

Study of the Persepolis skylight the castles and their arrangement on the main page, with an emphasis Pattern

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ABSTRACT - Various palaces are among numerous evidences of Achaemenid art which are scattered in present borders of Iran. In most archaeological and architecture studies, the dispersion, architectural structures and features and engravings are highly taken into consideration. However, there has been no engineering approach and emphasis on the architectural design which is in accordance with climate.

Using a technical approach and geometric analysis, the following research tries to take the skylight and ventilation into consideration.

In accordance with this, the library and review of literature were conducted using Kerfter indications and available 3Ds from Afkhami and Kamback.

Results to this research suggest that skylight and ventilation systems in palaces function due to the height differences among palaces and the main platform in Persepolis, so that, some skylights are done through sidelong ventilations, some are done from upper skylights and some are done through walls flanks.

Keywords: Achaemenid, Persepolis, skylight, ventilation.

I. INTRODUCTION

Persepolis, the symbol of Achaemenid architectural art, contains unique features of Persian art and a combination of ..., Babylonian, Assyrian, and Egyptian arts [Ravandi, 534:1368]. Since the majority of investigations done at Persepolis has focused on historical and archeological research, there has been a scarcity of studies on engineering and architectural aspects. Therefore, the present study is based on one of the ignored aspects of architecture, called "the investigation of climate conditions and light provision at Persepolis palaces". How skylight and ventilation is done at Persepolis?

The investigations on skylight and ventilation of the palaces have been done based on considered suggestions and documents presented by Krefter and provided 3Ds by "Afkhami and Gomback". Secondly, this investigation, using case studies, will benefit from comparative and argumentative methods for analyzing the indices and criteria in skylight and ventilation of palaces. It is done so that the theoretical topics would correspond to the arena of architecture.

II. LITERATURE REVIEW AND THEORETICAL PRINCIPLES

2.1. Background

Although there have been many theoretical topics and investigations about this monument, there has been very few studies based on the skeletal perception of this approach in architecture. The innovative aspect of this paper addresses this issue. The author of this paper has used the following references based on some perspectives and views of this article:

" Documents concerning the reconstruction of this building three dimensionally done by Afkhami and Gomback out of Iran which is regarded as the basis".

By reviewing this source one could acknowledge that Alexander has evaluated the visual weights in the qualities of aesthetics and has analyzed the function of spaces. While, according to the issues raised by him, the evaluation of the manifestation of visual qualities in space and in the exterior structure of the buildings, its communication with the internal space of the building.

III. THE ART OF ARCHITECTURE AND ACHAEMENID URBANISM

The development of Achaemenid Empire underlay the exploitation of the potentials of colony communities. Each of these communities had an ancient cultural and religious background. The forte of the politicians of this era, specifically Cyrus the Great (Cyrus the Second) and Darius the First, has been creating a uniform culture and art out of the cultural variety of subsidiary nations which is known as the Persian art (Bryan, 168:1377).

If one looks at the genuine/original indicators of the Persian architecture, distinctive styles of statesmanship eras of Cyrus, Darius, Xerxes, and the Achaemenid kings can be observed. This stylistic difference indicates the three stages of the formation and development of the Achaemenid architecture. In the first period, we observe the formation and construction of buildings. The second period is, in a sense, the period of the stability of the Achaemenid architecture. In this period, the dominant presence of architects and engineers in the development and completion of palaces could be seen, specifically the palace of the Persepolis complex. In the third stage (the downfall stage), although building projects continued up to the last moments of the government downfall, Persepolis has gone through a downward trend in the physical development of buildings. It seems that the social and political transformations had a great role in the development of the architecture and urbanization of the Persepolis complex. For instance, In the full bloom of the Achaemenid era, the economic transformations of this period such as the activation of marine trade, the development of road communications, the fiscal economic prosperity, and encouragement to perform international commercial activities had a huge influence on the development of the cities of the Achaemenid territory (Dandamayoff, 47:1366).



Through the infrastructural measures introduced by the Achaemenid kings including the construction of royal road, the development of inter-road facilities, consolidation of political authority with the conquests of Eastern and Western countries, altering the transaction methods from the exchange form to monetary economy, the Achaemenid policymaker cities found ritual, organizational-political and economic functions in the form of religious, royal, and commercial cities [Habibi, 11-1366]. In the meantime, one can cite Persepolis, Susa, and Babylon, each of each has had religious, political, and commercial uses, respectively (Fray, 165:1368).

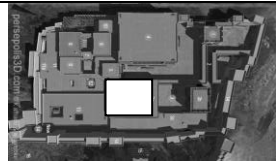
The reflection of Achaemenid royal art in the six capitals Enshan, Hegmataneh, Babylon, Pasargadae, and Persepolis provides valuable information about architectural patterns. Enshan was one of the early capitals of Persian kings (Abdi, 152:1374), where, previously, was considered as an important center of Elamite and had close interactions with the cities of Mesopotamia (Carter, 55:1372). Hegmataneh, the Achaemenid summer capital also presents evidence of construction activities of this dynasty (by discovering the column base). (Mehryar, 115:1361). Persepolis or Parse/Persia is another Achaemenid capital. It was constructed during the statesmanship of the First Darius on a huge platform with an area of 125000 square feet in the hillside known as the Mercy and was further developed during the statesmanship of the kings Xerxes and Artaxerxes. In one of his inscriptions, Darius declares that he has built ramparts where there has previously been no building (Shahbazi Shapour, 10:1355). The notable point in the evolutionary process of Persepolis is that the completion plan of palaces has been regulated and implemented in accordance with a pre-designed plan (Herzfeldt, 229:1381).

3-1-Introducing the Achaemenid palaces

In this section, some of the palaces of the Persepolis complex are briefly introduced in which some specifications such as height/area and their position to the main platform are investigated.

Table 2: Overview Palaces

the Position	Specifications	name of the Palace
	<ol style="list-style-type: none"> 1. a central four-square hall (60.5 * 60.5) with 36 columns. 2. three porticos, each with 12 columns in the northern, eastern, and western directions. 3. four towers at the hall outer foursquare and a a series of security rooms in the south 4. constructed in the era of Darius the First (515 B.C.). A 30 year construction time 	the Apadana Palace
	<ol style="list-style-type: none"> 1. In the southeast of Apadana Hall. 2. The central palace with a square-shape plan which is also known as the Bonquet Gate Palace and the Council Hall. 3. It has two porticos in north and south and was place for the consultation of the king with the officials (Shahbazi Shapur, 134:1379) 	the Bonquet Gate Palace (the Central palace)

	<ol style="list-style-type: none"> 1. the biggest reception palace in terms of the interior space (4900 square meters). 2. one hundred stone columns each with a height of 12 meters. 3. This hall, with eight entrance doorways, was built in Xerxes era and was completed in the era of Artaxerxes the first (Nkorf, 174:1381). 4. the interior room contains two doors and seven windows in the north and two doors and nine niches in other directions. 5. The biggest perceived defect is the darkness (Herzfeldt, 352:1381). 	<p>the 100-columned Palace (the throne hall)</p>
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3-2- The background of skylight in residential and royal architecture of contemporaneous civilizations with the Achaemenian

In the residential architecture of Mesopotamia, they contrived some doors and windows in the wall and the roof for the entrance of air and sunlight to the house and covered the window with a ceramic network. The flames or the cup-like lights, in which a groove can be seen in one side, illuminated the interior space. They usually poured oil or callus in these lamps. In addition, people of Mesopotamia were familiar with some properties of crude oil and sometimes poured it in those lights (Duma et al. 151:1381).

In ancient Egypt, the temple rooms have a view to the interior and beams of sunlight illuminate the hall and the interior through small holes that were contrived in the flat roofs. It should be noted that the temple walls were devoid of any kind of vent and window (Masoud Bani, 19:1385). In the temple of Amon, located in Karnak, the skylighting was done through floor lighting method (i.e. supplying the hall light by windows made from carved stones). It was as a result of a difference between the roof height and the surfaces in adjacent rooms (ibid: 22). Also, the ventilation in the graves of Egyptian kings took place by the method of ventilation to the outside (Gardner, 76:1379).

Also, in the region of Greece, Willdorant has presented some pieces of evidence about skylight in architecture. The houses of the Greeks were illuminated by beautiful lamps/lights or torches with olive oil fuel or Ranianj (a kind of gum) and candles (Dorant, 1367, Vol. 2:229). He also describes the Greek royal architecture and writes about the Tironez palace: "...Four columns, each of which contained a brazier, held the arch (ibid: 34-35). The palace of Odoseus in Italy is another region where the skylight was provided by some holes contrived in the roof and also the open space between plasterwork on column heads and the ledge/dormer of the roof. During the night, there were also several braziers that supplied the hall lighting on high pillars (ibid: 63). The technological development of the manufacturing of mica panes caused that the Romans utilize glass windows to provide skylight for their buildings in the third century (Duma et al. 263:1378).

In the architectural culture of the Corti civilization there has been some evidence indicating the skylight in the Kenesus palace which was provided by the holes in the flat roofs. But the situation was completely different in Greek temples. In those temples the ... roof of the temples were totally covered and their interior was dark and the sole light penetration and ventilation duct was the entryway (Masoud Bani, 38:1385).

IV. DISCUSSION AND ANALYSIS

4-1-The analysis of skylight and ventilation in Persepolis with an emphasis on the patterns and their positioning on the main platform of Persepolis

So far, many people have been involved with the reconstruction of Persepolis. Among those are Krefter (1971), Schpите (1976), Afkhami and Gombke (2006). In this research, we deal with the investigation of the patterns of palaces, their positioning on the main platform of the complex, their height, and the study on the skylight and ventilation of the palaces.

We study the position of palaces relative to each other and the existing shadings according to the three-dimensional investigations of Afkhami and Gombke.

Accordingly, we divide the palaces into two groups:

1. Those palaces which are located on the main platform.
2. Those palaces which are located on the platform with a surface difference.

Toward this end, we, first, use the available documents. One of these documents is the palace of "the harem of Darius" or the current museum which has been renovated by Grishmann. The investigation of the relevant skylights has been done according to the following pictures:

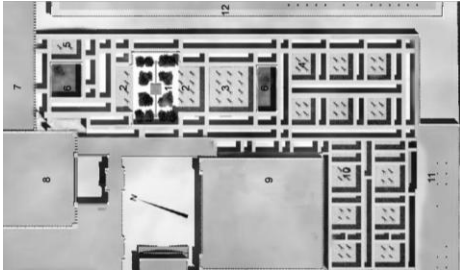


Fig. 2: The Harem plan (the current museum) [Afkhami and Gambcke: 2005].



Fig. 3: The Harem section (the current museum) [Afkhami and Gambcke: 2005]

The plan of this palace has been in the form of “L”. The skylight through the wall casings has not been possible due to the use of this palace. The skylight was done by creating the central yard. For the other part that has no central yard, the skylight was provided by the upper part of niche. Skylight in this palace, which has been located on the main platform of Persepolis and has no surface difference with it, was done through a central yard and via the upper part of niche. Their skylight is provided through the surface difference between the roof and the surroundings and supplies the skylight and ventilation for the space. To better illustrate this matter, we investigate the Apadana palace. The Apadana palace is located on a platform, which itself is situated on the main platform. The skylight and ventilation have been created through the surface difference in the roof and the height difference.

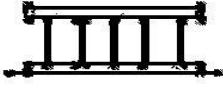
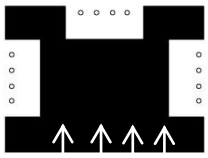
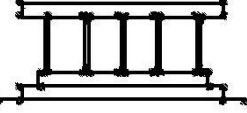






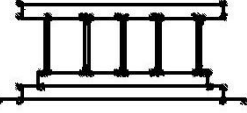
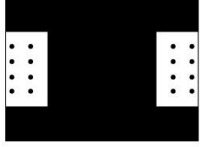



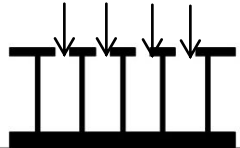





Fig. 4: the 3D of Apadana Palace [Afkhami and Gombcke (2005)]

4-2-The analysis of skylights in palaces based on their positioning on the main platform

The skylight analysis of the 8 available palaces in the palaces of Persepolis complex and the investigation of their heights and patterns which influence the positioning of skylights and ventilations are done in the following table:

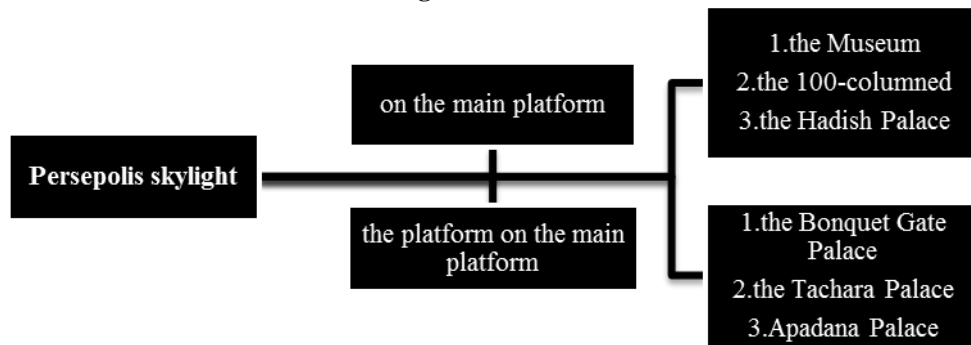
Table 2: The pattern of palaces and the effect of skylight on their positioning on the main platform

The manner of striking with the platform	Pattern	Skylight	Specifications	name of the Palace
 on the platform		skylight through the walls		Apadana Palace (the Baram Hall)
 the platform on the main platform			the portico and eight doorways at the front	the Tachara Palace (Darius special Palace)
 on the main platform		Skylight through the walls	the portico and eight doorways at southern and northern parts	the Hadish Palace (Xerxes special Palace)
		Skylight through the walls		the Harem (the Xerxes Harem)
				the Bonquet Gate Palace (the Central Palace)
			the entrance and skylight at the southern part	the 100-columned Palace (the throne hall)
			Skylight through the a part of volume that has a higher elevation (horizontal windows)	the Harem (the Museum)

V. CONCLUSION

According to the three-dimensional documents presented by “Afkhami and Gombcke” about the height and positioning of palaces on the main platform of Persepolis, for those palaces that are positioned with a surface difference to the main platform, the skylight is provided by the surface difference that has been already created in the roof. On the other hand, for those palaces that are situated on the main platform and has no defined surface difference with the main platform of the complex, the skylight is provided by the side walls and also by the creation of central yards in the complex. Accordingly, the palaces of Apadana, Three-Gates, and Tachara are categorized into one group and the palaces of Hadish, Harem, 100 Columns, and the museum are into another one. The skylight of the first group is in the form of some ducts in the height difference and the second group is done by the central yard, skylights above the niche or roof skylights.

Fig. 5: Conclusion



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