

# Structural transformations of traditional architecture from Hittites to Ottomans in Bogazkoy

Selin KÜÇÜK

kucukse@itu.edu.tr • Department of Architecture, Faculty of Architecture, Istanbul Technical University, Istanbul, Turkey

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## Abstract

In this study, a regular and temporal transformation of construction techniques between Hittite Traditional Architecture and Ottoman Traditional Architecture has been examined. Traditional houses, as a production of a manuscript culture, reflect an economic growth by their scale and advanced construction techniques. Hattusha, as a capital city of Hittites in Bronze Age and Bogazkoy as a region that wealthy immigrants (Dulkadirogullari) settled in Ottoman Age had been developing cities of different cultures.

One fictional Hittite house and an existing Ottoman House (Özelevi) are the archetypes. These two archetypes in the southern part of Çorum had emerged with same materials in the same region and had proposed almost same structural solutions to environmental conditions in spite of approximately three thousands of years between them.

Mud brick, natural stone and timber were the only construction materials used in buildings in Anatolia, quite different from the materials of the modern world. Accordingly, culture may define planning characteristics, yet local properties qualify construction techniques. Many studies show that the local construction materials and technologies used in the past are more sustainable than the ones used today. Consequently, transformations and adaptations of architecture, which generates awareness of sustainability, explored in those regions may help develop a good understanding of how the local traditional architecture can still help the construction of sustainable settlements.

A secondary study will also examine how energy efficient buildings were built in Turkey in the hope that these building types could offer lessons to resist against newly emerging concrete giants.

## Keywords

Hittite housing, Ottoman housing, Transformation, Traditional architecture, Energy efficiency.



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## 1. Introduction

Mesopotamia and Asia Minor nicknamed 'Motherland of Civilizations' sheltered some of the wealthiest civilizations and cultures of the world through the ages. However, technical and technological improvements caused economic reforms which eventually suppressed the growth of local architecture have forced people to live in densely-built mega structures in developing and industrialized cities of Turkey during last century. Thus villages and village houses have often been deserted or abandoned. Transformations from local architecture to concrete multi-storey apartments show the chaos that emerged in architecture.

'Deconstruction' of the key phrases and terms employed in this paper would help the readers to get through to the thesis being presented. 'Transformations of Traditional Architecture' was preferred instead of 'Evolution of Vernacular Architecture' or 'Development of Local Architecture' for the title. First of all, it should be noted that 'local architecture' is used in the meaning of architecture that constituted of local natural properties as local materials, local climate and local landscape. Traditional architecture integrates local properties with anthropological properties like experimentation of local construction techniques, cultural adaptations and occupant's requirements. Either transformation, development or evolution describe a 'change' during the time. However the difference is if they define a positive, negative or neutral change. Due to the change observed in traditional architecture, both in the negative and positive, 'transformation' as a term was employed to define the change. There is an architectural wealth from each social group either civic, traditional or monumental buildings in Hattusha. Accordingly, since vernacular architecture identifies domestic architecture rather than traditional and monumental buildings, the term 'traditional architecture' which involves both domestic and monumental references, has been preferred.

Despite having similar materials and invariable environmental conditions, construction techniques improve cumulatively in a local environment.

Thus every building and any specified time through ages has its own identity, like humans. In this sense, identity of buildings are not changing because their identities are different. The varying things are 'local techniques' according to the experiential factor and 'traditional characteristics' according to societies settled in. In addition to this, architectural imitations such as certain hotels in Hattusha were emulated to Hittite, Ottoman or Ancient Greek buildings which do not have identity, are apart from the matters examined in this research. These kind of imitations with their fake facades do not even symbolize any adaptations.

Traditional houses were the most developed house building types constructed with local techniques apart from monumental buildings in pre-industrial term. Target behind traditional type's enlarged dimensions in accordance with vernacular's minimum space are satisfying nonessential human needs in addition to functionality and supplementing cultural properties on plan.

The Hittite Capital City Hattusha and Modern Boğazköy Village, near the Northern part of Central Anatolia are situated on the slopes of a high rocky topography. There are the Elmalı Mountains in the northwest side and Zincirli Mountains in the southern side on which the highest point Kam-beli Tepe (1630 m) existed. The lowest level is Budaközü Stream which passes through the Boğazköy settlement plain, draws in Hattusha and reaches to Kayalıboğaz Canyon (Figure 1 and Figure 2).

In Hattusha, a previous modest village had existed which has then changed into an Empire between 1650 B.C. and 1200 B.C. Since thousands of years, different civilizations with miscellaneous beliefs, traditions and technologies have come to be established and settled in this location (Asurian, Hittite, Phrygian, Hellenistic, Ottoman etc.) (1). Some traditional buildings from these cultures either underground or on earth are now struggling to survive with the modern world. Some of them are still being used by villagers although they would like to live in better conditions.

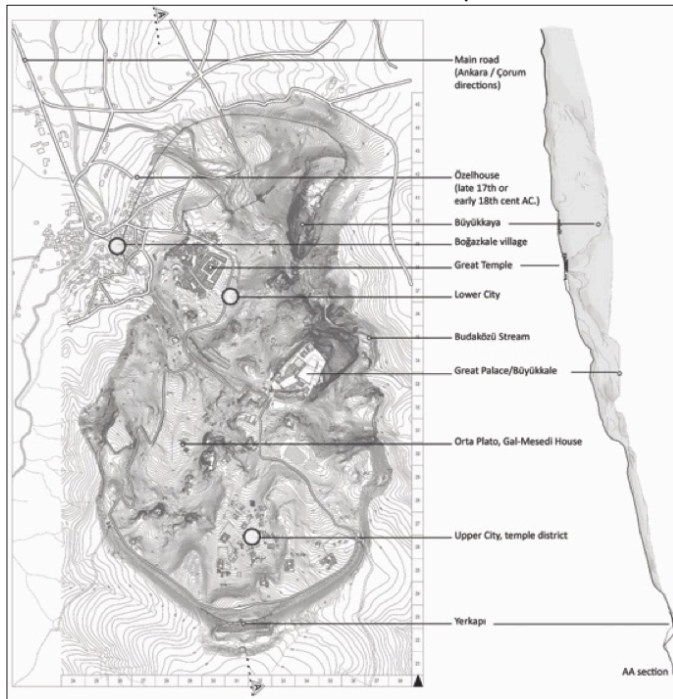
<sup>1</sup>The reference 'Küçük, S. & Şahin, M. (2014). *Archaeoacoustics: The Archaeology of Sound*. Linda C. Eneix (ed.), *The OTSF Foundation: Florida* involves interactive sections of Hattusha which varies by ages.



**Figure 1.** Borders of Çorum which contains Boğazköy in southern part (Source: author).

This study aims to generate a background for prospective energy efficiency comparison of Hittite Housing and a specific Ottoman House which were built in Hattusha. Because of having little evidence about Hittite construction, prospective efficiency results would be taken from an idealized reconstruction model of a fictional Hittite house. However, the Ottoman house which still stands and partially in use would give nearly correct results with respect to its exact three-dimensional model. Two and three-dimensional drawings and energy calculations would be done both manually and by utilizing computer-based programs.

It is essential to explain how and with whose aid the fictional Hittite House's prospective model was reconstructed. Initially, the extant local



**Figure 4.** Section of Hattusha (Source: Selin Küçük, Echopolis, 2013).



**Figure 2.** Boğazköy village and Hattusha (Seeher, 2011).

buildings were photographed and their construction details examined (Figure 19). However, literature was researched for unobtainable information of construction techniques and building elements such as chimneys and openings within the walls. The study specially benefitted from Jürgen and Ayşe Seeher's experimental archaeology studies, Naumann's texts on Hittite architecture, Peter Neve's observations and interpretations on Hittite construction.

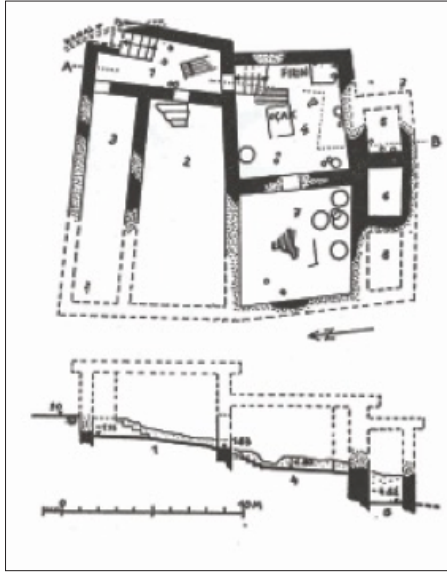
## 2. Transformations of traditional architecture in Hattusha

The cumulative experience of building materials' behavior and structural solutions have improved over thousands of years. Structural solutions developed according to sensory observations until modern science accessed the technology to get climatic data.

There is evidence that shows early small and scattered settlements from Chalcolithic Period in Hattusha around Büyükkaya Region. The Lower City and Büyükkale Regions were the settlements that had been used especially by Assurian Trade Colonies and afterwards, in Karum Age (Figure 5). Buildings were generally unsymmetrically planned, even though they had similar planning organizations with Hittite Houses.

From Hittites to late modern settlements in Hattusha, fire places, chimneys, openings, roofs and water management systems of houses have been transformed. However, building materials and construction technics are almost similar in these systems. Non-existent prop structure of solid walls in Hittite architecture were presented later on just as in the case of Özelevi.

Instinctive treatments and further methods of rural area construction



**Figure 5.** A house in Büyükkale from Karum Age (Source: Naumann, 1991).

have emerged, because people had reached this region coming from many cities. In fact, Özelevi has acquired slightly different characteristics compared to the village houses. It has larger windows instead of small windows, hipped roofs instead of plain roofs and are of enormous size instead of the modest size of the rural counterpart. In other words, Özelevi doesn't reflect the ordinary characteristics of most of Boğazköy local houses for having registered design anxiety of an Ottoman house. However, it is an adaptation attempt of an Ottoman House to Boğazköy Village houses. The modest Boğazköy Houses that are still partially in use reflect the in-between period of time from Hittites to Ottoman Age.

Both traditional houses from Hittite and Ottoman periods have geomet-

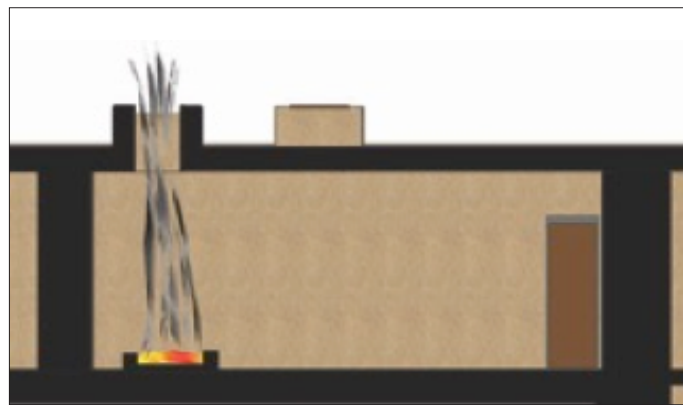
rically straight and smoothly divided spaces and level differences of grounds observed in separated spaces. Both have unitary planning characteristic.

## 2.1. Fireplaces and chimneys

Chimney construction has proceeded by stages until modern intra-wall, intra-pavement or extra-tubular systems using varying materials. Comparisons between ovens of any Hittite House and Ottoman House indicates that the smoke occurred by the oven removed from interiors through different systems. Hittite probably ejected smoke via holes in housetops in Hittite age. The two ovens in the central rooms of Gal Mesedi House, which are not attached to the walls, support this idea (Figure 14). Baytin quotes Assurian houses description in Koyuncuk as an example. In the description, there are circular planned domed houses described with a hole in the centre of domes (Figure 6). That represents an oven in the centre of the living area and smoke emitted via an opening on the top. Dome's function is to gather smoke before emitting. There are no circular planned buildings except a Turkish Bath (hamam) and Byzantine Church in Hattusha. Since most of the examples, even a high status person's or a villager's, are quadri-laterally planned, and there may be an inter-relation for chimney systems. Thus, there was probably a hood uptake raised from Hittite House's flat roof (Figure 7). Additionally, there should be a wooden cover which was accessible with a deck ladder to shut the opening. However, double roomed simple-planned houses have been found in Büyükkaya



**Figure 6.** Koyuncuk Houses (Source: Baytin, 1951).



**Figure 7.** Fireplace and chimney of a Hittite house (Source: author).





**Figure 8.** Filled fireplace of Özelevi (Source: author).

from Early Hittite Age, where there is an inner wall façade attached next to a fireplace. This informs us about an unusual application for ejecting smoke. Here, there is a clay pipe system which extends from the fireplace upwards by drilling the exterior wall (Naumann, 1991).

It is known from Hattusha ruins that Hittite fireplaces had a simple structure; semi-circular or rectangular in shape, which is made of compacted clay (Naumann, 1991).

## 2.2. Openings

Openings affect human life owing to their shape, material and aesthetic appearance. These significant parts of buildings have been transformed through the ages. However the previous applications have significant contribution to the current implementations.



**Figure 9.** Various interior and exterior windows and doors from Özelevi (Source: author).

Dark caves and underground spaces which have no openings except an entrance were the initial shelters that people hid and protected themselves from strenuous environmental conditions. Caves became insufficient shelters since people needed to connect with natural light. Therefore, by constructing their own roofs and wall covered spaces with a hole at the top, they let the light come in. Immediately afterwards, more openings have been created on the wall in order to establish connections with nature biologically and psychologically. There are such important innovations as the transition from circular plans to rectangular floor plans and the use of different materials to build walls which directly affected the door and window constructions.

It is known that openings placed within exterior walls or roofs were formerly closed with covers made of wooden, cotton and similar materials (Baytin, 1951). Hittites probably also utilized same techniques to close small openings within the exterior walls of their houses.

By the invention of glass and various shading and fencing systems in conjunction with their joint details and insulation solutions, openings evolved through time. Even though Hittite housing lacked this technology, massive mud-brick walls should supply a significant comfort level for interior spaces. Integration of these technologies would increase this level.

Chimney holes within the plain roof, as long as their covers are open, provide daylight.

## 2.3. Roofs

Previous flat or dome shaped roofs that are made of the same materials with the walls and are generally constructed contiguous of the walls evolved into integrated exceptional systems having their own structure by using roof tiles or cladding materials. Disadvantage or weakness of clay material against humidity and raining activity has been removed by utilizing these water-resistant materials and systems. On the contrary, eaves and hipped roof are used in traditional Turkish House as it can be seen in Özelevi.

## 2.4. Water management/sanitary installation

Several Hittite Dams in Anatolia show their advanced knowledge and technology in water management systems. Furthermore, one of the dams is very close to Hattuša, in Alacahöyük. In Hattusha, in Hittite Age, drainage systems diffused various houses on the narrow streets. This supports the idea of the presence of water management systems that were supplying water mostly from the local water sources. (Seeher, 2011)

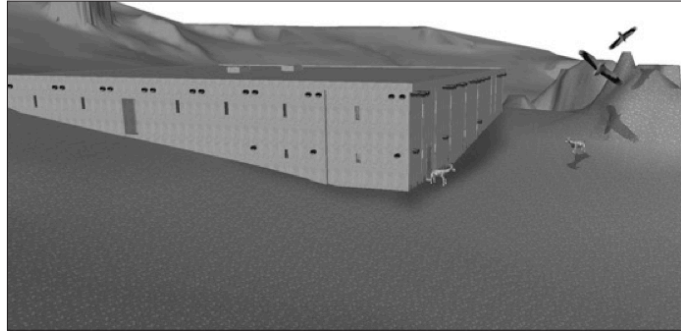
Organization and a permanent consideration of waterworks were facilitated by the foundation of the General Directorate of Civil Works (Bayındırlık İşleri Genel Müdürlüğü) in 1914 in Turkey. Moreover, drinking water had been supplied to Ankara the capital city of Turkey and the closest big city to Boğazköy by opening of the Çubuklu Dam in 1936 (DSİ, 2012). Özelevi does not have sanitary installations, and even though its construction date is still not identified, it is believed to have been constructed earlier than the times mentioned above. However, there is a hole within the entrance hall floor, drawing off interior water via clay pipes, streaming north-west direction and reaching the retaining wall of the garden at a lower layer (Figure 15).

## 2.5. Prop structure

Despite being solid walls, prop structure has been used in addition to lacing courses (horizontal elements) in many local buildings in Boğazköy in the last few centuries. However, according to Naumann's observations and drawings, there were no vertical diagonal structural elements (props) in a solid wall even in another regions in ancient Anatolia. Yet all the supporting structural elements were vertical and horizontal.

## 3. Proposal for a comparison of energy efficiency between Hittite and Ottoman housing

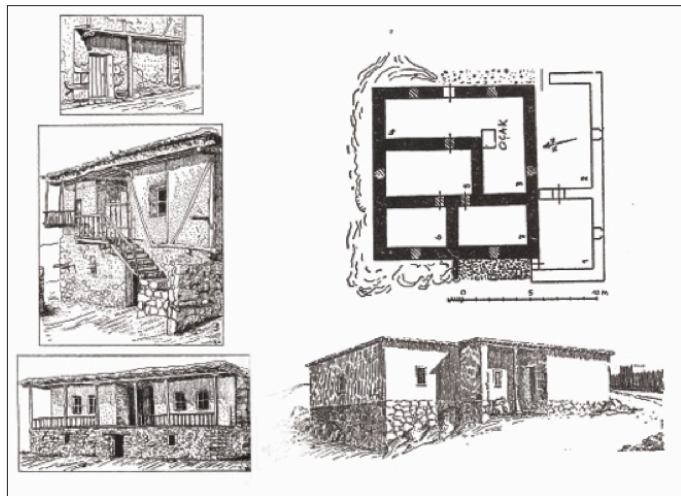
Energy efficiency and renewable energy became very important subjects in Europe after 1973 and 1979 oil crisis (Olivier, 1992). Over the years, energy efficient building technology improved and many new systems have been de-



**Figure 10.** Prospective reconstruction of a Hittite House (Source:author).



**Figure 11.** Reconstruction of a Hittite house in Lower City by U. Betin (Source: Seeher, 2011).



**Figure 12.** Local Boğazköy houses, sketches by Naumann in 1952 (Source: Naumann, 1991).



**Figure 13.** Özelevi North-west façade (Source: author).



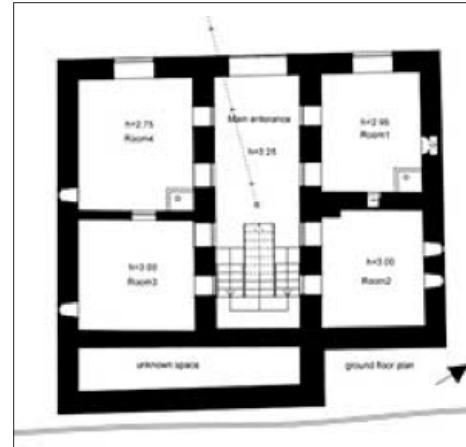


**Figure 14.** Plan of Gal Mesedi House (Schachner, 2015) (Source: Selin Küçük @ DAI).

signed. However, it should be noted that Hattusha village houses have been constructed for thousands of years in energy efficient ways without any sophisticated technologies. In addition to this, integration of the new efficient technologies to these village houses would yield much better efficiency results. In Turkey, since immigration of villagers to big cities and lack of builders, there is no more implementation possibility of them except reconstruction of specific buildings to construct such village houses.

Climatic data from the building's region, orientation of building and interior spaces, dimensions of rooms and openings, heating sources and types are significant parts of information necessary to consider energy efficiency of a building (Yılmaz, 2005).

Climatic conditions are immediately effective on local architecture. Highest comfort conditions for the users can be provided by consuming lowest energy



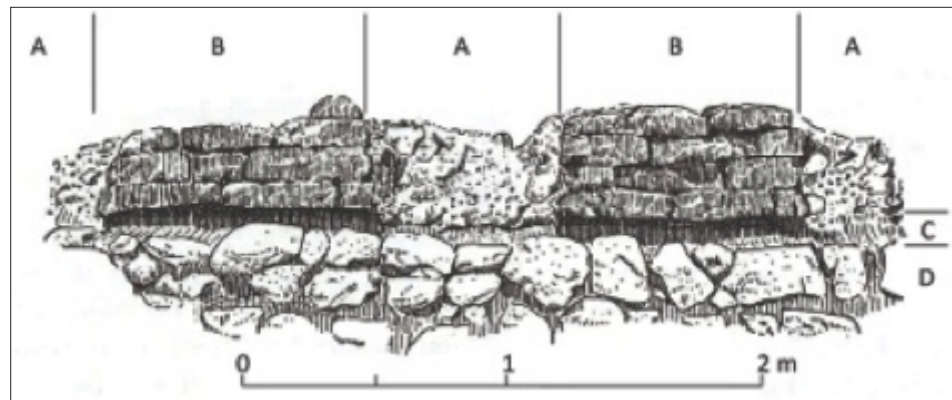
**Figure 15.** Plan of Özelevi (Source: author).

in conjunction with local climate based design (Hausladen et al, p.8).

Heat transmission values of building components would be determined according to TS 825. Because Çorum is in the 3rd climatic region, given heat transmission values for opaque and transparent components should be used for calculations. Prevailing wind (in winter session north-east 26.0 %; east 15.8 % and in summer session southwest 12.3 %) is very significant to obtain passive ventilation through openings.

Exterior design temperature value for Çorum which is higher than average temperature of Turkey received -15 °C principally in order to determine the heating load. Maximum raining activity, which has been showed in the table below, is in May.

Since relative humidity is remarkably low in Central Anatolia and Çorum is within a cold dry climatic zone, building adaptations such as small windows in order to keep warm air in-



**Figure 16.** Wall ruins in Büyükkale A: infill and vertical wooden lacing course; B: mudbrick wall; C: horizontal wooden lacing course D: stone foundation (Naumann, 1991).

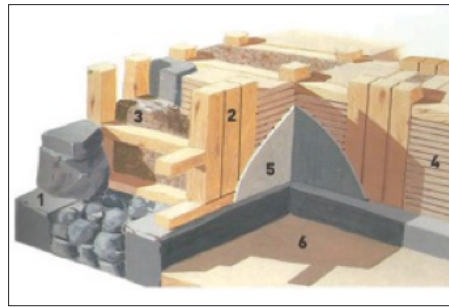
side in winters and cool air in summers and thick walls as high heat insulation elements have appeared subsequently. People constructed living spaces for themselves and their animals according to their observations without scientific climatic data for thousands of years. Present scientific data would probably show how comfortable spaces they generated by using common sense.

#### 4. Conclusion

Archaeological regions that are still in use or had been used for thousands of years demonstrate temporal transformation of architecture. Turkey has a great fortune of having research on that sort of places. Especially, ancient sites surrounded within thick walls, which symbolize influential civilizations, are relatively preserved. Additionally, modern villages have more interaction with previous local architecture. Ancient Ankara Castle and the settlement surrounding by its walls, Old City of Gaziantep and further examples are available.

Excavating living areas and collecting information of occupants and construction techniques was the initial activity of this study. Observations of local architecture through time shows that people learnt from previous experiences and improved construction techniques cumulatively over thousands of years.

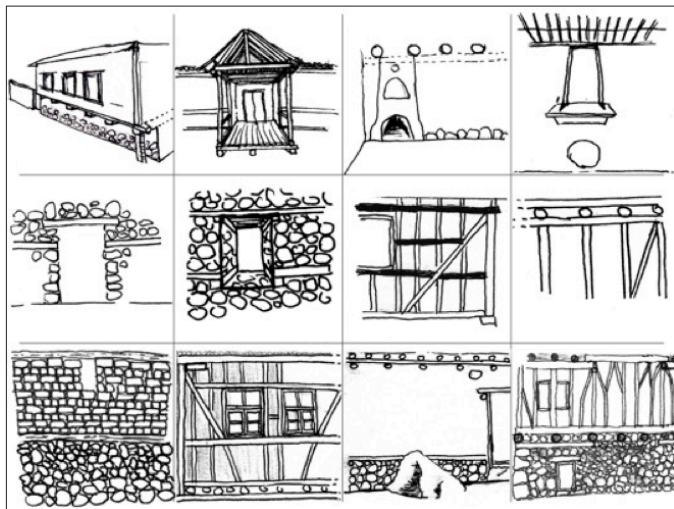
It is understood that every place has its own history and background as well as unique characteristics. However, this study can be seen as a prototype for studies to be conducted in other regions in Turkey to investigate history of Hattusha region according to its variable occupants and construction techniques.



**Figure 17.** Reconstruction of the walls in Great Temple, 1: foundation and socle stone blocks; 2: timber framework; 3: fill of earth and stones; 4: mudbricks; 5: wall plaster; 6: lime-plastered floor on a layer of packed earth (Source: Seeher, 2011).



**Figure 18.** Prop Structure of Özelevi (Source: author).



**Figure 19.** Sketches from Boğazköy houses (Source: author).

Climate Variable	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max Temperature °C (°F)	4 (39)	6 (43)	11 (53)	17 (63)	21 (71)	25 (78)	28 (83)	28 (83)	25 (77)	19 (66)	13 (55)	6 (43)	17 (63)
Average Temperature °C (°F)	0 (31)	1 (34)	5 (41)	11 (51)	15 (58)	18 (65)	21 (69)	20 (69)	17 (62)	11 (53)	6 (43)	2 (36)	11 (51)
Average Min Temperature °C (°F)	-4 (24)	-3 (27)	0 (31)	4 (40)	8 (46)	10 (50)	12 (54)	12 (54)	9 (48)	5 (41)	1 (34)	-2 (29)	4 (40)
Average Precipitation mm (in)	42 (2)	31 (1)	36 (1)	54 (2)	62 (2)	51 (2)	19 (1)	15 (1)	22 (1)	30 (1)	37 (1)	51 (2)	449 (18)
Average Daylight Hours & Minutes/Day	9h 37'	10h 36'	11h 53'	13h 15'	14h 25'	15h 01'	14h 45'	13h 25'	12h 03'	11h 53'	9h 19'	9h 19'	12h 00'
Sun altitude at solar noon on the 21st day (°)	29.5	38.9	49.7	61.4	69.6	72.9	69.9	61.5	50.1	38.6	29.5	26	49.8

**Figure 20.** Average weather data of Çorum (Source: [www.corum.climateemps.com](http://www.corum.climateemps.com), 2014).



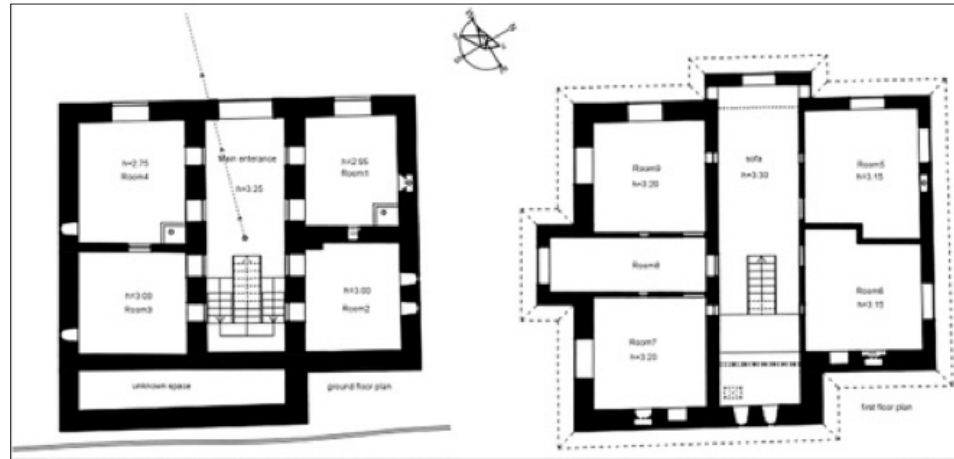


Figure 21. Natural lighting and ventilation draft scheme of Özelevi (Source: author).

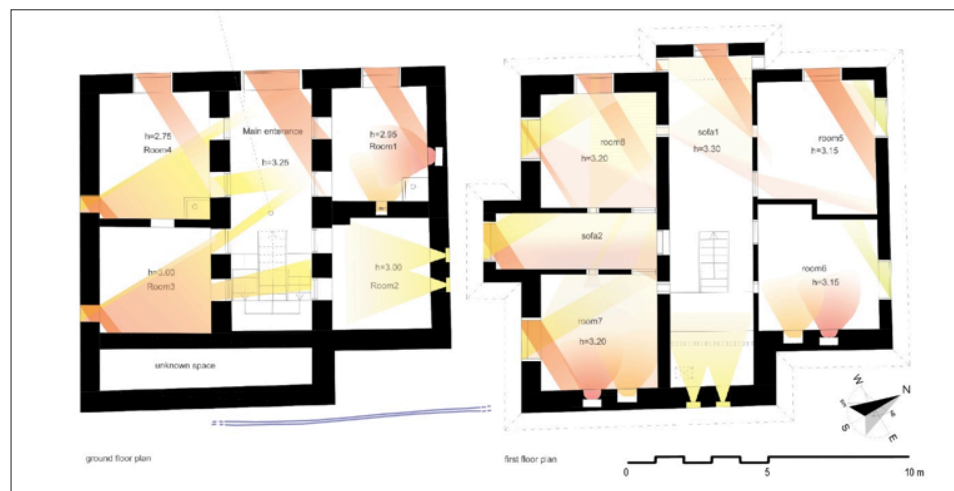


Figure 22. Natural lighting draft scheme of Özelevi that executed manually (Source: author)

Proliferation of modern industrial cities may not change, yet rural areas are still mainly preserved especially in Central Anatolia. There are clever buildings designed by sensitive people which are still waiting to be discovered. However, forgetting local architecture and using only modern materials without traditional experiences would result in the world changing negatively and would lead to forgetting the lessons that can be learnt from the history. Second National Movement (1934-1950) in Turkey and Post-modernism movement almost over the world made a stand against contextually disconnection of modernism's built environment from its natural and cultural environment. Especially, during Second National Movement, existing traditional pattern of Anatolia had been considerably surveyed and documented (Eyüce, 2005).

The critical point is designing according to local information and con-

structing still 'local'. Remembering what 'local architecture' means, would remove misunderstandings. Nature talks and local architecture makes its speech understandable.

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