

## AN EVALUATION OF APARTMENT DESIGN FLEXIBILITY PERTAINING TO APARTMENT AFFORDABILITY IN LSDPC ESTATES, LAGOS, NIGERIA

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### **Abstract**

*Affordability of apartment design began with incorporation of flexibility attributes into the apartment design to accommodate the biosocial life of the urban dwellers. There was no evidence that the connectivity between apartment affordability and apartment design flexibility had been explored in the study area. This study aimed to investigate the apartment design flexibility in relation to apartment affordability in government-built estates in Lagos, Nigeria. A purposive case study of three estates was adopted. Structured survey methods were employed for data collection. 10% of sample population was used as sample size which amounted to 270 units. Systematic random sampling of apartment was employed. The data were analysed using descriptive statistics. The major finding revealed that partitionability had highest significant influence on affordability of apartment in the study area. Dolphin II and Odonla Estates had higher affordability of the partitionability design of the apartment. Odonla and Amuwo-Odofin Estates had higher affordability of the extendibility design of the apartment. Odonla Estate had the highest affordability of the expandability design of the housing units. The study discovered the usage of apartment design flexibility as an indicator of measuring apartment affordability. There is opportunity in this area of research to be explored in future. The will assist the stakeholders in the built environment to improve on the conceptualisation of apartment design. The study affirms that the partitionability attribute of flexibility design could be incorporated into design-based affordability of apartment at point of creation.*

**Keywords:** *Affordability, Apartment design, Flexibility.*

### **1.0 Introduction**

Lagos, Nigeria, is a city that has grown rapidly over the years and is now classified as a megacity. The city faces residential apartment affordability challenges in many forms

and to different degrees. Strive to house the urban dwellers obviously led to classification of housing types and diversification in housing. The apartment affordability is never a short-term problem, but rather a holistic idea that considers the biosocial life of the intended users over the life-cycle of the apartment (De Parisn & Lopes,2018). This perspective draws attention to the dynamic nature of existence and the used for ample flexibility in the design of urban residential apartment such that changes in occupants' interaction and connectivity can be accommodated. Some previous studies have attempted to link affordability concept with flexibility from different perspectives. Okoye et.al (2021) used flexibility characteristics as key performance indicator of meeting changing social and dynamism nature of the users. Also, Alsaati et.al (2021) and Schmidt et al (2010) examined the connectivity between affordability and physical change in apartment. Similarly, Commonwealth of Australia (2014) used purchase, mortgage repayment & rental affordability as indicators, but these indicators emphasized on flexibility of pay back, not flexibility of design-based affordability. Actually, affordability concept needs to begin with an evaluation of the efficiency of the internal arrangements and effective utilization of apartments' spaces. This study seeks to bridge this gap by holistically evaluating housing unit affordability throughout their life-cycle, as designed by architects for the Lagos State Development and Property Corporation. Therefore, this study aimed to examine the apartment design flexibility vis-à-vis apartment affordability in government-built estates in Lagos, Nigeria. Emphasis is on the degree of manifestation of the characteristics that facilitate users' actions pertaining to partitionability, extendability and expandability, in relation to affordability.

## **2.0 Literature review**

### **2.1 Affordability of Apartment Design Flexibility**

The apartment design was conceived to characterize the individuality, diversity, privacy, individuality and personalization qualities of single-family homes (Stoiljković et.al,2020). The previous studies never revealed a common apartment design's concept but individuality, separateness and independence were revealed as most important characteristics of all apartment design definitions. The likes of Marshall (1890) and Turner (1972) explained similarity between the concept of apartment design and machine when operated as a system while as a commodity when not operated. This emphasized on the flexibility in the apartment design definition as commodity as well as system. Taylor-Harry (2018) went further to describe it as a close place where groups of people can live their biosocial life, by getting services, executing house tasks and other biosocial activity. Taylor-Harry (2018) explained the importance of integration and balancing of the economic, social, biological needs of the different class statuses of the residents. Danko (2013) went further to establish the affordability linkage between apartment design to the present and future demographic trends, market trends and the needs of different groups in the society. This showed how the user's needs were married together to offer flexibility of the usage. Alsaati et.al (2021) explained flexibility as the reality of a steadiness between adaptability and durability in the design of an apartment.

The history of flexibility in apartment design could be traced back to Le Corbusier' five point of architecture. In this context, the flexibility was 'ability and potential of a building to change, adapt and reorganize itself in response to the change' without compromising fitness

(Hassan, 2017). Similarly, Groák (1992) was able to define flexibility as capable of different physical arrangements. Zairul and Geraedts, (2015) went further to explain flexibility to be adaptable and responsive to the user's needs. The researchers in the architectural field used 'flexibility' for physical change. Flexibility dwelled on modification of physical form of the building through extension, joining, merging spaces. However, Gilani and Turker (2020) categorized flexibility into functional, structural and character flexibility. Functional flexibility was explained as the possibility to allocate new functions without professional intervention. Structural flexibility was where the household made physical modification of the interior space of the apartment in line with their needs based on professional intervention. While, character flexibility was the possibility of changing façade or the identity of the apartment. This study defined flexibility as the ability to make physical change in the interior of the apartment through expansion, extension and partition. Partition attribute of flexibility was the opportunity of dividing, rearranging, splitting up, or relating different spatial units in a simple way (Ichendu & Amadi, 2021). This characterized with the attribute of functional flexibility that allowed possibility of creating additional spaces using flexible elements such as sliding doors, movable wall. The extension attribute was the structural flexibility that made modification of the space either vertically or horizontally possible. This characterized with structural or functional extensions of the interior space of the apartment according to the demand of the users. Expandability attribute was one of the possibilities for expanding its use-value. This was the subset of character flexibility that made changing of façade or the identity of the apartment possible.

### **3.0 Methodology**

The data for this study were sourced from primary and secondary sources. Secondary data was obtained from unpublished materials and published materials (dissertation, journal, article, magazine, report) as well as reports on issues that related to affordability and flexibility. Interview and questionnaire administration constituted the primary data. Structured questionnaires were used to source relevant information from the apartments in DolphinII, Amuwo-Odofin and Odonla. These estates were purposively selected owing to exhibition of variables associated with flexibility characteristics. The study was limited to expandable housing estate at Odonla, Ikorodu, Industrially and conventionally built housing estates in DolphinII and Amuwo-Odofin respectively. The apartments in selected cases were 2,696 units. In order to have unbiased sample, a probability sample design was used to identify the apartments suitable among the 2,696 units in the three housing estates. 10% (270 units) of the selected apartments were sampled against 5% recommended by Krejcie & Morgan (1970). In all, 10% of sample population was used as sample size amounted to 270 units ( see Table 1). The population of this study was taken as number of bedrooms apartment available in the estates. Systematic random sampling of apartment types in each case was used to select randomly. 256 out of 270 questionnaires distributed were returned. The return rates were 201 questionnaires from Amuwo-Odofin, 51 questionnaires from DolphinII, and 4 questionnaires from Odonla Estates. However, 14 (5.5%) of the returned questionnaires were deemed unusable due to incompleteness or illegibility. 9 questionnaires from Amuwo-Odofin and 5 questionnaires from Dolphin II were returned uncompleted. 242 questionnaires

represented 90% of the total were used for data analysis. Evidently, this showed that there was non-response bias.

**Table1: The Sample Sizes for Various Apartment types in the Selected Estates**

Name of Estate	Mixed-Income Status	1-bedroom		2-bedroom		3-bedroom		Total	
		No. of Units	No. Selected	No. of Units	No. Selected	No. of Units	No. selected	No. of Units	No. selected
Dolphin II	Medium-income			136	14	440	44	576	58
Amuwo-	Low			-	-			2068	207
Odonla	Low-income	52	05					52	05
	TOTAL							2,696	270

## 4.0 Results and Discussion of Findings

### 4.1 Analysis and Discussion

Examinations of the overall mean score results for the affordability of the partitionability design of the apartment in Table2 indicated that respondents in the study area were neutral on the affordability of the partitionability design of the apartments. The mean scores were obtained for each of Amuwo-Odofin, Dolphin II, Odonla estates and the Pooled as 2.88, 3.26, 3.24 and 2.96 respectively. The results were succinctly depicted in Figure 1. Further, analysis of variance test (ANOVA) was carried out to determine if there was significant difference across the estates on the affordability of the partitionability design of the apartments.

*Table 2: The Affordability of the Partitionability Design of the Apartment in the Study Area*

Variable	Mea Response Rating											
	Amuwo-Odofin (n = 207)			Dolphin II (n = 58)			Odonla (n = 5)			Pooled (n = 270)		
	Mean Score	SD	M	Mean Score	SD	M	Mean Score	SD	M	Mean Score	SD	M
The creation of additional spaces is possible within the housing unit.	3.79	1.481	4	3.79	1.005	4	4.40	0.548	4	3.80	1.380	4
The time frame of achieving the additional space is minimal.	2.80	1.608	3	3.79	0.409	4	4.00	0.707	4	3.04	1.486	3
Minimum budget is possible with space partition.	2.80	1.474	3	2.97	0.898	3	2.40	0.548	2	2.83	1.359	3
Partitioning without	1.00	0.000	1	2.36	1.021	2	2.40	1.140	2	1.32	0.758	1

professional intervention is possible.												
Ability to remain fit during and after the partitioning is high.	3.99	1.561	4	3.36	1.210	3	3.00	1.414	3	3.84	1.512	4
Overall Mean Score	2.88	1.136	3	3.26	0.654	3	3.24	0.219	3	2.96	1.051	3

Source: Field Survey 2022. SD = Standard Deviation. M = Median. Category: Strongly Disagree = 1, Disagree = 2, Neutral = 3, Agree = 4, Strongly Agree = 5.

The results of the analysis in Table 3 revealed that there was a significant difference across the estates on the affordability of the partitionability design of the apartments at  $F = 3.167$  ( $p < 0.05$ ). Therefore, to determine the estate with the highest affordability of the partitionability design of the apartments, post-hoc analysis with multiple comparisons of means was carried out.

Table 3: Analysis of Variance (ANOVA) Test

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.889	2	3.445	3.167	.044*
Within Groups	290.449	267	1.088		
Total	297.339	269			

\* Test is significant at 5%.

The results of the post-hoc analysis in Table 4 revealed that there was a significant difference in means between Dolphin II (3.26) and Amuwo-Odofin (2.88) estates on the affordability of the partitionability design of the apartments at mean difference = 0.37884 ( $p < 0.05$ ). Also, there was a significant difference in means between Odonla (3.24) and Amuwo-Odofin (2.88) estates at mean difference = 0.36367 ( $p < 0.05$ ).

Table 4: Post-Hoc Analysis; Multiple Comparisons: Bonferroni

(I) Estate	(J) Estate	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Dolphin II	Amuwo-Odofin	.37884*	.15495	.023	.0055	.7522
Dolphin II	Odonla	.01517	.48613	.991	-1.1560	1.1863
Odonla	Amuwo-Odofin	.36367*	.47204	.045	.7735	1.5009

\*. The mean difference is significant at the 0.05 level.

There was no significant difference in means between Dolphin II (3.26) and Odonla estates (3.24). Therefore, based on the results, Dolphin II and Odonla estates had higher affordability of the partitionability design of the apartments.

Examinations of the overall mean score results for the affordability of the extendibility design of the apartment as indicated in Table 5 showed that respondents in Amuwo-Odofin estate (3.28) were neutral on the affordability of the extendibility design of the apartments. In Dolphin II estate (2.48) the respondents disagreed on the affordability of

the extendibility design of the apartments while in Odonla estate (3.52) agreed on the affordability of the extendibility design of the apartments. Generally, the pooled data, suggested that the respondents were neutral on the affordability of the extendibility design of the apartments.

Table 5: *The Affordability of the Extendibility Design of the Apartment in the Study Area*

Variable	Mean Response Rating											
	Amuwo-Odofin (n = 207)			Dolphin II (n = 58)			Odonla (n = 5)	Pooled (n = 270)				
	Mean Score	SD	M	Mean Score	SD	M	Mean Score	SD	M	Mean Score	SD	M
The housing unit has the potential for physical extension.	2.39	1.36	2	3.41	0.795	3	3.60	1.14	4	2.63	1.33	3
The time frame of achieving the extension is minimal.	3.59	0.80	4	2.59	0.795	3	2.80	0.84	3	3.64	0.91	4
Achieving physical extension without professional intervention is possible.	4.01	0.00	4	1.40	0.750	1	3.60	0.89	4	3.25	0.49	3
Minimum budget is possible with the space extension.	3.14	1.51	3	2.38	1.023	2	3.40	0.89	3	2.57	1.42	3
Ability to remain fit during and after the extension is high.	3.79	1.61	4	2.64	1.021	3	4.20	0.45	4	3.55	1.56	4
Overall Mean Score	3.38	0.90	3	2.48	0.567	2	3.52	0.39	4	3.13	0.85	3

Source: Field Survey 2022. SD = Standard Deviation. M = Median. Category: Strongly Disagree = 1, Disagree = 2, Neutral = 3, Agree = 4, Strongly Agree = 5.

The results were clearly depicted in Figure 2. Further, analysis of variance (ANOVA) test was carried out to determine if there was significance difference across the estates on the affordability of the extendibility design of the apartments.

The results of the analysis in Table 6 revealed that there was a significant difference across the estates on the affordability of the extendibility design of the apartments at F

= 4.725 ( $p < 0.05$ ). Therefore, to determine the estate with higher affordability of the extendibility design of the apartments, post-hoc analysis with Bonferroni multiple comparisons of means were carried out.

Table 6: *Analysis of Variance (ANOVA) Test*

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6.610	2	3.305	4.725	.010*
Within Groups	186.783	267	.700		
Total	193.393	269			

\* Test is significant at 5%.

The results of the post-hoc analysis in Table 7 revealed that there was no significant difference in means between Odonla estate (3.52) and Amuwo-Odofin estate (3.38) on the affordability of the extendibility design of the apartments at mean difference = 0.14367. However, there was a significant difference in means between Odonla estate (3.52) and Dolphin II estate (2.48) at mean difference = 1.04138 ( $p < 0.05$ ).

Table 7: *Post-Hoc Analysis; Multiple Comparisons: Bonferroni*

(I) Estate	(J) Estate	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Odonla	Amuwo-Odofin	.14367	.37854	.151	-.0171	.5817
Odonla	Dolphin II	1.04138*	.38984	.017	.3778	1.5006
Amuwo-Odofin	Dolphin II	.904229*	.12426	.027	.0683	1.7556

\*. The mean difference is significant at the 0.05 level.

Also, there was a significant difference in means between Amuwo-Odofin estate (3.38) and Dolphin II estate (2.48) at mean difference = 0.904229 ( $p < 0.05$ ). Therefore, based on the results, Odonla and Amuwo-Odofin estates had higher affordability of the extendibility design of the apartments in the study area.

The overall mean score results for the affordability of expandability design of the apartments in Table 8 indicated that respondents in Amuwo-Odofin estate (3.00) were neutral on the affordability of the expandability design of the apartments while respondents in Dolphin II estate (1.60) disagreed. In addition, respondents in Odonla estate (4.36) agreed on the affordability of the expandability design of the apartments. Generally, the pooled data, suggested that the respondents were neutral on the affordability of the expandability design of the apartments.

Table 8: *The Affordability of the Expandability Design of the Apartment in the Study Area*

Variable	Mea Response Rating											
	Amuwo-Odofin (n = 207)			Dolphin II (n = 58)			Odonla (n = 5)			Pooled (n = 270)		
	Mean Score	SD	M	Mean Score	SD	M	Mean Score	SD	M	Mean Score	SD	M
It has the capacity to expand its use-value through the physical change.	3.79	1.48	4	1.81	0.76	2	4.40	0.55	4	3.38	1.58	3
Minimum budget is possible with the space expansion.	3.41	1.02	3	1.60	0.49	2	4.80	0.84	5	3.01	1.19	3
The time frame of achieving the expansion is minimal.	2.20	0.75	2	1.81	0.40	2	4.40	0.89	4	3.54	0.73	4
Ability to remain fit during and after the expansion is high	4.20	0.75	4	1.40	0.49	1	4.00	1.00	4	3.59	1.35	4
The process is possible without the professional intervention.	1.40	0.49	1	1.40	0.49	1	4.20	1.30	4	1.41	0.52	1
Overall Mean Score	3.00	0.52	3	1.60	0.46	2	4.36	0.65	4	2.99	0.77	3

Source: Field Survey 2022. SD = Standard Deviation. M = Median. Category: Strongly Disagree = 1, Disagree = 2, Neutral = 3, Agree = 4, Strongly Agree = 5.

The results were clearly depicted in Figure 3. Further, analysis of variance (ANOVA) test was carried out to determine if there was significance difference across the estates on the affordability of the expandability design of the apartments.

The results of the analysis in Table 9 revealed that there was a significant difference across the estates on the affordability of the expandability design of the apartments at  $F = 171.387$  ( $p < 0.05$ ). Therefore, to determine the estate with the highest affordability of the expandability design of the apartments, post-hoc analysis with Bonferroni multiple comparisons of means are carried out.

 Table 9: *Analysis of Variance (ANOVA) Test*

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	90.419	2	45.210	171.387	.000*
Within Groups	70.431	267	.264		
Total	160.851	269			

\* Test is significant at 5%.



The results of the post-hoc analysis in Table 10 revealed the results of the post-hoc analysis revealed that there was a significant difference in means between Amuwo-Odofin Estate (3.00) and Dolphin II Estate (1.60) on the affordability of the expandability design of the apartments at mean difference = 1.39559 ( $p < 0.05$ ). Also, there was a significant difference in means between Odonla Estate (4.36) and Dolphin II estate (1.60) at mean difference = 2.75655 ( $p < 0.05$ ). Also, there was a significant difference in means between Odonla Estate (4.36) and Amuwo-Odofin Estate (3.00) at mean difference = 1.36097 ( $p < 0.05$ ). Therefore, based on the results, Odonla Estate had the highest affordability of the expandability design of the apartments in the study area.

Table 10: *Post-Hoc Analysis; Multiple Comparisons: Bonferroni*

(I) Estate	(J) Estate	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Amuwo-Odofin	Dolphin II	1.39559*	.07630	.000	1.2118	1.5794
Odonla	Amuwo-Odofin	1.36097*	.23245	.000	1.1990	1.5229
Odonla	Dolphin II	2.75655*	.23939	.000	2.1798	3.3333

\*. The mean difference is significant at the 0.05 level.

The Pearson’s correlation analyses results for connectivity among partitionability, extendibility and expandability characteristics in relation to affordability (Table 11) indicated that there was a significant correlation between affordability and partitionability at  $r = 0.904$  ( $p < 0.05$ ), affordability and extendibility at  $r = 0.868$  ( $p < 0.05$ ), and affordability and expandability at  $r = 0.452$  ( $p < 0.05$ ). Further, there was significant correlation between expandability and partitionability at  $r = 0.447$  ( $p < 0.05$ ), expandability and extendibility at  $r = 0.385$  ( $p < 0.05$ ), and extendibility and partitionability at  $r = 0.823$  ( $p < 0.05$ ).

Table 11: *Pearson’s Correlations Analysis*

	Partitionability Design	Extendibility Design	Expandability Design	Affordability
Partitionability Design	1			
Extendibility Design	.823*	1		
Expandability Design	.447*	.385*	1	
Affordability	.904*	.868*	.452*	1

\* Correlation is significant at the 0.05 level. n = 270.

Therefore, there was significant connectivity among partitionability, extendibility and expandability characteristics in relation to affordability. Further analysis was carried out to determine the degree of influence of partitionability, extendibility and expandability characteristics on affordability using multiple regression analysis. The model result (Table 12) revealed goodness of fit index  $R^2 = 0.866$  (86.6%), indicating model fit was significant at F-value = 575.180 ( $p < 0.05$ ) significant level. Hence the model was acceptable for further analysis. To determine the influence of Partitionability,

Extendibility and Expandability characteristics on Affordability, multiple regression analysis method was used.

Table 12: *Multiple Regression Analysis to Evaluate the Influence of Partitionability, Extendibility and Expandability Characteristics on Affordability*

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error			
(Constant)	1.195	.054		22.248	.000
Partitionability Design	.325	.023	.565	13.869	.000
Extendibility Design	.273	.028	.383	9.685	.000
Expandability Design	.041	.020	.052	2.094	.037
Dependent Variable: Affordability					
Model Summary: $R^2 = 0.866$ (Goodness-of-fit Index)					
ANOVA: F-value = 575.180 (p-value = 0.000 < 0.05)					

Source: Researcher's Computation, 2022. \* Significant at 5% level.

Affordability represented the dependent variable while Partitionability, Extendibility and Expandability characteristics represented the independent variables. The result of the analysis revealed that Partitionability, Extendibility and Expandability characteristics had significant influence on Affordability at  $t = 13.869$  ( $p < 0.05$ ),  $t = 9.685$  ( $p < 0.05$ ), and  $t = 2.094$  ( $p < 0.05$ ) respectively. Therefore, based on the standardized coefficients, partitionability had the greatest influence on affordability of apartments in the study area with Beta = 0.565 (56.5%).

## 5.0 Conclusion and Recommendations

Flexibility design had an undeniable connectivity with affordability. The evidence was particularly strong on the effect of partitionability design of apartments that could have aided affordability. This suggested that the partitionability attribute of flexibility design could be incorporated into design-based affordability of apartments at point of creation which is especially important for developing and implementing the housing policy in the study area.

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