NEW MOSQUES ARCHITECTURAL PLATFORM: DIGITALISED INVENTORY AND ANALYSIS FOR MOSQUES REFERENCING

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ABSTRACT

This research tackles the architectural typology of mosques built by religious associations in Algeria, which is a timeless issue. Despite the specific legislation of the new mosques' architectural typology, random or fanciful architectures in the field are considered Islamic architecture. Our research aims to analyze mosque architectural data by creating a digital platform that helps collect and analyze architectural data and report all the architectural and architectonic elements identified in two Algerian wilayas as a case study. It is then to classify and define the authentic typologies of Maghrebi, Ottoman mosques, or any others developed by specialists in Islamic architecture and art, especially if the platform is linked with the general inventory of Islamic architecture accredited by UNESCO. The concept of creating the platform starts with an inventory of mosques, and it is then developed to list various criteria for classifying mosques. Thus, a flexible filtering system is implemented to help perform multi-criteria analyses and visualize results in a geographic interface. This platform can meet several objectives in many research fields and be adapted for buildings other than mosques. Furthermore, the platform will serve as a basis for researchers and students, the Directorates of Religious Affairs, and the Ministry of Religious Affairs to analyze the architectural data of mosques.

KEYWORDS:

Mosques; digital; platform; Referencing; analysis; Algeria

INTRODUCTION

Research about the architectural typology of mosques is authentic and ongoing [1] in Algeria and elsewhere. This research explores the new mosques' architecture built by religious associations. A previous work [2] investigated this issue in Algeria; it examined an arbitrary architectural type of mosques due to unclear regulations. It should be demonstrated that the 2013 decree, which was expected to complete and improve the 1991 decree, obliged the respect of the «Maghrebi» mosque's architectural character; the same decree recommended editing a typical rulebook that underlines architectural features of mosques [3]. This rulebook is supposed to enrich the regulation set in the previous decree. However, as the Ministry of Religious Affairs claimed, the mosque's architecture is distorted as it violates the Maghrebi character on the field. This statement is seen as a "failure" of the current system of building mosques.

To address this problem, we chose to work on mosques built by religious associations in the Wilayas (districts) of El'Oued and Medea, where many typologies are noted. The mosques in the south of Algeria in El Oued are not similar to those in the north in Medea due to regional, local, historical, climatic, and social factors [3]. But currently, they are still under the same construction regulation respecting the same architectural typology [3]. It was confirmed by the new rule book published in the Official Journal on September 19th, 2022, related to the construction of mosques [4], which was to determine the architectural typology. It set, in particular, urban, architectural, technical, and programmatic standards for all mosques' designs nationwide. Whatever their classification is, this rulebook still sustains the Maghrebi character [4].

The Algerian legislation often stipulates using heritage references, whether Islamic or Maghrebi. The 2013 legislation [5] was adopted to fill the previous legislation gaps. However, the new rulebook is expected to fill the gaps in 2013. But we observed a divergence between the objectives of the legislation, the field, and the respect for each region's particularity [6]. Thus, the value of our research is to describe and define a research methodology based on field analysis and data collection to identify mosques' typologies better [7]. The objective is to help architects and authorities put specific rulebooks that respect each region's particularity.

METHODS

To answer our questions about the sample mosques of our study area, and given a large number of mosques and the lack of a general inventory (the absence of some documents and plans of mosques) at the level of the Directorates of Religious and Wakfs Affairs of El Oued and Medea, we started using an Excel file containing partial information such as the name of the mosque, address, and sometimes the area surface. At the same time, the decree of June 29th, 2017 [8] encourages the development of a national register of mosques, an instrument for the inventory of all mosques in the national territory. This register ensures optimal management of mosques, and the central services of the Ministry can carry out any technical study based on the information it contains [8]. This national register of mosques, as prescribed by law, includes the following data:

- A technical sheet of the mosque contains a name, location, category, capacity, and others.
- A census of all mosque components.
- Mosque personnel and Mosque movable furniture.
- Mosque plans and information about the body in charge of construction and equipment.

Even though there is a concept of a national register, if it were completed, it would be a paper file with more fragmented data that would be difficult to exploit. However, using new information technologies would undoubtedly be a major aid in developing databases and exploiting platforms and software. Yet, this is sometimes difficult because of their architectural system and their purposes to be achieved. Hence, the reflection on a digital tool is devoted to enriching our research, and that allows us primarily to conduct an inventory of the general data of mosques, namely, digitized plans, photos, names, locations, the capacity of reception, and other data that can be obtained from the national register cited above. Moreover, the digital tool allows us to collect and store all data simultaneously in the same file.

We turned to a software developer to help us embody our concept. Starting with an inventory, the question of classifying mosques throws this tool naturally arose. The software developer proposed a solution of a secure platform hosted on the internet, which necessitates a preliminary architectural design of this platform. So first, it was necessary to have a general conception of this platform before getting concrete.

Based on data from the National Register of Mosques, we designed an inventory sheet of mosques whose contents are organized into five parts: general, legal, material, construction, and extension to gather all data currently available about mosques.

Each inventoried mosque can partially or fully complete this sheet to provide multiple accessible data sources. Also, the platform design will allow adding plans and photos stored in the same window of the inventory sheet. This sheet can be filled in three ways; by predefined choices in the system, written text, or both at once. However, this sheet can be updated anytime to add and modify information. This inventory via this platform will be used for our research and its objectives, but it can also be part of a broader digitalization process [9], and inventoried mosques may become the future heritage [10]. The inventory sheet, as designed, includes the following parts.

THE GENERAL PART

It includes general information about mosque inventories (Table 1), such as the mosque's name and an inventory code given to each mosque for easy research. The mosque's address has four boxes to fill; we start predefining choices about Wilayas and Communes, then writing the exact address. For more accuracy, we added a GPS coordinates box that will be needed later. In the end, we can choose the urban or rural construction region and the mosque's legislative classification [5].

Table 1. General data in the inventory sheet

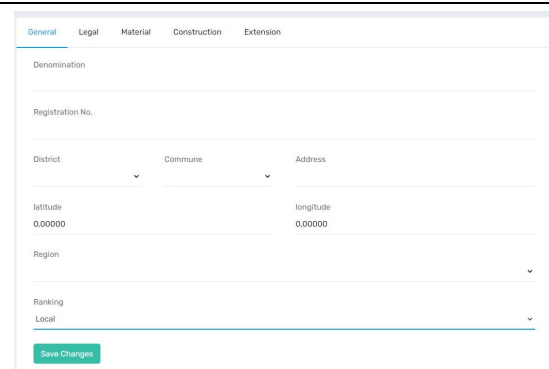| Data	Observation		Mode
Mosque Name			Text
Register number			Text
District	From a list of Algeria district		Choice
Commune	From a list of 1541 communes		Choice
Address			Text
GPS data	Latitude	Longitude	Text
Region	Urban	Rural	Choice
Ranking	Historic	Principal	Choice
	National	Local	Neighbor-hood	

Figure 1. A sample of general data inventory (platform screenshot)

THE LEGAL PART

This inventory part is devoted to the legal nature of private or public land, its reference, and the body in charge of the construction (Table 2).

Table 2. Legal data in the inventory sheet

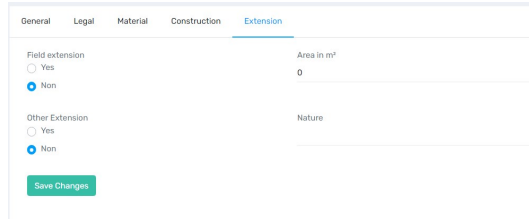| Data	Observation			Mode
Legal nature of land	Private	Public		Choice
Land registry reference				Text
Title deed reference				Text
Construction authority	State/ Local authority	Religious association	Moral and physical person	Choice

Figure 2. A sample of legal data (platform screenshot)

THE MATERIAL PART

This part includes technical information about the mosque (Table 3), namely, the overall area of land and the built one in m²; the choice of the mosque with an underfloor is mentioned in the letter (S) or (R) for a mosque which does not have an underfloor. Then we add the number of existing floors; this data can also be expressed in total height in meters.

We also mentioned the total number of accesses, access to the disabled, the capacity of reception in the number of worshippers for men and women, and the date of the construction to be completed in a digital agenda. If the mosque has not been completed yet, the construction completion date is not set, the unfinished work box is chosen, and the percentage progress of construction is given.

Table 3. Material data in the inventory sheet

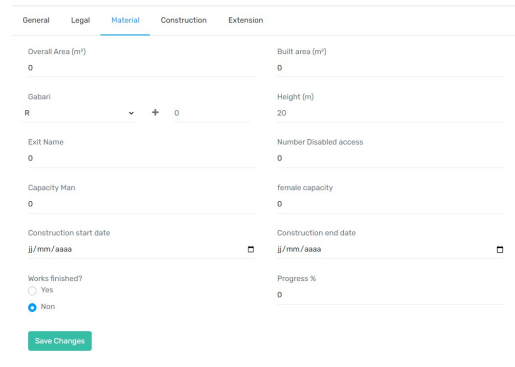| Data	Observation		Mode
Overall area	M²		Text (number)
Built area	M²		Text(number)
Floor number	S (underfloor) +	R +	Text + choice
Height	M		Text (number)
Exit number			Text (number)
Number disabled access			Text (number)
Capacity (men)			Text (number)
Capacity (women)			Text (number)
Construction start date			Choice
Construction end date			Choice
Work finished	Yes	No	Choice
Progress	%		Text (number)

Figure 3. A sample of material data (platform screenshot)

THE CONSTRUCTION PART

Table 4 shows the bodies in charge of studying, monitoring, and constructing the mosque (contractor, architect), funding, and completion deadlines. In addition, we added to the platform an option specifically to identify architects; this sheet contains all architects' information and is attached to the construction part; that is to say, once the sheet of architects is full, we can refer back to the construction part to choose any of the already set lists.

Table 4. Construction data in the inventory sheet

| Data	Observation		Mode
Contractor Name			Text
Contractor Address			Text
Contractor Contact			Text
Building reference permit			Text
Contractor Contract			Text
Funding value			Text
Completion time			Text
Design office	From setlist		Choice
Study date			Text
Follow-up Design Office	From setlist		Choice
Technical Contract office			Text
Approval of civil protection			Text
Certificate of conformity			Text
Type of opening	Partial	Total	Choice
Order of decision to open			Text
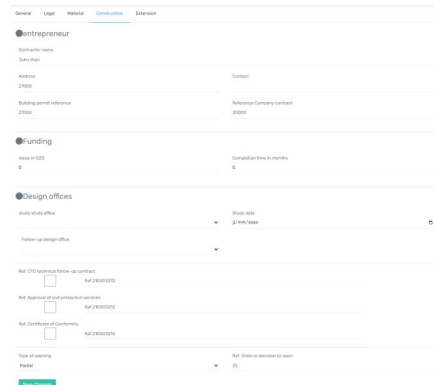
Figure 4. A sample of construction data (platform screenshot)

THE EXTENSION PART

This part allows additional information about the mosque and the extensions of the field area or the building. It can also be used and filled later for the already inventoried mosques, which will probably have an extension. (Table 5).

Table 5. Extension data in the inventory sheet

Data	Observation		Mode
Field extension	Yes	No	Choice
Area of extension	M²		Text(number)
Other extensions	Yes	No	Choice
Nature of extension			Text
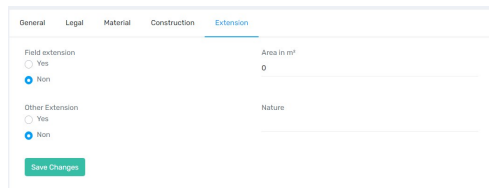
Figure 5. A sample of Extension data (platform screenshot)

Once the inventory is completed, a list of all inventoried mosques appears, and a primary search can be made on any mosque by name, address, or other information. This step makes it possible to monitor data progress and collection permanently. The platform ensures the speed and mobility of data collection and each mosque's geolocation. Here, a preliminary classification can be done.

ANALYSIS PLATFORM

A well-structured and organized database will help establish advanced analyses and classifications [11]. For example, the classification of a building [12] is described by its parts in a standardized way to define the purpose of the classification. Purpose defines properties of interest; purpose and properties are fundamental characteristics of a classification system [12].

Mosque classification can be done [13], first according to the dominant elements, geometry, design style, and size. The basis of these four classification criteria is the mosque components, that is, by the typology of each specific character of each component of each mosque. So, the classification is done by one or more important details and can have a different value.

Classification determines the properties and nodes of the taxonomy; different classification purposes can give rise to different taxonomies of the same objects [14]. Accordingly, the classification of the mosque depends on the elements of the properties of the components of the mosque [12]. Each component's property affects its classification and that of the mosque proportionally.

It lets us reflect on two concepts: the decomposition of the mosque and the flexibility of the taxonomy nodes [14]. How these two concepts can be applied to design this platform is to decompose the mosque into defined components and to create a flexible analysis system that a user or researcher can dynamically define their analysis grids. In short, classification properties will be defined dynamically and flexibly for any desired classification and analysis. These two concepts are applied to the architecture of the platform system. As for the decomposition, we returned to the National Register of Mosques, which defines a list of fifteen mosque-related components [8] (Table 6). We relied on this list in the platform system configuration [15].

Table 6. Mosque components dictated by legislation [8]

| Prayer rooms	Ablution rooms	Library	housing	Koranic school
Koranic class	Maksouras	Activity spaces	Green spaces	showers
Courtyard	Minarets	Domes	Magazine	Wakfs
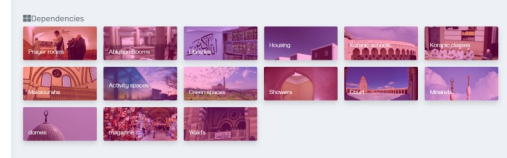
Figure 6. A sample of components in the platform (platform screenshot)

Analysis process

Creating the analysis grid is based on certain criteria and sub-criteria [14] [16]. In order to analyze a mosque component, we need to select an analysis criterion, and for each criterion, a list of sub-criteria of analysis is set. At this stage, the number of criteria is limited to ten; that is to say, each component has ten criteria of analysis. However, this can be updated to be more; an unlimited number of sub-criteria is included in one umbrella criterion.

Therefore, a reference option is added for creating and forming a customized analysis grid. We must click the reference icon and select the mosque component we want to analyze and classify. You start by adding an analysis criterion, naming it, and choosing criterion data in numbers or text. In other words, if it is an analysis based on quantity, choose the number; if it is a descriptive criterion, choose a text. This option is created to facilitate and enlarge the scope of analysis. Figure 7 illustrates the minaret as a component.
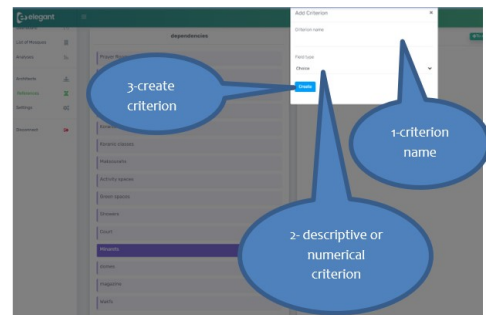
Figure 7. Creation of the criteria for the analysis grid of the minaret (platform screenshot)

After creating the analysis criterion, it is necessary to define the sub-analysis criteria; three criteria are listed for the minaret analysis as an example (Figure 8). First, the number of minarets in which a numerical criterion is set. The box of sub-criterion remains empty, whereas filling in the sub-criterion box becomes a numerical system.
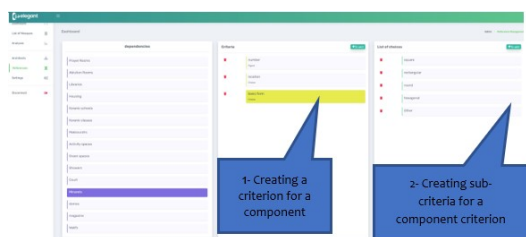

Figure 8. Criteria of an analysis grid for the minaret as an example (platform screenshot)

The second and third criteria illustrate the minaret's location and basic form. For the latter, we proposed the following sub-criteria: square, rectangular, circular, hexagonal, and others. It is just an example of how to create an analysis grid. When setting up the grid of a component in the reference option, the grid becomes a list of choices to be filled in (Figure 9). When a return is made to each mosque inventory sheet, one must choose just under the appropriate sub-criteria for each criterion and save these choices.

The platform system flexibility allows adding any new criterion or sub-criterion essential for the analysis or creating a new analysis grid adapted to the user. In addition, a simple return to the reference option allows to modify and update the analysis grid.
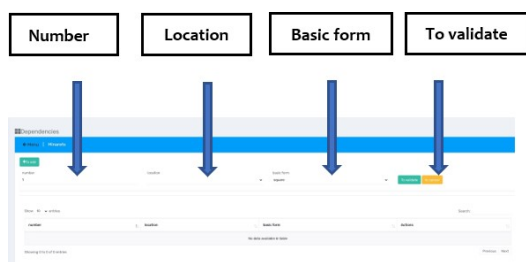

Figure 9. Filling in the analysis grid (platform screenshot)

Since the grid is fully designed and filled for any mosques we want to analyze, the analysis method is performed by creating an analysis filter by choosing first the component to analyze, the criterion, and then the sub-criteria. The system automatically detects all mosques with the same analysis filter in the study sample. This mono-criterion analysis is useful for generating accurate, detailed information.

The platform also supports an accumulation of analysis filters to be a multi-criteria analysis where several criteria and sub-criteria for the same or several components are analyzed simultaneously. Like the mono-criterion process, multi-analysis is useful for generating in-depth results and classification (figure 10). However, developing the platform in such a way makes it work as an inventory and an analysis tool simultaneously.
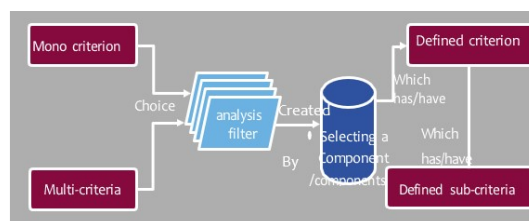

Figure 10. Basic diagram of how platform analysis works

To conduct the analysis, an option called analysis is created. We started with creating filters out of analysis conditions (Figure 11). To create a filter, we first chose a component, a criterion, then a sub-criterion, which all became options known by the system. To proceed with the analysis, we added an operation of two options in (figure 11), a normal option named ***and*** filtered the combined conditions altogether. The second one named ***or*** filtered one given condition out of all analysis conditions.
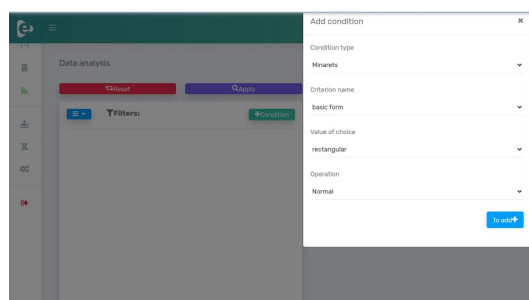

Figure 11. Example of creating the analysis filter (platform screenshot)

The defined analysis filters can be stored as a file known to the system for future use (Figure 12). The platform also allows to reuse and modify filters already saved.
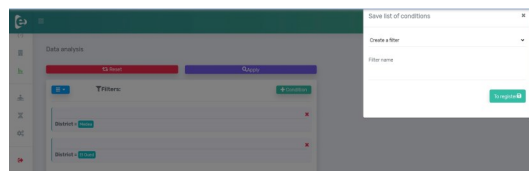
Figure 12. Analysis filter save and backup (platform screenshot)

Whatever way the analysis is processed, mono or multi-criteria ways, results are presented in two possible modes. The example (Figure 13) here presents an analysis filter including Wilaya as a condition, then a list of mosques that share the same analysis filter condition is displayed. The result list is searchable, and a detailed review of each mosque can be done when clicking on details; the platform opens a new window

to consult the result.

The platform allows the display of results on an interactive geographical interface (Figure 13) due to the GPS coordinates added to the inventory sheet of each mosque. It allows the user to extract various conclusions, zoom in, and see the details of each mosque.
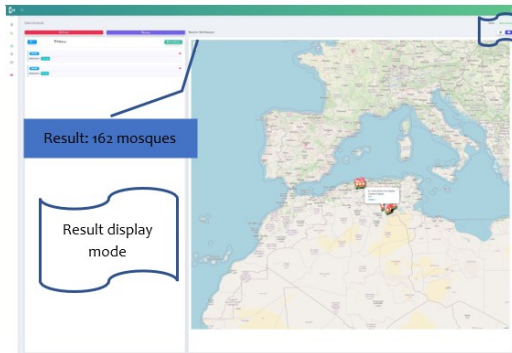
Figure 13. Display of result in an interactive map mode (platform screenshot)

This platform helps to classify the architectural and architectonic elements of mosque inventories in our study areas as it was developed. It also allows us to expand the field of study at a regional and possibly a national level. A platform is a tool that detects and highlights the architectural specificities of these mosques in each region.

To do our classification, a design of an analysis grid is based mainly on field observation of each mosque component's common and uncommon choices. To put it more simply, the grid is designed essentially based on observing the criteria and sub-criteria existing in the mosques and investigated in the defined area above. The result of this classification will help to compare and affiliate these mosques to legislative and heritage references.

RESULTS AND DISCUSSION

The objective here is to make the platform capable of auto-referencing between mosque inventories and historical and heritage references. It reminds us of the work already established under the patronage of UNESCO within the framework of the «Computerized Inventory of The Islamic Architectural Heritage» which concerns the historical-architectural heritage of the Islamic period [17]. The work affects several regions and countries that were influenced or transformed by the spread of Islamic culture during the last fourteen centuries [18]. This inventory includes 10259 religious typologies (Mosque, Minaret, Friday Mosque, Small Mosque, Mosque and Tomb, Open Mosque). It follows the method of Ce. S.A.D.A. Architectural Data, allowing a database according to a structured grid for each monument or mosque inventories [19].

We could consult the given database, examine its structure [20], and compare it to our platform (Table 7). Theoretically, it will likely link our platform to this inventory in an integrated global way. It is possible and can be done in two ways. However, the database copyright belongs to Iacopo Fasolo and Roberto Ruggerone [20].

Table 7. Comparison of two inventory systems Ce. S.A.D.A. architectural data and Mosque platform.

	Ce.S.A.D.A. architectural data	Mosques Platform
Typologies	Mosques and Different Typologies	Mainly Mosques /can be adapted for other typologies
Inventory sheet	Yes	Yes
inventoried monument date	Various	Various
Territories	73 countries [19].	Mainly Algeria, and can be adapted for more countries
System structure	Monument	Mosque
	-structures 1 (geometric) -Structure 2 (spatial organization) -structures 3 (component architectural) -materials -decoration	Component
	A defined choice grid	Criterion and sub-criterion
Database	Static	flexible and static

Regarding the Ce. S.A.D.A. inventory, an already predefined grid is distributed into five parts: three structures (1. 2. 3), materials, and decoration; the grid has a set of more than 1168 defined choices describing the monument. That is to say, each historical mosque inventory has an inventory sheet containing codes appropriately chosen from the grid of Ce. S.A.D.A., and all describing its architectural features.

The first possible way of linking both inventories is that our platform has a flexible analysis grid. If the predefined grid of the inventory Ce.S.A.D.A is used as much as possible to create the analysis grid. It facilitates the connectivity of the two systems. In the example of the minaret, we identified from the Ce.S.A.D.A grid (Table. 8) codes from (400) to (424) are dedicated to the form and the number of minarets. It remains an example. Checking other codes allowed us to find several possible codes connection for the prayer room, domes, courtyard, decoration, and others.

Another way to connect the two systems is through automatic detection and comparison of the analysis filter established by the user in the mosque platform with that of Ce.S.AD. A grid. In other words, an analysis filter is set with a single minaret and square in shape. Once the filtering results appear out of the sample inventory, they are converted to codes (420)

which refers to the single minaret, and code (400), which refers to the square minaret. If any resemblance is detected, the platform system can proceed with the analysis in the Ce. S.A.D.A. database and can detect all historical mosques with one or both codes.

Table 8. Linking between the two inventory systems for a minaret as a component. Source: Ce.S.A.D.A database

Ce. S.A.D.A		Platform mosque
Structure Code	Description of the Structure	Sub-criterion
Form		
400	Square minaret	Square
401	Rectangular minaret	Rectangular
402	Cylindrical minaret	Cylindrical
403	Polygonal minaret	Polygonal
404	Conical minaret	Conical
405	Pyramidal minaret	Pyramidal
406	Helical minaret	Helical
407	Spiral minaret	Spiral
408	Octagonal minaret	Octagonal
409	Fluted minaret	Fluted
411	Square, polygonal minaret	Square and polygonal
412	Square, cylindrical minaret	Square and Cylindrical
413	Cylindrical, conical minaret	Cylindrical and conical
414	Square, conical minaret	Square and conical
415	Polygonal, conical minaret	Polygonal and Conical
Number		
420	One minaret	One (01)
421	Two minarets	Two (02)
424	Minarets	More than two

(Column between Form and Number rows is labeled vertically: "Possible Interconnexion")

Our platform will likely benefit from the Ce. S.A.D.A. Database to compare historical mosques to the new ones [21] and to detect similarities and common types in different regions and periods. It will contribute to a better understanding of any common ties between new mosques and heritage. On the other hand, the Ce. S.A.D.A. database inventory can benefit from our platform to enrich these databases with all the historical mosques that can be inventoried by the new platform and are not included in the cited inventory.

Linking the two systems would be an answer to the problem related to the typologies of mosques; when the link is provided, the expected results of the proposed new mosques classification appear of two major classes that are to say; the first class is that of the dominant typologies, which means the architectural elements including a large number of cases of mosques. When comparing the dominant class to the historical and legislative reference, two possible cases are identified:

1. A referenced dominant case: mosque that complies with the current legislation.
2. An unreferenced dominant case: that refers to a local or regional typology [22], and that must be covered by the legislation and by a regional new rulebook.

The second class is a set of unique typologies:

unprecedented architectural and architectonic elements. The comparison of the second class to the historical and legislative reference will also be of two possible cases:

1. A referenced nondominant case: that must be strengthened by a new rulebook as a support to the extension and valorization of heritage [23].
2. An unreferenced undominated case: the rulebook must ban all these architectural and architectonic elements included in such case.

In short, the whole platform creation process aims to identify the typologies [24] existing today in the field at the local, regional, and even national levels. The findings pave the way for researchers, architects, and authorities to detect possible gaps in the current legislation on mosque construction; they help reset and improve such regulations and laws and provide new rulebooks.

CONCLUSION

In conclusion, this proposed new platform can be linked to other databases interested in all forms of heritage. It allows an inventory of the field whose information and results can be used by researchers, architects, and authorities in the present and future planning of mosque construction.

The platform system design, with a concept of decomposition and flexibility of the analysis grid, makes it open to other various field studies. It can be adapted to other buildings, housing, hospitals, museums, castles, etc. The researcher must specify the entities or the component and the criteria s/he wants to collect and analyze to determine the architectural references s/he is looking for.

This methodology, which we refer to as the analysis of typology and architecture by a digital platform, is likely to provide real support for legislation and the elaboration of a rulebook relating to the architectural typology of mosques by region. Also, it could be applied in historical, anthropological, social studies, and research. Finally, it would also be a tool for future planning.

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