1992 Technical Review Summary
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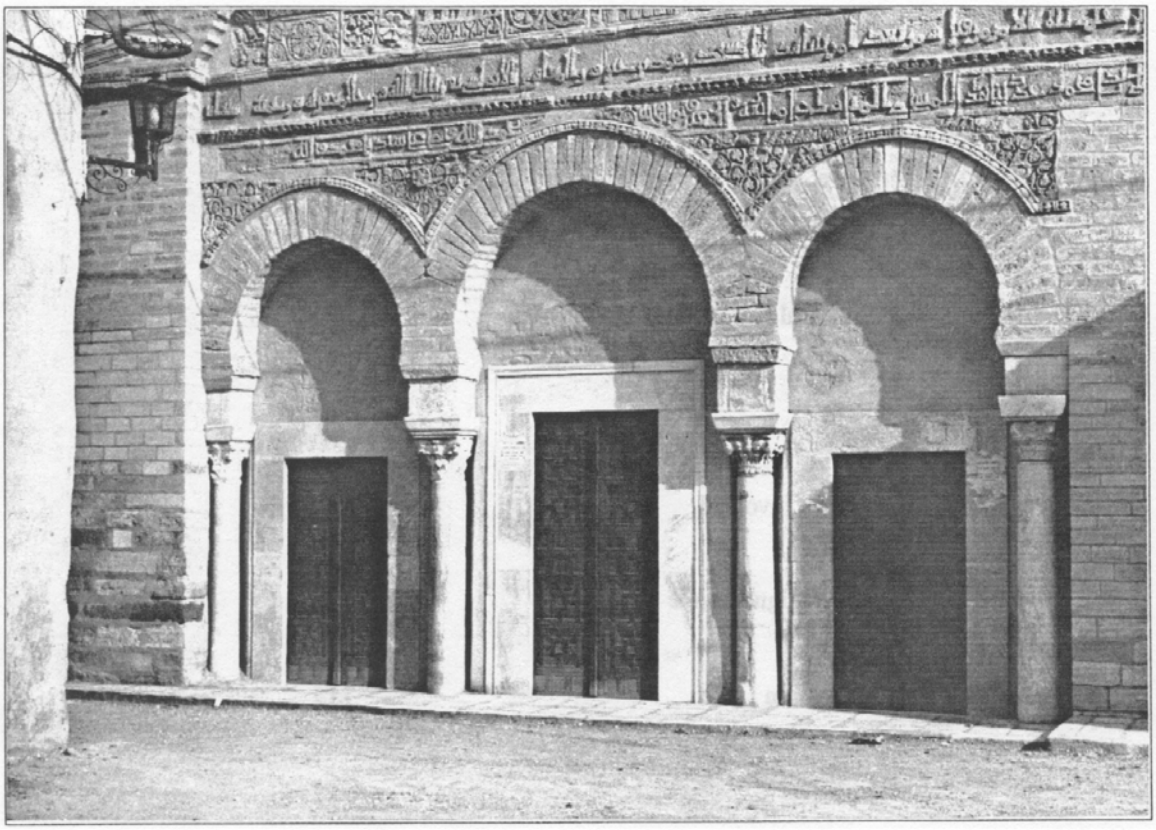
Kairouan Rehabilitation Programme

Kairouan, Tunisia



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Kairouan Conservation Programme, Kairouan, Tunisia

I. Introduction

The Kairouan Rehabilitation Programme was launched in 1977, with the establishment of *Association de Sauvegarde de la Medina de Kairouan* (ASM), to restore and protect the integrity of the Medina of Kairouan, one of the most revered cities of Islam in North Africa. In collaboration with *Institut National d'Archeologie*, ASM prepared the programme in two stages. The first stage foresaw the restoration, rehabilitation and operation of the important monuments of the Medina, including mosques, *zawiyas*, mausoleums and other public structures such as water installations, ramparts and city gates. After the conclusion of the first phase this year, the second phase is expected to concentrate on the rehabilitation of public squares, street façades and private residences, so as to preserve the traditional urban texture of the town as an integral whole. Thus, at the end of the second phase, together with the completion of the service networks which are being installed, Kairouan is expected to be ready for a future of higher civic standards, alongside a well preserved heritage and an integral urban fabric which has been formed within the course of more then a thousand years. The success of the project may certainly inspire similar projects in other historic cities of the Islamic world.

II. Context

a. *Historical Background*

Dating back to the days of the Muslim conquest of North Africa, Kairouan, the first Arab city of Maghreb, was founded in 50 H (A.D. 670-71) by Uqba bin Nafi, the famous commander and close companion of the Prophet, who was entrusted with the task of conquering North Africa in the name of the Omayyad Caliph Mu'awiyyah.

Safely situated at the centre of Ifriqiyya, approximately 160 km south of Carthage and 60 km inland, away from the threat of the powerful Byzantine navy, Kairouan was established as a stable base for future military operations against the Berbers, who dwelt in the distant mountains. Having first built the Grand Mosque and the Da'r-al-Imara, Uqba bin Nafi distributed the land around these structures among his soldiers, upon which they built their houses.

During the century after Uqba's death, the city's physical aspects were altered drastically. It was occupied by the Berbers for four years between A.D. 684-688 and it was pillaged and destroyed during the Kharijite Revolt of A.D. 758-761.

In 86 H (A.D. 703), Ifriqiyya was attached to Egypt with the status of a *willaya* and its governors were directly chosen by the Caliph.

In A.D. 762, the city was first enclosed by walls. The governor Mohammad bin al-Ash-ath wanted to protect the city from Berber attacks.

During the 8th Century A.D. the Grand Mosque was destroyed and enlarged three times by Omayyad and Abbasid Caliphs, to meet the demands of the growing congregation. Under the rule of the Aghlabids, between 800 and 909 A.D., Kairouan was developed extensively and the city was endowed with some of its most important monuments.

During this period, Ifriqiyya won its independence for the first time under the rule of Ibrahim bin al-Aghlab, and its capital, Kairouan, prospered as the most important Muslim town of North Africa. Ziyadat Allah I reconstructed the Grand Mosque in 221 H (A.D. 836). In 248 H (A.D. 862) Abu Ibrahim Ahmad enlarged the prayer hall and built the dome over the entrance of the central aisle. He was also responsible for the construction of the large water basin in 246 H (A.D. 860), which is known as one of the most incredible hydraulic installations of the Middle Ages.

It was during these years that two princely towns were built near Kairouan. These were Al-Abbasiya (al-Qasr al-Qadim) 186 H (A.D. 901), and Raqqada 264 H (A.D. 870). It was also

during these years that Kairouan was dotted with numerous small masjids or mosques. Masjid Ibn Khairoun, known as the *masjid* of Three Doors, was built in 252 H (A.D. 866) by Mohammad ibn Khairoun al-Ma'afiri, from Andolusia, and is one example of these small but important structures. During the 9th Century, Kairouan, like Kufa, Basra, and Fustat, had become one of the brilliant cities of Arab-Islamic culture. With Imam Suhnun's efforts, the city was transformed into a town for research of Islamic sciences and a universal centre for dissemination of knowledge and ideas.

The arrival of the Shi'ite Fatimids in 269 H (A.D. 909) was met with fierce resistance by the Sunni Kairouanese. Hence, the Fatimid reign between 296-361 H (A.D. 910-972) did not prove favourable for the city of Sidi Uqba.

The sovereign Shi'ites were disinterested in Kairouan, the citadel of Sunni-ism, and they later settled near Raqqada, from 296-308 H (A.D. 910-921), while they established a new capital in Mahdia from 303-308 H (A.D. 916-921). Mahdia was used as a shelter against local uprisings, as well as to provide access to the Mediterranean Sea.

The third Fatimid Caliph, al-Mansur, celebrating his victory over Abu-Yazid, built a new city 2 km south-east of Kairouan called Sabra al-Mansuriyya, to which he transferred all the commerce and industry of Kairouan. Thus, the town lost its metropolitan qualities in favour of the new capital, Mahdia, and the neighbouring al-Mansuriyya, which later developed into an important administrative and commercial centre.

During the Fatimid years, Kairouan's prosperity was further diminished through devastating earthquakes, floods and fires that reduced the city to rubble with a poor, inactive population trying to hold onto a rich Aghlabid heritage. It was this heritage that helped the city to attain the relative prosperity of the Zirid period.

After the Fatimid conquest of Egypt in 358 H (A.D. 969), the caliphate was transferred to Cairo by al-Muiz in 361 H (A.D. 974) and the administration of Ifriqiyya was entrusted to Buluggin bin Ziri, a faithful member of the Sanhaga tribe.

Even though Kairouan was relatively prosperous under Ziri rule, the year 439 H (A.D. 1047) marked a tragic turning point in the history of Sidi Uqba's beloved city, when it fell into rapid stagnation and collapsed under the continuous assaults of Banu-Hilal.

During the Hafsid rule in VIII H (13th Century A.D.), the town began to rise from the ruins. However, it was not until the 18th Century, when the town re-established religious and cultural prestige under the rule of the Hussaynids, that Kairouan again developed into one of the major urban centres of Ifriqiyya, with an active commerce and industry.

After the signing of the Bardo treaty which annexed Tunisia to France, Kairouan became one of the major centres of resistance until it was occupied by the French in 1881 (without bloodshed).

During the Second World War, the town became one of the strongholds of the German armies, who destroyed part of the city walls.

After Tunisia gained independence in 1956, Kairouan continued to exist as the provincial capital with a rich heritage but limited agricultural and industrial production which seems to hinder her physical and economic development.

b. *Local Architectural Character*

Kairouan today consists of the Medina, which is protected by walls and the ancient suburbs of Gabliya, Jabliya and Zlass, which lie immediately to the west and north-west of the Medina. New neighbourhoods have developed mainly to the south, east and north of the Medina. A complex network of narrow winding streets, blind alleys and white-washed buildings, occasionally doted with cupolas, square minarets and imposing portals, marks the general character of the traditional urban texture. Local houses are generally one or two storeys high with central courtyards, while

the streets, except for the major arteries, are in need of paving. The Grand Mosque on the east end of the Medina and the Ottoman barracks to the north are the two edifices that stand out in the homogeneous texture, due to their scale.

The new districts with their straight, paved street systems and the new architecture seem to have been controlled in the immediate vicinity of the ramparts, to leave intact the existing texture of the Medina. Nevertheless, a few four to five storey apartment buildings within the Medina, as well as in the modern section, somewhat disturb the integrity of the traditional fabric.

Within the Medina and the old suburbs, the buildings were built almost exclusively of brick, bonded by lime mixed with earth. The façade render is white-washed and timber parts are generally painted.

The new architecture in the modern districts is international with concrete skeletal structures and brick walls, rendered and white-washed to integrate with the old fabric. The use of simple massing, small windows and occasional arches is an effort to enhance this integration.

c. *Climatic Conditions*

Situated at 60 m altitude amidst an essentially semi-arid agricultural plateau, Kairouan, with its 140'000 inhabitants, is the administrative centre of the region which borders the more arid zone to the south.

The climate displays considerable seasonal differences with sub-zero temperatures in winter which rise above 40°C in summer. The sirocco blows approximately 21 days/year and precipitation in and around the town is approximately 250-300 mm/year. Even though this figure rises to approximately 500 mm/year to the west of the region, rainfall is very unpredictable from year to year and the danger of fierce drought is always present in the area which is poor in water preservation.

d. *Immediate Surroundings*

Kairouan is situated approximately 60 km west of Sousse, and almost half-way along the coastal road from Tunis to Sfax. The old seaside towns of Sousse, Monastir, and Mahdia nearby have all been transformed into tourist centres with extensive vacation facilities, and large international beach hotels which operate year round. The proximity of these cities has saved Kairouan from tourist development and abuse; thus, the city caters mainly to daily visitors from sea-side towns and has been largely able to retain the integrity of its homogeneous urban texture. More recent developments to the south of the walled city are low profile and have successfully integrated with the existing environment.

On arrival from the lush vegetation of the seaside, the far stretching land on which Kairouan rest strikes one as a semi-arid, dusty plain with little greenery, even though it is known to yield abundantly, when irrigated.

The hills to the west and in the distance do not affect the feeling of flatness all around the town. This feeling is particularly strong looking beyond the Basin of the Aghlabids to the north of the Medina. Unfortunately, the area is slowly being burgeoned with garden houses, which tends to destroy the feeling of confinement of the town within a vast, open space.

e. *Topography*

Kairouan is built on almost flat land, at the centre of a semi-desertic plateau, which is grandiose but also monotonous. The inclination towards the sea on the east is so gradual that it is almost unnoticeable.

III. Description

a. *Conditions Which Formulated the Programme*

One of the oldest cities of Islam, and a showcase for typical North African vernacular, Kairouan was in a serious state of neglect, abandon and misuse when the *Association de Sauvegarde de la Médina de Kairouan* was established in 1977. Most of the important monuments had been converted into makeshift houses and were in danger of collapse. In collaboration with *Institut National d'Archeologie*, the ASM started an extensive programme of restoration and rehabilitation of the most important monuments of the city.

During the past fifteen years, a considerable amount of work has been enacted and an impressive number of historic monuments have been restored to their original condition, including the imposing ramparts around the Medina.

b. *General Objectives*

- To safeguard the architectural, cultural and historical heritage of the Medina;
- To publicise and encourage public participation in the conservation programme;
- To protect the Medina from indiscriminate modernisation;
- To contribute to the socio-economic revival and development of the town.

c. *Functional Requirements*

Restoration and rehabilitation works were undertaken on the following structures:

- The mosque of Ibn Khayrun (also known as the Thalatha Biban/ Three Doors Mosque, built by the Aghlabids in 866). The Mosque of el Bey (the only Hanefite mosque of the town built by the Ottoman governor Mohammed Bey, in 1683). The smaller *masjids* of Ibn Tukhana, Ali Moktar, Ibn Khayrun II and Muallaqa;

- The Khan Barrouta (18th Century) has been transformed into a crafts centre;

- The Bir Borrouta (a two storey structure containing a water well, which dates to the early days of Kairouan but was restored during the 17th Century);

- Three old *suqs* including the *suq* of Cisterns (14th Century);

- The Mausoleum of Sidi Khedidi (18th Century) has been converted into a special school for the deaf and the dumb;

- The Mausoleum of Sidi Aloumi has been transformed into a new social information office;

- The Sidi Abdelkader Mausoleum (19th Century) has been put to use as a centre for diabetics;

- The Mausoleum of Sidi Siouni has been converted into offices for the Nature Protection Society;

- The Mausoleum of Sidi Abid has been rehabilitated to house the ASM offices;

- The Mausoleum of Amor Abada (19th Century) has been transformed into a Museum of Popular Arts;

- The Mausoleum of Sidi Sahib (17th Century); the restoration work is in process;

- The water basin of the Aghlabids (built in the 9th Century) has been restored to its original function;

- The ramparts and the city gates (3'200 metres long, built in the 18th Century) have been restored to their original condition, except for the missing parts which were destroyed by the Germans during the Second World War;

- The Grand Mosque of Kairouan was partially restored before the establishment of the ASM and the work was carried out by foreign architects. The ASM evaluates this building separately, even though their contribution is considerable and continues on, around and inside the building.

d. Building Data

During the first phase of the rehabilitation programme, the ASM was involved with the restoration of seven mosques of various sizes, three *suqs*, seven *zawiya* (mausoleums), one *wikala/khan*, one well structure, a large water reservoir and the ramparts and gates of the Medina.

The total restored area is 3.2 ha which comprises 1/15th of the whole area of the Medina. The restored structures are not concentrated in one particular area of the Medina but are dispersed throughout the city.

The mosques and *zawiya* that have been restored are in general one or two storey buildings with cubical masses and flat timber roofs. The burial chambers in mausoleums are usually covered by plain or plaited brick domes over circular or octogonal drums.

f. Structure, Materials, Decoration

Structural Systems

The historical structural systems in the buildings of Kairouan consist of simple bearing walls, and flat, timber roofs with exposed beams and rafters. In the courtyards and inside the mosques, arcades obtained by re-cycled Roman marble columns with classical or locally made capitals are crossed by circular horseshoe arches and they are occasionally covered by brick vaults.

Plain or plaited brick domes over octagonal drums are also used on important chambers, such as mausoleums and entrance halls.

Materials

The traditional building material in all Kairouan buildings is a thin, small brick made with local clay and bonded by either plain earth mortar or a mixture of local earth and lime, which is very weak against humidity. The timber for the roofs, doors and windows usually came from the northern mountains.

The walls and arcades are plastered over with mud or a mixture of earth and lime and white-washed. In some cases, as with the Three Doors Mosque, stone has been utilised as a facing material and has also been carved for decorative reasons.

Particularly in the monuments, the courtyards are paved with stone or black and white marble in geometric patterns.

Decoration

Geometrically carved gypsum plaster and colourful local tiles are used as decoration on certain areas of the walls, and the timber ceilings in most cases are hand painted and gilded in floral designs.
Bands of writing, usually in *kufic* character, are also utilised for decorative purposes in gypsum plaster, in brick revetments, in paint, in tile work and occasionally in stone carving.

g. Origin of Restoration Technology, Materials, Labour and Expertise

Strongly attached to the basic principles of restoration as defined by the Charter of Venice, ASM has been careful to use ancient methods and materials of construction during the restoration of the monuments in the Medina of Kairouan.

Technology

Local traditional techniques of construction have been utilised in the restoration of the monuments. The technical assistance and advice of *l'Institut National d'Archeologie* has been of great help.

Restoration of tilework, carved gypsum decoration, stone and wood carvings and painting on timber ceilings have been realised by local craftsmen working according to traditional methods.

Materials

Wherever it was possible, the original building materials of the ruined monuments were re-cycled. This was particularly possible in the case of the renovation of the ramparts, where falling bricks piled up at the foot of the walls. Where necessary, new stones, columns, and capitals were locally produced to order. Timber was usually one material which had to be replaced often. In the restoration of monuments in Kairouan, no imported materials were used.

Labour and Expertise

All workers and craftsmen employed by ASM in Kairouan are local and they vary in number according to the demand of the particular restoration work. Usually, the work is carried out by one or two masons, and a group of unqualified workers from the local population, under the guidance of a foreman.

Expertise is provided by the ASM staff and consists of one chief architect, two project managers, one photographer and one draftsman, under the direction of the general secretary of the Association, who is also an archaeologist.

IV. Restoration Schedule and Costs

The following is a list of restored monuments in the Medina of Kairouan, together with information on their history, basic restoration approach and costs.

a. Mosque of Ibn Khayrun or Three Doors Mosque

Built in 252 H (A.D. 866) by an Andolusian named Mohammad bin Khayrun al-Maafiri, the mosque is a fine example of Aghlabid architecture, with a rare, carved stone façade that displays three lines of inscriptions in *kufic* characters, with floral motifs in between. The square minaret, which was added in 1448, has partially blocked the inscription and the carvings on the facade.

Entered through three rectangular doors set within round, horse-shoe arches, the interior is much restored. The prayer hall consists of three cross vaulted rows, parallel to the *qibla* wall, separated from each other by two rows of horse-shoe arches, standing on antique columns with Roman capitals.

The mosque had degraded, and was characterised by crumbling stones on the façade, fissures on the arches and the minaret, and inclined walls due to weak foundations.
After precise measured drawings were established through photogrammetry, the ASM dismantled the front façade stone by stone and rebuilt it after consolidating the foundations. Hopelessly crumbled stones were replaced with new ones. New bonding was with hydraulic lime. Fissures on arches and the minaret were closed and the *mihrab* was completed only with fallen materials. The

flat roof was covered mainly with hydraulic lime and a thin layer of gravel to ensure greater solidity to the monument. The ground was covered with local tiles, and the roof drainage was re-directed to avoid seepage into the walls.

Technical data:

- time span	12 months spread over a 2 year period
- restored surface area	100 m^2
- cost/m^2	USD 100
- cost of materials	USD 4'000
- wages	USD 6'000
- total cost	USD 10'000

Work force:

- 1 foreman
- 1 site master
- 2 stone masons
- 4 unqualified workers.

b. The Khan Barrouta

Sharing the same name with the nearby well, the Khan was built in the 18th century. The two-storey building is reached through a stone arched portal decorated with floral motifs in Ottoman style which was popular during this period.

At the centre is a court, surrounded by an arcade of horseshoe arches, standing on re-cycled columns and capitals, which were brought from Sabra-al-Mansuriyya. The rooms beyond are all covered by brick barrel vaults. At one corner is a stable with a water trough for animals. The spiral stair leads to the upper floor, where the plan is similar to that of the ground floor. The flat, timber roof is carried by square, brick pillars.

As the building was in ruinous condition with fissures on arcades and vaults, the ASM began restoration in sections.

Bonding of bricks was done with a new mixture of local lime, hydraulic lime and sand in studied proportions, so as to achieve the maximum strength.

The restoration of the arcades required greater attention due to weak foundations which were consolidated up to the level of the columns. Because some of the columns and capitals were crumbled beyond repair, they were replaced by brick pillars.

The courtyard, the galleries and the rooms were paved with local tiles. The restored building has been transformed into a crafts centre.

Technical data:

- time span	36 months
- restored area	1'060 m^2 on two floors
- cost/m^2	USD 65
- cost of materials	USD 32'000
- salaries	USD 40'000
- total cost	USD 72'000

Work force:

- 1 foreman
- 1 site master

- 4 masons
- 10 unqualified workers.

c. *The Mosque of Al-Bey*

Founded by Mohammad Bey in 1094 H (A.D. 1683), after the Ottoman occupation, by Mohammad Bey, it is the only Hanefite mosque of the town. Built above the existing structural system of the covered Suq al-Attarin, the mosque is a rare example of its kind in the Maghreb. The prayer hall has seven aisles formed by horse-shoe arches standing on recycled columns from Sabra al-Mansuriyya. The sculptured *mihrab* is decorated with floral designs in prevalent Ottoman style. Juniper beams support the flat, timber roof, as in Kairouan houses. A single minaret sits on a square base in the north-east corner of the prayer hall.

The building suffered mainly from vertical fissures on laterally inclined walls and derangement of the northern gallery. The minaret was damaged due to the infiltration of rain-water into the brick.

The restoration was carefully carried through, to rehabilitate the building to its original condition, by making use of traditional techniques and materials. The restoration of the mosque, to a great extent, was financed by the inhabitants of the town.

- Technical data — Unobtainable
- Work force — Unknown.

d. *Bir Barrouta*

Dating back to the founding years of the town, the Barrouta well was first restored in the 17th Century. The two-storey building is covered by a simple dome on the upper floor, where a camel continuously circles the well so as to draw water through a simple mechanism.

The building also contains a small prayer hall, and a fountain which offers the citizens fresh drinking water.

Before restoration, the building suffered from vertical cracks on the façade and the drum of the dome due to weak joints. Timber parts were weakened because of humidity. From a nearby bakery, fuel oil was infiltrating the water reservoir.

After a careful measured drawing was made of the monument, the reservoir was emptied and a concrete lining was put in to make it water tight. After the restoration of the reservoir, the walls were consolidated up to the dome. As a final touch, the dome was given a finishing coat of hydraulic lime.

Technical data:

- time span — 18 months spread over a 3 year period
- restored area — 440 m^2 on two floors
- cost/m^2 — USD 50
- materials — USD 10'000
- wages — USD 14'000
- total cost — USD 24'000

Work force:

- 1 foreman
- 3 masons
- 6 unqualified workers.

e. *Mausoleum of Sidi Khedidi*

Built in the 18th century by a Kairouan scholar, it was used as a Koranic school where the scholar Sheikh himself taught theology. Upon his death, he was buried in the funerary chamber next to the prayer hall.

Through a rectangular door, one reaches two vestibules of equal grandeur. Thus, the entry is bent (turned) twice, contrary to Kairouan residences.

On the northern side of the central court there is an arcade of horseshoe arches carried by antique columns and capitals from Sabra al-Mansuriyya.

The prayer hall on the south-east side has four aisles. The *mihrab* is flanked by two *colonettes* with Aghlabid capitals. The funerary chamber, with its painted, timber ceiling, is situated to the west of the prayer hall. The floral and geometric figures used here are influenced from Spanish-Maghrebian art.

When the restoration work started, the building was totally dilapidated and deserted. The flat roof in timber was decayed due to rain-water that had seeped through. The walls were cracked and ruined. The lintel over the main entrance door was broken.

As with other monuments, a set of precise measured drawings was prepared first. Beginning from a depth of 80 cm below the ground level, the walls were re-built with the same old bricks but with new mortar composed of hydraulic lime, local lime and sand. The roof was renewed with juniper. The lintel above the door was replaced by a new one.

- Technical data — Unavailable
- Work force — Unknown.

f. *The Mausoleum of Sidi Abid al-Ghariani*

Built in 725 H (A.D. 1324), by one of the Hafsid Princes, the tomb was meant for Sidi Jedidi, who died in Mecca in 1384-85 and who was the teacher of al-Ghariani. Sidi Abid al-Ghariani died in 805 H (A.D. 1402) and was buried in the tomb.

The interior was renovated in the 16th Century. The two-storey building is clustered around three courts encircled with galleries. The three-row deep prayer hall adjoins the first court, which is paved in black and white marble. The larger of the other two courts belongs to the *madrasa*.

The Sidi Abid Mausoleum was the first experience of restoration for the ASM. The monument, like all the other monuments in the Medina, suffered from neglect and lack of maintenance. Arches and columns were de-stabilised. Water seeped through the walls and the timber ceiling. The pavement was in bad condition.

In order to restore the building substantially, part of the walls had to be demolished and then rebuilt with the existing materials. The prayer hall in the first court was planned to be used as an exhibition space. Therefore, the front row had to be heightened and clerestorey windows were installed. After the galleries were structurally restored, the wall tiles were completed with new tiles which were produced locally according to the existing models. New stucco decoration was also prepared according to the examples found in place.

The crumbling pavement of the courtyard was also repaired according to its original design with most of the old marble pieces re-used.

Technical data:

- time span — 36 months spread over a 6 year period
- restored area — 1'700 m^2 on two floors

- cost/m^2 USD 59.5
- materials USD 40'000
- wages USD 60'000
- total cost USD 100'000

Work force:

- 1 foreman
- 1 site master
- 3 masons
- 7 unqualified labourers.

g. The Mausoleum of Sidi "Amor" Abada

Popularly known as the "Mosque of the Swords" the Mausoleum of Sidi "Amor" Abada was built in the 19th Century. Its benefactor Sidi Abada died in 1871 and was buried in the mausoleum. Except for the five plaited domes which cover various rooms of the complex, the *zawiya* of Sidi Abada is not a very interesting building.

Having been employed as a dispensary for a time, the building has fallen into ruin and only a small part of it, comprising two domes totalling 420 m^2 in surface, have been restored by the ASM.

This area is being used as a crafts museum at present, and the remainder of the building awaits restoration.

Technical data:

- time span two years
- restored area 420 m^2/1800 m^2
- cost/m^2 USD 100
- materials USD 22'000
- wages USD 20'000
- total cost USD 42'000

Labour force:

- 1 foreman
- 1 site master
- 2 masons
- 6 labourers.

h. The Mausoleum of Sidi Sahib

The mausoleum dates back to the founding years of the city and reputedly contains the remains of Abu Jamaa al-Balawi, a close companion - *sahib* - of Prophet Mohammad. A substantial part of the present building was rebuilt by Hamouda the Muradite, including the dome of the mausoleum, which was constructed in 1629. Between 1685 and 1690, the minaret and the *madrasa* were erected by Mohammad Bey. It was greatly restored during the 19th Century.

The complex is planned around several courts of various sizes and it is popularly known as the mosque of "Berber". The restoration of the large entrance court, the colonnaded vestibule to the mausoleum court and the mausoleum itself is complete. However, work on the restoration of the *madrasa* is in process.

- Technical data Unavailable
- Labour force Unknown.

i. The Suq of Cisterns

The *suq* of cisterns, so called because of the presence of a series of rain water reservoirs underneath, was built in the 14th Century, at the beginning of the urban renaissance that the city experienced with the advent of the Hafsids. It is an integral part of the commercial and industrial zone of the town centre.

Previously restored during the 18th Century, the market consists of 60 shops which align a street covered by a tunnel vault.

From the 1960's, the market was dis-used and served as storage accommodation. After the consolidation of the walls and the vaults, uniform shop fronts and doors were installed in front of the shop units.

Technical data:

- time span	30 months spread over a period of 3 years
- restored area	1'100 m^2
- cost/m^2	USD 44
- materials	USD 20'000
- salaries	USD 24'000
- total cost	USD 48'000

Work force:

- 1 foreman
- 1 field worker
- 3 masons
- 6 labourers.

j. The Water Basins of the Aghlabids

Built in the 9th Century by Abu Ibrahim Ahmad, son of Mohammed Aghlabid, the larger of these open air water reservoirs is a 48-sided polygon, with a diameter of 128 metres. The smaller basin has 17 sides and its diameter is 37.40 m. Both reservoirs are buttressed from within and without against the force of the collected water, which is brought from Jebel Cherichera, 36 km west of Kairouan.

After careful chemical and organic analyses of the protective coating of the basins, the ancient composition which made this layer was obtained. Thus, the original mixture of hydraulic lime and sand was used once again, to completely waterproof the reservoirs. The whole area was encircled with a protective wall and a gate house, which also serves as a tourist information centre, was built nearby.

The cost for the whole project was USD 140'000.

k. The Ramparts

The existing walls of the Medina of Kairouan were built during the 18th century, roughly following the contours of the adobe walls which were constructed ten years after the destruction of the older walls in 1052.

The existing walls which are in the form of a deformed rectangle 3.2 km long are built with small burnt bricks.

Among several gates of the city, Tunus gate in the north and Bab Jalladin in the south are the most prominent ones.

The ramparts, which were built of bricks and bonded by plain earth, suffered particularly from rising damp. Due to the absence of water proofing at the top of the walls, rain seepage into the walls caused the formation of fissures and cracks as well as heavy efflorescence due to the high percentage of salt in the composition of bricks.

Fissures and cracks were also observed in the vaults of the gates. Cut stone door frames at these points crumbled under pressure and excessive moisture.

After careful and precise measured drawings were established, the restoration of the ramparts was enacted in sections 4 m long and 80 cm high. The depth was decided on site, after judging what thickness would yield the best stability at any particular point. The foundations were usually consolidated against water seepage, with broken pieces of brick and mixed with local lime and hydraulic lime, which also formed an excellent bonding material.

At the top of the walls, a layer of hydraulic lime was laid, over which a coat of white wash of local lime was applied to eliminate the seepage of rain-water into the walls.

The gates, which were crumbling, were dismantled stone by stone and built again with the new, strong mortar. The unusable stones were replaced by new ones.

Technical data:

- time span	36 months in a 10 year period
- restored volume	8'000 m^3
- restored length	1.5 km
- cost/m^2	USD 35
- materials	USD 120'000
- wages	USD 160'000

Work force:

- 1 foreman
- 1 site manager
- 3 masons
- 9 specialised labourers.

V. Technical Assessment

a. *Choice of Materials, Level of Technology*

The restoration interventions in the Medina of Kairouan were carried out according to the guidelines of the Venice Charter and care was shown to retain as much of the original building materials as possible. Local and traditional techniques of construction were also employed.

b. *Ageing and Maintenance Problems*

Compared with the yet un-restored buildings, the restored monuments of the Medina of Kairouan show a good resistance to ageing. However, a certain amount of time is necessary in order to understand the real effects of this latest restoration project. The new mixture of local lime, hydraulic lime and sand as a bounding mortar seems to be particularly successful, since it gives a very strong bond in comparison to traditional mortars. This mortar alone creates good hope for the maintenance of the monuments in future.

VI. Users

a. *Identification of Users*

The restored monuments of the Medina of Kairouan are used by the citizens of the town as well as the tourists who visit the city in ever increasing numbers each year.

The mosques and certain mausoleums, like the revered *zawiya* of Sidi Sahib, are particularly devoted to the use of the local population and Muslims from other countries.

Some of the other restored buildings that have been assigned different functions are also meant for the welfare of the local population, such as the school for deaf and dumb or the ASM centre.

b. *Response to Restoration*

With the increase in local employment due to increased tourist activity, the citizens of Kairouan are very well aware of the value of the restorations, and how they have upgraded their town. In fact they, together with the municipality are willing to fund part of the projects, such as some of the mosques, themselves. Furthermore, recently there is an ever increasing number of applications to the ASM for assistance to restore private houses.

VII. Persons Involved

Administrative and technical staff of the *Association de Sauvegarde de la Médina de Kairouan*:

- Brahim Chabbouh	President, ex-conservator of the Medina of Kairouan.
- Mourad Rammah	General Secretary, Conservator of the Medina of Kairouan.
- Hedi Ben Lahmar	Architect for historical monuments.
- Hassen Jelliti	Project manager.
- Abdelaziz Trabelsi	Project manager.
- Ahmed Gdah	Photographer.
- Abdellatif Guilene	Draftsman.

Yildirim Yavuz
Kairouan, May 1992