3.18 Seljuk Introduction: 1038-1118 AD

Seljuqs are Turkic nomadic origins, who ruled the Eastern Islamic region. Starting from Central Asian to Persia, conquering eastern Anatolia and finally settling in Isfahan. After the Seljuks defeat of Ghaznavids Dynasty in 1040 AD and demolishing the Buyid Dynasty in Bagdad they have established themselves as new protectors of Abbasid Caliphate in 1055 AD. Within fifty years, the Seljuqs created a vast empire, encompassing all of Iran, Iraq, and much of Anatolia [1]. By the end of the tenth century, Seljuq realm dissolved into separate territories governed by different branches of the dynasty. The main branch of Seljuq called, Great Seljuqs, maintained control over Iran. Under Seljuq sultanate, Iran had a period of material, cultural wealth, creativity in art and architecture [2] [3]. Turkic Seljuq adopted and supported local Perso-Islamic traditions. Seljuq art is recognized for the blend of Persian, Islamic, and Central Asian-Turkic elements together. During this period, the arts of Iran gained distinction in Islamic world. Beginning in the second half of the twelfths century, the art of inlaying bronze or brass objects with precious metals such as copper, silver, and gold became prominent in the Eastern Iranian province of Khorasan. The Seljuqs were great patrons of architecture. An unprecedented number of madrasas\(^{50}\) were erected throughout the Seljuq realm. Most notable, however, was the Madrasa Nizamiya, founded in Baghdad by the great Seljuq, Nizam Al Mulk, who ruled during 1063–1092AD to support Sunni\(^{51}\) education. In architecture, the four vaulted halls, iwan, became common in Islamic Period. The most celebrated period and

\[\text{[1] (Cavendish, 2006) P. 364} \]

\[\text{[2] (Bosworth, 2007) p. 280.} \]

\[\text{[3] (Britannica, 2015)} \]

\(^{50}\) Schools

\(^{51}\) A denomination of Islam
influential Seljuq monument. Funerary monuments were the significant structures in this period when the most prominent Mausoleum of Sultan Sanjar built. Following the Seljuks conquest of Baghdad in 1055 AD, the Seljuq dynasty, descendants of Central Asian Turkic, Oghuz tribe, managed to control most of West Asia, Iran, Iraq, and Syria. The attack on the Byzantine border in 1071 AD resulted into Seljuq victory and conquest of Anatolia to Turkic settlement. A branch of the Seljuqs in 1078–81AD ruled from Nicaea City in north-western Anatolia named as the Seljuqs of Rum\(^{52}\), referring to the Roman Byzantine past of the Seljuq territories. Apart from an earlier brief period of Arab rule in the east, Anatolia was new to Islam, and the Seljuqs were thus among the first to cultivate Islamic art and architecture in these lands. As heirs to the Great Seljuqs of Iran, the sultans of Rum adopted Perso-Islamic traditions. One of the major continual construction, Islamic site constructed since 771 AD is The Friday Mosque of Isfahan famed as The Jameh Mosque of Isfahan \[^{1}\] \[^{2}\] \[^{3}\].

a. The Great Mosque of Asfahan: 771 AD

The Mosque consist of a prayer hall and two brick domed chambers built by architect Abul Fath dated from the eleventh century. The south-west dome, Maqura, was built during Nizam Al Mulk in 1086-1087 AD and named by his name \[^{4}\]. While the North-East dome, Taj Al Mulk, was built a year later \[^{5}\]. The construction of the Northern East dome is related to Seljuk building methods. The Mosque was a hypostyle plan but the Seljuqs had the two brick dome chambers \[^{4}\] \[^{5}\]. The mosque considered a masterpiece in Persian architecture for its geometric balance. The North-East Dome rests on a square, massive piers with three slim round engaged columns, and

\(^{52}\) Rome
an octagonal transitional zone formed by four squinches, to rest another zone of sixteen arches with a drum comprising Islamic religious inscriptions.

Ten double-ribs emerge from the dome’s drum and ascend to inscribe a pentagon. This dome can be accessed from the south and west. On the inside of the dome are Quranic verses inscribed in letters formed by bricks [2] [3]. Many architectural historians consider the Friday Mosque of Isfahan epitomize to Seljuks and early Safavid period. The two domes are distinct in their system of ornament. The south-west dome, remnants of stucco ornament, while the northeast dome are bricks that creates structural integrated ornamentations of variety of patterns. This consistency in the architectural language called: brick as ornament Method. This method lacked the southern dome because it was built on an existing structure. The Architectural historians often draw comparisons, regarding structure and ornament, between the earlier Southwest dome, built by Nizam Al Mulk, and the later, smaller Northeast dome, also referred to as Gunbad-e Khaki. They view the north-east dome an epitome of mathematical perfection, evident in the harmony of its horizontal and vertical divisions. A British travel writer, Robert Byron described the two Domes in his book: The Road to Oxiana. In XI century Iran, hypostyle mosques started to be converted into four-iwan mosques. The Great Mosque of Isfahan reflects this design method. The mosque was a hypostyle mosque that was modified later by Seljuqs of Iran after their conquest of the city of Isfahan in the XI century. The four Iwan Mosque layout is arranged around a large open courtyard as well. However, in the four-iwan mosque, each wall of the courtyard is adjusted with a monumental vaulted hall, the iwan. This type of mosque became widespread in the XII century.

[2] (Galdieri, 1984)

[3] (Hillenbrand, 1972)
The Safavid rulers refurbished these walls with new tiles in the XVI century. Though it originated in Iran, the four-iwan plan would become the new plan for mosques all over the Islamic word, used widely from India to Cairo and replacing the hypostyle mosque in many places [1]. The hypostyle plan dates back to Buyids in the tenth century period. The fire occurred caused damages to the mosque and prompted rebuilding of some of its old architectural elements and introducing new ones. Consequently, the mosque's plan evolved from a hypostyle plan with a rectangular inner court surrounded by prayer halls comprised of round columns carrying a wooden roof to Seljuk type. the southwest dome, the northeast dome rests on a square base of square, massive piers with three slim round engaged columns, with an octagonal transitional zone formed by four squinches, on top of which rests another zone of sixteen arches with a drum comprising an inscription band with religious inscription. Ten double ribs emerge from the dome's drum and ascend to inscribe a pentagon. Most scholars consider this architectural act of Taj al-Mulk to be an attempt to surpass the dome built by his rival, Nizam al-Mulk, in the south. This dome could be accessed from the south and west. On the inside of the dome are Quranic verses inscribed in letters formed by bricks. Architectural historians often draw comparisons, regarding structure and ornament, between the earlier southwest dome, built by Nizam al-Mulk, and the later, smaller northeast dome, also referred to as Gunbad-e Khaki (the earthly dome) built by Taj Al-Mulk [2].
The origin of the Islamic Ribbed Vault located in North Africa and Spain

Rana AlKadi
Figure 263: South-West Dome, Tag Al Mulk Dome, 1086-1087AD

Figure 264: Taj Al Mulk Dome, 1086-1087AD

Source: Ozone 11
Figure 265: North-East Dome, Nizam Al Mulk

Figure 266: North-East Dome, 1088 AD

Figure 267: North-East Dome, 1088 AD

Source: http://artofislamicpattern.com/resources/educational-posters/
Figure 268: Nizam Al Mulk Dome
Source: Hassan Zohouri

Figure 269: Three Type of Pitched Brick Methods in The Fridy Mosque of Isfahan
http://artofislamicpattern.com/resources/educational-posters/
3.18.1 Monumental Anatolian Seljuq Architecture: 1077–1308 AD

Along with Perso-Islamic traditions, however, Anatolia had a strong Byzantine and Armenian Christian heritage, which emerged with Central Asian Turkic nomadic, northern Mesopotamian, and Crusader cultures. The exchange and synthesis of these different traditions is vividly reflected in Seljuq architecture and art. For instance, Gök Madrasa features carved stone, typical of Armenian architecture, alongside brick, a common material in Iran and Central Asia. In the arts, continued use of luster- and overglaze-painted tiles, as well as creations in wood and metal, are especially noteworthy [1].

a. Ahmad Sanjar Mausoleum, 1157 AD

This mud brick mausoleum represents the architectural peak of the destroyed Seljuk capital in Merv Oasis. Mohammad ibn Aziz in Khorasan had built the mausoleum soon after the Khwarazm Shahs deposed the Seljuk dynasty. The mausoleum was part of a complex connected to a mosque on its west with grille window. It marks a significant shift, from the typical vertically-accentuated Seljuk tomb tower towards squatter proportions with emphasis on interior space. The mausoleum consists of an enormous brick cube, approximately 27 meters square crowned by large dome nearly 18 meters in diameter. The outer dome was once embellished with turquoise tiles, but only its interior’s exposed, interlaced structural ribs exist today. These trace a central eight-pointed star motif within the dome's eye, surrounded by a radial series of foiled arches and stalactite-topped pilasters [2] [3] [4].

[1] (Galdieri, 1984)
[2] (Hillenbrand, 1994)
[3] (Knobloch, 2001) P. 138
Figure 270: Sultan Sanjar Mausoleum in Merv, Turkmenistan

Source: Tenth-century tomb of the Samanid, Bukhara, Uzbekistan (after Creswell)
Figure 273: Sultan Sanjar Mausoleum. *Source: after Creswell*

Figure 274: Mausoleum of Sultan Sanjar. External elevation.

*Source: by A. Kononenko, 1993. © A. Kononenko*
Figure 275: Sultan Sanjar Mausoleum, Built 1096–1157 AD.
Source: Photo by Hergit

Figure 276: Sultan Sanjar Mausoleum, Merv: Turkmenistan in 1157AD

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3.19 Factors for Vault Evolution from East to West

3.19.2 Silk Road

Turkmenistan has been at the crossroads of civilizations for centuries. In medieval times, Merv was one of the great cities of the Islamic world and an important stop on the Silk Road. The Silk Road was not a trade route that existed exclusively for the purpose of trading silk only, but many other commodities were also traded, from gold and ivory to exotic animals. As well as a wide variety of material including precious gems, metals like jade and horses, apricots, melons, raisins, ceramic lusterware, and lacquerware. More importantly, it carried people, and so its use spread technological advances such as medical science from India and religions such as Buddhism and of all the precious goods crossing this area, silk was the most remarkable for people of the West [1].

K. Kris Hirst, an Archaeology Expert described The Silk Road or Silk Route as the network of trade routes crossing Asia, first used in 206 BC starting from China. Over 4500 kilometres or 2800 miles of roadway crossing by three major trails between Chang’an in China until Rome in Italy. Using series of way stations and oases. The Silk Road spanned 1900 kilometres or 1200 miles of the Gobi Desert of Mongolia and the mountains Pamirs of Tajikistan and Kyrgyzstan. Important stops on the Silk Road included Kashgar, Turfan, Yarkand, Dunhuang, and Merv Oasis. [Figure 277]. Mosque of the Walking Pilgrims were major architectural buildings spreading in crucial cities on the track of the road.

---

53 A caravan route used for trade with China until the mid-15th century.
Figure 277: Silk Road Stations
3.19.1 Migration of Scholars and Science Evolution

From the eighth century to the thirteenth century AD, the Islamic period named as the golden Age. The Muslim expansions had experienced scientific, economic and cultural flourishing evolution. This period initially began during the Abbasid caliph Harun Al Rashid, when the House of Wisdom in Baghdad was the center of all Scholars. All of the world’s classical knowledge were translated into Arabic in this Period. An emphasize to the importance of obtaining knowledge had played virtual role in influencing Muslims of this time. Artists, Scholars and scientific started seeking for knowledge and the development of science. The Quran was engaged to the values of education. For this, lots of religious philosophies were added and used by Scholars in Art and Architecture methods. Khwarizmi a great scholar famed during 780 – 850 AD had added Geometry Science, which was adopted in Islamic Architecture and Art. This science had flourished From Eastern regions to western regions. [1] [2].

[1] (Liu, 2010)

[2] (Hirst, xx)
Sufism is a mystic and ascetic movement, which originated in the Golden Age of Islam, from about the ninth to tenth centuries. Sufiism started in Basra in 728 AD, it is defined as the inner mystical dimension of Islam. Over the years it developed to create its own architecture. Later, various Sufi orders had been influenced and adopted it philosophy into various religious and Architectural movements. Islamic Mausoleum developed since Sufism evolution started in Bagdad till it reached Central Asia. These structural designs were influenced by the Sassanid Char Taq structures. A combination of Zoroastrian Architecture with Islamic arithmetic and geometrical theories made by Muslim Scholars. The science developed by: Al Khorezmi, Al Fergani and Ibn Sina to be applied into brick Patterns famed has: Hazarbaf in Iranian Terminology, which is an architectural decorative art to create geometric patterns of a wall or to spell out sacred names or pious phrases [1]. This technique originated in Iraq in the eighth century, and matured in the Seljuq and Timurid era. Hazarbaf technique was found in Ukhadir Palace in Iraq, which was built around 762 AD. The technique appeared in Iran and central Asia more than a century later but with more sophisticated designs. The tomb of the Samanid ruler Isma‘ili in Bukhara, Uzbekistan had walls with of bricks that created a weaving pattern [3] [4]. Later, Khanqah\(^4\) had developed. a place for spiritual retreat and reformation. Khanqah is very often founded adjoined to shrines, mosques or madrasas\(^5\) [5].

\(^1\) (Ibn Khaldun, ibid., P. 403

\(^2\) Hasan Al Basri, is one of the earliest links in most Sufi lineages.

\(^3\) (Kana'an, 2008)

\(^4\) (Beckwith, 2009)

\(^5\) In the Arab world, especially North Africa, the Khanqah is known as a zawiyah. In Turkey and areas like Albania and Bosnia Khanqah is named Takiyah. Khanqahs later spreaded across the Islamic world, from Morocco to Indonesia. An example of a

\(^{54}\) A building designed specifically for gatherings of Sufi brotherhood practises.

\(^{55}\) Religious schools
PART IV

4. DEVELOPMENT OF VAULTS
FROM ANCIENT CIVILIZATIONS TO ISLAM
4. DEVELOPMENT OF VAULTS FROM ANCIENT CIVILIZATIONS TO ISLAM

4.1 Vaults in Mesopotamia

Massive structures of crude brick supported by buttresses began in Babylonian era. Later, the Assyrian Empire had imitated the Babylonian architecture and built their Palaces and Temples of bricks instead. This initiated a new construction methodologies by using both stones and bricks in buildings [1]. Bricks were the ordinary building material in Mesopotamian. In Sassanid architecture, the last Persian Empire before the conquest of Muslims massive use of mortar masonry invented vaulting methodologies in building. Although mud brick had been developed long before and mortar constructions were known during the Parthian era, both became crucial materials during Sassanid Architecture. Mud brick had remained most significant buildings in the old classical antiquity period in Mesopotamia, but later the use of stone and brick was adopted during the Sassanid time. Although Constantinople had retained the old traditional carving on stone, but Sassanids had used rubble, baked or sun dried bricks, not only in the brick walls but as well to build the columns, vaults and the isolated supports. The characteristic, lightness and solidity with mortar made it particularly proper for the settlement of vaults. This was particularly the start of adapting bricks in forming architectural elements on Islamic religious complexes. The domes and vaults are prevalent in the Sassanian Architecture; a square room domed on four niches over a central square named according to Sassanid Architecture Chahar-taqi Figure 281: [1][2][3] . It is one of the most characteristic structural elements of

[1] (Roman Ghirshman; Stuart Gilbert; James Emmons, 1962)


[3] (Franz Von Reber and Joseph Thacher Clarke, 1882)

56 Four arches
Sassanid Architecture which famed historically in Persia. But later, and later was successfully adopted by Muslims and became part of the Islamic Architectural tradition. It remains when the Parthians grab parts of Mesopotamia. In Ctesiphon, the founder of the Sassanian dynasty, had built the great vaulted Taq-e Kisra in 224 AD. Which Later, Arabs had capture in 637AD. And used Taq-e Kisra as prayer hall and part of their developed mosques. But by the VIII century Ctesiphon had ruined. Among these, rubble stone masonry with gypsum mortar became predominant. And Brickwork was often used for vaults and domes [1] [2].

[1] (Roman Ghirshman; Stuart Gilbert; James Emmons, 1962)

Figure 279: Taq Kasra, 224 AD

The origin of the Islamic Ribbed Vault located in North Africa and Spain

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Figure 280: Chahar Taqi locations

Figure 281: Chahar-taqi, Plan

Figure 282: Chahar-taqi Section

Source: Encyclopedia Iranica
Table 8: Mesopotamia Timeline

<table>
<thead>
<tr>
<th>Year</th>
<th>Historical Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>628 BC</td>
<td>Zoroaster’s Birth</td>
</tr>
<tr>
<td>560 BC</td>
<td>Cyrus The Great</td>
</tr>
<tr>
<td>330 BC</td>
<td>Alexander The Great Defeat Dariush II</td>
</tr>
<tr>
<td>238 BC</td>
<td>Parthian Empire Established</td>
</tr>
<tr>
<td>50 BC</td>
<td>Mithraism Fully Developed</td>
</tr>
<tr>
<td>224 AD</td>
<td>Sassanid Empire Established</td>
</tr>
<tr>
<td>651 AD</td>
<td>Arabs Conquest of Persia</td>
</tr>
</tbody>
</table>

Figure 283: Mesopotamian, Babylon, Assyrian
4.1.1 Sassanid Vault Traditions

Domes were important elements of architecture in the Sassanid structures for the need of fire and fume vanishing throughout the buildings. Through history, Persians had invented squinches which can be defined as series of concentric arches forming half-cone in the corner of a room to enable the transition from the walls of a square chamber to an octagonal base to set a dome. Previous transitions to a dome from a square chamber existed but were makeshift in quality and only attempted on small scales, not being consistent enough for large constructions. The squinch enabled domes to be widely used and became forefront of Persian architecture building methods [1]. Squinches are considered hybridization of semi-dome or cloister vault to support the domes.

Dietrich H. and O’Kane had defined squinches as:

‘Adjoining semi domes occurred in the Sassanid Buildings in Kis, Bozpar, Negar, Sarvestan [2]’.

The magnificence in which Sasanian emperors lived is well demonstrated by their surviving palaces, such as those at Firuzabad and Nishapur in Fars as well as the capital city of Ctesiphon named Iraq presently. The Parthian dynastic architecture initiated in Ctesiphon created a great Sasanian architectural characteristics. Altogether are characterised by the barrel-vaulted iwan introduced in the Parthian period [3]. The Brick masonry and its most relevant structural achievement, the barrel-vaults built without centering are the most significant Mesopotamian contributions to the ancient building technology.

[1] (Wikiwand, 2015)
[2] (Dietrich and O’Kane, 1990)
[3] (Ettinghausen, 1972)
The oldest brick vault of this kind, found at Tell al-Rimah in Iraq, dated c.2100. Due to the scarcity of wood in many areas of the Iranian plateau, domes were an important part of vernacular architecture throughout the Persian history. The Persian invention of the squinch, a series of concentric arches forming a half-cone over the corner of a room, enabled the transition from the walls of a square chamber to an octagonal base for a dome. Previous transitions to a dome from a square chamber existed but were makeshift in quality and only attempted on a small scale, not being reliable enough for large constructions. The squinch enabled domes to be widely used and they moved to the forefront of Persian architecture as a result [1] [2]. Here comes the start of the Squinch vault which is a hybridization of semi-dome or dome and cloister vault.

The first fully developed Cahartaq with arched or barrel-vaulted bays on the interior between the piers was Cahartaq at Ardashir Palace, which was dated to the time of Šosrow II in 590-628AD. The similarity in plan between excavated fire temples and Islamic shrines often makes it extremely difficult to determine the original function of unexcavated Cahartaqs, especially in Fars and Kerman, provinces where Zoroastrianism and Islam flourished side by side in the first centuries after the Arab conquest.

[2] (Arce, xxx)

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57 A holy or sacred place, which is dedicated to a specific deity, ancestor, hero,martyr, saint.
Figure 284: Tell Al-Rimah Plan

Figure 285: Tell Al-Rimah in Iraq, c.2100.

Source: Arab Encyclopedia
4.1.2 Chahar-Taqi Vaults

Fire Temple are the most historical astronomical developed buildings through history. These buildings belong to the late Parthian and Sassanid era where building without walls and roof rested on four pillars [1]. Chahar-taqi58 means four directions, an Iranian terminology of Four Arches defined as short barrel vaults between four corner piers, with a dome on squinches over the central square.

K.E. Eduljee has described Chahar-taqi in Zoroastrian Heritage as:

The Niasar Zoroastrian temple in Kashan is an example. Square domed buildings with entrances at the axes, inspired the forms of early mosques after the Islamic conquest of the empire in the 7th century. Some having been converted into mosques. The later isolated dome chambers called the "kiosk mosque" type may have developed from this tradition [2].’ (Eduljee, 2016)

And added:

‘There is no evidence of the roof. It could even have been a dome. The massiveness of the columns suggests a stone roof, and stones similar to the rest of the structure have been found in part of the citadel wall built during the seventh century ACE. Archaeologists surmise that the citadel stones were taken from the fire house.’


[2] (Eduljee, 2016)

[3] (Godard, 1965)

58 A rectangular hall or space, usually vaulted, walled on three sides
a. **Vaults of Ardashir Palace: 224–240 AD**

The earliest known example for the Sasanian Empire Architecture is Firuzabad Palace which named by its founder Ardashir I. In 224 BC, Ardashir had defeated the Parthians and built his own Palace in Firozabad town influenced by the Parthian Empire Architecture. The Palace is a hybridization of Persian and Hellenistic artwork for its location. Three elliptical domes with 45 feet in diameter characterize the Palace. It is built of local stones, mortar and covered with plaster within the interiors. The central dome is designed with an opening to permit light into the Place and some openings between the squinches are added for lighting purposes as well. The main entrance is an Iwan vault structure with 44 feet size, the arched entry innovation was late Parthian Tradition [Figure 289]. A large square hall under a large dome made of baked brick located in the center of the Palace [1]. Andre Godard in his book *The Art of Iran* mentioned:

> *The Parthians contributions to the development of architectural form, were the achievement of a dome on Squinches and the development of the vaulted iwan structure initiated later. The dome was modelled on the Islamic era while, according to the French archaeologist, Andre Godard, the original dome was egg-shaped* [2].

And added:

> *The domes at the Firuzabad were not made of concrete as Roman Architecture but bricks. The Palace structure contains three domes* [3]. (Godard, 1965)
George Michell in his book *Architecture of the Islamic World: Its History and Social Meaning* defined that:

‘The Barrel-vaulted Iwan, a rectangular room with the front side open, the visible shape of the vault became the dominant feature of the facade. It started in Parthian time, the Iwan became the most conspicuous element of Sasanian and later Iranian architecture’ [1]. ‘(Michell, 1978) And added:

‘Alternatively, The Sassanian Iwan is usually constructed between two halls as supporting elements of the Iwan’s main hall which can be founded in Sasanian Palaces [2].’

b. **Vaults of Sarvestan Palace: 420-38 AD**

The Sassanian Palace of Sarvestan with window openings, was built in 420 AD. The large brick dome of the Sarvestan Palace also appeared in Fars but later in date. Two centuries before Islam in 420-438 AD by Bahram V. The Squinches were used in Sarvestan Palace to support the rounded domes in addition columns were used to support the vaulting in the Palace [Figure 287] [Figure 288] [3].

Idem in his research paper: *Iran in the Ancient East* mentioned:

‘The function and date of the Sasanian palace at Sarvestan, which contains two Cahartaq are still being debated’ [4]. (Idem, 1975) [4] (Idem, 1975) P. 158
The origin of the Islamic Ribbed Vault located in North Africa and Spain

Rana AlKadi

Figure 286: Ardashir Palace Location, Fars Providence

Figure 287: Ardashir Palace, 224–240 AD

Figure 288: Plan of Ardashir Palace, 224–240 AD

Source: Archnet
Figure 289: The Entrance of Ardashir Palace, Sassanid Architecture

Figure 290: Squinches of Sassanid Vaults

Figure 291: Ardashir Palace Vault

Source: Carlos Placios
The origin of the Islamic Ribbed Vault located in North Africa and Spain

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Figure 292: Sarvestan Palace, 420-38 AD

Figure 293: Sarvestan Palace Plan

Figure 294: Sarvestan Palace 420-38 AD

Source: Archnet
The origin of the Islamic Ribbed Vault located in North Africa and Spain

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Figure 295: Sarvestan Palace, 420-438 AD

Figure 296: Sarvestan Palace Vault
Source: Carlos Palacios
c. **Niasar Chahar Taqi Vault**

This temple is a simple square pavilion converted later to an Islamic building famed as kiosk mosque with a dome carried on four heavy piers joined by arches. The arches were built by bridging the piers, without a keystone. This technique considered a Sasanian architectural technique. Niasar Char-Taqui Temple is 14x 14 meter building. The dome which only covers the Center of the Pavilion is raised on low square drum set on the piers [1]. It was made of stones bonded with mortar. The stones are used in the lower part of the building and those used in the arches and upper parts with square-shaped bricks. The lower parts of the building have been coated with plaster in recent years [Figure 300] [3].

Godard had mentioned:

> ‘The main dome of the fire temple had previously collapsed. The dome was reconstructed with the support of wooden ribs during the Islamic Period’. [4]

[1] (Idem, 1975) P. 158

[4] (Godard, 1965)
The origin of the Islamic Ribbed Vault located in North Africa and Spain

Figure 297: Chahar-Taqi with an opening, Iran

Figure 298: Chahar-Taqi with an opening
Figure 299: Zoroastrian Architecture in Sassanid Era

Figure 300: Niasar Zoroastrian temple

Figure 301: Niasar Zoroastrian interior Vault

Source: Sassanids Arch
Figure 302: Chahar-Taqi at Niasar near Kashan, Esfahan, Sassanian Era

Figure 303: Chahar-Taqi at Niasar
Source: Sassanids Arch
Ribbed Vaults started in Persia when introducing Chahar taqi method to the Architectural field. Although, the origins of Chahar taqi are still matters of debates, but it has been suggested that domes on squinches in mud-brick architecture are originated from Eastern Iran, where the development of simple pitched-brick dome or squinch vault had appeared. Prof. Dietrich Huff had mentioned in The Circle of Ancient Iranian Studies:

‘In Iran, there is no evidence of the Čahārtāq proper earlier than the beginning of Sassanid period. (Huff, 2016) [1].’

Ernest Herzfeld defined vaulting in early centuries by stating:

‘The earliest definite archaeological evidences of pitched-brick vaulting comes from Mesopotamia in the late 3rd or early 2nd millennium b.c. (Herzfeld, 1942) [2].’

Oates in his book The Excavations at Tell al-Rimah had mentioned:

‘It was fully developed in structures roofed with pendentive domes circumscribing the square, which were popular in 2nd- and early 3rd-century Roman Syria [3].’

John Fitchen clarified in his book Construction of Gothic Cathedrals

‘In ancient Egypt, brick vaulting was used chiefly for drains. The Chaldeans and Assyrians used vaults for the same purpose but seem also to have made architectural use of high domes and barrel vaults. The Greeks made no use of vaults [4].’ (Fitchen, 1981) [4]
4.1.3 Iwan Vaults

A vaulted space that opens on one side is called Iwan. The iwan developed in pre-Islamic Mesopotamia where it was used in monumental and imperial buildings. Iwan strongly associated with Persian architecture. It continued to be used in Sassanid era. Vaulting without centering depended on the qualities of gypsum mortar, which helps to set the vault without centering [1]. Professor Dietrich Huff mentioned in his Research *Iranian Architecture: Sasanian Dynasty and Architecture*

‘Vaulting without centering prevented the development of geometrical advanced constructions [3].’

And added:

‘Semicircular barrel vaults appear only when built on centering as a voussoir arch with, lying courses [4].’

And contributed to the definition of cross vault stating:

*The cross vault, resulting from the intersection of two barrel vaults at right angles, was not developed in the Sassanid Period. There are no examples of pointed arches built by formal intention, although they occur as a result of building practice in lesser monuments [5].

‘The Architecture prevalent in Persia under the Sassanid dynasty (3rd to 7th century) excelled in large palace complexes with open iwan extensive use of barrel vaults and parabolic domes on squinches of brick or rubble stone, set in plaster mortar and constructed without centering. The massive walls in these buildings were covered with stucco decor or articulated by pilasters and cornices [6].’
4.2 Roman Vault Tradition

Before the spread of Islamic, Roman Empire was powerful. It grew to create large territorial lands around the Mediterranean Sea in Europe, coastal Regions in South Western Europe until Asia and North Africa. It was the most powerful economic, cultural, political and military force in the world of its time known as the largest Empire of the classical Antiquity Period. The vaulting technique of Romans, started in the 1st century AD Casting concrete in one solid mass, the Romans created vaults of perfect rigidity, devoid of external thrust, and requiring no buttresses. Thus vaults and domes could be easily erected over vast spaces, producing impressive and complex Thermae\(^59\), Amphitheaters\(^60\), and Basilicas. Roman vaults were the basis on which more complex and varied forms were developed in middle Ages. The tunnel, or barrel vault spans between two walls, like a continuous arch. The cross, or groined, vault is formed by the intersection at right angles of two barrel vaults, producing a surface that has arched openings for its four sides and concentration of load at the four corner points of the square or rectangle. The semicircular arch was universally employed in Romanesque vaulting throughout Europe, and the Roman cross vault was the type used for covering square or rectangular compartments [1]. By time, The Roman Empire had been divided into two Empires: Roman Empire and East Roman Empire. The Eastern Roman Empire

\(^{59}\) Roman baths

\(^{60}\) Place for viewing, Performance

[1] (Encyclopedia, 2012)
included: Eastern Europe, the Roman near East, Egypt and portions of North Africa. When Islam reached Eastern Roman it introduced Muslims to Greek thoughts and their Architecture [1]. The exposure to the Byzantines Civilization Architecture abroad had presented new applications to the Arabian Peninsula. Vaults of Ancient Civilizations

A diaphragm arch is a transverse wall-bearing arch forming a partial wall dividing a vault or a ceiling into compartments. When used under a wooden roof, it has the advantage of providing a partial firebreak. It was first used in Roman Syria, during the 2nd century AD. In their vaulting structures, Umayyad period buildings show a mixture of ancient Roman and Persian architectural traditions. Diaphragm with lintelled ceilings made of wood or stone beams, or, alternatively, with barrel vaults, were known in the Levant since the classical and Nabatean period. They were mainly used to cover houses and cisterns. The architectural form of covering diaphragm arches with barrel vaults, however, was likely newly introduced from Iranian architecture, as similar vaulting was not known in Bilad al-Sham before the arrival of the Umayyads. However, this form was well known in Iran from early Parthian times, as exemplified in the Parthian buildings of Aššur. The earliest known example for barrel vaults resting on diaphragm arches from Umayyad architecture is known from Qasr Harane in Syria [2] [3].

[1] (Fernie, 2001)
[3] (Wikiwand, 2016)
During the early period, the diaphragm arches are built from coarsely cut limestone slabs, without using supporting falsework, which were connected by gypsum mortar. Later-period vaults were erected using pre-formed lateral ribs modelled from gypsum, which served as a temporal formwork to guide and center the vault. These ribs, which were left in the structure afterwards, do not carry any load. The ribs were cast in advance on strips of cloth, the impression of which can still be seen in the ribs today. Similar structures are known from Sasanian architecture, for example from the palace of Firuzabad. Umayyad-period vaults of this type were found in Amman Citadel and in Qasr Amra [1].

a. **Roman Fortress of Zenobia**

The river Euphrates was the shortest road from the Persian Empire to the Roman Empire. It was also one of the most accessible roads, because there was sufficient water for a big army. Halabiye was fortified in the 3rd century AD by Zenobia, Queen of Palmyra, after whom the site was named in antiquity. After her revolt against the Roman Empire in 273, Halabiye was captured by the Romans and subsequently refortified as part of the Limes Arabicus. Fortress Zenobia was later rebuilt by the emperor Diocletian in 284-305; a second building phase took place when Anastasius I ruler of the Byzantine Empire during 491-518 AD. The next rebuilding can be dated to the reign of Justinian in 527-565 AD, who sent his general Belisarius to the east to fight against the Persians [2]. The site have been taken over by the Persians during their epic fight against the Byzantines in the first third of the sixth century. Arabs took over the area in 637 AD, reused Zenobia, and modified the citadel. However, because both Syria and Iraq were part of Umayyad Caliphate of Damascus a public bath complex.

[1] (Hillenbrand, 1994)

[2] (Lauffray, 1983) P. 119
The origin of the Islamic Ribbed Vault located in North Africa and Spain

Figure 304: Roman Fortress of Zenobia

Figure 305: The Praetorium Vaults

Source: Damascus
4.3 Byzantine Vault Traditions

Byzantine architecture was of crucial importance to the development of early Islamic architecture and later the architecture of the Ottoman Empire. At the time of the Islamic conquest of Syria in the seventh century Byzantine was essentially a continuation of Roman architecture. There were, however, few major differences, the most significant of which was the massive church-building campaign of Justinian (sixth century) which made Christianity Byzantine architecture the central focus of architecture. Also noticeable in the architecture of this period was the influence of the capital Constantinople on the rest of the empire. During the ninth to eleventh centuries the Byzantines recovered from the disastrous effects of the Islamic conquests, and in this period there is evidence of Islamic influence on Byzantine architecture, particularly in descriptions of the palaces of Constantinople. During the fourteenth to fifteenth centuries Byzantine architecture was a major influence on that of the Turkish principalities in Anatolia. In particular the domed basilica church had a formative influence on early Ottoman mosques [1] [2].

The character of Byzantine architecture, which dates from the fourth century to the present day, is determined by the novel development of the dome to cover polygonal and square plans for churches, tombs, and baptisteries. The practice of placing many domes over one building is in strong contrast to the Romanesque system of vaulted roofs

Auguste Choisy and Hans Buchwald and others on this topic had mentioned [3]:

"Medieval European builders developed a modification, the rib vault, a skeleton of arches or ribs on which the masonry could be laid. The medieval mason used pointed arches; unlike round

[1] The thinner mortar joints smaller than the brick thickness, the opposite of the Byzantine technique


[3] (Choisy, 1883)
arches, these could be raised as high over a short span as over a long one. To cover rectangular areas, the mason used two intersecting vaults of different widths but of the same height’.

The origin of the Islamic Ribbed Vault located in North Africa and Spain

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4.4 Gothic Vault Tradition

Ribs to strengthen the groins and sides of a cross vault were first employed in the Church of Sant'Ambrogio, Milan in the eleventh Century. When the system of using ribs to form a complete organic supporting skeleton was developed, it became one of the basic principles of perfected Gothic architecture. The use of ribs in vault forms led to increasing complexity, beginning in the twelves Century in Europe. The pointed arch was dominant in medieval architecture from the thirteen century. On ward, helped to overcome the difficulties of vaulting oblong compartments exclusively with semicircular sections and to bring the various ribs of unequal spans to a crown at the same height. Some vaulting compartments or bays were divided by ribs into six segments and were known as sexpartite vaults, but the four-part vault generally prevailed. In England the multiplication of ribs for structural and decorative purposes culminated in the fifteenth century in the elaborate fan vault of the Perpendicular style.\(^1\)

4.5 Armenia Vault Tradition

Damascus was the capital of the Aramaean state Aram-Damascus during the Iron Age. The greatest achievement of Armenian architecture is generally agreed to be its medieval churches, though there are different opinion precisely in which respects. The first Armenian churches were built between the 4th and 7th century, beginning when Armenia converted to Christianity, and ending with the Arab invasion of Armenia. The early churches were mostly simple basilicas, but some with side apses. By the 5th

\(^1\) Term given the final period of English Gothic architecture
century the typical cupola cone in the center had become widely used. By the 7th century, centrally-planned churches had been built and a more complicated niched buttress. By the time of the Arab invasion, most of what we now know as classical Armenian architecture had formed.

The first Armenian churches were built on the orders of St. Gregory the Illuminator, and were often built on top of pagan temples, and imitated some aspects of Armenian pre-Christian architecture

[1] (Stevens, 2000)
4.6 Pre-Islamic Civilization Vaults Types

Figure 314: Armenia Vault, 908-943 AD

Figure 315: Karmravank, Armenia, 908-943 AD
Figure 316: Sassanid Vault Tradition, Ardashir

Figure 317: Sassanid Vault, Sarvestan

Source: Carlos Palacios
4.7 Islamic Dynasties Vaults Type from VIII Until X

Figure 318: Zigzag, Abbasid

Source: Archnet

Figure 319: Zigzag, Aghlabids

Source: Author

Figure 320: Lobbed, Aghlabids

Source: Author

Figure 321: Lobbed, Aghlabids

Source: Author
Figure 322: Buyids Pitched Brick Vaults
Source: Archnet

Figure 323: Samanid Vaults
Source: Wikiwand

Figure 324: Seljuk Dome
Source: Wikiwand

Figure 325: Seljuk Dome
Source: Wikiwand
Figure 326: Pitch Brick Woven Vaults

Figure 327: Woven Vaults

Figure 328: Cross Ribbed Vault

Figure 329: Cross Ribbed Vault
PART V

5. HYBRIDIZATION AND DEVELOPMENT OF ISLAMIC VAULT
5. HYBRIDIZATION AND DEVELOPMENT OF ISLAMIC RIBBED VAULTS

Brick masonry and its most relevant structural achievement, the barrel-vaults built without centering are the most significant Mesopotamian contributions to the ancient building technology [1]. It is often very difficult to determine whether particular structures belongs to the Sassanid or early Islamic period, as the form seems to have continued in use without interruption and to have been widely adopted in Islamic architecture of Persia. The structure of mosques appeared in early Islamic period. Many buildings of Sassanid era were converted into mosques. However, the rough stone masonry of the lower walls, the parabolic profiles of the arches, and the crude squinches determine the ear of the structure if it is Sasanian or early Islamic in date.

Shokoohy had explained:

‘Areas that had been remained a stronghold of Zoroastrianism, have been converted to mosques as late as the 9th/15th century [2].’

‘Pre-Islamic domes in Persia are commonly semi-elliptical, with pointed domes and those with conical outer shells being the majority of the domes in the Islamic periods.

‘Mosques of Persia inherited the Sassanian vaulting tradition and possess a distinctive character in their pointed onion-shaped domes which appeared in several Mosques in Khorasan [3].’

The earliest known Islamic domes in Persia have continued the rounded elliptical Sasanian form. Domed mausoleums contributed greatly to the development and spread of domes in Persian early the Islamic period. By the tenth century, domed
tombs had been built for Abbasid caliphs and Shitte martyrs. This type of building tradition was previously unknown in Islamic history. But Pilgrimage to these sites had helped to spread the form of these structures during the Islamic Empires expansions [1].

5.1 Islamic Ribbed Vault Structural Analysis

In construction, the arch is a rigid span curving upward between two points of support. It appeared in a variety of Islamic structures, such as fortress, mosques and mausoleums in early Islamic days. Muslim architects developed a rich variety of pointed, scalloped, horseshoe, and ogee and lobbed arches for mosques and palaces during it expansions to North Africa and Islamic Iberia. Islamic ribbed vault were developed in Medieval Islamic period during IX-X century. From simple elliptical domes to cross arched shaping a vault structure set on squinches. Rib vault is any vault reinforced by masonry ribs. It can be quadripartite rib vault, which is divided into four sections by two diagonal ribs or sexpartite rib vault , which is divided into six sections by three ribs. While, Pendentives are portions of spherical vaults, or spherical triangles, placed in the corners of square or other polygonal structures to form a circular base for a dome above. More complicated vaults include ribbed vaults, in which the inner vault surface is subdivided by a number of independent supporting arches, or ribs. Architecture that was prevalent in Persia, primarily in palace complexes. It featured extensive barrel vaults and parabolic domes set on squinches and stuccoed with plaster mortar. The squinch vault is a very idiosyncratic Central Asian vault that also shares the same structural and technical concepts of the Sassanian pitched-brick.

[1] (Stevens, 2000)

62 S-curve
vaults. This sort of vault is also known as ‘Khorasan’ due to the geographical area where it is more commonly founded in North East Iran. The construction process starts with a small arched course laid in each corner of a square room, advancing with new and increasingly larger arches leaning on the previous ones, defining thus four corner half-cones that meet in the centre of each side of the room. Squinch vaults were apparently hardly ever used in early Islamic monumental structures, as no samples from this period have survived. The only surviving vaults are later: in the east in Khorasan, Iran, Turkmenistan, Afghanistan complexes. The congregational mosque of Isfahan vaults are from the tenth century AD. The Dome squinches on the west are set on arches giving birth to a hybrid figure, almost spherical called: squinched spherical vault [1].

5.2 Islamic Ribbed Vault Structural Development

The Birth of Ribbed Vaults started after the development of clay masonry and complex forms of stacked mud bricks which famed at the beginning in Tigris and Euphrates River during early ancient periods. The Adobe-brick was used in these areas for its superior thermal properties and lower manufacturing costs. However, Red Bricks were used for decorations in small artistic spaces involving water and monumental constructions. By time, Glazed Vitreous bricks were invented.

‘Brick styles, which varied greatly over time, are categorized by period [2].’

[1] (Stevens, 2000)

As defined in Oxford Dictionaries 2010:

Adobe bricks are most often made into units weighing less than 100 pounds and small enough that they can quickly air dry individually without cracking and subsequently assembled, with the application of adobe mud, to bond the individual bricks into a structure [1].

However, since Rounded Bricks are not steady or stable, therefore the Mesopotamian technique have used bricklayers which lay a row of bricks perpendicular to the rest every few rows for strength stability. Likewise, the Plano-Convex bricks technique which speed the manufacturing process as well. The irregular surface that held the finishing plaster coat is better than a smooth surface from other brick types. However, these bricks were sun baked which eventually deteriorated, some destroyed or rebuilt on the same spot. The unusual vertical arrangement of the bricks were held together with quick-setting gypsum mortar; The span can be reduced by using overhanging horizontal brick layers, following the vault profile, and even offering an offset marking the false springing-line of the vault. Laying bricks on their edge is one of the most defining features of ancient Mesopotamian and Parthian architecture [2]. Vaults and domes are self-supporting structural forms when completed, they normally need support and centring while under construction. This usually involves first building an identical vault in wood over which the masonry vault rests, until complete and dried. In countries where timber is limited, this type of vaulting is hardly advantageous. A system of building vaults and domes, without this framework, or shuttering, evolved in countries like Egypt and Iran. There for squinches had been developed in these regions where mud bricks were the initial building materials.


During the Islamic Period, window openings built up with dry bricks and not mortar. For this, Arches are built over the dry brick forming windows. Small vault built in same way as large ones. Then, the loose bricks are removed from window openings forming continuous course from which dome can be completed. Circular arches built over vaults to form a base for the dome. Brick courses of dome incline increasingly until the dome is finished [1].

5.3 Islamic Ribbed Vault Brick Methods until Geometry

The tradition of brick building in Iran flourished under Sassanids from 224 until 651 AD. This period was the main source of knowledge of bricks constructing methods with masons.

Habibollah Ayatollahi mentioned in his book *The History of Iranian art* explaining:

‘After the end of the III Century AD and the beginning of the IV Century in the mountains regions of the country the use of rough uncut stone and rocks became very popular and the Sasanian stopped using cut stone in their buildings, whereas on the bricks were used to create the buildings and masterpiece of this era. The New techniques of building arches and domes presented the Sasanian with new abilities and skills, which in turn brought great and long lasting fame to the builders [2].’

The massive amount of sunshine in the Arabian Peninsula made Adobe bricks the selected choice for building. This technique was extracted from Ancient Egyptian Civilization. The Loamy Nile mud when mixed with straw result in forming strong bricks. A sun-baked mud brick without straw had strength of less than containing staw. This results for bricks three times strong in durability. And since groundwater did not dissolve the foundations and floods did not reach the Arabian Peninsula, well-tended mud brick walls had stand for generations. During Ancient Egypt, brick moulds of equal size


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were used. The brick sizes were standardized. The mortars used for mudbrick were basically the same material as that from which the bricks themselves were made, but generally no organic matter was added. It was mixed shortly before being used and was only applied between the horizontal layers, and not to stick the bricks together along their vertical joints. These Basic Building Methods were the initial Methods used in the Arabian Peninsula Buildings. In many areas of Islamic world brick is the primary building material. There is a primary building material. There is an important distinction to be made between fired or baked brick and mud brick. Fired brick requires fuel to heat the kilns, making it relatively expensive, although the firing makes it more durable and therefore more suitable for monumental building. Architecture of the early Islamic period drew on two distinct building traditions each of which used fired brick as a major component. In the Mediterranean area brickwork derived from Byzantine and ultimately Roman traditions whereas in former Sassanian territories it dated back to the ancient civilizations of Mesopotamia and Iran. In Byzantine tradition, bricks were usually used for specific parts of the building such as the dome or as string courses to level off layers of rubble wall. In the area of Syria and Jordan the availability of good quality stone meant that bricks were little used in Byzantine architecture of the area and consequently were little used in the early Islamic architecture of the area [1]. In the few examples, Al Mushatta and Qasr Al Tuba, brickwork is employed as Sassanian East Method rather than a continuation of local tradition. After the conquest of Ottoman to Anatolia, the Byzantine brickwork tradition becomes fully incorporated into Islamic architecture. In the East, Iran and Iraq, however, brick was employed in the earliest Islamic buildings as direct continuation of Sassanian practice. The techniques of decorative brickwork had developed in this area using either

standard bricks arranged in patterns or specially shaped bricks. Bricks could be laid vertically, sideways, flat on or in a herringbone pattern. Later, it was used to form geometrical patterns or even inscriptions late in the eleventh century. Elaborate brickworks refer to a Persian terminology: Hazarbaḵ. Brickwork of the Seljuk period, from the eleventh until the thirteenth century famed initially in Iran and Central Asia using specially manufactured bricks. A particularly good example is Aisha Bibi Khanum Mausoleum located on the Silk Road at Djambul, Uzbekistan. The Lime mortar is used in particular for building with fired bricks. Lime is also used in traditional external plaster, a mixture of mud and straw, in order to help preserve it. The earliest use of lime mortar in Iran is difficult to document because archaeologists did not clarify the distinction between lime mortar and gypum mortar named as Gac. Although both types tempered with variety of organic and inorganic materials which affect their appearance, setting time and adhesive qualities. Lime mortar is divided into two main categories, hydraulic, able to set under water and, non-hydraulic, and these in turn may be further subdivided. Roman engineers captured by the Sasanian 242-272 AD. [1] [2] [3].

Apparently introduced hydraulic lime into Iran, particularly for the construction of bridges. Non-hydraulic lime mortars appear earlier at the late Parthian (2nd-3rd cents. A.D.). The appearance of lime mortar in Afghanistan and Iran suggest that the use of lime mortar began before the Parthian period. The discovery of slabs and bricks of a concrete was late 4th millennium B.C. at Uruk in southern Mesopotamia demonstrates that at least some craftsmen in a neighbouring region were experimenting with a sort of lime mortar even earlier.

[3] (Marcais, 1955)
5.4 Islamic Vault Development through History until Geometry

Figure 330: Sassanid Brick Illustration

Source: Illustration after SassanidArch

Figure 331: Early Sassanid Brick Methods


Figure 332: Sassanid Brick Illustration

Source: Illustration after Tarski

Figure 333: Late Sassanid Brick Methods

Source: Outlook Traveller
Figure 334: Roman Mesopotamian Method

Figure 335: Abbasids, Sassanid Method
Figure 336: Umayyad Caliphatess, Byzantine Method  
*Photo by: Stefan Sonntag*

Figure 337: Umayyad Caliphatess, Roman Method  
*Photo by: Claire Robinson, (Robinson, n.d.)*
Figure 338: Umayyad Caliphates, Roman Methods

Figure 339: Umayyad Caliphates, Roman Mesopotamian Methods
Source: Dessert Castle
Figure 340: Umayyad Caliphates, Sassanid Method

Figure 341: Umayyad Caliphates, Sassanid Method

Figure 342: Umayyad Caliphates, Roman-Byzantine Method
Figure 343: Seljuk Pitched Vault

Figure 344: Seljuk Pitched Vault

Figure 345: Seljuk woven Pitched Vault
The origin of the Islamic Ribbed Vault located in North Africa and Spain

Figure 346: Pitched Brick Bujara, Uzbekistan

Figure 347: Wovean Pitched Brick Method, Iran

Figure 348: Pitched Brick Iran
Figure 349: Tahrids Flated Domes

Source: Archnet

Figure 350: Three types of Seljuk Pitched Brick Method

Source: Irani
Figure 351: Pitched-brick

Figure 352: Pitched-brick Method
5.3.1 Islamic Geometrical Ribbed Vaults

Figure 353: Seljuk Geometrical Vaults, I

Illustration Source: after Pugachenkova, 1954. © Ancient Merv Project

Figure 354: Cross Arch Dome Geometry, Central Asia

Illustration Source: Barucartd

Figure 355: Cross Arch Dome Geometry, Spain

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5.3.1.1 Islamic Geometrical Ribbed Vaults Layout

Geometry is a major element in Islamic Iberian architectural decoration. It has been studied by several scholars; however, the geometry of domes is still a debate of studies. Geometry is the key mark of Islamic crossed-arch vaults. The Muslims Philosophy had been transferred to geometrical Patterns in markable ribbed vault designs. Persian Architecture through history made use of abundant symbolic geometries, using pure forms such as the circle and square. These designs were based on symmetrical layouts. In Islamic Iberia, there is a massive range of possibilities for the design of the vaults Plans. However, Different layouts are used for each Vault. As it was explained previously, three different layouts describe the vault of the Great Mosque of Cordoba. Fifty years later, the construction of the nine vaults of Cristo de la Luz defined almost all the possible layouts and most of what was built afterwards was based in these designs. The octagon is possibly the most used figure in the layout design of these vaults. Octagons can be obtained in different ways. One of the most common methods consists in dividing the sides of a square into three parts, and placing eight ribs spanning between the internal divisions, so that two ribs arrive at each point, one rib parallel to the side of the square, and the other in the diagonal direction. According to the ratio between the divisions, the design in plan is different. The figure below shows the exterior top view of the nine vaults located in Cristo de la Luz, leaving imprints of the different cross arches and titrations in order to show a clear view of the arches access [1] [2].

[1] Geometry: The Language of Symmetry in Islamic Art: In Islamic art the geometric figure of the circle represents the primordial symbol of unity and the ultimate source of all diversity in creation. The natural division of the circle into regular divisions is the ritual starting point for many traditional Islamic patterns, as demonstrated in the drawings below. (Henry, 2016)

5.3.1.2 Islamic Geometrical Ribbed Vaults Patterns

Figure 359: Cross Arch Dome Geometry, Cordoba

Source: Illustration Barucartd

Figure 360: Cross Arch Vault, Cordoba

Source: Illustration Barucartd

Figure 361: Cross Arch Vault, Toledo

Illustration by the Author
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Figure 362: Cross Arch Vault, Toledo

Illustration by the Author

Figure 363: Cross Arch Vault, Toledo

Illustration by the Author

Figure 364: Cross Arch Vault, Toledo

Illustration by the Author
Figure 365: Cross Arch Vault, Toledo
Illustration by the Author

Figure 366: Cross Arch Vault, Toledo
Illustration by the Author

Figure 367: Cross Arch Vault, Toledo
Illustration by the Author
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Figure 368: Cross Arch Vault, Toledo

Illustration by the Author

Figure 369: Cross Arch Vault, Toledo

Illustration by the Author

Figure 370: Cross Arch Vault, Toledo

Illustration by the Author
5.4 Roof Vault Traditions

Byzantine Origin

Figure 371: Alhambra Court, Figure 372: Qarawiyyin Court top View

Figure 373: Alhambra Court illustration, After Figure 374: Qarawiyyin Court Illustration, After, Creswell

Figure 375: Great Mosque of Cordoba Roof Figure 376: Qarawiyyin Mosque Top Roof
Figure 377: Byzantine Roof Illustration

Source: Illustration by the Author

Figure 378: Byzantine Roof Illustration Section

Source: Illustration by the Author
PART VI

6. ANALYSIS OF THE FIELD VISITS TO NORTH AFRICA AND SPAIN
6. ANALYSIS OF FIELD VISITS TO NORTH AFRICA AND SPAIN

Mosques are the most obvious materialization of Islam. They had reflected the artistic elements of Islamic periods. For this, there are lots of variations in Mosque designs and elements. As a result, the research paper required field trips to historical Mosques of early Islamic Periods in order to observe The Islamic Ribbed vaults in North Africa and Spain. This was a major task of the study for better understanding of the Arched Domes since its initiate until it arrival to North Africa and Spain [1].

6.1 Development of Ribbed Vaults in North Africa

6.1.1 Tunis Vaults

6.1.1.1 Great Mosque of Kairouan Vaults

The Muslims conquest of North Africa resulted into erecting the first Mosque by a leader called *Uqba ibn Nafi* in 670 AD. After more than twenty years *Hasan ibn Al Nu’man* had demolish the whole Mosque except its Mihrab. Later, in 723 AD the Umayyad Caliph, *Hisham bin Abdul Malik*, ordered to renew the mosque and purchase the northern part land and combine it to extend the Great Mosque of Kairouan. *Hisham* also had added an ablution\(^63\) Space and a minaret in the middle of the north wall. The extension of the Mosque was added by commander, *Bishr ibn Safwan*. In 835 AD, *Abdullah bin Al Aqlab* demolish parts of the mosque to expand it and add a dome decorated with paintings and marble in the Mihrab niche. He wanted to demolish the Mihrab and rebuilt it again, but the scholars of Kairouan opposed him. In 862 AD, *Ahmed bin Mohammed Al Aghalibi* expanded the mosque and built the dome of the chamber hall. In the year 1057 AD, some Beduin tribes defeated the people

\[^63\] A ceremonial act of washing parts of the body before praying

[1] (Hillenbrand, 1994)
of Kairouan which resulted into evacuating the people of the City. After the end of this violent attack Hafsids\textsuperscript{64} renewed the Great Mosque of Kairouan based on the original design done in the old days by Abraham bin Ahmed Al Aglaby. The minaret of the mosque, which lies in the wall facing the direction of Qibla consists of three square shape layers, ranging in size, and above the three-layered is lobbed Dome. In conclusion, The Great Mosque of Kairouan contains of six domes: Mihrab Dome, Chamber Hall Dome, two domes in the East and the West, Dome above the Bank set aside of the mosque and a Minaret Dome. The prayer hall is entered from the courtyard, as well as from two sheltered doorways from the sides covered by Domes. The Mosque is a hypostyle design, with arcades emphasized in T-form. The T-design is formed by the Qibla wall and the central nave access. A total of seventeen bays wide and seven bays deep. The roof is flat, with the exception of the two domes, one Dome above the Mihrab dating from 836 AD and the other one is above the Chamber hall built in 856 AD. This Dome was reconstructed again in the nineteenth century. The Mihrab niche is framed with marble panels from the Zirid period \textsuperscript{[1]} \textsuperscript{[2]} \textsuperscript{[3]}

Due to Archenet Scholars:

\textbf{‘The simpler monochromatic tiles are said to be made by local Mesopotamian artist, while the more complex polychromatic tiles are said to have been imported directly from Mesopotamia.’}\textsuperscript{[4]}

\textbf{‘As the key monument of the Aghlabid period, the Great Mosque of Kairouan has played a major role in the evolution of North African architecture, serving as basis for Tunisian mosques, including Zaytuna Mosque [4].’}\textsuperscript{[4]}

\textsuperscript{64} Sunni Muslim dynasty of Berber descent

\textsuperscript{[1]} (Al-Kaa’by M., Beirut)
\textsuperscript{[2]} (Sebag, 1965)
\textsuperscript{[3]} (Uthman, 2000)
\textsuperscript{[4]} (Archnet Library, 2016)
Figure 379: The Great Mosque of Kairouan Vaults

*Photos by the Author*
Figure 380: Minartae Zigzag Dome

Source: By the Author
Figure 381: Entrance Zigzag Dome

Source: By the Author
Figure 388: Zigzag East Entrance Dome Location

Figure 389: Zigzag East Entrance Dome

Figure 390: Zigzag West Entrance Dome Location

Figure 391: Zigzag West Entrance Dome

Figure 392: Westbank Zigzag Dome Location

Figure 393: Westbank Zigzag Dome
Figure 394: The Great Mosque of Kairouan Three type Domes

Figure 395: Lobbed Dome, 836 AD

Figure 396: Zigzag Dome, 856 AD

Figure 397: Exterior Zigzag Dome
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Figure 398: Chamber Dome

Figure 399: Interior View of the Chamber Entrance Dome

Source: Photos by the Author
Figure 400: Mihrab Dome

Figure 401: Interior View of the Mihrab Dome

*Photos by the Author*
Figure 402: Lobed Dome Typology

Figure 403: Mihrab Lobbed Dome

Figure 404: Zigzag Dome Typology

Figure 405: Chamber Hall Entrance

Figure 406: Zigzag Dome Typology

Figure 407: Minaret Dome

Illustrations by the Author
6.1.1.2 Zaytuna Mosque Vaults

Zaytuna Mosque is a copy tradition of The Great Mosque of Kairouan. A vast courtyard leading to a Chamber hall that leads to the central nave reaching Al Mihrab. It is well observed that the Mosques is built from ancient material that was extracted from the ruins of Roman temples in Carthage. The central nave is wider than the others forming a T-shape hypostyle design. The Mihrab has a lobbed dome on an octagonal tambour with a square base. An inscription attributing the Mihrab to the Abbasid Caliph Al Must’in, who ruled during 862–866 AD. The entrance Chamber Hall dome is highly ornamented with ochre stone and red bricks. The profusion of niches covering the square base and the octagonal tambour is typical of Fatimid Zirid art. The Mosque contains two domes: The Mihrab Dome and the Chamber Hall Entrance Dome.

[1] (Alkhury, xxx)
Figure 409: Zaytuna Mosque Plan
Source: Archnet

Figure 410: Zaytuna Mosque Top View

Figure 411: Zaytuna Mosque
Source: http://www.discoverislamicart.org/
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Figure 416: Chamber Dome

Figure 417: Interior View to the Top
Figure 418: Detailed shot of Zaytuna Entrance Dome, Aghlabids Tradition

Figure 419: Zaytuna Mosque Chamber Dome, 991 AD
Aghlabid Tradition 905

Source: photos by the Author
Figure 420: Entrance Dome

Photos by the Author
Figure 421: Lobbed Dome Illustration

Figure 422: Lobbed Dome with Lime Coat.

Illustrations by the Author

Figure 423: Lobbed Dome, Aghlabids Methods
6.2 Type of Vaults in Tunis: VIII – XI

Figure 424: Type of Vaults in North Africa
6.1.2 Fes Vaults: 857 AD

6.1.2.1 Qarawiyyin Vaults

Fez Architecture was influenced by Andalusian architecture. During the reign of Moravids and Mohads, between the years 1056 - 1269 AD new vaults were added to the Qarawiyyin Mosque. Mystics architecture had effected Fes Architecture as a respond to the high luxury Andalusian decoration in building methods [1]. The Mosque of Qarawiyyin is one of the major intellectual centres in the medieval Mediterranean area as it contains the first and oldest university, founded in 857 AD by Fatima Al Fahri, the daughter of a wealthy immigrant who left Kairouan to Fes City after a great evolution in Tunis. The mosque became the congregational mosque of the Qarawiyyin quarter. Fes was intimately linked to Islamic Spain politically, economically, and culturally particularly after 1492 AD, when Ferdinand and Isabel kicked Muslims and Jews from the Iberian Peninsula. This brought an influx of refugees into the city. However, the Qarawiyyin T-shaped plan was created by an elevated central aisle perpendicular to an aisle fronting the Qibla wall, belongs to North African mosque tradition. The Moravid ruler, Ali bin Yusuf had expanded the mosque to its present size between 1134 and 1143 AD. The courtyard with tile flooring, recall the court of the Lions at the Alhambra, which were added by the Sa’did. There is dome over the Mihrab and the entrance porch consist of seven domes which cover the north arcade of the courtyard. The domes are made of elaborate muqarnas vaulting with zig-zag ribbing on the exterior [2].

[1] The Mosque of Qarawiyyin is one of the world’s oldest universities

Figure 425: Qarawiyyin Mosque

Figure 426: Qarawiyyin Seven Domes cover with roof
The origin of the Islamic Ribbed Vault located in North Africa and Spain

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Figure 427: Entrance Dome

Figure 428: Entrance Dome

Figure 429: Muqarnas Dome [2] Location

Figure 430: Muqarnas Dome [2]

Figure 431: Cross Arched Dome [3] Location

Figure 432: Cross Arched Dome [3]
Figure 433: Muqarnas Dome [4] Location

Figure 434: Muqarnas Dome

Figure 435: Muqarnas Dome [5] Location

Figure 436: Muqarnas Dome

Figure 437: Star Dome [6] Location

Figure 438: Stat Dome
Figure 439: Mihrab Dome Location
Source: Archnet

Figure 440: Mihrab Muqarnas Dome Typography
Source: Lima

Figure 441: Muqarnas Section
Source: Lima
6.3 Development of Ribbed Vaults in Spain

6.3.1 Spain Vaults

6.3.1.1 Great Mosque of Cordoba Vaults

Figure 442: Great Mosque of Cordoba Top view

Source: Brigitte Hintzen-Bohlen

Figure 443: Great Mosque of Cordoba Plan

Source: James
Figure 444: Section of the Great Mosque of Cordoba Domes, After Barucartd

Figure 445: Maqsura Dome
Figure 446: Center Dome
Figure 447: Maqsura Dome

Figure 448: Maqsura Location
Figure 449: Maqsura Location
Figure 450: Maqsura Location
The first crossed vault was built over a former Mihrab built during Abdul Rahman II period. The other three vaults were built in the Maqsura, Area. They follow a symmetrical pattern: the central one is different in the layout pattern. These domes constitute a completely new type of vault. Later, this type spreaded to the North Africa, Iran and Central Asia. During the X century, Al-Hakam II added a massive expansion to the Great Mosque of Cordoba. An evolution in Vaulting Methods initiated in his period after constructing the cross ribbed domes, which functioned to improve the lighting four skylights. Three Vaults in front of the Qibla and one located in the pre-Maqsura area, which currently holds the Chapel of Villaviciosa. The Pre-Maqsura consist of intersecting arches. The Mihrab in the Great Mosque of Cordoba is an open small octagonal room covered with a dome-shaped in shell form. The Mihrab central dome is covered with mosaics executed by Byzantine craftsmen sent by the emperor loaded with two hundred pounds of tiles [1]. The main materials used are wood, stone and baked brick, although mud brick was also used. Unlike many parts of the Middle East, Spain had plentiful supplies of timber suitable for building including both pine and oak. Wood was usually used for roofs which were normally gabled and covered with baked clay tiles, although occasionally wooden domes were also used. The pine roofs of the Great Mosque in Cordoba reflect the plentiful supplies of wood in medieval Spain. Stone was used for walls either in the form of ashlar masonry or in the form of coursed rubble [2] [3].

[1] Often masonry was reused from earlier Roman or Visigothic structures, although fine stone carving continued. One of the most distinctive features of Spanish Islamic architecture is the use of brick which, like ashlar masonry, was a direct continuation of Roman building methods. Sometimes stone was encased in brick in the same manner as Byzantine fortifications. (Petersen, 1996) p. 265

[2] (Fuentes, 2010)

[3] (Balbas, 1935)
6.3.1.1.a Great Mosque of Cordoba Cross Arches Analysis

Figure 451: Pre-Maqsura Pattern

Figure 452: Close shoot of the Pre-Maqsura Dome

Figure 453: Maqsura Dome Arch illustration

Source: After Barucartd

Figure 454: Maqsura Dome, 961-976 AD
The origin of the Islamic Ribbed Vault located in North Africa and Spain

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Figure 455: Close shoot of the Center Dome

Figure 456: Maqsura Dome

Figure 457: Central Dome Arch Illustration, After Barucardt

Figure 458: Maqsura Dome Close Shot

Source: After Barucardt
Figure 459: Center Dome Pattern
Illustration, After Barucartd

Figure 460: Close shoot of the Center Dome

Figure 461: Central Dome Arch
Illustration, After Barucartd

Figure 462: Central Maqsura Dome
Toledo was the capital of the Spanish Visigothic kingdom from 554 AD until the Moorish conquest in 711 AD. For three centuries, Toledo was incorporated into the Emirate of Cordoba and then regained its independence in 1012 AD. Toledo’s peak period was in the Middle Ages, when the civilizations of East and West: Moorish, Jewish, and Christian, got together. The mosque of Bab Al Mardum, current Cristo de la Luz, is a nine-domed mosque rest on Visigothic columns. Bab Al Mardum is recognized with its nine vaulted design influenced by the no Gunbad method arrived to Spain through the Asian Silk Road trips from Asia to Europe. The Mosque differentiate with its central dome raised in the Center famed as Cupula, and built in 999 AD. The Mosque is a square plan composed of nine bays, each develop a cross ribbed vault. The facade is made of brick with Kufic inscriptions written in geometric method influenced by the East. Later, Bab Al Mardum was converted into a Church after the Christian conquest, and a brick apse was added later in Mudejar tradition. The surviving Umayyad entrances have horseshoe or lobed arches, and the west facade carries blind intersecting horseshoe arches and blind arcading in two registers.
Figure 465: Cristo de la Luz, Christian Vault

Figure 466: Cristo de la Luz Nine Vaults

Source: Islamic Art Org.
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<td><img src="image2.png" alt="Illustration" /></td>
<td><img src="image3.png" alt="Photo" /></td>
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<tr>
<td>Vault 2</td>
<td><img src="image4.png" alt="Illustration" /></td>
<td><img src="image5.png" alt="Illustration" /></td>
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<td>Vault 3</td>
<td><img src="image7.png" alt="Illustration" /></td>
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<tr>
<td>Vault 4</td>
<td><img src="image10.png" alt="Illustration" /></td>
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</table>
Table 9: Vault 1 Typology, Cristo de la Luz

Table 10: Vault 2 Typology, Cristo de la Luz
Table 11: Vault 3 Typology, Cristo de la luz

Table 12: Vault 4 Typology, Cristo de la luz
**Table 13:** Vault 5 Typology, Cristo de la luz

**Table 14:** Vault 6 Typology, Cristo De La Luz
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Table 15: Vault 7 Typology, Cristo De La Luz

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Table 16: Vault 8 Typology, Cristo De La Luz
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<td><img src="image" alt="Figure 467 Outlines exterior top view of the nine vaults, Cristo de la Luz" /></td>
</tr>
</tbody>
</table>

**Table 17: Vault 9 Typology, Cristo De La Luz**
PART VII

7. CONCLUSION
7. CONCLUSION

After the comprehensive historical analysis of pre-civilizations, Islamic dynasties and regional once. The research conclude a strong potential of the challenging research study question in investigating the origin of the Islamic Ribbed vaults, located in North Africa and Spain. There were various characteristics and construction methodologies that reflected different Islamic dynasties, and constructed in the same century. Starting from the night century the Islamic domes had boomed from East to West with different patterns and Methodologies, which made the necessity of investigating on the vaults origin since pre-civilizations a major approach in my study. The theoretical part of the study was important in order to create a base for deep understanding of the ancient domes developments until the spread and arrival of Islam to North Africa and Spain to have a base conclusion. For this conclusion, the need for old studies of different languages: French, German, Spanish and Arabic since the initial birth of vaults until the arrival of Islam was important. There were difficulties to understand some Monuments of the past for the addition and renovation of their structures and changes that occurred under the successive dynasties. Some structures had been redesigned by time, while others, remained relatively untouched and big number had been reserved. At last, it makes it possible to outline in detail the architectural characteristics of the Islamic vaults and reach to an answer that lays on the historical comprehensive study and site observation. Proportion is a common characteristic of traditional Islamic patterns everywhere. Geometric proportions form the Islamic patterns which are initially based on mathematical ratios. There are philosophies that influenced these forms and patterns, which are related to the universe, human, nature and religions meanings and thoughts. Geometric proportion is strongly linked to Islamic cosmology, philosophy and metaphysical dimensions. It brings meanings and spiritual thoughts for the viewer. The geometrical rhythm as well as illustrates an infinity, which is align with the Islamic religion philosophy. These geometrical patterns were developed with geometric equations, relating to the understanding of natural forms based on geometric ratios. The geometrical science had been developed in the medieval time, which famed in the Islamic History as the golden Islamic age for its science, economic development, cultural art works, and construction flourish.
This period traditionally dated from the eight century to the thirteenth century, the art of Islam at that time had reached its peak and spread all over the Islamic regions. And the development of geometrical since had flourished and the use of geometrical philosophy had expanded. After the comprehensive analysis of the historical pre-civilizations, Islamic and regional vaults. The study conclude, that the first Islamic structure that contains geometrical ribbed vaults is located in the Great Mosque of Cordoba; however, vaults on squinches were early inventions of the Mesopotamian traditions. The study clarifies that cross arched ribbed vaults were not built during Byzantines nor Roman times or Central Asia. It also proof that the initial start of Cross Vaults was during the Umayyad Period in Damascus, but the cross arched vaults on squinches were an Andalusian origin, and this make it the initial start of the birth of the Islamic ribbed vaults on squinches that spreaded all over from Spain reaching the East.

Ibn Khaldun, an Islamic Philosopher in his Introduction *Al Muqaddima* had discussed the factors of flourishing science, professions and the factors of their decline. The Professions are Perfected and Become Plenty when the Demand for them Increase. Ibn Khaldun says that if a profession is in great demand, people will learn it. When a region becomes weakened, loses its affluence, and its population decreases the professions and it will diminish.
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### Islamic Events Timeline

<table>
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<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>570 AD</td>
<td>Mohammad, The Prophet of Islam was born.</td>
</tr>
<tr>
<td>622 AD</td>
<td>Mohammad and his followers’ emigrated to the nearby town of Medina, where the people there accepted Islam. This marks the &quot;Hijra&quot; or &quot;emigration,&quot; and the beginning of the Islamic calendar. In Medina, Muhammad establishes an Islamic state.</td>
</tr>
<tr>
<td>630 AD</td>
<td>Mohammad returns to Mecca with a large number followers. He enters the city peacefully, and eventually all its citizens accept Islam. The prophet clears the statues and images out of the Kaaba and rededicates it to the worship of God alone.</td>
</tr>
<tr>
<td>633 AD</td>
<td>Mohammad dies after a prolonged illness. The Muslim community elects his father-in-law and close associate, Abu Bakr, as caliph, or successor.</td>
</tr>
<tr>
<td>638 AD</td>
<td>Muslims enter the area north of Arabia, known as Sham, including Syria, Palestine, Lebanon and Iraq.</td>
</tr>
<tr>
<td>641 AD</td>
<td>Muslims enter Egypt and rout the Byzantine army.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>655 AD</td>
<td>Islam begins to spread throughout North Africa.</td>
</tr>
<tr>
<td>661 AD</td>
<td>Imam Ali, the fourth Caliph was killed, bringing to an end the rule of the four &quot;Righteous Caliphs&quot;: Abu Bakr, Umar, Uthman, and Ali. This also marks the beginning of the Umayyad rule.</td>
</tr>
<tr>
<td>711 AD</td>
<td>Muslims enter Spain in the West and India in the East. Eventually almost the entire Iberian Peninsula became under Islamic control.</td>
</tr>
<tr>
<td>750 AD</td>
<td>The Abbasids take over rule from the Umayyads, shifting the Capital of power to Baghdad.</td>
</tr>
<tr>
<td>1000 AD</td>
<td>Islam continues to spread through the continent of Africa, including Nigeria, which served as a trading liaison between the northern and central regions of Africa.</td>
</tr>
<tr>
<td>1099 AD</td>
<td>European Crusaders take Jerusalem from the Muslims. Eventually Muslims defeat the Crusaders and regain control of the holy land.</td>
</tr>
<tr>
<td>1299 AD</td>
<td>The earliest Ottoman state is formed in Anatolia, Turkey.</td>
</tr>
</tbody>
</table>
## Terminology

### Glossary of Arabic Terminologies

Most of terms defined below are Arabic words that are mentioned in more than one chapter of this thesis. The definitions are derived from *A Dictionary of Architecture and Landscape Architecture* and *The Grove Encyclopedia of Islamic Art and Architecture*:

<table>
<thead>
<tr>
<th>Word</th>
<th>Brief Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mecca</td>
<td>The holy city of Muslims in which the holy Kaaba located</td>
</tr>
<tr>
<td>Ka’aba</td>
<td>Muslims are expected to face the Kaaba when performing prayers</td>
</tr>
<tr>
<td>Hajj</td>
<td>Is an annual Islamic pilgrimage to Mecca</td>
</tr>
<tr>
<td>Mohammad</td>
<td>The Prophet of Islam</td>
</tr>
<tr>
<td>Muslim</td>
<td>Follower of the religion of Islam</td>
</tr>
<tr>
<td>Calipha</td>
<td>A leader of the entire Muslim community</td>
</tr>
<tr>
<td>Emir</td>
<td>A Muslim military commander or local chief.</td>
</tr>
<tr>
<td>Caliphate</td>
<td>In Islamic history and was founded after Muhammad's death</td>
</tr>
<tr>
<td>Rashidun</td>
<td>Is a term refers to the four caliphs following the death of the Islamic prophet</td>
</tr>
<tr>
<td>Hijra</td>
<td>The emigration of Muhammad from Mecca to Medina</td>
</tr>
<tr>
<td>Qasr</td>
<td>A castle in Middle Eastern countries</td>
</tr>
<tr>
<td>Masjid</td>
<td>A place of worship for followers of Islam</td>
</tr>
<tr>
<td>Sharia</td>
<td>Law of Islam</td>
</tr>
<tr>
<td>Qibla</td>
<td>Is the direction that should be faced when a Muslim prays</td>
</tr>
<tr>
<td>Mihrab</td>
<td>The niche in the wall of a mosque that indicates the Qibla</td>
</tr>
<tr>
<td>Maqsura</td>
<td>An enclosure in a mosque, situated near the Mihrab and Minbar</td>
</tr>
<tr>
<td>Pre Maqsura</td>
<td>An enclosure before the Maqsura</td>
</tr>
<tr>
<td>Qubbat</td>
<td>An architectural element that resembles the hollow upper half of a sphere</td>
</tr>
</tbody>
</table>
Glossary of Muslim Branches Terminologies:

Muslims believes that there is one God and Mohammed is the Islamic prophet. There are groups in Islam that believes in the same perception but with additional contexts that grew during history to lead to other branches such as Shia and Khawarij.

<table>
<thead>
<tr>
<th>Branch</th>
<th>Brief Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shi’a</td>
<td>Shia represents the second largest denomination of Islam. Shi’a is the short form of the historic phrase Shi’at Ali meaning followers of Muhammad's son-in-law and Cousin Ali. Shia Muslims constitute 10–20% of the world's Muslim population and 38% of the Middle East's entire population</td>
</tr>
<tr>
<td>Sunni</td>
<td>Is a denomination of Islam, which holds that the Islamic prophet Muhammad's first Caliph was his father-in-law Abu Bakr. Sunni denomination primarily contrasts with Shi'a, which holds that Mohammad's son-in-law and cousin Ali ibn Abi Talib, not Abu Bakr, was his first caliph. The Sunni is by far the largest denomination of Islam.</td>
</tr>
<tr>
<td>Khawarij</td>
<td>A group that appeared in the first century of Islam during the First Fitna, the crisis of leadership after the death of Mohammad broke into revolt against the authority of the Rashidun Caliph Ali after he agreed to arbitration with his rival, Muawiyah I. The Khawarij were a source of insurrection against the Caliphate. Descendants of the moderate Khawarij, the Ibadi survive today principally in Oman and Zanzibar in small numbers.</td>
</tr>
<tr>
<td>Zaidiyah</td>
<td>A branch of the Shia denomination, named after Zayd ibn Ali, the grandson of Husayn ibn Ali. Is an early branch that appeared in the VIII century out of Shi’a. The Followers of the Zaydi Islamic jurisprudence are called Zaydi Shi’a. They make up about 35-40% of Muslims in Yemen. The Zaydis were the oldest branch of the Shia and the largest group amongst the Shia before the Safavid Dynasty.</td>
</tr>
</tbody>
</table>
Glossary of Muslim States Terminologies:

The Terminologies are derived from *A Dictionary of Islamic Branches*

**Caliphates (Arabic: الخلفاء)***

Caliphate is an Islamic state led by a supreme religious and political leader known as Caliph or in another words successor to Prophet Mohammad. The successions of Muslim empires that have existed in the Muslim world are usually described as Caliphates. Conceptually, a caliphate represents an independent State of the entire Muslim faithful, ruled by a Caliph under Islamic law which is called Sharia.

The Islamic religious branches in the Islamic History caused lots of wars and killing for the reason of who is eligible for the Caliphate.

**Rashidun Caliphates (Arabic: الخلفاء الراشدون)***

Is the collective term comprising the first four caliphs named as the “Rightly Guided” or Rashidun caliphs in Islamic history and was founded after Mohammad's death. At its height, the Caliphate controlled a vast empire from the Arabian Peninsula and the Levant, to the Caucasus in the north, North Africa from Egypt to present-day Tunisia in the west, and the Iranian plateau to Central Asia in the east. The Caliphate were united to any degree, excepting the final period of the Rashidun Caliphate under Ali himself.

**Idrisid (Arabic: أليدرس)***

The Idrisid Dynasty was the first independent Dynasty during the Abbasid Period. An Arab origin who are the founders of the Moroccan state. Originally, they belonged to the Zaydi branch of Shi’a Islam. The founder of the Idrisid dynasty was, Idris ibn Abdallah, whose origin is back to Ali ibn Abi Talib and his wife Fatimah, the daughter of the Muslim Prophet, Mohammad.
Safavid dynasty (Arabic: مَجْمَعَةُ الصَّافِعِيَّةِ)
One of the most significant ruling dynasties of Persia after the fall of the Sasanian Empire - following the Muslim conquest of Persia in the VII century A.D. and established the Twelver school of Shi'a Islam as the official religion of their empire, marking one of the most important turning points in Muslim history. The Safavids ruled from 1501 to 1722 AD. They controlled all of modern Iran, Azerbaijan, Bahrain and Armenia, most of Georgia, the North Caucasus, Iraq, Kuwait and Afghanistan, as well as part pf Turkey, Syria, Pakistan Turkmenistan and Uzbekistan.

Hafsids (Arabic: فُهْضَيْةُ)
Were Sunni Muslim dynasty of Berber descent who ruled western Libya, Tunisia, and eastern Algeria from 1229 to 1574 AD.

Ibadi (Arabic: أَبَاضِيَةُ)
Historians and a majority of Muslim believers indicate that the denomination is a reformed sector of the Khawarij or Kharijite movement; Ibadis, however, deny anything more than a passing relation to the Khawarij and point out that they merely developed out of the same precursor group.

Ghaznavid Dynasty (Arabic: غَزْنِيَةُ)
A Persianate Muslim dynasty of Turkic Mamluk origin at their greatest extent ruling large parts of Iran, much of Transoxiana, and North India from 977–1186. They declared independence from the Samanid Empire and strated to expanded the Ghaznavid Empire afterwards.

Seljuk Dynasty (Arabic: شِيْخُوْذَةُ)
A Turkic Sunni Muslim dynasty that gradually adopted Persian culture and contributed to the Turko-Persian tradition in the medieval West and Central Asia. The Seljuks established both the Seljuq Empire and Sultanate of Rum, which at their total height stretched from Anatolia through Persia, and were targets of the First Crusade.
Tahirid dynasty (Arabic: طاهري ة)
A dynasty Persian origin that governed the Abbasid province of Khorasan from 821 to 873 AD, and the city of Baghdad from 820 until 891. The dynasty was leading the Abbasid Caliph, Al Ma’mun. Their Capital were in Khorasan at Merv, then later moved to Nishapur. The Tahirids enjoyed a high degree of autonomy in their governance of Khorasan, although they remained subject to the Abbasid Caliphate and were not independent rulers.

The Buyid dynasty (Arabic: آل بويه)
A Shia Muslim dynasty which represents the period in Iranian history famed as the 'Iranian Intermezzo' since, after the Islamic invasion of Persia, it was an interlude between the rule of Abbasid Arabs and Seljuq Turks.

The Muhallabids (Arabic: المهلّب)
Were an Arab family who ruled Basra and Ifriqiya. The founders of the family's fortunes were Al Muhallab ibn Abi Suffrah during 632 – 702 AD and his son Yazid ibn al-Muhallab, who ruled in 672–720 AD, governor of Khorasan and Iraq, who led an unsuccessful anti-Umayyad rebellion in Basra in 720.

Samanid dynasty (Arabic: ساماني ة)
A Sunni Iranian empire ruling from 819 to 999AD. The empire was mostly centered in Khorasan and Transoxiana during its existence, but at its greatest extent, the empire encompassed all of today's Afghanistan, and large parts of Iran, Turkmenistan, Uzbekistan, Tajikistan, Kyrgyzstan, Kazakhstan and Pakistan.
### Timeline of the Ruling Empires in Spain and North Africa:

<table>
<thead>
<tr>
<th>C.</th>
<th>North Morocco</th>
<th>North Algeria</th>
<th>Tunisia</th>
<th>West Libya</th>
<th>East Libya</th>
<th>Egypt</th>
<th>Spain</th>
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<td>Byzantine</td>
<td>Byzantine</td>
<td>Byzantine</td>
<td>Roman</td>
<td>Roman</td>
<td>Goth</td>
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<td>Umayyad</td>
<td>Umayyad</td>
<td>Umayyad</td>
<td>Umayyad</td>
<td>Umayyad</td>
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<td>Goth</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
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<td>Abbasid</td>
<td>Abbasid</td>
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<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
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<td>11th</td>
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<td>Fatmid</td>
<td>Fatmid</td>
<td>Fatmid</td>
<td>Fatmid</td>
<td>Umayyad</td>
<td>5&lt;sup&gt;th&lt;/sup&gt;</td>
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<tr>
<td>12th</td>
<td>Moravids</td>
<td>Bani Hamad</td>
<td>Bano Ziri</td>
<td>Bano Ziri</td>
<td>Fatmid</td>
<td>Fatmid</td>
<td>Moravids</td>
<td>6&lt;sup&gt;th&lt;/sup&gt;</td>
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<td>Mwahidon</td>
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<td>Ayobien</td>
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<td>Zian</td>
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<td>Mamlok</td>
<td>Mamluk</td>
<td>Bano Nasor</td>
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<td>9&lt;sup&gt;th&lt;/sup&gt;</td>
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<td>16th</td>
<td>Wtas</td>
<td>Zian</td>
<td>Hafsion</td>
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<td>Mamlok</td>
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</table>
Islamic Dynasties Maps

Figure 468: Abbasid Dynasty, 750-1259 AD, Wikipedia

Figure 469: Muhallabids, 771-793 AD, Wikipedia
Figure 470: Tahirids 821–873 AD, Wikipedia

Figure 471: Samanid Empire 819–999, Wikipedia
Figure 472: Samanid Dynasty 819–999AD, Wikipedia

Figure 473: Tulunid 868–905AD, Wikipedia
Figure 474: Ziyarid Dynasty, 931-1090AD, Wikipedia

Figure 475: Safavids, 1501-1736 AD, Wikipedia
Figure 476: Ghaznavid Dynasty, 977–1186 AD, Wikipedia

Figure 477: Moravids Dynasty, 1073-1147 AD, Wikipedia
The origin of the Islamic Ribbed Vault located in North Africa and Spain

Rana AlKadi
### Historical Complexes Glossary

#### List of Umayyads Historical Complexes

<table>
<thead>
<tr>
<th>Monument</th>
<th>Location</th>
<th>Year AD</th>
<th>Plan</th>
</tr>
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<tbody>
<tr>
<td>Amr Ibn AlAs Mosque</td>
<td>Fustat(^{65})</td>
<td>641–642</td>
<td><img src="image1" alt="Plan" /></td>
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<tr>
<td>Uqba Mosque or Great Mosque of Kairouan</td>
<td>Kairouan, Tunis</td>
<td>670</td>
<td><img src="image2" alt="Plan" /></td>
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<td>Sidi Uqba Mosque</td>
<td>Biskra, Algerie</td>
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<tr>
<td>Dome of the Rock</td>
<td>Jerusalem</td>
<td>685–691</td>
<td><img src="image4" alt="Plan" /></td>
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<tr>
<td>Dome of the Chain</td>
<td>Jerusalem</td>
<td>691</td>
<td><img src="image5" alt="Plan" /></td>
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\(^{65}\) Old Cairo
<table>
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<tr>
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<th>Region</th>
<th>Date</th>
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</thead>
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<tr>
<td>Qasr AlHallabat_ Hammam As Sarah</td>
<td>North Western Jordan</td>
<td>691 – 743</td>
</tr>
<tr>
<td>Al-Aqsa Mosque</td>
<td>Jerusalem</td>
<td>705</td>
</tr>
<tr>
<td>Qasr Kharana</td>
<td>Eastern Jordan</td>
<td>710</td>
</tr>
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<td>City of Anjar</td>
<td>Lebanon</td>
<td>714</td>
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<tr>
<td>Great Mosque of Aleppo</td>
<td>Aleppo</td>
<td>715</td>
</tr>
<tr>
<td>Building Name</td>
<td>Location</td>
<td>Date</td>
</tr>
<tr>
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<td>----------------------------</td>
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<td>Great Mosque of Hama</td>
<td>Hama, Sirya</td>
<td>700s</td>
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<tr>
<td>Khirbat Al-Mafjar or Hisham Palace</td>
<td>West Bank, Palestine</td>
<td>Byzantine Tradition</td>
</tr>
<tr>
<td>Khirbat Al-Minya_ Umayyad Palace</td>
<td>Palestinian</td>
<td>705-715 Roman Tradition</td>
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<tr>
<td>Mubarak AlNaqah Mosque_ Jami Al Mubarak</td>
<td>Bosra, southern Syria</td>
<td>X</td>
</tr>
<tr>
<td>Umayyad Mosque</td>
<td>Damascus</td>
<td>715</td>
</tr>
<tr>
<td>White Mosque Al Masjid Al Abyad</td>
<td>Ramla</td>
<td>720</td>
</tr>
<tr>
<td>Complex Name</td>
<td>Location</td>
<td>Period</td>
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<td>Al Omari Mosque</td>
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<td>Qasr Amra</td>
<td>Eastern Jordan</td>
<td>723 - 743</td>
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<td>Qasr AlHayr AlGharbi</td>
<td>Syrian Dessert</td>
<td>724 - 727</td>
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<td>Qasr Jabal AlQal'a</td>
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<tr>
<td>Qasr AlHayr AlSharqi</td>
<td>Syrian Dessert</td>
<td>728 - 729</td>
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<tr>
<td>Qasr AlMshatta</td>
<td>Amman, Jordan</td>
<td>743-744</td>
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Table 19: Umayyads Complexes Plans
List of Historical Mosques in Tunis, VII-X

<table>
<thead>
<tr>
<th>Mosque</th>
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<tr>
<td>Uqba bin Nafi</td>
<td>Kauiran</td>
<td>670</td>
<td><img src="image1" alt="Plan of Uqba bin Nafi" /></td>
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<td>Al Zaytuna</td>
<td>Tunis</td>
<td>698</td>
<td><img src="image2" alt="Plan of Al Zaytuna" /></td>
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<tr>
<td>Great Mosque of Sfax</td>
<td>Sfax</td>
<td>849</td>
<td><img src="image3" alt="Plan of Great Mosque of Sfax" /></td>
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<tr>
<td>Susa</td>
<td>Susa</td>
<td>851</td>
<td><img src="image4" alt="Plan of Susa" /></td>
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<tr>
<td>AlMahdiya</td>
<td></td>
<td>912 - 916</td>
<td><img src="image5" alt="Plan of AlMahdiya" /></td>
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Table 2.8: List of Historical Mosques in Tunis, VII-X
<table>
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<th>Monument</th>
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<td>Tarik Khana</td>
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<td>Al Ukhadir Fortress and Mosque</td>
<td>Karbara’, Iraq</td>
<td>775</td>
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<td>Great Mosque of Kairouan</td>
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<td>670 _</td>
<td>Dome Added: 835</td>
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<tr>
<td>Jawsaq Al Khaqani</td>
<td>Sammra, Iraq</td>
<td>836</td>
<td><img src="image3.png" alt="Plan" /> X</td>
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<td>Masjid-e Haji Piyada</td>
<td>Balk, Afghanistan</td>
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<td>The Great Mosque of Sammra</td>
<td>Sammra , Iraq</td>
<td>847-852AD</td>
<td><img src="image5.png" alt="Plan" /></td>
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<tr>
<td>Al Qarawiyyin Mosque</td>
<td>Fez , in Morocco</td>
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<td><img src="image6.png" alt="Plan" /></td>
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<td>Monument</td>
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<td>---------</td>
<td>-------</td>
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<tr>
<td>Plan of Abu Dulaf</td>
<td></td>
<td>860</td>
<td><img src="image" alt="Plan of Abu Dulaf" /></td>
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<tr>
<td>Qubbat Al Sulaibiya</td>
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<td>862</td>
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<td>Al Zaytuna</td>
<td>Tunis, Tunis</td>
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<td><img src="image" alt="Al Zaytuna" /></td>
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<td></td>
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<tr>
<td>Tariq Khan Mosque</td>
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<td></td>
<td><img src="image" alt="Tariq Khan Mosque" /></td>
</tr>
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<td>The Samanid Mausoleum</td>
<td>Bukhara, Uzbekistan</td>
<td>905</td>
<td><img src="image" alt="The Samanid Mausoleum" /></td>
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<tr>
<td>Monument</td>
<td>Location</td>
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<td>Plan</td>
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<tr>
<td>Jami’ AlKabir, the Great Mosque of Mahdiya</td>
<td>Mahdiya, Tunis</td>
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<td>Mosque of AlAzhar</td>
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<td>Cairo</td>
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List of Historical Mosques in Egypt, VII-X

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<td>Cairo</td>
<td>Fatimids</td>
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<td>Ibn Tulun</td>
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<td>Al Hakam Mosque</td>
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<td>Al Aqmar Mosque</td>
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Table 20: List of Historical Mosques in Egypt, VII