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## Evolution of Roof Systems in Ancient Coptic Churches: form 4<sup>th</sup> to 9<sup>th</sup> Centuries

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### Abstract

Few roof structures remain unscathed from the 4<sup>th</sup> to 9<sup>th</sup> centuries in the history of Egyptian architecture generally. The relatively large amount of well-preserved early roof structures in churches in Egypt is used as a point of departure to structurally define medieval Egyptian roof structures. Investigations of actual roof structures along with study of written sources provide the basis for the study, beside site visits if the structure still exists. The structures are defined according to inherited known systems, economics, politics, building materials and semiotics. We can grope an occurring evolution in the design of the churches' roofs. The medieval roof structures of Coptic churches can generally and concisely be described by tracing them and putting them in a chronological order. This study completes the constructed mental image about that period, and provide architects with simple architectural solutions within communities that enjoy the exitance of multicultures.

**Keywords:** Mediterranean architecture; Coptic churches; roof systems; multiculturalism.

### 1. Introduction

In the Egyptian history, the Coptic era witnessed many achievements that can be classified. Although the whole world appreciates and treasures such achievements, Copts and Egyptians are still unaware of many of those achievements along that era. Coptic monasticism, for instance, is one of the most important civilized achievements that Egypt offered to the Christian world. Coptic architecture has flourished in its monasteries, in addition to the Coptic arts, the various handcrafted productions, and the Coptic literature. That had huge influence on the European culture and motivated many universities in the western world to establish special academic departments for studying the Coptic heritage. Nevertheless, monasteries do not only draw attention to the history or heritage of the church, but also to the bases of every spiritual and educational renaissance. Copts used to deal with different cultures like those of the Romans, Arabians and many others for long centuries. They learned from their predecessors' art techniques and architecture and evolve them to satisfy their needs. That has created such a rich fortune to conduct research on their experience of dealing with structural systems.

Ancient Coptic architecture has crucial historical value for Copts in general and the Coptic Orthodox Church in Egypt. Researchers of Coptic architecture and archeology always argue about its origins. There is a group of them who reminds us with ancient Egyptian architecture and the resemblance between the structural systems of the ancient Egyptian temples, from the outer courtyard to the inner sanctuary that was hidden from that of the Coptic churches, an external narthex (in the rear buildings) and a sanctuary hidden behind an iconostasis. Others esteem the first Coptic churches, such as those of the Byzantine and Roman periods and the Greco-Roman basilica.

Thus, the Coptic architecture has combined the traditions and indigenous materials of Egyptian architecture and Greco-Roman and Byzantine-Christian roof systems. The fertile styles of nearby Christian Syria had a much greater influence after the 6th century. After the Muslim conquest of Egypt, one can observe that Coptic art and architecture cast their shadows on Egyptian Islamic architecture.

Throughout the Coptic history, Egyptians constructed a huge number of churches. Even though there haven't been much academic researches on the history of Coptic architecture, they have generally focused on three main areas: (a) the relationship between traditional Coptic architecture and environmental factors; (b) the geometry and documentation of architectural style/s of Coptic churches; and (c) building methods and materials.

Concerning the first subject, Nelly R. (Ramzy, 2012) inquired about how Coptic architects dealt with both the natural and man-made environments in order to make the best use of the resources that were at their disposal in terms of the environmental aspects of their work. She was able to demonstrate in a different study, that the designers of the traditional Coptic architecture utilized the most of the biophilic design concepts and standards instinctively (Ramzy, 2015). Despite biophilic design being a theory and a recent idea in architecture.

For the second subject, researchers had more success with studies that were concerned with the architecture, design, and documentation of Coptic churches. Also, they were concerned with the roots of Coptic architecture, its influence on other architectural forms, and inquired if it was influenced by others. In addition, they discussed how the spiritual dimension affected the architecture of design and formation. First of all, we shouldn't miss mentioning

the contribution of Sir Butler (Frothingham, 1886) in documenting and describing Coptic churches. He put his efforts in two volumes, considered as a bible reference for any scholar in this field. However, recently, Shaban Samir (Abd Elrazik & Bershaw, 2022, Amen & Nia, 2021, Aziz Amen, 2017), put his description for the Abu Sefein Church in Qena Governorate. Also Renete D. (Dekker, 2013), where he traced and documented the development of the Church at Dayr Anba Hadra, near Aswan. Its construction date goes back to about the sixth or seventh century. The Archangel Michael Church at Kafr El-Deir, whose construction predates the sixteenth century, also gained significant attention from Mohamed N. (Afify, 2019). From the fourth century through the eighth century AD, Atef Awad (Awad, 2019) also observed and documented the advancement of Coptic architecture. While Sherif M. (Morgan, 2016) introduced the research efforts that has been done to classify the architectural typologies of Coptic churches, and selects Shaker's one to apply it on the churches of old Cairo. From another viewpoint, Marriane N. (Guirguis et al., 2020) explores symbolism in Coptic architectural forms and classifies it in line with the characteristics of the various symbols, providing awareness of this legacy and preparing academics and practitioners for analysis of symbols in historic church structures. In the same context, and in another study, she showcases several artistic techniques used in churches and explores whether or not there are parallels between these techniques and church design form (Guirguis, 2023). Moreover, Merna Ph. (Philip et al., 2022, Amen & Kuzovic, 2018) claimed that when using socially responsible practices in Coptic architecture geometry, its key concept is to address the issue of achieving spirituality. Furthermore, Nelly, R. (Ramzy, 2014) examined the patterns of symbolic language used in Coptic architecture, where symbols served as the language supporting a particular aesthetic and spiritual discourse. However, searching for the roots of Coptic architecture Rehab Sh. (Sharafeldean, 2019, Aziz Amen & Nia, 2018) began by providing an introduction of Coptic art and architecture, including its history and relationship to ancient Egyptian culture. Similarly was the presented work of Amany A. (Hendy & Michael, 2020), however, she put her analyses for interior design.

For the last topic, where the building materials, Abubakr M. (Moussa & Roshdy, 2021), stands on the reaction of ancient churches with the environmental changes that causes deterioration for the structure. He gave recommendations to strengthen it and turn it to a sustainable building. Also, Bishop Samuel (Habib, 1990) observed and discussed Coptic domes in a setting relevant to the topic of this study, outlining the key elements of their development.

This research focuses on the structures of the roof systems in the architecture of the Coptic Church. That is to analyze them thoroughly, focusing on the relationship between the inner spaces and their roof structural system of the church that forms its character and articulate its mental image.

This research is interested in studying and analysing the roof systems of Coptic churches during the Coptic era (4<sup>th</sup>-9<sup>th</sup> centuries). Considering that studies of Coptic architecture are very few, comparing to other types of architecture in different eras along the history of Egyptian architecture. However, most of the documented architectural drawings of the Coptic churches did not mention or describe such various and rich types of roof systems.

Here we are tracing the evolution of Coptic churches roof systems during the Coptic era. Such tracing takes place by several resources; (a) any documentation or description mentioned by previous scholars. Texts that were written during the Coptic era by historians described Coptic churches at that time have special importance. Also, contemporary researchers such as Alfred Butler and Peter Grossmann provide this research with some information. In addition to the studies of Coptic monks who lived in Coptic monasteries. (b) site visits, by observing and analysing the remains of ancient Coptic structures and (c) ancient drawn religious icons that articulated buildings belonging to that time.

The methodology consists of three parts. The first one is a conceptual background, discussing the role of the roof system in the Coptic Churches generally. This part illustrates the function of the roof physically, environmentally and spiritually. The second part, introduces various types of roof systems. That, by classifying them according to the structural systems whether flat roof, domed, vaulted, gabled or even combined between some or all of them. The third part is the analytical one in this study. Coptic churches are arranged chronologically, while tracing the evolution of their roof systems along the different centuries. (Figure 1)

This paper can be considered as a piece of the puzzle of the history of Coptic architecture. It should be integrated with other researches to comprehend the full image of history of that time, to reflect social and cultural conditions. During that time Copts were under the rule of colonials (Romans, Byzantines ...etc). Each ruler composes his orders on Copts, however, they always had their own decisions that were reflected on their architecture. Studying Coptic architecture during the Coptic era, also, enriches architects' knowledge about the social priorities during weak periods, especially those who work in reconstruction projects.

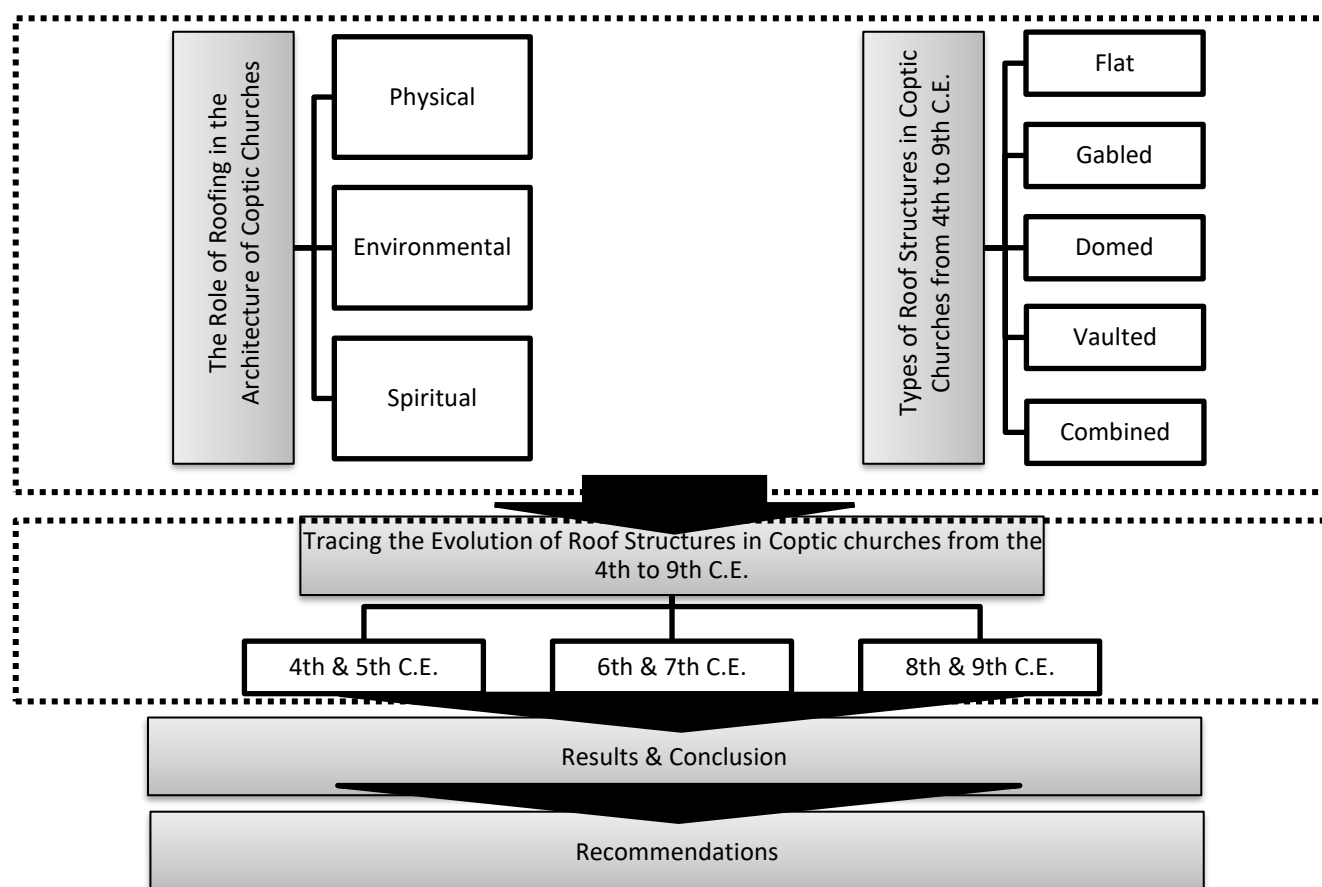


Figure 1. Structure of the Study (Developed by Author).

## 2. The Role of the “Roof” as an architectural element in Coptic Churches

The church, with its building and architectural system, and the arrangement of its furnishings from the inside, breaks through the ritual features of the spiritual path that those entering it must follow. Baptism in the far west of the Church, where the place of supra-birth is, and the sanctuary in the far east, heaven on earth, where the altar and the sacred secret of the Eucharist are located, crossing with a lectern, the place where the word of God is read. All indicate that entering heaven is only through birth first from water and the spirit in the baptismal font, then submission to the word of the Gospel throughout Christians lives, starting from Baptism and ending with the Eucharist.

By water, spirit, and word, be light; “In the beginning...the earth was formless and void, and darkness was upon the face of the deep, and the Spirit of God hovered over the face of the waters. God said, “Let there be light,” and there was light” (Genesis 1:1-3). The light is life, and the life is Christ for Copts; “In Him was life, and the life was the light of people” (John 1:3). In short: Baptism - the Gospel - the Eucharist, which are the landmarks of our journey to eternal life.

On the upper lintel of the sanctuary, Christ is crucified, who sacrificed himself for Christians’ sins to save people from this evil world. The crucified Christ is the inheritance of the Church, the secret of life, and its lukewarm song, both on earth and in heaven. Without suffering and death on the cross, there would be no resurrection. Because the resurrection necessarily means a rise from death.

Access to the bosom of the Father in the eastern part of the sanctuary can only be achieved through the altar, where the sacrifice is raised on. Since no one knows the Father except the Son, and whoever wants to know the Father, only the Son reveals to Him.

So, Copts did not see the church building, stone upon stone, and they no longer saw wood, colors and decorations, but rather the icon of the sky itself. How intimidating is the house of God. The historian Eusebius of Caesarea (260-340 C.E.) says: “The visible church is built on the image of the invisible church... it is heaven on earth.”

The roof system plays an integral part with the whole system of the church to achieve its functional and spiritual role. Its proportions, heights and forms cause different sense of place and, accordingly, different mental image.

### **2.1. Physically**

Regardless of the type of building or the function of work it does, people often need a roof that covers the building they use from a physical perspective. Typically, a roof is used for protection against bright sunshine, hail, and rain. However, due to Egypt's climate, we can observe that the ancient Egyptians had a section of their temples' open to exterior courtyards set aside for the common people. Moreover, the open courtyard was a crucial component of the mosque's architectural design in all mosques constructed in Egypt since the start of the Islamic conquest. These weren't the only physical factors that influenced the ancient Coptic churches' need for roofs, though. In Egypt and the entire Roman Empire in the first century C.E., converting to Christianity was a crime. However, the Egyptian Copts, who were eager to carry out their religious rituals, used the roof as a means of concealment from the eyes of their enemies. This is evident in their placement on the apses on the eastern side, where it is not prominent from the point of view of the eastern facade of the Coptic Church, but rather must be equal to the rest of the facade in order to avoid drawing any attention. This behaviour persisted even after Christians were permitted to convert and churches began to be built since the beginning of the fourth century C.E.

### **2.2. Environmentally**

Coptic architecture, generally, in addition to its interaction with people and location, has a concept of the relationship between character and environment, which over time has led to a wide range of treatments for its structural roof systems.

The interaction between ancient Coptic architecture and the local Egyptian environment's roofing systems had steered the latter's development in a particular direction with peculiar characteristics.

Coptic structural roof systems are not merely a product of physical needs or matter of art, but is the consequence of a complete range of socio and multi-cultural influences in their broadest meanings. (Ramzy, 2012)

### **2.3. Spiritually**

The nave's roof carries its own symbolic meaning. God is symbolised by a roof with just one dome or vault; the Holy Trinity is represented by three domes; and Jesus Christ and the four Evangelists are represented by five domes. A star-studded light blue background with an icon of Jesus Christ flanked by angels and saints was typically painted on the main central dome. The idea is that the dome reflects and affirms the building as an earthly heaven and a heavenly earth, which resembles Jesus Christ as the Head of the Church who is seated in heavens. (Middleton-Jones, 2012)

Additionally, the number of apertures in the ceilings had symbolic meanings: the multiple openings represent the stars of the sky; the cross was symbolised by the four openings, where three openings represent the Holy Trinity; and the seven openings represent the seven secrets of the church. (El-Suriany & Habib, 1995)

## **3. Tracing the Evolution of Roof Systems in Coptic Churches from the 4<sup>th</sup> to 9<sup>th</sup> C.E.**

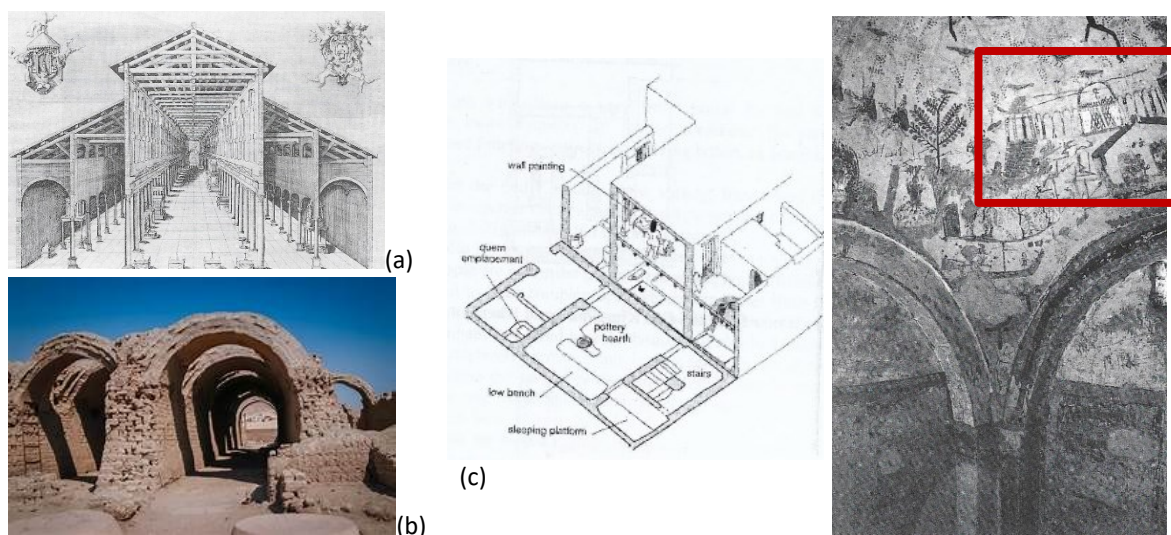
Since Christianity was permitted to be publicly practiced, it expanded throughout Egypt, and the vast majority of Egyptians converted to Christianity, the fourth century C.E. is regarded as the actual beginning of the construction of Coptic churches. However, for a number of reasons, including the fact that the church architecture at the time was characterized by simplicity in terms of formation as well as building materials, the information that is currently available regarding the construction system for the roofs of those in the first centuries is not fully available. Most of the Coptic churches' ceilings fell down at that period due to the poor quality of building materials and the fragile political and economic condition, but some of them were later reconstructed. However, by studying the records of historians and travelers from that era, as well as images of icons that predate that time and show their familiarity with the ceilings' construction methods, it is feasible to reconstruct the condition of those ceilings.

With regard to the second half of the period chosen for this study, what is remained of the Coptic churches' ceilings can provide us with some insight into the design of the construction system used to build them.

### **3.1. Fourth and Fifth Centuries**

This part of the study is to analyze the structure of roof systems of Coptic churches that were constructed during the fourth and fifth centuries C.E. Here, we depend on the documented case studies that were illustrated by cross-sections. Other than that, we may deduct the structural system of the roof according to the common construction systems that were known at that time and the covered span/s.

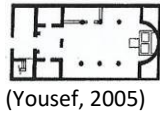
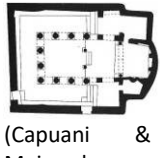
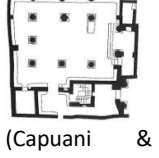
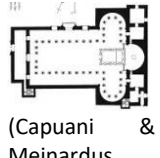
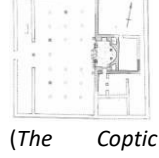

Even though it is well known that European buildings from the early days of Christianity had flat roofs (Fletcher & Cruickshank, 1996), as is the case with St. Peter's Church. The vaults and domes were better suited to Egypt's generally hot climate, and many non-religious structures have flat or vaulted ceilings dating back to the time of the ancient Egyptians. Examples include the residences in Tell el-Amarna, which dates to the Middle Kingdom, or the storage rooms at the Temple of Ramesses II at Qurna. (Figure 2 a, b, c)



**Figure 2.** (a) Flat timber roof from inside and gabled from outside of St. Peter's, Rome (Fletcher & Cruickshank, 1996), (b) Vault roofs for storage rooms at the Temple of Ramesses II at Qurna, made of mud-bricks, (c) Flat roofs of one of the houses in the Worker's Village at Amarna, using wooden beams covered with mud-mixture (Snape, 2015), (d) Iconic Drawings painted on the dome of a roof at Bagawat. It illustrates that they knew gabled roofs and multi-domed or vaulted roofs. (Capuani & Meinardus, 2002)

In summary, the Copts were famed for constructing flat, vaulted, and domed roofs using mud bricks, a skill they acquired from their ancient Egyptian forebears. Some localities still utilize the same techniques now due to the experience that was passed down through generations and various ages (Figure 2d). (Marei, 2018)

**Table 1.** Extrapolation of the roof's structural system by studying Coptic churches' floor plans, whose construction began in the fourth and fifth centuries C.E.

|                |          | 4 <sup>th</sup> Century C.E.  |  |  | 5 <sup>th</sup> Century C.E.  |   |   |
|----------------|----------|---|--|--|---|---|---|
| Floor plan     |          | <br>(Yousef, 2005) | <br>(Capuani & Meinardus, 2002) | <br>(Capuani & Meinardus, 2002) | <br>(Capuani & Meinardus, 2002) | <br>(The Coptic Encyclopedia, 8, 1991) | <br>(Shaker, 2012) |
| Roofing system | Flat     |   |  |  |   |   |   |
|                | Vaulted  |   |  |  |   |   |   |
|                | Domed    |   |  |  |   |   |   |
|                | Combined |   |  |  |   |   |   |
| Name           |          | St. Marina church   | Church of the Holy Virgin  | Church of Ain Shams Al-Din   | The Basilica  | Madinet Mady  | The circular church   |
| Location       |          | North coast   | Al-Menya   | Baris Oasis  | Al-Menya  | Al Fayyoun  | North Sinai   |

Extrapolating from the floor plans of churches from the fourth century, it appears that the basic basilica style is the predominant one in church architecture. Regarding the roofs' structural design, we may assert that the church of St. Marina's roof was gabled for two reasons. The floor plan has a regular shape, making it simple to cover with gables for the first reason. Regarding the second reason, it is because the location is near the northern coast, where there is no clay suitable for construction, as well as exposure to European cultural interchange because the location was a gateway for the romans to enter Egypt.

Despite their extremely simple floor plans, the Church of the Holy Virgin at El-Minya and the Church of Ain Shams Al-Din at Baris Oasis both successfully integrate cultures. The walls are not quite regular, and the floor plans are basilica. The Church of the Oasis is made of bricks, whereas the Church of St. Mary is a stone with irregular carvings. Therefore, we may assert that the ceilings' structural structure is vaulted, particularly over the nave area. In those parts of Egypt, the vaulted construction method is also inherited and well-known.

It is evident from the churches of the fifth century that the basilica plan started to evolve. The martyrion plan also appeared where the transept and the tri-conch sanctuary were inserted. This therefore has an impact on how the roof is shaped. We may assert here, with regard to the El-Minya Basilica, that the main nave is covered by a vault that connects with another vault over the transept, and that at the intersection is a higher dome resting on a semi-dome over the sanctuary and the connecting vaults.

From the floor plan is transversal, and divided into three bays. It appears that those bays of the church of Madinet Madi at Al-Fayyoun is covered with a three transversal vaults. Also, it is possible for the nave of the church to be covered with one central vault flanked by three transversal vaults on each side.

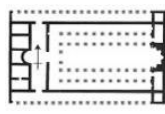
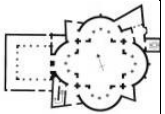
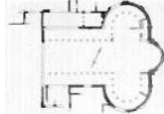
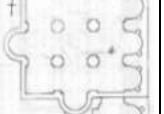
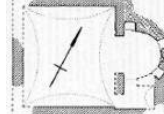

It is obvious from the circular church at North Sinai that the ambulatory's roof, which may be either a vault or a semi-vault, is covered with a dome that rests on columns. (Table 1)

### 3.2. Sixth and Seventh Centuries

In order to keep up with changes in the floor plan design, Coptic churches' roof structures underwent another stage of evolution in the sixth and seventh centuries. The construction of basilica churches resumed in the sixth century, along with the introduction of the choir and the tri-conch sanctuary (Yousef, 2005). We also observe that the Byzantine model (central plan-martyrium) in church architecture is still extant, perhaps in a more advanced form than that of the fifth century, when we look at the documented architectural designs of churches from the sixth century. We may also see that the introduction of the radial apses in the sanctuary. (Table 2)

In the seventh century C.E., roof systems with intersecting vaults appeared. Also, the central cruciform floor plan was introduced. Usually, such plan is covered with multiple domes with a central dominant one. And, the basilica continued to evolve in a royal manner.

**Table 2.** Extrapolation of the roof's structural system by studying Coptic churches' floor plans, which construction began in the sixth and seventh centuries C.E.

|                |          | 6 <sup>th</sup> Century C.E.  |   |   | 7 <sup>th</sup> Century C.E.   |   |   |
|----------------|----------|---|---|---|--|---|---|
| Floor plan     |          |  |  |  |  |  |  |
|                |          | (Capuani & Meinardus, 2002)   | (The Coptic Encyclopedia. 8, 1991)  |   | (The Coptic Encyclopedia. 8, 1991)   |   |   |
| Roofing system | Flat     |   |   |   |  |   |   |
|                | Vaulted  |   |   |   |  |   |   |
|                | Domed    |   |   |   |  |   |   |
|                | Combined |   |   |   |  |   |   |
| Name           |          | The Basilica of Armant  | Sanctuary of St. Menas, east basilica   | Al-Hawariya (Merea)   | Basilicat at old Dongola   | St. Barbara's Chapel  | Sanctuary of Abu Mina, North basilica   |
| Location       |          | Armant  | Alexandria  | Alexandria  | Dakhla Oasis   | Asut  | Alexandria  |

We can notice the Roman impact on church architecture by looking at the floor plans of Coptic churches from the sixth century. Regarding the Armant Church, we can see how the Roman and Egyptian architectural styles were combined. The floor plan is basilican in design, but as we can see from the western apse, it is encircled by two rows of Roman-style columns on the long sides. There is an ancient Egyptian influence in the return aisle and the way the apse is hidden from the eastern façade. Additionally, the sanctuary features radial apses, a design that was novel at the time and eventually used in Romanesque church architecture. This church could be covered by timber gabled ceiling because of its roman influence and wide naos.

St. Menas's Church is exceptional in terms of architecture. It is a martyrium, has a central hall with a dome covering it that rests on four semi-domes; this type of structure is known as a cascading domes. The arches and the outside walls receive the loads that were placed on the domes and semi-domes. The Hagia Sophia Church, which was constructed in the fourth century C.E., and other structures in the Byzantine architectural style served as inspiration for this construction concept.

Despite having a straightforward basilican design, the Church of El Hawariya's transverse wing transept with semi-circular extremities indicates that its ceiling is a vault finished with semi-vaults at the ends. As a result, a vault must intersect it to serve as the main nave's ceiling. It must also have a semi-dome at its end to create the apse. This formation is very new of its kind in Egypt and advanced for the world at this time, because, of course, the two vaults most probably intersect at a central dome. Thus, the Roman basilica and the central Byzantine design were united in this basilica-shaped church.

In the seventh century C.E., In Old Dongola, there were cruciform structures with many aisles that had exedras pertaining to the center zone at the end of the transverse axis. Although they must have existed (a scaled-down example of this type can be seen in the church of Al-Hayez Oasis), buildings of this type have not yet been



documented in Egypt (*The Coptic Encyclopedia*. 6, 1991). The rood system of this type most probably have been multi-domed structures.

The small chapel of St. Barbara at Asut has a modern roofing system regarding being constructed in the seventh century C.E. Because of its straightforward form, the presence of the radial apses, and the cross-vaulted ceiling (Fletcher & Cruickshank, 1996), it can be seen as a simple illustration of Romanesque architecture. It exhibits the fundamental features of Romanesque architecture despite its extreme simplicity.

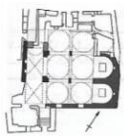
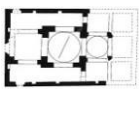
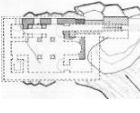
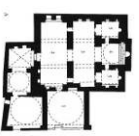
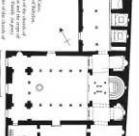
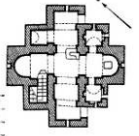
Also, the remarkable basilica, located on the settlement's north side, has a conventional basilican plan with a nave, two aisles, and a return aisle coming from the west (Atiya, 1991). To mimic the Roman configuration, such a scheme most likely has a flat roof structure or a timber gabled roof. It is situated in Alexandria, which has a port that is close to Europe. Along with the ease of importing wood, Alexandria exhibits the Roman Empire's cultural impact more so than Cairo and Upper Egypt, in addition to the less hot climatic conditions.

### 3.3. Eighth and Ninth Centuries

Egypt had already been ruled by the Muslims in the eighth and ninth centuries C.E. As a result, the first signs of Islamic cultural influence may be seen in the architecture of Coptic churches, and therefore in the form and construction system of their roofs. The transversal plan is second in importance to the basilica design at the level of the floor plan in the design of Coptic churches. While around that time the circular Byzantine martyrion model completely vanishes (Table 3).

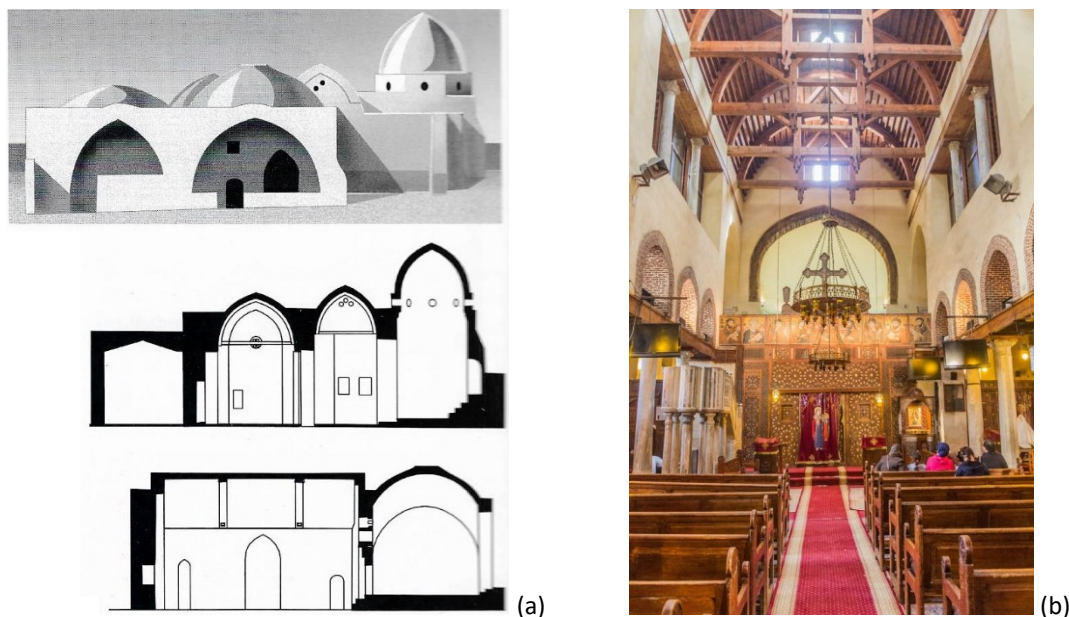
The usage of flat roofs reduced and the use of domes rose during that time, with the structural system of the roofs generally varying between vaults and domes. The Islamic architectural culture had an impact on the shape of the dome and vault, which changed from a round to a more pointed shape.

**Table 3.** Extrapolation of the roof's structural system by studying Coptic churches' floor plans, whose construction began in the eighth and ninth centuries C.E.

|                |          | 8 <sup>th</sup> Century C.E.   |  |  | 9 <sup>th</sup> Century C.E.  |  |  |
|----------------|----------|--|--|--|---|--|--|
| Floor plan     |          |  |  |  |  |  |  |
|                |          | (Shaker, 2012)   | (Capuani & Meinardus, 2002)  | ( <i>The Coptic Encyclopedia</i> . 8, 1991)  | (Capuani & Meinardus, 2002)   |  | (Fāsī, 1995)   |
| Roofing system | Flat     |  |  |  |   |  |  |
|                | Vaulted  |  |  |  |   |  |  |
|                | Domed    |  |  |  |   |  |  |
|                | Combined |  |  |  |   |  |  |
| Name           |          | Church of Prince Tadrus  | Church of Mar Buqtur   | Church of St. Psote  | Monastery of Syrians, Church of St. Mary  | Church of St. Barbara  | Angel Betamite Church  |
| Location       |          | Cairo  | Luxor  | Aswan  | Wadi El-Natrun  | Cairo  | Nubia  |

During the eighth century C.E., Church of Prince Tadrus, Cairo, is a multi-domed transversal church, with a narthex cover with two bays of intersected vaults. Each dome in this church is based on different form of stalactites (Morgan, 2016), which is influenced by the Islamic culture. Church of Mar Butur, Luxor, its nave has single dominant dome based on four piers., surrounded by three aisles. Also, there is a choir with a central single dome. Another example, church of St. Psote, Aswan, it has a squared nave with four piers in the middle which is most probably covered with a single dome. The lay out of the plan resembles the roman one in that the eastern apse is faced with a squared space, like a basilica with two opposite exedras.

As for the ninth century C.E., the church of St. Mary at Wadi El-Natrun, has also a transversal plan with two bays, which are roofed by two pointed vaults. Furthermore, it has three sanctuaries, the largest one is the middle sanctuary. All of them are covered with pointed domes, and the middle one is the higher (Figure 3a). Church of St. Barabara, Old Cairo, has a basilica plan with nave and two aisles and return aisle. The nave is covered by a barrel timber vault from inside and gabled from outside (Figure 3b).



**Figure 3.** (a) St. Mary church, Wadi El-Natrun, the elevation and cross-sections through the pointed vaults and the middle-pointed dome over the sanctuary. (b) Church of St. Barbara, Old Cairo, interior illustrates the barrel timber vault covering the nave.

#### 4. Results

There were no records proving the shape of the building construction system for the roofing of the first Coptic churches, which were built in the fourth and fifth centuries. That era is the period of time when most of the population of Egyptians embraced the Christian faith. However, a set of perceptions were produced for the form and kind of coverage of Coptic churches at that time, as a kind of reconstruction, through this research, taking into account the economic, political, and social aspects of the time and extrapolating the floor plans.



















The research of the building method of Coptic churches' roofing shows that the Egyptian Coptic society had, at some point, assimilated with the Roman culture in the construction of churches. Although the floor plan designs (whether those of a basilica or a martyria) look to be in the Roman style, the ceilings' construction techniques were mainly well-known and passed down from earlier periods.

The study traces the development of Coptic churches' roof systems between the fourth and ninth centuries C.E. and categorizes them into flat, domed, vaulted, or combined roofs. From which we can recognize the multiculturalism that was taking place in the Egyptian social life. Where during the fourth and fifth centuries C.E. the roof systems of Coptic churches were tending to be influenced from the roman culture. Where during the sixth and seventh centuries C.E. the byzantine influence emerged, then the Islamic influence took its place since the eighth century C.E. (Table 4)

However, despite the concert impact of the imported cultures, there are many local factors that affected the formation of the roofs of ancient Coptic churches. As the hot environmental climate in Egypt relative to Europe imposed the use of domes and vaults more, especially in the early Christian era. The ancient Egyptian culture and inherited knowledge of building techniques also had a significant impact.



**Table 4.** Classification of the structural roof systems of ancient Coptic churches according to their floor plans and ordered chronologically

|                | 4 <sup>th</sup> c. C.E.   |   |   | 5 <sup>th</sup> c. C.E.   |   |   | 6 <sup>th</sup> c. C.E.   |  |   | 7 <sup>th</sup> c. C.E.   |   |   | 8 <sup>th</sup> c. C.E.   |   |   | 9 <sup>th</sup> c. C.E.   |   |   |
|----------------|---|---|---|---|---|---|---|--|---|---|---|---|---|---|---|---|---|---|
| Floor plan     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Roofing system | Flat  |   |   |   |   |   |   |  |   |   |   |   |   |   |   |   |   |   |
|                | Vaulted   |   |   |   |   |   |   |  |   |   |   |   |   |   |   |   |   |   |
|                | Domed   |   |   |   |   |   |   |  |   |   |   |   |   |   |   |   |   |   |
|                | Combined  |   |   |   |   |   |   |  |   |   |   |   |   |   |   |   |   |   |
| Name           | St. Marina church   | Church of the Holy Virgin   | Church of Ain Shams Al-Din  | The Basilica  | Madinet Mady  | The circular church   | The Basilica of Armant  | Sanctuary of St. Menas, east basilica  | Al-Hawariya (Merea)   | Basilicat at old Dongola  | St. Barbara's Chapel  | Sanctuary of Abu Mina, North basilica   | Church of Prince Tadrus   | Church of Mar Bugtur  | Church of St. Psote   | Monastery of Syrians, Church of St. Mary  | Church of St. Barbara   | Angel Betamite Church   |
| Location       | North coast   | Al-Menyia   | Baris Oasis   | Al-Menyia   | Al Fayyoun  | North Sinai   | Armant  | Alexandria   | Alexandria  | Dakhla Oasis  | Asut  | Alexandria  | Cairo   | Luxor   | Aswan   | El-Wadi Natrun  | Cairo   | Nubia   |

## 5. Discussion

There is a lack of academic studies that deal with Coptic architecture generally, and its structural systems particularly. That is why this research is done to explore a piece of puzzle in the whole picture in the history of Coptic architecture. Since Coptic era is a very crucial and transitional period in the history of Egypt. Dr. Samy Sabry (Shaker, 2012) is almost the only one who classified the ancient Coptic churches according to two factors; the floor plan and the roofing system. Here we concentrated our efforts to classify those roof systems and their evolution between fourth and ninth centuries C.E.

We find that the structural roof systems during the ancient Coptic periods is not just an architectural element that work functionally only, however, it has its dynamics with the local context, politics, social culture/s. that helps us to put our expectations about some demolished roofs of churches belong to that period.

## 6. Conclusions

It is highly recommended to make more and more efforts in studying the early Coptic churches between the fourth and sixth centuries C.E. (Early Coptic Architecture) and before. That can be done by more excavations and deep studies in the art products – including icons – and literature. Such efforts may reveal much of the mystery surrounding the building methods of those times.

This study provides a broad overview of the design and construction of the roofs structural systems used in Coptic churches. However, this research point needs more deepening and studying each of the formulations and types of each of domes, vaults and timber gabled roofs each separately.

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## Conflict of Interests

We declare no conflict of interest.

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