



# Construction Techniques of *Hayat* Houses: Two Case Studies in the Vicinity of *İzmir*

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**Abstract:** This study aims to contribute to the analytic studies on constructional aspects of the *hayat* house typology with an eye on its historical evolution for conservation purposes. The method used included a review of the surviving examples of the typology in *İzmir* and its vicinity and the selection of two intact examples whose structural components are legible: one from the earliest period and the other from the latest period. The examples selected are *Kerimağa Konağı* in *Birgi, Ödemiş, İzmir* and a house in *Kırkağaç, Soma, Manisa*. The early example (probably eighteenth century, constructed over the remains of an older house) sustains the traditional box system in its wooden upper story that integrates with the roof. The provision of level differences on the upper floor, the traditional relationship of the sitting level—window design, and masonry base are its authentic features. The late example (probably early twentieth century) presents signs of modernization, such as the establishment of a systematic wooden roof and wall frames in relation to each other, lack of diagonals in the perpendicular wall frame, avoidance of projections, and relatively elongated windows placed at higher positions. DOI: 10.1061/(ASCE)AE.1943-5568.0000345. © 2019 American Society of Civil Engineers.

**Author keywords:** Timber; Masonry; *Hayat* house; Rationalization; *İzmir*.

## Introduction

The historical residential architecture of Turkey presents variety in different geographies (Kuban 1995a, b; Tanyeli and Kazmaoğlu 1979; Tanyeli 1996), but there is a house type that had been experienced in Ottoman lands for four centuries, especially in western Anatolia, north-central Anatolia, and the Balkans as an outcome of similar sociocultural factors (Kuban 1995a; Cesari 1998). Kuban refers to this house type as the Turkish *hayat* house, although it is also referred as a Turkish house with an exterior hall (Eldem 1955). The *hayat* house is a building type that evolved beginning in the sixteenth century in the geographic area of the Ottoman Empire. *Hayat* means life in Turkish and is the basic space in which life is experienced in this traditional dwelling. It is a porch oriented to a vista and warm sunshine yet with a comforting shadow. It is certainly private due to the elevated position of the first floor and its orientation to the courtyard and garden of the house itself. The rooms of the house, which are multifunctional living spaces, are entered from the *hayat* (Kuban 1995b).

The oldest research dealing with the constructional aspects of this house type may be taken as Strzygowski's 1917 study (Kuban 1969), and in that study, the author underlined the influence of the Turkish tent and its wooden construction on relatively less

temporary forms in the history of art and architecture. Arseven's 1928 comparative study supported this theory (Kuban 1969). Research on the construction techniques of Turkish *hayat* houses generally takes into consideration cases found in specific regions or settlements, for example, in north-western Anatolia (Kafesçioğlu 1955), the Muğla historical center (B. Irgat-Ergin, unpublished MS thesis, Iztech 2005), and the *Birgi* historical center (F. Diri, unpublished MS thesis, Metu 2010). Some studies have provided information on specific building elements, for example, windows (Uluengin 2000), or all the elements of the structural system of traditional Turkish architecture, including a number of valuable examples of the discussed typology, dating them based on their architectural characteristics (Tayla 2007).

Within this frame, this study aims to contribute to the analytic studies on constructional aspects of the *hayat* house typology with an eye on its historical evolution for conservation purposes.

The method used included a review of the surviving examples of the typology in *İzmir* and its vicinity and the selection of two intact examples whose structural components are legible: one from the earliest period and the other from the latest period. The examples selected are *Kerimağa Konağı* in *Birgi, Ödemiş, İzmir* and a house in *Kırkağaç, Soma, Manisa*.

## Historic Background of *İzmir* and Its Vicinity

The discussed region (Fig. 1) includes the Ionia and Lydia of antiquity and is rich in rivers running parallel to each other (Sevin 2015). Throughout history, a number of cities and towns have been founded on the plains of these rivers, including *Bakırçay* (Kaikos), *Gediz* (Hermos), and *Küçük Menderes* (Kaystros), and the hill skirts between them. In the early 1300s, Turkish populations had settled in these basins, and Muslim Turks had become the major group (Texier 1849; RT, unpublished fiscal notebook for *Birgi*, BOA, 1844 cited in Kiel 2001). In the sixteenth century, Jews fleeing Spain settled in the two developed cities of the region: *Tire* (Thyria) and *Manisa* (Magnesia) (Galanti 1947; RT, unpublished foundation charters, VGMA, 1441, 1743, 1817 and 1826 cited in Armağan 2005). Both

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Note. This manuscript was submitted on September 8, 2017; approved on September 12, 2018; published online on February 7, 2019. Discussion period open until July 7, 2019; separate discussions must be submitted for individual papers. This paper is part of the *Journal of Architectural Engineering*, © ASCE, ISSN 1076-0431.



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**Fig. 1.** Map of *İzmir* and its vicinity. (Imagery TerraMetrics, Map data © 2018 Google.)

had advantages in terms of their hinterlands, which were suitable for farming and positioned on caravan routes (İnalçık and Quataert 1997). Until the end of the sixteenth century, *İzmir* (Smyrna) presented the qualities of a small town (Ülker 1994).

In the seventeenth century, however, *İzmir* became an international trade center for the eastern Mediterranean. Europeans dealing with trade in raw materials necessary for developing industries of their countries settled in *İzmir* and its vicinity (Tournefort 1717; Tancoigne 1817 cited in Beyru 2000). In turn, its population increased, while commercial activity in *Tire* and *Manisa* decreased. The abovementioned Jews moved to *İzmir* to a great extent. Similarly, Armenians settled in *İzmir* and its hinterland and took an active role in commerce (Lengtes 1811; Rougon 1892 cited in Beyru 2000).

Consequently, the importance of the plains in terms of intensive agricultural production, commerce, and accessibility increased. Therefore, towns such as *Birgi* (Hypaipa) and *Tarhala* (Trakhoula) on the hillsides lost population, whereas settlements on the plateaus and plains, such as *Kula* (Katakekaumene) near *Sardeis* (Arkan 2006, Bozer 1990), *Ödemiş* near *Hypaipa* (RT, unpublished annual of the state of Aydın, TDVİAM, 1985–6 cited in Kiel 2001), and *Kırkağaç* near *Trakhoula* (Tuncel 1977; Gözenç 1977; Tekeli 1992 cited in Günay 2007) developed. *Tire* and *Manisa* sustained their significance in relation to their positions on the trade routes. In the 1770s, *Rums* fleeing Albanian pressure in Peloponnese came to the region. Subsequently, *Rums* living on islands across the western coast moved to the region (RT, unpublished annual of the state of Aydın, TDVİAM, 1895–6 cited in Kiel 2001). Finally, in the second half of the nineteenth century, the population of *İzmir* further increased as Muslims and Jews migrated from the Balkans, Caucasia, and Crimea in relation to the decline of the Ottoman

Empire (Sepetçioğlu 2013). In turn, there were increases in urban density and changes in housing manners.

### Evolution of the Typology in *İzmir* and Its Vicinity

The datable examples from before the eighteenth century are very limited both in Anatolia and the Balkans in accordance with the vulnerability of timber. In nine examples in northwest, central, and western Anatolia dated to the seventeenth century, timber structures with mudbrick infills over mostly rubble stone bases were left exposed without plaster. Continuity of the stone walls throughout the main floor, excluding the courtyard façade, was possible. Therefore, dim spaces with limited fenestration to the street and opening to a two-story wooden gallery at the courtyard façade could be seen. Lower and upper windows with lattices and stucco screens, respectively, were typical for the main floor. Raised platforms terminating the upper galleries and running along the walls of the rooms were possible (Akok and Gökoğlu 1946; Eldem 1955; Kuban 1995b). In the *İzmir* region, the limited examples datable to the late seventeenth–early eighteenth centuries are the *Malike* House at *Tire*, the *Ayşekadın* House at *Manisa* (Eldem 1955), and the house at the intersection of Streets 2 and 47 in the *Kadriye* neighborhood in *Kırkağaç* (Fig. 2). Their distinctive features are their compactness, two-story wooden gallery at the courtyard façade, a raised platform and fireplace (*sekilik*) terminating the upper gallery, two rooms opening to the *hayat*, sometimes with an *eyvan* in between, fenestration with lower and upper registers at the *hayat* façade only, continuity of U-formed enclosure walls with rubble stone at their bases, stone or mudbrick in the upper portion, which is exposed without plastering, and mudbricks infilling timber frames. Nevertheless,





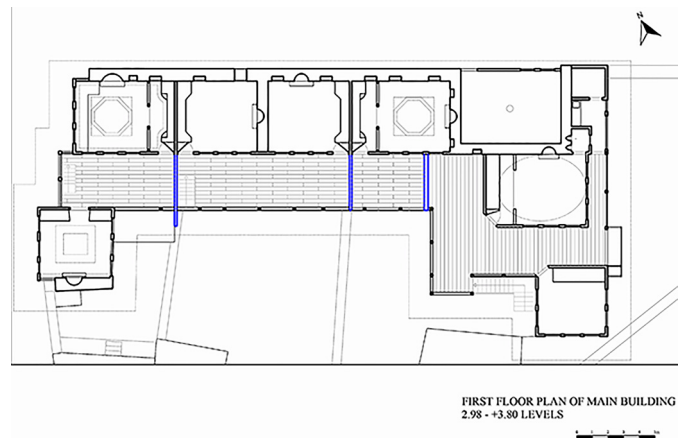
**Fig. 2.** View of a *hayat*, the house in *Kadriye* neighborhood, *Kırkağaç*.

the continuity of the U-formed exterior walls throughout the structures is seen in subsequent examples in small settlements, for example, *Kula* (Bozer 1990) and *Darkale* (A. Etlacakuş, unpublished MS thesis, Iztech, 2015).

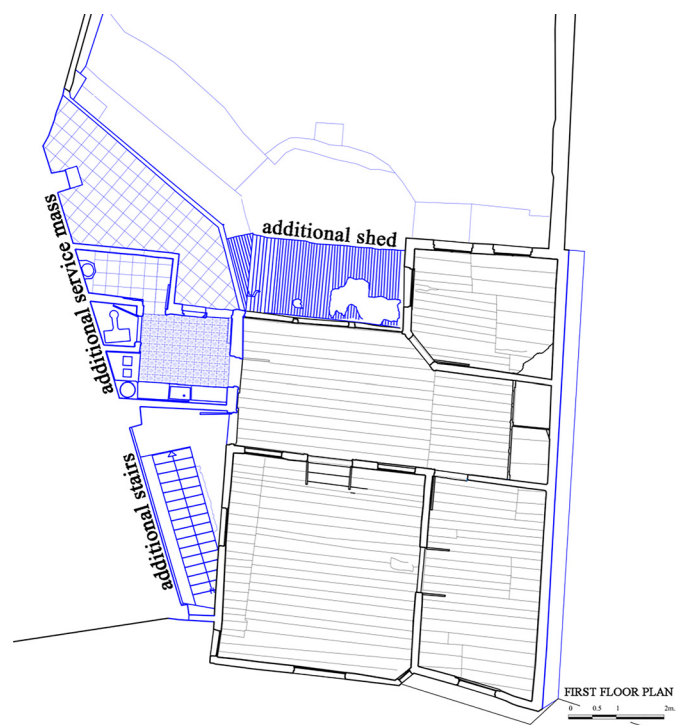
In the eighteenth century, the *hayat* house reached its classical expression. As seen in surviving examples in western Anatolia and the Balkans (Eldem 1955; Kuban 1995b), an open gallery with varying numbers of rooms added to one another on both floors had become a standard for houses in the cities and provinces. Timber had definitely replaced stone in the first-floor walls and became the major building material. The houses, with their large numbers of façades, were well illuminated. The rooms and the alcoves between them projected over the ground floor walls and were oriented to the surroundings rather than to other houses. In more restricted lots and for those with fewer requirements related to their rural settings, houses with more rooms along a long or U-formed *hayat* and an intermediate floor for winter usage became possible. The distinctive features of the examples in the *İzmir* region that are datable to the eighteenth century are well illuminated and volumetrically complex. Presence of an intermediate/half story, preference for U- or L-planned, long *hayats* with small kiosks projecting to the courtyard for large houses, and stone bases with timber-frame main stories filled in with mudbrick, brick, or stone are also characteristic. As revealed in the very limited surviving examples of *hayat* houses in the center of *İzmir*, the type was a standard there in this time interval, for example, *Selvili masjid*, No. 86. There are a number of examples in nearby small cities. Some exciting ones are *Çakrağa* and *Kerimağa* in *Birgi* and *Bekirbeyler* in *Kula* (Fig. 3).

The distinctive features of the early nineteenth century *hayat* houses are the three rooms that are asymmetrically placed around the *hayat*. In the *İzmir* region examples, rubble stone is used as infillings for the timber frames—945th Street, No. 30 at *İzmir* center (Fig. 4) is a typical example, which, according to its inscription panel, dates to 1843. This typology is represented by three examples in *Kula* (N. Akın, N. Zeren, G. Akın, A. R. Duben, and A. Tezer, unpublished conservation aimed development plan report, ITU, 1991).

This was a step before the subsequent axial or centralized type built at the end of the nineteenth century. After that threshold, interior halls were preferred in dense city centers (Kuban 1995b). In *İzmir*, this change in housing manners was represented by row houses built using industrialized building materials. At that time, *hayats* were closed with glass screens (Fig. 4). Nevertheless, the *hayat* house continued to be built until the Second World War in nearby settlements with less urban tastes, along with houses following the trends of their eras.



**Fig. 3.** *Bekirbeyler* house, *Kula*, first-floor plan. (Adapted from E. Kırtas unpublished master's thesis, *İzmir* 2013.)



**Fig. 4.** The house No. 30 on 945 Street, first-floor plan.

### Kerimağa Konağı in Birgi

The case study is in the vicinity of the Great Mosque dating to 1307, (*Cami-i Kebir* district, first Beyzade Street, No. 3, Lot 526). The *konağ* (a large-sized house of a notable person) was listed as a cultural asset on January 16, 1989, and it changed hands just after that date (December 6, 1989). The urban site within which the building is situated was listed on January 10, 1996 (RT, land registration of Lot 526, *Birgi*, ÖTM, April 10, 2011). It has been continuously used as a house, although the annex experiences high-density usage, and the main building accommodates services. It has not undergone any comprehensive restoration.

As the name *Ağa* indicates, the owner must have also owned an important amount of agricultural land. The *Çakrağa Konağı*, a

larger example in *Birgi*, is dated to the eighteenth century. These elaborate historical houses were constructed with the money that accumulated in the city as a result of the trade in olive oil and silk produced in *Birgi*. According to its size, number of stories, story heights, eave widths, richness of architectural elements and decoration, and construction technique, *Kerimağa Konağı* should have been completed before the second half of the nineteenth century (RT, conservation council January 16, 1989/194 and January 10, 1996/6425, unpublished decisions, *İzmir* No. 1 KTVKBBK; Kuban 1995b; Kiel 2001; F. Diri, unpublished M.S. thesis, Metu 2010). The house comprises a two-story main building, a single-story service building, and a courtyard. The plan form of the 3.75-m high ground floor is irregular in accordance with the street pattern, whereas the 3.90-m high living floor comprises orthogonal planned rooms that are entered from the fluid *hayat*, which is oriented to the *Ödemiş* plain to the west (Fig. 5). The design of the upper-floor rooms presents variations in terms of seasonal requirements; a corner summer room and two interrelated winter rooms juxtaposing the masonry service wall are present. In the original design, the winter room facing the courtyard was elevated, whereas the other housed the fireplace. The *ivan* in the *hayat* separates the summer and winter sections. It is thought that the building is a reconstruction on an old house lot because of the characteristics of the northern wall of the main mass, the portioning wall at its ground floor, and their articulation to the other building elements. The filled-in window that has no meaning within the interior spatial layout and the application of mud repair plaster on the exterior surface of the mentioned northern wall, the peculiar positioning of a first-floor “beam,” that is to say the main “beam” spanning the long side of the space and tying the northern wall to the rest of the building (Fig. 6), and the relatively extensive amounts of failures in these two walls indicate its age.

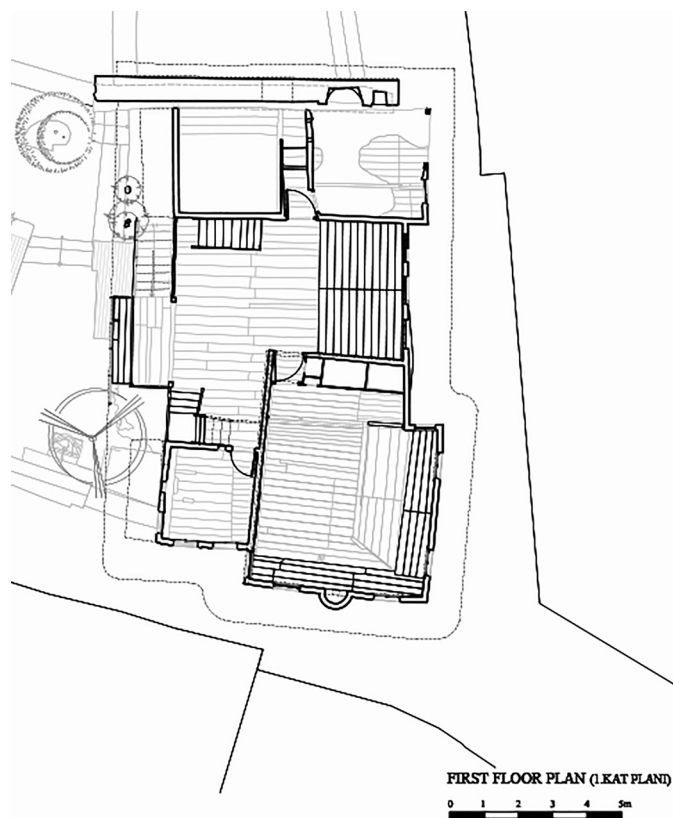


Fig. 5. *Kerimağa* House, *Birgi*, first-floor plan.

The possible sources of stones used in the construction are the beds of the two brooks in the settlement, ruins of historical houses, spolia from the nearby and ancient site of *Hypaipa*, and stone quarries in the Boz Mountains to the north. The materials were used either as they were, or they were broken into pieces. Bricks and tiles were provided from the traditional tile kilns in the villages of *Birgi*. Complete or half units and pieces of those materials are observed in *Kerimağa Konağı*. Wood was provided from poplar, chestnut, black pine, cedar, and juniper trees in the region (Ekinci 2005; Çekül 2017). Girders and floor joists were made by only cutting off the knots for processing a clear-cut circular cross section. The cross sections of the posts, braces, and sills are rectangular.

## Structural Elements

### Masonry Walls

In *Kerimağa Konağı*, the ground floor exterior walls and northern exterior wall of the upper floor are constructed using a masonry system with wooden lintels. The masonry walls are of an alternating type in terms of their bonding such that rubble stones alternate with groups of slate stone, tile, and brick pieces. The gaps that occur between the different sizes of stones are filled with thin stones (15–50 × 5–7 cm), which are called slate, and pieces of brick and tile. The gaps are mostly vertical, but there are also horizontal gaps, although smaller in area. These masonry walls are left exposed without plastering at their exteriors and interiors. Mud plaster observed in patches in the northern wall is interpreted as repair material. Only one masonry wall, the northern one, continues up to the roof and serves as the service wall that carries the fireplace. In this case, the interior surface has a double-layered plaster system: a mud under layer and a lime top layer. The same masonry wall thickness throughout the ground floor is seen: 65–75 cm. The southeast corner of the main mass was chamfered to ease the movement of horse-drawn carriages on the street. A sun symbol is observed on the northern masonry wall at ground level. It is carved on the *spolia* reinforcement stone at the northeast corner.

### Wooden Frame Walls

In most of the upper floor exterior walls, the upper floor interior walls, and projections, a wooden frame system is used. This system is also used in the partitioning walls at the ground floor and in some additional exterior walls of the service building. All are comprised of horizontal, vertical, and diagonal elements. The posts are placed every 1.6 m or more frequently in case of necessity of openings.

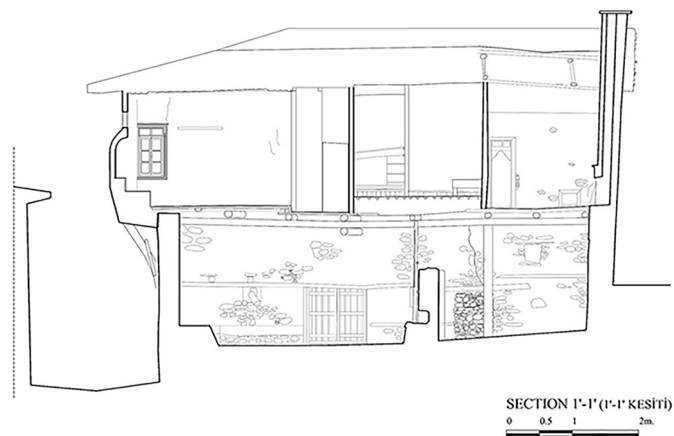


Fig. 6. *Kerimağa* House, *Birgi*, longitudinal section.



There are sills dividing the frame horizontally every 1.3 m or more frequently in relation to the articulated elements. Most of the wooden frame walls of *Kerimağa Konağı* are filled with stone, brick, mudbrick (approximately  $10 \times 10 \times 14$  or 21 cm) and mud mortar (*hmuş*) and finished with the above-mentioned double-layer plastering (Fig. 7). Wooden frame walls without infills are only seen in interior walls. They are finished with horizontal wooden laths and double layer plastering (*bağdadi*).

### Timber Posts

Timber posts are used at the ground floor ( $12\text{--}15 \times 10\text{--}15$  cm) to support the intersection point of the timber frame interior walls and at the upper floor ( $12 \times 12\text{--}16$  cm) at the open *hayat* façade facing the courtyard. Here, no wall is used to transfer roof loads to the ground; a sole north-south beam ( $\text{Ø}12$  cm) interconnects the posts. The posts have square cross sections. A stone plinth ( $45 \times 50 \times 15$  cm) provides humidity control at the ground level.

### Floor

The wooden floor between the first and ground floors has a cross section of 50 cm. For the purpose of dividing the span, girders and floor joists are used. Girders with diameters of 15 to 20 cm are placed in the direction of the short side. They span a distance of 5 to 6 m and are repeated every 1.4–2 m. They transfer their loads to the masonry walls by means of wall plates that they rest on. The floor joists are placed on the girders. The cross section dimensions of floor joists are approximately 10 cm, and the joists repeat approximately every 30 cm. There is a tension rod spanning the long side of the service space (approximately 12 m) and supported by a girder nearly 20 cm in diameter at its center. These two elements were not designed to support the transfer of floor loads. The intent was probably to connect the old northern wall with the new wall system.



**Fig. 7.** *Kerimağa House, Birgi*, exterior of the eastern wall of the main room.

### Roof

The roof of the main building comprises three surfaces and is a combination of hipped and gabled roofs. The gable wall is the old wall on the north. The service building has a hipped roof. They are both wooden structures covered with over and under tiles. The widths of the eaves vary between 80 and 180 cm, and they are covered with wooden laths. Water on the roof flows to the courtyard or directly to the street without a conduit.

### Architectural Elements

#### Projections

The upper rooms at their street sides project outward to achieve an orthogonal room layout and gain vistas. The corner projection of the summer room has a rectangular plan on both sides and is therefore parallel to the ground floor wall. The projection of the winter room has a trapezoidal plan is not parallel to the ground wall. Their widths vary between 60 and 110 cm. These are wooden frame structures and are supported by wooden braces. The wide structure is supported by concave-shaped wooden braces known as *eliböğründe*, whereas the narrow structure is a simple console made with floor joists. The braces rest on the ground floor lintels. They have rectangular cross sections of 8 to 12 cm.

#### Staircases

The wooden staircase rests on a stone base made of four steps, which serves as a preventive detail against humidity.

#### Fireplaces

There are two fireplaces, one of which is in the winter room, and the other is in the annex. In both, fires are lit directly on their bottom surfaces.

#### Platform

Platforms (*sekis*) used for sitting in the main room on the sides facing the street and the short side of the *hayat* are elevated 40 cm, are 70 and 240 cm in width, respectively, and have wooden structures covered with wood boards.

#### Abdestlik

The *abdestlik* is a counter and shelf system used for hand washing on the upper level of the courtyard side of the *hayat* and is hidden behind wooden lattices and positioned between two successive posts. It is a wooden structure that is 60 cm in width, 250 cm in length, 180 cm in height, and rests on the floor joists. It projects toward the courtyard.

#### Ceiling Coverings

Ceiling coverings are used in the upper floor rooms and the *hayat*. The ceiling surfaces are covered using  $1.5\text{--}2 \times 15\text{--}20$  cm ceiling boards that are nailed at floor joists. The cross sections are flat. At their intersection points, 1.5-cm-thick laths are nailed for decoration. In the winter room and entrance of the summer room, or *sekialtı*, the boards and laths are parallel to each other. In the living section of the summer room, however, they are placed diagonally to form a square and are framed at their edges. A decorative circular piece, which is named a *göbek*, is provided at the center. In the *hayat*, the laths form a grid.

#### Floor Coverings

The following finishing materials are seen: compressed mud in the service spaces of the ground floor, rubble and slate stones inserted into mud mortar in the courtyard and entrance to the service spaces at the ground floor, and wood in the upper floor.

Wooden floor boards are placed parallel to each other and nailed on floor joists in their perpendicular directions. The boards are  $1.5\text{--}2 \times 10\text{--}30 \times 100\text{--}200$  cm.

### Doors

There are two different types of original doors in *Kerimağa Konağı*: doors set in masonry walls and doors set in wooden frame walls. Doors of the first, Type 2, are observed in the entrances of the courtyard and the stable, serving as a central opening within its masonry wall, and the latter, Type 3, serve as entrances to the rooms from the *hayat*. The joinery is always wood. Doors of Type 1 are 193 cm in width, 240 cm in height, and double leafed. At least three upper door sills are used at the upper part of the opening, the widths of which vary between 5 and 15 cm. Type 2 doors are positioned at the intersection of two perpendicular wooden frame walls (2/3) and at a chamfered corner created in the mentioned intersection. Their widths vary between 84 and 115 cm, and their heights vary between 214 and 250 cm; the winter room entrance is relatively small.

### Windows

According to the desired spatial quality, four different types of windows are used in *Kerimağa Konağı*. In the winter rooms and *iwana* in the *hayat*, flat windows are seen. Each has double shutters and is crowned with an arched head window, known as *revzen*, excluding the room with the fireplace. In the summer room, an elongated window type is present, whereas in the stable and hayloft, embrasure windows facing the street or the courtyard are applied. They are all positioned between lintels and between posts in the wooden frame walls. The flat windows are sliding, 70–75 cm in width, 120–130 cm in height (approximately 3/5), and 30–35 cm above the associated sitting ground (*seki* or floor). The top windows are 50–70 cm in width, 60–100 cm in height (approximately 2/3), and 20–25 cm above the flat windows underneath them. The elongated windows are double leafed, 70 cm in width, 135–150 cm in height (approximately 1/2), and 30 cm above the related sitting platform (*seki*). The embrasure windows are  $15 \times 50$  cm at their exterior,  $70 \times 50$  cm at their interior, and 160–210 cm from the ground level. Their heights remain constant between the lintels. The joinery of the flat and elongated windows is wooden, and both types include sash frames and double shutters. The flat windows have wooden railings. The elongated windows include lattice frames as high as half of the entire frame. The top windows have decorated stucco networks within wooden frames.

### Niches

The niches are either in masonry walls on both floors or in wooden frame walls on the upper floor. The niches in masonry walls are rectangular prisms with various dimensions (40–90 cm in width, 50–180 cm in height, and 35–37 cm in depth); the smallest are in the winter room with the fireplace. The only niche in the wooden frame walls is the arched niche with a semicircular plan in the summer room; it makes a curvilinear projection to the street.

### Built-in Cupboards

The cupboards are either rectangular prisms in the masonry service walls, as in the elevated winter room, or cupboard systems running parallel to the interior wooden frame walls, as in the elevated winter room and the summer room. The systems include a series of niches, *yüklüks* (shelves for mattress, bedclothes, etc.), and/or a *gusülhane*, a bathing unit, in the summer room. They are connected to the wooden load-bearing elements of their neighboring walls.

## Eker House in Kırkağaç

The case study house (*Boduroğlu* District, Street 40, No. 94, Block 327, Lots 4 and 5) is found at the east of the commercial center, which houses a number of historical khans and is thought to have been constructed just before the end of the nineteenth or beginning of the twentieth century. It is not listed. Its annexes function as two housing units, while the main building is not used. It has not undergone any comprehensive restoration.

The house comprises a two-story main building, the southern portion of which has been demolished, two single-story annexes, and a courtyard. The *hayat* oriented to the *Kırkağaç* plain at the east is flanked by four identical rooms on the living floor, which is 3.60 m in height. This scheme is repeated on the service floor, which is 3 m in height. At present, it is vertically divided into three units. It is thought that the construction of the house was never completed given the lack of finishing traces at the upper floor. The ground floor was finished by Rahmi Eker, the first known owner. The present owners, the Erdoğan family, moved into the building in the 1950s. The room with built-in cupboards and ceiling decorated with wooden laths dates to the Turkish owners' period, as its positioning, lack of differences in the level of its floor, and the rough workmanship of its elements reveal. The same dating applies to the joinery at ground level, including that of the gateway. The orthogonality of the *hayat*; uniformity of the rooms; absence of level differences, subspaces, projections, and fireplaces on the living floor (Fig. 8); rectangular form of the ground floor; recessed positioning of the main mass, giving way to the formation of a front courtyard; the building-lot-block relationship in which the building is completely isolated from the streets; and the grid order of the streets are all indicators of the architectural and urban morphologies observed from the modernization era of the Ottoman Empire. The articulation of the fountain with masonry water storage to the main building and the rubble stone covering the courtyard grounds in its surroundings note the possibility of its adaptation from a previous structure on the same lot.

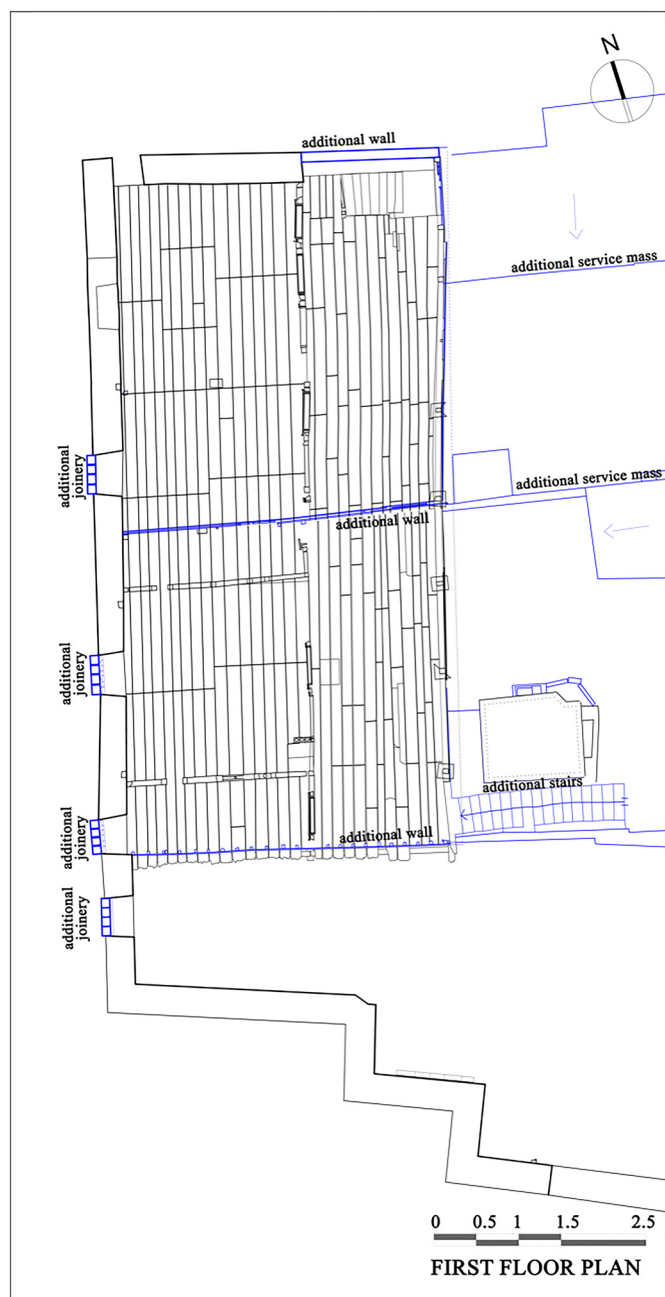
Local stones are limestone, basalt, andesite, sandstone, and anglo-mera. Wood was provided from chestnut trees in the region. Red pine and chestnut were sources of wood. Records from 1908 show that lumber mills were used in local construction in *İzmir* and its vicinity (E. Kösem, unpublished M.S. thesis, İstanbul Üniversitesi 1990; *Evrana and Satı 2000; Çolak 2013*).

## Structural Elements

### Masonry Walls

In the house in *Kırkağaç*, a U-formed masonry wall enveloping the exterior surfaces of the main building continues on both floors. Therefore, only the façade oriented to the courtyard has a wooden frame on both floors. The interior walls on both floors are also wooden frames, excluding the mid wall on the ground floor perpendicular to the U-envelope, which is approximately 50 cm in thickness. The masonry walls are made of relatively large, differently sized rough-cut stones and rubble stones (approximately  $25 \times 16 \times 5$  cm) and brick and tile pieces bonded with lime mortar and reinforced with wooden lintels every 160 cm. The bonding may be referred to as a coursed rubble stone masonry in terms of their balanced bonding. Their thicknesses are constant throughout the same floor: 66 cm on the upper floor and 100 cm on the ground floor. Due to its incomplete state, there is no plastering observed at the first floor, whereas the interior surfaces of the ground floor have been plastered throughout the time they have been used.





**Fig. 8.** Eker House, Kırkağaç, first-floor plan.

### Wooden Frame Walls

The interior walls are wooden on both floors. Thicknesses of 18 cm and 15 cm are recorded for the upper and ground floors, respectively. As observed on the upper floor, two different types of wooden frame walls are used [Figs. 9 and 10(a)]. Those in the north-south direction that connect the two ends of the U-formed masonry wall and improve the stiffness of the masonry wall system have no diagonal elements but comprehend rhythmic door and window openings supported with sills. The others are perpendicular to this system and are reinforced with wooden braces and sills at the intersection axes of the diagonals. They are all parallel to each other, generally overlap with the roof frames above, and increase the lateral stability in an east-west direction. The posts are placed every two meters or more frequently where openings are needed. The unfinished upper floor has no infill or wooden laths; the



(a)



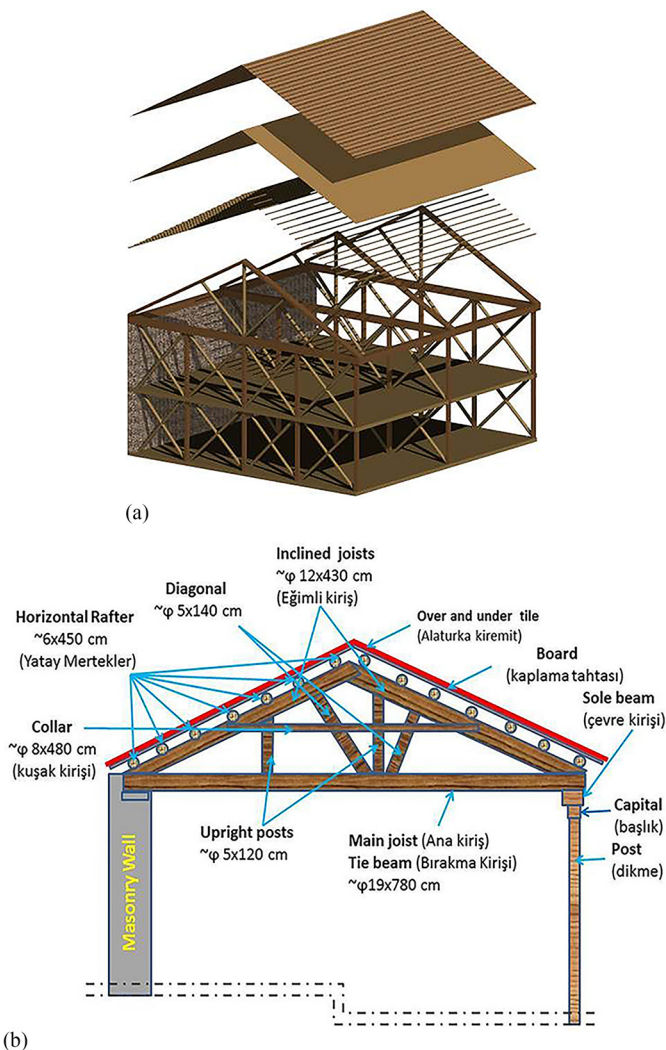
(b)

**Fig. 9.** Eker House, Kırkağaç (a) timber frame wall with diagonals; and (b) timber frame wall with voids.

plastered surfaces of the ground floor, unfortunately, do not provide clues about their interiors.

### Wooden Posts

At the *hayat* façade of both floors, there are series of wooden posts that transfer the roof load to the ground. At both floors, the posts ( $12 \times 13 \times 320$  cm upper floor;  $15 \times 16 \times 250$  cm ground floor), which are separated from one another by 2 to 2.5 m, are connected with a sole beam ( $11 \times 13$  cm) in a north-south direction. All the posts have rectangular cross sections. There are cushions that lower the stresses between the beams and the posts on both floors ( $65 \times 12 \times 12$  cm and  $70 \times 20 \times 40$  cm on the ground and first floors, respectively). Curvilinear brackets support the upper posts on both sides, whereas stone plinths ( $21 \times 22 \times 3$  cm) provide humidity control at the ground posts. The braces are finished with a lath



**Fig. 10.** Eker House, *Kırkağaç* (a) axonometric view; and (b) a typical roof frame.

technique and made ready for plastering, providing the impression of an arch.

### Floor

The wooden floor between the first and ground floors is only observable at the hall (*taşlık*). The floor joists spanning the short side of the ground hall (3.3 m) are separated by 50 cm from each other. They rest on the sole beam running over the post series. The girders and the sole beam have circular cross sections of 12 and 15 cm, respectively. The wooden floor boards, which are 2.5 cm in thickness, 21 cm in width, and 120 cm in length, are nailed in directions perpendicular to the floor joists.

### Roof

The wooden roof of the main building is hipped, and its south portion is partially demolished. A series of full roof frames separated by distances of 215 cm and half roof planes at the hipped portions are covered with roof boards (180 × 18 × 2 cm) and finished with over and under tiles at their exterior. The same roof system comprised of frames is repeated in the gable roof of the gateway, which is known as *saya*. The diameters of the frame elements vary between 5 and 19 cm. The horizontal rafter (5 × 230 cm), inclined joist (7 × 5 × 230 cm), king post (10 × 85 cm), stud (5 × 140 cm),

collar (8 × 9 × 480 cm), and tie beam (5 × 7 × 370 cm) [Fig. 10(b)] compose the frame elements. The roof water flows to the courtyard without a conduit.

## Architectural Elements

### Staircases

The quarter-turn wooden staircase with a width of 99 cm on the northern side of the *hayat* rests on stringers (10 × 11 cm). Fourteen wooden steps and a stone step at the ground connection, each of which has a width of 20 cm, have risers varying between 15 and 23 cm. A wooden cupboard (*yüklük*) is present underneath the stairs.

### Ceiling Coverings

The ceilings had not been completed in the main building. The 15–20-cm-wide ceiling boards decorated with laths at their intersections and observed in two of the rooms of the ground floor are additions from the period in which the building began to be used as a house by the Turkish family.

### Floor Coverings

Wooden floor boards on the upper floor are placed parallel to each other and nailed on floor joists in their perpendicular directions. The boards are 1.5–2-cm thick, 10–30-cm wide, and 100–200-cm long. The two rooms on the ground floor finished in the Republican years are covered with wooden boards that are 28 cm in width and 210 cm in length. The other spaces of this floor are finished with concrete. Rubble stones (*yumru taşı*) inserted into the ground observed around the water storage are interpreted as the original courtyard covering.

### Doors

The doors in the wooden frame walls are positioned between two wooden posts but not at the intersections of the wooden walls. Their widths and heights are approximately 1 and 2 m, respectively, on both the first and ground floors. Their joineries are incomplete on the living floor, whereas the Republican period additions on the ground floor are all built of wood. The only door in a masonry wall is that of the courtyard entrance, as observed from the wall remains at its south. It is doubled leafed at the north side to serve as an animal entrance and single leafed at the south to serve as a human entrance, 3.1 m in width, 2.9 m in height, and sheltered with a gable roof, defining an entrance space called *saya* (5 × 5 m). The roughness in the workmanship of the joinery points to the Republican era.

### Windows

On both floors, each room extends into the *hayat* and *taşlık*, with two windows on both floors. Six rear windows facing the neighboring lot were designed for the upper floor rooms, which is a peculiarity for a *hayat* house. They are all positioned between wooden window sills and posts in the wooden frame walls and between lintels in the masonry ones. The *hayat* windows are 0.9–1 m in width, 1.8–2 m in height (approximately 1/2), and 55 and 65 cm above the related floors on the first and ground floor levels, respectively. Their heights above the floor levels note that they were not designed for sitting on the ground. Similarly, the rear windows are 65 cm from the ground level and are 1 and 1.7 m in width and height (approximately 1/1.7), respectively.

### Built-in Cupboards

Built-in cupboards are only observed in the northern room on the ground floor. The cupboard system runs parallel to the interior



**Table 1.** Form, size, and shaping technique of structural elements

Structural element type	Birgi						Kırkağaç					
	Position	Form	Size	Axial distance	Spanning distance	Shaping technique	Position	Form	Size	Axial distance	Spanning distance	Shaping technique
Masonry wall	GF	Box	W: 50–60 cm; H: 4 m	—	—	Constructed at the site	GF	U	W: 50 cm; H: 3 m	—	—	Constructed at the site
Wooden frame wall	FF	Linear	W: 16 cm; H: 3.8 m	—	—	—	—	U	W: 50 cm; H: 3.6 m	—	—	—
Post	FF	R or C	10 × 15 cm; H: 3.7 m	≤160 cm	—	Shaped with axe or hand saw	FF	R	15 × 15 × 340 cm	≤2 m	—	Machine cut
Sill	FF	R	8 × 8 cm	≤130 cm	—	—	—	R	14 × 4 cm	—	—	—
Brace	FF	R	8 × 8 cm	—	—	—	—	R	10 × 12 cm	—	—	—
Wooden post system												
Post	GF	C	Ø27 cm; H: 3.25 m	—	—	Shaped with axe or hand saw	GF	R	15 × 16 × 250 cm	1.80–2.30 m	—	Machine cut
	FF	R	12 × 12–16 cm; H: 3.70 m	2.5 m	—	hand saw	FF	R	12 × 13 × 320 cm	2–2.50 m	—	—
Sole beam	FF	R	12 × 12 cm	—	—	Natural shape	GF/FF	R	11 × 13 cm	—	—	—
Cushion	—	—	—	—	—	—	GF/FF	R	65 × 12 × 12/70 × 20 × 40 cm	—	2–2.50 m	—
Wooden floor												
Girder	FF	—	Ø15–20 cm	1.4–2 m	5–6 m	Natural shape,	FF	C	Ø12 cm	1.2 m	—	Natural shape,
Floor joist	FF	—	Ø10 cm	30 cm	1.4–2 m	only knots cut off; sometimes shaped	—	R	5 × 6 × 430 cm	30 cm	4.5 m	only knots cut off; sometimes shaped
Wooden roof												
Rafter	Roof	C	Ø10 cm	30–35 cm	1.4–1.6 m	with axe or hand saw	Roof	C	Ø6 cm	30 cm	4.5 m	with axe or hand saw
Ridge beam	Roof	C	Ø15–20 cm	1.4–1.6 m	3.2–4 m	saw	—	—	—	—	—	—
Inclined joist	Roof	C	Ø15–20 cm	4.5 m	1.2 m	—	Roof	C	Ø 12 cm	2.1 m	4.3 m	—
Upright post	Roof	R	Ø12 cm; H: 20–145 cm	—	—	—	Roof	R or C	8 × 10 or Ø5 cm, H: 1.2 m	—	—	—
Diagonal	—	—	—	—	—	—	Roof	R	8 × 9 × 480 cm	2.1 m	—	—
Collar	—	—	—	—	—	—	Roof	C	Ø 8 cm, L: 4.8 m	—	—	—
Main joist	Roof	C	Ø 20 cm	4.5 m	0.9–2.8 m	—	Roof	C	19 cm	2.1 m	7.8 m	—

Note: C = circular; FF = first floor; GF = ground floor; and R = rectangular.



(a)



(a)



(b)



(b)

**Fig. 11.** Bonding in masonry walls: (a) *Kerimağa House, Birgi*; and (b) *Eker House, Kırkağaç*.

**Fig. 12.** Relationship of roof and wall frames in cross section: (a) *Kerimağa House, Birgi*; and (b) *Eker House, Kırkağaç*.

wooden frame wall and includes a central arched niche, cupboards, and *gusülhane*.

### Fountain

The fountain is a barrel-vaulted masonry structure positioned in the courtyard across the gateway. It is 431 m in width, 746 m in length, and 225 m in height. A blind arch houses the original spout, and there is an observation window at its northern side. The coursed walls are mainly square bricks, and the small rubble stones and brick pieces point to an earlier period.

### Evaluation

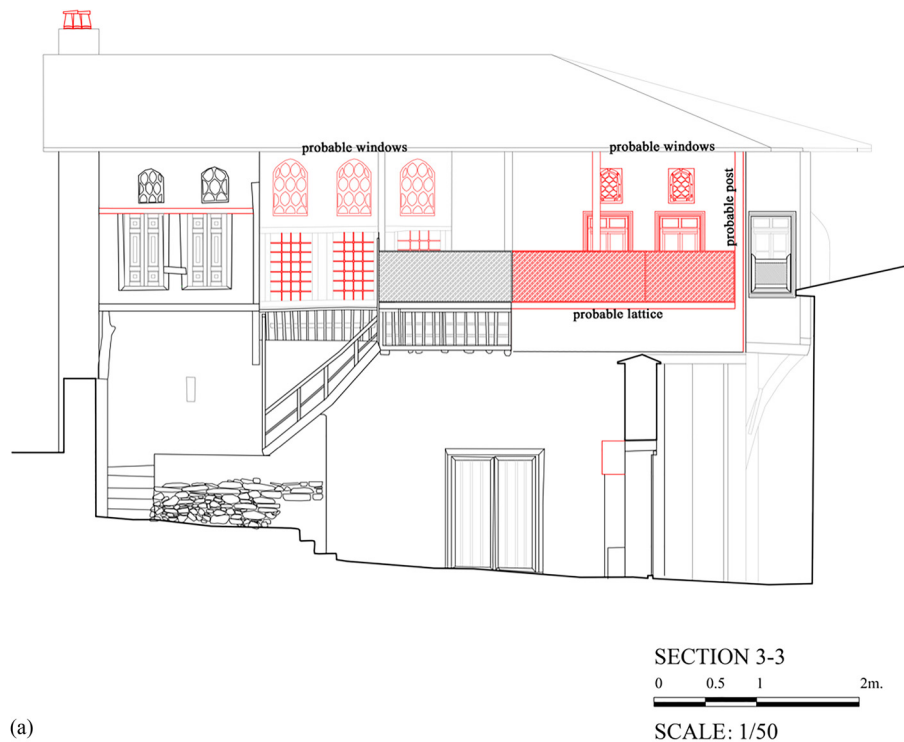
The construction techniques of the two *hayat* houses, an earlier example of the type from *Birgi* and a late example from *Kırkağaç*, have been identified (Table 1). The typical structural theme of a masonry base and a wooden frame upper floor is repeated in *Birgi*. The example in *Kırkağaç* is representative of the local characteristics: U-formed masonry exterior walls on both floors and wooden frames only at the *hayat* façade and interior walls.

In both examples, as a typical characteristic of *hayat* houses, wooden posts are observed at the transparent *hayat* façades. In *Birgi*, they also support the intersection points of interior wooden frame walls at the ground level. The masonry walls of the case studies, in terms of bonding, present qualities in parallel with their

construction dates (Fig. 11). In *Birgi*, *Tarhala*, and *Kırkağaç*, early examples use rubble stones that alternate with slate stone, brick, and tile pieces at their masonry bases. In *Birgi* and *Tarhala*, this technique is observed on the upper floor masonry walls, whereas in *Kırkağaç*, mudbrick can be seen at the upper floor. Late examples have coursed rubble stone masonry. In terms of their finishing, the exteriors of masonry walls are left exposed without plastering in a majority of the examples in *Birgi*, *Tarhala*, and *Kırkağaç*, independent of their dates. This characteristic is repeated in *Kerimağa Konağı* and the house in *Kırkağaç*. In terms of thickness, the same width is sustained throughout the same floor in the majority of *Birgi* and *Tarhala* examples. This was also recorded in the case studies. The usage of symbols on masonry walls is a characteristic seen in relatively early houses in western Anatolia. *Kerimağa Konağı* has a sun symbol. *Spolia* are recorded for *Tarhala* houses (Tayla 2007, F. Diri, unpublished M.S. thesis, Metu 2010; A. Etlacakuş, unpublished MS thesis, Iztech 2015) but are not observed in *Kırkağaç*.

In terms of the load-bearing elements of its wooden frame walls, *Kerimağa Konağı* is a representative of the Turkish *hayat* house—the load-bearing elements form a box system, mainly with horizontal and vertical elements, and the diagonals are distributed between them. The *Kırkağaç* example, on the other hand, has a systematic combination of walls, with diagonals parallel to the short side of the building and the wall without diagonals, but with openings parallel to the long side. Because the majority of the historical houses in *Tarhala* and *Kırkağaç* are in line with the





(a)



(b)

**Fig. 13.** Reconstructions of *hayat* elevations: (a) *Kerimağa House, Birgi*; and (b) *Eker House, Kirkağaç*.

box theme, the house in *Kirkağaç* is interpreted as a manner of subsequent design conscious of the advantages of linear continuity. In terms of infill, *Kerimağa Konağı* is representative of the Turkish *hayat* house with masonry infill at the exterior and application of lath technique at the interior. The use of mudbricks in infill is rare for *Birgi*, although it parallels the tradition in *Anatolia*. In the house in *Kirkağaç*, the infill and finishing are incomplete. Mudbrick, stone, and brick infills in the exterior and lath technique in the interior are observed in other *Kirkağaç* examples, whereas in *Tarhala*, stone infills and the lath technique, respectively, are recorded.

The simple details of the posts in *Kerimağa Konağı* are typical, but those in *Kirkağaç*, the brackets of which are finished with wooden laths, are signs of the developments beginning with the eighteenth century. The forms of the brackets, which give the impression of a series of arches, and the capitals crowning each post, are decorative elements that imitate the architectural orders of the West (Kuban 1995b).

The roof forms of both houses are in line with the characteristics of the *hayat* house: a combination of hipped and gable in *Kerimağa* and hipped in the house in *Kirkağaç* (Fig. 12). The structural

composition observed in the *Kirkağaç* case differs from the Anatolian tradition in terms of its systematic roof frames, which make linear continuity possible, together with the wooden frame walls and posts. The eaves of *Kerimağa Konağı*, which reach 180 cm in width and are finished with wooden laths, represent the tradition, whereas the 35-cm-wide eaves of the house in *Kirkağaç* note its lateness (Kafesçioğlu 1955; Kuban 1995b).

The projections, which determined the characteristics of the streetscape in historical Turkish settlements, are proofs of the respectable age of *Kerimağa Konağı*, whereas they are totally out of consideration in the *Kirkağaç* example. The centralization of the positioning of the house in its lot and block may be the main reason behind the lack of projections in its design. A limited number of historical examples in *Tarhala* and *Kirkağaç* do have projections.

The presence of typical architectural elements of *hayat* houses, such as a wooden staircase with a stone base, fireplace, decorated wooden ceiling, leveled floor organization, doors organized in hierarchy, windows in line with spatial necessities, and built-in furniture in *Kerimağa Konağı* further underline its relations with the tradition. The relation of sitting platforms and windows and the

proportions of the windows in the winter section and *ivan* are in line with the tradition. The thermal camera images of the upper floor walls have revealed other top-bottom windows: one on the southern wall of the elevated winter room and two on the western wall of the summer room [Fig. 13(a)]. In turn, the present windows of the summer room, which are in a 1:2 ratio, may be evaluated as a later intervention. Excepting the staircase, a few niches and the courtyard elements, these details are not considered in the design of the *Kırkağaç* case [Fig. 13(b)]. Its *hayat* façade windows are in line with the characteristics of the late period, but the rear ones are out of proportion (Uluengin 2000).

The building materials used in both constructions are thought to be from local sources. The structural elements of the roof frames and floors are roughly shaped, whereas those in the wall frames are out of a carpentry workshop and a lumber mill for *Birgi* and *Kırkağaç*, respectively.

## Conclusions

This study aims to contribute to the analytic studies on constructional aspects of the *hayat* house typology with an eye on its historical evolution for conservation purposes. In turn, interventions may be planned considering the characteristics of the relevant period, leading to preservation of material and workmanship authenticity. The study presents that the same configuration had been in use in cities and settlements with less urban tastes in different periods in the *İzmir* region. The surviving examples in the dense urban center of *İzmir* are scarce and in a poor state of conservation, for example, Selvili Masjid No. 86 and 945 Street No. 30. A relevant number of intact examples have survived in smaller cities and towns, for example, *Çakırağa* House in *Birgi*; *Bekirbeyler* House in *Kula*; the house at the intersection of Streets 2 and 47 in *Kadriye* neighborhood, *Kırkağaç*; and the house numbered 151 in *Darkale*. The cases presented in this paper, *Kerimağa* House in *Birgi* and *Eker* House in *Kırkağaç*, illuminate the distinctive features of the manners of construction from the eighteenth to the early twentieth centuries. The box system of the wooden upper story, which is integrated with the roof, was replaced with a systematic wooden roof and wall frames in relation with each other, and diagonals are only found in transversal wall frames. Level differences, projections on the upper floor, and the use of traditional rubble stone and mudbrick were replaced with a rationalized configuration and courses of rubble stone masonry. The limited number of surviving examples of *hayat* houses in *İzmir* center and the relevant number of examples in the smaller cities in its vicinity present that the typology had become a standard for the region before the second half of the nineteenth century but, with rationalization, continued to be experienced in half-rural settlements until the early twentieth century.

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