2023 IMEKO TC-4 International Conference on
Metrology for Archaeology and Cultural Heritage
Rome, Italy, October 19-21, 2023

Morphological Analysis of the Kheireddine Palace converted into the Museum of Tunis City

Rym Bouhamed[1],

[1] *Higher Central School of Letters, Arts and Communication Sciences, 08 Av. Kheireddine Pacha, 1002, Tunis, Tunisie, rym_bouhamed@aac.tn*

Abstract **: This article examines the spatial configuration of the Tunis City Museum through the use of both spatial syntax theory and Wayfinding method. In fact, field observations confirmed that the spatial morphology of the museum presents a smooth and coherent path, allowing users to navigate easily throughout the entire space. Despite similar findings about the museum morphology through concrete collected data, we presume that it is insufficient to draw definitive conclusions. Indeed, it would be more significant to consider other criteria to determine whether the space can be deemed successful and whether it has met the challenge of preserving our architectural heritage. Nevertheless, the ICOM Charter emphasizes the importance of conservation in a museum context. Currently, the museum functions as an art gallery. Thus, this conversion can be seen as a "partial success", while offering a high level of spatial quality for a fluent cultural visit.**

I. INTRODUCTION

Throughout the successions of civilizations, the Medina of Tunis and its surroundings has experienced urban development. It was during the Husseinite reign until the establishment of French protectorate that the Medina of Tunis witnessed its golden period in terms of construction. It was enriched with numerous buildings, including Beylical palaces, palaces of wealthy notables, grand residences, bourgeois houses, and more. They all bear witness to the economic and cultural prosperity that the regency experienced during that era.

Between 1905 and 1930, during the French protectorate period, architects carried out several conversions of important buildings and palaces, assigning them new functions. They were convinced of the significance of this act in order to preserve these structures. However, after Tunisia's independence in 1956, this effort did not last. The Medina of Tunis faced socio-economic disruptions that led to the deterioration of these buildings. Through the establishment of the Association for the Safeguarding of the Medina of Tunis (ASM) in 1967 and the National Institute of Archaeology and Art in 1973, the Medina of Tunis regained its importance and became home to numerous projects *involving restored or converted* heritage buildings, ensuring the resilience of the buildings within the medina.

Our article focuses on the morphological analysis of the Kheireddine Palace converted into the "City of Tunis Museum" through the theory of spatial syntax. It aims to determine whether this reassignment has been an effective mean to meet the challenge of conserving the cultural heritage through conversion.

II. PRESENTATION OF THE KHEIREDDINE PALACE MUSEUM OF THE CITY OF TUNIS

The Kheireddine Palace is a historic monument classified by a decree on October 19, 1992. It is located in the heart of the Medina of Tunis, on the Tribunal Square. It has been converted into the "City of Tunis Museum," which first opened in 1994 and was officially inaugurated in 1999. The museum hosts large-scale visual arts exhibitions. It falls under the jurisdiction of the Municipality of Tunis, specifically the Directorate of Communal Affairs, under the Direction of Cultural Affairs. In the 1990s, the Municipality of Tunis aimed to create a high-quality cultural complex. Therefore, the Association for the Safeguarding of the Medina of Tunis (ASM) proposed the conversion of the Kheireddine Palace and its annexes (including the Jewish school) into a cultural center housing a museum and temporary exhibition space.

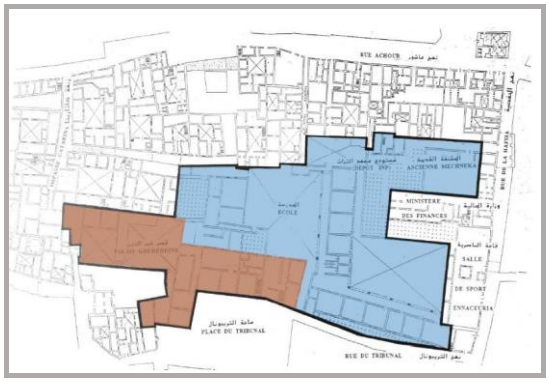


Fig. 1. Location and boundary plan for the entire redevelopment project (Museum and Art Gallery). (Source ASM)

The conversion project was planned in two phases: the first involved repairing and redesigning the administrative areas, the shop, and the area dedicated to temporary exhibitions (marked in brown). The second phase aimed to create the space dedicated to the permanent exhibition (marked in blue). The renovation at the palace included reconfiguration on the ground floor and first floor.

The Kheireddine Palace has undergone various changes in function and morphology over time. Indeed, architectural modifications have caused the loss of its original decoration and features. Its relatively simple ornamentation and spatial layout, consisting of large rectangular rooms interconnected, facilitated its adaptation for the new purpose of conversion: "the exhibited objects should not be hindered by an overly pronounced décor." [1].

However, the planned conversion for the museum and exhibition space was not fully completed, resulting in issues. According to the ASM, in an official document dating back to 1990, the space was intended to become a museum: "a museum of the traditional city […] aiming to showcase to the public and researchers documents tracing the urban history of Tunis and to establish a database on the historic centers of the Maghreb" [1]. Currently, the palace functions solely as an art gallery, occupying a portion of the building. The remaining part intended for conversion into a museum remains unfinished due to squatters occupying the premises.

III. PRESENTATION OF A RESEARCH TOOL BASED ON THE SPATIAL SYNTAX THEORY: DEPTHMAP/WAYFINDING

Spatial syntax is a theory based on predicting the orientation behavior of users in a given space. It quantifies the environment as a set of predictive variables for specific behaviors and predicts Wayfinding behaviors in public areas by targeting people's tendency to move to spaces with higher levels of integration. In other words, such spaces act as transit hubs and are more connected to other places [2]. It is based on human behavior in response to spatial configuration and allows for the decomposition of spatial characteristics in order to understand its structure. Additionally, it provides data on the accessibility of places, their configuration, and access, thereby highlighting social relations within a given space [3].

Depthmap [4] is a software that is based on this theory and has enabled us to derive results regarding the morphological quality of the Tunis City Museum. This method graphically represents the movement and physical and visual accessibility of users within the building. The modeling is based on two principles: visual accessibility, which is defined in spatial syntax by visual permeability, and physical accessibility, which, as the name suggests, refers to physical permeability. According to Hillier, the representation based on physical accessibility takes into account "all obstacles in the space in question that prevent the user from accessing it" [5]. During the modeling process using Depthmap, we consider all elements that constitute an obstacle in the user's visual and physical field in order to create a representation based on visual and physical accessibility. In this regard, we aim to configure the space while taking into account elements that may obstruct the individual's visual and physical field. This analytical method aims to measure the degree of influence of visual and physical accessibility on visitor behavior and the path they may take during their visit, ensuring they can easily orient themselves, follow a route, and have a clear understanding of the exhibition.

We consider first-order values such as "visual integration" and "connectivity," as well as second-order values such as "intelligibility." We used three types of analysis with Depthmap:

A. Visual Graph Analysis *(VGA)*

In our research, the aim of this analysis method is to interpret visual accessibility on a human scale within the museum circuit [6]. The most interesting aspect of this analysis is to correlate visual access within a building with natural user behavior. VGA analysis is based on both visual and physical accessibility and allows us to determine syntactic measures and calculate connectivity, integration, step depth (first-order measures), and intelligibility (second-order measure) [7].

B. Axial Analysis: "All line Analysis"

We conducted an axial analysis to evaluate accessibility in the museum space and signage. This method enables us to use techniques that provide visibility of the studied space through « All Line Analysis » [8].

C. Multi-Agent Analysis

This method reflects user behavior and movement in a space. This step involves launching virtual individuals, referred to as virtual agents, with the software, and they make circulation choices while taking into account the characteristics of the studied space [9].

To carry out this work step, we created the visibility graph and then launched the agents in a 3D plan, orienting themselves according to the configuration of the space. There are parameters in the software that we took into consideration, such as:

- The number of agents to be launched in this analysis

- The number of steps for the agents
- The visual field.

D. Observation through the "Wayfinding" technique

Field surveys are one of the best methods to confirm or refute the results obtained during the analysis conducted with the software. The qualitative study conducted through the survey allows us to compare the simulation results with reality. We will determine the paths chosen by users in the museum. This method provides precise data on users' choices and preferences in terms of routes.

IV. RESULT ANALYSIS

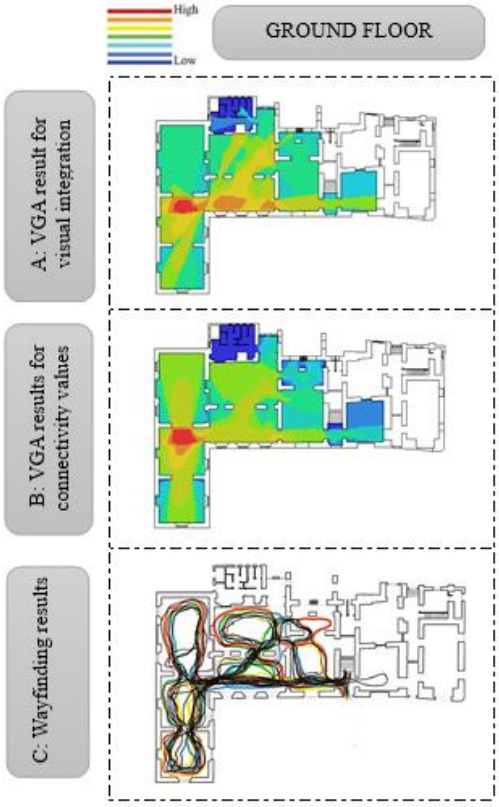


Fig. 2. VGA integration analysis, connectivity, and Wayfinding analysis:Ground floor Museum of the city of Tunis/Kheireddine Palace(source: author)

Figure 2 and 4 presents the VGA maps of integration and connectivity generated by Depthmap. In the third column of the figure, we find the tracing of the trajectory taken by users through the Wayfinding survey. It represents an overlay of about twenty circuits traveled by museum visitors during a temporary exhibition.

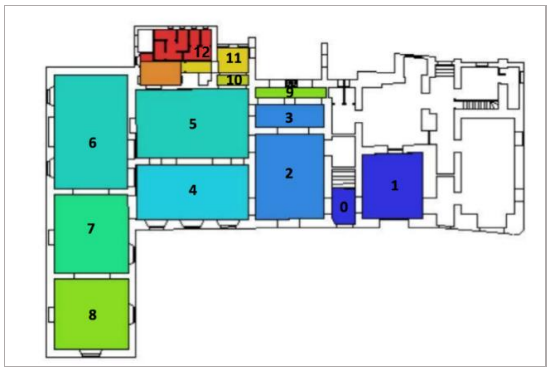
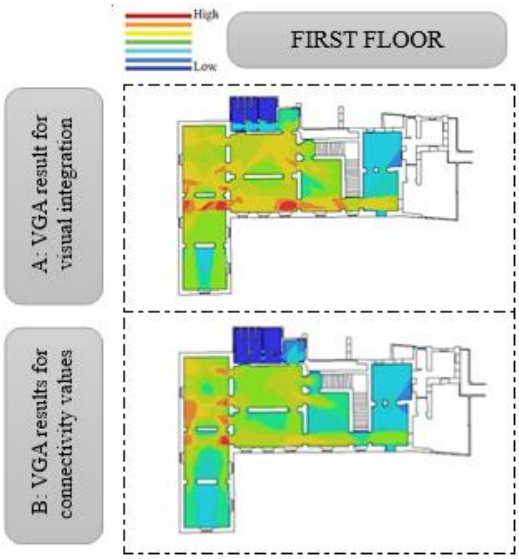


Fig. 3. Ground floor plan of the Kheireddine Palace with legend (source: author)

According to the maps generated by Depthmap, the space shows maximum values along the corridor that serves the three exhibition halls, 3, 4, and 7 on the ground floor (see fig 3), with a maximum value of 18.07. A second orange axis, equally important, diagonally stretches from room 8, crossing through 7 and 4, and ending in room 5. The red-colored area represents the intersection of these two lines, where we find the highest peak of integration.

The space exhibits a very strong connectivity on the ground floor, coinciding with the intersection of circulation corridors, with a value of 5467 connections in room 7. Therefore, it is considered the most integrated and connected space in its surroundings.



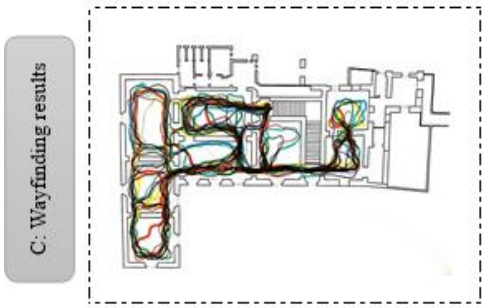


Fig. 4. VGA integration analysis, connectivity, and Wayfinding analysis: First floor Museum of the city of Tunis/Kheireddine Palace(source: author)

The distribution of connectivity values on the upper floor is quite similar to that of the ground floor, with a maximum of 4448 connections in space 4. Meanwhile, the restrooms in space 12 are the least connected spaces, with only 40 connections upstairs, in space 7 we have 57 connections downstairs.

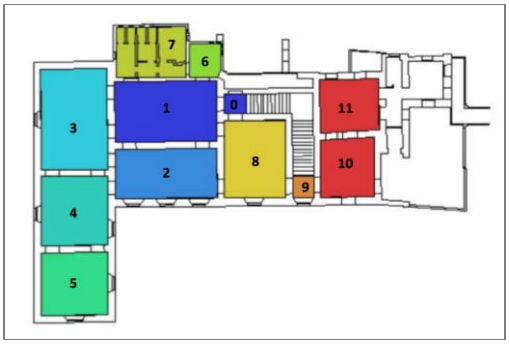


Fig. 5. Upper floor plan of Kheireddine Palace with legend (source: author)

On the upper floor in Figure 4 and 5, some rooms appear to be moderately connected. Despite the presence of the walkway connecting the main core to the other *rooms*, rooms 10 and 11 still seem to be somewhat isolated, with respective low values of 800 and 770 connections. Spaces with increasing connectivity values are those most accessible from different directions.

The visual connectivity maps partially reflect the same distribution of integration values. We observed similarities between the maps from the previous analysis and this one. The dominant axes in the integration and connectivity plans on both floors are almost identical. It can be concluded that the most integrated spaces are also the most connected to their environment.

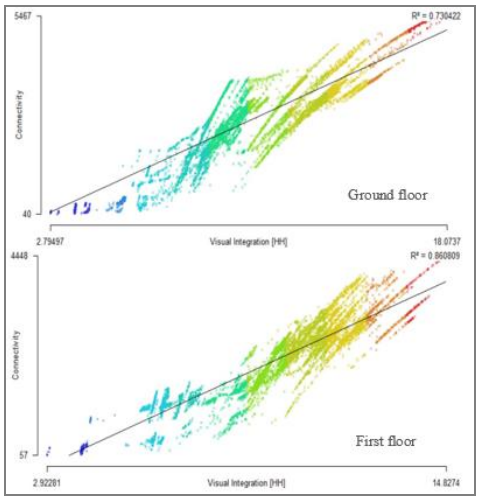
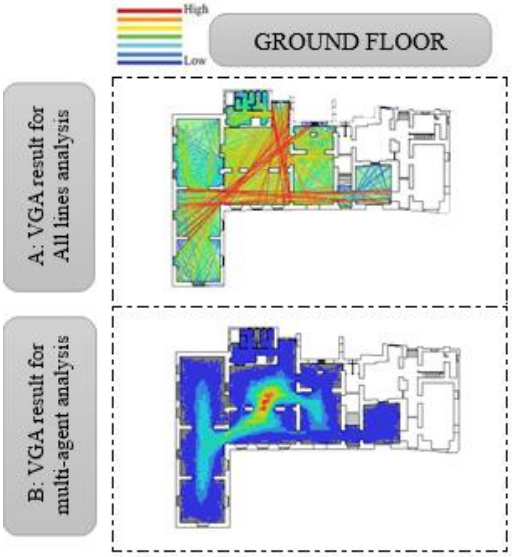


Fig. 6. Result of the VGA for the intelligibility (accessibility) values of the museum(source: author)

The intelligibility, which represents the correlation between connectivity and integration, describes from the overall plan how far the depth of a space can be determined and the number of its direct connections (see Figure 6). It facilitates the understanding of the overall relationship of a space and what is observed within it.

On the ground floor, R2 = 0.73 > 0.5, indicating that the lower floor is moderately intelligible. On the upper floor, R2 = 0.86 > 0.8, indicating that the upper floor is strongly intelligible. Therefore, we can conclude that the space is “intelligible” with optimal local connectivity and is well integrated into the overall system, making the spatial configuration successful.



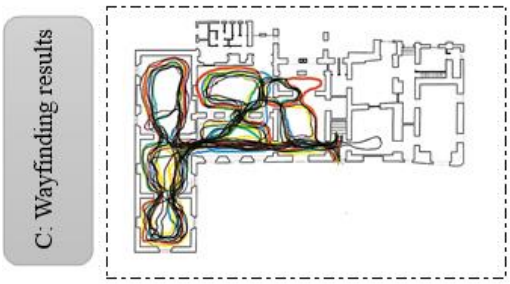


Fig. 7. VGA integration analysis, connectivity, and Wayfinding analysis: ground floor Museum of the city of Tunis/Kheireddine Palace(source: author)

Fig. 8. VGA integration analysis, connectivity, and Wayfinding analysis: first floor Museum of the city of Tunis/Kheireddine Palace(source: author)

According to Figure 7 and 8, column 1, and Figure 9 which represents the routes chosen by visitors using "All Line Analysis," we can identify in red the strong lines of the space. Space 7 is strongly controlled with a value of 1.71, as it is the intersection point of the three most important axes. They can be identified in fig. 9.

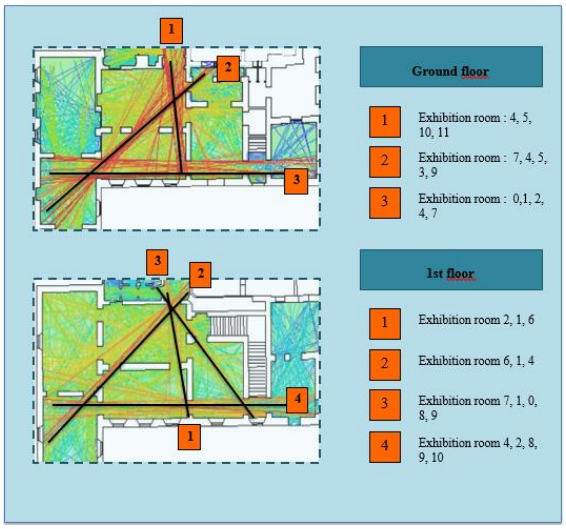


Fig. 9. Detailed result of the VGA for the "All lines analysis" values of Kheireddine Palace (source: author)

It has a relatively high potential, unlike Room 9, which is weakly controlled with a value of only 0.208. The results for the upper floor contradict all previous VGA analyses. The least controlled space is the landing of the stairs, with a value of 0.085. The highly controlled area has a value of 1.94, which corresponds to the restroom. Line 4 in Figure 9 represents an area heavily used by visitors.

In Figure 7 and 8, column 2, we find the plans from the multi-agent analysis. We launched about fifty virtual agents that moved freely within the space. For this step, we rely on dominant colors: blue indicates a low number of agents, while red indicates the opposite. During the setup, we set the number of steps to take before choosing a path to 3.

The virtual agents on the ground floor gravitate around Room 5. Another majority moves along the axis connecting Rooms 6, 7, and 8, without going all the way to each room. Rooms 3 and 9, leading to the garden, are not used during the routes.

The central space on the upper floor, including Room 2, is the most frequented, just like on the ground floor. These are the spaces most visited by users. The upper floor is better distributed among all the rooms. The smooth flow of movement between the first rooms and those served by the footbridge contributes to better user accessibility.

In Figure 7 and 8, column 3, we observe that the Wayfinding analysis via field surveys yields results very similar to those generated by Depthmap.

V. DISCUSSING THE RESULTS

Based on the results obtained through the theory of

spatial syntax, we can deduce that the converted space meets several morphological criteria that make it well suited for its new function as an exhibition space.

We conclude that overall, all exhibition areas are well connected and integrated, so there are no areas that have not been visited by visitors. This was confirmed through the Wayfinding analysis.

The absence of obstacles and changes in direction has made the space “intelligible”.

However, its new allocation, namely the space dedicated to the permanent exhibition, has not been completed. The palace continues to function solely as an art gallery, occupying only part of the building. The other complex that was supposed to be converted into a museum is still occupied by squatters. whereas, the ICOM Charter emphasizes the importance of conservation in the museum context [10].

The designation of the Palace as “the Museum of the City of Tunis” prompts us to question the future of this building, as it does not reflect its original vision of being a museum space. Would it be more appropriate to propose a different name or to create a dedicated area for the permanent exhibition within a portion of the palace, so that its name aligns with its function?

In another research we can use artificial intelligence and augmented reality [11] to create a permanent and virtual collection integrated in the space or exploit the adjacent outside area of the palace. This idea could eventually bring a solution to make the museum more coherent with its name.

REFERENCES

[1] ASM. “Projects and achievements 1980-1990 for the promotion of the medina”. Tunis, p. 68,1990.
[2] Peponis, J. ; Zimring, C. ; Choi, Y.K. Finding the Building in Wayfinding. Environ. Behav. 1990, 22, 555–590, doi :10.1177/0013916590225001.
[3] Space Syntax : A Different Urban PerspectiveArch J, 178 (48) (1983), pp. 47-63
[4] Pinelo, J., and A. Turner. "Introduction to Depthmap." UCL, London (2010): 15-26.
[5] Turner, Alasdair, et al. "From isovists to visibility graphs: a methodology for the analysis of architectural space." Environment and Planning B: Planning and design 28.1 (2001): 103-121.
[6] Turner, Alasdair, et al. "From isovists to visibility graphs: a methodology for the analysis of architectural space." Environment and Planning B: Planning and design 28.1 (2001): 103-121.
[7] B.Hillier, “Space Is the Machine: A Configurational Theory of Architecture”, Cambridge University Press, Electronic edition, London, United Kingdom, 2007.
[8] T. Turner, A., Penn, A., & Hillier, B. (2005), An algorithmic definition of the axial map. Environment and Planning B: Planning and Design 32(3):425
[9] Doulgerakis, Adam. Genetic programming+ unfolding embryology in automated layout planning. Diss. UCL (University College London), 2007.
[10] Conseil international des musées (ICOM) Maison de l’UNESCO 1 rue Miollis – 75 732 Paris cedex 15 – France consulted on 29/05/2023.
[11] Champion, Erik. "Mixed Histories, Augmented Pasts." Playing with the Past: Into the Future. Cham: Springer International Publishing, 2023. 163-184.