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## **HUMAN-CENTRIC PLANNING OF TRADITIONAL ISLAMIC SETTLEMENTS: A SPACE SYNTAX STUDY OF ITCHAN KALA, KHIVA**

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### **Abstract**

Traditional Islamic settlements reflect a sophisticated integration of spirituality, social organization, and spatial planning, yet few studies have examined these qualities at the scale of entire urban environments using analytical tools such as space syntax. This study investigates the fortified city of Itchan Kala in Khiva, Uzbekistan, to uncover how Islamic values are embedded within its urban planning and spatial configuration. Through axial and visibility graph analysis (VGA) using depthmapX, the research evaluates visibility, integration, and controllability at both global ( $R=n$ ) and local ( $R=3$ ) scales to explore the balance between openness, privacy, and movement regulation. The findings reveal a spatial structure that is compact yet hierarchically layered, supporting both communal interaction and seclusion. The highly integrated main market street, anchored by the central Juma Masjid, exemplifies the Islamic planning ideal of harmonizing commerce and worship. In contrast, residential quarters demonstrate low visibility and high controllability, fostering privacy and local stewardship. Madrasas, now repurposed as museums, occupy transitional zones mediating between public and private realms. As Itchan Kala continues to function as a living city with active residential, commercial, and institutional establishments much as it did a thousand years ago, its enduring spatial organization demonstrates the lasting effectiveness of Islamic planning principles across generations, socio-political transitions, and technological changes. Modern neighborhood planning can draw valuable lessons from Itchan Kala's integrated urban fabric—where residential, commercial, and institutional zones coexist harmoniously within a walkable and sustainable environment—offering a timeless model for holistic, resilient, and human-centered urban development.

**Keywords:** Space Syntax, Islamic Urbanism, Human-Centric Planning, Itchan Kala, Spatial Integration.

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## INTRODUCTION

The Space syntax analysis has been widely applied to traditional houses and masjids in Muslim civilizations; however, there are limited studies focusing on traditional settlements or towns within these civilizations (Asif et al., 2018; Sun, 2013). From the dawn of Islam in 623 CE in Madinah to the end of the Ottoman Caliphate in 1924, numerous cities and towns were established across the Islamic world. Unlike contemporary urban design approaches, which often neglect local culture and practices, Muslim settlements were shaped by local traditions and customs while adhering to the core principles of the revealed scriptures and the traditions of the Prophet Muhammad (PBUH) (Hillenbrand, 2004).

As a result, Muslim settlements—from Al-Andalus (present-day Spain) in the west to the far reaches of Indonesia in the east—despite their cultural differences, exhibit remarkable similarities. These commonalities are rooted in their shared adherence to the principles of the Qur'an and Sunnah.



**Figure 1:** Itchan Kala, Khiva, Uzbekistan (Source: 24<sup>th</sup> Heritage Studies, KAED)

This paper focuses on the fortified city of Itchan Kala in Khiva, Khorazm, Uzbekistan, with the intention of examining how Islamic principles are embedded within its urban fabric through the application of space syntax. Using visual interpretation of axial and visibility graphs, together with basic correlational observation, the study seeks to uncover the underlying spatial logic that shaped movement, privacy, and communal interaction in this historic settlement.

In the context of rapid transformations driven by artificial intelligence, revisiting human-centric planning becomes necessary—not only for Muslim societies but for broader discussions on sustainable urban futures. By grounding

itself in principles of dignity, privacy, and social cohesion, this study suggests that the spatial organisation of places like Itchan Kala continues to offer relevant insights for contemporary planning across different contexts and periods.

## LITERATURE REVIEW

### Islamic Principles in Traditional Urban Planning

Islamic shari‘ah, rooted in the Qur’an and Sunnah, establishes core principles that guide individual and communal life in Muslim societies. These principles form a coherent social framework expressed across scales—from the individual and family to the neighbourhood and wider community (Kamal et al., 2023). Although neither source provides explicit urban planning codes, Islam promotes a built environment aligned with moral and social objectives. Consequently, the values and aims of shari‘ah inform the spatial organisation and development of Muslim settlements (Mortada, 2003).

#### *a) Human-Centric and Inclusive Urbanism*

Traditional Muslim settlements exemplify inclusivity by fostering peaceful coexistence between different socioeconomic groups. Unlike the stark segregation common in capitalist or socialist models, Islamic settlements encouraged balance and mutual respect. Every individual, regardless of wealth, retained the right to property and social dignity, as emphasized in the Qur’an: “Do not devour one another’s wealth by false and illegal means” (Qur’an 2:188) (Sahih International, 2004). Fair markets and just economic practices were embedded in urban life, reinforcing equity and opportunity.

#### *b) Educational Integration and Intellectual Life*

The Islamic built environment traditionally prioritized education by embedding madrasahs within the urban fabric. These institutions not only promoted knowledge acquisition but also encouraged scholarly interaction within daily urban life. Planners and builders who shaped these environments often possessed deep religious and ethical understanding, ensuring that architectural decisions resonated with Islamic values (Omer, 2002).

#### *c) Commercial Accessibility and the Role of the Masjid*

Markets (*souqs*) were centrally located and distributed throughout residential quarters, ensuring equitable access to daily necessities. This layout fostered a walkable, community-oriented environment. In close proximity to these commercial hubs, the masjid served as a spiritual anchor, reinforcing the integration of worldly needs with religious duties—especially the observance of the five daily prayers (Omer, 2010).

**d) Privacy in Residential Design**

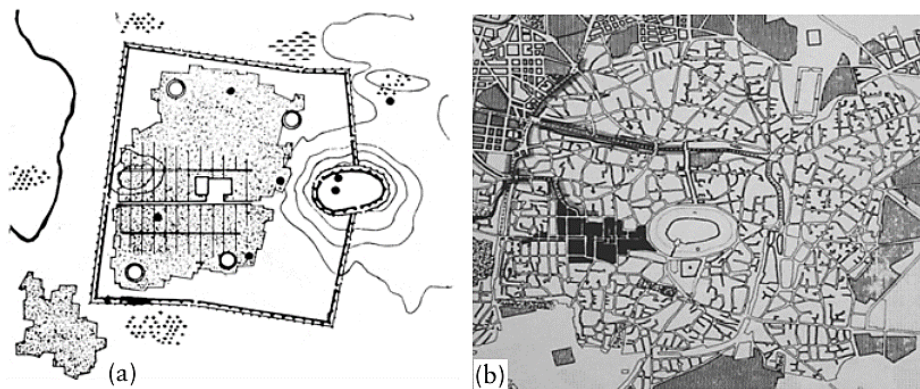
Privacy—particularly for families and women—holds significant importance in Islamic tradition. Accordingly, urban design avoided configurations that allowed commercial activity to intrude upon domestic spaces. For instance, shops were discouraged from facing residential units directly, protecting the sanctity of private life (Mortada, 2003).

**e) Hierarchical Spatial Structure**

Traditional Islamic urban layouts displayed a distinct spatial hierarchy, transitioning from public to private spaces. Broad, communal roads led to narrower alleys, semi-private lanes, and finally private courtyards. This progression not only reflected the principle of privacy but also fostered a sense of belonging and layered social interaction (Rasdi, 2010).

**f) Organic Growth Over Gridded Uniformity**

Contrary to the Roman grid-iron model prevalent in many modern cities, Islamic settlements typically evolved organically. This growth pattern reflected both spiritual guidance and practical responsiveness to community needs. The resulting morphology enhanced connectivity, equity, and a strong sense of place—attributes often lacking in contemporary vehicle-centric urban designs.



**Figure 2:** Maps of Aleppo in the beginning of the eighth century AD, showing the gradual transformation of the urban pattern from (a) the Roman grid to (b) organic as a result of the inhabitants' response to Islamic teachings according to Mortada (2003).

**Khiva's Cultural Heritage and the Influence of Islam**

Before Islam, Khiva's cultural and religious identity was shaped by Zoroastrian traditions that honored fire, air, water, and earth. The Arab expansions of the 7th and 8th centuries brought Islam to the region, leading to a flourishing of knowledge and culture during the Islamic Golden Age. The Khorezm region,

where Khiva is located, became a major center of scholarship and science, producing figures such as Al-Khwarizmi, Al-Biruni, and Ibn Sina. Supported by over sixty madrasahs, Khiva thrived as a hub of learning, philosophical dialogue, and artistic creation. (Durdieva et al., 2020). Rather than existing in isolation, these madrasahs were deeply embedded within the broader urban landscape, underscoring the Islamic ideal of integrating knowledge with community life (Niri, 2017). Khiva's distinct cultural character also persists in its artisanal crafts, including ceramics, silk production, and decorative painting—many of which remain closely tied to religious and communal architecture. Contemporary artisans continue to practice these time-honored techniques, echoing the rich heritage that once adorned the city's mosques, palaces, and schools (McClary, 2020).

### **Itchan Kala: Spatial Manifestation of Islamic Urban Values**

At the heart of Khiva stands Itchan Kala, the fortified inner city and UNESCO World Heritage Site. Enclosed by earthen walls and measuring about 650 by 400 meters, it served as the political and religious center of the Khiva Khanate from the 17th century onward. Early accounts, including those by the 10th-century geographer al-Maqdisi, describe Khiva as a canal-fed settlement centered around a major mosque, likely the Juma Masjid. Within its dense, walkable grid, religious, educational, residential, and commercial spaces blend seamlessly, reflecting Islamic ideals of mixed use and spatial balance. (Gaipova, 2021; Yusupova, 2012). This study applies space syntax analysis to examine Itchan Kala's urban structure, with the aim of identifying how foundational Islamic principles—such as privacy, interconnectedness, equity, and human-oriented design—are articulated in its spatial logic. Through a close reading of its urban form, the research seeks to offer insights relevant to both historical understanding and the contemporary discourse on sustainable, human-centric Muslim urbanism.

### **Space Syntax Analysis for Spatial Studies**

Space syntax has become an essential analytical tool for understanding spatial configuration and human movement in built environments. It enables researchers to quantify spatial relationships, visibility, and accessibility, offering insight into how spatial form influences social behavior. Rauof and Al-Qemaqchi (2019) applied space syntax techniques to hospital layouts to enhance visual connectivity and improve user navigation (Rauof & Al-Qemaqchi, 2022). Nes (2002) used angular step-depth analysis to measure the permeability of urban route networks, demonstrating how spatial configuration shapes movement patterns (van Nes, 2021). Similarly, another study utilized space syntax in urban plaza design to evaluate spatial integration and user experience (Sedki & Iaali, 2020). These studies highlight the versatility of space syntax, supported by tools such as

DepthmapX, in analyzing spatial logic across different architectural and urban contexts.

## **METHODOLOGY**

This study explores the traditional city of Itchan Kala using space syntax analysis to examine visual integration, connectivity, and controllability, as well as the interrelationships between these variables at both global and local spatial scales. Space syntax provides a systematic method to quantify spatial relationships and movement potential, revealing how the built environment influences accessibility, visibility, and social interaction patterns.

### **DepthmapX as a spatial analysis tool**

The visibility analysis was carried out using *Visibility Graph Analysis (VGA)* in DepthmapX, which converts the spatial layout into a network of intervisible points to evaluate how visual fields are connected across the urban fabric. The results were visualized as gradient maps superimposed on the base map of Itchan Kala, allowing identification of areas with higher or lower visual accessibility. The base map was sourced from *OpenStreetMap* ([openstreetmap.com](https://openstreetmap.com)).

Connectivity was assessed through *Axial Map Analysis*, where the longest and fewest lines representing potential movement paths were generated to analyze spatial integration and control. The axial map was analyzed at two radii:

- **R = n** for calculating *global integration* and *controllability*, representing citywide spatial relationships, and
- **R = 3** for assessing *local integration*, which reflects spatial characteristics relevant to pedestrian-scale movement (Hillier, 2007).

The analytical results were supported by descriptive interpretation to highlight the spatial characteristics of the traditional city. In addition, a quantitative correlation between integration and controllability was examined to identify the underlying spatial logic embedded within the settlement. A broader discussion of these findings is presented in the following section.

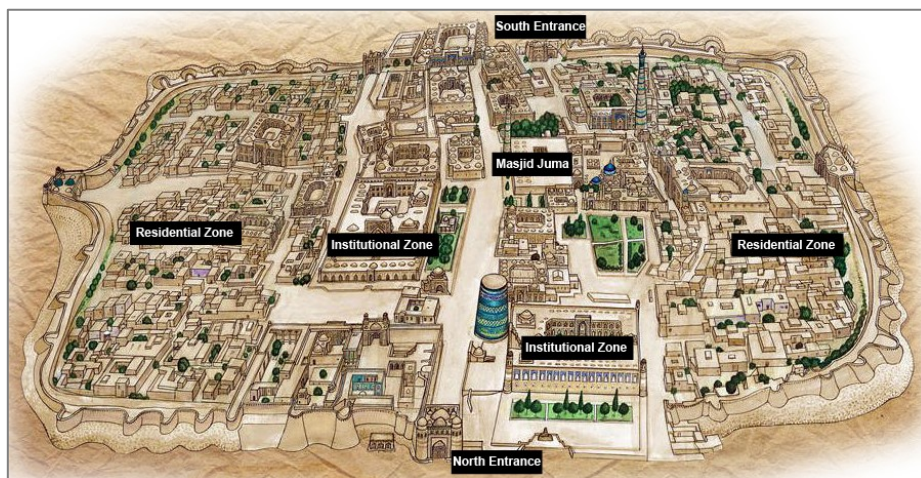
## **FINDINGS**

### **• Spatial layout of Itchan Kala**

Itchan Kala, the inner fortified city of Khiva, is enclosed within robust earthen walls and accessed through four main gates, strategically positioned at each cardinal point (Figure 3). Among these, the Ota Darvoza (West Gate) serves as the primary entrance today, welcoming most visitors into the city. On the opposite



side, the Palvon Darvoza (East Gate) functions as a secondary entrance, historically significant for its proximity to trade routes. Once inside, a central axial street runs longitudinally through the settlement, forming the city's main commercial spine. This bustling corridor is now lined with small shops and market stalls, where locals sell traditional crafts such as silk, ceramics, and carved wood items—preserving the legacy of Khivan artistry.



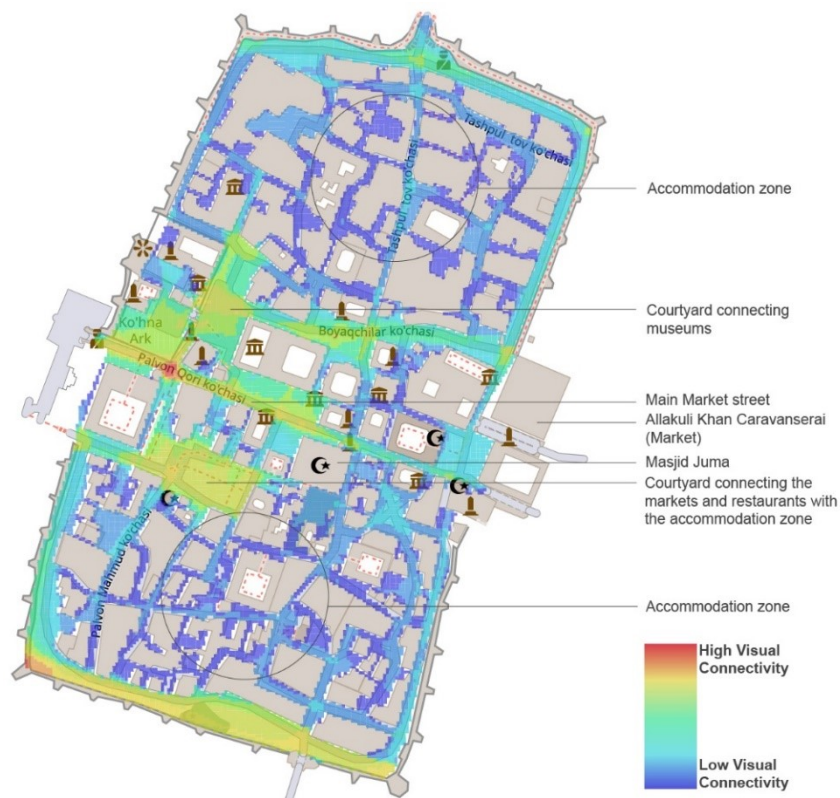
**Figure 3:** Layout of Itchan Kala (Source: <https://apkpure.com/visit-khorezm/com>)

At the heart of this street network stands the Juma Masjid, the Friday Mosque, acting as both a spiritual and spatial anchor. Its central location and architectural prominence reflect its significance in the daily lives of residents and the Islamic planning ethos of placing religious functions at the core of communal life. From the main street, a series of secondary streets and narrow lanes branch out, leading to numerous museums and heritage buildings tucked deeper into the urban fabric. These include former madrasahs, palaces, and caravanserais, now repurposed to showcase the city's rich cultural and intellectual history. A bit further removed from the commercial thoroughfare, several boutique hotels and guesthouses are discreetly situated, offering accommodation within quieter pockets of the city, in line with the traditional spatial hierarchy that balances public activity with private retreat.

- **Visual Connectivity**

The results of the visibility graph analysis reveal that the most visually connected area within Itchan Kala is concentrated along the main market street, which functions as the spinal axis of the present-day city. This thoroughfare accommodates the majority of local shops, where artisans sell traditional craft

items, along with several small restaurants serving authentic Uzbek cuisine. Strategically positioned at the midpoint of this spine is the Juma Masjid, exemplifying two fundamental principles of traditional Islamic urbanism: the placement of the mosque at the heart of the settlement and its proximity to the marketplace, fostering both spiritual and social cohesion (Figure 4).



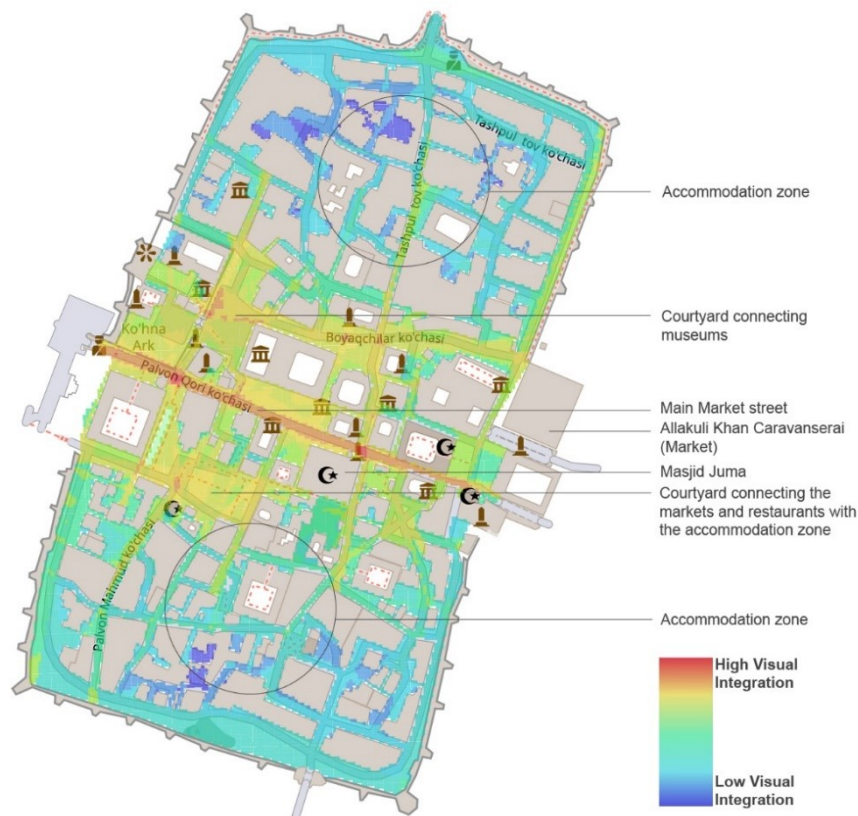
**Figure 4:** Visual Connectivity of Itchan Kala

In contrast, the city's museums—many of which are former madrasas adapted for contemporary use—are accessible via secondary streets, offering a quieter and more contemplative setting. This spatial placement preserves the educational and reflective character of the original madrasas while creating a suitable ambiance for museum functions. The least visually connected areas are occupied by hotels and guesthouses, typically located on the periphery of the visual network. This reflects another key tenet of Islamic spatial planning: the provision of privacy and tranquility within residential zones, ensuring seclusion without complete detachment from the communal core of the settlement.



- **Visual Integration**

The visual integration analysis further reinforces the findings of the visual connectivity graph, highlighting the main market street as the most visually integrated path within Itchan Kala (Figure 5).



**Figure 5:** Visual Integration of Itchan Kala

One particularly noteworthy observation is the presence of a caravanserai, or covered market, near the Pavlon Gate, the back entrance of the city. While its location may appear secluded at first glance, the integration analysis reveals that the caravanserai is, in fact, well embedded within the spatial fabric. Positioned between a primary and a secondary street, it enjoys multiple points of access, making it functionally integrated despite its peripheral location. This clever placement exemplifies the ingenuity of organic urban development, where the spatial growth of the settlement responds to functional needs rather than imposed geometry (Figure 5).

Additionally, the analysis highlights two key courtyards on either side of the main street, both demonstrating high levels of visual integration. The northern courtyard connects to a cluster of museums, while the southern courtyard links to the accommodation zone. These well-integrated yet spatially distinct zones illustrate a hierarchical arrangement of spaces characteristic of traditional Islamic urbanism. Here, residential areas are afforded a sense of privacy, while maintaining effective spatial connectivity to central communal and cultural functions—reflecting a thoughtful balance between seclusion and accessibility.

- **Spatial Integration**



**Figure 6:** Axial map analysis of Itchan Kala

The axial map analysis of Itchan Kala's Street network reveals an insightful spatial configuration. In addition to the main market spine, which dominates the integration values, there exists a prominent secondary street

running perpendicular to the main axis. This secondary street is well integrated within the overall network and plays a vital role in linking the accommodation zones at the northern and southern ends of the city directly to the Juma Masjid. This configuration reflects a core principle of traditional Islamic urbanism: residential areas are purposefully connected to the central masjid, ensuring ease of access and walkability for daily communal prayers.

Moreover, as seen in Figure 6, the axial analysis supports a visible zoning gradient based on privacy and function. As one moves away from the main street, the spatial arrangement gradually shifts from public to more private realms. Madrasas and museums, typically located just beyond the commercial spine, act as a buffer between the bustling marketplace and the quieter residential quarters. This layered spatial hierarchy illustrates the Islamic planning concept of graduated privacy, where different zones serve varying communal, educational, and private functions while maintaining a coherent and connected urban fabric.

- **Controllability**



**Figure 7:** Controllability of Itchan Kala

The controllability analysis of Itchan Kala (Figure 7) provides valuable insight into how the spatial configuration supports or restricts regulation and surveillance within the walled city. In this context, controllability is understood as a global spatial property—reflecting how easily movement can be guided or overseen based on the structure of the urban layout. Interestingly, the main market street exhibits low controllability, primarily due to its high connectivity and multiple entry and exit points along the spine. The street accommodates a variety of functions, including shops, eateries, and public institutions, which naturally invite high pedestrian flow and diverse movement patterns. The linear but visually permeable form, with several intersecting routes, makes it less suitable for spatial control or surveillance, thus reducing its controllability despite being a central space.

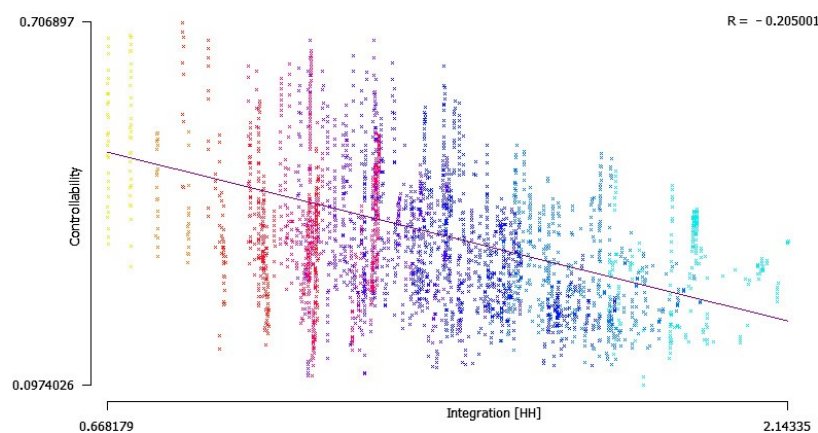
In contrast, the accommodation zones, particularly those located toward the north and south peripheries of the city, demonstrate relatively higher controllability. These areas are structured with fewer route options, limited access points, and a more segmented and hierarchical street layout, allowing for easier regulation of movement. The lower visibility and limited intersections enhance the privacy of these zones, aligning with traditional Islamic urban principles where residential areas are designed for seclusion and controlled access. This spatial arrangement supports not only physical privacy but also social cohesion and community management, reflecting a thoughtful integration of cultural values into urban morphology.

#### • **Correlation Between Integration and Controllability**

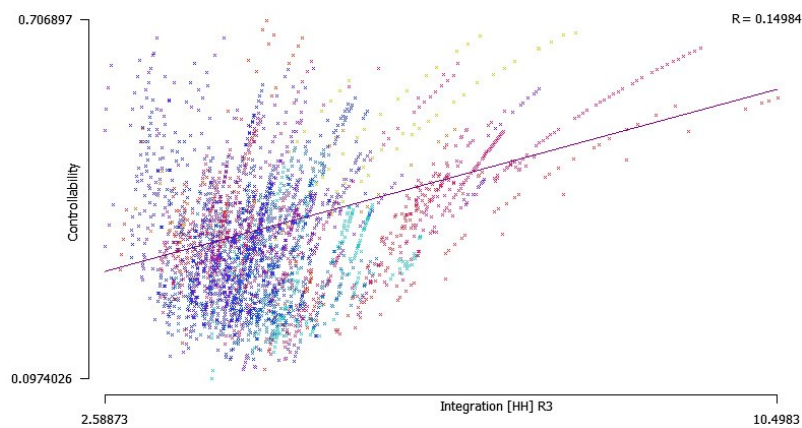
The correlation analysis between spatial integration and controllability reveals meaningful patterns that align closely with the underlying logic of traditional Islamic urban design. At the global scale ( $R=n$ ), the correlation between integration and controllability is weakly negative ( $R = -0.205$ ) (Figure 8). This indicates that the more a space is globally integrated within the overall urban fabric, the less controllable it tends to be. This pattern is evident in the main market street of Itchan Kala, which is highly connected and accessible from multiple directions, making it ideal for open public activities such as trade, communal gathering, or religious processions. However, this also implies limited control or surveillance, as the space offers many route choices and fewer restrictions on movement — a feature consistent with the design of central public routes in traditional Islamic cities, which aim to promote accessibility and interaction rather than control.

Conversely, at the local scale ( $R=3$ ) — suitable for pedestrian-based analysis — the correlation between integration and controllability is slightly positive ( $R = +0.149$ ) (Figure 9). This suggests that locally well-integrated spaces are also somewhat more controllable. These areas, typically composed of smaller

street networks and neighborhood clusters, offer tighter spatial configurations with fewer route options and more defined boundaries. In Itchan Kala, this is particularly true in the residential quarters, where such layout supports both privacy and local social regulation. These zones are not only visually and physically quieter but also more manageable, reflecting the Islamic urban principle of fostering self-contained, watchful communities within a larger, open urban system.



**Figure 8: Integration (Global) vs Controllability**



**Figure 9: Integration (R3) vs Controllability**

Taken together, these results highlight a fundamental spatial hierarchy in Itchan Kala — and by extension, in traditional Islamic cities — where public openness and private seclusion are carefully balanced. While main streets invite openness and free flow, residential areas prioritize control, community, and privacy. The urban layout is not random but reflects a deliberate cultural logic



that accommodates both collective social life and individual privacy through nuanced spatial design.

## CONCLUSION

The space syntax analysis of Itchan Kala reveals the underlying planning intelligence of traditional Islamic urbanism, where space is not merely functional but structured around social values and human needs. The city presents a compact physical form while offering a psychologically expansive environment — one in which spatial depth sustains privacy, intimacy, and social regulation within a dense urban fabric. At its core, Itchan Kala shows a careful balance between openness and privacy. The main market street—highly visible and well-connected—acts as the public route linking trade and faith through the Juma Masjid. This reflects the Islamic planning idea of harmonizing daily life with spiritual purpose. In contrast, residential areas and guest houses shift into zones with lower visibility and more control, using narrow lanes and limited access to protect privacy and family life. The city's layout shows a natural hierarchy where public spaces, madrasas, and homes support different ways of living—commerce, learning, worship, and rest. Positioned between public and private areas, madrasas once connected reflection with community life. The link between integration and control shows an important planning idea: open, connected spaces are less restricted, while local neighbourhoods maintain independence through enclosure. This decentralized form of city life reflects Islamic values of modesty, clear boundaries, and community responsibility.

The findings affirm that Itchan Kala is not just a preserved historic city but a living example of Islamic urban planning that still works today. Its layout supports both community life and personal privacy, creating a balance between public spaces and private areas. The design effectively guides movement, shapes social interaction, and reflects cultural and moral values through simple but thoughtful spatial arrangements. In contrast, many modern neighbourhoods are car-centric, separate residential and commercial areas, and often lack social interaction, making them unsustainable in the long run. Even after a thousand years, Itchan Kala remains active and functional, proving that Islamic planning principles can stand the test of time and offer valuable lessons for creating modern neighbourhoods that are walkable, sustainable, and people centred.

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