



## Traditional Earthen Architecture in Northwestern Greece

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## **SUMMARY**

The main aim of this paper is to present the design principles and analyse the constructional elements of the traditional adobe architecture in NW Greece. These buildings were mainly constructed by Macedonian master builders during the 18th and the 19th century, at a period when this area formed part of the Ottoman Empire. The objective of the overall analysis is to document the local traditional adobe construction systems in order to contribute to the restoration of this important architectural heritage.

The study is mainly based on a large-scale in-situ research, which included various field trips, and involved the detailed photographic recording of the remaining traditional buildings in 30 settlements. The research included the documentation of representative buildings in some of the settlements.

From all the above, the analysis of basic structural elements and different construction systems is derived. This analysis includes the presentation of three different traditional systems of building adobe walls (a. walls including wooden posts, b. walls with only horizontal wooden ties and c. light timber frame walls).

From the collected data, conclusions concerning the typology, the form, the construction techniques and the materials of the buildings are drawn. This leads to the formulation of a series of design principles, which characterised the architecture of the past and can be applied as guidelines for the restoration of existing buildings, as well as for the construction of new ones.

## **1. INTRODUCTION**

The traditional architecture of every area is based on the accumulated experience and practice of many centuries and can constitute a continuous source of knowledge. The use of local materials and the harmonisation with the local environment and climate are some of the factors, which contribute to the distinct architectural identity of every area.

The architectural heritage of NW Greece preserves a great number of adobe and timber-frame houses built in the 18<sup>th</sup> and 19<sup>th</sup> centuries by Macedonian master builders, which can constitute a valuable lesson on design and construction.

Apart from the town of Florina where a vernacular adobe structural system exists, in the various villages of Florina and Prespa Lakes area, a great number of adobe buildings can still be found. Furthermore, the Korestia settlements in Kastoria area constitute a very important and well preserved complex of villages, where the houses are characterised by uniform typological, morphological and constructional features.

## **2. TRADITIONAL ADOBE ARCHITECTURE IN NORTH WESTERN GREECE**

### **2.1. Methodology**

The study is mainly based on a large-scale in-situ research, which included various field trips, and involved the detailed photographic recording of the remaining traditional adobe buildings in 30 settlements (the town of Florina and 11 villages around it, 5 in the Prespa Lakes, 2 around the town of Kastoria and 11 settlements of the Korestia) (Fig. 1). The research included the documentation of representative buildings in some of the settlements. From the collected data, conclusions concerning the typology, the form, the construction techniques and the materials of the buildings are drawn.

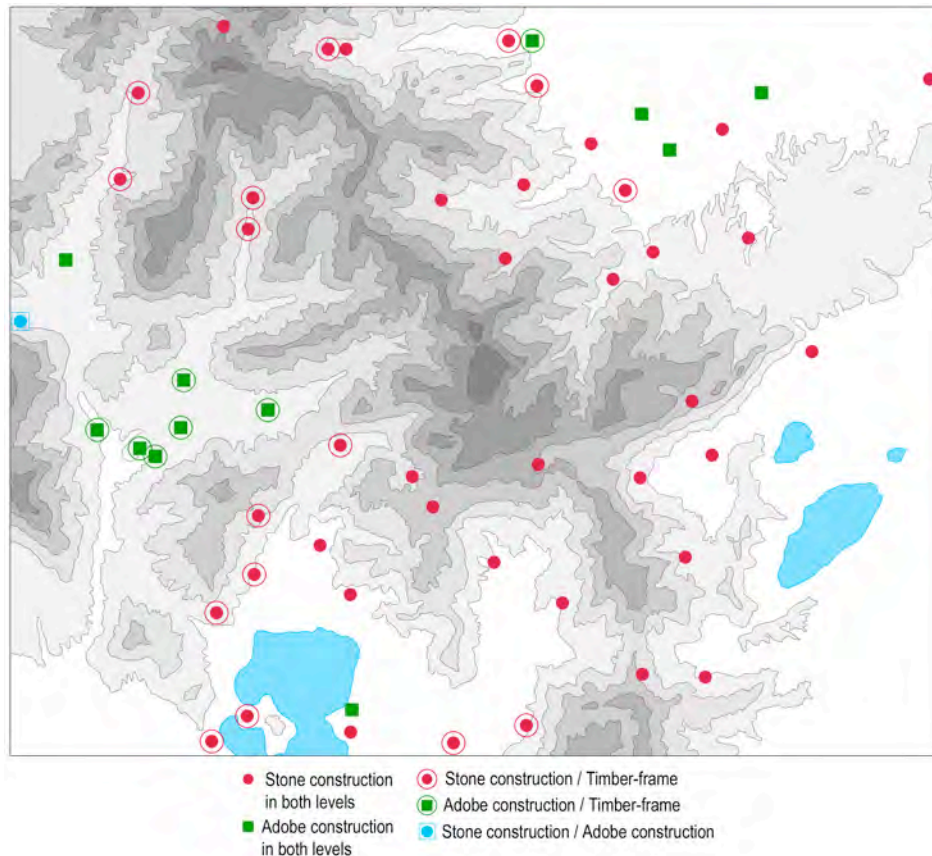


Fig. 1 - Map of the area representing the different building materials and construction systems.

## 2.2. Typological elements

The typology of the traditional houses of northern Greece is based on three basic elements: the private room (*oda*), the open space (*hayat*) and the closed, common space (*sofa*). (Eldem 1955; Kuban 1995) The private room (*oda*) is a closed living space with a square plan, which houses all the basic functions of the family life, such as eating, sleeping, and receiving guests. (Eldem 1955, pp.217-218; Kuban 1995, p.106) The *hayat* (or *loggia*) is a semi-open, transitional space, with a rectangular or square shape, which, sometimes extends between the rooms of the house in the form of an *eyvan* taking a T-shape. (Eldem 1955, p.219; Kuban 1995, p.137-138) Finally, the *sofa* is a closed, common space with rectangular shape used for circulation and/or social gatherings and events, similar to the hall of the Anglo-Saxon traditional house. (Eldem 1955, p.218) The three, afore-mentioned elements are combined in the plan and form three basic building types: the type with a *hayat* (outer *sofa*), the one with an inner *sofa* and the one with the central or cross-shaped *sofa*. (Eldem 1955, p.219; Kuban 1995; Gunay 1998, p.17)

In rural settlements of the Florina, Prespa Lakes and Korestia areas, the buildings have two storeys and the most predominant house type has two living spaces and a common, central, semi-open (inner *hayat*) or closed space (*sofa*) (Fig. 2). (Oikonomou & Bougiatioti 2009, p.505)

Other building types include the closed house with an inner *sofa* and four living spaces, and the rural, open *hayat* house, which has an outer semi-open space in front of two living spaces. In many cases, the *hayat* is partially or totally converted into closed space (Fig. 3). The type with the *hayat* was used mainly during the 19th century, whereas the types with the inner *sofa* were very common at the end of the 19th and during the first decades of the 20th century in the wider area. (Oikonomou & Bougiatioti 2009, p.505)



Fig. 2 - House with a sofa in Kranionas, Korestia.



Fig. 3 - House with an open hayat in Prasino, Korestia

After the Tanzimat reforms (1870), many European influences appear in the building plans, but mainly in the facades. These influences are introduced through Istanbul and also directly, because of the development of trade relations between the bourgeoisie of the various cities of the Balkans with other European countries. Thus, the type of hayat house was replaced by the type of symmetrical house with inner sofa, which is directly related to the typology of European residence with hall. (Oikonomou 2007, p.556-557)

The house types that are found in urban centres differ significantly from those in rural settlements, not only in their development through time, but also in their basic structure. The development of building types in the urban centres is parallel or later than this of the types in the villages, but it is not always linear and can be more intricate. We could talk about a synthetic design process, which is dictated by economic or spatial factors. The transition from simple to more complex types is achieved with the addition (multiplication) of spaces during the 18<sup>th</sup> and early 19<sup>th</sup> centuries (Kuban 1995, p.105). Nevertheless, during the second half of the 19<sup>th</sup> century, there are house plans, which derive from the reduction of the number of spaces - namely the subtraction of odas - from a closed, complete type, such as this of the house with the inner sofa (Fig. 4). (Oikonomou 2011, pp.772-773)

The master-builder proposes the application of the building type that is appropriate not only for the owners economic situation and needs, but also to the size of the plot, which, in urban centres, usually has a limited street front. These parameters lead to the adjustment of the basic model type with the subtraction of living spaces, and as a result variant types, which can be considered, for example, as the two thirds (2/3) of a complete and established type, occur. In other instances, the repetition of an element, such as the sofa, leads to larger, twin-type houses (Fig. 4). (Oikonomou 2007, p.231)

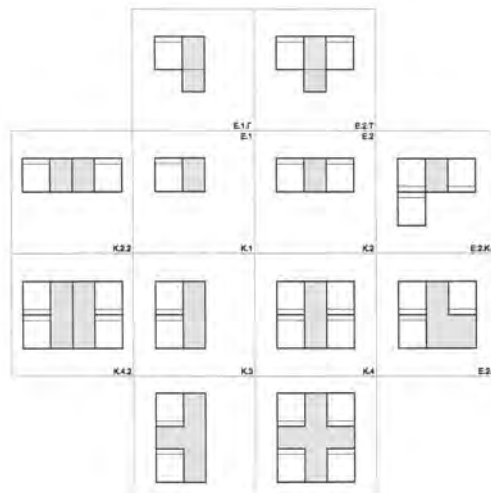


Fig. 4 - Typological considerations for the traditional houses of 19th century

### 2.3. Design and tracing

As proven by a relevant postdoctoral research (Oikonomou 2011), from older papers (Oikonomou & Dimitsantou-Kremezi 2009; Oikonomou et al. 2009) and by a Ph.D. thesis (Oikonomou 2007), the design and tracing was based on specific metric models and almost always was performed using right triangles.

The design and construction of traditional houses in the 19th century was based on the *mimar arsin*, or architects cubit of 75.8 cm. The *arsin* is divided into 24 *parmak*, or fingers; the finger is divided into 12 *hatt*, or lines; and the line is divided into 12 *nokta*, or points (Cerazi 1988, p.92). The *arsin* is also divided into two equal parts called *kadem* (Ozdural 1998, p.113).

From earlier studies (Oikonomou 2007; Oikonomou 2011), it was seen that the *oda* usually has a square plan with dimensions 5x5 or 6x6 *arsin*. The sofa has a rectangular plan with its small dimension (width) equal to 3, 4, or 5 *arsin*. When the hall results from symmetrical repetition, its width is equal to 7 or 8 *arsin* (2x3.5 or 2x4). The sizes of the *oda* and sofa are usually combined, resulting in many different possible variations.

For the tracing of the rectangular perimeter of the house and its basic walls, the Pythagorean theorem with the basic right-angle 3-4-5, 5-12-13 and 8-15-17 triangles is applied with the use of knotted ropes. Stoichkov has proven that master builders in Bulgaria used the 3-4-5 and 5-12-13 triangles during the nineteenth century (Stoichkov 1977, pp.126, 145). The same methods certainly apply in Northern Greece during this period.

As an example, the Bochkaris residence, which is a three-storied house (two storeys and a mezzanine), built around 1910 in Ano Kranionas, Korestia, is presented (Fig. 5). Its building type is that with an inner sofa and two *eyvans* resulting in a T-shaped sofa. The dimensions of all the *odas* are 5x5 cubits, while the sofa and the *eyvans* have a width of 4 cubits. In all the above dimensions, the thickness of the walls is included. The tracing of the outline is based on the triangle 10.5-14-17.5 (transformation of the triangle 3-4-5). (Oikonomou et. al 2009, p.554)

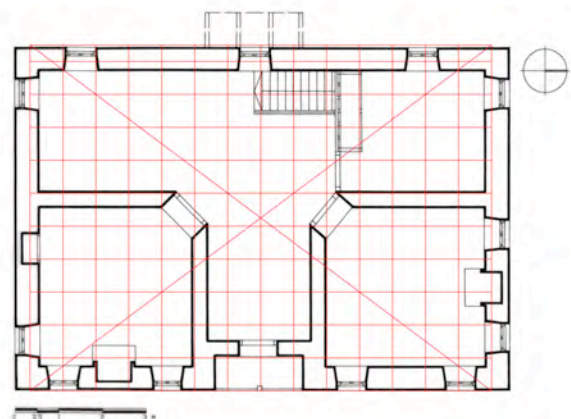


Fig. 5 - Bochkaris Residence in Ano Kranionas, Korestia. Upper storey plan.

### 2.4. Morphological elements

The basic morphological elements of traditional buildings are the projections (*sahnisi*) of the summer closed living spaces (*odas*) (Fig. 6) and the projections (*divanhane*) of the circulation space (*sofa*) (Fig. 7). These elements are found in both rural and urban buildings. (Oikonomou 2008, p.3)

Apart from that, the form of traditional house is defined by the shape and the number of windows on the main and secondary facades. (Oikonomou 2008, p.3) In most rural settlements, the house form is very simple and comprises two plain openings per elevation, in every living space. In some cases, specific morphological elements such a central projection of the inner sofa or a central, wooden balcony are seen, along with a central, small pediment. (Oikonomou & Bougiatioti 2009, p.506)

In the urban centres during the 18th century, the styles of the Tulip period and the Turkish Baroque are characterised by many small windows with shutters and separate upper course windows. (Gunay 1998, p.15) On the other hand, during the 19th century, the Empire Style dictates larger openings (proportion 1:2) with neoclassical decorative elements, without separate upper course windows. (Gunay 1998, p.15)



Fig. 6 - House with projections (*sahnisi*) in Kranionas, Korestia.



Fig. 7 - House with a projection of the central space and pediment in Antartiko, Prespes.

### 3. TRADITIONAL SYSTEMS OF ADOBE CONSTRUCTION

The analysis includes the presentation of three different traditional systems of building adobe walls. The first system is a local structural system that is used only in the town of Florina. The second one is characterised by the use of horizontal wooden ties and is used in the rural areas of Florina, Prespa Lakes and Kastoria, mainly in the ground floor walls. Finally, the third is the light-weight timber frame wall system, which is used in the walls of the upper storey, in all the Balkan areas.

#### 3.1. The vernacular adobe structural system in the town of Florina

It should be noted that in Florina where a vernacular structural system exists (Fig. 8), the ground floor walls of increased thickness include vertical structural elements (*direk*) at regular intervals (4, 5, 6 or 7 arsin) that follow the structural module and correspond to the interior partition walls. On the upper storey, the *direk* are placed in the corners and the middle of every space (at 2, 2.5, 3 or 3.5 arsin intervals) (Fig. 9). The main reason for the development of this system is the fact that the construction material (local river stone) is relatively weak and the subsoil is unstable because of the river bed.



Fig. 8 - Rear façade of a 19th c. traditional house in Florina.

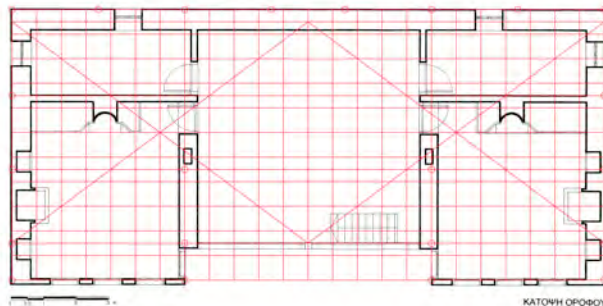


Fig. 9 - Upper storey plan of Rantzakis Mansion in Florina (19th c.)

### 3.2. The adobe construction in rural areas

In rural areas as the Prespa Lakes and the Korestia in Kastoria, the structural elements are usually thick walls made of adobe bricks. The walls are 57 to 75 cm thick (0.75 to 1 arsin), have an average height of 265 to 300 cm (3.5 to 4 arsin) and comprise horizontal structural wooden elements (ties) at intervals of 75 cm (1 arsin). (Oikonomou 2011, p.774) This construction is typical in most rural settlements. Depending on the time of construction, the wooden elements are visible, in the case of older buildings (19th century), or hidden, in the case of more recent ones (beginning of 20th century). (Oikonomou & Bougiatioti 2009, pp.506-507)

### 3.3. The light timber frame wall system

The light-weight walls of the upper storey (catma) have a small thickness (19 cm) and are formed by a complex timber frame, which is filled with adobe bricks and, in some cases, small stones or fired-clay bricks. (Fig. 10) The basic, vertical structural elements (direk) are positioned in the corners of the spaces and between the openings, at regular intervals of about 150 cm (2 arsin). In between, horizontal elements are placed at heights of 75 and 225 cm (1 and 3 arsin). This leads to the creation of large and small frames. In the former, openings with a width of 75 cm (1 arsin) are placed at regular intervals relative to the dimensions of the interior space. In the latter, smaller vertical elements are placed over and under the window. Finally, diagonal elements of triangulation are placed in all the frames in order to increase the rigidity of the structure. (Oikonomou 2011, pp.773-774) As Dogan Kuban stresses: it was like a box system where all the elements were integrated for the stability of the system (Kuban 1995, p.241)



*Fig. 10 - Timber frame construction of a house in Alona, Florina area.*

## **4. CONCLUSIONS - DESIGN GUIDELINES**

### **4.1. General conclusions**

From the above analysis general conclusions and design guidelines are derived. As far as the building typology is concerned, the conclusions point out issues of place and locality, but also issues of the peoples habits. The rural way of living during the 19<sup>th</sup> century led to the prevalence of building types with open hayats on the upper storey and storage rooms on the ground floor, which served for agricultural activities. At the end of the 19th and the beginning of the 20th century, the building types became more introvert, a fact which led to the construction of more compact buildings or to the modification of the existing ones. (Oikonomou & Bougiatioti 2009, p.508-509) The form of the oldest houses is characterised by a relative asymmetry (room-open space), whereas the latest examples have strictly symmetrical facades with tripartite organisation (room-hall-room).

In the different settlements, the materials vary depending mainly on their location (Fig. 1). In this way, rural buildings are constructed with adobe bricks in the plains and with local stone in the mountainous areas, whereas examples of mixed construction (stone or adobe walls in the ground floor and timbre frame walls filled with adobe bricks or covered by lath and plaster in the upper story) can also be found. (Oikonomou & Bougiatioti 2009, p.506)

The local materials and construction techniques (predominantly thick walls made of adobe) directly affect the form of the house. The windows in rural houses are less in number and smaller in size compared to the houses that are constructed during the same period in the urban centres of Florina and Kastoria, as well as in their nearby settlements. (Oikonomou & Bougiatioti 2009, p.509)

### **4.2. Design guidelines**

The typology of new adobe buildings may follow the four basic types: house with hayat, two-room house with open sofa, two-room house with closed sofa, four-room house with inner sofa and variants (twin houses). The openings in the plan could have a metric relation of  $a - a / 2$  to the wall between.



The form of new buildings may include projections of the central space or of the rooms. The openings could have specific ratios (1:2 - width to height) and their placement on the facades is characterised by a relationship of  $a - 2a - a$ , where  $a$  is equal to the windows width and the sill height, and  $2a$  to its height.

The restoration of existing and the design and construction of new adobe buildings in the region could follow the traditional module of 75 cm. The module in most cases is equal to the width of the openings. Before the construction of the house, certain basic architectural tracing, which assumes basic knowledge of geometry, should take place. The rectangular outline can be easily traced with the use of right triangles. For this to happen, the rectangle must have specific ratios (3:2, 4:3, 8:3, 10:4 or 13:6).

The wooden elements (horizontal ties, diagonals, timber frame) are essential to the static design of the structure and must be restored accurately. The same goes for the wooden roofs that follow the simple post and lintel construction system.

The group of the thirty settlements which was analysed in this paper, forms a significant cultural heritage. The present research constitutes an attempt to document, analyse and evaluate the many aspects of their traditional architecture. Further research should include a photographic documentation of all traditional buildings in the settlements, a more detailed survey-documentation of all existing building types and a complete construction detail analysis of all three systems.

### 4.3. Final conclusion

Today, most of the traditional adobe buildings in NW Greece have been abandoned and gradually fall down and disappear. What is left of the important architectural history of this area should be safeguarded and preserved, not only for the present, but also for the future generations. It reveals the wisdom of the master builders, who used this local, natural material to create buildings with unique constructional characteristics. The documentation, description and analysis of these constructional systems can be very valuable for the restoration of the remaining adobe buildings, as well as for the construction of new ones. In no way is it suggested to copy the traditional building types, forms and materials into the present. What is apparent, though, is the need to integrate the elements and principles, which were outlined in this paper, into the contemporary architectural practice.

### BIBLIOGRAPHY

Cerasi, M. (1988). Late-Ottoman Architects and Master Builders. *Muqarnas V: An Annual on Islamic Art and Architecture*. ed. O. Grabar. Leiden: E.J. Brill, pp. 87–102.

Eldem, S. H. (1955). *Türk Evi Plan Tipleri*. Istanbul: Istanbul Teknik Üniversitesi – Mimarlık Fakültesi, Pulhan Matbaası.

Gunay, R. (1998). *Tradition of the Turkish House and Safranbolu Houses*. Istanbul: Yapi-Endüstri Merkezi Yayınları.

Kuban, D. (1995). The Turkish Hayat House. Istanbul: T.C. Ziraat Bankası, MTR.

Oikonomou, A. (2007). *Comparative Investigation of the Architectural Structure and the Environmental Performance of 19th Century Traditional Houses in Florina*, Ph.D. thesis, Athens: National Technical University of Athens, School of Architecture.

Oikonomou, A. (2008). Bioclimatic elements and design principles of the traditional architecture in northern Greece, *Proc. PLEA 2008 - 25<sup>th</sup> Conference on Passive and Low Energy Architecture*. Dublin, Ireland.

Oikonomou, A. (2011). The Use of the Module, Metric Models and Triangular Tracing in the Traditional Architecture of Northern Greece. *Nexus Network Journal*, 13 (3), pp. 763–792.

- Oikonomou, A. & Bougiatioti F. (2009). Learning from the Past: Environmental aspects of the traditional settlements of Mt Verno, Greece, *Proc. PLEA2009 - 26th Conference on Passive and Low Energy Architecture*. Quebec City, Canada, pp. 504-509.
- Oikonomou, A. and Dimitsantou-Kremezi A. (2009). Investigation of the Application of the Module in the Traditional Architecture of Florina. *Appropriate Interventions for the Safeguarding of Monuments and Historical Buildings. New Design Tendencies. Proceedings of the 3<sup>rd</sup> National Congress*. M. Dousi and P. Nikiforidis, eds. Thessaloniki: Ianos Publications (in Greek), pp. 309-318.
- Oikonomou, A. et al. (2009). Application of the Module and Construction Principles in the Traditional Architecture of Northern Greece. *Proc. LIVENARCH IV (RE/DE) Constructions in Architecture. 4th International Congress Liveable Environments and Architecture*. ed. S.O. Gur. Trabzon: Karadeniz Technical University, Faculty of Architecture, Department of Architecture, vol. 2., pp. 543-562.
- Ozdural, A. (1998). Sinans Arsin: A Survey of Ottoman Architectural Metrology, *Muqarnas XV: An Annual on the Visual Culture of the Islamic World*. ed. G. Necipoglu. Leiden: E.J. Brill, pp. 101-115.
- Stoichkov, J. (1977). *Za Arhitekturata na Koprivchitza (The Architecture of Koprivchitza)*, Sofia: Tehnika.

## **BRIEF BIOGRAPHICAL NOTICE**

Aineias Oikonomou is an architect M.Sc., Ph.D.(2007) He was a post-doctoral researcher in the N.T.U.A. Laboratory of Architectural Form and Orders (2009 to 2010). He has published more than forty five scientific papers. Adjunct Lecturer in the Departments of Architecture, U.Patras and D.U.Th. (2008 to 2010), adjunct staff in Technical University of Crete. (2013 to 2014), adjunct in the H.O.U. (2014 -). He mainly works on restoration projects, has awards and participation in architectural competitions and exhibitions.