The Different Uses Of Sustainable Soil Materials: The Examples Of The Rüstem Pasha Caravanserai And The Hazrat Mevlana Tomb Restoration

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ABSTRACT

The physical cultural heritage from the past to the present continues to shed light on the next generations with its various aspects. In this respect, the Turkic Republics continue to exist examples in this geography which are coming from various nations and religions, with the most architectural diversity and cultural heritage in the world. These outstanding structures have been restored many times.

Restoration is a difficult process. Restoration applications require expertise. Moreover the using materials have to similar with the original ones. Two of these materials were used in both restorations that are the subject of our research. These are handmade bricks and tiles. Bricks were used to complete the vaults on the roof of the Rüstem Pasha Caravanserai. Tiles, on the other hand, were used on the outer surface of the Tomb of Hazrat-i Mevlana. These materials were used by making them with traditional techniques, just like in adobe bricks. The bricks were shaped in wooden molds from mud and dried in the sun. The tiles, on the other hand, were hand-pressed in wooden molds with a technique called "pat pat" and dried in ovens. Both materials were applied to the structure with the help of Khorasan mortar. Felt was also thrown into the Khorasan mortar to strengthen the binding. Khorasan mortar is a traditional material as it is known. Therefore, the originality of the buildings was preserved and their sustainability was ensured. In addition, the original design of these materials has been preserved in the applications. As the research is an action research, the researcher was also involved in the entire process from the construction of the materials to the application. The aim of the research is to show the analogous construction techniques and usage patterns of traditional materials with examples.

It is thought that the research will shed light on the applications that future generations plan to do in the future.

Key Words: Restoration, Handmade, Sustainability, Traditional Materials, Traditional Techniques

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1. INTRODUCTION

I will examine three materials that are the subject of my research. These; It is brick and tile that is similar to adobe. These materials are generally used in restoration today. These materials have been used for years for reasons of being healthy, cheap and easy to obtain from nature. However, today, with the proliferation of modern techniques, their use has decreased. They are still used in rural areas and in the renovation of historical buildings. The construction techniques of these three materials are similar to each other. They have content and binding differences in them. Wooden formwork is used in all three of them. The materials coming out of the wooden molds are cut and the desired dimensions are created. Then they are subjected to heat to ensure their strength.

These materials of various sizes are applied to the places where they will be used, again with different techniques. In addition, another feature of these materials is that they are sustainable. The crumbs of these materials can be used as binders in similar products that will be produced new.

The researcher took part in the action in all of these processes. I worked in these two Project as the Site Supervisor.

In this research, the comparison will be held on dealing with these materials. The comparison will include also the production - manufacturing and the application period.

The purpose of the research; It is to draw attention to these productions and applications and to shed light on the works to be done in the future.

2. PROUCTION AND APLICATION PROCESSES

The restoration of Rüstem Pasha Caravanserai and The Hazrat Mevlana Tomb are all in Konya. The restoration of the Rüstem Pasha Carvanserai, we use bricks. The restoration of the Hazrat Mevlana Tomb, we use tiles. I try to explain the production and aplication processes relating to the building materials which are sustainabil. These two materials, whose construction and application techniques are similar to adobe, have recently been restored. It is thought that the production and applications will reveal the similarities.

2. 1. MANUFACTURING AND APLICATION OF BRICKS, EXAMPLE OF THE RESTORATION OF THE RÜSTEM PASHA CARAVANSERAI

2.1.1. MANUFACTURING OF BRICKS

Yellow earth, a little bit straw and water is produced by mixing until it reaches a consistency. It is then put into moulds. This is the formula for the threshing brick. For the adobe, the formula is same except the quantity of straw. The straw in adobe is more than the threshing bricks.

The operations are performed as follows:

Stage 1: The dough is prepared and shaped in wooden molds (Figure 1).

Stage 2: The shaped parts (Figure 2 & 3) are left to dry for 2 days under a sun-permeable roof (Figure 4 & 5). The reason for this is to protect it from rain. The adobe can dry in 5 days.

Stage 3: For final drying for all pieces are making to change the position of the pieces. They are moved from the horizontal position to the vertical position for 5 days (Figure 6). The reason of this is to provide ventilation. In fact, another reason is to ensure that no surface remains damp.

Stage 4: Bricks freed from moisture are fired by burning in a mobile kiln which is not fabricated (Figure 7). The kiln is hand made structure. It is placed one row bricks and one row coal (Figure 8). Then, it is burned for 10 days. After 10 days, they allowed to cool in 5 days.

Stage 5: Adobe bricks are not burned in the kiln. They just stay under the sun for 5 or 10 days. This period is changing according to their dimensions.

Stage 6: After all these stages they are ready to use.

As a result; The Threshing Bricks take approximately 20-25 days, while Adobe Bricks are ready for use in 10-15 days.

The wooden mold used as a pulley. It is made by hornbeam, which will not bend, long lasting, not wear and tear. Then, these are fixed to each other with nails only.

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Sand powder is used to prevent the bricks which are made by clayey soil, paste from sticking to the mold. Only water is used to prevent the bricks which are made by yellow soil, paste from sticking to the mold.

The bricks which are made by yellow soil, are burned in the mobile kiln with the temperature 1100 °C. The bricks which are made by clayey soil, are burned in the mobile kiln with the temperature 860 °C.

Some manufacturers sprinkle salt on the bricks during burning in the mobile kiln. They are doing this action for speed coloring. However, this causes some damages fort he bricks. Because if this done, the inside of the bricks will not be burned or the fire will not penetrate inside. So the fire will effect only the out side. In other words, the surface will be the well done, but inside will not. Also w emay call this as fiddle.

Figure 1, The dough (Resource: Personal Archive)

Figure 2, The shaping (Resource: Personal Archive)

Figure 3, The sizing (Resource: Personal Archive)

Figure 4, Transperent roof (Resource: Personal Archive)

Figure 5, Under the sun (Resource: Personal Archive)

Figure 6, Ventilation (Resource: Personal Archive)

Figure 7, The kiln (Resource: Personal Archive)

Figure 8, The bricks and the coal rows (Resource: Personal Archive)

2.1.2. APPLICATION OF BRICKS

After manufacturing of the bricks, they are applied to the roof of the caravanserai (vault) with the traditional material which is khorasan mortar (Figure 9). The bricks application is done on the wooden mold surface (Figure 10). At the end, the joints are filled with also khorasan mortar including brick small pieces like dust and it is finished finally (Figure 11 &12).

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Figure 9, The roof **Figure 10**, The mold surface (Resource: Personal Archive) **Figure 11 & 12**, Final view (Resource: Personal Archive)

2.2. MANUFACTURING AND APLICATION OF TILES, EXAMPLE OF HAZRAT MEVLANA TOMB RESTORATION

2.2.1 MANUFACTURING OF TILES

Quartz sand (quartz mines + ground from stream beds + sand + kik + glass filite + water) is produced by mixing until it reaches a consistency. It is then put into moulds.

The operations are performed as follows:

Stage 1: The dough is prepared and shaped in wooden molds (Figure 13).

Stage 2: The shaped parts (Figure 15) are free of wind and sun for 15 days. left to dry.

Stage 3: Final sizing (Figure 16) of the top and bottom sides of the pieces that dry on their own is done.

Stage 4: If there is only one firing, it is directly glazed and fired. If there will be double firing and under glaze decoration will be made, the parts that have been leveled and dimensioned are primed with a specially prepared primer. After priming, it is left to dry for 15 days again.

Stage 5: After the primed parts are completely dry, the 1st firing is done in the kiln(Figure 17).

Stage 6: Decor is made with underglaze paints consisting of metal oxides on the primed parts in the 1st firing. After the decoration process, the entire surface is covered with a kind of glass composition, which we call the glazing process, and neither is the final firing. Finally, the tile is produced.

As a result; Single fired tiles take approximately 30 days, while double-fired tiles are ready for use in 45 days (Figure 19).

In high quartz tiles, slow firing should be done due to the expansion behavior of the quartz mineral. It can vary between 18 hours or 50 hours. The kiln takes 1 day to heat up and 4 days to cool down (Figure 18).

The reason why the use of high quartz tiles is preferred is that they have low water intake rates, withstand high pressure, do not form glaze cracks and do not undergo deformation.

Features of high quartz tiles:

1. Colors have vitality and three-dimensional perception.
2. It becomes pure whiteness.
3. It gives a feeling of depth by penetrating into the glaze.

The wooden mold used as a pulley; the lower part is plywood, the upper part is pine, which will not bend, and these are fixed to each other with nails or screws.

Cotton fabric (Figure 14) is used to prevent the tile paste from sticking to the mold.

The temperature of the kiln is 920 °C.

The kiln which has the dimensions 110cm x 110cm, get 320 tiles inside. The kiln which has the dimensions 90cm x 90cm, get 175 tiles inside.

The distance between the shelves in the oven is 6 cm.

Four manufacturers have been evaluated for Mevlana tiles. Comparisons of these according to the results of the tests performed by the independent laboratory are given in below (Table 1).

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CANDIDATES	WATER ABSORPTION	BREAKING LOAD (N)	BENDING STRENGTH (N/mm²)	BREAKING STRENGTH (N)	HEAT SHOCK RESISTANCE	FROST RESISTANCE	CHEMICAL MATTERIAL RESISTANCE	SMALL COLOR DIFFERENCE	SIO2 MUST >80,00
A	20,44	1257,6	13,26	2286,3 N	UNDAMAGED	25 TURN 10 DAMAGED **0 UNDAMAGED**	AVERAGE *(Not Bad - Not Good) (Acceptable)*	THERE **ARE COLOR DIFFERENCES**	77,51 < **80,00** DID NOT
B	20,63	3148,1	16,38	5338,9	UNDAMAGED	24 TURN 10 DAMAGED **0 UNDAMAGED**	AVERAGE *(Not Bad - Not Good) (Acceptable)*	THERE **ARE NOT COLOR DIFFERENCES**	88,32 > **80,00** DID
C	17,42	4111,6	28,42	7527,6	UNDAMAGED	100 TURN 5 DAMAGED **5 UNDAMAGED**	AVERAGE *(Not Bad - Not Good) (Acceptable)*	THERE **ARE NOT COLOR DIFFERENCES**	90,45 > **80,00** DID
D	20,41	1877,4	12,83	3454,1	UNDAMAGED	100 TURN 6 DAMAGED **4 UNDAMAGED**	AVERAGE *(Not Bad - Not Good) (Acceptable)*	THERE **ARE COLOR DIFFERENCES**	77,34 < **80,00** DID NOT

ASSESSMENT OF THE CANDIDATES ACCORDING TO THE DATA	
A	FROM 9 DATA: 2 OF THEM SUCCESSFUL, 7 OF THEM FAILED.
B	FROM 9 DATA: 7 OF THEM SUCCESSFUL, 2 OF THEM FAILED.
C	FROM 9 DATA: 9 OF THEM SUCCESSFUL, 0 OF THEM FAILED.
D	FROM 9 DATA: 3 OF THEM SUCCESSFUL, 6 OF THEM FAILED.
ACCORDING TO THESE RESULTS; C IS THE 1ST & B IS THE 2ND CANDIDATE.	

Table 1, The Comparison of The Tile Results, (Resource: Personal Archive)

The **Table 1**, shows the results and also the differences of the tiles of the four manufacturers. According to the results lead us to chose the right manufacturer. We get tiles from the manufacturers to chose. The criterias are decieded according to resist for all weather conditions. Because the tiles wil be installed to the outsides the tomb. And so did they.

Figure 13, The wooden mold (Resource: Personal Archive)

Figure 14, The cotton fabric (Resource: Personal Archive)

Figure 15, The shaped parts (Resource: Personal Archive)

Figure 16, The shaping period (Resource: Personal Archive)

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Figure 17, The tiles are in to the kiln (Resource: Personal Archive)

Figure 18, The tiles are cooling (Resource: Personal Archive)

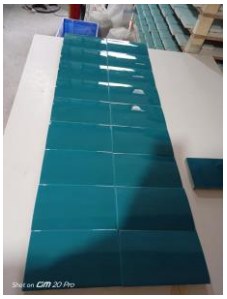

Figure 19, The tiles are ready to use (Resource: Personal Archive)

2.2.2. APPLICATION OF TILES

After manufacturing of the tiles, they are applied to the tomb with the traditional material which is khorasan mortar (Figure 20). The tiles application is done on the bricks (Figure 21). At the end, the joints are filled and it is finished finally (Figure 22).

Figure 20, The tiles are applied with khorasan mortar (Resource: Personal Archive)

Figure 21, The tiles are applied on the bricks (Resource: Personal Archive)

Figure 22, The tiles application is finished (Resource: Personal Archive)

3. CONCLUSION

The deterioration of the environment and the depletion of natural resources have increased the importance of such traditional materials, especially today, which leads to new searches in the field of architecture. Because such natural materials contribute to the sustainable environment. It is thought that researches continue to give importance to the construction of traditional architectural products and contemporary buildings by giving less damage to nature.

In the formation and decoration of our local architecture (Figure 23 & 24) since the first settlement ages in Anatolia; adobe, brick and tile materials are included in the masonry building system. They have always been a traditional building material chosen and preferred because they can be produced easily. In this study, the similar aspects of the construction and application techniques of adobe and the other two materials were tried to be evaluated. Similarities and differences in application techniques are discussed. The effects of the differences in their content on the production and application techniques were evaluated. In particular, the materials used in the techniques during the construction are also discussed. A review was also made in terms of manufacturing processes.

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Figure 23, The Rüstem Pasha Caravanserai (Resource: Personal Archive)

Figure 16, The Hazrat Mevlana Tomb (Resource: Personal Archive)

When the materials used are compared with each other, it has been observed that all of them can be found easily from nature. The differences between them are mainly the binders used in them. The wood used in the construction of these materials is also the most used material in architecture. It is still used extensively in the construction of contemporary buildings. Similarities are also observed in terms of the final shape. All of them are heat treated before use. Heat treatment times are also similar to each other.

It is hopeful that they are still used today, especially in restoration works. In this way, it makes a significant contribution to ensuring the continuity of materials and craftsmen. Thanks to this contribution, it can be thought that it paves the way for research and development.

As a result, these three materials have similar traditional manufacturing and construction techniques (Table 2). Also the dust or broken parts of these materials can be used into the dough to get strengtbility and into the khorasan mortar while filling the joints. So, they all have sustainability in the buildings as a material. And also while restoration, these materials are easy to repair then the modern materials. Moreover they are friendly with the nature and the enviroment then the modern materials.

MATERIALS	DOUGH WITH EARTH (SOIL)	DOUGH INGREDIANTS (FOR STRENGTHENING)	DOUGH THICKENER	MOLD MATERIAL	DRYING PERIOD	BURNING	BURNING DEGREE	COOLING
ADOBE	YES	YES / A LOT OF STRAW	YES / WATER	WOODEN	UNDER SUN	NO	NO	NO
BRICKS	YES	YES / A LITTLE STRAW	YES / WATER	WOODEN	UNDER SUN	YES / IN THE MOBILE KILN	1100 °C / 860 °C	YES
TILES	YES	YES / QUARTZ	YES / WATER	WOODEN	IN THE SHADE	YES / IN THE FABRICATED KILN	920 °C	YES
ASSESSMENT OF THE CANDIDATES ACCORDING TO THE DATA								
ADOBE	FROM 8 DATA: 4 OF THEM SIMILAR WITH ONE OF THE OTHERS.							
BRICKS	FROM 8 DATA: 8 OF THEM SIMILAR WITH ONE OF THE OTHERS.							
TILES	FROM 8 DATA: 6 OF THEM SIMILAR WITH ONE OF THE OTHERS.							
ACCORDING TO THESE RESULTS; THEY HAVE SIMILARITIES WITH EACH OTHERS.								

Table 2, The Comparison of The Materials, (Resource: Personal Archive)

We all must keep going to develop the manufacturing techniques of these materials and the quantities of the buildings which are built with these materials. In this way, we will be able to reach the sustaniable environment and friendly with the nature.

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REFERENCES

1. Keskin, Alihan (2021). Restorasyon Uygulamalrında Sahadaki Tasarımcının Katkıları Rüstem Paşa Kervansarayı Restorasyonu Örneği. (Mithat Kandemir, Tekin Bayrak, Özgül Yiğit). Elsander Sosyal Bilimler Araştırmaları I. Konya: Palet Yayınları / Şelale Ofset, 109 – 126.
2. Keskin, Alihan (2021). Hazreti Mevlana Türbesi İçi Ahşap Koruma Ve Çalışma İskelesi. (Editors: Mithat Kandemir, Tekin Bayrak, Özgül Yiğit). Elsander Sosyal Bilimler Araştırmaları I. Konya: Palet Yayınları / Şelale Ofset, Pages: 93 – 108.

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