

## Construction Materials In Historical And Monumental Buildings - Gjirokastrer

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### ABSTRACT

In 2005, Gjirokastra was declared a UNESCO protected site<sup>1</sup>. These give priority to the protection to the town from a general urban point of view. But, upon closer inspection, one can see that the architecture of this city holds other values, as well.

One of these values is the use of materials, which reflects the mature, rational and careful decisions made by the master-builders of Gjirokastra.

The city has inherited a considerable number of buildings. A part of them requires immediate conservation, restoration and revitalization. Knowledge of the construction techniques and the materials used in the original construction will make these interventions more accurate and sustainable.

Our work over the past 3 years has consisted in collecting data, documentation and evaluation of several first and second category monuments in Gjirokastra. During these experiences, we encountered various architectural, technical and historical aspects which could be problematic for restoration. The solution to these always required deep knowledge of original building materials and construction techniques. All of this data and experience serve as the basis for our presentation.

Gjirokastra is known as the "City of Stone," but despite one's first impressions, the buildings also make skilful use of wood and iron. Particularly in the case of wood, it is extremely important to understand the types of wood used and the reason why they are used. A mismatched reconstruction could jeopardize not only the character of a historic house but its structural integrity, as well.

In this way, we can understand not only how to restore, but also how to conserve and how to maintain these monuments, based on sustainable and scientific data. In the end, this leads to a better appreciation of these monuments and will allow future generations to enjoy them.

**Keywords:** *Cultural heritage, Architecture, Restoration, Preservation, Building materials.*

### INTRODUCTION

Gjirokastra is one of the most important cultural cities in Albania. In the year 1961, Gjirokastra was designated a Museum City<sup>2</sup> for the reason of its cultural heritage wealth.

Monuments of Gjirokastra are designated by two categories: 1<sup>st</sup> category, 56 monuments and 2<sup>nd</sup> category, 540 monuments, while the entire city contains around 1200 stone buildings.

In 2005, the historic core of Gjirokastra became a World Heritage Site, under the patronage of UNESCO. However, the first studies about the houses of Gjirokastra, their

typology and building characteristics, were done several years after the city was proclaimed a Museum City. In 1971, Prof. Emin Riza wrote an article for the publication “Monumentet”

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1.Criterion (iii), Criterion (iv), [www.unesco.org](http://www.unesco.org)  
2.[Decision of the Council of Ministers Nr. 172, Dt. 02.06.1961]

Nr. 1/ 1971. In 1981, the same author published the monography entitled “Qyteti - muze i Gjirokastrës” (“The Museum City of Gjirokastra”, republished 2004). Following the first published articles in 1971, a number of articles were sporadically published, which discussed the problems of the building materials used.

One of those articles was by Thanas Kamberi, entitled “Disa të dhëna mbi teknikën e ndërtimit të banesës gjirokastrite” (“Several Details about the Building Techniques of the Gjirokastran Residences”) and published in “Monumentet” Nr. 2/ 1971.

In 2006, as a part of the project that dealt with the recuperation of the historical center of Gjirokastra, Pierluigi Ferracuti – Francesca Ospitali published an article with the title “Studies of Materials Used in Historical Buildings of Gjirokastra”. According to this author, “The work realized so far, represents only the first step in a research process”.

So, until today there has been no study developed in the course of detailed research about building materials used, their characteristics, the relations among materials used, their preparation and the models of their usage.

## **MATERIALS**

In the historical buildings of Gjirokastra different building materials were used. One portion of the materials used was of local origin, while another portion of them was imported. The process of importing materials also sheds light on historical trading relations that Albania had with other countries at the time, as well as on the economic level and culture of the owners of the buildings.

From the materials used, we can make the following selection:

### **Natural materials:**

- Stone
- Wood
- Earth (clay, or clay-based earth)

### **Produced materials:**

- Steel
- Lime
- Glass
- Gypsum

### **Mixed materials:**

- Binding mortar
- Plaster

### **Secondary materials:**

- Natural oils (olive oil, nut oil, linseed oil and others), wax
- Goat hair, straw, egg white
- Ground brick
- Various pigments for paints

From the above listed materials, naturally the ones mostly used are stone and wood. And it is exactly those two materials which we will describe in more detail.

## **STONE**

The material most predominantly used is stone. Stone is used in the foundations of the buildings, in the walls, all the way to the roofs being covered with stone. Due to the wide usage of this material, Gjirokastra is also known as the “City of Stone.” From detailed observation, it is clear that the stone is local.

This material can be identified through three of its main physical – chemical qualities:

- White limestone
- White limestone, semi crystalized
- Black stone – silicat

The white limestone that is used for buildings was taken either from the work site or from locations close to the city. In both cases, the white limestone is of a very good quality, judging by aspects of its mechanical and physical resistance.

The old quarries were found in locations around Gjirokastra, in Lazarat, Dervician, Goranxi and Grapsh. These rocky formations were of differing thickness (fig.1), and the old masters were taking the material for it to be used in different parts of the building. Many years ago, the masters used to extract the stone from the sides of the stream, because there they could penetrate through the thinner surface layers without having to dig through surface layers that were not usable.

The layers that were appropriate to use are certain layers of limestone that are found in the area from Viroi to Zervat, where the position of those layers alternated between being close to the surface or near the mountain core. This horizon of stones, as it's called, is usually made of three layers. The first layer is made of 13 different sub-layers of varying thickness (from 1-16cm).

Between the first and a second layer, there is a crystalized layer of lime, which varies in thickness from 0.35-0.40m and is not used for buildings (usually it is used for millstones).

The second layer is made up of 11 sublayers, which are a maximum of 10cm thick. Between second and third layer, we usually find a layer of lime, 0.6m of thickness, which is not used as it is way too fragile.

The third layer is made of 16 different sublayers, where the thickest is 12cm. Below this layer, there are 4 binding layers, which are again not used in construction.

The white limestone can be found in three different colors:

- *Gushpellumbi(peagon neck)* (the color is released by the oxyde of copper that can be found in this layer)
- White matte (the color is released by magnesium oxide)
- Red (the color is released by the oxyde of iron,  $Fe_2O_3$ )

At every site, you can find all three of the colors.



Fig.1 Layers of stone in quarries



Fig. 2 black and white stone



Fig.3 Decorative limestone

White limestone is exclusively used for the stone slates of the roof. The thinnest layers of white limestone slates are used for the roof, and their thickness is from 1.5-3cm, and those are usually found in the first layer of the panel, and usually only in two of its sublayers. To pick the stone is usually a lengthy process because those layers are very rare to be found, while their selection is very strict and rigorous. The stone slates for the roof are of different dimensions and thickness, because the thickness affects the weight of the roof, which under normal conditions (thickness of slates being 1.5cm and with varying dimensions according to traditional measures) would come to 280 kg / m<sup>2</sup>.

In addition, the process of covering the roof had to follow certain rules, where the part closer to the ridge would be covered by slates of smaller dimensions, while the dimension is getting larger as the slates are laid lower down the roof. The reason for this is that the slates smaller in dimension are simply resting on each other using gravity due to their sheer weight and are not pushing the bigger slates onto the eaves, which secures their continuous position.

The pieces of slate that vary in thickness from 7-16cm are used for walls. Generally at the corners of the walls we find stones of larger dimensions. The reason for this is that they form structurally stable corners.

The stone that is used for decorative architectural elements is a grainy white limestone (semi-crystallized). The layers of this stone are usually found in the top of mountains.

Layers of this type of stone are massive and vary from 0.4-2m of thickness. In Gjirokastra, these are selected from the stone that is found in brook of Çullos (local brook).

The black stone is used in stone walls as well as in floors or pavement. The black stone has a natural layering, which is formed in large blocks of varying thickness 0.8-1.2m. In order to extract this stone, small openings in the in-between layers are used and small pikes are inserted in order to divide it from the mass of the mountain. The black stone is either used from the area of the building or from the surrounding area of the city, like Poliçan. In contrast to the white stone, this stone is formed chemically. It is a mixture with hydroxides, mangan, quartz and phosphates, the latter of which determines its color.

### **WOOD:**

This material is also important and very often used in the buildings of Gjirokastra, excluding the Bazaar area, where this material is generally avoided due to the risk of fire. It is used in a similar manner in all residential monuments, both 1<sup>st</sup> and 2<sup>nd</sup> category. The castle of Gjirokastra is not taken into consideration in this paper because it has a specific character and construction.

The types of wood that are used (listed according to the usage) are:

1. Pine - (*Pinus pinea*)
2. Spruce (*Abies*) ; White spruce (*Abies alba*) ; Red spruce (*Picea excelsa*)
3. Oak (*Quercus pubescens Willd*)
4. Beech - (*Fagus sylvatica*)
5. Plane – (*Platanus orientalis*)
6. Chestnut – (*Castanea sativa Mill*)
7. Wholenut - (*Juglans regia*)
8. Maple – (*Acer*)

**The preparation:** The way the timber is cut – the period when it is cut, the manner of drying and the storage are part of a well-thought and rigorous process.

The period of cutting timber, is linked with seasons of cold weather, when the tree is in its stagnant phase. The trees in this area are usually cut from mid-December until the end of February. This is for the reason that the transportation of liquids in the trunk are at a minimal level, and the tree is not exposed to insects.

The timber for construction was historically available from the local forests or by import. According to Emin Riza<sup>1</sup>, who once talked to the old masters, the timber for Gjirokastra was usually taken from a couple of villages near Ioannina, since the forests around Gjirokastra were rather poor.

Today, however, we find several zones, where the trees are 100-250 years old. This includes forests in Zagoria, Delvina (Bushec – chestnut, Dhrovjan – oak), Sotira (Spruce, Chestnut) and other.

**Drying and storage:** Drying was natural. When the tree is cut, the trunks are bonded vertically in a way that a majority of liquids can flow out. Later, trunks would be placed with a space in between them, so as to secure air ventilation. The natural storage would last no longer than a year; for stronger types of wood that were used in carpentry, it would take 2 years; oak would usually be stored for 4 years.

**Use:** Different types of wood are used for different elements. According to all data up to the present, pine is the main wood type for the roof structure. It was used to make the rafters, beams and other roof elements<sup>2</sup>.

The material used in the roof has a small section which varies 8cm to 12-15cm. this material was skilfully used by the old masters, and this is why it is so resistant to time. The floor beams also had dimensions of 10cm - 12 cm, and they are generally pine, while the

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1. Prof, Emin Riza, Qyteti - Muze i Gjirokastrës (monografi). *Shtëpia Botuese "8 Nëntori", Tiranë, 1981.*

2. Elemente Projektimi, Lageshtia; Dritaret, grup autoresh, botuar ne ISP Nr.1, page 86

The floor beams also had dimensions of 10cm - 12 cm, and they are generally pine, while the boards were made of fir (red or white color).

For the eaves elements (testek), beech, oak or chestnut is used, which are resistant to atmospheric agents (also used for the sofa).



Fig. 4 Wood in roof construction

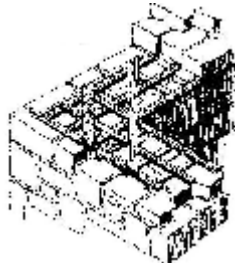


Fig.5 Timber ties



Fig.6 Wooden floor

The wood type for architectural elements, (doors, windows, stairs, ‘tataposh’) was selected depending on the position and exposure to atmospheric agents or functional activity. To illustrate:

- The windows are generally made of pine, but the shutters, which are closed in bad weather to protect the window, are made of chestnut or beech.
- The outside doors are generally made of beech, oak or chestnut. Very rarely, they are made of walnut (Babameto 1<sup>st</sup> category) to show the prestige of the family.
- The internal doors are made of pine, for the same above-mentioned reasons.
- The stair combines two types of wood, (Babameto 1<sup>st</sup> category) beech, oak or nut wood resistant to shocks and friction used for treads and pine, fir-tree wood, used for the closed riser, which are less exposed to mechanical activities.
- For the furniture elements such as shelves or decorative elements, maple wood or other fruits woods such as cherry, walnut and mulberry are used because these types of wood are easily engraved. (soft woods)

Wood is also combined with the stone. Oak, beech and chestnut woods have good constructive qualities and were used like timber ties inside the walls. For the “catma” (wooden wall), columns pine was used.

**Wood treatment and protection:** Wood is an extraordinary construction material, but it also has its own needs and specifics. If the wood is in contact with moisture, it decomposes like any organic material. Wood selection, as mentioned above, is a very important decision. For a period of time after the construction of the building, the kitchens were left without a ceiling and the chimney smoke spread to the roof. This created a layer (membrane) which protects the wood from insects. The wood used for the other elements was treated with wax or oil.

**Protection of timber ties:** Timber ties were not generally left under the influence of atmospheric agents and they had to be plastered. In walls with thickness more than 60 cm, a 10-12 cm stone was always placed to cover the wood on the outside face of the wall, protecting it from humidity (rain water). These timber ties were placed 120-130 cm above the ground level to avoid the capillary moisture/humidity from the ground

To protect the roof timbers at the contact points with the stone walls, 2 small wooden beams were added above the wall. Above these wooden beams, the roof timbers were placed. In this way, they avoided direct contact between the roof timbers and the wall, in order to protect them from the condensation and emergence of mushrooms in this part. In addition, the wood beams, as a part of the wall, have the same temperature with it, which prevents them from condensing. However, the beams/timbers condense because they meet the wall at only one point, and they are coming from a space with a different temperature.

### PLASTERS AND MORTARS

There are two types of stone masonry in Gjirokastra: dry masonry (without mortar between stones) and masonry where mortar is used. In the latter, two types of mortars are used: clay mortar and lime mortar. Clay was mainly found between stone layers in quarries. Lime mortar was produced by mixing sand with lime. Mortar was used only in the two external leaves of the wall - instead the space between the two external leaves is filled with a loose, low-strength material made of small pieces of stones.

We find two layers of plaster in the building walls of Gjirokastra. Generally, the walls of ground floor were not plaster, in order to keep the humidity of the terrain from coming up the walls. According to Thanas Kamberi<sup>1</sup>, the oldest and most widespread plaster was composed of clay. They mixed clay with straw and left it for two or three days to spread the moisture uniformly, and then it was applied to the walls. This type of plaster was used everywhere except in the guest room. A very good plaster was gained as a result of mixing this type of plaster with lime. After applying this type of plaster with 2cm of thickness, it was left to dry until the clay shrank and created cracks.

Another type of plaster used as a first layer was a mixture of sand and lime with a ratio of 2.5:1. To this type of plaster could be added ash and crushed bricks, which has been found in the plaster layers of the Babameto 1<sup>st</sup> category monument, according to Nihad Çengiç's report<sup>2</sup>. All these elements were sieved before mixing, in order to give them a more homogeneous mass.



Fig.7 Plaster with straw and clay



Fig. 8 Different layers of plaster



Fig.9 different layers of pigments

The second plaster layer, with 5mm thickness, was produced by mixing lime and goat hair. They used to hit the goat hair with a wooden stick in order for it to be uniformly spread. After this, it was added to the sieved lime and mixed until a viscous mass was created. During summer, to reduce lime shrinkage, fine sand was added. A technical feature of this type of plaster filled with animal fibers is that it serves as a strong and resistant felt animal fibers add flexibility to it. This kind of plaster was used as a second layer in stone walls, as well as for plastering wooden walls. Sometimes glair was added.

On the decorated parts of the walls, such as the fireplaces, a special type of plaster was used, produced by mixing the crushed white stone of Gjirokastra with lime.

Moslluket (the water cisterns) and parts of the building where hydroisolation was needed were plastered with horasan. Horasan was made of two layers with a total thickness of 3cm. The first layer was with lime and crushed brick, and above this, a stronger layer with glair and olive oil was applied.

## METALS

Metal materials were mainly provided by imports. The early use of iron was without doubt for nails and for fixing elements of doors and windows. Blacksmiths' nails were of different sizes. They were used to nail all the wooden elements of the building, like wooden floors and ceilings, elements of the roof and wooden walls, wooden ties in the walls, different window and doors elements, like ties in the walls, etc. Another element where the iron was used is window-grates, but these are not so old. The older ones were wooden.

1. Thanas Kamberi, Disa të dhëna mbi teknikën e ndërtimit të banesës gjirokastrite, Revista "Monumentet" Nr. 2/ 1971, *Pronë letrare e Institutit të Monumenteve të Kulturës pranë Ministrisë së Arsimit dhe Kulturës.*

2. Nihad Çingic, Analiza e shtresave të bojës dhe punimeve të drurit për banesën e familjes Babameto, Monument i Kategorisë së I-re, në Gjirokaster, Shiperi. *Projekti "Gjirokastra 2009-2011"*, porosities: organizata suedeze CHwB

Metal gutters, the ones we see now on buildings, seem to be a new element. We don't have information about what the old ones were like. Probably, they were made of lead, but we don't have any example remaining.

The 'I'-shaped iron profiles, used as construction elements in the bazaar facades, are new as well. They were probably added after the big fire in the bazaar, when the need for big openings in the shops was created.

Metal was also used for shutters for big shop windows in bazaar. There are only few of them remained on some ruined buildings.



Fig.10 Metal elements of door



Fig.11 Brick and metal floor



Fig.12 glass in windows

## BRICKS:

Brick is a later material used in Gjirokastra. The origin of this material has not yet been elucidated, but probably it was imported from Western Europe. There is not any published study in Albania about this material. Bricks were used for floor construction inside buildings and for balconies outside them.

They have holes for the sole reason of making them lighter. The whole construction of the floor was combined with iron profiles. Between two 'I'-shaped iron profiles were positioned two bricks at an angle (not horizontal). At connection point between them was a small piece of brick that had the role of the key. This unit was repeated until the creation of the whole floor.

## GLASS

We don't know exactly when this material was used in construction (mainly windows). According to Emin Riza<sup>1</sup>, the first windows were closed only with wooden shutters because glass was a very expensive material. Colored glass has only been used in some windows that don't open, situated above the normal windows in guest rooms. These were used in order to let light inside the room when the wooden shutters were closed during cold days of winter.

As a very rare and expensive material, glass was used in small formats for the sole reason of maintaining and replacing it easily and without huge costs. In photos from the 20s-30s, we can see glassed windows in the big openings of bazaar shops. Today not a single one of these windows has been saved.

## CLAY

It was mainly found either in quarries or in building sites between layers of rock. Clay mixed with lime was used as a leveling layer for stone floors. It was used also as filler in the floor at the base of the chimney or as one component in some kinds of mortars and plasters.

## **LIME**

Lime is the main bond material. It is provided after the burning and slaking process of limestone. Wood is used for the burning process inside the kiln. After the burning, the produced quicklime is added to the water. The slaking process generally lasts three years.

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1.Prof, Emin Riza, Qyteti - Muze i Gjirokastrës (monografi). *Shtëpia Botuese "8 Nëntori", Tiranë, 1981.*

Lime is stored inside big holes in the ground. Traditionally, each house in Gjirokastra used to store lime in big jars inside the ground. This lime was used for small repairs or for wall painting. It was used alone or in combination with other pigments. Lime was also used as one of the most important components of mortars and plasters.

## **CONCLUSION**

Restorers should have a good knowledge about traditional techniques and materials, contemporary restoration and conservation practices and restoration theories and philosophy. As this presentation shows, it is obvious that the use, the treatment and the selection of the materials are essential, and this knowledge directly affects the restoration practice.

As we mentioned above, there are no fundamental studies about materials. A scientific study must have a supportive background; the basis of this could be a solid interaction between restoration practice and laboratory tests and the preparation of the materials according to traditional practices.

The integrity of these structures requires the use of traditional materials.

The reactivation of the old quarries and the usage of high quality wood and lime directly effect restoration standards.

The involvement of a broad spectrum of specialists (construction engineers, geologists, chemists, biologists, etc.) in the field of restoration enriches the knowledge about a complex site like Gjirokastra.

The creation and publication of guidelines for restoration would be able to provide needed instructions about the proper use of materials and techniques.

## **REFERENCES**

- [1] Prof, Emin Riza, Qyteti - Muze i Gjirokastrës (monografi). *Shtëpia Botuese "8 Nëntori", Tiranë, 1981.*
- [2] Prof, Emin Riza, Banesa e fortifikuar gjirokastrite, Revista "Monumentet" Nr. 1/ 1971, *Pronë letrare e Institutit të Monumenteve të Kulturës pranë Ministrisë së Arsimit dhe Kulturës.*
- [3] Thanas Kamberi, Disa të dhëna mbi teknikën e ndërtimit të banesës gjirokastrite, Revista "Monumentet" Nr. 2/ 1971, *Pronë letrare e Institutit të Monumenteve të Kulturës pranë Ministrisë së Arsimit dhe Kulturës.*



- [4] Pierluigi Ferracuti – Francesca Ospitali, Studimi i Materialeve te Perdorura ne Banesat Historike te Gjirokastrës, Alla Scoperta della Citta’ di Pietra, Il Piano di Ricupero del Centro Storico di Gjirokastra, Quaderni di Piano Nr. 2 a cura di Fabrizio Torrezi, 2006
- [5] Nihad Çingic, Analiza e shtresave te bojes dhe punimeve te drurit per banesen e familjes Babameto, Monument i Kategorise se 1-re, ne Gjirokaster, Shiperi. *Projekti “Gjirokastra 2009-2011”*, porosities: organizata suedeze CHwB
- [6] Elemente Projektimi, Lageshtia; Dritaret, grup autoresh, botuar ne ISP Nr.1

Authors wish to thank Thanas Llahana (geolog), Sokrat Lili (wood ingeener), Lejla Hadzic ( Restaurator Architect ) and Jonathan Eaton ( antropolog ).