

*Archaeological study of the Sidi Ibrahim al-Masmoudi Mosque in
Tlemcen: Analysis of structural challenges and conservation strategies*

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Summary :

The Sidi Ibrahim Al-Masmoudi Mosque in Tlemcen represents a significant monument of Zayyanid architecture, currently facing critical preservation challenges. Structural deterioration, initiated by unstable foundation soil and exacerbated by the high water absorption (>70%) of traditional building materials, led to partial collapse in 1993. Despite restoration efforts (1994-2005), persistent issues including moisture damage, biological growth, and inadequate ventilation continue to threaten the structure's integrity. This condition is further aggravated by insufficient maintenance and environmental factors. Sustainable conservation requires an integrated approach combining urgent technical interventions, systematic maintenance, community engagement, and strengthened protective measures to ensure this cultural heritage is preserved for future generations.

Keywords: Architectural conservation; Cultural heritage; Islamic architecture; Structural deterioration; Sidi Ibrahim Al-Masmoudi; Zayyanid architecture

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I- Introduction :

The city of Tlemcen is of ancient origin, but it did not rise to significance in the annals of history and civilization until the Arabs established their presence there, Islam spread throughout its confines, and its tolerant religion prevailed across its realms.

The primary reason for its renown is its strategic geographical location, which made it a vital link between the eastern and western regions of North Africa on one hand, and between the Mediterranean Basin and the lands of the Sahara on the other. Thus, for centuries, it served as an important commercial center, its bounties and springs making it a city that did not rely on other regions for grains, livestock, vegetables, or fruit. The second reason for its fame is that God endowed it with conscious kings and princes who cared for its development and cultivation. (Al-Tammar, 1985, p. 267)

In addition to the character of the Tlemcenian people at that time and the breadth of their circumstances, one would find a Tlemcenian only as a merchant, craftsman, student of knowledge, teacher, or a soldier in the army defending his homeland. Its crafts reached completion, and crafts only reach completion with the maturity and abundance of civilizational development (Ibn Khaldun, n.d., p. 349).

Among the city's prosperous eras, we mention the Zayyanid period, which lasted for approximately 328 years, from 635 AH / 1235 CE until 963 AH / 1554 CE, during which it was a major center of science and politics in the Islamic world.

Nestled within the storied fabric of ancient Tlemcen, a city that whispers tales of a glorious past, stand enduring civilizational monuments that speak to the zenith of Western Islamic history. At the heart of this city, the Sidi Ibrahim Al-Masmoudi Mosque rises with the solemn dignity of its centuries, a testament to the grandeur of Zayyanid architecture that masterfully blended authenticity and innovation. Commissioned in 763 AH / 1362 CE by Sultan Abu Hammu Musa II, this architectural edifice was conceived not merely as a place of worship but as a radiant center of knowledge and learning within the religious complex of the Al-Ya'qubiyya Madrasa.

However, this historic monument, which has withstood the ravages of time for centuries, now faces existential challenges that threaten its very survival. Since the early 1990s, signs of structural fatigue began to manifest, culminating in successive collapses of its primary elements, peaking with the fall of central piers and the roof in 1993. The roots of this problem lie in a complex interplay of historical and geotechnical factors, most notably the mosque's construction on unstable backfill, the deterioration of its traditional building materials due to moisture, and their high water absorption rates exceeding 70%, compounded by neglect and a lack of periodic maintenance.

Despite the extraordinary efforts undertaken by a team of experts and engineers between 1994 and 2005, which included soil stabilization, foundation grouting, and

structural reinforcement, the mosque continues to suffer from persistent issues. Insidious moisture permeates its walls, mold spreads in its corners, the ventilation in the prayer hall remains inefficient, while drainage systems falter and leaks persist in the ablution facilities' networks.

How, then, can this civilizational heritage be saved from oblivion? What technical and administrative solutions are capable of safeguarding it for future generations? This study seeks to answer these questions through a precise diagnosis of the mosque's condition, proposing a comprehensive, practical plan that integrates urgent interventions with sustainable solutions, in an endeavor to preserve the memory of a place that has, for centuries, served as a beacon of knowledge, a landmark of identity, and the living soul of Tlemcen.

II– Archaeological study of the Sidi Ibrahim al-Masmoudi Mosque:

II .1. The Geographical and Astronomical Location of the City of Tlemcen:

Tlemcen is among the finest cities of North Africa, as described by most scholars and travelers (Zaydān, n.d, p. 95), because it lies at the crossroads of main routes. Anyone traveling to the Far Maghreb coming from the East, Tunisia, and central Algeria, or leaving it heading to Marrakesh and Fez, must pass through Tlemcen and stay there, even if briefly.

On the other hand, those coming from the European continent, especially from Al-Andalus on the opposite shore via the sea, or travelers from the Sahara and Sudan, must also pass through it and make a stop. This excellent location made Tlemcen, especially during the Middle Ages, an important center for war, trade, and tourism. (Shawsh, p. 29)

Tlemcen stretches across a location surrounded on all sides; this characteristic allowed the city to develop excellently (Bouali, 1984, p. 39). It lies at the foot of a mountain that protects it from the south, making it, as described by Yahya Ibn Khaldun, like a young bride in her bed (George & William, 1903, p. 7).

The province of Tlemcen is located in the far west of Algeria, in the western region. It is bordered to the north by the Mediterranean Sea and the province of Aïn Témouchent, to the south by the province of Naâma, to the east by the province of Sidi Bel Abbès, and to the west by the city of Oujda (Far Maghreb). It spans an area of approximately 9,020 km². Astronomically, it is located at longitude 1° 28' West, and between latitudes 34° 53' and 35° 15' North (see Plate 01).

As for the city of Tlemcen, it is bordered to the south by the Lalla Setti Plateau, to the north by the plains of the city and the district of Chetouane, to the west by the ruins of the Marinid city of El-Mansoura, and to the east by the heights of the village of El-Abad. Astronomically, the city is located at longitude 1° 28' West and latitude 34° 53' North.

The city is about 160 km from the city of Oran, and about 600 km from Algiers. It sits at an elevation of approximately 827 meters above sea level and is about 60 kilometers away from the sea, which can be seen on clear days from the mountains overlooking Tlemcen, especially towards the island of Rachgoun. The city of Tlemcen is situated among a group of mountains that protect it from the Simoom winds coming from the Sahara and the Sirocco winds arriving from the west. The elevation of the city center specifically is about 810 meters above sea level at the Great Mosque.

The Historical Development of the City of Tlemcen:

It is difficult to determine who originally founded the city of Tlemcen, just as we do not know precisely who gave it its name or the exact time period of its initial establishment.

Tlemcen holds a significant historical stature in Algeria and the entire Islamic world. Various nations and peoples successively ruled over the region or city of Tlemcen, beginning with the prehistoric era, in which it had a share, as evidenced particularly by the stone industries found, most notably at the site of Al-Mawilihi in Maghnia. Subsequently, we can mention the Berbers, who built the core of the old city there. (George, Tlemcen In Encyclopédie de l'Islam., 1889, p. 65)

During the Roman era, at the time of the Roman state's takeover of North Africa, Tlemcen was a military center and fortress. The Romans established a famous aqueduct there (Yahyā, 1980, p. 11), and it is likely that they ruled the city until the last quarter of the 5th century CE (Acc), up until the arrival of the Islamic conquests in 55 AH / 675 CE, led by Abu al-Muhajir Dinar, the Mawla (client) of Muslimah bin Mukhallad al-Ansari, the Caliph Mu'awiyah's governor over Egypt and Ifriqiya (Shawsh, p. 53).

In the Islamic period, rule over Tlemcen passed successively through several kings and different dynasties, listed here in order: the period of various dynasties, including the Almoravids, the Almohads, the Zayyanids, the Marinids, followed by the period of Ottoman rule after the Spanish expansion along the Oranese coast. After the Turks, the region experienced a power vacuum until the allegiance to Emir Abdelkader as the ruler of the region. This was followed by the French colonial period until independence and the restoration of national sovereignty.

II .2. The Concept of a Historic Building

A historic building refers to all architectural and urban remains inherited from past eras, such as ancient cities, their ruins, or some of their surviving neighborhoods and marketplaces. These monuments and relics constitute a vital aspect of cultural heritage. This heritage is considered a link between a nation and its past, and a source of its pride and identity, in addition to its importance and benefits from political, cultural, and scientific perspectives. (El Rihawi, 1979, p. 8)

For example, Syrian legislation provided a precise and comprehensive definition of a historic building, considering it any monument whose construction dates back 200 years and which possesses distinctive historical, artistic, or national characteristics. (Legislative Decree No 222 pertaining to Material Heritage., 1963)

The contemporary concept of a historic building is based on the Venice Charter of 1964, particularly Article 1, which stated that the concept of a historic building includes not only the individual architectural work but also the urban or rural setting that bears witness to a specific civilization, a significant development, or a particular historical event. This applies not only to great works of art but also to more modest historic works that have acquired cultural significance over time.

II .3. Sidi Ibrahim Al-Masmoudi Mosque:

A. Location:

Sidi Ibrahim Al-Masmoudi Mosque is located approximately in the center of the city of Tlemcen, in its western part (see Plan 01). It is bounded to the east by the Ibn Al-Khamis neighborhood, which separates it from the Central Cultural Center. Its other three sides (west, north, and south) are adjacent to residential clusters and somewhat narrow alleys, with the mosque being directly attached only to its northern side. The mosque is part of a religious complex known as the Al-Ya'qubiyya Madrasa (Ibn Maryam, 1908, p. 83) (His) (Yahyā, 1980, p. 104), of which only the mausoleum and the mosque remain today. The total area of the complex is approximately 2000 m².

The madrasa was demolished during the colonial period, around the same time as the Tashfiniyya Madrasa in 1870 (Lachachi). Most historians mention that the complex followed the Egyptian methodology in its construction, commissioned by Abu Hammu Musa II, with all its elements situated within an enclosure surrounded by gardens (George & William, The Arab Monuments of Tlemcen, 1903, p. 302).



Figure 1: Location of the Sidi Ibrahim Al-Masmoudi Mosque within the city of Tlemcen.

B. Historical Background:

The mosque is located in the southeastern part of the aforementioned religious complex. Al-Tanasi noted that Abu Hammu Musa II was a patron of science who held scholars in high esteem. The Sharifian scholar Al-Tilimsani (Al-Tansi, 1985, p. 179) visited his court, and in response, the Sultan built for him a Zawiya (Sufi lodge), a madrasa, and a mosque in 763 AH / 1362 CE (Hajjiyat, 1982, p. 181). Approximately eighty years after the establishment of the complex, the mosque later acquired the name of the pious saint, Sidi Ibrahim Al-Masmoudi. The mosque has been described as a pinnacle of beauty and artistic decoration throughout various historical periods, owing largely to its central location within the Zayyanid city of Tlemcen. For instance, Bergès reported that in 1846, he saw near the mosque a massive entrance made of carved and painted brick (Bargès, 1859, p. 391), with a horseshoe arch opening inscribed with the first three verses of Surat Al-Nasr.

C. Description of the Mosque:

Historians note that Abu Hammu Musa II ordered the construction of a wide range of religious facilities in the northwestern part of the "Mashwar" (royal citadel), a project which took many years to complete. (Yahyā, 1980, p. 104)

C-1. External Description:

The design of Sidi Ibrahim Al-Masmudi Mosque differs from other Zayyanid mosques, showing instead the influence of Marinid architecture following the Marinid siege of Tlemcen. Externally, the mosque presents an elongated form. Its southern side is enclosed by a fence and a wall, while its northern side has been fitted with new ablution facilities. The mosque has lost much of its external decorative elements due to multiple restoration campaigns (Georges, 2003, p. 87). Its minaret is located in the northwestern corner; its dimensions are moderate, and it does not reach the grandeur of the Zayyanid minarets constructed in the city.

There is significant disagreement regarding the construction date of the minaret of Sidi Ibrahim Al-Masmoudi Mosque; some researchers find it difficult to attribute the foundation date of this minaret to the era of Abu Hammu Musa II, a period distinguished by progress in various arts, especially architecture. According to them, it is more likely that the minaret was added during the final years of the Zayyanid state or the Ottoman period (Georges, William, & Marçais, *Manual of Muslim Art: L'Architecture (Tunisie, Algérie, Maroc, Espagne, Sicile)*, 1907, p. 524). The minaret was built with brick, standing 16.55 m tall with a base side length of 4 m (Bourouiba, 1983, p. 276).



Figure 2 : The Courtyard of Sidi Ibrahim Al-Masmoudi Mosque, Tlemcen

Externally, the minaret is divided into two main sections:

- a) The Shaft: 13.75 m in height, divided into two bands of decorative tilework.
- b) The Lantern: Reaches a height of 4.70 m with a base width of 1.42 m. It is almost devoid of decoration.

The shaft is surmounted by a parapet wall 1.56 m in height and 0.42 m thick, crowned with merlons measuring 0.76 m in height, with a base width of 0.53 m tapering to 0.16 m at the top.



Figure 3 : External view of the minaret of Sidi Ibrahim Al-Masmoudi Mosque.

C-2. Entrances:

Access to the mosque is provided through three wooden doors:

A side door in the eastern wall, dimensions 1.96m x 0.52m.

A main door opening onto the courtyard (sahn) on the northern side, dimensions 2.15m x 1.95m.

A third door opposite the first door in the western wall, sharing the same dimensions (see figure4).

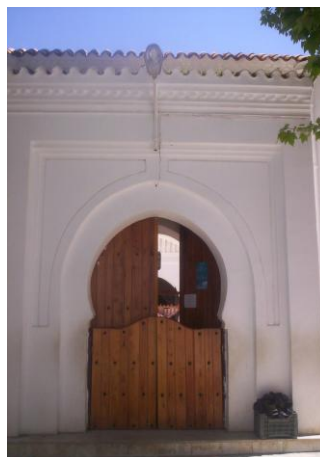


figure4: The western Entrance (Third Entrance)

C-3. Internal Description:

The prayer hall of Sidi Ibrahim Al-Masmoudi Mosque has a rectangular plan, elongated in form, with dimensions of 19.20m x 15.40m, covering an area of 295.68 m². This hall is divided into four aisles (parallel to the qibla wall) and five bays

(perpendicular to the qibla wall), following the same plan layout as Marinid mosques built during the same period (e.g., Sidi Abu Madyan Mosque and Sidi Al-Halwi Mosque) (see figure 5).

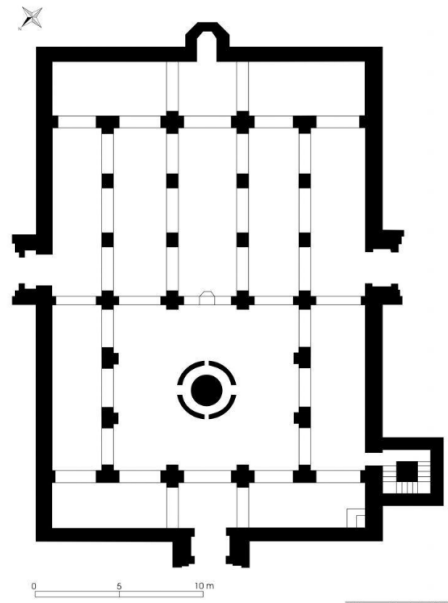


figure 5: General Layout Plan of Sidi Ibrahim Al-Masmudi Mosque.

The structural support system of the prayer hall relies on piers, which vary in shape (square, cruciform, and chamfered corners), with a total of 24 piers. These piers support broken arches (see Plate 04), forming a series of intersecting arcades. These architectural elements are largely devoid of decoration. Regarding the roofing, the prayer hall is covered with gabled roofs, except for the two side aisles, which have been replaced with cross-vaults, leading researchers to hypothesize significant modifications to the structure. (Bessenoussi, 1990, p. 276)



Figure 6: The System of Arches and Columns (Arcade System)

Sidi Ibrahim Al-Masmoudi Mosque features a spacious rectangular courtyard (sahn) measuring 10m x 11.20m, covering an area of 112 m². It is surrounded by single-aisle arcades (riwaqs) on the eastern and western sides, which represent extensions of

the two side aisles of the prayer hall, and a single riwaq at the rear. A square-shaped ablution fountain is located in the center of this open courtyard.

The mihrab (prayer niche) of the prayer hall is a recessed opening with the following dimensions: depth 1.16m, width 1.64m, height 1.92m. It is flanked by two projections, each 0.28m wide. The mihrab is crowned by a decorated semi-dome and is adorned with diverse motifs (floral, epigraphic, geometric). Above the mihrab runs a decorative frieze of varied themes, consisting of three closed rosettes in addition to stucco decorations.



Figure 7: The Mihrab of Sidi Ibrahim Al-Masmoudi Mosque

To the right of the mihrab is the opening for the minbar (pulpit), 0.98m wide. To the left is a door leading to a rectangular chamber (width 1m), which in turn leads via another door to the outside of the mosque on the eastern side.

Internally, the minaret consists of a central core with a side length of 2.20m and a width of 1.40m. A staircase winding around this core provides access to the top of the minaret, comprising 60 steps in total, with approximately 4 steps per revolution; each step is 0.79m long. This minaret features ventilation openings.

Notably, the prayer hall contains a dome incorporating four open and three closed oculi. The transition to the dome is achieved using four corner squinches at the first level.

II .4. Building Materials and Techniques in Tlemcen's Religious Monuments

A. Building Materials

A1. Brick: This was the most commonly used building material. Its widespread adoption is attributed to its ease of use, especially in complex structural elements like domes, arches, and vaults, as well as its low cost and the local availability of its raw

materials. It also served as an effective thermal insulator. In the Maghreb, this material was known as fired brick. Its primary raw material is clay, which was shaped in molds and then fired in kilns. Its use is clearly visible in minarets, with application techniques varying from one location to another, as will be discussed later. Bricks were also used for paving floors, as observed in the floors of the Sidi Ibrahim Al-Masmudi Mosque. Their dimensions were standardized at 0.25m x 0.12m x 0.04m.

A2. Pisé (Rammed Earth): This material was widely used, particularly in the external walls of mosques. It consists of a mixture of clayey or limey earth, small stones, or pottery fragments, stabilized with the addition of lime. This material was identified, for instance, in the western wall of the Sidi Ibrahim Al-Masmudi Mosque.

A3. Stone: Stone was not extensively used in the studied monuments, except within foundations, as observed in the mosque's substructure.

A4. Roof Tiles: These semi-cylindrical tiles were predominantly used for roofing, a feature noted in the roof of the Sidi Ibrahim Al-Masmudi Mosque.

A5. Mortar: Mortar is a mixture of earth, sand, and lime. Ibn Khaldun described it as follows: "...Among them [building methods] is construction with hewn stones, with which walls are erected, joined one to another with clay and lime which binds with them, becoming as if they were a single body..." (Abd al-Rahman, 1961, p. 726)

A6. Wood: Wood had diverse applications, playing a fundamental role in roofing structures and also serving as a support for elements above it. In addition to wood, other materials like copper (used for the finial of the Sidi Ibrahim Al-Masmudi Mosque's minaret) and iron (for structural reinforcement) were also employed.

B. Building Techniques

The construction techniques observed in the studied monuments of Tlemcen were varied:

B1. Rammed Earth (Pisé) Technique: Abd al-Rahman Ibn Khaldun summarized this method, which he called "Al-Tabiya". He stated that it involves using two wooden planks of specific dimensions, erected on a foundation. The space between them is filled with a mixture of earth and lime, which is then compacted with rammers until it becomes a homogenous mass. The planks are then repositioned higher, and the process is repeated course by course until the entire wall is complete. (Abd al-Rahman, 1961, pp. 726- 727)

B2. Vertical Brickwork Technique: This technique relies on bricks and mortar, with vertical and horizontal brick courses bonded together lengthwise with mortar. This method is found in walls and minarets.

B3. Alternating Course Technique: This involves using bricks alternated with other materials, the most important of which was stone.

B4. Composite Technique: This is a fusion of two techniques. First, the structure is built using the vertical brickwork technique. Upon reaching a certain height, the mason constructs an arch without using centering, making it appear integrated into the wall. This technique also provided a form of decoration, as seen in the minaret of the Sidi Ibrahim Al-Masmudi Mosque.

B5. Arch Construction Technique: Arch construction begins with building the supporting elements. The first step involves laying bricks horizontally to form the springers. A wooden centering is then placed across the arch's span. From this, a triangular form is established. The space between this triangle and the intended intrados of the arch is filled with a mixture of brick fragments and mortar until the arch's curvature is achieved. The final bricks are then laid, relying on a central keystone. Once the arch has set, the wooden centering is removed. This technique was used for constructing all types of arches.

B6. Lengthwise and Crosswise Brick Placement Technique: Also known as the "Adiya wa Shnawi" technique, this method involves placing bricks according to the desired pattern. It was used especially for constructing piers of various shapes (rectangular, square, cruciform, chamfered). (Labtar, 2007, pp. 61-64)

II .5.. Major Restoration Interventions at the Mosque:

The most significant transformative interventions that affected the mosque are poorly documented, despite substantial evidence of their occurrence, particularly during the colonial period, as attested by French sources themselves. Most Orientalist historians provided detailed descriptions of the mosque prior to these "modification" works.

The first major intervention occurred in 1870, involving the removal of a chamber (maqsura), the existence of which is confirmed by topographical maps of the city dated 13/01/1851. Additionally, the roof was originally flat externally and covered with tile paving, as confirmed by the engineer Duteux in his 1870 description of the mosque. Significant damage also occurred in recent years, particularly in mid-1992, following the deterioration of its primary structures. On May 21, 1993, two central piers collapsed, pulling a third pier with them, followed by the collapse of the roof, which had lost its supporting pillars. In response, local authorities undertook emergency rescue interventions, consisting of three main actions: (Oulebsir, 2004, pp. 195-200)

Metal cladding/encirclement of the piers (cerclage métallique).

Reinforcing the arches with iron braces, supporting them with straight metal legs, and filling the voids with a lime-based mixture.

Removing the earthen fill (consisting of debris and soil) from the roof and replacing it with metal sheeting to prevent water infiltration, These operations were

carried out by a design office under the direction of the architect Abdelkader Ben Osman (Tlemcen).

Subsequently, the monument underwent extensive restoration work from 1994 until 2005, covering all parts of the mosque and extending to the mausoleum. Additionally, ablution facilities were added separately to the north of the mosque, some doors were closed off, and two rooms located between the mausoleum and the mosque were removed, according to the restoration plans.

Perhaps the most substantial restoration involved reinforcing the mosque's foundations using reinforced concrete beams extending down to the stable, undisturbed ground (virgin soil).

II .6. Diagnosis of Damage to the Mosque:

Collective investigations and analyses have allowed for an understanding of the damage afflicting the mosque. The primary cause is the loss of equilibrium and compatibility between the building materials (rammed earth, brick, timber, mortar) due to their high water absorption rates, exceeding 70%. This is particularly critical for the foundations, composed mainly of rammed earth (pisé), and the mortar between the bricks. This has rendered them a collection of individual blocks loosely connected to one another, exacerbated by the peeling of the protective coating from the top of the foundations up to the base of the walls. Furthermore, the ground has become unstable due to rising groundwater caused by capillary action.

The following table summarizes key material properties:

Material	Description	Resistance to Moisture	Water Absorption
Brick	Varied colors, dimensions 26x12x13.5 cm. Rough on one side, smooth on the other.	Resistance estimated at: 75 bar (dry) 60 bar (wet)	20% to 30% (higher than normal brick standards). Water release process takes 35 hours.
Rammed Earth	Known as pisé or tabiya.	Resistance estimated at: > 75 bar (initially high)	Absorbs water significantly due to organic content, leading to loss of cohesion.

Material	Description	Resistance to Moisture	Water Absorption
Mortar	Composed of sandy granules (25%) with a clayey base.	Loses cohesive properties due to moisture and capillary action.	High absorption rate, estimated at 69%.

Field observations indicate an unbalanced distribution of loads between the load-bearing elements, resulting from the continuous settling of the ground. This is attributed to the recent drought periods experienced in Tlemcen. Given that the monument is built on deep fill material (as mentioned earlier, 5.50m to 8m deep) with high groundwater presence, the drying out of this fill has caused the shrinkage of its layers, consequently leading to soil deformation and ground subsidence.

III- Results and discussion :

III .1. The Restoration of Sidi Ibrahim Al-Masmudi Mosque:

The restoration of Sidi Ibrahim Al-Masmudi Mosque was one of the most difficult and extensive restoration operations witnessed in Tlemcen. In the 1990s, no one could have imagined that the structure would survive the severe ruin and the repeated collapse of its parts that began in 1992.

As mentioned previously, the mosque is built on a foundation of backfill, meaning the ground is unstable. This indicates that the mosque is subject to movement, which reached a rate of 25% at the springing of the vaults, while at the roof level it was estimated at 0.18m horizontally. (Culture, dn, pp. 54-58)

Additionally, significant transformations occurred in the materials, causing them to lose their mechanical properties due to changes in their structure.

Consequently, an unbalanced distribution of loads between the load-bearing elements is observed. This necessity prompted the restoration team, led by a group of professors from the Faculty of Engineering, notably Professor Ghemmari Fouad, Professor Megnounif, and Architect Ben Osmane Abdelkader, to search for the most effective solution. This involved stabilizing the ground and injecting additional foundations down to the stable bedrock. Although the work was highly complex, the results are clear and evident today in terms of the overall structural integrity.

However, the damage we observe today on the mosque is primarily due to neglect, a lack of periodic maintenance, and a general public unawareness of the importance of preserving material heritage. This is compounded by the authorities' delay in implementing a strict policy for the management of these immortal historic monuments that bear witness to important historical eras in the city. The current damage observed at the Sidi Ibrahim Mosque primarily consists of atmospheric and visual pollution, particularly issues related to humidity.

III.2. Proposed Interventions for Sidi Ibrahim Al-Masmoudi Mosque:

The most urgent task is to remove the door of the minaret to allow for better ventilation. This door could be kept open for as long as possible, though this is unlikely due to fears of worshippers climbing onto the minaret's roof. A solution would be to replace this door with a perforated one, a grille, or a barred door to allow for air renewal and circulation.

Repainting the previously indicated damaged areas with new paint that allows the walls to breathe.

Removing the bitumen placed on the minaret's roof.

Periodically cleaning all areas affected by mold.

Re-cleaning the rainwater drainage channels and adding additional downpipes at various levels of the roof.

Another proposal, recorded following a request from the Imam of the mosque, is to study the possibility of opening windows in the eastern and western walls of the prayer hall to allow for better ventilation inside the mosque.

Regarding the ablution facilities, the best solution is to re-examine the supply and sewage pipes for leaks. As for the excessive use of water, we recommend placing informative signs and posters encouraging reasonable use, based on the principle that our Islamic religion forbids wastefulness.

The final point is to find a solution for the open, unused space on the minaret's external facade and to reuse the discarded building materials inside it, which require cleaning operations.

IV- Conclusion:

Following this scientific and archaeological journey into the depths of the history of one of Tlemcen's architectural landmarks, we can conclude that rescuing the Sidi Ibrahim Al-Masmoudi Mosque is not merely a conventional restoration process, but rather a comprehensive civilizational project. Technical solutions alone—such as reinforcing foundations and improving ventilation—will not suffice without being accompanied by serious administrative and awareness-raising measures.

The future of this historic edifice depends on adopting a holistic vision that integrates:

Urgent interventions, such as addressing humidity and improving ventilation.

Regular periodic maintenance according to a defined schedule.

Community awareness regarding the importance of architectural heritage.

Protective legislation for historical monuments.

Only through this integrated approach can we ensure the sound transmission of this civilizational heritage to future generations. Thus, the Sidi Ibrahim Al-Masmudi Mosque will remain an eternal testament to the genius of its location and the splendor of Islamic architecture in Algeria, as well as a source of inspiration for those interested in architectural heritage throughout the world.

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