CONSTRUCTION TECHNIQUES OF TRADITIONAL TIRILYE HOUSES

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ABSTRACT

CONSTRUCTION TECHNIQUES OF TRADITIONAL TIRILYE HOUSES

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Master of Science, Conservation of Cultural Heritage in Architecture
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Studies on construction techniques of historical buildings are critical in terms of giving significant information about the architecture, structure, material selection, spatial organization, relationship with the place, and creative architectural solutions against existing problems of the studied buildings. Tirilye houses, which form the historical fabric of the settlement, represent the tradition of the period with their construction systems, material choices, and architectural features. This study aims to create reliable information about the construction technique and material usage of the traditional Tirilye houses. For this purpose, a literature survey on the history and general characteristics of Tirilye is made. Planning and conservation activities for the Tirilye settlement are investigated. In this study, the characteristics of the Tirilye houses are defined in relation to the environment and its local characteristics. The traditional Tirilye houses, which preserve their authenticity, are selected according to the legibility and richness of the construction techniques used, and the system

details are documented in specific scales. Till today, several academic studies about the Tirilye settlement have been made. However, there is no specific research focusing on the construction techniques of traditional Tirilye houses. Declared as an urban site by the Bursa Cultural and Natural Heritage Preservation Board in 1981, Tirilye settlement acquired the Development Plan for Protection in 1990. However, traditional houses face the danger of negligence and unconscious intervention. Therefore, it is essential to document the traditional construction techniques of Tirilye houses to be used in later conservation interventions and transfer the knowledge to the future.

Keywords: Traditional Houses, Tirilye, Construction Technique

ÖZ

GELENEKSEL TİRİLYE EVLERİNDE KULLANILAN YAPIM TEKNİKLERİ

Doğan Tavas, Özge
Yüksek Lisans, Kültürel Mirası Koruma, Mimarlık
Tez Yöneticisi: Prof. Dr. Neriman Şahin Güçhan

Aralık 2021, 233 sayfa

Tarihi yapıların yapım tekniği ile ilgili çalışmalar, mimari, strüktür, malzeme seçimi, mekânsal organizasyon, mekânla ilişki ve yaratıcı mimari çözümler üzerinde çalışılan yapının mevcut sorunlarına karşı önemli bilgiler vermeleri açısından çok önemlidir. Tirilye'de tarihi dokuyu oluşturan Tirilye evlerinin yapı sistemi, malzeme seçimleri ve mimari özellikleri ile döneme ait geleneğin örneğini oluşturmaktadır. Bu çalışmanın amacı, geleneksel Tirilye evlerinin inşaat tekniği ve malzeme kullanımı hakkında güvenilir bilgi oluşturmaktır. Bu amaçla öncelikle Tirilye'nin tarihi ve genel özellikleri hakkında bir literatür taraması yapılmıştır. Tirilye yerleşimindeki planlama ve koruma faaliyetleri incelenmiştir. Tirilye evlerinin nitelikleri, çevreye ve yerel özelliklere göre belirlenmiştir. Bu çalışmada, özgünlüklerini koruyan geleneksel Tirilye evleri kullanılan yapım tekniğinin okunabilirliği ve zenginliğine göre seçilmiş ve sistem detayları belli ölçeklerde belgelenmiştir. Bugüne kadar Tirilye yerleşimi hakkında birçok akademik çalışma

bulunmaktadır. Ancak, geleneksel Tirilye evlerinin yapım teknikleri üzerine odaklanan bir araştırma yoktur. 1981 yılında Bursa Kültür ve Tabiat Varlıklarını Koruma Kurulu tarafından koruma alanı olarak ilan edilmesiyle kentsel sit ilan edilen Tirilye'nin Koruma Amaçlı İmar Planı 1990 yılında onaylanmıştır. Buna rağmen Tirilye ihmal ve bilinçsiz müdahalelerin tehtidi altındadır. Bu nedenle, daha sonraki koruma müdahalelerinde kullanılması ve bilginin geleceğe aktarımı için, Tirilye evlerinin geleneksel yapım tekniğinin belgelemesi çok önemlidir.

Anahtar Kelimeler: Geleneksel Evler, Tirilye, Yapım Tekniği

To my family,

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I owe the succession of this study to many people around me supporting me from the start to the end.

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ABBREVIATIONS

BKTVKBK	Bursa Regional Council for the Conservation of Cultural and Natural Property
BKVKBK	Bursa Regional Council for the Conservation of Cultural Property
DIE	State Institute of Statistics (Devlet İstatistik Enstitüsü)
GEEAYK	Superior Council of Immovable Monuments and Antiquities (Gayrimenkul Eski Eserler ve Anıtlar Yüksek Kurulu)
İRAM	İstanbul Directorate of Surveying and Monuments (İstanbul Rölöve ve Anıtlar Müdürlüğü,)
KTVKYK	Superior Council for the Conservation of Cultural and Natural Property (Kültür ve Tabiat Varlıkları Koruma Yüksek Kurulu)
TF	Timber frame structure
TKTVYK	Superior Council of Immovable Cultural and Natural Heritage (Taşınmaz Kültür ve Tabiat Varlıkları Koruma Yüksek Kurulu)
TÜIK	Turkish Statistical Institute (Türkiye İstatistik Kurumu)

CHAPTER 1

INTRODUCTION

Tirilye, also known as Zeytinbağı, is a coastal settlement surrounded by olive groves, at the southern side of the Marmara Sea, in Bursa (Figure 1). Before the population exchange in the 1920s, it was a Rum-populated settlement where Muslims were the minority. It is one of the historic urban conservation sites of Bursa and surrounded by 1st, 2nd, and 3rd-degree natural conservation areas declared in 1990 (BKTVKK decision no: 31.08.1990/1299).

Figure 1.1. Location of Tirilye in the physical map. Google Maps. (2018). [Access date: 15.09.2018]

Tirilye was an economically and culturally rich settlement, a commune center with a municipality since the late 19th century. By the population exchange following the Turkish War of Independence and the Lausanne Treaty (1923), Tirilye lost its community and part of its economic capacity except for olive cultivation. Since 1923, Turkish immigrants from Crete, Thessalonike, Usturumca, Dedeağaç, and

Seres, live in Tirilye. Today, Tirilye still preserves its historical pattern, natural and urban character despite the various interventions.

1.1 Problem Definition

Studies on construction techniques of historical buildings are critical in giving essential information about the architecture, material selection, spatial organization, relationship with the place, and creative architectural solutions against existing conservation problems of the studied buildings. Tirilye houses, which form the historical fabric of the settlement, are the heritage left by Rum[1] people who lived there for centuries. The houses represent the tradition of their period with the construction systems, material choices, and architectural features. This study aims to create reliable information about the construction technique and material usage of the traditional Tirilye houses. Tirilye settlement is an interesting research subject presenting well-defined spatial organization with traditional architecture; shaped within a context of natural features and rich cultural history.

There are MS and Ph.D. thesis' (Akgün, 1995; Pekak, 1995, 2009; Acar Bilgin, 2015; Yılmaz Akyıldız, 2016; Yinsel, 2018; Demir, 2019) and many articles related to the Tirilye settlement (Bektaş, 1983, 2008; Dostoğlu Türkün, 2000; Akıncıtürk, 2002; Ertürk, 2010). However, there is no comprehensive research focusing on the construction techniques of traditional Tirilye houses in detail. Even though the

[1] Rums are people or persons who lived within the borders of the Eastern Roman Empire and had the rights of Roman citizens (Baykal, 1974). Although these people were a community of individuals of various ethnicities, this word was later used to refer to people of Greek origin living in Muslim countries outside of Greece, since these people abandoned the Latin they spoke and adopted Greek and lived in places where the majority of them were Muslims (Baykal, 1974). However, in this text, the term Rum is used to mean the Christian people of Anatolia who were subject to exchange within the scope of Lausanne.

Tirilye houses are protected by being declared an urban conservation site by Bursa Council for the Preservation of Cultural and Natural Assets in 1981, they are still under threat due to negligence and unconscious treatment. Because of this reason, it is important to document the traditional construction techniques of Tirilye houses to create reliable information for later conservation interventions and transfer the existing knowledge to the future.

1.2 Aim and Scope of the Study

The aim of the study can be described as follows:

- to create reliable and comprehensive documentation on construction techniques that can be used in future studies and future conservation interventions of traditional Tirilye houses
- to study the relationship between the techniques used, topography, and material used by understanding the logic behind building traditional houses.

Among the building stock of Tirilye settlement, there are 340 (36%) of 938 buildings built in traditional techniques which are traditional houses, monumental buildings, industrial buildings, coffeehouses, and shops (Table 1.1), (Figure 1.3).

Table 1.1 Table showing number and ratio of traditional structures in the total building stock in Tirilye

	BUILDING STOCK			
	NEW BUILDINGS	TRADITIONAL BUILDINGS	NOT STUDIED	TOTAL
#	482	340	116	938
%	52%	36%	12%	100%

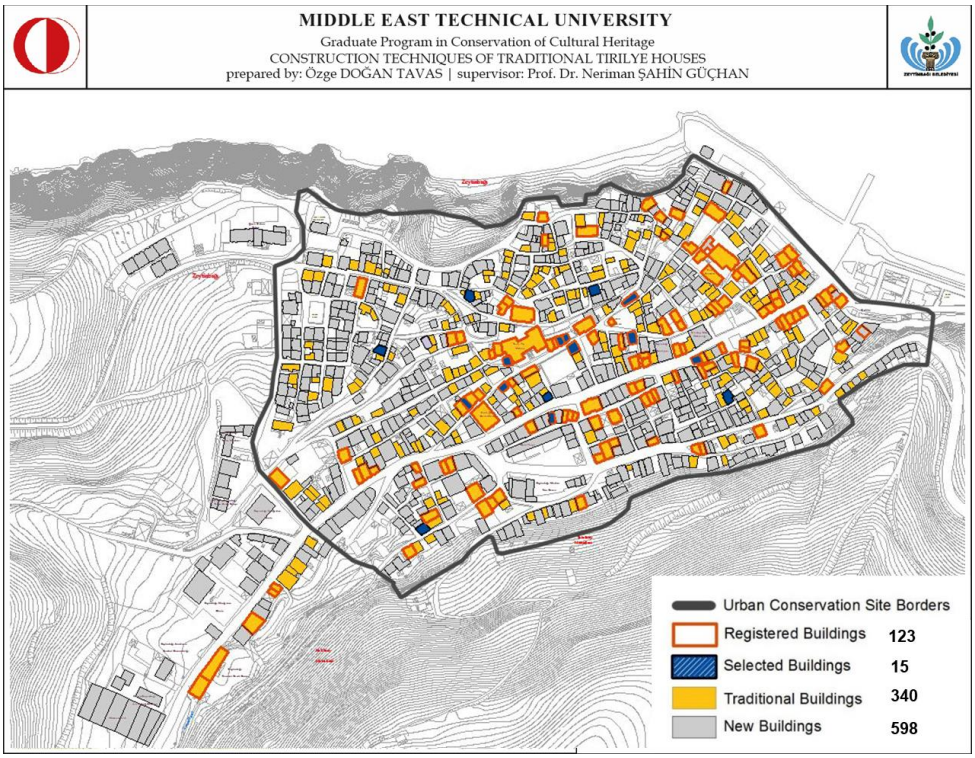

Figure 1.2. Map showing the study area

The main focus of this study is documenting the construction techniques of traditional residential buildings **within the borders of the urban conservation site of Tirilye** (Figure 1.2). The number of traditional houses is 245, which constitutes 72% of the traditional buildings in the settlement. Among traditional houses, 96 of them are registered. Today there are 29 houses with shop spaces on the ground floor, making up 8,5% of traditional buildings (See Fig. 1.4), (Table 1.2).

Table 1.2 Table showing number and ratio of traditional houses in the total building stock in Tirilye

	TRADITIONAL STRUCTURES			
	TRADITIONAL HOUSES		OTHER HISTORICAL STRUCTURES	TOTAL
	TRADITIONAL HOUSES	TRA. HOUSES WITH SHOPS		
#	216	29	95	340
%	63,5%	8,5%	28%	100%

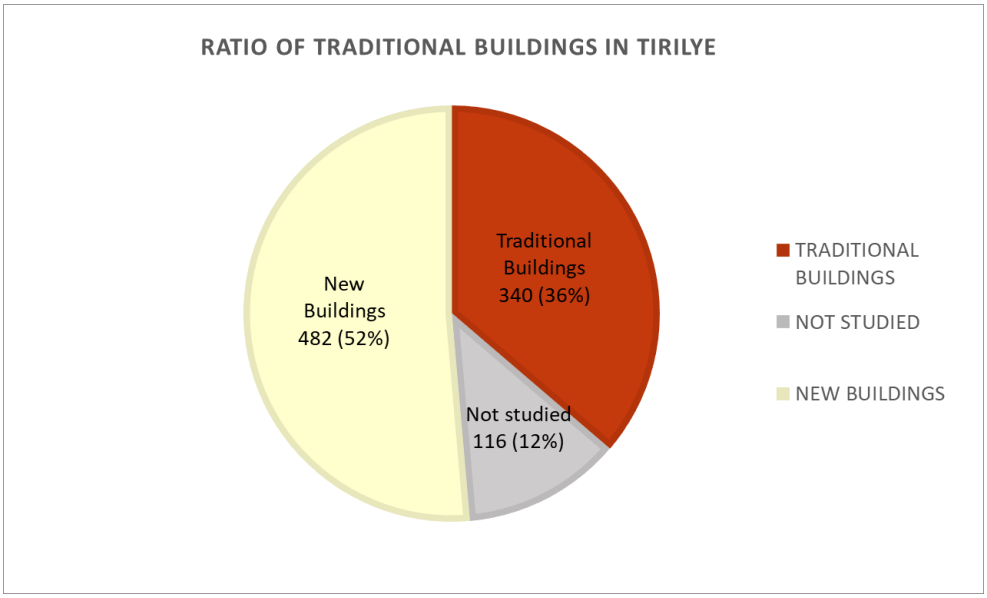

Figure 1.3. Pie chart showing ratio of traditional structures and houses in the total building stock in Tirilye

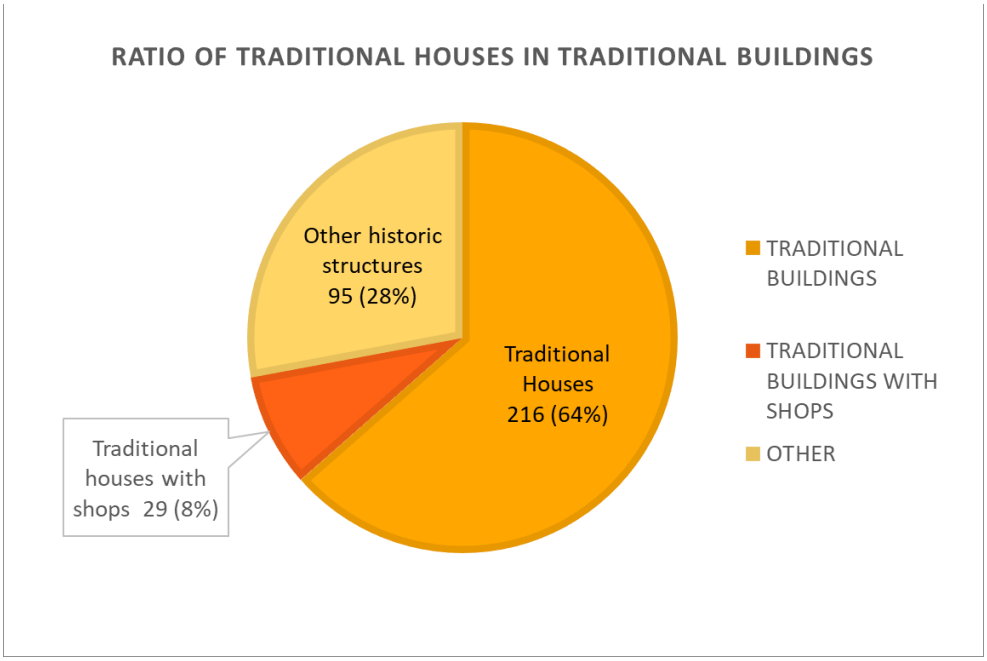

Figure 1.4. Pie chart showing ratio of traditional houses in total 340 buildings built with traditional techniques in Tirilye

During the pre-site survey conducted between 07.10.2018 and 24.12.2018, 86 of the traditional houses exhibited **their authentic construction system.** Among the observed houses, three types of construction techniques were observed in traditional Tirilye houses:

Type 1: timber frame structure built on a masonry base,

Type 2: timber frame structure built on a brick masonry base,

Type 3: stonemasonry buildings.

Among the traditional houses (245) in Tirilye, 69 (28%) of them belong to type 1, 11 (5%) of them belong to type 2, and 6 (2%) of them belong to type 3. Construction techniques of 160 traditional houses were not detected due to various repairs, restorations, or interventions affecting their legibility (Figure 1.5) (Table 1.3).

Table 1.3 Table showing number and ratio of construction techniques seen in traditional Tirilye houses

	TRADITIONAL HOUSES				TOTAL NUMBER OF TRADITIONAL HOUSES
	STONE MASONRY BUILDINGS	TF STRUCTURE BUILT ON STONEMASONRY BASE	TF STRUCTURE BUILT ON BRICK MASONRY BASE	ILLEGIBLE	
#	6	69	11	159	245
%	2%	28%	5%	65%	100%

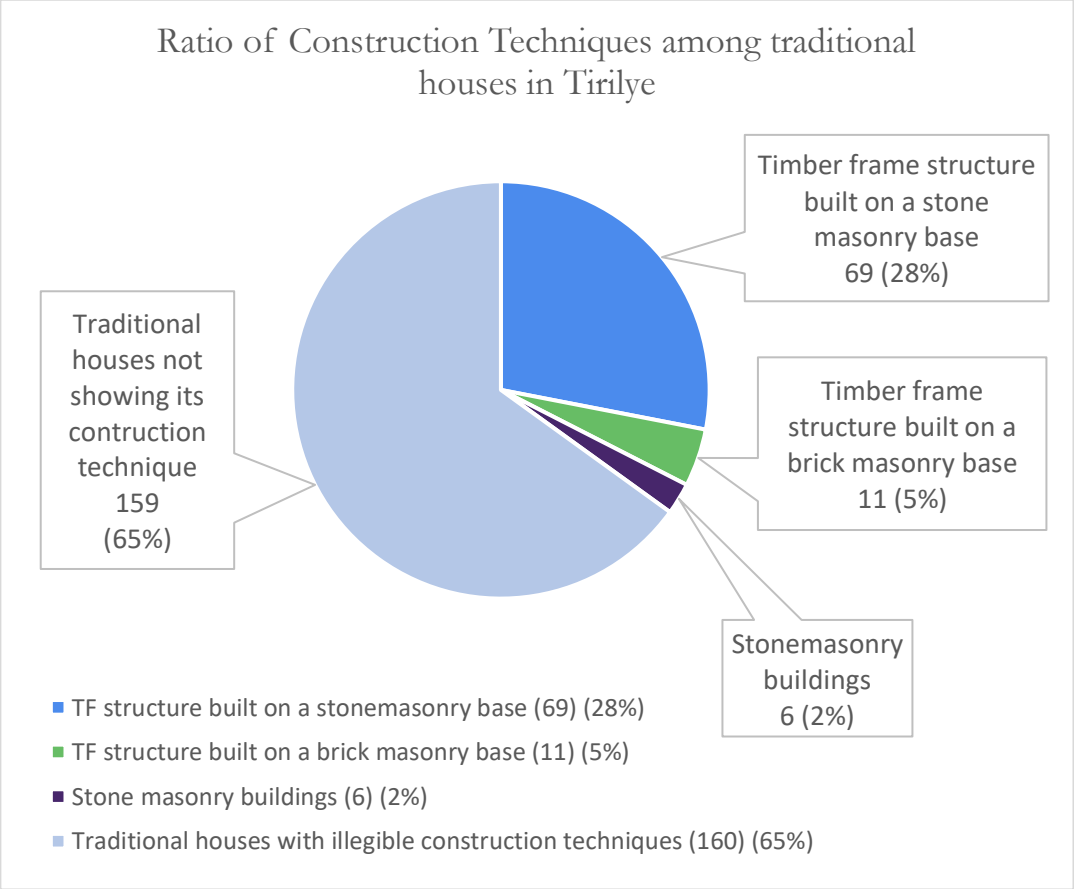

Figure 1.5. Pie chart showing the ratio of construction techniques among traditional Tirilye houses

The studied structures are selected among the stone masonry & timber-framed houses, which constitute 28% of the existing traditional houses. The study includes two groups of houses. The first study group, which is the main study group, shows both architectural elements and the construction technique together. The second group consists of highly-deteriorated houses.

1.3 Methodology

This study's methodology is based on years of research on the construction technique studies, developed by Prof. Dr. Neriman Şahin Güçhan (1995) and her former students, especially Filiz Diri (2010). The latest studies which were handled with this methodology belonged to Alveena Rahim (2019) and Tuğba Kızılkuşak (2019).

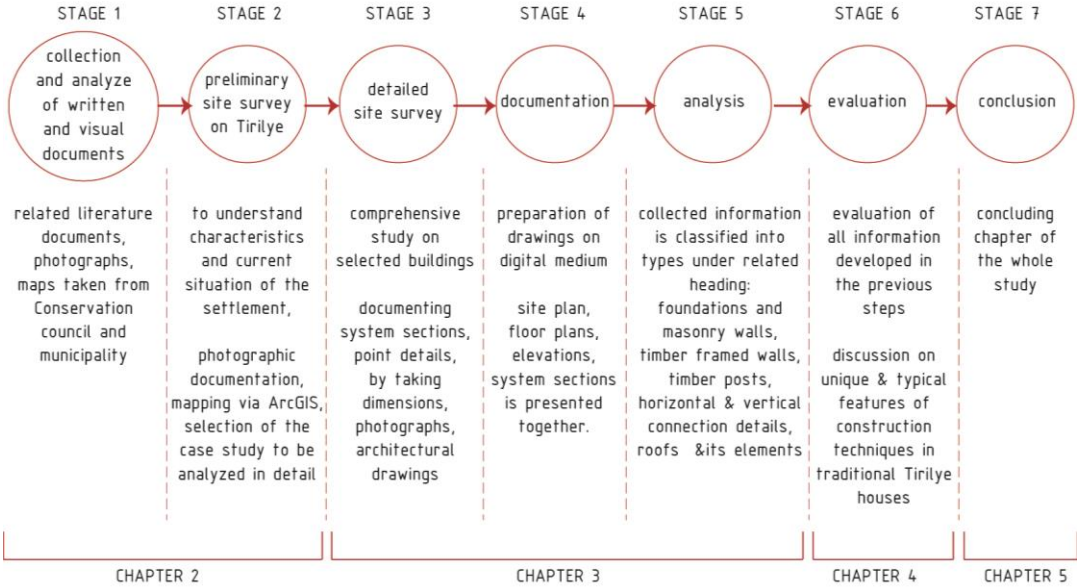

Figure 1.6. The diagram shows the seven steps of the study process.

This study is developed in line with field studies on the historic Tirilye settlement and traditional Tirilye houses. It was carried out on two different scales. With

reference to the conducted site surveys, the thesis is completed in 7 stages:1) collecting related written and visual materials, 2) prelimary site survey, 3) detailed site survey, 4) documentation, 5) analysis, 6) evaluation, and 7) conclusion respectively (See Fig. 1.6).

In the first stage, literature documents, photographs, and required maps related to the selected case were collected. This process started in 2018 fall. Base map of Tirilye drawn in 2011 was taken from Mudanya Municipality. Cadastral map dated 2007 was obtained from the Directorate of Land Registry and Cadastre in Mudanya. Moreover, conservation master plans, plan notes, inventory lists, decisions, and old photographs of the settlement were taken from the conservation council of Bursa (Bursa KVKKBM).

The second stage of the study consists of a preliminary site survey of Tirilye, aiming to understand the traditional Tirilye houses and to select the houses to be studied in detail. A comprehensive mapping study was conducted by the author within the borders of Tirilye's historic urban site, documented via photographs, taking notes, marking on the base map between 07.10.2018 - 24.12.2018.

In this process, to understand characteristics and current condition of the traditional fabric of the settlement holistically, category of historical buildings, registration status, construction system, and the changes in the mass and the façades of the traditional buildings, building condition, construction date, and current uses were surveyed and mapped in the borders of urban conservation site. The collected information about all buildings existing within the urban site is mapped in the ArcGIS environment by using the codes given to buildings at the site, the photographs were taken, and the registration information obtained from the Bursa KVKBK. The one obtained from the Municipality was used as base maps of this study. The result of these studies is presented in chapter 2 to define the characteristics of Tirilye and Tirilye houses.

After that, according to the data gathered during the preliminary site survey, given below **selection criteria** for traditional houses to be studied in detail were designed:

- Houses that **have not been subjected to any** restoration/reconstruction/ **intervention affecting its authenticity,**
- Houses that are legible in terms of **construction techniques,**
- Houses that have the **representative architectural characteristics of traditional Tirilye houses.**

According to these criteria, 15 traditional Tirilye houses were selected in total:

1. 10 authentic houses in good structural condition having local architectural elements and legible construction techniques together
2. 5 authentic houses in ruin condition where special construction details are legible

The third stage consists of a comprehensive study of selected buildings. The construction techniques of the selected houses were surveyed in detail, in various scales, between February-April 2019. The buildings were analyzed in elevations and, more importantly, in system sections, from foundation to roof; every system change was analyzed in detail by documenting with sketches, photographs, and dimensions. A coding system was used in this process. The methodology of the coding system of this study is based on the systematic created by Filiz Diri and Neriman Şahin Güçhan in 2010 (See Fig. 1.7).

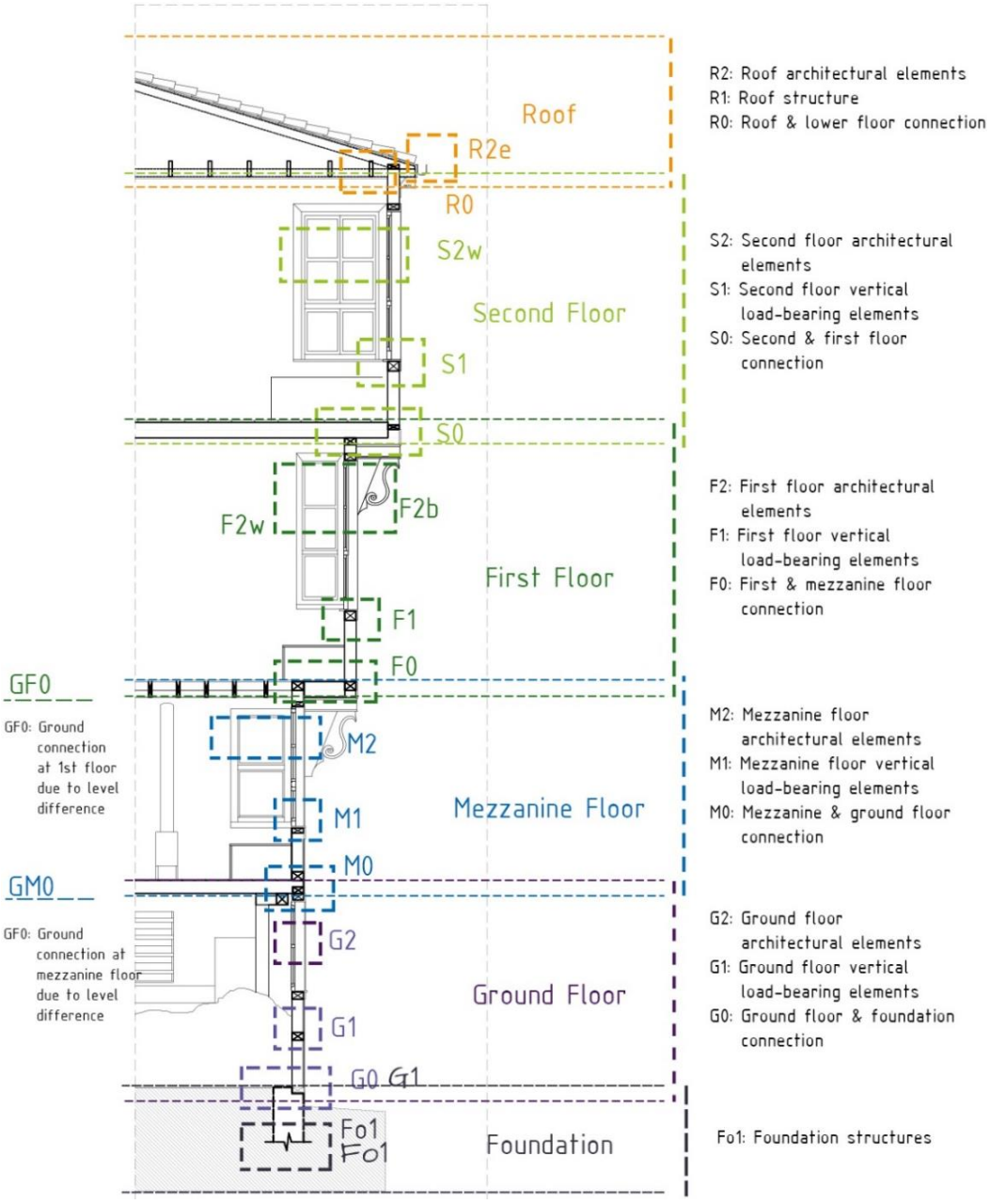

Figure 1.7. The coding system was adapted for the traditional Tirilye houses.

During the surveying, equipment such as range pole, steel meter, folding wooden meter, plumb line, laser meter was used. The dimensions were recorded on sketches

drawn at the site, notes and photographs were taken. During this study, a local master was not encountered.

4th stage of the study includes the documentation process. Collected data were drawn in the AutoCAD environment. Drawing sheets were prepared for each and every surveyed house, including the drawings and related photographs together (See Fig 1.8). The drawings were prepared in various scales. Site Plans in 1/500 scale, floor Plans in 1/200 scale, elevation drawings in 1/100 scale, and section drawings in 1/50 scale were prepared and presented together in the posters. Results of these studies are given in Appendix A. Besides, the information gathered from studied houses is used to define characteristics of Tirilye houses defined in Chapter 2.2.2.

Figure 1.8. An example of the drawing sheets prepared for each studied house.

In this 5th step, load-bearing and architectural elements of the surveyed houses were analyzed. According to their construction techniques' repetitive or distinctive features, used materials, forms, and finishings, types were defined. These types are discussed in Chapter 3 under the related heading of building part as such: foundations and masonry walls, timber-framed walls, timber posts, horizontal & vertical connections, and roof and its elements. The information collected on the construction

techniques of the houses is classified and presented in Chapter 3 to define the construction techniques used in these houses. Furthermore, this information was analyzed according to their location in the houses. Thus, the numerical majority of some details on specific locations can be seen through a table.

Due to the inclined topography of Tirilye, houses can have multiple ground levels. For this reason, in this study, the main ground level is named G, while the upper ground levels are named according to their position in the third dimension, such as GM (ground-mezzanine floor level) or GF (ground-first floor level).

In the 6th stage, the construction process of a selected Tirilye house is examined and explained step by step as if it was being built. This section forms the 4th chapter of the study. It can be regarded as an evaluation of all the information gathered in the previous stages to define the logic behind this construction tradition. The process is explained with 3D models of the house. Moreover, this chapter discusses unique and typical features of traditional Tirilye houses through their date and context, architectural, spatial, and functional features.

The 7th step is the concluding chapter of the whole study, which is presented in the 5th chapter of the thesis.

CHAPTER 2

CHARACTERISTICS AND HISTORY OF TIRILYE SETTLEMENT

2.1 General Features of Tirilye

Tirilye is known for its natural beauty because of its location, topography, relationship with the sea, and surrounding green texture. At the same time, it stands out with its cultural richness, with its historical urban fabric in harmony with the topography, monumental structures, and civil architecture unique to the region.

2.1.1 Geographical Features

Tirilye is a coastal town located in the Mudanya district of Bursa, at the west end of the Gemlik gulf in the southeast of the Marmara Sea. The center of Tirilye is at the coordinates of 40°23’33 “N and 28°47’44 "E (see Fig.2.1).

Figure 2.1. Location of Bursa and Tirilye in Turkey (prepared by using mapchart.net)

Tirilye is located 11 km away from Mudanya, 60 km from Karacabey district, and 40 km from Bursa city center. In the close vicinity, there are smaller settlements such as Kumyaka village in the east (5 km away), Kaymakoba village in the south (8 km away), and Yalıçiftlik village in the west (9.8 km away) (Figure 2.2).

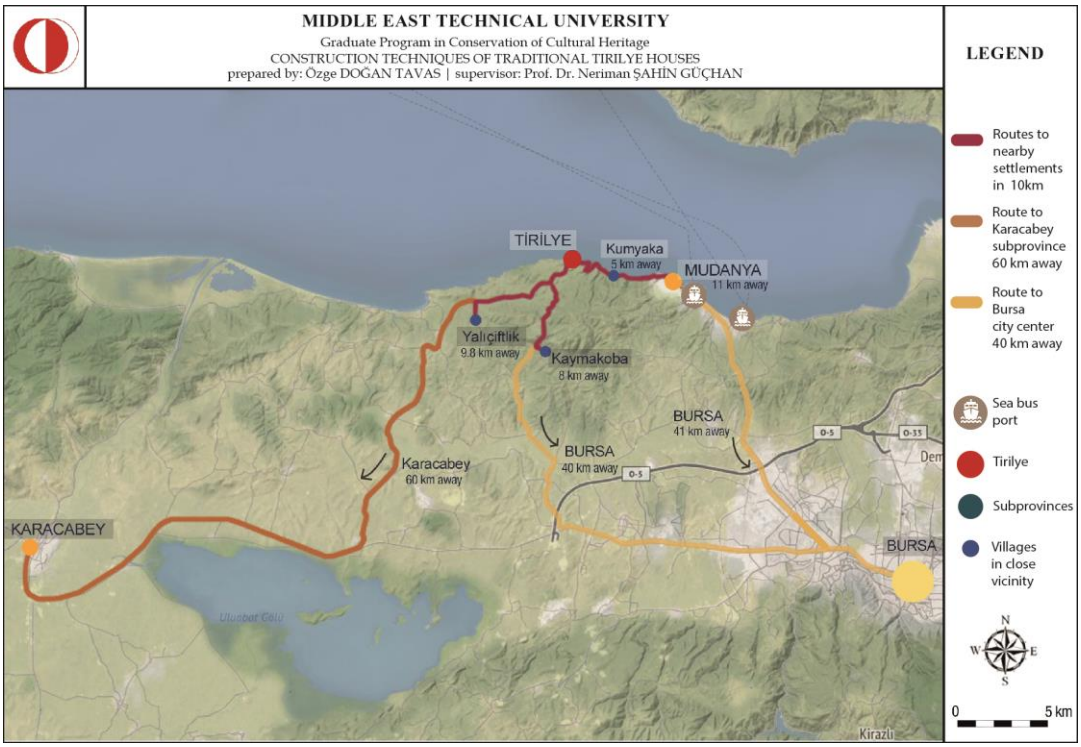

Figure 2.2. Road and sea transportations to Tirilye shown in a physical map prepared by the author

Tirilye is an easily accessible settlement both by road and sea transportation. There are two separate asphalt roads are leading to Tirilye. The first one is Mudanya - Tirilye road, which is preferable for transportation between Tirilye - Bursa city center. The other one is Karacabey - Tirilye road, a proper route to access most of the surrounding villages.

The intercity transportation by sea is provided between Istanbul, Yalova, and Bursa provinces by the IDO[2] and BUDO[3] sea bus companies, departing from Güzelyalı port and Mudanya port 16.8 km and 12.2 km away from Tirilye, respectively. Public transportation to the center of the Mudanya district and the ports can be provided by minibusses arranged between Mudanya and Tirilye.

Topographical features:

The Mudanya district has hilly topography because of the Mudanya mountains, which act as a set between the Bursa plain and the Marmara seashore (See Fig. 2.3). Tirilye, on the other hand, is established at the seaside, in a valley between two hills which are perpendicular to the sea. The hills that define the valley, Bulitepe and Kartaltepe, belong to this mountain range (Akgün, 1995). While the valley encloses the east and west of the settlement, the seashore is in the north. Therefore, the hills, slopes, and coast define the perimeter of the town and form a natural border.

There is a slightly flat area towards the seaside in the center of the valley while the topography rises to the surrounding hills. However, there is a high elevation difference in the range between 15 to 40 meters at the northern coast of Tirilye. According to the information taken from the existing official map of Zeytinbağı[4] approved in 2011, the settlement area starts from 1.5 meters above sea level and reaches 68 meters.

[2] IDO, short for *İstanbul Deniz Otobüsleri*, Istanbul Seabusses Company

[3] BUDO, short for *Bursa Deniz Otobüsleri*, Bursa Seabusses Company

[4] Former name of Tirilye. Zeytinbağı name was used between 1963 and 2012.

Figure 2.3. Tirilye and its topography. (Retrieved from Google Earth, 2020)

There are studies investigating the geological evolution of the Tirilye settlement. According to the results, the oldest rock assemblage in this region belongs to the Upper Cretaceous period. Flysch belonging to the lower Eocene period, is the most common around the settlement, composed of sandstone, claystone, siltstone, shale, and conglomerate (Ülgen, 2011). In a broader scope, in the Mudanya district, Neogene sedimentary masses such as sandstone, marl, limestone are known to cover a wide area (Doğan, 2001, p.14).

Tirilye is in the first-degree earthquake zone in the Turkey seismic zone map. The Zeytinbağı fault line passing through the region belongs to the southern branch of the North Anatolian Fault (See Fig. 2.4).

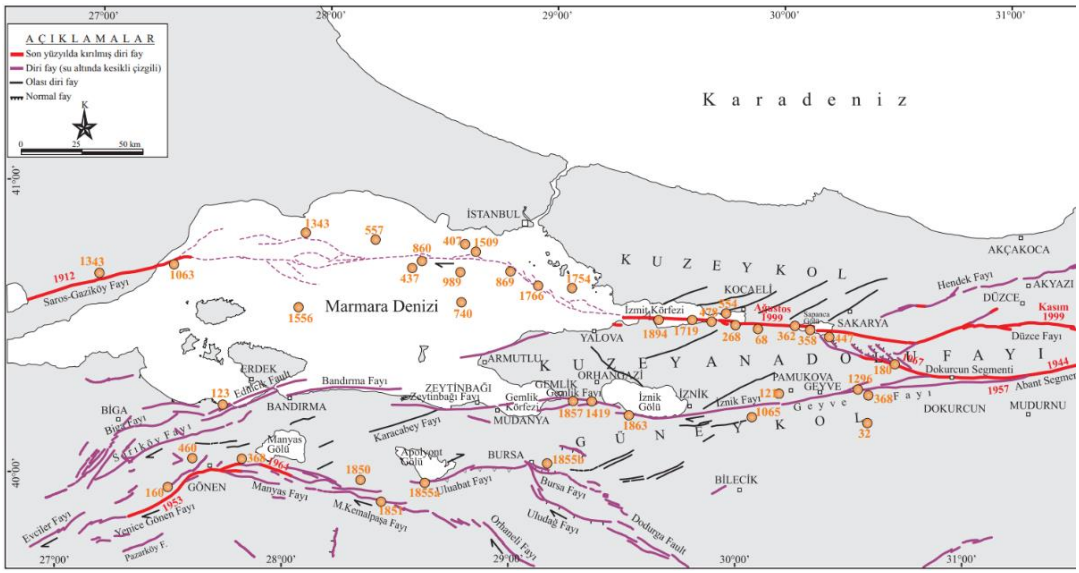

Figure 2.4. Fault line map of Marmara region and spots showing major earthquake centers in history. Reprinted from "Kuzey Anadolu Fayı Güney Kolu'nun Segment Yapısı ve Gemlik Fayının Paleosismik Davranışı, Kb Anadolu", by S. Özalp, Ö. Emre & A. Doğan, 2013, *Maden Tetkik ve Arama Dergisi,* (147), 1-17.

Water Assets of Tirilye

The relationship with the water in Tirilye is strong since it is a coastal settlement. In addition to the Marmara Sea, there is a seasonal stream, Manastır Deresi, passing through the middle of the valley, continuing along Karacabey and İskele Street. Because of the odor and the decrease in the flow rate, half of the stream was closed towards the end of the 1930s, at the time of the Headman Hasan Bey, while the other half was closed in 1950 (Bektaş, 1983).

Climatic properties:

Tirilye's climate is between the Mediterranean and the Black Sea climate due to its location in the South Marmara region. The weather is hot and dry in summers and warm and rainy in winters. However, the temperature values of the settlement are lower than the Aegean and Mediterranean regions. The hottest months in the region

are June, July, and August, while the coldest months are December, January, and February.

Table 2.1 Climate chart of Tirilye in 2020, retrieved from climate-data.org, (2020), redrawn by the author

	January	February	March	April	May	June	July	August	September	October	November	December
Average Temp (°C)	5,9	6,7	9,0	12,6	17,5	22,0	24,6	24,9	21,3	16,5	12,2	7,9
Min. Temp (°C)	3,0	3,5	5,1	8,4	13,3	17,7	20,3	21,0	17,8	13,6	9,2	5,2
Max. Temp (°C)	9	10,1	12,9	16,6	21,3	25,8	28,7	29	25	19,8	15,5	10,9
Precipitation (mm)	86	73	70	47	36	31	17	21	47	69	73	105
Humidity (%)	78%	76%	73%	73%	71%	67%	65%	65%	68%	75%	76%	79%
Rainy days (day)	9	9	8	6	4	4	3	2	5	6	7	10
Sunshine duration	5,2	6,1	7,7	9,5	10,9	12,0	12,1	11,1	9,5	7,2	6,3	5,4

Tirilye is a windy settlement both in summers and winters. The wind is usually dominant in the north-south direction. The dominant wind, the northeaster, brings cool weather in summer, cold and rainy/snowy weather in winter. According to the data taken from Mudanya Meteorology Station, the annual minimum and maximum average temperature values are 5.9˚C in January and 24.9˚C in August. The most intense precipitation months are between October and March, while December and January have the highest amount of rainfall. Accordingly, the rate of humidity increases in these months (Table 2.1), (Figure 2.5).

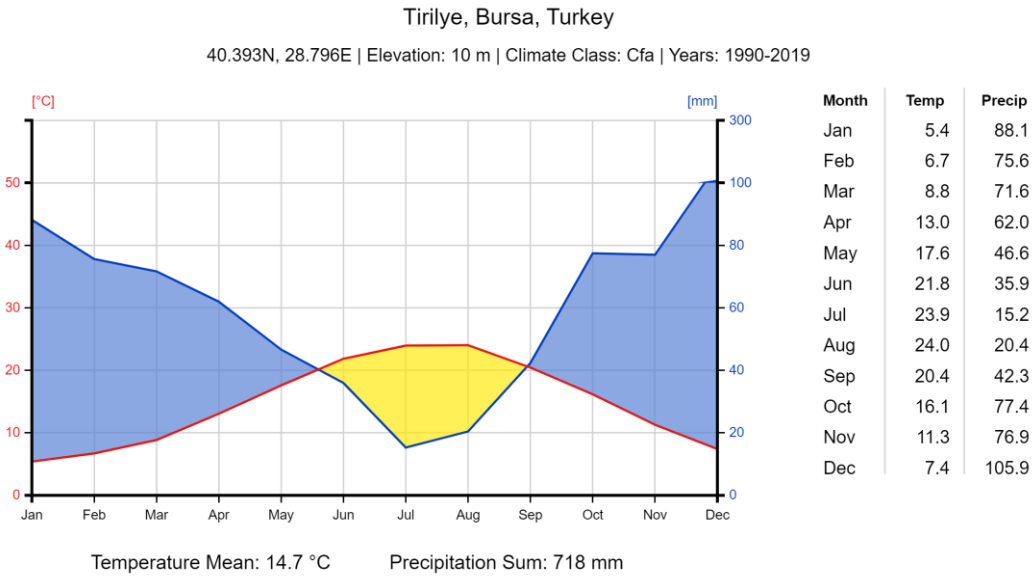

Figure 2.5. Graph of average temperature and precipitation of Tirilye between 1990-2019. Retrieved from ClimateCharts.net, [Access date: 5.10.2021]

Flora of Tirilye:

Olive trees and pines cover large areas inside and around Tirilye. They have a significant place as a characteristic feature of the visual image of this coastal town. The hills surrounding the settlement are mainly covered with olive groves. Also, it constitutes the primary financial income of the region. The land is also suitable for cultivating vineyards and mulberry fields, which was quite common due to winemaking and silkworm-breeding until the 1950s (Akgün, 1995).

2.1.2 Historical Development of Tirilye

Tirilye remains within the boundary of the antique region called Bithynia. Historically, the settlement remained within the borders of significant states such as the Kingdom of Bithynia, the Roman Empire, the Byzantine Empire, the Ottoman Empire, and the Republic of Turkey.

The name Trigleia (Τρίγλεια in Greek, the historical name of Tirilye) has not been mentioned in any ancient sources as a settlement center. However, in the close vicinity, the information about the ancient settlement of Mudanya, Myrleia/Apameia[5], can be reached through ancient sources (Plin. Nat. (V, 43, 2); Str. (XII, 4, 3).

The history of Tirilye is not known clearly until the Byzantine period. However, in the lists dated 425-24 BC and 241 BC, which show the cities that paid taxes to Athens in ancient times, there is a settlement named Brylleion Tereia associated with Tirilye by many researchers.[6]

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[5] Myrleia is the closest ancient city to the Tirilye. Myrleia was established as a colophon colony in the Gulf of Cius (Gemlik), according to the narrations of Plinius (V, 43, 2). Strabon (XII, 4, 3) mentions Myrleia/Apameia as a city near Prusa and Cius. Developed as an ancient port city, Apameia became a significant center with its sea connection to Constantinopolis and served as the closest port to Prusa. The Prusa - Apameia - Constantinopolis connection was a significant trade route; however, it was also preferred for military purposes (Doğancı, 2005; 2007).

[6] In the article "Zeytinbağı/Trilye Bizans Dönemi Kiliseleri", Pekak (1995) has compiled the publications of researchers who have presented various opinions on this issue. As mentioned by Pekak (2009, p.19) Evangelides, the historian from Tirilye, claims that the Bryllion was the ancient name of the settlement, and the name of Trigleia came from the Trigleia Monastery. On the other hand, while Corsten (1987) was pairing Bryllion with Mryleia/Apameia, he emphasizes that the settlement named Tereia should be searched around Mudanya, and it might be Tirilye (Pekak, 2009, p.19). For more information, see; Evangelides 1889;1934; Kleonymos & Papadopoulos 1867; Bürchen 1897; Hasluck1910; Menthon 1935; Ruge 1939; Luis 1949; Beck 1959; Corsten 1987; Pekak 1995; 2009.

The evidence that reveals the existence of an ancient settlement in Tirilye is the inscriptions and tombs found in the vicinity.[7] Similarly, Bedri Yalman (1989) mentions two graves found in olive groves in Tirilye, which he dated back to the 1st century AD. Although the presence of an ancient settlement in the region is proven, it is not clear whether it is Bryllion Tereia or not.

The region went under the rule of Romans, as the kingdom of Bithynia joined the Roman Empire after the death of the last King III. Nicomedes Filapator in 74 BC. Bithynia began to be Christianised in the 1st century, and it became a preferred region for monastic life (Pekak, 2009). After the division of the Roman Empire in AD 395, the shores of Bursa entered Byzantine rule.

Documents providing information about the history of Tirilye belong to the 11th century and onwards. However, there are various researches about the origin of Trigleia and its name. According to one of them, to be protected from the attacks of the Genoese pirates in the 13th century, the peoples of the villages in the Sivzi, Kapanca, and Ketendere regions established the Trilye settlement referring to three villages**.** The other study mentions the name Trigli means red mullet in Greek, and the settlement was named Triglia, which means 'red mullet land' (Yinsel, 2018, p. 17-18). According to another study**,** the three saints "Aya Yani, Aya Sotiri, and Aya Yorgi"; who were excommunicated from the Second Council of Nicaea in 787; settled in the region, and the settlement was named Tri-Ilya after them. In fact, in the close vicinity of Tirilye, there are several religious monuments associated with the saints, which are Pelekete (Aya Yani) monastery (dated to 8th c.), the Medikion monastery (dated between late 8th c. to early 9th c.), and Aya Sotiri church.

[7] Previous studies on the region revealed that findings show the traces of a cult center belonging to Zeus, Kybele, and Apollo. According to the dialect used, it is stated that the ancient Tirilye was a Byzantium colony of Megara (Corsten, 1987; Pekak, 2009; Yinsel, 2018).

About the Byzantine period history of Tirilye, the earliest written source belongs to the middle of the 11th century.[8] In 14th-century documents**,** there are also references stating that Trigleia was preferred for receiving military intelligence and providing military assistance to the Prusa through Trigleia.[9]Trigleia was one of the Bithinian ports at the west end of the territory with Kapanca (Caesarea Germenica) and Ketenderesi settlements. As Apameia was the main commercial port of Prusa, Trigleia was also commercially active, primarily known for its wine and alum trade (Mango & Ševčenko, 1973, p. 236).

Similarly, in the medieval trade records and maritime maps, there are several documents related to commercial activities with Tirilye, underlining the importance of its port in the medieval era. The most related information is taken from the Genoese trade documents[10] and Italian and Greek portolan charts. As quoted by Selma Akay Ertürk (2010, p.5) from Kemal Büyüköğen (1969, p.8):

> *"After 1261, the Roman Emperor Mikhael Palaiologos (1261-1282) allowed the Genoese to trade on the shores of the Marmara Sea. The Genoese exported the salt mine from the vicinity of Lopadium (Uluabat) from the ports of Trilye and Apameia on the Marmara Sea coast."*

[8] The region was within the borders of the Byzantine state Opsikion thema. A letter from Mikael Psellos to Judge of Opsikion, written from Medikion Monastery in Tirilye, mentions the Trigleia name as a point of departure by ship (Pekak, 1995).

[9] Ioannis Cantecuzeni, 1828

[10] With reference to earlier sources, Pekak (2009) mentions that trade documents related to Tirilye can be helpful to understand the history of Tirilye settlement. According to Genoese trade documents dated 1284, the Trigia name is seen related to wine merchandise. Another record mentions that the wine was exported from Trillie to Caffa in 1381-82.

Italian and Greek portolan charts[11] also underline the importance of the port of Tirilye in the middle ages. The settlement's name is seen as Triglia or Tregia in Greek portolans, while it is mentioned in Italian portolans as Tregian, or Triglia.

The date when Tirilye came under the rule of the Turks is uncertain. However, during the siege of Prusa, co-emperor Andronicus III sent provisions from Trigleia (Mango & Ševčenko, 1973). Ottomans conquered Mudanya in 1321, Prusa in 1326, Iznik (Nicaea) in 1331, Gemlik (Kios) in 1334, and Izmit (Nicomedia) in 1337. According to Mango and Ševčenko, it was still in Byzantine hands in 1337; however, they estimate the conquest of Tirilye took place not so long after as well. After the region came under Ottoman rule, most of the Christian population around Bursa moved to the coastal settlements, while the Rums in Tirilye kept their inhabitancy until the population exchange in the 1920s.

The oldest Ottoman source found about Tirilye is *Hüdavendigar Livası Tahrir Defteri* (the Cadastral Record Book of Sanjak of Hüdavendigar), dated to 15th century. It is stated in the cadastral records 'Dirigle' and 'Siği' were transferred to the Bayezid Hüdavendigar and Erdek Vakf-ı Sultaniye in 1409 and in 1423 respectively (Barkan ve Meriçli 1988:14; Pekak, 2009). According to Ertürk (2010), the name of the settlement was given as Aya Yorgi, Naz-Ili, Virikli, or Trig-ili in the Ottoman cadastral records. In the *Tahrir Defteri dated 1530*, 'Virükle' name is seen as a village of the Kite (Üründül) district, referring to the Tirilye settlement as well. Another source from the Ottoman era is that inscriptions found in Tirilye give dates from the 16th century onwards. The earliest one is the Fatih Mosque inscription,

[11] Portolan charts, are historical marine maps illustrating the ports and trade routes of the Mediterranean, emerged in Spain and Italy in the 13th century. Portolan Charts. (2021). Retrieved 4 April 2021, from https://beinecke.library.yale.edu/collections/highlights/portolan-charts

dated to 1560, about the church's transition into a mosque by Hacı Hasan (Pekak, 1995).

With reference to earlier sources, Pekak (2009) mentions that the information about Tirilye between the 17th and 19th centuries can be reached through the narratives of some travelers. As mentioned by Pekak (2009, pp. 29-30) with reference to Covel (1676: 265v-266r), the earliest one belongs to 1676; Dr. J. Covel and Pekak mention three churches, Pantobalissa church, Medikion monastery, and Pelekete monastery, with sketches**.** Katip Çelebi (Kâtip Çelebi 1732-33, pp. 658-59) mentioned only the name Trilya in his book Cihannüma dated 1732-33. The German historian Hammer (1818, pp. 1-2, 173) mentioned Trigleia as a settlement known for its olives and three hours away from Mudanya in his notes of 1804 (Pekak, 2009).

In 1855, the Bursa region had two devastating earthquakes with magnitudes of 7.1[12] and 6.3[13], which severely affected both center of Bursa and surrounding villages and centers such as Mudanya and Mustafakemalpaşa (Oğuzoğlu, 2001). In the 1855 earthquakes, the entire settlement of Tirilye, especially its churches, was damaged (Akgün, 1995).

Hüdavendigar Vilayeti Salnameleri (The Hüdavendigar Province yearbooks) gives various information about Tirilye in the late 19th - early 20th century. Tirilye was a trade center in its close vicinity. The broad olive grooves and the industry of olive oil and viniculture were the primary sources of income. Besides the Mudanya port, the commercial products were exported from Tirilye. According to the study of Düvenci Karakoç, 2008, those who came for trading were spending time in the

[12] N. N. Ambraseys, J. A. Jackson, Seismicity of the Sea of Marmara (Turkey) since 1500, Geophysical Journal International, Volume 141, Issue 3, June 2000, Pages F1–F6, https://doi.org/10.1046/j.1365-246x.2000.00137.x

[13] For more information and dates of the Bursa eartquakes in 1855, see Özaydın, 2017.

settlement; therefore, the number of shops was higher in comparison to the population.

In particular, the *Salname* dated 1900 (1316 H.) contains detailed information on its economic structure and production capacity. According to the document, there were 95 shops, 19 oil shops, 5 watermills, and 20 weaving looms in Tirilye. The production capacity of Tirilye was recorded as 4000 tons of olives, 170 tons of wine, and 19 tons of *rakı,* and 40 tons of cocoon per year (Düvenci Karakoç, 2008).

According to *Hüdavendigar Vilayeti Salnameleri*, at the end of the 19th century, Tirilye's population was almost 4000 people, and the non-Muslims constituted 95% of the population in general. In 1900, the population was above 4000, with 850 households. The population of both Muslims and non-Muslims slightly increased collectively (Table 2.2).

Table 2.2 Population and number of households of Tirilye according to *Hüdavendigar Vilayeti Salnameleri*,

YEAR	POPULATION			NUMBER OF HOUSEHOLDS
	TOTAL POPULATION	NON-MUSLIM	MUSLIM	
1870	1715	1660	55	800
1886	3996	3812	184	643
1895	3856	3657	199	-
1900	4131	3878	253	820
1915	4014	-	-	-

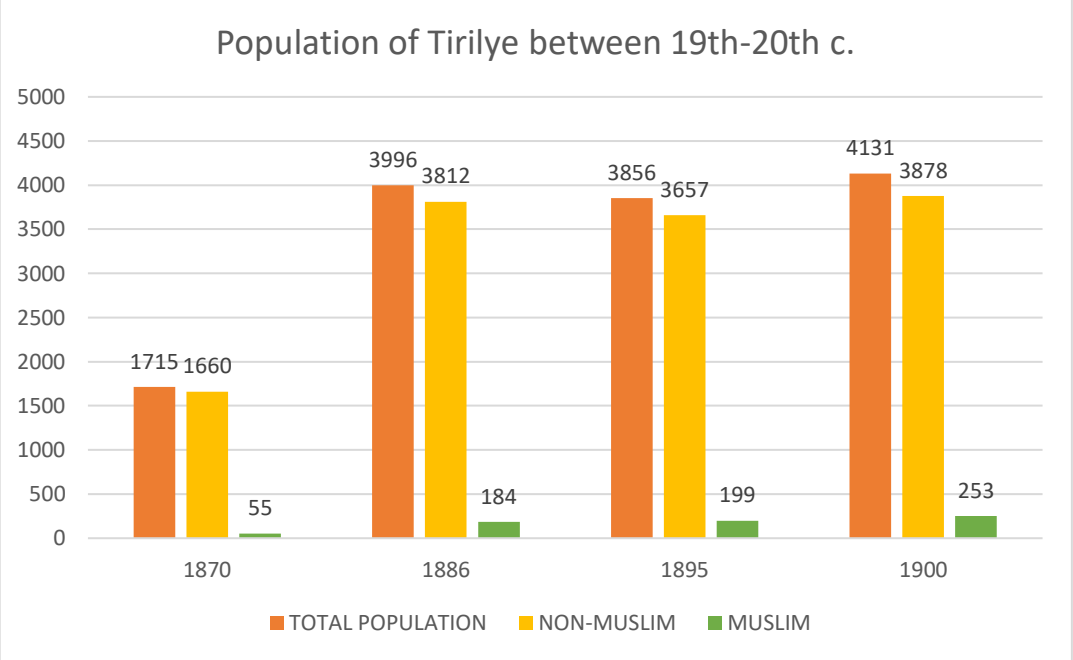

Figure 2.6. Population of Muslim and Non-Muslim groups in Tirilye before the Exchange (Dostoğlu, 2000; Düvenci Karakoç, 2008; Ertürk, 2010)

In the *Hüdavendigar Vilayeti Salnamesi*, dated 1906, Tirilye settlement was described as such:

> *"It is located in the west of the Mudanya district and on the shores of the Marmara Sea. It has a nice atmosphere. There is a mosque-i-sheriff, an Islamic and two Christian primary schools, seven churches, and three monasteries which are historical monuments. There are some ancient artifacts in the inner part of the Kemerli Kilise (Panagia Pantobasilissa). Its main production consists of olive, silkworm, and various in-house manufacturing industries. Olives are sent to East Rumelia, Black Sea coasts, and Alexandria."* (Akkılıç, 2002, p. 1764).

Tirilye was a religiously special place for the local Rum people. As stated in the *Salname* dated 1906, there were one mosque, seven churches, and three monasteries

in the town. Fatih Mosque was the only mosque in Tirilye, originally the old Hagios Stephanos Church dated to the 9th century. The fact that this church was converted into a mosque may be the most notable element of Ottoman domination in the region. The number of mosques and churches in the settlement coincides with the ratio of Muslim to non-Muslim. The Turkish neighborhood of Tirilye was developed around the mosque.

At the end of the 19th century, a municipality was established in the Tirilye commune before the population exchange. According to the *Hüdavendigar Vilayeti Salnamesi* dated 1927, the Municipality was founded in 1902; however, the *Salname* dated 1896 (1312 H.) contains the names of the administrative officers. Additionally, according to the *Salname* dated 1900 (1316 H.), there were various administrative institutions in Tirilye, including one school, one government office, one town hall, one post office, one customhouse, 1 *Duyun-u Umumiye* (Ottoman public debt administration), and one port (Düvenci Karakoç, 2008).

In the early 20th century, Tirilye had a dramatic change in its socio-political structure. After WWI, Mudanya was invaded by the British on 6th July and Bursa by the Greeks on 8th July 1920.[14] During the Greek occupation of Tirilye, the minaret of the Fatih Mosque was destroyed and utilized as a church. In September 1921, King Konstantin, King of Greece, visited Tirilye. This event highlights Tirilye as an important center for the Rums with the churches and monasteries (Düvenci Karakoç, 2008). As a result of the War of Independence, Bursa came under Turkish rule again on 11th September and Mudanya on 12th September 1922. After the Rums left the

[14] İstiklâl Savaşımız ve Mudanya. (2021). Retrieved 4 April 2021, from https://www.mudanya.gen.tr/mudanya/mudanya-tarihi/istiklal-savasimiz-ve-mudanya.html

region, the monument was used as a mosque again (Pekak, 2009; Evangelides, 1934).

In 1923, with the Treaty of Lausanne, the exchange took place due to the Turkish-Greek Population Exchange Agreement. Therefore, in the early 20th century, Tirilye had a dramatic change in its socio-political structure. Muslim immigrants from places such as Crete, Thessaloniki, Usturumca, Alexandroupolis, Serres, and Karacaovalı were settled in Tirilye (Akgün, 1995). Tirilye Rums mostly settled in the Rafina and Nea Triglia in Greece.

According to Pekak's study (2009, p. 28), an encyclopedia published in Greece in 1933 contains the following information under the heading Triglia:

> *"The village on the Marmara Sea coast has 6000 inhabitants, and 30 families are Turkish while the others are Greek. After the Treaty of Lausanne, signed in 1923, most of its people migrated to Greece and settled in Nea Trigleia in Calcidiki, also known as Sofular. The population of Nea Trigleia was 1064 in 1928."*[15]

Within the last century, the settlement's name changed several times. During WWI, "Trilye" name was changed to "Mahmutşevketpaşa" in the early 1900s. However, the settlement continued to be called Trilye. In 1963, the town was named "Zeytinbağı" as a reference to the surrounding olive groves. In 2011 by the decision of the Parliament, it was renamed "Tirilye." Till 2014, the settlement was a commune center of Mudanya and governed by the Tirilye (Zeytinbağı) Municipality founded in 1946[16]. Today, the settlement is a neighborhood of Mudanya Municipality of Bursa.

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[15] Megle Hellenika Enkylopaideia, Pyrsos, 32, Athenai 1993.

[16] Kolukısa, K., & Yörük, M. (1973). *Bursa 1973 il yıllığı*. Ankara: Ajans-Türk Matbaacılık.

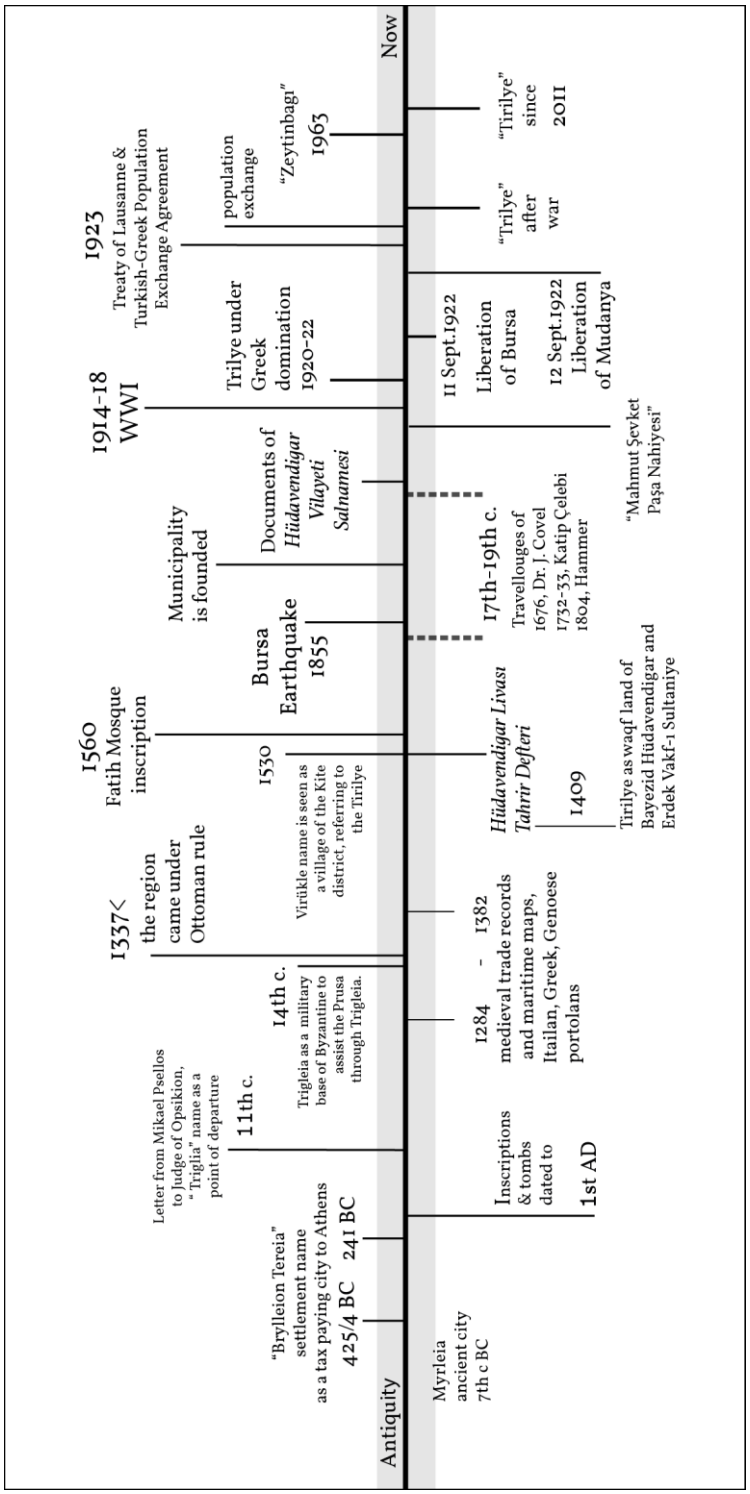

Figure 2.7. Historical timeline of Tirilye settlement throughout the history

2.1.3 Preservation History of Tirilye

According to the Bursa Cultural Assets Regional Conservation Board (BKVKBK) archives, the oldest document about the Tirilye settlement dates back to the year 1978. In the document undersigned by Prof. Dr. Orhan Alsaç, the head of the Superior Council of Immovable Monuments and Antiquities (GEEAYK) at the time, it has been stated that the examples of cultural/religious and civil architecture that need to be preserved have survived to the present day and are dense enough to form a site to be conserved. 1/1000 and 1/5000 scale maps were requested from the Bank of Provinces (İller Bankası) to determine the borders of the conservation area.

Then by the first conservation decision dated 10th May 1980, the Tirilye settlement was registered as a natural and urban site by GEEAYK within the borders of the Zeytinbağı Municipality.

In 1981, protection activities had accelerated in Tirilye. Firstly, by the decision no V 12588 of GEEAYK in 13.3.1981, Tirilye was declared as a historic urban site with new borders. Additionally, the examination for defining the boundaries of the natural site and determining its degree of protection is requested. Until the completion of inventory work, all types of intervention were suspended, which may adversely affect the historic settlement, such as not demolishing any structure, not opening new roads, not changing road pavements, and no changes in parcels.

Correspondingly, the "1/1000 scaled Zeytinbağı Master Plan", approved by the Bank of Provinces, came into force in the same year. In the master plan, 25 hectares between Tirilye and Eşkel were proposed as the new settlement area to protect the historic texture from new constructions (Akgün, 1995, p. 16).

Tirilye and its natural environment remained without a conservation master plan from 1981 to 1990; however, the necessary preservation efforts have continued. In 1981, Transitory Period Building Conditions were brought. These regulations

defined the basic features for new buildings to be built in the parcels within the urban conservation site will be valid till to preparation of a Conservation Master Plan for the designated natural and urban conservation area.

In 1983, inventory of cultural and natural assets of Tirilye had been issued by İstanbul Directorate of Surveying and Monuments (İstanbul Rölöve ve Anıtlar Müdürlüğü, İRAM) consisting of 148 traditional houses, 13 monuments -including fountains-, 3 industrial buildings and 12 monumental trees. In the following years, revisions have been made to the existing preservation decisions. In 1987, the inventory was revised, and some registered traditional houses were eliminated from the inventory due to demolishing and excessive interventions. Moreover, the Superior Council of Immovable Cultural and Natural Heritage (TKTVYK) revised the borders of the urban conservation site. As of March 1988, the conservation actions of Tirilye have been moved to the jurisdiction of the Bursa Regional Council for the Conservation of Cultural and Natural Property (Bursa KTVKK).

On 31st August 1990, the Zeytinbağı Conservation Master Plan and plan notes were approved by Bursa KTVKK with the decision no 1299, prepared by Architect Cengiz Eruzun, Architect Mithat Kırayoğlu, and Planner Architect Osman Ayradilli. Besides, with the same decision, the natural site of Tirilye was declared as 1st, 2nd, and 3rd-degree natural protected areas partially. The significance of preservation actions in Tirilye's natural environment was emphasized since the green texture creates integrity with the historic settlement and strengthens the silhouette. Olive agriculture, which gave its name to the region, is an indispensable part of the settlement. In addition, a necropolis area defined on the west side of the settlement had been declared as a 1st-degree archaeological site.

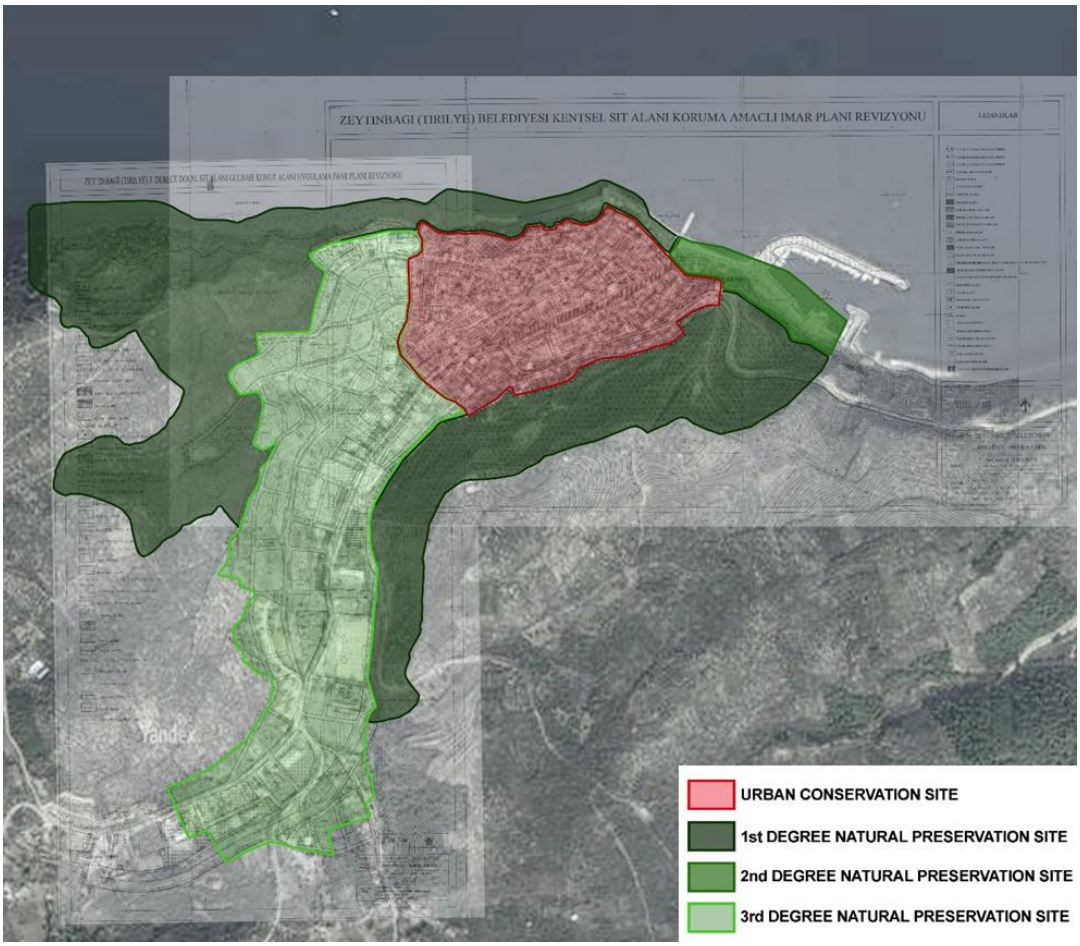

Figure 2.8. Preservation sites of Tirilye

In the same year, the 1/25.000 scaled Bursa Coastal Landscaping Plan, including Tirilye, was approved by the Ministry of Public Works and Settlement. In order to maintain the integrity among the fundamental decisions of the 1/25.000 scale environmental plan and the new 3rd-Degree Natural Protected Area Settlement Plan, principal planning values were suggested. In parallel with those recommendations, in 1992, the 3rd-Degree Natural Protection Site's New Settlement Plan and plan notes were approved by Bursa KTVKK.

In 2002, both Zeytinbağı Urban Conservation Plan and the 3rd-Degree Natural Protection Site Master Plan were revised to digitalize the maps. The reasons behind this decision were to make these plans compatible with cadastral maps and show the plan decisions and cadastral situation together.

In the following years, preservation efforts were carried out at various scales in the region. One of these is the registration decisions regarding archaeological sites between 2006-2009. In 2006, the antique Kapanca Port (10 km away from Tirilye) and Ketendere beach (10 km away from Tirilye) were declared a 1st-Degree Archaeological Site and a 3rd-Degree Archaeological Site, respectively. In 2009, the spreading area of the Aya Yanni Monastery was determined as a result of the on-site studies under the supervision of the experts of the Bursa Museum Directorate. Upon this, the Aya Yanni Monastery's surroundings, registered as a monument in 1990, are declared a 3rd-Degree Archaeological Site with new borders.

Another progress is the completion and enforcement of upper-scale planning of the region. In 2006, the "1/25.000 scaled Mudanya Planning Zone Master Plan" was approved by the Metropolitan Municipality of Bursa. In line with it, "1/5000 scaled Zeytinbağı Master Plan" and "1/10.000 scaled Zeytinbağı Municipality Master Plan" were approved, respectively in 2008 by the Zeytinbağı Municipality and 2009 by the Bursa Conservation Council.[17]

The 1/5000 scaled Zeytinbağı Master Plan is the first plan showing both urban and natural conservation sites and planning decisions of the settlement together. In addition, the public service areas (such as town garages, sports facilities, the bazaar area) are moved to the new development area, and the touristic facilities are planned

[17] Bursa Regional Council for the Conservation of Cultural and Natural Property (BKTVKK), also known as Bursa Conservation Council.

at the eastern entrance of the settlement, outside the conservation site borders. The latter shows land-use decisions both in the urban and natural area, proposed touristic areas, infrastructure, and preservation sites of the region on the 1/10.000 scale. It is the only plan that shows all the natural, archaeological and urban sites together in the close vicinity. Also, an alternative route to the Mudanya-Karacabey road is proposed to separate the city traffic from the settlement center.

Thirdly, since 2004, restoration and rehabilitation works have been carried out on monumental buildings and fountains in Tirilye. According to the records of the conservation board, the Fatih Mosque, also known as the Hagios Stephanos Church, was easily repaired in 2004 and 2008. In 2009, the historical Hagios Basileios Church, which was also used as a cinema and dining hall, was restored. Today it is used as a cultural center. In 2011, the Taş Mektep building underwent restoration, which was continuing in 2020. The restoration project proposes a cultural and educational function for the monumental historical school building dated the 20th century.

In 2012, restorations of the registered fountains and the historical bath next to Fatih Mosque were completed. The building is currently used as a cultural center. There is also the İskele Street Rehabilitation Project prepared by Aksoy Architecture in 2017; however, it has not been implemented yet. In 2020, the approach to the planned projects' for the historical settlement had evolved from a development plan module to an urban design project phase.

In October 2020, a workshop organized by the Historical Cities Association[18] in Tirilye discussed the urban design project, aiming for Tirilye to be included in the UNESCO World Cultural Heritage List. The considered proposal divides the settlement into seven different project areas: focusing on conservation and rehabilitation actions that will be taken for the monumental buildings and their surroundings, thus, enhancing their significance as attraction points. The restoration of the industrial heritage historical oil factory as a museum, revitalizing of Eskipazar street as a cultural axis in accordance with Taş Mektep, the establishment of new facilities such as a parking area at the entrance of the settlement, a square arrangement and accommodation on Çamlık Hill are parts of the project under consideration. In the same year, Mudanya Municipality took action to expropriate one olive oil factory, one church, and three civil architecture houses in line with this project.

[18] Histroical Cities Association, *Tarihi Kentler Birliği,* is a founded organization in 2000, aiming preservation of cultural and natural fabric of the cities in Turkey. For more information, see *https://www.tarihikentlerbirligi.org*

Figure 2.9. Timeline of preservation and planning history of Tirilye (1980-2012).

2.1.4 Social, Demographical, and Economic Structure

Historically, Tirilye used to be a commercially active settlement, becoming a commune center with a municipality at the end of the 19th century. Tirilye was always a significant strategic coastal settlement due to its location and port. According to the trade-related documents dated to the 13th and 14th centuries, various products were exported through Tirilye. Genoese trade documents, Italian and Greek portolan charts underline the importance of its port (Pekak, 2009).

In 1923, the exchange took place with the Treaty of Lausanne due to the Turkish-Greek Population Exchange Agreement, signed on 30th January 1923[19]**.** The exchange was between 1921-29. While around 120.000 Greeks and Armenians left Bursa with the population exchange, 40.000 Muslims settled instead (Emigli, 2014). Muslim immigrants who came to Tirilye were mainly from Crete and Thessaloniki, Usturumca, Alexandroupolis, Serres, and Karacaovalı (Akgün, 1995). Tirilye Rums mostly settled in the Rafina and Nea Triglia in Greece.

After the exchange, the first census of the Republic of Turkey was in 1927. The population of Tirilye was 2516 people, of which 1227 were men and 1279 were women, and the number of households was 633 in 1927. According to these values, the population of Tirilye decreased 40% after the exchange.[20]

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[19] The first article of the exchange treaty defines the exchange groups:
"Starting from May 1, 1923, a forced exchange will be undertaken for Turkish nationals from the Greek Orthodox religion settled in Turkish lands and Greek nationals from the Muslim religion settled in Greek lands. None of these people will be able to return to Turkey or settle in Greece without the permission of the Turkish Government." (Lozan Mubadilleri » Mübadele Sözleşmesi. Retrieved 14 November 2020, from http://www.lozanmubadilleri.org.tr/mubadele-sozlesmesi/)

[20] According to Kaya (2017) the information on the population, number of households, and the origin of the new settlers could be obtained from the exchange records. In 1924, 74 households and 928 inhabitants from Crete settled in Tirilye.

The social life after the exchange was conflicting due to the disputes between residents and newcomers. First-generation immigrants who settled in Tirilye by forced migration; have experienced problems such as being described as outsiders (*gâvur*), language problems, and differences in food cultures (Öztok Akay, 2012). Despite all these differences, the inhabitants overcame the discrepancies over time due to sharing the same religion, race, or culture. In time, language problems had disappeared, especially when the second-generation immigrants learned both Crete and Turkish (Öztok Akay, 2012).

The economic effects of the population exchange caused Tirilye's income sources to change over time. The most important reason was the occupational difference between the two immigrant populations. The non-Muslim population who migrated through the exchange mostly made a living from crafts, industry, and commerce, while the incoming Muslim immigrants were mainly from rural settlements (Emigli, 2014).

Olive cultivation continued to be the main livelihood of the settlement even after the exchange. The most important reason for this is that the Cretan immigrants know about olive cultivation. Thus, olive and olive oil production continued without interruption. Tirilye's new residents have stimulated economic life. However, Tirilye began to lose its old commercial activity due to the impact of many factors. First of all, the trade links of Tirilye port weakened, as the traders were no longer resident in Tirilye (Emigli, 2014, p.116). According to the 1934 Bursa Provincial Yearbook, Tirilye products were exported from Mudanya port in the 1930s (Düvenci Karakoç, 2008).

Secondly, only olive cultivation and fishing have survived today among olive cultivation, viticulture, fishing, silkworm breeding, weaving, and alcoholic beverage production. Winemaking**,** which was one of the traded products, could not be continued as it required expertise. Therefore, viticulture decreased; however, grape

production continued. After a while, the vineyards were dismantled and replaced by olive groves because the vineyards were damaged the olive groves. Although the silk industry[21] is also among the sectors affected by the exchange, silkworm breeding continued to be a significant source of income in Tirilye after the population exchange; however, like weaving, the silk industry lost its importance over time due to the industrialization of production (Emigli, 2010).

In the following years, Tirilye's population was between 2200-2500 until the 1980s. In the census 1985, Tirilye's population reached its climax, 2809, since the population exchange. Since then, the population has declined gradually. According to the address-based population registration system of TÜİK[22], Tirilye's population in 2020 had reached its lowest population, 1478 (See Fig 2.16). This decrease is because the young population does not prefer to live in Tirilye due to the lack of sufficient education facilities and job opportunities in the settlement. This insufficiency sometimes causes young people to leave Tirilye with their families (Ertürk, 2010).

Olive cultivation has preserved its continuity until today. Fishing is likewise still a source of livelihood since it is a coastal town in Tirilye. However, Tirilye's economy is unable to offer a variety of employment opportunities; thus, it resulted in the migration of the population to more prominent centers.

[21] Emigli argues the effects of population exchange on the Turkish economy in the article, *"Türk-Yunan nüfus mübadelesi'nin Türkiye Cumhuriyeti'nin millî iktisadının oluşumundaki etkisi".* According to the information given about the silk industry, the number of silk mills in Bursa decreased from 41 to 12 between 1914-1926.

[22] TÜİK is short for *Türkiye İstatistik Kurumu*, which is Turkish Statistical Institute in English.

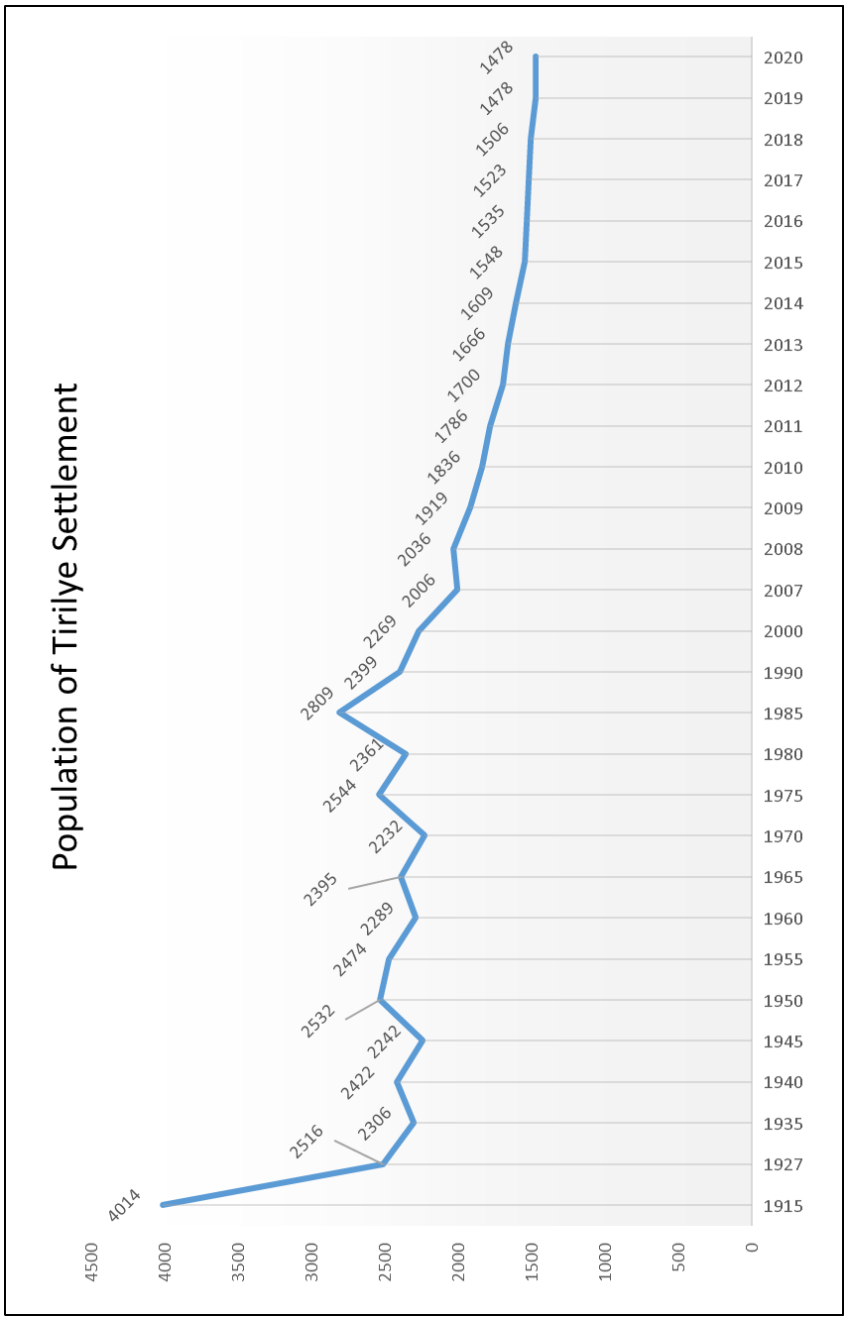

Figure 2.10. Population graph of Tirilye between 1915-2020 (data taken from DIE General Population Censuses between 1927-1960, TÜIK General Population Censuses between 1965-2000, TÜİK Address-based population registration system between 2007-2020).

As a new source of income, tourism gained importance in Tirilye. It attracts attention with its cultural heritage, historic urban tissue, and natural beauty. It has received visitors from Bursa and nearby cities with daily and weekend tours as a cultural tourism spot. With the increased interest in the settlement, some traditional Tirilye houses have become boutique hotels, shops, and restaurants. According to the study by Ertürk (2010), it is shown that Tirilye hosts both local and foreign tourists. According to the Bursa Provincial Directorate of Culture and Tourism data, the graphs prepared by Ertürk (2010) show the number of local and foreign tourists staying in Turkey between 2005-2009 and the distribution of accommodation by months. Accommodations in Tirilye are preferred mostly in August and the least in February.

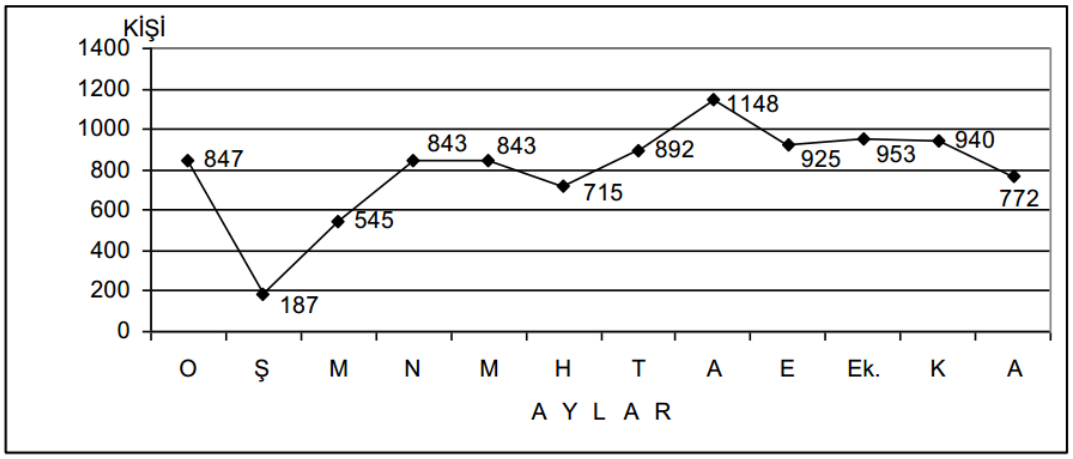

Figure 2.11. The number of visitors accommodated in Tirilye according to months (Ertürk, 2010)

2.2 Characteristics of Tirilye and traditional Tirilye houses

2.2.1 Characteristics of the Settlement

Tirilye is one of the settlements of Bursa where the historic fabric is still preserved. The characteristics of this settlement were shaped according to its location, nature, topography, socio-cultural structure, architecture, and source of income.

Figure 2.12. View of Tirilye, in the early 20th century (Tuvi, 2000)

Tirilye settlement is a neighborhood of Mudanya district, since 2014[23]. Earlier, Tirilye (Zeytinbağı) was a commune center of the Mudanya district of Bursa,

[23] The Law on Establishing Districts within the Borders of Metropolitan Municipality and Amending Some Laws No.5747 dated 2008 was amended by Article 129 of Law No. 6552 on 10/9/2014. According to this decision, commune centers were abolished in all provinces of Turkey. The towns and villages connected to the these centers, communes were decided to be attached to the

governed by the Tirilye (Zeytinbağı) municipality. Tirilye commune was composed of 13 villages; Çamlık, Çayönü, Çınarlı, Emirler Yenicesi, Esence, Evciler, Eyerci, Hançerli, Mesudiye, Söğütpınar, Yalıçiftlik, Yaman, Yörükyenicesi. Apart from these, the center of Tirilye consisted of Camişerif, Enverpaşa, Halilbey, Niyazibey, and Talatbey quarters. Following the current changes in the Metropolitan Municipalities Act (amended in 2014), both Tirilye commune and its villages changed their status and became neighborhoods of Mudanya.

Figure 2.13. Tirilye view through the sea, taken by Nilay İlçebay. Retrieved from nilay.ilcebay.com, [Access date: 15.09.2021]

administrative unit to which the commune was affiliated. Accordingly, the Tirilye commune center and its villages were declared neighborhoods and connected to the Mudanya district.

Figure 2.14. The hills and cliffs which are surrounding Tirilye. Taken by Nilay İlçebay. Retrieved from nilay.ilcebay.com, [Access date: 15.09.2021]

Tirilye is located in a valley between two hills perpendicular to the sea and is covered with olive groves. The creek, passing through the middle of the valley, is the freshwater source of the region. It flows at an altitude close to sea level and forms a wide plane in the middle of the valley. Due to the topographical characteristics, Tirilye's urban texture has developed around this stream and on the valley. Moreover, the hills, slopes, and the sea define the town's perimeter and form a natural border (Figure 2.14-15). In this case, the terrain defines the boundary naturally and has a restrictive role in developing the settlement through the east-west axis. Therefore, topography and natural elements both highly influence Tirilye's settlement plan.

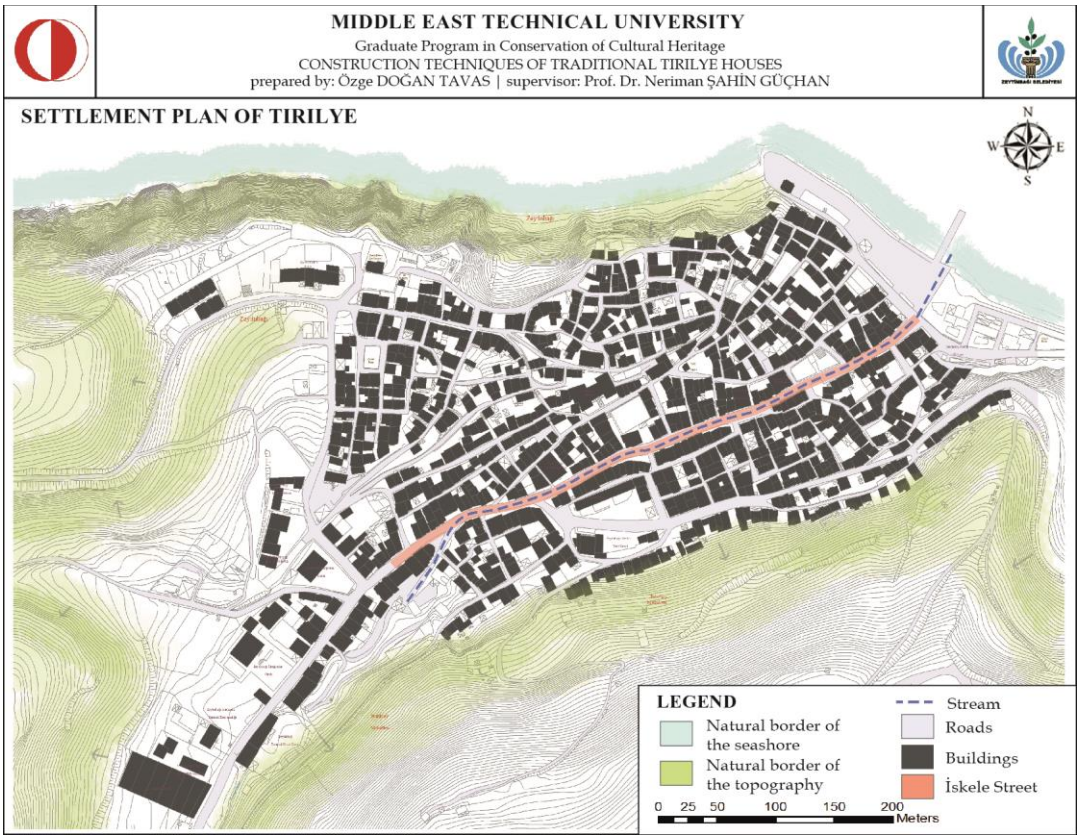

Figure 2.15. Map showing natural thresholds affecting the plan of Tirilye

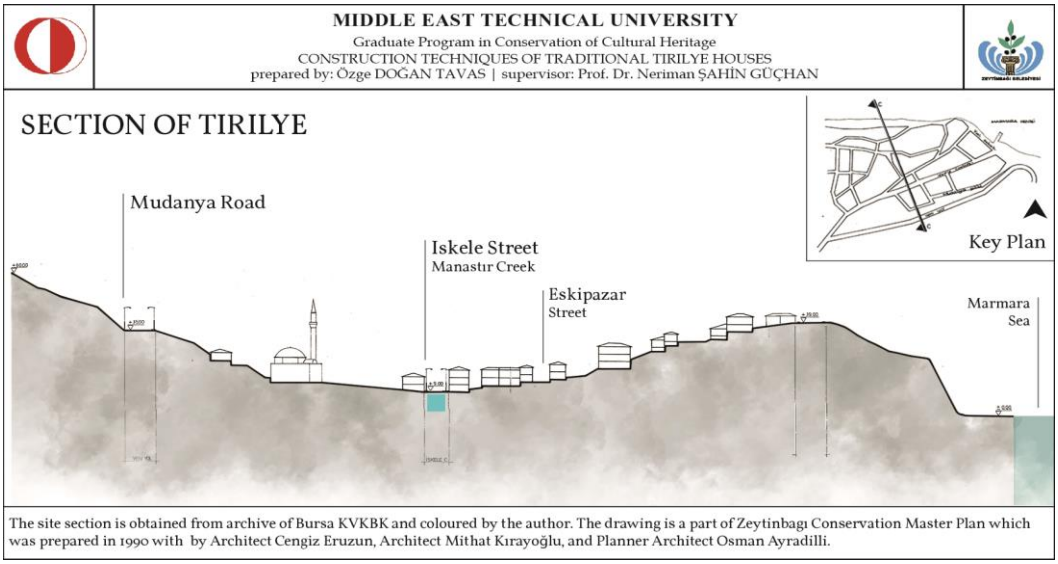

Figure 2.16. Site section of Tirilye

Figure 2.17. The authentic street pavement of Tirilye street, which is lost today. (Bektaş, 2008, p. 48)

The formation of the street pattern follows Tirilye's sloping terrain. The main streets are parallel to the topography and the creek, while the streets connecting to the main ones are formed perpendicular to the slope. Even though the formation of the streets is parallel or perpendicular to the slope, sometimes it creates an organic pattern that

offers simple solutions to adapt to the topographical changes. Due to the terrain, the elevation of the streets increases towards the northwest and southeast sides of the settlement. Because of the inclined terrain, steep streets, public stairs, and/or staired streets are common in the fabric of Tirilye. These public stairs present 14% of the street pattern, while the high-sloped streets constitute the majority with 49%.[24]

Figure 2.18.A staired street in Tirilye. Image retrieved from punto-punto.blogspot.com/ [Access date: 24-08-2021]

[24] According to the table of mapping study on physical features of street texture of Tirilye settlement, belonged to Gizem Yılmaz Akyıldız's master's thesis on "Scrutinizing Current Conservation Issues Of Mudanya Zeytinbağı and Determinating Conservation Proposals", there are 66 uphill streets, 51 low-inclined streets, and 19 stepped streets or stairs among 136 total (Yılmaz Akyıldız, 2016).

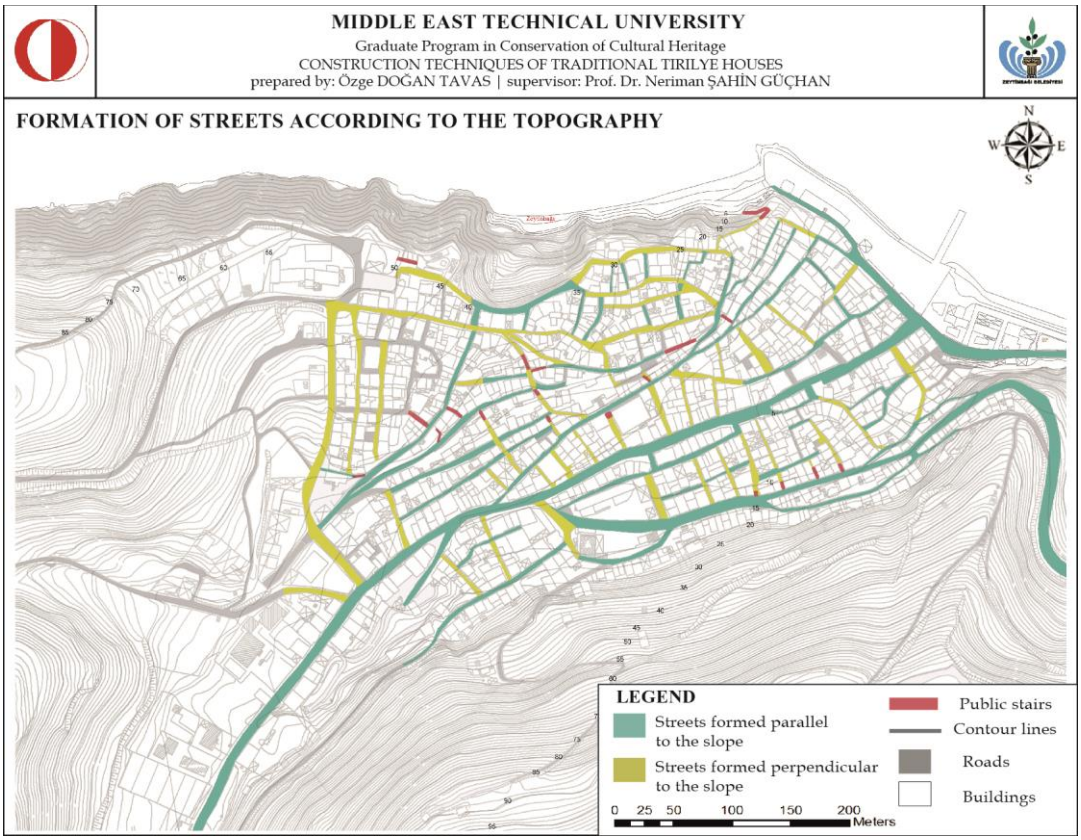

Figure 2.19. Map showing the formation of streets and public stairs of Tirilye

Today's urban fabric of Tirilye has several large open areas; an artificial coastal road joining the İskele Street, parks built on emptied building lots, and the Pine hill at the north side of the settlement. However, the rest of the urban texture is dense due to the limitation of the land**, and large public spaces are not encountered in the historic urban fabric.** Instead, small squares and triangular areas function as open public spaces, which present themselves as characteristic elements of the settlement pattern.

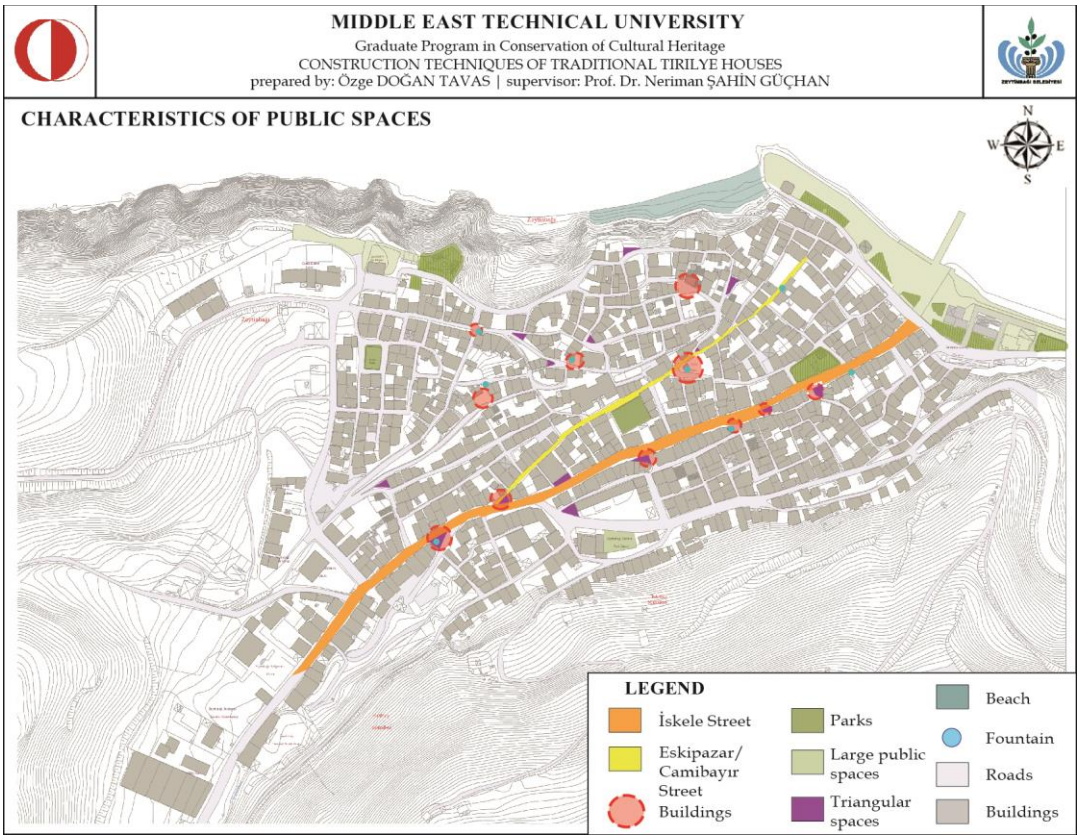

Figure 2.20. Map showing the characteristics of public spaces in Tirilye's settlement plan

Small squares constitute the nodes in the settlement. Usually, these squares have fountains that enhance the context. On the other hand, triangular spaces are used for various purposes such as storage, parking lot, green area, or recreation area. In some examples, these areas are enlarged by merging with nearby empty lots. Both open areas create expanded public spaces within the dense housing texture (See Fig 2.22).

Figure 2.21. An emptied lot was utilized as a park, Yeldeğirmeni Street, Tirilye

Figure 2.22. An example of the use of a triangular space as greenery

Figure 2.23. An example of the use of a triangular space

Figure 2.24. View of Tirilye, taken from personal archives of Makis Apostolatos

Figure 2.25. View of Tirilye in 1978, Retrieved from triglioni.gr
[Access date: 08.09.2021]

There are two significant axes of Tirilye; İskele Street and Eskipazar Street. Today, İskele Street is the busiest and central axis of the settlement, while Eskipazar Street was the main axis before. İskele Street starts from the center of the Tirilye and ends at the seashore. It is relatively wider than other streets in the settlement; thus, the traffic flow is heavy on this axis.

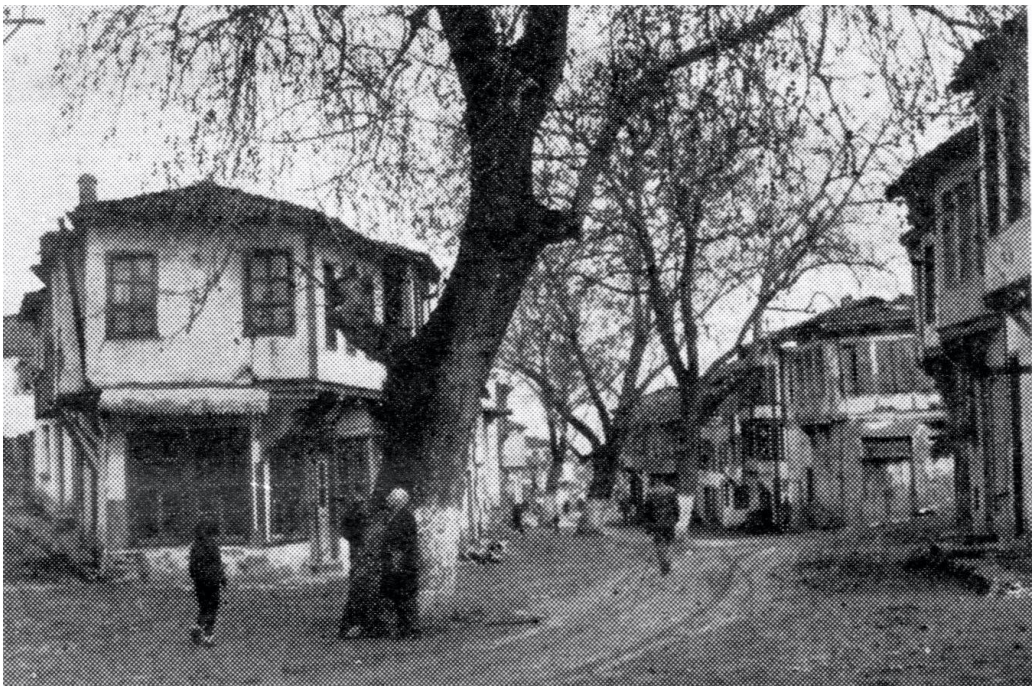

Figure 2.26. View of Tirilye, archive of Bursa KVKBK

Figure 2.27. Tirilye İskele Street, archive of Bursa KVKBK

Figure 2.28. İskele Street today

Further analysis shows that the İskele Street's form is defined by the stream of the valley which is enclosed today. Originally, the street consisted of roads running from both sides of the stream. According to the monumental trees on the street, it is understood that the trees were grown around this water source. Considering the historical elements that have survived to the present day on this street, we assume that this street was a social and recreational axis. There were mostly houses, a few warehouse structures, coffee houses, and a church along this axis.

According to Bektaş (1983), the stream was enclosed because of the odor from the wastewater drains that were connected to the stream. Half of the stream was closed towards the end of the 1930s, at the time of the Headman Hasan Bey, whereas the other half was closed in 1950. After the creek was covered, the character of the street gradually became what it is today.

Figure 2.29. Sketch of İskele Street of Tirilye, depicting the former state of the street by Cengiz Bektaş[25], colored by the author

The Eskipazar/Camibayır Street, on the other hand, is the main historical axis of the settlement. Eskipazar Street was the most important commercial and administrative axis of Tirilye, where a church, a historical school structure, a former post office building, a historical fountain, and a mosque are located (Akgün, 1995, p. 17). The ground floors of the traditional houses on this street were designed as shops with large openings.

Today, commercial activities like coffeehouses, cafes, restaurants, and touristic shops are concentrated on İskele Street and continue along the coast. Eskipazar Street has become a cultural route for touristic activities. Administrative structures are located on the Karacabey road behind the historical settlement (Figure 2.31).

[25] Bektaş, C. (1983). Trilye II. Mimarlık Dergisi, (4)

Figure 2.30. Eskipazar Street and Tirilye houses image retrieved from https://www.tatilvegezi.com [Access date: 15.09.2021]

Tirilye settlement is rich in cultural and historical structures, such as monuments, industrial buildings, and Tirilye's traditional house architecture, which mostly dates to the 19th century and onwards. Among the monuments, there are three churches, Panagia Pantobasilissa (*Kemerli kilise*), Hagios Ioannes Rum Church (*Dündar evi*), and Hagios Vasileios Church (Tirilye Culture Center). Additionally, Tirilye has one historic mosque (Fatih Mosque), one Turkish bath, and one monumental school structure (Taş Mektep) (See Fig 2.32-37).

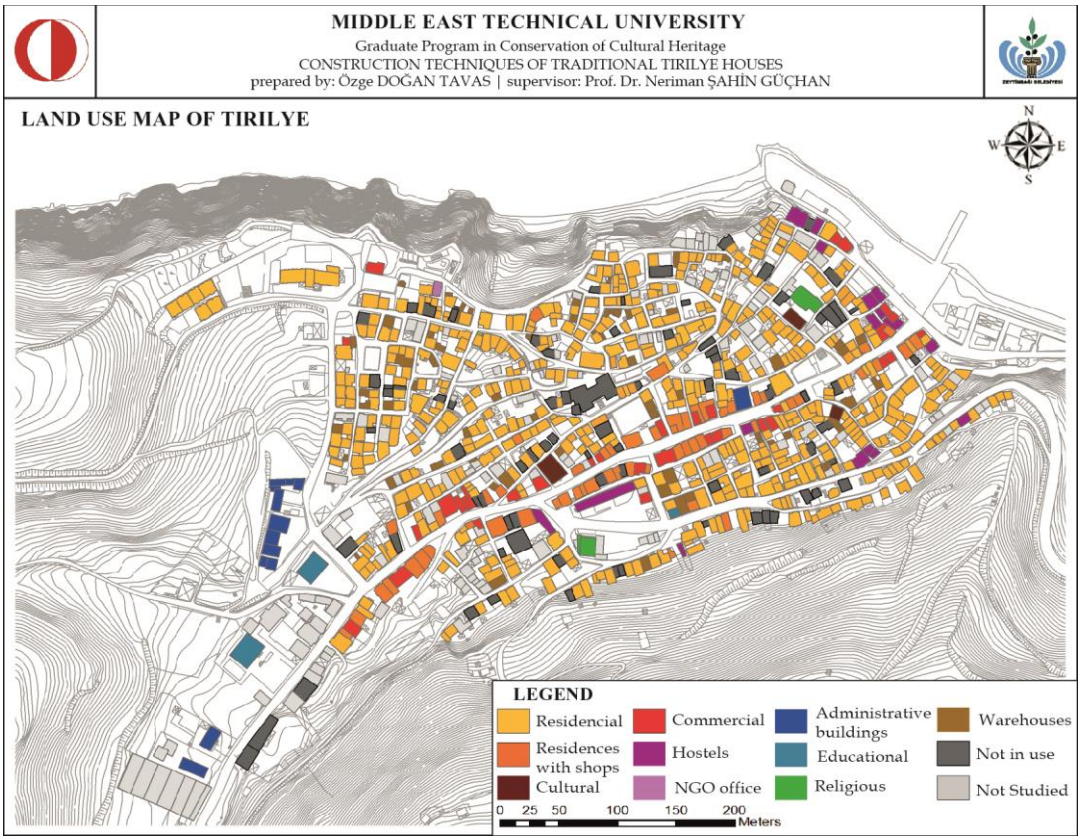

Figure 2.31. Land use map of Tirilye, according to the survey done in Fall 2018

Industrial structures are also present in this dense urban texture. Tirilye has olive oil factories, oil shops, wineries, workshops, and warehouses based on olive cultivation and viticulture activities. Among them, there are three registered industrial structures (See Fig. 2.39). Today olive cultivation continues as the main livelihood of the settlement.

Figure 2.32. Panagia PantobasilissaChurch (*Kemerli kilise*), dated to end of 13th c., Retrieved from https://www.bursa.com.tr [Access date: 15.09.2021]

Figure 2.33. Hagios Ioannes Rum Church (*Dündar Evi*), dated to 19th c., Retrieved from http://www.bursanindegerleri.com [Access date: 15.09.2021]

Figure 2.34. Tirilye Cultural Center, Hagios Vasileios Church, dated to 19th c., Retrieved from https://www.bursayadairhersey.com [Access date: 15.09.2021]

Figure 2.35. Tirilye Fatih Mosque in 1995, converted into a mosque in 1560, from Hagios Stephanos Church dated to 9th c. Retrieved from https://archives.saltresearch.org [Access date: 15.09.2021]

Figure 2.36. Tirilye historic Turkish bath structure. Retrieved from http://www.turkiyenintarihieserleri.com/ taken by Erol Şaşmaz [Access date: 15.09.2021]

Figure 2.37. Tirilye *Taş Mektep* monumental school building dated to1909. Image retrieved from http://www.bursakutuphanesi.com [Access date: 15.09.2021]

The traditional houses of the region constitute the cultural heritage of Tirilye. Due to two earthquakes that occurred in 1855, the entire settlement was damaged, especially the traditional houses of Tirilye (Akgün, 1995). Thus, the traditional Tirilye houses also have 19th-century house characteristic elements, evident in the construction technique, materials, and opening sizes. Therefore, the Tirilye houses, which constitute today's historic residential tissue, might have been built or repaired after the earthquake.

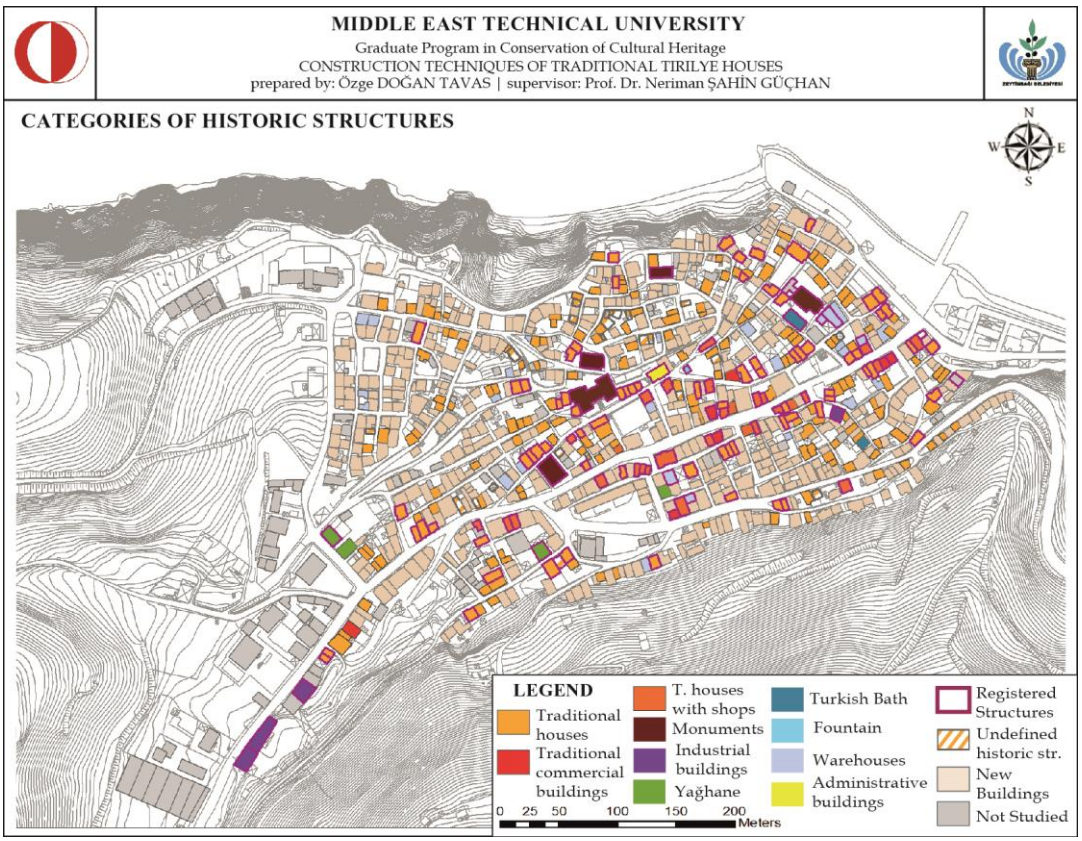

Figure 2.38. Map showing categories of traditional structures in Tirilye

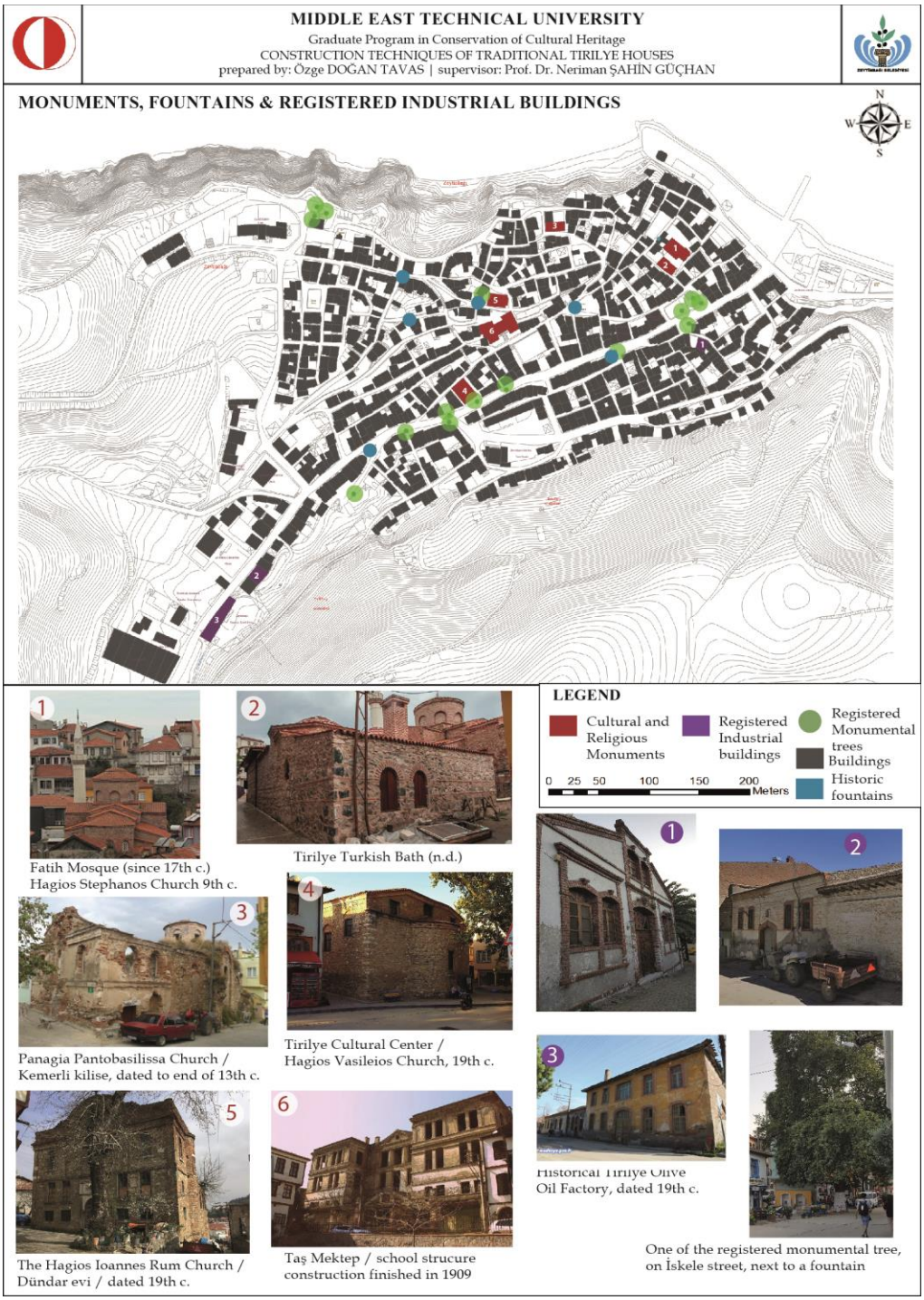

Figure 2.39. Cultural and natural monuments and registered industrial heritage buildings of Tirilye settlement.

Table 2.3 Table showing number and ratio of traditional structures in the total building stock in Tirilye

	BUILDING STOCK			
	NEW BUILDINGS	TRADITIONAL BUILDINGS	NOT STUDIED	TOTAL
#	482	340	116	938
%	52%	36%	12%	100%

Among the existing building stock of Tirilye settlement, 340 (36%) of 938 buildings are traditional historic structures such as traditional houses, monumental buildings, industrial buildings, coffeehouses, and shops (Table 2.3).

Table 2.4 Table showing number and ratio of traditional houses in the total building stock in Tirilye

	TRADITIONAL STRUCTURES			
	TRADITIONAL HOUSES		OTHER HISTORICAL STRUCTURES	TOTAL
	TRADITIONAL HOUSES	TRA. HOUSES WITH SHOPS		
#	216	29	95	340
%	63,5%	8,5%	28%	100%

The number of traditional houses is 245, which constitutes 64% of the traditional buildings in the settlement. Among traditional houses, 96 of them are registered. Today there are 29 houses with shop spaces on the ground floor, making up 8% of traditional buildings (Table 2.4).

2.2.2 Characteristics of Traditional Tirilye Houses

In this section, the characteristics of traditional Tirilye houses are defined. Tirilye houses were examined through their construction date, the relationship of the houses with the ground and the street, plot layout, mass characteristics, plan organization, and facade characteristics.

The intention of this study is not to determine the location of the traditional Tirilye houses in the traditional Ottoman house typology discussions. However, the traditional house literature is examined to evaluate the information coming from the literature and to understand the technological features, similarities, and differences of the traditional Tirilye house. Şahin Güçhan (1995; 2017) divides typological studies on traditional Ottoman houses into three groups according to their conceptual approaches:

> *" 1) Studies focusing on the spatial organization of the traditional houses (Eldem, 1968; Kuban, 1982; Küçükerman, 1991);*
>
> *2) Studies focusing on the relationship of the character of the houses to regional characteristics, construction technology, and local materials (Aksoy, 1963; Kuban 1966; Eriç, 1979; Kazmaoğlu, Tanyeli 1979);*
>
> *3) Studies investigating the historical development of these houses and their interaction with different cultures (Arel, 1982; Cerasi 1998, 2001)."*

The studies in the first group mainly focus on the top floor plan organization of the Ottoman house tradition. They define typologies among the sofa (main hall), rooms, and additional spaces via their spatial order. Eldem (1968) explains the evolution of the houses from the 15th-16th century and groups the houses as without-sofa type, the exterior sofa type (until 17th c.), inner sofa type (18th c.), and central sofa type, from the simplest one to the most developed plan scheme.

Küçükerman (1991), on the other hand, develops his ***Anatolian Turkish house*** typology through the relationship between the rooms and linking their functionality to the tent-dwelling tradition of Turks. He defines "the room" as the basic unit of the spatial arrangement of the plan typology, where each room is the living space of a family and carries all the functions in it.

Kuban (1995), on the other hand, argues that the typologies of the **traditional Turkish house** derived from various combinations of a "module," consisting of the room and secondary spaces in front of it. According to this definition, while the rooms are the center of the module, the sofa space is formed by the combination of the spaces in front of the room. In addition, Kuban states that these structures were built with the Hımış[26] construction technique developed in the Turkish period of Anatolia.

The second group consists of studies that focus on the effects of regional characteristics, climate, and local material on the traditional house culture in Anatolia (Kuban, 1966; Kazmaoğlu & Tanyeli, 1979). Kuban (1966) defines traditional housing typology as "regional housing styles" developed depending on geographical and historical conditions and argues that these styles parallel the distribution of local building materials with the region where they are common.

Kazmaoğlu and Tanyeli (1979) discuss the traditional Ottoman house as an Anatolian-Turkish house as a product of socio-cultural synthesis, but mostly argues the effect of regional climatic conditions and local material on the characteristics of the house. Over the traditional houses' physical, spatial and structural features, they divided Anatolia into two groups as "authentic Anatolian synthesis" and "transition

[26] Hımış structures are composite construction system which is a Ottoman house tradition emerged in 17th century. In this system, the foundation and ground floor walls are built with masonry, while the upper floors are timber frame structure with a timber roof. (Şahin Güçhan, 2017)

area", which are also divided into subregions. Kazmaoğlu and Tanyeli (1979) also emphasize that the dominant house type in the authentic Anatolian synthesis region is Hımış structures built by masonry and timber frame structure with a timber roof. The subject of our study, Tirilye houses, is within the authentic "Anatolian Synthesis" region, under the West-Northwest Anatolia subregion, and are hımış structures.

The studies in the third group claim that it is insufficient to examine the discussions on the Ottoman house by excluding cultural interaction and suggest different approaches for typology discussions (Arel, 1982; Cerasi, 1998). In her study, Arel (1982) questions the ***comprehensiveness*** of the definition of the Turkish house and adopts the Ottoman house terminology instead. She finds the classifications made with typological and morphological approaches based on top floor characteristics insufficient and discusses the historical development process of traditional houses. She explores the relationship between local, physical, and cultural conditions and ethnic and participatory elements directly affecting the housing tradition (Arel, 1982). Arel (1982) proposes a list of principles consisting of contrasts between ground-top floors, the tradition of köşk (kiosk)/ Divanhane / Başoda (main room), and open/closed space relationships.

Cerasi (1998) emphasizes the heterogeneous cultural tradition of the Ottoman Empire and questions the role of cultural interaction in the formation and development of the Ottoman housing tradition by examining it via comparative analysis. Cerasi (1998) defined the area where the traditional Ottoman house was spread as the ***core area*** in his research. This vast area includes the western and northern parts of Anatolia, Rumelia, and Balkans, where Tirilye is within this area.

Besides those traditional Ottoman house literature mentioned above, there are also various studies, books, articles, Ph.D. and MSc theses on the historical texture of

Tirilye, mainly discussing the urban texture and general characteristics of the settlement (Bektaş, 1983, 2008; Akgün, 1995; Akyıldız, 2016; Demir, 2019).

The most relevant study on Tirilye houses is Akgün's master's thesis (1995), which aims to "document the characteristics of the *civil architectural* structures of Tirilye." In her study, Akgün (1995) observed 43 houses and studied 11 of those over their spatial characteristics. However, the study did not go beyond examining spatial organization.

Akgün (1995) describes the basic features of the spaces and explains the plan typology according to the relationship of the sofa with other spaces from the perspective of Eldem (1968). She mentions the circulation spaces of all floors, including the ground floor, with the term sofa that we see in Ottoman / Turkish houses (Akgün, 1995). However, the characteristics of the spaces do not match with the term sofa. Even though this space provides the relationship between the rooms on the top floor, it does not have the feature of being a common living area. Because of that, the use of the concept of sofa is incompatible with its traditional meaning and is controversial. In this study, we believe the term circulation space is more appropriate instead of the ***sofa*** term.

Tirilye houses developed within a multi-cultural context in a Rum-dominated Ottoman town. The houses were shaped according to and local characteristics of this geography, local material, culture, capital, aesthetics, and technology of their period. In this context, the traditional Tirilye house has an architectural tradition with more local characteristics compared to the Ottoman house typologies. While discussing the typological analysis of the Ottoman house, Arel (1982) emphasizes that both the construction materials and techniques and the plan schemes are incompatible between the upper and lower floors in traditional Ottoman houses. However, Tirilye houses' characteristics do not correspond to that feature.

First of all, The traditional Tirilye houses are multi-story structures built on sloping land, in adjacent order with the ***hımış*** construction technique. They have the characteristics of a 19th-century house with their used construction technique, material dimensions, opening sizes, story heights, and less built-in furniture. Tirilye houses are among the A1 part of the authentic Anatolian synthesis region defined by Kazmaoğlu and Tanyeli (1979).

In Tirilye houses, the timber frame structure starts from the mezzanine or ground floor and is built on a masonry foundation. Load-bearing elements are aligned to axes, and this order continues on all floors. This is due to both the small square meters and the understanding of the construction technique of the period. In most Tirilye houses, there is no difference in construction between the lower and upper floors, as Arel (1982) stated as a 19th-century feature.

Due to two earthquakes that occurred in 1855, with magnitudes 7.1 and 6.3[27], the houses of Tirilye were damaged, as were the entire settlement (Akgün, 1995, p.11)[28]. Şahin Güçhan (2007) investigates the earthquake resistance of hımış structures through the cases of the 1894 Istanbul, 1970- Gediz, and 1999 Kocaeli earthquakes. According to the results of the study, masonry and masonry infilled timber frame walls are the weakest parts of the hımış structures against earthquake forces, whereas the timber frame walls are resistant to the earthquake forces with the use of timber lintels, bracings, and nails (Şahin Güçhan, 2007) (Figure 2.42-43). Even though there are no historical records on how many of the Tirilye houses were affected by the 1855 earthquakes, we can assume that the houses in Tirilye were severely damaged, considering the damage to traditional structures caused by the 17 August 1999

[27] N. N. Ambraseys, J. A. Jackson, Seismicity of the Sea of Marmara (Turkey) since 1500, Geophysical Journal International, Volume 141, Issue 3, June 2000, Pages F1–F6, https://doi.org/10.1046/j.1365-246x.2000.00137.x

Gölcük and 12 November 1999 Düzce earthquakes. For this reason, the traditional Tirilye houses must have been rebuilt or repaired after the earthquake.

Figure 2.40. Traditional house in Iğdiş village after 1970 Gediz earthquake (Şahin Güçhan, 2007, p.843, fig no:1)

The spatial organization of Tirilye houses is quite simple but still differs from the traditional Ottoman type. As mentioned above, the sofa space, typical in traditional Ottoman houses, is not encountered in Tirilye houses (Figure 2.60). Upper floors generally consist of circulation space and non-household rooms. On the ground floor, although the multifunctional *taşlık* spaces are encountered, we also see that in some houses, the ground floor spaces are divided into specific spaces like entrance hall, kitchen, cellar, or shop spaces. This feature also shows the impact of the 19th-century on the functioning the spaces (Figure 2.53).

In the following section, the general features of the Tirilye houses are explained in detail.

Figure 2.41. Traditional house in Örencik, after 1970 Gediz earthquake (Şahin Güçhan, 2007, p.844, fig no:3)

General characteristics: Street/Lot/Mass characteristics

The fundamental characteristics of Tirilye houses were defined according to many conditions, including topographical conditions, lot shapes, local construction materials, lifestyle and culture, and financial condition of the owner.

Figure 2.42. The studied traditional Tirilye House No:6, photos are taken from inventory archive and author's personal archive, respectively

Figure 2.43. Relationship between a Tirilye house and inclined streets (Lot no: 2217/16, Tirilye).

The topography of Tirilye is the primary determinant. As explained in the 2.1.2 chapter, Tirilye's natural borders limit the area where settlement can spread. Because of this limitation, the settlement order is quite dense. Several story buildings are built in adjacent order in small lots where their sizes commonly vary between 38 and 65 m^2 [29]. Due to the small parcel sizes, Tirilye houses occupy the entire building lot, and the ground floor plan takes the form of the parcel. The majority of the houses do not have open areas. Narrow and terraced gardens are rarely seen on the back of some buildings in the settlement (Akgün, 1995), (Figure 2.44).

[29] This calculation was made in the ArcGIS environment over the 2011 current map of the municipality. The calculation includes only traditional house parcels. The m2 values of 245 selected parcels is in the range of 20 m2 the lowest and 140 m2 the highest, whereas the average is 65 m2.

Figure 2.44. A terraced garden of an empty parcel (Lot no: 143/113, Tirilye)

Lot shapes and level differences between the surrounding streets affect the form of the structure. Since the building lots are usually narrow and trapezoidal, the use of projections is prevalent. Both the mezzanine and top floors enlarge their spaces to a rectangular geometry. The orientation is generally towards the center of the valley or the seaside. Apart from projections, balconies are also common elements of the Tirilye houses. They are often supported by decorative covered bracings (See Fig. 2.44-45-47).

Figure 2.45. Tirilye houses near seashore before the construction of new coastal road, obtained from archive of Bursa KVKBK

In terms of massing extrusion, the three-dimensional variations can differ depending on whether the parcel is located in-between or at the corner of the street. The corner lots let the structure expand through two or even three-direction planes. These houses generally have hipped roofs. On the other hand, the intermediate parcels are restricted to have projections in only one direction due to the attached building order. In this case, the buildings are completed with gable roofs (Figure 2.46).

Tirilye houses are timber frame structures with rubble stone/mudbrick/fired brick infill walls built upon stone masonry walls. These masonry walls are generally at the plinth-wall level; however, there are some examples of the complete ground floor being formed by masonry walls. The rest of the structure is constructed with a timber frame system, timber walls, and timber roof (Figure 2.46).

Figure 2.46. Tirilye houses on Mektep street

Timber frame walls are constructed with bracings, which support the frame against the lateral forces. The spaces between the bracings and the posts are partitioned by secondary timber elements such as studs, tie beams, window or door sills. Commonly used timber elements have trimmed rectangular cross-sections. Although walls with rubble stone/mudbrick/fired brick infills are primarily used on the ground floors, they can also be used on all house floors. The facades of the mezzanine and uppermost floors facing the street are constructed with the timber lath (*bağdadi*) system (Figure 2.46).

According to the lot's slope, the relationship of the houses with the ground can be grouped into two. In the first group, houses are built on slightly sloped terrain and

associated with only one ground floor. On the other hand, in the second one, as the terrain steepens, the relationship of the houses with the ground becomes more complex. In cases where the ground level difference on one side coincides with the floor height, the houses are built relative to both levels. Similarly, some houses have basement spaces designed because of such elevation differences.

The relationship of the building mass with the adjacent street is apparent and clear in these houses. As mentioned above, Tirilye houses can be associated with more than one ground level. For this reason, in this study, the main ground level is named G, while the higher ground levels are named GM (ground-mezzanine floor level) or GF (ground-first floor level).

Secondly, Tirilye houses usually have more than one access, one leading to taşlık space, one the ground floor entrance hall, or upper ground levels' circulation space. In the houses on the commercially active streets of Tirilye, there are examples of shop spaces occupying part of the ground floors. These houses have separate entrances for the house and the shop. These entrances are directly from the street, as there is no special concern for privacy, which is different from the traditional Ottoman houses. Thus, no intermediate space between the street and the ground floor spaces is designed or present.

Plan Organization: Ground floor plan

The ground floor of the Tirilye houses is related to the street, and the plan scheme is defined within this context. As mentioned before, there is no intermediate space between the street and the ground floor spaces in Tirilye houses. Entrances to the houses are directly from the street and can be more than one. The spatial organization of the ground floor is primarily composed of taşlık, entrance hall, WC, and storage spaces. The ground floor of the houses can also include specialized spaces like a kitchen, winter storage space, and olive cellar. Moreover, there are examples of shop spaces occupying part of the ground floors, in the houses on the commercially active streets of Tirilye.

Tirilye houses are defined in 3 groups according to the ground floor plan layout; with taşlık space, with taşlık and entrance hall, and without taşlık space.The houses with entrance hall and taşlık space have two entrances from the street. Taşlık place can be accessed through the entrance hall or entered directly from the street. However, in Tirilye, some houses do not have taşlık space. In this case, a part of the ground floor space is configured differently with a kitchen, cellar, or shop space taking its spot (See Fig.2.51).

Taşlık Space:

The *taşlık* space is the main service area of the house, separated from the entrance hall by a timber frame wall. This place can be accessed through the entrance hall or entered directly from the street. In this space, storage, cooking, stocking, laundry actions were held. Fireplaces, olive tanks, large earthenware olive jars, storage spaces are located at the *taşlık* space. Some houses have a "winter storage room," which is slightly elevated from the ground. The ground-level flooring is generally rock cladding or left as pressed soil. Today most of the houses have leveling concrete as flooring.

Figure 2.47. *Taşlık* space of the House No: 4,

Figure 2.48. *Taşlık* space of the House No:10 is seen through the collapsed back façade (Eskipazar St, Lot no: 2245/11)

Entrance hall:

The entrance hall is a narrow, rectangular space where the staircase and sanitary spaces are located (Figure 2.49). The stairs are made of timber with timber railings and start close to the door, continuing in L or U shape. The WC or storage space is hidden under the staircase. Some houses have a small sink near the entrance door. In some houses, entrance spaces have geometric (*karosiman*) tiles as floorings.

Figure 2.49. Entrance hall space of houses no: 3 and 1

Shop:

If the house design includes a shop, part of the façade and ground floor plan is occupied by it. These spaces have separate entrances from the street and have large window openings serving as display windows. It is separated by timber frame walls and can be accessed from the interior.

Figure 2.50. Shop space of the House No:1

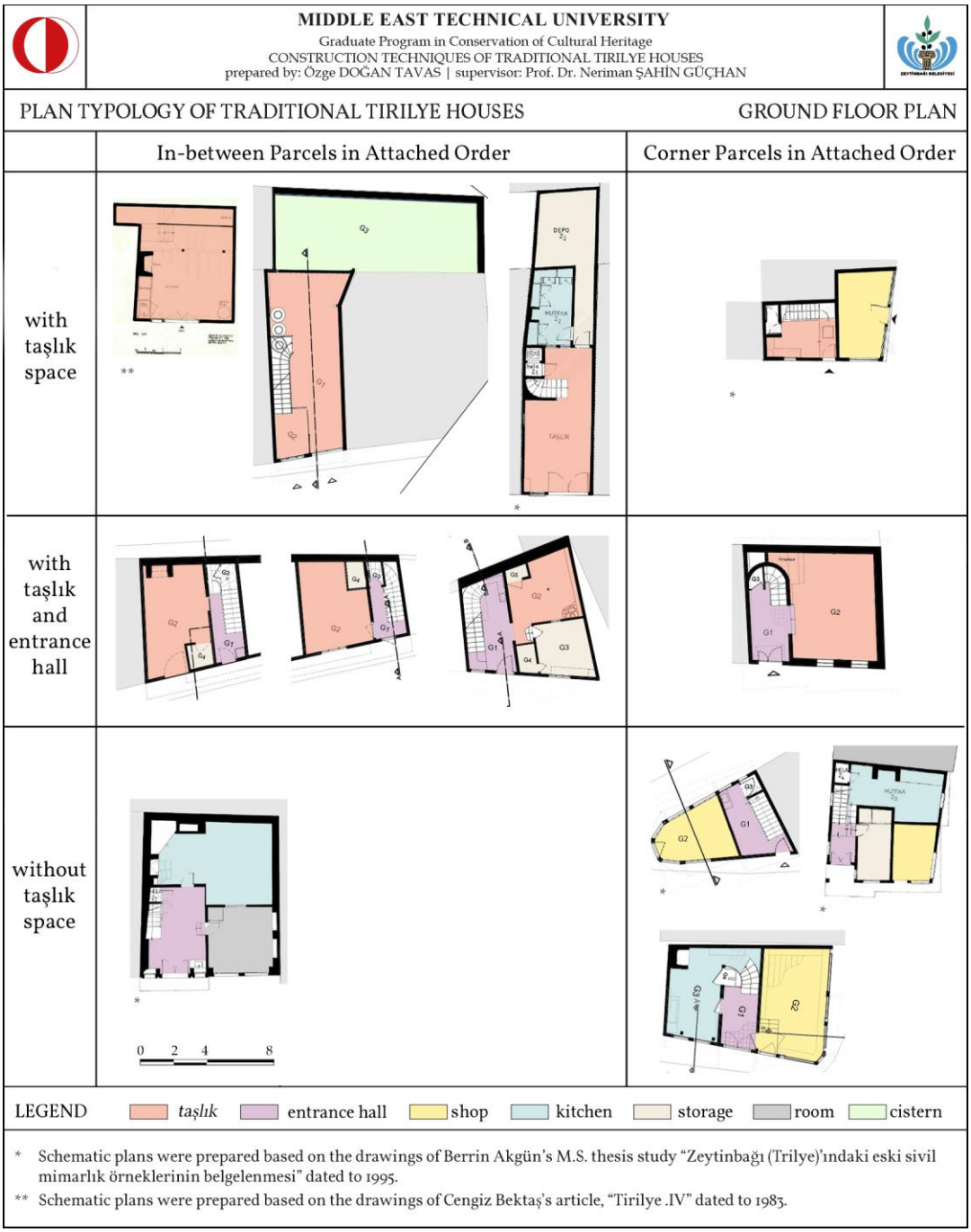

Figure 2.51. Ground floor plan typology of traditional Tirilye houses

Mezzanine Floor Plan:

The mezzanine floor, also known as the "winter floor," is located between the ground and the first floor. It has the lowest floor height among the other stories of the building; however, as a 19th-century house feature, the mezzanine floor of Tirilye houses is almost as high as the main floor and generally has the same number of windows. The mezzanine floor can expand with projections, or it can follow the form of the ground floor.

The spatial layout of the mezzanine floor is composed of a staircase, circulation space, and rooms. The rooms are organized to receive daylight and to view the street primarily. Thus, the circulation space is either in the middle of the plan or at the back. If there is a facade where it can receive light, it has one or two windows. However, if the circulation space does not have a chance to receive daylight directly, the windows on the interior walls of the rooms illuminate the space.

Figure 2.52. Photo of the room (M2 space) in House No:1, taken by Filiz Bozdere. M1 circulation space is seen behind the door opening.

The area of the circulation spaces of the mezzanine floor varies between 4 and 13 m^2 among the studied houses. Staircases occupy one side of the circulation space. On the other wall, there can be cupboards or shelves with countertops serving as a kitchen (Figure 2.53).

If the house has a second ground level at the mezzanine floor level, the circulation space receives direct access from that side of the street. The floors are timber floor cladding, and the ceilings are uncovered.

Figure 2.53. Circulation space in the mezzanine floor plan of House No:3

Uppermost Floor Plan:

In Tirilye houses, the uppermost floor, also known as the main floor, corresponds to the first or, in some examples, the second story of the houses. The uppermost floor usually has the largest area of the house because it is also enlarged into a rectangular geometry with projections towards the light and view.

The spatial organization of this floor mainly consists of rooms and a circulation area, and there can also be balcony spaces. As in the mezzanine floor, rooms and balconies are generally at the front, whereas the circulation space is at the back or center. The layout can be divided into three types according to the position of the circulation area in the plan; whether it is located on one side, in the middle, or in the corner (Figure 2.57). The rooms are bright with lots of large windows. The circulation space can receive direct or indirect light depending on its location. The floor covering of this floor is made of timber boards like the mezzanine floor. The ceiling is timber cladding in contrast to the rest of the house. The floor height of the uppermost floor varies between 280 cm and 320 cm.

The circulation space:

The circulation space, unlike the Turkish/Ottoman houses, does not function as a common living area. The area of the circulation spaces on the top floor varies between 5 and 18 m^2 among the studied houses. However, these spaces are narrow, do not receive enough daylight, are not used for living and circulation space at the same time as in sofa space, and do not contain elements that make the place special, such as a *köşk* or an iwan.

Figure 2.54. Circulation space in the first-floor plan of House No:1, the photo is taken by Filiz Bozdere

Figure 2.55. Circulation space in the second-floor plan of House No:1

Rooms:

In Tirilye houses, rooms are the main spatial units on top floors in the plan scheme and are primarily positioned to face the street and allow daylight to enter. There are generally two rooms, one of which is larger, on the top floor. Depending on the size of the room, it is entered with a double-wing door or a single-wing door. Contrary to the Turkish/Ottoman house tradition, rooms in Tirilye houses do not have the character of a *hane*. Functional architectural elements such as cupboards, sedirs, and niches are not used in some houses. Timber wall cladding elements like coat hanger, chair rail, skirting board are seen, which shows that furniture use was preferred (Figure 2.56).

Figure 2.56. Room on the second floor (S3 space) of House No:1 (Lot no: 2192/5)

Figure 2.57. Top floor plan typology of traditional Tirilye houses

Façade Characteristics:

The houses have rich façade organization with projections, balconies, window and door openings, ornamented bracings, timber cladding elements, covered timber eaves, and hipped or gable roofs (Figure 2.58).

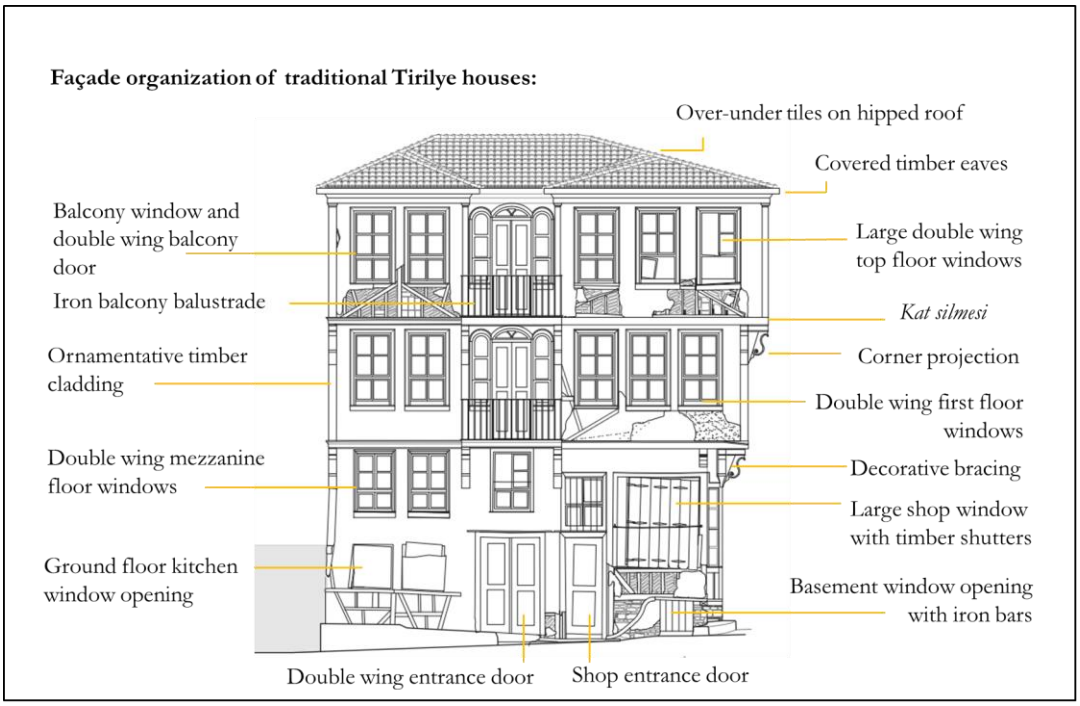

Figure 2.58. Façade elements and organization in Tirilye houses are shown in front façade of House No:1 (Eskipazar Street, lot no: 2192/5)

The defined façade characteristics are seen on the street-facing elevations of the houses. The reason for that is, Tirilye houses are built in attached order; therefore, the houses generally have blind sides, modest back elevations, and elaborately designed front elevations.

Tirilye houses usually have 2 or 3 floors, but 4-story examples are also encountered. According to the houses examined in detail in this study, the ground floor height generally varies between 225-360 cm; the mezzanine floor height is between 260-

275 cm, and the top floor(s)' between 280-320 cm. The heights of the mezzanine and the upper floors are close to each other and have many windows.

In Tirilye houses, the width of the facades also varies. Although the houses are shaped according to the building lot they are located in, their facades expand via projections for attaining a rectangular geometry in the interior and orientation towards the daylight. In some extreme cases, the elevation width can be as narrow as 2.37 cm or as wide as 15 m (See Fig 2.59-60).

Figure 2.59. Narrow façade of House No:5 (Cami St, Lot no:2186/)

Figure 2.60. Façade of House No:5 (Cami St, Lot no:2186/)

Besides the various volumetric elements and ornamentations, multiple window/door openings enhance the relationship between the house and the street. On the street-facing façades, there are multiple window openings on the upper floors of the structures. Some houses with large windows and doors on the ground floor show that such houses were planned to have shops on the ground floors.

Akgün (1995) prepared a façade typology on the order of the projections at the front elevation. It is based on the types and location of projections, locations on the facades, the number of spaces on the façade, the number of floors, and also the presence of the balcony (See Fig 2.61).

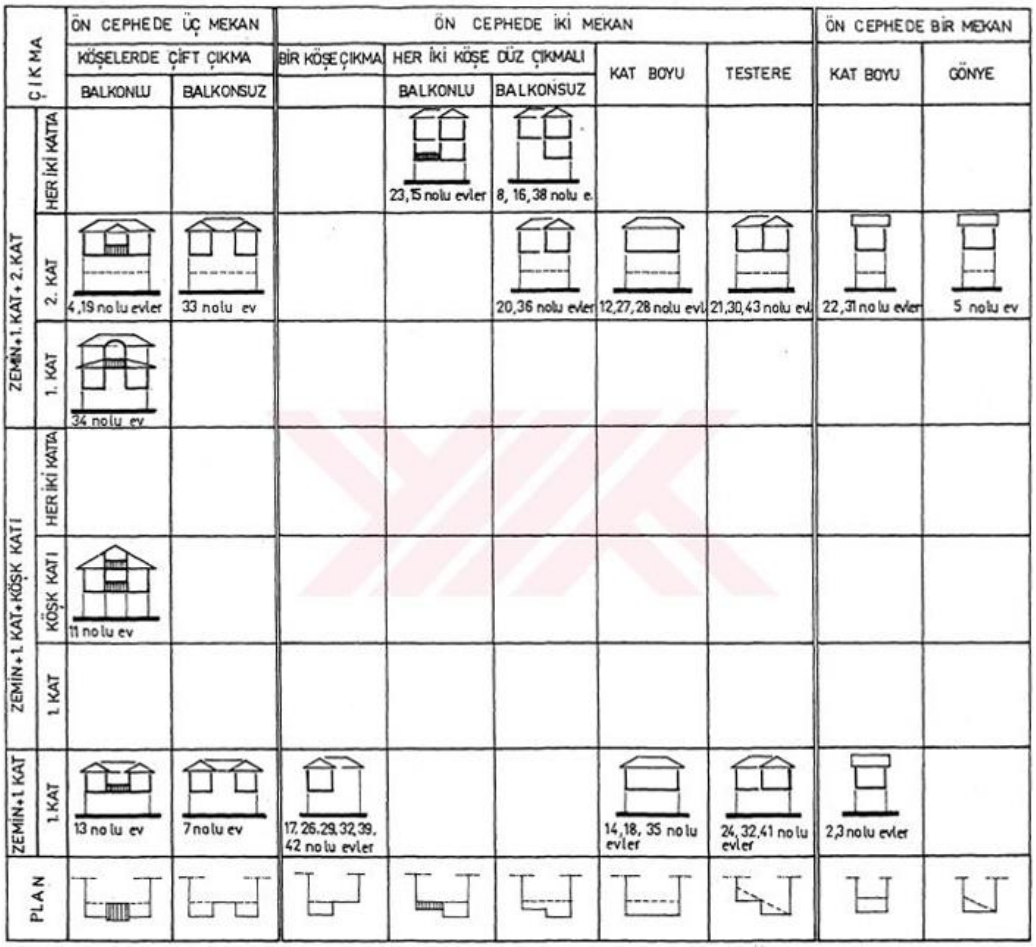

Figure 2.61. Projection typology of Tirilye houses made by Akgün (1995, p. 49 table. no. 4)

Tirilye houses are rich in architectural elements. In the following part, architectural elements belonging to the façade organization are examined under sub-headings.

Architectural elements on facades in Tirilye houses:

Projections:

Projections are one of the characteristic features of the Tirilye houses, which create volumetric movements on the façades. Due to limited land, the building lots in the Tirilye settlement are small and trapezoidal. By the use of projections, both the mezzanine and top floors enlarge their spaces to a rectangular geometry towards the light and view.

There are three types of projections: regular, triangular, and corner projections, which can be seen at the mezzanine, first or second floor of the houses. Projections are always extruded towards streets; therefore, the corner projections can only be seen on the corner lots. Regular projections can be grouped into two, whether it is supported with bracings or not (Figure 2.62). Triangular projections mainly serve for arranging the orientation of the façades (Figure. 2.63).

Figure 2.62. Examples of projections with and without bracing.

Figure 2.63. Examples of a corner and triangular projections, respectively

Balconies and terraces:

Balconies are similar to the projections. They are also part of the Tirilye houses' identity; however, they are rarely used. Generally, balcony spaces are constructed next to projections. Balconies can be grouped under three types with bracings, without bracings, and terrace balcony (Figure 2.64). In only two examples, we see the use of terraces in Tirilye houses (See Fig 2.42-43). They are located on some parts of the ground floor and used as an open space of the house.

Figure 2.64. Examples of balconies; with bracing, without bracing, and terrace balcony, respectively.

Bracings:

Since projection and balcony use are seen in Tirilye houses, bracings became one of the facade elements of Tirilye houses, which are essential loadbearing elements. In traditional Tirilye houses, while the use of bracings is seen in all extrusions larger than 40 cm, bracings may not be used in some projections or balconies with narrow extrusions (Figure 2.63-64). With the ornamented timber claddings, they are also a significant architectural element on the facade. Various types of decorative bracing claddings can be seen in traditional Tirilye houses (Figure 2.65).

Figure 2.65. Decorative bracing examples

Façade Doors:

Tirilye houses are rich in openings on the street-facing façades. They generally have multiple entrances, which can be from different ground levels. The doors in relation to the street can be grouped according to which space they are connected to; the *taşlık* door, entrance hall door, shop's door, or doors at the other ground level.

In single-entry houses, if there is an entrance hall, the door opens to the hall; otherwise, it opens to Taşlık space. Taşlık doors are usually timber doors with double wings and can have a top window. Entrance hall doors are single or double-wing doors with arched or rectangular-shaped top windows. Shop doors, on the other hand, are designed together with shop windows and are mostly single, sometimes double-winged, and have a top window (Figure 2.66). Today, most of the traditional houses have replaced authentic doors with metal doors.

Façade Windows:

Tirilye houses have many windows on the **street-facing elevations**. Each floor has certain openings to fulfill the spatial requirement of light. On the ground floors, some houses have large openings and a door next to them, which shows that such houses were planned to have shops spaces. There can be rectangular windows of kitchen spaces, which are much smaller than the shop windows (Figure 2.66).

There are **multiple and closely placed window openings on the upper floors.** The measurements of mezzanine and first-floor window openings are quite similar to each other. Instead of guillotine windows, generally, double-wing windows are used. Some houses also have double-wing timber blinds (Figure 2.67).

Figure 2.66. The house before restoration, İskele Street, Tirilye Lot no: 2226/3. (Photo taken from Bursa KVKBKM archive)

Figure 2.67. House on İskele Street Lot no: 2206/3 (Photo taken from Bursa KVKBKM archive)

Timber cladding elements:

Another element used in the façade organization of Tirilye houses is timber cladding elements. While these elements are used for decorative purposes, they also protect load-bearing timber elements from external factors. Timber claddings extending horizontally along with the floor levels *(kat silmesi)*, vertical coatings on the corners of the walls, timber window/door frames, and projection soffit boards covering the lower surface of the projections are included in this group.

Eaves:

Timber eaves constitute the top part of the façade organization of Tirilye houses. There are two different types of eaves, covered and uncovered, and both are used in

Tirilye houses. The facades facing the street have covered eaves that can be divided into two; arc-profiled eaves or covered regular eaves (See figure 3.33.). Uncovered eaves are almost seen in every Tirilye house, especially at the back facades.

For the detailed examination of eaves in traditional Tirilye houses, see Chapter 3.5.1, pp. 161-164).

Interior architectural elements of traditional Tirilye houses:

The interior elements of Tirilye houses are simpler than traditional Ottoman houses. The rarity of built-in furniture, which is another feature of 19th-century houses, also draws one's attention in Tirilye houses. Interior architectural elements include interior doors and windows, fireplaces, staircases, floor coverings, timber ceilings, sedir, niches, cupboards, timber cladding elements.

Interior Doors:

Figure 2.68 Interior door types of Tirilye houses

The interior doors of Tirilye houses are single or double wing timber doors with timber thresholds. Compared to the other rooms, the larger rooms on the mezzanine and top floors have double wings. Glazed timber doors are preferred in houses where the circulation space does not receive direct daylight. Generally, balcony doors are also glazed and can be single or double-wing doors (Figure 2.68).

Interior Windows:

Windows can be found on the partition walls in Tirilye houses. The purpose of using these windows is to illuminate the places that do not get enough daylight. It is especially preferred to illuminate circulation spaces in Tirilye houses. Generally, double-wing windows are used (Figure 2.69).

Figure 2.69 Interior window opening on partition wall of the room in the first floor (F2 space) of House No:1 (Eskipazar Street, lot no: 2192/5)

Fireplaces

During the survey, only three examples of fireplaces could be examined due to the interventions already done to the houses. Based on this limited information, the fireplaces are located at *taşlık* spaces of the houses. In one example, the fireplace was located in the kitchen area, on the ground floor (Figure 2.70).

Figure 2.70 Fireplace at the kitchen space of House No:1 (Eskipazar Street, lot no: 2192/5)

Staircases:

The staircases of the ground floors are located very close to the entrance of the house. Their shape can be L or U type. Railings can have decorative designs (Figure .2.71-72).

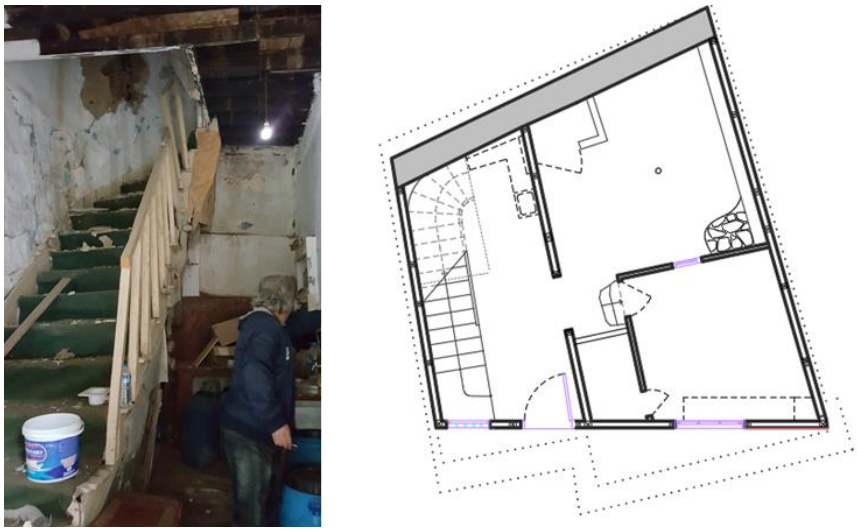

Figure 2.71. L-shaped staircase example. (House No:4)

Figure 2.72. U-shaped staircase example. (House No: 1)

Floor Coverings:

Floor coverings can be grouped under stone coverings, timber coverings, and cement tile (*karosiman*) coverings. Floor coverings in Tirilye houses vary according to floors. Due to the interventions on the ground floors of Tirilye houses, the original examples found are limited. Generally, the floors of the houses are covered with screed afterward. In addition, due to negligence, accumulated debris challenges collecting information of floor coverings in the houses.

Stone coverings:

This type is used on the ground floor level, at the service spaces and taşlıks. However, due to excessive interventions on the floor, the studied examples are limited and provide partial information (Figure 2.73).

Figure 2.73 Stone covering at the *taşlık* space of studied houses no 4

Timber floorboards:

Timber boards are the primary floor covering material in the mezzanine and upper floors of the Tirilye houses. Timber boards are placed perpendicular to the floor girders, creating the timber flooring (Figure 2.74).

The widths of the timber boards are similar to each other. Dimension of the floorboards are 2 cm thick, ranging in width from 30-35 cm, and up to 3 meters in length. In addition to nailing, a separate system has been developed. Timber floorboards have protrusions of approximately one cm at both ends to interlock with each other. In this way, timber boards are stacked on top of each other. Later on, the installed boards are fixed to the beams with nails.

Figure 2.74 Timber floorboard covering at the mezzanine floor M2 space of the studied houses no 4

***Karosiman* / Geometric cement tile coverings:**

The third type of floor covering is geometric cement tile, seen in the entrance halls of some houses in Tirilye. The use of cement tiles underlines the date of the houses, as these tiles are 19th-century floor covering elements[30]. The total thickness of the tiles is between 2.2-2.5mm. The examples seen in Tirilye houses are square and 20x20 cm in size. According to the researches on the cement tiles of Orhon (2011) and Uçar (2014), these patterned tiles used in the Tirilye houses are among the classical patterns of their period (Figure 2.75-76).

Figure 2.75 Cement tile covering at the entrance space of studied houses no 1 (Eskipazar Street, lot no: 2192/5)

[30] Cement tiles, also known as Rum tiles, came to Anatolia in the middle of the 19th century with Levantine houses. Towards the end of the century, it started to be produced mainly in Istanbul and Izmir by Rum masters (Uçar, 2014; Orhon, 2011).

Figure 2.76 Another cement tile example at the entrance space of houses no 7 Eskipazar St, Lot no: 2189/2

Timber Ceiling

Timber ceilings are seen only at the top floor ceiling. Ceilings constructed in this way were obtained by driving polished or flat boards under the joist to form a smooth surface longitudinally. Profiled timbers cover the connection of timber ceiling boards (Figure 2.77).

Although the *başoda* (main room) tradition seen in Ottoman/Turkish houses is not encountered in Tirilye houses, the S2 room of House Number 7 has an ornamented timber ceiling, unlike other rooms (Figure 2.78).

Figure 2.77: Common type of timber ceiling, House No:1

Figure 2.78: Ornamented timber ceiling, House No:8

Sedir:

Sedir is an indoor sitting platform used in rooms or sofas in traditional Ottoman/Turkish houses. Sedir is basically a kind of built-in furniture made of timber elements. According to Akgün (1995), in Tirilye houses, there are no sedirs in the circulation spaces, which she calls "sofa." In Tirilye houses, sedirs are generally located on the street-facing side of the rooms. Among the studied houses, a sedir example was only seen in one of the studied houses, House No:1 (Figure 2.79).

Figure 2.79. Sedir at the top floor room in House Number 1

Niches:

Examples of niches in Tirilye houses are found on both timber frame walls and masonry walls. However, the niche examples on the masonry wall are rare in these houses. Generally, niches are located at the curvilinear surfaces of timber frame walls of the staircases. These niches are usually closed with shutters, but open types with shelves have also been seen (Figure 3.49). According to Akgün (1995), niches are also used to display mirrors, ikons, and paintings on the upper stories (Figure 2.80).

Figure 2.80. Niches on the curvilinear timber frame walls of the staircases

Cupboards:

Cupboard examples were only seen in the largest houses among the studied houses. The cupboards are located in rooms on the 1st and 2nd floors of the Tirilye houses. They are located either on the wall where the door opens or on the sidewall.

According to Akgün (1995), there are no bathhouses between timber cupboards in Greek houses (Figure 2.81).

Figure 2.81. Cupboard covering the sidewall of the room on the first floor

Timber claddings on the walls:

These claddings are architectural elements designed as a coat hanger, chair rail, skirting board, or metal elements like a hook next to the windows for pulling the curtains aside (Figure 2.82-83).

Figure 2.82. Examples of timber elements on the wall are skirting board, *sandalyelik*, coat hanger, or curtain holder

Figure 2.83. Example of metal element used as curtain holder at two sides of windows

CHAPTER 3

CONSTRUCTION TECHNIQUES OF TRADITIONAL TIRILYE HOUSES

In this chapter, construction techniques of traditional Tirilye houses are examined in detail through a comprehensive study of selected 15 buildings, consisting of 10 representatives and 5 houses in ruin condition. As mentioned in Chapter 1, the houses were selected at the end of an evaluation made after the information collected on the entire settlement and traditional houses during the site survey presented in Chapter 2. Based on a detailed survey of selected 15 houses, this chapter aims to describe the used construction techniques and local material usage of Tirilye houses via classifying and discussing the information collected from the site.

Through the documentation and analysis period of the study, the buildings were studied in elevations and, more importantly, in system sections, which documents the details of the construction technique of traditional Tirilye houses from foundation to the roof. Every system change in each case was documented and analyzed in detail with the help of the systematically taken measured system sections, sketches, and photographs. This systematic section documentation based on a coding system (See Fig. 3.1) developed by Filiz Diri Akyıldız and Neriman Şahin Güçhan in 2010 provided the categorization of the gathered information on traditional house construction system in Tirilye.

In this section, Tirilye houses are examined under five following major headings:

3.1 Foundations and masonry walls

3.2 Timber frame walls

3.3 Timber Posts

3.4 Horizontal and vertical connections

3.5 Roof and its elements

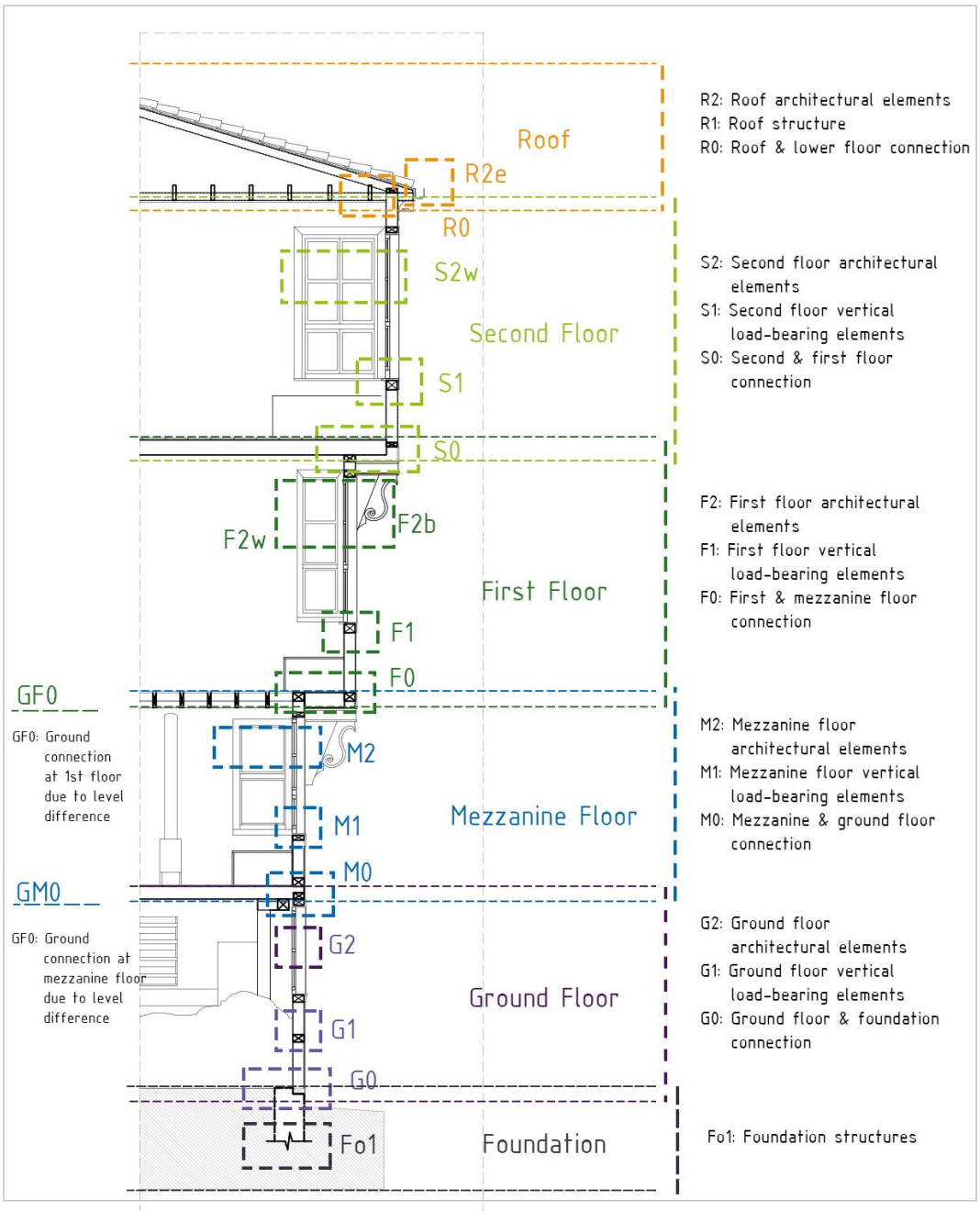

Figure 3.1. The coding system schema of traditional Tirilye houses

3.1 Foundations and Masonry walls

Information on the foundations of the Tirilye houses is not visible unless the interiors of basement spaces are visited. Due to the debris in the underground spaces and excessive interventions on the empty parcels, traces of the foundations are not easily seen, but the visible ones are documented in this study. In addition to that, the lot shapes and the use of masonry in the Tirilye houses help us understand traditional Tirilye houses' foundations.

In Tirilye houses, it is prevalent to use timber frame walls with wide openings on the ground floors, just above the stone masonry ground floor level. In this context, the use of masonry is quite limited in these houses. The stone masonry walls join with the timber frame structure approximately 30-40 cm above ground level. Due to the relationship of the masonry wall with the ground, these walls can be defined as the continuation of the risen foundation walls. Hence, the foundation and masonry part of the Tirilye houses are discussed together in this chapter.

3.1.1 Foundations

Tirilye has a sloped terrain since it is settled on a valley. As mentioned in chapter 2, the settlement has sedimentary rock assembles covering a broad area underneath Tirilye and Mudanya regions. This rocky terrain is visible on the cliffs and some empty lots (Figure 3.2). The depth of foundations depends on the thickness of the surface soil to reach the firm ground. In Tirilye, the soil layer above the rock mass is not thick in places where we can see cross-sections of the land (Figure 3.2). This information shows us that the foundation of the Tirilye houses sits on a hard rock base. However, the foundations would be built deeper in the alluvial region located in the center of the valley.

Figure 3.2. View of a cliff where the cross-section of the rocky terrain, from the Tirilye port (Taken by the author, 2019)

Figure 3.3. Rock mass at the back of an empty lot (Taken by the author, 2019, Lot no: 143/98)

Although the information taken from the site is limited, the foundation types of traditional Tirilye houses can be grouped into two according to the construction logic on the site:

1. Continuous foundation:
2. Foundation and rock combination

3.1.1.1 Continuous foundation

This type of foundation continues through to the masonry walls of the structure. After leveling the ground, the foundation walls were designed according to the site conditions. In the case of traditional Tirilye houses, they are defined by the boundaries of the building lot. Due to the parcel sizes, most of which vary between 38-65 m^2, Tirilye houses occupy the entire building lot, and masonry walls surround the parcel. Also, the interior wall layout is usually linear in particular axes to make the best use of the space. For this reason, it is the most common foundation type of Tirilye houses (Figure 3.4.).

As studying the foundation walls' characteristics above the ground, the foundation can be assessed to be rubble stone walls, consisting of local rocks such as claystone, sandstone, shale, and siltstone, with mud mortar used as the binding material.

3.1.1.2 Foundation with rock combination

The building blocks in Tirilye are aligned as the terrain allows. Some of the houses are directly located on a rock base. In these building lots, the foundations were built according to the shape of the rock mass found. After roughly leveling the surface of the rock in preparation, the stone masonry foundation, walls were built on rock-cut bedding (Figure 3.5).

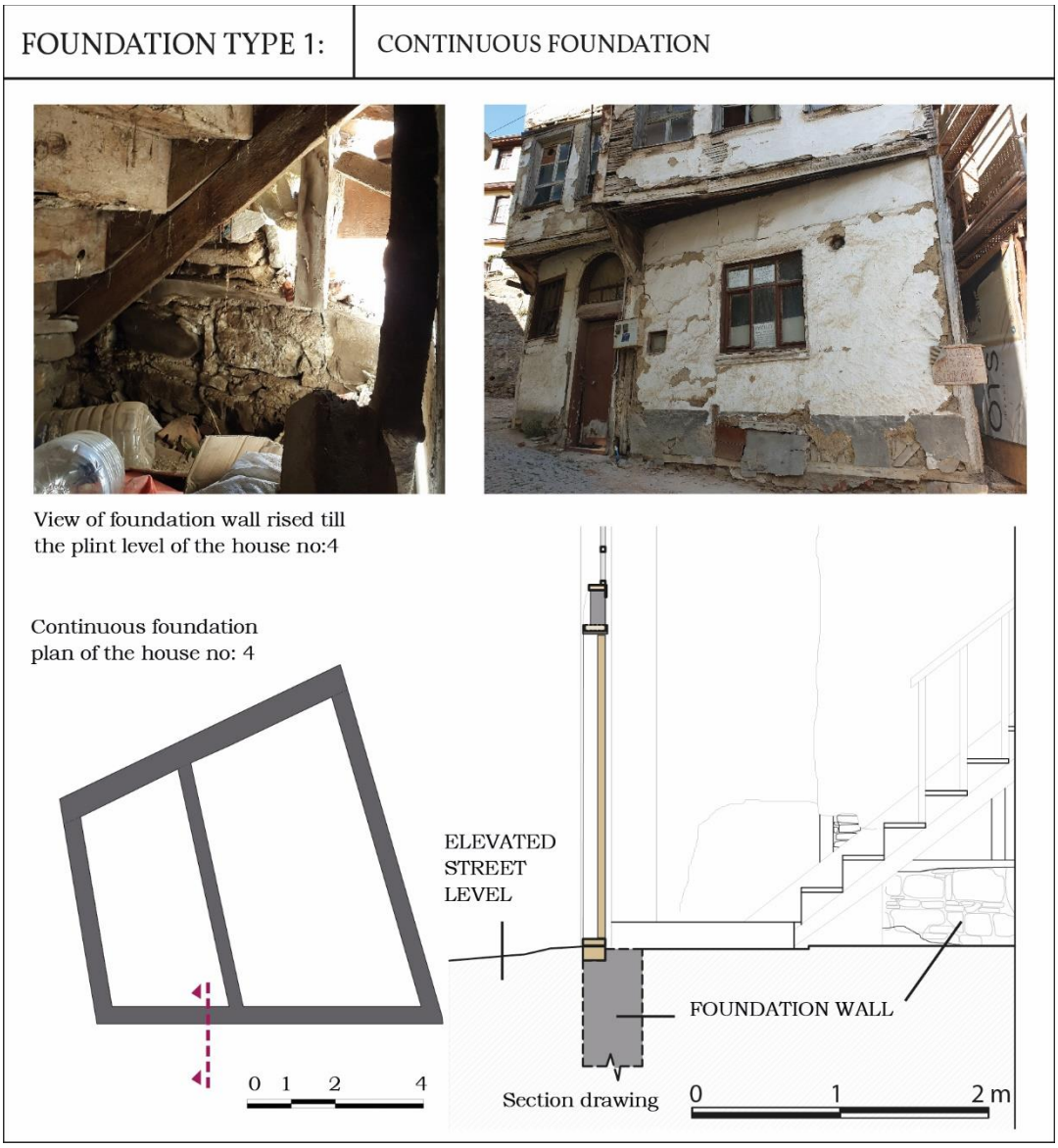

Figure 3.4. Continuous foundation detail example (Lot no: 2188/9)

After observing the empty building lots, there are cases where the rocky ground is cut to form a bedding plane. In some cases, the rock mass has joined the ground floor space. Depending on the height of the rock mass, the rock - stonemasonry wall connection detail can be seen at different levels, as seen at the skirts of the rear wall in Figure 3.5.

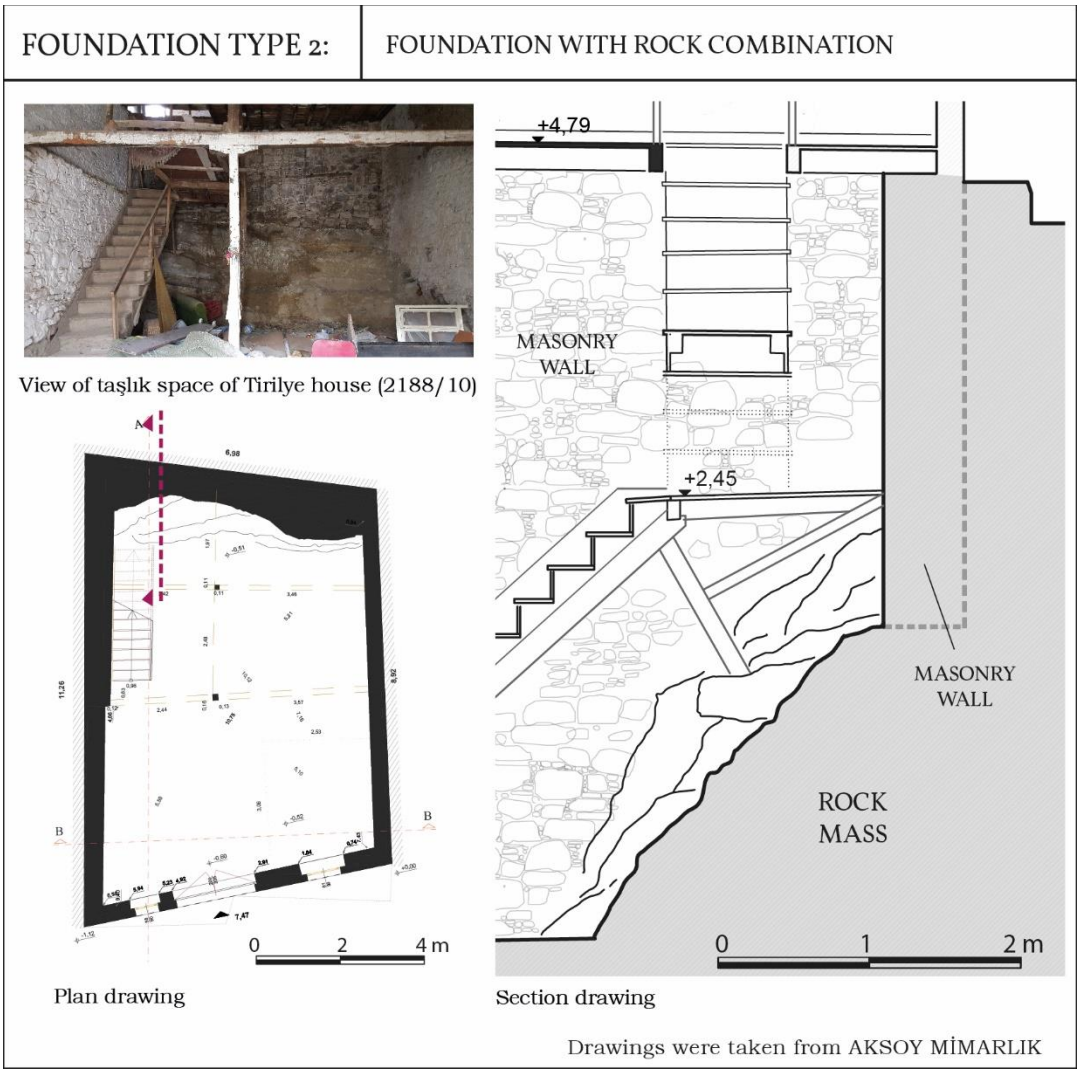

Figure 3.5. Foundation detail built on rock, due to its volume it has joined the ground floor space (Lot no: 2188/10)

3.1.2 Masonry walls

Masonry wall use in traditional Tirilye houses is shaped according to the conditions of the terrain. In the settlement, which has inclined land, stonemasonry walls rise enough to keep the timber frame structure away from rising dampness. In these houses, dating to the 19th century and onwards, there is no concern with raising the masonry walls till the floor height. Its use is seen primarily on foundations, the lower part of ground floor walls, and the rear facades of houses built on the inclined terrain. In most traditional Tirilye houses, the ground floor walls are completed with timber frame walls built above the masonry walls.

Figure 3.6. Rubble stone masonry wall coursing example (Lot no: 2167/1)

Figure 3.7. Rubble stone masonry wall coursing example (Lot no: 2188/8)

Rubble stone masonry is seen in the traditional Tirilye houses, consisting of local rocks such as mudstone, sandstone, shale, and siltstone with mud or lime mortar used as the binding material (Figure 3.6-7). There are also examples of 4 or 5 cm thick brick use in this rubble stone masonry as brick lintels or as infill material in some cases (See Fig. 3.15). At the corners, relatively larger and roughly cut stones are placed, giving a neat edge to the wall. These stones are placed simultaneously on the masonry wall corners, and a rope is stretched between these stones. With the help of a rope, the wall is aligned through a defined axis. The wall coursing comprises of large and horizontally placed stones, thin brick, and shale pieces filling in between them.

The masonry wall section is composed of stones forming the inner and outer surfaces of the wall and small rubble stones filling the gap between them. The wall thicknesses vary between 35-60 cm in parallel with their height, whereas the most common thickness is between 40 and 45 cm. The rubble masonry walls have rough-

hewn surfaces on both the exterior and interior sides, although the exterior has more elaborate craftsmanship than the latter. However, since the retaining walls of the houses are facing the earth or rock mass, only the inner surface of the walls is intended to be smooth (Tayla, 2007, p. 187).

Periodically repetitive wall courses were not encountered in the masonry walls (See Fig. 3.6-7). While the flat thin stones found in masonry are useful for filling spaces and creating alignment, there is no continuous pattern. Since the appearance of the masonry walls on the facades of the buildings is relatively minimal, there is no elaborate craftsmanship in the masonry. Moreover, according to the plaster residues on the walls, it becomes clear that the masonry walls were rendered with lime plaster and paint layer. On the inner surfaces, on the other hand, there are examples of the walls plastered or left as unplastered surfaces.

As mentioned before, masonry wall use in traditional Tirilye houses is limited. It is generally seen up to the ground floor wall level; however, it finishes at the plinth level of the associated street level. The most influential factor causing this is the slope of the terrain, or in other words, the level difference in the streets around the structure. Thus, the use of masonry walls varies according to the slope in the building lot. Therefore, although the logic is the same, the masonry walls serve differently in terms of usage (Figure 3.8-11).

3.1.2.1 Masonry usage in the low slope building lot

In the building lots with low slopes, masonry walls are only seen until the plinth level, which is approximately 30-40 cm**.** The use of masonry here forms a base for the timber frame structure and protects the timber elements from dampness. As seen in houses no:6 and no:8, masonry walls do not rise to a higher level unless necessary

to strengthen the structure. From this level, the rest of the structure is built with the timber frame structure.

The use of masonry on low-slope parcels is almost non-visible as the ground level rises with interventions to the authentic street pavement (Figure 3.8).

Figure 3.8. Relationship of the House No:6 with the ground (İskele Street, Lot no: 2219/5)

3.1.2.2 Masonry usage in the mid-slope building lot

In cases where the level difference on the lot is between 1-1.5 meters, masonry walls are built with the same understanding. In any case, the walls are built up to approximately 40 cm above the ground level. The height of the walls is adjusted through the slope by rising or descending its level vertically where necessary. The upper parts of the ground floor walls are completed with timber frame walls. In this

case, the connection detail of masonry to timber frame structure is seen in the middle of the wall (Figure 3.9).

Figure 3.9. Stonemasonry walls of the House No:4 (Dikkaldırım St, Lot no: 2188/9)

3.1.2.3 Masonry wall in the high slope building lot

In some building lots, we see high ground level differences between the street and rear façades of the lots. In such cases, the masonry wall rises to the plinth of the higher rear side ground level to create a base for the timber frame wall of the upper floor. Therefore, some of the houses have high masonry walls, serving as a retaining wall, at the back façade of the house. These walls also serve as the service wall of

the house where the fireplace is attached. The masonry use of buildings with elevation differences between the front and rear facades' street levels can be divided into two:

In the first type, the same logic is maintained. As the street level changes, the masonry walls maintain the ideal height from the ground. In this type, which is the most common, there is a significant height difference between masonry walls on different facades as well (Figure 3.10).

Figure 3.10. Example for type 1, (House No: 4, Dikkaldırım St, Lot no: 2188/9)

The second type is that all ground floor walls are built at the plinth level of the upper ground level; in other words, the ground floor only consists of masonry walls. This type is seen in relatively a few examples in the settlement (Figure 3.11). According to the texture of the masonry and the surfaces of the stones, it can be argued that these houses belong to an earlier period, probably before the 1855 Bursa earthquake or earlier than the 19th century.

Figure 3.11. Example for type 2 (Tohumcu St. Lot no: 2156/1)

According to the construction technique, masonry walls can be divided into three types.

Type 1: Rubble stone masonry wall

The first type of walls comprises rubble stones, slate stones, brick, and brick pieces. This masonry wall type is both seen in plinth-level walls and ground floor walls. The height of the wall changes between 55-275 cm, and the thickness varies between 35-45 cm. It does not have lintel in the coursing. It primarily consists of medium-sized rubble stones. However, there are also rubble stones similar in size to cornerstones within the wall coursing. Thin slate blocks and brick pieces with thickness varying between 2-4 cm, adjust the horizontal level of the wall, and fill the gaps between the other stones. These are used extensively on the upper part of the wall at the masonry-timber frame structure transitions.

Figure 3.12. Masonry wall coursing without lintel (Lot no: 2167/1)

Type 2: Rubble stone masonry wall with timber lintels

The use of timber lintel is not quite common in Tirilye houses' masonry walls; however, examples of this wall type were found on some wall remains during the site survey. The thickness of this type of masonry wall is between 45-65 cm. Timber lintels are located on the wall approximately 80-100 cm above the ground and repeat regularly with certain intervals (about 85 cm), as seen in Figure 3.13.

Figure 3.13. Timber lintel levels on the highly deteriorated stone masonry wall (Cami street Lot no: 2186/2)

In this type, the rectangular cross-section elements continue along the wall on both sides of the masonry wall. Their cross-section dimensions vary between 8x9 or 8x14 cm. There are also tie-beams, the horizontal elements that connect the timber lintels to each other. The dimensions of these elements, which usually have a rectangular section, vary between 6-9 cm and repeat every 65 cm horizontally. Timber lintels and tie-beam use help the masonry wall keep its resistance against lateral loads resulting from earthquakes. There are also examples of retaining walls built with timber lintels. Since we can see tie beams on the wall surface, timber lintels are on both sides of the wall as usual (Figure 3.13-14).

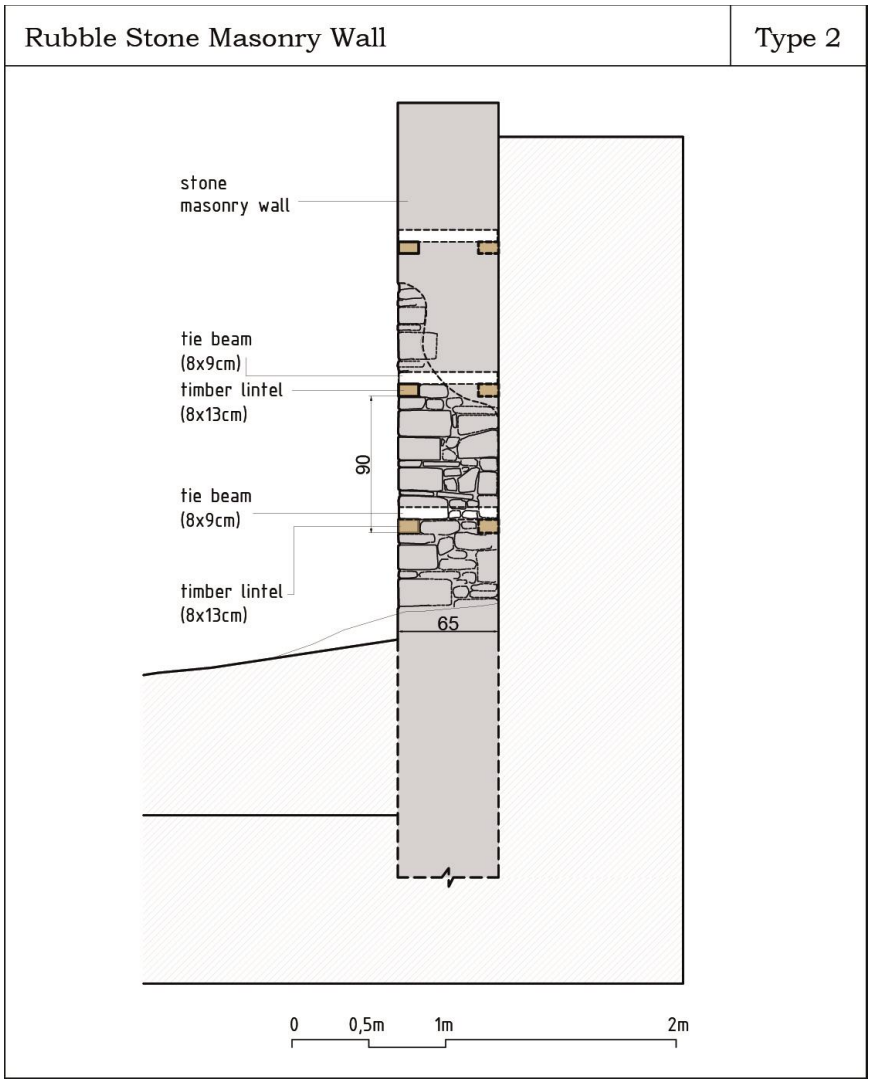

Figure 3.14. Rubble stone masonry wall with timber lintel (Lot no: 2186/2)

Type 3: Use of bricks as the lintel of the stone masonry walls

In some Tirilye houses, instead of timber lintel use, two rows of bricks are used as a lintel in the masonry walls. Since the unit and joint spacing are different, the brick lintels add resistance to the wall due to the difference in the stretching share of the brickwork. According to Tayla (2007, p. 191), brick lintel use in masonry is a rarely seen example in masonry wall constructions. However, in Tirilye houses, brick lintel use is more common than the use of timber lintels.

Examples of this type in Tirilye are seen on the ground floor walls of houses and the wall remainings of the ruins. The height of the first row of brick lintels could not be recorded due to the ground with infills. These brick lintels are generally one row in the wall course; however, two rows are also seen in the settlement. As an example, the masonry walls of House Number 7 have two rows of brick lintel spacing between 55 cm. In another case, located in parcel number 2188/10, there is 90 cm height between brick lintels. The brick dimension is 5x11x22 cm, and the joint gap is between 1-1,5 cm. according to the thickness of the bricks used, these walls can be dated to the 19th century and onwards (Figure 3.15).

Figure 3.15. Basement wall of House No:1, stonemasonry wall with brick lintel (Eskipazar Street, lot no: 2192/5)

3.1.3 Corner chamfer

Figure 3.16. The only example of authentic corner chamfer seen in traditional Tirilye houses (House No:1, Eskipazar St, Lot no: 2192/5)

In Tirilye houses, the use of a corner chamfer is very rare. There are four examples of corner chamfer in Tirilye. However, one unique corner chamfer example within the selected buildings shows its construction technique and architectural features

together. In this example, where there is an original shop space and window on the façade, both the masonry walls and timber frame system follow the ground floor's chamfered edge. The masonry part of the chamfer is made of both large rubble stones and bricks. The use of brick is practical to create angular edges. The width of the chamfer is 70 cm. At its two corners, there are timber posts, stand on the wall plate on the masonry wall. In this unique case, the timber frame section starts at 70 cm higher from the ground level (the height of the pavement is omitted). It consists of a masonry base, a timber frame wall with infill, and a narrow window opening (50x188cm).

3.2 Timber Frame Walls

The timber frame system constitutes an essential part of the traditional Tirilye houses. Via being constructed upon the masonry walls, the timber frame skeleton system forms the walls from ground floor level to the roof, floors, and ceilings.

Kuban (1995, p. 241), explains the timber frame structure as a "box system" formed by a combination of the used timber elements (Kuban,. The timber frame structure's load-bearing elements are timber posts, wall plates, beams, floor girders, and bracings. The horizontal surfaces are completed with timber floorboards or timber ceilings, while timber frame walls make vertical surfaces.

Timber frame walls are used at every floor level in traditional Tirilye houses (Figure 3.17). It consists of primary structural elements such as wall plates, timber posts, timber bracings; and secondary timber elements such as studs, tie beams, bolsters, windows, and door sills. The connection details of these elements are usually made with traditional nails. Both butt joint and lap joint details are seen in Tirilye houses. Lap joint use is extensive on the timber post-bolster connection details.

Figure 3.17. An example for timber frame wall usage on the ground, mezzanine, and top floors (House No:2, Eskipazar St, Lot no: 2188/7)

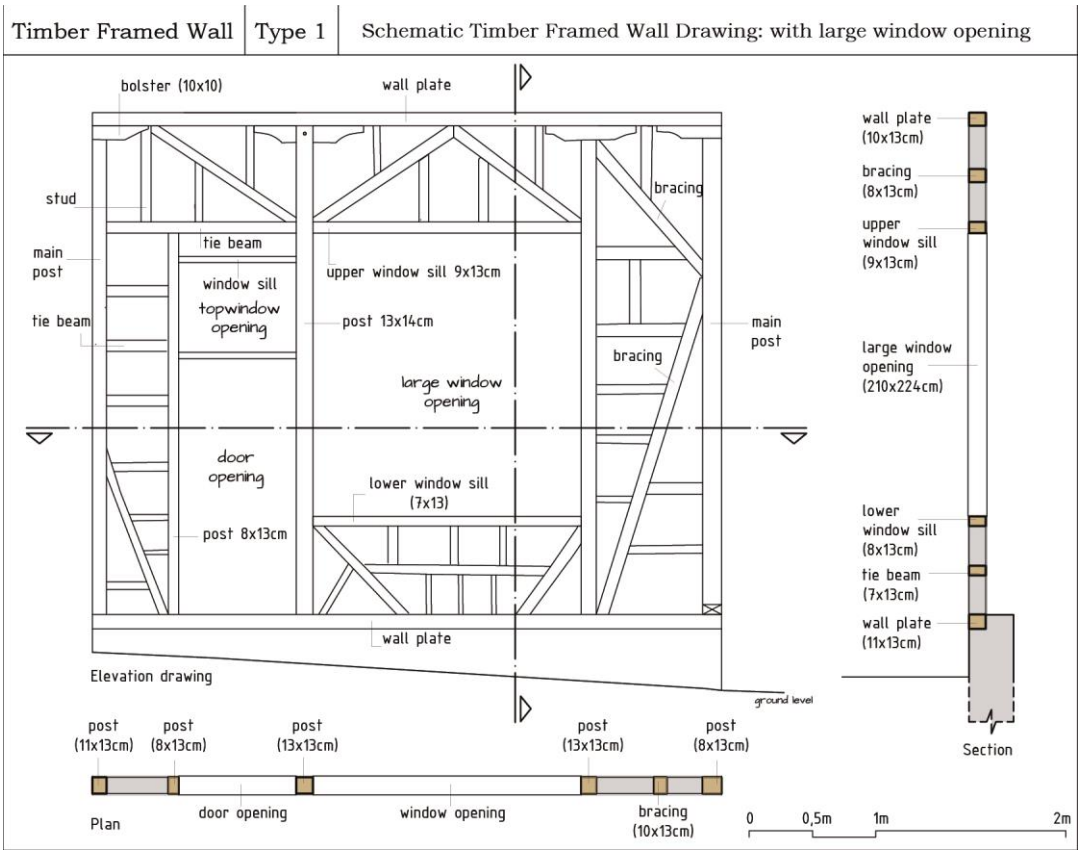

Figure 3.18. Schematic drawing of a timber-framed wall with large openings (House No: 5, Cami St, Lot no:2186/3)

Timber wall plates are the horizontal elements that constitute the lower and upper edges of the timber frame wall planes; and the main girders of the structure. The use of wall plates in Tirilye houses is interesting. The walls share the same timber element used both as wall plates and footplates at the same time by the overlapping wall planes. Thus, these elements are named as wall plates without being separated according to their location on the wall planes on each floor. The cross-section of the wall plates varies in dimensions of approximately 5 x 10, 10x10, 10 x 15 cm.

Timber posts are constructed directly upon the lower wall plate. The connection detail between them is generally the butt joint; however, there are also rare examples of the lap joint detail. At the top end of the post, the post and upper wall plate connection are supported by bolsters. The bolster-post relationship is always by lap joint. In this way, both elements can be nailed to each other by forged iron nails at once.

The wall height depends on the length of the timber posts. Since timber frame wall use is seen in all floors, including the ground floor, the height of the posts varies according to each floor. While the length of the timber posts varies between 225-360 cm on the ground floor, this value is generally between 200-260 cm on the mezzanine floors. The first-floor timber posts' length is in the range of 280-300 cm and 300-345 cm on the second floor. The most common values are 335 on the ground floor, 260 on the mezzanine, 300 on the first floor.

Figure 3.19. Butt joint example of two wall plates

The cross-sections of the timber posts are rectangular; however, the dimensions vary depending on the location of the posts. The cross-sections of the corner/main posts vary between 10x11 and 14x14; though, the latter is more common. The cross-sections of the intermediate timber posts, on the other hand, have square cross-sections ranging from 10x10 to 12x12 cm. The distance between these posts varies between 70 cm to 290 cm, whereas the most common range is between 120-200 cm.

Figure 3.20. Lap joint example of post and bolster

The use of bracing in the timber frame wall is quite essential for the stability of the timber-framed structures. These elements strengthen the structure against lateral loads and increase its earthquake resistance. In particular, bracings are crucial in high timber frame structures with many window openings, such as traditional Tirilye houses.

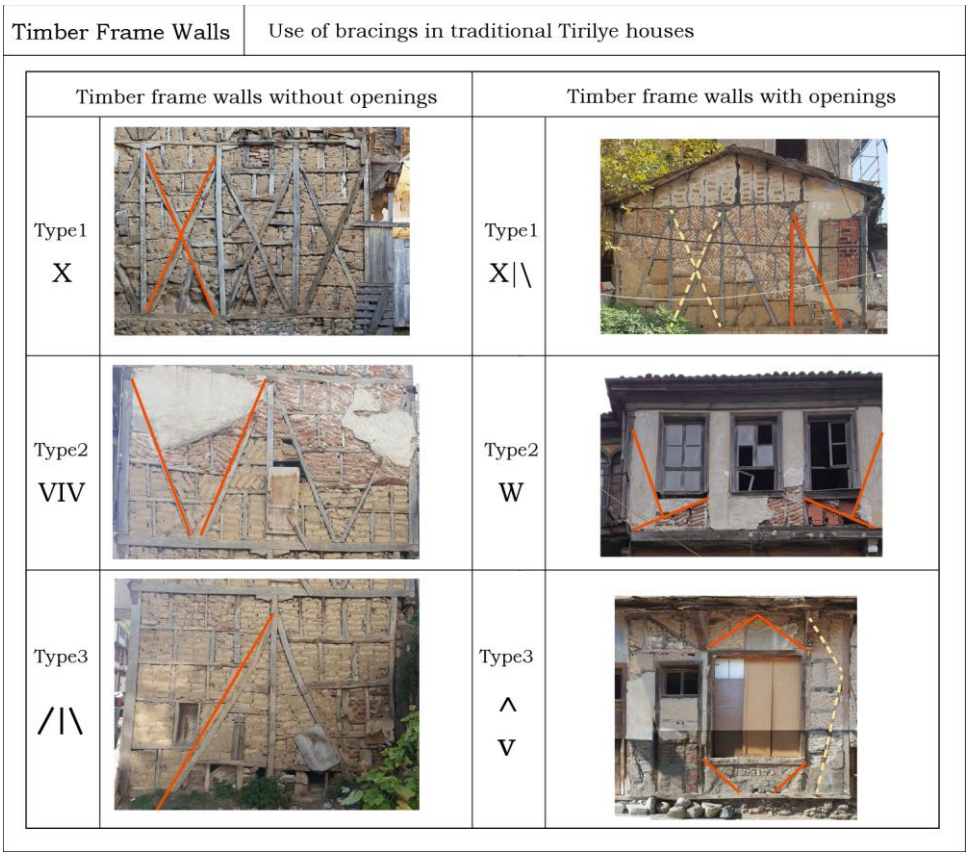

Figure 3.21. Variations of bracing use in timber frame walls

The use of bracings in Tirilye houses' timber frame walls varies depending on whether there are openings in the walls or not. There are three variations of positioning the bracings in blind timber frame walls, which are used at the adjacent walls of the buildings. The first and most common type is the cross-shaped one, formed by two or three bracings, supporting the timber posts diagonally (Figure 3.19). The other type is formed by two bracing elements, each supporting a post and connecting at the bottom edges, forming a V shape. The last type is the most basic version, composed of one bracing, supporting the posts diagonally.

On the other hand, in timber frame walls with openings, bracings' positioning was arranged according to the openings' placement, number, and size. In the case of a

wall with multiple window openings, the basic need for bracing use is to support the lower edges of windows. The use of bracing also has three variations in this type, either of which can be seen in Figure 3.19. The thickness of bracings is in a range between 6 to 10 cm, whereas the depth changes between 10 to 13 cm.

The gaps between the posts, wall plates, and bracings are divided by tie beams, studs, window/door sills. Crosssection of these elements are similar and is generally 5x10 cm.

According to the construction technique, the timber frame walls can be grouped into two groups:

1. Timber frame walls with infill
2. Timber frame walls with *bağdadi*

Type 1: Timber frame walls with infill

The first type of timber frame walls is consists of load-bearing timber elements, masonry materials filling the gaps within the wall frame, and plaster layer (Figure 3.20). The infill material of the timber frame structure system of these structures varies, and even three different infill materials can be found in the same structure. Therefore, no classification was made according to the usage of infills.

Both mud plaster and lime plaster can be applied to the walls filled with mud bricks or rubble stone. However, only lime plaster was used on the walls filled with fired bricks.

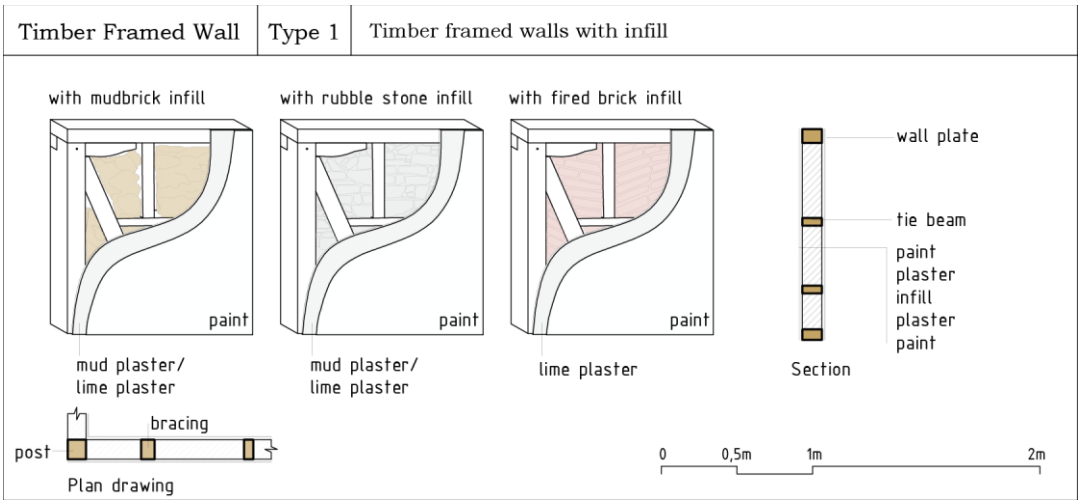

Figure 3.22. Schematic drawings of timber frame walls with infill

The use of timber frame walls with infill can be seen in every level of the Tirilye houses. The walls are generally used at the ground floor timber frame walls mainly. Due to the attached building order, the adjacent timber frame walls have infills and have one face plastered. Generally, these walls are not preferred on the front façades and projection walls. However, in House No1 example, the first and second floors' exterior timber frame walls, including the projections, have fired brick infills.

It is common to use both mud plaster and lime plaster for plastering and rendering the walls. While both plaster types are preferred for mud-brick and stone-filled walls, only lime plaster is used for the walls with fired brick infills (Figure 3.20)

Type 2: Timber frame wall with *bağdadi*

This type of timber frame walls have the same load-bearing timber elements; however, the gaps within the frame are left empty. To create wall surfaces, 1 cm thick timber laths were used. These laths were nailed to the timber elements with an interval of 1-2 cm gaps in between them and form a surface on which the plaster can hold. The width of the laths used can vary between 2-3 or 4-5 cm. Both mud plaster and lime plaster were used on these walls.

This type of wall is generally used on the mezzanine and upper floors on the front facade. This type of timber wall is widely used on wall surfaces with multiple window openings, as the timber laths give the wall elasticity and also it is a lightweight solution compared to mudbrick, brick, or stone infill (Figure 3.23).

Figure 3.23. Highly deteriorated example of a timber frame wall, with timber lath covering on the interior face with plaster (House No:10, Eskipazar St, Lot no: 2245/11)

3.3 Timber Posts

The use of timber posts as a single structural element in traditional Tirilye houses is scarce. Among the selected houses, only House Number 7 has a structural timber post element. This post is located on the balcony of the first-floor level, supporting the corner of the projection of the top floor. It is a load-bearing element; however, it is clad by timber laths, giving a hexagonal shape to the post. Thus, it also serves as a decorative element of the rich façade organization of House Number 7. The post

sits upon the tip of wall plate of the floor, which was supported by a timber brace underneath. The connection with the upper floor level is built in a similar way.

Figure 3.24. Location and connection of the timber post in House No:7, Eskipazar St, Lot no: 2189/2.

3.4 Horizontal and Vertical Connections

Connection details of Tirilye houses are explained in this heading, in 5 stages, from the bottom to the top. These stages can be sort as follows:

1. Rock to masonry transition
2. Masonry to timber frame structure transition
    a. Masonry to timber frame structure without projection

b. Masonry to timber frame structure with projection

3. Timber frame to timber frame transition
    a. Timber frame to timber frame structure without projection
    b. Timber frame to timber frame structure with projection
4. Timber frame structure and timber post-transition
5. Timber frame structure - roof connection

3.4.1 Rock to masonry transition

As mentioned under heading 3.1.1, the rock-masonry transition is seen in the foundation section of the house. However, it can be seen on several levels as well. In this transition, firstly, the rock mass is roughly shaped to create a wall bedding. After that, the stone masonry wall is built in line with rock-cut bedding.

3.4.2 From masonry to timber frame structure transition

- **Timber frame connection to a masonry wall without projection**

This transition is seen at G0, G1, GM0, M0, GF0, F0 levels. According to the differences in section and elevation of the details, there are four types.

The first type is the most common detail of masonry to timber frame structure transition. It consists of a combination of three loadbearing timber elements – 2 wall plates and a timber post- on the masonry wall at the corner joint (Figure 3.22). There are three variations of this connection type that have the same section. In the first variation, the elements are connected to each other with a butt joint, while in the second one, the lap joint is preferred in the post-wall plate connection. In the third detail, the wall plates are interlocked with each other.

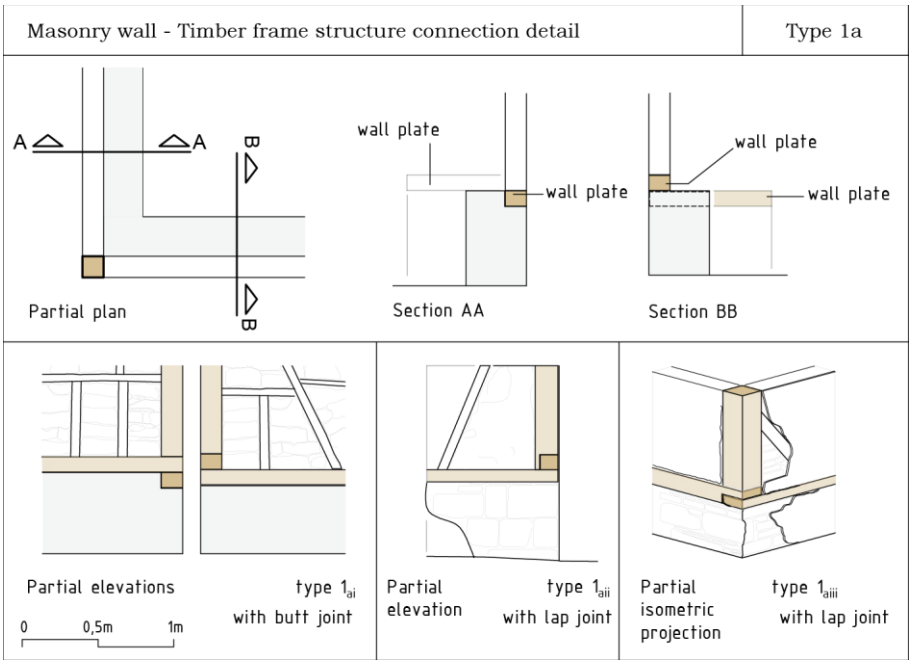

Figure 3.25. Timber frame - masonry connection detail type 1a and its variations

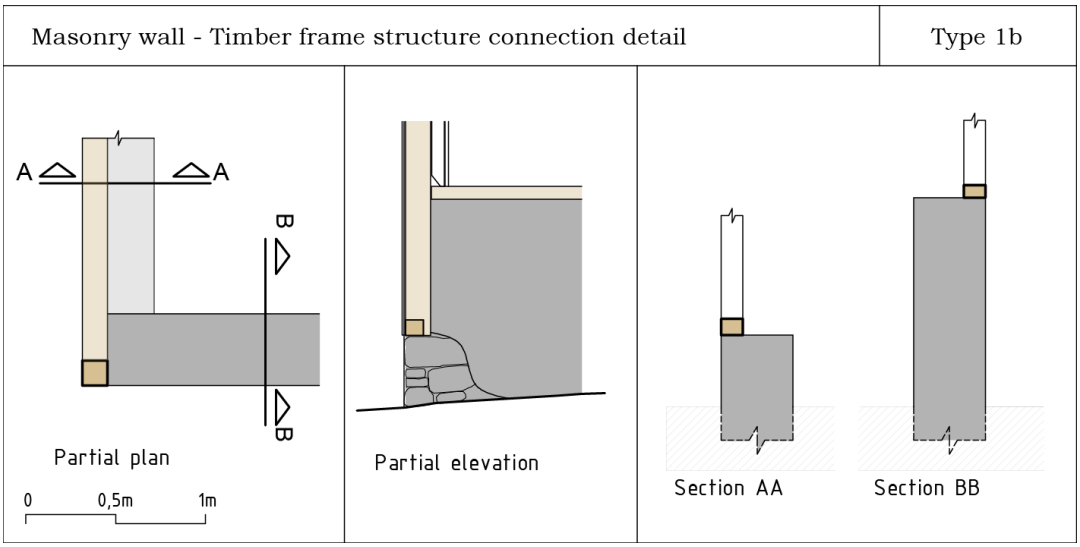

Figure 3.26. Masonry wall timber frame structure connection detail type 1b (House No:4, (Dikkaldırım St, Lot no: 2188/9)

Unlike the first group, in **the second type** of detail, these timber elements do not meet at the same point detail; instead, the wall plates are joined to the timber post from different levels. This detail is seen where the masonry wall height changes. Both lap joint and butt joint can be seen in this joint detail (Figure 3.23).

The third type is the detail that contains more elements than the other types. The wall plates on the outer surface of the masonry wall are interlocked at the corner with a lap joint. Floor joists are placed in the same direction as the lower wall plate. Then another row of wall plates with the same detail is placed on the floor joists. In this detail, the wall plate is not shared with the masonry wall (Figure 3.39).

Type 4 is a rare detail type in which the wall plates of two neighboring houses are built together with the masonry walls of each other (See Fig.3.40).

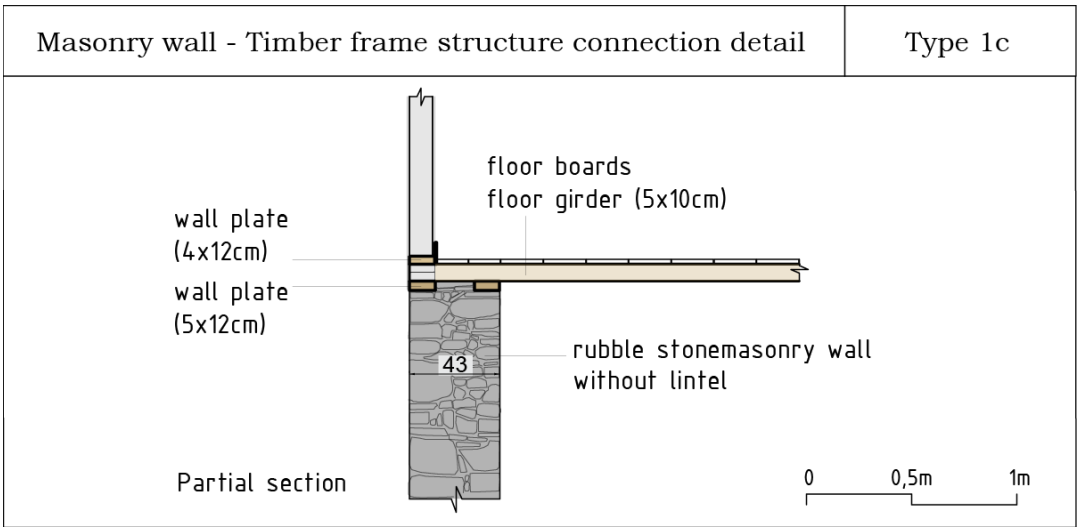

Figure 3.27. Masonry wall timber frame structure connection detail type 1c (House No: 14, (Marangozhane St, Lot no: 2167/1)

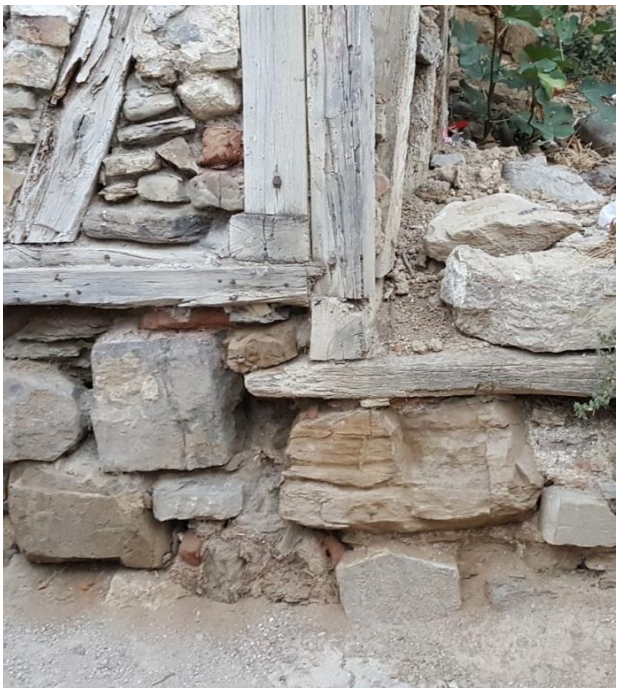

Figure 3.28. Unique masonry – timber frame connection detail of two attached buildings.

- **Timber frame connection to a masonry wall with projection**

There is only one example of masonry- timber frame transition with projection encountered among the surveyed houses. In this transition detail, the load-bearing timber element usage is as in the 4th type. Extending joists form the floor of the projection. The projection walls are formed by the timber frame wall with wall plates and studs resting on the main beams. Timber floorboards complete the flooring, while the bottom of the overhang is covered with projection soffit boards (See Fig. 3.41-42).

Figure 3.29. Masonry – timber frame connection detail with projection.

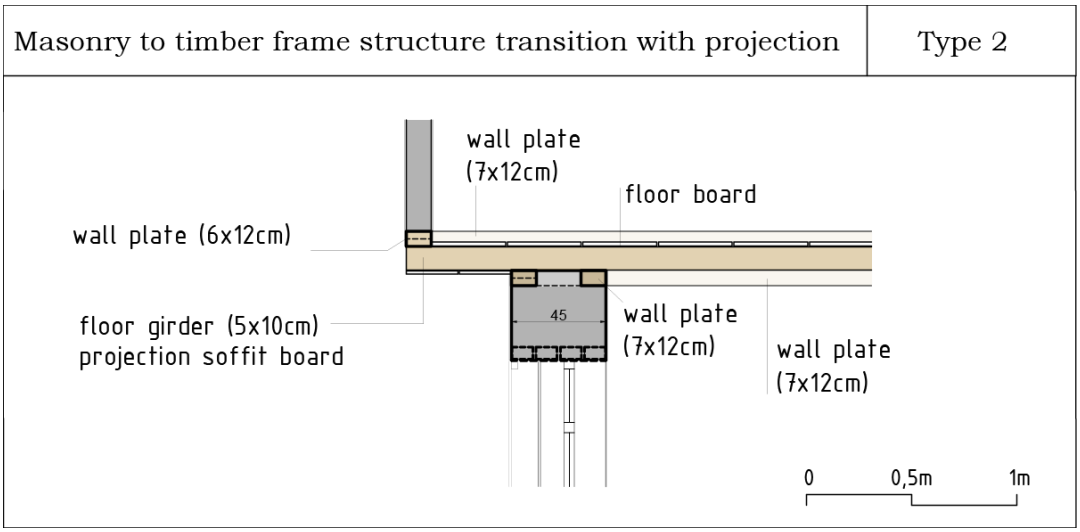

Figure 3.30. Masonry – timber frame connection detail with projection.

3.4.3 Timber frame to timber frame transition

- **Timber frame connection to timber frame without projection:**

There is only one type of variation in this transition. It is consists of wall plates, lower and upper floors' timber posts, bolsters, floor girders, and timber floorboards. The wall plates are built on the lower floor's timber post with butt joints. Generally, bolster supports the joint by enlarging the surface of load transfer. The floor girders are parallel to the upper wall plate and are placed on the lower wall plate. The girders are usually joined on the wall plate with a lap joint. Later on, the floor is covered with timber floorboards, and skirting boards are used at the joint of timber wall and timber flooring.

The point details are generally the butt joint between the wall plates and the posts. However, the bolster–timber post connection is always a lap joint. This type is quite common in the Tirilye houses and seen at M0, F0, S0 levels.

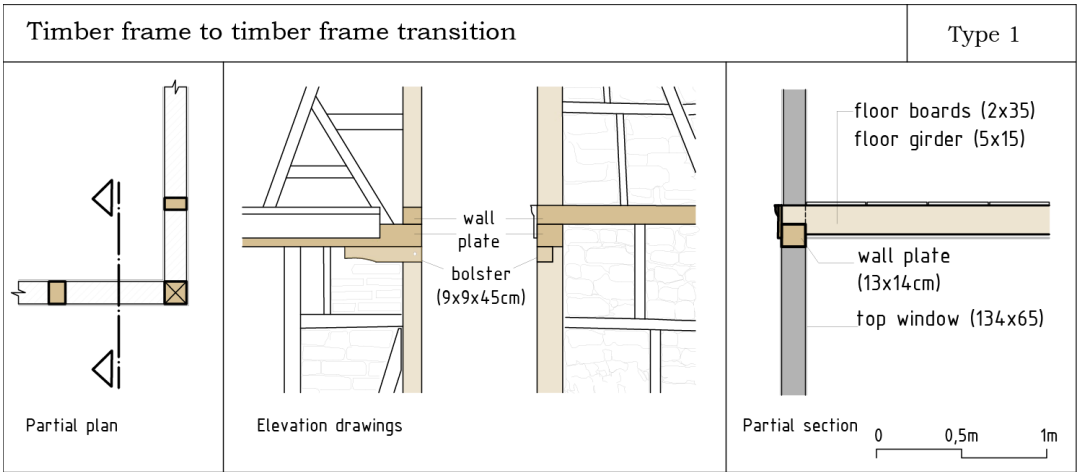

Figure 3.31. Timber frame to timber frame connection detail without projection.

- **Timber frame connection to timber frame with projection:**

In traditional Tirilye houses, there are three types of projections which can be grouped as regular, triangular, and corner projections, which can be seen at S0, F0, and M0 levels. Apart from the form of the projection, the connection detail has three variations depending on the direction of the floor girders. These details are not specific for a single form, except for corner projection.

Projection type 1:

The upper wall plate extends outwards to form the projection. Floor girders can be placed parallel or perpendicular to the projection direction, depending on the size of the space. In this type, floor girders are parallel to the projection and placed upon the wall plate of the lower floor's timber frame wall. The wall plate is put on these wall plates and floor girders. The timber post and intermediate elements of the projection's timber frame wall are placed on this wall plate. The flooring is completed with timber floorboards. The lower surface of the projection is covered with projection soffit boards. The cross-section of the floor girder and wall plates is covered with a 20 cm wide timber board. Projection depth is between 40 and 70 cm. This detail is both seen in regular and triangular projections.

Projection type 2:

In projection type 2, the floor girders are perpendicular to the projection direction. The most important difference in this detail is that the wall plate of the lower floor is above the wall plates extending outwards; in other words, the lower wall plate of the projection wall and the upper wall plate of the lower floor are at the same level. Similarly, this detail is also both seen in regular and triangular projections. Projection depth is between 40 and 100 cm.

Figure 3.32. Triangular projection example

Projection type 3: Corner projection detail

Projection type 3 is only seen in corner projection details. In this detail, the floor girders are both parallel and perpendicular to the projection directions. This detail contains both first two sections with a minor difference. Both upper wall plates of the lower floor extend exteriorly to create corner projection. Among those elements, the one on the top repeats at the projection edge and becomes the lower wall plate of the projection wall. Next, floor girders are placed parallel to this element. A wall plate is placed upon those girders to create a base for the timber frame wall at the other edge of the projection. This 3rd-row wall plate is a necessary and distinguishing feature of this type. Projection depth is between 40 and 60 cm on both sides.

Figure 3.33. Connection detail number t_{1a}

3.4.4 Timber frame structure and timber post transition

Timber frame structure and timber post transition:

In this title, both transition details of the timber frame structure to the timber post and the timber post to the timber frame structure were examined. The combination of timber post and timber frame system is constructed in the same way as the timber frame wall posts. The butt joint is used at the junction of both the lower end and the upper end of the timber post with the wall plates. The most important difference in these transition details is the absence of bolsters at the upper end of the timber post.

Figure 3.34. Corner projection example

Figure 3.35. Connection detail number t_{2a}

3.4.5 Timber frame structure and roof transition

The timber roof structure needs a load-bearing horizontal base for transmitting and distributing the load to lower sections of the structure. For this purpose, wall plates of the top floor or roof girders serve as this load-bearing base. There are three types of this transition detail.

The first detail (R0.1) is the most minimal roof transition detail seen among the studied houses. It consists of wall plates as roof girder and end purlin, rafters and roof boards, and roof tiles. In this detail, the upper wall plates of the top timber frame walls also serve as load-bearing elements required for the roof structure (Figure 3.48). This detail is seen on the timber frame wall connections with gable roof, 3-sided roof, and one-sided roof types.

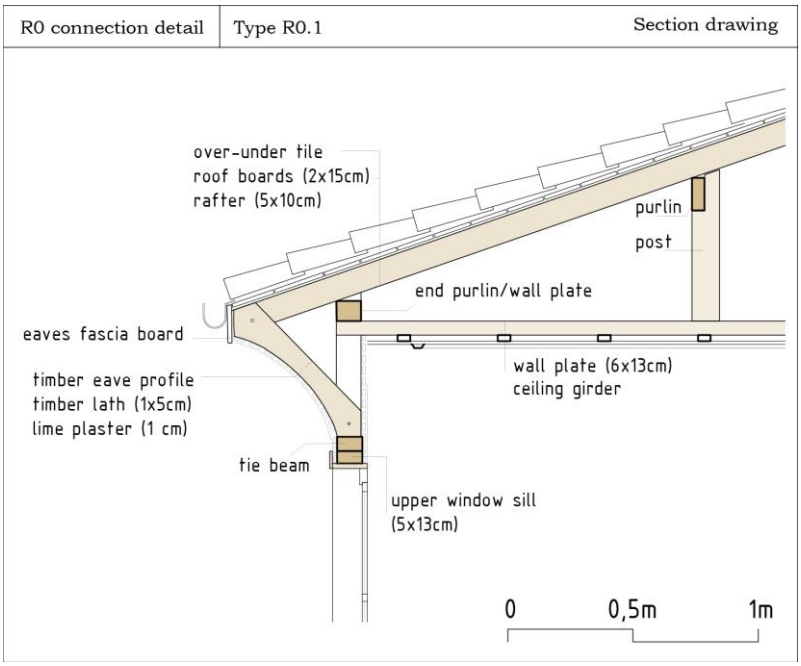

Figure 3.36. Timber frame structure roof transition detail type R0.1

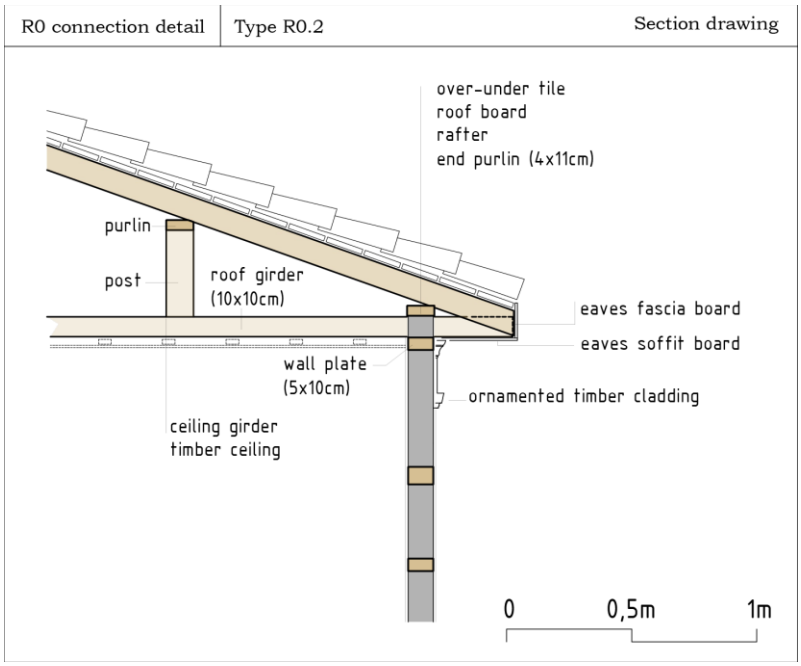

Figure 3.37. Timber frame structure roof transition detail type R0.2

The second transition detail (R0.2) is common among the hipped and 3-sided roof types. It consists of wall plates, roof girders, end purlin, rafters, roof boards, and roof tiles (Figure 3.49). Contrary to R01, wall plates cannot act as a roof girder in this detail. Because of the roof geometry, elements that are set on the diagonals are required. These roof girders (10x10cm) are placed on wall plates,

The third transition detail (R0.3) is seen on gable roofs and consists of wall plates, end purlin, rafters, roof boards, and roof tiles. In this type, upper wall plates of the top floor walls extend outward to form the eaves. End purlin is set on the edge of the wall plates, and the rafters meet the end purlin and wall plate at the edge. Similar to the (R0.1) detail, wall plates serve as roof girders. Among the studied houses, this type is seen in 1 house over 15 houses.

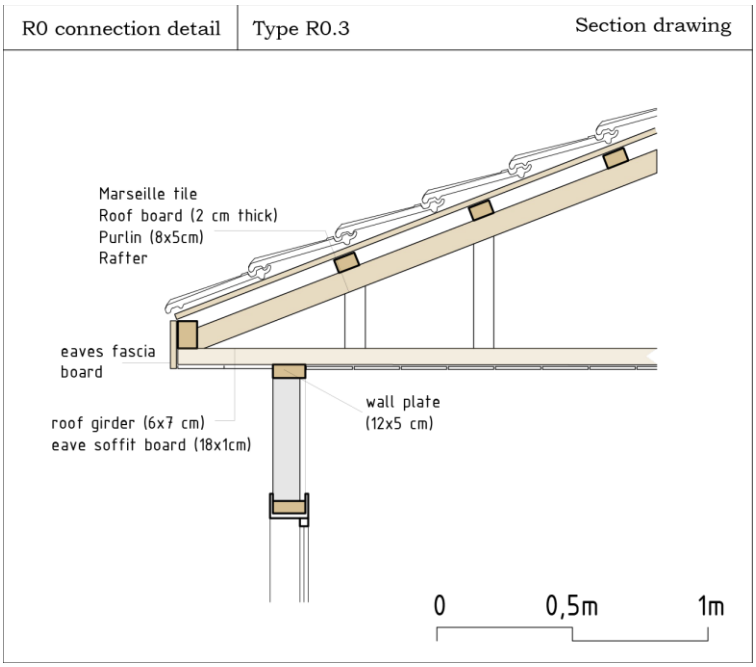

Figure 3.38. Timber frame structure roof transition detail type R0.3

3.5 Roofs and Its Elements

In Tirilye houses, collecting information about roof structures was challenging due to the lack of accessible detail. However, the overall shape, its materials, the logic of the building the load-bearing elements gives us some hints about its structural features.

First of all, there are four types of roof structures: gable roof, hipped roof, three-sided roof, and single-sided roof. Both the gable and hipped roofs are commonly used. Three-sided roofs are basically a combination of both gable and hipped roof types. Single-sided roofs are rare and not preferred within the traditional fabric of Tirilye.

The roof's shape is defined by the location of the house parcel within the building block since the houses are built in adjacent order. The traditional houses with hipped

roofs are generally located at the corner lots. However, the parcels which are attached to the neighbor houses from both sides can only have a gable roof. On the other hand, as a special type, the 3-sided roof is found in corner plot houses such as hipped roofs. In these houses, which share a single facade with the neighboring house, a gable wall is formed on the adjacent wall, while the roof turns into a hipped roof on the sides facing the street.

The choice of the hipped or 3-sided roof depends on the height difference of the building with the neighboring structures. Since this roof type is a combination of gable and hipped roofs, the building system consists of the repetition of the two types.

Figure 3.39. An example to hipped roof with closed eaves

Figure 3.40. An example of the deteriorated gable roof structure

Figure 3.41. An example of the deteriorated 3-sided roof structure

Figure 3.42. An example of a one-sided roof structure (Taken from Bursa KVKBKM archive, Lot no:2254/8)

In Tirilye houses, top floors' ceilings are always covered. Because of this reason, gathering information about roof structures was challenging. Thus, each and every bit of information about roof structure became important information for the research. According to the data collected via observation, the roof is constructed upon the main roof girders or top floor's upper wall plates. After that, corner and king posts are placed, and then ridge purlins, purlins, and end purlins are set. In the next stage, firstly rafters, after that roof boards were installed. Generally, the over and under tiles finish off the roof, whereas marseille tile use is also seen less often.

Even though the logic is the same, the configuration of roofs differs according to their type.

Figure 3.43. An example of the gable roof structure of the Tirilye houses. This house partially shows its roof structure and creates a base for understanding the roof system.

Gable roof is a simple 2-face roof type. It forms eaves on the front and rear facades, while gable walls emerge on the side. The ridge of the roof is positioned to center the area that is covered by the roof. The roof girders are placed according to this alignment. These girders are also the wall plates of the top floor on gable roofs in some cases. King posts placed on the girders determine the height and slope of the roof. In order to support the roof structure, there may be braces between the roof posts.

Timber posts and purlins are placed to divide the distance between the roof ridge and the outer wall. Upon them, rafters are placed on the purlins, nailed to both sides of the ridge purlin. The wall plate of the front and rear timber frame walls serves as end purlin. Rafters run down the ridge and extend outward between 25 – 50 cm to form eaves. Rafters are placed in a range between 24-30 cm, so the skeleton of the roof surface is formed. In some structures, there are horizontal tie beams connecting the rafters. After the roof boards cover the rafters, the roof surface is laid with marseille tile or over-under tile. The gaps between the gable wall studs are closed with infill.

Figure 3.44. Highly-deteriorated roof structure and the connection of king posts, ridge purlin, and braces

Figure 3.45. Highly deteriorated timber roof structure, purlins are below the rafters

The hipped roof is built with the same understanding as the gable roof but is stylistically different. Hipped roofs generally have four surfaces and form eaves on each facade. Roof girders placed on wall plates form a plane for king and corner posts. Posts fixed on the girders determine the slope of the roof. Angle rafters reach the corners of the structure over these struts.

There are instances where purlins are above and below rafters. The rafters are aligned parallel to the surface slope on each surface. The length of the rafters is adjusted according to the intersection with the angle rafter. There are end purlins at the point where the rafters meet with the wall. Roof surfaces are covered with roof boards and roof tiles in the same way as gable roofs.

Figure 3.46. The roof structure of House No.1 is seen from the opening at the top floors' timber ceiling

3.5.1 Eaves

The architectural elements of the roof structure are timber eaves in the traditional Tirilye houses. The eave types can be grouped under the covered eaves and uncovered eave groups. Covered eaves have two different types as covered regular eaves and arc profiled eaves. There are three different eave types seen in traditional Tirilye houses, as its examples are seen in Figure 3.47.

Figure 3.47. Eave types of traditional Tirilye houses

The decorative covered eaves are generally seen on the front façades. On the other hand, uncovered eaves are almost seen in every house, especially at the back facades of the houses.

Eave type 1, covered regular eaves, are usually seen on hipped roofs, rarely on gable roofs. The lower surfaces of this type of eaves are covered with timber soffit boards to form a horizontal plane. In this eave detail, there are auxiliary timber elements necessary for covering the underside of the eaves at the level of the roof girders (Figure 3.48).

The arc-profiled eaves (eave type 2, R2.e2) are a little more complex than the other types. It requires specially cut timber profiles, and it has to maintain a similar curvilinear surface through the façade. Each edge of the timber profile is nailed to

the rafter or a stud of the timber frame walls. After that, timber laths are nailed upon the curved surface to create a base for the lime plaster (Figure 3.49).

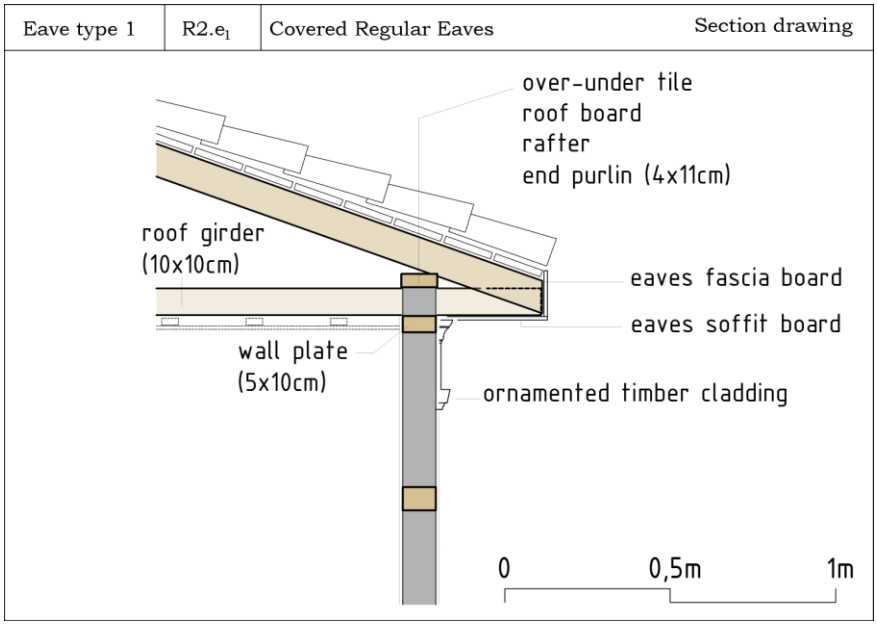

Figure 3.48. Detail of covered regular eaves of traditional Tirilye houses

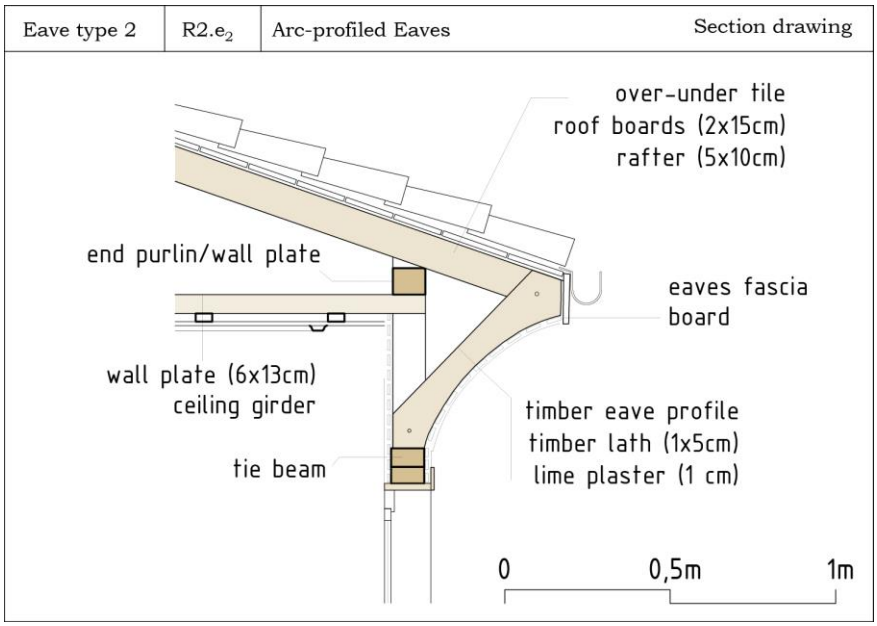

Figure 3.49. Detail of arc-profiled eaves of traditional Tirilye houses

Eave type 3, uncovered eaves, can be seen on any roof type. In this type, the rafters are clearly visible on the façades. It is the simplest eave detail and mostly seen on the facades where there is no aesthetic concern, in other words, on the back facades of the houses. In some houses only this type of eaves is used (Figure 3.50).

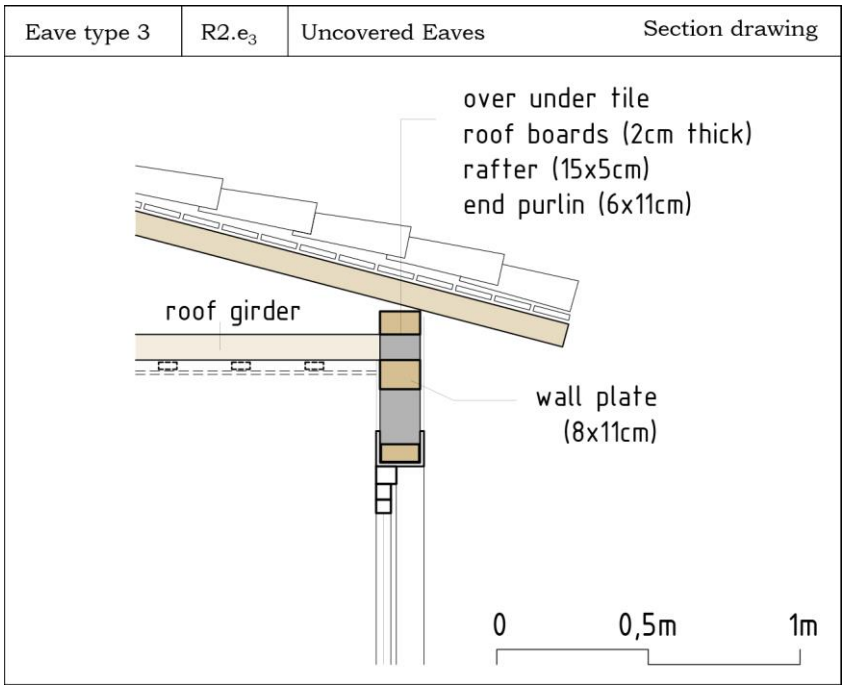

Figure 3.50. Detail uncovered eaves of traditional Tirilye houses

CHAPTER 4

EVALUATION OF THE CONSTRUCTION PROCESS OF TRADITIONAL TIRILYE HOUSES

Tirilye houses have distinctive characteristics in terms of their material selection, used construction techniques, spatial organizations, and massing and style. Tirilye houses, which have the characteristics of a traditional 19th-century house, represent special local unique solutions in their construction technique dominated by the timber frame structure.

Based on the survey results presented in the last two chapters, this chapter aims to describe the documented construction phases of Tirilye house in detail with reference to the used construction techniques and locally available materials. The construction process is examined and narrated step by step as if a traditional house is being built in Tirilye today by using the information presented in the former sections. In this way, the evaluation of all information developed in the previous section is used and discussed with the unique and typical features of construction techniques in traditional Tirilye houses.

For this purpose, this chapter is defined under two major titles:

4.1 General evaluation of the life and architecture in Tirilye in the 19th century

4.2 Construction process of a traditional Tirilye house

4.1 General evaluation of the life and architecture in Tirilye in the 19th century:

The traditional Tirilye houses are multi-story structures built on sloping land, in adjacent order with the hımış construction technique of the late 19th c. They have the characteristics of a 19th-century house with their used construction technique, material dimensions, opening sizes, story heights, and less built-in furniture.

Traditional houses, which constitute 26% of the building stock in Tirilye today, were shaped according to the living conditions of the 19th century. Dating similar types of buildings to a similar period in a historic settlement like Tirilye can be either associated with mass construction for rapid population growth or post-disaster restoration. For this reason, it is necessary to discuss how the living conditions in the 19th century affected "the house" and the construction technique of "the house" in Tirilye.

Firstly, the relationship between the increase in the number of houses, economic welfare, and population in the 19th-century can be questioned. As it is known, after the 1856 Reform Edict, the rights granted to minorities, and the 1st Constitutional Monarchy proclaimed in 1876, social liberation and economic welfare increased.

After the earthquakes, we also know that Tirilye's population, which was counted as 1700 people and 800 households in 1870, reached a population of 4131 with 820 households and 95 shops in 1900. Construction of Hagios Vasileios and Hagios Ioannes Rum Churches, the olive oil factory, and the monumental school building Taş Mektep in the 19th- 20th century provide information about the increase in the welfare level of the period. Although there was a big earthquake, considering the period's economic developments, it can be argued that Tirilye houses belonging to

the 19th century may have been built in such a period to meet the household needs due to population growth.

Secondly, the traditional houses of Tirilye must have been affected by the Bursa earthquakes with magnitudes of 7.1[31] and 6.3 in 1855[32]. Historical records on how many Tirilye houses were affected by earthquakes could not be reached. However, considering the damage to traditional structures caused by the 17 August 1999 Gölcük and 12 November 1999 Düzce earthquakes (with magnitudes 7.6[33] and 7.1[34], respectively), we can assume that the houses in Tirilye were severely damaged.

Şahin Güçhan (2007) discusses the earthquake resistance of traditional *hımış* houses through damaged traditional structures affected by the 1896 Istanbul, 1970 Gediz and 1999 Marmara earthquakes. She presents the damaged houses in the 1970 Gediz earthquake with photographs whose masonry sections like masonry exterior walls, service walls, and chimneys were severely damaged in the earthquake, while the lighter and more elastic timber frame sections had lesser damage due to their higher resistance to lateral forces with the use of timber lintels, bracings, and nails (Şahin Güçhan, 2007). For these reasons, it is strongly possible to agree that the houses must have been rebuilt or built after the earthquake.

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[31] N. N. Ambraseys, J. A. Jackson, Seismicity of the Sea of Marmara (Turkey) since 1500, Geophysical Journal International, Volume 141, Issue 3, June 2000, Pages F1–F6, https://doi.org/10.1046/j.1365-246x.2000.00137.x

[32] For more information and dates of the Bursa eartquakes in 1855, see Özaydın, 2017.

[33] 17 Ağustos 1999 Gölcük Depremi. [online] Available at: <https://deprem.afad.gov.tr/tarihteBuAy?id=37> [Accessed 25 October 2021].

[34] 12 Kasım 1999 Düzce Depremi. [online] Available at: <https://deprem.afad.gov.tr/tarihteBuAy?id=61> [Accessed 25 October 2021].

The living conditions in the 19th century and especially the earthquake history affected the architecture, spatial organization, and preferred construction technique of Tirilye houses. The use of timber frames, including the ground floors, and the use of masonry walls to protect the building from rising dampness should obviously be a precaution against different natural factors affecting these buildings. At the same time, it allowed the structures to be built quickly with its fast and easy construction of timber frame system.

Figure 4.1. Traditional house in Iğdiş village after 1970 Gediz earthquake, destruction of ground floor masonry wall of a traditional house while the timber-frame upper floor still preserves its integrity (Şahin Güçhan, 2007, p.843, fig no:1)

Figure 4.2. Traditional house in Örencik, after 1970 Gediz earthquake, destruction of a two-story-high stone masonry wall of a house while the rest of the timber frame section of the structure still stands (Şahin Güçhan, 2007, p.844, fig no:3)

Although the architecture of traditional Tirilye houses is built with the same/similar building materials, they have different features from the traditional Ottoman house. The functionality and spatial organization of the Tirilye house are different from the Ottoman house tradition, both on the ground and upper floors.

On the ground floors, although the multifunctional taşlık spaces are encountered, they are closed spaces and have no relation with open space as there are no gardens/courtyards. In some houses, the ground floor spaces are divided into specific spaces like entrance hall, kitchen, cellar, or shop spaces. As the industrial production increased in Tirilye during the second half of the 19th century, Tirilye had 19 olive-oil workshops (*yağhane*) in 1900,[35] including Tirilye olive oil factory (Acar Bilgin,

[35] *Hüdavendigar Vilayeti Salnamesi*, 1900

2015). It can be assumed that the taşlık space, where the production activities were held in the house, was moved to other buildings such as depots, warehouses, or workshops.

On the uppermost floors, Tirilye houses do not have a special living and circulation space similar to "sofa" space, which is typical in traditional Ottoman houses (See Chapter 2.2.2). Upper floors generally consist of a simple, usually small circulation space and non-household rooms. This space provides access to the rooms on the upper floor; however, it does not have the feature of being a common living area. Instead, the plan scheme's focus is on the rooms which are larger, directed to the streets, and have more windows than the circulation spaces in Tirilye houses. Even though Akgün (1995) defines the circulation spaces of all floors, including the ground floor, with the term "sofa" that we see in Ottoman / Turkish houses, the use of the concept of sofa is incompatible with its traditional meaning, function, and space hierarchy, and is controversial.

The fact that Tirilye is built on a valley is also an important determinant in shaping the houses. Tirilye houses, which developed on an introverted land due to the valley hills and the sea, were shaped in a dense texture with the increasing population. The ground is rocky and sloping, and the settlement does not have an area to expand, necessitating resorting to local solutions to construct the Tirilye houses. In Tirilye, where large public open and/or green spaces are not encountered even in the historical urban fabric of the settlement, the houses are 3-story high structures with a small floor area, compatible with the slope, adjoining, without a garden.

The divisions of the rooms in Tirilye houses are clear from the very beginning. It can be said that the foundations, some of the ground floor walls, the separation of the rooms were made with predetermined axes. The walls on these axes are available on each floor. This is quite different from the Ottoman house tradition. Arel (1982) emphasizes that both the construction materials and techniques and the plan schemes

are incompatible between the upper and lower floors in traditional Ottoman houses, regarding the use of masonry in the ground floor and timber frame in the upper floors. However, in Tirilye houses, the use of masonry on the ground floors is not a common feature. On the contrary, the timber frame system is used almost on all floors of the houses. The reason behind this can be a technical precaution against earthquakes, but still, this preference created a difference in construction techniques of traditional Tirilye houses, which is quite peculiar to this settlement.

4.2 The construction process of a traditional Tirilye house

In this section, the construction process of a hypothetically Tirilye house is explained in detail. The construction process starts with gathering the construction materials and continues with the preparation of the site, construction of foundations and masonry walls, timber frame section, timber roof, and finishing works. This section aims to give information about the general construction framework by mentioning both common and rarely used details seen in Tirilye houses.

Unfortunately, during the thesis process, it was not possible to reach local masters who knew the local construction techniques. Since the former owner of the houses who built the traditional Tirilye houses migrated with the population exchange, any information about the construction process and building masters could not be reached. Bektaş (2008), in his book Şirince-Tirilye in which he compiled his notes about his visit to Tirilye in 1982, mentions the masons and carpenters who migrated from Albania, Strumica, and Serez.

4.2.1 Gathering the construction material

As mentioned in Chapter 2, the Tirilye settlement is settled on a rocky valley near the Marmara sea, and it is covered by vast forests which are protected by 1st, 2nd, and 3rd-degree natural site decisions. The characteristics of the land are very much influential in massing the Tirilye house.

Traditional Tirilye houses consist of rubble stone masonry, timber frame structure, and timber roof. Stone, brick, mud or lime mortars, mud brick, brick, rubble stone infills, timber elements in various sections, and mud and lime plasters, traditional nails, over under or marseilles tiles are the main construction elements.

Due to the inclined topography, plots in Tirilye need to be arranged for construction. Since the ground is rocky, the rocks may need to be chipped, especially in houses on very sloping parcels. Rubble stone masonry is seen in the traditional Tirilye houses**,** consisting of local rocks such as mudstone, sandstone, shale, and siltstone with mud or lime mortar used as the binding material. The location of the quarry could not be found; however, the chipped stones may have been used during the construction of the masonry parts.

The thickness of the bricks used in masonry walls or as infill material is seen as 5x10x21 or 5x10x26 cm. It is not known where the plaster and mortar materials were obtained. The sand may have been obtained from the seasonal stream passing through the middle of the valley.

Similarly, the type of used timber could not be defined due to the author's lack of expertise. However, the timber elements may have been obtained from the forest surrounding Tirilye, mostly composed of olive trees and pines.

4.2.2 Preparation of the site and building the masonry section:

The first stage of the construction process is leveling the site and excavating the pits for the foundations. The foundation's depth depends on the surface soil's thickness to reach the firm ground; excavation continues until a solid base is reached. Since the Tirilye settlement has a rocky terrain, the foundations do not have to go very deep to settle on the solid ground. If necessary, the surface of the rock mass is chipped enough to create a suitable surface.

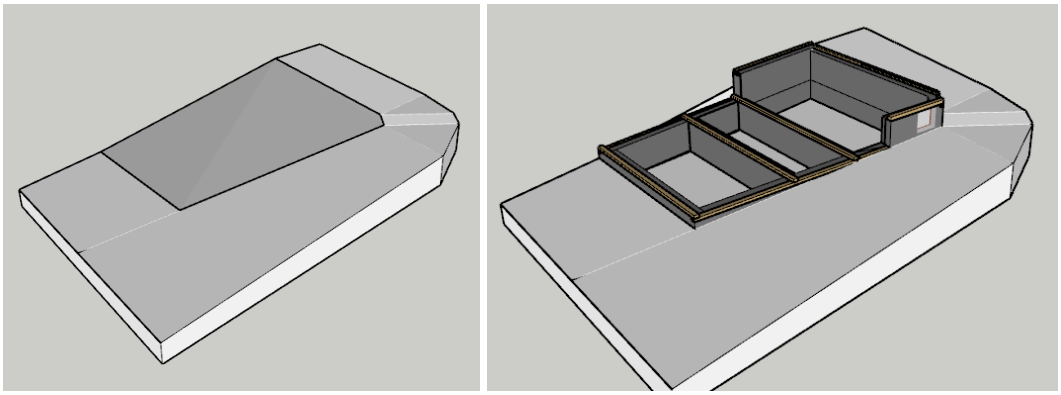

Figure 4.3. Continuous foundations and masonry walls of the structure, constructed on building lot with a medium slope (House no:1)

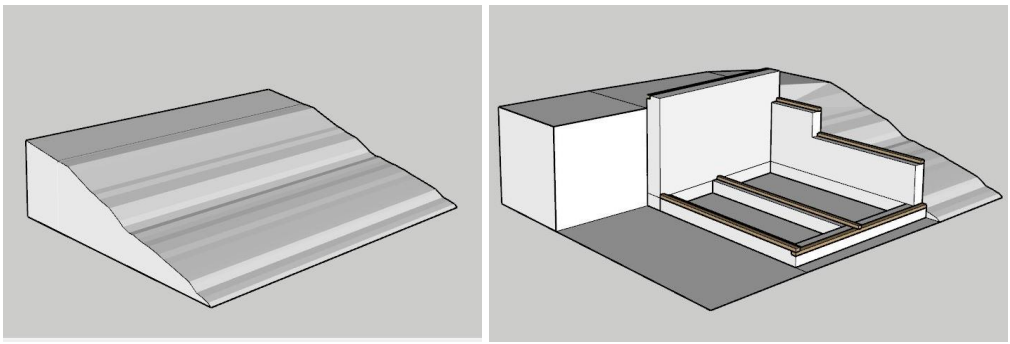

Figure 4.4. Section of the land before the construction in a building lot with a high slope, and construction of masonry walls of house no:4, the structure built according to the level of the ground around the building lot

After that, foundation walls are constructed in continuous foundation order, alined through lot boundaries, and defined building axis. Local stones of the region, such as claystone, sandstone, slate, and siltstone, are used with the mud mortar as binding material. These foundation walls are built up to the plinth level, approximately 40 cm above the ground level of the street (See Fig 4.3-4). The walls forming the foundation continue as stone masonry walls after this level.

The building material of masonry walls is similar to the foundations, consisting of local rocks such as mudstone, sandstone, shale, and siltstone with mud or lime mortar used as the binding material. At the corners, relatively larger and roughly cut stones are placed, giving a neat edge to the wall. The wall coursing comprises of large and horizontally placed stones, thin brick, and shale pieces filling in between them.

The masonry walls can be built in 3 different ways: without lintel, with timber lintel, or brick lintel; however, among the studied houses, masonry walls without lintel or walls with brick lintel walls are more common. The wall thickness varies between 40-60 cm. Features such as the use of lintels at certain intervals and wall thickness are directly related to the height of the walls.

Although there are examples of masonry ground floor walls, masonry walls built up to a certain level of ground floors, depending on the slope of the lot, are more common. The height of masonry walls differs at each elevation due to the sloped terrain. For this reason, the construction strategy differs in cases where the slope of the lot is low, medium, and high.

First, **if the building lot is slightly slopy or flat**, the masonry walls are built at the same level on all sides, rising from the street to the minimum height above the plinth level. **If the building lot is on a medium slope**, where the level difference is between 1-1.5 meters, The height of the walls is adjusted through the slope by ascending or descending its level where necessary. If the level difference reaches or exceeds 1.5

m, this level difference can be utilized as a basement space in houses on a medium slope. On the other hand, **in parcels with high slope**, the rear masonry walls rise to the upper ground level and become retaining walls. In all cases, rubble stone foundation walls and masonry walls are built up to reach the plinth level of the associated ground level. The other exterior walls of a building that interact with different ground levels do not have to match each other's level (See Fig 4.3-4).

The use of masonry walls in Tirilye houses just enough to protect the building from surface water is a conscious choice. This choice is related to the earthquake resistance of masonry and timber building elements. Instead of high masonry walls, the timber frame structure, which is more resistant to earthquakes, may have been preferred more because of its quick and easy construction and is easily available from the forests around Tirilye.

4.2.3 Construction of timber frame structure:

The timber frame structure is found on every floor in 19th-century traditional Tirilye houses. Especially on the ground floors, timber frame wall use is very common in Tirilye. Among the houses surveyed, timber frame walls are used at 80% on the ground floors and the front facades. In 4 of the 15 houses, all the ground floor walls were timber-framed, while in 8 of them, except for the rear, timber frame walls were used on the front and side facades.

On the ground floor level, after completing the masonry walls, the 10x15 timber wall plates were placed on masonry walls, aligned to their outer surfaces. These wall plates are the lower horizontal part of the timber frame walls. The wall plates are nailed to each other at the corner where they intersect, and a timber corner post is placed on them (See Fig. 3.37). In the case of masonry walls being at different levels, these wall plates do not overlap. Instead, two timber wall plates at different levels

are fixed to the corner post (See Fig. 3.38). These masonry-timber frame wall connections can be seen on the G0, G1, GM0, and GF0. Both butt joints and lap joints are preferred in these transitions.

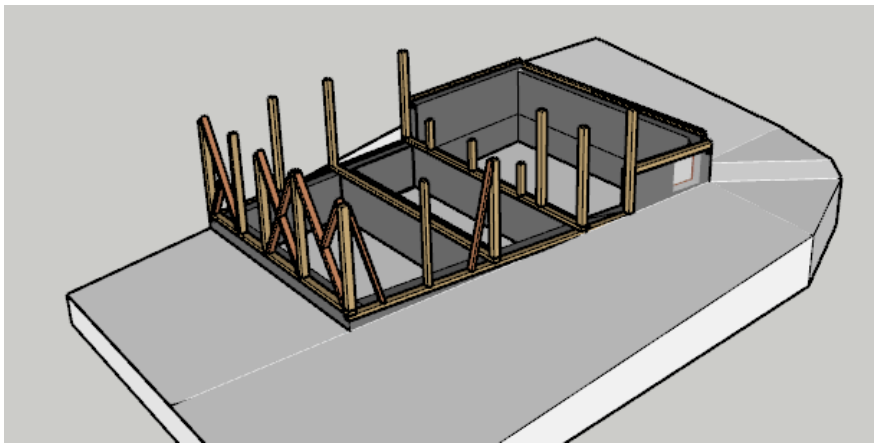

Figure 4.5. Installation of timber posts and bracings of ground floor level, in house no: 1

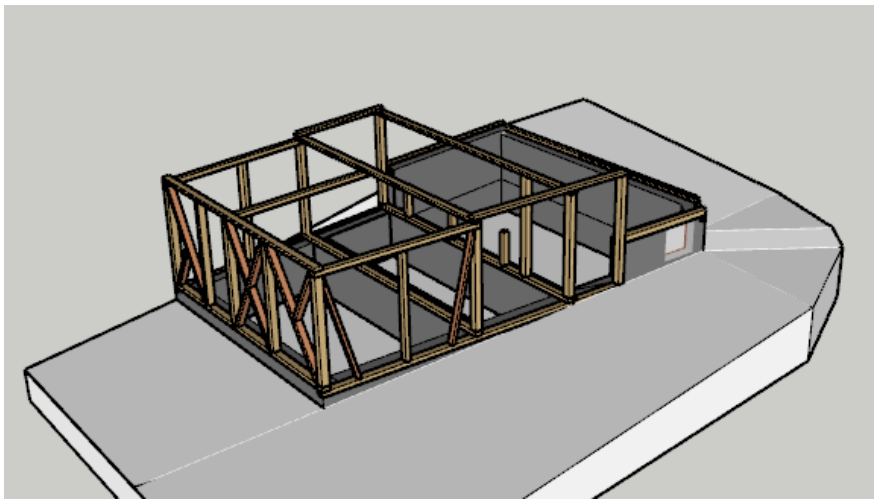

Figure 4.6. Wallplates are installed upon the posts to close the wall frame and create a basis for flooring the upper story.

As the corner posts are placed on the wall plates, the intermediate posts are also mounted. Next, timber bracings are nailed diagonally between the posts to strengthen the structure against lateral loads and increase its earthquake resistance. On top of timber posts, bolsters join the upper end of the posts with a lap joint to enlarge the area where vertical loads are transferred. In this connection detail, both timber post and bolster are nailed from the cut-out parts. Then, wall plates are installed upon the posts in order to complete the timber wall frame and create a basis for constructing the upper story. If the rear wall of the house is one story high masonry wall, these wall plates extend to meet the top surface of the masonry wall.

In Tirilye houses same wall plates are shared by adjacent upper-lower floors; in other words, the ground floor's wall plate is also the footplate of the mezzanine floor's wall. The logic behind this detail may be to make the construction more affordable by reducing the thick-section load-bearing timber elements due to post-disaster conditions in 19th c. These wall plates are also the main girders of the house structure. Likewise, projections are made by the extrusions of these wall plates towards the projection axis. Therefore, the decision of whether there will be a projection at the upper floor is made at this stage.

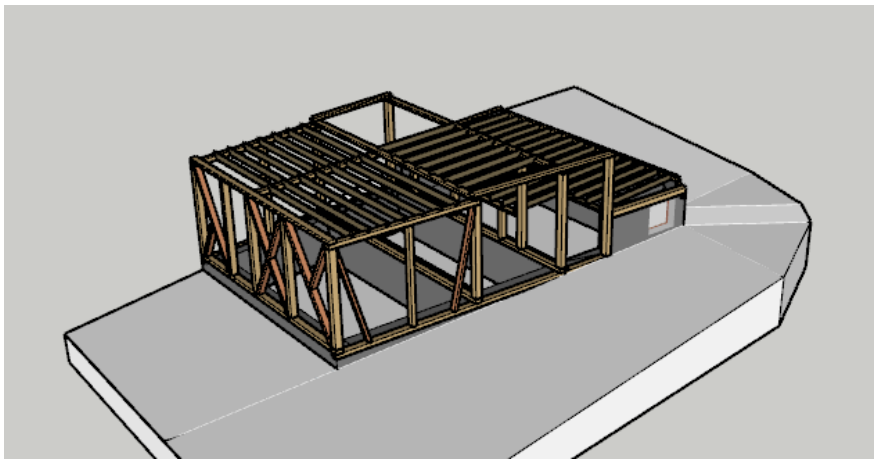

Figure 4.7. Floor girders are placed upon the wall plates

After completing the frame of ground floor timber frame walls, mezzanine floors' floor girders are placed upon the wall plates. The cross-section of the floor girders is 5 by 15 cm with a notch (5x10cm) at both ends, allowing lap joint connection to wall plates. The girders are placed parallel to the shorter side of the rooms at 35-40 cm intervals, and the maximum length used in the studied houses is 515 cm. If there is a masonry wall on the ground floors, those floor girders are set on both the timber frame wall and masonry wall. In some cases, in order to add strength to the floor, auxiliary timber pieces of the same cross-section are placed perpendicularly between the floor girder (House No: 4, Dikkaldırım St, Lot no: 2188/9).

Mezzanine Floor:

8 out of 10 of the first group houses have mezzanine floors among the studied examples. The height of the mezzanine floor among 5 of the studied houses varies between 260-275, while the other 3 houses have a height of 200-230 cm. 5 of these houses have projections on the facades facing the street.

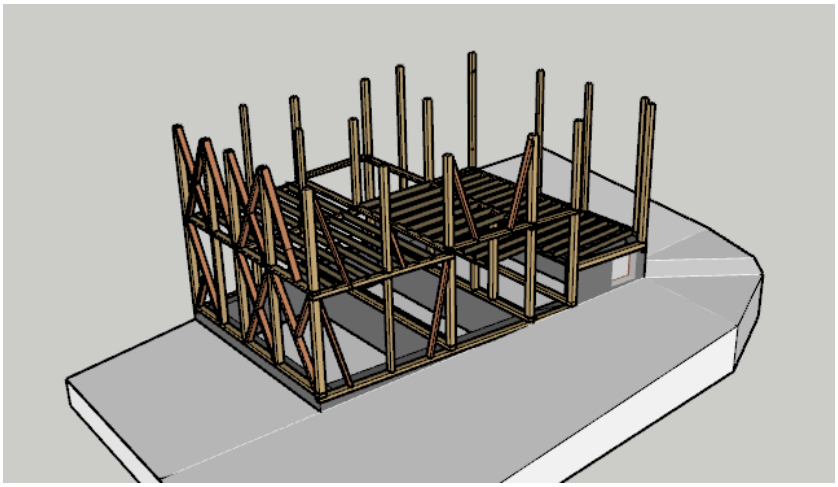

Figure 4.8. Installation of timber posts and bracings of the mezzanine floor's timber frame walls

After setting the floor girders of the mezzanine floor, timber frame walls are built with the same logic as described in ground floor timber frame walls. The biggest difference here is the transition details used. There are two different timber frame to timber frame transition: regular transition (without projection) and transition with projection. Moreover, in a house with a masonry wall on the ground floor, masonry-timber frame transition detail is seen in GM0 or M0 levels (House No:2, 3; Lot no: 2188/7 – 2188/6).

The first detail of transition, without projection, is identical and repetitive in each studied Tirilye house. It consists of timber corner posts and intermediate posts placed on the wall plate, bracings placed by considering the window spaces and bolsters. In the same way as the ground floor timber frame walls, wall plates complete the top of the frame. This connection is quite common in the Tirilye houses. The wall plates and the posts are connected with butt joints. However, the bolster–timber post connection is always a lap joint.

If the mezzanine floor has projections, this transition requires additional elements. Firstly, another wall plate is placed perpendicularly to the extended wall plates; only then the timber corner posts are placed on top of the edges of the projection. Then, intermediate posts and diagonal bracings are placed accordingly. These projections are supported by bracings inferiorly. However, there are also examples of cantilever projections.

Formally in Tirilye houses, regular, triangular, and corner projections can be seen, while there are 3 different types in terms of construction technique. These types basically vary depending on whether the floor girders and the projection direction are parallel or perpendicular. Since both types can be seen at the same time in the corner projections, a separate system section emerges.

After completion of the frame of the walls, the upper wall plates for projections extend outwards for the first-floor plan.

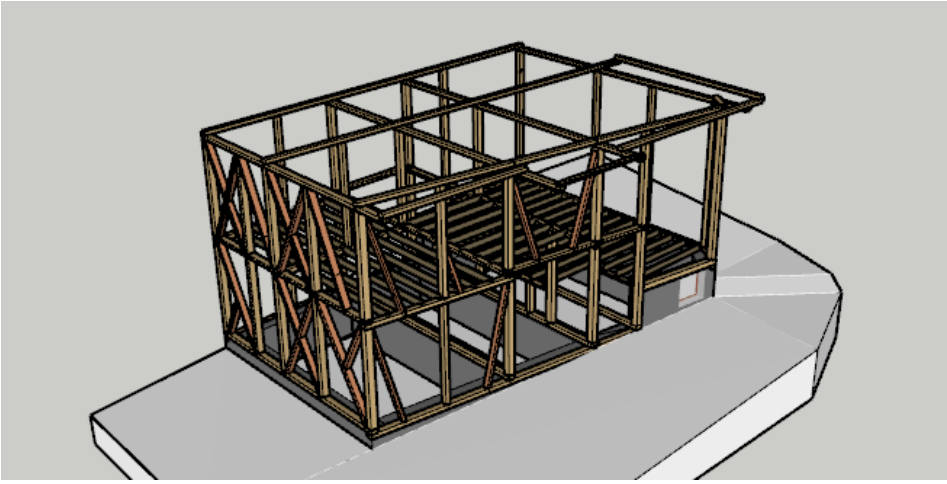

Figure 4.9. Wallplates are installed upon the posts; in order to create the projections of the first floor of the house, the wall plates extend through the projection axis.

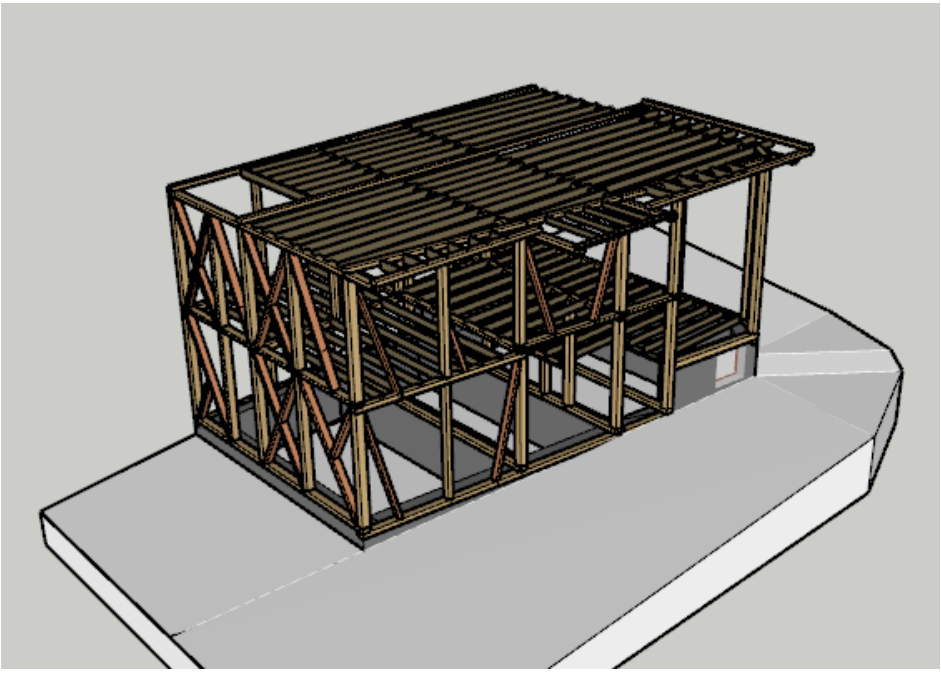

Figure 4.10. Floor girders of the first floor are placed upon the wall plates

Upper floors :

After this point, the basic details of the timber frame structure repeat on the top floor. After the floor girder of the first floor is completed, timber frame walls are created with timber posts, braces, and wall plates. The upper wall plates complete the upper end of the timber frame walls. If there is a second top floor, the same system repeats itself. Among the studied examples, 2 out of 10 of the first group houses have a second floor. The height of the top floors varies between 280-320 cm.

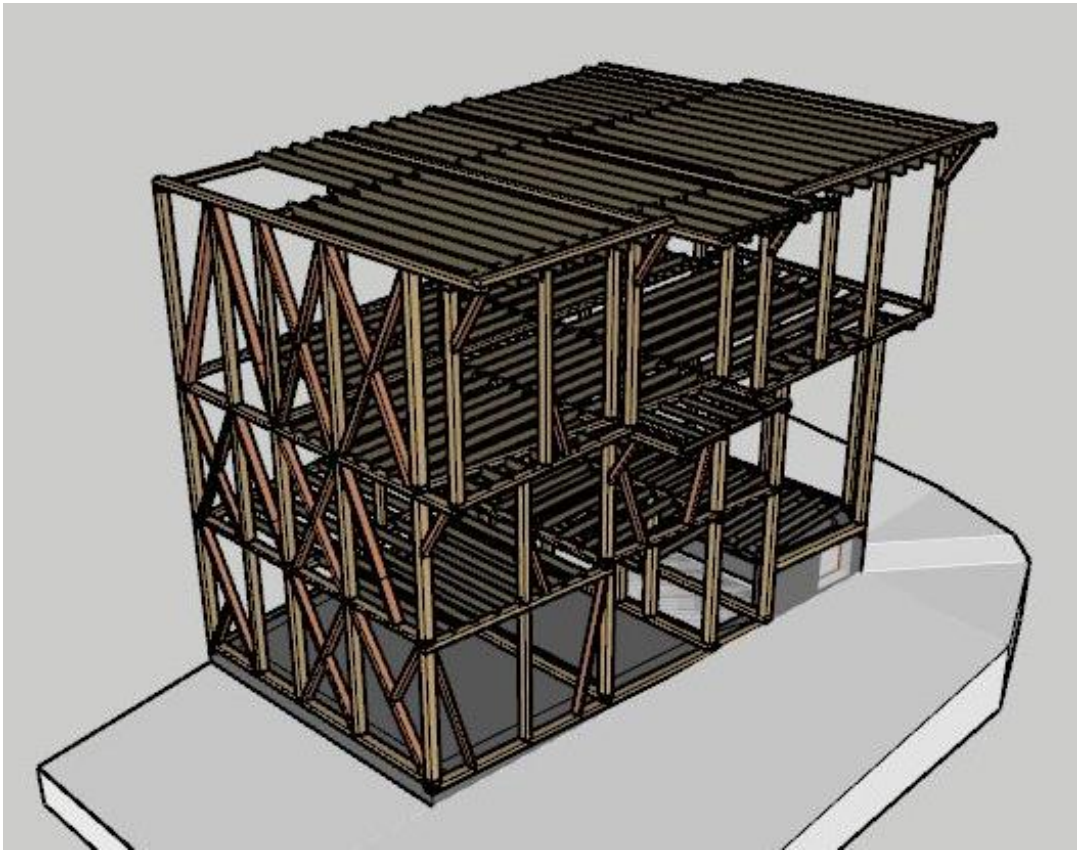

Figure 4.11. After setting timber posts and bracings, wall plates complete the first-floor timber frame walls. The floor girders make up the second floor's plane.

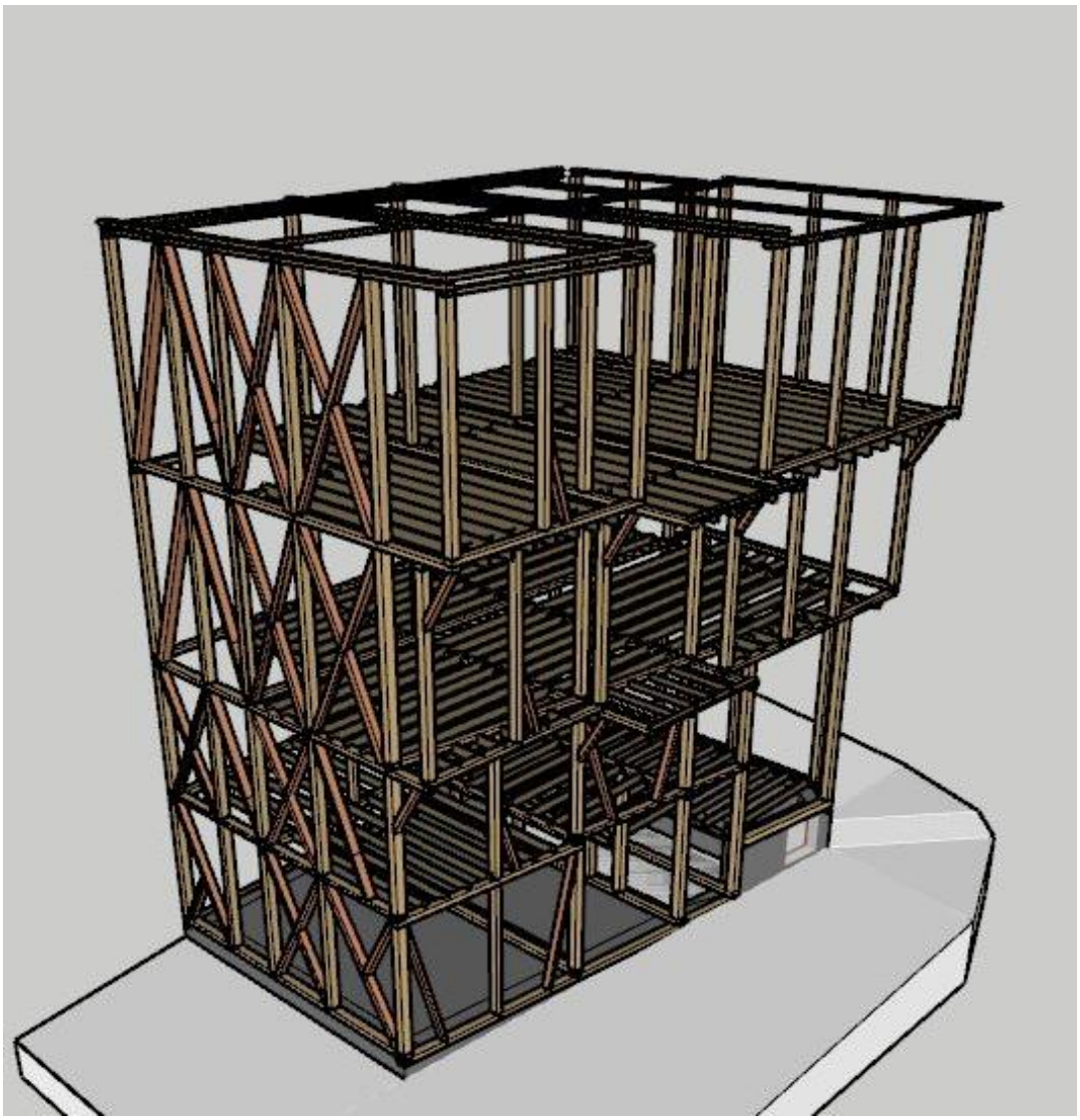

Figure 4.12. The basic details of the timber frame structure repeat on the top floor.

4.2.4 Construction of the timber roof

After completing the timber-framed floors, constructing the roof structure and its covering immediately is essential in order to protect the structure from external factors (Şahin Güçhan, 2007). In Tirilye houses, four different roof types are

observed based on their number of surfaces: gable roof, hipped roof, three-sided roof, and single-sided roof. The roof's geometry is shaped by the location of the house parcel within the building block since the houses are built in adjacent order. Among the studied 15 houses, 6 houses have gable roofs, 6 have hipped roofs, 2 have 3-sided roofs, and 1 one-sided roof. Both the gable and hipped roofs are commonly used. Three-sided roofs are basically a combination of both gable and hipped roof types. Single-sided roofs are rare and not preferred within the traditional fabric of Tirilye.

After deciding the required roof geometry, the first stage is constructing the timber roof's main load-bearing elements. Firstly, a load-bearing horizontal base is set for transmitting and distributing the load to lower sections of the structure. For this purpose, wall plates of the top floor or roof girders serve as this load-bearing base.

The use of these elements differs according to the roof geometry. In 40% of the studied houses, wall plates serve as roof girder and end purlin. Among the examples of gable roofs, it is seen in 4 of 6 houses. However, roof girder use is also common in Tirilye houses, especially in hipped roofs. Six of the surveyed houses have hipped roofs, and four of these houses have roof girders placed upon the wall plates of the top floor.

Next, king and corner roof posts are placed on the roof girders/wall plates, and their height determines the roof's slope. Ridge purlin is set on the king and corner posts. Lap joint or butt joint use is seen at the connection detail between ridge purlin and king posts.

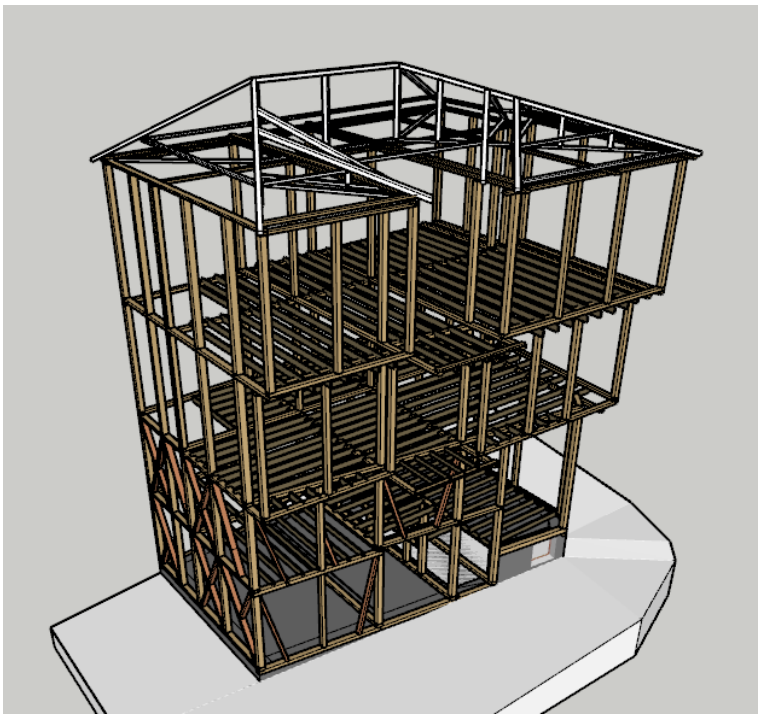

Figure 4.13. Constructing timber hipped roof

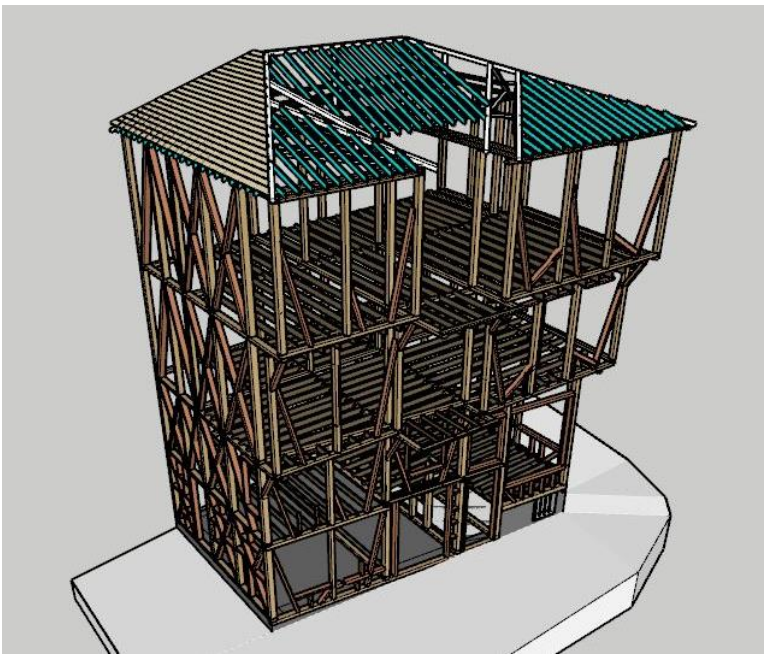

Figure 4.14. Constructing rafters and roof boards

Angle rafters meet with ridge purlin and reach the corners of the structure over these posts. Three different R0 detail types are seen in Tirilye houses. Among them type 1 is the most common detail, seen in 6 houses, consisting of upper wall plates of top floor acting as end purlin and roof girder. Purlins and the roof posts support the angle rafters from below in 87% of the houses. However, the purlins are placed on the rafters in the roof details seen in 2 of the 15 houses. In both cases, the roof is covered with roof boards and over-under tiles or marseille tiles.

4.2.5 Finishing and rendering process

After completion of the roof structure, wall infills, floor coverings, timber ceilings, installation of architectural elements, plastering, rendering, and ornamental works are applied.

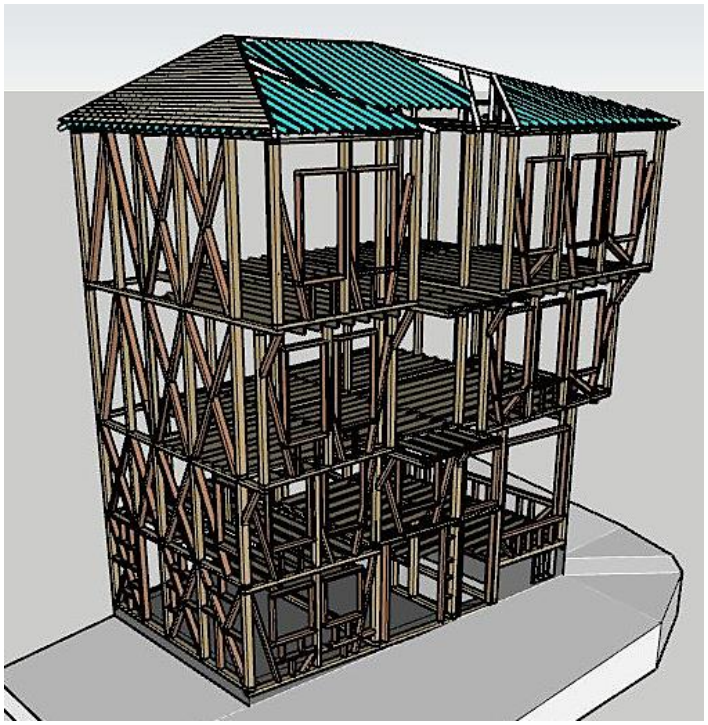

Figure 4.15. Constructing the window and door sashes within the timber frame

CHAPTER 5

CONCLUSION

Studies on construction techniques of local traditional buildings are important in terms of giving significant information about the architecture, structure, material selection, spatial organization, relationship with the place, and creative architectural solutions to solve problems in different geographies. This study aims to create reliable information about the construction techniques and material usage of the traditional Tirilye houses, to be used in later conservation interventions and transfer the knowledge to future studies.

Despite the declaration of Tirilye as an urban conservation site by BKTVKK in 1981, the traditional houses are still under threat due to negligence and unconscious treatment. Moreover, the **acceleration of restoration works with tourism pressure** is another threat in preserving the authenticity of Tirilye's cultural heritage.

In this study, the construction techniques of traditional Tirilye houses within the borders of the urban conservation site were investigated, and their repetitive features were examined in detail. The number of traditional houses is 245, which constitutes 72% of all traditional fabric in the settlement. A total of 15 traditional houses were examined in detail among 69 still authentic and legible timber frame structures built on a stone masonry base. The selected examples include two groups of houses in terms of structural condition. The first group of houses (10) forms the main study group representing all original architectural features and construction techniques.

The second group (5) of selected houses consists of decayed or highly-deteriorated houses where cross-sections of the walls & floors and details can easily be seen due to structural conditions. This study is expected to be used as a guide in future conservation implementations related to the Tirilye houses.

Considering the construction technique details and cross-sections of the used material, the Tirilye houses were found to be similar to the 19th-century examples of the timber frame structure *Hımış* construction technique found in the Ottoman housing tradition. However, Tirilye houses do not reflect the relationship between high masonry ground floor walls and timber frame upper floors that we see in traditional Ottoman houses and some local examples in Tirilye. In Tirilye, there are also houses with masonry ground floors; however, we assume those houses belong to an earlier period.

The traditional houses of Tirilye must have been affected by the Bursa earthquakes with magnitudes of 7.1 and 6.3 in 1855. It is thought that the traditional Tirilye houses must have been rebuilt or repaired after 1855 to be more earthquake resistant, considering the number and repetitive construction details seen in the documented houses.

As examples of the late 19th-century hımış structures, Tirilye houses are built on a solid rock base, with minimum use of masonry and timber frame structure on every floor, including the ground floors. On the other hand, interesting details such as the widespread use of lap joint uses, the sharing of wall plates in the transitions between floors, and some load-bearing timber elements serving more than one purpose were encountered.

As a conscious choice, masonry walls in Tirilye houses are built to a height that is just enough to protect the timber frame structure from the rising dampness of the ground. This choice is related to the earthquake resistance of masonry and timber building elements. For the rest of the structure, the timber frame system is preferred

for its higher resistance against lateral forces and its easy and quick construction. The structure is completed with a timber roof. The whole process related to the construction technique was assessed in the 4th section.

Tirilye houses are 3-story high buildings, built on slopy terrain with small square meters in attached order, having multiple openings on the street-facing façades. The houses are directly in relation to the street and may have multiple entrances and ground floor levels.

Structurally, the windows are too large and too often placed, thus limiting the use of bracings, therefore weakening the structure. Although the timber frame weakens in the upper floors, the adjacent structures support each other, even though there is no wall sharing.

As a result of the study, it has been understood that the Tirilye houses have many features indicating that they are 19th century period structures. The traditional Tirilye house has an architectural tradition with more local characteristics compared to the Ottoman house typologies. Although the Tirilye house was built with the same materials as the Ottoman houses, it also has different spatial and functional features.

Tirilye houses have unique spatial characteristics and functionality on both ground and upper floors. On the ground floors, there are no open spaces, and the taşlık space may not be present in some houses. Kitchen, shop, or storage spaces can replace the taşlık space. Entrance hall spaces are very common in the spatial organization of the ground floors, and WC spaces are found below the staircases.

The uppermost floors, on the other hand, consist of rooms and “circulation spaces.” The uppermost floor plan scheme focuses on the rooms. Rooms are placed facing the street and receive direct light. Due to the preference for movable furniture, built-in elements such as sedir are not seen very often.

Although there are studies relating Tirilye houses' planimetric features with Ottoman houses, these arguments are questionable. Because the sofa in the Ottoman house is a dominant space, defining plan scheme and used as living and circulation space where all the spaces are directed. On the other hand, in Tirilye houses, there is just a domestic circulation space connecting rooms, having a staircase connecting floors. Even though this space provides the relationship between the rooms on the uppermost floor, almost in all examples, it is a plain space that does not have the feature of being a common living area, as it does not receive sufficient or direct daylight and is small in square meters. Therefore, the use of the sofa term in Tirilye houses is incompatible with its traditional meaning and is controversial. In this case, this thesis presents a different approach to the existence of "sofa" in these houses and argues that Tirilye houses have circulation space in-between rooms instead of sofa space.

To conclude, this study examines the construction techniques and technology of the Tirilye houses, which are valuable examples of late 19th-century hımış structures. It is apparent that the local architectural style has developed in the traditional houses of Tirilye, and this study has documented this through the selected houses. 19th-century traditional Tirilye houses, which form the majority of the existing historic fabric, have different characteristics from the Ottoman house in terms of spatial scheme and usage.

Unfortunately, it was not possible to reach local masters who knew the local construction techniques during the thesis process. Since the former owner of the houses who built the traditional Tirilye houses migrated with the population exchange, any information about the construction process and building masters could not be reached.

Moreover, this study could not go beyond bringing a general view on where the building materials were obtained according to the surrounding assets. However,

building materials are directly related to building construction practice and the quality of the work. Besides the building materials such as timber elements, used stones, brick, mortar, plaster can give significant information about the properties of the authentic materials. For this purpose, the origins of the materials can be examined in a future study for creating reliable information to be used in future conservation activities in Tirilye. It can also be examined whether the infills and plasters used in the Tirilye houses have special properties.

Apart from this, the detailed structural examination and assessments of Tirilye houses can provide interesting information, especially since they are structures built after the earthquake. The effect of the masonry-timber frame structure usage ratio on the statics of the building may be worth investigating.

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APPENDIX A

Drawings Of Surveyed Houses

Drawing sheets of surveyed houses are given in the following pages between 201-225 (Figure A.1-13).

Figure A.1 Documentation of House no: 1

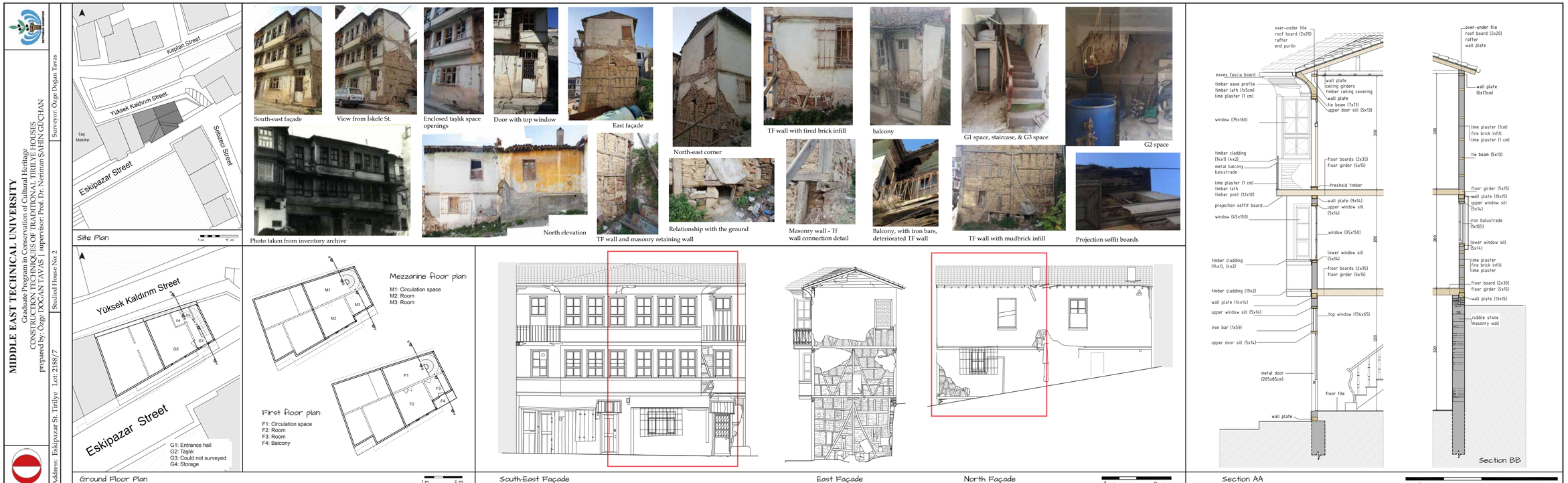


Figure A.2 Documentation of House no: 2

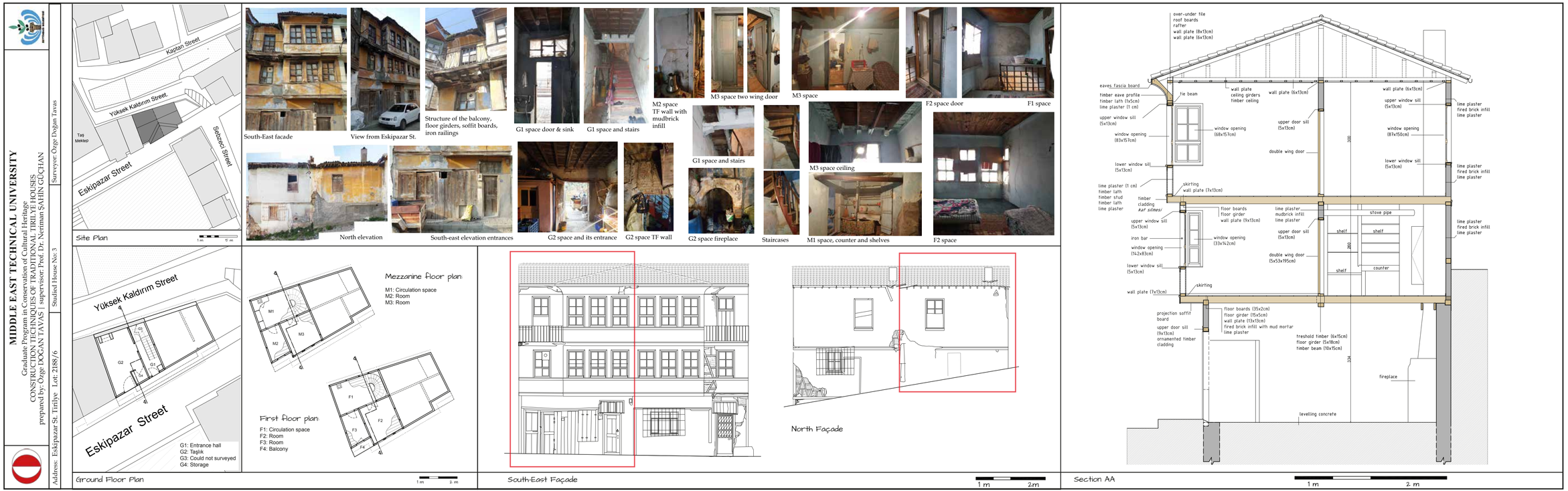
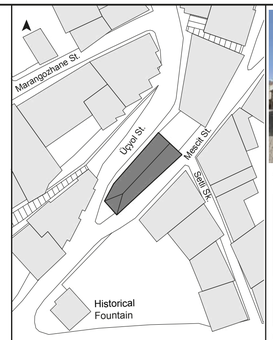


Figure A.3 Documentation of House no: 3

Figure A.4 Documentation of House no: 4

MIDDLE EAST TECHNICAL UNIVERSITY
Graduate Program in Conservation of Cultural Heritage
CONSTRUCTION TECHNIQUES OF TRADITIONAL TRILYE HOUSES
prepared by: Özge DOĞAN TAVAS | supervisor: Prof. Dr. Neriman ŞAHİN GÜÇHAN

Address: Üçyol St. No:2 Trilye Lot no: 2186/3 | Studied House No: 5 | Surveyor: Özge Doğan Tavas



Site Plan


SW facade


South-East Facade


Lower left corner of SW facade


Left side of the front elevation. TF section is left underground,due to rised ground level


Timber shop doors with top windows


Floor girders of the projection


Projection soffit boards


Deterioration


Another entrance & window openings


Enclosed openings, with rubble stone infill, and timber boards


TF wall with rubble stone infill bracings support edges of the openings


Arc-profiled eave detail


masonry wall, TF connection

40 cm thick masonry wall


Unique masonry-TF connection detail of two neighbouring structures


NW façade


stonemasonry wall traces


TF wall details seen behind the plaster layer


North-East facade, TF & mudbrick infill

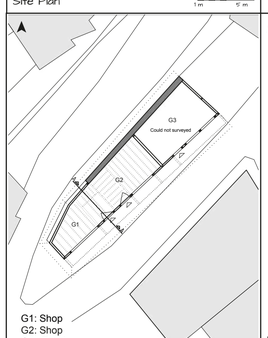
Window with timber shutters

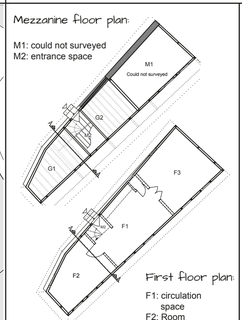

Partial mezzanine floor level, for the entrance from back façade

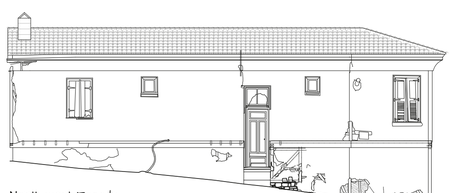

Gable roof and gable wall of the house

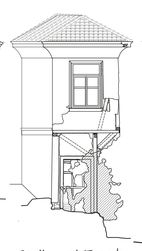
Elements of the roof structure is partially seen from the view


masonry wall of the g.floor level

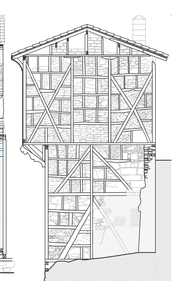





North-west Façade

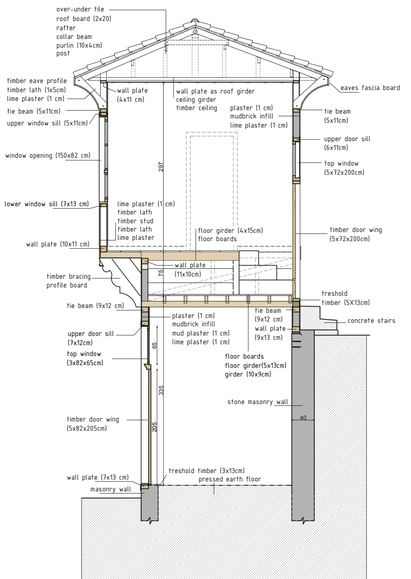

South-west Façade


South-East Façade


South-west Façade

1 m 2m

Schematic plans were prepared based on the drawings of Berrin Akgün's M.S. thesis study "Zeytinbağı (Trilye)'ndaki eski sivil mimarlık örneklerinin belgelenmesi" dated to 1995



Section AA

1 m 2 m

Figure A.5 Documentation of House no: 5

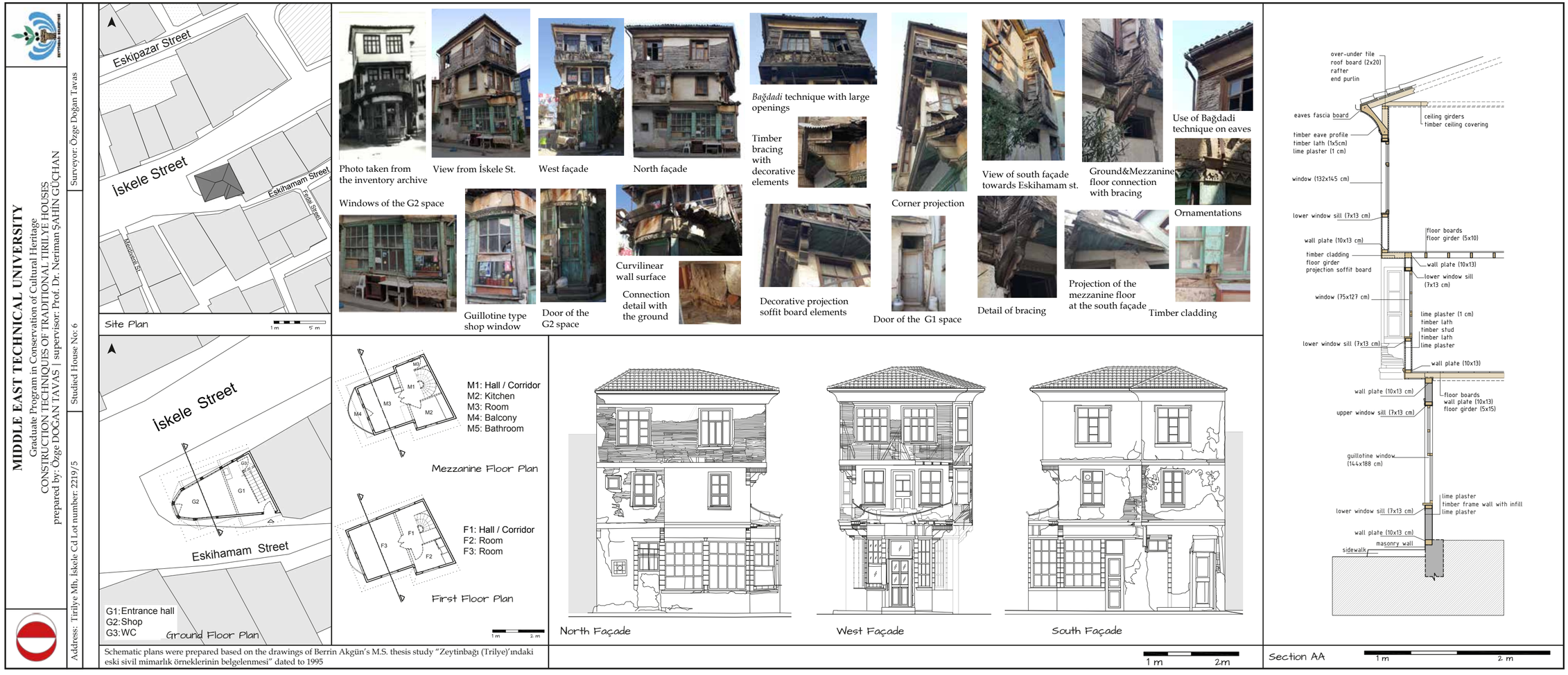


Figure A.6 Documentation of House no: 6

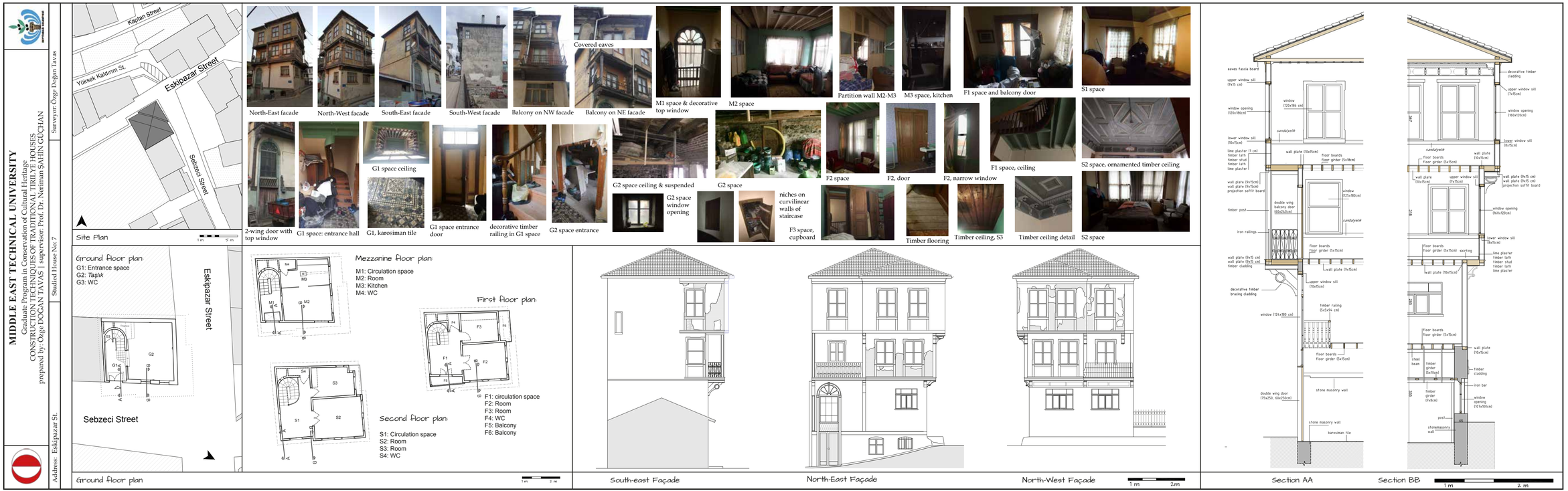


Figure A.7 Documentation of House no: 7

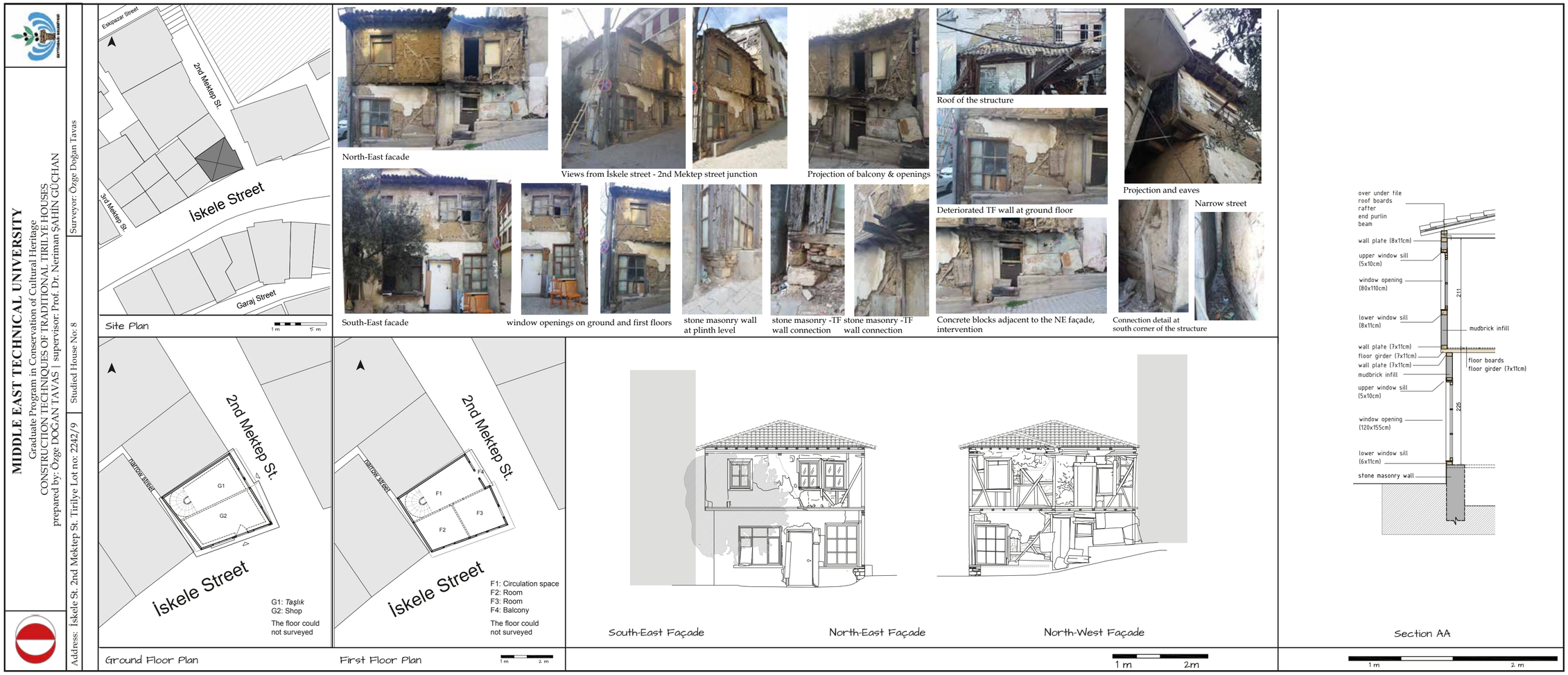


Figure A.8 Documentation of House no: 8

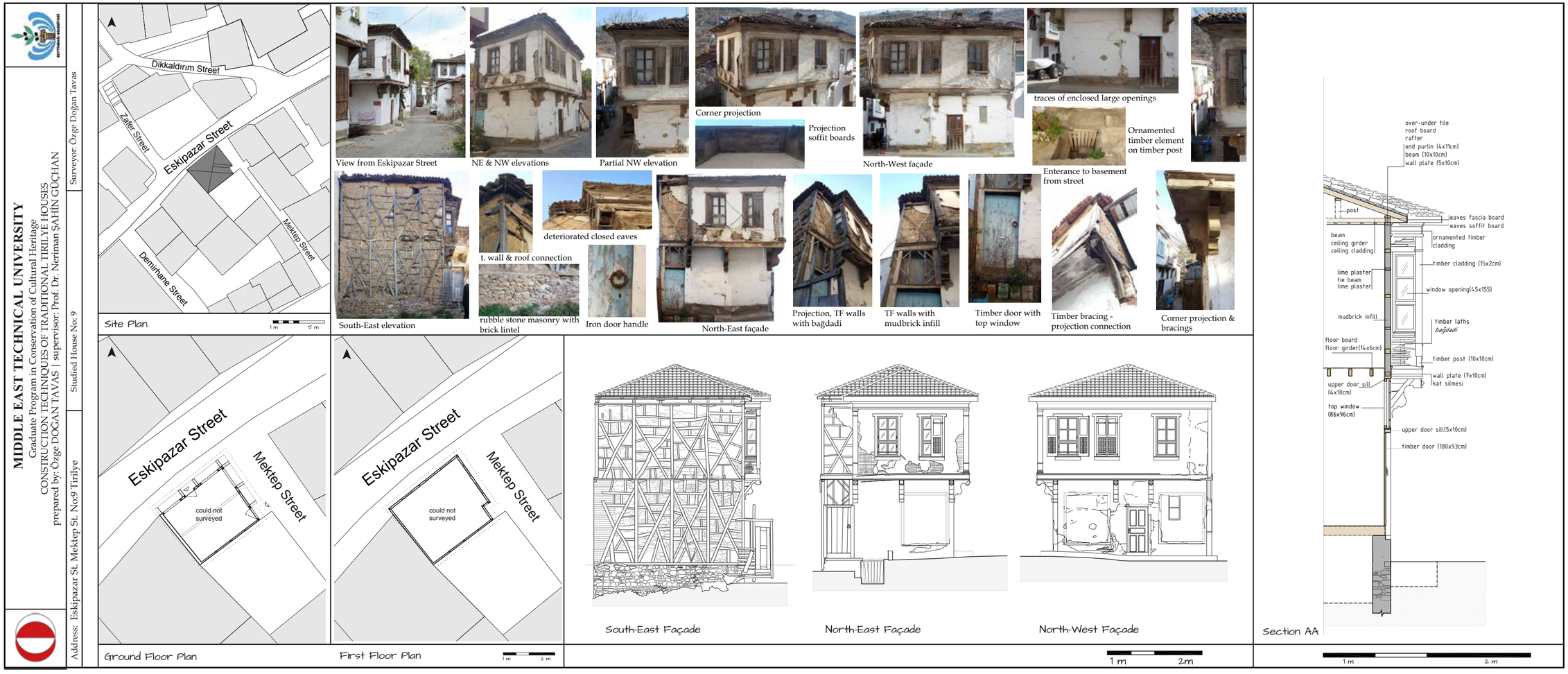


Figure A.9 Documentation of House no: 9

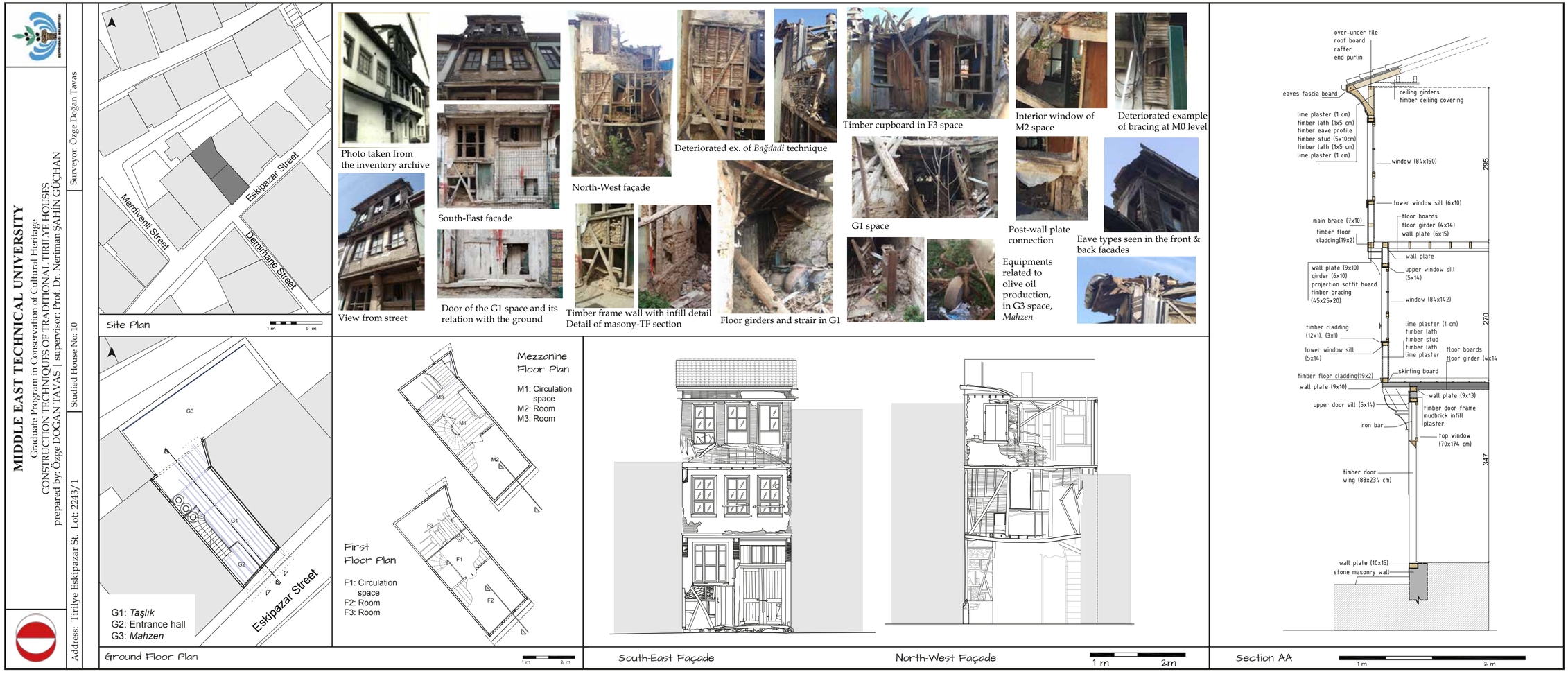


Figure A.10 Documentation of House no: 10

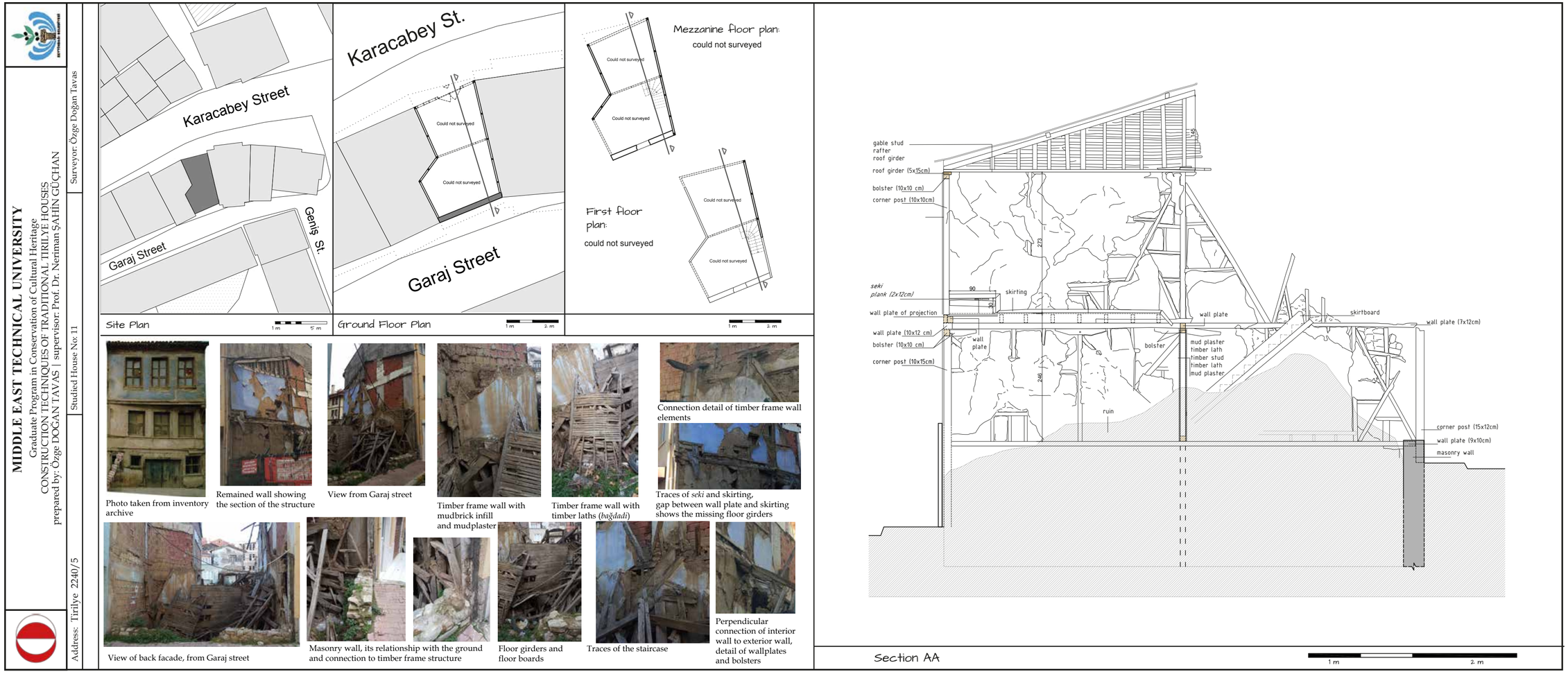


Figure A.11 Documentation of House no: 11

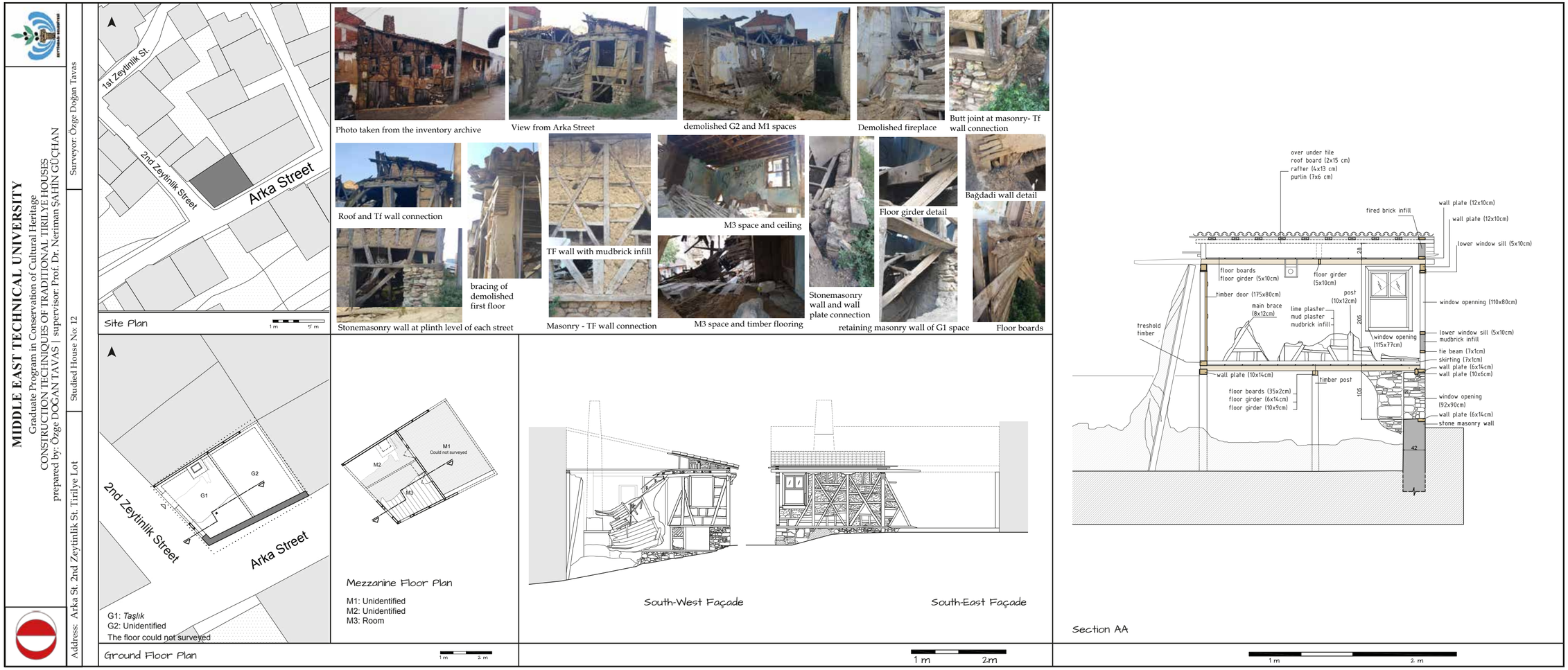


Figure A.12 Documentation of House no: 12

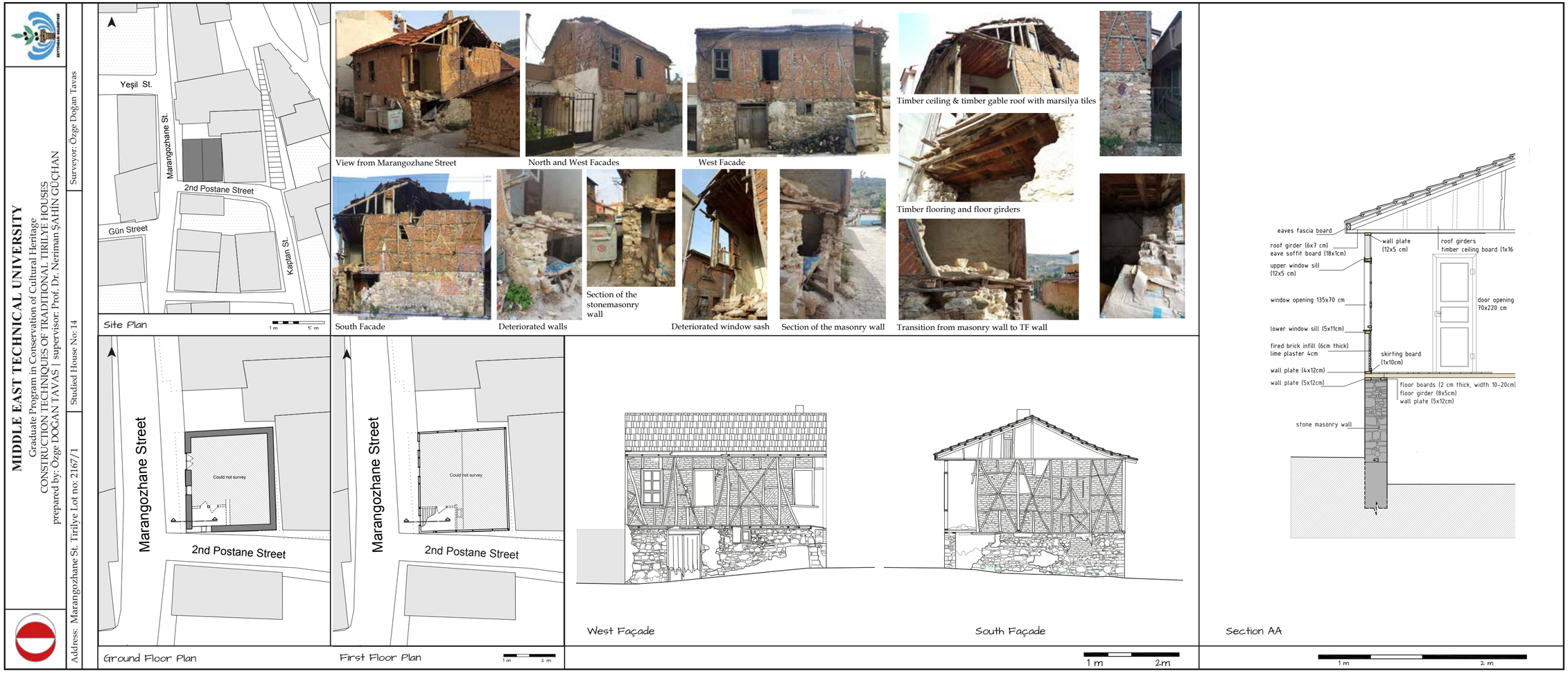


Figure A.13 Documentation of House no: 14

APPENDIX B

The coding system is shown here which is used for the identification of construction details in the traditional Tirilye houses

Tirilye Codes of Construction Details:

R2= Roof Architectural Elements

R2e= eaves

$R2e_1$= eaves (covered -regular type)

$R2e_2$= eaves (covered -arch profiled type)

$R2e_3$= eaves (uncovered)

R1= Roof Structure

R1g = Gable roof

R1g1 = Gable roof type 1

R1g2 = Gable roof type 2

R1h= Hipped roof

R1m= 3-sided roof

R1s= Single sided roof

R0= Roof and Lower Floor Connection

R0.1= Roof and timber frame connection type 1

R0.2= Roof and timber frame connection type 2

R0.3= Roof and timber frame connection type 3

S1= Second Floor Vertical Load Bearing Elements

S1t= Second Floor Timber Frame wall

- $S1t_1$= Timber Frame Wall with infill
- $S1t_2$= Timber Frame Wall with *bağdadi*

S0= Second Floor and Lower Floor Connection

S0tt= Transition from timber frame to timber frame

- $S0tt_1$= Without projection
- $S0tt_2$= With projection
    - $S0tt_{2a}$ = projection type 1
    - $S0tt_{2b}$ = projection type 2
    - $S0tt_{2c}$ = projection type 3

S0pt= Transition from timber post to timber frame

F1= First Floor Vertical Load Bearing Elements

F1t= First Floor Timber Frame Wall

- $F1t_1$= Timber Frame Wall with infill
- $F1t_2$= Timber Frame Wall with *bağdadi*

F1t= First Floor Timber Post

F0= First Floor and Lower Floor Connection

F0mm= transition from masonry to masonry

F0mt = transition from masonry to timber frame

- $F0mt_1$= without projection
    - $F0mt_{1a}$
    - $F0mt_{1b}$
    - $F0mt_{1c}$
    - $F0mt_{1d}$

- F0mt$_2$= with projection

F0tt = transition from timber frame to timber frame

- F0tt$_1$=without projection
- F0tt$_2$= with projection
  - F0tt$_{2a}$ = projection type 1
  - F0tt$_{2b}$ = projection type 2
  - F0tt$_{2c}$ = projection type 3

F0tp = transition from timber frame to timber post

M1= Mezzanine Floor Vertical Load Bearing Elements

M1t= Mezzanine Floor timber frame wall

- M1t$_1$= Timber Frame Wall with infill
- M1t$_2$= Timber Frame Wall with *bağdadi*

M1m= Mezzanine Floor stone masonry wall

- M1m$_1$ = without lintels
- M1m$_2$ = with timber lintels
- M1m$_3$ = with brick lintels

M0= Mezzanine Floor and Lower Floor Connection

M0mm= transition from masonry to masonry

M0mt = transition from masonry to timber frame

- M0mt$_1$= without projection
  - M0mt$_{1a}$
  - M0mt$_{1b}$
  - M0mt$_{1c}$
  - M0mt$_{1d}$

M0tt = transition from timber frame to timber frame

- $M0tt_1$=without projection
- $M0tt_2$=with projection
    - $M0tt_{2a}$ = projection type 1
    - $M0tt_{2b}$ = projection type 2
    - $M0tt_{2c}$ = projection type 3 (corner)

G1= Ground Floor Vertical Load Bearing Elements

G1t= Ground Floor timber frame wall

- $G1t_1$= Timber Frame Wall with infill
- $G1t_2$= Timber Frame Wall with bağdadi

G1m= Ground Floor stone masonry wall

- $G1m_1$ = without lintels
- $G1m_2$ = with timber lintels
- $G1m_3$ = with brick lintels

G0= Ground Floor and Lower Floor/ Foundation Connection

G0mm= transition from masonry to masonry

G0tm= transition from masonry to timber frame

- $G0tm_1$= transition from masonry to timber frame
    - $G0mt_{1a}$ = transition type 1
    - $G0mt_{1b}$ = transition type 2
    - $G0mt_{1c}$ = transition type 3
    - $G0mt_{1d}$ = transition type 4

B1= Basement Floor Vertical Load Bearing Elements

B1m= Masonry retaining Wall

- 1m = Rubble stone masonry wall
    - $1m_1$ = without lintels
    - $1m_2$ = with timber lintels
    - $1m_3$ = with brick lintels

FO= Foundation Structures

Fo1: continuous foundation

Fo2: foundation with rock combination

APPENDIX C

The coding system is shown here which is used for the identification of construction details in the traditional Tirilye houses

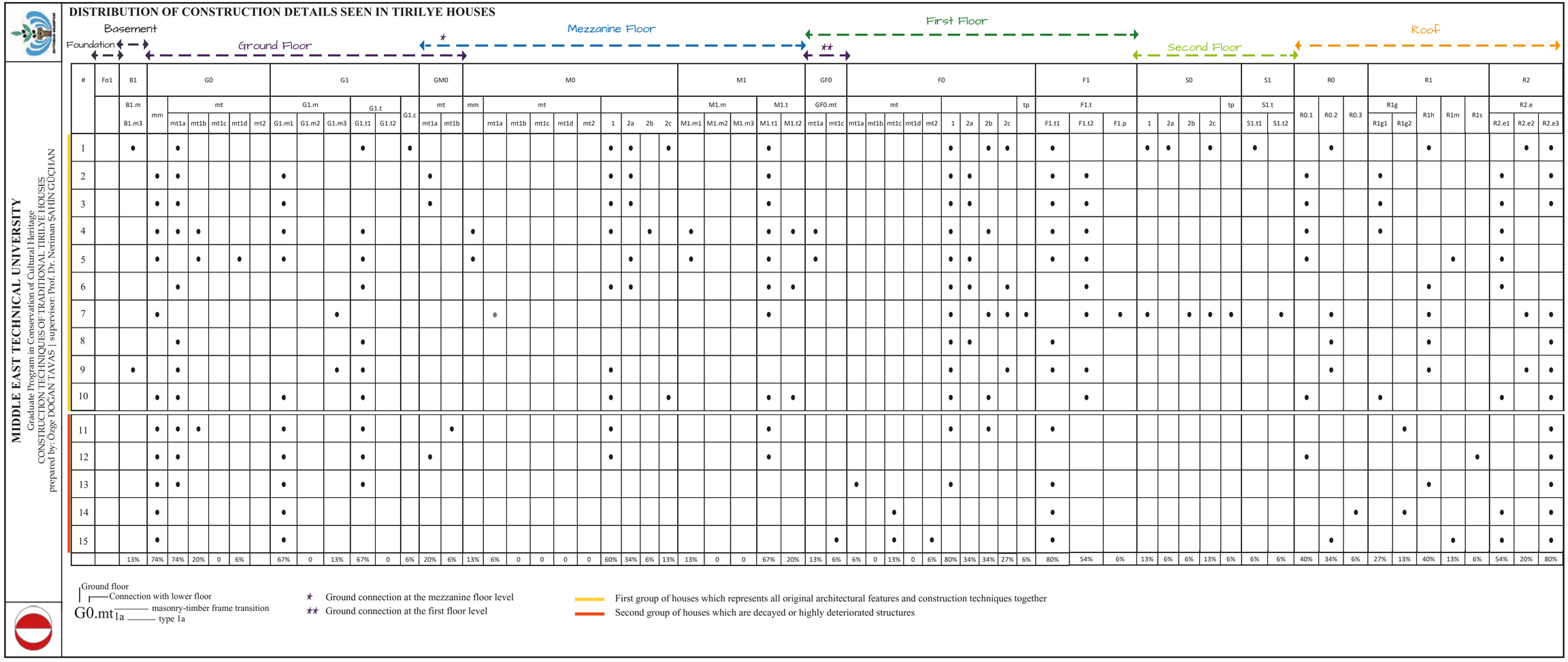


Figure C.1 Showing the detail of studied buildings with codes