THE ARCHITECTURE OF MOSQUES AND THE COVID-19 PANDEMIC

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1. Introduction

The architectural typology of the mosques of Algeria and elsewhere is a timeless subject. This issue is continually being investigated, and most often regards historical mosques. However, our research focuses on those mosques built by religious associations.

Senhadji Dalila [1] has worked on this issue in Oran where she has highlighted random architectural models (i.e. they do not correspond to criteria of Islamic architecture) because of the ambiguity of the legislation. The 2013 decree which came into force clearly states that the Maghrebian architecture for mosques should be adapted and was supposed to fill the gaps existing in the 1991 decree.

Article number 26 of the 2013 decree[1] stipulated the elaboration of a standardised rulebook relating to the construction model to be used for building mosques and was a common decision made by three ministries, the Ministry of the Interior and local authorities, the Ministry for Religious Affairs and waqfs[2] and the Ministry of Housing. This rulebook should help to fill the gaps in the legislation regarding architectural typology, but is difficult to achieve given the vast territory, and the regional and local specificities of historical, climatic and social pattern in the country. In other terms, mosques in the south of Algeria are unlike those in the north. But today, they are subject to the same legislation in terms of construction and architectural typology.

In this study, we opted to focus on mosques in the vicinity of the wilaya[3] of El Oued[4] whose town centre is called One Thousand Cupolas, and where many typologies, mostly built and financed by religious associations, have been observed. The name symbolizes a specific architectural characteristic where the roofs are

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replaced by vaults and cupolas that cover the buildings [2]. In the historical neighbourhoods of Zgoum, Guemar and El Oued [2], the vernacular buildings are characterized by the classical Maghrebian model of houses where various rooms are situated around the inner courtyard. They were built in accordance with the climatic conditions[5] and local culture of the place. Unlike the vernacular houses, there is no courtyard in the historic mosque of Sidi Messaoud[6] which dates back to the end of the 16th century.

We first observed the absence of the inner courtyard or *sahn*[7] in recent mosques and the existence of another courtyard. The paradox in relation to the traditional houses lies in: first, the absence of the courtyard named the *sahn* in the mosques of El Oued; second, the existence of another component, an outer courtyard which played a fundamental role in health measures during the global Covid-19 pandemic.

Therefore, the added value of our research, regarding the typology of mosques built by religious associations and the gaps related to current legislation concerning the construction of mosques, revolves around the particular architectural component – the outer courtyard – in managing health crises like COVID-19.

2. Mosques and the COVID-19 pandemic

In Algeria, the law[8] groups mosques into six categories. The first two categories are the Great Mosque of Algiers and the historical mosques. The remaining four categories are classified according to two important factors: the number of worshippers and the area surrounding the mosques. Thus, the main mosques receive more than ten thousand worshippers, the national mosques more than a thousand worshippers, while the local and neighbourhood mosques less than a thousand.

But the COVID-19 pandemic and its unexpected effects have shown the important role that the established capacity of mosques can play, as stipulated in current legislation. Thus, the Algerian government was compelled by such preventive measures, like other countries, to close all mosques nationally on February 17, 2020. However, as the health crisis eased and on the basis of the capacity factor, a first decision to partially reopen mosques was made on August 15, 2020 [9]. Only mosques with a capacity of more than a thousand worshippers were allowed to open. A second decision was then made, dated December 2, 2020[10], to reopen mosques with a capacity of five hundred worshippers or more, until finally all mosques reopened on February 14, 2021[11]. The COVID-19 pandemic contributed to the creation of a new category of five hundred worshippers or more.

The second factor of classification requires spaces adjacent to mosques to be used as follows: local mosques must have one or two Quranic classrooms and a house, while the national and main mosques must have a Quranic school, a conference room and spaces for cultural activities.

Decisions made in response to the spread of COVID-19 have also affected such spaces. For example, ablution facilities have been closed for a long time[12], but the pandemic has revealed the importance of the use of the outdoor spaces. In the case of places of worship, the World Health Organisation [3] has recommended that any gathering taking place during prayers should preferably be in an outdoor space.

The WHO also recommended keeping a physical distance between worshippers, with fixed seating, managing the number and flow of people at the entrance and exit, as well as inside the places of worship. This situation necessarily calls for an outdoor space. In the context of the pandemic, it reminded us that an outdoor space (i.e. an outer courtyard) already exists in the mosques of El Oued that have been built and financed by the religious associations there. This outdoor space is different from the typical courtyard that is also found under the name of *sahn*. It occupies an important status in the practice of worship and is usually used during the summer for night prayers, and in the winter for day prayers. When the mosques were reopened during the pandemic, people continued using the outer courtyard for their prayers.

3. An outer courtyard or a second courtyard

Does the outer courtyard of El Oued mosques qualify as a second courtyard?

Did this courtyard originate in mosques in the course of the history of Islamic architecture?

Did it ever exist in historical mosques in Algeria?

In order to be able to provide an adequate answer, this research focused on the presence of courtyards in the history of Islamic architecture.

4. The origin of the courtyard in Islamic history and historical mosques in Algeria

Islam originated in a hot climate where it rarely rains hence it was natural to perform prayers in the open air. The first mosque of Medina had a simple courtyard with a surrounding wall. It was a model for many of the mosques that were built later on. The mosque at that time was also a place of political and religious decision-making from where everything was managed.

In the Maghreb or south of the Mediterranean and in the Middle East, the courtyard allowed the reception of a number of worshippers to participate in the Friday prayer and religious festivals when the temperature was moderate but when the heat and light caused discomfort there would be fewer worshippers or none at all in the courtyard because they moved indoors to avoid the sun and heat [4]. In most western Islamic mosques, the courtyard was an appendage and generally smaller than the covered space [4]. In some cold regions, prayers are performed in covered rooms for almost the whole year. In the Ottoman Empire, for example, there was an inner courtyard, but the prayer hall had direct access from the outer space. The courtyard was more of a cultural element [4]. In short, the design of a mosque with or without a courtyard depends on two essential elements: climate and culture [5] .

The Islamic dynasties that passed through Algeria left many examples of historical mosques across several regions. We focused on the *sahn* or inner courtyard and outer courtyard in mosques which were selected so as to cover many regions and list as many dynasties as possible over different periods of time. Examples are represented in Table 1.

Table 1. Courtyards in Algerian historical mosques (source: [6]*)*

Mosque	Period	Dynasty	Inner courtyard	Inner courtyard shape	Outer courtyard	Outer courtyard shape
ALGER						
The Great Mosque of Algiers	1096	Almoravid	●	rectangular		
Djamaa Safir	1535	Ottoman				
Ali Betchine	1622	Ottoman				
Djamaa Jdid	1660	Ottoman				
Ketchaoua	1794	Ottoman				
TLEMCEN						
The Great Mosque of Tlemcen	1136	Almoravid	●	square		
Sidi Belhcen	1296	Zayyanid				
Mansourah	1303-1336	Marinid	●	square		
Sidi Boumediene	1339	Marinid	●	rectangular		
Sidi Haloui	1353	Marinid	●	square		
Agadir	1364	Idrisid				
Sidi Brahim	13 C	Zayyanid	●	square	●	irregular
CONSTANTINE						
Great Mosque of Constantine	1136-1137	Hammadid	●	square		
Souk El Ghezel	1730	Ottoman				
Sidi Lakhdar	1743	Ottoman				
ORAN						
Pacha	1792-1799	Ottoman	●	semi-circle		
GHARDAÏA						
The Old Mosque of Ghardaïa	1048	Ibadites				
The Great Mosque Bennoura	1349	Ibadites			●	irregular
The Funeral mosque of Bâba Waldjimma		Ibadites			●	irregular
Beni Isguen	1321-1347	Ibadites	●	rectangular inclined		
Guerrara		Ibadites	●	rectangular inclined		
ANNABA						
Abi Merwane	1033	Zirid	●	rectangular		
Saleh Bey	1792	Ottoman	●	irregular		
MASCARA						
Great Mosque D'Ain Beida	1780	Ottoman	●	rectangular		
BISKRA						
Sidi Okba	686					
Sidi Mabrouk	1628	Hafsid	●	square		
EL OUED						
El Adouani	13 C				●	irregular
Sidi Messaoud	1600					

● Presence of architectural elements

The table revealed five categories of mosques in Algeria.

- Mosques with neither an inner courtyard nor an outer courtyard.
- Mosques with only an inner courtyard of various shape: square, rectangular (Figures 1A and B), semi-circle or irregular (Figures 2A and B).

- Patio and outer courtyard; the example of the great mosque Bounoura (Figure 3A).
- Mosques with an inner courtyard and an outer courtyard, such as Sidi Brahim Mosque (Figure 3B).
- Mosques with only outer courtyards, such as the El Adouani and Baba Waldjimma Funerary Mosque (Figure 4).

From Table 1 it is therefore clear that the outer courtyard existed mainly in the South of Algeria.

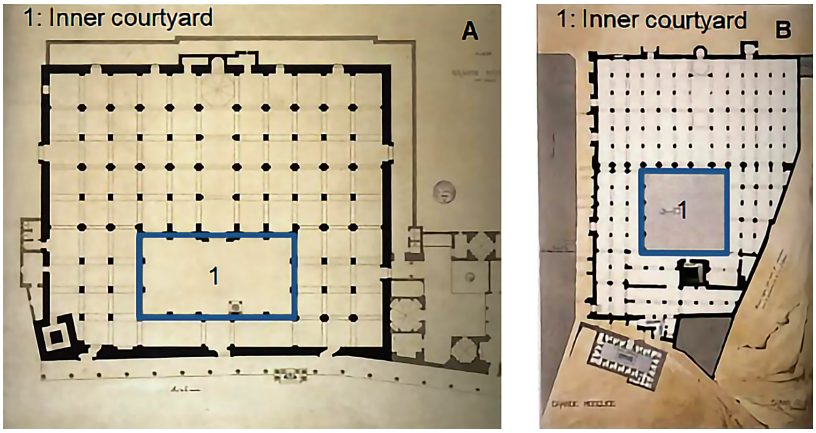


Figure 1. A) The Great Mosque of Algiers; B) The Great Mosque of Tlemcen (source: Ahmed Koumas; Chéhrazad Nafa [7]*)*

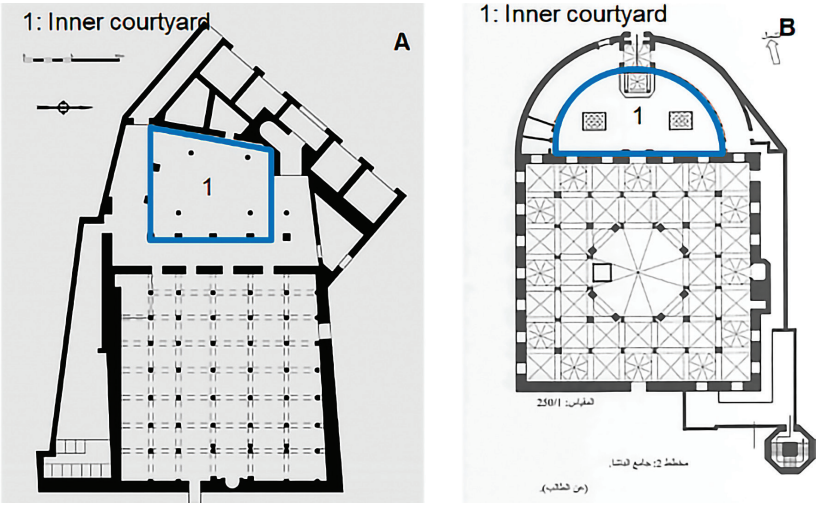


Figure 2. A) The Great Mosque of Constantine; B) Mosque of Pacha (source: Ali Boutchicha [8]*)*

2: Outer courtyard

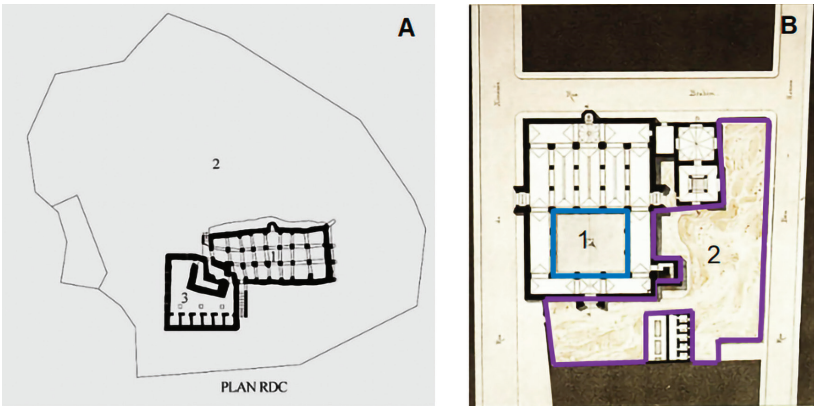


Figure 3. A) The Great Mosque Bounoura, Ghardaia (source: [9]*); B) Mosque of Sidi Brahim, Tlemcen (source: Ahmed Koumas; Chéhrazad Nafa).*

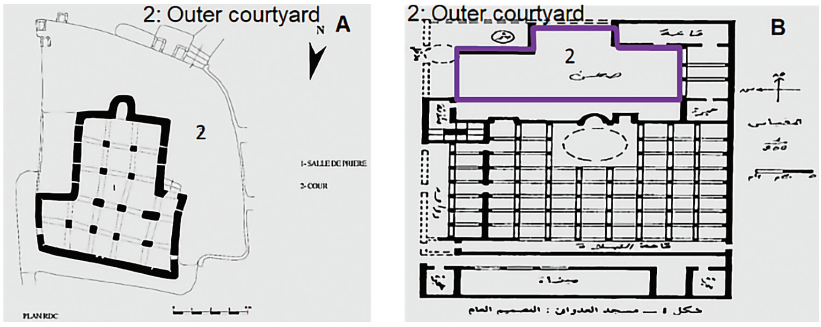


Figure 4. A) The Funeral Mosque of Bâba Waldjimma, Ghardaia (source: Houda Ben Younes); B) Mosque El Adouni, El Oued (Abd Elaziz Chahbi [10] *)*

5. The studied area

The existence of an inner courtyard and an outer courtyard was highlighted in the previous paragraph. To try to better understand this component – the outer courtyard – and the role it played in managing the COVID-19 pandemic, we worked on the mosques built and financed by religious associations in El Oued and its surroundings (Figure 5). We asked the following questions:

– Do all mosques have an outer courtyard?
– What is the area of the outer courtyard? Is this area proportional to that of the mosque?

– What are the similarities and differences between these outer courtyards in terms of location?
– What role did this outer courtyard play during and after the pandemic?

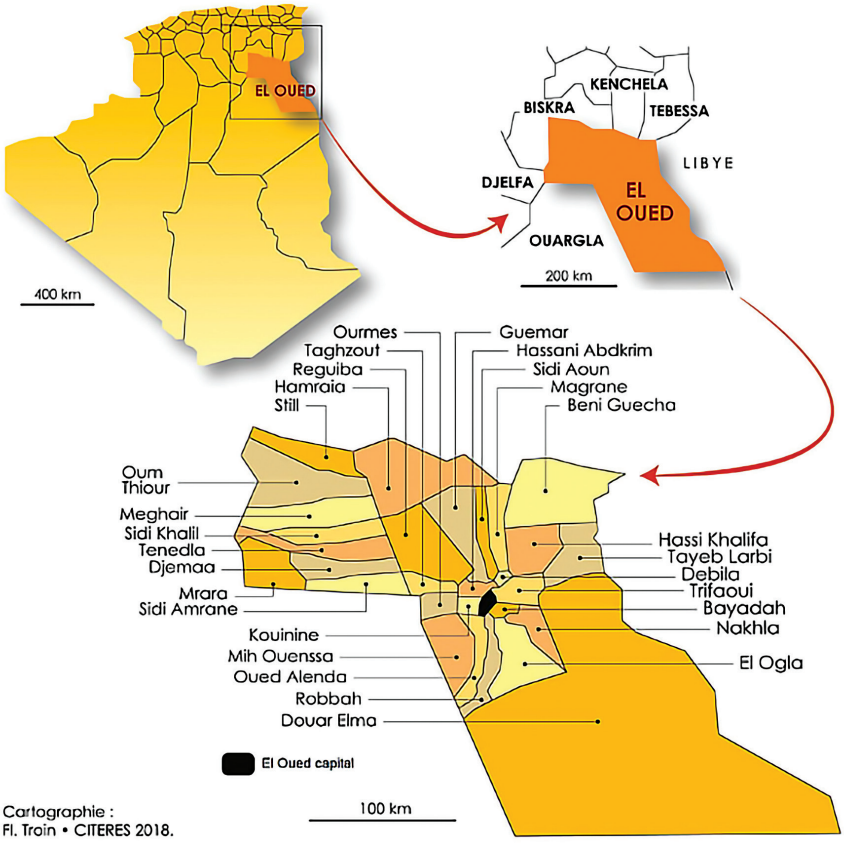


Figure 5. El Oued and the surrounding areas, and municipalities. (Source: Salima Rayene Kadri and Salah Chaouche [11] *).*

5.1. Statistical data

The study was carried out through two major research tools and two samples; first, we adopted samples from 314 mosques in 29 municipalities where we examined their area and proportion. It should be mentioned that the inventory, which was established on December 31, 2019, included 633 mosques[13] but we could obtain data for only 314 mosques.

Second, we conducted a field survey on a hundred mosques in 17 municipalities, where we examined the location of the courtyard, its organization and its development in the era of the pandemic (Table 2).

Table 2. Sample studies according to the municipalities (source: authors)

N°	Municipalities	Inventory	Inventory sample	Field-visited sample	Common sample in-inventory and field	*	**
01	EL OUED	99	69	25	18	EL OUED	EL OUED
02	KOUININE	17	04	02	01		
03	REGUIBA	41	22	00	00		
04	HAMRAIA	04	02	00	00		
05	GUEMAR	74	37	13	08		
06	TAGHZOUT	12	07	00	00		
07	OURMES	11	05	00	00		
08	DEBILA	22	15	03	03		
09	HASSANI ABDKRIM	29	19	07	04		
10	HASSI KHELIFA	35	24	10	07		
11	TRIFAOUI	11	06	00	00		
12	MAGRAN	21	10	00	00		
13	SIDI AOUN	14	08	00	00		
14	ROBBAH	20	05	08	01		
15	NAKHLA	14	03	03	00		
16	EL OGLA	09	02	02	00		
17	BAYADAH	34	21	06	04		
18	TALEB LAARBI	07	01	03	01		
19	BENI GUECHA	02	01	00	00		
20	DOUAR EL MAA	07	00	01	00		
21	MIH OUNESSA	25	11	06	02		
22	OUED ALENDA	11	02	04	00		
23	MEGHAIR	24	12	03	02		MEGHAIR
24	SIDI KHELIL	04	03	01	01		
25	STILL	04	02	00	00		
26	OUM THIOUR	09	01	00	00		
27	DJEMAA	32	09	03	01		
28	SIDI AMRANE	27	08	00	00		
29	MRARA	04	02	00	00		
30	TENDELA	10	03	00	00		
	Total	633	314	100	53		

* Administrative division of February 04, 1984.

** The new administrative division of December 11, 2019.

5.2. Areas of outer courtyard

We chose to categorize the areas of the outer courtyards of the 314 sample mosques on the basis of variables extending from 0 m², 500 m², 1000 m² or more. Table 3 shows that:

- 4.14 % of mosques have no outer courtyards.
- 24.20% of mosques have outer courtyard areas of less than 500 m².
- 28.66 % of the mosques have outer courtyard areas of 500 m²-1000 m².
- 42.99 % of mosques have outer courtyard areas of more than 1000 m² with an average area of 2165.74 m².

Table 3. The outer courtyard area (source: authors)

The outer courtyard area in m²	Number of mosques	Percentage	Average area in m²
0	13	4.14 %	0
Less than 500 m²	76	24.20 %	264.79
From 500 - 1000 m²	90	28.66 %	748.63
More than 1000 m²	135	42.99 %	2165.74

5.3. Proportion of outer courtyards

The comparison of the outer courtyard area with that of built mosques indicates that the outer space is clearly larger (Table 4).

Table 4. Proportion of area between outer courtyard and covered mosque (source: authors)

Covered area in m²			Outer courtyard area in m²			Proportion outer courtyard / covered	Result
min*	max**	ave***	min*	max**	ave ***		
178	2068	767.6	0	635	169.27	Less than 50 %	55
200	1942	686.85	100	1418	525.76	50% à 100 %	55
269	7000	857.27	331	7460	1019.15	101% à 150%	44
186	1800	652.74	331	3228	1128.78	153% à 200 %	40
225	1500	633.32	675	3500	1584.53	201% à 300%	49
100	1300	542.57	480	4472	2082.61	304% à 500 %	45
160	1200	484.84	1215	6450	2759.10	501% à 931%	19
100	483	317.2	1799	5047	3709.6	1024% à 1779%	05
100	100	100	4590	4734	4662.00	4590% à 4734%	02
100	**7000**	**667.11**	**0**	**7460**	**1209.79**	**241%**	**314**

* Minimum, ** Maximum, *** Average.

The results in Table 4 show that:

- For 110 mosques, representing 35.03%, the outer courtyard area is smaller than the covered area.
- For 204 mosques representing 64.97%, the outer courtyard area is larger than the covered area. With an overall average of 2.41 times, this ratio is derived from the addition of the outer courtyard areas, and then divided by the covered area of the entire sample.
- The outer courtyard area is larger than the covered area 47.34 times, in a mosque called El Rayane, in the municipality of Hassani Abdelkrim[14], where the covered area is 100 m² and the outer courtyard is 4734 m².
- The largest outer courtyard has an area of 7460 m² in Abd El Madjid Haba Mosque in the municipality of El Meghair[15]; this mosque has a large, covered area of 7000 m² as well.
- The average area of the outer courtyards of the entire sample is 1209.79 m².

5.4. The outer courtyards in the construction process

Our investigations in the field revealed that mosques were built in a covered "single-block" design[16], with an open outdoor space enclosed by a wall. The process of building mosques begins with obtaining a piece of land. To protect the property, the land must first be fenced; this explains why today the majority of mosques are fenced. Second, a provisional prayer room is built. After the mosque is built, the provisional prayer room is then used for Quranic classes if it is separate from the mosque, and used for prayer if attached to the mosque. The construction of the first provisional prayer room paves the way for the process of building a mosque and basically for the call to collect the funds to accomplish it. However, until now, religious associations continue to construct new mosques in a traditional way in the region of Oran [1]. The process of fencing in the land and building a prayer room naturally creates a space between them which is used later as the outer courtyard.

An analysis of 100 mosques (Table 2), and based on the criterion of having courtyards or not, revealed that three types of mosques exist and are listed as follows:

- *Mosques with no courtyard*

They are single-block mosques that occupy almost all the area of land. They have no outer or inner courtyard. These mosques are usually located in small densely populated areas.

- *Mosques with an outer and inner courtyard*

The design of a mosque with an inner courtyard could probably be considered new in El Oued. Only two mosques – namely, the Drissi Mohamed mosque[17] in Hassani Abdelkrim and the Khadîdja Oum El Mouminine mosque[18] in El Oued, have inner courtyards. The design of these two mosques is similar.

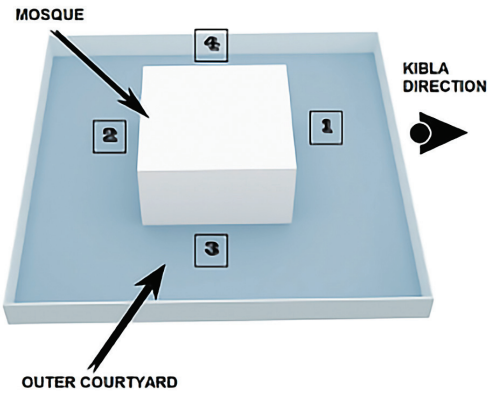
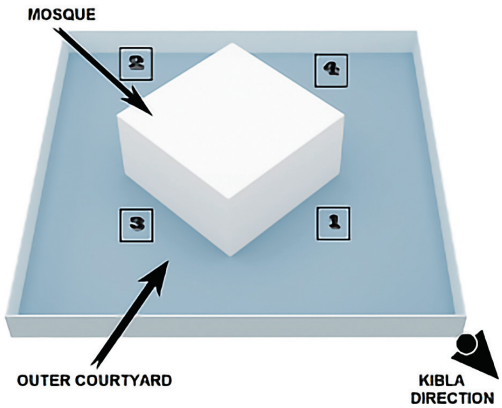
- *Mosques with outer courtyards only*

There are two possible patterns for these mosques according to the urban planning of each municipality and the shape of the area. In pattern A (Table 5) the Kibla wall is parallel to the border and the fence wall, thus creating a regular, or almost regular,

outer courtyard. In pattern B (Table 5) the mosque is rotated to face the Kibla, thus creating irregular forms in the outer courtyards.

Both patterns allow the mosque to have four possible outer courtyard locations (Table 5). Depending on the layout, the largest part of this outer courtyard is dedicated to prayer. The important point to emphasize here is that the external prayer space can occupy one to four locations around the mosque. The analysis of these locations is illustrated in the table below (Table 5).

Table 5. Location of the prayer space in the outer courtyard (source: authors)

Patterns	The main mosque				Result
	Front	Back	Right	Left	
Pattern A	1	2	3	4	
	●				15
		●			06
			●		09
				●	08
	●	●			02
	●		●		02
		●	●		01
		●		●	01
	●	●	●	●	02
					04
Pattern B					
	●				21
		●			07
			●		03
				●	01
	●	●			02
	●		●		02
		●	●		05
	●			●	02
	●	●	●	●	02
					05

● Presence of prayer space in outer courtyard.

5.5. The result

The results show that:

- 50 mosques appear in pattern A and the same for B.
- 15 mosques have external prayer spaces in front of the mosque in pattern A and 21 mosques in pattern B.
- 4 mosques do not have external prayer spaces as in pattern A and 5 as in pattern B.
- The prayer space in front of the mosque is most common in both patterns, with a total of 36 mosques out of 91.
- To the right of the mosque in pattern A and behind the mosque in pattern B is the second choice of prayer space.

5.6. The outer courtyard layout

These findings clearly show that the creation of such outer courtyards and the external prayer spaces in the mosques is a deliberate choice and where three different layouts for the outer courtyard prayer space have been identified: an unorganised space, an organised space and a roofed space.

5.6.1. Unorganised outer courtyard and prayer space

These are outer courtyards that have never been improved. The mosques are located in rural areas officially classified as neighbourhood mosques. The mosque occupies a part of the fenced ground, leaving a large area as a courtyard for prayer.

Figure 6. El Rahma Mosque (source: authors).

Figure 7. Ali Ben Abi Taleb Mosque (source: [12] *).*

The example of El Rahma Mosque in Taleb Laarbi municipality[19] (Figure 6) has a total area of 875 m² and an outer courtyard that is 2.12 times the size of the covered mosque. The second example of the Ali Ben Abi Taleb Mosque shows the worshippers

(Figure 7) performing the Tarawih[20] prayer on May 8, 2021, on the sand. The built area of this mosque is 375 m² out of a total of 2400 m² or an outer courtyard that is 5.14 times the covered area of the mosque.

5.6.2. The outer courtyard and the organised prayer space

In this case, part of the outer courtyard is bounded for prayer by a low screen wall or is surrounded by a mobile brick delimitation which can be modified when necessary. One example is the Abi Horaira Mosque[21] (Figure 8), whose covered area is 700 m² and outer courtyard is 1050 m². Another example is the Mosque of Oued El Alenda El Chamali (Figure 9).

Figure 8. Abi Horaira Mosque (source: authors).

Figure 9. Oued El alenda El Chamali Mosque (source: authors).

5.6.3. The outer courtyard and the roofed prayer space

The striking feature of this layout compared to the previous ones is the presence of a form of roof supported by light metal pillars. The spaces reserved for prayer are generally delimited. For example, the El Bassair Mosque in the municipality of Debila[22] has a built area of 800 m² and an outer courtyard area of 2328 m² (Figures 10A and B).

Figure 10. A) Outer prayer space of El Bassair Mosque (source: authors); B) closer outer prayer space of El Bassair Mosque (source: authors).

However, it is important to note here that these layouts are not included in the plans or studies intended for the construction of mosques. Our investigations have shown that these are the result of the voluntary work of the religious associations and those who are responsible for the construction of the mosques, which is seen as a way of expressing their needs and know-how.

In short, this classification remains temporary until any sort of improvement is made and can be seen in both mosques listed below using the Time Lapse option in Google Earth[23].

The Imam El Termedi Mosque in the municipality of El Oued (Figure 11) is taken as a first example regarding changes. It has undergone four steps. First of all, the outer courtyard was not organised in any specific way (Figure 11A). Secondly, the open space (outer courtyard) was improved by marking the area for prayers with a low wall (Figure 11B). Thirdly, it was destroyed and cleared (Figure 11C). Finally, it was rebuilt and delimited again with a low wall (Figure 11D), but this time the Mihrab was enlarged"[24] .

Figure 11. A) Unorganised prayer space in Imam El Termedi Mosque; B) organised prayer space in Imam El Termedi Mosque; C) unorganised prayer space in Imam El Termedi Mosque; D) organised prayer space in Imam El Termedi Mosque (source: Google earth)

The second example taken is that of the Oued El Alenda El Chamali Mosque in the municipality of Oued El Alenda (Figures 12A and B). Its outer courtyard went from being a courtyard without borders to one with an organised prayer space.

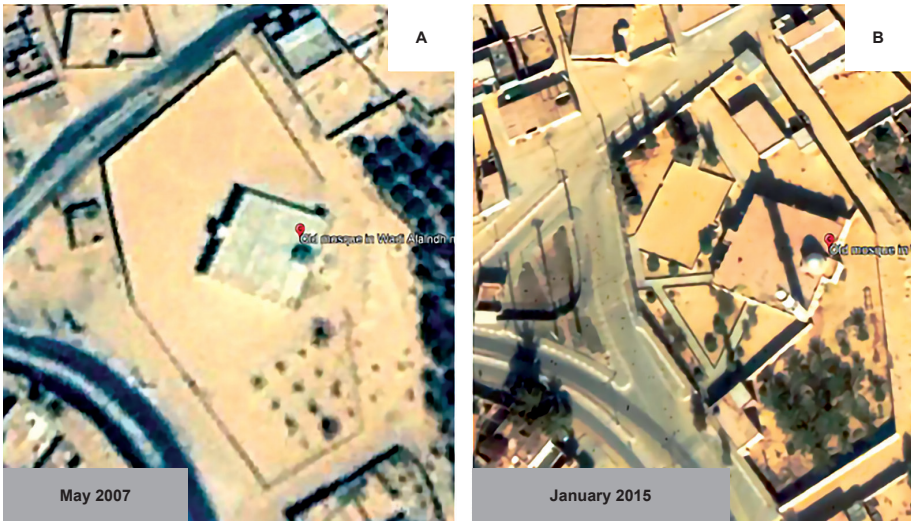


Figure 12. A) Unorganised courtyard in Oued El Alenda El Chamali Mosque; B) organised prayer space in Oued El Alenda El Chamali Mosque. (source: Google earth).

It is clear that a logical arrangement goes from an unorganised to an organised and then probably to a roofed prayer space.

5.7. The Mihrab in the outer prayer space

Inside these organised and covered prayer spaces, is the Mihrab, which indicates the location of Imam and Kibla, recalling the fact that in the mosque of the Prophet in Medina, the Kibla was indicated by a large block of stone. In early mosques, the Mihrab was indicated by a strip of paint or a block of stone embedded in the Kibla wall. An example of the existence of an external Mihrab is in the Great Mosque of El Nouri in Mosul, Iraq[25] where there used to be three Mihrabs inside the prayer hall and one Mihrab outside in the courtyard [13] built of stone and decorated in marble. This last has survived and is now kept at the palace of the Museum in Baghdad.

In our case study, we found the symbolic presence of the Mihrab in these external prayer spaces most often in the form of a hemicycle and sometimes a rectangle (Figure 13A).

Some Mihrabs in the external prayer space are provided with electricity which facilitates the setting up of sound equipment for prayer (Figure 13B). These Mihrabs become independent from those inside the covered mosques, thus introducing a second outer mosque, which is attached to the main mosque.

Figure 13. A) Abi Horaira Mosque; B) El Bassair Mosque; C) El Atik Mosque; D) Othman Ben Afan Mosque (source: authors).

5.8. The sandy spaces used for prayer and COVID-19

Although there are differences between the various courtyards described above, sand is a common feature in the areas used for prayer (Figures 13C and D). According to local sources[26], in the past, the ground of the prayer rooms was always covered entirely by the sand of the dunes. One of the main characteristics of this type of sand is its fine grains [14], which was thought to help reduce the temperature inside the mosque. This is scientifically proven because of the thermal behaviour of El Oued sand – its thermal capacity[27] is Cp= 920 J/kg [15]. This data is mainly used in building contexts to evaluate the behaviour of construction materials. In summer, materials with high thermal capacity keep the building cold for a long time. In winter, they keep the heat in the buildings longer. The use of this type of sand has a medium capacity and it is less expensive compared with materials such as tiles or marble which have a thermal capacity of 1000 J/kg. °C [15] or with the capacity of a carpet or textile that varies from 1300 to 1800 J/kg. °C [16].

Unfortunately, the introduction of air conditioning has contributed to the disappearance of this ancestral culture. Using sand is currently limited to the outer spaces[28]. Older worshippers are accustomed to this tradition, and they clearly prefer saying prayers on the sand. They argue this through the physical aspects of the sand that facilitate kneeling and contribute to peoples' well-being to comfortably perform their prayers. Difficulties due to a variety of health problems and illnesses, such as arthritis and vertebrae disorders are attenuated by the sand, so it has commonly been used for health purposes.

As far as COVID-19 is concerned, a study of beach sand [17] showed that it can exceed 38°C when the outside temperature is only 24°C and that when the ambient temperature is 32°C, the heat from the sand destroys the CODIV-19 proteins; the coronavirus disintegrates more quickly when the temperature rises [18]. In the light of this finding, there is still no published study on the survival of the SARS-CoV-2 coronavirus on the sand of the Sahara and in El Oued in particular.

It is necessary to emphasize that exploiting the outer courtyards may turn out to be one of the key solutions to managing the COVID-19 situation. Likewise, the experience in the region has also demonstrated that the outer spaces contributed to solving a major urban technical problem of electricity supply. New unit transformer substations had to be installed in some of these outer courtyards in dozens of mosques because of the lack of suitable areas.

6. The outer courtyard and COVID-19

The WHO recommended gathering in places of worship outdoors when possible. This has become one of the six factors for assessing the risks of mass gatherings during the COVID-19 pandemic [19]. This factor has been ignored in mosques in the study area, despite having outer spaces. According to the Religious Affairs and the WAKF Directorate[29], the partial reopening of 88 local mosques[30] depended only on the area of the main prayer hall[31] This has been proved by the area data analysis; 04 mosques[32] were reopened, but had no outer courtyards and 14 mosques of less than 500 m² courtyards were also reopened. It should be mentioned that the data available concerns only 66 mosques out of 88.

When investigating the neglect and devaluation of the outer spaces of the mosques we came up with a new classification of mosques under the current legislation. If this outer courtyard were taken into account, the capacity of mosques would increase. This new classification would contribute to managing the flow and number of worshippers. In other words, the more the open mosques and areas were made available, the lower the density of the spaces would naturally be. A study on the spread of the COVID-19 virus in Algeria [20] has demonstrated the relationship between population density and the spread of the virus. The more people there are in public places, the faster the virus spreads.

In order to practically implement the suggested classification of mosques, we used a sample of 314 mosques to be categorised, basically depending on the number of worshippers in the built and the outdoor spaces. However, the information for the areas of the mosques is given in square meters and not in the number of worshippers attending the mosques. An attempt was made to convert the areas of the mosques given in square meters to the number of worshippers the mosques can receive. It required us to set a simple calculation method. First of all, out of the 314 mosques, we were obliged to choose only five[33]. Secondly, the area occupied by the structure of each mosque, the stairs, the hallways and other secondary parts were subtracted from the general built area to obtain the net area of the space used for prayer. If the ratio of 3 worshippers in 2 m² as stated by law[34] is applied, the result is that the built area in m² is approximately[35] equal to the number of worshippers even if the mosque has two floors.

As for the outer courtyards and taking into account all the above-mentioned types of layouts, the area of the outer courtyard can also be equal to the number of worshippers using the same calculation method. This hypothesis reveals the results presented in Table 6.

Table 6. Proposed classification of mosques (source: authors).

Mosque type			Outer courtyard		Covered mosque		Outer courtyard and covered area	
	In more than x (worshippers)							
local	district	unfinished	500	1000	500	1000	500	1000
140	23	40			●			
29	05	15				●		
153	37	17	●					
91	27	30		●				
195	54	50					●	
110	17	41	●		●			●
161	36	40						●

● Presence of elements (worshippers)

According to the obtained data, adding the number of worshippers in both covered and uncovered spaces increases the number of mosques that actually have a capacity of more than 500, 1000 or probably even more worshippers.

Therefore, this is a key solution to managing the density of flow of worshippers during COVID-19, or to put it more simply; the area for a single worshipper was 0.66 m² before the pandemic as stated by law; this area has naturally increased during the COVID pandemic to become 1.66 m² for each worshipper [21]. In El Oued, there are about 990,000 [36] people. The male age group over 15, represents 35.17% [22] and they were permitted to go to mosques during the COVID crisis by the national authorities. Thus, we counted the portion of area each worshipper can have in both covered and uncovered spaces in the 314 mosques.

- 0.60 m² in covered spaces.
- 1.09 m² in outer courtyards.
- 1.69 m² is the total average area in covered and uncovered spaces for each worshipper out of the male age group. Naturally, this average increases if the sample is larger.

7. Conclusion

It was not our intention to investigate the architecture of mosques since the dawn of Islam; prominent studies, such as those by Rachid Bourouiba [23], Lucien Golvin [24] and Jean Sauvaget [25] are still the bases of future studies. The problem of the architectural components of mosques built by religious associations persists, even though previous studies have tackled the very same issue. The gaps in current legislation on building mosques have grown, especially after the pandemic. The COVID-19 pandemic and its effects have revealed an ignored component (i.e. the outer courtyard) in the mosques in the El Oued region. This ignored component should be integrated into the official code and rulebooks for constructing mosques as a regional or even national preventive measure against pandemics.

In conclusion, our research has demonstrated the existence of a courtyard outside the main mosque; the findings have revealed that the areas of the outer courtyard are

larger and have more capacity than those of covered mosques. The outer courtyards devoted to prayer were deliberately founded in response to social needs and were used for prayer before and during the Covid-19 pandemic regardless of the way they were organised. Therefore, the outer courtyards helped increase the mosques' capacity which should be considered as part of the parameters used to classify mosques in future.

The covered mosque with an outer prayer space, an independent outer Mihrab and a sandy ground, all form a cultural, traditional, climatic and therapeutic model of mosque architecture which could be adopted as an adequate preventive spatial measure against COVID-19.

Notes

[1] Executive decree of 2013 no. 13- 377 of Nov 09th, 2013 on the principal law of the mosque. https://www.joradp.dz/FTP/JO-FRANCAIS/2013/F2013058.pdf . [Accessed: 30/06/2020]

[2] Charitable endowments.

[3] Wilaya means district, Algeria is divided into 58 wilayas.

[4] Located in the South East of Algeria. The wilaya has existed since 1984; it had thirty municipalities, which were then reduced to twenty-two following the creation of the wilaya of El M'Ghir in 2019 (now they are two separate wilayas).

[5] Summer is extremely hot and dry and winter is chilly and dry. During the year, temperatures generally range from 5°C to 40°C.

[6] The mosque is located in the protected area of Lacheche in the municipality of El Oued.

[7] A sahn is an architectural element: a courtyard. A courtyard is an outdoor area of flat ground that is partly or completely surrounded by the walls of a building, so a sahn is an inner courtyard inside the building. https://dictionary.cambridge.org/dictionary/english/courtyard?q=COURTYARD . [Accessed: 29/01/2022]

[8] The decree of 2013, executive decree no. 13- 377 of Nov. 9th, 2013 on the principal law of the mosque.

[9] Executive Decree No. 20-225 of 8 August 2020 on adapting measures to prevent and combat the spread of the Coronavirus COVID-19. https://www.joradp.dz/FTP/JO-francais/2020/F2020046.pdf?znjo=46. [Accessed: 19/03/2021]

[10] Executive Decree No. 20-360 of 1 December 2020 adapting measures to prevent and combat the spread of the Coronavirus COVID-19.
https://www.joradp.dz/FTP/JO-francais/2020/F2020071.pdf?znjo=71. [Accessed: 29/03/2021]

[11] Closed for 363 days or 11 months and 26 days.

[12] The ablution closets remained closed despite the opening of the mosques. They were re-opened on Nov 22nd 2021, a closure period of 464 days or 1 year, 3 months and 7 days.

[13] 403 local mosque types, 115 neighbourhood mosques, 98 unfinished, 17 old and abandoned mosques.

[14] Located at the east of the capital of El Oued.

[15] Former municipality in El Oued, which became the capital of the wilaya of El Mghair.

[16] In a single closed building.

[17] Completely finished and opened on November 18, 2020.

[18] Not completely finished, the building permit was dated 21/08/2017.

[19] A municipality located in the north-east of El Oued on the Algerian-Tunisian border.

[20] Performed daily at night after Isha's prayer, during the fasting month of Ramadan.

[21] It is located in the municipality of El Oued.

[22] It is located 28 km north east of El Oued.

[23] The clearest photos available have been selected. The dates mentioned do not represent the real dates of modification.

[24] El mihrab is a kind of apse that shows the direction of the Kibla.

[25] Built in 1010 A.D by Noureddine Mahmoud Zanki.

[26] The head of the Religious and Wakf Directorate of El Oued, is a native inhabitant.

[27] The thermal capacity of a material corresponds to the energy required to increase its temperature by one degree. The unit of thermal capacity is Joule per kelvin (J/K) and denoted by the letter "C".

[28] The sand layer should usually be changed twice a year when it becomes dusty.

[29] An interview with the architect of the Religious and Wakf Affairs Directorate of El Oued in December 2020.

[30] A list published on Aug 13th 2020 on the official Facebook page of the Religious Affairs Directorate and Wakf of El Oued. https://www.facebook.com/Dar.eloued39/posts/pfbid02dsJrj1E5KFD5bDzVLyjZZzibrsAMxAmRJqd5Wicr5Lbs6eJuviW9275Zb-zfrroWJl. [Accessed: 19/08/2021]

[31] Main refers to the covered prayer room.

[32] Moad Ben Djebel, Khaled Ben el Walid and Sidi Abdellah Mosques located in El Oued municipality and Ahmed Ben Slimane mosque in Taghzout municipality.

[33] These are digitized formats.

[34] Decree no. 76-36 of 20 Feb.1976 on the protection against the risks of fire and panic in public buildings. Section of religious institution, article 2 (source: Civil Protection Directorate).

[35] The average number of worshippers is +4.47% more than the built area in m².

[36] Because the lack of an up-to-date official census since 2008.

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Summary

This article attempts to provide some answers to the unexpected effects of the global Covid-19 pandemic relating to the architecture of mosques. For this, we observed mosques in El Oued in the south of Algeria; the climatic and social features of the region involve the use of outer courtyards for prayer and are taken as a motivating case study. Our investigation in relation to the spread of COVID-19 is the fact that the topic has not been tackled before. COVID-19 has had a great impact at all levels, including the closure of mosques. As the pandemic developed, decisions about the gradual and controlled opening of mosques were made based only on the capacity factor of the covered spaces of mosques. These decisions ignored the uncovered outer spaces found in mosques in El Oued and some other regions in Algeria. They were, of course, a response to the health protocol requirements related to measures to prevent and protect against COVID-19. We then asked ourselves the following questions: How could the knowledge and spatial arrangement of mosques guide us towards better management and decision-making during a health crisis like COVID-19? And what would the impact of this pandemic on the future architecture of mosques be? Our article is an attempt to find some answers to these questions.

Riassunto

Questo articolo tenta di fornire alcune risposte agli effetti inaspettati della pandemia globale di Covid-19 relativamente all'architettura delle moschee. Sono state prese come caso di studio le moschee di El Oued, nel sud dell'Algeria visto che le caratteristiche climatiche e sociali della regione permettono l'uso di cortili esterni per la preghiera. Questo studio è il primo in relazione alla diffusione di COVID-19. Il COVID-19 ha avuto un grande impatto a tutti i livelli, compresa la chiusura delle moschee. Con lo sviluppo della pandemia, sono state prese decisioni sull'apertura graduale e controllata delle moschee, basate solo sul fattore di capacità degli spazi coperti.

Queste decisioni hanno ignorato gli spazi esterni scoperti presenti nelle moschee di El Oued e in alcune altre regioni dell'Algeria. Tali decisioni erano, ovviamente, una risposta ai requisiti del protocollo sanitario relativo alle misure di prevenzione e protezione dal COVID-19. Ci siamo quindi posti le seguenti domande: in che modo la conoscenza e la disposizione spaziale delle moschee possono guidarci verso una migliore gestione e un migliore processo decisionale durante una crisi sanitaria come il COVID-19? E quale sarebbe l'impatto di questa pandemia sulla futura architettura delle moschee? Il nostro articolo è un tentativo di trovare alcune risposte a queste domande.