

Investigation of Construction Techniques and Materials in a Group of Ottoman Baths

Kader Reyhan and Başak İpekoğlu

İzmir Institute of Technology, Department of Architectural Restoration, İzmir, Turkey

ABSTRACT: The Ottoman baths built both in small and large settlements, which reflect some aspects of the lifestyle of their period, should be considered as historic evidences worth preserving. The objective of this study is to determine the construction techniques and materials employed in the architectural components of some Ottoman baths found in the small settlements of Western Anatolia, Turkey. The materials mainly used in these buildings were stone, brick and lime mortar as binder. Timber was also used as beams placed in the walls to distribute loads vertically. Terracotta pipes belonging to the heating, lighting and water installation systems were the other construction materials used in the examined baths. The study of the construction techniques and materials of these local baths is determined original qualifications to be conserved and led to protection decisions of their historical identities.

1 INTRODUCTION

In historic buildings, in addition to stylistic ones, the achievements in the architectural features, such as scale, plan layout, mass and facade orders and spatial quality largely depend on the choice of suitable materials and construction techniques. For this purpose, some Ottoman baths located in Seferihisar and Urla nearby surroundings of İzmir in Western Turkey, were selected to determine their characteristics of construction techniques and building materials. Despite their modest and unpretentious scales, they evidently reflect the general outlines of Ottoman bath architecture and the way of life of the period (Fig. 1). In addition, they also offer information on the traditional construction techniques and material use identical to the region, but, being out of use today and negligence for years, these buildings are losing their characteristic values, which render their historic identity. Since no precautions have been taken to conserve these studied baths it is necessary to document their current situations before losing their construction features due to abandonment, lack of maintenance, natural effects and vandalism.

The studied baths are Double Bath (Hersekzade Ahmet Paşa Bath) and Rüstem Paşa Bath in the center of Urla, Kamanlı Bath (Yahşi Bey Bath) in Kamanlı neighbourhood of Urla, Özbek Bath in Özbek village of Urla, Great Bath and Small Bath in the center of Seferihisar, Kaleiçi Bath in Sığacık neighborhood of Seferihisar, Ulamış Bath in Ulamış village of Seferihisar and Düzce (Hereke) Bath in Hereke village of Seferihisar. Despite the absence of their inscription panels, the baths were dated to the 15th and 16th centuries with reference to their architectural features, material use and construction techniques (Reyhan and İpekoğlu, 2004; Reyhan, 2004).

To be based on sound interventions for their preservation, the study has been concentrated on the documentation of the original building materials and construction techniques through field surveys and analysis of the obtained data. Field surveys consisted of architectural measurements together with freehand sketches of architectural details carried out with conventional techniques and photographic documentation.

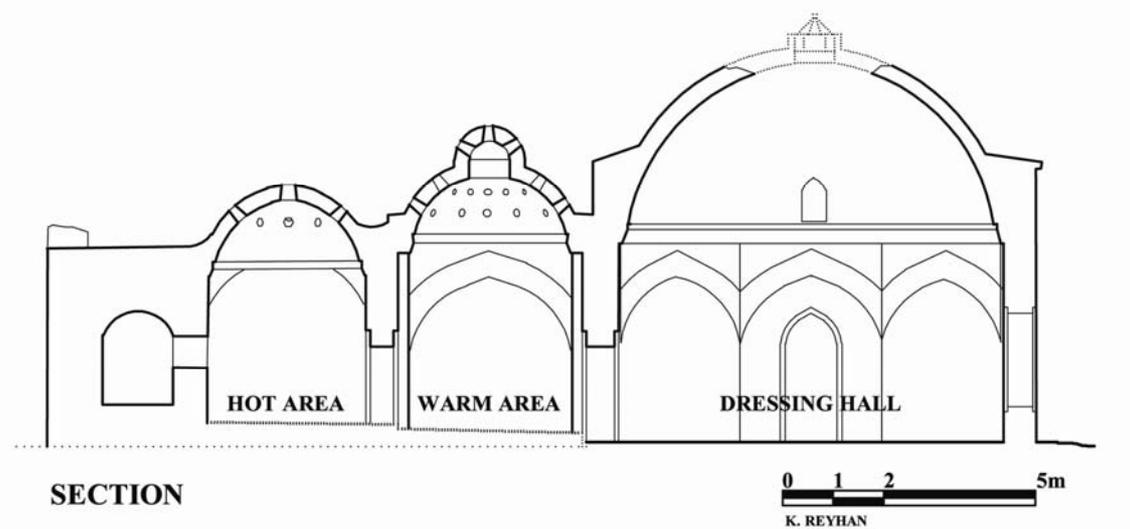


Figure 1 : Longitudinal section of the Düzce (Hereke) Bath (Reyhan, 2004).

2 ANALYSES OF CONSTRUCTION TECHNIQUES AND THE USE OF MATERIALS IN THE BATHS

In the studied baths, the use of materials was examined in four components of the structural system; in vertical support elements (walls), in transition elements to the superstructure, in superstructure elements, and floor system.

2.1 Vertical Elements - Walls

In all of the baths, the walls, which constitute the vertical supporting elements, were constructed of rubble stone, rough-cut stone, reused cut stone, brick, timber, and lime mortar as the binding material. The thickness of the exterior walls varies from 70 cm to 85 cm and the interior walls from 60 cm to 80 cm. The exterior surfaces of the buildings were not plastered, whereas the interior surfaces were finished with lime plaster and brick-lime plaster (horasan). On the walls at specific heights and on the transition zones to the superstructure there are horizontal timber beams that encircle the building. On the walls of the bathing spaces (sıcaklık) there are terracotta pipes in horizontal direction belonging to the water installation system, and there are vertical terracotta flues belonging to the heating system.

Rubble stone, rough cut stone, alternating bond as rubble stone / brick, rough cut stone / brick, and reused cut stone / brick were used as the bonding techniques (Fig. 2).

2.1.1 Rubble stone bond

Three different rubble stone bonding techniques were observed in the studied baths; plain rubble stone bond, rubble stone bond with bricks in some places, and rubble stone bond with large pieces of bricks in flush joints.

1. Use of plain rubble stone bond: Small and large rubble stones were used by baffling vertical joints together. On the exterior part, the joint among rubble stones was built with small stones and mortar forming smooth surfaces. Rubble stones and mortar were filled in the thickness of the wall in random. The northern walls of the reservoir in Ulamiş Bath, Seferihisar Small Bath, almost all the walls of the Urla Double Bath and Özbek Bath, the southwest wall of the Rüstem Paşa Bath and the walls belonging to the dressing hall (soyunmalık) of the Kamanlı Bath were built in this bonding technique.

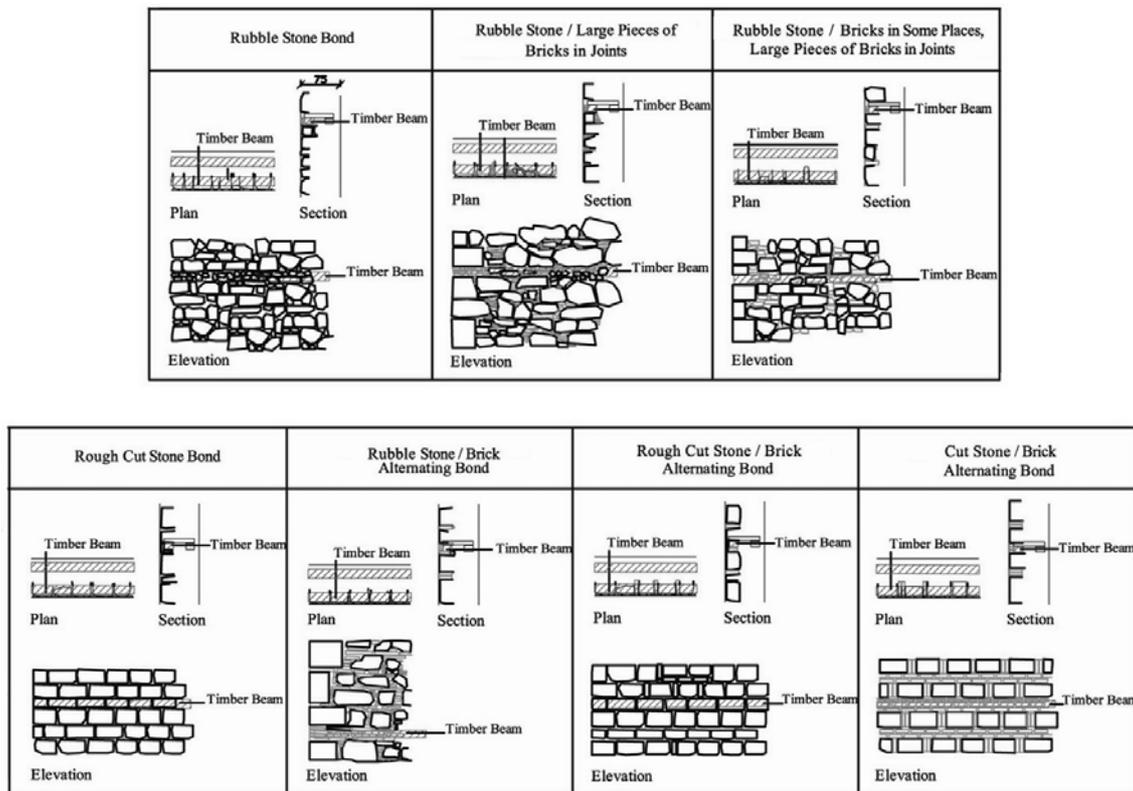


Figure 2 : Types of bonding techniques of the walls (Reyhan, 2004).

2. Use of rubble stones and large pieces of bricks in joints: Brick pieces in the rubble stone bond were placed into the lime mortar filling the voids among rubble stones parallel to the horizontal joints on the surface and in the thickness of the wall. This bonding technique was used for the walls of the bathing spaces in Ulamış Bath, Seferihisar Small Bath and Sığacık Kaleiçi Bath; north, south and except the projecting part of the east wall of Düzce Bath, the east walls of the bathing spaces of Seferihisar Great Bath and the northern wall of the water reservoir of Özbek Bath. The corners of the exterior walls of Seferihisar Great Bath and Sığacık Kaleiçi Bath were strengthened with a vertical line of reused cut stone.

3. Use of rubble stones, bricks in some places and large pieces of bricks in joints: In rubble stone bond, bricks were placed parallel to joints among rubble stones in some places and large pieces of bricks were used in the horizontal and vertical joints on the surfaces of the walls. All of the interior walls of Seferihisar Great Bath and Düzce Bath and north and west exterior walls of Seferihisar Great Bath were built with this bonding technique.

2.1.2 Rough cut stone bond

On the external surfaces of the walls; among rough cut stone, well-arranged bonds were formed with 1-1.5 cm joints with lime mortar. The width of the walls was filled with rubble stones and mortar in random. The northeast and northwest exterior walls of Rüstem Paşa Bath and projecting part on the northwest wall of Urla Double Bath were constructed with this type of bond. Both rough-cut stone and rubble stones were used in the interior walls of Kamanlı Bath and smooth surfaces were achieved by using rough cut stone at the corners of the interior walls.

2.1.3 Alternating Bond

Alternating bonding technique can be seen on the exterior walls in three different types: rubble stone / brick, rough-cut stone / brick, and cut stone / brick.

1. Rubble stone / brick alternating bond: On the exterior surfaces, one or two rows of brick bonds were placed among rubble stones in the horizontal joints while in the vertical joints, large pieces of bricks were placed into the lime mortar parallel to the horizontal joints. In the thickness of the wall, rubble stones, pieces of bricks and lime mortar were filled in random. The west wall and the projecting part belonging to the third private room (halvet) of the east wall of

Düzce Hamamı were built with this bond type (Fig. 3). In addition, at the corners of the walls, on the sides of the doors and windows, one row of brick and one row of reused cut stone encircled by brick can be seen.

2. Rough cut stone / brick alternating bond: This bonding technique is a course of rough-cut stone encircled by bricks in some places and a course of brick. Exterior surfaces were built with joints 1-1.5 cm in width, rubble stones and lime mortar were filled into the thickness of the walls. This bond was only applied to the exterior walls of the warm area (ılıkık) and bathing spaces in Kamanlı Hamamı.

3. Cut stone / brick alternating bond: This bonding technique was formed by a row of reused cut stone encircled by bricks, two rows of brick with horizontal and vertical thin joints. It can be seen in Seferihisar Great Bath, on the parts belonging to the dressing hall (soyunmalık) and the warm area (ılıkık) of the east wall where the entrance was placed (Fig. 4). In the alternating bond seen at the corners of the exterior walls and the sides of the doors and windows in Düzce Bath, one row of reused cut stone and one row of brick were used.

The use of structural timber on the walls has two different types. The first one is the timber beams that were placed at specific heights and encircled the building horizontally. The other one is timber lintels, which existed above the rectangular door and window openings. Timber beams were generally placed in two rows in the thickness of the wall. The first is behind brick bond which consists of three courses and close to the surface, the other was placed in the thickness of the wall. The beams, which are approximately 15x15 cm, are connected to each other by the timber elements placed vertical to the beams in the wall using metal clamps. Timber lintels are 10x15 cm, placed above the rectangular door and window openings to distribute the load vertically. Above them, there are relieving arches built with brick bonds.

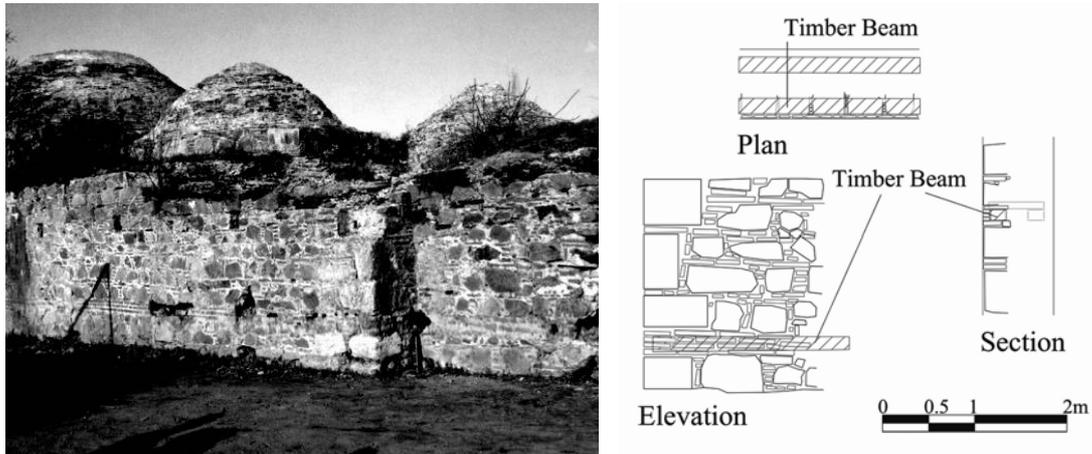


Figure 3 : Düzce (Hereke) Bath, west facade, rubble stone / brick alternating bond (Reyhan, 2004).

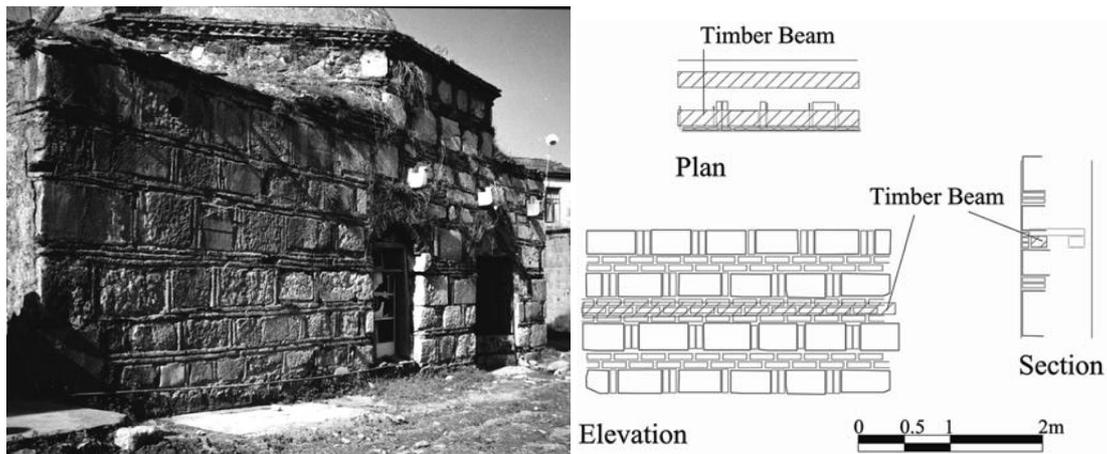


Figure 4 : Seferihisar Great Bath, east facade, cut stone / brick alternating bond (Reyhan, 2004).

Bricks were used on the arches of the door and the window openings in the exterior and interior walls, on the arches of the niches located on the interior walls, on the arches of warm area and bathing spaces that open up to the side vaulted spaces and in some examples they were used inside of the niches for the purpose of decoration. The size of bricks was measured as 21 x 32 x 3-4 cm, 10.5 x 32 x 3-4 cm, and 16 x 21 x 3-4 cm. Generally used joints were thin in the intrados, 3-4 cm in width in the extrados. Bricks were used for decoration in lobed parts on the niche which is placed in the warm area of Seferihisar Great Bath and in the muqarnas arranged in the fountain niche located in the main bathing space of Kamanlı Bath and the surfaces were covered with horasan plaster. Bricks were used with their geometric opportunity as decoration on the facades, on the upper level of the walls and drums with saw-tooth arrangements. These arrangements can be seen in Seferihisar Great Bath and Urla Kamanlı Bath.

Terracotta pipes belonging to the water system are 37.5 cm in length cylindrical pipes that were connected to each other with 10.5 cm in diameter on one side and 12.5 cm in diameter on the other side, and 1.5 cm in thickness. These pipes that provide water from the water reservoir to the bathing spaces were arranged as one or two (one on the top of the other) rows according to the dimension of the building and needs. Their surfaces were plastered with horasan. Tap panels were placed in the wall bonding system in which pipes reach the basin point out the outlets of faucets.

Flues (tüteklik) which let the smoke come out from hypocaust (cehennemlik) space were vertically placed in the walls of the warm area and bathing spaces. They were formed by placing cylindrical terracotta pipes which are 14 cm in diameter, 1.5 cm in thickness, and 36 cm in length one on the top of the other. The chimneys over the walls were raised with brick material of 16 x 21 x 6-7 cm dimensions.

The surfaces of the walls in the dressing hall are covered with lime plaster while in the warm area and bathing spaces they are covered with horasan plaster. Horasan plaster was applied as a double layer which has a 3-4 cm thickness to approximately 100-120 cm high from the floor and 2-3 cm thickness in the upper parts.

The arches are generally structural elements used on the squinches, in the openings of side units in the warm area and bathing spaces, in the niches on the walls as well as in the window and door openings. According to the spaces and their openings where they were used, they are in different dimensions, shapes and materials. There are also blind arches on the surface of the walls of interior spaces and in the entrance and window openings, which were used as a relieving arch in brick bonding technique in some facades. Arches were generally constructed with thin joints 1-1.5 cm thick in the intrados and large joints 3-4 cm thick in the extrados. At the springing levels of arches, mostly large rubble or cut impost stones were placed inside the wall bond. When impost was a cut stone, it was in various profiles.

2.2 Transition Elements

Transition elements are structural elements that provide transition between the dome, which sits on a circular base, and the walls, which are vertical supporting elements in the square spaces. The loads coming down from the dome are transmitted to the walls and then to the base through the transition elements. In the studied baths, transition elements from square plan to the springing level of the domes are squinches, pendentives, plane triangles and belts of Turkish triangles. These elements were built of bricks and lime mortar with horizontal wide and vertical thin joints. Transition elements in the dressing hall are squinches, and in the warm area and bathing spaces they are generally pendentives. In the dressing hall of Seferihisar Great Bath, transition to the dome was provided with lobed squinches (Fig. 5).

When transition from square planned substructure to the springing line of the dome was provided by plane triangles formed by one or two units arranged on the corners, forming 3-4 cm joints on horizontal brick bond courses and the surfaces were plastered.

Among the examined baths, belts of Turkish triangles as transition element were determined only in the warm area of women's section in Urla Double Bath and southwest private room of Kamanlı Bath (Fig. 6). The corners of the base and the top of the prismatic triangle units were connected to each other by turns in the form of lozenge shape. The Turkish triangles were built with bricks forming large joints.

When the transition element to the dome is pendentive or plane triangle, there is a drum built with brick bond between the springing level of the dome and transition elements and dome starts from the top of it. At the interior, the drum was built of bricks with 3-4 cm joints and the surface was plastered. It was formed as an octagonal frame between the walls and the dome on the exterior, which raises and supports the dome from the exterior. Generally it has the same construction technique and material of wall bonding technique without plaster.

2.3 Superstructure

In the studied baths, the spaces are mostly covered with domes and vaults that were generally built with bricks and lime mortar. However, the dressing halls in some baths have timber roof. In Sığacık Kaleiçi Bath and Özbek Bath, the timber roof of the dressing hall was constructed by placing the timber beams over the rubble stone masonry walls.

Vaults, which are mostly the superstructure of small rectangular spaces, were built with bricks or brick / rough cut stone and lime mortar. The vaults are in two different types: barrel vault and panelled vault. Side units of warm area and main bathing spaces were covered with barrel or panelled vault, whereas water reservoirs were covered with barrel vault. Interior and exterior surfaces of vaults were covered with horasan plaster. Depressed pointed or semi-circular vaults were built by placing the long side of brick or brick and rough-cut stone vertically to the short side of the space. Along the central axes of barrel vaults that belong to the



Figure 5 : Seferihisar Great Bath, the lobed squinches in the dressing hall.

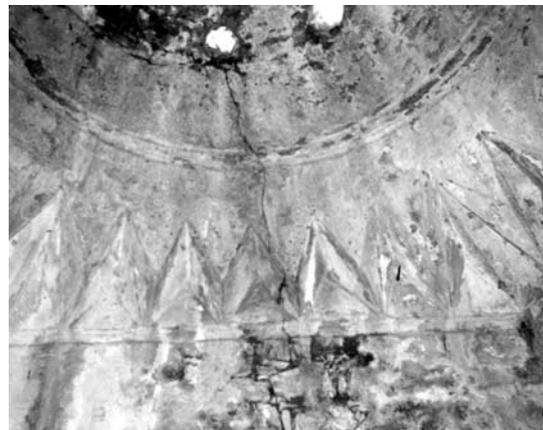


Figure 6 : Urla Kamanlı Bath, the belt of Turkish triangles in the southwest private room.

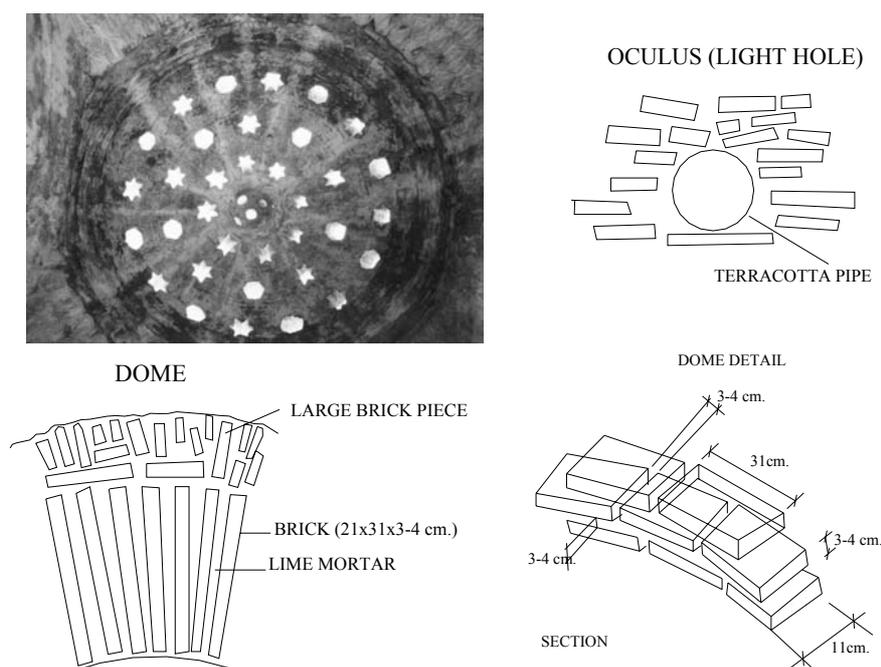


Figure 7 : Urla Kamanlı Bath, the dome of the main bathing space (Reyhan, 2004).

the bathing spaces and warm area spaces, oculi (light holes), made of terracotta pipes were arranged among brick bond for the purpose of lighting. On the central axis there are generally three oculi.

Dome, which is superstructure of dressing hall, the middle units of warm area and main bathing spaces and private rooms was constructed with bricks and mortar. Thickness of the domes is one or one and a half brick, in other words it is 35-45 cm. The bonding system of the domes was formed by placing the units of brick radially against the centre. The dome, in the bathing space of women's section in Urla Double Bath, rises as octagonal pyramid in the interior and close to the top it turns into a circular shape. On the transformation level, an octagonal border was built with a course of brick. Both the interior and exterior parts of all domes are covered with horasan plaster, but in the Özbek Bath the plaster is covered by traditional tiles. On the top of the dome, at the keystone opening either an oculus in the shape of hexagon by placing terracotta pipes or lighting cupola in the depressed hemispherical shape were arranged. On the cupola there are also oculi. The oculi arranged among brick bond of domes ease the load of the dome and lighten the spaces (Fig. 7). The opening that narrows towards the exterior of terracotta pipes are in the shape of hexagon, circular, star or rectangle and the interior part is between 25-40 cm and the exterior is between 19-25 cm. The oculi belonging to the lighting system are generally in circular two lines, hexagon shaped and towards the top decrease in number.

2.4 Floors

The floor system of warm area and bathing spaces including hypocaust were built by masonry walls made of bricks or cut stone, which are 90-120 cm in height and covered with cut stone. Above the openings between the walls that form the hypocaust space, in some examples timber lintels, in other examples plain, slightly curved or arched stone lintel were discovered. The size of cut stone varies in the spaces. Generally, they are 55-60 x 70 x 7-8 cm in dimension.

Waste water channels belonging to waste water installation system were arranged on the floors of the spaces which have hypocaust beneath. The channels formed by placing cut stone covering, which were on the masonry walls, next to the walls and stone seats in steps are 10-12 cm in width, 7-8 cm in depth. Waste water coming from private rooms goes along the stone

seats and it turns into one channel in the warm area and eventually it ends up either in the toilet of warm area or it is discharged from a corner of the warm area.

Basins placed on the floor of the bathing spaces were made of stone. For basins in women's section of Urla Double Bath and some basins in Seferihisar Small Bath reused materials were used. The basins are in the shape of circle, semi-circle, semi-octagon or semi-decagon. The stone seats next to the basins were arranged as raised with bricks around 20 cm from the floor level and covered by cut stone.

3 CONCLUSIONS

In general, the Ottoman bath consists of row of spaces which are dressing hall, warm area, and bathing spaces in addition to furnace (külhan) and water reservoir. According to the classification of Turkish baths considering the plan organization of bathing spaces, the studied baths are generally in the plan type of elongated rectangular bathing spaces with a domed central unit and two private rooms (Eyice, 1960). Transition elements to the superstructure and their domes and vaults, pierced by oculi, create plastic effects in their spatial perception.

In all the baths, the main material used for walls are stone and transition and superstructure elements are mostly brick. Brick differentiated the bonding system on the walls as secondary material. Use of bricks in some places and large pieces of bricks in joints in the rubble stone bond, and timber beams placed at specific heights on the wall bonding system, which encircle the building horizontally, can be considered as local and traditional features seen before the Ottoman period and also continued during this period (Aktuğ Kolay, 1999).

On the walls of bathing spaces, there are vertical terracotta flue pipes, belonging to the heating system and horizontal terracotta pipes, which belong to the water system. Oculi in the vaults and domes were built by placing terracotta light pipes along brick bond. For the seats and basins, which are internal elements, mostly stone was used although some basins were constructed of reused materials.

In addition, the techniques used to strengthen walls at the corners, encircling the arches with one or four rows of brick bond, and saw-tooth arrangements on the upper level of the walls and drums were local techniques seen before the Ottoman period, and they were continued.

In the studied baths, the floor system formed with masonry walls covered with cut stone differs from Roman baths' floor system raised on high platform with pillars. In hypocaust section, above the opening of the walls that forms the hypocaust, in some examples timber lintels, in other examples flat, slightly curved or arched stone lintel were noticed as original local construction techniques.

The studied baths reflect the social and cultural life of the Ottoman period in small settlements. The survival of the historical identities of these investigated local examples depends on the conservation of the original construction techniques and materials.

REFERENCES

- Aktuğ Kolay, İ. 1999. *Batı Anadolu 14. Yüzyıl Beylikler Mimarisinde Yapım Teknikleri*. Ankara: AKM Yayınları.
- Eyice, S. 1960. İznik'te Büyük Hamam ve Osmanlı Devri Hamamları Hakkında Bir Deneme. *Tarih Dergisi* 11(15), p. 99-120.
- Reyhan, K. and İpekoğlu, B. 2004. Osmanlı Dönemi Bir Grup Hamam Yapısında Malzeme Kullanımı. 2. *Ulusal Yapı Malzemesi Kongresi ve Sergisi; Kongre Bildirileri, İstanbul, 6-8 October 2004*, p. 482-493. İstanbul.
- Reyhan, K. 2004. *Construction Techniques and Materials of the Ottoman Period Baths in Seferihisar – Urla Region*. Unpublished MS Thesis, İzmir Institute of Technology, İzmir.