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The Role of Interior Spatial Connectivity in Museum Visitor Experience: A Space Syntax Investigation

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ABSTRACT Interior spatial connectivity is a crucial defining factor of the visitor experience in museums, affecting movement patterns, wayfinding, and exhibit interaction. This study investigates how spatial layout affects visitor interaction at the Peshawar Museum, a heritage site famous for its Gandhara art collection. Space Syntax theory is employed through DepthmapX software to analyze the spatial parameters of integration, visibility and connectivity and their effect on the facilitation or obstruction of visitor flow across different spaces. The results show that highly integrated spaces such as the Main Hall promote visitor interaction while segregated spaces are less engaged, causing limited interaction with some exhibits. This is supported by agent-based simulations showing a direct effect of spatial visibility on foot traffic patterns. On the basis of this study, non-intrusive design propositions such as an agile wayfinding system, redistribution of exhibits, and digital navigation enhancements are to be investigated in order to improve circulation without compromising the architectural integrity of the museum. This study contributes to the limited number of spatial connectivity studies in South Asian heritage museums and provides a replicable framework for using evidence-based spatial interventions to enhance visitor experience.

INDEX TERMS DepthmapX, heritage conservation, museum design, Peshawar Museum, space syntax, spatial connectivity, visitor movement

I. INTRODUCTION

Museums are of great importance for preserving and communicating culture, history, and art. The orientation and layout of a museum might affect how its visitors flow and interact with the exhibits. In architectural and cultural studies, there has been a growing interest in how spatial connectivity shapes the experiences of museum visitors. Originating in Space Syntax theory, the term "spatial connectivity" describes how visually and physically connected locations are, impacting the way individuals move through and engage with their surroundings [1].

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There is a research deficit regarding spatial connectivity concerning South Asian museums. Most of the existing studies rely on visitor survey data and observations, which can be biased and subjective [2]. In an effort to bridge that gap, this study analyzes the layout of the Peshawar Museum, renowned for its Gandhara civilization artifacts, by means of the spatial analysis software, DepthmapX [3]. This museum serves as a perfect case study to assess how spatial connectivity affects visitors' experiences. As this study analyzes the spatial connectivity of the Peshawar Museum, its main objectives are:

- To examine how the museum's layout determines visitor movement by analyzing spatial integration and connectivity values through DepthmapX.
- To identify the most connected and least connected areas through visibility graph analysis, demonstrating how spatial organization affects access to exhibits.
- To suggest design improvements to enhance visitor circulation and engagement in the museum based on the findings.

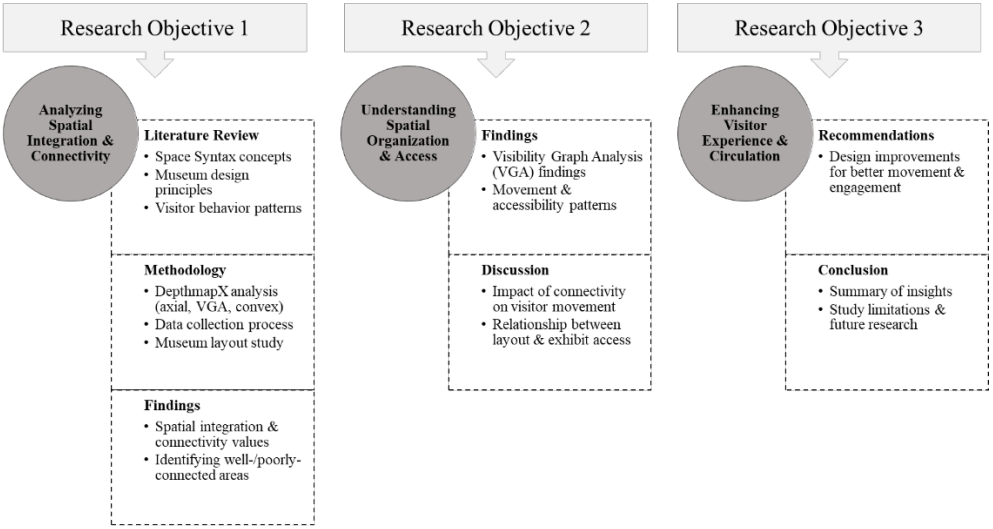


FIGURE 1. Research structure aligned with objectives

This research holds significant importance as it pioneers the application of Space Syntax to museum studies in South Asia, where such an analysis remains rare. The Peshawar Museum has cultural and historical significance hence the understanding of its spatial layout would help improve the visitor

experience and future undertaking. In addition, DepthmapX offers an objective, thus replicable, method for examining the layout of museums, applicable to any number of other institutions [3]. This study analyzes only the floor layouts of the Peshawar Museum based purely on the spatial data from DepthmapX. It does not include visitor surveys or interviews; therefore, subjective visitor experiences such as reactions or learning outcomes were excluded [4].

A. SPACE SYNTAX THEORY AND ITS APPLICATIONS

The Space Syntax theory of Hillier and Hanson [1] provides a framework for understanding spatial configurations and their impact on human behavior. The fundamental premise of Space Syntax concerns with the arrangement of spaces and influences how people move, interact, and use the spaces. Among the key concepts are axial lines, which are the longest unobstructed lines of sight and movement through space. Secondly, Integration values measure the extent of connections a space has with the others in the system [5]. These measures thus allow researchers to evaluate spatial connectivity and also to predict the probable use that people would make of that space. Street networks and building layouts are just two examples of the wide range of applications of Space Syntax in urban planning and architecture [6]. However, there have been fewer uses of it in cultural and heritage contexts, such as museums. Among the first academics to apply Space Syntax in a museum setting, Li and Psarra demonstrate how spatial arrangements impact visitor engagement and investigation [7]. Tzortzi also explored Space Syntax as a basis for making contrastive comparisons of museum layouts; she found that the more integrated a space, the more visitor activity it also tends to attract [8]. These studies show a promising avenue through which Space Syntax can be applied to understand and optimize museum design.

Space Syntax has limitations despite its benefits. The social and cultural factors that greatly impact visitor behavior are often overlooked in favor of its major focus on spatial layouts [9], [10]. While exhibit placement, lighting, and signage may all have an impact on how people move around a museum, Space Syntax assessments do not specifically address these factors. The theory of space syntax is still a useful tool for examining the structural elements of spatial design, particularly when used in conjunction with additional approaches.

B. PESHAWAR MUSEUM: SPATIAL CONNECTIVITY AND VISITOR EXPERIENCE

Established in 1907 during the British rule, the Peshawar Museum is known for one of the largest collections of Gandhara art, including sculptures, coins, and manuscripts concerning the region's rich historical and cultural heritage[11]. The museum's architecture has British colonial and Mughal influences, with high ceilings, arched entrances, and wide galleries meant to accommodate the artifacts and the movement of the visitors [12].

From a spatial connectivity perspective, the museum presents an amazing case for analysis with Space Syntax application. Unlike contemporary museums built with open, highly integrated layouts, the Peshawar Museum adopts a relatively compartmentalized one, with separate galleries housing different themes, including Gandhara art, Islamic art, and ethnography [12]. This separation makes it easy to classify collections, but might also serve to hinder wayfinding, movement behaviors, and engagement of visitors with the exhibits. According to research on museum spatial analysis, Choi and Tzortzi [8] found that high integration in certain spaces tends to encourage exploration, while lower connected spaces are often neglected. The layout of the Peshawar Museum encourages a top-down navigation pattern, whereby some spaces overshadow others from a visitor's perspective in traversing lengthy hallways through somewhat isolated galleries.

C. MUSEUM DESIGN AND VISITOR EXPERIENCE

Museums are expansive spaces where architecture, exhibit design, and visitor behavior work together harmoniously. The design of these spaces plays a very important role in visitor experience, from wayfinding to engaging with exhibits. Bitgood underlines the role of environmental psychology in a museum setting by mentioning that these factors might either facilitate or inhibit visitors' movement and interaction [13]. Open and connected spaces encourage exploratory behavior, while narrow or poorly connected pathways might lead to congestion or, worse, neglect. Falk and Dierking have further consolidated the museum experience by analyzing three key dimensions: the physical, the social, and the personal [14]. The physical dimension is the spatial layout and design of the museum, administering how the visitors move through space directly. The social dimension refers to interactions with other visitors or staff, while the personal dimension refers to individual preferences, motivations, and

learning styles. The study is concerned specifically with the physical dimension, but these dimensions undoubtedly interact to influence the entire visitor experience.

Spatial connectivity influences the museum learning outcomes as well [15]. Well-designed spaces enhance cognitive engagement through easy accessibility of exhibits and decreased cognitive load [10]. A meticulously planned museum layout enables the visitors to wander to engage in the exhibits. On the contrary, a perplexing layout may be frustrating and detract the visitors from the experience.

II. METHODOLOGY

This study utilizes Space Syntax principles to investigate the spatial connectivity of the Peshawar Museum. The research proceeds with DepthmapX to assess how visitors move from one space to another, and how accessible and configured the spaces are. The important parameters studied include Visibility Graph Analysis (VGA), Integration, Connectivity, and Agent-Based Analysis.

The first stage of the analysis considers Visibility Graph Analysis to assess sightlines and spatial relationships among the spaces. VGA determines what part of the museum is visible from any given point so that the analyst can identify places that are well-exposed and those that are hidden. High visibility spaces show a greater probability of drawing in visitors, while those with lower visibility may be ignored. Integration Analysis examines the degree of connectivity within a given layout. As such, the highly integrated spaces are central to movement and thus receive more foot traffic in their vicinity. On the other hand, segregated areas are harder to access potentially leading to lower visitor engagement. The Connectivity Analysis examines how many direct connections each space has with the surroundings. If a space has high connectivity, it serves as an important nexus that facilitates smooth movement. On the contrary, spaces with low connectivity may be said to exist in isolation. Finally, Agent-Based Analysis is employed to model pedestrian movement in the museum. Simulating the behavior of visitor flow, this analysis identifies the highly visited areas, bottleneck spaces, and underutilized spaces. Such findings assist in predicting real-world navigation patterns while highlighting areas where movement can be improved.

The combinations of these analyses paint a holistic picture of spatial

connectivity in the museum. The study aims to provide evidence-based recommendations to improve visitor experience, optimal space organization, and increase accessibility in the Peshawar Museum.

III. RESULTS

The spatial analysis of the Peshawar Museum underscores the importance of visibility, integration, and connectivity, with each notion affecting visitor movement and exhibit engagement. This section investigates the relationship of spatial configuration to the distribution of foot traffic through Visibility Graph Analysis (VGA), Integration Analysis, and Agent-Based Simulations to identify zones that enhance or suppress visitor flow.

(a) Main Hall

(b) Transition Corridor towards Gandhara Gallery

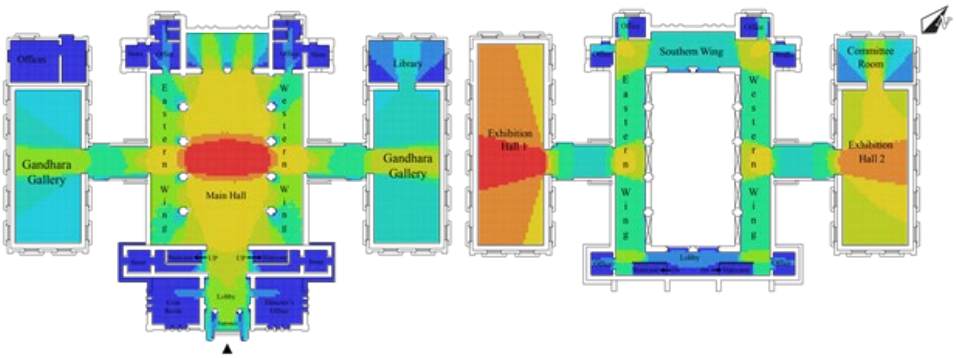
(c) Staircase

FIGURE 2. Some glimpse from Peshawar museum

A. SPATIAL VISIBILITY AND EXPOSURE

Visibility Graph Analysis (VGA) of the Peshawar Museum provides insights through the lenses of spatial visibility, movement potential, and integration concerning both floors. This study investigates how various spaces provide visual access and movement flow by utilizing heat maps and quantitative values. Among other spaces, the Main Hall (ground floor) appears as the most visually connected space (represented in red on the heatmap) and has the highest connectivity values (maximum: 5859, average: 2463.1). This implies that the Main Hall has the furthest visual access and is the main reference point for visitors. In contrast, the Gandhara Galleries and Library hold a position of moderate visibility (represented by a green-to-blue gradient) validating these spaces' comparatively lower connectivity. Moderate connectivity and visibility across the lobby areas

and staircases are important in bridging other spaces within the museum but have limited visibility when compared to the Main Hall. Peripheral spaces, like offices, the coin room, the Director's office, and storage areas, fall under the least visible ones (Blue in the heatmap). Their limited visibility and connectivity with the rest of the museum establish them as isolated spaces, with their connectivity values being the lowest (minimum: 9).



(a) Ground Floor Plan (b) First Floor Plan

FIGURE 3. Heatmaps of visibility graph analysis of Peshawar museum

The Main Hall stands out for its central role in visual accessibility (Point First Moment) and its greatest variation in spatial depth (Point Second Moment). This suggests a regimented yet flexible navigation system, with the Main Hall as an anchor, and a hierarchical movement pattern due to varying depth relationships. On the first floor, Exhibition Hall 1 (left) continues with the integrity of the Main Hall as the biggest visible hub. With a maximum connectivity value of 2600 and an average of 1497.63, this space has the highest connectivity, rendering it the most visually dominating space on this floor. The Eastern and Western Wings have moderate visibility (Yellow-Green), forming a passageway while still being secondary to Exhibition Hall 2 (right). The Southern Wing, together with offices and the Committee Room indicate the lowest level of visibility (blue zones), meaning they have little integration with the rest of the space.

Quantitative analysis confirms the hierarchy, with the First Floor showing lower Point First Moment values (avg: 2,124.98, max: 4,634.67) and less variation in spatial depth (Point Second Moment: max: 12,342.6, avg: 4,187.23), indicating a more compartmentalized floor.

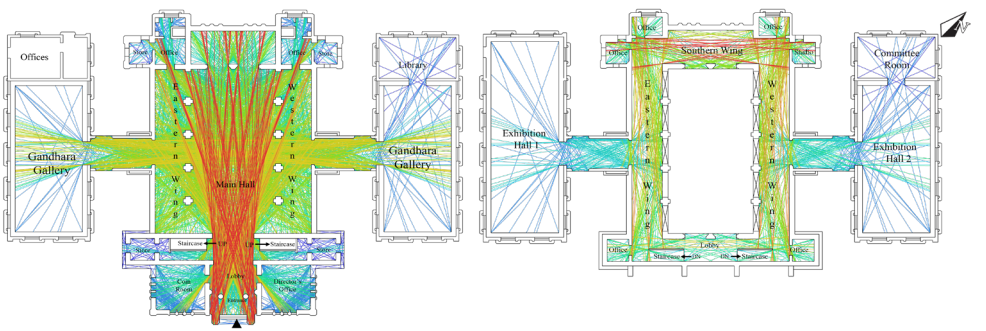
TABLE 1
QUANTITATIVE VALUES OF VISIBILIATY GRAPH ANALYSIS OF PESHAWAR MUSEUM

Attribute	Ground Floor			First Floor		
	Minimum	Average	Maximum	Minimum	Average	Maximum
Connectivity	9	2463.1	5859	79	1497.63	2600
Point First Moment	1.18126	4637.24	10795.3	19.6734	2124.98	4634.67
Point Second Moment	0.135	12629.3	52340.7	5.33	4187.23	12342.6

The cross-floor analysis reveals that the Main Hall (Ground Floor) and Exhibition Hall 1 (First Floor) are the highest visible cores, creating a focus for movement and interaction. While these spaces are central, staircases are moderately integrated with lower connectivity than the halls they connect, suggesting that vertical circulation does not strongly reinforce visual continuity across floors. The spaces along the edges of both floors have low visibility. This creates a strong spatial hierarchy. The central spaces guide how people move, while the outer spaces remain visually disconnected and less noticeable.

B. INTEGRATION AND CONNECTIVITY OF SPACES

The spatial hierarchy and movement potential of the museum layout are quantitatively highlighted by an integration analysis performed with DepthMapX. Interestingly, the Main Hall on the ground floor is the most integrated area (max: 21.2102, avg: 10.9371). The Main Hall is a major point of interaction with substantial connectivity indicators (max: 1608, avg: 737.122) that surpass direct connections.



(a) Ground Floor Plan (b) First Floor Plan

FIGURE 4. Heatmaps of integration and connectivity analysis of Peshawar

museum

On the other hand, the Director's Office and the Coins Room have significantly lower connectivity levels (<4), indicating acute inaccessibility. With an average of 1.30604, entropy—a measure of randomness—remains low, indicating predictable patterns of movement. Access to less integrated spaces is limited on the ground floor, where mobility is concentrated in core areas. The maximum value (8.66927) and average line length (2.93698) both corroborate this finding. With high integration [HH] values (max: 8.50115, avg: 4.89799), the Exhibition Hall on the first-floor functions as an important navigation nexus. In contrast to the ground floor, the connectivity values are lower (max: 266, avg: 125.126), indicating a reduced accessibility. More diverse movement patterns are indicated by an increase in entropy (avg: 1.94976).

TABLE II

QUANTITATIVE VALUES OF INTEGRATION AND CONNECTIVIY ANALYSIS OF PESHAWAR MUSEUM

Attribute	Ground Floor			First Floor		
	Minimum	Average	Maximum	Minimum	Average	Maximum
Connectivity	4	737.122	1608	16	125.126	266
Line Length	0.108973	2.93698	8.66927	0.225141	2.2074	5.14775
Entropy	0.982578	1.30604	1.54178	1.4714	1.94976	2.51705
Integration [HH]	3.1113	10.9371	21.2102	2.11206	4.89799	8.50115
Integration [P-value]	3.1113	10.9371	21.2102	2.11206	4.89799	8.50115
Integration [Tekl]	0.805668	0.932203	1.02731	0.757252	0.846752	0.923942
Intensity	0.452207	1.61528	2.71972	0.765538	1.35517	1.93319
Harmonic Mean Depth	5.87738	55.7313	217.646	34.3299	87.5595	181.27
Mean Depth	1.4131	1.92562	3.81618	1.8078	2.51043	4.25145
Node Count	2596	2596	2596	693	693	693
Relativized Entropy	1.14203	1.57329	3.04037	1.27754	1.62092	2.31132

Since the first floor has a more segregated spatial structure, the mean depth (average number of steps to reach a location) is higher there (2.51043 vs. 1.92562 on the ground floor). A drop in the harmonic mean depth (181.27 vs. 217.646) also suggests less perceptible movement. The first floor has a shorter average line length (2.2074), which limits mobility routes to more constrained spaces.

C. MOVEMENT PATTERNS AND CONGESTION POINTS

The agent-based analysis of the Peshawar Museum offers a comprehensive understanding of how visitors navigate through the space, validating the insights from VGA. With the movement simulation, the analysis explains how spatial layout affects visitor flow and concentration. The results support high-visibility areas as the primary movement spaces, while low-visibility zones seem to be isolated.

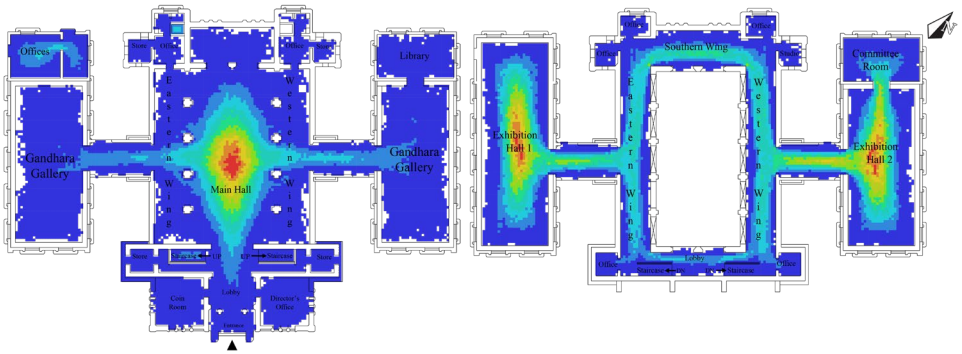


FIGURE 5. Heatmaps of agent-based analysis of Peshawar museum

The Ground Floor heatmap confirms the Main Hall as the key movement area, with red zones of high intensity standing for major visitor presence. This is consistent with the VGA, which confirmed the Main Hall as the most visually integrated space, hence having high connectivity (max: 5859, avg: 2463.1) that facilitates an abundance of foot traffic. The pathways leading to the Gandhara Gallery and Library observe moderate agent movement, with a gradient scale of green to yellow, indicating secondary yet significant circulation. These areas are equally visible, but visitors tend to avoid them, confirming the museum's movement hierarchy. In contrast, the Offices, Coin Room, and Director's Office see almost no activity. The entrance, lobby, and staircase area experience moderate foot traffic, serving as transitional spaces that facilitate circulation rather than attracting visitors. The quantitative correlation between the VGA metrics and the results of agent simulation further supports these patterns of circulation. In the Main Hall, high values of the First Moment and Second Moment reflect complex spatial depth relationships that correlate with agent density.

Exhibition Hall 1 (left) on the first-floor functions as the main connectivity hub similar to the Main Hall on the ground floor. Heat-maps reveal, it

receives the most activity from agents. This is because its VGA connectivity values are the highest, with a maximum of 2600 and an average of 1497.63. Eastern and Western Wings gather moderate concentrations of movement, with the green-to-yellow range indicating that those spaces are facilitating circulation but are not major attractors. The staircases have moderate movement connecting both floors, serving as secondary and necessary transition areas. The Main Hall and Exhibition Hall 1 serve as key areas for movement and visibility, forming a strong spatial hierarchy where visitors converge in core zones. Areas with low visual connectivity are largely abandoned, confirming a strong relationship between visual connectivity and movement. Staircases and other transitional spaces maintain moderate movement levels, providing vital connective paths that facilitate circulation without being primary destinations.

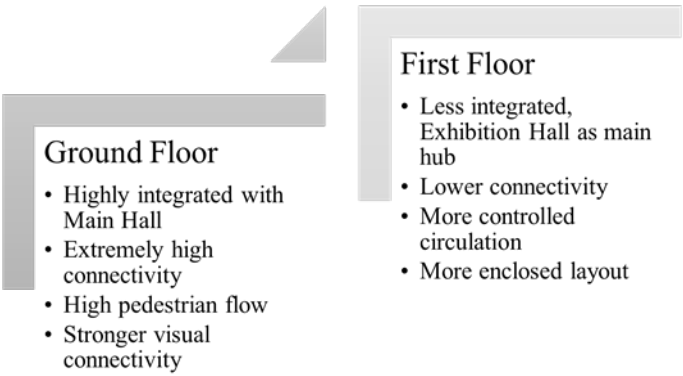


FIGURE 6. VGA, integration, and movement trends in Peshawar museum

IV. DISCUSSION

The findings highlighted how spatial connectivity and visibility influence visitor movement, shaping exhibit engagement and the general experience of the museum. This section interprets the results one degree further, examining their implications concerning wayfinding, accessibility, congestion, and exhibit placement within Peshawar Museum.

Visibility plays a crucial role in shaping the museum experience and directs the way visitors wander through the exhibits. The ground floor is better connected and has a stronger visibility graph. The ground floor enables free movement towards rich visitor orientation. Open, interconnected spaces

allow better wayfinding ensuring easy findability between key exhibits and disorientation-free movement. This resonates with Wineman and Peponis's findings, which hold that spatial affordances directly structure visitor engagement to exploration patterns [10]. In contrast, the first floor provides a more enclosed configuration that produces lower visibility, and spatial inaccessibility. Such exhibit division can lead to a more structured and linear museum visit where visitors are constrained to a channel of specific pathways instead of a free-ranging experience. Whereas this could benefit narrative-based exhibition strategies, it may tend to develop bottleneck areas [7]. Restricted visibility provided by museums presents numerous problems with the flow of people leading to congestion at important places and underutilization at minor zones as stated by Li and Psarra [7].

From the VGA perspective, the ground floor promotes serendipitous discovery where visitors can interact with exhibits unplanned but with interest. Open, highly visible areas tend to draw more foot traffic according to this logic, thus suggesting the relevance of spatial layout on exhibit popularity. According to King et al., museums should balance the use of open and enclosed spaces for spontaneous discovery and storytelling [15]. The current spatial analysis indicates that the ground floor is the area best suited to spontaneous open exploration, while the first floor is better for controlled thematic storytelling.

Integration emerges as a significant measure in determining how to design museums, wherein spatial hierarchy influences visitor movement. The higher integration values for the ground floor imply that it functions essentially as the main circulation hub of the museum, linking a number of spaces. Consequently, the main hall serves as the prime anchor, reinforcing Hillier and Hanson's theory of space syntax as a highly integrated space that naturally attracts and holds the interest of visitors [1].

The first floor is characterized by lower integration levels, hence more shattered experiences of space. This could lead to wayfinding disruption, especially for first-time visitors. Tzortzi points out that museum layouts with low integration scores would typically also need complemented wayfinding aids such as signage, maps, or guided tours for intuitive spatial flow [8]. The Exhibition Hall 1 on the first floor is integrated most closely but even that hall does not seem to relate to the surrounding spaces, which indicates that some wayfinding strategies need to be further improved. Also, the first-floor depth values are greater; this indicates that some areas need

several transitions before one can reach them. This probably deters casual exploration and could even lead to drop-off points for visitors in less accessible places. Turner et al. note that spatial depth tends to determine movement patterns by making deeper spaces far less frequented by visitors [3]. This highlights the strategic placement of exhibits, ensuring that key artifacts or displays are not tucked away in low-integration zones, where they might attract minimal attention.

Smooth connectivity and circulation become vital for the museum since they strengthen exhibit engagement as well as a visitor's experience and accessibility. An effective functional setting within a museum facilitates movement on the part of visitors into and through the space, and encourages engagement with the displayed artifacts. Studies about layouts in museums have shown that spatial affordances guide people in their navigation and engagement with exhibits. It implies that some spaces may even dissuade movement [16].

Seamless connectivity, intuitive pathways, and accessibility are the primary aspects that concern the connectivity scheme. The spatial configuration of a museum serves to facilitate visitor-induced movement and engagement with the displayed artifacts. Research on museum layouts indicates that people are guided by spatial affordances in their navigation and engagement with exhibits, which implies that certain spaces may also discourage movement [16]. The primary considerations for a connectivity scheme include seamlessness, intuitive pathways, and accessibility. Application of space syntax theory has shown that spaces with good connectivity can create an organic flow of visitors, which minimizes crowding and promotes circulation efficiency [9], [10]. Space syntax analyses such as axial mapping and visibility graphs point out highly connected areas in the museum space, informing architects about designing spaces to favor smooth transitions among galleries and exhibit areas [6], [17].

A hierarchy of spaces—with primary spaces for major transitions and secondary spaces for exploration—enhances visitor experience with structured trajectories and spontaneous movement. It can be shown that visitors tend to enjoy the clarity of being on direct paths that provide them with opportunities for serendipitous discoveries [15]. Wayfinding elements like signs and visual clues contribute to directing visitors through the museum as efficiently as possible, reducing confusion and backtracking [13]. The contrasting scenarios of guided tours versus almost free

movement would also weigh into connectivity; studies show higher satisfaction levels associated with self-guided movement when spatial connectivity is optimized [14]. With respect to the enhancement of connectivity, technological support in terms of real-time tracking of visitors and interactive digital maps would reinforce connectivity. DepthmapX has been used to provide an analysis of traffic patterns and to forecast expected points of congestion for the improvement of the museum layout, based on an open-source space network analysis tool [3]. Such methods would offer insight into circulation efficiency to allow fluidity in visitor movement pathways to reflect different densities of visitor crowds.

Bottlenecks within a museum arise due to a combination of factors such as constraints of architecture, exhibit placement, and visitor behavior. Congestion in high-traffic areas at entrance junctures and transitional points between exhibitions and popular displays compromises visitor comfort and leads to extended periods of time spent in critical areas[18]. . The redistribution of space for exhibits of interest is one of the main strategies for flow optimization. Evidence exists that places, where exhibits receive focal attention, are dispersed over many zones to spread the visitor demand more evenly among exhibits and lessen congestion within given sections [7]. This method is in accordance with space syntax theory wherein high integration spaces tend to be natural attractors balancing the movement density throughout the entire museum layout [19]. With multiple visual and physical access points to displays, designers can disperse visitor flow within the museum. The integration of flexible exhibition spaces provides an opportunity for circulation patterns to best respond to visitor demand as well as seasonal variations in foot traffic.

Another important consideration in flow optimization is to facilitate multiple accesses and exits. A museum with a single entrance and exit often exhibits bottlenecks at these openings, especially during peak times. The decentralization of entrance points with staggered timings would potentially decrease congestion and enhance circulation efficacies [2]. By utilizing real-time crowd monitoring, museums can enhance the visitor experience while managing visitor density and circulation efficiency in an adaptive manner [20]. Successfully upheld connectivity and circulation efficiency within the museum constitute appropriate design considerations for visitor engagement and experience. By applying an intelligent site-planning strategy, manipulating advanced analytical tools, and following adaptive

management strategies, museums might be in a better position to counter bottlenecks and optimize movement flow on a visitor journey.

A. DESIGN RECOMMENDATIONS

Considering the history of the Peshawar Museum, Design modifications should be non-intrusive and respectful of the museum's architectural integrity. The emphasis should be on improving circulation, wayfinding, and visitor engagement using spatial analysis without necessitating structural alteration to the building.

- Installing prominent bilingual (English and Urdu) signage at key junctions can enhance wayfinding, particularly for isolated areas, such as staircases and peripheral galleries. Subtle, removable floor markings can lead visitors along the best routes based on space syntactic analysis, with color-coded pathways leading to associated exhibit themes, including Gandhara art, Islamic art, and others. Additionally, mobile apps with real-time interactive maps or digital touchscreen kiosks can make wayfinding more effective and provide better travel preparation for guests.
- Establishing a visitor circulation path can effectively organize visitor movement through a high-integration space while delivering a seamless visitor experience by regulating traffic at peak times. By relocating or emphasizing key objects to underused spaces, one could encourage more movement throughout the entire floor.
- Strategic placement of seating within the transition spaces may allow users to rest and encourage natural movement patterns to promote further access. By using virtual tour screens, the museum experience becomes more inclusive by providing a digital extension of inaccessible exhibits in not-so-frequented or physically demanding areas.
- Vertical circulation is a significant issue affecting the museum's accessibility. The staircases exhibit only moderate interconnection, further complicating access. Improved illumination, wall art, or contrasting floor colors can help them stand out and attract even more visitors. Floor-based navigation and wall art displays leading to the staircases could improve exploring both floors even more.

B. *CONCLUSION*

This study reflects a significant influence on how spatial connectivity, integration, and visibility shape the visitor experience at the Peshawar

Museum. The three research objectives are met holistically through Space Syntax analysis. First, concerning the spatial layout of the museum, highly integrated and visually linked spaces, such as the Main Hall and Exhibition Hall 1, can function as primary anchors for movement and interaction. The second outcome is a visibility graph and integration analysis, which produces zones of limited access and exposure; in these zones, peripheral and upper-floor spaces may be those where connectivity is low and foot traffic is minimal. The unequal engagement of visitors can partly result from spatial disparities, leading to the underuse of some potentially valuable exhibit areas. Agent-based simulation validated the correlation between space properties and movement behavior. This attests that space configuration not only influences circulation but also the quality of interaction with exhibits. Taken together, these findings call for subtle but strategic interventions, such as improved signage, digital wayfinding tools, and well-optimized exhibit placement, to create a more intuitive and inclusive navigation experience. These design improvements can enhance accessibility, balance visitor distribution, and elevate experience quality without altering the historic architectural fabric of the building.

In brief, this study offers a comprehensive spatial analysis of the Peshawar Museum. It provides a replicable template to cultural institutions wishing to base their practices on fact-based evidence and enhance visitor flow. It reinforces the idea that museum architecture is not simply about the backdrop of its collection but contributes actively to the building of experience and engagement.

Author Contribution

Sole Author

Conflict of interest

The author of the manuscript has no financial or non-financial conflict of interest in the subject matter or materials discussed in this manuscript.

Data Availability Statement

The data associated with this study will be provided by the corresponding author upon request.

Funding details

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Generative AI Disclosure Statement

The authors did not used any type of generative artificial intelligence software for this research.

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