THE EXAMINATION OF CONSTRUCTION TECHNIQUES OF MUĞLA HISTORIC HOUSES

A Thesis Submitted to the Graduate School of Engineering and Science of İzmir Institute of Technology in Partial Fulfillment of the Requirements for Degree of

MASTER OF SCIENCE

in Architectural Restoration

by

Burcu IRGAT ERGİN

October 2008

İZMİR

We approve the thesis of **Burcu IRGAT ERGİN**

Assist. Prof. Dr. S. Sarp TUNÇOKU
Supervisor

Assist. Prof. Dr. Mine HAMAMCIOĞLU TURAN
Committee Member

Inst. Dr. Zeynep DURMUŞ ARSAN
Committee Member

27 October 2008

Prof. Dr. Başak İPEKOĞLU
Head of the Architectural Restoration

Prof. Dr. Hasan BÖKE
Head of the Graduate School
of Engineering and Sciences

ACKNOWLEDGEMENTS

I would like to express my sincere thanks to my advisor Assist. Prof. Dr. Selim Sarp Tunçoku for his guidance. I also would like to emphasize my gratitude to him for his patience and encouragement he showed throughout the study.

I am much indebted to committee members, Assist. Prof. Dr. Mine Hamamcıoğlu Turan and Inst. Dr. Zeynep Durmuş Arsan for their contributions by their invaluable comments and recommendations.

I am also thankful to Prof. Dr. Başak İpekoğlu, Prof. Dr. Hasan Böke and Inst. Dr. Önder Marmasan for attending my thesis juries and for their significant critiques.

My special thanks are due to my friends, Research Assistants; Fulya Murtezaoğlu, Çağlayan D. Kaplan and Specialists Elif Uğurlu and Kerem Şerifaki in the Material Conservation Laboratory of the Department of Architectural Restoration for their kind helps during material analyses. My thanks are also for the staffs of the Centre for Materials Research of the Institute for XRD, TGA and SEM analyses, especially to Specialist Evrim Yakut for helps and patience in XRD analysis.

I should extend my gratitude to the Restorer Architect Ertuğrul Aladağ for his invaluable information about Muğla Houses. I also thank to the Architect Sermin Madanoğlu and Building Technician Hüseyin Kaya for their helps and providing contact with the master builders in Muğla.

I indebted to the staffs of the Department of Public Works and Housing of Muğla Municipality and Muğla Regional Board for the Conservation of Cultural and Natural Assets for supplying the necessary information and documents. My sincere thanks are extended to the Art Historian Fikret Gürbüzer, Head of the Council, for his understanding and helps.

I also would like to thank to my friends for taking me from the stress of the thesis with their friendship.

I am grateful to my mother Necibe Irgat and my father Ali Irgat for their endless support and care during this period as they did in all my life. My deepest thanks are for my grandmother Selma Irgat, my sisters Gülşah Mutlu and Selma Çağlar and my niece Irmak Çağlar for standing by me and giving moral support.

Finally, I am greatly indebted to my dear husband Tolga Ergin for his love, support and patience throughout the research and valuable helps during the field survey.

ABSTRACT

THE EXAMINATION OF CONSTRUCTION TECHNIQUES OF MUĞLA HISTORIC HOUSES

The aim of the study is to make contribution for better restorations by providing reliable and detailed information about their construction techniques and materials in traditional houses of historic urban site of Muğla. For this aim, the houses damaged and abandoned and therefore easily accessed, have been determined due to that they give way for a thorough examination of construction details which can not be observed when they are in sound conditions since they are covered with rendering materials.

In addition to geographic and historic background of Muğla, architectural features of the houses and former efforts for the preservation of historic urban part are also evaluated in the light of previous studies. The examination has been carried out in terms of the details of constructional components such as, foundations, walls, floors, projections and the roofs of the houses. In addition, the properties of masonry materials which form the major portion of houses have also been determined through laboratory analyses.

The evaluations, done in the light of survey results and previous studies, proved that the walls enclosed the houses in the north, east and west are built of stone masonry and combined use of infilled wood-frame which is called ‘hımış,’ and stone masonry. It is seen that bağdadi technique is also employed beside hımış and composite systems.

It can be deduced that, careful consideration of the topography of the land, the choice of proper construction techniques and materials accordingly yielded in earthquake resistant buildings and a unique historic environment in Muğla.

ÖZET

MUĞLA TARİHİ KONUTLARININ YAPIM SİSTEMLERİNİN İNCELENMESİ

Çalışmanın amacı, Muğla kentsel sit alanında yeralan tarihi konut yapılarında uygulanan yapım teknikleri ve malzeme kullanımına ait güvenilir ve detaylı bilgi üreterek bu konutların onarımlarına katkıda bulunmaktır. Bu amaçla, sağlam durumlarında sıva, badana, boya ve seramik gibi malzemelerle kaplı olmaları nedeniyle izlenemeyen yapım tekniklerinin incelenmesine imkan veren terkedilmiş ve hasarlı konutlar seçilmiştir.

Muğla'nın coğrafi özellikleri, tarihi geçmişi ve bu konutların mimari özellikleri yanında Muğla kensel sit alanının korunması için geçmişteki çabalar, daha önce yapılan araştırmalar ışığında değerlendirilmiştir. İnceleme, bu konutları oluşturan temel, duvar, döşeme, çıkma ve çatı gibi bileşenler altında yapılmıştır. Ayrıca, laboratuvar analizleri ile bu konutların önemli bir bölümünü oluşturan yığma yapı malzemelerinin özellikleri de saptanmıştır.

Alan çalışmasından elde edilen bilgilerin geçmişte yapılan çalışmalar ışığında değerlendirilmesi, konutları kuzey, doğu ve batıda çevreleyen duvarlarının yığma taş, hımış ve yığma taş ile hımış yapım sistemlerinin birlikte oluşturduğu bileşik yapım sistemleri ile inşa edildiğini göstermiştir. Yığma taş, hımış ve bileşik yapım teknikleri yanında bağdadi yapım tekniğinin de uygulandığı saptanmıştır.

Arazi eğiminin dikkate alınarak doğru yapım sistemlerinin ve doğru malzemelerin seçimi, depreme dayanıklı yapıların elde edilmesi yanında Muğla'ya özgü tarihi bir çevrenin oluşması ile sonuçlanmıştır.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Table **Page**

CHAPTER 1

INTRODUCTION

The necessity of the preservation of old or historic edifices stem from the fact that they were the social products which were formed only for once and may never be created again. They are not important only for having documentary values, but also for the roles to undertake in our social and economic life at present as well as in the future. The preservation concept, which was only a traditionalistic resistance against implementations of site or building scale, which denied or oversimplified historic values in the past, is rather different at present. While preserving documentary properties, the attitude of preservation today has possessed a new vision which embraces the daily, traditional and communal values, and open to different ideas and discussions about the present physical environment (Akçura 1993, Ekinci 1985).

Within this context, historic urban part of Muğla is one of a prominent living examples who succeeded to preserve its authentic properties despite development plans which were irrespective of preservation principals since the Early Republican Period until when, for the first time, 178 traditional Muğla houses considered and registered as historic edifices to be preserved by the decision of Supreme Council for Historic Monuments in 1979 (Ekinci 1985). Since that time, the efforts have been maintained through the revisions of the former regulations and the addition of new ones as briefly reviewed in the proceeding chapters of the study.

1.1 Previous Studies on Historic Turkish Houses with Emphasis on the Construction Techniques of Muğla Examples

Traditional Turkish house has been the subject of many studies carried out by researchers (mostly academics) concentrated on different view points. Some of them were the efforts of establishing an overall typology with respect to their plan layouts by taking either sofa or room(s) as the main descriptors according to their locations in the layout of the main floor (Eldem 1955, Küçükerman 1973). In addition to plan types, other works dealt with the identification of the spatial features from the point of view of

religious and ethnical co-existence and respectively the life style of the Ottoman community in the past (Kuban 1995, Arel 1982, Asatekin 2005), and the classifications by the consideration of regional climate conditions, construction techniques and available construction materials around (Aksoy 1963, Kazmaoğlu and Tanyeli 1979, Eriç 1979, Bektaş 2001, Asatekin 2005, Güçhan 2007).

Except the studies of Arel (1982) and Asatekin (2005), in these studies, classifications of plan types are generally based on the main floor(s) which is usually the first, in some cases together with the floors above the first one with the same layout. Not only for plan typology, but also the construction techniques of the façades of these floors (mostly facing to the courtyard or public spaces) have been taken as representatives in the overall classifications. The construction techniques and materials employed in the other parts of the houses are partially mentioned or totally disregarded in the overall typology.

In her overview of residential architecture of Anatolia, Asatekin (2005) states that in most of the houses load bearing walls are used in the ground floors with wood frame at upper floors, and service wall carrying ablution space (*gusülhane*), fireplace and cupboards up to roof level implying the use of composite system.

Concentrated especially on the construction techniques of houses in a historic part of a specific town, such as historic houses of Ankara, or a certain type of construction technique, e.g. timber houses according to different regions in Anatolia are also studied (Güçhan 1995, Çobancaoğlu 1998). These studies are concluded with the remarks on their maintenance and restorations.

On the other hand, the urban texture of Ottoman towns, such as İzmir, Manisa, Muğla, Kula, Birgi, Bergama and Çeşme in Western Anatolia are discussed in a study by the examination of the group of houses that are located at the specific neighborhoods, e.g. Saburhane District in the case of Muğla by Tosun (1983). In addition to local site plans and information about the land use, such as the building/plot ratio, schematic plans of the houses on site scale and verbal description of the construction techniques are also provided. The study also includes general recommendations for their restorations and criteria for the new buildings to be built in such historic urban parts.

Despite many studies on historical, social and economic aspects of Muğla, the studies on the historic urban part and traditional houses of Muğla are relatively scarce. Among them, the most prominent work is accomplished by a group of academics from

the Department of City and Regional Planning and Department of Restoration of the Middle East Technical University in 1993. In addition to its history, the evolution of the city is examined intensively. Including important historic monuments, historic urban part of Muğla is also documented in site-scale by a field survey, and examined in terms of preservation concept in general (Tekeli 1993).

Development plans foreseen and already in effect for Muğla and its historic urban part are scrutinized in terms of sustainable development criteria on the regional, national and global levels in a study (Doğru 2006). From the point of view of urban problematic, another study analyzed the physical, social, economic and environmental impacts of speculative housing development in Karabağlar Plateau where plenty of traditional farmhouses are found (Koca 2004).

With respect to structural concerns, another study discussed two criteria put forward by the Protective Redevelopment Plan Regulations for Muğla, and Building Regulations in Natural Disaster Areas which was issued by The Ministry of Public Works and Settlements for the new buildings (Süer 1990). The study concluded that the recommendations and precautions foreseen in the redevelopment plan are seemed to be focused mostly on the formal and visual features of architectural layout rather than structural and constructional needs of the houses. On the other hand, the content of the Building Regulations in Natural Disaster Areas is found to be rather limited to judge the rich variety of construction techniques achieved in the traditional houses of Muğla.

Including a classification for their plan layout, the study of Ekinci (1985) concentrates on the evolution of historic part of Muğla, background of the public efforts for its preservation in a chronological order, and general characteristics and problems of the houses. The work is supplemented with sketches and photographs of the houses and the articles related to the preservation of historic houses of Muğla which were belonged to the author took place in media.

In the study of Aladağ (1991), in addition to brief information about Muğla, present situation, architectural characteristics, spatial elements, construction techniques and materials of the traditional houses of Muğla, and detailed information about twelve houses that were documented through a survey are given along with drawings and photographs. The study provided a brief guideline for their preservation. A glossary of local construction terminology is also provided at the end of the study.

1.2 Aim

As the brief review of previous studies reveals, the preservation of traditional Muğla houses still calls for further detailed studies to provide reliable information in terms of their construction techniques and materials satisfying the needs for appropriate interventions. This is not only important from the point of view of preserving architectural heritage, but also forming a source of knowledge for contemporary construction techniques. Thus, the study aimed to provide further and more detailed information about the techniques and materials employed in the historic houses of Muğla for better works of restoration.

Despite the efforts for its preservation, the historic part of Muğla still includes houses abandoned which have been gradually disappearing due to their abandonments stemming from several reasons. For this study, such a situation is considered to be an opportunity to collect information about their structural components and constructional details that are evidently displayed, but not easily seen and documented since they are usually concealed with roof covers, renderings, mostly plasters, whitewash, ceramic tiles etc. when they are in sound conditions. Therefore, the documentation which is done in this study should be considered as the collection of supplementary information about the constructional components of Muğla houses to be evaluated in the light of the previous studies.

1.3 Method and Content

Essentially, the study is composed of four stages; literature and archives research, field survey, laboratory analyses for the characteristics of construction materials and evaluation of the results in the light of information gathered from the previous studies.

Literature and archival research containing geographical features, such as the location in Aegean and Mediterranean Regions, topographic, geologic, tectonic, climatic features and sources of forests of Muğla that are directly effective on the construction techniques and raw materials employed; and a brief information about the historical background which shape the architectural layout of historic houses of Muğla from socio-cultural point of view are included in Chapter 2. Archival research carried out in the archives of Muğla Municipality and Muğla Regional Board for the

Conservation of Cultural and Natural Assets was done to obtain information about the previous official efforts and the evolution of determination of the boundaries of Development Plan for Muğla Historic Urban Part. Together with the introduction of the settlement texture of the historic part, the results of archival research are presented in Chapter 3. Following the classification of the plan types, characteristics of spatial components such as the basements, ground floors, main floor comprised of sofa and the rooms of Muğla houses are given in Chapter 4.

Field survey is carried out in June-July 2007 covering the construction techniques and construction materials that are examined according to the constructional components such as foundations, walls, floors and roofs of the damaged and abandoned houses at the site. The houses to be examined were determined after a thorough search covering all parts of historic site wherever possible to access them. Therefore, other than basing on a systematic zoning and systematic selection, the selection of the houses for this study had to be obligatorily based on the situation of their accessibility, kind of information they offer (e.g. one house may clearly display foundation details, while another one gives clues about its wall structure or roof), and their location within the site. Together with their addresses, seventeen houses which are examined for detail drawings and material analyses have been indicated and listed on the Urban Site Conservation Development Plan (Figure 3.4) given in Chapter 3. As will be seen in the map, the 12 of the houses are remained within the boundaries of the Zone I, while the 2 houses in the Zone II, 1 house in the Zone III and the 2 of them remained in the Zone V. In addition to the addresses of the houses, the type of the components (foundation, wall, floor, projections and roof structure) and the type of information, which was obtained and presented either by photograph and/or drawing, have also been given in a chart (Table 5.1) in Chapter 5. Documentation of the construction techniques is done through measurements and detailed sketches on the site and rendered by using CAD software as drawing medium with appropriate scales indicated on each drawing. Wherever necessary, documentation is also supplemented with photographs by the use of amateur cameras.

As a certain source of firsthand information, interviews with builders, Mustafa Böce (Böce 2008) a carpenter, Mehmet Ali Ayhan (Ayhan 2008) experienced in chimney construction and repair and, a contractor-Architect Ertuğrul Aladağ who is involved in restoration works in Muğla (Aladağ 2007) were also done during the survey.

Different from the previous studies, the basic properties and raw material compositions of widely used materials in the construction of the houses for adequate interventions are examined through **material analyses** in the laboratory. Forming most of the structural parts, the samples of masonry materials, such as stone and mortars from the walls of the houses and courtyards, and plasters as rendering materials from interior and exterior faces of the walls were collected during the survey. Together with the addresses of the houses, the kind of material and the spots from where the samples were collected have been given in a list (Table 6.1). The sample collection spots have also been indicated on the photographs (Figure 6.1, Figure 6.2, Figure 6.3, Figure 6.4). The procedure of sampling, type of analyses and the results have been presented in Chapter 6.

In the light of the information obtained from previous studies on historic houses in Muğla and Anatolia respectively, an overall **evaluation** is done in Chapter 7. Due to the constructional similarities, the evaluation is also supplemented with the results of other studies on structural characteristics of the vernacular houses built in timber or composite systems found in some places in neighbour countries.

1.4 Limitations of the Study

Different from the houses built before the 19th century at the upper parts of the site, examination of the houses built of cut stone seen in the 19th century in Saburhane area (Ekinci 1985, Akçura 1993) was not possible due to two main reasons; although occupied, but their owners have been living out of Muğla, or, they were empty but locked due to the great number of inheritors. Their examination was done by exterior observation.

Regarding the abandoned houses at the upper parts, however, the most important problem was their structurally unsafe situations preventing accurate measurements especially at the upper floors. In such cases information is gathered by photographs.

CHAPTER 2

CHARACTERISTICS OF MUĞLA

Muğla is located on the southwestern promontory of the Aegean Region, the terrain where Aegean and Mediterranean regions are joined. The area of the land is 12.851 square kilometer and the length of its coastal band is more than the length of land border including its vicinities, Bodrum, Milas, Yatağan, Kavaklıdere in the north and west, Datça, Marmaris, Ula, Köyceğiz, Ortaca, Dalaman and Fethiye towns in the southwest and south. The cities neighboring to Muğla are Aydın in the north, and Denizli, Burdur and Antalya in the east and south (Figure 2.1).

In terms of coastal and cultural tourism, Muğla is one of the most well known spots in Mediterranean and Aegean region.

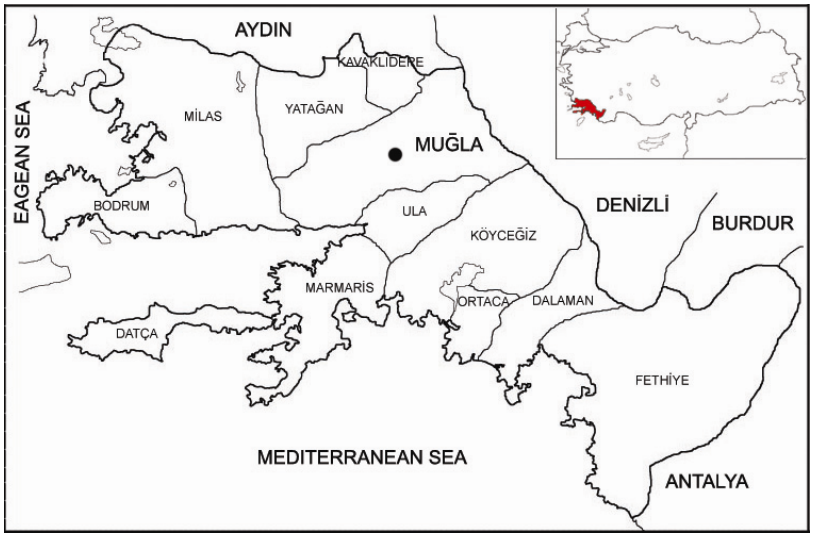


Figure 2.1. Map of Muğla
(Source: Modified from Governorship of Muğla 2007)

The city centre is surrounded with Kızıldağ and Asar Mountains in the north, Yılanlı Mountain in the east, Hamursuz Mountain in the southeast and Karadağ in the southwest. Basmacı and Karamuğla Creeks pass through the town (Figure 2.2).

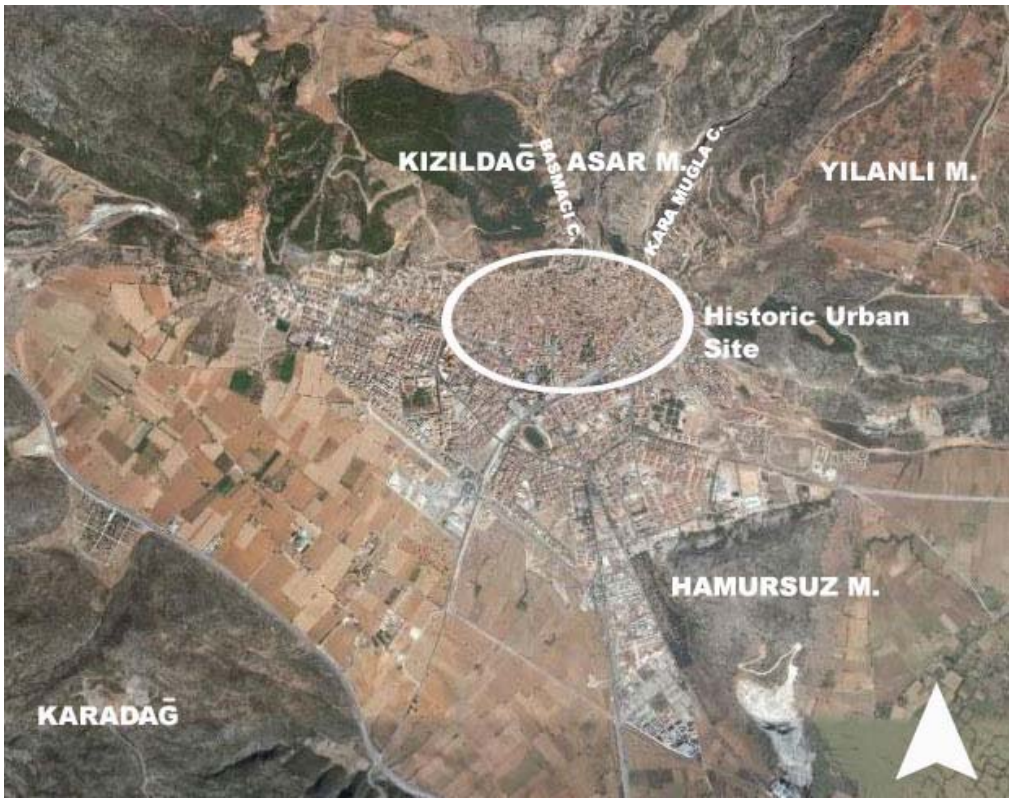


Figure 2.2. Aerial view of Muğla
(Source: Modified from Google Earth 2008)

2.1 Topography

All variations of earth forms can be seen in Muğla (Figure 2.3). Steep and mountainous areas cover the 77% of the total land. 12.3% of the mountainous area is formed by the plateaus and the 10.7% is by the plains. Plateaus are lined up at the skirts of the East and West Menteşe Mountains. Possessed with an uneven topography, Muğla Polje, which lies in the northwest-southeast direction at the altitude of 620m, forms the largest closed basin in the region. The polje, which has a fairly flat and elongated base, is surrounded by steep side-walls in the north and south. With the beginning of rainfalls in winter, lower levels of the polje turned out to be a shallow lake. The water accumulated in the base is drained through the doline, Çayır Düdeni, in the east of Hamursuz Hill and the crevices in base (ÇED 2006, İkiel 2004).

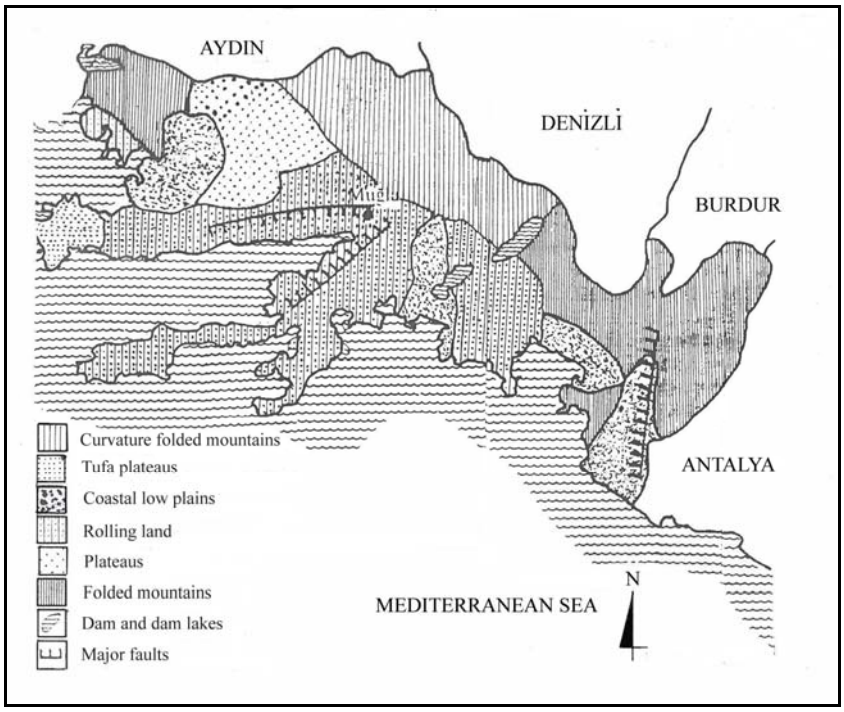


Figure 2.3. Geomorphologic features of Muğla
(Source: Modified from ÇED 2006)

2.2 Geological Structure

Formations appeared in almost all geological time come across in the boundaries of Muğla. Precambrian (first time) formations in the area are the formations like gneiss, mica-schist, fine-grained schist and quartzite which start from the mountainside in the north of Yatağan and Milas district and spread towards the north further. In the south, first time old sandstones, marbles and schists cover these formations. Different marbles and limestones, clayey schists, sandstones, conglomerates, silica and schists in patches which come across in the south of Yatağan-Muğla centre line are all first time formations (ÇED 2006).

In the area, Paleozoic aged, whitish or greenish, gray colored schists form the basin. The basin called 'Menderes massif' consists of barysphere, which gneisses form, and a cavernous nappe, consisting of schists around this. At upper levels, schists are observed in patches. On these beds, Mesozoic aged limestone becoming steep suddenly in the north of plain because of the faults in the direction of northwest-southeast, offering slight slopes in the south-southwest and southeast exist too. On these,

sandstone with red colored loose cement beginning with conglomerate and Neocene sediments carrying on with marl and uppermost anthropogenic alluviums and slope debris exist (Erdem Yerbilimleri 2007).

All Muğla Plain is represented with alluvium covering Gökova and Yenice Plains and consisting of calcareous sand and gravel. Alluvium having 1.85m depth is covered with clayey farm soil which has thickness changing between 1 and 2m. We can group alluviums into two, being old and new. Old alluviums consisting of sand and gravels are seen in the northeast part of area. The parts which new alluviums cover consist of gravel, sand and silt being carried by brooks and creeks coming from mountains. The thickness of them is about 50-60 meters.

Brown forest soil consisting of calcareous sandy clay having low lime content, chestnut soils being mediocre calcitic and mixed with clay in patches, limestone, dolomite, calcareous sandstone and red Mediterranean soils with calcareous-binding and conglomerate, granite in the areas being near mountainous terrains, red-brown Mediterranean soils consisting of clay stone and metamorphic rocks and the areas which red-yellow brown forest soils without calcareous form surround the plains being the most important cultivated area of the land. Calcareous formations constitute the base of the mountainous terrain which surrounds the city (Sezer 2004).

Apart from those, the areas consisting of alluvial coast bogs being in the lake and sea coasts being always wet or in a large part of the year with the effect of both sea and lakes and runoff, sandy areas consisting of sand being carried with wave and wind from the sea and lakes, river bed in which sandy gravel and rubble materials exist and competent rocks which are partially or never decomposed form the soil structure of Muğla.

2.3 Tectonic Structure

The region which is placed on ‘the first degree seismic zone’ of Turkey contains Karaova-Milas, Muğla-Yatağan, Ula-Ören and Gölhisar-Çameli active fault lines (Figure 2.4).

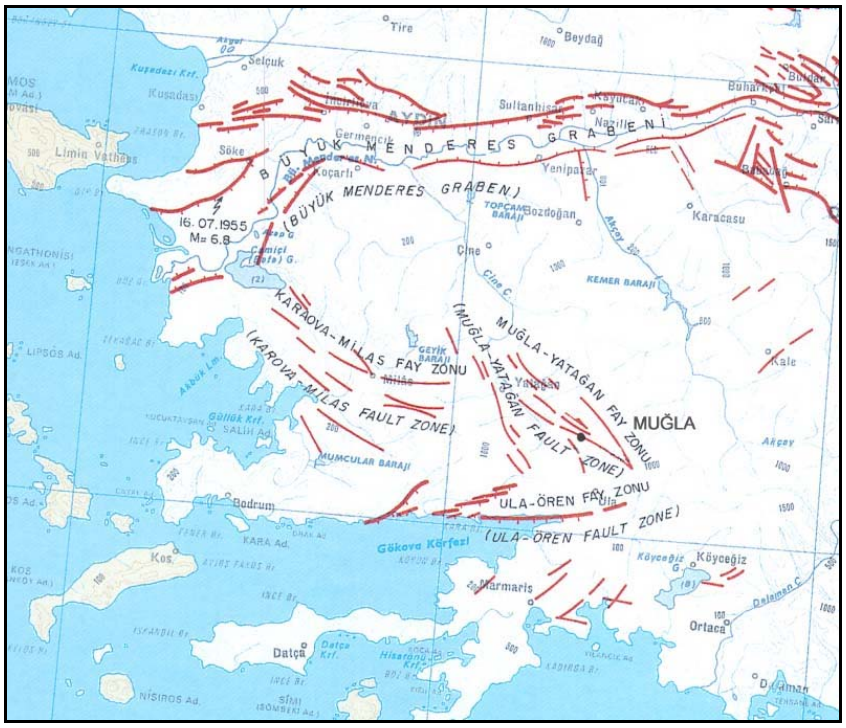


Figure 2.4. Map of active fault lines in Muğla and close by surroundings
(Source: Modified from General Directorate of Mineral Research & Exploration 2007)

The people of Muğla are well acquainted with earthquake owing to the fact that most of the residential areas are located on such risky zones (Sezer 2003). Muğla seismic zone, having a quite active nature, caused forty three severe earthquakes resulted with the losses of life and property in the past (Table 2.1).

Table 2.1. Earthquakes seen in Muğla and close by areas
(Source: General Directorate of Disaster Affairs 2008)

Date	Location	Magnitude (Ms)
1941	Muğla	5.7
1941	Muğla	6.0
1957	Rodos-Muğla-Fethiye	7.1
1959	Köyceğiz	5.7
1961	Marmaris	6.5
1969	Fethiye	6.2
2004	Gökova Körfezi	5.4

Although most of the earthquake-producing faults are short, the existence of relatively longer faults bears the risk for Muğla. Especially, in the plains having the potential of liquefaction, the risk increases much more. It is reported that the possibility of an earthquake, of 7.0 M or over to be occurred in the land is less than that in the sea floor. The safer areas of the city, where the shocks are rather harmless are Milas and some parts to the west and the north (Sezer 2003, ÇED 2006).

2.4 Climate

In Muğla region, where the Mediterranean climate is dominant, the weather is mild in winter and hot in summer (Table 2.2). Depending on the altitude and the distance to the sea, different climate conditions may also be observed between the coastal line, plateaus and the mountainous areas. This situation becomes more evident in winter. For instance, in January, monthly mean air temperature is 5.3˚C in Muğla, while 11.1˚C in Bodrum (İkiel 2004).

Table 2.2. Average temperatures and rainy days in Muğla (1975 – 2006)
(Source: Turkish State Meteorological Service 2008)

Months	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Mean Temp. (^{o}C)	5.5	5.8	8.5	12.4	17.6	22.8	26.2	25.8	21.6	16.1	10.2	6.8
Average Rainy Days	13.5	12.2	10.3	10.1	7.7	3.9	2.7	2.2	3.4	6.0	9.9	14.4

Depending on the layout of the topography, the north winds are not much effective in Muğla. Despite the prevalence of the northeast wind (*poyraz*) only in winter (Governorship of Muğla 2007), the prevailing wind in Muğla is the westerly wind (*günbatısı*) with the annual average frequency rate of 38.1% (İkiel 2004).

In Muğla, where the rainfall regime of Mediterranean climate is dominant, the weather is dry in summer, but high amount of rain is received in winter months (Table 2.2). In the beginning of spring, convective rains, sudden and usually accompanied with

thunder, are also observed in the hinterland such as Ula, Yatağan and Milas as well as in Muğla (Governorship of Muğla 2007).

2.5 Sources of Forest

Natural vegetation of Muğla which is constituted with the condition of climate and earth makes a varying and fertile flora. Mild Mediterranean climate dominates a large part of area. Due to the relatively low temperature and rainfall, winter is suitable for plant grove. However, drought summer causes arid formations to develop. While there are lemurs to 600-800m altitude, red pine (*pinus brutia*) to 800-1000m altitude, in the areas to 2000m altitude forests consist of oak, black pine and juniper. There is alpine lawn in higher areas. The areas higher than 2200m are of bare rocks (İkiel 2004) (Figure 2.5).

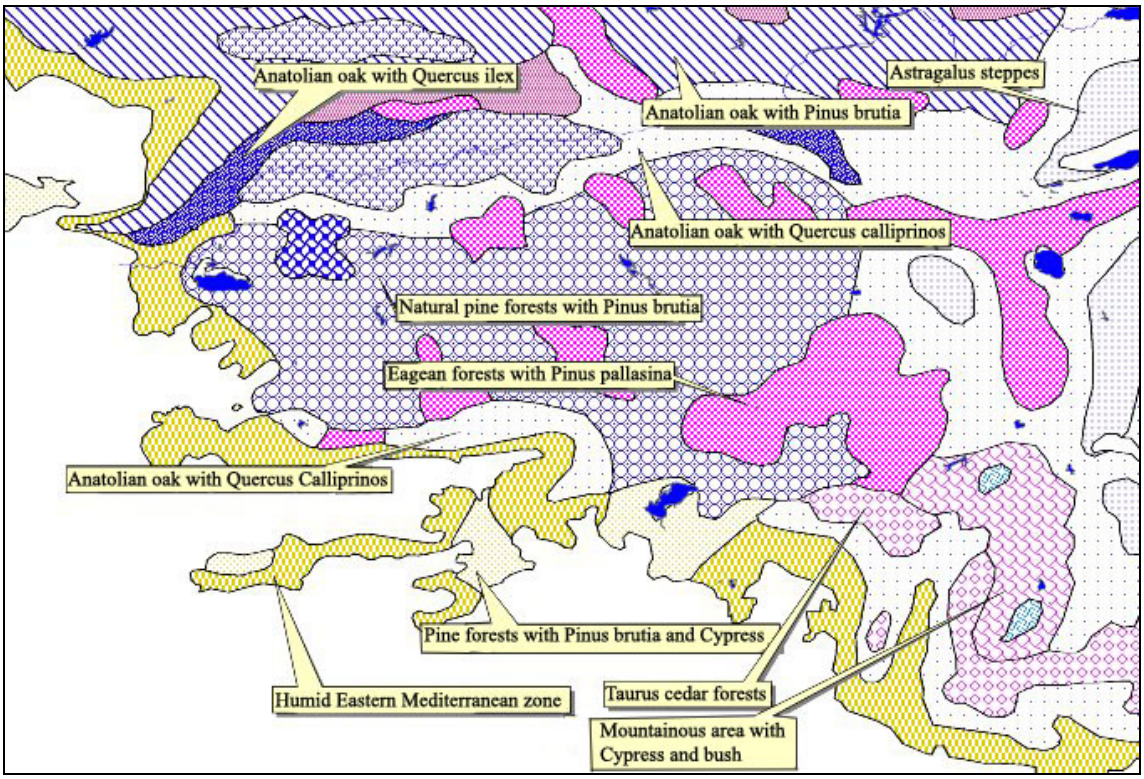


Figure 2.5. Map of forests in Muğla
(Source: Modified from General Directorate of Forestry 2007)

Forests in Muğla are constituted with local type of coniferous trees such as red pine, black pine, stone pine, Aleppo pine 95% of which is found in Milas and Gökova, juniper, cedar and cypress. Those with wide leaves, such as oak, willow, sweet gum, chestnut, eucalyptus, acacia, redwood and olive which can be grown to 800m altitude are the richness of Muğla (ÇED 2006).

Red pine, which has abundant amount of resin in its fabric and seen in Aegean and Mediterranean regions, is the most common type pine tree in Muğla forests covering 404.405.9ha (ÇED 2006).

2.6 History of Muğla

The ancient name of Muğla whose history dates back to 3000 B.C., was Caria. The boundaries of Caria were Büyük Menderes River in the North, Dalaman Creek in the South, Phrygia in the east and Aegean Sea in the west (Figure 2.6). Due to its geographical location and the richness of its history, the region was influenced by many civilizations and became one of the attractive in the world. It is thought that the first settlers in the region were the Carians or Leleges whose origins are under debate. Only houses and tombs were left from the six of the antique cities in the region where they lived (İrem 2004, Buluç 1993).

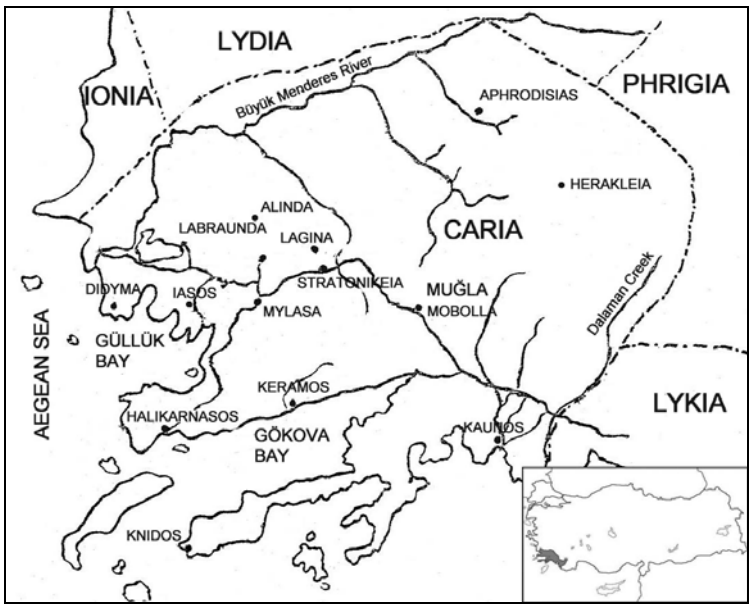


Figure 2.6. Map of Caria
(Source: Modified from Yaşar 1995)

Muğla was dominated by the Egyptians between 1297-1239B.C., Ionians in the 11th century B.C., Dorians in the 10th century B.C. and the Lydians between 700-546 B.C. The region, captured by Alexander the Great in 334 B.C., ruled by Pergamon Kingdom in 188B.C., Roman Empire in 133 B.C. and remained under sovereignty of Byzantine until 800 A.D. (Akça 2004, Buluç 1993). The name 'Mobella' was called 'Mogolla' later (Ekinci 1985). Despite a few remains from ancient times and Roman Period, no trace from Byzantine Period was found. The reason is likely that Muğla and its surroundings had minor importance in comparison to other states, such as Halikarnassos and Milas (Bakırer 1993).

The emergence of the Turks in the region is seen in the 11th century and concluded with the establishment of Menteşe Principality following the conquest of Aydın and Muğla by Menteşe Bey in 1284. The region was added to Ottoman territories by Yıldırım Beyazıt in 1394 and became the centre of the Menteşe Sancak. Following the World War I., Muğla was occupied by Italians by the Sèvres Agreement, but it was evacuated a day after the inauguration of Turkish Grand National Assembly in 24th April 1920 (Ekinci 1985, Akça 2004).

CHAPTER 3

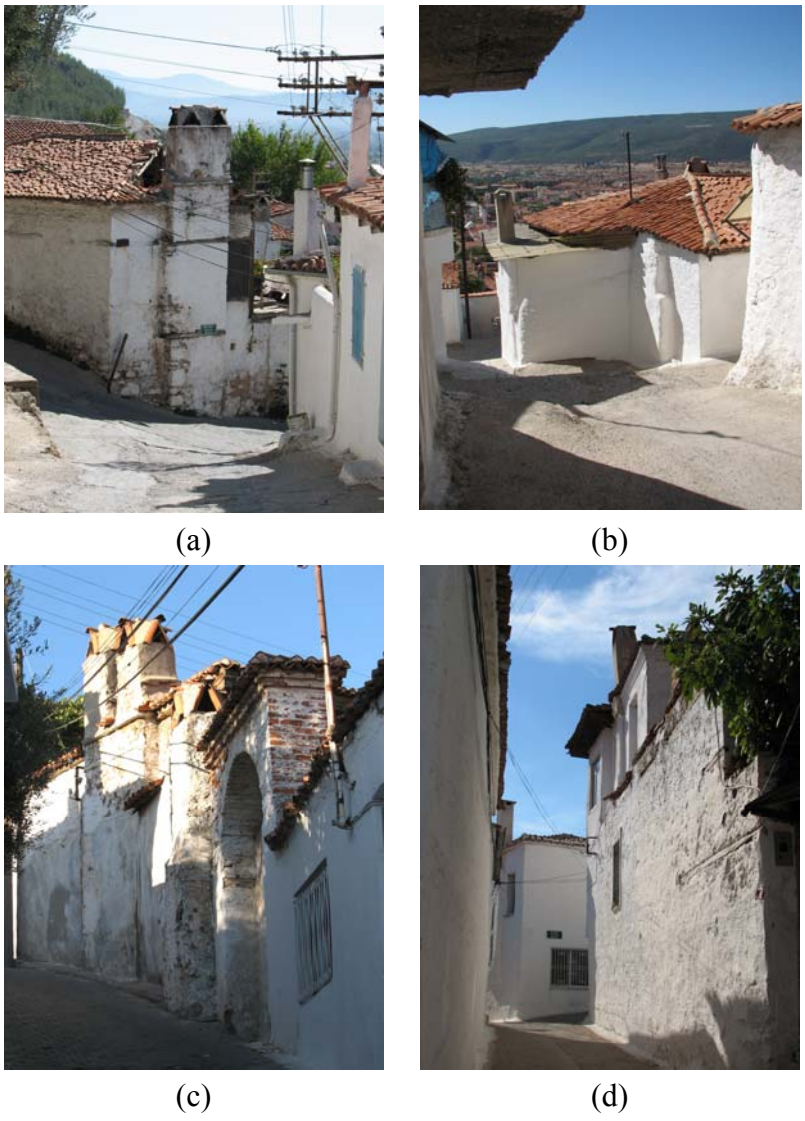
MUĞLA HISTORIC URBAN SITE

The evolution of Muğla started from the upper parts of Asar Hill and to the south along the hill thereafter. The first settlements were placed on the sloped lots, while the latter ones took place on the relatively flat parts where the slope ended (Akçura 1993, Aladağ 1991). For this reason, it can be deduced that the topography of the land was prevalent in the formation of the layout characteristics of the streets, street-plot relations, and the positioning of the house in the plot, in short, townscape as a whole (Figure 3.1).

Figure 3.1. General view Muğla from the south

In general, the texture of the town has been developed with a certain order although it displays an organic pattern. The most important reason of the well-organized pattern was that Muğla was the center of a *satrap* (governorship in the past) where the construction activities were controlled by the central authority (Tosun 1983). The essential idea in the formation of the pattern was to ease the life and provide good conditions in the living spaces. For this aim, the streets were kept in parallel with the topographical curves and zigzags were formed upwards to provide easy access to the upper parts with a gentle slope as much as possible. The corner walls of the houses

corresponding to the turning points of the streets were beveled to a certain height to ease the turning of the carts. The accesses to the plots, which had no boundary with the streets, are provided through the neighbor plots, thus, cul-de-sacs 1.5 – 3 meters in width are frequently seen in the area. The plots are arranged along both sides of the streets by the consideration of the topographical curves (Figure 3.2).



(a) (b)

(c) (d)

Figure 3.2. Views from the streets in historic urban part of Muğla a. Emir Sayit Street b. Nalıncılar Street c. Hisar Street d. Topallar Street

Owing to such a consideration of the slope, the houses could be built in a way that none of them prevent the scenery and sun light of the other (Aladağ 1991, Ekinci 1985, Tosun 1983).

3.1 Street Pattern

Streets, in fact the lanes in the site are usually narrow and less than two meters in width except main transport arterial roads which are 3.5-4 meters. Parallel to the slope, the streets are limited with the front side of the courtyard walls of the houses at the level above, and with the rear walls of the houses below. The streets connecting the parallel ones are limited with lateral walls of the houses on either side. These white lime-washed walls shade and cool down the narrow streets in hot summer days (Figure 3.2).

It is known that the original floor cover of these streets, most of which are asphalt or concrete at present, were of natural stone. The rows of large stone, usually of slate and called '*kayrak'* on both sides that are sloped towards the central axis of the street thus letting rain water flow are repeated at both edges of the street as pavements (Tosun 1983, Aladağ 1991).

3.2 Plot-House Relations

Because of the slope of the land, houses are mostly located in the northern borders of the plots and directed to south. North façades of structures are embedded into the ground to a certain depth due to the slope. Similar to the rear façade walls, the lateral façades of the houses have also no opening since they face to the neighbor parcels. If it is considered that the majority of urban site is sloped, it can be deduced that the three of the façades of Muğla houses are blind, but south façades facing to the courtyards are open. However, in some houses, where one of the lateral façades rests on the edge of the street, two small window openings at both sides of the chimney wall protrusion are frequently seen.

In some places where the slope begins evened, differences in plot-house relations are seen by the results of the spatial changes in time. In some houses, it is observed that transition of street-courtyard-house in the sloped areas changed into the form of street-house-courtyard, and the houses can directly be accessed from the street. Houses in this area are also directed to the southeast. But different from other houses, by the influence of their location in even parts, only one façade or two perpendicular

façades, or two parallel façades are blind, but other façades are more extrovert with respect to their openings.

3.3 Development of the Urban Site

The first settlement in the city was thought to be the castle on Asar Hill. Newton, who visited the Muğla in 1894, stated that there was a platform, surrounded with ashlar wall without mortar. He also presumed that the acropolis of the city was situated there (Akçura 1993).

It is thought that the development of the city in history, at first began with disordered settlements, and then with the formation of regional and commercial centers, it turns into a regular structure between Kara Muğla Creek in the east and Basmacı Creek in the west (Akçura 1993, Ekinci 1985).

The emergence of Islamic culture in Muğla corresponded to when it became a settlement belonging to Menteşe Principality. The oldest building is Ulu Cami which was constructed by Menteşe Bey in 1344. Muğla became a city of the principality consisted of institutions of Islamic culture such as *zaviye*[1], *tekke*[2], *madrasa*[3] in the 12th and 14th centuries (Akçura 1993).

Another element, still preserved its continuity in the city is the part of İzmir-Aydın-Çine-Denizli-Tavas caravan road which was the only connection to outside world passing through Muğla. Starting from Sekibaşı street, the route proceeds in the zone where Yağcılar Hanı, Kocahan (not exist today) and the *arasta*[4] which is actively used today, and ends in Saburhane District (Ekinci 1985). In the Ottoman Period, the greatest implementation is Kurşunlu complex which was built in the 15th century. Şeyh Cami, built before 1550, and the names of the districts and streets in this part preserved their existence until now (Akçura 1993).

With the development in the sea trade after the 18th century, new areas owned by the rich merchants such as Konakaltı emerged. The wealth of Rum merchants in

[1] *Zaviye:* A religious place of gathering for ritual practice and other related performances.

[2] *Tekke:* Similar to *zaviye* ritual practice is done. But it served for different sects of Islam.

[3] *Madrasa:* Theological school of Islamic Periods. In addition to religious education, the students were also equipped with the knowledge of mathematics, astronomy, medical science, pharmacology, etc.

[4] *Arasta*: Commercial place of Ottoman Period where small shops of same commerce are lined up on both sides of a passage.

Konakaltı and Saburhane was also reflected on the buildings (Akçura 1993). In the same years, construction activities of Ottoman Empire in the course of westernized vision are seen with the construction of wide and well-ordered roads, stone mansions with neo classical features and openings to outside, education and administration buildings. Besides, re-functioning of Hancılar Khan first to a hotel, then a club, and later to a printing office display the attitude of utilizing old buildings with new functions appeared in the city life.

Later, by the first development plan in 1936, buildings and areas where new administration and life style were reflected started to be added. New structuring started with the construction of Cumhuriyet Square continuous in the south of the city.

Apart from authentic development of the city from the southern part of Asar Hill toward the lower parts, the first planned implementation began in 1934 with the new center, which was formed in accordance with official view of new republic, in the point where entrance to the city is provided from Aydın-Marmaris road. Five main roads were opened to this circle shaped square, surrounded with Government Office, has an important function as diffusing republic philosophy, building of community centre, Atatürk Primary School and Abide Hanım Kiosk and have statue of Atatürk in the center. Two of the five roads are exit road to Aydın and Marmaris, two of them are connection roads to the city and one of them is the road which leads to the city spread towards the South. In the works after 1950s, by disregarding the authentic settlement in the north of Aydın-Marmaris Road, Cumhuriyet Square was accepted as focal point and development was oriented to South of this road (Akçura 1993, Ekinci 1985).

As mentioned above, the historical site lies from the skirts of Asar Mountain to the İsmet Çatak Avenue including the Cumhuriyet Square. Its west and east boundaries are the borders where the settlements end. But in districts, out of historic site such as, the northern parts of Dibektaşı Street, although altering buildings having features of pre-19th century also exist. Low density fabric in the south of Dibektaşı Street and Saburhane are highly altered and new structuring is observed in empty spaces (Akçura 1993) (Figure 3.3).

High rise structuring in developing district by the development plan began to be applied in 1960s, caused that wealthy families having houses in old part as well as lands in new district evacuate the old city with the desire of living in modern houses. Meanwhile, the people with low income, who have no house in region, and villagers from close by surrounding, began to settle in the old fabric.

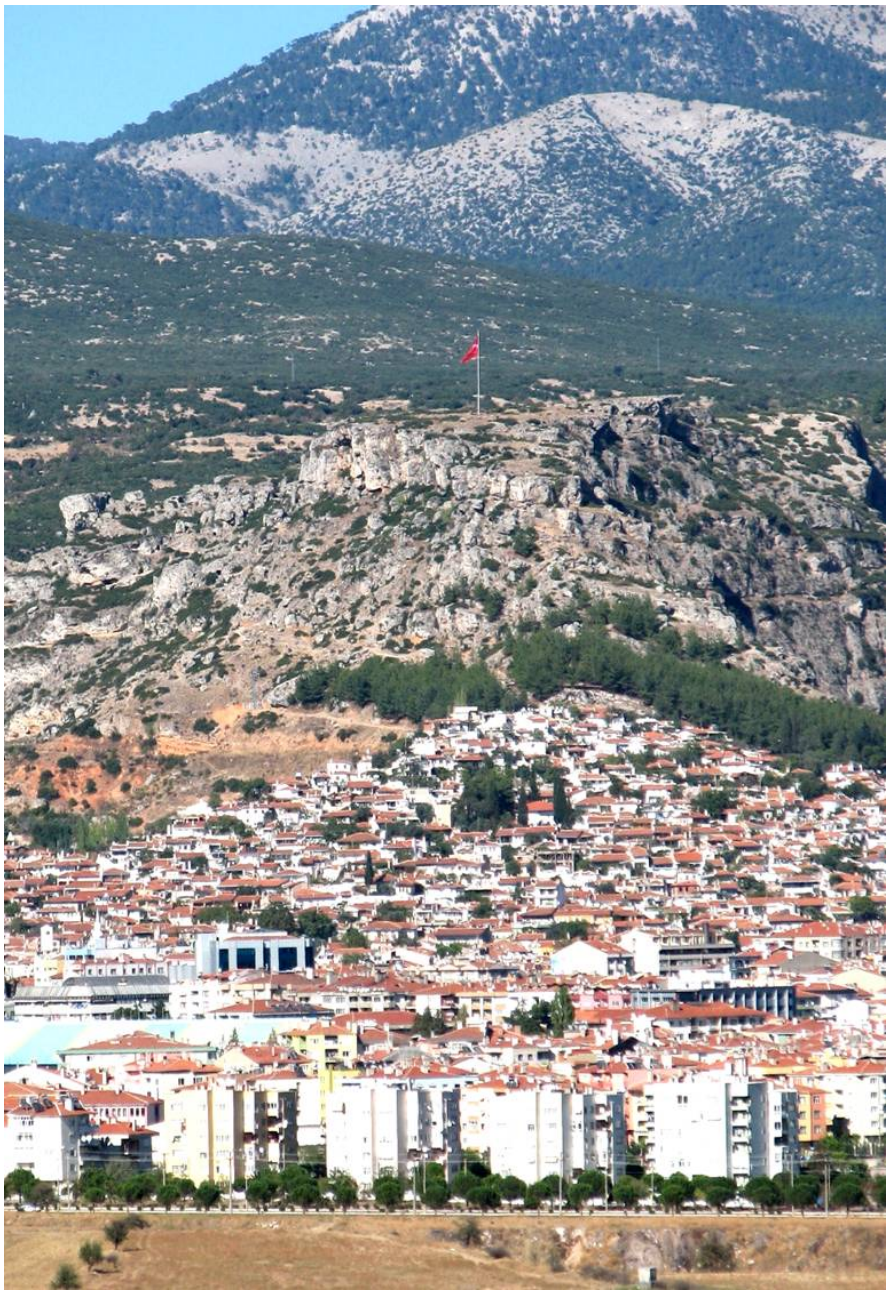


Figure 3.3. Close view of Asar Hill and historic part of Muğla above the new development zone

The old city was neglected since the investments were directed to the new districts and new population with low income. In addition to these unfortunate developments, decisions which provoked the people to '*yık-yap-sat*' (demolish-built-sell) idea and the rights of high-rise structuring in lots facing to the wide roads in new development plan brought the danger of a rapid devastation in the old city (Ekinci 1985, Akçura 1993).

Despite these hazardous regulations remained in effect between the years 1960 and 1979, however, the expected devastation did not happen. This fortunate situation was attributed to four factors (Ekinci 1985);

1. No change happened in the life of people and they persisted in the same as before.
2. The people who moved to the new dwellings kept their old houses and maintained.
3. Expansion of the roads determined in the new plan was not realized.
4. The municipality displayed a decisive attitude in the point of conservation of old city.

3.4 Decisions Taken for the Preservation of Muğla Historic Urban Site

The first official attempts for the preservation of Muğla began with bringing 25 buildings under protection by putting preliminary injunction, with the decision taken in 1974, within the nationwide act of 'Inventory and Listing of Official and Religious Buildings' which is undertaken by Supreme Council of Immovable Ancient Cultural Assets and Monuments after 1970s (Ekinci 1985). After putting individual buildings used as mosque, *mesjid*[5], bath, school, *etc.* under protection, decisions were taken intended for sustaining samples of vernacular architecture on the scale of historical urban site by applying the traditional features of these samples to the buildings to be newly built (Ekinci 1985).

With the first decision of Supreme Council for Monuments, dated 11.03.1977 and reference number of A-394, Muğla city center and Karabağlar plateau was adopted as a site to be preserved totally (Ekinci 1985). As a result of determination and evaluation works took two years for the purpose of implementation of the main principles accepted with this first decision, 178 houses in the city were determined as ancient monuments which have to be preserved with the following decision of the council, dated 27.04.1979 and reference number of A-1643 (Figure A.1). Urban site borders of the old settlement were determined and the site was divided into six districts

[5] *Mesjid*: A small-scaled mosque. Diferent from larger mosques, Friday common prayer is not performed in a *mesjid*.

in the point of the principles of urban scale preservation. Within the same decision, which covers each district, restoration and renovation principles for listed buildings and physical characteristics to be applied to the new buildings in other lots were defined. Karabağlar Plateau, adopted as the area to be protected under the title of Yurtlar Bölgesi by the Council, only a few works done by the municipality, but decisions for the details of conservation were not taken until 1985 (Ekinci 1985).

In the same period, efforts for fulfilling the idea of making a separate preservation developing plan for the preserved area and by this way being applied of council's comprehensive decision into plan discipline were began. For this purpose, 'Urban Site Conservation Development Plan' prepared by the cooperation between Municipality – Bank of Provinces - Supreme Council for Monuments to ensure the preservation of traditional urban texture of Muğla. It was approved by Supreme Council for Monuments, dated 19.09.1981 and with the reference number A–3129 (Figure A.2). Repair of listed buildings and new construction terms in the districts in preserved area to be applied were also determined with the same decision (Ekinci 1985). Later, in 2001, the number of the determined zones was dropped to five with the decision of the Council, dated 11.05.2001 and with the reference number 421 (Figure A.3).

The five zones were determined according to the following criteria (Figure 3.4);

Zone I**.** This zone is the area where examples of civil architecture are most intensively found. Both listed single buildings and existing texture as a whole were intended to be preserved.

Zone II. It is a transition zone surrounding the first zone which intersects with the development areas. It is constituted with highly altered-low quality buildings. Restrictions are made for minimizing probable degenerations in the first zone and prevent excessive differences between the old and new pattern.

Zone III. This zone, which is in the south of the Zone I and Zone II, consists of the area where the buildings which have architectural characteristics identical to the republic and post-republic periods were situated. Important republic buildings, such as the building of Muğla Municipality, the courthouse and the Municipality Park are located in this zone.

Zone IV. This part which reflects the vision of the first preservation plan carried out in Muğla and surrounds of the Cumhuriyet Square where Aydın-Muğla and Muğla-Marmaris Highways are crossed. It contains public buildings harmonized with the square.

Zone V. It is a buffer zone, formed for the prevention of sharp transitions to the residential area which is assigned for developing in the end of preserved part. Despite the absence of building or environment worth to preserve, it is considered to be preserved for its buffering liability.

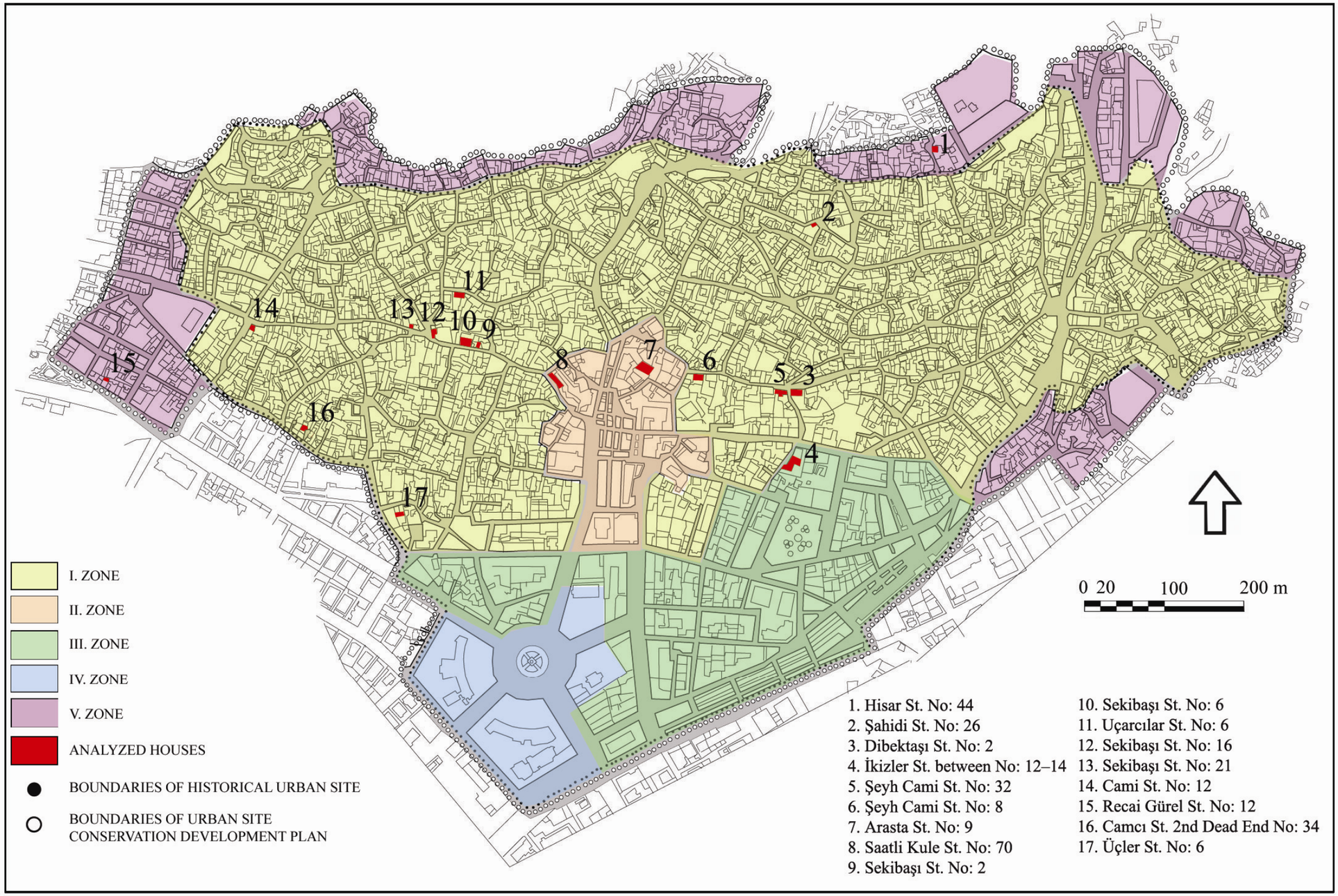


Figure 3.4 Determined zones in Muğla Urban Site
(Source: Modified from archives of Muğla Municipality)

CHAPTER 4

ARCHITECTURAL CHARACTERISTICS OF MUĞLA HOUSES

Except those accessed directly from the street built in relatively latter periods, in a classical Muğla house which always possesses a courtyard, the house is accessed through the courtyard by entering the ground floor. This floor contains service spaces, such as storage space, kitchen, stable and sometimes toilet if it is not located outside. As the details will be documented in the proceeding chapter some houses may include basement floor or a basement like space for ventilation purpose which is accessed from the ground floor or courtyard. First floor, where the main activities of daily life took place, is accessed from the ground floor through the stairs always reaching to the sofa. As discussed at the beginning of the study, the sofa is the most determinant space, not only for Muğla, but also for any classical Turkish house. Whatever the geometry of the ground floor is, the first floor always has a regular geometry and contains the combinations of the sofa and rooms in varying orders. For this reason, the classifications of plan layouts have always been based on the layout of these floors. The similar attitude is also available for the classifications of construction systems of Muğla houses carried out in the previous studies (Ekinci 1985, Aladağ 1991, Tosun 1983). While reviewing those classifications, this chapter is devoted to brief information about the most identical outer and inner spatial elements of a Muğla house.

4.1 Plan Types

The examination of the previous works shows similar approaches in terms of plan layout of Muğla houses. In his classification, Tosun (1983) groups the houses as; those without sofa, and with exterior and interior sofas. Excluding the houses without sofa, this classification is based on the position of the sofa in the general layout of the house.

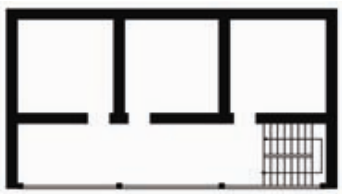
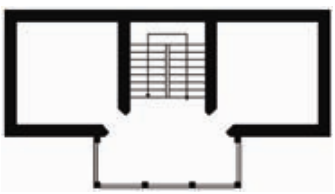
The second classification, made by Ekinci (1985), takes the location of the staircase in the sofa as the basic descriptor, and classifies the houses, first into two main

groups as; the sofas with central and lateral staircases, and then, under these two main groups, he forms sub-groups according to the position and form of the sofa in the general plan layout of the houses. Thus, six plan types of the houses, as those;

- With central staircase and closed sofa
- With central staircase and open-longitudinal sofa
- With central staircase and open-central sofa
- With lateral staircase and open-longitudinal sofa
- With lateral staircase and half sofa
- With lateral staircase and 'T' shaped sofa were obtained.

Although similar to Ekinci's approach, the number of rooms was also included in the combinations of the staircase and the sofa in the classification of Aladağ (1991). Despite such various combinations, these studies reveal that the sofa is the most determinant spatial element in Muğla Houses. The exclusion of the courtyard, which was accessed from the street, is most likely that the house always possessed its certain position at one of the edges of the parcel and that entrance to the house is provided from the courtyard. Therefore, the courtyard had no specific influence on the house plan layout. Among these studies, the modest classification which was done by Tosun (1983) is considered to be convenient to sum up the general characteristics of Muğla houses for this study (Table 4.1).

Table 4.1. Plan types in Muğla urban site
(Source: Tosun 1983)

Without Sofa	With Outer Sofa	With Inner Sofa
		

4.1.1 Houses without Sofa

In this type, the house is composed of a single storey where the rooms are directly accessed from the courtyard. It is said that, such houses are hardly found in Aegean Region due to the climate conditions that are improper for this type (Tosun 1983). However, in his travel notes, Evliya Çelebi mentions some houses that were composed of single storey with flat roof covered with earth. At present, such houses built in relatively latter years are rarely seen in Saburhane where the slope of the land ends.

4.1.2 Houses with Outer Sofa

Belonging to the Ottoman Period, the houses with outer sofa are found in western parts of Anatolia (Tosun 1983). In this plan type, which was frequently found in Muğla houses, the house has two storeys and the sofa which faces to the courtyard is placed in front of the rooms that are lined up side by side. Providing the access from the ground floor, the staircase is located at any of the shorter sides of the sofa or between the rooms. In some examples, a certain portion of the other side of the sofa is occupied by the extension of the house, as an additional room (Ekinci 1985). The traces of a fireplace found on the extension of the side wall of a house on Şahidi Street, was an evidence of such a room which was once existed (Figure 4.1).

Figure 4.1. The traces on the wall of an additional room in the sofa (Şahidi St. No: 26).

4.1.3 Houses with Inner Sofa

In this type of houses, which has also two storeys, the rooms are lined up on both sides, usually the longer ones, of the sofa. If the sofa is open, a projection, a certain part of sofa, towards the courtyard, if closed, a jetty called *'cumba'* towards the street is located at one of its either sides. The staircase is placed at the other side of the sofa or between the rooms. This plan type, with closed inner sofa and a *cumba* which is defined by Ekinci (1985) as Greek style, but, claimed by Aladağ (1991) and Asatekin (2005) that it emerged under the social and economic influences of the period is seen in the houses built of stone and accessed from the street in Saburhane.

4.2 Features of the Spaces

Due to its importance in the daily life of the past, the characteristics of courtyards are also included in the examination of the spatial features of Muğla houses. Including their architectural elements, the features of courtyards, basement or basement-like floors, ground floor and first floors are examined separately.

4.2.1 Courtyard

While providing open space and private greenery, the courtyard which is encircled with high walls of stone masonry, functions as an open passage between the street and the house. It possesses a gate with two panes. A small door, called '*kuzulu',* is fixed in one of the two panes.

The pavement material of a certain portion of the courtyard is usually composed of large blocks of slate stone called '*kayrak',* Different kinds of stones collected from brooks or rivers, and, especially in the courtyards of the houses of later periods, gravels were also used. Courtyards are planned to satisfy the daily needs of the household. An additional building which includes kitchen with a fireplace, a coop for poultry, storage for firewood, utensils for garden work and the toilet are placed leaning to one of the courtyard walls. Also, there is a semi-open space, called *'salındırma,'* with a big fireplace in the garden (Aladağ 1991).

Muğla had a water supply network in the past (Aladağ 1991). In this system, water was provided from a spring and brought by means of baked clay pipes to a certain spots from where it is distributed to the ponds of the houses situated towards the upper parts of the site (Figure 4.2.a and Figure 4.2.b). Making use of the natural slope of the land, water was distributed to the ponds of the houses at lower parts.

Although this network has been completely destroyed at present, some of the ponds in the gardens are still used. In addition to these ponds for ornamentation the ones converted from these ponds for leisure or watering flowers in the gardens are observed in some houses (Figure 4.3.a and Figure 4.3.b).

(a) (b)

Figure 4.2. a. Pipes of the water supply network, b. water distribution storage

(a) (b)

Figure 4.3. a. Pond for leisure (Arasta St. No: 9), b. Pond for watering purpose (Mustafa Muğlalı St. No: 37)

4.2.2 Basement Floor

Generally, basement floor, 1-1.5m in height, is built to provide air circulation to prevent upper floors from dampness. Circulation is provided through the small holes on the basement façade walls (Figure 4.4). However, some of them may include spaces, slightly higher than those for air circulation, for storage purpose or a small kitchenette with a small fireplace (Tosun, 1983).

Figure 4.4. Small holes for air circulation on the basement façade wall (Şeyh Cami St. No: 32)

4.2.3 Ground Floor

Except for the courtyard façade, other ground floor façades of the most of the houses in Muğla do not possess opening to outside. While integrated with the courtyard, the spaces like toilet, kitchen and a storage space for daily needs are placed in this floor.

In the houses, located at lower parts of the site, where sofa is accessed from the street by the stairs, the other side opposite to the entrance is assigned for the access to the garden. The staircase and the rooms are lined up on both sides of this sofa

In some cases, irregular form of the plot and the desire for complete use resulted in the irregularities in the form of the ground floor plan. However, such inconveniences are corrected at the first floor in several ways such as projections, triangular in plan, thus, completing the rooms to regular forms, mostly rectangular ones.

The flooring material of the ground floor is usually slate stone or compacted earth. In the houses, which possesses basement, the ground floor is composed of timber beams and planks nailed on (Aladağ 1991).

4.2.4 First Floor

The essential floor of the house is always the first floor. The characteristics of sofa and its combinations with the rooms around determine the plan type. The openings are mostly seen on the courtyard façade. However, the houses accessed from the street may also have some openings and a *cumba* which is the extension of the sofa towards the street.

4.2.4.1 Sofa

While giving the plan characteristics to all houses, sofa may also be considered as an important urban texture element in the panoramic view of the historic part of Muğla. Houses with exterior sofa are seen in Muğla widely. While providing access to the rooms, the sofas that are supported by the posts at the courtyard façades, also prevent the house from excessive sunlight and rain. Although, front part is open to the courtyard, the lateral walls of sofa have no openings in most cases. As well as *cumba,* some of the sofas which face to the street make projection over and called '*kerevet.*'

Another extension of the sofa seen in the houses built in relatively later years, towards the street about a meter in the *cumba*. It usually takes place at the first floor over the entrance door. Together with its supporting braces it is designed in varying ways. These are two or three windows in the front and done in each lateral façades.

Being an important element of the sofa, the situation of the staircase has influence on the general plan layout of the house. It is usually placed at one of the ends of the sofa. Their plans and forms vary with their positioning and the dimensions of the sofa. It can be arranged as 'single straight-run,' 'half – turn' and 'winding' forms. It is always built of wood. They may possess landings; however, the majority of them do not. The width of the flights varies between 90 -100cm. The dimensions of the depth of their treds vary between 25-30cm, and their risers between 17 and 20cm.

The space under the stairs is utilized in varying ways. The space under ones placed between the rooms is used as storage and isolated from the circulation area by means of a door. Those placed at one of the ends of the sofa are usually connected to the courtyard and septic pit. Therefore the spaces under such staircases are utilized as toilets (Ekinci 1985).

It is stated that the sofas were initially closed to outside by wooden shutters, later with lattice works, and from 1940's by means of wood-framed glass panels (Aladağ 1991). Such sofas are also frequently met at present.

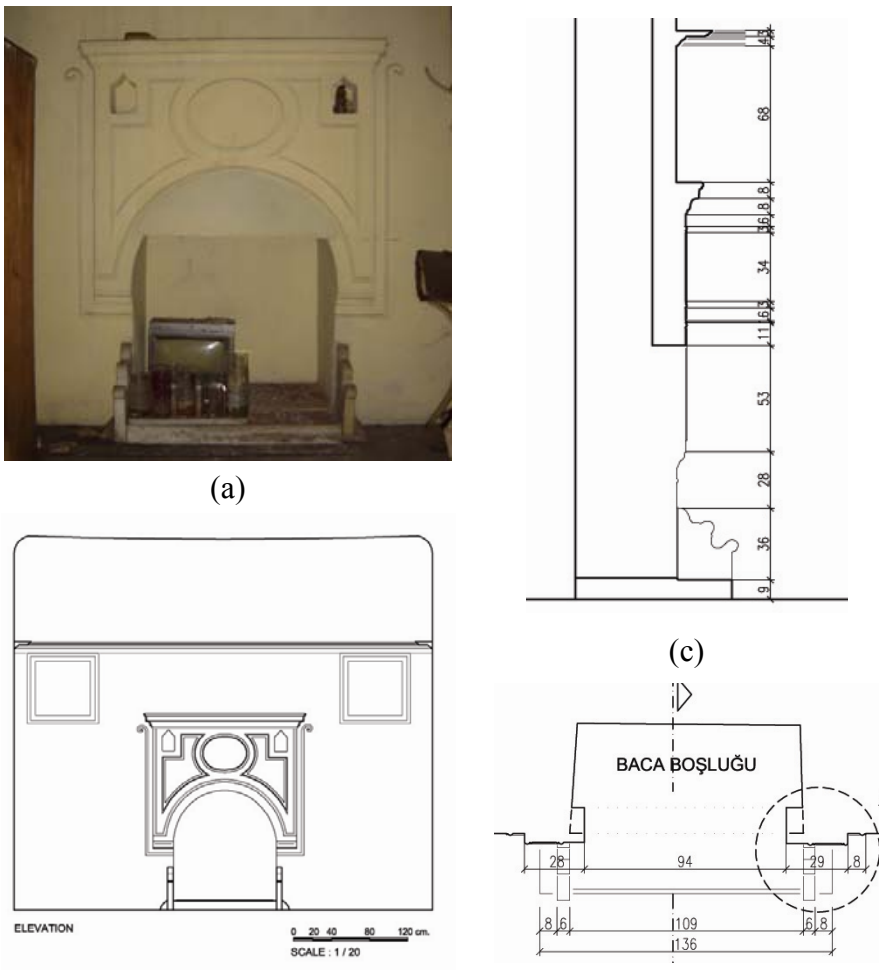
4.2.4.2 The Rooms

As in most of the traditional Turkish houses, the rooms of Muğla houses are arranged to meet most of the daily needs of a family life. Depending on the economic or social statute of the owners, square or rectangular, the dimensions vary greatly. However, due to the hot and humid conditions, the height of the rooms does not happen to be below 2.80 m., while it may extend till 3.5 m at the first floor. The height of the rooms of ground floor is 1.90 m. at minimum (Aladağ 1991). Each of the rooms of the first floor possesses fireplace, a large built-in closet, called '*yüklük,*' and a shelf, called '*elmalık,*' 18-20 cm in width encloses the room at the height of 2-2.10m (Ekinci 1985, Aladağ 1991). The closet generally contains an ablution space, called '*gusülhane,*' storage for beds '*döşeklik,*' and an alcove '*çiçeklik.*' It measures 50-60 cm in width and rises till the level of *elmalık*. Usually, *gusülhane* makes 15 cm protrusion from the closet. The floor of it is covered with zinc sheet and sloped outward to discharge wastewater (Ekinci 1985, Tosun 1983). *Döşeklik* part, below which is used as storage is placed 70-80 cm above the ground level (Figure 4.5.a). *Çiçeklik*, a semi-circled alcove like niche used as a place for flower arrangement or light, usually a candle, is located at the same level with *döşeklik* (Figure 4.5.b).

The fireplace which is usually located across the door measures 90-100cm in width and 50-60cm in depth (Figure 4.6). Fireplace is crowned with a projection which is called '*ocakbaşı*', 160-170 cm above the floor (Aladağ 1991, Ekinci 1985).

(a) (b)

Figure 4.5. a. view from *döşeklik* and b. view from *çiçeklik* (Arasta St. No: 9)
(Source: İYTE 2005)



(a) (c)

(b) (d)

Figure 4.6. a. view from the ocak in Arasta St. No: 9, b. elevation, c. section and d. plan
(Source: İYTE 2005)

4.3 Features of the Façades

Due to the slope of the land, which descends from Asar Mountain towards the south, the main façades of the houses are southern façades and open to the courtyards with their sofas, doors and windows of the rooms and very wide eaves. This façade is the most elaborate and relatively transparent façade of the house.

The northern façades, on the contrary of the southern, are embedded in the ground depending on the slope (Figure 4.7). Usually they do not have fenestration to outdoor. The other side adjacent to the neighbor house is also blind. The façade facing to the streets is enriched with the chimney which is collecting the flues of the fireplaces of the ground and first floor rooms. It protrudes 30-40 cm from the wall surface towards the street. The capping of the chimney which is found in numerous houses in Muğla is formed by means of specifically arranged Turkish roof tiles.

Figure 4.7. Northern façades of the houses embedded in the ground (Nalıncılar St. No: 6)

In some houses, two small windows, belonging to the rooms of the first floors, also take place on both sides of the chimney wall (Figure 4.8). The façades, facing to the street and neighbor houses are of rubble stone masonry without plastered but white-washed. Except the southern façade the band of eave formed of courses of slate stone, on which roof tiles rest on, encircles the façades. This kind of façade composition is seen most of the houses in Muğla. However, some different examples can also be found where the slope of the land ends. Although having the same plan type, as well as opening to the courtyard, in these houses it is seen that the rooms also open to the street

via *cumba*, and hence, the rear façade which had no opening in the other houses has changed. These houses were built in the 19th century. In such houses the front façade corresponds to the street façade. It is composed of an entrance door with a *cumba* above in the center, and the windows of the ground and first floors on both sides of this entrance axis (Figure 4.9). They give the impression that they are integrated with the street. The other façades may also have window openings.

Figure 4.8. Street façade with chimney wall and small windows on its both sides (Şemsiana St. No: 16)

Figure 4.9. Houses which is composed of an entrance door with a *cumba* above located in the central axis and the windows of the ground and first floors on both sides (Ragıp Bey St. No: 2 and 4)

CHAPTER 5

CONSTRUCTION CHARACTERISTICS OF HISTORIC MUĞLA HOUSES

As mentioned at the beginning of the thesis, general specifications of plan types of traditional houses are generally based on the main floor(s) which is usually the first floor. Except the statements by Asatekin (2005) and partially by Arel (1982), the construction techniques of the façades of these floors have been taken as representatives. In such classifications the dominant construction technique of Muğla houses is therefore included in the 'infilled timber-frame (*hımış*) zone' in Anatolia (e.g. Kazmaoğlu and Tanyeli 1979). However, the wall construction system of Muğla houses does not conform to the general specifications for the walls of Turkish houses.

Basically, a Muğla house is composed of two parts; ground floor which is formed of stone masonry and the first floor formed of stone masonry, *hımış* alone or composite in the form of two leafs as *hımış* and stone masonry. In addition to plastering purpose, structural use of *bağdadi* system is also seen in Muğla houses as documented below. Besides ground and first floors, Muğla houses may also have a basement or a basement-like gallery under the ground floor which were composed of stone masonry. In addition to the foundations, the stone masonry of the basement and stone masonry parts of the upper floors in the north, east and west, which is defined as 'U-shaped masonry' (Tosun 1983) the overall structural system of a Muğla house can be defined as composite. As far as the topography of historic part of Muğla which descends towards the south is concerned, especially the northern part (always stone masonry extended till the roof level) of this U-shaped enclosing wall system has to support the slope behind and undertake an additional role in the overall stability of the house.

Starting from the courtyard walls this chapter is devoted to the examination of constructional features of the components, such as; the foundations, walls, floors, projections and the roofs of Muğla houses. A table, that can be accompanied with the site map in Chapter 3 (Figure 3.4) showing the surveyed parts of the houses (each of which is given a reference number in the first colomn), their addresses and documentation types took place is presented as a guide (Table 5.1).

Table 5.1 List of the houses examined

Ref. No	Location	Foundations		Walls							Floors						Projection		Roof Structure					Material Analyses
		Drawing	Photo	Courtyard walls		Walls of houses					Courtyard	Ground floor		First Floor		*Bağdadi* vault	Drawing	Photo	Roof		Eaves		Chimney	
				Drawing	Photo	Stone Masonry		*Hımış*		*Bağdadi*	Photo	Drawing	Photo	Drawing	Photo	Photo			Drawing	Photo	Drawing	Photo	Photo	
						Drawing	Photo	Drawing	Photo	Photo														
1	Arasta St. No: 9			+							+				+	+				+				
2	Bahçe St. No: 49								+															
3	Bahçe St. No: 53								+															
4	Camcı St. No: 66						+																	
5	Camcı St. 2nd dead end No: 34													+	+				+	+				
6	Camcı St. 2nd dead end No: 36						+																	
7	Cami St. No: 12													+	+					+	+	+		
8	Çınarlı St. No: 18																						+	
9	Dibektaşı St. No: 2																						+	+
10	Havana St. No: 33																						+	
11	Hekimbaşı St. No: 9						+																	
12	Hisar St. No: 44																							+
13	İkizler St. between No:12-14					+	+																+	+
14	Kahveoğlu St. No: 28				+															+				
15	Karamuğla St. No: 29						+																	
16	Konakaltı St. No: 5						+																	
17	Konakaltı St. No: 7								+															
18	Konakaltı St. No: 33				+																			
19	Çeşme St. next to No: 2																			+				
20	Pirinççiler St. No: 1				+		+																	
21	Ragıp Bey St. No: 7						+																	
22	Recai Güreli St. No: 12											+	+											
23	Saatli kule St. No: 70		+						+	+														
24	Saburhane St. No: 44								+															
25	Sekibaşı St. No: 2																+	+						
26	Sekibaşı St. No: 6																+	+						
27	Sekibaşı St. No: 16																+	+						
28	Sekibaşı St. No: 21																+	+						
29	Süleymanbey St. No: 3						+													+				
30	Süleymanbey St. No: 10								+															
31	Şahidi St. No: 26		+			+	+	+	+					+	+	+								+
32	Şahidi St. No: 34						+																	
33	Şeyh Cami St. No: 8																							+
34	Şeyh Cami St. No: 32	+	+			+	+	+	+			+	+	+	+				+	+	+	+		+
35	Topaltı St.No: 53				+																			
36	Uçarcılar St. No: 6																+	+						
37	Ulucami St. No: 24						+																	
38	Üçler St. No: 6																+	+						
39	Yayla St. No: 13						+													+				
40	Yayla St. No: 18						+																	

5.1 Courtyard Walls

Together with the rear and side walls of the houses, courtyard walls define the boundaries of the plot with the minimum height of two meters but can be more depending on the width of the street, slope of the land and the household privacy to be visually protected. They house the entrance gate composed of two panes and a canopy above. One of the panes includes a smaller pane which is called '*kuzuluk*' (Figure 5.1, Figure 5.2).

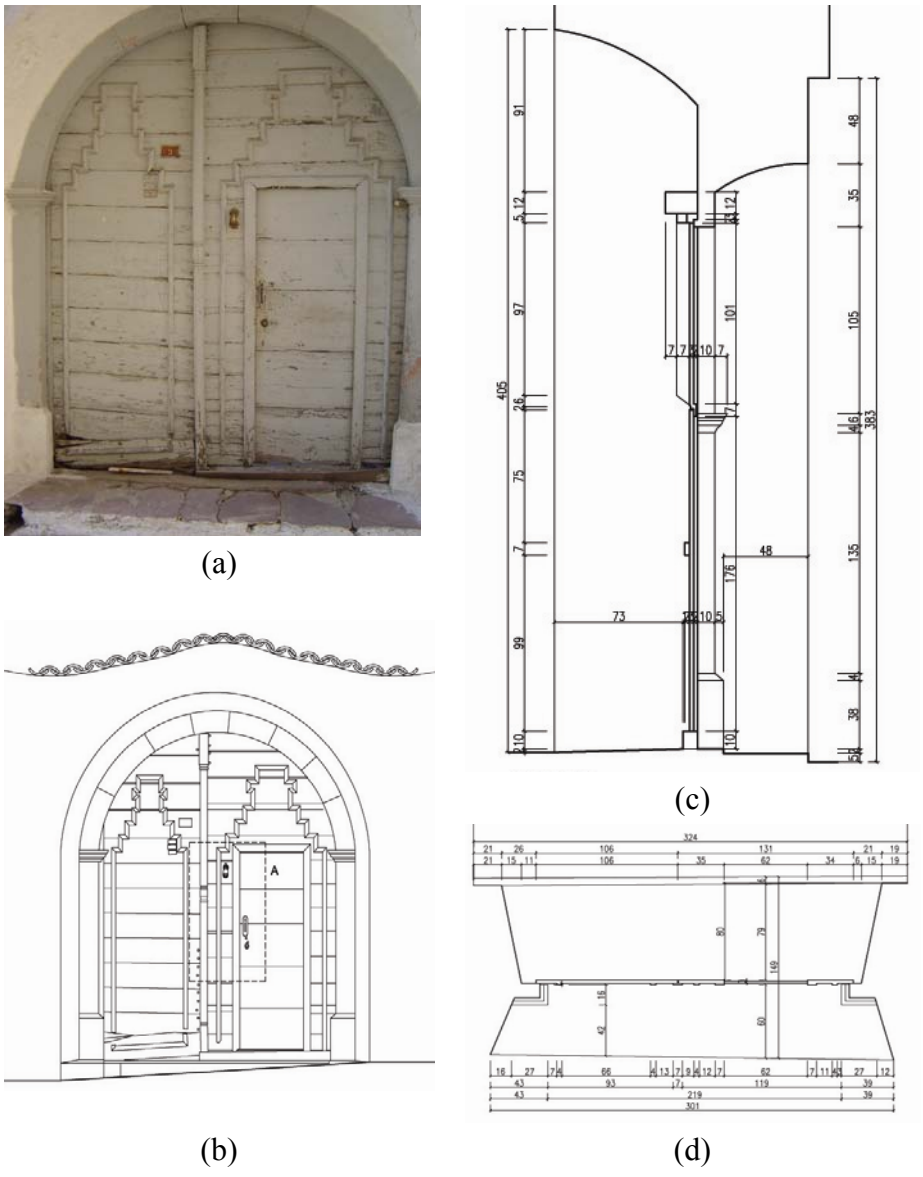


Figure 5.1. Example of a kuzulu kapı. a. front view, b. elevation, c. section and d. plan (Arasta St. No: 9) (Source: İYTE 2005)

(a) (b)

Figure 5.2. Examples of entrance gates with ‘kuzuluk’. a. Prinççiler St. No: 1, b. Konakaltı St. No: 33

These walls are built of rubble stone laid mostly with mud mortar and their thickness varies from 40 to 50 centimeters. Most of the courtyard walls do not possess continuous wall plates (*hatıl*), except the ones partially observed that were inserted into the walls at the levels to which the jambs of the gate were fixed (Figure 5.3.a). The courtyard walls are finished with coping made of Turkish tiles. (Figure 5.3.b).

(a) (b)

Figure 5.3. a. Partial wall plates (hatıls) inserted into the walls at the levels where the jambs of the gate were fixed (Kahvecioğlu St. No: 28) and b. lime-washed courtyard wall with Turkish tile coping (Topaltı St. No: 53)

5.2 Foundations of Houses

Some previous works report that two basic types of foundations were employed in traditional Turkish houses: continuous and discontinuous order. It is proved that both types are used also in the same house (Akan 2004, Güçhan 2007) (Figure 5.4). However, these descriptions do not include any information about the footings which distribute the loads of the building to the ground. The relations between the footings' surface area in contact with the soil strata, their profile and dimensions, and the properties of the soil are important factors in terms of the stability of the building. To obtain a complete profile of the foundation walls with footings, local excavations descending until the level where the soil and footings of the foundations meet are necessary. Although it was not possible to carry out excavations during the survey, but it was possible to see some parts foundation walls protruded at the bottom of the rubble stone masonry and *hımış* walls of the house as presented through photographs in the following.

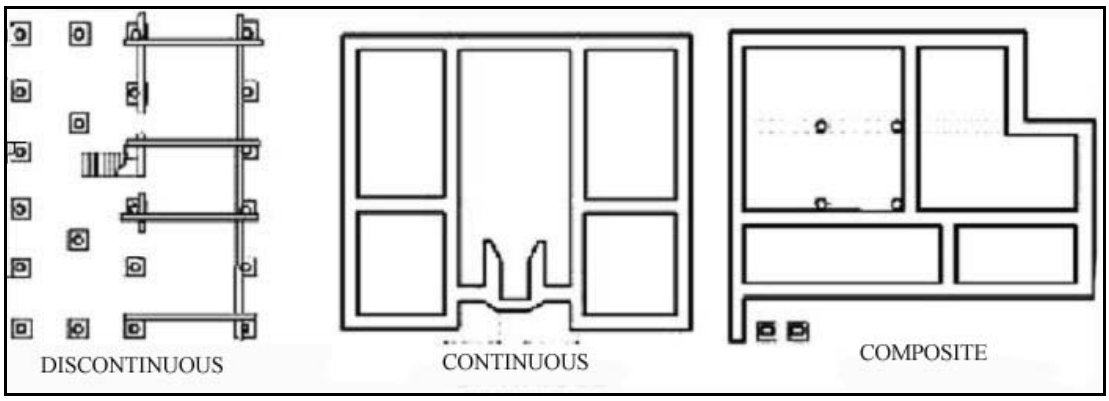


Figure 5.4. Schematic drawing of foundation types in a timber-framed structure
(Source: Güçhan 2007)

Continuous foundations: The foundation walls, built of roughly cut rubble stone masonry bonded with mortar, form a frame under the walls of the building usual to all masonry buildings.

During the survey, continious foundation system is observed in an excavation carried out for the restoration of a house (Saatli Kule St. No: 70), (Figure 5.5). Both

rubble masonry and *hımış* walls of the house were set approximately 15-20cm back from the surface of the foundation walls. However, it was not possible to see the footings, since the depth of the ditch was not more than 40cm.

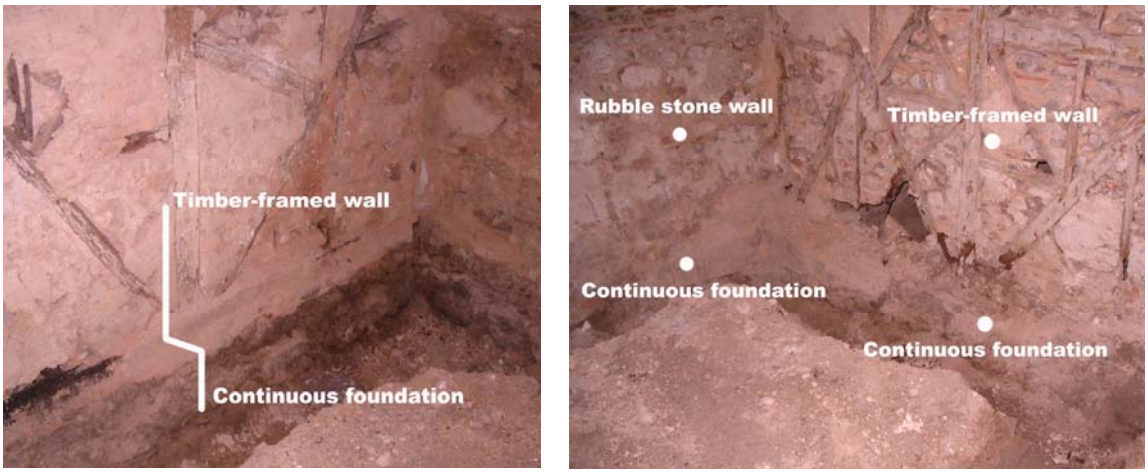


Figure 5.5. Continuous foundation (Saatli Kule St. No: 70)

Unless specified, as that; footing and the portion of the wall from footing till the ground surface, such information should be taken with care not to confuse them with the properties of the basement walls. Because, in hot and humid environments, some of the basements may merely serve as ventilation galleries that are only accessed through manholes at the ground floor and they may be misleadingly interpreted as foundation walls (Figure 5.6.a and Figure 5.6.b). The ventilation is provided with the holes left on the exterior façade of the basement (Figure 5.7).

(a) (b)

Figure 5.6. a. Basement from a house in Alaçatı and b. basement from a house in Muğla (Şeyh Cami St. No: 32)

Figure 5.7. Holes left on the exterior façade of the basement for ventilation (Şeyh Cami St.No:32)

However, it is stated that in traditional houses, which possess not more than two or three stories, the foundations usually descends till the depth of 1-1.5m where the solid strata of the ground is met. Although depends on the number of the stories, the optimum depth of a foundation is said that 45-50cm from the surface was enough in case firm grounds (Akan 2004, Aladağ 1991).

Discontinuous foundation: In this type, the foundation is composed of large sized blocks of stones placed under the free-standing timber posts (Figure 5.8).

Figure 5.8. Timber post of the sofa placed on a single stone footing (Şahidi St. No: 26)

An example of combined use of continuous and discontinuous system is documented in a house located in Şeyh Cami St. No: 32. In addition to continuous walls, discontinuous (or single) footing is used in space A (Figure 5.9). The posts

resting on the single footings are connected to the ground floor beams set on the wall plates (or lacing - *hatıl*).

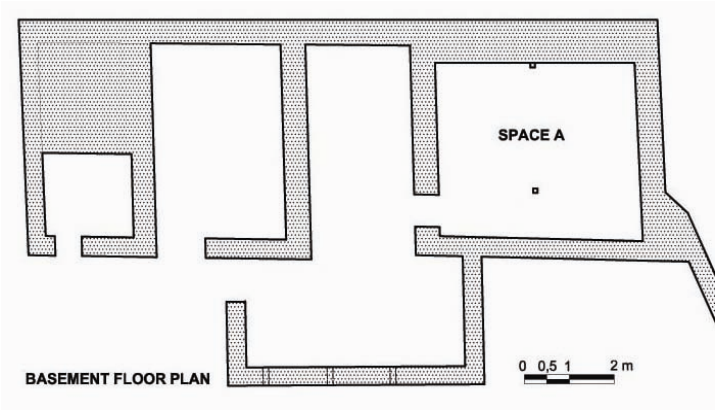


Figure 5.9. Basement floor plan of house in Şeyh Cami St. No: 32

In the same space it is also seen that the service wall into which fireplace, built-in closet and/or cupboards are installed at the ground and first floors are thicker than the others.

5.3 Walls of Houses

As mentioned at the beginning of this chapter, the construction techniques of the walls of houses located at the sloped parts and likely built before the 19th century vary in three ways; stone masonry alone, stone masonry combined with *hımış* which is defined as composite system, and *hımış* alone. In such a variety, stone masonry alone in the basement and basement-like gallery walls, ground floors and some walls of first floors. *Hımış* system alone formed the front façades (facing to the courtyards in the south) and partition walls between the rooms of houses. In addition to *hımış*, the application of *bağdadi* technique is also seen in interior walls.

Enclosing walls of the houses in the north, east and west are stone masonry or composite. Thickness of stone masonry walls varies between 35 and 60 cm while the timber-framed ones between 12 and 15cm in Muğla houses.

5.3.1 Stone Masonry Walls

In Muğla houses both rubble stone and cut stone masonry walls are used. While cut stone walls are seen in the houses built after the 19th century, rubble stone masonry employed much more in the historic part of Muğla.

Ruble stone walls in Muğla houses are made of lime stones and mortar which is the mixture of lime and mud in random bond. The stones, in varying size, are laid with mortar in a way that the small ones are placed in the gaps between the big ones (Figure 5.10.a and Figure 5.10.b).

In the corners of the houses, big stones with regular shapes overlap each other locking the two joined wall faces (Figure 5.10.c). The cross sections of these walls reveal that they are composed of single leaf, known as solid-type wall (Figure 5.10.d and Figure 5.10.e).

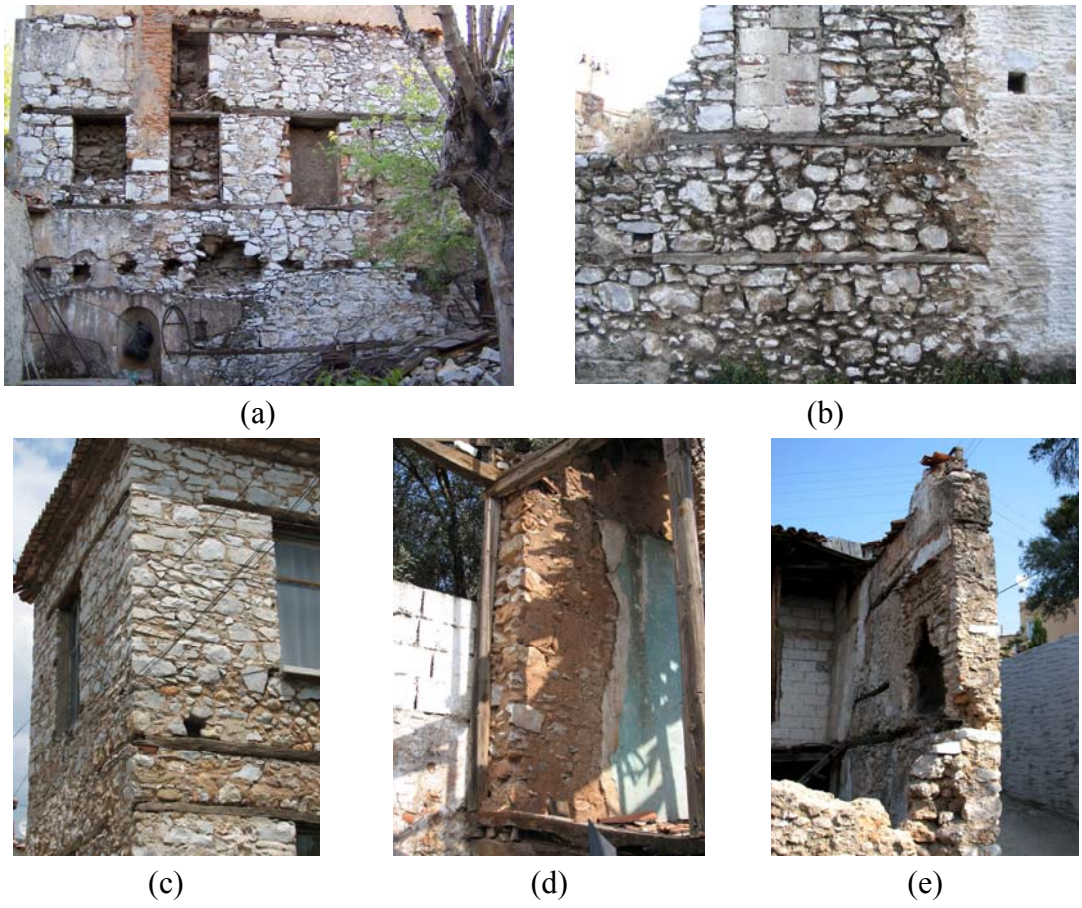


Figure 5.10. Views from rubble stone walls: a. Konakaltı St. No: 5, b. Yayla St. No: 13, c. Usage of big stones with regular shapes in the corners (Camcı St. 2nd dead end No: 36), d. Section of a ruble wall (Camcı St. 2nd end No: 34) and e. Şahidi St. No: 26

These rubble walls, that are relatively weak when compared to that of cut stone walls, are strengthened with wooden wall plates, *hatıl*s, the cross-sections of which vary between 5/6 to 11.5/11.5cm, and usually placed interior and exterior surfaces of the walls. Including the levels of sill, floor and eaves the vertical intervals between these wooden elements on the façades vary between 100 and 150cm (Figure 5.11 and Figure 5.12).

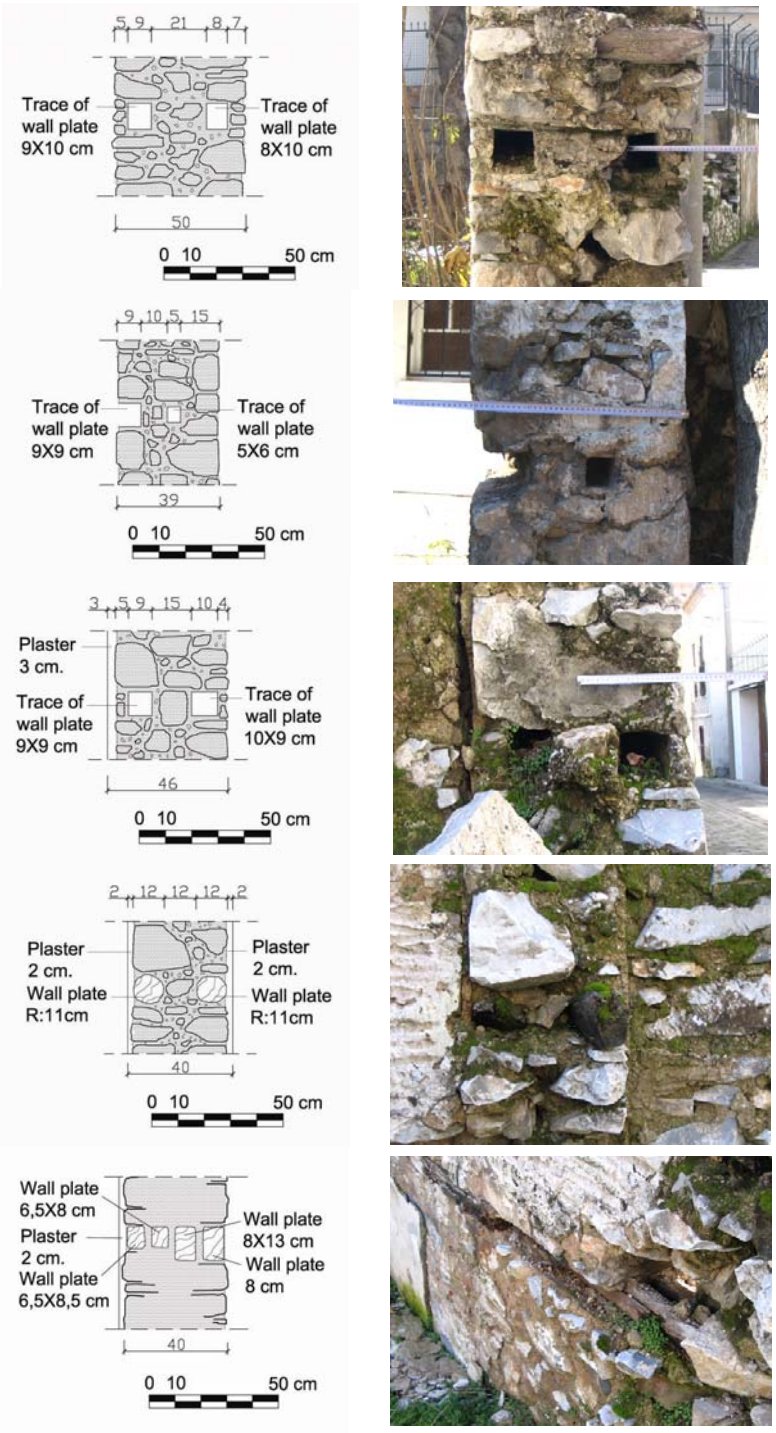


Figure 5.11. Uses of hatıls in ruble stone walls (İkizler St. between No: 12-14)

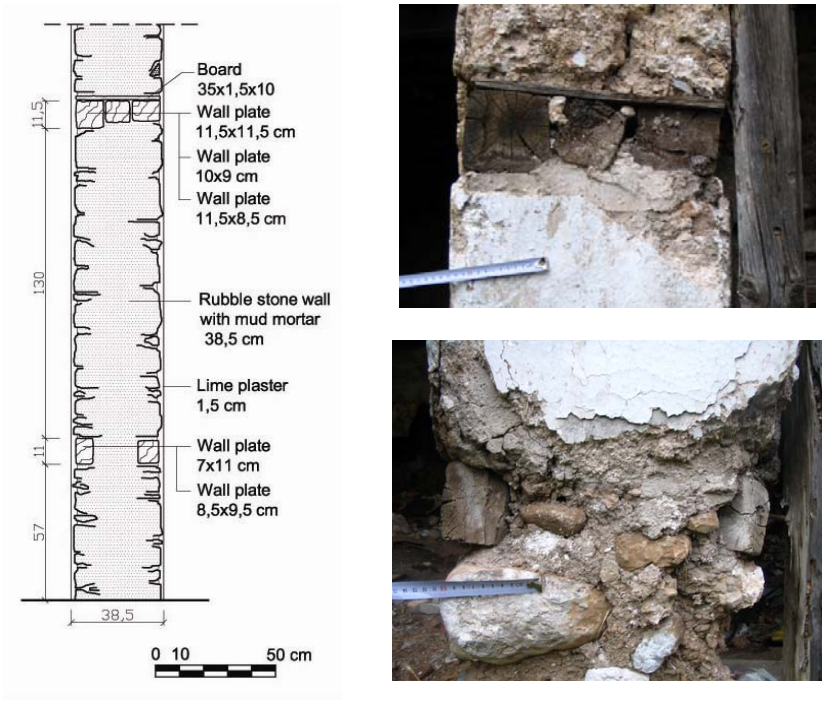
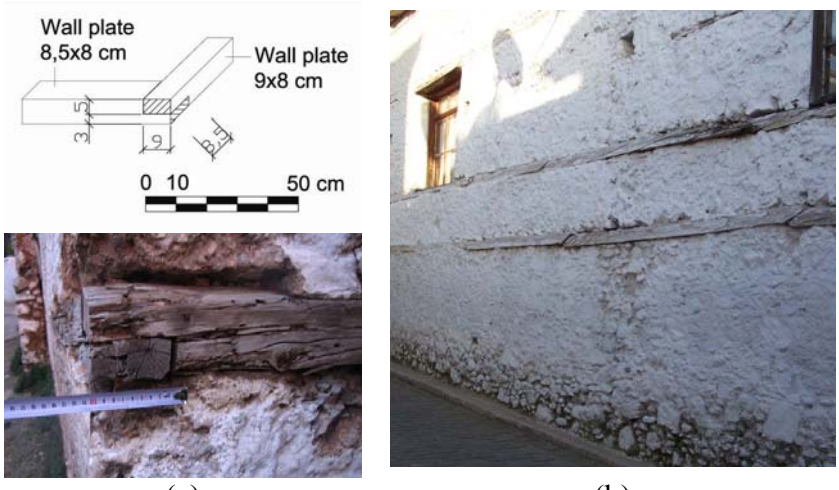


Figure 5.12. Hatıls placed in 100-150 intervals (Şahidi St. No: 26)

At the corners where they meet, *hatıl*s overlap each other in the form of half-lap joints in most of the houses observed in Muğla (Figure 5.13.a). It is observed that, in most cases the wall plates do not run throughout the whole façade. Two or more pieces were connected by the use of scarf joints (Figure 5.13.b).



(a) (b)

Figure 5.13. a. wall plates with half-lap joints at the corner (Şahidi St. No: 26), b. wall plates running through the whole façade with scarf joints (Yayla St. No: 18)

Another observation is that there are wooden ties, with about 9/9 or 10/10cm cross-sections, placed under the wall plates in floor levels with different intervals from 100 to 300cm. On the other hand, at the end of the wall plates, a board, 1.5-2cm in thickness and a length equal to wall thickness is placed over plates. Such members are most likely used to fasten the wall plates at the ends to prevent them from separating during the construction of the portion above (Figure 5.14).

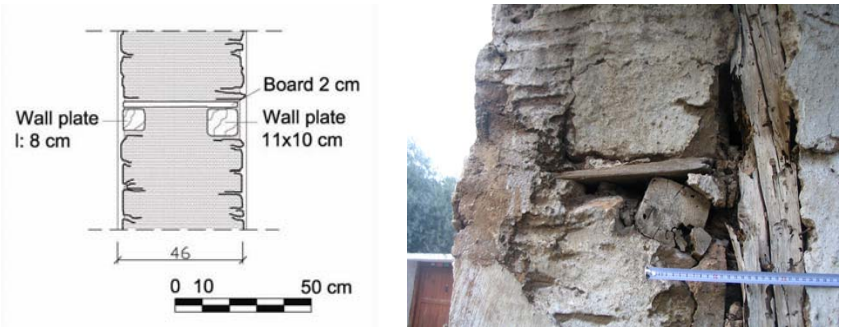
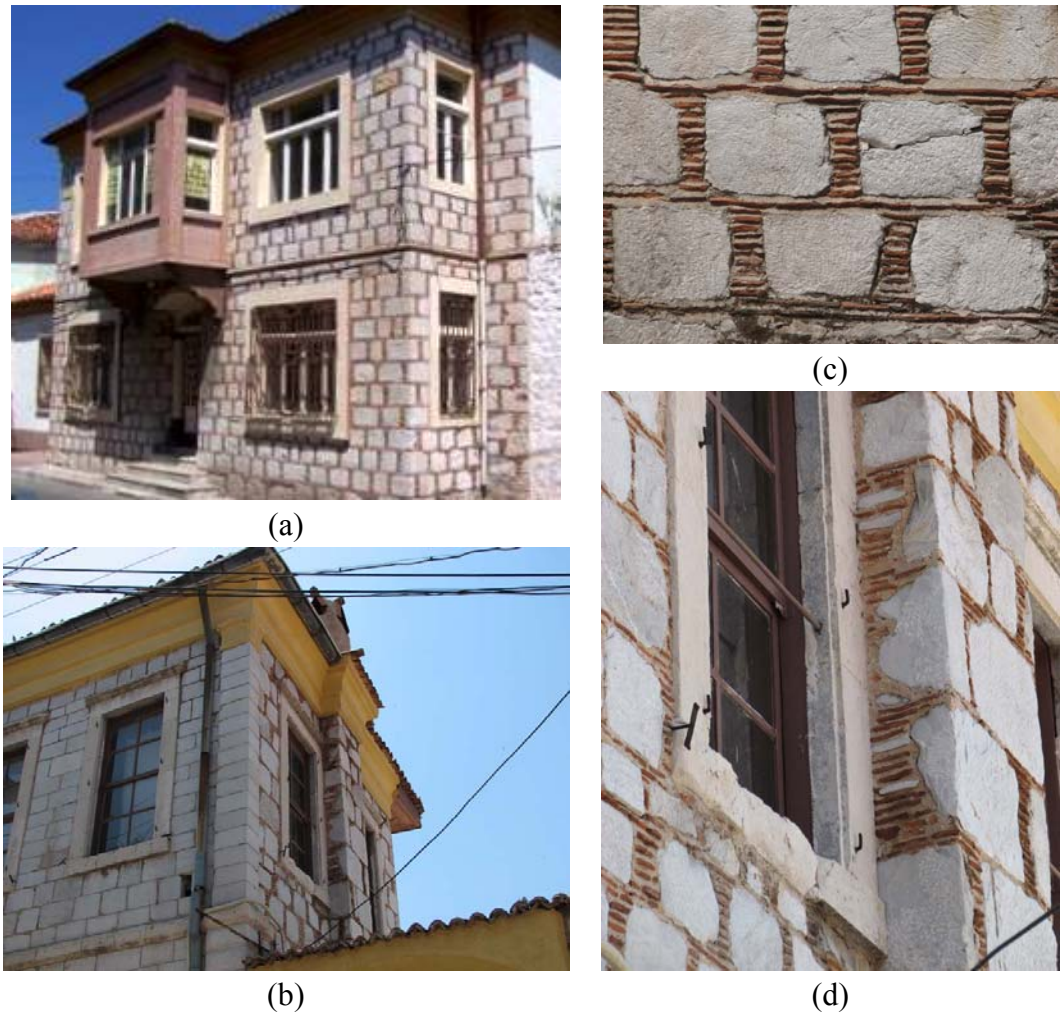


Figure 5.14. Connections of wall plates by the placement of board (Şahidi St. No: 26)

Inner surfaces of stone masonry walls are plastered. The outer surfaces are not plastered but white washed, in many cases annually. However, it is observed that the outer faces of the walls of some houses are plastered with a special technique, which is known as '*çivileme*' amongst the master masons of Muğla (Figure 5.15). In this technique, plaster is applied to the joints but extending over the stone surface to provide a further prevention against water penetration in addition to mortars in the joints (Aladağ 2007).

Figure 5.15. Rubble stone wall plastered with '*çivileme*' (Ulucami St. No: 24)

In the houses, built after the 19th century, the outer faces of the walls made of roughly shaped blocks of lime stone placed in horizontal courses with the pieces of roof tiles inserted between them are observed (Figure 5.16.a, Figure 5.16.b). They are said to be 45-50 cm in thickness (Süer 1990). Vertical joints are wider (Figure 5.16.c). As seen in Figure 5.16.d, it can be estimated that they are composed of two leafs; the outer leaf is cut stone of which its backside is left rough and inner leaf is of rubble outer face of which is plastered, or as in many cases in the region and in Anatolia, of timber frame with infill (Güçhan 2007). The openings in these walls are framed with stone casings in all sides of the opening. Since could not be entered, information is not available about the cross-section as well as the inner surfaces of these walls.



(a) (b) (c) (d)

Figure 5.16. Examples from façades made of cut stone a. Ragıp Bey St. No: 7, b. Hekimbaşı St. No: 9, c. Roughly shaped rubble stone wall with roof tile pieces Hekimbaşı St. No: 9, d. Corner joint of cut stones and opening in cut stone wall Hekimbaşı St. No: 9

In masonry walls, for constituting openings and supporting the portion of the wall above, generally, stone or wood lintels and arches are used. In Muğla houses, lintels are obtained by lying wall plates side by side through the cross-section of the opening either a door or a window (Figure 5.17).

Figure 5.17. Wall plates used as a lintel above the opening in rubble stone wall. (Şeyh Cami St. No: 32)

The number of plates changes from three to five depending on wall thickness and cross-sections of plates. In some cases they are extended till the corner of the wall. The frames of the openings are fixed to the wall plates placed at the mid of the opening in its each side perpendicular or parallel to side of opening (Figure 5.18.a and Figure 5.18.b).

(a) (b)

Figure 5.18. Wall plates placed at the mid of opening to fix jambs a. Yayla St. No: 13, b. Camcı St. 2nd dead end No: 36

As in many houses in Anatolia, one of the outer walls from ground floor to roof level, relatively thicker than the other walls (~ 90cm) is assigned as a service wall also in some houses in Muğla. In this wall fireplace, built-in cupboards and niches are placed. Similarly to the openings in rubble stone wall, the built-in cupboards and niches are also formed by using wall plates as lintels (Figure 5.19).

Figure 5.19. Opening of a built-in cupboard formed with wall plates (Konakaltı St. No: 5)

The exterior walls of the fireplace and the chimney make a protrusion, about 30-40cm, from the wall surface. In the case of a single fireplace, the width of this protrusion equals to the width of the fireplace together with its side walls. If there are two fireplaces, one in the ground floor and the other in the first floor, the width of protrusion increases. For the arrangement of two fireplaces on the ground and first floors are not positioned on the same vertical axis. They are set in a way that each chimney of which are placed side by side on two separate axes (Figure 5.20).

Two fireplaces can be arranged in the same wall structure making a single protrusion raised from the ground to the level of the roof, or in separate protrusions on the same wall (Figure 5.21.a and Figure 5.21.b). In such a case, the back wall of the first floor fireplace is laid by deviating it on a wall plate set above the back wall of the fireplace on the ground floor (Figure 5.21.b). In case of the absence of a fireplace below, the exterior walls of the fireplace are laid on the big sized stone blocks set and

protruded from the wall (Figure 5.22.a). The width of the protruded wall is decreased to the thickness of the chimney wall below or above the level of the eave.

(a) (b)

Figure 5.20. Arrangement of two fireplaces in different levels. a. view from the fireplaces inside the house (Karamuğla St. No:29) and b. view from protrusions in the façade (Pirinççiler St. No: 1)

(a) (b)

Figure 5.21. a. Two fireplaces placed in a single protrusion (Camcı St. No: 66), b. Protrusion of fireplace in the first floor set on wall plates above the one in ground floor (Yayla St. No: 18)

(a) (b)

Figure 5.22. a. Protrusion of fireplace in first floor set on big stones placed in the wall (Yayla St. No: 18). Views from the inside of chimney (Şahidi St. No: 26). b. through fireplace, c. through upper part of chimney

The flue of the chimney, which is also concealed in the same wall without protrusion measures 30/45cm and its inner surface is plastered to provide a better draught while preventing the leaks of smog through the joints of the rubble masonry (Figure 5.22.b). However, the outer surface of the walls of this chimney is also white washed without plaster like the other walls of the house.

5.3.2 Walls of *Hımış* System

Hımış construction technique which emerged in the 18th century and used until 1960s when the concrete system was began to use. This widely used construction system have been displayed a good performance against earthquake even today (Akan 2004, Doğangün, et. al 2006).

Hımış system of Muğla houses are generally composed of the wooden framework and infill materials placed in its compartments. The structural components of the frame are the main posts, wood beams, studs and, horizontal and diagonal bracings (Figure 5.23). The frame is set on the wood beam which is the base for the wall. The cross-section of the beam, usually square and dimensions of which vary between 10/10 and 12/12cm mostly. Its length depends on the wall span. The main

posts, placed on wood beam at the corners and main axes of the walls, have a cross-section similar to beams. There may be wood headings on these posts for making a wider base for the beam to rest, and placed on them decreasing the span they support. The headings are about 60-65cm in length and tapered towards its edges. The span between the main posts is divided into partitions with studs of 9/9, 10/10cm in cross-sections. Each partition is again divided by horizontal and diagonal bracings into further compartments to be filled with infill materials. Generally a main diagonal bracing, with a cross section almost equals to the main posts, is placed at the corners of the wall. The dimensions of the cross sections of studs and other bracings varied between 4/8 and 10/10cm. All these members are fixed each other by nails without any joints. Their edges either left unshaped or tapered according to their positions in the frame.

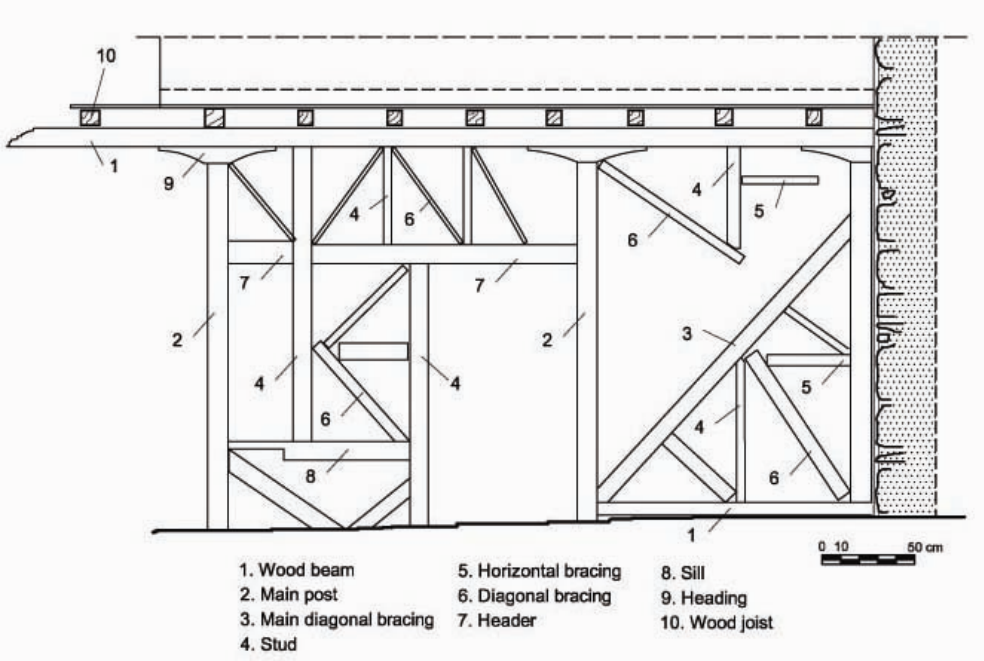


Figure 5.23 Components of a *hımış* wall (Şahidi St. No: 26)

The openings in *hımış* walls are placed between two studs (Figure 5.24, Figure 5.25.a and Figure 5.25.b). The jambs are fixed to the posts in the frame or to the studs added for this purpose. Serving as lintel, headers are placed on the upper parts of the openings between studs. In window openings, there is a sill between studs which is also support the stud placed for jamb. The cross sections of these members are 7/7, 8/8 or

10/10cm in dimension. The portions of the wall under the sill and above the header are also divided with stud and diagonal bracings further. If the window opening is close to the corner of the wall, the stud closer to the corner and the sill which form the opening, set on the main diagonal bracing at the corner of the wall (Figure 5.25.c).

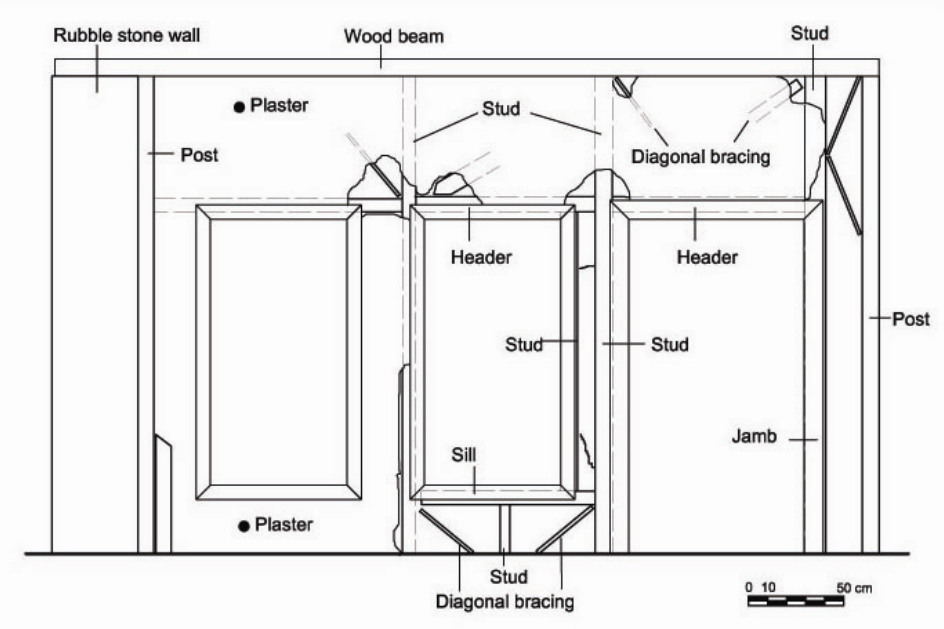


Figure 5.24. Openings in timber-framed wall. (Şahidi St. No: 26)

(a) (b) (c)

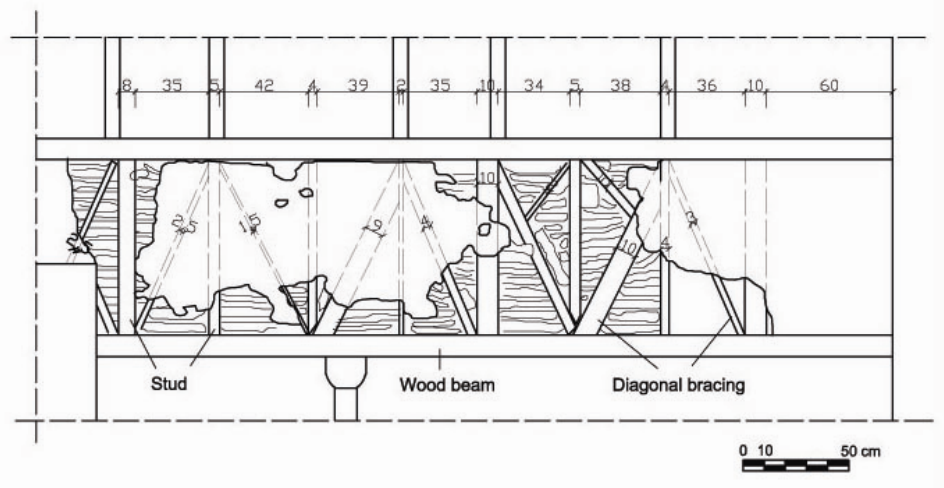
Figure 5.25. a. and b. Openings in *hımış* wall (Saatli Kule St. No: 70), c. Opening set on diagonal bracing at the corner Süleymanbey St. No: 10

In the walls without opening, partitions between main posts can be divided further by main diagonal bracings supporting the posts. In this situation the studs may not be necessarily extend till the wall height but fixed to main bracing like the other bracings (Figure 5.26).

(a) (b) (c)

Figure 5.26. Views from infilled hımış wall. a. Şahidi St. No: 26, b. Saatli Kule St. No:70 and c. Konakaltı St. No: 7

The infill materials of these walls are mud, brick, stone, usually mixed with lime mortar, and wood. However, the rubble stone with mud mortar is common infill in Muğla houses owing to being easily obtainable in the region. Infill material of the house in Şeyh Cami St. No: 32 is wood pieces which was the only observed example in Muğla urban site during the survey. In this wall structure, wood pieces of 3-4cm in thickness, are placed parallel to wood beam, between frame components with mud mortar, but not nailed on to the frame members making the structure lightweight (Figure 5.27). If those pieces are nailed, the system is referred as *dizeme* technique applied in inner parts of Western Black Sea Region such as Bolu, Mudurnu and Göynük. *Hımış* walls are plastered on both sides with lime plaster, sometimes including chopped straw (*kıtık*) and goat hair. The common problem for plastering these walls is the lack of adherence capability to wood elements. To solve this problem, the beams in floor level and posts in the corners are covered with wooden veneers (Figure 5.28.a and Figure 5.28.b) or the surface of the wood elements are notched or nails are partially inserted into the wooden member and slightly bended making an uneven surface to hold the plaster (Figure 5.29).



(a)

(b)

(c)

Figure 5.27. Timber-framed wall with wood-infill. a. partial elevation drawing, b. and c. views from the façade (Şeyh Cami St. No: 32)

(a)

(b)

Figure 5.28. Covering wood elements in corners and floor levels with veneer; a. Saburhane St. No: 44, b. Bahçe St. No: 53

Figure 5.29. Using nails to hold plaster applied on wood elements (Şeyh Cami St. No: 32)

5.3.3 Walls of *Bağdadi* System

The *bağdadi* type of construction is frequently considered as a wall structure technique similar to *hımış*. In this technique, thin – usually not of more than one centimeter in thickness – bands of wood bands are nailed on both faces of the frame members to hold plaster. While used for plaster base it is also noted that *bağdadi* system also increases the resistance against earthquake (Doğangün, et al. 2006, Langenbach 2002, Karaesmen 2002) even more than *hımış* system, if the gap between the surfaces is not infilled (Akan 2004). Both *hımış* and *bağdadi* systems may also be employed in the same house as the one found in Saatli Kule St. No: 70 (Figure 5.30).

(a) (b)

Figure 5.30. Use of *hımış* and *bağdadi* techniques in the same house (Saatli Kule St. No: 70). a. *Hımış* wall, b. *Bağdadi* wall

Despite its contribution to the seismic stability bağdadi system is usually referred as plastering technique, having the similar duty with that of 'rabiç' (wire mesh) not only on flat surfaces but also used to form curved surfaces such as vaults, bracings of cumbas (see section 5.4, Figure 5.41, Figure 5.50 and Figure 5.52).

5.4 Floors

As stated by Aladağ, Muğla house does not possess a mezzanine floor between ground and first floor differing from other houses in Anatolia (Aladağ 1991). Therefore the examination of the floors of Muğla houses covered the floors of courtyards, ground and first floors.

5.4.1 Courtyard

The pavement of courtyard is usually formed of large sized plates of slate or cobble that are set on the leveled land. However, some houses in Saburhane district, the pavements may also be formed of pebbles that are embedded in the leveling mortar (Aladağ 1991). Since they are destroyed or changed largely with concrete, original floor structure of the courtyard could be observed only in one house during the survey (Figure 5.31).

Figure 5.31. Views from a slate stone pavement of courtyard (Arasta St. No: 9)
(Source: İYTE 2005)

5.4.2 Ground Floor

The ground floor of the earlier example of Muğla houses without basements were composed of slate or earth, often white clay, which are laid over bare earth. Owing to the progress in time, clay tile and wood are used. Common type of material is wood in most of the houses reached today (Küçükerman 1996). In a house, at Recai Güreli St. No: 12, which was recently demolished to be rebuilt, the system of the ground floor was comprised of planks nailed on the joints (with the intervals of 35-45 cm) rested upon the wall plates with different cross-sectional dimensions (12/15 cm) which were set on the protrusion of the basement wall. Other than being a basement, the space below the floor is very shallow, likely that it was functioning as the gallery for ventilation. The cross-sectional dimensions of the joist were 7/2, 7/9 or Ø12 cm and of the wall plates, which were used in pieces in varying lengths (Figure 5.32, Figure 5.33).

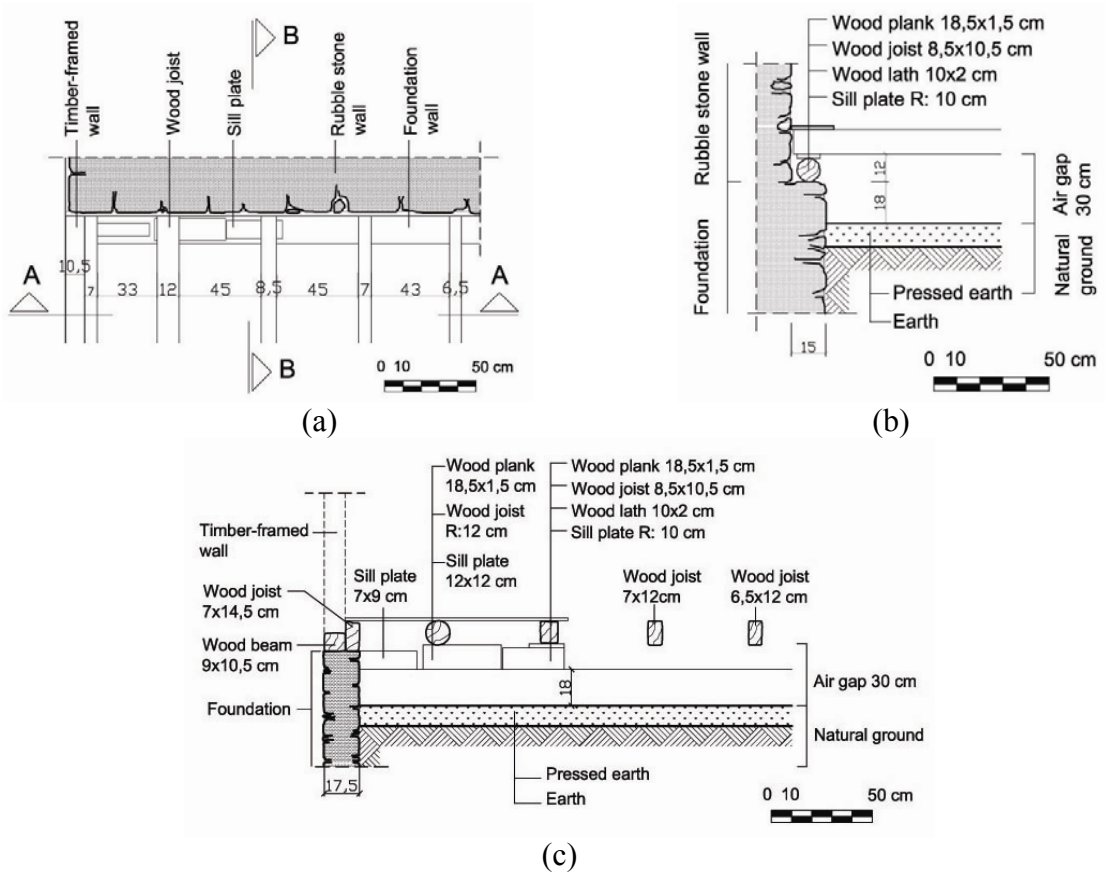


Figure 5.32. Details of a ground floor covering the basement. a. Plan, b. Section B-B, c. Section A-A (Recai Güreli St. No: 12)

Figure 5.33. Views from ground floor covering the basement (Recai Güreli St. No: 12)

In the second example at Şeyh Cami St. No: 32 and unfortunately burned during the survey time, the house had a similar space but it was higher (1.20 m) and was possibly used as the basement. The ground floor above this basement was formed in a way similar to the former example. Joists (approximately 8/8 cm), on which planks were nailed, with 30-45 cm intervals rest on the beams with the cross section of approximately 12/12 cm. Two beams were set on the wall where it extended upward in a different system, which was of wood frame with infill (Figure 5.34).

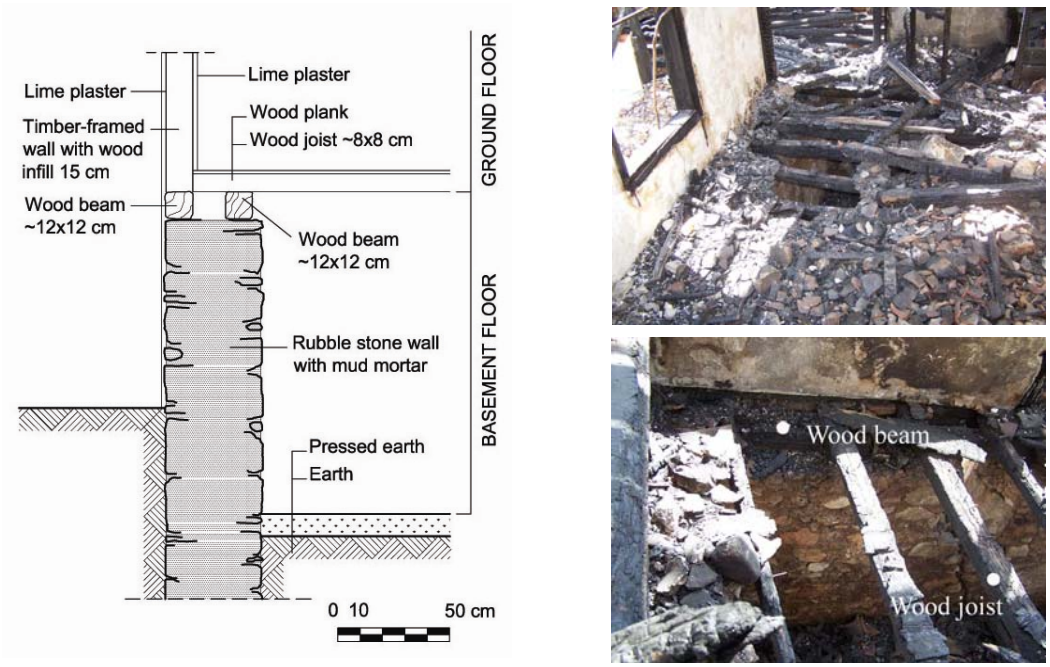


Figure 5.34. Connection detail of ground floor with *hımış* wall if there is a basement (Şeyh Cami St. No: 32)

The members (studs and bracings) of the upper wall rested on the beam which was set at the exterior side of the basement wall. When the upper extension of the basement wall is of masonry, the beam takes place longitudinally in the wall, or adjacent to the wall and supported at the mid with a wooden post which is rested on a stone block (discontinuous/single footing) (Figure 5.35). The ends of the beams perpendicular to the wall were supported by wall plates.

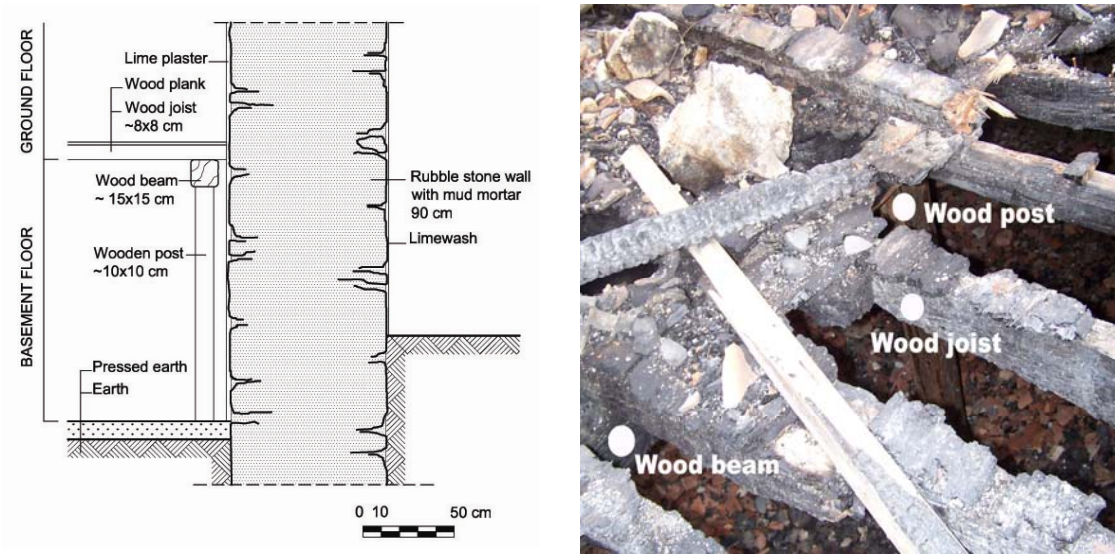


Figure 5.35. Wood beam supported by wood post in ground floor (Şeyh Cami St. No: 32)

5.4.3 First Floor

The positioning and connection details of the flooring system of the first floors largely depend on the wall structures of the first and ground floors. If both ground and first floor walls are rubble stone masonry, generally, wood joists rest on wall plates in the interior surface of the wall (Figure 5.36).

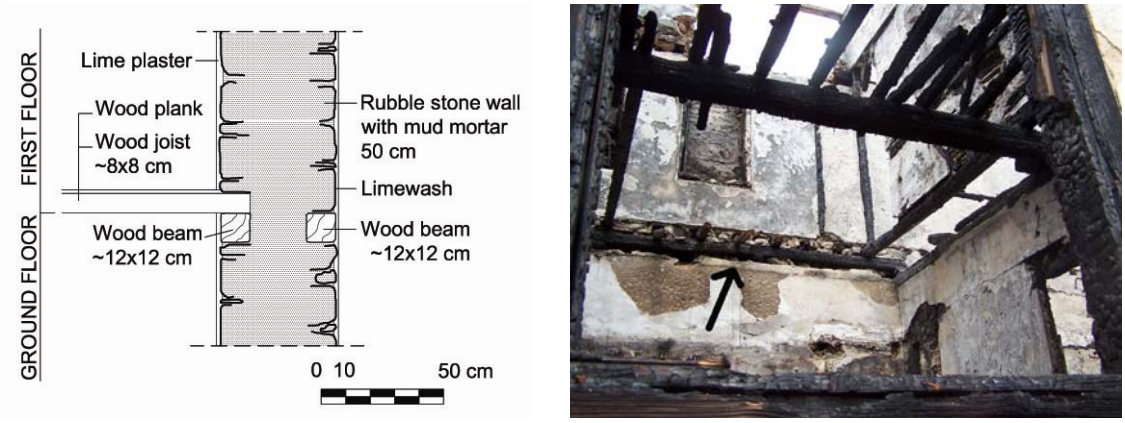


Figure 5.36. Connection detail of first floor joists with rubble stone wall (Şeyh Cami St. No: 32)

Another solution is making a platform by decreasing wall thickness in upper floor. In this technique, the ground floor wall thickness reaches 90 cm because of placing fireplace inside the wall. Wood joists are placed on wood beams laid on this platform and the gaps between joists are filled with rubble pieces with mortar (Figure 5.37). In another example (Şahidi St. No: 19), wood joists are placed on wall plate in exterior surface of rubble stone wall and wooden beam of wall structure is laid above the wood joists (Figure 5.38).

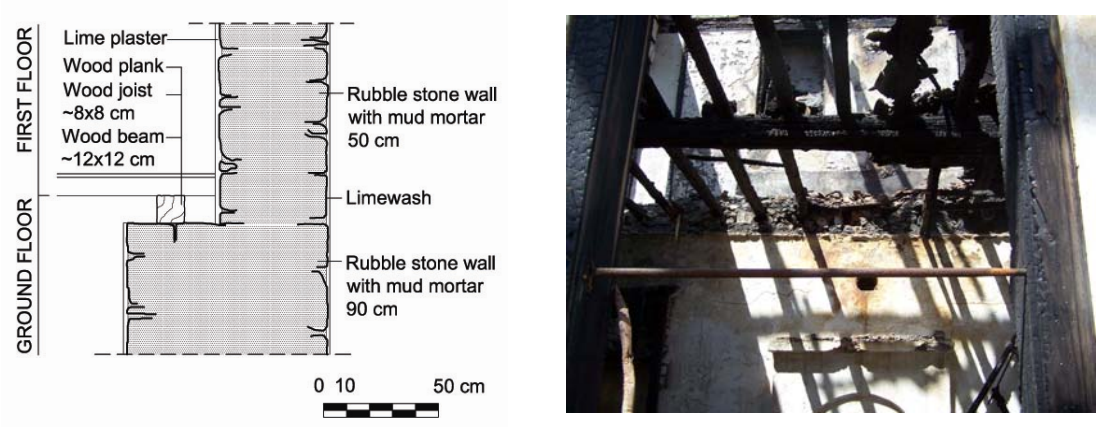
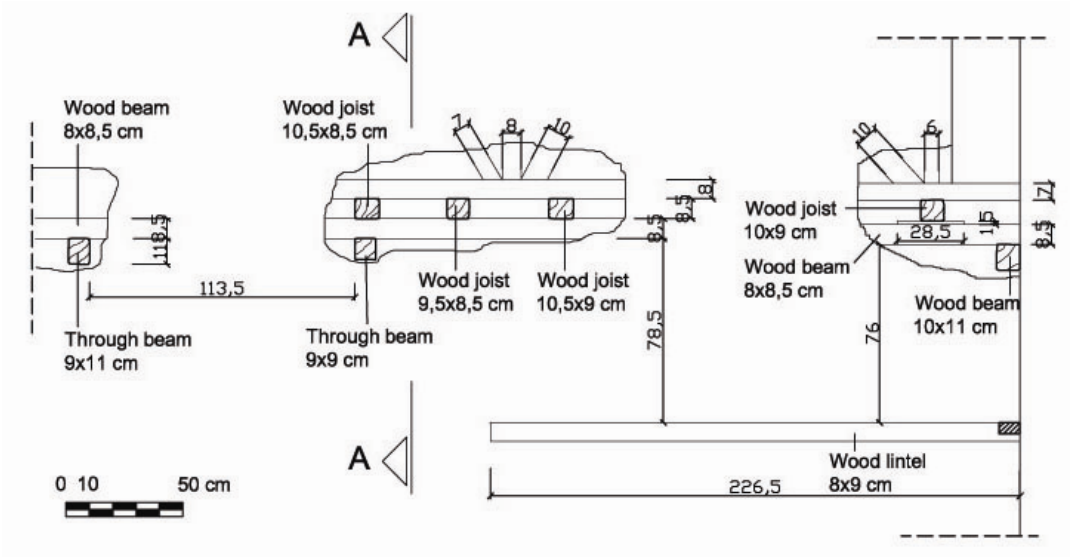
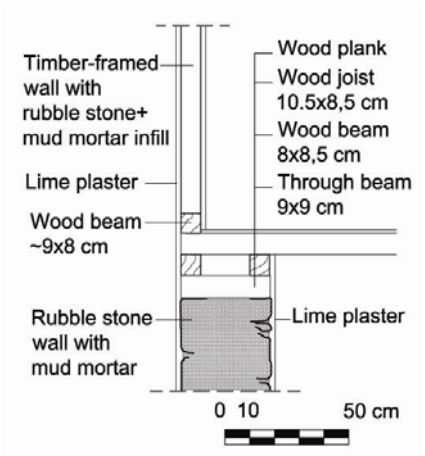


Figure 5.37. Connection detail of first floor joist with rubble stone wall (Şeyh Cami St. No: 32)



(a)



(b)

(c)

Figure 5.38 Connection detail of timber flooring with timber-framed wall in first floor. a. partial elevation, b. section, c. view from the façade (Şahidi St. No: 26)

If both of walls are made of timber-framed, generally, wood joists are placed on the wood beam which is supported by the posts and studs of the ground floor wall. Another beam is set on these joists. The posts and studs of first floor wall rest on this beam (Figure 5.39). In second solution, wood beam on which joist rested, is placed perpendicularly on the timber frame of the wall (Figure 5.40).

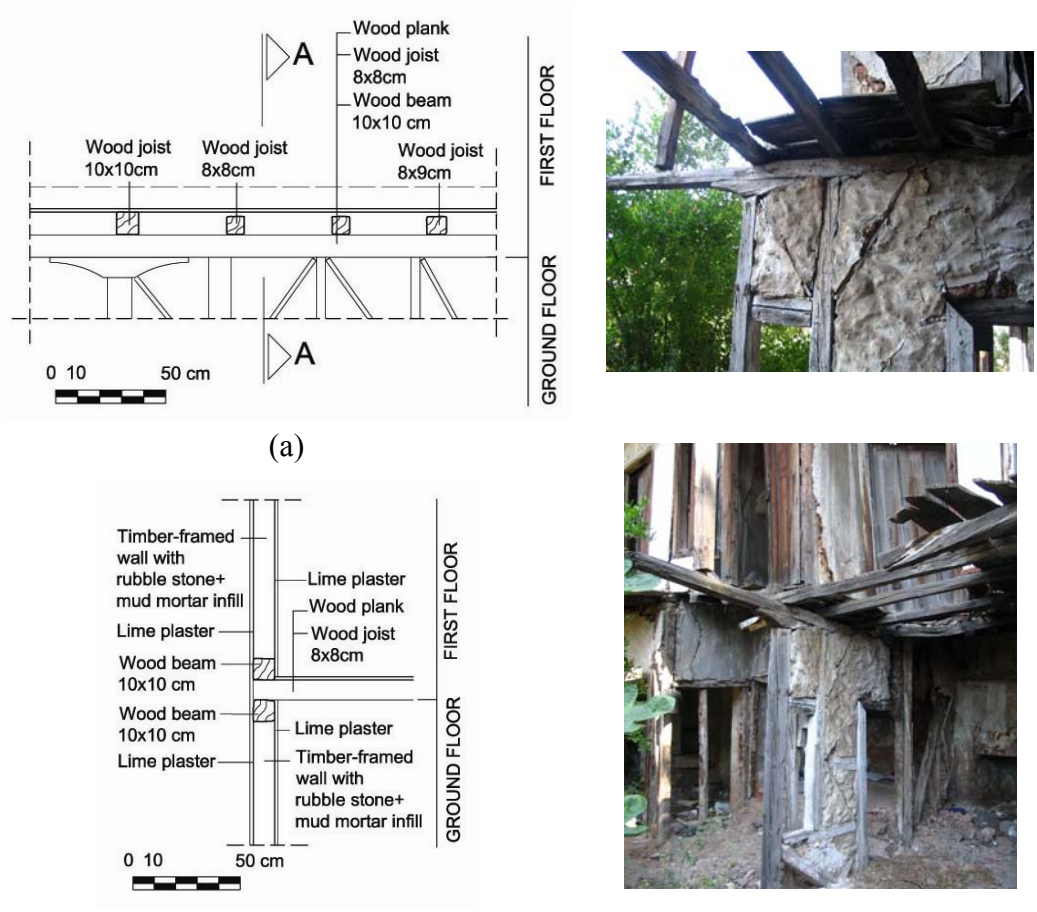


Figure 5.39. Connection detail of first floor wood joists with timber-framed wall (Şahidi St. No: 26) a. partial section, b. section A-A, c. views from the floor

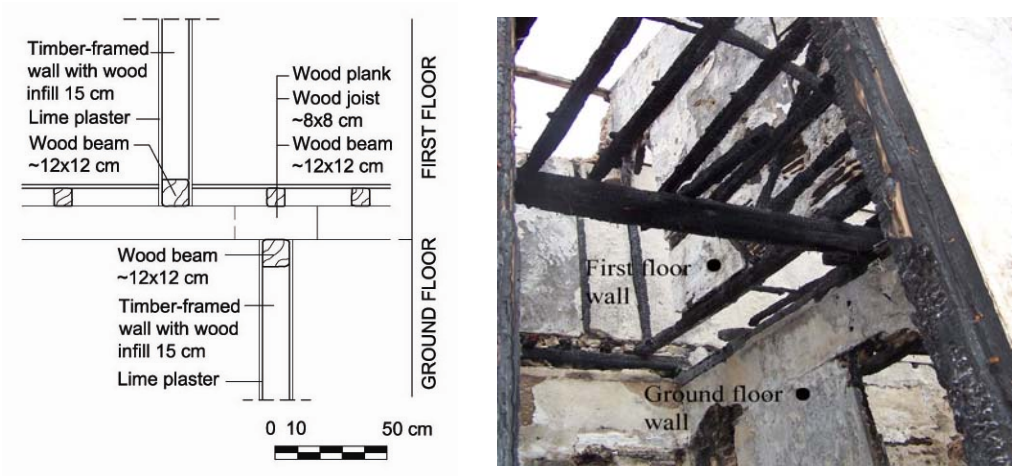
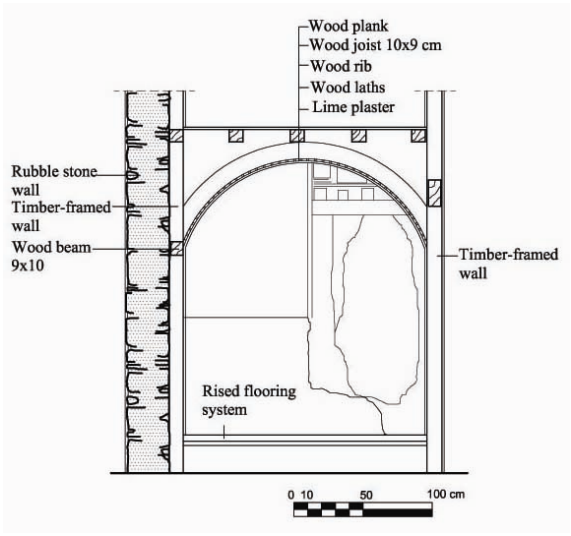


Figure 5.40. Connection detail of timber floor with timber-framed wall (Şeyh Cami St. No: 32)

The ceiling of the ground floor is left uncovered. However, the first floor ceiling is formed with lath, 5/5 cm in dimension, nailed on bottom of tie beams in roof structure with 30 cm intervals. These laths covered with wood planks, 1.5 cm in thickness and 20cm in width. The ceilings are mostly modest but the ornamented ones are also found in Muğla houses (Aladağ 1991).

With respect to ceiling, *bağdadi* system was also applied in Muğla houses. Vaults observed in two houses at Şahidi St. No: 26 were formed by laths that are nailed on curved ribs (obtained by uniting three or more pieces of flat wood-members forming a curved line) and plastered (Figure 5.41.a, Figure 5.41.b and Figure 5.41.c). A similar technique was also observed in the wet space of another house at Arasta St. No: 9 surveyed by İ.Y.T.E. (2005) (Figure 5.41).

(a)



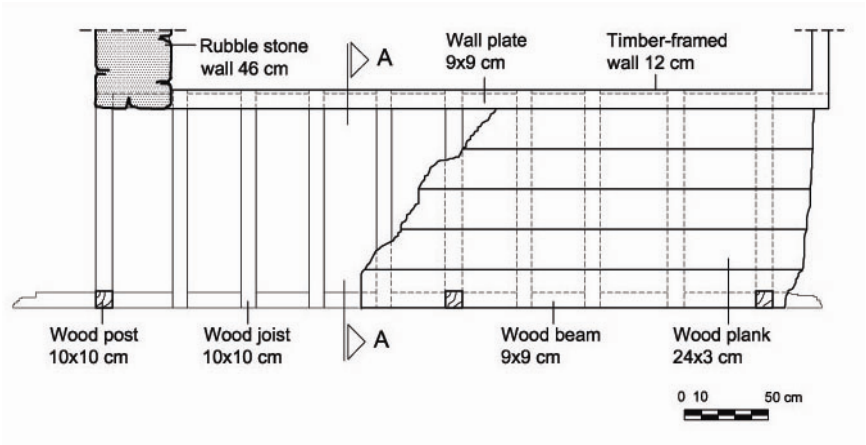
(c)

(b)

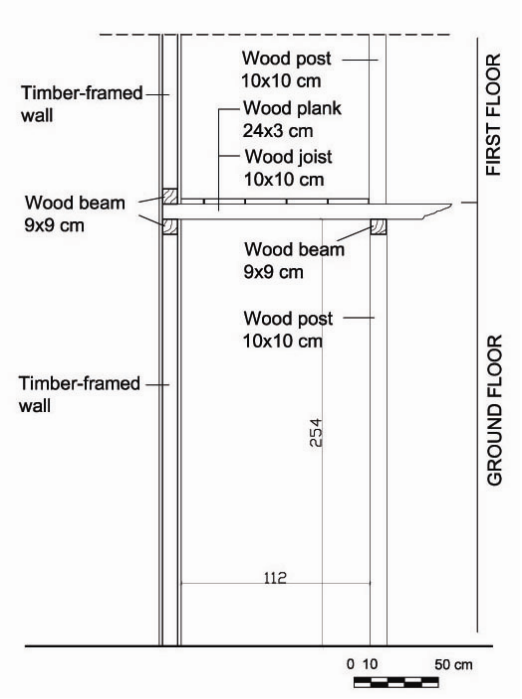
(d)

Figure 5.41. *Bağdadi* vaults. a. and b. views, c. section of *bağdadi* vault at a house (Şahidi St. No: 26) and d. view from the *bağdadi* vault at Arasta St. No: 9 (Source: İYTE 2005)

As an extension of the first storey, sofa floor is supported with wood posts, about 12/12, 11/11, 10/10 cm in cross-section and arranged with intervals around 150-240 cm in the houses with outer sofa (Süer 1990, Aladağ 1991) (Figure 5.42).



(a)



(b)

Figure 5.42. Components of sofa and connection of wood joist with timber-framed wall (Şahidi St. No: 26). a. plan, b. section A-A

These wood posts, with chamfered edges, are placed on stone blocks (slate stone) in the ground and finished at top ends with wood head, called '*vuruş*', in order to diffuse the load (Figure 5.43).

Figure 5.43. Detail of 'vuruş' (Camcı St. 2nd dead end No: 34)

The lengths of these heads vary between 60-80 cm length and they have triangular shape formed by chipping them towards the ends. Its later examples are volute shaped. The posts in the ground floor are tied with wood beam with variable cross-sections between 8/9, 12/12 cm. The floor of sofa is constituted with wood joists, 6/9, 8/9, 9/9 cm in cross-sections, placed on the wood beam at one or both of their edges, or to the wall plate of the rubble stone wall depending on the supporting structure in the ground floor (Figure 5.42). They are covered with wood planks of 2-3 cm in thickness. The posts of the first floor set either on wood joist or on a beam placed on wood joists. When second beam is used, the posts of two floors may not be placed on the same axes. Since they rest on the beam rested on the joists that are also placed on a beam, their axes may be deviated (Figure 5.44). The interval between the first floor posts enveloped with wooden railing called '*tırabzan*', or a thin wall made of infilled timber-frame with lime plaster 90 cm height (Aladağ 1991, Tosun 1985, Ekinci 1985).

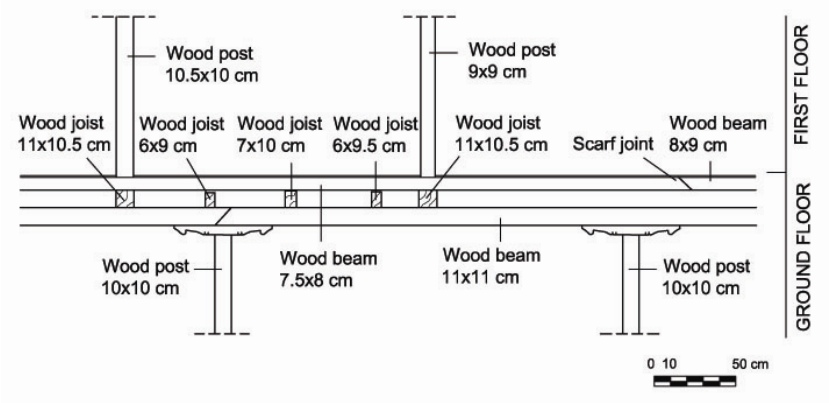


Figure 5.44. Sofa with posts in different axes (Camcı St. 2nd dead end No: 34)

There may also be an imitation of '*Bursa arch*' between the upper parts of these posts formed by fixing the woods in cut with quarter-circular shapes in the ends, laths nailed between and plastered with lime and goat hair (Figure 5.45), (Aladağ 1991, Ekinci 1985).

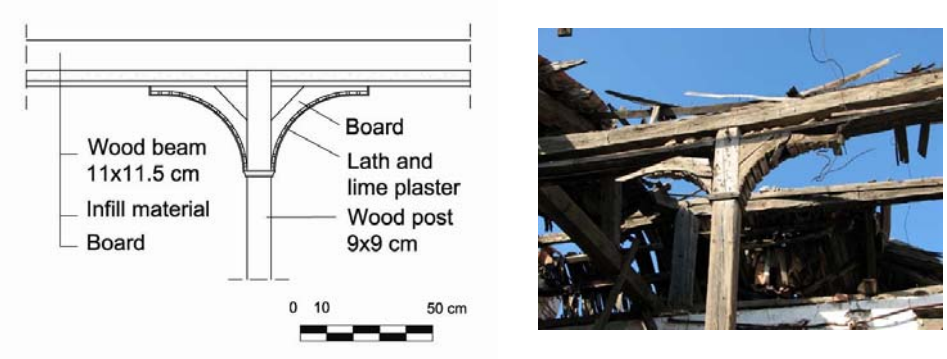


Figure 5.45. Detail of Bursa arch (Cami St. No: 12)

In the inner sofas, the wood joists are supported by wood beams on the posts of ground floor, in front, and on the wall plates of the ground floor walls, at the other sides. The ceiling of the sofa in ground floor left without veneer while in the first floor covered with wood planks nailed to laths, 5/5 cm in cross-section, placed under tie beams of the roof trusses.

In some houses there are elements, called '*kerevet*', placed on one edge of the sofa, elevated around 50-70 cm from the sofa floor and extended 75-100 cm over the courtyard or street (Figure 5.46). It is supported either by posts or bracings connected the sofa beam on which railing of the sofa took place (Figure 5.47).

Figure 5.46. Views from *kerevet* (Cami St. No: 12)

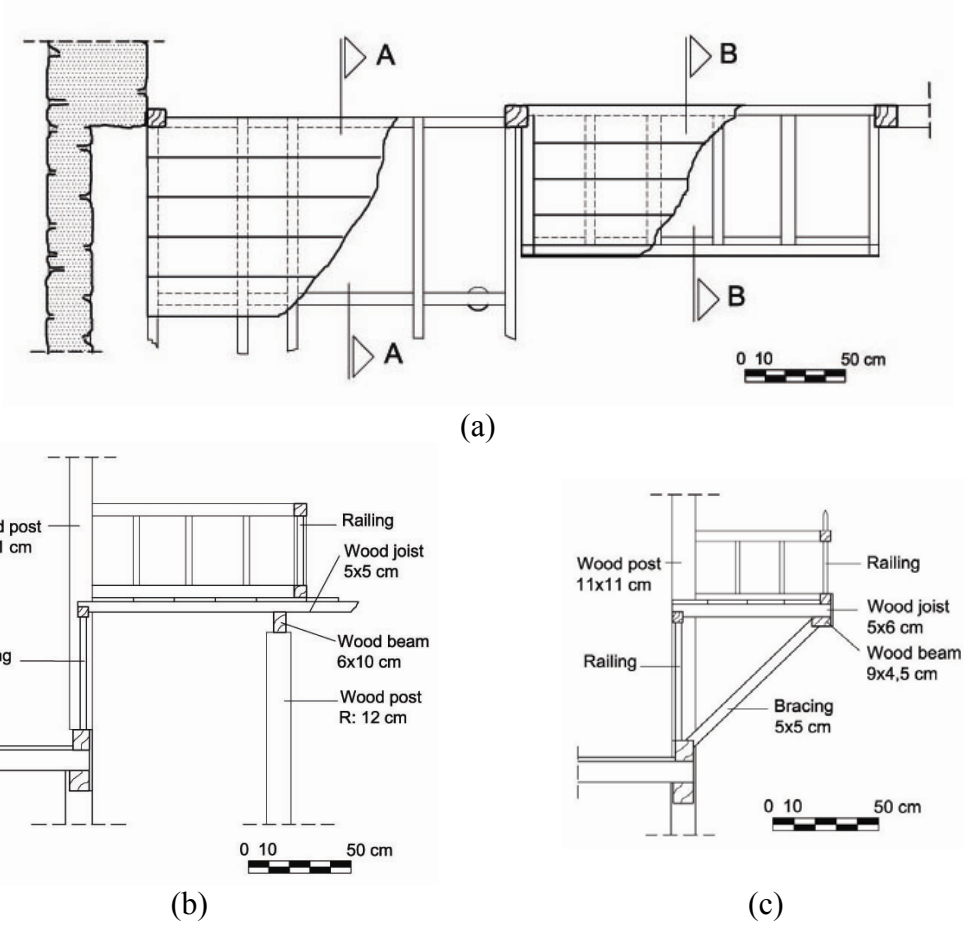
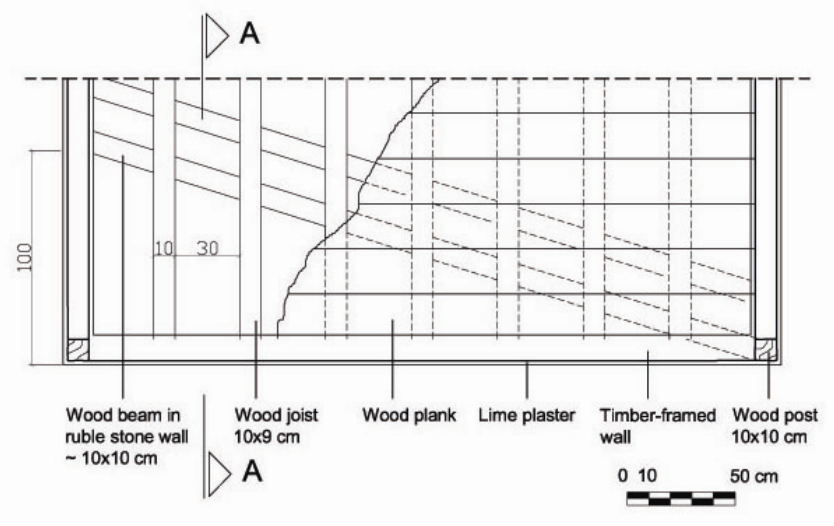


Figure 5.47. *Kerevet* (Cami St. No: 12). a. plan, b. section A-A, c. section B-B

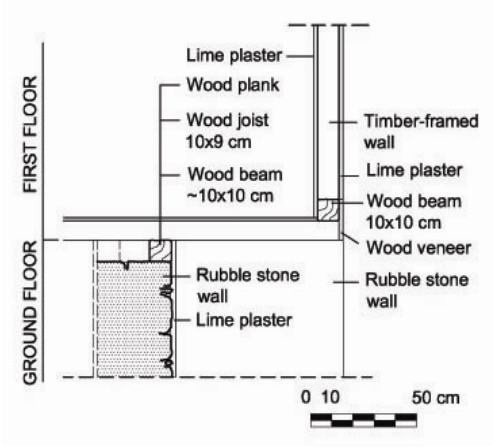
5.5 Projections

In some of Muğla Houses, especially in the late ones, there is a projection, called '*çıkma*' on their street façades with an approximate extension of 70-100 cm through street.

The projection observed in Muğla houses are made for two different purposes. First one is applied to correct the distortions of ground floor layout which is shaped by the plot, in the first floor. In this type the projection, generally triangular in plan, formed by extending wood joists of first floor, supported by rubble stone wall of the ground floor and tying them with a wood beam at the end, the base of timber-framed wall of the projected part (Figure 5.48).



(a)



(b)

(c)

Figure 5.48. Projection for correcting distortions in first floor. a. Plan, b. section A-A, c. a view from projection (Sekibaşı St. No: 16)

The second type projections are made for widening the street vista to be perceived from inside the house. These projections, seen especially in late houses and the ones situated in the lower part of the site where the land evened are the parts of a room or sofa and their widths change between 200-400cm depending on the widths of rooms and sofas. The construction principle of this type is similar to the first one. However, such type of projection or jetty, called '*cumba*', is supported by two or more bracings. The connections of the braces with wood joists are made in two different ways; placing the wood joists on bracings (Figure 5.49 and Figure 5.50) or on wood beam supported by bracings (Figure 5.51).

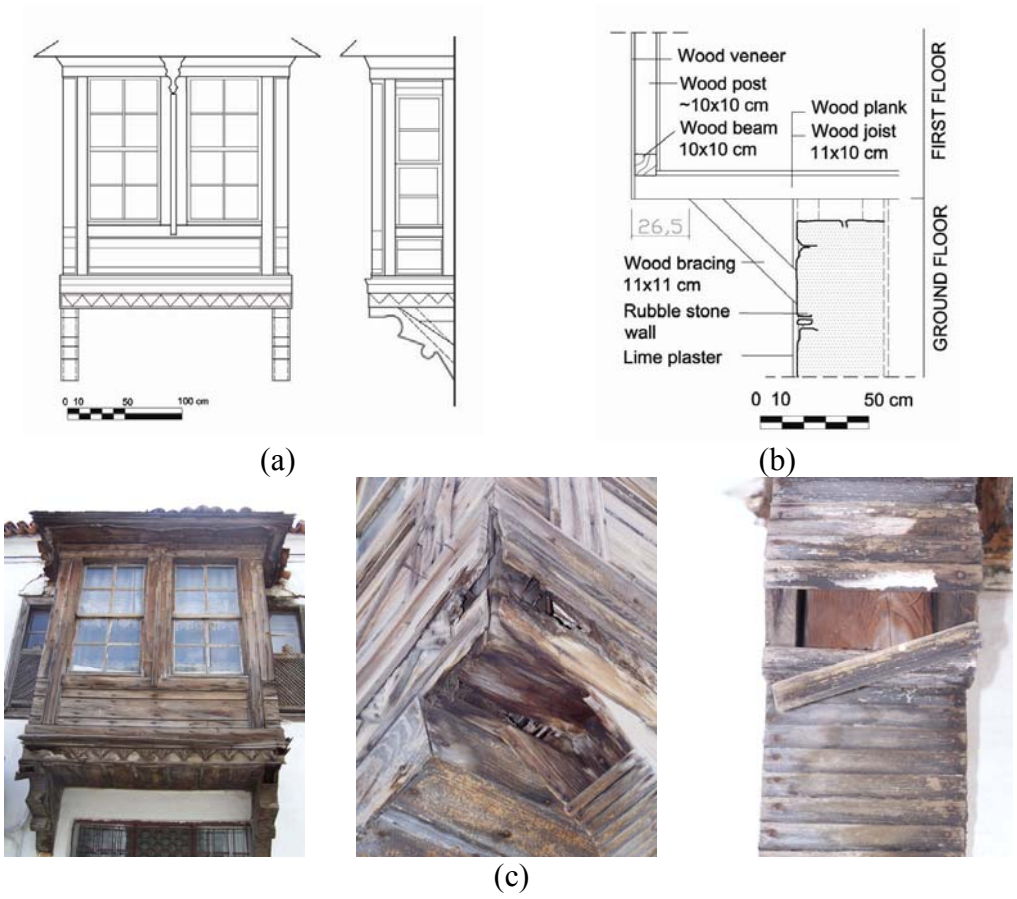


Figure 5.49. *Cumba* supported with bracings covered with wooden veneer. a. front and side elevation, b. section, c. views from *cumba* (Uçarcılar St. No: 6)

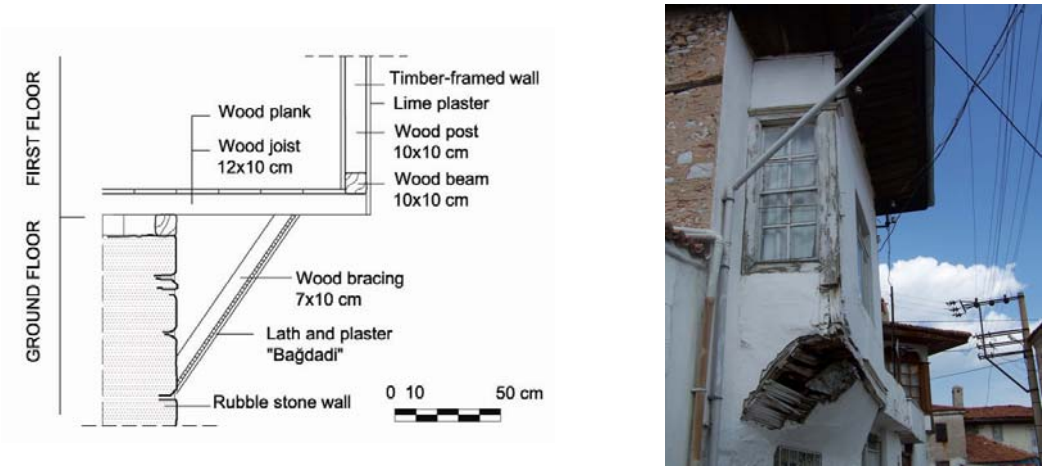
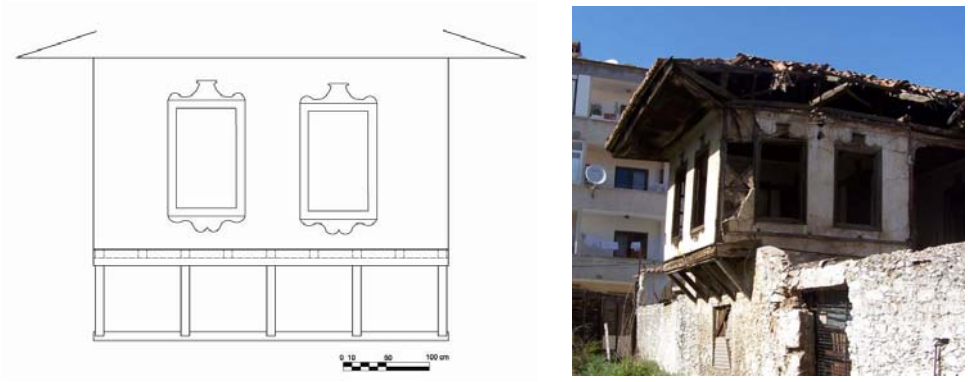
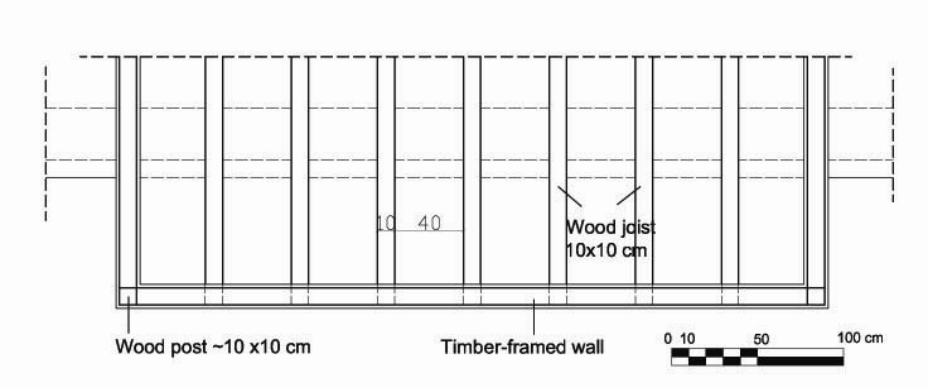


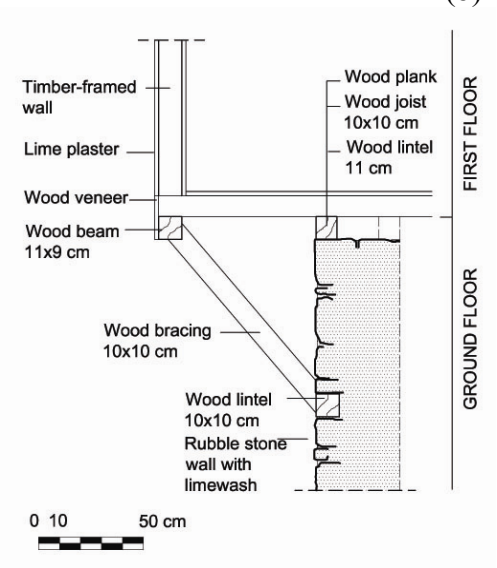
Figure 5.50. Projection supported with bracings covered with *bağdadi* type of plastering (Sekibaşı St. No: 21)



(a)



(b)



(c) (d)

Figure 5.51. *Cumba* supported with five wooden bracing; a. elevation, b. plan, c. section and d. close views (Üçler St. No: 6)

Similarly, the wood beam, the base of the timber-framed wall, placed over wood joists. In the bottom of *cumba*, the wood joists are left open or covered with boards with

ornamentations. As seen in an example (Sekibaşı St. No: 6), *bağdadi* type of plastering technique is applied at the bottom of the *cumba* (Figure 5.52).

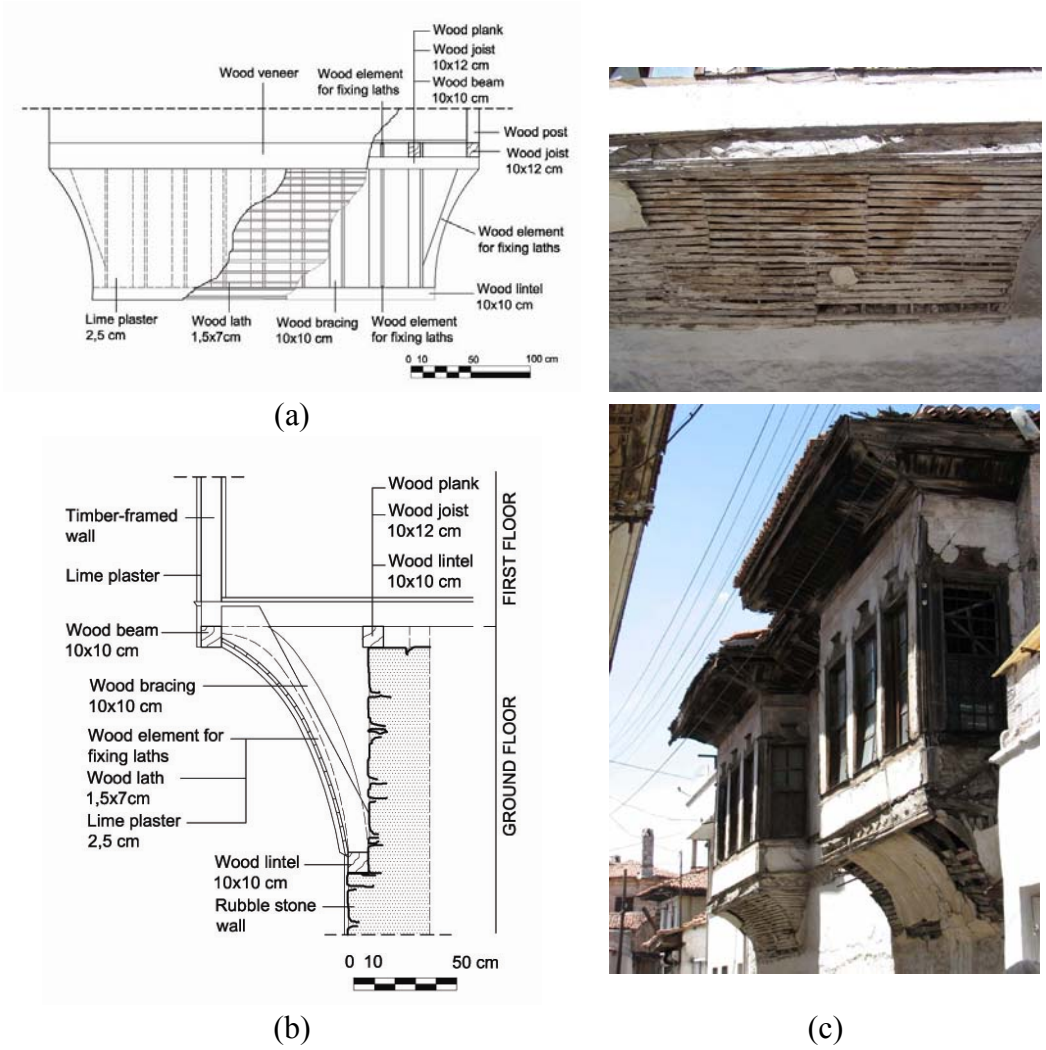


Figure 5.52. Partial elevation and section of the *cumba* supported with wooden bracings covered with plaster on laths (*bağdadi*); a. partial elevation, b. section, c. views from *cumba* (Sekibaşı St. No: 6)

Braces, of wood or iron, are fixed at one of the edges of the beam or joist and at the other edge to the wall plate in rubble stone wall of the ground floor by nails or screws (Figure 5.53).

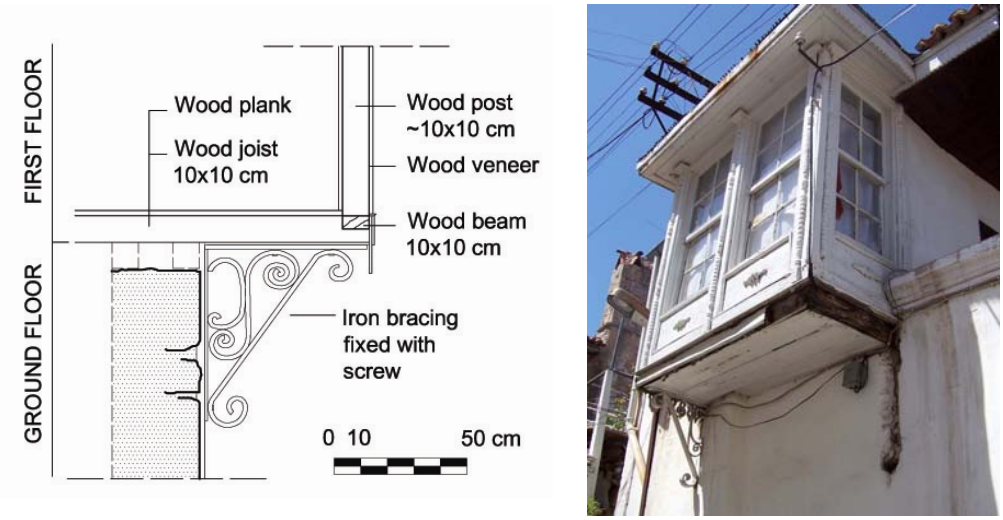


Figure 5.53. The *cumba* supported with iron bracing (Sekibaşı St. No: 2)

5.6 Roof Structure

It is stated that roofs with earth cover had been used until the end of the 19th century. These roofs were covered clayey earth, called '*geren*', and after every rain, the soil was pressed with cylindrical stone called '*yugu*' (Aladağ 1991). The earthen roofs which do not exist in Muğla historic urban site today, however, they can still be found in close by surroundings of Muğla, especially in some of the coastal settlements (Figure 5.54).

Figure 5.54. Earthen roof in Bodrum – Muğla
(Source: Aran 2000)

The roofs of Muğla houses are pitched or hipped. Pitched roofs are formed with two surfaces sloped towards to opposite directions and intersect at the ridge purlin which usually corresponds to the central axis of the plan. While these two surfaces sloped through the longitudinal edges of the roof, at the shorter edges, gable walls took place. The tie beams, which transfer the roof load to walls and/or the posts of the sofa, are placed parallel to gable wall with the approximate spans of 130-200cm (Figure 5.55).

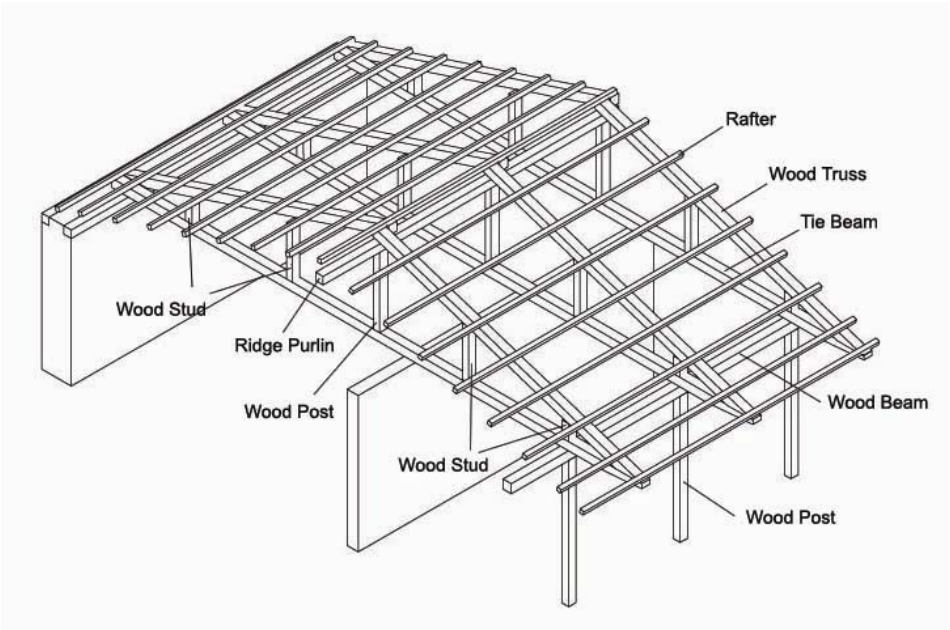


Figure 5.55. Structure of pitched roof

One edge of these beams is set on the wall plate in inner surface of rear wall of the house, while the other extended till the end of eaves and they are supported by front wall in first floor and posts of the sofa. On each tie beam, a post for supporting ridge purlin and studs, generally two on each side, all of which forming the wood trusses, are placed. Unlike to many other regions, there is no intermediate purlin on these studs. The slope of the roof is formed with the trusses, rested on the ridge purlin and directly on the tie beams (Figure 5.56, Figure 5.57). On the contrary to others, rafters; called '*soymok*' with cross-sections of 5/5 cm, in Muğla roofs are nailed perpendicular to the trusses with equal intervals. Then wood planks, called '*bedavra*' 130/10/0.3 cm in dimensions (Aladağ 1991), are nailed on rafters overlapping on each other. Turkish tiles, 15/12/30 cm in dimensions (Ekinci 1985) are laid over *bedavra*s (Figure 5.58).

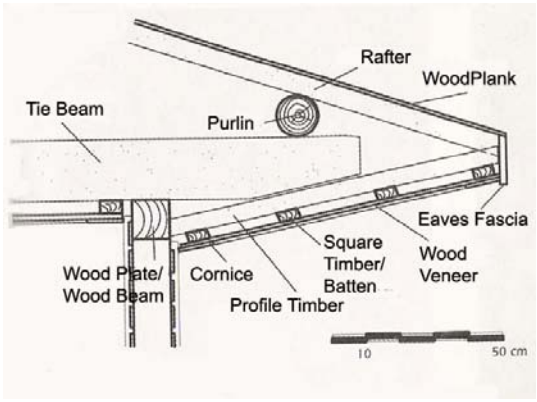


Figure 5.56. Detail of roof system of a house in Birgi
(Source: Ekinci 2005)

Figure 5.57. Slope of roof is formed with wood trusses, supported by post and studs, placed on ridge purlin and tie beam (next to Çeşme St. No: 2)

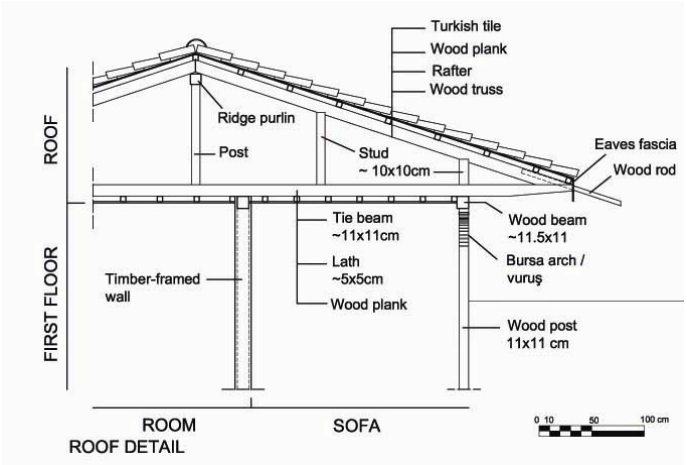


Figure 5.58. Pitched roof detail (Camcı St. 2nd dead end No: 34)

Gable walls, in the shorter sides of pitched roofs, can be considered as the extension of rubble stone outer walls. The ridge purlin is set into the gable wall at both ends. As well as those set in between, the wood trusses at the shorter sides of the building are placed at the gable walls (Figure 5.59). A certain part of the gable wall, corresponding to the side walls of the sofa may also be built of timber-framed with infill (Figure 5.60). In some houses, gable walls can be made of timber-framed with infill totally (Figure 5.61).

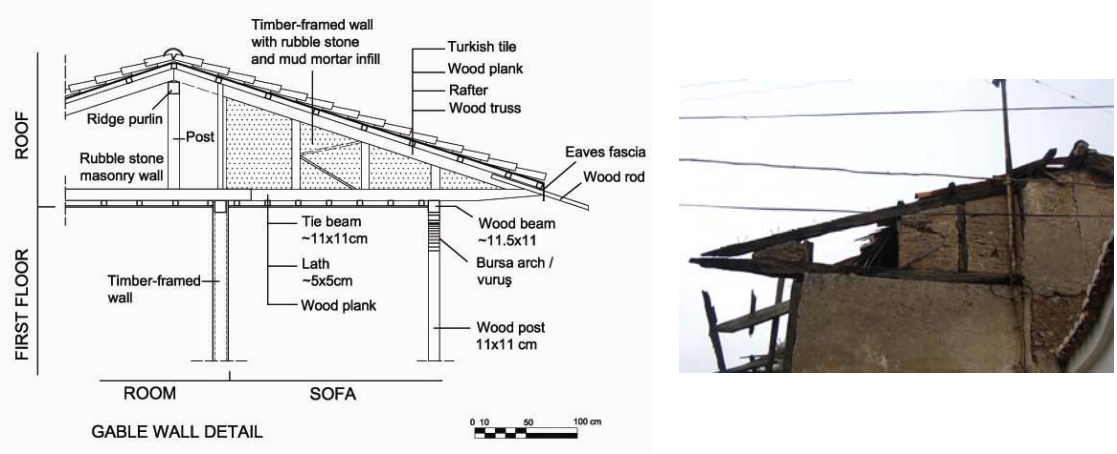


Figure 5.59. Detail of gable wall in pitched roof (Camcı St. 2nd dead end No: 34)

(a) (b)

Figure 5.60. Timber-framed gable walls over short sides of sofa; a. Kahveoğlu St. No: 28, b. Süleymanbey St. No: 3

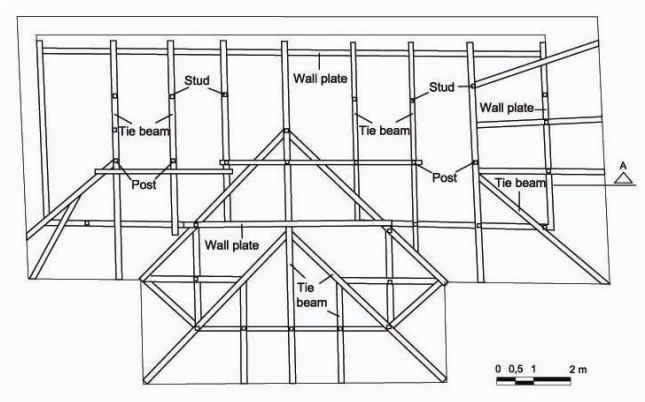
Figure 5.61. Gable wall made of timber-framed totally (Yayla St. No: 13)

The roof is finished with wide eaves on the front façade facing to the courtyard and small eaves, called '*gumile*', on other façades. The bottom of roof is covered with wood planks nailed on laths fixed under tie beams perpendicularly (Figure 5.62).

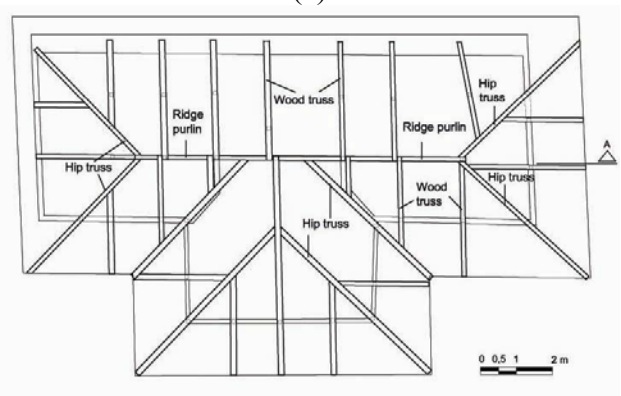
Figure 5.62. Wood plank covering at the bottom of roof which form the ceiling of the first floor (next to Çeşme St. No: 2)

Hipped roofs have four sloping surfaces, triangular in short sides and trapezoidal in longer ones, which forming the roof intersected on the ridge purlin on the longitudinal axis of the plan (Figure 5.63). In some houses one of the shorter sides may be ended with a gable wall and the roof may have three sloping surface. In the houses with inner sofa, there is a small roof on the projection over the sofa joining to the main

part of the roof. This small roof can be either hipped or pitched roof with a triangular pediment (Figure 5.64).



(a)

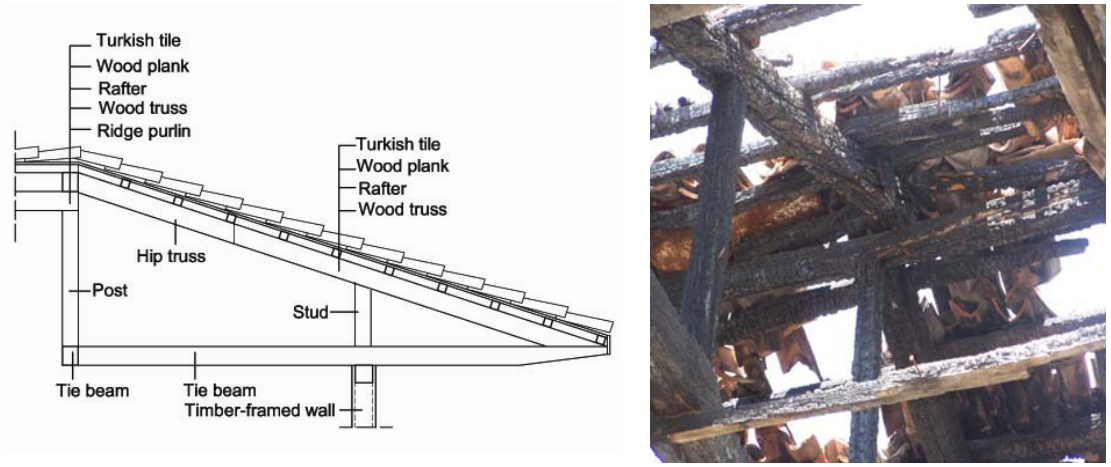


(b)

Figure 5.63. Roof plan of hipped roof of a house (Şeyh Caami St. No: 32). a. Tie beam distribution in hipped roof, b. Wood truss distribution in hipped roof

Figure 5.64. Intersection of pitched roof over the triangular pediment of *cumba* with the hipped roof (Arasta St. No: 9)

Structure of hipped roof is similar to that of pitched roof. The surfaces, slopes towards long sides are formed like the ones in pitched roof. The slope is constituted with trusses joined on ridge purlin and ended on the tie beams, and supported by posts and studs. Tie beams that form the diagonals are connected to the beams on which the studs supporting the ridge purlin at the ends are rested. At least two more tie beams are placed between the tie beams coming from the corners. Sloped surfaces are formed by the hip trusses and others which join them. In general the trusses placed on the shorter sides are supported with a single stud. In case of wider eaves, tie beams are extended. Similar to the pitched roof, rafters are parallel to the longitudinal edges and joined with those parallel to the shorter sides on the hip trusses. The roof is covered with wood planks and Turkish tiles (Figure 5.65a). In the connections of the roof elements, no joint detail is observed. The elements are fixed each other simply overlapped and nailed (Figure 5.65).



(a) (b)

Figure 5.65. a. Detail from sloping surface in short side of hipped roof (Şeyh Cami St. No: 32) b. Connection details of roof elements (Cami St. No: 12) [b].

5.6.1 Eaves

In Muğla houses, deep and large eaves are seen on the front façades, over the sofa and always facing to the courtyard. The width of these eaves, which prevent timber-framed outer walls and the sofa from rain, changes between 80 and 150 cm sometimes more and they are supported by posts and beams of the sofa.

They are formed by extending the tie beams, with the same depth of the eaves in front. The ends of tie beams are tapered with an angle of 20 degree to give a lightened visual effect (Ekinci 1985). The laths with the cross-section of 5/5 are nailed on tie beams. The bottom of the eaves is then covered with wood planks, 1.5 cm in thickness (Figure 5.66).

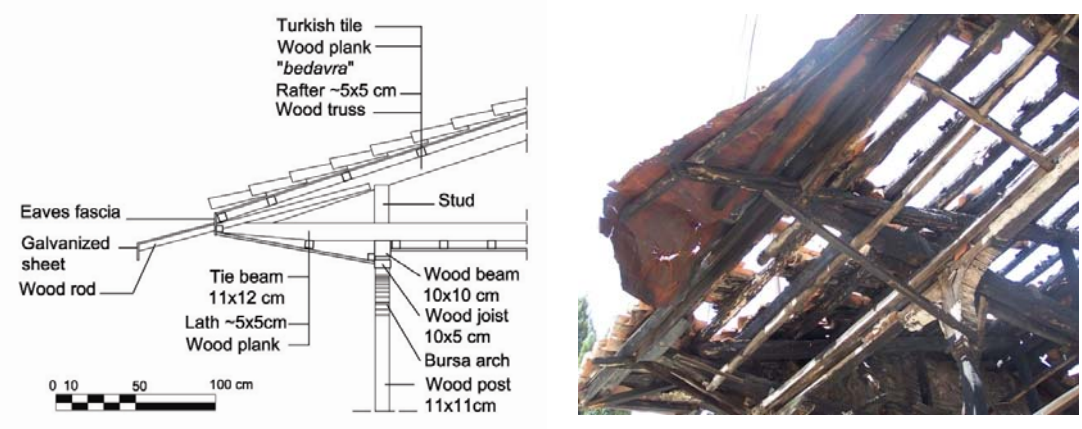


Figure 5.66. Detail of eaves in front façade (Cami St. No: 12)

The eaves are usually decorated in varying forms with battens. Eaves fascia is 2.5 cm in thickness and 20 cm in width and made of wood in the shape of amulet rows. At the end of the eave, another eave, which is formed by covering with galvanized sheet over the wood rods that are nailed on the sides of trusses, is added in order to drain rain water away from the sofa. These eaves, called '*tura*', are 80-100 cm in width (Aladağ 1991) (Figure 5.67).

Figure 5.67. Eaves made of galvanized sheets (Topaltı St. No:53).

In the other façades, the wall is finished with small eave, called '*gumile*', which is formed by the placement of slate stone plates, in two or three courses, extending about 10 - 20 cm over the wall surface, where the wall and roof join (Figure 5.68, Figure 5.69).

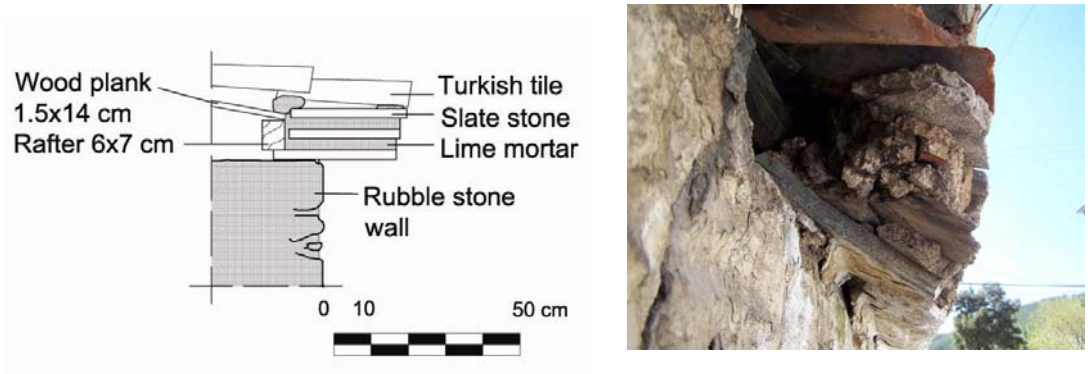


Figure 5.68. Detail of short eave - *gumile* (Cami St. No: 12)

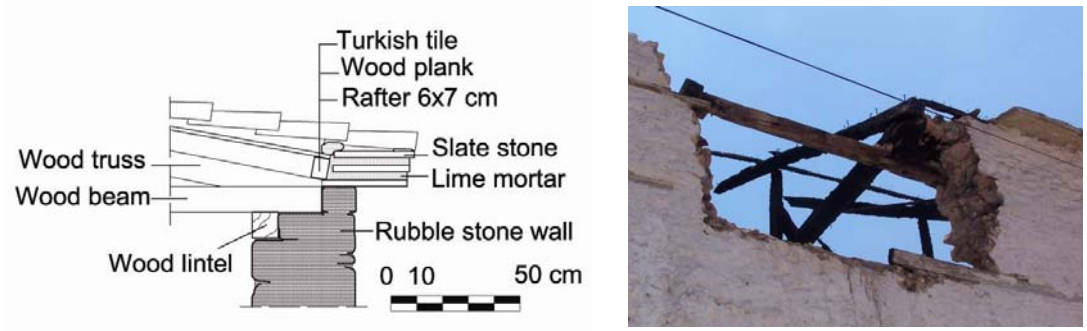


Figure 5.69. Detail of *gumile* (Şeyh Cami St. No: 32)

5.6.2 Chimneys

The most characteristic element of a Muğla house is its chimney with its cowl. It has a square plan and its cowl is obtained by a simple and quick arrangement of Turkish tiles abutting against each other as demonstrated by a master builder involved in the repair of old houses in Muğla (Ayhan 2008) (Figure 5.70).

Figure 5.70. The stages of the construction process of chimney cowl of Muğla houses (Source: Ayhan 2008)

He noted that it is good as protection against heavy rainfalls in the region and winds, blow from different directions. Turkish tiles are also used in chimney flashings. Aladağ states that these chimneys emerged at beginning of the 20th century, which was a period of transition from earthen roof to those covered with Turkish tiles (Aladağ 1991).

Giving most characteristic feature, became the symbol of traditional houses in historic urban part of Muğla, the chimneys are constructed in different compositions with square or circular cross sections (Figure 5.71).

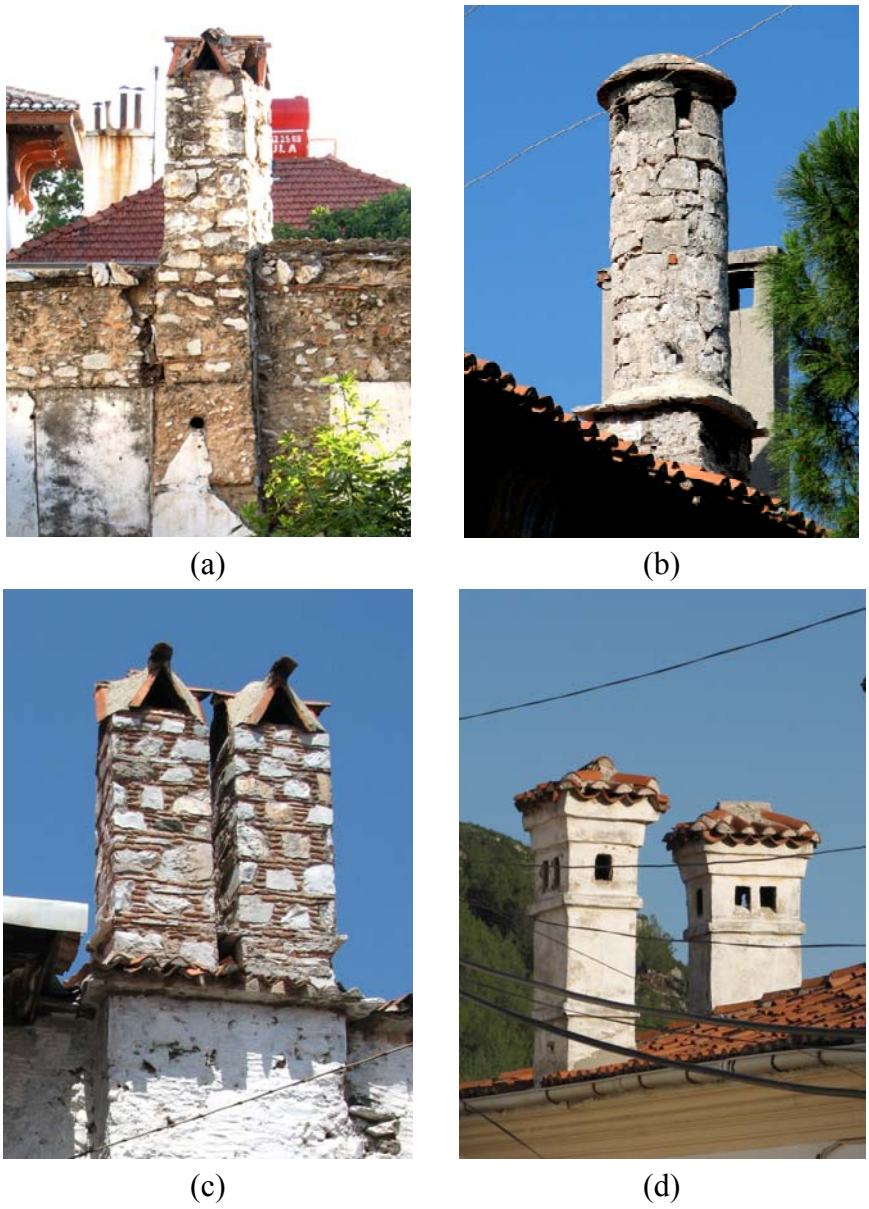


Figure 5.71. Examples from different kinds of chimneys. a. İkizler St. between No: 12 – 14, b. Dibektaşı St. No: 2, c. Havana St. No:33, d. Çınarlı St. No: 18

5.7 Evaluation of the Survey Results

As the results of the survey reveal, Muğla houses offer a rich variety of construction techniques, including their foundations (Table 5.1 Ref. No: 23), the stone masonry of the basement and basement-like galleries (Table 5.1 Ref. No: 34, 22) and combined use of *hımış* and stone masonry parts of upper floors being different from the classifications given in the previous studies.

Used as the members of floor beams, studs, bracings and horizontal ties, it is seen that wood becomes an important structural element in combining these two different structural systems with the formation of a network, simply, with post and beams from the basement to the roof.

Being typical to *hımış* technique, wooden skeleton of the upper parts rest on the wall plates – *hatıl* – set on both inner and outer parts of the rubble stone masonry bonded with mud mortar. While distributing the loads of the upper parts to the masonry evenly, wall plates form the base for the posts, main beams and joists over them. In a Muğla house (Table 5.1 Ref. No: 34) it is seen that the frame of the upper parts is extended till the foundations with the posts that are connected to the beams for a better resistance against lateral forces. These posts rest on the single blocks of stone footings as also noted in some studies (Langebach 2002, Arun 2005).

Except the main posts of the structure, the span between the studs does not exceed 60 centimeters depending on the cross sectional area of the posts. The frame is tied almost at the mid of the story by means of horizontal and diagonal timber members. Bracings are usually set in contact with the studs and sills of the window openings. The gaps in the frame are filled with rubble stone and/or fragments of brick and roof tiles and mortar.

The evaluation of the observation results of the houses, which were constructed with *hımış* system and damaged or partially collapsed by the severe earthquake in 1999 struck Kocaeli, Yalova, Adapazarı and Düzce, pointed out the superior qualities of this construction technique (Güçhan 2007, Doğangün, et al. 2006, Aksoy and Ahunbay 2005, Gülkan and Langebach 2004). Another study involved in the examination of seismic behavior of timber structures of Turkey was carried out by using integrated software for structural analysis and design (SAP 2000). The study suggests that timber framed structures can sufficiently resist against lateral forces caused by earthquake (Akan 2004). Similar to *hımış* system, the construction system of the vernacular houses of Lefkada İsland in Greece also prone to earthquake have shown sufficient performance against seismic forces as three successive studies revealed (Karakostas et al. 2005, Makarios and Demosthenous 2006, Vintzileou, et al. 2007). The studies also suggested that most of the tensile forces concentrates around the corners and window openings at the mid of the first floors implying the importance of; the size of the openings and the correct placements of the bracing members in the framework.

The *bağdadi* type of construction is frequently considered as another structural technique similar to *hımış*. In this technique, thin – usually not of more than one centimeter in thickness – bands of wood bands are nailed on the outer faces of the frame members to hold plaster (Table 5.1 Ref. No: 23). While used for plaster base it is also noted that *bağdadi* system also increases the resistance against earthquake (Langenbach 2002, Karaesmen 2002) even more than *hımış* system (Akan 2004). Despite its contribution to the seismic stability, it is usually mentioned as plastering technique, having the similar duty with that of wire mesh, called '*rabiç*' in Turkish. However, as documented in a house in Şeyh Cami St. No: 32 (Table 5.1 Ref. No: 34), short and roughly cut pieces of wood is also used as infill material instead of masonry fill in the gaps of timber frame without nailing. This is also called '*bağdadi*' making the structure lightweight when compared to those having masonry infill (Langenbach 2002, Karaesmen 2002). Both exterior and interior can be plastered.

Regarding masonry parts of Muğla houses, the widely used construction technique is rubble masonry system (Table 5.1 Ref. No: 4, 6, 13, 15, 16, 20, 29, 31, 32, 34, 37, 39, 40). However, the walls of the houses of later periods, which could not be entered and examined, may probably be composed of two leafs, in other words, composite; as the outer face is composed of cut stone and inner part is likely rubble or *hımış* (Table 5.1. Ref. No: 11, 21).

CHAPTER 6

PROPERTIES OF CONSTRUCTION MATERIALS OF HISTORIC MUĞLA HOUSES

As revealed in the previous chapter, a typical historic house of Muğla displays the features of composite system in which masonry and timber frame are used together or separately in different components. Within such a system of construction, the properties of materials used alone or combined with others, and their preparation techniques play the major role in terms of structural stability as well as long-term durability. While supporting the house from foundations to the roof in the north, east, west, and forming the courtyard all around it will be realized that the major portion of the house is formed of masonry system as far as material use is concerned.

Representative samples belonging to the walls and their rendered surfaces in sufficient amounts were collected from five of the fifteen houses examined during the survey to be analyzed in the laboratory for their physical properties, raw material compositions.

6.1 Sampling

As well as from the walls, the samples of stone, mortar and plasters from other constructional components of architectural elements such as the stone casings of fireplace and gates, were collected with chisel and hammer without causing further damage. They were labeled, packed in polyvinyl backs and sealed on the site. Labeling was done indicating the location of the house by the abbreviation of the name of the street which is followed by the abbreviation of its type and the sample number. For instance; Sah (P.1) represents the sample of plaster (P) of the house located on Şahidi Street. Thus ‘S’ represents stone and ‘M’ mortar in the labels of other samples. Additional information about the component from where they were collected and precise addresses of the houses have been presented in the table below (Table 6.1).

Table 6.1 Identification of the samples

Sample	**Function**	**Address of the house**
Sah (S.1)	Roughly cut stone, exterior wall	Şahidi St. No: 26
Sah (S.2)	Finely cut stone, fireplace casing	Şahidi St. No: 26
Sah (M.1)	Mortar, infilled wood frame	Şahidi St. No: 26
Sah (M.2)	Mortar, rubble – exterior wall	Şahidi St. No: 26
Sah (P.1)	Plaster, *bağdadi* vault	Şahidi St. No: 26
Sah (P.2)	Plaster, interior wall	Şahidi St. No: 26
SC32 (S.1)	Finely cut stone, courtyard – gate casing	Şeyh Camii St. No: 32
SC32 (M.1)	Mortar, rubble – exterior wall	Şeyh Camii St. No: 32
SC32 (P.1)	Plaster, rubble – exterior wall	Şeyh Camii St. No: 32
SC8 (M.1)	Mortar, rubble – exterior wall	Şeyh Camii St. No: 8
Ik (S.1)	Finely cut stone, fireplace casing	İkizler St. No: 13*
Ik (M.1)	Mortar, rubble – exterior wall	İkizler St. No: 13*
Ik (M.2)	Mortar, rubble – exterior wall	İkizler St. No: 13*
Ik (P.1)	Plaster, exterior wall (*çivileme*)	İkizler St. No: 13*
Ik (P.2)	Plaster, fireplace, interior face (base layer)	İkizler St. No: 13*
Ik (P.2')	Plaster, fireplace, interior face (finishing layer)	İkizler St. No: 13*
Ik (P.3)	Plaster, fireplace, exterior face	İkizler St. No: 13*
H44 (M.1)	Infill mortar, exterior wall	Hisar St. No: 44
DT2 (P.1)	Plaster, exterior wall (*çivileme*)	Dibektaşı St. No: 2
(*) *The house abandoned and had no door number. No: 13 is given according to the number of the house before (No: 12) and after (No: 14) on the same streets*		

The positions of the spots of sample-collection have also been indicated on the photographs according to the components of the houses individually or in pairs if they are located on the same street (Figure 6.1, Figure 6.2, Figure 6.3, Figure 6.4).

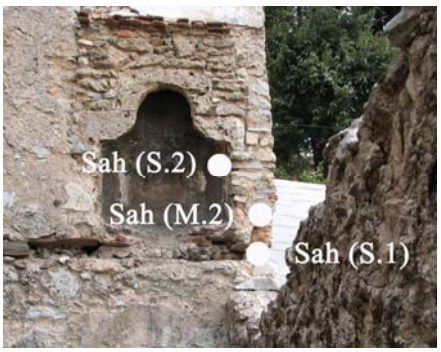
6.2 Laboratory Analyses

Four stones, fifteen mortars and ten samples of plaster from the damaged parts of five different houses were analyzed in order to determine their physical properties, such as porosity and density, and raw material compositions binder and aggregate ratios, aggregate particle size distribution.

Sah (P.1)

Sah (P.2)

Sah (M.1)



Sah (S.1), (S.2), (M.2)

Figure 6.1 Samples from the house on Şahidi St. No: 26

SC32 (P.1)

SC32 (M.1)

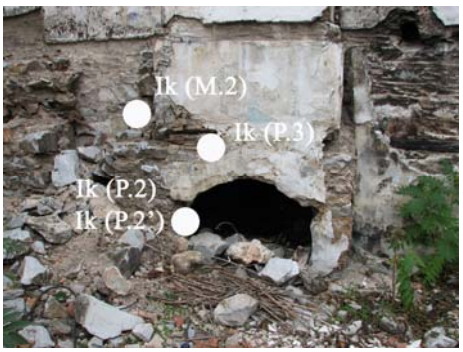
SC32 (S.1)

SC8 (M.1)

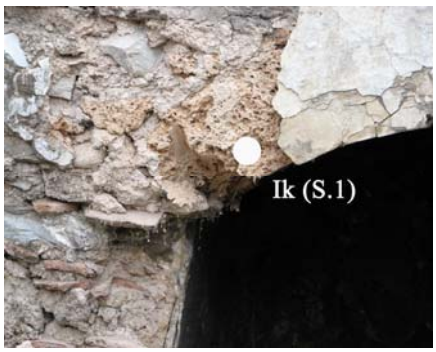
Figure 6.2 Samples from the houses on Şeyh Camii St. No: 32 and No: 8

Ik (P.1)

Ik (M.1)



Ik (M2), Ik (P.2), Ik (P.2'), Ik (P.3)



Ik (S.1)

Figure 6.3 Samples from the house on İkizler St. No: 13

H44 (M.1)

DT2 (P.1)

Figure 6.4 Samples from the house on Hisar St. No: 44 (H44 (M.1)) and Dibektaşı St. No: 13 (DT2 (P.1))

6.2.1 Determination of Basic Physical Properties

Bulk densities and porosities of mortars, plasters and stones used in Muğla traditional houses were determined by using RILEM Standard test methods (RILEM 1980). Density is the ratio of the mass to its bulk volume. It is expressed in grams per cubic centimeters (g/cm³). Porosity is the ratio of the pore volume to the bulk volume of

the sample, and is usually expressed in per cent (%). They were calculated by the following formulas;

$D\ (g/cm^3) = M_{dry} / (M_{sat} - M_{arch})$

$P\ (\%) = [(M_{sat} - M_{dry}) / (M_{sat} - M_{arch})] \times 100$

where;

D : Density (g/cm3)

P : Porosity (%)

M_{dry} : Dry weight (g)

M_{sat} : Saturated weight (g)

M_{arch} : Archimedes weight (g)

$M_{sat}-M_{dry}$: Pore volume (g)

$M_{sat}- M_{arch}$: Bulk volume (g)

6.2.2 Determination of Raw Material Compositions of Mortars and Plasters

Lime-aggregate ratios and the particle size distributions of the aggregates were determined in order to define raw material compositions of mortars.

6.2.2.1 Determination of Binder-Aggregate Ratios of Mortars and Plasters

Binder-aggregate ratios of the mortars and plasters were determined by dissolving the carbonated lime ($CaCO_3$) in samples with dilute hydrochloric (HCl) acid (Jedrzejevska 1981, Middendorf and Knöfel 1990). Three pieces of 50-60g from each mortar and plaster sample were dried and weighed (M_{sam}) by a precision balance. Afterwards the dried samples were left in a dilute hydrochloric acid (%5) solution until the carbonated lime ($CaCO_3$) in the samples completely dissolved. Insoluble part of each sample was filtered, washed with distilled water, dried in an oven and then weighed (M_{agg}). Ratios of acid soluble and insoluble parts were calculated with the following formula:

Insoluble % : $[(M_{sam} - M_{agg}) / M_{sam}] \times 100$

Acid Soluble %: 100 – Insoluble %

where;

M_{sam} : Dry weight of the sample (g)

M_{agg} : Dry weight of the aggregates (g)

6.2.2.2 Particle Size Distribution of Aggregates

Determination of particle size distribution of aggregates were carried out by sieving each sample's aggregates through a series of sieves (Retsch mark) having the sieve sizes of 53µm, 125µm, 250µm, 500µm, 1180µm by shaking manually in distilled water. Each of the particles retained on each sieve was dried, weighed and each of their percentages was calculated.

6.2.3 Determination of Mineralogical and Chemical Compositions and Micro-structural Properties of Plasters and Mortars

Mineralogical compositions of plasters, mortars and aggregates used in them were determined by X-ray Diffraction (XRD) analyses by using a Philips X-Pert Pro X-ray Diffractometer. The analyses were performed on finely ground samples of less than 53µm.

Chemical compositions and microstructural properties of samples were determined by Philips XL 30S-FEG Scanning Electron Microscope (SEM) equipped with X-Ray Energy Dispersive System (EDS).

6.2.4 Determination of Hydraulicity of Mortars and Plasters by TGA

In this analysis, weight losses in one gram finely ground samples during the heating process from 25˚C to 1000˚C were recorded by TGA instrument (Shimadzu TGA-21 thermogravimetric analyzer). Weight loss at 200˚C is due to the loss of hygroscopic (adsorbed) water. Weight loss at 200 to 600˚C is mainly due to the loss of chemically bound water of hydraulic products. Weight loss at temperatures over 600˚C is due to the decomposition of calcium carbonates present as binder in mortars and plasters (Moropoulou et. al. 1995).

6.3 Results

6.3.1 Basic Physical Properties of Mortars and Plasters

Density and porosity values of mortars ranged between 1.68-2.00g/cm³ and 24.95-36.88% by volume respectively (Figure 6.5). Density values of plasters were in range of 1.33-1.99g/cm³ and porosity values varied between 25.68-49.57% (Figure 6.6).

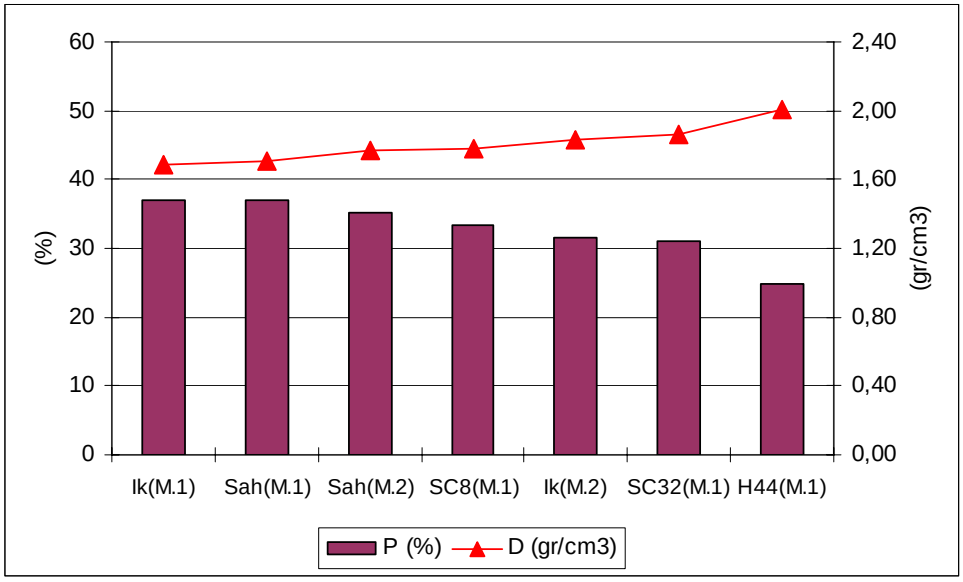


Figure 6.5 Porosity (P) and density (D) of mortars

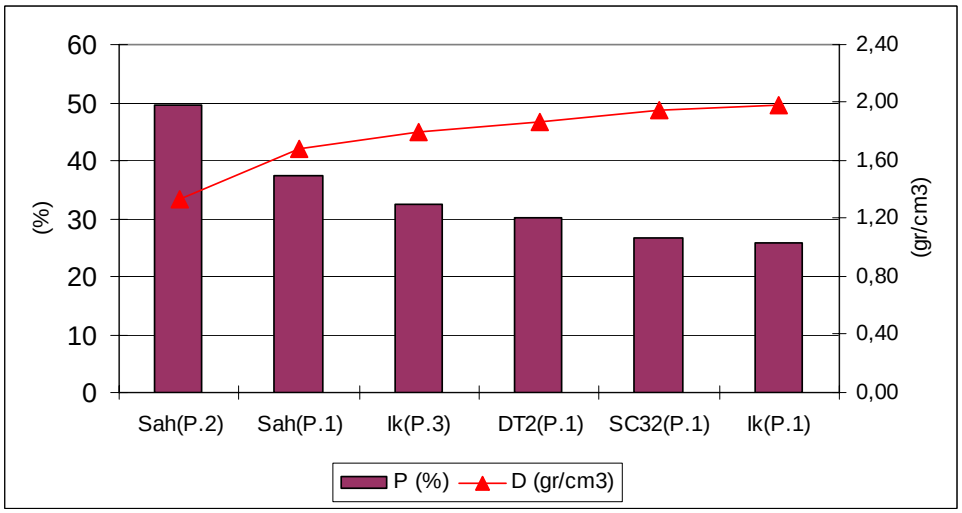


Figure 6.6 Porosity (P) and density (D) of plasters

6.3.2 Properties of Binder and Aggregate Parts of Mortars and Plasters

Binder/aggregate ratios of mortars covered the approximate range from 90 to 95% except for H44(M.1) which is 78% (Figure 6.7). Except for the ratio of Sah(P.2), which is 82% this ratio is similar in plasters (Figure 6.8). The results indicated the use of excessive amount of lime in the mortars and plasters.

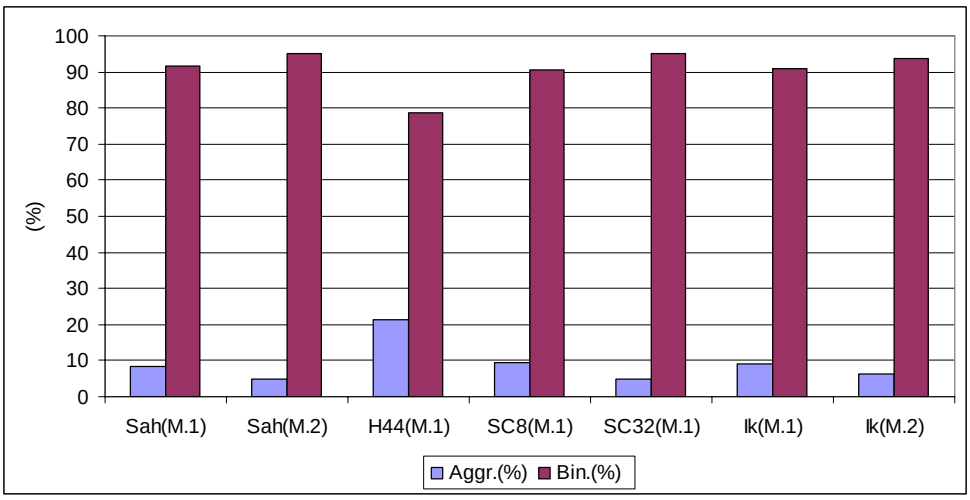


Figure 6.7 Binder and aggregate proportions in the mortars

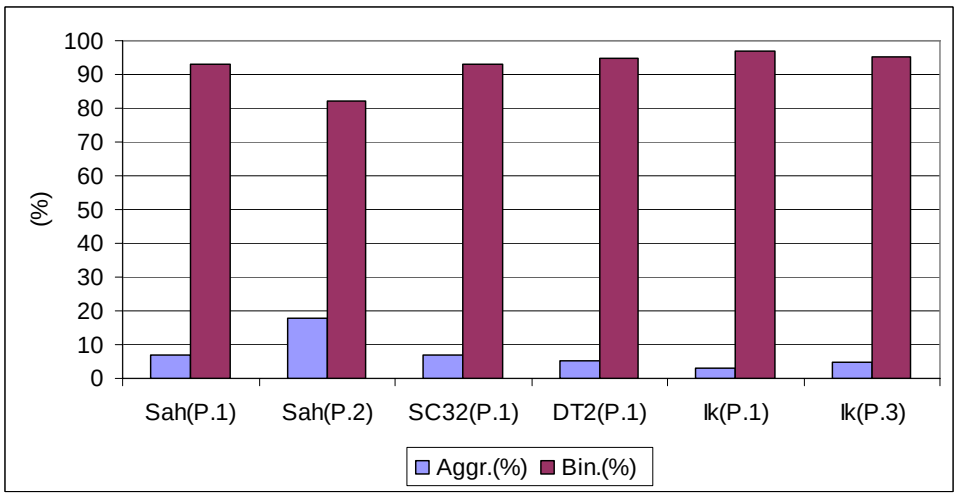


Figure 6.8 Binder and aggregate proportions in the plasters

Sieve analyses indicated that aggregates of mortars and plasters were mainly composed of the aggregates with particle sizes less than 53µm, and their average percentages are close to each other, as 63.6 % for mortars and 63.3% for plasters. Particle size distribution in the aggregates above 53µm may also be said that they are similar with minor variations (Figure 6.9, Figure 6.10). The percentage of the other aggregates which had different particle sizes varied between 4.7-9.1% in mortars and 5-9.3 % in plasters on average.

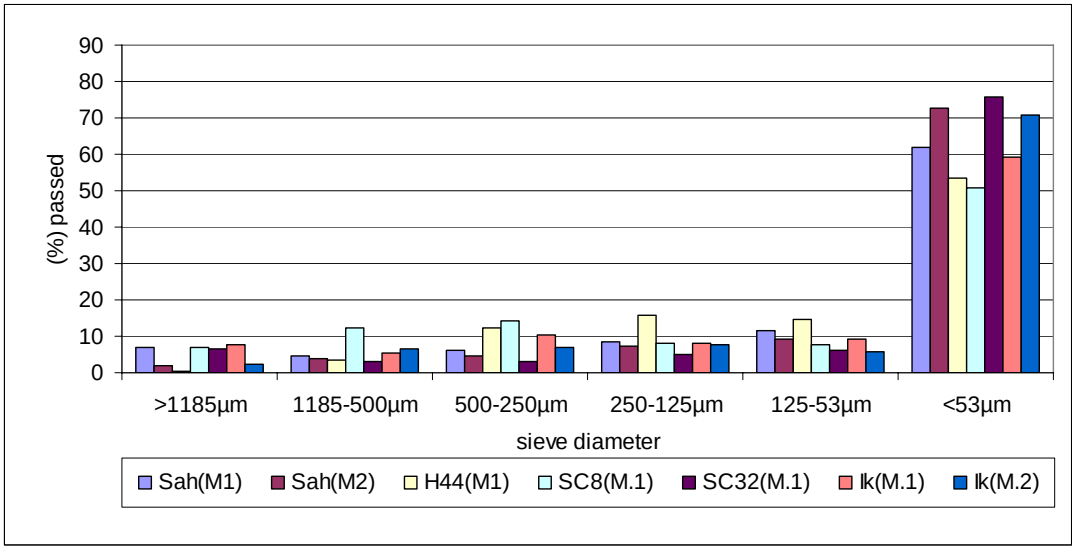


Figure 6.9 Particle size distribution in the aggregate parts of mortars

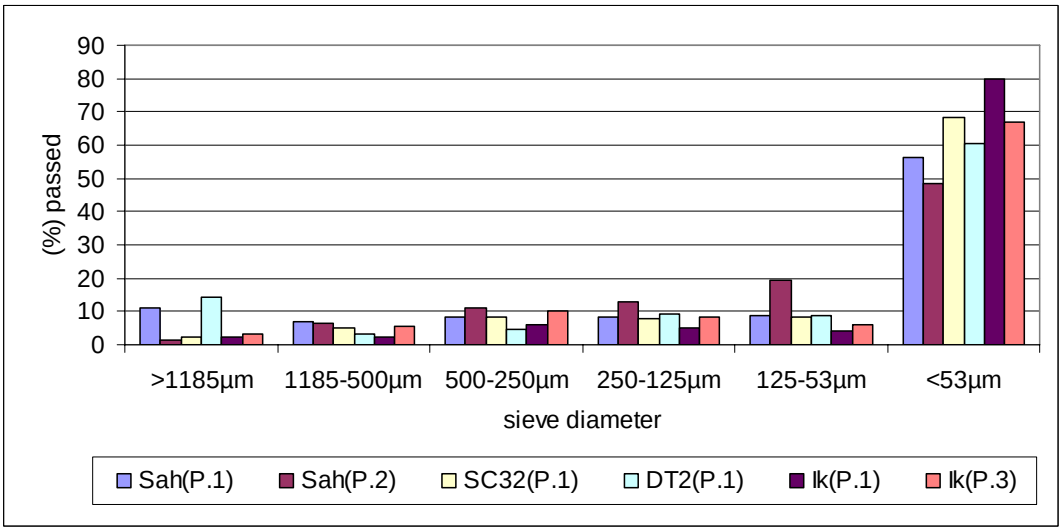


Figure 6.10 Particle size distribution in the aggregate parts of plasters

6.3.2.1 Mineralogical and Chemical Compositions and Micro-Structural Properties of Plasters and Mortars

XRD analyses were performed for the binder and aggregates of mortars and plasters. The analyses of the binders that are obtained from the white lumps showed that they were composed of calcite minerals (Figure 6.11) displaying micritic crystal structure and of high-calcium lime as the SEM image and EDX analysis (Figure 6.12) showes.

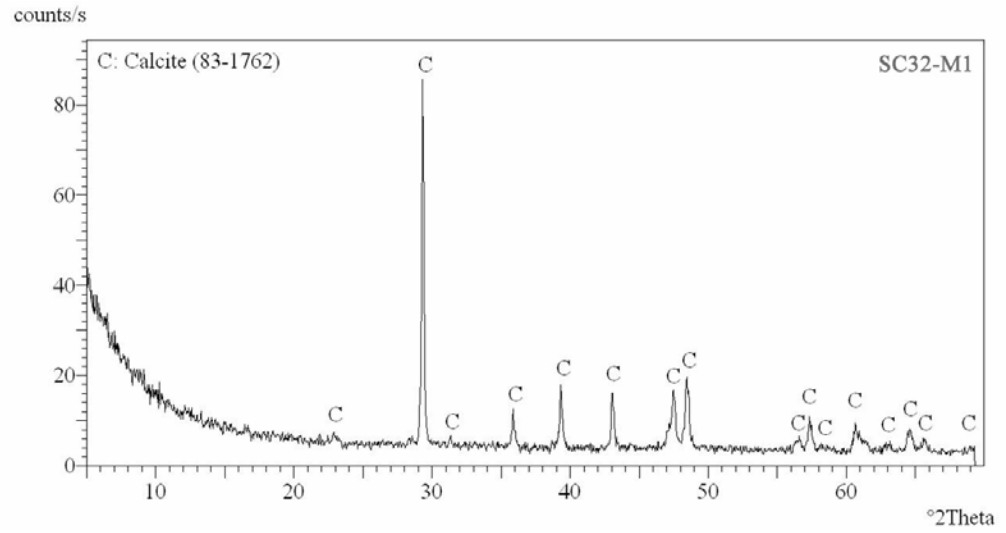


Figure 6.11 XRD pattern of the binder of a white lump in the sample SC32(M1)

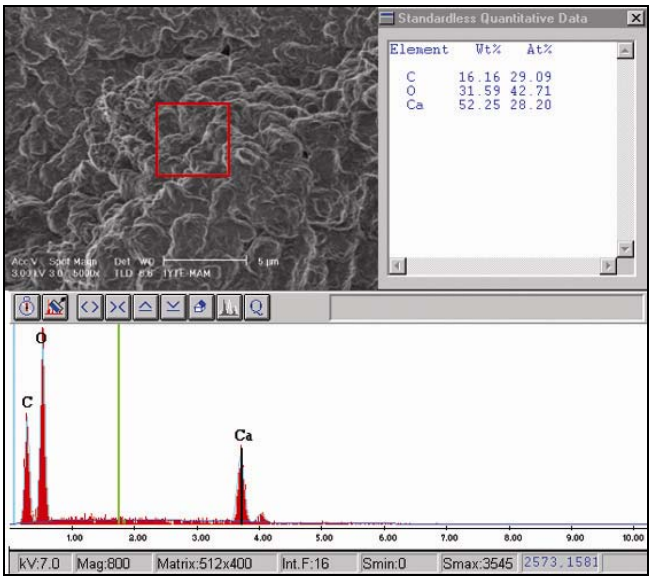


Figure 6.12 SEM image and EDX analysis of a white lump in the sample of Sah(M2)

XRD analyses performed on the <53μm sized aggregates, which formed the major group in all, of the mortars and plasters revealed that in addition to quartz, they were composed mostly of clay (such as kaolinite, phyrophyllite, illite), feldspar (such as albite, orthoclase) and mica (such as muscovite) group minerals (Figure 6.13, Figure 6.14, Figure 6.15).

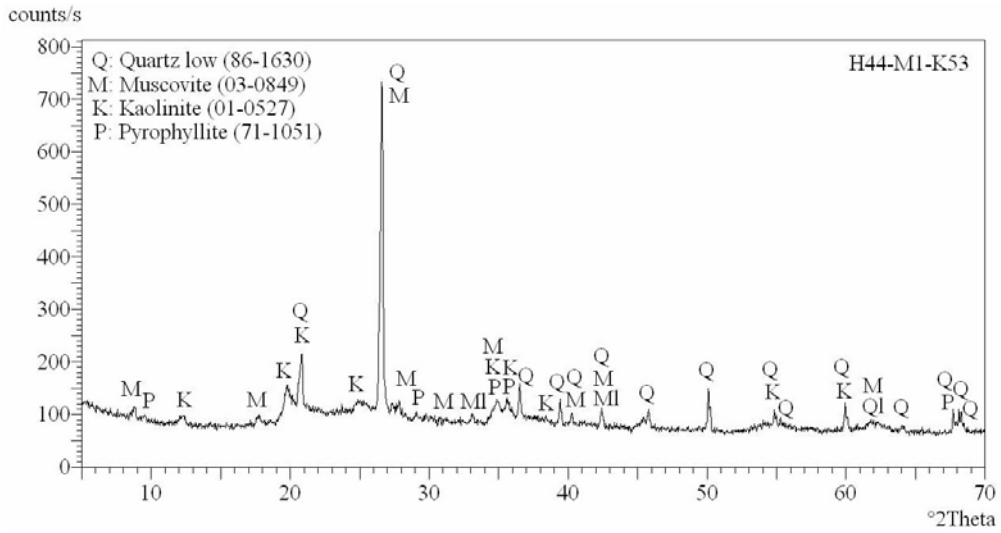


Figure 6.13 XRD pattern of H44-M1 mortar aggregate

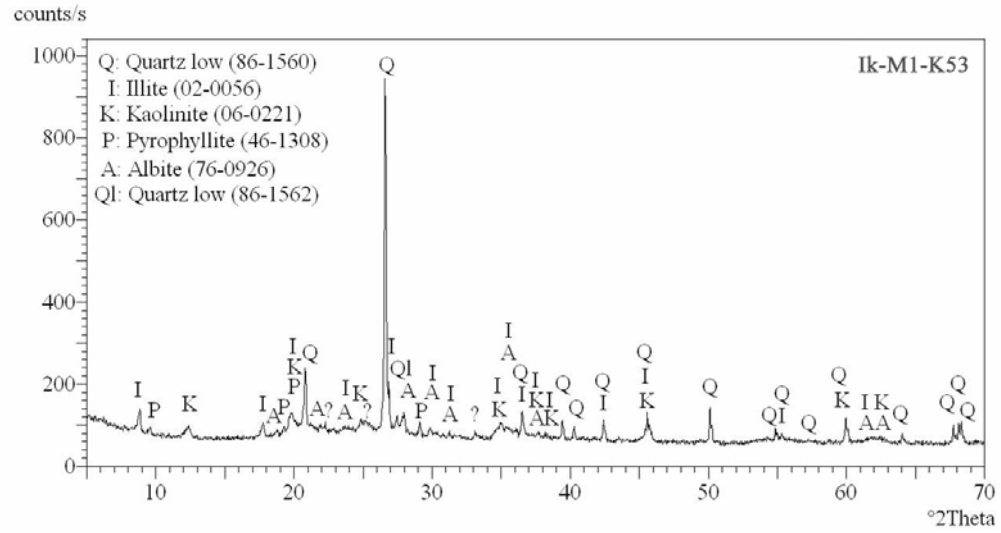


Figure 6.14 XRD pattern of mortar aggregate Ik(M1)

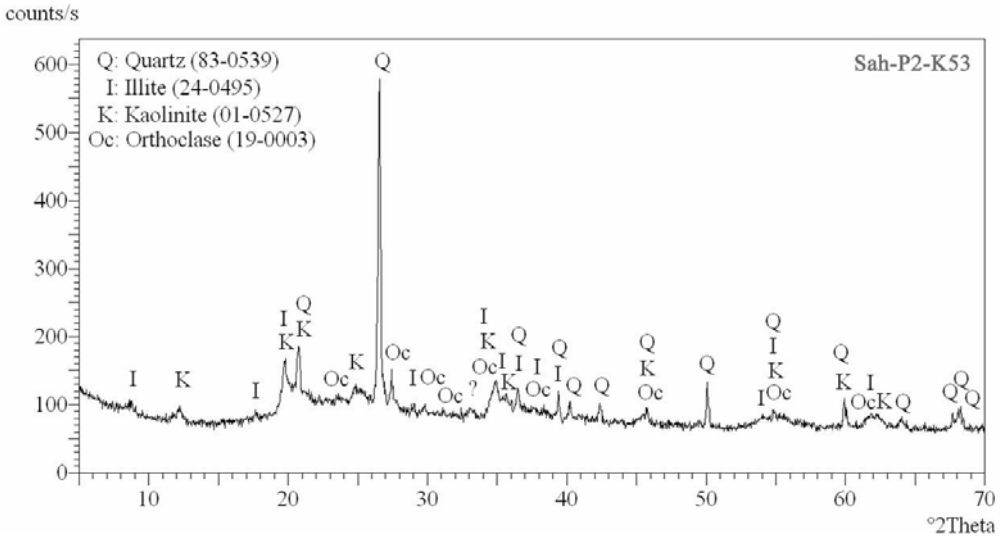


Figure 6.15 XRD pattern of plaster aggregates Sah(P2)

XRD analyses were also performed on stone samples from, the frames of fireplaces Ik(S1), Sah(S2), the casing of gate SC32(S1), and Sah(S1) which is a sample of roughly cut lime stone most frequently used in the masonry walls of the houses and courtyard walls. According to these analyses, the sample of SC32-S1 which contains quartz and clay mineral illite with calcite is silt stone (Figure 6.16). The SEM image and EDX analysis show the clay mineral and its elemental composition of this sample (Figure 6.17).

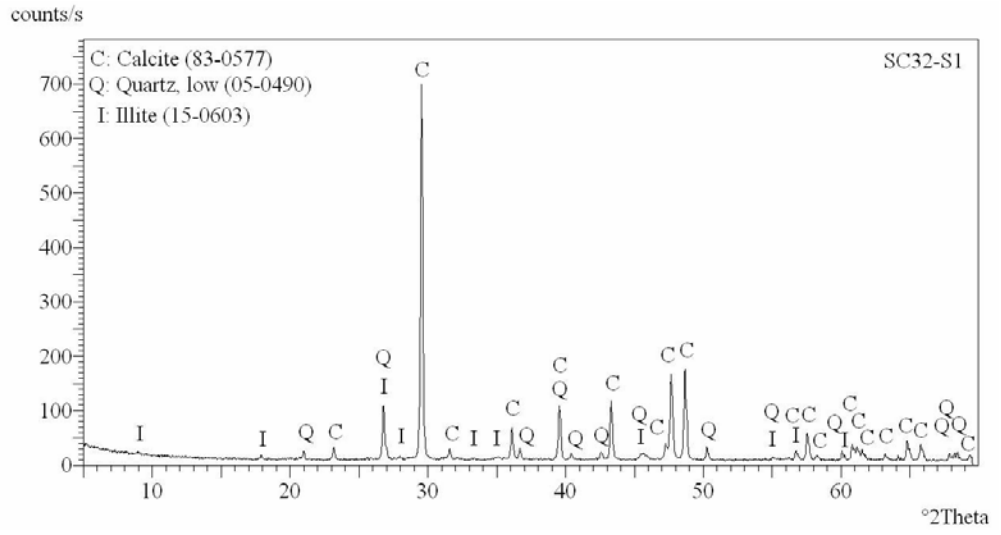


Figure 6.16 XRD pattern of the stone sample SC32(S1)

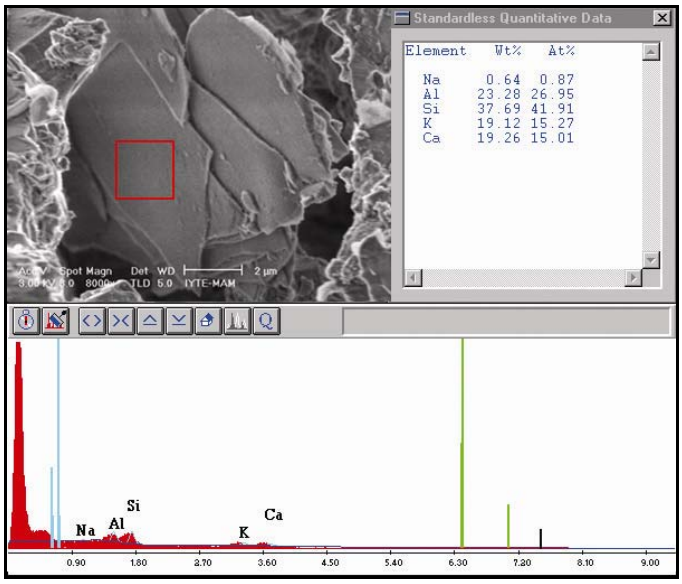


Figure 6.17 SEM image and EDX analysis of the sample SC32(S1)

XRD analyses of the samples of Ik(S1) and Sah(S2) from the frames of fireplaces revealed that they were also lime stones (Figure 6.18) like the stone, Sah(S1), from the masonry wall (Figure 6.19).

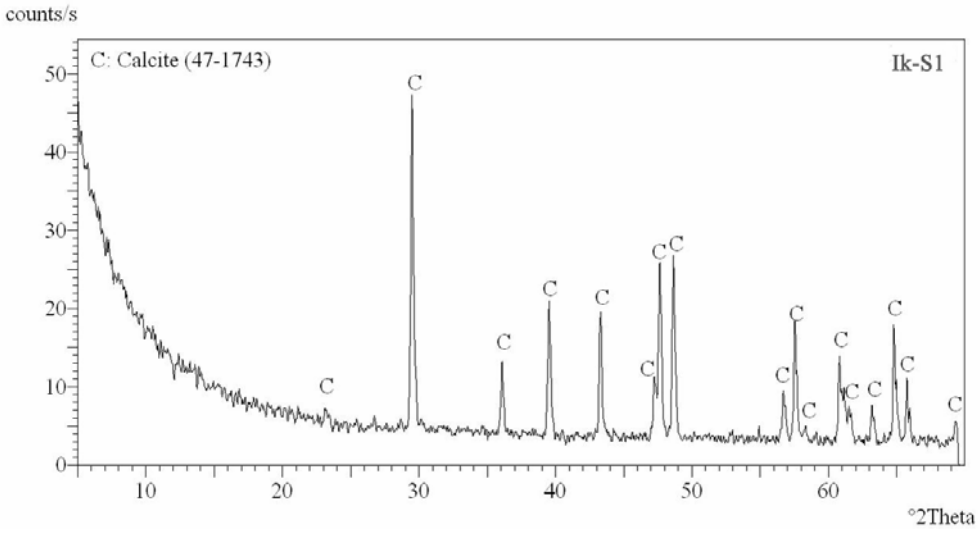


Figure 6.18 XRD pattern of the stone sample Ik(S1)

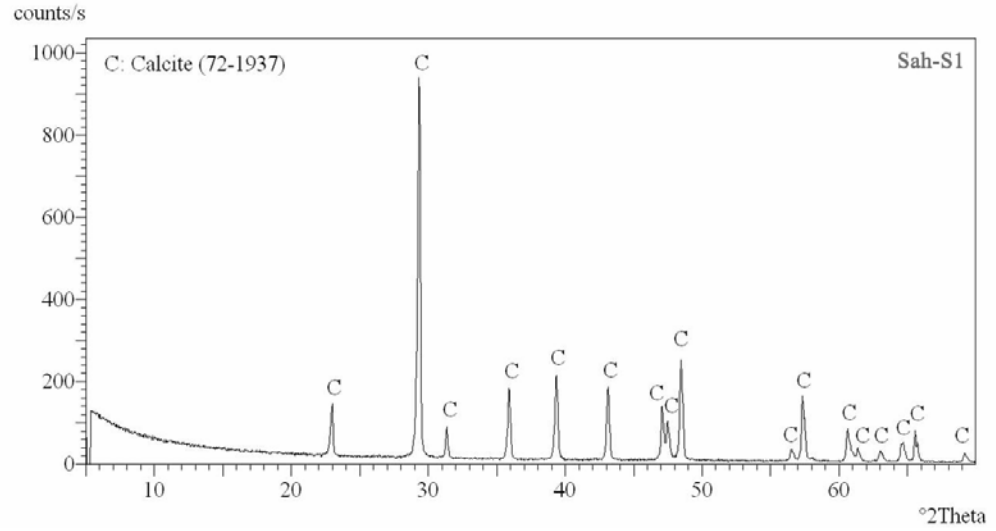


Figure 6.19 XRD pattern of the sample Sah(S1)

The stone samples from fireplace frames should a very porous structure and defined as tufa likely formed around the roots of plants in marshy areas (Figure 6.20).

Figure 6.20 Stereo microscope image of the cross-section of sample Ik(S1)

6.3.2.2 Hydraulicity of Mortars and Plasters by TGA

Weight decreases between 600˚C - 800˚C detected in TGA analyses which were performed for the white lumps indicated that they were of re-carbonated calcium hydroxide used in the preparation of the mortars (Figure 6.21).

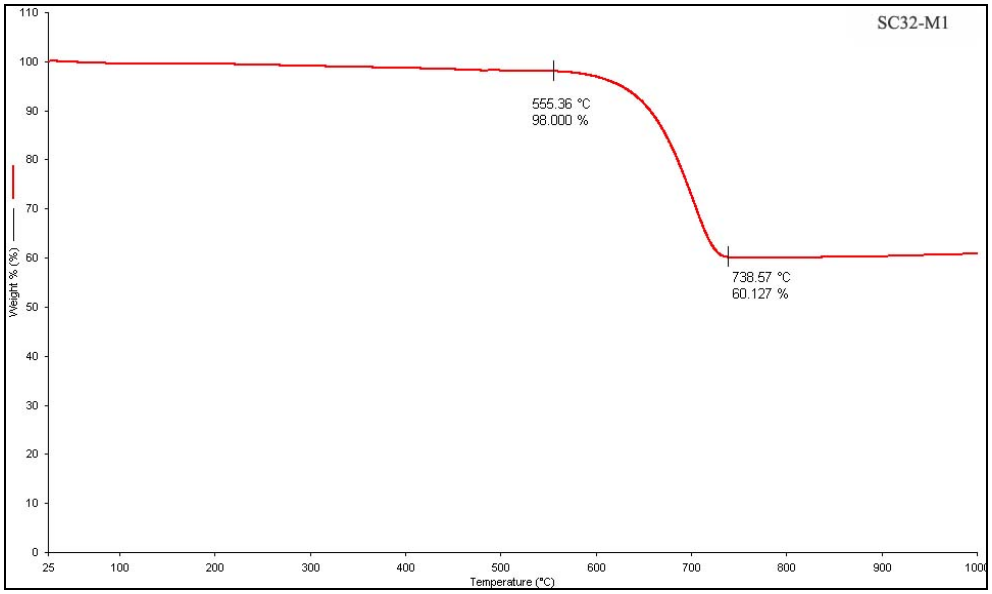


Figure 6.21 TGA analysis of the white lump in the SC32(M.1)

The same analyses performed for the matrices of plasters and mortars revealed the results similar to those of white lumps. The weight decreases between 600-800˚C showed that lime content did not belong to calcareous aggregates which decompose high temperatures, above 800˚C (Figure 6.22, Figure 6.23).

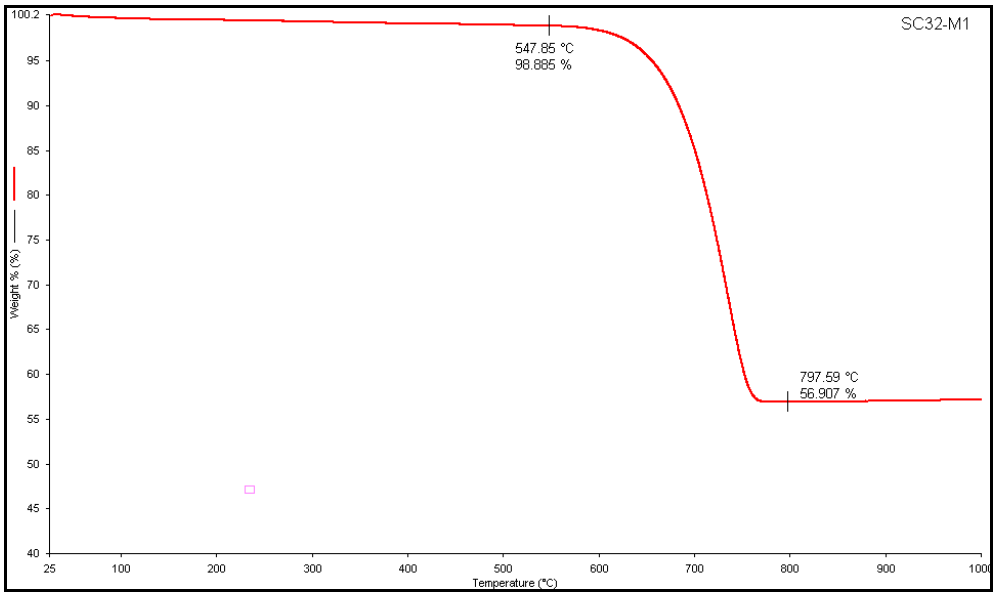


Figure 6.22 TGA analysis of the mortar sample SC32(M1)

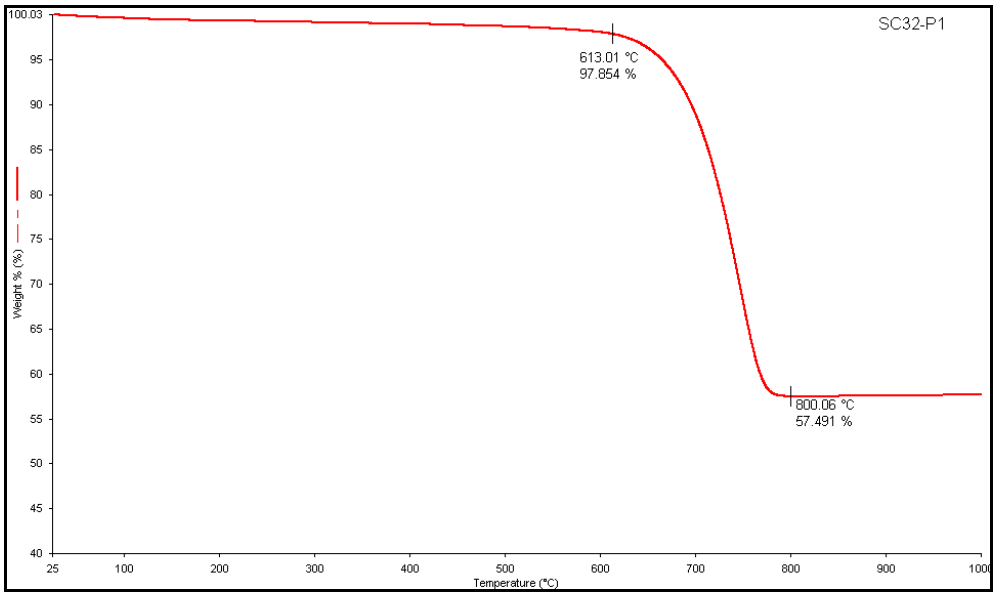


Figure 6.23 TGA analysis of the plaster sample SC32(P1)

Both TGA data from white lumps, mortar and plaster matrices indicated the use of high amount of lime in the mortars and plasters of Muğla houses.

6.4 Evaluation of the Material Analyses

As well as the observations, the results of the analyses revealed that limestone, usually of marble, is the main type of structural masonry material used in the walls of the houses at the site. Although rarely, but small blocks of slate stones and andesite were also used in the walls of the courtyards as well as in the walls of the houses (Table 5.1 Ref. No: 31). Slate stone is used as floor covering and pavement material in the courtyards (Table 5.1. Ref. No: 1) and especially in the eaves of the northern, eastern and the western edges of the roofs (Table 5.1 Ref. No: 7, 34). Siltstone is used in the casings of the gates of the courtyards possibly because of its homogeneous structure and softness which allow shaping it easily (Table 5.1 Ref. No: 34). As determined for the fireplace of a house (Table 5.1 Ref. No: 31), tufa stone is said that it is widely used in the frame of fireplace construction in historic houses of Muğla (Aladağ 2007, Ayhan 2007).

Regarding mortars and plasters, the analyses indicated the use of high amount of lime in the mortars and plasters. Possibility of such excessive amount of lime may be due to lime-wash which is traditionally applied (called '*ayranlamak*' among Muğla people) to all parts of the houses as well as the courtyards in every spring and absorbed by the walls for years in Muğla houses. It was stated that Hamursuz Mountain in the southeast of Muğla (see Figure 2.2 in Chapter 2) was popular with its rich sources of limestone from which good quality of lime is obtained and used for the preparation of mortars and plasters in the past (Aldağ 2007, Ayhan 2007).

As well as analyses, literary sources indicated the use of clay-rich soil (called '*geren*' and '*kızıl toprak'*) sources around Muğla giving the dominant colors of pink, pinkish red and reddish brown to the mortars and plasters of Muğla houses. It is also stated that such soils are still exploited for the preparation of mortars and plasters in the villages of Muğla (Aladağ 1991).

CHAPTER 7

CONCLUSION

As well as the previous studies, the observations on the site revealed that topography of the land descending towards the south had considerable effects not only on the overall layout of the historic urban part but also architectural and structural layout of Muğla houses.

The systems of load bearing walls in Muğla houses varied in three ways; stone masonry alone, stone masonry combined with infilled wood-frame defined as composite system, and infilled wood frame alone which is termed as '*hımış*.' In such a variety, stone masonry alone is used in the foundations, courtyard walls, in the basement and basement-like gallery walls, ground floors and some walls of first floors. *Hımış* system alone formed the front façades (facing to the courtyards in the south) and partition walls between the rooms of houses. Enclosing walls of the houses in the north, east and west are stone masonry or composite. In addition to masonry and *hımış*, *bağdadi* technique, either for plastering purpose or lightening the loads of wood framed wall without infill, was also observed in Muğla houses.

As in many *hımış* constructions in Anatolia, stone masonry parts of Muğla houses are integrated by the use of wood undertaking essential role. Being capable of working well especially in tension, it is used in all parts of Muğla houses. Mostly used wood type was the red pine. Although not determined by laboratory analysis, this preference was due to its high content of resin which provides resistance against water, and surely the rich sources of pine tree of Muğla.

Material analyses indicated the employment of the local raw material sources, such as limestone and clay-rich soils available in the close by surroundings, for the construction of the houses.

As the study reveals, careful consideration of the topography of the land, the choice of proper construction techniques and materials yielded in earthquake resistant buildings and a unique historic environment in Muğla.

Although it was not in the scope, but the reasons for damages which were observed during the survey are worth to be noted;

- The most rapid devastation occurs due to the abandonment of the houses. The reason for abandonment is the great number of inheritors sharing the ownership of the houses. Pillage, aimed at the wood elements – usually structural ones because of their larger cross sections – in best conditions was one of the main causes of collapses.
- Decomposition and respectively the discharge of infill material and the mixture of lime and mud are the subsequent events following penetrations.
- Despite the high risk of earthquake in the area, rainwater and wind work in combination steadily are much more effective than seismic shocks, as the reason for such a resistance explained previously.
- Regarding earthquake, the enlargements of windows or opening new ones buy cutting the supporting structural members were the invitations seismic-based dangers.
- Extremely narrow streets and cul-de-sacks formed the most critical obstacles for fire engines to extinguish the fire immediately which calls for urgent solutions against the fastest and the most threatening danger in the future.

Despite all these conveniences, it can be concluded that Muğla still possesses a rich architectural heritage offering a rich source of information about construction techniques and material use in the past. As seen in the documented cases, the study is concentrated on the houses at critical stages with the aim of collecting information before they perish away. It tries to illuminate and draws attention to the necessity and emergency of more detailed studies covering more different cases as detailed as possible for better interventions.

REFERENCES

Akan, A. E. 2004. Some Observations on the Seismic Behaviour of Traditional Timber Structures in Turkey. *Middle East Technical University, Thesis of Ms*.

Akça, B. 2004. Muğla'nın 20. Yüzyıla Kadarki Tarihi. In *Muğla Kitabı,* ed. Ali Abbas Çınar, 47-63. İzmir: Printer Ofset Matbaacılık.

Akçura, N. 1993. Muğla'da Geleceğe Yönelik Çabalar, Tarihi Çevre Koruması. In *Tarih İçinde Muğla*, ed. İlhan Tekeli, 240-263. Ankara: Middle East Technical University Faculty of Architecture Publication.

Aksoy, D. and Ahunbay, Z. 2005. Geleneksel ahşap iskeletli Türk konutunun deprem davranışları. *İTÜ Dergisi/a* 4(1): 47-58.

Aksoy, E. 1963. Orta mekan: Türk sivil mimarisinde temel kuruluş prensibi. *Mimarlık ve Sanat* 7-8: 40-91

Aladağ, E. 1991. *Muğla evi*. Muğla: Hamle Matbaacılık.

Aladağ, E. 2007. Interview: A contractor-Architect who is involved in restoration works in Muğla. Muğla, October 19, 2007.

Aran, K. 2000. *Beyond shelter: Anatolian indigenous buildings*. Ankara: Tepe Mimarlık Kültürü Merkezi.

Arel, A. 1982. *Osmanlı konut geleneğinde tarihsel sorunlar*. İzmir: Ege Üniversitesi Güzel Sanatlar Fakültesi Yayınları.

Arun, G. 2005. Yığma kagir yapı davranışı. *Yığma Yapıların Deprem Güvenliğinin Arttırılması Çalıştayı*, METU, Ankara. 17 February 2005

Asatekin, G. 2005. Understanding traditional residential architecture in Anatolia. *Journal of Architecture* 10(4): 389-414.

Ayhan, M.A. 2008. Interview: A builder experienced in chimney construction and repair. Muğla, April 26, 2008.

Bakırer, Ö. 1993. Ortaçağda Muğla. In *Tarih İçinde Muğla*, ed. İlhan Tekeli, 10-15. Ankara: Middle East Technical University Faculty of Architecture Publication.

Bektaş, C. 2001. *Halk yapı sanatı*. İstanbul: Literatür Yayınları.

Böce, M. 2008. Interview: A carpenter. Muğla, September 21, 2008.

Buluç, S. 1993. İlkçağda Muğla. In *Tarih İçinde Muğla*, ed. İlhan Tekeli, 1-8. Ankara: Middle East Technical University Faculty of Architecture Publication.

ÇED. 2006. Muğla Valiliği İl Çevre ve Orman Müdürlüğü, Muğla İl Çevre Durum Raporu. http://www.cedgm.gov.tr/icd_raporlari/muglaicd2003.pdf (accessed November 6, 2007).

Çobancaoğlu, G. 1998. Türkiye'de Ahşap Evin Bölgelere Göre Yapısal Olarak İncelenmesi ve Restorasyonlarında Yöntem Önerileri. *Mimar Sinan University, Thesis of Phd*.

Doğangün, A., Tuluk, Ö. İ., Livaoğlu, R. and Acar, R. 2006. Traditional wooden buildings and their damages during earthquakes in Turkey. *Engineering Failure Analysis* 13: 981-996.

Doğru, E. 2006. Issues of Sustainable Development in Local and Global Context: The case of Muğla. *Middle East Technical University, Thesis of Ms*.

Ekinci, O. 1985. *Yaşayan Muğla*. İstanbul: Numune Mücellithanesi.

Ekinci, Z. 2005. *Anadolu Türk evi geleneğinde Birgi örneği ve Sandıkoğlu Konağı, bir konağın kurgusu*. İstanbul: Yapı Yayınları.

Eldem, S.H. 1954. *Türk evi plan tipleri*. İstanbul: İstanbul Teknik Üniversitesi Mimarlık Fakültesi Yayınları.

Erdem Yerbilimleri Ltd. Şti. 2007. Muğla – Merkez- Şeyh Mahallesi-Hacımemişağa Sokağı-22 Pafta- 350 Ada- 11 Parselin Zemin Etüd Raporu.

Eriç, M. 1979. Geleneksel Türk mimarisinde malzeme seçim ve kullanımı. *Yapı* 33(3): 42-45.

Google Earth. 2008. http://earth.google.com/ (accessed June 25, 2008).

Güçhan, N. Ş. 1995. A Study on Conservation and Rehabilitation Problems of Historic Timber Houses in Ankara. *Middle East Technical University, Thesis of Ms*.

Güçhan, N. Ş. 2007. Observations on earthquake resistance of traditional timber-framed houses in Turkey. *Building and Environment* 42: 840-851.

Gülkan, P. and Langebach, R. 2004. The earthquake resistance of traditional timber and masonry dwellings in Turkey. *13th World Conference on Earthquake Engineering*, Vancover, Canada, Paper No. 2297.

İkiel, C. 2004. Muğla İlinin Coğrafi Özellikleri. In *Muğla Kitabı,* ed. Ali Abbas Çınar, 15-24. İzmir: Printer Ofset Matbaacılık.

İrem, K. 2004. İlkçağ Boyunca Muğla İli. In *Muğla Kitabı,* ed. Ali Abbas Çınar, 27-45. İzmir: Printer Ofset Matbaacılık.

İYTE, 2005. Karaosmanoğlu House on Arasta street (No: 9) was studied in the scope of *RES 501 Design in Architectural Restoration* given in the Fall Semester Course in 2005 in the Department of Architectural Restoration of İzmir Institute of Technology (İ.Y.T.E.). The project is supervised by Prof. Dr. Başak İpekoğlu and Asst. Prof. Dr. S. Sarp Tunçoku, and accomplished by MS student – architects; İpek Akbaylar, Özge Akbulut, Burcu Irgat, Abdurrahman Kibar and H. Oya Saf.

Jedrzejevska, H. 1981. Ancient mortars as criterion in analysis of old architecture. *Proceedings of Symposium on Mortars, Cements and Grouts Used in the Conservation of Historic Buildings*, Rome: 311-329.

Karaesmen, E. 2002, *Öncesiyle Sonrasıyla Deprem*. Ankara: Atılım Üniversitesi Yayınları: 10.

Karakostas, C., Lekidis, V., Makarios, T., Salonikios, T., Sous I. and Demosthenous, M. 2005. Seismic response of structures and infrastructure facilities during the Lefkada, Greece earthquake of 14/8/2003. *Engineering Structures* 27(2): 213-227.

Kazmaoğlu, M. and Tanyeli, U. 1979. Anadolu konut mimarisinde bölgesel farklılıklar. *Yapı* 33(3): 29-41.

Koca, F. 2004. Urban Growth and Conservation Problematic in Muğla, Karabağlar. *Middle East Technical University, Thesis of Ms*.

Kuban, D. 1995. *The Turkish hayat house*. İstanbul: Eren Yayıncılık ve Kitapçılık Ltd. Şti.

Küçükerman, Ö. 1996. *Turkish house, in search of spatial identity / Kendi mekanının arayışı içinde Türk evi*. İstanbul: Turing ve Otomobil Kurumu Yayını

Langenbach, R. 2002. Survivors among the ruins: Traditional houses in earthquakes in Turkey and India. *APT Bulletin* 33(2/3): 47-56.

Makarios, T. and Demosthenous, M. 2006. Seismic response of traditional buildings of Lefkas Island, Greece. *Engineering Structures* 28: 264–278.

Middendorf, B. and Knöfel, D. 1990. Use of old and modern analytical methods for the determination of ancient mortars in Northern Germany. *Proceedings of the 3rd Expert Meeting, Hamburg, NATO-CCMS Pilot Study on Conservation of Historic Brick Structures*, Berlin, Germany: 75-92.

Moropoulou, A., A. Bakolas and B. Bisbikou. 1995. Characterization of ancient, Byzantine and later historic mortars by Thermal and X-ray Diffraction techniques. *Thermomica Acta* 269/270: 779-795.

Official Website of the Governorship of Muğla. 2007. http://www.mugla.gov.tr/ (accessed November 13, 2007).

Official Website of the General Directorate of Mineral Research & Exploration. 2007. http://www.mta.gov.tr/mta/bolge/adana/dirifay.jpg (accessed November 14, 2007).

Official Website of the General Directorate of Disaster Affairs, Earthquake Research Department. 2008. *Turkey National Strong Ground Motion Program.* http://angora.deprem.gov.tr/rapor.htm (accessed May 21, 2008).

Official Website of the Republic of Turkey Ministry of Environment and Forestry, Turkish State Meteorological Service. 2008. http://www.meteoroloji.gov.tr/2006/tahmin/tahmin-iller.aspx?m=MUGLA (accessed May 21, 2008).

Official Website of the General Directorate of Forestry. 2007. http://www.ogm.gov.tr/kbulten/mugla3.htm (accessed November 12, 2007).

RILEM. 1980. Tentative recommendations, comission-25-PEM, recommended tests to measure the deterioration of stone and to assess the effectiveness of treatment methods. *Materiaux and Construction* 13(73): 173-253.

Sezer, L.I. 2003. Muğla ve yöresinde deprem aktivitesi ve riski. *Kuvaterner Çalıştayı IV*, İTÜ Avrasya Yerbilimleri Enstitüsü, İstanbul: 111-120.

Sezer, S. 2004. Muğla'da Kentlileşme ve Kent Yönetimi. *Muğla University, Thesis of Ms*.

Süer, D. 1990. Comparison of Traditional Building Methods with Contemporary Rules, Regulations and Technologies. *Dokuz Eylül University, Thesis of Ms*.

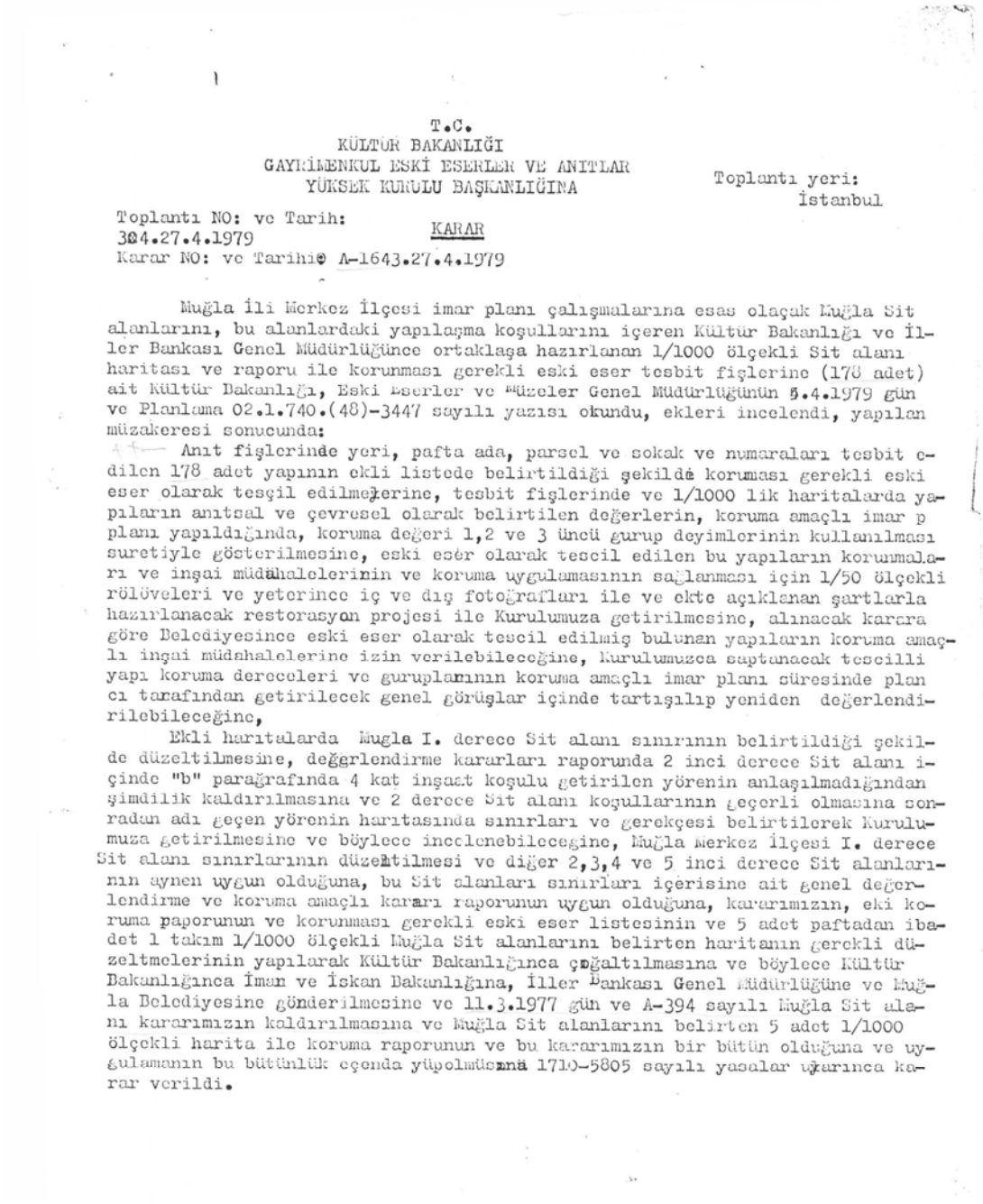
Tekeli, İ. 1993. Ed. of '*Tarih İçinde Muğla*,' Ankara: Middle East Technical University Faculty of Architecture Publication.

Tosun, Y. 1983. *17-19.Yüzyıllarda Batı Anadolu'da Osmanlı- Türk şehir dokuları, bu dokuları oluşturan evler ve korunmaları.* İzmir: Ticaret Matbaacılık T.A.Ş.

Yaşar, Ö. 1995. En Eski Devirlerden Roma Hakimiyetine Geçişe Kadar Karia Tarihi. *Selçuk University, Thesis of Ms*.

APPENDIX A

DECISSIONS OF SUPREME COUNCIL FOR MONUMENTS



T.C.
KÜLTÜR BAKANLIĞI
GAYRİMENKUL ESKİ ESERLER VE ANITLAR
YÜKSEK KURULU BAŞKANLIĞINA

Toplantı yeri:
İstanbul

Toplantı NO: ve Tarih:
304.27.4.1979

KARAR

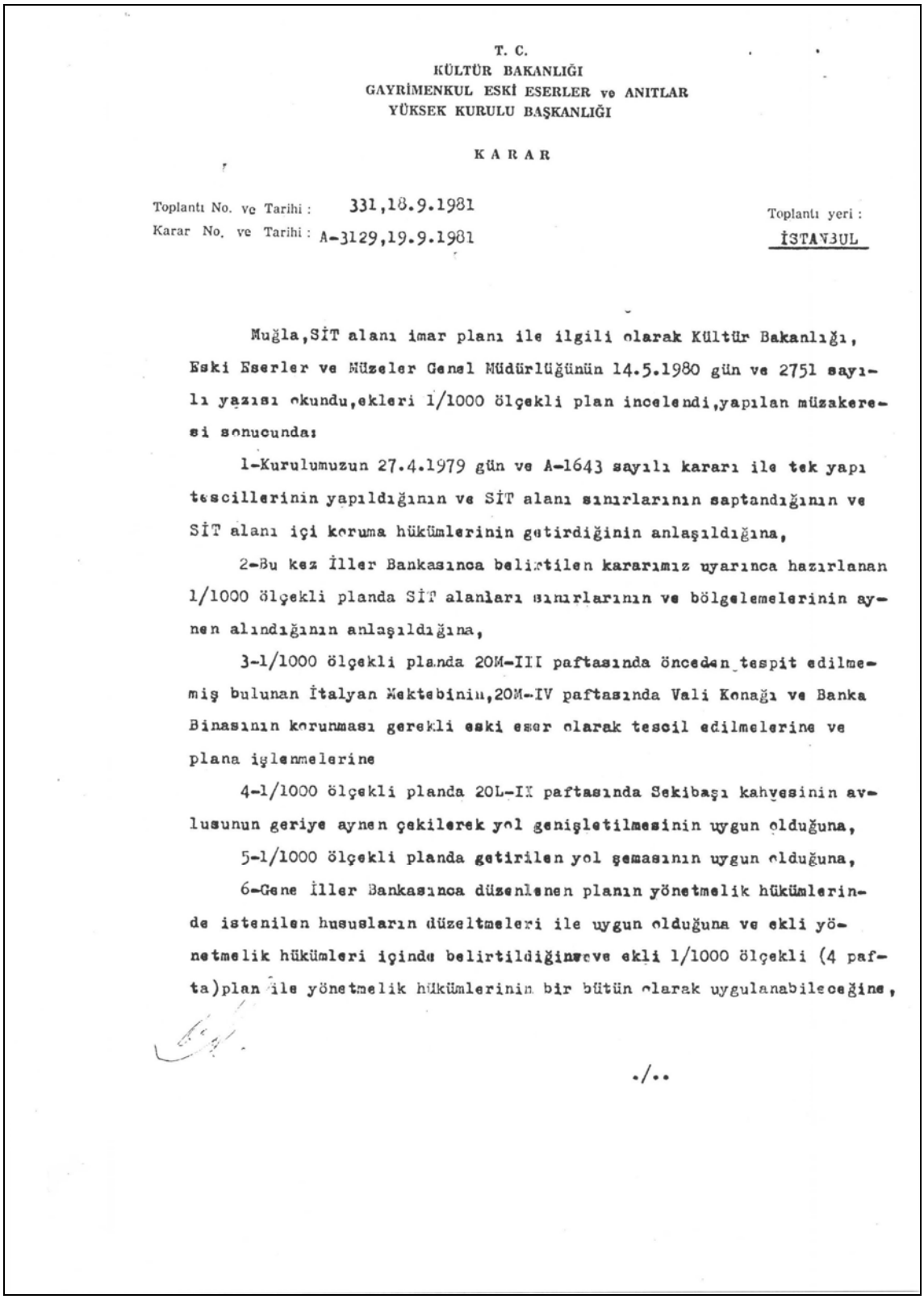
Karar NO: ve Tarihi: A-1643.27.4.1979

Muğla İli Merkez İlçesi imar planı çalışmalarına esas olacak Muğla Sit alanlarını, bu alanlardaki yapılaşma koşullarını içeren Kültür Bakanlığı ve İller Bankası Genel Müdürlüğünce ortaklaşa hazırlanan 1/1000 ölçekli Sit alanı haritası ve raporu ile korunması gerekli eski eser tesbit fişlerine (178 adet) ait Kültür Bakanlığı, Eski Eserler ve Müzeler Genel Müdürlüğünün 5.4.1979 gün ve Planlama 02.1.740.(48)-3447 sayılı yazısı okundu, ekleri incelendi, yapılan müzakeresi sonucunda:

Anıt fişlerinde yeri, pafta ada, parsel ve sokak ve numaraları tesbit edilen 178 adet yapının ekli listede belirtildiği şekilde koruması gerekli eski eser olarak tesçil edilmelerine, tesbit fişlerinde ve 1/1000 lik haritalarda yapıların anıtsal ve çevresel olarak belirtilen değerlerin, koruma amaçlı imar p planı yapıldığında, koruma değeri 1,2 ve 3 üncü gurup deyimlerinin kullanılması suretiyle gösterilmesine, eski eser olarak tescil edilen bu yapıların korunmaları ve inşai müdahalelerinin ve koruma uygulamasının sağlanması için 1/50 ölçekli rölöveleri ve yeterince iç ve dış fotoğrafları ile ve ekte açıklanan şartlarla hazırlanacak restorasyon projesi ile Kurulumuza getirilmesine, alınacak karara göre Belediyesince eski eser olarak tescil edilmiş bulunan yapıların koruma amaçlı inşai müdahalelerine izin verilebileceğine, Kurulumuzca saptanacak tescilli yapı koruma dereceleri ve guruplarının koruma amaçlı imar planı süresinde plan cı tarafından getirilecek genel görüşler içinde tartışılıp yeniden değerlendirilebileceğine,

Ekli haritalarda Mugla I. derece Sit alanı sınırının belirtildiği şekilde düzeltilmesine, değerlendirme kararları raporunda 2 inci derece Sit alanı içinde "b" parağrafında 4 kat inşaat koşulu getirilen yörenin anlaşılmadığından şimdilik kaldırılmasına ve 2 derece Sit alanı koşullarının geçerli olmasına sonradan adı geçen yörenin haritasında sınırları ve gerekçesi belirtilerek Kurulumuza getirilmesine ve böylece incelenebileceğine, Muğla Merkez İlçesi I. derece Sit alanı sınırlarının düzeltilmesi ve diğer 2,3,4 ve 5 inci derece Sit alanlarının aynen uygun olduğuna, bu Sit alanları sınırları içerisine ait genel değerlendirme ve koruma amaçlı kararı raporunun uygun olduğuna, kararımızın, eki koruma paporunun ve korunması gerekli eski eser listesinin ve 5 adet paftadan ibadet 1 takım 1/1000 ölçekli Muğla Sit alanlarını belirten haritanın gerekli düzeltmelerinin yapılarak Kültür Bakanlığınca çoğaltılmasına ve böylece Kültür Bakanlığınca İmar ve İskan Bakanlığına, İller Bankası Genel Müdürlüğüne ve Muğla Belediyesine gönderilmesine ve 11.3.1977 gün ve A-394 sayılı Muğla Sit alanı kararımızın kaldırılmasına ve Muğla Sit alanlarını belirten 5 adet 1/1000 ölçekli harita ile koruma raporunun ve bu kararımızın bir bütün olduğuna ve uygulamanın bu bütünlük içinde yürütülmesine 1710-5805 sayılı yasalar uyarınca karar verildi.

Figure A.1. Decission of the Council dated 27.04.1979 with reference number A-1643
(Source: Archives of Muğla Regional Board for the Conservation of Cultural and Natural Assets)



T. C.
KÜLTÜR BAKANLIĞI
GAYRİMENKUL ESKİ ESERLER ve ANITLAR
YÜKSEK KURULU BAŞKANLIĞI

KARAR

Toplantı No. ve Tarihi : 331,18.9.1981
Karar No. ve Tarihi : A-3129,19.9.1981

Toplantı yeri :
İSTANBUL

Muğla,SİT alanı imar planı ile ilgili olarak Kültür Bakanlığı, Eski Eserler ve Müzeler Genel Müdürlüğünün 14.5.1980 gün ve 2751 sayılı yazısı okundu,ekleri 1/1000 ölçekli plan incelendi,yapılan müzakeresi sonucunda:

1-Kurulumuzun 27.4.1979 gün ve A-1643 sayılı kararı ile tek yapı tescillerinin yapıldığının ve SİT alanı sınırlarının saptandığının ve SİT alanı içi koruma hükümlerinin getirdiğinin anlaşıldığına,

2-Bu kez İller Bankasınca belirtilen kararımız uyarınca hazırlanan 1/1000 ölçekli planda SİT alanları sınırlarının ve bölgelemelerinin aynen alındığının anlaşıldığına,

3-1/1000 ölçekli planda 20M-III paftasında önceden tespit edilmemiş bulunan İtalyan Mektebinin,20M-IV paftasında Vali Konağı ve Banka Binasının korunması gerekli eski eser olarak tescil edilmelerine ve plana işlenmelerine

4-1/1000 ölçekli planda 20L-IX paftasında Sekibaşı kahvesinin avlusunun geriye aynen çekilerek yol genişletilmesinin uygun olduğuna,

5-1/1000 ölçekli planda getirilen yol şemasının uygun olduğuna,

6-Gene İller Bankasınca düzenlenen planın yönetmelik hükümlerinde istenilen hususların düzeltmeleri ile uygun olduğuna ve ekli yönetmelik hükümleri içinde belirtildiğine ve ekli 1/1000 ölçekli (4 pafta)plan ile yönetmelik hükümlerinin bir bütün olarak uygulanabileceğine,

./..

Figure A.2. Decission of the Council dated 19.09.1981 with reference number A-3129
(Source: Archives of Muğla Regional Board for the Conservation of Cultural and Natural Assets)

(Cont. on next page)

KÜLTÜR BAKANLIĞI
GAYRİMENKUL ESKİ ESERLER ve ANITLAR
YÜKSEK KURULU BAŞKANLIĞI

KARAR

Toplantı No. ve Tarihi : 331,18.9.1981
Karar No. ve Tarihi : A-3129,19.9.1981

-2-

Toplantı yeri : İSTANBUL

7-1/1000 ölçekli imar planındaki tablonun ekli yönetmelik hükümlerine göre düzenlenmesine, herhangi anlaşmazlıkta yönetmelik hükümlerinin geçerli olduğuna 1710 ve 5805 sayılı yasalar uyarınca karar verildi.

Aslı Gibidir.

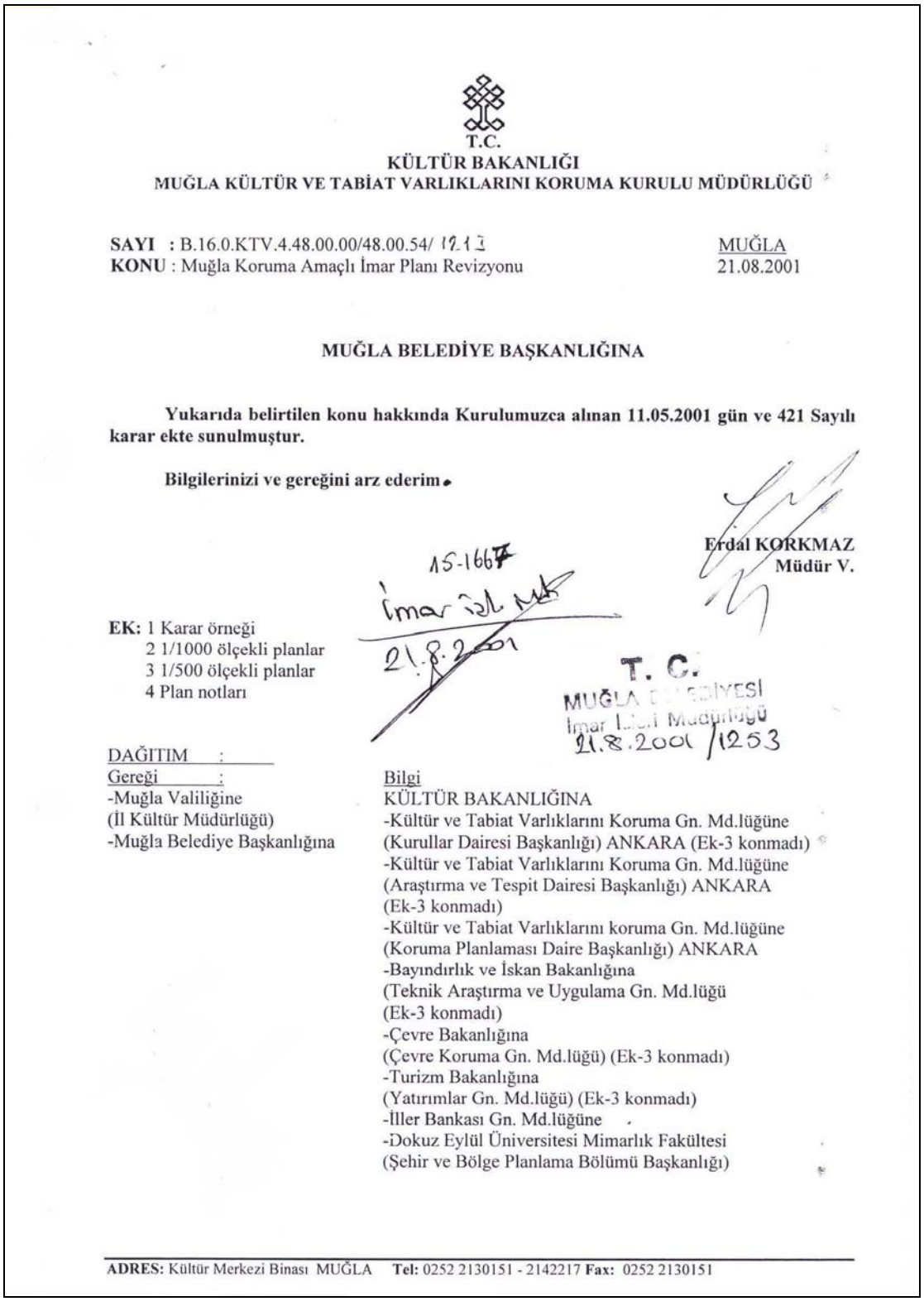
Prof. ORHAN ALSAÇ

Prof. Dr. DOĞAN KUBAN

BAŞKAN			BAŞKANVEKİLİ	
Üye Akozan (Feridun) Bulunmadı	Üye Aktepe (Münir)	Üye [illegible] Cevdet Bayburtluoğlu Bulunmadı	Üye [illegible] Metin Sözen	Üye Alsaç (Orhan)
Üye Serdaroğlu (Ümit) Bulunmadı	Üye Eyice (Semavi)	Üye Kırmızıoğlu (Fahrettin) Bulunmadı	Üye Kuban (Doğan)	Üye Kuran (Aptullah)
Üye Biler (Remin) Bulunmadı	Üye Ögel (Semra)	Üye Erder (Cevat) Bulunmadı	Üye Tayla (Hüsrev)	Üye Tandoğan (Rıfat)
Üye Kültür Müsteşarı Kemal Cökçe Bulunmadı Rauf Beyru Üye	Üye Vakıflar Genel Müdürü Galip Yiğitgüden Bulunmadı	Üye Eski Eserler ve Müzeler Genel Müdürü Nurettin Yardımcı	Üye Turizm Genel Müdürü Ömer Faruk Sever Bulunmadı	Üye Planlama ve İmar Genel Müdürü Erdem Kırdar Bulunmadı

27.10.1981:RO/AS

Figure A.2. (Cont.) Decission of the Council dated 19.09.1981 with reference number A-3129 (Source: Archives of Muğla Regional Board for the Conservation of Cultural and Natural Assets)



T.C.
KÜLTÜR BAKANLIĞI
MUĞLA KÜLTÜR VE TABİAT VARLIKLARINI KORUMA KURULU MÜDÜRLÜĞÜ

SAYI : B.16.0.KTV.4.48.00.00/48.00.54/ 12.13 — MUĞLA
KONU : Muğla Koruma Amaçlı İmar Planı Revizyonu — 21.08.2001

MUĞLA BELEDİYE BAŞKANLIĞINA

Yukarıda belirtilen konu hakkında Kurulumuzca alınan 11.05.2001 gün ve 421 Sayılı karar ekte sunulmuştur.

Bilgilerinizi ve gereğini arz ederim.

Erdal KORKMAZ
Müdür V.

15-1667
İmar İşl. Müd.
21.8.2001

T. C.
MUĞLA BELEDİYESİ
İmar İşleri Müdürlüğü
21.8.2001 /1253

EK: 1 Karar örneği
2 1/1000 ölçekli planlar
3 1/500 ölçekli planlar
4 Plan notları

DAĞITIM :
Gereği :
-Muğla Valiliğine
(İl Kültür Müdürlüğü)
-Muğla Belediye Başkanlığına

Bilgi
KÜLTÜR BAKANLIĞINA
-Kültür ve Tabiat Varlıklarını Koruma Gn. Md.lüğüne
(Kurullar Dairesi Başkanlığı) ANKARA (Ek-3 konmadı)
-Kültür ve Tabiat Varlıklarını Koruma Gn. Md.lüğüne
(Araştırma ve Tespit Dairesi Başkanlığı) ANKARA
(Ek-3 konmadı)
-Kültür ve Tabiat Varlıklarını koruma Gn. Md.lüğüne
(Koruma Planlaması Daire Başkanlığı) ANKARA
-Bayındırlık ve İskan Bakanlığına
(Teknik Araştırma ve Uygulama Gn. Md.lüğü
(Ek-3 konmadı)
-Çevre Bakanlığına
(Çevre Koruma Gn. Md.lüğü) (Ek-3 konmadı)
-Turizm Bakanlığına
(Yatırımlar Gn. Md.lüğü) (Ek-3 konmadı)
-İller Bankası Gn. Md.lüğüne
-Dokuz Eylül Üniversitesi Mimarlık Fakültesi
(Şehir ve Bölge Planlama Bölümü Başkanlığı)

ADRES: Kültür Merkezi Binası MUĞLA **Tel:** 0252 2130151 - 2142217 **Fax:** 0252 2130151

Figure A.3. Decission of the Council dated 11.05.2001 with reference number 421
(Source: Archives of Muğla Regional Board for the Conservation of Cultural and Natural Assets)

(Cont. on next page)

T.C
KÜLTÜR BAKANLIĞI
MUĞLA KÜLTÜR VE TABİAT VARLIKLARINI
KORUMA KURULU MÜDÜRLÜĞÜ

Toplantı Tarihi ve No : 11.05.2001-22
Karar tarihi ve No : 11.05.2001-421

Toplantı Yeri
MUĞLA

Muğla İli, Merkezinde İzmir 2 Nolu K.T.V.K.K.' nun 21.12.1994 gün ve 4477 sayılı kararı ile tescil edilen Kentsel Sit Alanı için hazırlanan Koruma Amaçlı İmar Planı Revizyonuna ilişkin İzmir II Nolu K.T.V.K.K.' nun 17.11.1993 gün ve 3637, 12.01.1994 gün ve 3762, 21.12.1994 gün ve 4477, 08.07.1998 gün ve 7887, 16.10.1996 gün ve 6163, 26.03.1999 gün ve 8418, 01.12.1999 gün ve 8933, 16.02.2000 gün ve 9164 sayılı kararları, Muğla Belediyesi' nin 12.07.1999 gün ve 769 sayılı yazısı, Dokuz Eylül Üniversitesi Mimarlık Fakültesi Dekanlığı' nın 15.12.2000 gün ve 4906 sayılı yazısı, Dokuz Eylül Üniversitesi Şehir ve Bölge Planlama Bölümü' nün 16.03.2001 gün ve 106 ve 08.05.2001 gün ve 247 sayılı yazıları kurulumuzun 09.02.2001 gün ve 266 ve 28.04.2001 gün ve 373 sayılı kararları Müdürlüğümüz uzmanlarının 09.02.2001, 29.03.2001 ve 08.05.2001 günlü raporları okundu, ekleri ve işlem dosyası incelendi, yapılan görüşmeler sonunda;

Muğla İli, Merkezinde İzmir 2 Nolu K.T.V.K.K.' nun 21.12.1994 gün ve 4477 sayılı kararı ile tescil edilen Kentsel Sit Alanı için hazırlanan Koruma Amaçlı İmar Planı Revizyonuna ilişkin,

1- Maddi hatalarla ilgili olarak:

a) Kurulumuzun 28.04.2001 gün ve 373 sayılı kararında belirlenen düzeltmelerin yapıldığına ve aynı karar ekindeki "tescilli kültür varlığı parselleri" (LİSTE I) ile (İzmir II Nolu K.T.V.K.K.' nun 08.07.1998 gün ve 7887 sayılı kararıyla sehven tescil edilen parseller (LİSTE II) listelerinin yürürlüğe girmesine, bu listelerin plan eki olarak dikkate alınacağına,

b) 1(a)' da belirtilen tescilli yapı kadastral bilgilerini kesinleştiren listelerin dikkate alınarak Muğla Kentsel Sit' indeki tüm tescilli yapıların bu düzeltmeye göre Müdürlüğümüzce nihai listesinin hazırlanarak koruma planı eki olarak dağıtılmasına,

c) Kentsel Sit Alanı etkilenme bölgeleri sınırının karar eki paftalara işlendiği şekilde plan paftalarına aktarılarak çoğaltmaların buna göre uygulanmasına,

2- Plan notlarıyla ilgili olarak;

a) Plan notlarında kurulumuzca yapılan redaksiyonların notlara ait metinlerine eklenerek yeniden düzenlenecek metnin planla birlikte bir bütün olarak yürürlüğe sokulmasına,

ASLI GİBİDİR

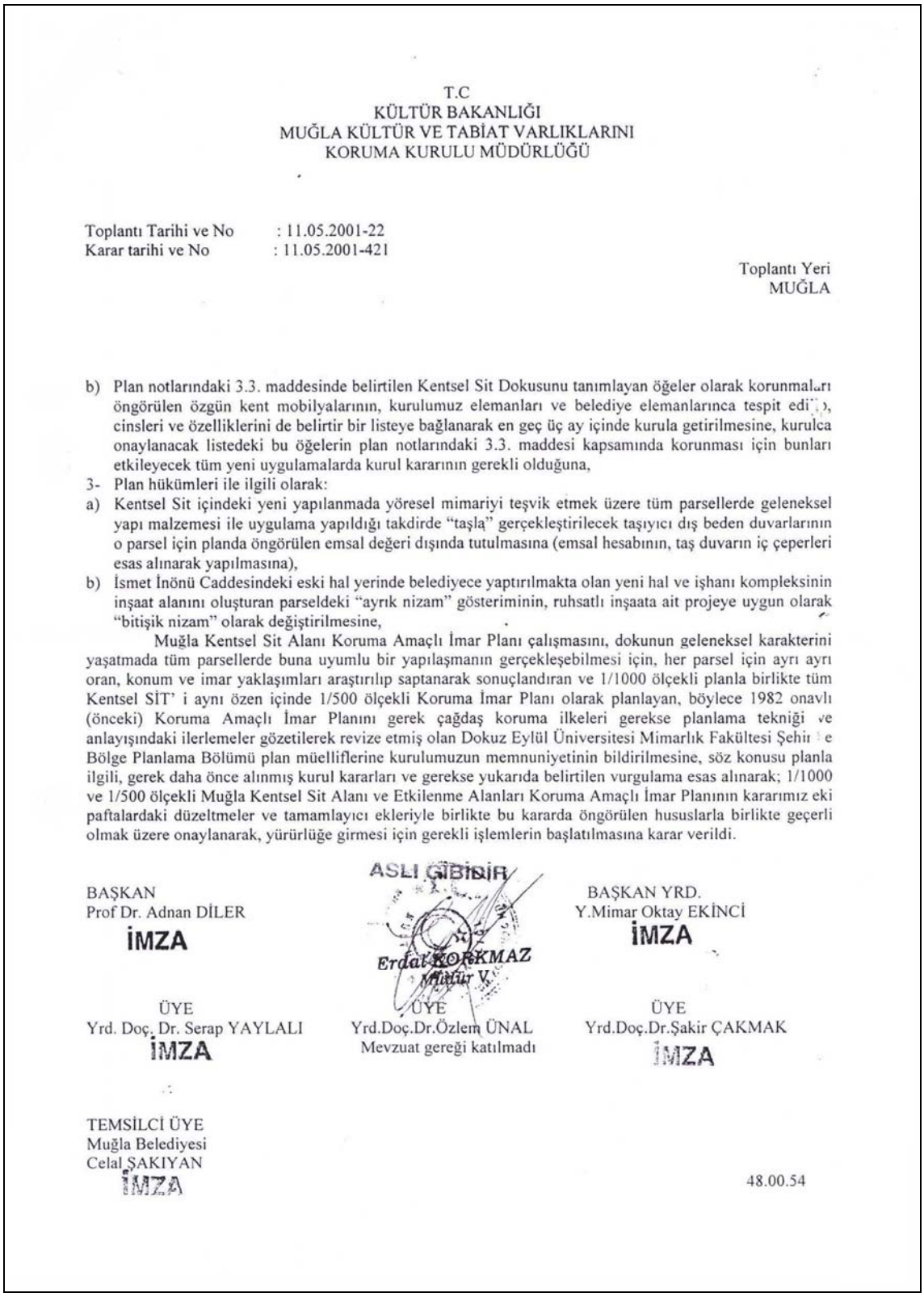
Erdal KORKMAZ
Müdür V.

BAŞKAN Prof Dr. Adnan DİLER İMZA		BAŞKAN YRD. Y.Mimar Oktay EKİNCİ İMZA
ÜYE Yrd. Doç. Dr. Serap YAYLALI İMZA	ÜYE Yrd.Doç.Dr.Özlem ÜNAL Mevzuat gereği katılmadı	ÜYE Yrd.Doç.Dr.Şakir ÇAKMAK İMZA

TEMSİLCİ ÜYE
Muğla Belediyesi
Celal ŞAKIYAN
İMZA

48.00.54

Figure A.3. (Cont.) Decission of the Council dated 11.05.2001 with reference number 421
(Source: Archives of Muğla Regional Board for the Conservation of Cultural and Natural Assets)



T.C
KÜLTÜR BAKANLIĞI
MUĞLA KÜLTÜR VE TABİAT VARLIKLARINI
KORUMA KURULU MÜDÜRLÜĞÜ

Toplantı Tarihi ve No : 11.05.2001-22
Karar tarihi ve No : 11.05.2001-421

Toplantı Yeri
MUĞLA

b) Plan notlarındaki 3.3. maddesinde belirtilen Kentsel Sit Dokusunu tanımlayan öğeler olarak korunmaları öngörülen özgün kent mobilyalarının, kurulumuz elemanları ve belediye elemanlarınca tespit edilip, cinsleri ve özelliklerini de belirtir bir listeye bağlanarak en geç üç ay içinde kurula getirilmesine, kurulca onaylanacak listedeki bu öğelerin plan notlarındaki 3.3. maddesi kapsamında korunması için bunları etkileyecek tüm yeni uygulamalarda kurul kararının gerekli olduğuna,

3- Plan hükümleri ile ilgili olarak:

a) Kentsel Sit içindeki yeni yapılanmada yöresel mimariyi teşvik etmek üzere tüm parsellerde geleneksel yapı malzemesi ile uygulama yapıldığı takdirde "taşla" gerçekleştirilecek taşıyıcı dış beden duvarlarının o parsel için planda öngörülen emsal değeri dışında tutulmasına (emsal hesabının, taş duvarın iç çeperleri esas alınarak yapılmasına),

b) İsmet İnönü Caddesindeki eski hal yerinde belediyece yaptırılmakta olan yeni hal ve işhanı kompleksinin inşaat alanını oluşturan parseldeki "ayrık nizam" gösteriminin, ruhsatlı inşaata ait projeye uygun olarak "bitişik nizam" olarak değiştirilmesine,

Muğla Kentsel Sit Alanı Koruma Amaçlı İmar Planı çalışmasını, dokunun geleneksel karakterini yaşatmada tüm parsellerde buna uyumlu bir yapılaşmanın gerçekleşebilmesi için, her parsel için ayrı ayrı oran, konum ve imar yaklaşımları araştırılıp saptanarak sonuçlandıran ve 1/1000 ölçekli planla birlikte tüm Kentsel SİT' i aynı özen içinde 1/500 ölçekli Koruma İmar Planı olarak planlayan, böylece 1982 onaylı (önceki) Koruma Amaçlı İmar Planını gerek çağdaş koruma ilkeleri gerekse planlama tekniği ve anlayışındaki ilerlemeler gözetilerek revize etmiş olan Dokuz Eylül Üniversitesi Mimarlık Fakültesi Şehir ve Bölge Planlama Bölümü plan müelliflerine kurulumuzun memnuniyetinin bildirilmesine, söz konusu planla ilgili, gerek daha önce alınmış kurul kararları ve gerekse yukarıda belirtilen vurgulama esas alınarak; 1/1000 ve 1/500 ölçekli Muğla Kentsel Sit Alanı ve Etkilenme Alanları Koruma Amaçlı İmar Planının kararımız eki paftalardaki düzeltmeler ve tamamlayıcı ekleriyle birlikte bu kararda öngörülen hususlarla birlikte geçerli olmak üzere onaylanarak, yürürlüğe girmesi için gerekli işlemlerin başlatılmasına karar verildi.

ASLI GİBİDİR
Erdal KORKMAZ
Müdür V.

BAŞKAN
Prof Dr. Adnan DİLER
İMZA

BAŞKAN YRD.
Y.Mimar Oktay EKİNCİ
İMZA

ÜYE
Yrd. Doç. Dr. Serap YAYLALI
İMZA

ÜYE
Yrd.Doç.Dr.Özlem ÜNAL
Mevzuat gereği katılmadı

ÜYE
Yrd.Doç.Dr.Şakir ÇAKMAK
İMZA

TEMSİLCİ ÜYE
Muğla Belediyesi
Celal ŞAKIYAN
İMZA

48.00.54

Figure A.3. (Cont.) Decission of the Council dated 11.05.2001 with reference number 421 (Source: Archives of Muğla Regional Board for the Conservation of Cultural and Natural Assets)