, it is aimed to document the current situation of these buildings with photographs and drawings and contribute to the conservation practices or academic studies to be carried out in the following processes.

3 THE IMPORTANCE OF AHİ EVRAN DISTRICT IN THE SCOPE OF SOCIOCULTURAL SUSTAINABILITY

Located on the Ankara-Kayseri highway in Central Anatolia, Kırşehir is a medium-sized settlement located in the middle of two cities. The city, which is the junction of the transportation line in four directions and the intersection of the road, is an important stopover place due to its location in the past and today [4].

Due to its location in the city, it has become a settlement area in the historical process and its position in the cultural, social life and physical structure of the city has been an important benefit. The process of being the settlement of the city has continued without interruption from prehistoric times to the present day and cultural layers of civilizations that have existed in the city have been provided. Excavations carried out in and around Kırşehir reveal the findings of the Phrygian, Persian, Hellenistic and Roman civilizations following the Colonial Age, Hittite Period and the effects of these civilizations. In the finds obtained in the excavations of Kültepe, Alişar, Boğazköy, Alacahöyük, Kaman Kalehöyük and Yassıhöyük, the existence of houses with a plan scheme suitable for the geographical and climatic characteristics of the settlement was documented by using the same architectural style and material [5, 6, 7].

Located in the continental climate zone, the city is a topographical slope settlement. The city, which has the steppe characteristics of the Central Anatolia Region, generally has weak forest areas and steppe vegetation. Although the general vegetation of the city and the region is steppe, the area chosen as the study area is closer to Kılıçözü Creek and is more wet and green area (Figure 1). In addition, the continuity of the green tissue can be ensured by the fact that the residences in the study area are being used continuously or in certain periods, thus ensuring the maintenance of the houses in the garden.

Figure 1. Ahi Evran Mahallesi Housing Examples (O.T. YURDUGÜZEL's Archive)

Ahi Evran Mahallesi Kuyubaşı Street and 645. Street, which is selected as the study area, is located 1.5 km away from the Intercity Bus Terminal in 2015 at the eastern exit of the city. Residential users are engaged in agriculture and animal husbandry to meet their needs. Consequently, each residence has gardens and courtyards to be used in planting and livestock works. In addition, the use of courtyards for the preparation of winter food and for the activities carried out by means of meetings with neighbors is common.

In the settlement, the houses can be positioned in the garden in different ways. The main structure of the dwellings in the garden consists of the main structure and the outbuildings such as barn, haystack, woodshed, warehouse, coal and wc. There are examples where the main structure (living space) and outbuilding parts of the house give way to the road and the garden gate is located among these spaces, as well as free settled houses in the garden. There are examples where the entrance of the dwellings which are positioned to give way to the road can be from the garden gate to the courtyard or garden, the entrance is from the structure and the courtyard or garden is accessed through the structure. The regional plan scheme is the plan scheme with the inner hall (sofa). Two or four venues are reached from the sofa. One of these spaces is used as a kitchen and the other places are used as bedrooms, while sofa is used as a living space [Figure 2-10]. There is no room differentiating from the others with the features such as interior details, size and positioning.

Figure 2. Kuyubaşı Street (O.T. YURDUGÜZEL's Archive)

In the examples where the building entrance is provided from the road, there is a door on the opposite side of the entrance to the hall and it opens to the garden. Although there are some examples in which the WC is added to the venues opened to the hall, the common settlement decision is to use the WC as a separate unit in the garden outside the residence.

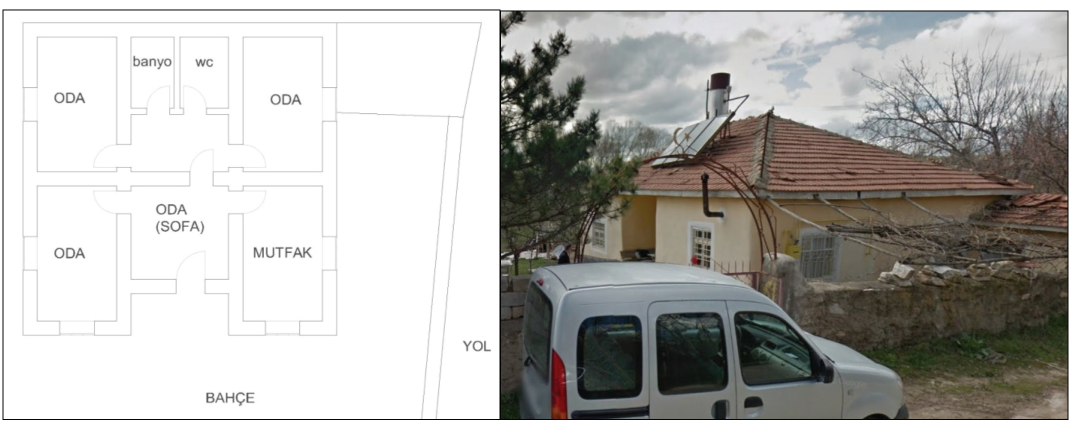

Figure 3. Kuyubaşı Street (O.T. YURDUGÜZEL's Archive)

Examples of the houses covered in the study are mudbrick masonry structures. In order to protect the material from adverse climatic conditions, the structures were plastered and painted with mud mortar. There are also examples where plaster is not applied in the outbuildings and back sides of the houses. It is seen that wood is used as lintel and beams on the surfaces which are not plastered on the facade. The buildings are covered with a fitted wooden roof. The open spaces added to the entrance or other facades of the building were covered with a porch and marseille type tiles were used on all roofs.

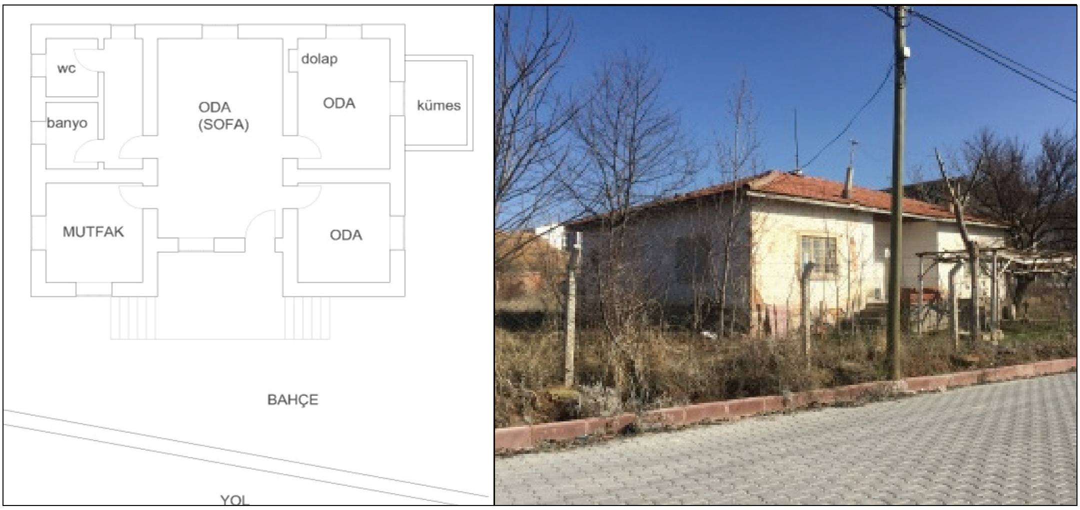

Figure 4. Kuyubaşı Street (O.T. YURDUGÜZEL's Archive)

The façades are largely symmetrically shaped. The center axle is defined as the entrance axle and has symmetrical windows on both sides of the entrance. There are also examples in which facade symmetry is disturbed by facade movement or changes over time [Figure 2-10]. Single and double casement windows are installed on the outer surface of the wall and the wall thickness inside is used as a niche. There are niches and cupboards in the rooms and kitchens of the houses which are shaped quite plain in the front and interior spaces. The mudbrick houses located in Ahi Evran District and center of Kırşehir have 1 and 2 floors. Only one of the mudbrick houses on the streets determined within the scope of this study has 2 floors. In the examples of 2 floors house, access to the upper floor is provided by a wooden ladder placed on the facade. The entrance area of the 2 floors house on the upper floor was replaced by the entrance door of the house and started to be used as a balcony.

Figure 5. Kuyubaşı Street (O.T. YURDUGÜZEL's Archive)

In order to increase the comfort level in the process, it is seen that wet spaces are added to the houses. In the original space design, the so-called "çağ" is used as a bathroom. One of the rooms, which is formed by the low level of floor formed near the entrance, still continues to be used today. In addition to this, it is quite common to divide the hall or one of the rooms into sections and add bathroom and wc spaces. Differences such as closing the doors and windows on the facade, making them out of use, closing the entrance part behind the facade and making new entrance halls and adding new spaces are common facade and space changes in the settlement.

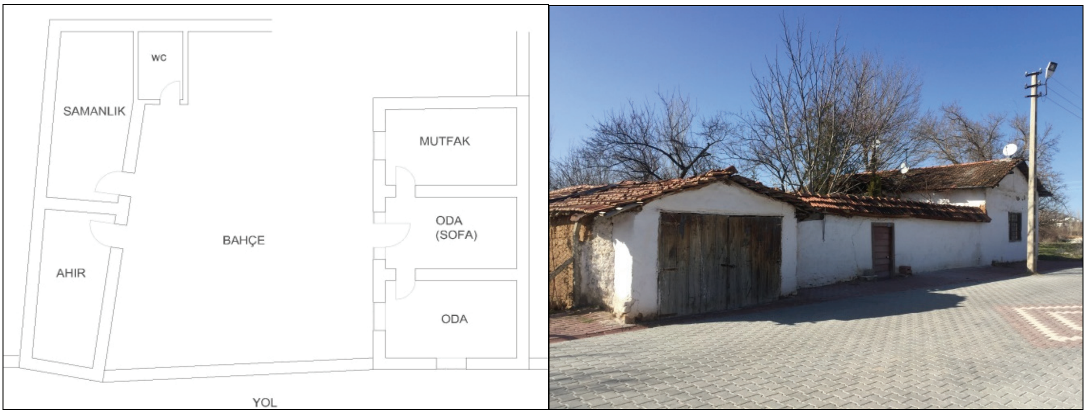

Figure 6. Kuyubaşı Street (O.T. YURDUGÜZEL's Archive)

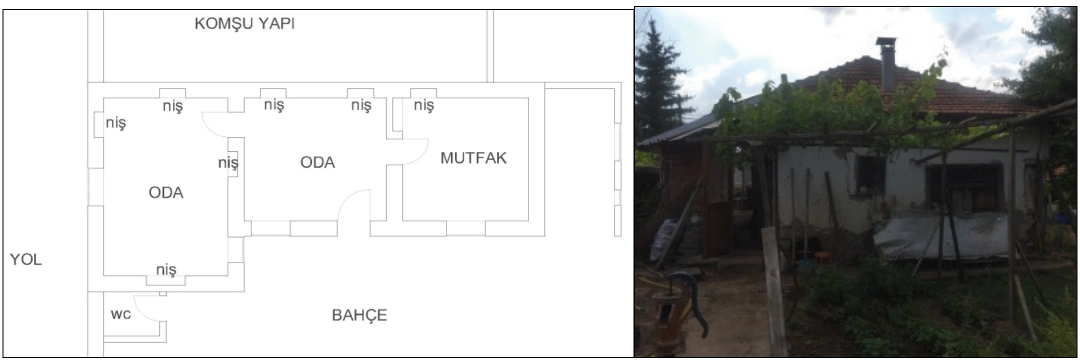

Figure 7. Kuyubaşı Street (O.T. YURDUGÜZEL's Archive)

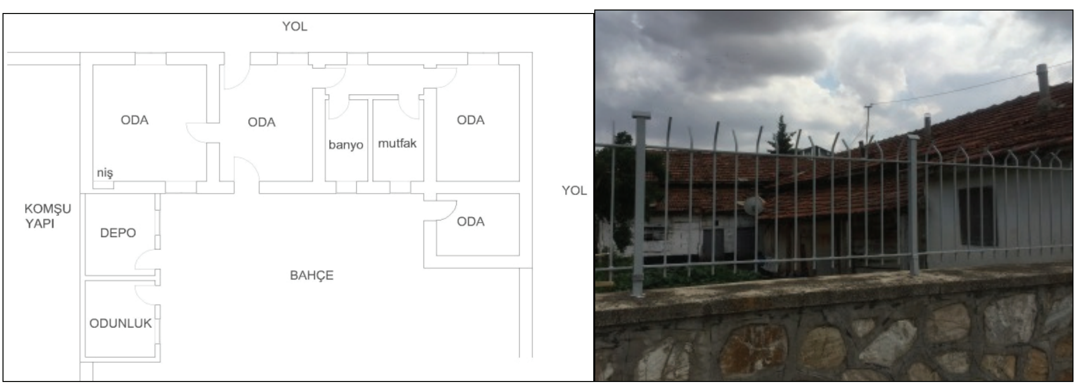

Figure 8. Kuyubaşı Street (O.T. YURDUGÜZEL's Archive)

The residences determined in the study area are used by the users continuously, during certain periods of the year or in the city center and as second residences. Spatial changes have been made in a small number of examples in the area where the plan schemes are largely preserved.

The mudbrick houses that do not form a certain texture in the center of the city intensify and form as they progress to the suburb of the city. The plan scheme is thought to be physical examples of the connection it has with the past of the city and the study area in terms of the historical and architectural value of the houses that resemble the traditional plan scheme. These houses cannot be evaluated in the protection practices carried out in the city because they are unregistered(Out of inventory in other words Non-Registeres by Protection Board). The fact that the houses are used even in certain periods is preferred because of the prolongation of the life of the structure and the continuous maintenance of the structure. In this context, it is important to emphasize the importance of the memory values of the houses on a single building scale, although not on an urban scale, and to ensure continuity of use.

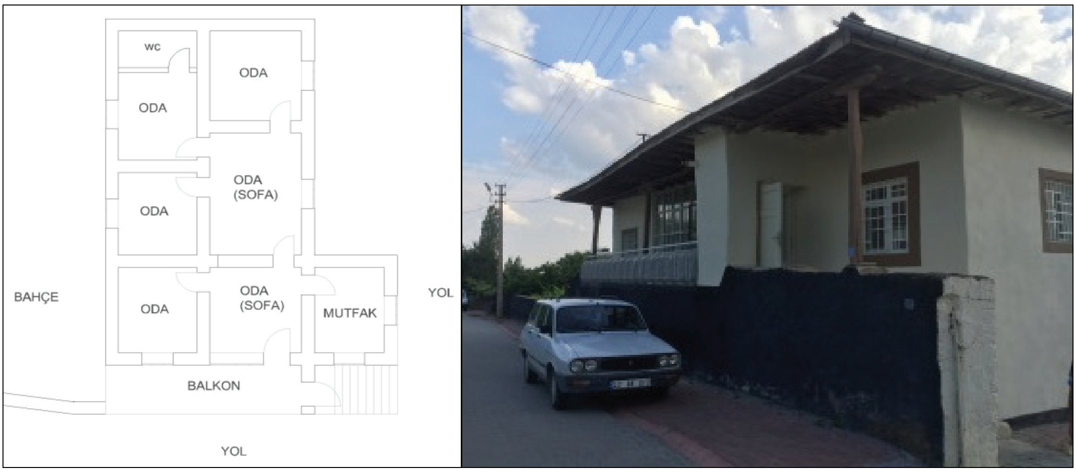

Figure 9. Kuyubaşı Street (O.T. YURDUGÜZEL's Archive)

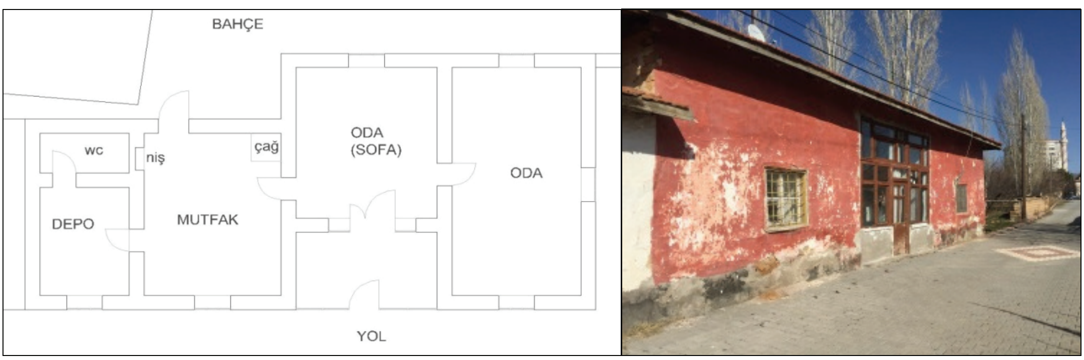

Figure 10. Kuyubaşı Street (O.T. YURDUGÜZEL's Archive)

The fact that some of the users have been using these dwellings for several generations, or that they are stored and used as family heirlooms, makes it possible to evaluate the dwellings in the study area within the scope of sustainability. These houses, which carry the historical, cultural and economic reflections of the social life and the period they were built, may necessitate some changes in accordance with today's social life and developing technology. Houses that try to take part in today's social life can be defined as the cultural promotion face of the city. In this context, increasing the touristic value of the city and supporting the protection and development of the settlement with the awareness of the local production and local user's value and importance can be considered as an important step in the protection context.

4 EVALUATION AND CONCLUSION

Rural settlements are examples of rational solutions according to the opportunities provided by local materials, topography and climatic conditions where the locality is protected more intensely than the city centers. Rural settlements, which are important physical spaces in ensuring the cultural continuity of the settlement, are instructive with settlement decisions and design parameters [8].

It is thought that the mudbrick houses on Kırşehir Ahi Evran District Kuyubaşı Street and 645 Streets, which are considered as the subject of the study, can be taken as examples of rural architecture of the city. The fact that these dwellings, which have not been registered by the Conservation Board, have important footprints on transferring the sociocultural structure of the settlement to the present and future generations makes it important to evaluate these buildings within the scope of sustainability. In this context, it is thought that these buildings should be registered and prevented from being abandoned to their fate and should be handled in the conservation practices that will be made in urban scale. The fact that these buildings, which have historical, cultural and memorial value, are being used continuously at certain times of the year or as a second residence can be considered as positive in terms of protection. Based on the idea that the best maintenance is in use, the fact that the houses are not in an abandoned condition reinforces the idea that the building needs maintenance and repair.

The mudbrick houses, which are cultural examples of the settlement, can contribute to the preservation of local users and local characteristics by evaluating them within the scope of cultural tourism through proper conservation policies and conservation practices. In this context, first of all, it is thought that correct protection steps will be taken by ensuring user participation in protection practices by informing the users and local people about the cultural value of the structure and contribution to tourism. The Intercity Bus Terminal, which was completed in 2015 and affects the physical structure due to its proximity to the study area, is thought to be capable of damaging the originality by accelerating the concrete process. For this and similar settlements, applications such as a guide book application that will contribute to the preservation of local architectural values in rural settlements are thought to contribute to the documentation of rural architectural examples.

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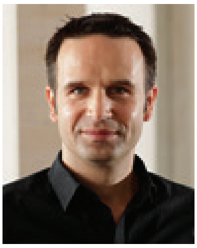
The Success Story of Earth Building Standards in Germany



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ABSTRACT

Earth building materials have become a normal and modern choice in German building practice and their use has risen steadily in recent years. A key reason for both these developments is that they are regulated by rules and standards, enabling architects, engineers and artisans to use and specify earth building materials without undue risk. These standardised building materials are now used widely in both new construction and in conservation work.

The first set of building codes for earth building materials was published as the *Lehmbau Regeln* in 1998. The first series of official *DIN standards* on earth building materials, based on a subset of the earlier codes, were published in 2013. The current second generation of earth building DIN standards were published in December 2018 and revise, restructure and expand the existing norms to cover further earth building products. Work is already underway on the third generation of standards, which will include new structural design concepts for earth block structures.

German standards for earth building materials serve as a model for standardisation work in other countries. In France, for example, a standard for earth blocks is currently being developed based on the corresponding German standard. It is, however, too soon to talk of the creation of uniform European standards as too few European countries have initiated the development of regulations for earth building materials and construction.

Keywords: codes, rules, standards, earth building materials, regulations

1 INTRODUCTION

The purpose and necessity of rules and regulations for earth building was debated at length by the members of the Dachverband Lehm e.V., the German Federal Association for Earth Building, immediately after its foundation in 1992. The consensus was that the goal of promoting the application of earth building cannot be achieved by the internal exchange of information alone but that specialist information on earth building should be available to everyone in the form of regulations. Keen proponents of earth building will be prepared to take a higher risk and overcome difficulties in the planning process through greater personal commitment and diligence in the planning and building process. While this attitude can be seen as selfless and idealistic, it is ultimately also selfish in that, without the general availability of knowledge, only the experts are able to navigate the additional hurdles of so-called 'unregulated' construction. The Dachverband Lehm e.V. has therefore always advocated the development of regulations for earth building materials and this has contributed significantly to the more widespread adoption and recognition of earth building in Germany, which is seen as a model for earth building around the world.

Among the concerns voiced during the early debates was that rules and regulations in earth building:
- limit creativity in the planning and construction process
- restrict the usability of locally-sourced earth, or
- disadvantage small-scale manufacturers of earth building materials as the cost of testing building materials is disproportionately high.

In an attempt to mitigate these concerns, they were taken into account in the wording and clauses of the regulations, and today general acceptance of the regulations is very high.

2 REGULATIONS FOR EARTH BUILDING MATERIALS IN GERMANY – DEVELOPMENT AND CURRENT STATE

In 1996, the German Institute for Building Technology (DIBt) approached the Dachverband Lehm e.V. in 1996 with the proposal to formulate a new set of building regulation for earth building materials. Two years later, the first set of rules for earth building, the so-called *Lehmbau Regeln*, was published [1]. They cover all earth building methods and materials and outline each with a short description. As official building regulations, the Lehmbau Regeln are recognised by the federal building authorities and form the legal basis for building with earth in Germany. The third edition is currently valid. According to the regulations, non-loadbearing construction with earthen materials such as plaster and clay boards is permitted in all building categories and all heights of buildings. Loadbearing earth building materials may be used in constructions no taller than two storeys. Where loadbearing earth building materials are used in taller constructions, an exception in the form of a "special approval in individual case" must be obtained from the planning authorities.

The short descriptions of all earth building materials and building methods in the Lehmbau Regeln are, however, not detailed enough for the specific requirements of the building industry. The Dachverband Lehm e.V. therefore decided to continue their standardisation efforts as follows:
- DIN standards should be developed for the most important prefabricated earth building materials.
- DIN standards will not be developed for less important prefabricated earth building materials and their application as this would be unreasonably expensive. For these materials, so-called Technical Datasheets will be elaborated that are essentially just as detailed as the norms but have not undergone the complex and expensive procedure of becoming a standard. As a set of technical rules published by a federal professional association, the technical data sheets belong to the so-called generally recognised rules of construction engineering in Germany [2], [3].
- The Lehmbau Regeln will be shortened to cover only those materials and building methods not governed by the DIN standards or Technical Datasheets. Essentially, the Lehmbau Regeln now primarily cover building with local earth resources and buildings techniques used in historical building conservation. This revision of the Lehmbau Regeln is still pending.

In August 2013, the first generation of new DIN standards for earth building materials – authored by the DIN Working Committee NA 005-06-08 AA Lehmbau – was adopted and published. These were:
- DIN 18945:2013-08 Earth blocks – Terms and definitions, requirements, test methods
- DIN 18946:2013-08 Earth mortar for masonry – Terms and definitions, requirements, test methods
- DIN 18947:2013-08 Earth mortar for plasters – Terms and definitions, requirements, test methods.

The primary goal of the DIN standards for earth building materials is to ensure material stability and performance. Additional goals included incorporating softer ecological criteria such as the establishment of procedures to determine CO_2-equivalent characteristic values or parameters affecting the indoor environment such as water vapour sorption capacity. Natural radioactivity values, which needs to be declared for all mineral construction materials, have also been incorporated at a very low prevention guidance level in accordance with European legislation as well as critical user expectations.

The DIN standards are now well established in the daily work and design processes of architects and engineers. In addition, earth building product producers have adopted and applied the testing procedures and declaration systems and to date there has been no significant criticism of the standards, whether in general or in detail.

The number of cases of damage caused by unsatisfactory products has also decreased significantly since the standards were published.

In Germany, regulations must be revised every five years to meet current developments. As a result, the first generation of DIN standards from 2013 was revised and published as the second generation in 2018. The following changes and additions were made:

- The description of terms contained in each of the existing technical standards were separated out into a new, single terminology standard: DIN 18942-1.
- Similarly, the conformity assessment procedures from each of the existing standards was separated out into a new conformity assessment standard: DIN 18942-100.
- Only minor changes were made to the main content of the standards for earth blocks, earth masonry mortar and earth plaster mortar, as the existing standards have proved useful and practicable in everyday practice.
- A new DIN standard was developed for earthen boards to reflect the considerable growth and advancements in this product sector: DIN 18948.

As a result, the currently valid standards for earth building are:

- DIN 18942-1: 2018-12 Earthen materials and products – Part 1: Vocabulary
- DIN 18942-100: 2018-12 Earthen materials and products – Part 100: Conformity assessment
- DIN 18945:2018-12 Earth blocks – Requirements, test and labelling
- DIN 18946:2018-12 Earth masonry mortar – Requirements, test and labelling
- DIN 18947:2018-12 Earth plasters – Requirements, test and labelling
- DIN 18948:2018-12 Earthen boards – Requirements, test and labelling.

Not covered by the Lehmbau Regeln or the DIN standards for earth building are earth building materials that consist of earth or clay with other binders, such as gypsum, lime or cement. Such stabilised earth building materials do not comply with the Lehmbau Regeln or the DIN standards for earth building in Germany.

3 OUTLOOK

The level of regulation in the field of earth building in Germany has developed well and is currently better than in any other country in the world. However, it is still not at a level that allows unhindered planning and building with earth building materials. Standardisation therefore remains a high priority for the Dachverband Lehm e.V. in the coming years.

Work is already underway on a third generation of DIN standards with special focus on the development of a new structural design concept for earth block structures. For example, experimental proposals for partial safety factors on the material side for earth blocks and earth masonry mortar are currently being developed. Depending on the application of earth blocks, these are exposed to different moisture influences. Since the strength of earth building materials depends on moisture content, factors for the consideration of moisture must be assigned to the respective area of application, as seen, for example, in wood building materials. Further tests are currently also taking place to determine reliable values for long-term strength and creep in structural design.

German standards in earth building materials serve as a model for standardisation work in other countries. In France, for example, a standard for earth blocks is currently being developed based on the corresponding German standard. It is, however, too soon to talk of the creation of uniform European standards as too few European countries have initiated the development of regulations for earth building materials and construction.

The Dachverband Lehm e.V. is currently also investigating financing possibilities for translating the German regulations into English to encourage the development of corresponding regulations in other countries.

4 ACKNOWLEDGMENTS

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- the German Federal Environmental Foundation (DBU) and
- the Federal Ministry of Economics and Energy (BMWi).

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Köyceğiz Movie Plateau

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ABSTRACT

The purpose of this study is to share the production experience that we have gained during the construction of 800 square meter Alker structures of Beşiktaş Kültür Merkezi (Beşiktaş Culture Center) Köyceğiz Movie Plateau. We are very excited about Alker / Earth which we think is a magnificent construction material and sharing this with you the academics.

The stages and the results of the compression apparatus which we have developed as the result of our experiences are shown in our presentation. You will also find the visual of the two form houses that we are in the process of constructing using the apparatus we have improved.

To build up the structure at its most durable form, we find it that the compacting and molding is very important.

Key Words: Alker, Sustainable, Köyceğiz Movie Plateau, Adobe,

1 INTRODUCTION

Most of the population of our country lived and worked in rural places until the end of early 80's. After the government policy has changed into establish big cities and in need of industrial area manpower support, high percentage of the population moved to cities. This also means people moved from their adobe brick made, earth houses to unplanned concrete buildings.

Now and then we all started to look at our roots, where we come from and how they were beautiful. Understanding the experiences in the past, what our elders done before and honestly realizing these knowledge and arranging this into our time is very exciting also need many tryouts.

In between past and future we stand where we are and feeding from our roots and look at the future.

Figure 1. Traditional Anatolian Turkish adobe house, (Photo Credit by Author)

Figure 2. Reinforced concrete buildings from Istanbul, Turkey (Photo Credit by Author)

2 HISTORY OF THIS STUDY AND USING APPARATUS AND MOLDING SYSTEMS

After we met with Alker, we saw that the material is natural, and it saves energy by improving the quality of life.

When we started the construction of the BKM Besiktas Culture Center in Köyceğiz, we reached the conclusion by applying the knowledge of Prof. Bilge Işık. Thank her for her contributions from here. Alker's heat-proofing soil neutral and natural material has led us to extensive research and trials in this regard. After we have seen the earthquake resistance as a result of our experiments, we have entered into research on what we can add to this structure style.

Firstly, we had difficulties with the use of compactor and mixing machine. We planned to use a concrete crushing machine instead of a compactor. Since the concrete crushing machine is compressed with vibration, we thought it would give better results than the compactor. We started to work by making apparatus. It took some time for the apparatus to become final because we could not fully calculate the clamping power of the machine. Because the concrete crushing machine was compressed with vibration, we got a tougher result and ease of use. It also provided savings.

Figure 4. Apparatus designs as a compactor from beginning to the last form. (Photo Credits by Author)

When the compaction and mixing has become at its best, Alker has turned into a "dream it and build" material. In movie studio project it could rise 11m high on 30m long walls. To build up the wall as an earthquake resistant building, wall thickness increased also wooden beams and columns are used.

Figure 5. Apparatus application to the drill (Photo Credit by, Author)

Figure 6. Using the drills as a compactor with apparatuses (Photo Credit by, Author)

To build up the walls more smooth and economical way, Plywood material on 125cm x 250cm metal profiles used as a mold. Quick Setup we've initiated studies to ensure that fewer reinforcements and soil are not adhering to the mold surface and we get smooth results

We have reduced the reinforcement vents and a board can be secured with 4 reinforcement holes. Three days after removing the mold, we destroy the reinforcements by compressing them from the surface with the same soil material.

Figure 7. Example of private building in Köyceğiz, Muğla, Turkey (Photo Credit by, Author)

Figure 8. Molding Systems by Plywood (Photo Credit by, Author)

Figure 9. Molding examples from private house in Köyceğiz, Muğla, Turkey (Photo Credit by, Author)

Figure 10. Wall samples from private building in Köyceğiz, Muğla, Turkey (Photo Credit by, Author)

We have experienced ways to achieve a more aesthetic appearance on the wall using different lands of colors, and achieved positive results.

As the experience progresses, we have discovered that artistic and aesthetic concerns can be painted with sculpture relief plus transparent mold. We continue to work with sculpture molding techniques in this regard.

Figure 11. Samples of different colored rammed earth walls

Figure 12. Artistic samples of rammed earth walls

Figure 13. Various textures of rammed earth walls

We were using wooden beams on the door, and in our final structure, we created the 2.5 m openness from the soil with the beam reinforcement system. We use the roofs of our alker structures as carrier wooden beams and the frame as a coating material. The use of the bamboo is a natural material, but it brings a very economical solution. We are grabbing 5 cm plaster gypsum on the frame, preventing heat loss of the roof. Of course, we're doing water insulation and making it final according to the project's condition.

Figure 14. BKM's movie studio in Köyceğiz, Muğla, Turkey

Figure 15. BKM's movie studio guest house and lounge, Köyceğiz, Muğla, Turkey

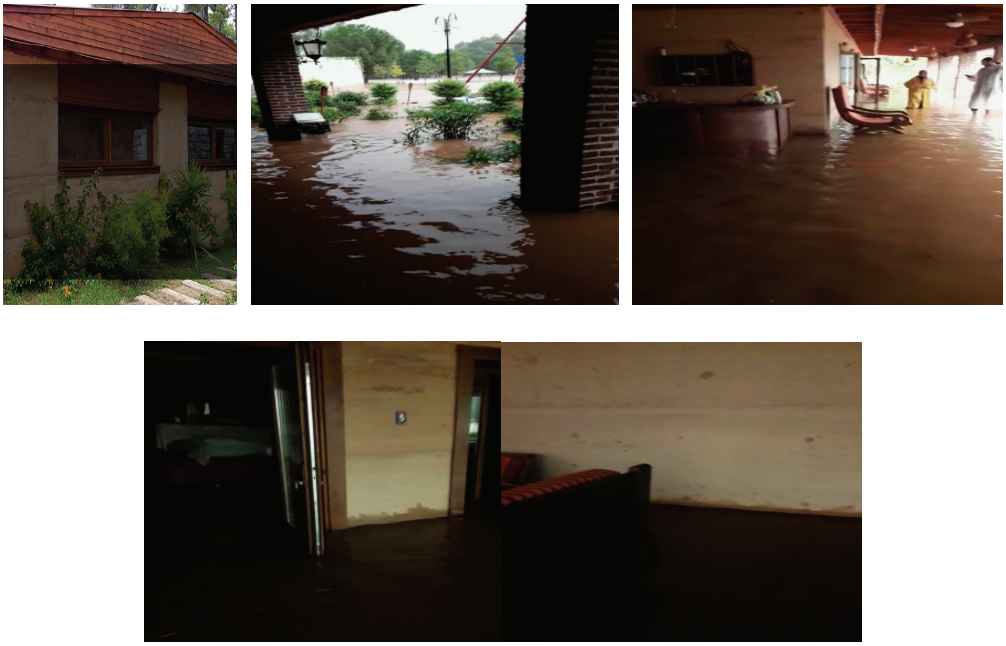

Figure 16. Movie Studio's situation during the flood, 2017, Köyceğiz, Muğla, Turkey

CONCLUSION

The last project we started was a hobbit-style plan for the elevation difference. We're thinking of completing the roof by covering it with soil. In the back of the structure, we created a natural gallery below the building, and we planned the natural air conditioning in that section to make the weather in the canals, and the work continues. Therefore, in summer the building will be warm and in cool winter.

We aim at minimal energy consumption while building natural habitat. We have some other works to create ecological ponds in our projects. We create subsoil cistern to store rainwater for use.
We appreciate the opportunity to share our experiences as we are aware of the widespread Alker building system.

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Alker, who belongs to the good and the wisdom, spends effort to develop and disseminate the structure, especially the Professor Bilge IŞIK and academic teachers and the art teacher Yilmaz ERDOĞAN prefers alker structures in the project. Be in love and peace.

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