Investigating The Visual Privacy on Houses layouts in Traditional Desert Settlement of Ghadames City- Libya- By Using Space Syntax Analysis

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Abstract
This paper is interested with the impact of visual privacy and the built environment of traditional desert settlement in Ghadames city. The main aim of the study is to analyze the visual privacy within traditional samples of houses and neighborhoods where study employs USL Depthmap software (which is based on theory of space syntax) and questionnaire which covers about 150 samples as methods to measure the visual privacy and its influence on the built environment in the old-muddy town. Results of the paper would assist designers to improve houses' design and town planning in terms of visual privacy and produce designs that are modern and appropriate for Islamic culture of Ghadames society.

Keywords visual privacy, traditional settlement, USL Depthmap, space syntax, built environment.

INTRODUCTION
The term "privacy" has been studied in different scientific fields. Few scholars have considered it as a universal process which involves a unique regulatory mechanisms in different societies that form various private spheres in people's lifestyle . Altman,(1977) pointed out privacy differs among cultures in term of the behavioral mechanism used to regulate desired levels of privacy. However, Abu Gazzeh,(1997) emphasized that privacy is a process that aims to control transaction between persons with the object of enhancing autonomy and minimizing vulnerability. Moreover, Hisham and Rahim (2008), pointed out privacy is a two way process involving the permeability of boundaries between one self and others.

As a result the main elements of the process of privacy includes one self, family and society. Where privacy could be considered as a regulator of the interaction between individual and society, between public and private domains.

The islamic teachings persuade the privacy (especially visual privacy and gender segregation) and consider it as a very crucial factor that controls the interaction between males and females. Therefore, traditional settlement of Ghadames was built to be a perfect example for the influence of visual isolation and gender segregation on the built environment.

VISUAL PRIVACY REGULATING SOURCES AMONG MUSLIM SOCIETY
In Muslim societies the main sources of regulating mechanisms of social lifestyle, political system, economy and culture are extracted from:-

a- THE HOLY QUR'AN COMMANDS
For Muslims the holy Qur'an is the main source that organizes the mechanisms of social life issues. Several verses regulate the interaction between individual and society such as :-

Oh you who believe! Do not enter houses other than your own, until you have asked permission and greeted those in them: that is best for you, in order that you may remember. If you find no one in the house, enter not until permission is given to you, if you are asked to go back, go back, that makes for greater purity for yourselves, and God knows well all that you do. It is no fault on your part to enter buildings not used for living, which serve some (other) use for you, and God has knowledge of what you reveal and what you conceal (24: 27-29)

Such verses emphasize on separation and shield of the domicile from public domain. It also reveals the boundaries between the open public sphere and protected private which is defined and required in Islam (Mortada, 2003).

Theses versus encourage separation between public and private domains and create limits between the (external) and internal (private) environments.
b- **AL-HADDITH (the prophet commands)**

Abu Sa'id Al-Khudri (May Allah be pleased with him) reported:

The Prophet said, "Beware of sitting on roads (ways)." The people said: "We have but them as sitting places." Messenger of Allah said, "If you have to sit there, then observe the rights of the way". They asked, "What are the rights of the way?" He said, "To lower your gaze (on seeing what is illegal to look at), and (removal of harmful objects), returning greetings, enjoining good and forbidding wrong".[Al-Bukhari and Muslim]. The Book of Miscellany

https://sunnah.com/riyadussaliheen/1/190

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**VISUAL PRIVACY AND SPATIAL ORGANIZATION OF TRADITIONAL HOUSE AND SETTLEMENT**

The house is defined as a symbolic place that offers notions of domesticity, comfort, and well being through domestic intimacy and privacy (Rybczynski, 1987). Another meaning, residents should live in their houses in intimacy and their houses should provide acceptable levels of visual privacy. Furthermore, spaces within dwellings should be organized to provide maximum level of privacy. Therefore, spatial organization within dwellings is controlled according to privacy and intimacy requirements.

Visual privacy has been defined as the ability to carry out everyday activities hidden from the eye of outsiders or without fear of being observed by them (AL-Kodmany, 1999). Therefore house must be designed and built to provide visual privacy and better quality of lifestyle.

The perfect design of house must meet privacy requirements by ensuring the safety of family and separating the private life from public interactions (Memarians 2003). Privacy requirements include the control of visibility through visual privacy, and noise transmission through acoustic privacy (Mortada 2003).

Hank Lu has classified the spatial configuration in terms of privacy into:-

- **Public (street, garden and sidewalk).**
- **Semi public (the front yard).**
- **Semi private (the porch).**
- **Private (living room, dining room and kitchen).**
- **Semi intimate (sitting room and bedrooms).**
- **Intimate (master bedroom).**

According to Hank Lu classification the visual privacy in the house should be at minimum in bedrooms, living room and kitchen whereas, it could be higher in front yard and porch.

HWAISH classified spaces within Muslim houses in terms of privacy into four domains:-

- **Private (intimate).**
- **Semi private (for family members).**
- **Semi public (for family members and guests).**
- **Public.**

The previous classifications divide Muslim house contents into family members spaces and outsiders spaces (guests). 

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**CASE STUDY AND SAMPLES**

The traditional settlement of Ghadames is a desert town that was built in the middle of the desert. The city was built through history gradually where houses form layers attached to each other layer after layer.

Therefore, The old town is considered as one of the most unique old settlements in north Africa where several historians called it (pearl of the desert). Its uniqueness is referred to its outstanding architectural style and its architectural environment which was built by local natural materials.

Several studies had been done about the old city in terms of its architectural features, its ability to meet hot-arid climate conditions and cultural requirements.

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**Location**

The city of Ghadames is located in the western region of Libya (Tripoli region) near the intersection between Tunisian, Algerian borders.
The old town of Ghadames was established in the middle of an oasis with position of 30.08 N and 09.3 E. It is about 600 Km from the coastline of the Mediterranean sea and about 300 m over the sea level where it is surrounded by palm trees and sand hills (EL-AGOURI, 2004).

As a result of its magnificent architecture the city was selected to be under the protection of UNESCO World Heritage Center in 1986 (EL-AGORI, 2004).

Sample of the Study

The old city contains seven main neighborhoods, these neighborhoods are connected to each other by network of narrow covered and non-straight streets where dwellings are attached to each other to form compact fabric. Study attempts to choose three samples. Choosing samples basically depended on the availability and the validity of samples. Researcher could provide three samples from different neighborhoods (see figure 3).


Figure 3: Left, plan of the old settlement (source Ghadames Baladyah 2002), right, top view of Tasku neighborhood.
The chosen samples are located in different spots within the town. Plans of the samples in the following table:

<table>
<thead>
<tr>
<th>samples</th>
<th>H1</th>
<th>H2</th>
<th>H3</th>
<th>Colors key</th>
</tr>
</thead>
<tbody>
<tr>
<td>floor</td>
<td><img src="image1" alt="ground floor" /></td>
<td><img src="image2" alt="first floor" /></td>
<td><img src="image3" alt="top floor" /></td>
<td><img src="image4" alt="ground floor" /></td>
</tr>
<tr>
<td>Roof area</td>
<td>28.5</td>
<td>61.87</td>
<td>51.65</td>
<td>50.23</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>存储</th>
<th>楼梯</th>
<th>浴室</th>
</tr>
</thead>
</table>

It is obvious that the three samples are similar in terms of the design or spatial organization (spatial configuration) where:

a- Houses were built in three floors.

b- Ground floor includes the main (and the only) entrance, storage room (for agriculture tools and food).

c- Living space (living hall), bathrooms and bedrooms are situated in the first floor.

d- Top floor contents the kitchen, summer place and women stairs where they move from house to another through network of passages and stairs on top roofs.

Piccolo mentioned that Ghadames stands like a fortress against the sun and the desert. It seems rather like a giant coral reef. One thinks of it as the slowly extended crust of collective life that has gone on through generations of always similar individuals, as a natural product that has arisen spontaneously through thousands of years (EL-AGORI, 2004). This description is referred to the traditional settlement which was built organically through history by local natural materials, these houses are attached to each other forming a compact fabric with a unity and harmonious in terms of the architectural style. Traditional residential units were built by mud or clay, wood, Lime stones, gypsum and palm trunks.

**Figure 4:** Living hall in sample 1 (source, author).
By observing several ruined houses, the constructional system depends on thick stone wall that carries palm trunks (work as beams) that carry mixture of and straw concrete.

**METHODOLOGY**

This study attempts to investigate the influence of visual privacy on the built environment in Ghadames city, to achieve this target research would use the following methods:

1. **Questionnaire**
   
   Questionnaire a method is used to investigate the residents’ opinions of the old city about the role of visual privacy in Ghadamesian culture and its impact on the built environment of the city where, several questions have been prepared to find out the opinion of dwellers in terms of visual privacy and its affect on dwellings design and forming of the plan of the whole city.

   The questionnaire is designed according to LIKART Scale to cover several aspects of life in Ghadames such as social life, culture, climate and the architecture of the city.

   Answers of the contributors are considered as a crucial indicator of the importance of visual privacy within the case study and its influence on house design.

2. **Space Syntax Analysis**

   Theory of space syntax was presented by Hillier and Hanson in the book (Social Logic Of Space) to analyze how spaces
influence human development by measuring spatial configuration (spatial organization (Hillier, et al, 1984). In another meaning, This theory was established to analyze how individuals identify with space in built environment as well as the relationship between social behavior and space (Ageal, 2017).

The basic methodology in space syntax is to divide space by scale of human visual ability (Ageal, 2017). Where space is divided into extensive and small-scale spaces (Montello, 1993).

According to Ageal, 2017, space syntax has become a computer language that describes the spatial pattern of urban space which is classified it in terms of visibility (visuality) into:-

a- Free space:-
Free space is the part of urban space where people could engage in uninhabited movement.

b- Blocked space:-
Which is the space that comprised of spatial obstacles such as buildings and people cannot move freely within this space.

Then, in terms of visibility (visuality) the free space is more open and visually more exposed than blocked space. Another meaning blocked spaces are having higher value of visual privacy than free spaces. For measuring visibility or visuality within samples, study suggests using UCL Depthmap parameters.

UCL Depthmap is a software which had been designed according to both space and time theory and space syntax theory, developed by BILL HILLER, this software analysis the relationships between urban plans elements such as spaces, streets, and the built environment. On the micro scale this software could be used to analyze the spatial analysis inside buildings and the relationships between building spaces and visibility (visual fields).

Visual privacy could be measured by few parameters within the software. The most important parameter is:-

a- Isovist Area Measurements
Benedikt (1979) adopts the term isovist from Tandy (1967) who used it to describe landscapes. The key criterion in defining isovist is how far can one see or move from every point in the space. Analysis of visibility within urban landscapes (external and/or internal visibility) raises additional questions and problems. With buildings and streets represented as 2D polygons, rather than 3D grids, a first level of visibility analysis can be carried out – this kind of analysis is generally described as isovist analysis (Benedikt, 1979). In addition, Isovist analysis has been developed in landscape studies and is integral to GIS (Rana, 2002). Isovist area is defined as the exposed area within visual field in a specific point, it is measured by m². This parameter possibly could be used to examine visibility or visuality within house environment. It is used when examining complex patterns of behavior. For example, open spaces could be seen and have visibility more than closed spaces or in case of existence of obstacles.

Isovist area could be measured automatically by using isovist icon in UCL DEPTHMAP software. study would use two main reference points, first point is at entrances and second point is at the middle of the plan.

After clicking on isovist icon and specifying location of the center of the isovist the program would ask the user to choose the angle of visual field (90 degrees, 120 degrees, 180 degrees or 360 degrees).

By clicking on the chosen angle, the program gives the user direct plot of the visual field or the isovist. The given plot specifies whether this space is open or not, in other words this space is visually exposed or not and then this space provides acceptable levels of visual privacy or not. For example, the following plan is for a room with area of 4m*4m would be used as a sample to apply isovist on it.
After transferring the original autocad drawings into dxf format, plan would be imported to UCL Depthmap and then by clicking on isovist icon, program would specify the plot of visual field according to the chosen angle and place of clicking.

The previous figure shows the isovist (visual field) of the center of the room (middle) with angle of 90 degrees. It is obvious that the whole room is visually exposed unless there are barriers or obstacles.

Entrances (doors) are considered as the transfer stage between public and private environments. “The placement of the entrance doors of houses should come within the principle of maintaining private life and ensure that no offence is caused to neighbors’ privacy. Muslim jurists agree that these doors should not be opened opposite to or near each other and they should be offset in order to prevent the person standing at an entrance from looking directly into the house opposite or Adjacent” (Mortada, 2003). therefore, entrances and doors must be considered as a reference point of isovist measurements.

For the previous sample, isovist field in the entrance as follows:

![Figure 10: Applying isovist in on the entrance of ample plan (source, by author).](image)

Isovist area in the middle is 16.23m² while the area of isovist in entrance is 14.4 m². These values indicate that the area of visual field in the middle of space is bigger than The area of visual field in entrance.

The ratio between isovist area and total area of the space ranges between 0.0 to 1.0. the less percentage points to less visual area and then more visual privacy. While, the higher values indicates to less visual privacy. The ratio of the given example could be calculated as follows:-

\[
\frac{\text{Isovist area}}{\text{total area of space}} \times 100 = (16.23 \div 16.25) \times 100 = 99\%.
\]

This means that the exposed area of the room in the middle (reference point1) is 99%. The visual field in the entrance (reference point2) is:

\[
\frac{14.4}{16.25} \times 100 = 88\%.
\]

This parameter could be used as a method to specify whether space is visually private or not and what is the most private spot within the house.

DISCUSSION

Most of Ghadames residents believe that visual privacy plied a major role in both traditional house design and in forming of the whole settlement.

The importance of visual privacy in house design:-

Visual privacy has been defined as the ability to carry out everyday activities hidden from the eye of outsiders or without fear of being observed by them (AL-Kodmany, 1999). Therefore house should be designed and built to provide visual privacy and better quality of lifestyle of inhabitants.

According to questionnaire results, dwellers of Ghadames believe that visual privacy is a crucial factor in house design and dwelling provide high levels of visual privacy. Gadames occupants are Muslims and their social life is controlled according to Islamic teachings where gender segregation is very important factor in visual privacy.
Q12- mixing between genders is acceptable in traditional society of Ghadames.


Figure 12: Opinion of occupants about mixing between genders.

Q13- during social activities, women and men are being separated.


Figure 13: Opinion of occupants about segregation between genders.

The Influence of visual privacy on house design:

Builders of traditional muddy houses have built these houses according to climatic and cultural determinants. Spatial organization of traditional houses was organized to provide higher visual privacy by separating between foreign male guests and family members which is highly recommended in the culture of Ghadames dwellers. Separating between sons (males) and daughters (females) in bedrooms where most of traditional houses include three bedrooms and space for living and dining (living hall).

Table 2: Spatial configuration and privacy degrees (source, author).

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>GROUND FLOOR</th>
<th>FIRST FLOOR</th>
<th>TOP FLOOR</th>
<th>SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRIVACY DEGREE</td>
<td>PUBLIC</td>
<td>SEMI PRIVATE</td>
<td>PRIVATE</td>
<td>VERY PRIVATE (INTIMATE)</td>
</tr>
</tbody>
</table>
Table 3 Isovist measurements in samples (source, by author).

<table>
<thead>
<tr>
<th>SAMPLES</th>
<th>TRADITIONAL HOUSES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plans</td>
</tr>
<tr>
<td></td>
<td><img src="image1" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td><img src="image2" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td><img src="image3" alt="Diagram" /></td>
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<tr>
<td></td>
<td><img src="image4" alt="Diagram" /></td>
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<tr>
<td></td>
<td><img src="image5" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td><img src="image6" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td><img src="image7" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td><img src="image8" alt="Diagram" /></td>
</tr>
<tr>
<td>Plan area</td>
<td>28.5</td>
</tr>
<tr>
<td>Isovist at Reference point (a)</td>
<td><img src="image9" alt="Diagram" /></td>
</tr>
<tr>
<td>Entrances m²</td>
<td>3.01</td>
</tr>
<tr>
<td>Isovist/plan area %</td>
<td>10.56</td>
</tr>
<tr>
<td>Isovist at Reference point (b)</td>
<td><img src="image18" alt="Diagram" /></td>
</tr>
<tr>
<td>Middle</td>
<td>8.1</td>
</tr>
<tr>
<td>Isovist/plan area %</td>
<td>28.42</td>
</tr>
</tbody>
</table>

It is obvious that traditional houses were built to maintain family members especially females away from external visual interaction. Where entrances are small and mostly open against walls and dwelling floors are divided to separate between foreign people and family members. Furthermore, Spaces in houses are not open to each other. Isovist measurements could be summarized in the following table:

The extracted values of the ratio of \(\frac{\text{isovist area}}{\text{total area}}\) % could be summarized as follows:

![Image](image27)

**Figure 14:** The ratio of isovist and plan area in two reference points

According to program results and calculations of ratio of exposed area, the lowest value is in the entrance of ground floor of sample 1 (H1) while the highest value is in top floor of house 2 (H2) (see table 3).

Constructors of traditional residents have used several techniques to avoid visual intrusion and to increase visual privacy, these techniques could summarized as follows:

- dividing dwellings into three floors, ground floor was occupied by men (males), first floor for family and top floor for women, were women are allowed to move from house to another by network of pedestrian on top roofs. While men (males) are moving in covered streets in ground floor.

![Image](image28)

**Figure 15:** Left, plan of roof passages for women, right section in the street (source, author).

- Old occupants of traditional Ghadames have found their own way to avoid visual intrusion by minimizing visual field at the main entrance, where most of entrances with area ranges from \((1.5\times0.7)\) m to \((1.7\times0.8)\) m. most of the main entrances open directly in covered streets. location of the main entrances
is not randomly chosen. Entrances should not be facing neighbors’ entrance.

Figure 15: Left distributing entrances in part of Tasku street, right main entrance of sample 2 (source, author).

b- Using non-straight passages and streets minimizes the exposed area within roads which increases the visual privacy in streets. For example, the previous figure is a part of main street of Tasku neighborhood, isovist measurements of this track is:-

Table 4: Isovist measurements in samples (source, by author).

<table>
<thead>
<tr>
<th>Sample</th>
<th>Reference point</th>
<th>Isovist area m²</th>
<th>Isovist area\total area %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tasku street</td>
<td>Point 1 (entrance)</td>
<td>3.4</td>
<td>23%</td>
</tr>
<tr>
<td></td>
<td>Point 2 (middle)</td>
<td>10.17</td>
<td>70%</td>
</tr>
<tr>
<td>Djursan street</td>
<td>Point 1 (entrance)</td>
<td>45.02</td>
<td>30.6%</td>
</tr>
<tr>
<td></td>
<td>Point 2 (middle)</td>
<td>29.02</td>
<td>19.73%</td>
</tr>
<tr>
<td>Tangzin street</td>
<td>Point 1 (entrance)</td>
<td>23.3</td>
<td>21%</td>
</tr>
<tr>
<td></td>
<td>Point 2 (middle)</td>
<td>61.62</td>
<td>55.6%</td>
</tr>
<tr>
<td>Aoulad Bilel street</td>
<td>Point 1 (entrance)</td>
<td>22.1</td>
<td>19.5%</td>
</tr>
<tr>
<td></td>
<td>Point 2 (middle)</td>
<td>68.34</td>
<td>60.28%</td>
</tr>
</tbody>
</table>

The previous isovist measurements of streets could be transferred to the following graph:-

Figure 17: The ratio of isovist area in four streets (source, author).

The graph shows that the ration between isovist area (visually exposed area) and total area in four streets (randomly chosen) ranges from 19.5% to 60.28% which means streets are not completely exposed.

CONCLUSION

This study examined the relationship between visual privacy and the built environment especially houses in traditional settlement in Ghadames which was built gradually attached to each other by shared walls and connected by a network of narrow, covered and non-straight roads.

Residences of old city took into consideration visual privacy as religious command and cultural needs and they applied it on house design were floor of dwellings were divided into three floors to maintain females out of visual interaction with males.

Reducing visual intervention influenced the distribution of entrances where main door were distributed in non-meeting way.

Results of isovist measurements support this hypothesis were most of traditional house spaces are small and visually non-exposed.

This feature had been developed through decades and should be considered as a main factor in future house design.

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