

A SURVEY ON CONSTRUCTION TECHNOLOGY IN TRADITIONAL BATHS OF IRAN (CASE STUDY: ESFAHLAN BATH OF OSKU - TABRIZ)

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ABSTRACT

Architectural typology of different areas shows that many factors such as natural, cultural, social, and economical factors have been introduced on behalf of the residents as effective factors in the formation of traditional architecture. Although, environmental conditions had the most effect on the form and structure of traditional buildings, but for constructing Iranian baths, trying to keep the warmth and moisture generated inside the bath is the most important and effective factor on the form and structure of Iranian traditional baths. It was experienced that putting the building floor a few meters above the ground surface, constructing thick walls, and also inside architecture of this traditional building all show efforts to maintain the warmth and moisture inside the building. Classic spaces of Iranian bath and architectural pattern of it were constant in all these conditions, but on the other hand, different limitations such as area, land position, and usage of different architectural and decorative elements has caused dissimilarity of any two baths.

Within the present paper, in order to investigate the construction of these buildings (i.e. Esfahlan baths of Osku), historical baths registered by the Cultural Heritage Organization of Tabriz were studied as statistical population by the use of knowledge of experience or use of a new technology. Also the study benefited from analytical survey method with a toolbar containing figures, tables, and maps.

The results obtained from the research shows that traditional architecture of baths, considering the sample study, has unique properties which alongside with paying attention to proper designing and using local-coordinated materials could also response to environmental issues without having a primary basic technology but on the base of the residents' experiences and observations of the area. It would be possible to carry out more research in contemporary projects considering the findings of the present study.

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1. INTRODUCTION

Architecture of bathroom like other old buildings follows specified spatial patterns such as access to water, maintain separate, clean and dirty areas. The original three conditions were used for the created complex and different spatial with other building in Building bath.

With regard to the limitations like area, land limit, decorative elements, architecture and various forms of spaces have caused changes in the historical bathroom but there is no bath exactly similar to the other one. Studies show that even beside the mentioned factors, special principles at the stages of design and later in construction of baths in each area has been considered as determining factors for the residents. These principles are the result of factors such as climate, natural environmental conditions as well as maintaining the principles and general pattern of architecture in baths specially in the type and arrangement of the location.

2. ARCHITECTURE OF BATHHOUSE

Bathhouses were one of the most important buildings of a city. They were usually located at the center of towns or near the bazars and main roads. From the pre-Islamic era the remainders of private bathrooms were discovered in Persepolis (Achaemenian era) and Assyrian Palace (Parthian era). But the development of the traditional bathhouses, that were used until the time before the modern urban piping emerge dates back to the Islamic era. Since bathing includes several steps, therefore Iranian traditional bathhouses had spaces with different functions. In this respect the spaces in a bathhouse can be divided into three parts:

1-semi hot and semi humid

2- hot and humid

3-very hot and very humid (Ghobadian, 2006).

The controlling system of the bathhouse was in a way that the heat and moisture enter from the Entrance vestibule and changing room (semi hot and semi humid) to the hall and bathhouse (hot and humid) and finally would reach to its maximum level in Khazineh (very hot and humid). Therefore these spaces were independent and they were only connected through indirect tunnels or vestibules.

2.1. Architecture of the inner spaces of bathhouses

Investigations of the section of old bathhouses show that the ceiling of these places were high and were capped by a dome (Kolombe, Tarkin, Karbandi, and Araghchin). Changing room dome the main dome of the bathhouse was in the main hall of the bathhouse. And the smaller domes belonged to the other spaces. Although the dome cover is one of the characteristics of Iranian architecture in terms of the structure of models for ceilings and openings, the height and dome-like ceilings were used for other reasons that originated from the functions of such buildings.

The skylight service, generally, was provided through the ceiling and with the help of an element called "Jamkhaneh" that was from glass, and a material called

“moine” (a combination of washed wool, oil, and clay) were used for sticking the glass and the clay. In addition to these items, we should mention that the circuitous tunnels prevented the outside air and dust into the bathhouse.

3. THE EFFECTIVE FACTORS IN PROVIDING GOOD CONDITIONS FOR BATHING

The main function of bathhouses can be put forward in bathing, and in order to accommodate a good condition for bathing, four factors are necessary. For a detailed study these factors have been mentioned as follows: a. Headings of Main and sub-sections should be numbered, b. The headings of main sections should be written in capital letter, c. For the headings of sub-section, only the first letter of word should be written in capital letter as illustrated in the examples (all the headings should be in bold), and d. Lines of space between sections should be as in the examples.

3.1. Temperature

One of the most important factors and perhaps the main one is temperature. Providing the temperature in the bathhouse was not possible directly. It was due to the reason that in the past the artificial heat was generally created by burning organic materials, the smoke and Carbon dioxide which prevented respiration and other human activities inside the enclosed area of the bathhouse (Kiani, 2011). Therefore, the required temperature was obtained outside of the bathhouse and by burning the organic materials in the fireplace under the caldron of Khazine, and it would heat the water of Khazine. The smoke and the heat of fire would also be transferred under the ground of the bathhouse (Memarian, 2008). The fireplace room (Patoon) had a way to the public path that was the way by which fuel would enter the bathhouse. The heat and smoke of the fireplace go to through underground tunnels (Gorbero) that are narrow paths. These Gorberos would cross under the floor of bathhouses and bring the heat to the atmosphere of the bathhouse. The Gorberos were covered with marbles and other similar stones. These stones would both provide the heat transfer and were durable and easy to be cleaned (Ghobadian, 2006).

3.2. Water and Moisture

Water and Moisture are at the next level of our classification. The required water were obtained from the creeks, aqueducts, and wells. In the proximity of those bathhouses that were supplied by the well water, a well would be created and some men or bullocks would take out the water. The water would then enter a pool and by some ceramic pipes called “Tanbooshe” would enter the bathhouse Khazineh. In the proximity of Garmkhane in some of the bigger and better bathhouses there was a pool called “Chaharhoze”. Their water were not usually warm and they were used for swimming in the summer, however some of these Chaharhozes had Tian that was used to heat the water. Except for the Chaharhozes, there were also other small pools that people washed themselves up beside them.

There was usually a big pool at the center of the changing room that in addition to beauty would help to moisturize the atmosphere. The paths to the main spaces of

bathroom were indirect and restricted, therefore the excessive moisture of the humid areas would not be entered to the semi-humid sections. The body of the clients, when entering the bathhouse, would gradually feel the water or the temperature and at the time of leaving, too, the temperature and moisture would be reduced gradually (Ghobadian, 2006).

3.3. Light

Light can be regarded as one of the influencing factors in baths construction. The residents' experiences made them benefit from such a factor as well as others, too. The ceiling provided the Light of bathroom spaces, usually placed at the center of roofs which provided baths space with harmony, and brighter shade which in turn creates a bright beautiful environment. Pool of water under the skylights on the front adds lighting.



Figure 1. Ganjali Khan bathroom, Kerman, Iran (Memarian, 2008)

Since a major part of the lateral surfaces of most bathrooms are located under the ground therefore the sunlight would go into the bathhouse through the skylights and the windows under the vault. In order to meet the necessities, convex glasses called "Goljam" were installed at the top of the dome, and its surrounding was sealed with Sarooj or Mumine mortar. In cases of lacking adequate light, handheld lights would be used (Ghobadian, 2006).



Figure 2. Windows beneath the dome in the Ganjali Khan bathroom, Kerman, Iran (Memarian, 2008)

3.4. Ventilation

Bringing up the good conditions for bathing, in addition to controlling the temperature, moisture and light, requires a regulation of ventilation system. Bathing of many people at the same time as well as the moisture and heaviness of the bathhouse air, utilization of lights which produces smoke and carbon dioxide and the restricted area of the bathhouses requires a controlled ventilation, otherwise it may lead to Asthma or even suffocation. Therefore, the windows under the vault should be opened to avoid any respiratory problems (Ghobadian, 2006).

Then, these factors (on behalf of architects or the habitants) appeared as the permanent principles or to be more clear technologies used there after for construction of baths.

4. THE ARCHITECTURE OF THE TRADITIONAL BATHHOUSES OF TABRIZ

The traditional bathhouses of Tabriz have the same classic atmosphere of Iranian bathhouses, with the same hierarchy of the architectural patterns. If we want to be more specific about the architecture of the traditional bathhouses of Tabriz we should start from the effects of environmental conditions of this region on the main pattern of the bathhouses. As the researchers noticed, one of the features of this region is the existence of many aqueducts in this city in the direction of south to north and major proportion of the drinking water of the city provided through them. Therefore, it can be definitely stated that most of the water supply of bathhouses were provided by the aqueducts. On the other hand, Tabriz is located in a cold climate, therefore to avoid the energy exchange with the outside air and the accessibility to the aqueducts, most of the bathhouses of Tabriz (like most Iranian cities) were built in the ground.

5. ANALYSIS AND COMPARISON OF ARCHITECTURE PLANS OF THE TRADITIONAL BATHHOUSES OF TABRIZ WITH OTHER CITIES

The most important pattern used in the Changing rooms of the Iranian Bathhouses is the pattern of porch, that is octagonal plan or Eight and a Half Eight plans. Figure 3 shows the octagonal plan or Eight and a Half Eight plans of the changing room of the traditional bathhouses of Iran (Rashid Najafi, 2009).

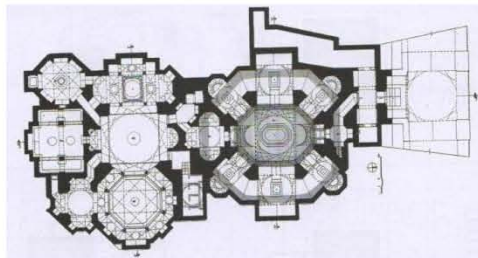


Figure 3. Nowbar Traditional Bath in Tabriz
(Rashid Najafi, 2009)

Analysis of the plans of some of the (available) historical bathhouses of Tabriz introduces two other types in addition to the typical types which are shown in figures 4 and 5 in the plan of Nowbar bath.

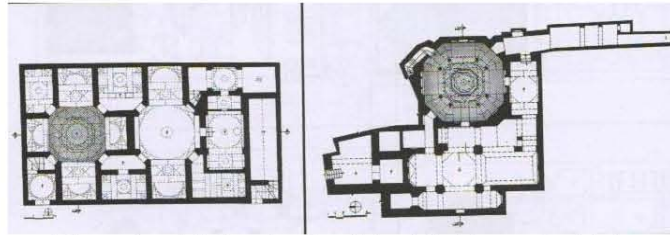
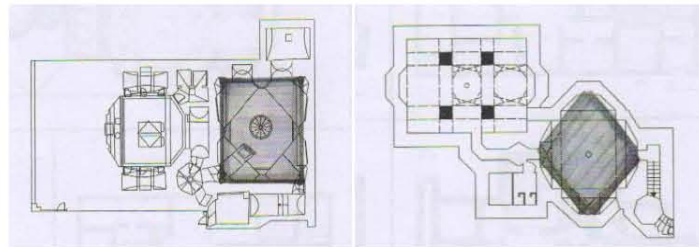


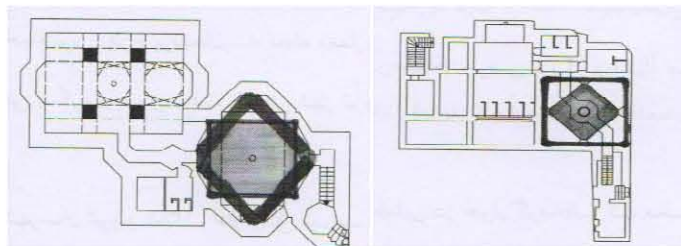
Figure 4 and 5. Sample of traditional Bathhouses in Tabriz
(Rashid Najafi, 2009)

Figures 6 and 7 shows these two types of plans. Both of them are changing room plans contrary to the typical plans of changing room which are octagonal, they are in forms of squares or rectangular. This is one of the noticeable features of the architecture of Tabriz bathhouses i.e. using square-like plans to make changing room.



Figures 6 and 7. Sample of traditional Bathhouses in Tabriz
(Rashid Najafi, 2009)

In the octagonal plan, four verandas were usually placed on the four main sides that one of them was bigger and decorated with feather that was called “Shahneshin” meaning the place that Shah or the king would sit. The other sides were used for the connections. But in the square-like plans of Tabriz changing rooms, two were used for connections and two were used for the verandas that one of them would naturally be used as Shahneshin. The interesting point is the application of half octagons in sides and verandas that would make it possible for the corridors to turn. This led to the point that four half octagons be combined with a square and create a new square, and therefore in some of the plans of Tabriz bathhouse, the form of changing room is in the form of two squares that are embedded in each other and made a 45 degree angle i.e. two squares that are turned inside. As depicted in figures 8 and 9. As it is illustrated the changes are based on the newer experiences of habitants and improved according to the use knowledge of previous designs and/or construction experiences.

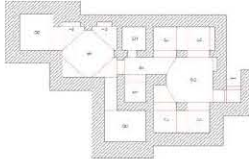

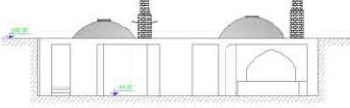
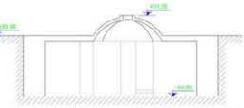
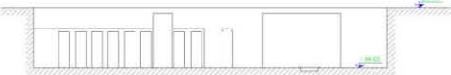

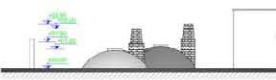


Figures 8 and 9. Sample of traditional Bathhouses in Tabriz
(Rashid Najafi, 2009)

6. INTRODUCING ESFAHLAN BATHHOUSE

The 400-year-old Esfahlan bathhouse is one of the monuments of Osku province (near Tabriz). This place was built by the people of village that were called “ill”. It survived during Arabs attacks and even passed the Sasanian dynasty. Esfahlan was originally the Arabic form of “Sepahlan”, a village in this region that was a military base even before Islam. According to the previous evidences, this region was geographically and strategically important as well as military perspectives. There were reasons that paved the way for the construction of bathhouses. Reasons like time and geographical requisites, policies of the kings, the traditional culture of the people, the need for building bathhouse, religious and generous people were the driving factor in the construction of bathhouses in Esfahlan.

Table 1. Information about Esfahlan Bath

 <p>Old Plan</p>	 <p>New Plan</p>	Plan
 <p>B-B</p>	 <p>C-C</p>	
 <p>A-A</p>		Elevation
 <p>South</p>	 <p>East</p>	

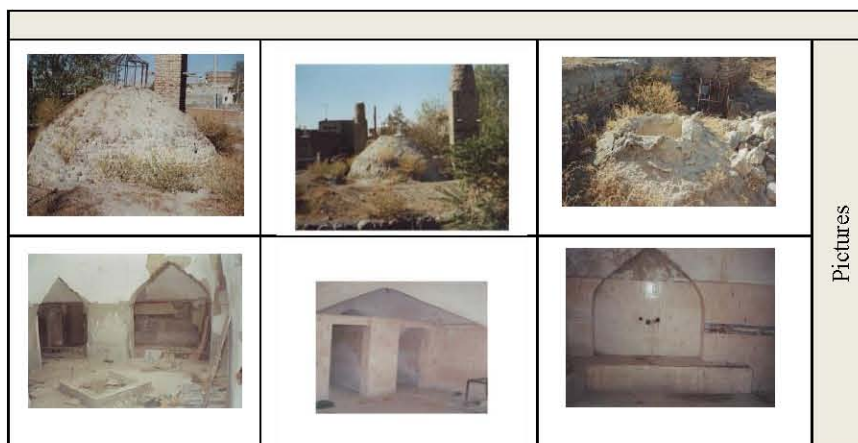


Table 2. The additions or deletions of Esfahlan building

	date
It had two water reservoirs (Khazineh) of hot and cold water that its water was provided by the aqueduct that was under the bathhouse.	1961
These two Khazinehs turned into 8 private bathrooms that their water was supplied to the showers by pumping.	1963
The bathhouse was accommodated with electricity.	1971
The bathhouse was facilitated with an equipped water piping system.	1988

This building undergone many damages during the years. Since there were not exact information about all of them we just mention the last ones:

Table 3. The damages happened on Esfahlan bathhouse

	date
Damages due to earthquake	1856
Severe damages due to the flood	1928
It was closed by sanitation office because of its insanitary khazinehs	1961
With the help of people, khazinehs turned into private bathrooms and got the authorization back from the sanitation office.	1963
It was damaged again due to the flood	1971
With the help of people, it was repaired and accommodated with electricity.	1979
Due to having private bathrooms in houses, people did not use the bathhouse anymore. It was while the bathhouse was equipped with pipe water.	1988
This bathhouse was not used from this year up to the present time.	1991

7. ARCHITECTURE SYSTEM IN THE ESFAHLAN BATHHOUSE

Architecture system of this building like other buildings of regions is based on the traditional architectures which has a special condition in terms of the location. In cold regions, the buildings would be built under the ground as much as possible to keep the temperature and heat (Kasmaei, 2006). Due to the cold climate of Tabriz

and even the prolonged winters, hot bathhouses were very pleasant for people in terms of social and environmental aspects. Therefore, architects would try to make a pleasant place. Since the bathhouse required enough hot water and the water should be supplied by the aqueducts or springs, therefore, in order to direct the water into the bathhouse storage it should be built under the ground. The deeper the storage is the deeper the bathhouse would be built.

The researchers went to Esfahlan and completed their information by asking for extra detail from the oldest residents of the location.

According to the habitants, the most important issue in the architecture and construction of this building is the utilization of things that nature easily provides like different kinds of stones, sands, plasters, etc to make mortar. Rubble stones were available in the river beds. They would be carried to the construction site with the lowest possible expenses and they were used according to their size. They would use the medium-sized stone for the foundation of the building. They would also use the bigger stones for the wall of the building to be able to bear the weight of the domes of the bathhouse. Their width would sometimes surpass one meter.

Mortar or Sarooj in this region and regions around Tabriz is a mixture of lime, gypsum, ash, sand and sometimes the pure clay. This mixture, based on the need of the building, and according to the preferences of the architect would be kept in liquid mortar so as the material could be completely mixed with Sarooj and turns into sticky mixture to be used in the foundation or walls of the building. Then, they would become stiff enough to be durable for years (the ash would also be obtained from village furnaces that had an important role in the Sarooj mixture).

In general, the mortar used in bathhouses were durable and the dome of most bathhouses were dome-like vaults. However, at the beginning, since wood was more available than Sarooj or the access to bricks was limited, they might use wooden rods or thatch to cover the roof as it was easier and economic.



Figure 10. Materials used in the roof of the bathroom Esfahlan

Although the inner space of the bathhouse was independent from the outside environment, in small regions the inner space of the bathhouse had different functions, therefore adjustment of the temperature, moisture, light and ventilation in each of the spaces were highly important. Therefore, designing and running the operation of buildings required special environmental techniques to have a stable

and adequate condition for bathing in all the spaces of the bathhouse and in all the seasons of the year and in the twenty four hours of the day (Kasmaei, 2006).

According to the surveys and the supplied information by residents, direct (natural) heat accommodation was not possible and as the artificial heat would be obtained from burning the organic material, respiration and other activities would be impossible. Therefore the required heat would be supplied from outside of the bathhouse and by burning the organic materials in Toon (fireplace) that was under the caldron of Khazineh. It would heat the water, and the transfer of smoke and heat would take place under the bathhouse. This bathhouse has common features with other urban or rural constructions including the way of creating heat for the Khazineh. All the bathhouses had one fireplace (Patoon) (in Turkish Azari "tolambaz"-Toon Anbar) that had connections to the public path that through which the fuel would be transferred to the bathhouse. The fuel were usually the dung of animals (yaba and karme) and woods and leafs of trees that was used with Toon Tabi (Toolambarchi) to keep the bathhouse warm. The temperature and the smoke of fuel burning would be directed to the chimneys through underground tunnels called "Gorbehro" (Pishikpooli). They directed these Gorberos in a way that it both heat the floor of the bathhouse and also disperse the heat in the atmosphere of the bathhouse especially Garmkhaneh.

Since the Gorbehros were exposed to smoke, they would set their dimensions in a way that someone would be able to go inside and clean or take after it. They would cover the Gorbehros under the floor of the bathhouse with a delicate smooth stone (Sal Dash. These stones not only could help to exchange the heat between Gorbehros and the inner space of the bathhouse but also was very good in terms of durability and the washability of its surface.

One of the necessary measures to reduce the heat exchange between the outside and inside of the bathhouse was to place the bathhouse in the ground in a way that the bathhouse was often some meters below the surface of public path. Therefore, the soil around the walls would act like a heat insulator and would reduce the heat exchange between inside and outside of the bathhouse. Moreover, the thick walls of the bathhouse in addition to the nearby soil act as a thermal capacitance in conversion of the temperature fluctuation inside the building.

One of the other advantages of these measures is the fortification of the building against earthquake and also directing the aqueduct or spring water into streamlets and leading them to the bathhouse. The sanitary precautions were also important in Esfahlan bathhouse like in any other populated areas. There are some discoveries that show the interesting equipment and facilities that were used in bathhouses. The river or spring water was directed to the Khazineh through ceramic pipes (Tanbooshe) or Gong in Turkish Azari language, if they wanted to change the water they would first empty the Khazineh and after cleaning they would lead the water, through the ceramic pipes, first in the pool to make sure that it is clean and then to the Khazineh. Changing the water was dependent to the owner of the bathhouse as well as bathhouse quality, however, it was usually changed once in a week but sometimes it might even happen once in several weeks.

8. CONCLUSION

In the present study, the building under study is a public one and many factors were involved in its creation and disintegration. According to the information the residents and architects provided the researchers with, and later through the detailed study and analysis of the associated factors, with concentration on this building, the researchers came to the point that most of these factors were related to the weather and the climate and architects awareness was highly important in this respect. The climatic condition and the expertise of the architects were the main factors that led to building be durable in ages. A building that was providing 24/7 service to the public and yet was surrounded by humidity, cold or hot weather and various kinds of bacteria were the main reasons of the deterioration in a building. Here by observing the elements of space and the skills of architects in terms of resisting and minimizing the erosive factors we can see how they have exploited the so-called erosive factors into the advantage of the stability of the building. For instance, the thick buildings that can be the fortification factor against the earthquake. Besides, at the proximity of the building there was intact soil that not only help the building to resist against the earthquake but it keeps the heat in the winter and in summer prevents the outside heat to enter the building. We also see that the ceiling of the traditional bathhouses was made in forms of domes in different sizes for different functions. It can be assumed that the smaller domes with lower heights were used for ventilation in a way that reduce the energy loss of the building and the bigger domes with higher height were used to have the best ventilation and skylight service and create clean atmosphere in the building. All of these create a balance in the temperature fluctuation of the building. The most important stability factor can be the application of the mortars that in all the traditional bathhouses utilization of lime was common. Building materials that if remain in an adequate condition can lead to higher stability of the building. These factors hand in hand with the expertise of experience architects of this country were the stability criteria of our traditional buildings, like bathhouses.

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