Post Occupancy Evaluation of Internal Spaces Sufficiency In Multi-Family Housing

Mand Ibrahim Aziz

Department of Architecture Engineering, College of Engineering, Salahaddin University, Erbil, Kurdistan Region, Iraq.

E-mail: mandibrahimaziz@gmail.com

Bilind Ramadan Omar

Department of Architecture Engineering, College of Engineering, Salahaddin University, Erbil, Kurdistan Region, Iraq.

E-mail: bilindebo@gmail.com

ABSTRACT:

Multi-family housing had been considered as an optimum solution to cover the housing need in Duhok city. Therefore, this type of housing structure should be designed based on standards established by authorities to be proper to family criteria. So the research problem is, some parameters of spaces sufficiency in multi-family housing did not follow the standards, and this led to resident's dissatisfaction. This study aims to compare the number and size of spaces in dwellings as the main parameters of space sufficiency with housing technical standards for Iraq, and it attempts to evaluate these parameters from the resident's satisfaction view by using the post-occupancy evaluation method. Cases study are multi-family housing settlements implemented by the investment sector in Duhok city. The methodology is based on a questionnaire survey for data collection. Results from data analysis show that most of the internal spaces sufficiency parameters are exceeded the standards, except the size of internal storage, which had been neglected in most of the dwellings' design. The results also illustrate that there is a significant relationship between the level of resident's satisfaction and the sufficiency of dwelling spaces, while

the critical factor that has the highest contribution in predicting the satisfaction of overall dwelling size is the number of bedrooms. Finally, the study recommends that housing technical standards for Iraq should be adopted as a guideline for dwellings' design regarding the number and size of internal spaces to minimize the waste in the dwelling areas and reduce the prices while increasing the value of dwellings in order to have a more affordable housing and sustainable living condition in multi-family housing projects in Duhok city.

KEYWORDS: Post-Occupancy Evaluation, Residential Satisfaction, Multi-Family Housing, Spaces Sufficiency, Housing Technical Standards.

1. INTRODUCTION

Housing is considered as one of the essential needs of human, and it is the most important for his survival after the demands for food (Amin and Al-din, 2018). According to Maslow's theory of human needs hierarchy shown in figure (1), the primary purpose of housing is to provide occupants with a safe, conductive, comfortable, secure and healthy indoor environment to carry out different kinds of activities ranging from work, leisure and social interactions (Maslow, 1943).

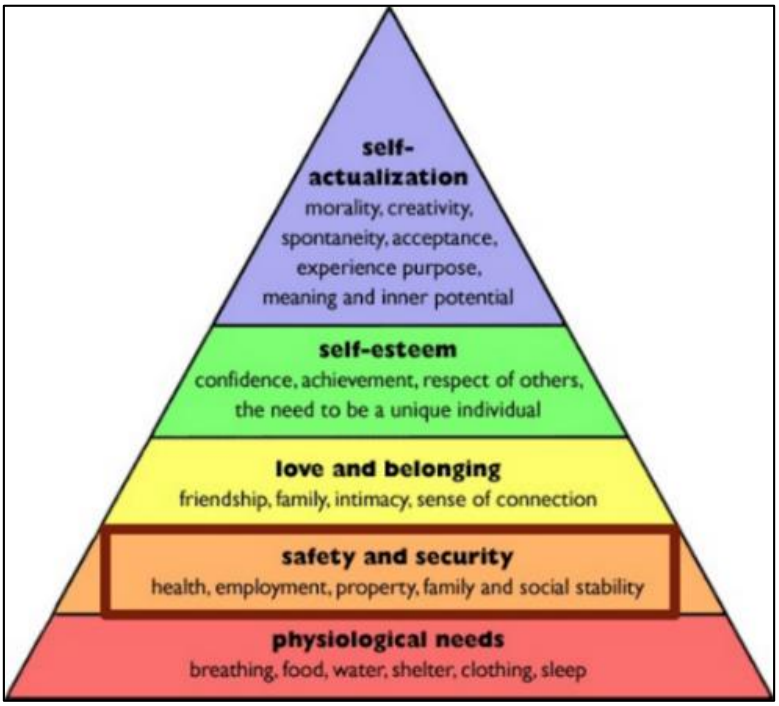


Figure 1 Maslow's hierarchy of needs (Maslow, 1943)

In order to achieve the primary goal of housing both in units or multiple forms as mentioned in Maslow's theory, houses should be designed and constructed based on standards and specifications established by governments,

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

experts, and professionals who are supposed to have enough experience of users' needs and expectations. (Gupta and Chandiwala, 2010).

Housing technical Standards for the year (1982) was considered the foundation of the housing standards in Iraq in collaboration with the Poland Consultative Group (Pol Service). These standards were aimed to link between the housing; internal and external environment; they were expressed as minimum square meters per person or minimum sizes for rooms. These standards had been adopted as the national standard for housing planning and development in Iraq (Polservice, 1982). Occasionally, these standards and specifications might not conform to the desire and changing needs of users who are not always satisfied with the performance of their houses. Thus, the necessity for this research is obvious, and that is done through post-occupancy evaluation (POE) of dwellings in multi-family housing settlements to identify problems in dwelling design related to the internal space sufficiency based on residential satisfaction.

1.1 Post occupancy evaluation (POE)

Post-occupancy evaluation is defined as an evaluation of opinions systematically about buildings in use, from the perspective of the people who use them (Watson, 2013).

Understanding the views of users is the most critical measure in any evaluation of a building's quality, whether it satisfies user requirements or what users feel about it. However, understanding the views of users is not such easy; there might be many different and conflicting views held by individuals or might all have different perspectives on the same facility (Gann et al., 2003). Thus, to assess performance concerning a criterion, it requires that performance be measured. Still, there is always the problem of how to deal with multiple performance aspects; some performance will be relevant to the intended assessment, and some of which will not. Thus, Post-occupancy evaluation (POE) is the best solution for this problem because it stresses the value of assessing environments in use, rather than independent from occupancy. Also, the degree to which the multiple users of a building feel satisfied with their experience of that environment is one such criterion. The POE process model was developed, which can be outlined in three phases and nine steps according to the time required; the scope of the evaluation; resources and cost involved (Preiser and Hardy, 2018). See Figure (2)

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

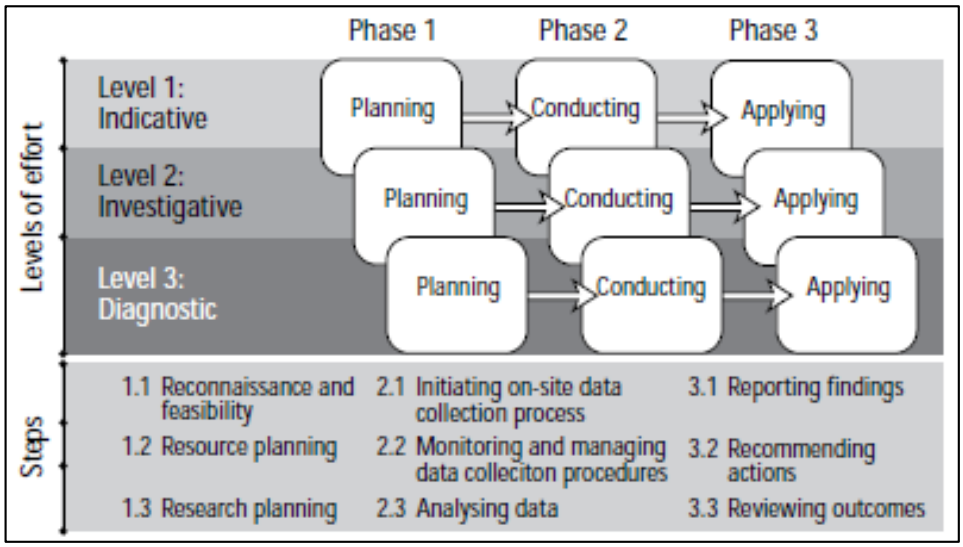


Figure 2 Post-occupancy evaluation process model (Preiser and Hardy, 2018)

1.2 Spaces sufficiency

Space is a fundamental property of housing in both architecture and the behavioral sciences. Spatial attributes such as number, size, and detail of spaces have been proven to affect occupant's behaviour (Preiser et al., 2015). It means a house is a functional performance if the design of its spaces supports the requirements for living. However, this must be integrated with the characteristics of the users in terms of household size and composition of the family.

At the fundamental level, the amount and size of spaces in a dwelling affect the "atmosphere" in the home, though larger rooms may produce feelings of expansiveness and freedom; conversely, small rooms are found to lead to feelings of confinement and crowding, this means dwelling spaces sizes affect people's psychology and well-being (Agyefi-Mensah et al., 2015).

2. PREVIOUS RELATED STUDIES

Many studies have been devoted by several researchers addressing residential satisfaction by using post-occupancy evaluation (POE) methods in different societies. Some of these researches are listed and briefly discussed as follows:

Buys and Miller (2012), in their study, discovered the predictors of residential satisfaction in Brisbane, Australia. The methodology based on residential satisfaction survey for data collection. The study evaluated both dwelling and neighbourhood design based on resident's satisfaction by assessing satisfaction factors. In the case of a dwelling, the study assessed satisfaction factors related to spaces sufficiency for dwelling, including the number of rooms, spacious living, size of rooms, and storage space. While the Significant attributes associated with dwelling satisfaction were (Spacious living and size of rooms), they were the critical attributes in predicting dwelling satisfaction related to spaces sufficiency (Buys and Miller, 2012).

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

Ibem et al. (2013) assessed the residential building performance in public housing estates constructed between 2003 and 2009 in Ogun State, Nigeria. A structured questionnaire survey was used to obtain data; the data were subjected to factor analysis and descriptive statistics, from factor analysis, the study implies that sizes of living rooms; sizes of bedrooms and sizes of cooking and storage spaces were the most predominant factors that were meeting users satisfaction related to sizes of internal spaces. The number of bedrooms and dining room size was not loaded on internal spaces factors extracted from the factor analysis (Ibem et al., 2013).

Khair et al. (2015) also evaluated the physical environment in low-cost public housing in Johor Bahru, Malaysia. The methodology depended on the preference of occupants by using the POE method. The results from factor analysis showed that size of bedrooms and the number of bedrooms have higher factor loading in dwelling unit features. These two factors were the most top preference amongst occupants from 13 others physical environment factors, with Eigen Value (18.016), this factor was included dwelling size; size of bedroom; size of living room; size of kitchen; size of a dining room; size of toilets and bathrooms; laundry and washing (Khair et al., 2015).

Mridha (2015), in his study, investigated residential satisfaction in an apartment building in Dhaka, the capital city of Bangladesh. The method of the study depended on a structured questionnaire survey conducted to collect data. Results from factor analyses showed that the architecture feature was one of the factors that play a significant role, has a good correlation (r =.403) with overall satisfaction, it is about spaciousness and setting of various functions within an apartment unit where the respondents live. These functions included master bedroom size; other bedrooms (s) size; living room size; kitchen size; dining room size; bathroom(s) size and veranda(s) size. The size of the bathroom loaded highest among the items with factor loading (0.67). The study also concludes that the bathroom is one of the most frequently used functional spaces. Therefore comfort in using that space is an essential matter. That is why bathroom size becomes a dominant predictor of satisfaction (Mridha, 2015).

Wongbumru and Dewancker (2016), in their study, investigated how residents comprehend their building and environmental conditions in housing schemes with different periods of housing development in Bangkok. Two projects have been selected as a case study Klong Chan Flat (old project) and Buengkum Baan Eur Arthon (new project). The methodology depended on the POE method base on the occupant's satisfaction survey. Regarding the size of the dwelling factor, which included the living area, kitchen, bedroom, toilet, bath, and balcony, these variables were ranked on a moderate level for both projects. The result also showed that the toilet and balcony were ranked the lowest rate, whereas bedroom size was ranked the highest scoring for Klong Chan Flat and Buengkum Baan Eur Arthron (Wongbumru and Dewancker, 2016).

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

Ning and Chen (2016), in their study, aimed to develop a post-occupancy evaluation (POE) framework and identified factors that contribute to students' residential satisfaction for university dormitories in China. The methodology was based on the POE method by using a structured questionnaire to collect the data. Regarding the use of spaces factors, which included the adequacy of storage space; adequacy of living space, room space utilization; amount of washroom space, dormitory room height. Students' dissatisfaction with the use of room space is associated with the inadequacy of storage space (mean = 2.94). However, it was found that bedrooms were quite crowded, especially for seniors or female students who have more personal items (Ning and Chen, 2016).

Ziama and Li (2018), in their study, evaluated the livability of social housing from the residents' perspectives in the suburb of Monrovia, Liberia. The study based on the POE method by using the survey questionnaire. The result from user's satisfaction survey showed that most of the variables that related to the size of rooms, including the size of bedrooms, living area, and services areas, had been ranked with a moderate level of satisfaction except the height of celling which users were unsatisfied about it. (Ziama and Li, 2018).

Babalola et al. (2019), in their study, evaluated housing quality and its predictors in governmental, residential estates in Lagos, Nigeria. The study depends on data collecting by a questionnaire survey. Concerning the number and size of spaces, the study investigated the adequacy of sizes of bedrooms; number of bedrooms (s), size of living/dining space; number bathrooms; size of bathrooms; size of kitchen; circulation space in the dwelling units, and the height of living rooms. The result showed that most of the respondents felt that the sizes of living/dining space; number of bedrooms and bathrooms were adequate, while most of them claimed that the circulation spaces in their houses were inadequate. However, most of the residents were not sure of the adequacy level of the sizes of bedrooms and kitchens in their dwelling units (Babalola et al., 2019).

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

3. RESEARCH GAPS

As noted in the literature review, most of the (POE) works concentrated on the level of a single type of buildings or dwellings, whereas this study had measured the sufficiency of internal spaces of different category of groups of dwellings rather than a single type of dwellings. It focused on the different type of dwellings regarding the (number of bedrooms + number of living rooms) in multi-family housing estates recently built in Duhok city. In order to determine and compare the level of residential satisfaction towards the spaces sufficiency variables in different dwellings types in such housing structure type.

Furthermore, most of the previous related studies concentrated on some variables of space sufficiency, while the current study covers all (13) variables of space sufficiency that are related to the number and area of internal spaces of dwellings, as shown in table (1).

Table 1 Findings from previous related studies (researcher)

	Previous related studies Authors (years)	Buys and Miller (2012)	Ibem et al. (2013)	Khair et al. (2015)	Mridha (2015)	Wongbumru & Dewancker (2016)	Ning and Chen (2016)	Ziama and Li (2018)	Babalola et al. (2019)
Space sufficiency variables	No. of bedroom in the dwelling	✓							✓
	No. of living spaces in the dwelling	✓							
	No. of baths in the dwelling	✓					✓		✓
	No. of toilets in dwelling	✓							
	Area of total bedrooms		✓	✓	✓	✓		✓	✓
	Area of total living rooms	✓	✓	✓	✓	✓	✓	✓	✓
	Area of kitchen		✓	✓	✓	✓		✓	✓
	Area of bathrooms			✓	✓	✓		✓	✓
	Area of toilet			✓		✓			
	Area of internal storage	✓	✓				✓	✓	
	Area of Entrance & circulation								✓
	Area of balconies				✓	✓		✓	
	Overall dwelling size/net area	✓		✓					
Total Number of space sufficiency variables		7	4	6	5	6	3	6	7

*(✓) indicate the specific variable was used in the previous related studies

4. RESEARCH PROBLEM

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

The dwellings in multi-family housing did not follow housing technical standards correctly regarding the number and area of internal spaces; also, these standards might not conform to the changing needs and desires of users, this had shown signs of residential dissatisfaction.

5. RESEARCH QUESTIONS

1) Are the dwellings in multi-family housing estates in Duhok city designed according to standards regarding the number and area of dwellings' internal spaces?

2) Are the residents satisfied with the size and number of dwellings' spaces in multi-family housing?

3) Is there a difference in satisfaction level of residents towards spaces sufficiency variables regarding the number and area of internal spaces in a different type of dwellings?

4) Is there a relationship between the number and size of dwellings' spaces and residential satisfaction?

5) What are the predictor space sufficiency variables that determine the overall dwelling size satisfaction?

6. RESEARCH AIM AND OBJECTIVES

The research aimed to assess how the spaces sufficiency of dwellings in multi-family housing contribute to creating conditions congruent with residents' satisfaction to identify problems in dwellings' design related to the number and size of dwellings spaces by suing on (POE) method, while the specific objectives of the study are to :

1) Conclude the theoretical framework of the study and determine the research variables related to the number and area of dwellings internal spaces adopted from previous related studies and prepare a conceptual model of the current study as shown in figure (3)

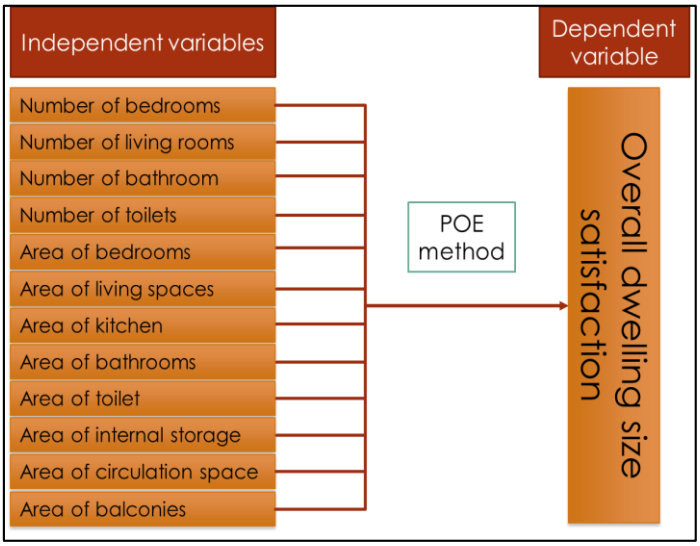


Figure 3 Conceptual Model of space sufficiency variables (researcher).

2) Compare the existing measurements of dwellings objectively regarding the number and size of dwellings

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

internal spaces with housing technical standards.

3) Evaluate and compare the level of resident's satisfaction towards the number and size of internal dwelling spaces in different dwelling types.

4) Find the degree of relationship between the objective measurements of space sufficiency variables and the subjective assessment of user satisfaction for the same variables.

5) Identify the predictor space sufficiency variables that determine the overall dwelling size satisfaction.

7. METHODOLOGY

In order to achieve the research objectives, the study depended on (POE) methods where;

- The first step is concerned with collecting data of space sufficiency objectively related to the number and size of dwellings' internal spaces in multi-family housing settlements from technical drawings of residential buildings in selected estates then comparing the collected data with housing technical standards for Iraq, by categorizing dwellings (D.W) regarding the number of bedrooms in dwellings, see table (2).

Table 2 Iraqi average standards for multi-family houses with two and three bedrooms adopted by (researcher)

Category of dwelling (D.W)	**Family size**	No. of bedroom in a dwelling	No. of living spaces in dwelling	No. of baths in dwelling	No. of toilets in dwelling	Area of total bedrooms (sq.m)	Area of total living rooms	Area of the kitchen (sq.m)	Area of bathrooms(sq.m)	Area of a toilet (sq.m)	Area of internal storage (sq.m)	Entrance & circulation (sq.m)	Area of balconies (sq.m)	Dwelling net floor area (sq.m)
Two bedrooms D.W	4	2	1	1	1	27	24	12	3.5	1.5	6	12	9	106.5
Three bedrooms D.W	6	3	1	1	1	39	24	12	3.5	1.5	6	15	12	126

- In the second step, a questionnaire was prepared as shown in the appendix (A), that included questions about user's satisfaction towards numbers and sizes of their dwelling spaces, by asking them to rank their satisfaction levels based on a five-point of (Likert Scale) ranging from (1) for very dissatisfied, (2) for dissatisfied, (3) for neutral, (4) for satisfied and (5) for very satisfied.
- In the third step, a field survey had been conducted to collect data's of subjective assessment of user satisfaction via the questionnaire.
- The last step is concerned with analyzing the collected data from the questionnaire survey by using different analyzing technic in (SPSS) software such as:

  1) Descriptive statistics: for determining the evaluation of user's satisfaction levels (satisfaction score) towards the space sufficiency variables.

  2) Analyses of variance (ANOVA): for comparing the users' satisfaction levels in different dwelling type.

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

3) Correlations for determining the relationship between the existing measurements of space sufficiency variables and the subjective assessment of user satisfaction for the same variables.

4) Regression: for producing a model of the predictor variables of spaces sufficiency (independent variables) that determine the overall dwelling size satisfaction (dependent variable).

7.1 Case studies

Dwellings within residential buildings from ten multi-family housing settlements in different areas of Duhok city were selected as a case study, as shown in Figure (4). The site plan of each settlement shown in appendix (B).

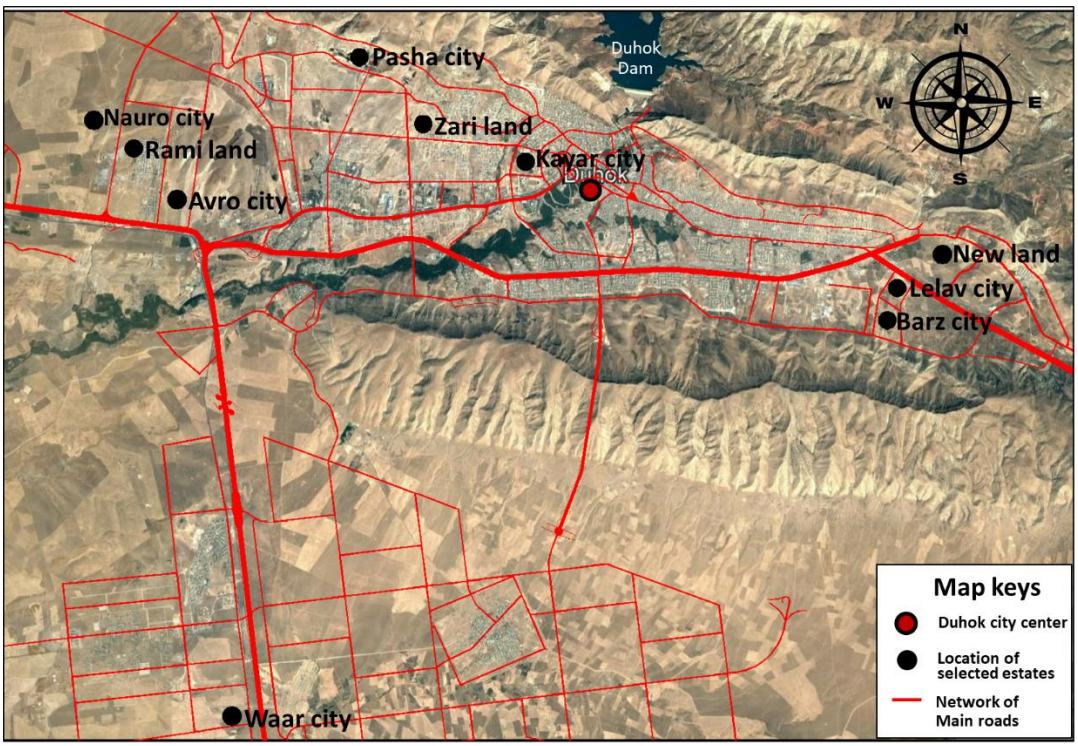


Figure 4 Selected residential settlements in the map of Duhok city (researcher)

- **Avro city**: is a residential complex located on the west of the Duhok city with (7.3Km) distance from the city center. It contains (93) single-family houses and (4290) dwellings of multi-family housing with four types of dwellings ;(2+1), (2+2), (3+2), and (4+2). Dwellings of type (4+2) did not take in this study, because the number of dwellings was insufficient statistically for determining the effective sample size.
- **Rami land**: is a high-rise residential multi-family housing project located on the west of the Duhok city with (8Km) distance from the city center. It contains (448) dwellings of one type of (2+1) dwellings.
- **Nauro city**: is a high-rise residential multi-family housing project located on the west of the Duhok city with (8.6Km) distance from the city center. It contains (720) dwellings of one type of (3+1) dwellings.
- **Pasha city**: is a high-rise residential multi-family housing project located on the north of the Duhok city with (4.5Km) distance from the city center. It contains (240) dwellings of one type of (3+1) dwellings.

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

- **Zari land**: is a complex of residential multi-family housing located on the west of the Duhok city with (3Km) distance from the city center. It contains (808) dwellings of two type of (2+1) and (3+1) dwellings.
- **Kayar city**: is a high-rise residential multi-family housing project located on the center of the Duhok city with (0.5Km) distance from the city center. It contains (760) dwellings of one type of (3+1) dwellings.
- **New land**: is a mid-rise residential multi-family housing project located on the east of the Duhok city with (7.1Km) distance from the city center. It contains (300) dwellings of one type of (2+1) dwellings.
- **Lelav city**: is a complex of residential multi-family housing located on the east of the Duhok city with (6.4Km) distance from the city center. It contains (1292) dwellings of four type of dwellings; (2+1), (2+2) (3+1) and (3+2) and dwellings. Dwellings of type (3+2) and (3+1) did not take in this study, because the number of dwellings was insufficient statistically for determining the effective sample size.
- **Barz city**: is a mid-rise residential multi-family housing project located on the east of the Duhok city with (6.6Km) distance from the city center. It contains (400) dwellings of one type of (2+1) dwellings.
- **Waar city:** is a low-rise residential multi-family housing project located on the south of the Duhok city with (11.5Km) distance from the city center. It contains (1632) dwellings of one type of (3+1) dwellings.

The study used a stratified sample design to ensure a good representation of the dwellings and to make comparisons among different dwellings types. In statistics, stratification is defined as the "classification of the populations into subpopulations or strata based on some supplementary information, and then the selection of separate samples from each stratum." (Buron et al., 1998).

The stratification in the current study was based on the (Number of bedrooms + Number of living rooms) in the dwellings. As a result, four subsets of the dwellings were chosen within each residential building type from selected settlements, i.e., dwelling type (2+1); dwelling type (2+2); dwelling type (3+1) and dwelling type (3+2) as shown in figure (5).

Figure 5 examples of different dwellings types' plan (researcher)

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

7.2 Sample size

The calculation of sample size was based on Cohen's (1977) method, as shown in table (3), by estimating the desired significance level of Alpha (0.05) (Cohen, 1977).

Table 3 Sample size required to achieve effective size with alpha 0.05 (Cohen, 1977)

Power	Cohen's **d**		
	0.2	0.5	0.8
0.25	84	14	6
0.5	193	32	13
0.6	264	40	16
0.7	310	50	20
0.8	393	64	26
0.9	526	85	34

While the parameters used for the calculation of sufficient sample size were:

- The acceptable statistical power of the study was (0.6).
- Cohen's **d** is equal to (effective size), which is the expected difference between the means of the target values between the control group and the experimental group, divided by the expected standard deviation. For this study (0.2) was used as Cohen's **d**.
- The sample error (Alpha) was considered to be 0.05 in this study. It means there is 95% confidence that the sample size (n) will accurately represent the population (N). It will result in (264) samples as the sample size (n), as shown in the previous table (2).

The total population size (N) of the current study was (10584) as shown in table (4), this was the total number of dwellings, While (264) dwellings (n) was a minimum required samples with power (0.6) and d (0.2) needed for this study as shown in table (3) this size results on (2.5%) of the total population size (N). See Equation (1)

$$\text{Sample size Ratio} = \frac{\text{minimum sample size (n)}}{\text{Total Population(N)}} \quad \text{. Eq. (1)}$$

$$\text{Sample size Ratio} = \frac{264}{10584} = 0.025$$

(2.5%) from each dwellings category has been determined as the sample size ratio, this ratio determined the actual sample size for each dwellings' type, while the net sample size has been close to the constant number without fraction. Therefore the total sample size of this study became (269) dwellings. See table (4).

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

Table 4 classification of dwelling types and determined sample size (researcher)

Dwelling type	Estates	Building type	No. of dwellings	sample size =2.5% of dwellings	net sample size
2+1	Lealv city	A-G	780	19.5	20
	Zariland	C	472	11.8	12
	Barz city		400	10	10
	Newland		300	7.5	8
	Rami land		448	11.2	12
	Avro city	A	1308	32.7	33
2+2	Lelav City	H	288	7.2	8
	Avro city	B	2316	57.9	58
3+1	Waar city		1632	40.8	41
	Nauro city		720	18	18
	pasha city		240	6	6
	Zariland	A	336	8.4	9
	Kayarcity	A	760	19	19
3+2	Avro City	C	584	14.6	15
Total			10584	264.6	269

8. RESULTS AND DISCUSSION

This part of the research focuses on the results obtained from data analysis. The first part illustrates results from the comparison of existing measurements of the number and size of rooms with standards and satisfaction scores. The second part concentrates on the results of differences in residents' satisfaction level towards these measurements in different dwellings types. The third part displays the results of the relationship between existing measurements of dwellings related to the number and size of dwellings' spaces and user satisfaction scores. The last part identifies the predictor variables of overall dwelling size satisfaction.

8.1 Comparison of the existing dwelling measurements with the standards and satisfaction scores.

In order to answer the first research question, regarding the dwellings' obligation to housing technical standards, this part of the study will compare the number and the average area of internal spaces in different types of dwellings with the housing technical standards of Iraq. Positive amount indicates that the measurements of spaces have exceeded the standards, while the negative results indicate that they are less than standards. The findings will illustrate that the dwellings in which type are designed according to standards related to spaces sufficiency variables. To answer the second research question, regarding the residential satisfaction scores, the level of residential satisfaction towards each space sufficiency variable has been calculated. The findings will determine whether the residents satisfied or dissatisfied with the existing measurements of dwellings regarding the number and size of dwellings' spaces.

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

8.1.1 Dwellings with two bedrooms and one living room (2+1)

The results from the average measurement of the number and size of internal spaces and satisfaction score of residents for dwellings of type (2+1) shown in table (5)

Table 5 Comparison between the existing measurement of dwellings spaces with standards and satisfaction score in dwellings of type (2+1) (researcher)

Dwelling type (2+1)	Existing (Average)	Average standards	Difference	Relation with standard (%)	satisfaction score (mean)
Family size	5.05	4	+1.05	+26.25%	
No. of bedroom in dwelling	2	2	0	0.00%	3.32
No. of living spaces	1	1	0	0.00%	3.47
No. of baths in dwelling	1.12	1	+0.12	+12.00%	3.68
No. of toilets in dwelling	1	1	0	0.00%	3.70
Area of total bedrooms (sq.m)	27.71	27	+0.71	+2.63%	2.82
Area of total living rooms (sq.m)	21.66	24	-2.34	-9.75%	3.48
Area of kitchens (sq.m)	11.31	12	-0.69	-5.75%	2.94
Area of bathrooms (sq.m)	3.82	3.5	+0.32	+9.14%	3.43
Area of toilets (sq.m)	2.47	1.5	+0.97	+64.67%	3.56
Area of internal storage (sq.m)	2.53	6	-3.47	-57.83%	2.14
Area of circulation space (sq.m)	11.94	12	-0.06	-0.50%	2.98
Area of balconies (sq.m)	6.5	9	-2.5	-27.78%	2.69
Dwelling size /net area (sq.m)	102.35	106.5	-4.15	-3.90%	3.32

The results illustrate that the number of bedrooms; living rooms and toilets were designed according to standards while the number of bathrooms exceeded the maximum standards because some dwellings had more than one bathroom especially in the dwellings with suite bedrooms and that made satisfaction score reached (3.68), it means residents generally were satisfied with the number of bathrooms in the dwellings. The average area of bedrooms had been slightly exceeded the standards by (2.63%), but residents felt dissatisfied about it because the average family size had been exceeded the criterion in this type of dwelling by (26.25%). Nevertheless, a little difference (9.75%) was found in the area of living spaces less than standards; still, residents were satisfied with this size; this finding supports the argument of Morris and Winter,(1978) when they said: “residents judge their housing situations according to family norms and limitation of financial resources”(Morris and Winter, 1978).

The highest value of positive differences with the standard in this type of dwellings was found in the area of toilets which had exceeded the standards with more than (64%), while the area of internal storages and balconies had the highest value of negative differences ratio with standards about (57.83%) and (27.78%) respectively. This difference made residents felt dissatisfied with the existing size of internal storage and balconies. Another finding

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

is that the total net areas of dwellings were slightly less than the standards that made the residents felt fairly satisfied with the total net area of dwellings.

8.1.2 Dwellings with two bedrooms and two living rooms (2+2)

The results from the average measurement of the number and size of internal spaces and satisfaction score of residents for dwellings of type (2+2) shown in table (6).

Table 6 Comparison between the existing measurement of dwellings spaces with standards and satisfaction score in dwellings of type (2+2) (researcher)

Dwelling type (2+2)	Existing (Average)	Average standards	Difference	Relation with standard (%)	satisfaction score (mean)
Family size	4.83	4	+0.83	+20.83%	
No. of bedroom in dwelling	2	2	0.00	0.00%	3.79
No. of living spaces	2	1	+1.00	+100.00%	4.24
No. of baths in dwelling	1.40	1	+0.40	+40.48%	3.90
No. of toilets in dwelling	1	1	+0.00	0.00%	4.07
Area of total bedrooms (sq.m)	30.42	27	+3.42	+12.68%	3.21
Area of total living rooms (sq.m)	43.08	24	+19.08	+79.49%	4.07
Area of kitchens (sq.m)	13.29	12	+1.29	+10.71%	2.95
Area of bathrooms	4.57	3.5	+1.07	+30.57%	3.21
Area of toilets (sq.m)	2.42	1.5	+0.92	+61.22%	3.69
Area of internal storage (sq.m)	0.00	6	-6.00	-100.00%	2.55
Area of circulation space (sq.m)	16.44	12	+4.44	+36.99%	3.45
Area of balconies (sq.m)	10.64	9	+1.64	+18.21%	3.24
Dwelling size /net area (sq.m)	139.67	106.5	+33.17	+31.14%	3.69

The results illustrate that the majority of the spaces had been designed above the standards expect internal storages, that were neglected in this type of dwellings, that made residents felt dissatisfied with this space.

On the other hand, this type of dwellings had an average area of living spaces larger than the standards about (79.49%) because this category of dwellings obtained two living spaces, the first one was used as a multi-purpose living space, while the second one was used as a reception for guests which is classified as a secondary living space. This secondary living space is not included in Iraqi housing technical standards for multi-family housing standards, that is why the total net area of dwellings in this type had been exceeded the standards about (31.14%). Thus residents felt more satisfied with the number and size of this type of dwellings as can be noticed with a satisfaction score of (3.69) for the total net area as can be seen in the table (5).

8.1.3 Dwellings with three bedrooms and one living room (3+1)

The results from the average measurement of the number and size of internal spaces and satisfaction score of

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

residents for dwellings of type (3+1) shown in table (7).

Table 7 Comparison between the existing measurement of dwellings spaces with standards and satisfaction score in dwellings of type (3+1) (researcher)

Dwelling type (3+1)	Existing (Average)	Average standards	Difference	Relation with standard (%)	satisfaction score (mean)
Family size	5.71	6	-0.29	-4.87%	
No. of bedroom in dwelling	3	3	0.00	0.00%	4.17
No. of living spaces in dwelling	1	1	0.00	0.00%	3.94
No. of baths in dwelling	1.22	1	+0.22	+22.47%	3.40
No. of toilets in dwelling	1	1	0.00	0.00%	3.78
Area of total bedrooms (sq.m)	44.05	39	+5.05	+12.96%	3.30
Area of total living rooms (sq.m)	28.54	24	+4.54	+18.93%	4.25
Area of kitchens(sq.m)	12.12	12	+0.12	+0.99%	3.27
Area of bathrooms	4.14	3.5	+0.64	+18.29%	3.39
Area of toilets (sq.m)	2.42	1.5	+0.92	+61.24%	3.56
Area of internal storages (sq.m)	0.00	6	-6.00	-100.00%	1.84
Area of circulation space (sq.m)	16.95	15	+1.95	+13.00%	3.45
Area of balconies (sq.m)	8.75	12	-3.25	-27.12%	3.07
Dwelling size /net area (sq.m)	135.93	126	+9.93	+7.88%	3.67

The results demonstrate that in this type of dwellings, most of the other spaces were exceeding the standards, but the differences were small except the area of toilets, which exceeded more than half of standard about (61.24%). The residents were satisfied with the most of dwelling spaces; however, the areas of balconies were designed less than the standards, but the residents felt neutral (neither satisfied nor dissatisfied) with satisfaction score (3.07), because these spaces were unusable for most of the residents primarily in this type of dwellings where they have the number of habitable rooms quite enough for carrying out their activities. On the other hand, the residents felt dissatisfied towards the area of internal storages, because it was noticed that the internal storage had been neglected in this type of dwelling, as can be seen in the table (7).

Regarding the size of dwellings, however the total net area of dwellings were slightly exceeded the standards about (7.88%), but the residents were satisfied with such areas of dwellings at the high level with a satisfaction score of (3.67), because the average family size was (5.71) person and was less than the standards about (4.78%). This finding indicates that the families had additional square meter per person inside dwellings, and this may produce feelings of expansiveness that have a positive effect on residents' psychology and well-being.

8.1.4 Dwellings with three bedrooms and two living rooms (3+2)

The results from the average measurement of the number and size of internal spaces and satisfaction score of residents for dwellings of type (3+2) shown in table (8).

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

Table 8 Comparison between the existing measurement of dwellings spaces with standards and satisfaction score in dwellings of type (3+2) (researcher)

Dwelling type (3+2)	Existing (Average)	Average standards	Difference	Relation with standard (%)	satisfaction score (mean)
Family size	6.25	6	+0.25	+4.17%	
No. of bedroom in dwelling	3	3	0	0.00%	4.33
No. of living spaces in dwelling	2	1	+1	+100.00%	4.50
No. of baths in dwelling	2	1	+1	+100.00%	4.58
No. of toilets in dwelling	1	1	0	0.00%	3.75
Area of total bedrooms (sq.m)	53.21	39	+14.21	+36.44%	3.33
Area of total living rooms (sq.m)	60.26	24	+36.26	+151.08%	4.75
Area of kitchen (sq.m)	19.66	12	+7.66	+63.83%	3.58
Area of bathrooms (sq.m)	5.63	3.5	+2.13	+60.86%	4.00
Area of toilets (sq.m)	3.01	1.5	+1.51	+100.67%	3.83
Area of internal storage (sq.m)	0.00	6	-6	-100.00%	2.33
Area of circulation space (sq.m)	21.30	15	+6.3	+42.00%	3.17
Area of balconies (sq.m)	18.28	12	+6.28	+52.33%	4.42
Dwelling size /net area(sq.m)	214.77	126	+88.77	+70.45%	3.83

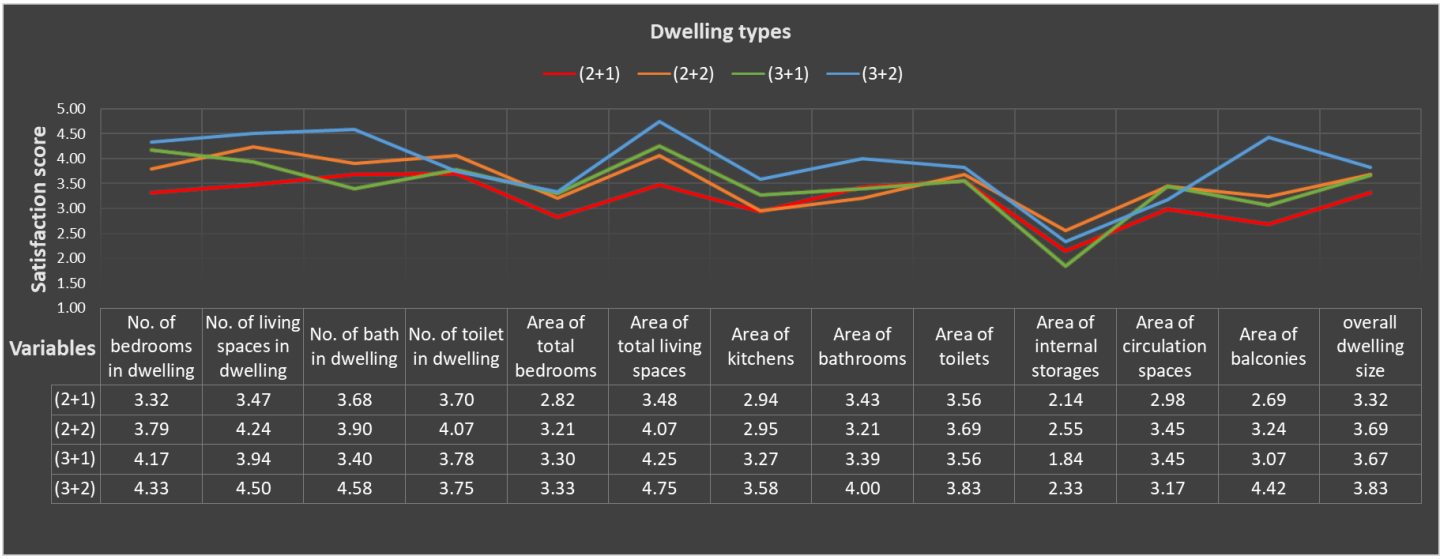
The results indicate that all spaces of this type of dwellings except the area of internal storages have larger areas than standards and most of the spaces have a positive displacement from standard with a significant difference. For example, the total areas of living spaces exceeded standards by (151.08%) because this category of dwellings had two living spaces, the first one was used as for family and the second one is used for guests, these number of living spaces exceeds the housing technical standards for Iraq as there are no secondary living rooms in multi-family housing. The results from tables (8) illustrate that the dwellings of type (3+2) had been designed to be luxurious; that is why residents felt very satisfied with the number and the average area of most of the spaces except the area of internal storages which is neglected in this type of dwellings.

These findings of dwelling type (3+2) demonstrate that there are significant relationships between existing measurements of dwelling spaces regarding the space sufficiency variables and residential satisfaction. This finding indicates that when the dwellings' spaces have exceeded the standards regarding the number and area of spaces, the residents felt more satisfied with those spaces, conversely when the spaces were designed less than the standards the resident express their dissatisfaction towards those spaces.

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

8.2 The difference in residents' satisfaction levels in different dwellings types

Analysis of variance (ANOVA) by using (SPSS) has been conducted to answer the third research question regarding the differences in residential satisfaction level in different types of dwellings. (ANOVA) is a statistical method used to compare more than two means to show the significant variation between sampling categories. Figure (6) shows the results of (ANOVA) to compare the difference in satisfaction scores for all variables of spaces sufficiency regarding the different types of dwellings.



Variables	No. of bedrooms in dwelling	No. of living spaces in dwelling	No. of bath in dwelling	No. of toilet in dwelling	Area of total bedrooms	Area of total living spaces	Area of kitchens	Area of bathrooms	Area of toilets	Area of internal storages	Area of circulation spaces	Area of balconies	overall dwelling size
(2+1)	3.32	3.47	3.68	3.70	2.82	3.48	2.94	3.43	3.56	2.14	2.98	2.69	3.32
(2+2)	3.79	4.24	3.90	4.07	3.21	4.07	2.95	3.21	3.69	2.55	3.45	3.24	3.69
(3+1)	4.17	3.94	3.40	3.78	3.30	4.25	3.27	3.39	3.56	1.84	3.45	3.07	3.67
(3+2)	4.33	4.50	4.58	3.75	3.33	4.75	3.58	4.00	3.83	2.33	3.17	4.42	3.83

Figure 6 user satisfaction level in different dwelling type (researcher)

- Number of bedrooms achieved the highest value of satisfaction score (4.33) in dwellings of type (3+2), followed by dwellings of type (3+1), (2+2) and (2+1) with scores of (4.17), (3.79) and (3.32) consecutively.
- Number of living spaces recorded the highest level of satisfaction (4.50) in dwellings of type (3+2), followed by dwellings of type (2+2); (3+1) and (2+1) with scores of (4.24) (3.94) and (3.47) respectively.
- Number of bathrooms attained the highest satisfaction score (4.58) in dwelling type (3+2), followed by dwellings type of (2+2) (2+1) and (3+1) with satisfaction scores of (3.90), (3.68) and (3.40) consecutively.
- Number of toilets had obtained the highest value of satisfaction (4.07) in dwellings of type (2+2) while the other dwellings type recoded a value close to each other, (3.78) for dwellings of type (3+1) followed by (3.75) and (3.70) for dwellings of type (3+2)and (2+1) successively.
- Area of total bedrooms gained the satisfaction scores in close together in dwellings of type (3+2) and (3+1) and (2+2) with the scores (3.33),(3.30)and (3.21) successively, and it was (2.82) for type (2+1).
- Area of total living spaces acquired the top score of satisfaction(4.75) for dwellings of type (3+2) followed

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

by dwellings type of (3+1) and (2+2) with the scores of (4.27) and (4.07) respectively, while dwellings type of (2+1) obtained the lowest score of satisfaction (3.48).

- Area of kitchen fulfilled the higher level of satisfaction in dwelling type (3+2) followed by dwelling type (3+1) with a score (3.27) while the lowest level of satisfaction went toward the dwelling type (2+2) and (2+1) with the scores (2.95) and (2.94) consecutively.
- Area of bathrooms achieved the highest satisfaction scores of (4.00) in dwelling type of (3+2) followed by dwelling type (2+1), (3+1) and (2+2) with the scores of (3.43) (3.39) and (3.21) successively.
- Area of toilets recorded satisfaction score close together in different dwelling types where it was (3.85) and (3.69) for dwelling type (3+2) and (2+2) successively, followed by (3.56) for both dwelling type (3+1) and (2+1).
- Area of internal storages earned the lowest level of satisfaction among all variables. The lowest score (1.84) was for dwellings type of (3+1), while dwelling type of (2+2) recorded satisfaction scores of (2.55) followed by dwelling type of (3+2) and (2+2) with satisfaction scores of (2.33) and (2.14) consecutively.
- Area of circulation spaces recorded the same score of satisfaction (3.45) in dwelling type of (2+2) and (3+1) followed by satisfaction score (3.17) and (2.98) for dwelling type of (3+2) and (2+1) respectively.
- Area of balconies achieved the highest score of satisfaction (4.42) with a noticeable difference for dwelling type (3+2) followed by satisfaction scores of (3.24) (3.07) for dwelling type (2+2) and (3+1) successively while the lowest score (2.69) was for dwelling type (2+1).
- Overall dwelling size (net area of dwelling) achieved the highest score of satisfaction (3.83) for dwelling type (3+2) followed by (3.69) and (3.67) for dwellings type of (2+2) and (3+1) consecutively, while the lowest satisfaction score went towards the dwellings type of (2+1) with a score (3.32).

The differences in satisfaction scores for all variables of spaces sufficiency had been noticed regarding the different types of dwellings. The main findings indicate that most of the variables of spaces sufficiency achieved the highest score of satisfaction in dwelling type of (3+2), in contrast, the lowest level of satisfaction has been recorded for dwelling type of (2+1).On the other hand, the dwellings in the same category that have two living spaces scored higher satisfaction level than the dwellings with one living spaces for most of the variables of space sufficiency.

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

8.3 Relationship between existing dwelling measurements and residents' satisfaction scores

In order to answer the fourth research question, regarding the relationship between the number and size of dwelling internal spaces and residential satisfaction, correlation analyses by using (SPSS) software has been conducted. Correlation is a static device that measures the strength or degree of a supposed linear association between two or more variables (Johnson and Bhattacharyya, 2019). Figure (7) shows the results of correlation coefficients between the variables of existing measurements of dwellings' spaces and the level of residential satisfaction for the same variables of spaces sufficiency, with indicating in three zones of correlations coefficients. The lower zone was between (0 to 0.3) for the scores of low correlations coefficients, and the middle zone was between (0.3 to 0.7) for moderate correlations coefficients, while the top zone was between (0.7 to 1) for high correlations coefficients, The high amount of correlation coefficients reveal that the measurement of dwellings related to the number and size of spaces has a robust relationship with residents' satisfaction level.

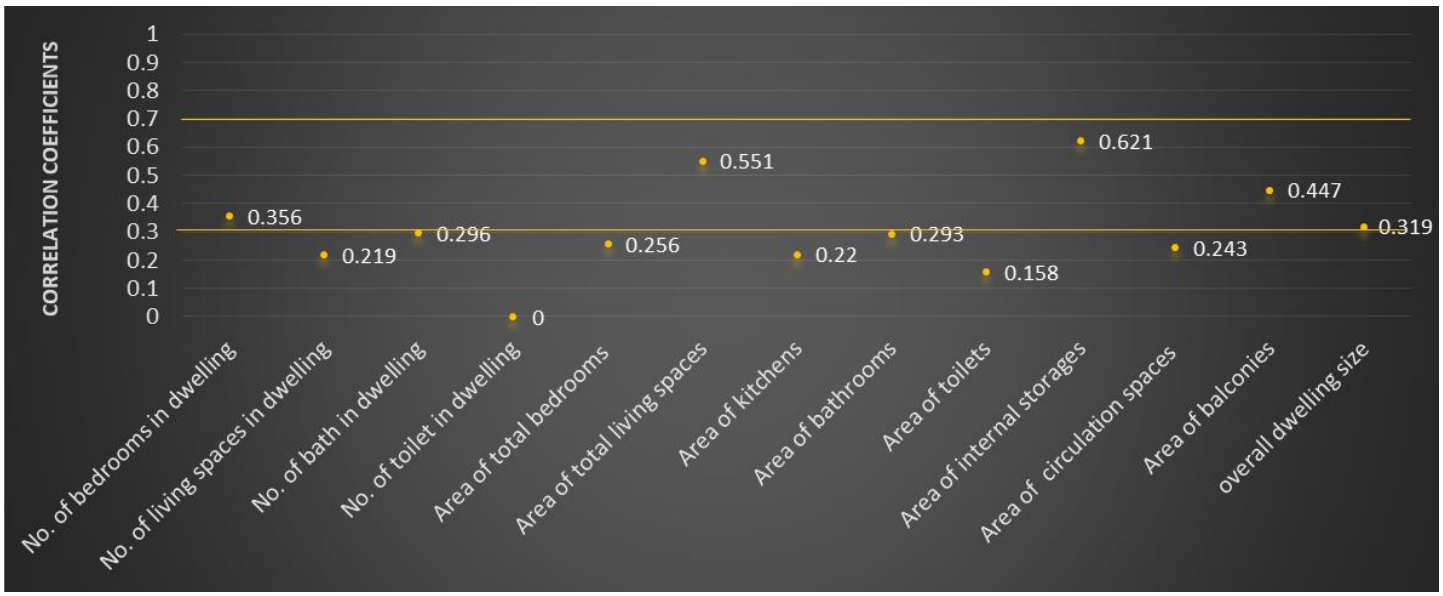


Figure 7 Correlation between user satisfaction and current dwelling measurement

The highest score of correlations coefficients was found in the variables of (area of internal storages; area of total living rooms area; area of balconies; and overall dwelling size) with positive moderate correlation coefficients. The correlation was in a positive low correlations coefficients for other variables of space sufficiency, while the lowest correlation coefficient was found in the number of toilets with no correlation because all survey dwelling had a constant number of a toilet. The main findings from correlation analyses show that all correlation coefficients score were ranked between (0) to (+1). It means all variables of existing measurements of dwelling regarding the number and size of dwellings' spaces have a significant positive relationship with residents' satisfaction levels for the same variables. These findings indicate that when the number and size of spaces increased the residential satisfaction

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

level towards the same variables increased too, and vice versa.

8.4 Identification of the variables that predict overall dwellings size satisfaction.

Multiple regression facilitating (SPSS) software by (enter processing method) was used in order to achieve the fifth research objective regarding the predictor variables of space sufficiency that determine the overall dwelling size satisfaction. Regression analysis is a method for measuring the simultaneous effects of two or more predictors independent variables to explain variations in the dependent variable (Johnson and Bhattacharyya, 2019). The results from multiple regression suggested a model of dependent and independent variables with interpretation value (R-square 0.597) indicating that the variation of the dependent variable (overall dwelling size satisfaction) is (60%) explained on the identified independent variables that have a significant (p-value ≤ 0.05) as shown in a table (9).

Table 9 Predictor variables in determining overall dwelling size satisfaction (researcher)

Model	R		R Square	Adjusted R Square	Std. Error of the Estimate
1	.773a		.597	.577	.500
Spaces sufficiency variables	Unstandardized Coefficients		Standardized Coefficients	t	p-value Sig.
	B	Std. Error	Beta		
(Constant)	.640	.158		4.048	.000**
No. of bedrooms in the dwelling	.130	.036	.184	3.606	.000**
No. of living spaces in the dwelling	-8.789E-05	.037	.000	-.002	.998
No. of bath in the dwelling	.062	.034	.094	1.835	.068
No. of toilets in the dwelling	.064	.033	.096	1.916	.057
Area of total bedrooms	.126	.036	.171	3.484	.001**
Area of total living spaces	.088	.034	.137	2.576	.011*
Area of kitchens	.054	.032	.086	1.682	.094
Area of bathrooms	.056	.037	.082	1.514	.131
Area of toilets	.036	.034	.054	1.047	.296
Area of internal storages	.087	.023	.157	3.723	.000**
Area of circulation spaces	.091	.029	.142	3.164	.002**
Area of balconies	.078	.029	.125	2.732	.007**
a. Dependent Variable: overall dwelling size satisfaction			b.*p- value significance at level 0.05 c.** p- value significance at level 0.01		

The suggested model was presented by determining the combined effect of the independent variables regarding the dependent variable formulated as follow:

$Y1 = B0 \text{ (constant)} + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + \ldots\ldots$

Y_1; the dependent variable

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

B_0, B_1, B_2….; (B) Beta-value of independent variables

X; independent variable

The model means every unit of change in identified items from (independent variables) is correlated with the B-value of change in (dependent variable).

The main finding is that overall dwelling size satisfaction as a (dependent variable) in quantity (60%) is based on predictor variables with p-value significance and highly significance ones, as can be seen in the table (9) and listed below :

- Number of bedrooms in the dwelling
- area of total bedrooms
- area of total living spaces
- area of internal storages
- area of circulation spaces
- area of balconies

While the obtained model is as follow:

Overall dwelling size satisfaction = 0.640 +0.130 Number of bedrooms in dwelling +0.126 Area of total bedrooms +0.088 Area of total living spaces +0.087 Area of internal storages +0.091 Area of circulation spaces +0.078 Area of balconies. Model (1)

The model's interpretation value (R-square) was (0.597), and it was acceptable statically. Thus the findings from the model (1) answer the fifth research question, which is (What are the predictor space sufficiency variables that determine the overall dwelling size satisfaction?).

The items with a higher value of B means this independent variable has more influence on the dependent variable (Overall dwelling size satisfaction) that is why the number of bedrooms in dwelling considers as the most important variable that has the highest contribution in determining the overall satisfaction about dwelling size With B vale (.130) with highly significant at p-value (.000)< (0.01).

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

9. CONCLUSIONS

The main conclusions obtained from results and discussions, in the same sequent of research objectives and research questions as follows:

- The majority of variables of spaces sufficiency related to the number and area of spaces had been exceeded the standards in most dwelling types. Mostly the spaces of dwellings that have more habitable rooms had been exceeded the standards more than the spaces in dwellings with a less habitable room.
- The study also reveals that when the dwellings' spaces had been designed corresponding to or over the standards regarding the number and area of paces, residents felt more satisfied with those spaces.
- Due to the nature of social life, the secondary living room had been added to some dwellings to be used as a guest room, this caused the increase of total living spaces area of these type of dwellings and to be out of standards, because according to housing technical standards for Iraq (1982) there is only one living space in multi-family housing. However, it was noticed that most of the spaces sufficiency variables recorded the highest level of satisfaction in dwellings that have secondary living rooms. In contrast, most of the dwelling types had neglected to add the internal storages inside the dwellings, and that was the reason for residential dissatisfaction towards this space sufficiency variable and dwellings in general.
- The difference in satisfaction scores for all variables of spaces sufficiency had been noticed regarding the different types of dwellings, while the lowest level of satisfaction for most of the variables of space sufficiency was found in the dwellings of type (2+1). In contrast, the highest level of satisfaction was found in the dwelling of type (3+2); these findings indicate that the residents felt more satisfied in dwellings that have more number of habitable rooms (bedrooms and living rooms).
- This study also concludes that there is a significant positive relationship between the level of residents' satisfaction and the majority of the existing measurements of dwelling spaces, mostly when the existing measurements of space sufficiency variables regarding number and area of spaces increased the residential satisfaction level towards the same variables increased too.
- The predictor variables that determined the overall satisfaction of dwelling size were; number of bedrooms in the dwelling; area of total bedrooms; area of total living spaces; area of internal storages; area of circulation spaces and area of balconies, while the critical variable that has the highest contribution in determining the overall satisfaction of dwelling size was the number of bedrooms in the dwellings.

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

10. RECOMMENDATIONS

- The findings of this study indicate that consideration of Iraqi standard needs to be set up as regulations and policies by Kurdistan investment board to reduce the price of dwellings in multi-family housing settlements by minimizing the waste in the dwelling areas, in order to reduce the residential dissatisfaction and have a more economical and sustainable living condition in such housing structure type.
- Despite, Housing technical Standards for the year (1982) was adopted as guidelines for housing planning in Iraq, but these standards also need to be updated and examined and new factors that affect the prescribed criteria be determined, due to the changing of user's needs; families structure and their lifestyle.
- In order to enhance resident's satisfaction, periodically studies of (POE) need to be conducted in the housing field in order to identify problems in dwellings design based on views of users to determine what needs to be kept and what need to be avoided in future designs of dwellings in multi-family housing.

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

ألتقيم ما بعد الإشغال لكفاية المساحات الداخلية في الإسكان متعدد الأسر

مند ابراهيم عزيز قسم الهندسة المعمارية، كلية الهندسة ، جامعة صلاح الدين، أربيل ، أقليم كردستان، العراق.

البريد الإلكتروني : mandibrahimaziz@gmail.com

بلند رمضان عمر قسم الهندسة المعمارية، كلية الهندسة ، جامعة صلاح الدين، أربيل ، أقليم كردستان، العراق.

البريد الإلكتروني : bilindebo@gmail.com

الملخص

تم اعتبار السكن متعدد الأسر كحل أمثل لتغطية الحاجة السكنية في مدينة دهوك. لذلك ، يجب تصميم هذا النوع من الهياكل السكنية على أساس المعايير التي وضعتها السلطات لتكون مناسبة لمعايير الأسرة. لذا فإن مشكلة البحث هي أن بعض عوامل كفاية المساحات في الإسكان متعدد الأسر لم تتبع المعايير ، مما أدى إلى عدم رضا السكان. تهدف هذه الدراسة إلى مقارنة عدد وحجم المساحات في المساكن كعوامل رئيسية لاكتفاء المساحات مع المعايير الفنية للإسكان في العراق ، وتحاول تقييم هذه المعايير من وجهة نظر رضا السكان باستخدام طريقة تقييم ما بعد الإشغال. الحالات الدراسية هي مجمعات سكنية متعددة الأسرنفذها قطاع الاستثمار في مدينة دهوك. اعتمد منهجية البحث على الاستبيان لجمع البيانات. تظهر النتائج من تحليل البيانات أن معظم عوامل كفاية المساحات الداخلية تجاوزت المعايير ، باستثناء حجم المخزن الداخلي ، والذي تم إهماله في معظم تصميمات المساكن. كما توضح النتائج أن هناك علاقة معنوية بين مستوى رضا السكان وكفاية المساحات السكنية ، في حين أن العامل الحاسم الذي له أكبر مساهمة في توقع الرضا عن حجم المسكن العام هو عدد غرف النوم. وأخيرًا ، أوصت الدراسة بضرورة اعتماد المعايير الفنية للإسكان للعراق كدليل إرشادي لتصميم المساكن من حيث عدد وحجم المساحات الداخلية لتقليل الهدر في مساحات وتقليل الأسعار مع زيادة قيمة المساكن من أجل الحصول على السكن بأسعار معقولة أكثر والظروف المعيشية المستدامة في مشاريع الإسكان متعدد الأسرة في مدينة دهوك.

الكلمات الدالة: تقييم ما بعد الإشغال، الرضا السكني، إسكان متعدد الأسر، كفاية المساحات، المعايير الفنية للإسكان.

11. REFERENCES

Agyefi-Mensah, S. *et al.* (2015) 'The need for post-occupancy evaluation of public apartment buildings in Ghana', *Journal of Engineering, Design and Technology*, 13(2), pp. 315–333. doi: 10.1108/EL-01-2017-0019.

Amin, R. M. and Al-din, S. S. M. (2018) 'Evaluation of the Sustainable Aspects In Housing Sector To Overcome Housing Stress In Northern Iraq', *Contemporary Urban Affairs*, 3(1), pp. 67–81. doi: 10.25034/ijcua.2018.4684.

Babalola, O. D. *et al.* (2019) *Housing quality and its predictors in public residential estates in Lagos, Nigeria*, *Environment, Development and Sustainability*. Springer Netherlands. doi: 10.1007/s10668-019-00367-8.

Buron, L. *et al.* (1998) *Guidebook for Conducting Resident Satisfaction Surveys in Public Housing: CHA Resident Satisfaction and Management Needs Survey*.

Buys, L. and Miller, E. (2012) 'Residential satisfaction in inner urban higher-density Brisbane, Australia: Role of dwelling design, neighbourhood and neighbours', *Journal of Environmental Planning and Management*, 55(3), pp. 319–338. doi: 10.1080/09640568.2011.597592.

Cohen, J. (1977) 'Statistical power analysis for the behavioral sciences (rev. ed.) Lawrence Erlbaum Associates', *Inc., Hillsdale, NJ, England*.

Gann, D. M., Salter, A. J. and Whyte, J. K. (2003) 'Design quality indicator as a tool for thinking', *Building Research and Information*, (5), pp. 318–333. doi: 10.1080/0961321032000107564.

Gupta, R. and Chandiwala, S. (2010) 'Understanding occupants: Feedback techniques for large-scale low-carbon domestic refurbishments', *Building Research and Information*. Routledge, 38(5), pp. 530–548. doi: 10.1080/09613218.2010.495216.

Ibem, E. O. *et al.* (2013) 'Performance evaluation of residential buildings in public housing estates in Ogun State , Nigeria : Users ' satisfaction perspective', *Frontiers of Architectural Research*. Elsevier, 2(2), pp. 178–190. doi: 10.1016/j.foar.2013.02.001.

Khair, N. *et al.* (2015) 'Post occupancy evaluation of physical environment in public low-cost housing', *Jurnal Teknologi*, 75(10), pp. 155–162. doi: 10.11113/jt.v75.5284.

Maslow, A. H. (1943) 'A theory of human motivation', *Psychological Review*, 50(4), pp. 370–396. doi: 10.1037/h0054346.

Mridha, M. (2015) 'Living in an apartment', *Journal of Environmental Psychology*. Elsevier Ltd, 5th ed, pp. 42–54. doi: 10.1016/j.jenvp.2015.05.002.

Ning, Y. and Chen, J. (2016) 'Improving residential satisfaction of university dormitories through post-occupancy evaluation in China: A socio-technical system approach', *Sustainability (Switzerland)*, 8(10). doi: 10.3390/su8101050.

Preiser, W. F. E. and Hardy, A. E. (2018) *Building Performance Evaluation*. doi: 10.1007/978-3-319-56862-1.

Watson, C. (2013) 'Review of Building Quality Using Post Occupancy Evaluation', *Journal of Programme Education Building*, 53(9), pp. 1689–1699. doi: 10.1017/CBO9781107415324.004.

Wongbumru, T. and Dewancker, B. (2016) 'Post-occupancy evaluation of user satisfaction: a case study of "old" and "new" public housing schemes in Bangkok', *Architectural Engineering and Design Management*, 12(2), pp. 107–124. doi: 10.1080/17452007.2015.1106399.

Ziama, J. A. and Li, B. (2018) 'Residents Post-Occupancy Evaluation of Social Housing in Liberia', *Journal of Building Construction and Planning Research*, 6(1), pp. 1–22. doi: 10.4236/jbcpr.2018.61001.

Johnson, R. and Bhattacharyya, G. (2019) *Statistics: principles and methods*. Available at: https://books.google.com/books?hl=en&lr=&id=0k6MDwAAQBAJ&oi=fnd&pg=PA1&dq=Johnson.and+Bhattacharyya,G.statistics+principles+and+methods+,university+of+washinton,at+madison+,1978&ots=5y4xLLhrBs&sig=h-6d2vr9XCYPiJfoj8Nh9r_KeoA (Accessed: 5 November 2019).

Morris, E. and Winter, M. (1978) 'Housing, family, and society'. Available at: http://bases.bireme.br/cgi-

bin/wxislind.exe/iah/online/?IsisScript=iah/iah.xis&src=google&base=REPIDISCA&lang=p&nextAction=lnk&exprSearch=153094&indexSearch=ID (Accessed: 5 October 2019).

Polservice (1982) *Housing Technical Standards And Codes of Practice-for Iraq*. Available at: http://investpromo.gov.iq/wp-content/uploads/2013/04/URBAN-HOUSING-STANDARDS.pdf.

Preiser, W., White, E. and Rabinowitz, H. (2015) *Post-Occupancy Evaluation (Routledge Revivals)*. Available at https://books.google.com/books?hl=en&lr=&id=vjACgAAQBAJ&oi=fnd&pg=PP1&ots=kW5M3ju197&sig=QYc8133QbGti88ahm7C0TswCGYY (Accessed: 24 September 2019).

APPENDIX

A-Questionnaires of residential satisfaction in multi-family housing complexes.

Dear Sir /Madam

We are asking you to participate in this study entitled (post-occupancy evaluation of internal spaces sufficiency in multi-family housing). We are trying to learn more about residential satisfaction in multi-family houses to enhance the design of dwellings in residential projects in Duhok city in the future.

APPENDIX

A-Questionnaires of residential satisfaction in multi-family housing complexes.

Dear Sir /Madam

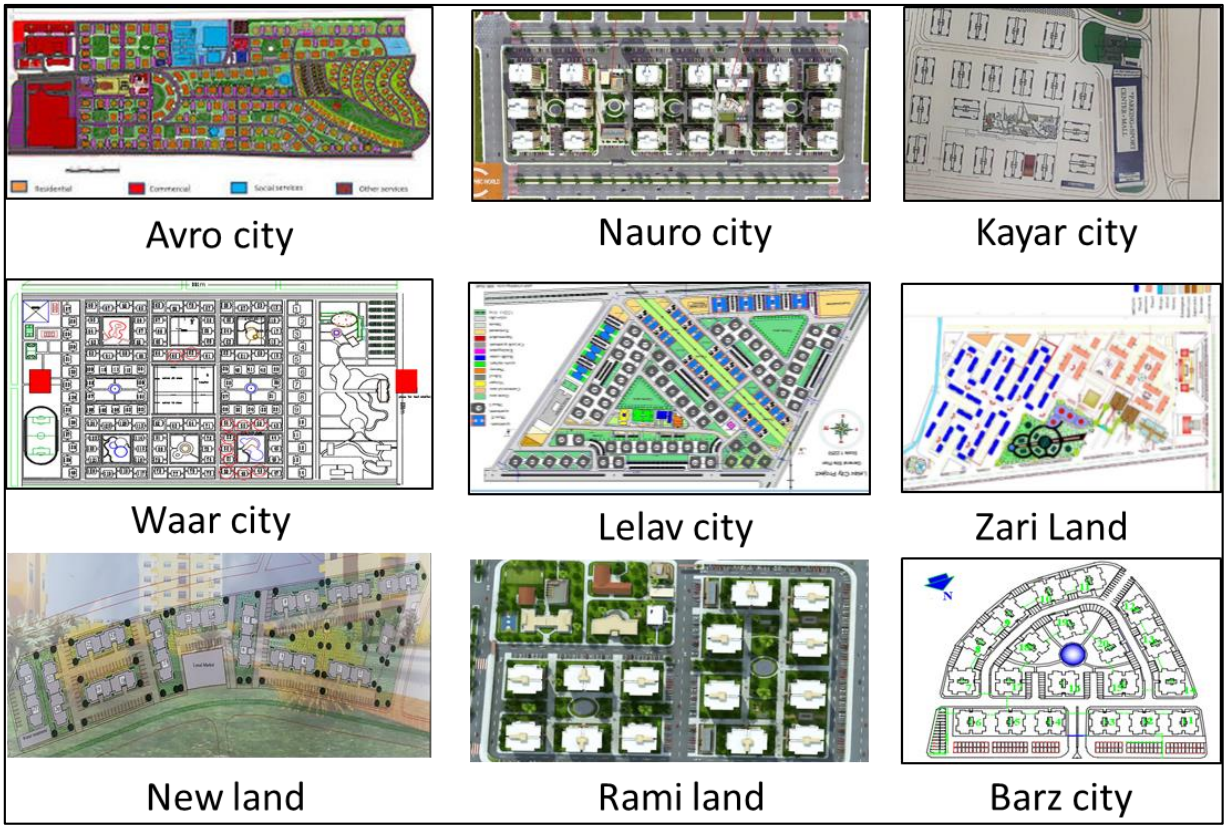
We are asking you to participate in this study entitled (post-occupancy evaluation of internal spaces sufficiency in multi-family housing). We are trying to learn more about residential satisfaction in multi-family houses to enhance the design of dwellings in residential projects in Duhok city in the future.

Part A-: - General information									
A1	**Form No:**	**A2**	**Estate/ Neighbourhood**	**A3**	**Building No.**	**A4**	**Dwelling No.**	**A5**	**Family size (Persons)**

DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020

Part B: - dwelling characteristics								
B	Specs sufficiency variables	Existing measurement	Satisfaction score					
			1	2	3	4	5	
1	No. of bedrooms in the dwelling							
2	No. of living spaces in dwelling							
3	No. of bath in dwelling							
4	No. of toilets in dwelling							
5	Total bedrooms area (sq.m)							
6	Total living spaces area (sq.m)							
7	Kitchen area (sq.m)							
8	Total bathrooms area (sq.m)							
9	Toilets area (sq.m)							
10	Internal storage area (sq.m)							
11	Entrance & circulation area(sq.m)							
12	Outdoor summer spaces(balconies) area (sq.m)							
13	Dwelling net floor area (sq.m)							

B-Site plans of selected estates for case studies



DOI:https://doi.org/10.26750/Vol(7).No(3).paper27 http://journal.uor.edu.krd/index.php/JUR Vol.7. No.3, August.2020