A material that has witnessed the past in Anatolia: adobe

Tülay Çobancaoğlu & Uğur Tuztaşı
The Faculty of Architecture, Mimar Sinan Fine Arts University, Istanbul, Turkey

ABSTRACT: The traditional use of adobe in Turkey and especially Central Anatolia is known to have originated from the primary ages of settled civilization period. The building techniques that were used in Central Anatolia in BC 5000s and that can be seen in the examples that have survived today resemble one another. We can tell that this is an indication that the architecture defined as vernacular is not pure. The forms have affected each other and similar techniques have been used. Within the scope of this statement, vernacular examples of houses made of “adobe” that we have defined as a material that has witnessed the past in Anatolia have been examined and application methods that differ from region to region and their differences have been explained.

1 INTRODUCTION

Since the primary ages of settled civilization, the first building material that human being has produced and given shape has been adobe. The adobe becomes a brick after having been put into a stove. This property has given human beings the facility of an economical building material that is as hard as a stone and can be found anywhere. In every region where wood and stone are hard to obtain, the main building material of the house has been adobe and brick.

It is mentioned in the sources that the building material of rural houses located in the temperate zone of the world has been adobe and the most important historical data of building tradition based on adobe and brick has been produced in Mesopotamia, Iran and Central Asia (Kuban, 1990).

2 THE HISTORY OF ADOBE

It is observed in our country that the unrevealed parts of traditional houses during the digs in Anatolia have spread out a period of approximately ten thousand years. These have put forward the whole stages of development in the house concept and related building techniques that human beings have passed through. Natural materials have been used together since the earliest period that the archeological remains were found in. It is written in the documents that in the settlement area that was revealed within a digging area of nearly 8000 m² in Cayonu, a simple cottage built by twigs in a circular plan was changed into a building of rectangular plan with adobe brick walls standing above a stone foundation, a flat roof, a door and a window (Ozdogan, 1996).

By depending on another example, we can also tell that there have been buildings made of adobe without a foundation or with a stone foundation or based on a stone wall in this settlement area of Anatolia during Trojan I period (Nauman, 1991). Although there are many stone walls found in Anatolia, a small number of solid adobe walls have been protected or seen.

In the applications of adobe in Anatolia, the adobe has been prepared within the site where enough amount of silt and water could be obtained. If the silt has been taken from the neighbourhood of the settlement area, the undesired mixture of broken pieces of cups, ashes and garbage, rubble usually comes out. Straw, animal food cut into small pieces, reed, sand and small pebbles have been added to silt on purpose, in order to loosen the mass of the brick and to provide a mechanical connection between the materials. It can be said that parts of plants have often been added into the adobe mortar in Anatolia. It is certified in the documents within sources that thousands of years ago this process was no different from the application today (Nauman, 1991) (Figures 1–2).

3 THE DESCRIPTION OF ADOBE

The mastery in adobe that was the traditional building material in Old Anatolia and Mesopotamia and has continued to be used for thousands of years requires a peculiar experience in the aspect of “building technique”. The selection of soil that shall be used in adobe production is important. According to the experienced
Adobe craftsmen, the soil to be used should be taken from the surface of a field where an alluvial layer has been formed. This material should be cleaned out from other materials by filtration. The subsidiary element and binding material of loam is straw. The straw that shall be added to loam in a specific quantity is cut into very tiny pieces. The loam mixed with straw is left to rest for a long time and fermented. Then the loam is crushed by foot until it reaches its maturity. In the second phase, the loam is poured into wooden moulds of definite dimensions. This is called the cutting process of the adobe. Then it is left to dry and harden under the sun. The dried ones are stowed to be used later according to the rules (Tarhan, 1975).

The properties of adobe material can show some differences due to the type of the soil used, quantity of water, the methods and intervals of moulding and drying. The chemical composition of clayey adobe soil is an aluminium silicate. It is observed that soil with plant-based and organic materials have not been used in adobe production. Clay that has schist and tiny pieces of sand shows a high plastic quality when kneaded by water. Pieces of stone bigger than 3 cm should not exist in adobe soil. The dimension of adobe and the preparation of the mortar used as the binding material differ according to the region where it is used (Eric, 1980).

4 THE APPLICATION OF ADOBE

The main building materials of traditional architecture in Turkey have been wood, stone and adobe. These materials have been used in the building systems according to the type that can easily be obtained within the district. Turkey can geographically be divided into seven regions: 1. Northern Anatolia, 2. Marmara Region and Istanbul, 3. Western Anatolia, 4. Southern Anatolia, 5. Central Anatolia, 6. Eastern Anatolia, 7. South-eastern Anatolia (Figure 3).

Although there are not definite borders between the regions in the aspect of house building techniques, architectural building techniques are formed by vernacular effects. The adobe is mostly seen as the main building material of Central Anatolia Region and also can be observed in other regions in different techniques by the use of adobe with stone and wood. Within the scope of this statement, we are classifying the application of adobe by examining traditional adobe houses of nearly 150 years in three groups such as massive system, adobe filling between wooden skeleton system and the mixed system, and introducing these groups by original examples.

4.1 Adobe houses in massive construction system

The buildings that do not have load-bearing wooden elements between adobe materials and have walls made of adobe blocks are called massive adobe buildings. Massive adobe houses are usually common in the rural areas of Anatolia. The most significant properties are a flat roof, one or two floors and a prismatic appearance (Figures 4–7). These houses are reinforced with 1–3 rows of horizontal peripheral ties due to the
The easiness of finding wood. Peripheral ties that have a circular section of 6–10 cm diameter and are placed in both sides of the wall are made of poplar or willow trees. These are placed inside the wall in every 1.50 or 2.00 meters and can be connected to each other at the corners. Lintels are pieces of wood of smaller sections. In some examples, vertical posts apart from the wall system have been used to support the span between massive walls (Kafescioglu, 1949).

The use of wooden peripheral ties causes a reduction in the dimension of the adobe. The dimensions of the adobe used in Asvan of the Keban district where wood is used in the adobe walls (30 x 30 x 10), (30 x 15 x 10) are smaller than the adobe used in the district of Adıyaman and Urfa where wooden peripheral ties are not used (Erdim, 1979). Similarly, the adobe in Calli Village of Sivas (32 x 30 x 10), (32 x 15 x 10) is smaller than the adobe in Adıyaman and Urfa.

Massive adobe walls are classified into three groups according to the differences in the building technique of the wall: Building the wall with adobe blocks of same dimensions; using two kinds of adobe blocks—the big one, the dimensions of which are twice the other is called “mother”, the small one is called “lamb”; thick walls built with adobe on two sides and a filling material between them.

The most common technique is building up a wall with mother and lamb adobe blocks. The mother adobe block usually has a length of 40–30 cm, a width of 40–20 cm and a height of 15–8 cm. For example, (30 x 30 x 10), (30 x 15 x 10) etc. are used in the lower district of Ulupınar in Malatya and Balaban (Basakman, 1991). The thickness of the wall depends on the dimensions of the adobe. It can reach 70–80 or 50–60 cm when muddy mortar mixed with straw is applied on both sides of the wall. In these houses the thickness of external walls is one and a half, and internal walls is one block of adobe. The use of adobe with larger dimensions makes the wall more durable.

If we make a brief explanation about the other horizontal building elements such as the roof covering, ceiling and floor covering; the flat roof made of soil that is an important characteristic of vernacular adobe architecture is composed of three layers: load-bearing beams, a floor made of reed and twigs supporting the soil and a layer of compact soil laying upon them (Kafescioglu, 1949).

First of all, wooden beams that are made of trees such as juniper, poplar, willow and are circular and decorticated, are arranged in parallel rows in definite intervals above the load-bearing walls of the building and make up the roof skeleton system (Barusta, 1990).
The internal surface can either be covered with an ornamented ceiling covering or left bare with no paint or be painted. There are also independent posts used for taking away the load of roof skeleton from the walls. These posts are settled on a stone above the floor. Timber of smaller diameters or decorticated twigs of small dimensions (Ankara, Sivas, Mus, Van, etc.) are used to cover the wooden beams. So the wooden roof skeleton defined above is covered by a kind of fence consisting of reed or twigs. A mortar of soil and straw is applied on this fence and clayey soil is put on the muddy mortar. The soil of muddy mortar is sand with clay. This mortar is mixed better than adobe and wall mortar and left to dry. When it cannot be found, a soil that has absorbed water with saturated salt is used instead. This kind of roof or covering system is compressed by driving a cylinder made of stone and called as “stone roller” (Alioglu, 1991) on the soil layer. The material used in building the roof differ from one region to another. For example, reed has been used instead of twigs (Adyaman, Konya, Isparta, Burdur, etc.) and small pieces of stone have been used instead of reed or twigs where stones with a large surface are common (Kayseri, Agrnas District). If the building consists of two floors, the end points of the twigs are not inserted into the walls. The barren flat roof has a low inclination within its borders and water is given out through waterspouts in definite points.

The flat-roof-houses located in the city centres of Anatolia were replaced by inclined roofs covered with tiles beginning from the XVIIIth century. Ridge roof with triangle pediment or hipped roof that were seen as a decorative element in the facade of privileged houses at first, have taken the place of flat roofs in time. The effects of this application were later seen in the countryside. The floor coverings of massive adobe houses are made of soil or stone due to the functions of the space.

4.2 Adobe houses with adobe filling material between wooden skeleton system

In the settlement areas of Anatolia where it is easy to find wood (for example, the inner districts of Northern Anatolia, Amasya (Figure 8), Safranbolu (Figure 9), Samsun-Havza (Figures 10–11), Kutahya in Central Anatolia (Figures 12–13), Sivas-Divrigi (Figures 14–15), we come across houses with adobe filling material between wooden skeleton system. In these houses, wooden skeleton is settled upon massive stone or adobe construction. The trees that make up the wooden skeleton are used as main and subsidary vertical posts and horizontal beams and they are fitted together at some intervals. The main load-bearing material of this system is wood, and adobe is used as the filling material. The span between the wooden skeleton system is modified according to the dimensions of the adobe. In this building system that is generally called “HIMIS – post and pane”, the distance between vertical posts have become wider, for example 80 cm, by the advantages that adobe provide (Çobancaoğlu, 1998).
In most of the centres where wooden houses are located, walls are made of wooden skeleton and filled with adobe. Although the dimensions of adobe are similar, they show some vernacular differences. For example, \(9 \times 12 \times 30 - 15 \times 30 \times 60\) in Kutahya (Eser, 1955), \(15 \times 25 \times 30, 15 \times 50 \times 50\) in Sivas–Divrigi (Sakaoglu, 1978), \(27 \times 27 \times 10, 27 \times 22 \times 10, 27 \times 13 \times 10\) cm in Safranbolu (Ozeke, 2001). The most common dimensions are mother adobe of \(40 \times 40 \times 12\) and lamb adobe of \(40 \times 20 \times 12\) and \(20 \times 10 \times 5\) cm. With the adobe blocks that are used as the filling material of this system, walls are built by using horizontal, diagonal or both bond techniques (Figures 16–17).

In some districts of Anatolia, the climate and the direction of the building has become an important factor; so adobe has been used as a material preferred for its heat insulation. In this skeleton system, plaster has been applied to the internal and external surfaces of the walls. The plaster can be applied on either adobe or little wooden lath that is called lath-and-plaster system.
The internal partitions of houses are different from each other due to the material used. Adobe and pieces of stone are used to fill between the wooden posts and then the wall is covered with plaster or the adobe blocks have been used in massive system, especially in the walls where the stove is located.

Wood has been used in the other elements of this building system, such as roof covering, beams supporting the roof and the floor, and also ceiling and floor coverings. In the courtyard or some service spaces, stone or compact soil has been used for floor covering. The roof is hipped and covered with mission tiles.

4.3 **Mixed system adobe houses**

The building system that we call the mixed system has generally been applied in the rural areas of Anatolia and is an application where massive system and the filling between the wooden skeleton system can be seen together. In the external massive walls of these houses that are generally located in the city centres, vertical posts have sometimes been used due to the easiness of finding wood. And in some examples, the upper floor walls overlooking the landscape or the walls of the oriel have been built with adobe filling between the wooden skeleton; and the other external walls have been built in massive system. Internal walls have usually been built with adobe filling between the wooden skeleton. (For example Van (Figures 18–19), Konya (Figure 20), Mus, Malatya – Yediozonu (Figure 21), Malatya – Yesilyurt (Figure 22), etc.) The thickness of the external walls is one-and-a half or two blocks and internal walls are one or a half block with wooden skeleton inside. In two-storey houses, external walls on
the ground floor are made of two, the external walls on the first floor are made of one and a half row of blocks. The internal walls on the ground floor are made of one and a half, and internal walls on the first floor are made of one row of blocks.

Adobe houses in mixed system are similar to the adobe houses in massive system in some aspects such as the massive wall system settled upon a stone foundation that is usually below the floor level and composed of round stones, adobe dimensions, covering the walls with mud, building a flat roof (for example; Van, Adiyaman, Mus, etc.). They also have some similarities with the adobe filling between wooden skeleton system, such as walls made of adobe filling between skeleton and hipped roof application that has sometimes been used (Konya, Malatya, etc.). The similarity to both systems has made this system a mixed type.

The examples of one-storey mixed system adobe houses in rural are bee-hive (stone, brick and adobe) houses of the Harran Plain and domed houses with curvilinear surface in the Suruc Plain (Figure 23). In the other districts of Anatolia where soil is used, these building forms have not been used.

5 CONCLUSION AND REVIEW

As a result, the adobe material has been a traditional building element that has always been chosen and preferred (because of the easiness of its production).

As a result, the adobe material that has sometimes served as the plaster on a block or as an adobe block with stone, and has always been chosen and preferred in massive construction system due to the easiness of its production, has been a traditional building element in the formation of our vernacular architecture since the primary ages of settlement in Anatolia. In this study, a structural classification has been made by searching the place of adobe architecture in Turkey and examining original examples. The structural differences caused by vernacular factors between the traditional adobe houses that are grouped as (1) In massive construction system, (2) In adobe filling between wooden skeleton system, (3) In mixed system, have been put forward.

Adobe buildings were accepted as cultural heritage with a judgement of ICOMOS after the 3rd International Adobe Conservation Symposium that took place in Turkey in 1980. As a result of migration from rural to city centres, most of the unique adobe houses are not being lived in today or are facing many physical and structural problems by going through destruction as a result of losing their originality. The factors that cause the destruction of this system that requires maintenance at routine intervals can generally be classified in three groups, as heat, water and a variety of biological reasons. The most important defect of adobe is that it is not resistant to heat and humidity; so the structural problems depend on the relation between water and clay. The massive adobe buildings built in rural are more influenced by water and humidity than the buildings in adobe filling between wooden skeleton system located in city centres as a result of their structural properties. Another important problem for adobe buildings is the earthquake. More than the half of the damage caused by earthquakes throughout world is linked to adobe buildings and there has not been
any improvement in the structural systems of adobe buildings. This is another dimension of the structural problems of this system. For the renovation of the soil roofs in the flat-roof houses in Anatolia, a new layer of soil is added in place of the soil lost every year. The new soil layer causes the roof to become heavier and the statical balance of the physically worn-out walls in wooden construction system to be lost.

This causes a negative influence against earthquake in the buildings. The culture of vernacular adobe buildings, the formation of which is the result of a long-lasting tradition especially in Anatolia, is beginning to get lost because of many factors (Figures 24–26). Furthermore, the differences between the systems of adobe building culture and wood and stone have not been fully examined during the research of vernacular architecture. For the adaptation of the adobe houses that have an important place in Turkey to contemporary conditions; they should be consolidated in the aspect of material and structural system and also be remodeled according to the vernacular conditions of the district they are located in. The continuity of the adobe that has witnessed the past in Anatolia shall have been provided when these conditions have been fulfilled.

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