Introduction

Persian architecture has a continuous history—one that dates back to more than 6,000 years. Still, it doesn't fail to fascinate us with both its architectural and aesthetic value which was considered to be "magical and in vocational in character" (Pope 1965).The overall motif centers on cosmic symbolism, which brings man in "communication and participation with the powers of heaven" (Pope 1965). Through this guiding motif, the architecture in Persia has maintained a certain continuity that persisted in spite of frequent retardation or temporary diversion caused by internal conflicts or foreign influence. It has also achieved a particular style that had been one of the defining features of Persian culture.

Although it may seem logical to conclude that since all kinds of Persian architecture arose from one guiding concept, they may have similar characteristics. However, the historical background of a specific architectural style may also be considered worthy of notice. It would be very interesting to note how Persian architecture may be subdivided into types of architecture according to its history and style.

Background of the Study

The History of Persian Architecture

Persia, or Iran, as it is known today, possesses an architectural style that has a history of thousand years. It started from about 5000 B. C. and persisted up to the present (Pope 1965). The materials used were almost the same: heavy clays, bricks, stones and wood. The building technique used somewhat dictates the major forms of the structures (Pope 1965).

In its earlier years, Iranians used a building technique that involves compression of pisé-molded mud as solidly as possible and allowing it to dry (Pope 1965; Mehraby n.d.).

These resulted to large, well-defined masses that had broad surfaces which are suitable for ornamentation.

This kind of architecture had matured while facing certain factors such as the climate, the availability of materials, the religious purposes, and the dominant cultures in the periphery of the structure. While these factors played decisive roles in the architectural development, the Iranian landscapes, on the other hand, provided inspiration (Mehraby n.d.). It can be clearly seen that the domes we adore were patterned after the huge, snow-capped mountains of Persia. And the Persian concept of beauty (which is associated with light and clarity) added up to the grandeur of the domes' architectural design. Beauty was an attribute of the divine (Mehraby n.d.), for ancient Persians, and this may justify the usage of domes for religious purposes.

Statement of the Problem

The current study would like to know the architectural differences of two specific domes in Persia: The Firuzabad domes and Sarvistan domes. The following were the main questions that this study would like to answer using the existing literature:

1. What are the differences between the Firuzabad domes and Sarvistan domes?
2. On what aspect of Persian culture or architectural history may we account the differences?
3. What, if there is, the more dominating architectural style based on the comparison made?

The course of the study will be centered on concepts and topics related to the questions above.

Objectives

This paper focuses on the differences of the domes constructed in Persia, particularly their architectural aspects. The paper will provide a deeper analysis of two specific domes that were famous both in Persia and also worldwide. Thus, the following were the objectives of the study:

1. Provide an in-depth and comprehensive understanding of the differences between Persian domes while taking into account the history of the architectural style used.
2. Compare two specific Persian domes and delve into the weaknesses and strengths of these famous domes.
3. Give a conclusion while integrating the knowledge gained from the literature and relating it to personal experiences and thoughts.

These objectives were the guiding element of the study and the researcher hopes to stick to it.

Scope and Limitation

The study will be tackling the history of the Persian architecture and the origin of dome-building. Then, comparisons will be made between the two specific dome mentioned earlier. The data will be gathered from the existing literature, and therefore the comparisons that will be made will be based on it also. The study is limited to the two specific domes that were mentioned and the form of data will depend solely on the existing literature.

Literature Review

Persian Architecture

According to Mehraby (n.d.), the farming hamlets, which dated from about 8000-6000 B.C., are referred to as the origin or predecessors of Persian architecture. Bricks and mud

mortars, together with painted rooms, appeared after the construction of Sialk mounds. Later development in architecture involved usage of cone mosaics and colored/glazed bricks in huge ziggurats (Mehraby n.d.).

The following are the different types of architecture that emerged as the Persian architecture evolved;

The Elamite Architecture

According to Gwendolyn Leick (Dictionary of Ancient Near East Architecture), the Elamite architecture were only popular in few places:

"Sussa (the main city) was completely rebuilt during the Persian period; Haft Tappeh has remains of several ziggurats, royal graves, temples and palaces. Chogha Zanbil was built some 200 years later, during the most illustrious period of the Elamit kingdom. The Elamite were very skilled in building vaults and arches. The tombs at Haft Tappeh and Chogha Zanbil were roofed with massive barrel vaults, and so were many rooms in the palaces of Sussa…."

The Elamite architecture was generally made up of unfired brick. Although in some cases, red bricks were also used for revetments. Several structures in the northwestern cities had double stonewalls (few centuries before Medes). According to Mehraby (n.d.), some even have triple walls. There were also towering, heavily thickened buildings with columns.

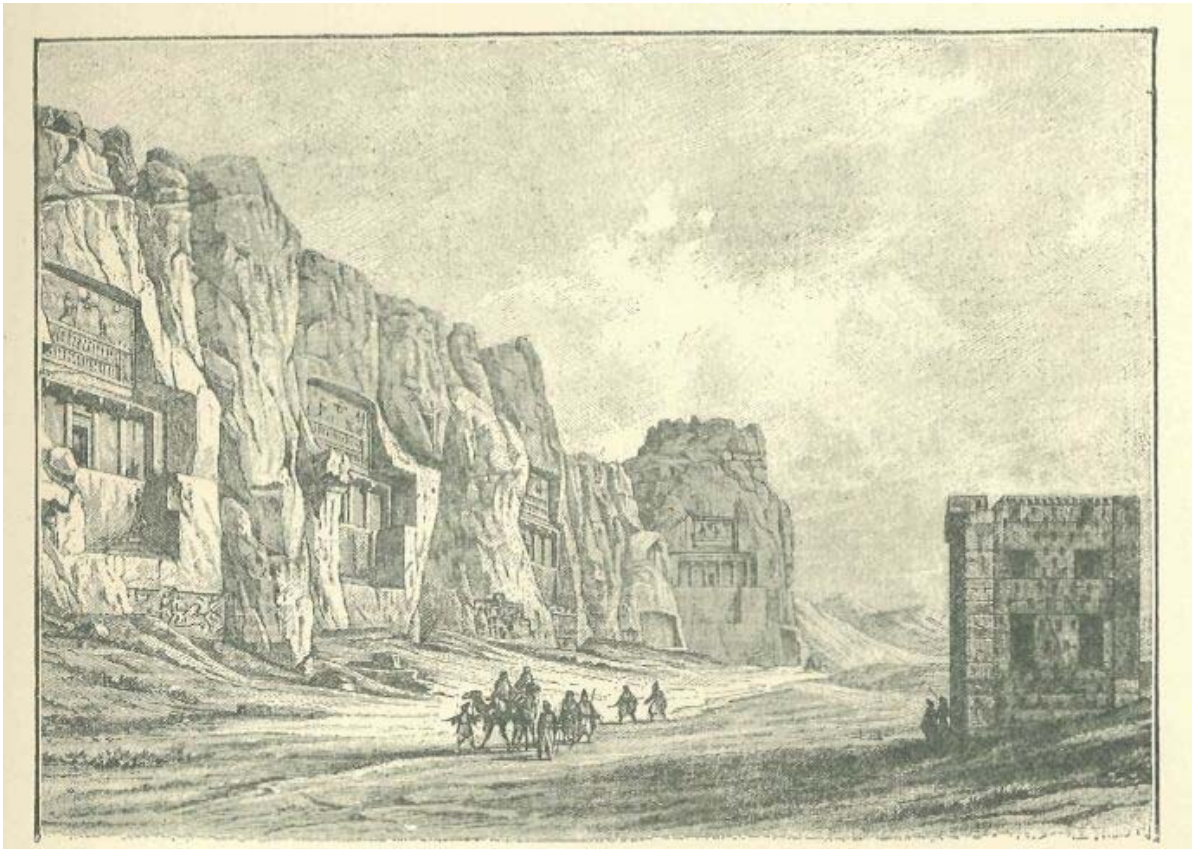
Achaemenian Achitecture

The imperial Achaemenid style of building was best seen in two palace complexes: One is at Pasargadae, where Cyrus the Great constructed a complex af temples and palaces as his first expression of political power and divine sanction in 550 B.C. (Pope 1965), and the

other is at Persepolis, which was constructed by Darius I (Wright n.d).

Achaemenids were known to have the capacity for large-scale planning and practical administrative ability (Pope 1965) and this can be seen by how the Pasargadae complex was created. According to Pope (1965):

"A huge artificial platform with enormous stone revetments and the use of tall, slender stone or wooden columns recall northern practices. There were three palace buildings, each enclosed by its own large masonry wall. Its size tells the imperial story: the central room of the main audience hall or temple (political and religious functions intermingled) covered an area 230 feet by 131 feet and there were other rooms half as large. This main building was square and probably had an entrance on each side; the other buildings were rectangular. Black and white, strikingly combined, as well as rich polychromy (some of the wooden columns were painted blue, green, red, and yellow) and impressive use of precious metal plating, all emphasized that this was a city apart, the focus of royal and sacred power. For the holy fire, there was a square tower…"



THE HILL OF THE ROYAL ACHÆMENIAN TOMBS AT NAKHSH-Î-RUSTEM.[2]

Fig. 1 The Achaemenian tombs (from: http://www.gutenberg.org/files/17329/17329-h/images/261.jpg)

Although the respect for the tradition was made evident at Pasargadae, it was not the case with the Persepolis complex. A highly idiosyncratic design principle was dominant: concentric (centralized) square planning. Such principle works by setting square units concentrically within other square units.

Median, Assyrian, Elamite, Egyptian, Ionian and Urartian archetypes mostly consist the Achaemenian architectural style (Mehraby nd). However, some of its major elements—specifically the columns, rock tombs and stairways—were purely Persian. And, as was described earlier, the columns were very high and relatively far from each other, which requires accurate measurements and precise calculations. Such were important elements in

architecture which gave the Achaemenids recognition in terms of the development of the Iranian architecture.

The materials used by the Achaemenids were mixed. Their buildings were characterized by extremely fine ashlar masonry (Wright n.d.). There was a great podia that was faced with huge blocks. This podia is where the complexes stood, and what primarily elevates the whole complex. The walls of the structures were given emphasis by articulating them with stone frames. However, a large area of the wall was made up of mud brick. The most notable and distinguishing feature of the Achaemenian structure is the columnar development and the lines of immensely tall stone walls (Wright n.d.).

The elements of Iranian architecture exhibited by the Achaemenians represent harmonious composition. It would be very interesting to know how that was made possible. Although the construction of the palace complexes were done by the people, it is still the King who had conceptualized its design. The palace building had inscriptions to account for this. The general design had satisfied the intentions of the King. The inscriptions also indicated that the planning of the palace complex was entirely determined by Iranian taste (Wright n.d.). However, it is still uncertain whether the architect behind the complex structures was a Persian. The general style and overall appearance in elevation, though, is unique as compared to contemporary building field is obscure (Wright n.d.). There are archaeological evidences that it is defective. Also, according to Wright (n.d.):

"What appears clear is that Achaemenid building had a negligible impact on the great monumental traditions of Egypt and Mesopotamia...It is in the Levanto-Anatolian region where there are indication (or possibilities) of interaction with an older tradition." (Wright n.d.). If we are to consider the currently existing information given by the literature, however, the Achaemenid building had left traces and effects that were at its most recognizable state after the end of its regime.

Seleucid Architecture

The main areas covered by the Achaemenid Empire consists of Iran and Mesopotamia, and then right after the fall of the empire, the house of Seleucus had built its capital in Babylon and its periphery. However, Seleucids have lost their control over the eastern part of their kingdom. This happened when the Parthians came to claim the lands' possession in 129 B.C.

Seleucus, the most royal-minded of Alexander the Great's successors, continued the Macedonian King's pursuit for the brotherhood of man. Over the years, evidences have been found that confirms a symbiosis of Greek forms in architecture with other native architectural forms (Wright n.d.). This form of expression may be called Greco-Oriental art, which was considered to be adopted by the Parthians who came after the Seleucids (Wright n.d.).

Hellenistic designs became dominant in this era, although it wasn't completely accepted (Mehraby n.d.). The Seleucids maintained the old Mesopotamian style: massive brick building. Using this, they have provided for the restoration of old buildings and the building of new ones (like that in Babylon and Uruk). This became a tradition which was practiced in the regime and only ended in the Parthian times. Greek forms, however appeared immediately by 300 B.C.. Both Greek design and construction were seen on towns that were planned on Hippodamian lines. Greek theaters and temples were also seen in this period. There are also many Greek roofing tiles that have been found, like those in Babylon, for example (Wright n.d.).

Parthian Architecture

When Parthian political power is at its highest, Greek forms were blended with "oriental reaction" was culminated and came to its strongest during the later part of the first century B. C. (Wright n.d.).

The element “Eyvan” emerged during this time. Vaulting techniques evolved: from mud bricks to fire bricks, stucco was used as mortar. It was rapidly hardened and used to build barrel vaults without any scaffolding. Ceilings and walls were also stucco-ornamented. The ornamentation were usually engraved and painted and also usually treated with large-scaled, rich-colored mosaics. Other ornamentations like plasterworks were molded, not engraved. And motifs were repeated and lengthened (Mehraby n.d.).

Fig.2; Parthian Architecture from: www.cais-soas.com/.../zahak_castle.htm

Two local forms in planning prevailed in this period: first is the centralized square units, and second is the open-fronted hall chamber (also known as the “iwan”). The former was, as stated earlier, notable at Persepolis, while the other’s origins were somewhat harder to account for. These forms, which were generally brick built, were dressed with Greek ornaments. Although earlier in the period, the stone columns and entablatures were the most identifying features, the tendency was for the details to be decorated in stuccoed brickwork

which is paralleled to the Roman development of transforming the Greek orders (from structure to ornament). Residues of Achaemenid styles were still present. Such styles in execution of architectural details were made evident by relatively thin, lofty columns and sometimes accompanied by campaniform bases (Wright n.d.).

Sassanian Architecture

The Parthian dynasty collapsed in the middle of the third century B.C., and was replaced by the Sassanians. Sassanians were from the province of Fars, centered on the ancient capital of Persepolis. The Sassanian technique discarded the Greek components of Parthian building and kept the oriental elements, the square cells, and the “iwan”. The dome was added to the vault as the focus of design, particularly in elevation. *(*Wright n.d.)

Mortared rubble was also used together with bricks, and both were considered as important basic building materials. Gypsum mortar, on the other hand, was considered as a basic load-bearing element. However, the use of stucco remained, though it has shed off its Greek forms and assumed an over-all oriental style. As a result, it has made the distinction between Sassanian building and early Islamic building more difficult (Wright n.d.), since the early centuries of the Islamic architecture happened just in 637 (Mehraby n.d.).

The Emergence of Domes

Persian Domes before 1400 A. D.

According to Creswell (1913), there was a time when domes were thought to be not really very antique. This opinion, however, can no longer be held, because in ancient Egypt, domes were known at a very early era. At Hieraconpolis, domed “shuna”, or store pits, with about 6-feet diameters have been found. Such were assumed to have belonged to houses of the pre-pyramid age. Some foundations of isolated circular buildings were also found. In the 12th dynasty, still according to Creswell (1913), domes were built over circular chambers

within pyramids. These domes, however, were built in horizontal courses, like the beehive tomb at Mycenæ.

A house model, probably designed around the 10th dynasty was found at Rifeh. It showed a terrace roof with three rounded cupolas partially emerging through it. It was exactly like a style of the present-day Eastern houses (Lethaby 1912). There was a widespread use of little domes for granary. The granaries, together with the barns and storehouses were almost always dome-shaped (Perrot and Chipiez 1883). Flat-roofed structures were very few back then (Perrot Chipiez 1883).

The domes were also known from very early times in Chaldæa and Assyria. A bas-relief that was found in the Sennacherib palace at Nineveh, which dates back to 705-681 B.C. depicted hemispherical cupolas; some with tall, cone-shaped domes. These were probably peasants' houses. In Rome, however, domes have been known just some centuries before our era. According to Creswell (1915):

"It seems to have been introduced as a feature in bath-building, and the only domes known to Vitruvius, who wrote about the beginning of the 1stcentury, were those required for the hot chamber of the bath…"

The bath at Pompeii, with its ruined cupola, is very conical, somewhat alike to the domes depicted in the bas-relief (Creswell 1913).

One thing is common to the domes mentioned: the size and purpose. All of them were small and probably used in buildings of low or secondary importance. It is very evident in Egypt, where domes can only be found in "small and unimportant buildings". While in Chaldæa and Assyria, great palaces, such as Sargon and Sennacherib were without domes (Creswell 1913). A possible explanation, according to Creswell, is that building a big dome will not be of much use unless a square chamber has been devised. Large-scale domes cannot

be placed over circular spaces o be set over a square space by a makeshift penditive. It has also been the case in Rome: domes for the hot chambers of the baths are set over a circular space. Even as the years passed, this is still the case the huge dome of the Pantheon.

Persians were the first to devise a satisfactory penditive, different from those found in the places mentioned, and it has played a vital role in domical construction.

The Sassanian and Early Islamic Period (Domes)

Domes first appeared in Persia in the Sassanian period, in Firuzabad. Then came the most numerous ancient Sassanian domes over *chahârtâqs,* which were usually the central chambers of fire temples. Domes on squinches have survived in the Islamic period. This was assumed to have been caused by the transformation of *chahârtâqs* into religious structures called mosques (O'Kane n.d.).

The appearance of domed mausoleums proved most relevant for the development of domes in the early Islamic Iran. Another tradition in the mausoleum building in Persia are the tomb towers. With its magnificent execution, these towers were undeniably representative of the Iranian way of mausoleum construction. The following were the different periods of dome-building, which have created domes theater different in appearances, materials, and architectural plan (O'Kane n.d.).

Saljuq Period

The Saljuqs were the one who introduced the *maqsûra,* or enclosure in front of the mihrab of the hypostyle mosque. This new introduction helped to transform the skylines of Persian towns, and the views of the horizon have changed. In the early Islamic period, dome chambers were used for small neighborhood mosques. In its time, it was the biggest masonry dome. It embodied a new form of squinch: it uses a barrel vault above two smaller quarter domes. In this period, various tastes in different forms of vaulting became the trend. It is in

this period when double-shelled domes construction had begun. Windows were made inside the bearing walls. Brick-bonds and brick based designs were used to face the buildings, even for embossed calligraphies (Mehraby n.d.).

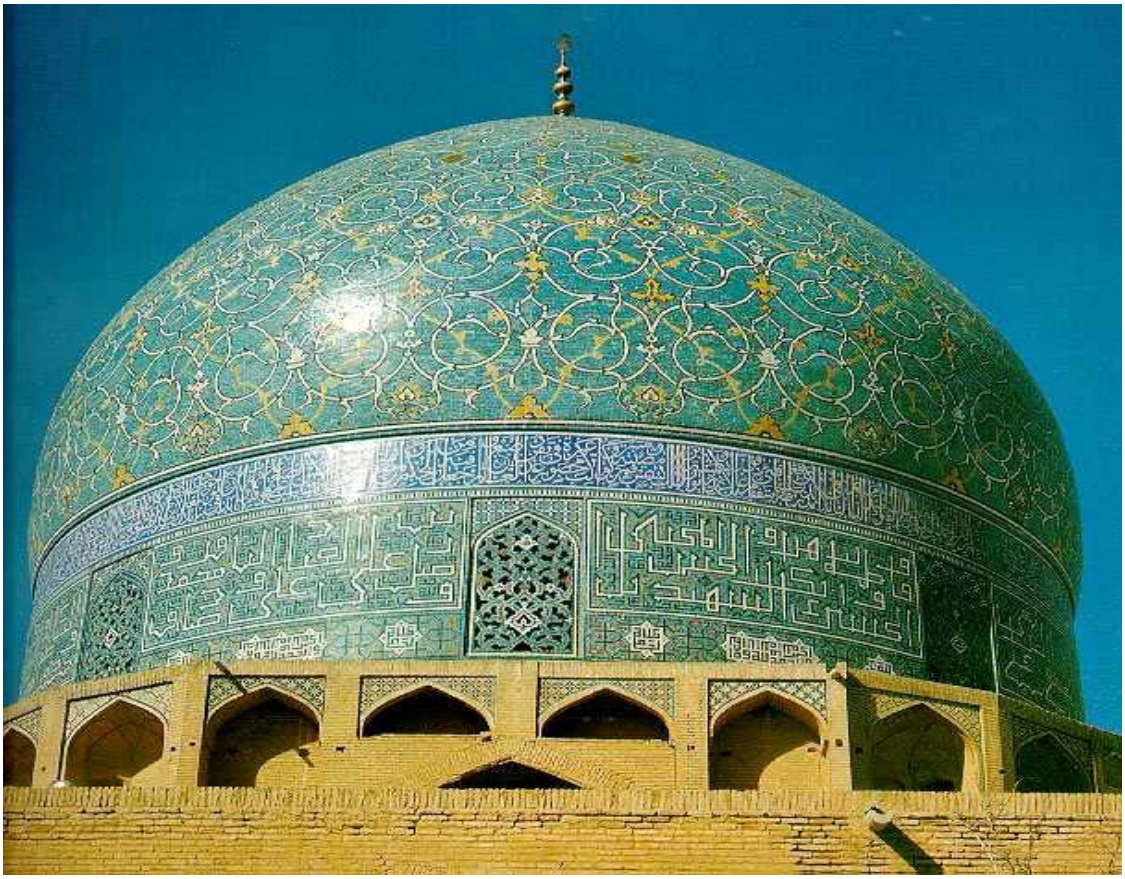


Fig. 3: Intricate tile and brick designs on the Masjid-i Shah in Isfahan from: IslamiCity www.islamicity.org

Architectural elements became clearer and brick and clay in bright and dark shades of blue. The Saljuqs have been known to revive the Islamic civilization and art in Persia.

Il-Khanid Period

The domes of the mausoleums of Guazan Khan at Tabriz and Oljeitu at Soltanyiya were the major Il-Kanid domes. Each of those domes were located at the center of a larger complex of buildings. The Guazan mausoleum has twelve sides—which is no longer extant.

It is said to be rivaled by Ouljeitu, and the latters magnificence cannot be undermined. Oljeitu's mauseleum is 50 meters high and about 25 meters in diameter (O'Kane n.d.).

The Il-khanid period had surviving ornamentation techniques that survived and examples of these are the decoration of tiles, stucco and paiting. A distinct, double-sheeled dome was also a feature of the period, and it was assumed to have been reinforced by the arches between the shells. An example of the evolution of Persian domes in this period is the dome chamber in Varamin. The congregational mosque in the region had increased height of the zone transition (O'Kane n.d.).

Tomb towers that mirrors the beautiful and majestic Oljeitu's mausoleum became rampant in the Il-Khanid period. A number of these towers even have *moqarnas* domes. This feature was also found in brick at the Saljuq congregational mosque at Sin. In this period, structures consist of plaster shells. Plaster shells were used for the purpose of masking the underlying structures. “The best example would be the plaster shells that were found at the tomb of Abd-al-Samad in Natanz. The form may be assumed to have been adopted from the founder of the order to where the said tomb belonged—Shaikh Sohravardi” (Blair 1983).

In Isfahan, the dome over the chamber that connects the Do Manar is an important development in domical design[1]. There were, according to O'Kane (n.d.) radical and non-traditional trends in the interior design and decoration of domed chambers from the Saljuq

[1] The following is a quotation from O'Kane that exemplifies the differences in the construction of domes: ``If contemporary with the gravestone of Soltan-Bakht Aqa inside (753/1351-52. Honorfar, Esfahan, p.317), it is the earliest known example of a double-dome in which the inner and outer shells have substantially different profiles. It has been claimed that the dome of the Soltaniya complex in Cairo (probably built by Sultan Hasan, ca. 1356-60) was the origin o this form, which then spread to Persia (Meinecke, p.175), but the interior buttressing at the Soltaniya complex betrays the influence of brick tradition, suggesting a Persian origin. The trend toward taller drums continued in the Timurid period, finally reaching the inordinate proportions of the Esrat-khana in Samarqand (ca. 869/1464). One factor responsible was the increasing height of pistaqs, which at the boq a (shrine) of Zayn-al-Din Khuaffi at Taybad (848/1444-45) led the architect to abandon the outer shell of the dome altogether. Where the drum was retained, however, it usually rose straight from a lower square, resulting in the loss of an external zone of transition".

period up to the other periods that followed it. “What was most prominent in this period was that, the technique that involves substitution of plain and painted plaster for brick”. (O'Kane 1984). The increase in use of tilework was also rampant. At Yazd, there exists a congregational mosque that may serve as a good example for the current discussion. This was probably made by the same craftsman as the one who made the congregational mosque at Sava (O'Kane 1984). Also, the interior design of the mausoleums in the Sah-e Zenda in Samarquand were also reveted in tilework (O'Kane n.d.).

There are about 90% of the monumental structures remained from the Il-Khanid era that were religious in nature and 50% of those were places for burial. Persian architectures in this era used decorations that were mosaic-based. Colored and lustered tiles were used for this mosaics (Mehraby n.d.).

Timurid Period

A combination of bright and dark monochroe glazed tiles for facades was one of the peculiar characteristics of this period. There are also prevailing tecniques in vaulting and an accurate calculation of huge size and dimension chosen as an integral part of natural structures. The domical structures, or dome buildings, reflected the Timurid architects' ineterest in the art of vaulting. There were major changes in the way they traditionally vault: the drum of domes started to be heightened, domes changed in to glyph forms, and the exteriors were decorated with tile works (with different designs and calligraphy) (Mehraby n.d.).

Safavid Period

Architecture in the Safavid period was assumed to have influenced the other countries constructional activities. There was emphasis on the greatness of the structures in this period and it continued to be a principle all throughout the era. Radial symmetry was also executed

splendidly (Mehraby n.d.).

Color had a central and major role in the Safavid architecture (Mehrby n.d.). Also, in this era, tiles covered wider surfaces, and the colors and ornamentations were the focus f the architects, not the structure itself (Mehraby n.d.).

Zand Period

The Zand dynasty promoted an architecture that resembled some aspects of different architectural styles from different era (Mehraby n.d.). Glazed tiles were innovated in such a way that it would be almost be pink and stone-made half vases were installed at dadoes and under designed tiles (Mehraby n.d.).

Qajar Period

Many of Safavid works and structures have been covered under this period's renovations. New forms were introduced in Persian architecture by this period's architects. Some of these new forms were deep courtyards, onion-domes and extravagantly ornamented entrance gates at major cities. It was also in this period when military structures received plnty of attention (Mehraby n.d.).

Such was the history of the architecture and dome-building in Iran. It is from the perspectives gained from these eras that we wil try to examine the differences in two specific domes in Persia.

Significance of the Study

The study will provide deeper understanding of the various aspects of Persian architecture through the comparisons that will be made. Such understanding will be significant in terms of considering the culture and era as major factors of the evolution of architectural styles.

Methodology

Data Gathering

The data that will be used in this study will be based purely on the existing literature, thus, examinations were limited to what the literature says. The researcher gathered information from articles and books to have a basis for the comparison. The researcher then tried to compare to specific domes in light of the information given y the literature. In the same way, conclusions will be drawn on the discussions, as it was explained in the literature used.

Results and Discussion

Two places: Firuzabad and Sarvistan are attributed by the Sassanian period by a lot of authorities and scholars.

Firuzabad

Firuzabad is a palace-city of Sultan Firuz Shah Bahmani, and it is built in the fourteenth century. It remained virtually unknown to a lot of scholars in spite of its optimal location (which is between Gulbarga and Vijayanagara). It is situated seventeen miles south of the main Bahmani capital of Gulbarga, lay directly on the road to Vijayanagara, the Bahmani's chief opponent. Firuzabad was also used as a rallying point by Firuz Shah and his troop before each campaign against Vijayanagara commenced, and it was used as a reting station after it terminated. It was also in this palace city that Firuz Shah sought the religious and spiritual authority needed not only to confirm, but also to validate his rule. It has been percieved as the King's major pleasure resort (Asher 1993).

At Firuzabad, domes applied on a large scale were seen for the first time. This dome

was 45 feet in diameter. It was also the fisrt time that such a large dome was built over a square space, and it brought to reality the conception that such formation is indeed possible, by means of a squinch. A squinch is a devise that is considered as wholly Persian, which consists of a series of concentric arches thrown across the angle, and advancing one over another. The square is reduced to an octagon by the system mentioned, and upon the resulting structure, the dome was built (Creswell 1915)..

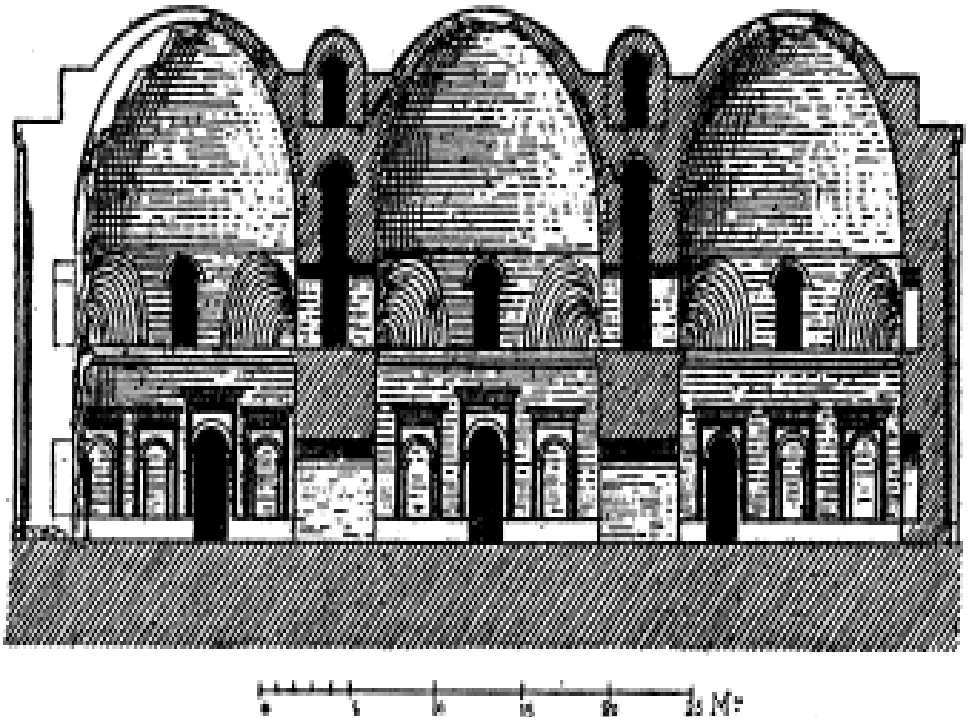


Fig. 4: Firuzabad, Section through width. From Creswell (Persian Domes before 1400 A.D., *The Burlington* Magazine for Connoisseurs, Vol. 26, No. 142,)

It is impossible to overrate the importance of this discovery, which happened for the east what the Byzantine penditive did for the western region. In Persia, the idea of dome-

building was en-nobled. The dome-building was raised to the very front rank as a premiere method of roofing. It has kept that rank up until now. There are in fact a lot o generalizations that Persia is “the land of domes”. (Creswell 1915).

The plan of Firuzabad is noted for its striking simplicity. It measures about 170 feet by 320 and is therefore a reall large structure.

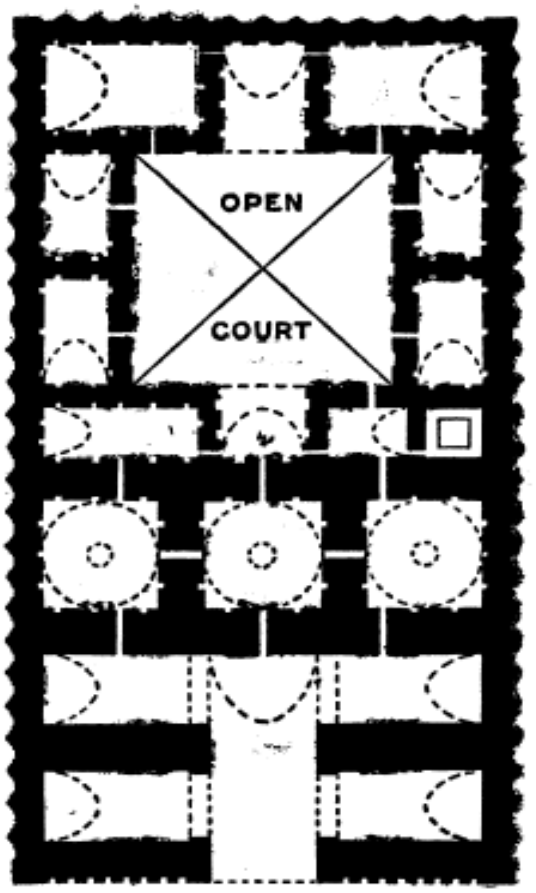


Fig. 5: The Plan of Firuzabad. From: Creswell (Persian Domes before 1400 A.D., *The Burlington* Magazine for Connoisseurs, Vol. 26, No. 142,)

All the spaces that are shown in the figure are covered by barrel vaults except the

open court. The three square rooms, which are covered by elliptical domes, are set on squinches. These three domes, each measuring 45 feet in diameter, are much larger than any dome in Egypt or Chaldaea. The vaults' stability is ensured either by adjacent structures or by large voids in the thickness of the walls spanned by barrel vaulting. These were once called 'discharging chambers". A notable feature in Firuzabad is the stucco decoration, a good deal of which remains. The exterior decoration recalls the style of building that used in Chaldaea, at Khorsabad for instance, and consists of reed-like pilasters of semi-circular, with panelling between (Creswell 1915). This features were depicted in the following figure:

Fig. 6: The section of panelling in Firuzabad. From Creswell (Persian Domes before 1400 A.D., *The Burlington* Magazine for Connoisseurs, Vol. 26, No. 142,)

The doorways are ornamented with great arches which are set in frames, which recalls those that were used in the Achaemenid palaces at Susa and Persepolis. They are executed in stucco, and were applied to the face of the wall, whereas in the Achaemenian period those

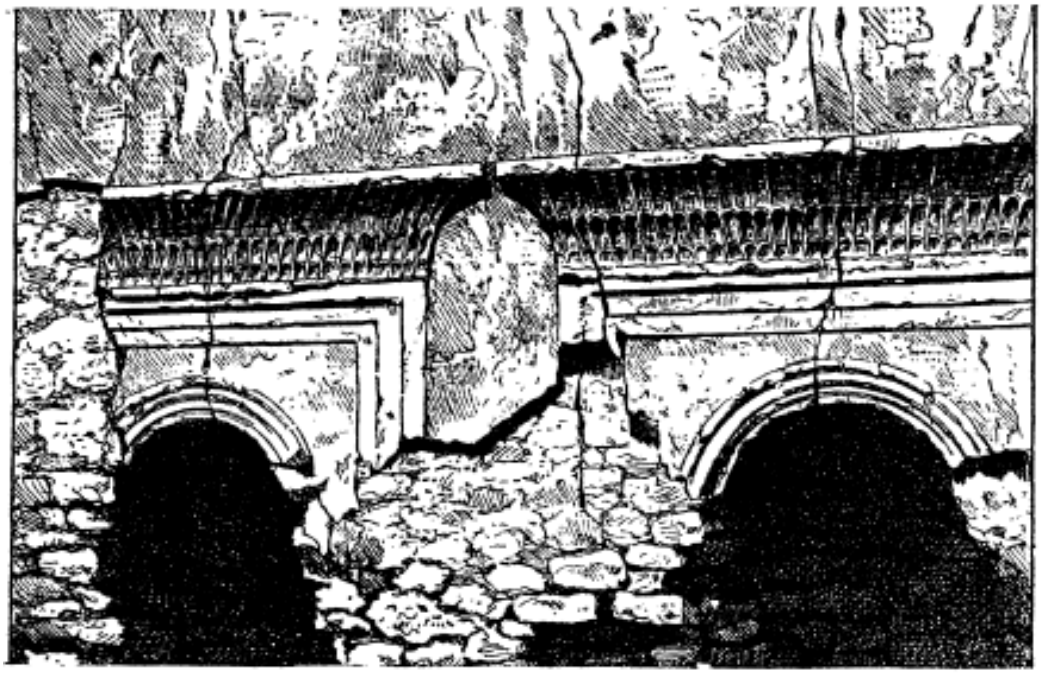


Fig. 7: Interior Decoration of Firuzabad. From Creswell (Persian Domes before 1400 A.D., *The Burlington* Magazine for Connoisseurs, Vol. 26, No. 142,)

were always carved in stone. Also, the reed-cornice, instead of commencing with a vertical rise, spreads out, which shows a decadent form of composition.

Sarvistan

The Sarvistan palace measure about 120 by 140 feet. It has three domes which is shown in the following figure.

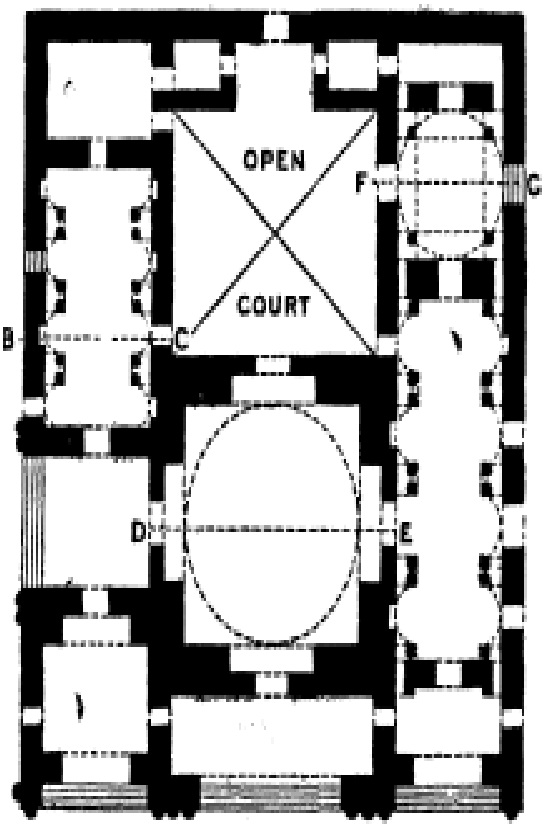
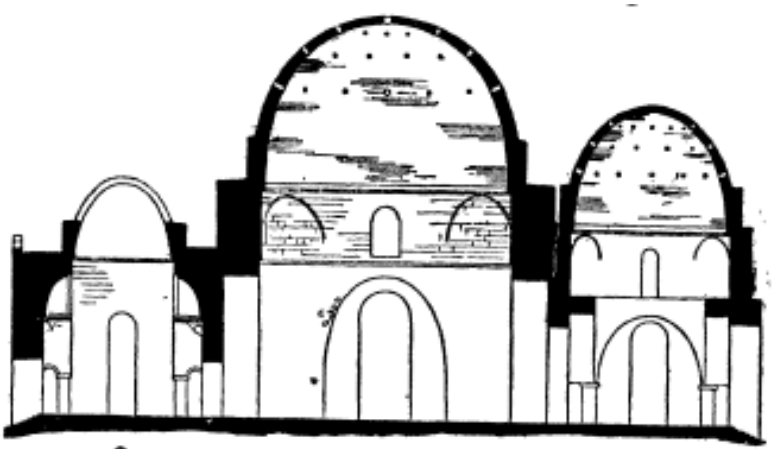


Fig. 8: Plan of the Palace of Sarvistan From Creswell (Persian Domes before 1400 A.D., *The Burlington* Magazine for Connoisseurs, Vol. 26, No. 142,)

The walls of the palace are built of stone. The domes were built of brick, although practically, all the stucco decoration has disappeared. In the Sarvistan vaulting arrangement, a great advance in scientific knowledge is shown. To decrease the thrust of the elliptical barrel vaults and to avoid very thick side walls, piers were built within the walls, which forms a

Fig. 9: Section of Palace of Sarvistan. From Creswell (Persian Domes before 1400 A.D., *The Burlington* Magazine for Connoisseurs, Vol. 26, No. 142,)



series of recesses. These recesses are just developments of the method employed at Firuzabad, by which hollow spaces that were left in the thickness of the walls were utilized to add to the floor-space itself. These piers do not carry heavy transverse arches. Their purpose is to support semi-domes or barrel vaults over the recesses between them, above which rises the central elliptical vault. The span of the central elliptical vault was reduced by about 9 feet by this arrangement (from 26 feet to about 17). The lower portion of the piers is carried on two columns. These columns give increased space, so that the builders must have recognized the fact that the thrust may be resisted (or eliminated) and the actual weight can be borne by supports of less superficial area than the piers themselves. Since the recesses are rectangular, squinches were once again used in the angles to carry the semi-domes over them. While the domes in Firuzabad were made with an eye in the center, for the admision of light, at Sarvistan, the domes (as well as the vaults) were pierced for the same purpose by hollow terra-cotta pots (Creswell 1915).

Semidomes of different sizes were employed heavily at Sarvistan. The Northern end of the halls and the western end of some rooms have a roofing system that covers twelve alcoves in other rooms (and nine wall niches in some), according to Bier (d.d.). There is also a shallow entrance *iwan* which is also covered with a large semidome. There are three large

semidomes in Sarvistan, but of those structures, only one remains intact. This particular semidome is made up of mortared rubble. It is also faced with roughly squared stones set in horizontal rings (Bier n.d.).

In Sarvistan, the bricks of the domes were laid in radial rings. However, one distinguishing characteristic of these rings is that it has narrow horizontal and vertical joints. In the final phase, the undersurface was coated with plaster, and the original structure may be dated to post-Sassanian era (Bier n.d.).

The uniqueness of the domes in Sarvistan depend primarily on its architecture. The brickwork, it seems, was intended to be displayed. This aspect of architecture is actually unique of Iran. It was done without special decorations in the structure and no special surface treatment were made. Even the vertical and horizontal joints were brought up flush by careful pointing. This indeed indicate that the brickwork was intended to be displayed (Bier n.d.).

Similarities

Both the Firuzabad and Sarvistan domes made use of squinches. As was discussed earlier in the paper, the squinch was one of the major identifying feature in Persian architecture. It can assume various forms—a multitude actually—as long as it consists of a spanning member such as an arch, or a lintel which rests on the walls. These are essential to the squinch for these serve as the carrier of the base of a dome across a corner (Bier n.d.).

Perhaps the earliest known squinches were those at Firuzabad. These squinches were made up of rough slabs of stone, which are laid across the corners in rings. Such rings increase in diameter, up until half-cones were evident (Bier n.d.). Still according to Bier (n.d.), squinches of this type maybe constructed even before building the warped connecting walls of the transition zone. However, both the squinches and the walls may be constructed at the same time. The workers of the Firuzabad domes may have employed the latter building style: they may have laid up the walls and squinches at a uniform rate (Bier n.d.).

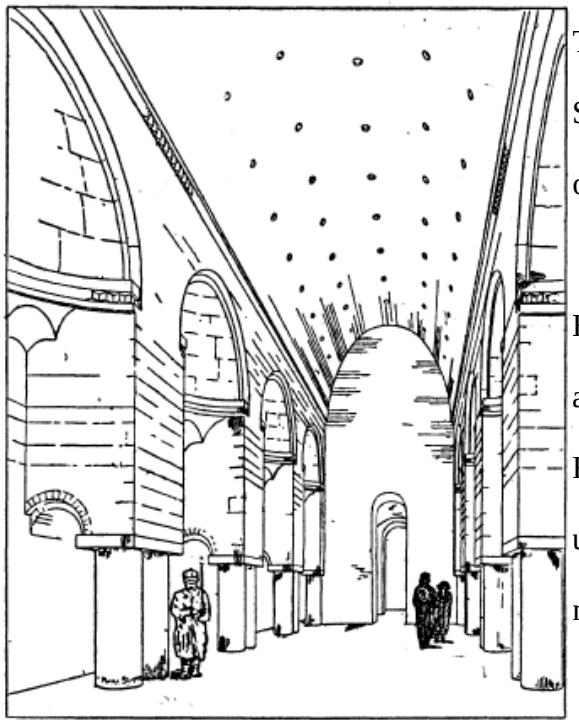
Sarvistan's squinch is quite different from that of Firuzabad. The cone is replaced by segments of a couple of tunnel vaults that seem to arch forward, from the walls that support them. These vaults intersect [in the corner] at a certain angle. The angle of intersection fades into a rounded hood. These kind of squinches are not usually seen in structures attributed to the Sassanian period (Bier n.d.).

Sawtooth moldings are also apparent in both places. These moldings first appear in Firuzabad. The molding set the squinch zones off from the lower walls in the domed chambers. They were made of stucco, like the ones in Sarvistan, but they were more massive and thicker in terms of the proportion to the distance between the adjacent teeth. The stucco strips, which serve as brackets were omitted in Firuzabad (Bier, n.d.).

Traces of sawteeth were also seen in the Andasir palace, at the section where one may see the springing of the vaults in the large rooms that surround the open court. These were continuous around all four walls (Bier n.d.).

The third-century palace at Bishapur also display evidences of the employment of sawtooth molding. Several walls in this palace were not preserved, which makes it difficult to pinpoint the extent to which sawtooth molding was used. Some sections of molding are preserved though, and examinations of these reveal a resemblance with the moldings in Firuzabad, with respect to the size and the technique used. In Bishapur, however, an upper strip was added. This strip marks the springing of the vault. A miniature teeth, molded in stucco, was also used mainly to distinguish the dome from the squinch zone (Bier n.d.).

In Sarvistan, sawtooth moldings were employed in a Sassanian fashion—which is unknown, and cannot be seen in early Islam monuments. Stucco was used instead of bricks, and stucco strips were applied immediately below the teeth. This makes the stucco appilication in Sarvistan unique, from the style used in all other monuments (Bier n.d.).



According to Bier (n.d.), the interior friezes of sawteeth, as they were used at Sarvistan and Firuzabad to mark the base of a dome, were not used elsewhere except for some Central Asian mausoleums of the tenth century (Bier n.d.).

The two domes are also similar in purpose, mostly for religion. The central purpose of domes, as we know, depends primarily on how they will be used in religious activities. The Firuzabad and Sarvistan domes were not exceptions.

Differences

It may be assumed that Firuzabad was built earlier than Sarvistan. First, there is a highly involved vaulting system in Sarvistan, unlike in Firuzabad. The plan of Firuzabad was much more simple, which reflects the simplicity of the architecture at that time, whereas in Sarvistan, the plan is much more intricate. Similarly, Piers that were found in Sarvistan are also used in one of the halls at Ukhaidir to support arches that carry barrel vaults, and at Qsair 'Amrah (c. 711-750) and Kasr Kharaneh. The only difference of the Sarvistan with the places mentioned is that the vaulting system used by those places are much more complicated (Creswell 1915).

Since the palaces compared were like those that were found in the Achaemenian palaces in Persepolis and Susa, it may be assumed that these were also built around the Achaemenian period. However, some scholars argue that these palaces were built in the Sassanian dynasty (Creswell 1915).

Conclusion

Domes, as we know, were built by ancient people with relatively no hi-tech appliances, no formal education on architecture and such advances that we have nowaday. Dome-building, fascinating as it is, is indeed an achievemnt of mankind that is worthwhile to wonder about. We have just discussed in this paper how the architectural structures have evolved, while taking into consideration the cultures that prevailed at every era of evolution. It is indeed an accomplishment for us to get into discoveries about these ancient structures every single time we put it as topics for our studies.

Firuzabad and Sarvistan palaces, though relatively built at the same time, were not built in the same manner. We have discussed the differences between the two palaces using the literature and we discovered that up until now, scholars have not yet come into a consensus on when those two structures were really built. These confusion may have rooted from the extreme differences of these two palaces. In a more radical point of view, we may even assume that these palaces were not built in the same era, if we are to consider the details of construction.

We have come to realize one important thing in this exploratory study though, that we'll find new information in ancient structures. It is indeed significant for our generation to know about these things to serve as a spring board for the next architectural development. The construction of domes, aside from the marvelous execution of the structure, cover other aspects of architecture, which is not only suitable to the generation of those who built it, but

for other generations to come. We knew that the admission of light in the two domes that were studied were different, but the same in a working principle: A dome structure provided room to where light may bounce and reflect in a larger surface, than it would in a flat roof. We may also conclude that such structure proves very important in terms of spreading the temperature around the chambers, because air may freely diffuse around the dome, without really escaping. Thus, both cold and heat may be regulated by the structure.

We have come to realize that dome structures, aside from its relevance in the development of Iranian architecture, may have practical uses. Such technique, as was relayed to us may help us develop a more sophisticated structure, with more aesthetic value and practical applications. We ought not to forget, however, that we used these two domes as our starting point.

Bibliography

Articles

Asher, C.B. 1993, “Firuzabad: Palace City of the Deccan”, *The Journal of Asian Studies* Vol. 52, No. 4, p.1064

Creswell, K. A. C. 1913, “The Origin of the Persian Double Dome’, *The Burlington Magazine for Connoisseurs*, Vol. 24, No. 128, pp. 94-99

Creswell, K. A. C. 1915, ‘Persian Domes before 1400 A. D.’ *The Burlington Magazine for Connoisseurs*, Vol. 26, No. 142, pp. 146-155

Mehraby, R. (no date), ‘Architecture of Iran’, Available at: http://destinationiran.com/Architecture.htm

§O’Kane, B. (no date). ‘Dome in Iranian Architecture’, *Iranian Art & Architecture*, Available at: http://www.cais-soas.com/CAIS/Architecture/dome.htm

Wright, G. R. H. (no date),’Imperial Iranian Architecture: From Achaemenids to Sassanians’. Available at:: http://www.cais-soas.com/CAIS/Architecture/imperial_architecture.htm

Books

Bier, L. (no date), 'A Study in Early Iranian Architecture', Retrieved as an online file from: http://books.google.com/books?id=GTgBYRD8wvYC&pg=PA56&lpg=PA56&dq=sarvistan+dome&source=web&ots=ZHItxYbQ4P&sig=weAWEyFmRXO4Bp-H-BZRydrAJkg#PPP11,M1

Blair, S. 1983, 'The Octagonal Pavilion at Natanz: A Reexamination of Early Islamic Architecture in Iran, *Muqarnas*, pp. 69-94

Lethaby, W. R. 1912, *Architecture*, London, p.58

O'Kane, B. 1984, 'Timurid Stucco Decoration', *Annales Islamologiques*, Tehran, 1970

Perrot G. and Chipiez, C, 1883 *History of Art in Ancient Egypt*, London. p.37

Pope,A. U. 1965, *Persian Architecture*: *The Triumph of Form and Color*, George Brazillier Inc, New York