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From Heritage to Commerce: Utilizing Space Syntax to Optimize Visibility for Retail interior design in Al-Turaif's Touristic Landscape

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Abstract

This study investigates retail visibility within the heritage tourism context of Al-Turaif district, Saudi Arabia, applying Space Syntax theory including isovist analysis, axial mapping, and Visibility Graph Analysis (VGA) to examine both outdoor and indoor visual and navigational possibilities. It aims to explore how Najdi interior design concepts can be integrated into Culture Concept Stores to enhance spatial connectivity, product visibility, and visitor attraction. The research draws on extensive spatial mapping, many qualitative interviews with stakeholders, site observations, and visitor feedback.

At the macro level, the study assesses how retail locations influence visitor patterns, storytelling, and engagement within the broader heritage site. Locally, it analyzes interior spatial connectivity, external sightlines, zoning effectiveness, and commercial performance. Findings reveal that enhancing spatial visibility consistently supports cultural authenticity and visitor demand while preserving traditional aesthetics. The study culminates in a practical design framework that

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aligns traditional architectural identity with retail functionality. This framework serves as a valuable tool for urban designers, heritage site managers, and policymakers seeking to balance cultural preservation with economic viability, ultimately boosting both the cultural and economic value of heritage tourism destinations.

Keywords: Al-Turaif, Najdi Interior Design, Heritage Tourism, Visibility Interior Design, Products Value, Visibility Graph Analysis (VGA), Space Syntax.

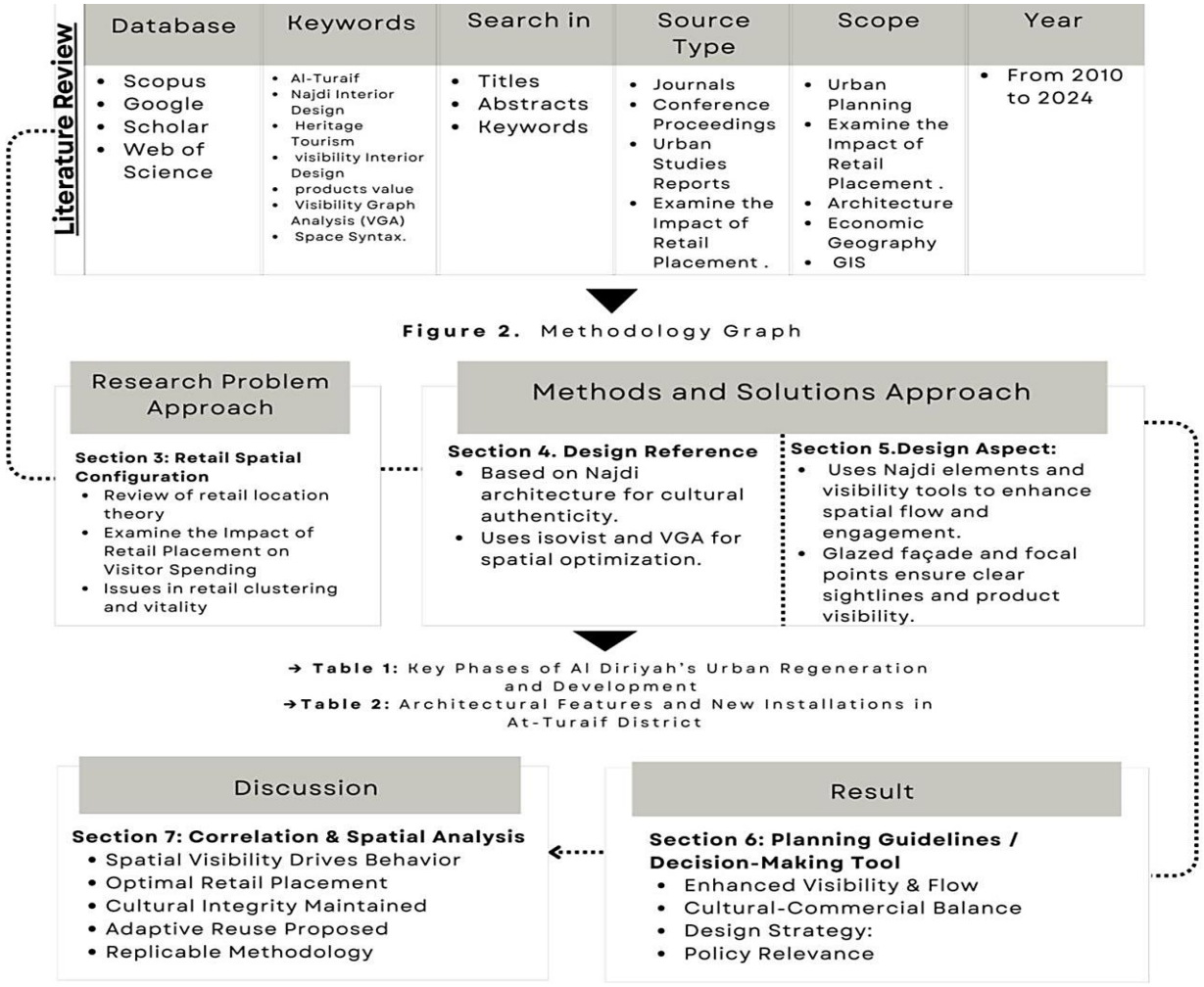

Figure 1. Abstract Graph

1. Introduction

1.1. Background:

Aligned with Saudi Vision 2030 and King Salman's Urban Charter, this study develops spatially informed commercial frameworks that balance heritage conservation with sustainable economic growth in historic urban areas. Smart retail technologies like digital navigation and augmented reality enhance visitor experience and operational efficiency, especially when integrated with traditional Najdi spatial patterns. Al-Turaif, a UNESCO site under redevelopment, exemplifies how heritage and commerce can coexist through such frameworks (Mazzetto, 2022; Ilayan, 2024). Glodzinski (2018) emphasizes the need for structured assessment models to align cultural preservation with commercial viability. Under Vision 2030, heritage conservation supports economic diversification and sustainable cultural tourism (Saad Hanif & Riza, 2024). Combining traditional design with smart retail boosts engagement and economic resilience (Bay et al., 2022), but balancing innovation with historical authenticity remains a challenge (Alnaim, 2021). This study proposes an integrated framework to evaluate spatial visibility, cultural coherence, and commercial function, using Al-Turaif as a case study.

Heritagization strengthens national identity and economic development by adaptively reusing historic sites (Geçikli et al., 2024). Effective management requires frameworks that assess the spatial and economic integration of commerce and heritage (Glodzinski, 2018). Najdi architecture, with its earthen materials and climate-adaptive design, offers a strong basis for this integration (Aliraqi, 2022).

The proposed framework applies space syntax and spatial visibility analysis to Al-Turaif's interiors, assessing how spatial layout influences movement, product interaction, and cultural meaning. It aims to identify spatial arrangements that uphold heritage integrity while enhancing commercial viability. The findings

support the design and management of heritage-commercial revitalization projects, contributing to sustainable urban development (Naseem, 2021; Bay et al., 2022).

1.2. Problem Statement:

There is a growing demand for robust assessment frameworks that support the integration of commercial functions into heritage sites while preserving cultural authenticity and spatial coherence (Glodzinski, 2018). Existing approaches often overlook spatial visibility, user movement, and the application of heritage design principles resulting in retail environments that fail to fully engage visitors or respect the historical context.

Although studies show that positioning retail zones at the end of heritage tours increases tourist spending (Garcia et al., 2022), limited research addresses how spatial configurations within heritage buildings influence behavior, interaction, and economic performance. Moreover, design elements such as glazed façades used to enhance visual access and draw visitor attention lack structured evaluation within culturally grounded spatial models.

This study responds to these gaps by proposing an integrated assessment framework based on space syntax and isovist analysis to evaluate visibility, cultural alignment, and commercial potential. The framework is applied to Al-Turaif, a UNESCO World Heritage Site, where it informs spatial planning strategies that balance heritage preservation with economically sustainable retail development.

1.3. Research Objectives:

This study seeks to develop a comprehensive design framework for integration of commercial functions within heritage architecture, with a focus on spatial visibility, cultural coherence, and economic viability. Building on the principles of space syntax and heritage-informed design, the research addresses how spatial configurations and visual strategies such as glazed façades can enhance visitor

engagement and support sustainable development in heritage-commercial environments. Specifically, the objectives are to:

1. Adapt Najdi Architectural Elements into Commercial Interiors: Examine how traditional Najdi design features can be integrated into retail layouts to maintain cultural identity while enhancing commercial utility.
2. Inform Heritage Retail Policy and Spatial Design Guidelines: Generate practical recommendations for policymakers, planners, and designers aiming to balance commercial objectives with heritage preservation in the redevelopment of historic urban sites, using Al-Turaif as a case study.
3. Analyze Visual Performance through Architectural Features: Explore the role of design interventions such as glazed façades in drawing attention and increasing interaction with retail spaces in culturally sensitive contexts.
4. Establish a Spatial Assessment Framework: Develop and apply a methodological model using space syntax tools such as isovist and visibility graph analysis to assess spatial visibility, accessibility, and user movement in heritage retail settings.

2. Literature Review

Hanif and Riza (2022) examine the transformation of Al-Diriyah, a UNESCO World Heritage Site, through the lens of cultural branding and developmental planning. Their qualitative, multi-method research combines document analysis and on-site fieldwork to trace how heritage revitalization in Al-Diriyah has evolved beyond preservation into a model of cultural capital formation. The study positions "heritagization" not merely as a conservation strategy but as a process that facilitates the commodification of culture, boosts tourism, and stimulates economic development. This rebranding aligns with broader state efforts to reposition heritage assets within the framework of national identity and global cultural tourism markets

The transformation of Al-Diriyah has boosted cultural tourism but also raises concerns about heritage commodification and loss of authenticity. The study stresses the need to balance economic gains from urban branding with the preservation of cultural integrity. While Vision 2030's heritagization efforts can revitalize historic sites, the research calls for strict preservation protocols to protect their original significance and cultural essence

Hanif and Riza (2022) examine the transformation of Al Diriyah from a historical ruin to a cultural tourism hub under Saudi Arabia's Vision 2030. Once the capital of the First Saudi State (1446– 1818), Al Diriyah gained UNESCO World Heritage status in 2010, following research initiated in 1974.

With the establishment of the Diriyah Gate Development Authority (DGDA) in 2017, the site saw a $18.5 billion redevelopment aimed at attracting 25 million annual visitors. Major projects like the Arena and King Salman Boulevard reflect this shift toward global tourism. The study identifies three transformation phases conservation (1986–2010), preservation (2010–2017), and tourismdriven development (2017–2024) while cautioning against over-commercialization that may undermine cultural authenticity.

The research highlights the need to balance development with cultural preservation, promoting heritagization as a tool for sustainable urban growth. Alnaim (2021) examines traditional Najdi architectural elements across settlements like Ad-Diriyah, Sudus, and old Riyadh, focusing on the Alfuraj pattern and Shuraf features. These elements served both functional and symbolic roles, reflecting shared socio-cultural meanings.

The Alfuraj, commonly found on exterior walls near open areas, enhances airflow and daylight while softening dense facades. Its use varied by building size and location, reflecting adaptability without class restrictions. Alnaim emphasizes that

preserving the authentic identity of Najdi architecture requires understanding the evolution of these elements, not just their final forms.

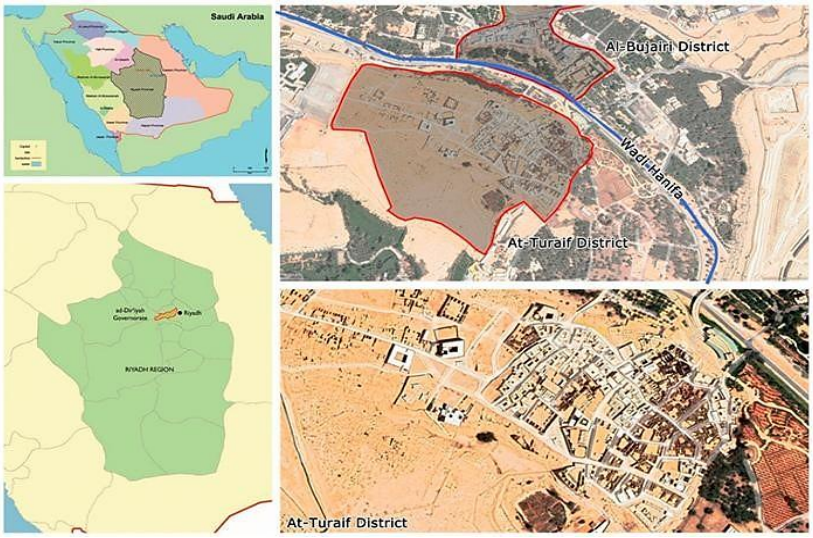

Figure 2 At-Turaif District in Ad-Dir'iyah and its unique location on the Hanifah Valley and part or Riyadh Region

Bay et al. (2021) examine the heritage management of At-Turaif through historical images, archives, and stakeholder interviews, identifying three phases: pre-2010, conservation (2010–2017), and redevelopment under Vision 2030 (2017–present). Saudi Arabia's $18.5 billion investment aims to establish At-Turaif as a global heritage tourism hub attracting 25 million visitors annually. While the project offers economic and cultural benefits, the study warns against over-commercialization and emphasizes the importance of maintaining cultural authenticity in heritage-led development.

In heritage retail, product value is shaped by spatial visibility, cultural narrative, and experiential design. Strategically positioning merchandise in authentic environments enhances perceived worth and user engagement. Geçikli et al. (2024) underscore the role of culturally integrated design in reinforcing product appeal and emotional resonance.

Additionally, Geçikli et al. (2024) conducted a bibliometric analysis of 657 studies

on cultural heritage tourism and sustainability from 2001–2024. The research identifies four major themes: authenticity, conservation, ecotourism, and sustainable development. China and the U.S. lead in research output, while Tourism Management and Sustainability are the most cited journals. The study calls for cross-disciplinary collaboration and evidence-based policymaking to support sustainable heritage tourism.

Assessment frameworks are essential in adapting heritage spaces for commercial use while preserving cultural integrity. Glodzinski (2018) offers a multidimensional model that combines qualitative and quantitative indicators such as user engagement, stakeholder satisfaction, and cultural alignment across two stages: preparation and execution. Though robust, such frameworks are underused in heritage-retail settings, especially for evaluating visibility and spatial coherence.

This study adapts Glodzinski's model to Al-Turaif, integrating space syntax and isovist tools to analyze visual connectivity and optimize retail layout without compromising authenticity.

Isovist and Visibility Graph Analysis (VGA) help assess how spatial layouts influence perception and behavior. Benedikt's (1979) isovist method quantifies visibility, supporting insights into psychological responses like prospect and refuge (Dawes & Ostwald, 2014), while VGA models local and global connectivity. In Al-Turaif, these tools identify optimal visibility zones for retail, guided by metrics like area and occlusivity. Software like Isovist_App and DepthmapX, supported by recent advancements (Alamdari et al., 2022), improve practical application in heritage design.

In heritage interiors, visibility influences both navigation and cultural interpretation. At Al-Turaif, preserving Najdi aesthetics through visual continuity enhances cultural resonance (Bay et al., 2022). Mazzetto (2022) and Aliraqi (2022) highlight how strategic openness improves flow and emotional connection. This study extends isovist and VGA use to propose design strategies such as transparent

glazing—that enhance visual engagement while respecting heritage values.

Naseem (2021) shows tourism's strong impact on Saudi GDP, with a 1% rise in receipts and expenditure contributing 0.834% and 0.82%, respectively, to growth. A 1% increase in tourist arrivals raises GDP by 0.925%. Tourism accounted for 9.5% of GDP and 11.2% of employment in 2019. The study supports Vision 2030 goals and calls for sustainable policies that balance economic growth with environmental protection.

3. Methodology

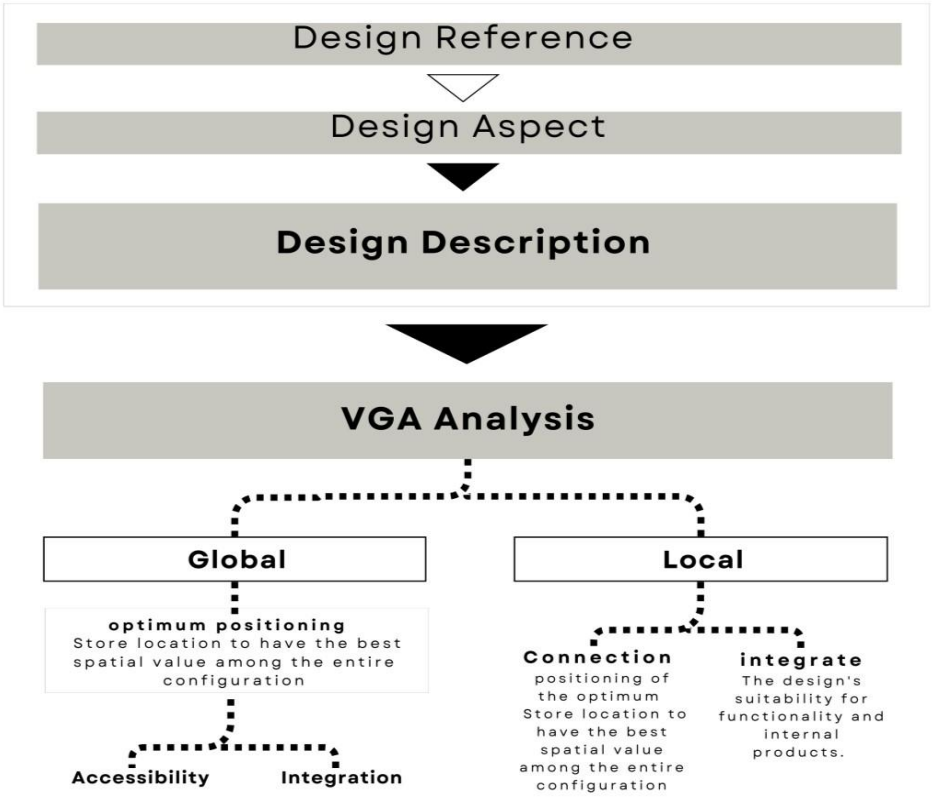

Figure 3. Methodology Graph

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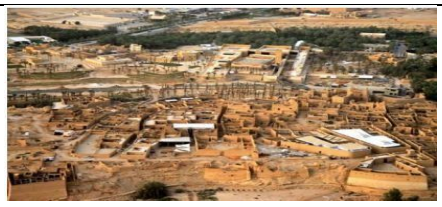
Design Reference:

This study's design methodology draws direct inspiration from the heritagerich context of At-Turaif in Al-Diriyah, incorporating traditional Najdi architectural elements as outlined by Alnaim (2021) and further supported by Bay et al. (2022). The methodology integrates spatial visibility tools such as isovist and Visibility Graph Analysis (VGA) to analyze and optimize circulation, visual access, and functional zoning. As emphasized in the literature review, Alnaim's analysis of Alfuraj and Shurfa elements historically to manage light, ventilation, and symbolic meaning serves as a guiding principle in the design strategy. This aligns with Bay et al.'s (2022) assessment of At-Turaif's adaptive reuse efforts, which highlights the need to preserve cultural identity while integrating commercial and experiential functions. Thus, the design process does not merely retrofit commercial elements into a heritage space but rather derives its spatial logic and material vocabulary from Al-Diriyah's authentic Najdi architecture, ensuring cultural coherence and enhancing visitor engagement.

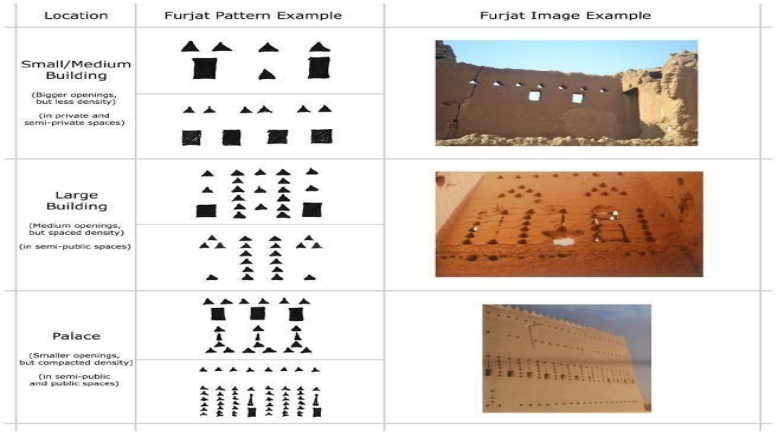
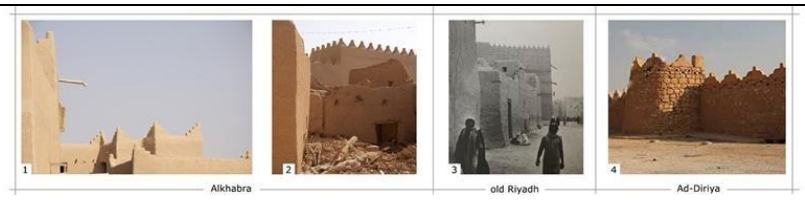
Table 1: Key Phases of Al Diriyah's Urban Regeneration and Development.

Ruined state of Al Dariya before the Urban Regeneration	
Al Dariya before/under the Urban Transformation	

The Dariya Company revealed the concept design for the arena in Al Dariya.	
Regenerated Al Diriyah prior to its public opening in August 2022	

Table 2: Architectural Features and New Installations in At-Turaif District

The new additions and installments inside AtTuraif district	
The architecture of AtTuraif district represents authentic Najdi style	

Complex patterns of Furjat elements in the façade.	
Different physical representations of the Shurfat element.	

Design Aspect:

Everything that affects the fundamental decisions regarding visual performance. The design prioritizes spatial visibility as a core driver of visitor engagement and retail success, using both traditional Najdi architectural cues and analytical tools such as isovist and Visibility Graph Analysis (VGA). These methods informed strategic decisions about spatial arrangement, circulation flow, and visual accessibility throughout the store.

One of the primary visibility-focused interventions is the glazed façade, intentionally designed to capture the attention of passersby and create strong sightlines into the interior. This transparent surface acts as an invitation, offering a clear view into the store and highlighting key product zones even from a distance. The glazing not only

encourages entry but also draws the eye deeper into the space, enhancing curiosity and engagement through a layered visual experience.

Inside, the layout is optimized to maintain continuous visibility from one zone to the next, ensuring that visitors can perceive multiple display areas from any vantage point. High-visibility anchor points such as illuminated product displays, interactive installations, and culturally themed focal walls are strategically placed to attract attention and guide intuitive movement.

Traditional Najdi elements like courtyards and decorative screens (mashrabiyas) are adapted to frame views and subtly guide line-of-sight pathways, preserving the authenticity of the architectural style while serving modern visibility goals. Lighting is carefully layered to accentuate focal products and improve depth perception, especially in shaded or enclosed areas.

these design elements create a visual rhythm that transitions seamlessly from the exterior to the interior, amplifying product exposure and reinforcing the cultural narrative embedded within space.

Design Description:

Zoning:

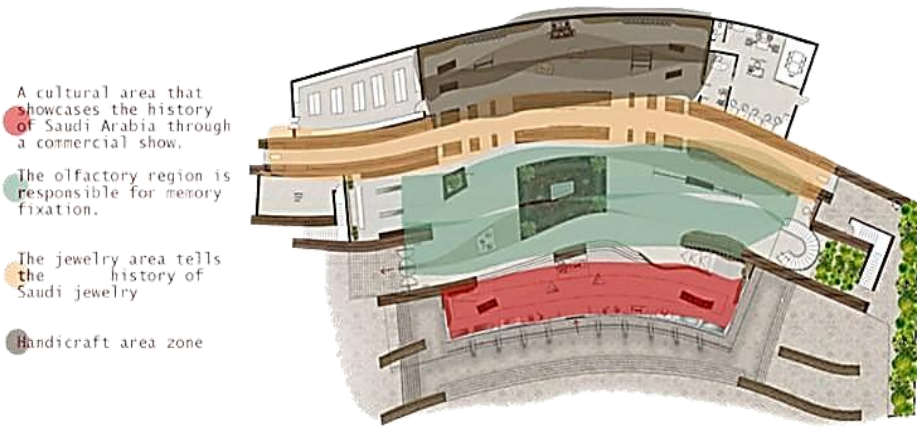


Figure 4. The zoning diagram.

The zoning diagram for a Saudi Arabian experiential space focuses on three strategic points: Cultural & Commercial Value Zone, Sensory Engagement & Memory Retention Zone, and Heritage Preservation & Luxury Branding Zone. The Cultural area educates and entertains visitors through storytelling and commercial displays about Saudi Arabia's rich history, enhancing national branding and promoting cultural tourism. The Sensory Engagement & Memory Retention Zone incorporates scents to create emotional and lasting impressions, strengthening memory retention and boosting visitor recall. The Heritage Preservation & Luxury Branding Zone showcases traditional Saudi jewelry, aligning with luxury and exclusivity, boosting national pride and appealing to global markets. The Community & Artisan Empowerment Zone highlights traditional crafts and supports local artisans, encouraging sustainable development and cultural continuity. The zoning concept transforms the pavilion into a cultural destination and brand platform, blending storytelling, sensory marketing, artisanal authenticity, and commercial opportunity, resulting in a space that deeply resonates with its audience.

Plan:

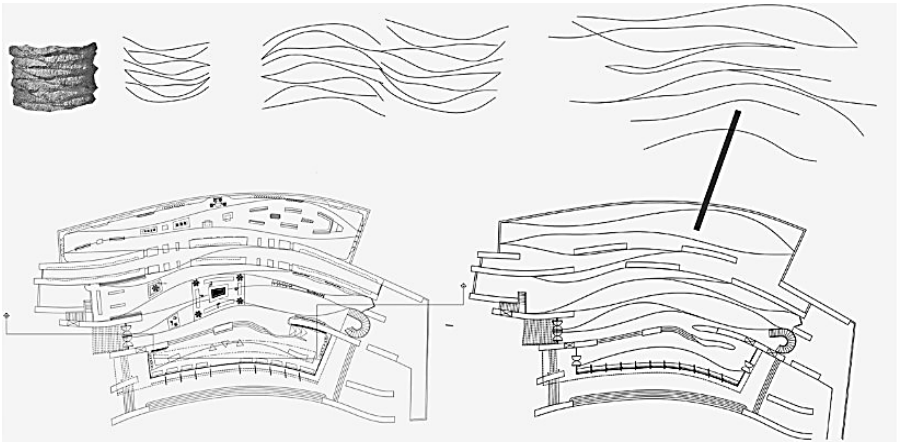


Figure 5. The plan design.

The plan design is a fluid and layered spatial organization inspired by traditional Najdi architectural motifs and natural landscapes. The layout consists of curvilinear

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bands, echoing desert terrain and vernacular mudbrick construction techniques. The two main sectional drawings show a multi-zonal programmatic layout, with each band corresponding to different functional zones. These bands promote visual openness and legibility without rigid walls. The wave sketches represent the conceptual development of the design language, indicating how the architect experimented with rhythm, density, and directionality to establish a cohesive interior topography.

The plan effectively merges aesthetic softness with functional clarity, guiding visitors through a curated narrative experience. The fluid arrangement allows seamless movement between zones, encouraging exploration and sustained engagement, making it ideal for a cultural concept store or interpretive exhibition space that values immersive interaction and thematic storytelling.

Section:

Figure 6. The sectional perspective design.

The sectional perspective design combines sustainability, cultural identity, and spatial clarity. Visibility Graph Analysis (VGA) is used to assess visual performance and guide spatial arrangements. Key sustainable strategies like green roofs, solar panels, HVAC zone controls, and motion sensor lighting are integrated to support visual pathways. Natural lighting and ventilation are calibrated to enhance comfort and depth, while smart thermostats and adaptive lighting systems maintain environmental quality without compromising visual coherence. Culturally expressive elements like Arabic calligraphy, traditional materials, and crafted wood details are strategically placed within high-visibility zones. Green walls and planted courtyards support biophilic design and act as visual anchors. By prioritizing visual performance through VGA, the section achieves a balanced spatial rhythm, making functionality, sustainability, and cultural resonance accessible and experientially impactful.

Perspective:

The perspective view offers an immersive snapshot of the pavilion's interior experience, revealing how spatial elements are layered to enhance visibility, comfort, and cultural engagement. Grounded in the principles derived from Visibility Graph Analysis (VGA), the spatial arrangement is designed to ensure that everything that affects the fundamental decisions regarding visual performance from light penetration and view corridors to focal product placements is fully optimized. Visitors are naturally guided through the space by a sequence of visual anchors: curated displays, green zones, crafted cultural elements, and open sightlines that connect key functional areas.

The warm palette of natural materials such as rammed earth, textured stone, and timber enriches the atmosphere with authenticity and tactile appeal. Culturally significant features like Arabic calligraphy panels and Najdi-inspired screens not only serve aesthetic functions but also act as interpretive elements that bridge the

historical with the contemporary. Vertical greenery and open atriums enhance the visual depth and spatial breathing room, reinforcing biophilic comfort while supporting sustainable indoor air quality.

VGA Analysis:

Global:

1. Positioning of the Optimum Store Location:

Justification: The store is strategically positioned near the main circulation paths and acts as the terminal point of the cultural tour, aligning with best practices in heritage-commercial planning. This enhances visitor engagement and maximizes footfall as it captures residual movement energy.

The VGA confirms its high global integration, making it easily reachable from multiple zones.

1. Accessibility:

Justification: Accessibility is strong due to the proximity to major entry and exit points, aided by intuitive visual flow supported by isovist field depth. The open spatial arrangement and lack of visual obstructions further improve direct access. Minor improvements could be made with additional signage or directional cues.

2. Integration:

Justification: The store is well-integrated into the overall spatial logic of the pavilion. It aligns with both visitor flow and cultural narrative, ensuring that the transition from exhibition to retail feels natural. Its location at the end of the heritage route capitalizes on emotional readiness to engage commercially.

Local:

1. Connection (Store's Visual & Functional Proximity to Adjacent Spaces):

Justification: Locally, the store is visually connected to adjacent display and sensory zones, with strong sightlines and layered visibility from various points. The isovist

analysis confirms minimal blind spots and effective line-of-sight connections, enhancing its immediate spatial value.

2. Integration (Design Suitability for Functionality and Internal Product Placement):

Justification: Internally, the layout supports clear zoning, flexible product displays, and natural circulation patterns. The store's internal configuration—supported by lighting, materiality, and Najdi-inspired partitions ensures product visibility and cultural coherence. It fully supports both functionality and thematic storytelling.

4. Result

This research successfully develops and applies an integrated spatial assessment framework rooted in Space Syntax theory, specifically ISOVIST and Visibility Graph Analysis (VGA), to analyze and optimize visibility, accessibility, and user movement within a heritage-tourism context. The study uses Al-Turaif, a UNESCO World Heritage Site in Saudi Arabia, as a case study to examine how Najdi architectural elements can be harmoniously incorporated into retail spaces without compromising cultural authenticity. The development and application of a spatial assessment framework that successfully integrates heritage architecture with commercial retail functions., Key findings include:

1. Improved Spatial Visibility and Engagement:

   Through ISOVIST and Visibility Graph Analysis (VGA), the study demonstrates that relocating the visitor center and optimizing retail positioning at the end of the cultural route can significantly enhance visitor flow, interaction, and commercial engagement. The current placement of the visitor center limits visual access and spontaneous engagement. Relocation to a more spatially connected area significantly enhances navigation and visitor interaction.

Figure 7. ISOVIST Analysis the pathway

Figure 8. ISOVIST Analysis end the tour

2. Cultural and Commercial Integration:

The research proves that Najdi architectural elements can be adapted into retail interiors without compromising authenticity. This supports both cultural preservation and economic viability, aligning with Saudi Vision 2030. Positioning retail zones at the end of heritage tour routes maximizes commercial potential by reinforcing the natural flow of visitor engagement.

3. Design Recommendations for Heritage Sites:

   It proposes a multifunctional cultural concept store that blends interpretive content, local crafts, and digital elements offering a practical model for adaptive reuse in heritage tourism. Integration of traditional architectural features with modern retail strategies such as glazed façades and thematic zoning strengthens both the visual experience and economic value of the site.

4. Policy and Planning Impact:

   The study provides actionable guidelines for urban designers, policymakers, and site managers, showing how spatial design can elevate product value, visitor satisfaction, and site identity. The study confirms that spatial optimization directly contributes to increased visitor satisfaction, longer dwell times, and stronger emotional engagement with the heritage space.

5. Discussion

The research findings reinforce the value of spatial visibility as a key driver of user behavior, cultural engagement, and commercial success within heritage environments. By applying isovist analysis and Visibility Graph Analysis (VGA), the study demonstrates how spatial configurations influence both global accessibility and local visual connectivity in a heritage commercial setting like Al-Turaif. One of the most significant outcomes is confirmation that positioning retail functions at the terminus of the visitor route enhances engagement. This design choice aligns with global heritage tourism strategies and supports the hypothesis that spatial layout can guide visitor movement and purchasing behavior. The visual data confirms that this location provides high integration and connection values, making it an optimal point for commercial

interaction. Furthermore, the analysis validates that integrating Najdi architectural features such as decorative courtyards, patterned mashrabiyas, and natural

ventilation elements preserves cultural identity without compromising functionality. These elements were adapted in ways that support both emotional resonance and experiential richness, reinforcing spatial legibility and thematic coherence. The discussion also reflects on the practical implications for designers and policymakers. The study proposes adaptive reuse strategies for underperforming visitor centers, advocating for their transformation into multifunctional cultural concept stores. These hybrid spaces can blend interpretive content, interactive digital displays, and authentic local products responding to both cultural expectations and economic goals in line with Saudi Vision 2030.

Finally, the study's methodology offers a replicable model for similar heritage sites. The use of VGA and isovist metrics ensures that spatial decisions are not only visually impactful but also analytically grounded. This supports long-term site resilience by improving visitor satisfaction, dwell time, and overall engagement through informed spatial planning.

6. Conclusion

This study presents a comprehensive spatial assessment framework utilizing Space Syntax theory, specifically ISOVIST and Visibility Graph Analysis (VGA), to evaluate and enhance the integration of commercial functions within the Al-Turaif heritage site in Saudi Arabia. The research demonstrates how traditional Najdi architectural elements can be successfully adapted into retail environments to improve spatial visibility, user engagement, and cultural authenticity, all while maintaining historical integrity.

Key findings reveal that the existing visitor center suffers from limited visibility and accessibility, reducing its impact on visitor interaction. Through spatial analysis, the study proposes relocating the center to a more strategically connected area and placing retail zones at the end of cultural routes. These interventions significantly

improve visitor flow, enhance interaction, and support commercial performance. The integration of modern design elements such as glazed façades and thematic zoning with authentic Najdi features enhances the overall heritage experience and strengthens economic potential.

A central recommendation is the adaptive reuse of the visitor center into a multifunctional cultural concept store that blends interpretive exhibits, local crafts, and digital interaction. This model not only increases dwell time and emotional engagement but also aligns with the goals of Saudi Vision 2030, promoting both sustainable tourism and economic resilience.

Ultimately, the study offers a replicable and scalable design model for revitalizing historic urban environments. By emphasizing spatial visibility, cultural coherence, and experiential design, the research provides valuable guidance for policymakers, urban designers, and heritage site managers aiming to balance heritage preservation with commercial viability in culturally significant settings.

In conclusion, while Al-Turaif holds immense cultural value, its transformation into a leading heritage tourism destination hinge on strategic spatial, experiential, and commercial interventions. Improvements in visibility, adaptive reuse of key spaces, and authentic product integration will collectively help align the site with the goals of Saudi Ariba.

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