Investigating the Impact of Modernism on Indoor Privacy Satisfaction in Desert House by using Space Syntax Analysis Case study- Ghadames City- Libya

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Abstract
This study aims to examine the impact of transformation from vernacularism to modernism on indoor privacy satisfaction within desert houses in Ghadames city. The research employs several methods such as questionnaire that covers 150 samples, in-depth interviews and space syntax analysis. A comparative analysis or a comparative study had been applied on two samples of traditional houses and two samples of contemporary houses to figure out to how extend modernity has affected privacy levels in these samples.

Keywords: Privacy, vernacularism, privacy satisfaction, space syntax.

Objectives:
To examine the impact of transformation from vernacularism to modernism on indoor privacy satisfaction within desert houses in the city of Ghadames, Libya

Methods/Analysis: To figure out the extent to which modernity has affected privacy levels in the desert houses of Ghadames, I used several methods such as a questionnaire that covers 150 samples, in-depth interviews and space syntax analysis. Additionally a comparative analysis or a comparative study was applied on two samples of traditional houses and two samples of contemporary houses.

Novelty/Improvements:
This study is using social survey techniques (questionnaire) and computerized methods (softwares) to figure out the degree of privacy satisfaction in Ghadames houses in different historical periods. This process leads to finding out the positive aspects in terms of visual privacy to be a base or main determinant in houses design in future.

1 INTRODUCTION
Through history, the daily needs of mankind had developed from food and protection to education, industry, vehicles, electricity, and the internet. This development has been studied by several scholars such as Maslow who classified privacy as a part of safety. It has played a major role in the spatial configuration of traditional house layouts in different cultures, regions, periods, and societies. Yet, degrees of privacy differ from one society to another where it is higher in conservative societies (especially in Muslim societies) than secular societies. Lawrence and Unlu have described the relationship between privacy and spaces within house layout as: a house is a symbolic place combining paradoxical concepts that can easily be identified as binary codes such as internal and external, private and public, female and male, sacred and profane, clean and dirty that are used to explain roles and activities of people in spaces [1]. For Heathcote, architectural style and spatial elements such as windows, doors, and bedrooms are parts that are functional and form substantial influence on human domestic behaviors and interactions within the home environment.

Thus, privacy is the relationship between individual activities and spaces and surrounding environment. Analyzing and understanding this relationship leads to examining degrees of privacy within house layout.

2 PRIVACY DEFINITIONS

Term of privacy is derived from the Latin words (privatus) (e.g. withdrawn from public life) and (privare) (e.g. to deprive). It acquires conventional opposition to public life during the sixteenth century and was considered to be a privilege, not a deprivation [2]. Privacy as a term was presented in Britannica Encyclopaedia as the quality of being apart from company or observation. As an act, privacy provides freedom from undesired intervention. Another definition states that privacy points to a place of seclusion [3]. The Webster's online dictionary mentions that privacy is the quality of being secluded from the presence or view of others or the condition of being concealed or hidden [4]. In another meaning privacy is defined as insulation from observability[5]. The term of privacy is linked to seclusion and unlike public, social and communal. Several scholars have studied privacy through different discourses, Irwin Altman suggested that privacy is serving the individuals self-identity by creating personal boundaries[6]. Rapaport had explained the privacy as the ability to
control interaction, to have points, devices and mechanisms to prevent unwanted interaction and to achieve desired interaction. Westin has defined privacy as, the right of individual to decide what information about himself should be communicated to others and under what condition[7].

3 SPATIAL CONFIGURATION AND PRIVACY

The relationship between spaces and the hierarchy of spaces have been studied by many scholars where they pointed out that the juxtaposition and the sequence of spaces are the determinant factors in privacy regulation. “The most widespread opinion about space is that the spatial organization is a sign of the common attitudes and the hierarchy of their different levels.” [8]. The combination of individual, space, and privacy form the relationship between the person and the ambient environment. Privacy could be considered as the regulator of the intervention between oneself, others, and the environmental stimuli [9]. According to Hillier, space configuration affects the way occupants find their way inside the building and spatial behaviour of any person. Then, space configuration (spatial configuration) is a fundamental relationship between person and space which is appropriated in the processes by which buildings are transformed from bodily objects to social and cultural objects. In both senses, society acquires a definite and recognizable spatial order [10]. Ordering of space is the purpose of building, not the physical object itself. Therefore, houses are not just objects, but transformation of space through objects.

Fig (1) Space and spatial configuration. (source: Hillier,1996)

Private places within houses are allocated to be more segregated (bedrooms, rooms for females) and provide more privacy, secrecy, concealment and isolation from the public intervention, which includes visual, aural and accessibility restriction. Whereas, public spaces are referred to as living areas that are used by the public such as gardens, football stadiums, theatres and squares where social activities take place and social integration is allowed with unrestricted visibility. Public spaces basically are controlled by males and could be identified by the absence of women. In contrast to public spaces, private areas are dominated by females [11]. Throughout history, the need for privacy has been considered as a major factor that affected the traditional houses layouts where occupants built their houses to be a more private environment and well protected from external intervention that negatively influences house quality. Because of the appearance of new mechanics and concrete materials, mass production of housing projects have occurred in last century producing new houses that are totally different from traditional houses. This has led to the changing relationship between space configuration and privacy satisfaction.

4. CASE STUDY AND SAMPLES

Ghadames is a desert settlement built in the middle of the desert consisting of two main areas, the traditional district (mud and wood houses) and the contemporary area (concrete buildings). Since the research is a comparative study, two samples of vernacular houses and two samples of modern houses were chosen to figure out how modernity affected privacy satisfaction within each sample.

4.1. LOCATION

The city of Ghadames is located in the western region of Libya (Tripoli region) near the intersection between Tunisian, Algerian borders.
Figure (2) location of Ghadames.

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 Mediterranean sea coast and about 300 m over the sea level where it is surrounded by sand hills [12].

4.2. HISTORICAL BACKGROUND

Previous historical studies pointed that Ghadames city was established 4000 years ago, and occupied by several civilizations which had contributed in the growth of Ghadames. Historical staged of the city could summarized as follows:

a- Foundational stage:

During ancient times, Ghadames city was considered as a meeting and rest point for convoys that are coming from middle Africa to coastal regions of north Africa and that are coming from east to west. According to several archeological studies this period goes back to about 4000 years ago.

b- Greek period:

This stage went back to Paleolithic and Neolithic times.

c- Roman age:

In 4-5th centuries, the city was taken over by Romans to be a military base for defending the empire borders from barbarians attacks. The roman castle in Ghadames is a concrete evidence for their existence.

d- Islamic age:

The age of Islam in Ghadames has began when ARAB-MUSLIM armies came into the city in the 7th century.

e- Italian colonization stage:

In 1914 Italian soldiers had colonized the city which remained under the Italian administration till the French period.

f- French colonization:

During second world war the city had witnessed a conflict between Italian and French armies which finally took over the city in 1955.

g- Modernity period:

Several historians believe that modern age of Libya has started from independence day in 24th of December, 1951 where Libya had become a kingdom under leadership of the king Idrees AL-ssanousi. During this time oil has occurred and the economy of Libya has changed. Government had started a transformation from traditional housing to modern housing provided by electricity, infrastructure, sewage, and water supply networks. In the 1st of September 1969, ALQADDAFI had led a military coup against the king and took over Libya. At the beginning of the seventeenths of last century, Libyan government had decided to build new housing projects to move Ghadames citizens from vernacular settlement to modern houses. New houses were designed and built by foreign designers and built by new hand-made concrete materials.

Fig (3) models of traditional and new houses. Source (Alabid and Taki).

4.3. STUDY SAMPLES

Preparing a comparative study requires choosing samples for each type of dwellings (traditional houses and contemporary houses) and applying on these samples would show to how extent modernity affected privacy satisfaction within dwelling environment. Therefore, two samples of traditional houses (H1 and H2) and two samples of contemporary houses (H3 and H4) were chosen for analyzing. These samples could be presented in table (1).
5. METHODOLOGY:

To achieve the aim of the research, study would conduct using the following methods:

5.1. Questionnaire:
The study employs LIKART scale questionnaire with five points as shown in figure (3). Surveying process covers 150 member of city occupants.

![Five points questionnaire](image)

5.2. SPACE SYNTAX ANALYSIS:

Studying the relationship between spaces within house layout by using the following methods:

5.2.1. Justified graph and gamma analysis:
Justified graph and Gamma analysis is a program which is being used to analyze the relationship between spaces within house envelope.

5.2.2. Isovist measurements:
Isovist area is the visual field of visible area inside the house and measured by UCL depthmap software.

5.2.3. Visibility graph measurements:
Both of isovist and visibility graph measurements are extracted from UCL depthmap software results. Where as soon as you click the icon of visibility graph results show how extent the spaces of houses are visually exposed or not.

By comparing between the extracted results, study would find out the impact of transformation process (modernity) on privacy satisfaction in both types of dwellings.

6. RESULTS

study results could be summarized as follows:

6.1. Questionnaire analysis:

According to the questionnaire survey, 91% of the participants (occupants of Ghadames) believe that traditional houses are more private than contemporary houses.
96% of the participants indicated that modern houses are more visually exposed than traditional houses (see Figure 5). Furthermore, gender segregation was considered by 92% of contributors as a mean determinant in the Ghadames traditional settlement, and they expressed that gender segregation in contemporary dwellings is lower than in vernacular fabric.

![Fig (5) privacy satisfaction graph (by author).]

As for accessibility to the core of dwellings, 56% of participants see that the ability to access the core of modern houses is higher and shorter than the accessibility in traditional houses. Overall, Ghadames citizens believe that vernacular desert houses were built to be more segregated spaces, more private, less accessible and less visually exposed than contemporary houses.

6.2. space configuration and privacy within houses:-

Daily family activities and use of domestic space are closely connected to individual, social and cultural factors, as well as the spatial dimensions of their dwellings [13]. Domestic daily activities determine the use of space and degree of its privacy. According to questionnaire results, daily activities in Ghadames family divide spaces within dwellings into:-

A- public spaces: streets.
B- Semi private: male and female guests room, kitchen, external courtyards and storage rooms.
C- Private spaces: living spaces and bathrooms.
D- Very private spaces (intimate spaces): bed rooms. See table (2).

6.3. Justified graph and gamma analysis:-

As for accessibility to the core of dwellings, 56% of participants see that the ability to access the core of modern houses is higher and shorter than the accessibility in traditional houses. Overall, Ghadames citizens believe that vernacular desert houses were built to be more segregated spaces, more private, less accessible and less visually exposed than contemporary houses.

![Fig (6) the importance of gender segregation. As for accessibility to the core of dwellings, 56% of participants see that the ability to access the core of modern houses is higher and shorter than the accessibility in traditional houses. Overall, Ghadames citizens believe that vernacular desert houses were built to be more segregated spaces, more private, less accessible and less visually exposed than contemporary houses.]
depth of that space. All the spaces that have the same depth values are placed on the same line.

After the graphs are formed, the analysis shows some numeric measurements which are related to the properties of spatial configuration. These measurements are the mean depth (MD) of spaces within the spatial system (house layout) and the integration value of space: relative asymmetry (RA). These properties have a significant role in detecting the indoor privacy level of interior spaces.

The integration and permeability are influential predictors of how "busy" or how "quiet" a space will be [15]. Spaces are usually linked to each other in ways that vary the distribution of integration throughout the structure. Some spaces of a house are more accessible (public spaces) than others (private spaces).

The morphological properties of a house layout could be specified with these terms according to numerical values: symmetric-asymmetric and distributed/non-distributed. These properties are related to the permeability and depth of the spatial configuration. Symmetry/Asymmetry reflects the relative depth of space in relation to the rest of spaces in the system [16]. The MD of space from all other spaces in the configuration (house layout) is integration. It describes how permeable that particular space is. The low values of MD indicate higher integration, and the high values indicate high segregation.

The depth of each space is calculated in the graph from the root space where the depth of each space is represented by the number of spaces that should pass through to transition from the root space to any space in the system. The least depth is achieved when all spaces are directly connected to the original space (root space). While the highest depth exists when all spaces are arranged in a linear sequence away from the original space.

In the first case, space can be symmetric with respect to other spaces in the system and asymmetric in the second case [16]. Symmetry/Asymmetry is about the integrating/segregating (less private/more private) effects of a space regarding the house layout. This property can be described by RA, which has a range from 0 to 1. A low value indicates that a space tends to integrate the system in its entirety, and a high value indicates that a space tends to be segregated from the space. Thus, if it is low, the plan has a quality of symmetry and the spaces are equal in terms of permeability control and privacy [17].

The researcher used Gamma Analysis to investigate privacy and prepare a comparison between traditional and modern houses samples to figure out the impact of the transformation process on privacy levels within the samples’ layout.

Gamma Analysis of the samples is summarized as follows:

- The average of MD in traditional houses is 3.58
- The average of MD in contemporary houses is 2.7
- The average of RA in contemporary houses is 0.5
- The average of RA in contemporary houses is 0.23

(see Table 3)
Table (3) justified graph and gamma analysis of samples

<table>
<thead>
<tr>
<th>Samples</th>
<th>Justified graph</th>
<th>MD</th>
<th>RA</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td><img src="image" alt="Justified graph" /></td>
<td>4.2</td>
<td>0.68</td>
</tr>
<tr>
<td>H2</td>
<td><img src="image" alt="Justified graph" /></td>
<td>2.95</td>
<td>0.32</td>
</tr>
<tr>
<td>H3</td>
<td><img src="image" alt="Justified graph" /></td>
<td>2.86</td>
<td>0.24</td>
</tr>
<tr>
<td>H4</td>
<td><img src="image" alt="Justified graph" /></td>
<td>2.55</td>
<td>0.2</td>
</tr>
</tbody>
</table>

In the case of traditional house layouts (H1, H2), the overall spaces are more segregated (more private/more privacy) than the overall spaces in the case of modern house layouts (more integrated spaces/less privacy). This is supported by a high mean value of 0.5 RA regarding traditional houses, which refers to the tendency of the system to be more segregated (more private/ more controlled). Modern houses carried a low mean value of 0.23 RA, which indicates that the spatial configuration of these type of layouts tends to be more integrated (less private/more accessible).

6.4. measuring isovist area (visual field or visibility) by UCLdepthmap:–

UCL DEPTHMAP is software which had been designed according to space and time theory and space syntax theory. Developed by Bill Hiller. This software analyses the relationships between urban plan elements such as spaces, streets, and the built environment. On the micro scale this software could be used to analyse the spatial orientation inside buildings and the relationships between building spaces.

Visual privacy could be measured by few parameters within the software. These parameters could summarized as follows:-

6.4.1. Isovist area:–

Benedikt adopted the term isovist from Tandy who had 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. Isovist analysis has been developed in landscape studies and is integral to GIS [18]. Isovist area could be defined as the exposed area within visual field in a specific point, it is measured by m². This parameter 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.

Fig (7) UCL depthmap software.

![Fig (7) UCL depthmap software.](image)

Fig (8) visual field or exposed area.
The isovist area is measured automatically by using the isovist icon in the UCL DEPTHMAP software. In this study, we used two main reference points. The
first point is from the entrances, and the second point is from the middle of the plan. The isovist areas of the samples are:

Table (4) isovist area measurements of samples.

<table>
<thead>
<tr>
<th>samples</th>
<th>TRADITIONAL HOUSES H1 AND H2</th>
<th>CONTEMPORARY HOUSES H3 AND H4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isovist measurements plans</td>
<td>plans</td>
<td>plans</td>
</tr>
<tr>
<td>Reference point Entrances m²</td>
<td>3.01</td>
<td>20.2</td>
</tr>
<tr>
<td>Reference point Middle m²</td>
<td>8.1</td>
<td>27.55</td>
</tr>
</tbody>
</table>

Isovist measurements could summarized as follows:-
a-Isovist area in reference point 1 (entrances):-

Fig (9) isovist measurements of samples in reference point 1 (entrances).

h- Isovist area in reference point 2 (middle):-

Fig (10) isovist measurements of samples in reference point 2 (middle).
Reference point 2 is located in the middle of each plan (floor) where the exposed area is higher. According to the previous results, the isovist area in sample 3 and sample 4 (contemporary houses) is higher than isovist area in traditional houses (sample 1 and 2). That means entrances in traditional houses are less exposed than modern houses.

6.4.2. Visibility graph measurements:

The element of space visualization within house layout design is an essential factor where occupants prefer living in private state without undesired visual intervention. From this point of view, we studied the relationship between spaces and visibility. Visibility was analyzed by using visibility graph analysis (VGA) that was introduced in the eighteenth of last century by Braksman and Cook [19], where they calculated the co-visibility of several spaces within an airport plan and proposed an adjacency matrix to represent these relations. They assigned a 1 for two points that were mutually visible and a 0 for non visually linked spaces. Later, visibility graph analysis was transformed into UCL DEPTHMAP software which allowed for the use of 2d plan drawings in (dxf) format. After importing the dxf plans, the program represented these plans with a grid. As soon as the icon for the visibility graph analysis was clicked upon, results occurred: The main parameters this study attempted to use were:

- **Maximum length:** This parameter is given in m and indicates the extent of the visual axis cross the layout. The longest lines mean that the layout is more open or more visually exposed than the less visually private layouts.
- **Maximum connectivity:** The higher values of connectivity indicate that spaces are less integrated and more visually private.

<table>
<thead>
<tr>
<th>samples</th>
<th>TRADITIONAL HOUSES</th>
<th>H1 AND H2</th>
<th>CONTEMPORARY HOUSES</th>
<th>H3 AND H4</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLANS</td>
<td>plans</td>
<td>plans</td>
<td>plans</td>
<td>plans</td>
</tr>
<tr>
<td>Space configuration</td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
<tr>
<td>Visibility graph</td>
<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
<td><img src="image7.png" alt="Image" /></td>
<td><img src="image8.png" alt="Image" /></td>
</tr>
<tr>
<td>Max connectivity</td>
<td>397</td>
<td>659</td>
<td>307</td>
<td>654</td>
</tr>
</tbody>
</table>

Table (5) visibility graph measurements of samples.
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