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Structural Interventions for Conservation of the 15th Century Tahtakale Bath, Tire, Turkey

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Abstract Tahtakale Bath, which is located in the town of Tire in the province of İzmir, Turkey, was constructed in the 15th century and is one of the outstanding existing examples of Ottoman period baths. The building, which was designed as a double bath, was considerably damaged because of inaccurate interventions after losing its original function, lack of maintenance and natural circumstances. The parts which were reused have considerably lost their original characteristics. This study aims to introduce the construction technique of Tahtakale Bath, which was studied in the scope of a restoration project, and to present the studies on the determination of structural problems, structural strengthening decisions and implementations.

Strengthening implementations were carried out in the bathing spaces of the men's section and felt workshop of the building depending on decisions of the restoration project. The original construction technique and materials of the walls, superstructure and architectural details of the building were consolidated by appropriate restoration decisions and implementation works.

Keywords: Structural restoration, ottoman bath, masonry construction technique, strengthening.

Introduction

Tahtakale Bath, located in the town of Tire in the province of İzmir in Western Turkey, is an impressive example of the existing Ottoman Baths. The building was dated back to the first half of the 15th century according to the foundation charter dated to 845 H./1441-1442 A.D. (Armağan 1983, Çakmak 2002). It is the only bath that is located in Tahtakale Square, which is the historic bazaar quarter and has a distinctive value in its location. Tahtakale Bath was a component of Tahtakale Külliye (complex) which was a social and commercial center of Tire during the Ottoman Period.

Tahtakale Bath was originally designed as a double bath with a large section for men and a small section for women. However, the building lost its original function during the course of time. At present, dressing hall, bathing spaces of the men's section and the bathing spaces of women's section are divided into three separate lots and ownerships. Dressing hall of the men's section, which is privately owned, is used as a textile shop. The domed superstructure of the women's section was demolished and a poor quality second level was constructed for residential use and is presently a storage area. It is also privately owned. In 2005, The Municipality of Tire expropriated the men's section in order to prevent further destructive effects. Upon the request of the Municipality, documentation, restitution studies and a restoration project were carried out and implementation consultation was conducted by İzmir Institute of Technology, Department of Architectural Restoration on this section (Kaplan et.al. 2006).

The aim of this paper is to introduce the construction technique of Tahtakale Bath and to present the studies on the determination of structural problems, structural strengthening decisions and implementations. The building was first architecturally documented by measured drawings to determine the alterations and structural problems. Following documentation phase, the historical

research and analysis of the structural condition were done and the strengthening decisions were developed.

Spatial Characteristics

Tahtakale Bath is surrounded by shop units on three sides and it can only be perceived from its northwest facade. The original entrance to the bath was through Tahtakale Square, from the southeast where the dressing hall is located. However, the bathing spaces of the men's section cannot be accessed from dressing hall as in the original plan, since the dressing hall is under different ownership and the door opening to the men's section was filled in. At present, the entrance of the bathing spaces of the men's section is provided through Bakır Han Street and by three doors which were opened later and the door of the felt workshop on the northwestern facade.

Tahtakale Bath is a double bath with men's section in its east and women's section in its west (Fig. 1). The domed superstructure of the women's section was seriously altered when it was demolished to make way for a poor quality second level construction. In the original plan the men's section contained a dressing hall (soyunmalık) which is octagonal in plan, the passageway (aralık) and the warm area (ılıklık) rectangular in plan, the hot area (sıcaklık) cross-like in plan with three iwans and two private bathing spaces (halvet) at the corners.

The water storage, rectangular in plan, is to the west of the bath, adjacent to the men's and women's sections and the felt workshop is to the east of the bath, flanking to the men's section. The rectangular space in the east of the felt workshop is thought to be used as a passage in order to access Tahtakale Square. Today, this space was included to the men's section because it lost its function due to the construction of the shop units at one end.

Dressing hall, main space of warm area, toilet, main space of the hot area with its northern iwan and private bathing spaces at the corners are covered with domes, while the rectangular iwans of the hot area are covered with half-domes. The west of the warm area was widened with semi-circular arch and covered with a paneled cloister vault. The passageway is covered with a barrel vault in its east direction and quadrangle pyramidal dome in the west direction. The water storage, felt workshop and the passage space are covered with barrel vaults.

The transition elements to the superstructure are Turkish triangles in dressing hall, warm area, central space of hot area and private bathing spaces and squinches with muqarnas in western and eastern iwans of hot area and pandantives with muqarnas in toilet and northern iwan.

Hypocaust of the bath was totally damaged and the floor coverings were removed. The floor was filled with earth and slates were randomly placed.

The northwestern facade, which is the only perceived facade as a whole, was constructed with bonds of thick and small plates of slates. The facade order was altered by the doors each opened later to the northwestern iwan and north and west private bathing cells. In addition, a stone staircase was constructed to the northern part of the facade leading to the roof.

Construction Technique and Material Use

Tahtakale Bath was constructed out of slate, brick and lime mortar as binding material in masonry system. The thickness of the exterior walls varies between 85-130 cm, while interior walls vary between 83-106 cm. The thickness of the wall between water storage and bathing spaces is measured as 143 cm. In the walls of the bathing spaces, there are terracotta pipes placed horizontally in 1.00 m height belonging to water system and vertically belonging to the heating system for exhaust.

Brick bond is used in the construction of arches, transition elements as pandantives, squinches and Turkish triangles, vaults of the passageway and warm space, and domes of dressing hall, warm area, and bathing spaces. The bonding technique of vault on the water storage is bonds of thick and small fragments of slate with brick bonds. Felt workshop and passage are covered with vaults constructed with bonds of thick and small fragments of slate.

All the interior walls are plastered. There is no trace of any plaster on the northwest facade. However, interior walls, transition elements and superstructure are plastered with brick-lime plaster 2.5 cm thick and lime plaster 1.0 cm thick on top of it. In the bathing spaces, there are 2 layers of brick-lime plasters up to 1.50 m from the floor. First layer of the plaster is 3.5 cm thick and second layer of the plaster is 2.5 cm thick. The higher levels of the walls are plastered with 2.5 cm thick brick-lime plaster and lime plaster 1.0 cm thick on top of it as in the upper structure. Brick-lime plaster with 3.5 cm thickness is observed on the walls of water storage up to 1.20 m from the floor level. The walls of felt workshop are covered with 2.5 cm thick brick-lime plaster.

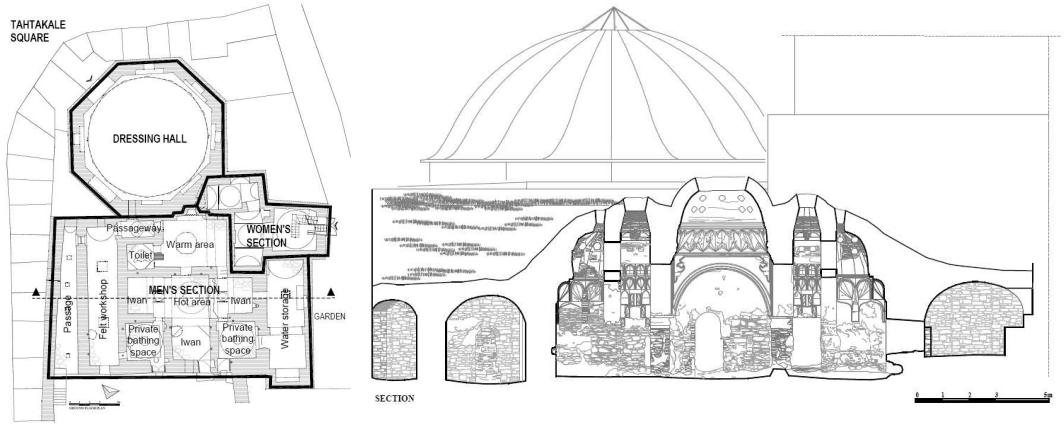

Figure 1: Plan and section of the bath (Measured drawings)

Structural Problems

The structural problems observed in the men's section of Tahtakale Bath are due to the damages occurred on superstructure, the additional entrances on the northwest wall, human intervention, dampness problems and environmental conditions.

The collapse of the additional wooden roof, which was constructed on the domes and vaults in order to provide more space, caused debris heap and plant growth on the superstructure. The rainwater which penetrated into the building through the cracks, oculi and partial collapses on the domes and vaults caused plant and crack formation on the roof and northwest facade.

The upper part of the wall on the northwest facade was partially collapsed. The additional entrances on this facade caused structural problems to the wall. The wall between the relieving arch providing entrance to the iwan and the additional door opening at the western private bathing space was damaged as a result of the loads coming from the broken lintel on the western private bathing space. As a result, some cracks formed on the wall and relieving arch of iwan entrance.

In the interior, partial collapses, which are thought to be formed when the building was used as storage, were observed on the upper parts of the domes of bathing spaces and warm area as a result of dilapidation, human intervention and rain penetration.

The rainwater, which penetrated through the partially collapsed domes and vaults of superstructure, caused mortar discharge in joints, partial losses and damages in the bonds of superstructure and walls as a result of freeze-thaw cycle (Fig. 2, Fig. 3).

The tension cracks formed on the key section of the arches in the central area of bathing spaces are some of the crucial structural problems. These cracks are thought to be formed because of the load of additional roof.

On the other hand, the removal of floors for reuse, destruction of hypocaust and filling this space with earth caused rising damp problems in the building. It is observed from the damaged lower parts of the walls that the rainwater penetrating into the building accumulated on the floor and caused it to penetrate into the walls. There is loosening of the bonding system at the lower parts of the interior walls and damages on the corners of the walls (Fig. 3). The loss of original plasters were also observed

in bathing spaces, warm space, water storage and felt workshop as a result of human destruction and rainwater.

Figure 2: Damages on the domes

Figure 3: Damages on the walls of bathing spaces of men's section

Restoration Decisions and Implementations

In the restoration project, the men's section is to become a workshop and store to make and display the handmade textiles particular to the Tire area (felt and beledi weaving). Before the structural implementations, the soil filling on the floor of the hot area was excavated to investigate the hypocaust. Excavations showed that the hypocaust of the bath was completely damaged and only the smoke gaps in the lower parts of the walls were determined.

Debris on the superstructure that is one of the basic reasons for the structural problems was removed. Tons of debris were removed from the roof and the vaults, domes and the exhausts of the vertically located terracotta pipes were documented in detail by drawings and photographs. Removal of the debris from the roof changed the load distribution in the building. Thus, structural system of the building was reinvestigated to determine the structural deteriorations that may have occurred after removal of the roof debris. This investigation showed that a new crack in the transition element of the northwest iwan dome occurred after removal of the roof debris.

Plant formation on the superstructure and northwest facade were cleaned with chemicals that do not cause any deterioration on the original building materials such as stone, brick and mortar.

Deteriorated parts of the wall bonding such as disintegrating mortar, cracks in mortar joints, loose bricks or stones, were consolidated with hydraulic lime mortar, slate and brick material as in the original bonding system (Fig. 4). The mixture used in the filling of the wall pointing was prepared compatible with the original mortar and composed of 1 part hydraulic lime mortar, 1 part powdered and cracked marble and 2 parts washed sand.

Cracked and broken terracotta water pipes were changed with the terracotta pipes in hexagonal form. Tensile cracks in the arches and the cracks in the transition elements were restored by injection method using hydraulic lime mortar. At first, the plasters in 25-30 cm range, around the cracks were removed and the interior parts of the cracks were cleaned. Injection tubes were placed into the interior parts of the cracks and filled with hydraulic lime mortar (Fig. 5). Finally, joints around the cracks were filled and the exterior parts were leveled.

Figure 4: Restoration works on the walls of the bathing spaces

Figure 5: The strengthening implementations on the arches with injection tubes

Figure 6: Bathing spaces before restoration

Figure 7: Bathing spaces after restoration

The detached plaster layers were removed while the sound parts were conserved. The removed parts were rendered with hydraulic lime plaster. The finishing coat was applied on the conserved original plasters using hydraulic lime plaster. The brick-lime plaster was applied on the walls of water storage upto 1.20 m from the floor as in the original. The plaster used in the restoration works is composed of 1 part of hydraulic lime plaster readymade, 2 parts of washed sand and 1 part of powdered brick. The damaged parts of the transition elements were completed in their original forms by using hydraulic lime mortar (Fig. 6, Fig. 7).

In order to prevent dampness problem in the building, an isolation layer using hydraulic lime mortar (20 cm thick) was implemented on the floor of hypocaust. The wooden floor covering with steel supporters was constructed on the isolation layer. The original floor height of the bath was taken into consideration and the floor was constructed at 1.00 m height from the ground level which is same with the original height of the hypocaust. The heating and ventilation system was set through the steel construction under the floor coverings and ventilation holes were arranged in the wooden floor coverings.

After the removal of debris on the superstructure, it was determined that there were slate covering over compacted soil on the vaults and on the domes two layers of brick-lime mortar one containing brick powder in 1 cm thickness and the other containing brick powder and tile particles in 5 cm thickness. During the implementation works, a first layer of hydraulic lime mortar containing water proof material was applied over the original compacted soil layer on the vaults. Then membrane

isolation material was laid on and second layer hydraulic lime mortar layer containing water proof material was implemented and over the sand leveling the slates were placed as in the original.

The upper structure where cupolas existed in the original and oculi on the domes were covered with semi-transparent hemispherical caps made of weather resistant thermoplastic material in 4 mm thickness since the original forms of the cupolas could not be determined.

The additional entrances on the northwest facade were filled with slate and hydraulic lime mortar. In order to protect the facade of the building from rainwater, two layers of brick bond were built as eaves (2.5 cm) and gutters were located on the upper parts of the northwest facade. A drainage system was implemented in front of the northwest facade of the building in order to protect the building from the effects of rainwater.

Conclusion

The aim of the restoration implementations of Tahtakale Bath, a historical 15th century Ottoman Bath, was to conserve and consolidate the original construction techniques and materials by appropriate intervention decisions. The major strengthening implementations made in the building may be summarized as follows:

- The additional entrance openings on the northwest facade, which do not exist in the original design of the bath, caused structural problems on the wall. Thus, the additional openings were filled using slates and lime mortar except the opening to the iwan from the outside to provide a secondary entrance for public use.
- The cracks observed on the walls, transition elements and arches were strengthened using hydraulic lime mortar by injection method.
- The slate covering over compacted soil on the vaults and brick-lime plaster on the domes were conserved as in the original system using readymade hydraulic lime mortar including water proof additive in order to provide water insulation on the superstructure.
- The original floor covering above the hypocaust system, which does not exist today, was marble considering the restitution information. Since the forms and order of the original covering could not be determined in the restoration implementations, the wooden floor covering over steel carriers was adopted appropriate for new use. The wooden floor was constructed on an insulation layer on the ground at 1.00 m height which is same with the original height of hypocaust and heating and ventilation installations were concealed in this part.

The strengthening and restoration implementations were carried out considering the restitution information and restoration approach to the building. The materials used in the implementations were chosen considering the characteristics of the original materials used in the bath. In this scope, the restoration of Tahtakale Bath is one of the examples which contribute the conservation of the construction techniques and structural strengthening implementations.

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