Exploring Residents' Attitude towards Implementing Housing Design Flexibility in the Gaza Strip

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Abstract—Population density in the Gaza Strip rapidly increases overtime. Considering the limited area of the Gaza Strip, there is a need to rationalise consumption of the limited available housing land. In this context, there is a need for innovative solutions that help increasing housing design efficiency. This study addresses the potential of housing design flexibility as a possible solution. It examines residents' attitude towards design flexibility as a starting point in this regard. To achieve this aim, the study carried out a field study based on a questionnaire. The quantitative analysis of the questionnaire leaded to accept the study main assumption that residents are satisfied with the idea of implementing design flexibility in residential spaces and furniture design in order to increase the efficiency of their housing units. This is true regardless several examined variables including income level. Thus, the study recommends implementing design flexibility in the housing market as a strategy that helps rationalization of resources consumption, in addition to securing adequate housing for all.

Index Terms— Housing, design flexibility, urban planning, the Gaza Strip.

I INTRODUCTION

The Gaza Strip is a part of the Palestinian Territories, and is known as the southern governorates. It stretches along the Mediterranean coast with an area of 365 km^2. Its population is about 1.7 million, distributed over 7 major cities, 20 villages and 8 refugee camps [1]. This Strip experienced different consecutive political periods, which has negatively affected its stability and development. It has a high density of 4,661 people per square kilometre [1]. This high density requires careful planning of the different land uses. This includes housing sector, where the increasing need is not met by a sufficient supply, despite the fact that several stakeholders are involved in the housing sector. This includes Ministry of Housing and Public Works (MHPW), Palestinian Housing Council (PHC), United Nations Development Programme (UNDP), and United Nations Relief and Works Agency (UNRWA).

Some statistics [2] suggest that the projected need of housing units in the year 2020 is expected to be about 242,505 housing units. When this figure is compared to the actual number of units supplied in the period from 2011 to the mid of 2013, which is about 15,000 units, it is possible to realise that there is a great annual deficit of about 70%. The deteriorated economic situation is an additional challenge that restricts housing supply. This makes possession of an adequate housing unit a dream for majority of people in Gaza. To overcome the challenge of this increasing housing demand, a conscious housing planning strategy is required to ensure the highest possible efficiency of housing land utilisation. Housing designers and planners should get involved in this regard. Furthermore, efficiency of housing design and planning is fundamental in the saving of our natural resources, as 50% of the global resources go into construction [3].

Within this context, this paper discusses design flexibility as one possible solution that helps increasing housing design efficiency and, therefore, alleviating housing problem in the Gaza Strip. In general, the term 'flexibility' refers to the use of a space for various purposes without making physical alterations, while the term 'adaptability' refers to the ability to adapt the housing environment as user needs change [4]. The main aim of design flexibility is to save area on one hand, and to increase housing utilisation efficiency on the other hand. This helps reducing housing cost. It also promotes the concept of sustainable housing, where the rule of 'reduce' in consumed resources is essential. Moreover, design flexibility is socially important as family grows up by time and becomes in need to satisfy the new requirements and aspirations without essentially replacing the housing unit [5].

This flexibility can be noticed in the works of several prominent architects including [6] the domino style of Le Corbusier, the open plan of Mies van der Rohe, the service core of Kenzo Tange, and the capsule housing units of Kisho Kurokawa. A great deal of design flexibility in these works comes from the structural flexibility. Several other ideas can also be implemented to enhance housing design flexibility such as:

- Functional swap between spaces.
- Reusing a specific space for a new function.
- Using the open space strategy.
- Zoning modification using movable partitions.
- Space expansion.
- Using multi-use furniture.
- Utilization of the third and fourth dimensions, i.e. volume and time.

It is essential to note that implementation of housing design flexibility doesn't means design complexity. Simple ideas may do in this regard. For example, the use of foldable furniture can facilitate space multi-functionality. Figure 1 shows an example. In this example, two functional modes of a residential unit are illustrated: day-time and nigh-time modes. It can be noticed that in the day-time mode the bed is folded to offer wider living space.

Design flexibility is tackled in several studies. For example, Altas & Gzsoy [4] investigated the relationship between housing spatial adaptability and flexibility, and user satisfaction. They carried out their study with reference to Istanbul, Turkey. The study argued that residential satisfaction on dwelling space is a function of several variables. These include users' characteristics and their perception of the space (social parameters), and the physical attributes of this space (physical parameters). Users' satisfaction on the space was evaluated using on the basis of 398 samples chosen from 4 different types of 2-bedroom dwellings. The study found that space consciousness in a dwelling is a function of several variables such as size, shape, solid and void ratio, furniture type, colour, etc. There is a complex relation between the perceived space and the real dwelling size. In this context, a proper organization of the dwelling space can encourage adaptation and flexibility.
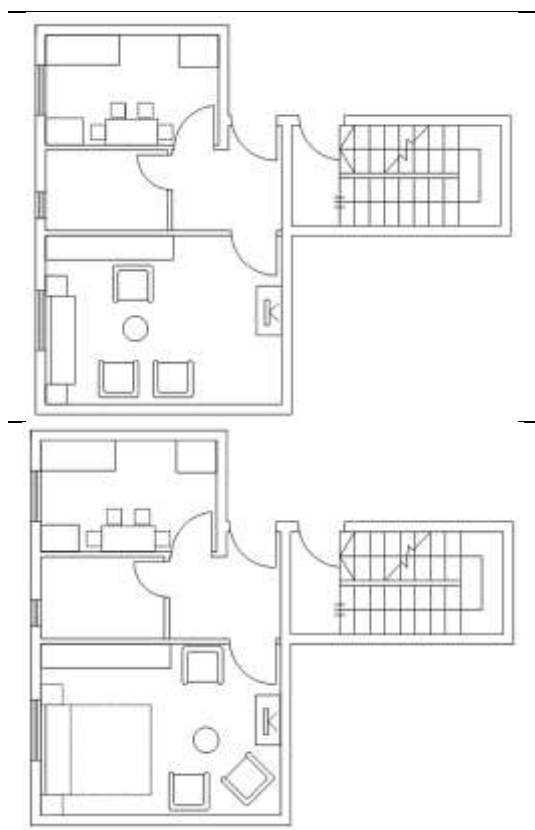
Figure 1
Day-time (up) and Night-time (bottom) Functional Modes of a Residential Unit

Wong [7] discussed the need of housing design flexibility and adaptability in high density mass housing projects with reference to Hong Kong. Wong argued that without this flexibility and adaptability, a great deal of the massive resources invested in these projects may be lost in the future when the need for upgrading arises. Wong analysed the design of 80 public housing units in Hong Kong through a field survey. The survey consisted of face-to-face interviews with residents to document the current situation and the need for any adjustments to the design. In addition, the furniture-level configuration in each unit was measured and recorded. A set of housing unit plans were produced, and residents' suggested alterations were tested including unit size, room size and merging, opening location, and shear walls location. The study concluded that a more systematic approach to incorporate spatial configuration data in the massive housing design process is required.

Cao et al. [8] carried out a study to specify the factors that inhibit promotion of skeleton and infill (SI) housing system in China. This system is known for improving residential adaptability and flexibility compared to traditional housing construction. However, the promotion of this system in China's building industry is not common. The study conducted an investigation based on Factor Analysis method. In this context, 56 semi-structured interviews were conducted with pioneer enterprises, research institutions and government sectors in the country. In addition, 167 questionnaires were distributed to professionals from all relevant stakeholders. The study found that the four major factors that confine the application of SI housing system in China are: costs and benefits, technology and management, industrial chain and enterprise capacity, and policies and regulations.

II METHODOLOGY

Post occupancy evaluation in housing is usually based on field studies that are based on questionnaires, interviews, and/or special analysis. This study aims to investigate residents' satisfaction with the current status of their housing units in terms of satisfying their proposed functional role. The study also aims to investigate residents' attitude towards implementation of design flexibility in these units. To fulfil these aims, the study carried out a field study based on a questionnaire. The study then carried out in-depth quantitative analysis to examine and discuss study assumptions, as highlighted below.

A. Sampling

The targeted population is the households of Gaza city. Gaza city is the main and most densely populated city in the Gaza Strip. Thus, Gaza city is assumed to have a great need for housing flexibility. According to PCBS [9], Gaza city population in 2015 is estimated at 566,331. According to PCBS [1], the average Palestinian family size is 6.2. This means that about 91,343 families live in Gaza city. Considering the conceptual nature of this study, a confidence level of 95%, and a margin of error of 10% are assumed. Thus, a sample size of 96 sampling units is acceptable [10]. A total of 120

questionnaires were randomly distributed. Distribution was done in person to ensure high response rate. A total of 111 questionnaires were correctly filled and returned back for analysis.

B. Questionnaire Description

The questionnaire starts with the personal data of gender, age, qualification, profession, marital status, family size, and income level. This is followed by questions about respondent's housing unit aspects such as place of residence, housing unit ownership, area, type, number of rooms, and types of these rooms. Then, the main 32 questions are listed in three parts based on five-point Likert scale. These parts are:

- Part 1: Functional adequacy of housing unit design: This includes 12 questions to measure this adequacy to the family needs from respondents' point of view.
- Part 2: The potential of design flexibility in the unit: This includes 10 questions to measure this potential from respondents' point of view.
- Part 3: The potential of furniture flexibility in the unit: This includes 10 questions to measure this potential from respondents' point of view.

C. Validity and Reliability

Firstly, the authors sent the questionnaire to three referees for review. Their comments were considered. Then, they conducted a pilot study to examine questionnaire face validity. 10 questionnaires were distributed. It has been found that all questions were clear to the respondents. The study examined questionnaire internal validity using Pearson correlation to ensure that each statement in the questionnaire is well-correlated to the part it belongs to. Structure validity was tested too using Pearson correlation to ensure that each part of the questionnaire is well-correlated to the questionnaire as a whole. Correlation coefficients in these two tests were significant at significance level $\alpha \le 0.05$, which shows that the questionnaire is valid. To examine questionnaire reliability, Cronbach Alpha Coefficient was used. As shown in Table 1, alpha coefficient value is good for parts 1 and 3, and is acceptable for part 2.

D. Study Assumptions and Variables

Parts 3, 4, and 5 are used to test the following assumptions, respectively:

- Assumption 1: The current status of housing unit design satisfies the functional requirements from residents' point of view.
- Assumption 2: Residents believe that housing design flexibility increases housing utilization efficiency.
- Assumption 3: Residents believe that furniture design flexibility increases housing utilization efficiency.

The study examined the effect of several variables on the study assumptions mentioned above. These variables are:

- The effect of gender using Independent-Samples T-Test.
- The effect of age, family size, income, and housing unit area using ANOVA Test.

III RESULTS AND DISCUSSION

Data collected from respondents was entered and coded properly into SPSS program. The study used Kolmogorov-Smirnov test to examine data normality. Table 1 shows the results obtained. It can be noticed that Sig. value in all questionnaire parts is higher than the significance level of $\alpha \le 0.05$. This indicates that data follows the normal distribution, and that parametric tests can be used in the analysis.

Table 1
Cronbach Alpha and Kolmogorov-Smirnov Tests Results

Questionnaire Part	Cronbach Alpha Coefficients	Kolmogorov-Smirnov Sig.-Value
Part 1: Functional adequacy of the housing unit design	0.9	0.205
Part 2: Potential of design flexibility in the unit	0.7	0.571
Part 3: Potential of furniture flexibility in the unit	0.8	0.550

A. Sample and Housing Unit Characteristics

Sample characteristics were as follows:
- Gender: males: 61%, females: 49%.
- Marriage status: married: 62.2%, unmarried: 37.8%.
- Age: less than 20 years: 0.9%, 20-29: 51%, 30-39: 23.3%, 40-49: 10.6%, 50 and more: 14.2%. It can be noticed that majority of the sample falls within the age 20-39, which is much targeted in the study.
- Economic status: low income: 28%, middle income: 38.7%, high income: 33.3%.

Respondents' current housing unit characteristics were as follows:
- Ownership: owned housing: 85%, rented housing: 15%. This supports study aim, where majority of residents have more freedom to implement alterations that serve design flexibility.
- Housing type: villa: 3.6%, detached house: 34.2%, flat in multi-storey building (less than 7 floors): 54.1%, flat in multi-storey building (7 floors and more): 8.1%.
- Housing unit area: less than 100 m^2: 12.6%, 100 to less than 130 m^2: 33.3%, 130 to less than 160 m^2: 17.1%, 160 to less than 200 m^2: 22.6%, more than

160 m^2: 14.4%. The highest percentage can be observed in the category 100 to less than 130 m^2. This area is sufficient for the average Palestinian family but requires good utilization of the space [11].
- Number of bedrooms: one: 1.8%, two: 30.6%, three: 43.2%, four: 19%, more than four: 5.4%.
- Availability of guest room: yes: 82%, no: 18%. This

could be a reason for the relatively high housing unit area in the Gaza Strip. 40% of respondents who don't have a guest room said that they use portable partitions in the living room to mind privacy when guest come, while 60% of them said that they use alternative spaces for guests.

Table 2
Respondents' Answers of the Questions Related to the First Hypothesis

No.	Statement	Mean (0-5)	Relative Weight (%)	Sig.-value
1.	Lobby area in your housing unit is sufficient	3.52	70.37	0.00*
2.	Bedrooms area is appropriate for the required function and furniture	3.59	71.89	0.00*
3.	You have separate bedrooms for girls and boys	3.67	73.45	0.00*
4.	Bedroom area is sufficient for each category (girls/boys)	3.58	71.59	0.00*
5.	Kids' bedrooms include sufficient area for study and play	3.06	61.12	0.339
6.	Kids' bedrooms are flexible for future changes	3.01	60.19	0.472
7.	Your living room is multi-functional (living, guests, and dining), and its area is sufficient for that	3.81	76.18	0.00*
8.	Living room area is sufficient for your family size and furniture	3.83	76.70	0.00*
9.	Kitchen area is sufficient for all functions and appliances	3.65	72.91	0.00*
10.	Kitchen area is sufficient to include additional dining zone	3.03	60.56	0.422
11.	There is a main bathroom and additional one for guests	3.83	76.51	0.00*
12.	You have sufficient area for balconies	3.41	68.15	0.00*
	All Statements	3.5	70.0	0.00*
* Mean is significant at α ≤ 0.05				

B. Hypotheses Testing

Firstly, the study examined the three main assumptions of the questionnaire. These three assumptions have been rewritten as null hypotheses to facilitate the use of T-test, as follows:
- H_{01} (part 1 of the questionnaire): The current status of housing unit design doesn't satisfy the functional requirements from residents' point of view.
- H_{02} (part 2 of the questionnaire): Implementation of housing design flexibility to increase housing utilisation efficiency is not supported by residents.
- H_{03} (part 1 of the questionnaire): Implementation of furniture design flexibility to increase housing utilisation efficiency is not supported by residents.

One-Sample T test was used to examine the above-mentioned three hypotheses. Mean value of respondents' answers on each statement was estimated. Then, the total Mean

of the questionnaire part was estimated. One-Sample T-test was used to find out if there is a statistically significant difference between this total Mean and the mid value of the five-point Likert scale, i.e. 3, or between the total Relative Weight and the value 60%. As shown in Tables 2, 3, and 4, the total Sig. value for the three parts is less than the significance level (0.05). This means that the three null hypotheses can't be accepted. Alternative hypotheses are accepted instead as follows.

Table 2 shows that the following hypothesis is accepted: "*the current status of housing unit design satisfies the functional requirements from residents' point of view.*" The total mean is 3.5 and relative weight is 70%. Although this is not a high score, it is statistically significant considering sig-value (0.0<0.05).

In addition, Table 2 shows the following observations:

- Statement 3 shows that most respondents (73.5%) have separate bedrooms for girls and boys in their housing unit. However, the rest don't have. When we asked them about this issue, 26.5% said that they make special arrangements, such as using portable mattresses so that some kids can sleep in the living room. However, the rest, i.e. 73.5%, didn't mention any special arrangements.
- 61.1% of respondents said that kids' bedrooms include sufficient area for study and play (statement 5). However, this doesn't show statistically significant difference considering sig. value (0.339>0.05). This means that this design aspect requires further im-

provement from residents' point of view.
- Similar to above, 60.2% of respondents said that kids' bedrooms are flexible for future changes (statement 6). However, this doesn't show statistically significant difference considering sig. value (0.472>0.05). This means that this design aspect also requires further improvement to enhance design flexibility in kids' bedrooms.
- The third aspect that requires further improvement from residents' point of view is kitchen area (statement 10). 60.6% of respondents said that kitchen area is sufficient to include a dining space.

Table 3
Respondents' Answers of the Questions Related to the Second Hypothesis

No.	Statement	Mean (0-5)	Relative Weight (%)	Sig.-value
1.	Internal columns form a main obstacle to future design alterations	3.20	63.96	0.058
2.	Open plan is a main advantage that facilitates future design alterations	3.73	74.63	0.00*
3.	The possibility of vertical expansion to add new spaces to the housing unit enhances design flexibility, if applicable	3.57	71.35	0.00*
4.	It's an advantage to give residents more flexibility in changing spaces functions	3.99	79.82	0.00*
5.	The use of adaptable partitions such as sliding doors and panels is better than the fixed ones	3.74	74.73	0.00*
6.	Merging similar functions, such as living, guest and dining rooms, in one space helps enhancing design flexibility	3.46	69.19	0.00*
7.	It is possible to designate two different functions to a space in day and night times.	3.28	65.56	0.00*
8.	Multi-functional spaces reduce housing cost	3.42	68.47	0.00*
9.	The possibility of horizontal expansion to add new spaces to the housing unit enhances design flexibility, if applicable	3.87	77.45	0.00*
10.	The use of studio housing units for the new families is practical, given that they will move to a larger one when family size increases	3.67	73.45	0.00*
	All Statements	3.67	73.41	0.00*
	* Mean is significant at α ≤ 0.05			

As for the second hypothesis, Table 3 shows that it is accepted. This hypothesis states that "*implementation of housing design flexibility to increase housing utilization efficiency is supported by residents.*" The total mean is 3.67 and relative weight is 73.41%. This value is statistically significant considering sig-value (0.0<0.05).

In addition, Table 3 shows the following observations:
- Respondents agreed on almost all the suggested design flexibility measures. Flexibility in changing spaces functions comes on top (79.8%), which means that spaces shouldn't be designed and customized for a single use.

- This is supported by other answers such as the use of portable partitions (74.7%), the use of open plan (74.6%), and the use of time dimension by using two different functions to a space in day and night times (65.6%).
- 73.5% of respondents believe that the use of studio housing units for new families is practical under the condition that the family will move to a larger one when family size increases. This is important indicator since this type of housing is required in the Gaza Strip considering the high need and shortage of housing supply and available urban land.

Finally, Table 4 shows that the third hypothesis is accepted too. This hypothesis states that "*implementation of furniture design flexibility to increase housing utilization efficiency is supported by residents*." The total mean is 3.98 and relative weight is 79.6%. This value is the highest score observed in the three hypotheses, which shows respondents' support of design flexibility of furniture. This value is also statistically significant considering sig-value (0.0<0.05).

In addition, Table 4 shows the following observations:
- Respondents agreed on almost all suggested furniture flexibility measures. These measures were illustrated by colour illustrations in the actual questionnaire to ensure that they understand the idea. 89.5% of respondents understand that furniture selection is highly dependent on housing unit area. Considering housing unit area limitation, 83% of them believe in multi-functional furniture.
- Respondents were given six examples on furniture design flexibility. They agreed on them all and results were within the range of 73% to 81.8%. This gives an indication for furniture manufacturers to invest in the field of multi-functional furniture. Some designs in this fields are quite simple and don't need high technical capacity or significant cost.

Table 4
Respondents' Answers of the Questions Related to the Third Hypothesis

No.	Statement	Mean (0-5)	Relative Weight (%)	Sig.-value
1.	You consider easiness of furniture disassembly and reassembly as an advantage	4.17	83.42	0.00*
2.	Easiness of furniture disassembly and reassembly facilitates its portability	3.90	78.02	0.00*
3.	You believe in multi-functional furniture	4.15	83.09	0.00*
4.	New furniture designs should be introduced to fit small housing areas	4.48	89.54	0.00*
5.	Master bedroom can be used as a living room at daytime, e.g. by using a sofa that can be spread to form a bed	3.65	72.97	0.00*
6.	Multi-functional designs of kids' beds are practical, e.g. beds including study station and storage space.	3.77	75.50	0.00*
7.	Multi-functional designs of dining tables are practical, e.g. tables that can be folded and converted to storage chest	3.74	74.77	0.00*
8.	The conventional work station can be replaced by portable one that can be folded down and stored	3.90	78.02	0.00*
9.	In living rooms: multi-functional sofas can be used, e.g. for securing storage space	3.89	77.84	0.00*
10.	It is practical to fold up the ironing table and use it as a mirror for instance to save storage space	4.09	81.80	0.00*
	All Statements	3.98	79.6	*0.00

* Mean is significant at α ≤ 0.05

C. Study Variables Testing

The study examined the effect of five variables on the three main assumptions, discussed above, as follows:
- The effect of gender using Independent-Samples T-Test.
- The effect of age, family size, income level, and housing unit area using ANOVA Test.

Table 5 shows the effect of gender on the main study assumptions using Independent-Samples T-test. The null hypothesis suggests that there is no statistically significant difference between the means of male and female answers at significance level α ≤ 0.05. It can be noticed that means of female and male answers are close in the three parts of the questionnaire, which represent the three main assumptions of the study. The differences noticed between male and female answers are statistically insignificant, given that sig-value is higher than the significance level 0.05.

Therefore, the following null hypotheses are accepted:
- Part 1 of the questionnaire: At significance level 0.05, there is no statistically significant difference between males and females regarding their satisfaction with

the current status of their housing unit design in terms of functional requirements.
- Part 2 of the questionnaire: At significance level 0.05, there is no statistically significant difference between males and females regarding their support of the implementation of housing design flexibility to increase

housing utilization efficiency.
- Part 3 of the questionnaire: At significance level 0.05, there is no statistically significant difference between males and females regarding their support of the implementation of furniture design flexibility to increase housing utilization efficiency.

Table 5
The Effect of Gender on the Main Study Assumptions Using Independent-Samples T-Test

Question-naire Part	Assumption	Means		T-Value	Sig.-Value
		Male (μ_1)	Female (μ_2)		
Part 1	The current status of housing unit design satisfies the functional requirements	3.28	3.49	-1.239	0.218
Part 2	Residents believe that housing design flexibility increases housing utilization efficiency	3.64	3.72	-0.846	0.400
Part 3	Residents believe that furniture design flexibility increases housing utilization efficiency	3.98	4.12	-1.394	0.166

* Means' difference is significant at $\alpha \leq 0.05$
** H_0: $\mu_1 = \mu_2$

Table 6 shows another set of variables, which are age, family size, income level, and housing unit area. The aim here is to examine the effect of these variables on the main study assumptions. This was done using Analysis of Variance (One-Way ANOVA Test). The null hypothesis again suggests that there is no statistically significant difference between the three specified means in each variable considering a significance level of $\alpha \leq 0.05$.

Table 6 shows the following results:
- As for age variable, it can be noticed that it has an effect on residents' satisfaction with the functional aspects of their housing units. Observed means for the three examined age categories were between 3.08 and 3.55. This shows statistically significant difference as sig-value is less than the significance level of $\alpha \leq 0.05$. Younger people showed more satisfaction with the functional requirements of their housing units. This could be possibly due to the relatively small size of their families. However, this is not the case for the second and third assumptions. Results show that there is no statistically significant difference between the means provided by the different ages at significance level $\alpha \leq 0.05$ regarding their support of housing design and furniture design flexibility. This shows that these ideas are supported by all age categories.
- As for family size variable, it can be noticed again

that it has no effect on the three assumptions of the study. Results show that there is no statistically significant difference between the means provided by the different family sizes at significance level $\alpha \leq 0.05$.
- As for income level variable, it can be noticed that it has an effect on the first assumption, i.e. residents' satisfaction with the functional aspects of their housing units. Observed means for the three examined income categories were between 2.99 and 3.54. The least value of satisfaction is observed at the lower income category. As for the second and third assumptions, results also show that there is no statistically significant difference between the means provided by the different income categories at significance level $\alpha \leq 0.05$. This shows that housing design and furniture design flexibility are supported by all income categories.
- Finally, the effect of housing unit area is examined. It can be noticed that housing unit area has an effect on the first assumption of the study. Residents' satisfaction with the functional aspects of their housing units increases as area of the unit increases (from 2.24 to 4.01). This is also true for their support of furniture design flexibility, where people having smaller housing units showed more enthusiasm to the suggested measures.

Table 6
The Effect of Age, Family Size, Income Level, and Housing Unit Area on the Main Study Assumptions Using ANOVA Test

Questionnaire Part/ Assumption	Means According to Age			F-Value	Sig.-Value
	29 & less (μ_1)	30-39 (μ_2)	40 & more (μ_3)		
1	3.55	3.24	3.08	3.494	0.034*
2	3.75	3.65	3.52	2.457	0.091
3	4.11	4.02	3.89	1.753	0.178
Questionnaire Part/ Assumption	Means According to Family Size			F-Value	Sig.-Value
	2-4 (μ_1)	5-6 (μ_2)	7 & more (μ_3)		
1	3.28	3.50	3.36	0.562	0.572
2	3.63	3.73	3.68	0.361	0.698
3	3.97	4.09	4.07	0.586	0.558
Questionnaire Part/ Assumption	Means According to Income			F-Value	Sig.-Value
	Low (μ_1)	Middle (μ_2)	High (μ_3)		
1	2.99	3.48	3.54	4.590	0.012*
2	3.60	3.79	3.59	2.401	0.095
3	3.94	4.11	4.01	1.042	0.356
Questionnaire Part/ Assumption	Means According to Housing Unit Area			F-Value	Sig.-Value
	100m² & less (μ_1)	100-159 m² (μ_2)	160m² & more (μ_3)		
1	2.24	3.28	4.01	28.025	0.000*
2	3.54	3.72	3.69	0.652	0.626
3	4.14	4.14	3.89	3.138	0.018*

* Means' difference is significant at $\alpha \leq 0.05$
** H_0: $\mu_1 = \mu_2 = \mu_3$

IV CONCLUSION

Housing sector in the Gaza Strip faces several challenges. This includes the limited available resources including urban land, the deteriorated economic situation, and the great deficit between housing demand and supply. These challenges require housing solutions that help families find adequate housing that respond to their present and future needs. In this context, this study particularly pays attention to the issue of housing land consumption and the role of design flexibility to rationalise this consumption. Implementing the principle of design flexibility in the Gaza Strip housing sector has been discussed and expanded to include furniture flexibility as well.

In this regard, the study carried out a field study based on a questionnaire. The questionnaire examined three assumptions. The first assumption states that the current status of housing unit design satisfies the functional requirements from residents' point of view. The second one states that residents believe that housing design flexibility increases housing utilization efficiency. Similarly, the third one states that residents believe that furniture design flexibility in-

creases housing utilization efficiency. The quantitative analysis carried out leaded to accept these three assumptions. This means that residents are generally satisfied with the functional capacity of their housing units. However, they accept ideas that enhance this capacity such as the use of design flexibility and furniture flexibility.

Statistical analysis of study variables revealed that design and furniture flexibility is accepted by all the examined categories classified under the gender, age, income level, family size, and housing unit area. Despite the statistically insignificant differences observed within these categories, the principles of design and furniture flexibility seem to be generally accepted in the Gaza Strip. Thus, it is recommended to promote these deign strategies in the local market in order to improve efficiency of housing supply. Furthermore, it is essentially vital for the Gaza Strip to encourage the culture of 'reduce' in natural resources consumption. Considering the scope of this study, this sustainable principle is achievable in the housing sector through implementing the principles of housing design flexibility. This could have a great impact on the housing sector in terms of increasing supply, reducing cost, and improving residents' satisfaction towards their housing units.

REFERENCES

[1] PCBS, Palestinian Central Bureau of Statistics, *Conditions of Palestinians residing in Palestine*. Ramallah: PCBS, 2013.

[2] MPWH, Ministry of Public Works and Housing, *Housing situation in the Gaza Strip*. http://www.mpwh.ps, Retrieved 28/5/2015.

[3] O. Asfour, E. Kandeel, "The Potential of Thermal Insulation as an Energy-Efficient Design Strategy in the Gaza Strip". Journal of Engineering Research and Technology, 1 (4), 117-125, 2014.

[4] N. E. Altas, A. Gzsoy, "Spatial Adaptability and Flexibility as Parameters of User Satisfaction for Quality Housing". Building and Environment 33 (5), 311-323, 1998.

[5] M. Prins, The management of building flexibility in the design process: a design decision support model for optimization of building flexibility in relation to life cycle costs. In: M.P. Nicholson (ed.), *Architectural Management* (pp. 65-75), London: E & FN Spon, 1992.

[6] W. Tannous, Z. Mouhana, O. Fakoush, "Design flexibility as one of the most important standards for economic housing". Damascus University Journal of Engineering Sciences, 29 (1), 619-638, 2013.

[7] J. F. Wong, "Factors affecting open building implementation in high density mass housing design in Hong Kong". Habitat International 34, 174–182, 2010.

[8] X. Cao, Z. Li, S. Liu, "Study on factors that inhibit the promotion of SI housing system in China". Energy and Buildings. 88, 384–394, 2015.

[9] PCBS, Palestinian Central Bureau of Statistics, *Localities in Gaza Governorate by type of locality and population 2007-2016 estimates*. http://pcbs.gov.ps/Portals/_Rainbow/Documents/gza.htm. Retrieved 6/6/2015.

[10] M. Dhamen, *Fundamentals of scientific research*. Amman: Dar Al-Massira, 2007.

[11] O. Asfour, "Towards an effective strategy to cope with housing land scarcity in the Gaza Strip as a sustainable development priority". Habitat International, 36 (2), 295-303, 2012.

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الملخص

تزداد الكثافة السكانية في قطاع غزة بشكل متسارع مع مرور الوقت مما يؤدي إلى استهلاك ملحوظ للأراضي السكنية على حساب الاستخدامات الأخرى للأراضي. هذه الظاهرة تجعل قطاع غزة في حاجة لحلول مبتكرة تساعد في زيادة كفاءة تصميم المسكن. لذا تتناول هذه الدراسة دور تطبيق المرونة في تصميم المسكن كأحد الحلول الممكنة، حيث تبحث في مدى تقبل السكان لتطبيق تلك المرونة كخطوة أولى في هذا السياق. ولتحقيق هذا الهدف، تم إجراء دراسة ميدانية اعتمادا على استبانة موجهة للسكان وتم تحليل نتائجها تحليلا كميا. وقد خلص هذا التحليل إلى تأكيد قبول فرضيات الدراسة التي نصت على أن السكان راضون عن فكرة تطبيق المرونة في تصميم الفراغات السكنية وتصميم الأثاث، وذلك بهدف زيادة كفاءة استخدام الوحدات السكنية الخاصة بهم. كما خلصت الدراسة إلى أن هذه الفرضية صحيحة بغض النظر عن مستوى الدخل للسكان. لذا توصي الدراسة بضرورة تبني تطبيقات المرونة السكنية في سوق الإسكان كإستراتيجية من شأنها المساهمة في الحفاظ على الموارد من ناحية، وتوفير سكن لائق للجميع من ناحية أخرى.