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The Impacts of Spatial Parameters on Space Efficiency in Hybrid Villa-Apartments in Greater Khartoum, Sudan

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Abstract: With the recent increase in hybrid villa-apartments (HVAs), which combine owner-occupier and renters in one building, in Greater Khartoum in response to high housing demand, there is a need to understand the main determinants of their layouts. The need for efficient designs of such a complex housing type raises questions about the impact of spatial parameters on their space efficiency. This study aims to contribute to developing HVA design guidelines by focusing on the impact of key spatial parameters – namely, plot location and dimensions, and location of vertical circulation, yards and entrances – on their space efficiency. Quantitative analysis of a sample of sixty HVAs was performed to show the relationship between spatial parameters and space efficiency. Interviews with practicing architects were conducted to ascertain the determining factors of HVA layouts and the optimum location of identified spatial parameters. The results revealed that the most efficient location for the plot is the corner location; the center-edge for vertical circulation; the back location for yards; and for plot dimensions, it is where the width is longer than the depth. These results can assist designers, owners and developers during the design stage to maximize the space efficiency, hence the feasibility, of HVAs.

Keywords: Hybrid villa-apartments; spatial parameters; space efficiency; housing design; Greater Khartoum.

1. Introduction

The cost of land and building construction is a primary concern for the vast majority of developers and owners (Cunningham, 2013). The feasibility of a real estate project can be achieved by maximizing its net rentable areas, as permitted by building regulations, to enable developers and owners to reap the maximum returns. Given the high cost of land in prime locations and in rapidly-growing areas, a project should include sufficient functional and net rentable spaces to increase its utility (Kim and Elnimeiri, 2004). A sensible balance has to be struck between space efficiency and a good, economically-feasible design. Real estate investments usually seek to reduce common and dead spaces that cannot be used for profitable purposes to a minimum and to maximize the allowable rentable areas (Ratcliffe, Stubbs, Keeping, 2021).

With rapid increase in the number of hybrid villa-apartments built in Greater Khartoum in recent decades, architects need to understand the main determinants of their layouts so as to maximize their space efficiency; hence, their feasibility. Likewise, landowners, investors and homeowners have stakes in maximizing the space efficiency of hybrid villa-apartments. Space efficiency essentially results from an inter-related decision-making process during the early planning and development of the building project (Kim and Elnimeiri, 2004).

2.Problem Statement and Research Questions

Having an adequate, safe and affordable home with basic services is a vital human need that has been identified as the first target under Sustainable Development Goal number 11 (UNDP 2015; Inter-Agency and Expert Group of Sustainable Development Goal Indicators, 2016). Greater Khartoum, the capital of Sudan, is experiencing a severe housing crisis manifested in a high demand for housing and a deficient supply mechanism. This unsatisfied demand is reflected in skyrocketing rents and land prices and high occupancy rates (Hamid, 2021b).

Because of this unsatisfied demand for housing, harsh economic pressures, high cost of land and building construction and lack of alternative profitable investment opportunities, the demand for hybrid villa-apartments has surged during the past few decades since they have become one of the popular options in the real estate market. To maximize economic returns out of this investment, maximum efficiency in space utilization must be achieved. Space efficiency is directly related to key spatial parameters, which include plot location, plot dimensions, vertical circulation location, open spaces (yards) location and location of main entrances, which have to be carefully arranged and analyzed. Architects need to ascertain which parameters affect hybrid villa-apartments' layouts and their space efficiency in order to understand the main determinants of the layout, which must be taken into consideration while making decisions to develop their preliminary designs.

Focusing on the design issues of hybrid villa-apartments for architects, owners and real estate investors, the main research questions addressed in this paper are:

- How spatial parameters affect space efficiency in hybrid villa-apartments?
- What are the main factors that affect hybrid villa-apartments' layouts?
- What is the optimum location of key spatial parameters in hybrid villa-apartments?

3.Research Objective

This paper aims to study hybrid villa-apartments layouts in Greater Khartoum to find out the effect of certain spatial parameters on their space efficiency in order to inform designers' decision-making process during the initial design stages.

The significance of this research lies in its contribution to achieving efficient designs that increase the feasibility of a nascent and increasingly popular form of housing, i.e., the hybrid villa-apartments; hence to contribute to obtaining the maximum benefit out of limited financial resources and urban land, which is a finite resource (Hamid 2021b).

4.Literature Review

Hybrid villa-apartments have gained prominence during the past two decades, as an emerging form of urban housing (Osman 2015; Abdalla, 2020). Composed of a family villa, or house, mostly built on the ground floor of a residential plot, and several rental units on upper floors, hybrid villa-apartments represent a form of small-scale housing investment that could be implemented by individual homeowners whereas big real estate companies would be more interested in bigger apartment blocks that require substantial investments (Figures 1, 2, 3).

Figure (1). A Villa in Khartoum; Credit: Gamal M. Hamid

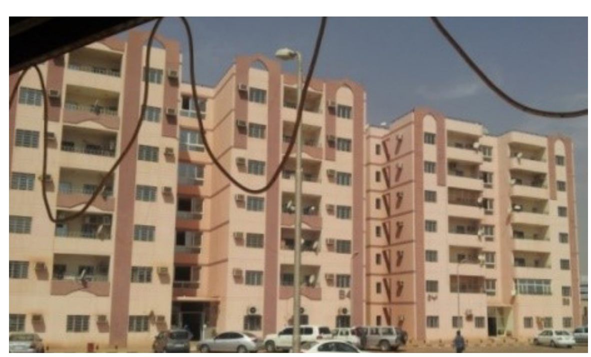

Figure (2). Apartment Blocks, Khartoum; Credit: Gamal M. Hamid

Figure (3). Hybrid Villa-Apartments, Kafuri, Khartoum North; Credit: Gamal M. Hamid

As shown in Table 1, hybrid villa-apartments are relatively a new type of housing that did not figure in the 2008 census results (Hamid, 2021b). However, recent studies have estimated that about 80 per cent of new housing constructed in new urban neighborhoods in Greater Khartoum is in the form of hybrid villa-apartments (Osman 2015; Abdalla, 2020). Apparently, they resemble a marriage of convenience for landowners who seek to invest their limited capital in a rather secure type of investment, or to provide housing for their married sons and daughters, on one hand; and for young families who seek rental housing units in serviced neighborhoods at reasonable rents, on the other hand.

Evidently, hybrid villa-apartments have managed to meet users' requirements in terms of adequacy, services and affordability (Mohammed, 2016). In an empirical post-occupancy study of hybrid villa-apartments in Khartoum, Wini (2017) concluded that their residents felt very satisfied with living in them. The parameters that registered the highest scores of satisfaction, in a descending order, are safety and security, indoor air quality, privacy, circulation and space utilization.

In Khartoum State, architects who have been interviewed by the present authors confirmed that about 80% of their recent residential projects could be included under the hybrid villa-apartments category. An observation they attributed to several reasons such as:

- Rampant inflation and macro-economic hardships forced landowners to invest in their own private houses so as to reap steady incomes.
- Land prices and construction costs are significantly high, so most landowners strive to make the maximum benefit out of their lands.
- According to socio-cultural factors, and Sudanese habits, parents often tend to secure the future of their dependents after marriage by providing them with separate apartments.
- The government's failure to meet the high demand for housing has created a huge market for small-scale, as well as large-scale, real estate investors.

When we compare the housing types prevalent in Sudan, and in Greater Khartoum, shown on Table 1 to housing types inhabited by Saudi households, we notice that the most popular type of housing in the latter is apartments, which accounted for 43.7% of all dwellings lodged by Saudi households. This was followed by villas that accommodated 29.4% Saudi households, then by traditional houses (18.4%), then by "floors in villas occupied by Saudi households" (7.7%), and, finally, "floors in traditional houses occupied by Saudi households" which accounted only for 0.8% (General Authority for Statistics, 2017:10-11). Regardless of their seemingly insignificant percentages, the last two housing categories may be the predecessors of a fledging market for hybrid-villa apartments in Saudi Arabia.

Table (1). Households and Housing Types in Sudan and Greater Khartoum (2008)
[1] Other dwelling types include tents, those built of straw and mats, and unreported cases.

	Households/ Residences	Dwelling Types				
		Flat/ Apartment	Villa	Single-Storey House	Multi-Storey House	Other[1]
Urban Sudan	1,992,512	15,530	2,147	1,290,760	24,658	659,417
Urban Sudan dwelling types (%)	--	0.8%	0.1%	65%	1.2%	33%
Greater Khartoum	688,810	12,208	1,697	605,494	20,132	49,279
G. Khartoum dwelling types (%)	--	1.8%	0.2%	87.9%	2.9%	7.2%
G. Khartoum dwelling types as (%) of urban Sudan's	--	79%	79%	47%	82%	7%

Source: Hamid, 2021b, Calculated from CBS, 2008, Table H1

Rapid economic decline in Greater Khartoum in recent years has led to an increase in land values and construction costs. Undoubtedly, land and property prices in Greater Khartoum are very high even by international standards. Urban planning specialists think that the reason behind this is due to the way Sudanese houses are laid out horizontally because each family requires a separate house. With expanding population growth and competition over land for other land uses (e.g., agriculture and industry), households may need to shift to live in multi-story housing units, which will make life for them much easier in terms of transport, infrastructure availability, maintenance and security. As noted by Elzubair (2009), the reason behind many people investing in real estate in Greater Khartoum is that they find it the safest form of investment in Sudan that generates high returns.

Space efficiency is a building's net rentable space – not counting the areas occupied by elevators, hallways, lobbies, restrooms, etc.– calculated as a percentage of its gross floor area (Spreiregen, 2005). Space efficiency is an important design parameter for investors and homeowners. The purpose of an efficient design is to identify the aspects that contribute to obtaining the most functional aspects from a given space. The aims of a space-efficient design are the reduction of redundant spaces and a careful analysis of all spatial parameters in order to eliminate any unnecessary spaces and to strike a balance between usable areas and built ones (Chiddick, 2006).

Space efficiency of any building relates to the quantity of space, generally calculated in terms of floor area though occasionally volume may also be relevant. It also relates to the potential number of users and actual ones (ibid.). Space efficiency is directly related to the spatial parameters' arrangement in buildings, so these parameters must be paid additional attention in the early stages of design so as to achieve maximum space efficiency. If the building acquires some additional rentable spaces through arrangement of spatial parameters, the economic benefits can be considerable. Neglecting the consideration of space efficiency in a design may lead to inability of achieving the maximum allowable rentable area. Therefore, the project –e.g., hybrid villa-apartments– will not be a feasible investment.

5.Research Methodology

The research methods adopted in this paper include desk review of secondary sources of information (viz. books, reports, papers, etc.) as well as the extraction of information from primary sources (namely, a sample survey and interviews). The authors performed quantitative and comparative spatial analyses for a sample of sixty housing units collected from five consulting companies (namely, KARPLEN, TEKNO, Ali Zaroug and Partners, Newtech, and Abubakr) as well as from a previous M.Sc. research paper on hybrid villa-apartments (Osman, 2015). The relatively small sample size has been dictated by the scarcity of resources available to the authors for this exploratory study. The sample has been selected from different neighborhoods in Greater Khartoum, including first-, second- and third-class housing areas, whose plot sizes ranged between 300 – 700 m2, which are typical in Greater Khartoum, in order to clarify the effect of plot size and location on space efficiency.

Furthermore, the authors selected and interviewed 10 practicing architects to verify and corroborate, from their vantage points, the determining factors of hybrid villa-apartments' layouts and the optimum location of identified spatial parameters. The criteria used to analyze the layouts of all case studies include analysis of spatial parameters in relation to space efficiency. Spatial parameters are selected according to their perceived impact on the use of space. They also have strong effects on design decisions at the early stages of the project. The analysis and area calculations have been performed on typical and ground floor plans using the 2008 Khartoum Building Regulations, which are currently used to control what is built. Spatial parameters were also analyzed at typical and ground floor levels to ascertain their impacts on space efficiency.

Based on the reviewed literature, observations and their own professional experience, the authors have developed the analytical yardstick, shown in Figure 4 and Table 2, to analyze the case studies vis-à-vis their spatial parameters' locations. The yardstick focuses on the locations of vertical circulation means, entrances and yards as follows: the ground and typical floor plans for each sample have been divided equally into nine zones depending on the plot shape and size, three zones vertically (A-B-C) and three zones horizontally (1-2-3) according to the street location - regardless of the north point direction. When a plot is facing more than one street, one of them is considered the main. Thus, the location of the spatial parameters can be identified and the space efficiency can be calculated.

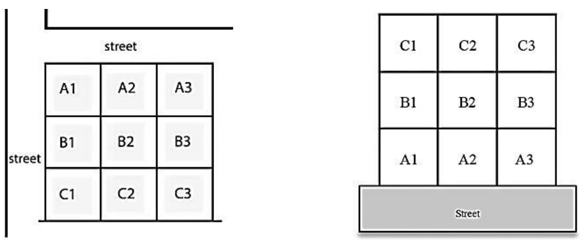

Figure (4). Yardstick for analyzing case studies (middle and corner plots). Source: Authors

Table (2). Yardstick for analyzing case studies (middle and corner plots)

Spatial parameters	Location	Zone
Plot locations	Corner, Middle	—
Vertical circulation locations	Center-Edge, Corner, Center	A2, B1, B3, C2 / A1,A3,C1,C3 / B2
Entrance locations	On main street	A1,A2,A3
Yard locations	Front, Back	A1,A2,A3/ C1,C2,C3

Quantitative analysis of the selected samples has been performed using simple mathematical equations. This included calculation of plot areas, gross floor areas, net/rentable areas, common areas or shared spaces at ground and typical floor levels, and space efficiency. Built-up areas, maximum allowable areas according to the 2008 Khartoum Building Regulations (mostly 75% of gross plot area) and yard areas have been calculated at ground floor levels; then the coverage ratio and yard percentage have been calculated and compared to space efficiency. Table 3 lists the set of formulae used by the authors to calculate the areas and space efficiency. It should be noted that in this research we defined the attained space efficiency as the percentage of a buildings' net rentable area (not counting the areas occupied by stairs, elevators, hallways, lobbies, etc.) over the maximum allowable built-up area as defined by the Khartoum Building Regulations, 2008.

The analysis of two hybrid villa-apartments examples using the yardstick and the methodology discussed above is attached as an appendix to this paper.

Table (3). Area calculation formulae

Parameter	Formula
Gross floor area	Net usable area + structural areas
Common areas (shared spaces)	Service areas+ circulation areas (including stairs) + mechanical areas
Rentable area in typical floors	Gross floor area – common areas
Assignable area in ground floor	Site area – common areas
Built-up area	Total floor-built area
Maximum allowable built-up area	75% (ref. Khartoum Building Regulations)
Maximum allowable space efficiency	(Rentable area ÷ Maximum allowable built-up area) *100
Coverage ratio	(Building area ÷ Site area) *100

Source: Capital Planning and Development-Space Management, 2007

6.Results and Discussion

6.1 Spatial parameters' location

The analysis of layouts and spatial parameters' locations was performed by the authors to identify the impacts of the selected spatial parameters on space efficiency. The study's yardstick facilitated the organizing of the case studies' spatial parameters according to their locations, hence allowed a deeper understanding of hybrid villa-apartments' layout determinants and their most efficient layouts.

The criteria for identifying the spatial parameters' locations at ground and typical floor levels were used to analyze all case studies. Using the study's yardstick, spatial parameters' locations have been identified as follows: case studies' plot areas were grouped into four categories: 300-399M2, 400-499M2, 500-599M2, and 600-699M2. Plot locations were categorized as either corner or middle plots. Vertical circulation locations are either at the center of the façade (i.e., in zones A2, B1), or at the center of the plot's edge (i.e., in zones B3, C2). Yard locations are either back or front (i.e., in zones A1, A2, A3; B1, B3; C1, C2, C3) (See Figure 1). Once these have been identified, space efficiency and the most efficient location for each spatial parameter could be determined. In order to understand the main determinants of hybrid villa-apartments' layouts, a comparative evaluation was conducted between ground and typical floors to find out the most efficient location for each spatial parameter.

6.2. Space efficiency and area calculations

With regard to space efficiency, calculations and thorough analysis of the samples were performed to measure it and to categorize and rate the samples according to their plot areas and spatial parameters' locations. To calculate the efficiency of a layout, the net rentable area is divided by the gross built-up area. The net area is the sum of all usable floor spaces measured from the inside faces of enclosing walls or the lines of other space dividers; but it does not include circulation and general service areas such as corridors, lobbies and mechanical systems' spaces. The gross building area, on the other hand, is the sum of all building areas measured from the exterior face of perimeter walls, including all interior walls, columns, shafts, etc.

Using Spreiregen's (2005) formula for calculating space efficiency, the net area of each case study was divided by its gross area then multiplied by 100% to express the efficiency as a percentage.

The relationship between space efficiency and the attained space efficiency in typical floors, and the relationship between the plot area and space efficiency were assessed to identify the most efficient plot area ranges. Similarly, the relationship between space efficiency at ground floor and typical floor levels compared to the plot areas was assessed. The relationship between the coverage ratio and the maximum allowable coverage ratio compared to the plot areas was also discerned.

Figure 5 exhibits the relationship between plot areas and space efficiency and maximum allowable space efficiency. It indicates that when considering the floor plate, the achieved space efficiency is always above 90% regardless of the plot area. When the floor area is increased to accommodate three and four housing units, the shared spaces also increase resulting in keeping the space efficiency around 90%. The graph also indicates that the larger the plot area, the larger the space efficiency will be, and the lower the maximum allowable space efficiency. This is due to the high yard percentage in larger plot areas, as required by the building regulations, which reduces the coverage ratio at ground floor and increases the maximum allowable floor area at typical floors.

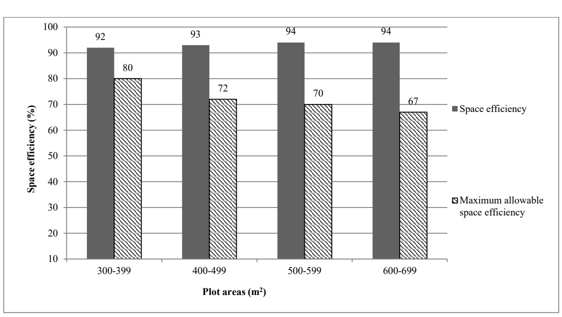

Figure (5). Relationship between plot areas and space efficiency

Figure 6 illustrates the relationship between the plot area and space efficiency at ground and typical floors. It is clear that the larger is the plot area, the larger is the space efficiency at typical floors, and the reverse is true at ground floor. This can be attributed to the need for large common areas at ground floor proportionate to the plot size.

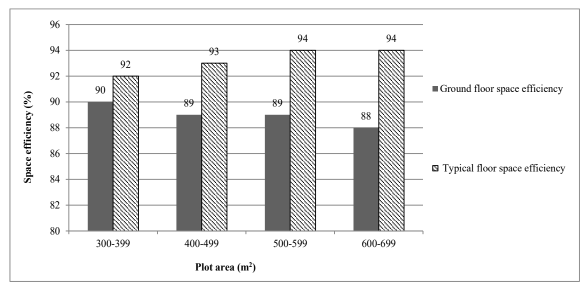

Figure (6). Relationship between plot area and space efficiency at ground and typical floor levels

6.3. The impact of plot location on space efficiency

The relationship between plot area, plot location and space efficiency is shown in Figure 7. It is noticeable that space efficiency increases in corner plots larger than 500 m2 while it drops in middle plots larger than 500 m2.

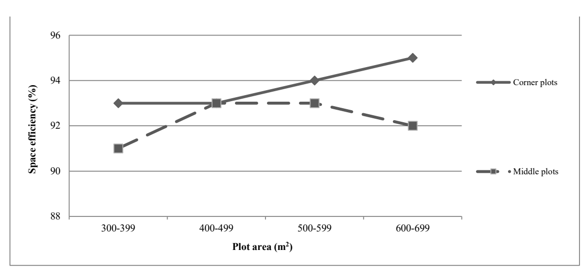

Figure (7). Relationship between plot area, location and space efficiency

6.4. The Relationship between Plot areas, Plot location and Maximum allowable built-up areas

The analysis of the relationship between plot location and plot areas yielded the maximum allowable built-up areas shown in Table 4. It is clear that corner plots always yield higher built-up areas. Moreover, it indicates that the larger the corner plot the larger is the permissible built-up area and the possibility to maximize rentable and usable spaces, and therefore, the higher is the space efficiency.

Table (4). Relationship between plot areas and maximum allowable built-up areas in corner and middle plots

Plot Areas (M^2)	Max. Allowable built-up area (M^2)	
	Corner plots	Middle plots
300-399	305	257
400-499	408	342
500-599	471	416
600-699	578	490

6.5. Vertical circulation location and space efficiency

The vertical circulation location is the spatial parameter with the highest impact on space efficiency compared to other parameters. Therefore, attention should be paid to place it in the optimum location. As shown in Figure 8, the center-edge location yielded, on average, 94% space efficiency, which is the most efficient location for vertical circulation. The corner location, on the other hand, yielded an average of 92% space efficiency; while the center location yielded an average of 91% space efficiency.

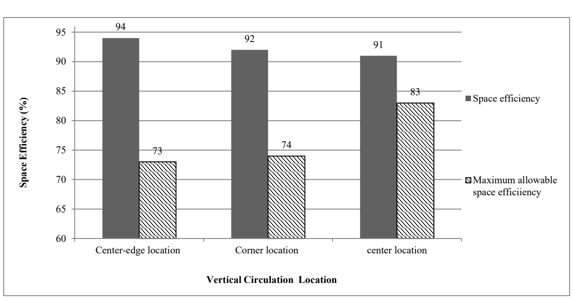

Figure (8). Relationship between vertical circulation location and space efficiency

It is noticeable that 72% of the studied layouts had their means of vertical circulation located in the center of the façade, which indicates that most architects prefer the center-edge location for vertical circulation because it yields high space efficiency, this is on one hand. On the other hand, this analysis indicates that architects do not prefer the center location for vertical circulation because it has the least access to natural day lighting, and also because it creates more common areas (viz. corridors and lobbies) especially at ground floor levels.

6.6. Impacts of other spatial parameters on space efficiency

The location of open spaces (i.e., yards) is not an important component in hybrid villa-apartments' design. Most architects indicated that they prefer the front location; and this preference is not commensurate with space efficiency where the most efficient location for open spaces is the back location.

In ground and typical floor levels, the longer the depth of the plot, the lower is the space efficiency it yields; conversely, the longer the width of the plot, the higher is its space efficiency. Therefore, the most efficient plot configuration is where the width of the plot is longer than its depth.

7.Conclusions

The main results that can be obtained from the present study is that the main determinants for achieving the maximum space efficiency at typical and ground floors of hybrid villa-apartments are:

7.1. Plot location

In general terms, corner plots are more efficient than middle ones especially at typical floor levels since building regulations permit projecting the building at upper floors over the streets by one-to-two meters. This represents a significant result that justifies the higher cost of corner plots compared with middle ones. This result could guide hybrid villa-apartments investors to be keen on acquiring corner locations for their projects to achieve maximum space efficiency and higher returns on investment.

7.2. Vertical circulation location

Most architects prefer the center-edge location (i.e., A2, B3, C2, B1) for vertical circulation in both middle and corner plots. This preference is commensurate with high space efficiency, this is on one hand. On the other hand, architects do not prefer the center location (i.e., location B2) for vertical circulation because it has the least access to natural day light, and because it tends to disturb the ground floor layout by creating redundant common areas (corridors, lobbies, etc.).

7.3. Open space location

The most efficient location for open spaces (yards) is the back location vis-à-vis the main street, i.e., zones C1, C2, C3 for middle plots; A3, B3, C1, C2, C3 for corner ones.

7.4. Plot proportions

The most efficient plot proportions are where the width of the plot is longer than its depth.

These determinants of hybrid villa-apartments' layouts, which have been confirmed in this study through quantitative analysis, are crucial for architects, investors and homeowners. They can guide architects to select the most appropriate and efficient location for spatial parameters at the initial design stage, and help investors and homeowners select the plots with the highest potential return on investment. Moreover, they can help researchers in their search for improving hybrid villa-apartments' layouts.

8. A final word:

This paper endorses the innovation in housing form that the hybrid villa-apartments entails due to their considerable land saving potential, which will be reflected in reduced costs of infrastructure networks and less pressure on valuable urban lands. Hence, the paper advocates a change in building regulations, land planning by-laws and funding mechanisms to facilitate the promulgation of hybrid villa-apartments in both Sudanese and Saudi urban areas.

It is evident from the interview results that 80% of architects do not appreciate the concept of "space efficiency" and have no clear method for calculating it. They tend to focus more on building form, space configuration, owner's requirements, aesthetic aspects, plot orientation, accessibility and privacy as the main determining factors of hybrid villa-apartments' layouts. Moreover, this research paper has highlighted the importance of paying more attention to space efficiency as an important design issue, especially in hybrid villa-apartments.

Finally, as Kim and Elnimeiri (2004) noted, we should bear in mind that "A well designed building cannot be determined only by higher space efficiency. When a building achieves high space efficiency, it has more chances of becoming a feasible building".

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10. Appendix

Following are two examples of hybrid villa-apartments that have been analyzed using the methodology adopted in the study. First of all, a spatial analysis of the ground and typical floor plans has been performed, and then calculation of the spatial parameters using the formulae presented in Table 3 has been conducted and presented in the following tables.

Hybrid Villa-Apartments’ Examples

Example 1: Kafuri, Khartoum North.

Example 2: Abu Adam, Khartoum.

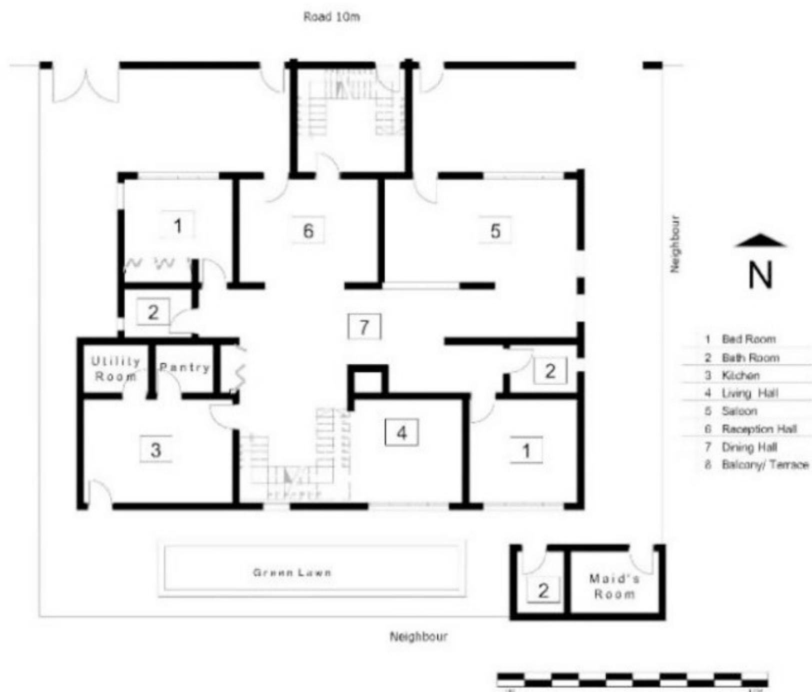

Figure (A1). Example 1, Ground floor plan

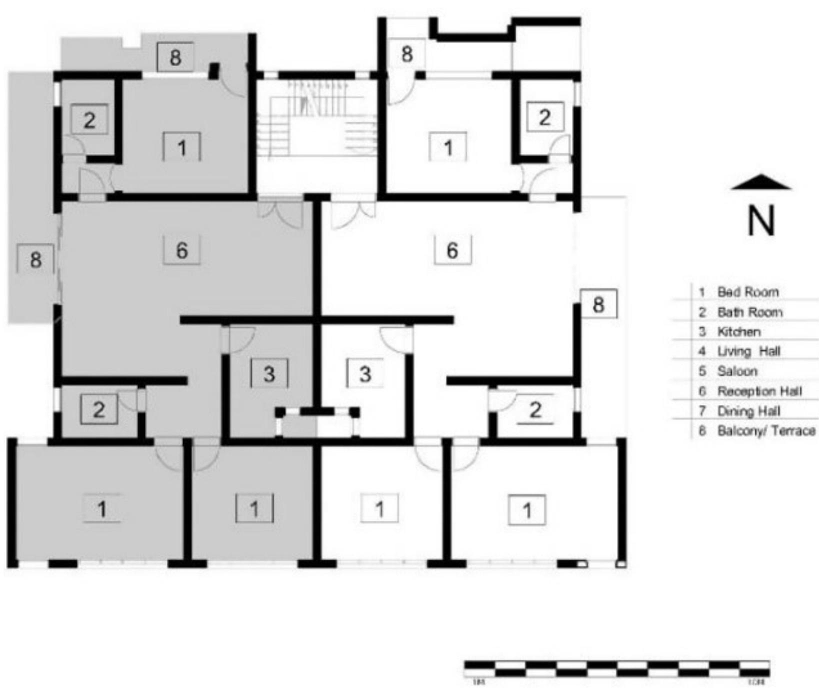

Figure (A1). Example 1, Typical floor plan

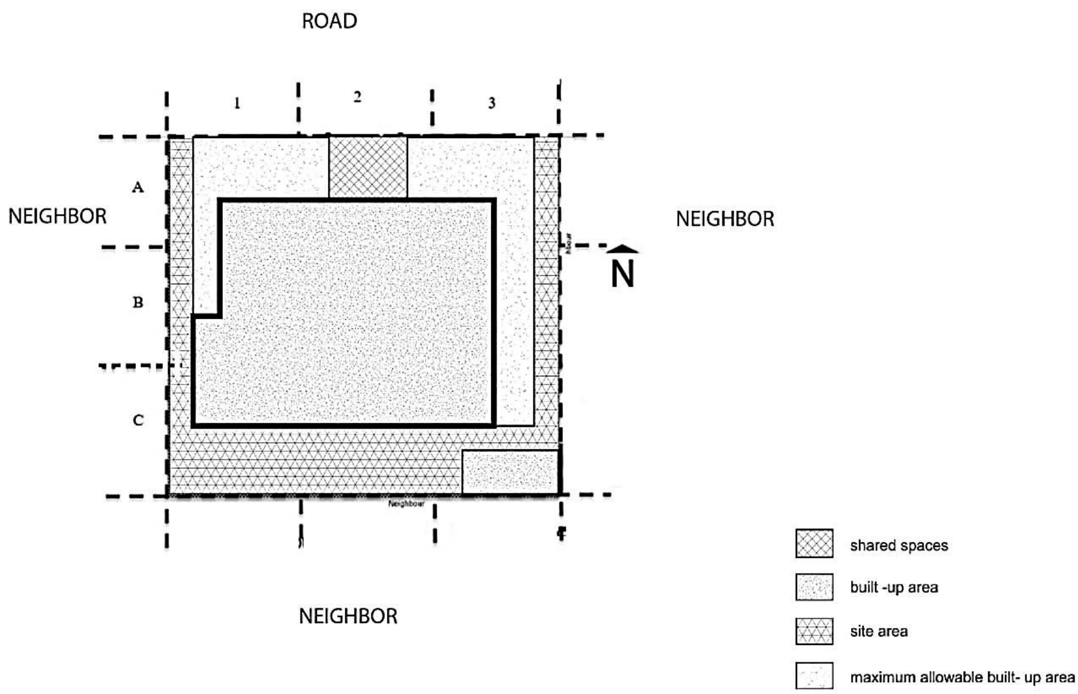

Figure (A3). Example 1, Ground floor Analysis

Table (A1). Example 1 analysis- Ground Floor areas and space efficiency calculations

Case No.	Plot area (M^2)	Shared space (M^2)	Built-up area (M^2)	Open spaces (M^2)	Assignable Area (M^2)	Max. allowable Area (M^2)	Efficiency Calculated from GFA (%)	Efficiency Calculated from MAA (%)
1	420.2	13	230	190	217	315	94	69

Table (A2). Example 1 Analysis- Ground Floor spatial parameters' locations

Case No.	Plot location	Plot dimensions	Vertical circulation location	Open spaces location	Entrances location
1	Middle	19.10 m x 22m	A2	C1, C2, C3	A2

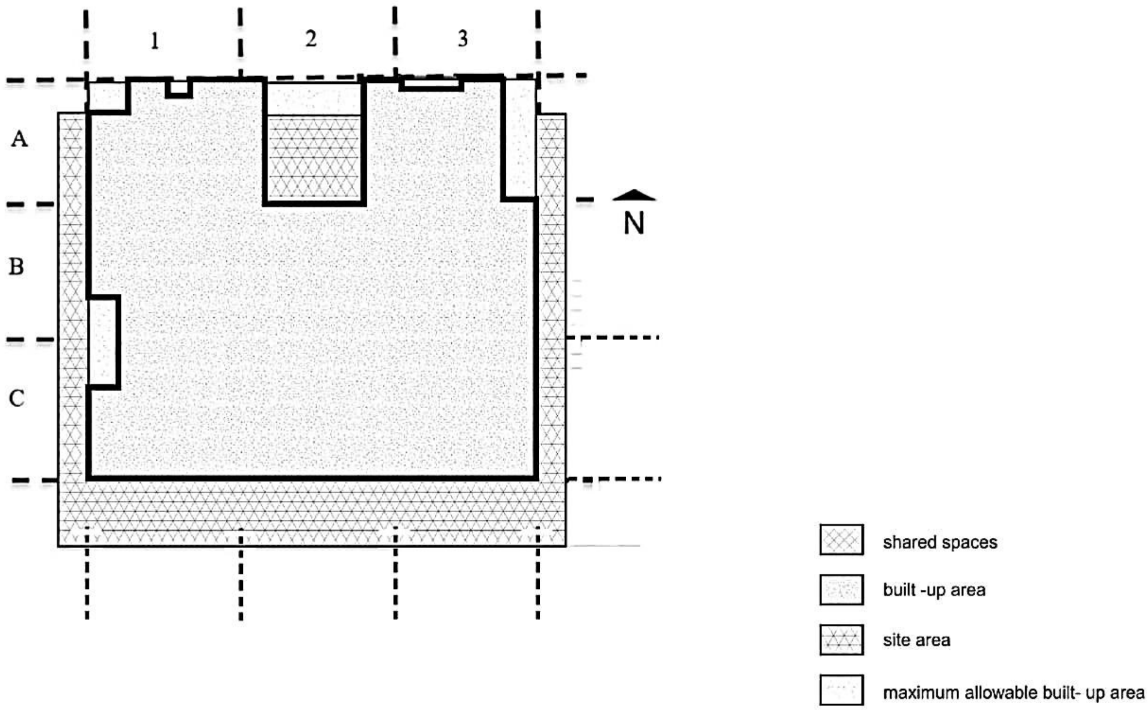

Figure (A4). Example 1, Typical floor analysis

Table (A3). Example 1 analysis- Typical floor areas and space efficiency calculations

Case No.	Plot area (M^2)	Gross floor area (M^2)	Shared space (M^2)	Rentable area (M^2)	Max. allowable area (M^2)	Number of units /floors	Efficiency calculated from GFA (%)	Efficiency calculated from MAA (%)
1	420.2	295	13	282	315	2	96	90

Table (A4). Example 1 analysis- Typical floor, spatial parameters' locations

Case No.	Plot location	Plot dimensions	Vertical circulation location
1	Middle	19.10 m x 22 m	A2

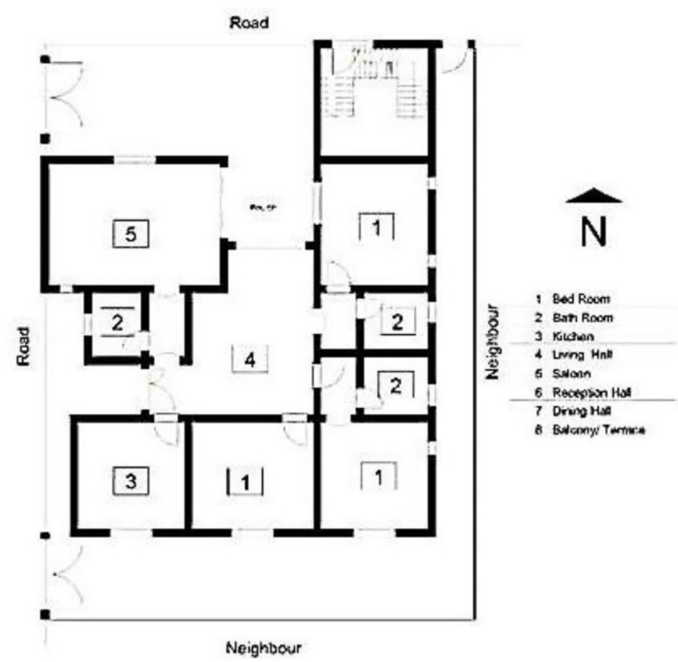

Figure (A5). Example 2, Ground floor plan

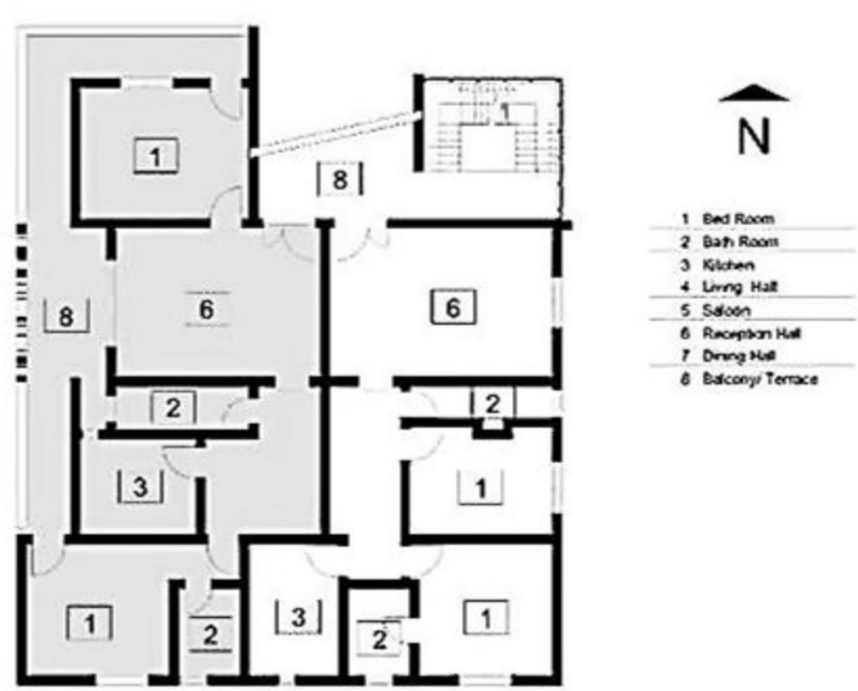

Figure (A6). Example 2, Typical floor plan

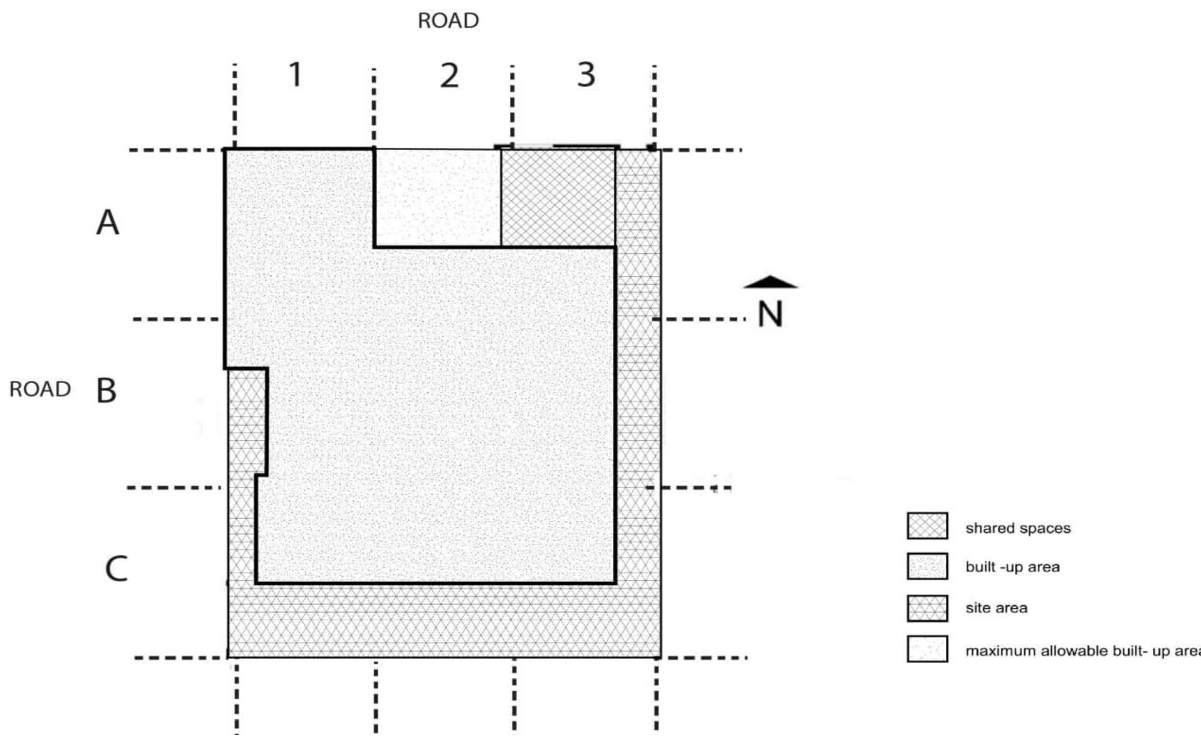

Figure (A7). Example 2, Ground floor analysis

Table (A5). Example 2, Ground Floor analysis- Areas and space efficiency calculations

Case No.	Plot area (M^2)	Shared space (M^2)	Gross built-up area (M^2)	Open spaces (M^2)	Assignable Area (M^2)	Max. allowable Area (M^2)	Efficiency Calculated from GFA (%)	Efficiency Calculated from MAA (%)
2	325.5	16	218	107.5	202	244	93	83

Table (A6). Example 2, Ground Floor Analysis- spatial parameters location

Case No.	Plot location	Plot dimensions	Vertical circulation location	Open space's locations	Entrance locations
2	Corner	15.5mx21m	A3	A1, A2, C1, C2, C3	A1, A3, C1

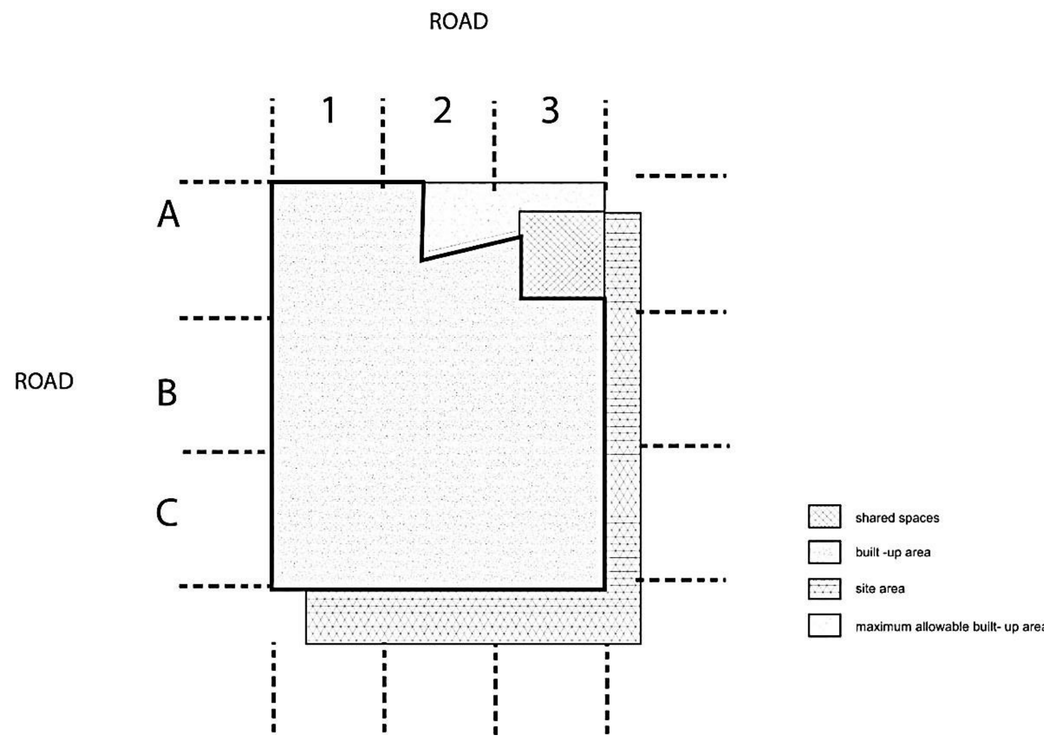

Figure (A8). Example 2, Typical floor analysis

Table (A7). Example 2 analysis- Typical Floor areas and space efficiency calculations

Case No.	Plot area (M^2)	Gross floor area (M^2)	Shared space (M^2)	Rentable Area (M^2)	Max. allowable area (M^2)	Number of units /floors	Efficiency Calculated from GFA (%)	Efficiency Calculated from MAA (%)
2	325.5	267	16	251	282	2	94	89

Table (A8). Example 2 analysis- Typical Floor Spatial parameters' locations

Case No.	Plot location	Plot dimensions	Vertical circulation location
2	Corner	15.5mx21m	A3

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تأثير المحددات المكانية على كفاءة الفراغ في هجين الفيلا – الشقة في الخرطوم الكبرى، السودان

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ملخص البحث. مع ارتفاع أسعار الأراضي والبناء في مدينة الخرطوم، وانتشار ظاهرة هجين الفيلا – الشقة، التي تجمع بين السكن والاستثمار في منزلٍ واحدٍ؛ ازدادت الحاجة إلى معرفة المحددات الرئيسة لتصميم هذا النوع من السكن بكفاءة فضاء عالية، وهو الأمر الذي يثير التساؤلات حول تأثير بعض المحددات المكانية على الكفاءة. تسعى الورقة للإسهام في تطوير استراتيجيات تصميم هجين الفِيلا – الشقة تبعاً لكفاءة فضاء المبنى؛ لمساعدة المصممين في تحقيق التصميم الأمثل لهذا النوع الجديد من المباني السكنية، ومساعدة المستثمرين والملاك في تحقيق أعلى كفاءة ممكنة في استثماراتهم حتى تكون مجديةً اقتصادياً. تستعرض الورقة أهمّ المحددات المكانية – وهي موقع القطعة السكنية وأبعادها، مواقع وسائل الحركة الرأسية، الفناءات والمداخل. تم إجراء تحليل كمّي لستين عينة من هجين الفِيلا – الشقة لإظهار العلاقة بين المحددات المكانية وكفاءة الفضاء. وأُجريت مقابلات مع بعض المصممين المعماريين للتحقق من العوامل التي تحدد تصميم هجين الفِيلا – الشقة، ومناقشة الموقع الأمثل لتلك المحددات المكانية. أظهرت النتائج أن أفضل موقع للقطعة هو الناصية، ولموضع السلم والمصعد هو الوسط الطرفي، والموقع الخلفي للفسحات، وأن أفضل تناسب بين أبعاد القطعة هو الذي يزيد فيه عرضها عن عمقها. يمكن أن تساعد نتائج البحث المصممين والملاك والمطورين في تحقيق كفاءة مكانية عالية خلال مراحل التصميم الأولية، من أجل زيادة الجدوى الاقتصادية لهجين الفِيلا – الشقة.

الكلمات المفتاحية: هجين الفيلا–الشقة؛ المحددات المكانية؛ كفاءة الفراغ؛ تصميم الإسكان؛ الخرطوم الكبرى.