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Continuity & Changes in the Morphology of Urban Sudanese Homes

Dr. Khadiga M Osman[1]

El Nasr Technical College, Omdurman, Sudan e-mail: dr_khadiga@yahoo.com

Mamoun M Suliman[2]

Saudi TELCOM
Riyadh, Saudi Arabia

Key words: Associate professor, architecture, Dean College.

Abstract:

Through a topological analysis of Sudanese house plans and settings, collected from the city of Omdurman, this paper detects a shift in the house type aspired and developed by people during the last four decades. The traditional mud house with its scattered rooms is no longer the prevailing trend; neither are its modified patterns, the institutional house. People today build a compact concrete frame house that encloses all spaces, activities, & people in one built unit. However, despite the new design trends some of the traditional house features, such as the high boundary walls and the segregation between male/female domains, continued to exist in the newly developed types of houses in Omdurman.

1 Introduction

In this age of information a particular society norms not to be viewed as the sole influencing factor in the behavior of its people and consequently any cultural artifact they produce including houses, but are to be looked at as a multi cultural by product. Until very recently, the last decade of the preceding century, the observer would only detect Western European influence in the architecture produced around the world. A phenomenon that began during the European colonial time and continued afterwards as most architectural schools and practitioners adopted the Western paradigm of design impeded in the theoretical concept of the modern and postmodern movement of architecture. Such influence was so pervasive, as Duncan [1] argued we should not treat a housing phenomenon as a "self-contained cultural entity " but view it in the context of the degree of Western influence in a particular culture. In recent days, however, the information technology, as a global phenomenon, is making changes in the way people around the world use and view urban spaces, including houses & other buildings, should function [2&3].

In the Sudan, the effect of Western norms of planning and designing buildings is still apparent[3]. Western planning norms influenced the approaches of both public and private

practitioners'. Before and after independence, planning agencies established strict, and sometimes too rigid planning laws and design guidelines, to replace the native norms. However, in recent times, with the immigration of Sudanese professionals and skilled labor force to rich oil producing gulf countries and with the advances of the IT revolution other cultural milieus came to influence housing preference among the various social groups of the local population.

The finding of a wider study, on spatial and aspatial features of urban Sudanese housing [4&5], is used as a base for the investigation of the above arguments. A sample of Sudanese house plans, collected (first in 1992, and recently to enhance their findings in year 2000 & 2004) from the city of Omdurman, are analyzed to gauge the degree of their conformation to local and traditional house types as well as other cultural and technological aspects that influences their design. The main purpose is to detect traditional morphological patterns of relationship continuing to appear in today house settings and to pin points of other influencing factors.

2 Methodology

To achieve the stated above study aims, a modified approach of space syntax [4,5, 6&7] is used to project the underlying morphological features of the collected plans of houses and for comparison purpose. Described below are the adopted methods for data collection and analysis.

2.1 The case study:

Omdurman is one of the three towns that constitute the present capital of Sudan[4]. The study selected Omdurman for this investigation for various reasons. Such as: 1) it is the first national capital of the country. 2) It is the melting pot of all Sudanese cultural milieus. 3) It offers a uniform and homogeneous ways of how households view, perform, and celebrate the day- to-day and major events. 4) Unlike Khartoum and Khartoum North, where almost all housing are the creation of public and private housing agencies, Omdurman, due to its historical heritage, has diverse types of settlement such as planned/organically grown neighborhoods, planned neighborhoods which are the product of modern planning ideologies, and spontaneous settlements. These three types of neighborhoods offers variety of housing experience ranging from housing designed and built by professionals to those, solely created by their inhabitants.

2.2 Data collection methods:

As stated previously, the study conducted a field survey in the city of Omdurman[5] to collect, among other data, a sample of scaled architectural floor plans of houses occupied by households in the various neighborhoods of the city as well as to record predominant physical features of each house type. To collect the needed data, the study employed methods of building documentation, using measured drawings and photography, and systematic observations to record physical features of housing and the actual use of domestic space.

2.3 Data analysis methods:

To elicit the underlying patterns of organization of houses, floor plans are considered as systems of relationships of nodes and permeability lines following a modified procedure of space syntax and graph theory [5]. Analysis using this procedure includes the following steps:

1. At first, the analytical procedure divides floor plans into its largest and fewest convex spaces needed to cover the whole house setting.
2. From the convex map, of each house plan, justified permeability graphs of nodes, denoting spaces, and lines, denoting links between spaces, are drawn. A permeability graph is the base of spatial analysis.
3. The basic syntactic parameters-- Integration, Connectivity, Control, Cyclomatic, and Complexity[6]-- are calculated from permeability diagrams using a computer software[7].

3 Results & Findings

3.1 Houses Categories:

For the casual observer, Omdurman houses are similar. High boundary walls that provide physical and visual separation between the house domain and the public domain of the street are predominant. However, a closer look reveals numerous differences among the houses resided by the city dwellers. The finding of this research identifies three categories of houses[8]. These are: 1) the "traditional" house which is observed mainly in the old unplanned areas of the city; 2) the "institutional", referring to the houses commonly built in some of the planned neighborhoods and resided by low and middle income groups; 3) the "contemporary", a multi story house inhabited by high income people. These three categories vary considerably--by their architectural form, morphological patterns, spatial allocation of functions within a plan, and the degree to which both professionals and users have influenced their final product--in response to variation in functional, social, and economical aspects of users, as indicated below.

3.1.1 The "traditional" house setting:

General description:

This type of house setting is common in the unplanned areas of the city. The study labeled it as "traditional" because it shares similar features with the indigenous mud dwellings of rural Sudan. Inheritance is the main source of acquiring a "traditional" house; and it normally accommodates more than one generation of families, who either share their daily domestic life or live separately.

The floor plan of this house type is composed of scattered rooms and divided in two separate parts: the front part, the shallowest and directly linked to the street, is the male domain; while the back and the deepest from the street level, is the female domain. Thus, this way, it ensures maximum physical, social, visual, and auditory segregation between male and female members of the same household[9]. The number and type of spatial units, contained in this house, may vary from one house to another[10].

Fig (1) Traditional Plan

Spatial Qualities:

The permeability graph of a house from this category and values of Syntactic analysis reveal, in-spite of the apparent informality of the traditional house design (Fig. 1), ordered arrangement of two parallel branching trees or linearly ordered branching trees linked to each other at one, two, or more levels. Values of syntactic measurements (Cyclomatic, Complexity, Control, and Integration) reflect a complex, non- linearly ordered, fairly integrated circuit pattern that has fewer rings than the maximum number, which may theoretically exist.

Other analysis parameters (Integration, Control, and Depth) when applied to measure the spatial allocation of individual spaces within a house system (Table 1.1) indicate that: the kitchen, the saloon, the master bedroom are among the most segregated and controlled spaces in a traditional house setting. In general, though from the values of the analysis, it appears, male and female spaces of clear gender division (kitchen & saloon) may share similar integration and control values depth values differentiate between them. Female spaces are at least one level deeper than male spaces of similar function.

3.1.2 The "institutional", post-independence house setting:

General description:

Since the independence of Sudan in 1956, the different government of the country adopted the policy of providing serviced open plots and the left development of the building to the beneficiaries. The size of the plot as well as the type of building to be constructed are all

governed by sets of standard based on the socio economic group of a household. Until very recently, most of the houses from this policy are single floor, low-rise development, with flat timber or corrugated iron sheets roofs and walls made from red bricks, sun-dried mud bricks, or mud. The construction of this house type follows a prototype design, originally suggested by government agencies with some additions and subtractions.
On the average, such house plan shares identical set of spatial units and labeled similarly to those observed in the traditional house.

Fig. (2) Institutional Plan

Spatial Qualities:
Government agencies, consciously, initiated the design of this house type to bare some of the spatial feature of the traditional house as well as to overcome its basic shortcoming-- the scattered nature of rooms and built areas. The permeability graph of this house type (Fig. 2), thus, came similar to that of the traditional house--a system composed of two parallel network branches representing male/female domains. Other measurements reflect complex, non-linear arrangement, and fairly integrated circuit patterns.
Data obtained from syntax measurements, (Table 1.2), indicates that, among the most integrated spaces in this setting are female's veranda, saloon veranda, master bedroom, and female bedroom. Of the four spaces two--the saloon veranda and female veranda are highly integrated and highly uncontrolled, but the female veranda is deeper in the system than that of the saloon. The other two spaces, the master bedroom and female bedroom share similar syntax values. They are among the most integrated, moderately controlled and deeper in the system. In addition, in this setting the kitchen is highly segregated, very controlled, and located, deep in the house.
In general, the configuration of this house indicates that: male and female spaces of similar function may share one syntax quality--integration or control, as in the traditional setting but depth values highlight their morphological differences**.**

3.1.3 The "contemporary" house design:
General description:
The contemporary house is a villa type of one, two, or more floors constructed out of concrete structural frame and red brick walls. In most cases, private architects design houses of this type. The arrangement of this house is based on a central built area surrounded by courtyards, and contains similar spaces to those observed in the traditional and the institutional houses in addition to introducing three new spaces--the hall, the guest bedroom, and the guest bathroom--and discarded the saloon veranda.

Fig.(3) Contemporary Plan

Spatial Qualities:
The spatial arrangement of this house type shows a large branching tree wrapped with a linearly related set of open spaces or circulation routes (Fig. 3). Values of syntactic measurements indicate complex non-linear systems with alternative routes that interconnect spaces together.
Data obtained from individual space analysis (Table 1-3) order the saloon and the hall similarly in terms of their syntactic qualities; the two spaces have the lowest integration values, the highest control values, and the lowest depth. In addition, from the same data, it is clear that the female courtyard shares with the male courtyard most of its qualities-- highly connected and shallow, but the female courtyard tends to integrate with more spaces than the male one. The most segregated spaces in the setting are the master bedroom, the master bathroom, the guest bedroom, and the guest bathroom. In general, this type of setting regards, only, a space function in the spatial allocation of units. Consequently, male and female spaces of similar function share equal syntax values.

4 Discussion

By observation, spaces in all three house categories are labeled in, almost, similar way; the observed variation is a product of the dwelling size. However, Contemporary houses introduced a range of new spaces such as the hall, the guest bedroom, and the guest bathroom. Smaller houses from the traditional or the institutional category have fewer spaces and may not have spaces labeled as saloon or kitchen.
The inspection of the graphical representations of each map in the three houses categories, reveal some similarities between the morphological patterns of the traditional and the institutional plans. Graphs corresponding to both types of plans reflect the division of the house into male and female domains. They are both composed of two parallel sets of branching trees--each branch represents a separate sex domain--connected to each other at different levels. On the other hand, graphs of contemporary house plans exhibit one branching tree containing both male and female quarters and surrounded by linearly related set of open spaces and circulation areas. Results from the analysis of the general syntax measurements--Control, Complexity, Integration, and Connectivity--indicate, fairly, connected, complex, non-linearly ordered networks.

Table 1, 2 &3
Syntax Values For the Traditional, Institutional, & Contemporary

1- Traditional Plan Syntax Values: 1.1 lowest - highest RRA values

plan											
	FCY	MBR/BAR	VERS	FBAR	FWC	VERKIT	MCY	FRB	Saloon	kit	Mwc
a	0.974 <	1.262 <	1.305 <	1.334 <	1.251 <	1.578 =	1.578 <	1.664 <	1.693 <	1.965<	2.324
	FCY	MCY	VERS	BAR/WC	Kit	MBR	Saloon	FRB			
b	0.821 <	1.132 <	1.217 <	1.245 <	1.500 <	1.585 <	1.699 <	1.811			

1.2 Lowest - highest control values

plan											
	MBAR	BBR	FBAR	Saloon	FBR	M/ FWC	Kit	VerKit	Vers	FCY	MCY
a	0.200 =	0.200 <	0.250 <	0.333 =	0.333 <	0.500 =	0.500 <	1.250 <	1.750 <	1.833 <	2.333
	Kit	FBR	Saloon	BAR	WC	MBR	FCY	MCY	Vers		
b	0.333 =	0.333 =	0.333 <	0.500 =	0.500 =	0.500 <	0.583 <	1.333 <	1.5		

1.3 Lowest - highest depth values

plan										
	MCY	Vers	M/FWC	MBR/BAR	Saloon	FCY	FBAR	VerKit	FBR	Kit
a	1 <	2 <	3 <	3 <	3 <	3 <	4 <	5 <	5 <	6
	MCY	Vers	BAR	WC	Saloon	FCY	MBR	Kit	FBR	
b	1<	2 =	2 =	2 <	3 =	3 <	4 <	5 <	6	

2- Institutional Plan Syntax Values: 2.1 lowest - highest RRA values

plan											
	VerF	MBR	VerS	MCY	Saloon	FBR	FCY	FBAR/WC	Kit	MBAR/WC	
a	0.272 <	0.857 <	0.961 <	0.987 <	1.195 =	1.195 <	1.221 <	1.247 <	1.273 <	1.455	
	Saloon	MBR	VERS	MCY	FCY	ChBR	BAR	Kit	FBR	FWC	MWC
b	0.839 =	0.839 <	0.911 <	0.935 <	1.055 <	1.151 =	1.151 =	1.151 <	1.558 <	1.750 <	1.798

2.2 Lowest - highest control values

plan											
	MBAR/WC	Kit	FBAR/WC	FBR	Saloon	MBR	Vers	FCY	VerF	MCY	
a	0.161 <	0.200 =	0.200 <	0.250 <	0.500 <	0583 <	1.167 <	1.200 <	2.033 <	3.833	
	ChBR	Kit	FWC/MWC	FBR	Saloon	MBR	BAR	VerF	Vers	FCY	MCY
b	0.167 <	0.333 <	0.500 =	0.500 =	0.500 =	0.500 <	0.700 <	1.167 <	1.200 <	2.167 <	2.833

2.3 Lowest - highest depth values

plan											
	MCY	M/FWC	M/FBAR	VerS	Saloon	MBR	VerF	FBR	FCY	Kit	
a	1 <	2 =	2 =	2 =	2 <	3 =	3 <	4 =	4 =	4	
	MCY	M/FWC	BAR	VerS	Saloon	MBR	VerF	ChBR	FCY	Kit	FBR
b	1<	2 =	2 =	2 <	3 =	3 <	4 =	4 =	4 <	5 =	5

3-Contemopary Plan Syntax Values: 3.1 lowest - highest RRA values

plan												
	Hall	FCY	VerKit	Saloon	MBR	BAR	MCY	FBR	ChBR	Kit	GBR	
a	0579 <	0.887 <	0.941 <	0.977 <	0.995 <	1.158 <	1.176 <	1.195 =	1.195 <	1.357 <	1.394	
	Hall	Kit	Saloon	SHED	MBR	BAR	ChBR	FBR	MCY	FCY	GBR	GBAR
b	0.621 <	0.816 =	0.816 <	0.971 <	0.997 =	0.997 =	0.997 =	0.997 <	1.165 <	1.217 <	1.554 =	1.554

3.2 Lowest - highest control values

plan											
	MBR	Ch/FBR	BAR	GBR	Kit	FCY	MCY	VerKit	Hall	Saloon	
a	0.200 <	0.250 =	0.250 =	0.250 <	0.333 <	1.083 <	1.250 <	1.583 <	2.083 <	2.333	
	MBR	Ch/FBR	BAR	GBR/GBAR	Saloon	Kit	FCY	MCY	SHED	Hall	
b	0.111 =	0.111 =	0.111 <	0.250 <	0.361 <	0.444 <	0.667 <	1.083 <	1.333 <	7.000	

3.3 Lowest - highest depth values

plan										
	MCY	FCY	Saloon	Hall	VerKit	GBR	MBR	Kit	BAR	SH/FBR
a	1 <	2 =	2 =	2 <	3 =	3 =	3 <	4 =	4 =	4
	MCY	FCY	Saloon	SHED	Hall	Kit	MBR	CH/FBR	BAR	GBR/GBAR
b	1<	2 <	3 =	3 <	4 =	4 <	5 =	5 =	5 <	8

The results of the analytical procedures of the Space Syntax and Graph Theory show further evidence of similarities and variations among the spatial values of the three categories of houses. Values of syntax measurements like Integration, Depth, and Control reveal a variation in the allocation and order of spatial units/ functions in the three plans. Of the three measurements, depth values differentiate between the spatial allocation of male and female spaces of the same function in Traditional and institutional plans. In both settings, female spaces are at least one level deeper than male spaces of the same function. This spatial distinction vanishes in contemporary plans where male and female spaces of similar functions share all three syntactic values.

Syntactic values also show considerable variation in the allocation of specific spaces within the four categories of plans. For instance, the spatial position of the saloon changed from highly segregated, to relatively segregated, to highly integrated in traditional, institutional, and contemporary houses respectively. The status of the female courtyard as the most integrating and the most uncontrolled in the traditional plan--a focal point from which other spaces radiates--has been taken over by the female veranda, and the hall in the institutional and contemporary settings respectively. Further, syntax values show changes in the kitchen position from segregated and deep in traditional and institutional plans to moderately integrated and highly uncontrolled in contemporary houses. Bathrooms and toilets share similar integration and control values in all three types of plans; however, they are minimally one level deeper in the contemporary than in traditional and institutional plans.

5 Summary & Conclusion

- During the last four decades, the type of house built in Omdurman has changed from the traditional, the institutional, to the contemporary house with its compact design.
- Contemporary houses, like Western European house, adhere to the principle that group all spaces and function in one built area.
- Traditional and institutional houses respond to the cultural needs of its users. The morphology of both plans show a house space divided into male/female quarters, female spaces located at a deeper level than male spaces, a segregated saloon, and a separated kitchen from other living quarters to seclude women from the eyes of the visiting male.
- As mentioned previously, government agencies initiated institutional house plans, yet its design respects the cultural life style of the users. This is so because of the rigorous research conducted by officials at that time to insure the compatibility of design to local cultural needs [8 & 9].
- The designs of most contemporary houses integrate the saloon with the female quarter, locate the kitchen in close proximity to the saloon for quick services, and position the female courtyard at the same depth as the male one. All these syntax qualities are in conflict with the corresponding qualities detected in the traditional and institutional houses and consequently with the cultural needs of users.
- In all types of houses, there is a clear gender classification of a house space; there are fixed male spaces and other female spaces. However, such distinction may not exist in small houses where a house space is limited.
- The distribution as well as the spatial arrangement of spaces in the houses of Omdurman does not express clear distinction between diurnal and nocturnal activities; at the same time, they do not specify spaces for private or collective use as observed in Western houses [10]. Any given activity can take place in various parts of the house, depending on the nature of the activity and the status of its participants[11].

6 End Notes

1- Dr. Khadiga M Osman, Associate Professor of architecture, Dean, El Nser Technical College Omdurman Sudan.

2- Dr. Momoun M Suleiman, Associate professor of electronic engineering, Sudan University of Science & technology.

3- The Sudan, as a former British colony, has a considerable heritage of colonial architecture in the form of public buildings and residential units produced at that time to accommodate the staff of the colonial government. Buildings of such types are observable around the capital and other major towns.
4- The capital of Sudan, due its unique location at the confluence of the Nile and its two branches, is composed of three towns Khartoum, Khartoum North, and Omdurman.
5- In 1993, the study collected various types of data included socio-demographic aspects of people, household life pattern, and floor plan of the house resided by each interviewed household. In the year 2000, the Authors conducted similar study, but smaller in sample. The present study collected only house floor plan recently built in the city, using multiple sampling procedures.
6- Syntactic analysis is of two levels; overall house or system analysis and individual space analysis. At the system analysis, the study used measurement such as, Cyclomatic, Complexity, Control, and Integration; and the parameters used at the space level analysis include Integration, Control, and Depth. For the definition and value interpretation of each of these parameters, see Appendix 1.
7- The study used a binary coding system of one for connection and zero for no connection to feed the constituent spaces of a floor plan in the computer.
8- The author established this classification in Osman KM 1993, PhD dissertation.
9- This finding coincides with the observed segregation between male and female members of the same household in the Sudanese culture. In the "social literature" of the Sudan [11,12,13&14] this relationship is a topic of considerable weigh, often going in parallel to the distinction, or presumed opposition between community and family.
10- On the average, the main living space may have ten to twelve units depending on the number of families residing the house and the number of people in a family.
11- For example, entertaining guests can occur in any one of several rooms depending on the gender, the status of the visitor, or the formality of the occasion. Similarly, many different activities take place in the same space, as circumstances dictate. This latter conclusion suggests some similarities between the use of space in a Sudanese house and the use of space in a Greek village in the island of "Eressos" (Eleftherios and Hasser, 1989), excluding the gender division.

7 References

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8 Appendices

Appendix 1
Syntactic Analysis Prameters

1. Depth value, mean depth (md) = 1/ (K-1). ∑(all depth values between a point &all other points in a graph)

The depth value between two points in a graph is equal to the minimum number of connections that must be taken to reach from one point to another (the shortest bath). K is the total number of nodes in a graph.

2. Integration value (RA) = 2 (md-1) / (K-1)

3. Real Relative Asymmetry (RRA)= RA /X

Where $X = \{6.644K \cdot \log10(K+2) – 5.17K+2\} / (K^2 - 3K +2)$

$H = - \{ [\ln (a/t) \cdot a/t] + [\ln (b/t). b/t] + [\ln (c/t) \cdot c/t]\}$

$H^* = (H – \ln2) / (\ln3 – \ln2)$

H is the difference factor, H* is the relativised difference factor, a, b & c are the integration values of spaces, & t is their sum, In is the natural logarthim log2.

4. Control value (a) $= \sum_{D(a,b)=1} 1/Val\ (b)$

D(a,b) is the connectivity between point a&b (shortest path), and value (b) is the number of direct connections for pointb. So the control value for any point (a) is calculatedby summing the reciprocal number of connections for each point direcly connected to a.

5. Cyclomatic value (m) = E- K + 1
6. Complexity (b) = E/K
7. Connectivity (Alpha) = 2E / {K . (K-1)}

Appendix 2
Space Abbreviations

Abbreviations	*Meaning*	*Abbreviations*	*Meaning*
BAR	Bathroom	Kit	Kitchen
BBR	Boys' bedroom	MBAR	Male bathroom
BR	Bedroom	MBR	Master bedroom
CBR	Common bedroom	MCY	Male courtyard
ChBAR	Children bathroom	MWC	Male toilet
ChBR	Childrens' bedroom	St	Store
CY	Courtyard	Ter	Terrace
DBR	Dependant bedroom	Ver	Veranda
FBAR	Female bathroom	VerF	Female veranda
FBR	Female bedroom	VerKit	Kitchen veranda
FCY	Female courtyard	VerS	Saloon veranda
FWC	Female toilet	WC	Toilet
GBR	Guest bedroom		