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The Evaluation of Living spaces and Service parts in The Dwelling Units in single-family Housing Projects in Erbil city

Mand Ibrahim Aziz ^a, Siham Musheer Kareem ^b

^{a,b} Department of Architecture, College of Engineering, University of Salahaddin, Erbil, Iraq

PAPER INFO

Paper history:

Received 23/07/2022

Revised 18/09/2022

Accepted 27/09/2022

Keywords:

Dwelling units,
living and services spaces area,
Iraqi housing standards,
Dwelling satisfaction,
Kurdistan Investment Board

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ABSTRACT

Housing is one of the main concerns raising critical problems in the Kurdistan Region. Due to the fast growth of the urban population through the last period, the Kurdistan-Investment Board was ongoing in construction of effective amount of housing estates by investment companies. Due to the rapid increase in population, many housing estate projects neglected specific family requirements, with low commitment to housing standards, quality of dwellings, and the resident's lifestyles. This study investigates living space and services parts of dwellings in those estates, finding out the factors that direct residential satisfaction supported by fixing correlations among determinants of overall satisfaction.

The adopted methodology consists of evaluation based on two steps, the first was by a technical assessment using checklist comparing spaces with Iraqi standards, while the second part was through survey of resident's satisfaction. Field data collection had consisted of a questionnaire list and data collection performed for five housing projects (10 types of dwelling units covered by eighty-three samples) selected in Erbil city. Then the questionnaire results were analyzed using the SPSS program using correlations, regression, and descriptive statistics. Low commitment to Iraqi Standards was obvious in most cases. Results also showed that dwellers were satisfied with their dwelling units in cases despite differences with Iraqi urban housing standards. For instance, in two bedrooms dwellings, areas of services were below the standard by 21% while the resident's satisfaction in this group varied between neutral and satisfied. It had been found a clear correlation between indicators of dwellings units' spaces. The regression has shown that the indicators of the kitchen location's size and shape highly affected the householder's satisfaction. The descriptive statistics have shown the satisfaction level mostly been neutral in all projects. Finally, the study suggests some recommendations regarding dwelling units in addition to the need to amend the Iraqi standards of housing.

3. Introduction

Housing has widely been defined "as a basic vital of human beings in line with other infrastructure services such as roads, access to health services, adequate water, electricity, and schools among others"[1]. "Housing satisfaction helps na-

tional economic progress as an indicator of a person's standard of living and place in society" [2] Housing is a crucial component in the creative life course of an individual, family, public, and nation. "The provision of satisfactory housing that meets governments' arranged standards of quality and users' needs, meeting aspirations have always been

* Corresponding author. : Mand Ibrahim Aziz ; mandibrahimaziz@gmail.com ; +9647504547515

the goal of every housing program in every country" [3]. KRG Regional Statistics Organization, [4] (2009) estimated the need for housing in Kurdistan in 2010 to 1,131,700 housing units, whereas the need will increase to 1,287,500 housing units in 2017. Kurdistan Regional Government (KRG) started to distribute lands and giving advances to workers and citizens to solve the problem of housing for Kurdistan citizens. The KRG has continued its plans by encouraging companies to invest in the housing sector issuing Investment Law No. 4 of 2006 by Kurdistan Parliament. The current production of housing in Kurdistan has changed the sight of main cities across the region.

Fast variations since [5], created many architectural structures and large housing projects that have reshaped the landscape of cities. Resident assessment of housing quality is something that arises quite naturally. Every resident has the skills in the places evaluating life conditions differentiating the suitable and non-suitable things of dwellings and neighborhoods. The research aimed to improve dependable and valid measures for assessing housing from the residents' viewpoint supporting technical comparison with valid standards, remains a main base in the country (UN Habitat, 2006) [3]. It is constructed on this premise that Fatoye and Odusami [6] suggested that improving housing quality needs an understanding of the user's requirements.

1.1. Housing Standards

According to [7], Housing Standards could be defined as standards to determine the qualitative and quantitative levels for achieving the housing needs on the social, economic, and physical levels. The concept of housing standards also includes the public infrastructure of residential areas. Urban Housing Standards aim to determine housing needs within urban and semi-urban areas. The respective standards determine technical program, functional, spatial, and technical requirements to be used as a tool while designing and the development of plans for residential areas [8].

Housing standards must be continually reviewed to ensure residents housing needs and affordability, not compromising critical health and safety concerns and environmental conditions. Continual innovation in design, materials, energy efficiency and environmental impacts is to be considered to improve the quality of housing (Ministry of Construction and Housing, Iraqi) [9].

1.2. Housing satisfaction

"Housing satisfaction relates to how a customer of housing products responds to the overall components of such products in response to their expectations. It is equally the degree to which the inhabitants feel that them.

housing is helping them to achieve their goals" Jiboye [10]. Francescato et al. (1979) defined residential satisfaction as the emotional response to a person's dwelling, the positive or negative sense that the occupants have for where they live. Residential satisfaction has been used as a measure to observe the success of housing. The term has been in used since early 1960s as the basis for optimizing the architectural design of large housing progresses, where feedback been collected from residents of housing projects with concern to resident's views on the physical features of proposed housing developments and then feeding back into the planning and design process.

"The technique of choice for evaluating residential satisfaction today uses structured surveys followed by statistical correlation of variables" [11]. From the 1980s to the present day, residential satisfaction has been a critical tool to assess and improve housing developers' performance and key government policies related to housing ([12]. Studies of residential satisfaction are of two types; those that reflect residential satisfaction as a predictor of behaviour (purpose to stay/move from current housing) or residential satisfaction as a criterion of housing quality [13]. Current study will follow the second model.

1.3. Term's definitions

1.3.1. Living spaces

It means the room in a house or apartment where people sit or relax together but do not usually eat or sleep and a room in a home used, especially by a family, for leisure activities, entertaining guests, consist of (family room, guest room, dining room and living room). (Source: author)

1.3.2. Service spaces

It means the spaces specified for servicing in a dwelling or apartment which consist of (Kitchen, Bathroom, and Toilet) (source: author) [7].

1.3.3. Dwelling units:

is a single unit of the house for a family of one or more persons. Samples of a dwelling unit protected by these rules contain a cooperative, an apartment unit inside an apartment building, and an additional type of dwelling in which sleeping spaces are provided. Still, toilet or cooking services

are standard by occupants of more than one room or helping of the dwelling. Examples of the last include hall rooms and sleeping spaces in shelters planned for occupancy as a residence for homeless persons. The latter are out of focus of current study (source: author) [7].

1.3.4. Single-family dwelling

it means a building containing one or more rooms with living, sleeping, eating, cooking, and sanitation services organized and designed as perpetual living accommodations for one family or household; might be devoted to one or more than one other dwelling unit by one or more vertical walls. This description also contains duplex, zero-lot-line, townhouse, and row house dwelling units designed for one family or household in addition to detached single-family dwelling units. (Source: Portland doregon.gov)

1.4. Research problem

Housing is one of the main significant life components giving shelter, safety, warmth, and a place to rest. Unfortunately, commitment in housing construction in Erbil city towards Iraqi standards is under question. Due to the dramatic increase in population of major cities responded by developing housing projects in the Kurdistan region, many projects implemented by investment sector neglected specific family requirements rather than controlling standards that affect the quality of dwellings and residents' lifestyles, needing further studies.

1.5. Research aims and objectives

The primary purpose of this study is to analyze then direct the way to develop housing sector in the Kurdistan region for projects applied by companies done by investment law No.4 of 2006 through evaluating resident satisfaction by:

- Recognizing living spaces and service parts sizes as determinants of the dwelling units compared to the Iraqi standards.
- Investigating and examining the level of residential satisfaction and the factors that affect that within investment housing projects in Erbil city.
- Recognizing the demand for residence for such spaces, i.e., living and services spaces.
- Examining the correlation and regression between overall satisfaction of investment housing and key factors that formulate that satisfaction.

1.6. Research questions

According to the objectives mentioned above, there are few questions emerged as:

- Availability of evidence of differences in variables of general indicators and housing indicators with the Iraqi housing standards?
- What are the levels of residential satisfaction perceived by the dwellers in investment housing units in Erbil city?
- What are the factors that determine or enhance the level of residential satisfaction for dwellers in investment housing in Erbil city?
- What correlations apply between general satisfaction of housing and variables for each space?

4. Previous Related Studies

Numerous researchers have dedicated many studies to addressing residential satisfaction by using questionnaire survey methods. Some of these researches are listed and briefly discussed as follows:

Muhammad, S.et. al., conducted the study by evaluating residential satisfaction between public and private housing estates in Federal Capital City (FCC) Abuja, study observed the resident's satisfaction with housing components and the whole housing, using the quantitative research design approach. Conclusions proved that more concern should be paid to the neighborhoods' environment, social, economic, and management components to improve the overall satisfaction of the residents [14].

Wongbumru and Dewancker, study investigated residents realization of building and environmental conditions in housing arrangements with altered periods of housing development in Bangkok. Two projects have been nominated an old and new project. Study determined the POE method base to observe the occupant's satisfaction. The results presented that the Toilet and balcony were ranked the lowest, whereas bedroom size ranked the highest scoring in limiting satisfaction [15].

Ishak et al., showed that the development of current space design criteria is a crucial change and should be contained through all industry companies to increase the value of housing in Kuala Lumpur, Malaysia. The foremost concern of this study is on space and design criteria precisely. Study addressed space standard container is clear as a set of summaries which orders fixed inside space minimums as an aspect of housing quality [16].

Buys and Miller, study, exposed the predictors of residential satisfaction in Brisbane, Australia. In the case of a dwelling, the study evaluated satisfaction factors connected to space sufficiency for dwelling, counting the number of rooms, spacious living, size of rooms, and storage space. Study found that (Spacious living and size of rooms), are the most critical attributes in forecasting dwelling satisfaction connected to space sufficiency [17].

Jiboye, observed tenants' satisfaction with public housing in Lagos, Nigeria. This was talented by assessing the levels of housing satisfaction of the overall population and the grades of satisfaction of tenants living in selected public housing lands inside the Lagos metropolis. Three generals of housing indicators recognized to be, work environment (E), dwelling (D), and management (M) [10].

Khair et al., also assessed the physical environment in low-cost public housing in Johor Bahru, Malaysia. The results from factor analysis showed that the size and number of bedrooms have higher factor loading in dwelling unit features, Eigen Value (18.016). This factor included dwelling size; the size of the bedroom; living room, the size of the kitchen, a dining room, toilets and bathrooms, laundry and washing [18].

Fatoye and Odusami, conducted a study that revealed that residents in public housing in Lagos, Nigeria, were most satisfied with building design features, including the number of rooms, the ceiling height, and various locations rooms of dwelling units. The study recommended development in the establishment and maintenance of essential housing facilities [19].

Babalola et al, in their study, assessed housing quality and its predictors in governmental, residential estates in Lagos, Nigeria. The study examined the adequacy of sizes of bedrooms; the number of bedrooms, size of living/dining space; the number of bathrooms; the size of bathrooms; the size of the kitchen; circulation space in the dwelling units, and

the height of living rooms. The result showed that most respondents felt that the sizes of living/dining space, number of bedrooms, and bathrooms were adequate but evaluated that the circulation spaces to be insufficient [20].

5. Methodology

The methodology of this study for dealing to solve those housing problems explained previously consists of Two main parts: Documentation and a Questionnaire list

5.1. Documentations part

In this part, data collected about the case study by visiting the investment housing project in Erbil, carrying out field survey, photographing, and interview with the residents.

5.1.1. Selecting Samples Sizes and Case Studies

Five housing projects based on the ratio of bedrooms (Table 1, appendix 3) representing the contribution in all of Erbil city have been selected namely "Minara city, Atlantic, Kamaranii, Lana city, and Darwazay Hawler. Furthermore, according to the number of bedrooms, these five housing projects (living spaces and service parts) were categorized into the following groups with respect to the listed facts

- To increase the reliability of results different housing projects were selected for each group; twenty-six questionnaire forms for two bedrooms, twenty-four for three bedrooms, twenty-eight for four bedrooms, and five for five bedrooms were used for interview for projects. Summing up eighty-three questions collected from all groups, this followed proportional sampling method as shown in Table 1.
- A questionnaire was arranged, and field visits were done as pilot survey after that upgrading of the questionnaire practiced then delivered to respondents.

Table 1. Selected five housing investment projects according to ratio number of the dwelling units and number of bedrooms (Source: Authors)

Project name	Plot size sq.m. .	No.of bed.rm	No. of stories	No. D.U.s per type	% D.U.s per type	Total D.U. per type	D.U. per project	Opt. Sample per type	Total Sample size
Minara A	200	2	1	1050	32.01%	1050	32.01%	26	26
Kamaranne City A	200	3	2	56	1.71%			2	
Atlantic City A	200	3	2	409	12.47%	929	28.32%	10	24
Lana City A	200	3	2	464	14.15%			12	
Minara B	200	4	2	386	11.77%			10	

Kamaranne City B	200	4	2	276	8.41%			7	
Atlantic City b	200	4	2	296	9.03%	1110	33.85%	7	28
Darwazay Hawler A	250	4	2	97	2.96%			2	
Lana City B	300	4	2	55	1.68%			2	
Darwazay Hawler B	250	5	2	191	5.82%	191	5.82%	5	5
Totals				3280	100%	3280	100%	83	83

5.1.2. Classification of the dwelling units according to the number of bedrooms

These five housing projects where dwelling units been categorized into the following groups, according to the number of bedrooms/ houses:

- Two-bedrooms dwelling units: contained in (Minara city) projects.
- Three-bedrooms dwelling units: contained in (Kamarany, Atlantic city, and Lana city) projects.
- Four-bedrooms dwellings: contained in :(Atlantic, Darwazay Hawler type A, Lana city, and Kamarany) projects.
- Five-bedrooms dwelling units: contained in (Darwazy hawler city type B) projects.

5.1.3. Description of housing investment projects

Minara project:

This estate was built in 2008, is in the east of Erbil City with 5Km distance from the city centre. It encompasses two types of residential units (two bedrooms/unit and four bedrooms/unit). The total number of dwelling units is 1436 residential units, 1050 units for two bedrooms, and 386 units for four bedrooms with plot area for each unit is 200sq.m. (Kurdistan Investment Board [9]).

Atlantic project:

located Koya road in Erbil with a 15.8 Km distance from the city centre. It contains two types of residential units (three bedrooms/unit and four bedrooms/unit). The total number of dwelling units is 705 residential units, 409 units for three bedrooms and 296 units for four bedrooms'; the plot area of each is 200sq.m. (Kurdistan Investment Board [9]).

Kamarany project:

located in Koya road in Erbil City with a 10 Km distance from the city centre. That contains two types of residential units (three bedrooms/unit and four bedrooms/unit). The total number of dwelling units is

334 residential units, fifty-six units for three bedrooms' type A and 276 units for four bedrooms type B, with two the plot area for each unit is 200sq.m. (Kurdistan Investment Board [9]).

Lana city project:

This project is in the Kurdistan Region in Erbil city along Koya's Road. It consists of two hundred units with two different areas, 200sq.m. and 300sq.m.. The total number of dwelling units is 519 residential units, 464 units for three bedrooms' type A and 55 units for four bedrooms type B, with two plot area for each unit is 200sq.m. (Kurdistan Investment Board [9]).

Darwaza Hawler project:

Along Erbil-Salahadden Road, with a 14 Km distance from the city centre, the total number of dwelling units is 288 units, ninety-seven units for four bedrooms' type A and 191 units for five bedrooms type B with two bedrooms plot area for each unit is 250sq.m. (Kurdistan Investment Board [9]).

5.2. Questionnaire's list

Due to the nature of the current study, as a case study, a questionnaire technique had been adopted. The questionnaire consists of five main sections to gain research objectives. The starting three groups of questions is responded by numeric data while the fourth group used the Likert scale selected for designing those questions. The questions were asked in the form of statements while answers will be in five points formats for showing satisfaction level, where (5) represents highly satisfied, (4) satisfied, (3) neutral, (2) dissatisfied and (1) highly dissatisfied. The fifth group of questions focuses on direction of demand or need whether in the positive or negative direction for low level satisfaction for items under question in the form of (much smaller, smaller, same, larger, much larger). As shown in Table 2

Table 2: Selected five housing investment projects according to ratio number of the dwelling unit and number of bedrooms (Source: Authors)

1. General indicators	2. Specific indicators	3. Derived indicators	4. Satisfaction household-er's indicators level	5. Demand (NEED) definition
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Number,of bedrooms	1.Living spaces	A. The total area of Living Space	A. Satisfaction of size	1.Living spaces
Built-up area	Living room with dining	B. The total area of habitable spaces	B. Satisfaction,of number	Living room with dining
Plot area	Guest room	C. The total area of Service parts.	C. Satisfaction,of shape	Guest room
Family size	2.service parts	D. Bedrooms' area/person	D. Satisfaction of location	2.service parts
Number of floors	Kitchen	E. Living rooms area/person	E. Overall satisfaction in all areas	Kitchen
	Storage	F. Habitable area/person		Storage
	Bathrooms, and toilets	G. Service area/person		Bathroom and toilets

6. Results and Discussions

6.1. General indicators: Analysis of spaces for two and three bedrooms

Data from Table (3) shows:

- General indicators result for two and three bedrooms. Difference discovered in areas for each dwelling unit according to the number of bedrooms with relation to increased plot area, built-up area, number of floors and family size, for example, comparing the built-up area in dwelling units, Minara city (A) with two bedrooms shows lower numbers regarding built

Table 3: General indicators of dwelling units with two and three bedrooms (Source: Authors)

General indicators	Existing of Two bedrooms		Existing of Three bedrooms	
	Minara city type A	Atlantic city type A	Kamaranee type A project	Lana city
1.No. bed room	2	3	3	3
2.Built up area	130	188	145	122
3.Plot area	200	200	200	200
4.Family size	4	6.3	6.5	6
5.No. floor	1	2	2	2

Data from Table (4) shows:

- General indicators result in four and five bedrooms shows a slight difference in areas for each dwelling unit by increasing the number of bedrooms with no effect on built-up area.as average of four-bedroom projects are around 161 sq.m. the five-bedroom dwellings in Darwazy hawler is just 157sq.m. like four bedrooms in different projects.

Table 4: General indicators of dwelling units with four and five bedrooms (Source: Authors)

General indicators	Existing of four bedrooms				Existing of five bedrooms	
	Minara city B	Kamaray type E	Atlantic type B	Darwazy hawler A	Lana city	Darwazy hawler B

up areas than others but near to Lana city dwellings.

- According to the number of bedrooms range of family size increased from Minara city with four persons, increased accordingly to higher family sizes in next three projects with 6 - 6.5 persons.
- Therefore, all variables of general indicators were identical to the number of bedrooms.

- Increase in average family size is witnessed between 4 and 5 bedrooms The average family size in four dwelling units of four bedrooms is about 8.2 persons. While in darwazy hawler type B is 9.5 persons.
- For plot sizes some variance is observed as average is increased from 230sq.m. in four bedrooms to 250sq.m. in five bedrooms.
- Therefore, not all variables of general indicators were identical to the number of bedrooms.

1.No.bed	4	4	4	4	4	5	7
2.Built.up	140	150	188	152	173	157	
3.Plot area	200	200	200	250	300	250	
4.Family	8.5	8.6	8.0	8.	7.5	9.5	
5.No. floor	2	2	2	2	2	2	

6.2. Specific and derived housing indicators

A. Comparing dwelling units for two bedrooms with Iraqi standard.

- Data from Tables (5) & (6) clarify that the bedrooms, living space, and habitable spaces area were above the range of the Iraqi standards for the Minara; the amount by the criterion was 24.44%, 27.27%, and 25.00% for bedrooms, living, habitable areas, respectively.
- The total areas of service spaces were 24.51% below Iraqi standards for Minara project.
- The average family size for the project is slightly higher to what was specified in the Iraqi standard.
- Areas per persons are slightly higher than standards for bedroom, living and habitable rooms with percentages ranging between 11.11% and 15.64%.
- Corresponding to service areas per persons there is a clear shortage with a percentage of -28.64% comparable to Iraqi standards.

B. Comparing dwelling units for three bedrooms with Iraqi standard.

- Tables (5) & (6) clarify that the highest value of differences with the Iraqi standard was found in the Lana city house type A. It is above the Iraqi standard in terms of total living spaces with 53.1sq.m. compared to 33.0sq.m in standards, however in Atlantic city the size is below standards due to absence of guest room as second living space.
- On contrary the total service areas in Lana city were lower than the standard with magnitude of 19.8sq.m. out of 26.0sq.m. in standards.
- Kamaranee project house type A, shows less differences with standards in comparison to Atlantic and Lana cities.
- The average family sizes are around or marginally above what is stated in the Iraqi standard.

Table 5: Spaces areas of Specific Housing indicators (variables) with Iraqi standards (Source: (Iraq.2010[21])).

Housing indicators	Existing Two bed- rooms		Existing Three bedrooms			Iraqi standard
	Minara city A	Iraqi standard type	Atlantic city	Kamaranee type A project	Lana city A	
Living spaces	Area sq.m.	Area sq.m.	Area sq.m.	Area sq.m.	Area sq.m.	Area sq.m.
Living area	21.00	18.00	24.00	24.60	29.40	18.00
Guest room area	20.80	15.00	0	20.80	23.76	15.00
Total living space	42.00	33.00	24.00	45.40	53.16	33.00
Service parts	Area sq.m.	Area sq.m.	Area sq.m.	Area sq.m.	Area sq.m.	Area sq.m.
Kitchen	15.96	12.00	25.00	18.48	12.00	12.00
Storage	0	6.00	0	0	0	6.00
Bathroom	3.30	3.50	B1=4.00	B1=4.77	B1=3.20	3.50
Toilet	1.20	1.50	2.00	1.43	1.40	1.50
Total services area	20.46	26.00	35.00	29.08	19.80	26.00

- Areas per persons shows some differences with Iraqi standards for bedrooms, ranging between 5.08% and 27.57% topped in Kamaranee city houses.
- The main imbalance is observed in living areas per person indicator with high fluctuations

between -30.73% and 61.09% nearby 100% , an observation for quite neglection to standards, numbers became more moderated when habitable indicator analyzed for range between - 11.42% and

32.92% just below 50% which is estimated to be exceedingly high.

fluctuating in between -23.79% and 28.48%, with less variation in Kamaranee project.

- Corresponding to service areas per persons there is a high spread for results of per person

Table 6: Derived Housing indicators (variables) comparable with Iraqi standards (Source: (Iraq.2010[21])).

Housing indicators	Two bedrooms				Three bedrooms				Iraqi standard	
	Minara city type A		Atlantic city type A		Kamaranee type A		Lana city A			
	Area	Relation-standard	Iraqi standard	Area	Relation-standard	Area	Relation-standard	Area		Relation-standard
Total bedroom	33.00	+24.44%	27.00	43.00	10.26%	53.90	+38.21%	42.60	9.23%	39.00
Total Living spaces	42.00	+27.27%	33.00	24.00	-27.27%	45.40	+37.57%	53.16	61.09%	33.00
Total Habitable space	75.00	+25.00%	60.00	67.00	-3.94%	99.40	+42.51%	95.70	37.21%	69.75
Total of Service Area	20.46	-24.51%	26.0.	35.00	34.61%	29.08	+11.85%	19.80	-23.85%	26.00
Average. Family size	4.40	10.00%	4.00	6.30	5.00%	6.50	8.33%	6.00	0.00%	6.00
Bedroom area / Person	7.50	11.11%	6.75	6.83	5.08%	8.29	27.57%	7.10	9.23%	6.50
Living area / Person	9.54	15.64%	8.25	3.81	-30.73%	6.98	26.99%	8.86	61.09%	5.50
Habitable Area / Person	17.04	13.60%	15.00	10.63	-11.42%	15.29	27.44%	15.95	32.92%	12.00
Service. Area / Person	4.65	-28.46%	6.50	5.56	28.48%	4.48	3.46%	3.30	-23.79%	4.33

C. Comparing dwelling units of four bedrooms with Iraqi standard.

- Tables (7) & (8) clarify that the highest value of differences with the Iraqi standard was found in the Darwazay Hawler type A and Lana city house type B. It is above the Iraqi standard in terms of bedrooms spaces with 89.49sq.m. and 79.95sq.m. compared to 51.0sq.m in standards.
- For total living spaces Minara type B and Lana city type B far exceeded standards with 85.6sq.m. and

66.65sq.m. respectively while standards suggest 42.0sq.m.

- On the opposite side Atlantic project house type is so low below standards with just 24.0sq.m.
- Regarding total service areas all types in the 5 projects are either equal or a little above size recommended by housing standards.
- Kamaranee project house type A, shows less differences with service sizes standards in comparison to Darwazay hawler project.

Table 7: Spaces areas of Specific Housing indicators (variables) with Iraqi standards (Source: (Iraq.2010[21])).

Specific Housing indicators	Four bedrooms					Iraqi standard
	Minara type B	Kamaranee city type B	Atlantic project type B	Darwazay hawler A	Lana city type B	
Living spaces	Area sq.m.	Area sq.m.	Area sq.m.	Area sq.m.	Area sq.m.	Area sq.m.
Living area	59.20	21.50	24.00	29.48	38.70	21.00
Guest room area	26.40	22.50	0	18.00	27.95	21.00
Total living spaces	85.60	43.50	24.00	47.48	66.65	42.00
Service parts	Area sq.m.	Area sq.m.	Area sq.m.	Area sq.m.	Area sq.m.	Area sq.m.
Kitchen	21.00	18.53	25.00	23.86	23.65	15.00
Storage	0	0	0	0	0	7.50

Bathroom	6.40	11.17	8.00	13.60	11.86	4.50 3.00
Toilet	4.00	4.20	2.00	6.84	3.80	1.50
Total service spaces	31.50	33.90	35.00	44.47	39.31	32-38

Table 8: Derived Housing indicators (variables) with Iraqi standards (Source: (Iraq.2010[21])).

Derived Housing indicators	Minara type B		Kamaranii city		Atlantic city type A		Darwazay hawler A		Lana city type B		Iraqi standard (sq.m.)
	Area	Relation-standard	Area	Relation-standard	Area	Relation-standard	Area	Relation-standard	Area	Relation-standard	
Total bedroom	56.00	9.80%	62.00	21.57%	59.00	15.69%	89.48	75.45%	79.95	56.76%	51.00
Total Living spaces	43.60	3.81%	43.50	3.57%	42.00	0.00%	47.48	13.05%	66.65	58.69%	42.00
Total habitable space	99.6	7.1%	105.5	13.44%	101.0	8.60%	136.96	47.27%	146.6	57.63%	93.00
Total of Service Area	31.50	-10%	33.90	-3.14%	37.00	0.00%	44.47	27.06%	39.31	12.31%	35.00
Avg.family(Person)	7.00	-12.50%	6.20	-22.50%	6.20	-22.5%	7.00	-12.50%	7.20	-10.00%	8.00
Bedroom /Person	8.00	25.60%	10.00	56.99%	9.52	49.45%	12.78	100.63%	11.10	74.25%	6.37
Living zrea /Person	6.23	18.70%	7.02	33.71%	6.77	28.95%	6.78	29.14%	9.25	76.19%	5.25
Habitable a /Person	14.23	22.4%	17.02	46.35%	16.29	40.07%	19.57	68.27%	20.36	75.06%	11.63
Service area/Per-	4.5	-2.8%	5.47	18.14%	5.65	22.03%	6.35	37.15%	5.46	17.93%	4.63

- The average family sizes are all beyond what is stated in the standards, smaller family sizes than expected by standards, a fact that might be considered seriously in evaluation.
- Bedrooms areas per persons shows clear higher magnitudes against standards, ranging between 25.60% and 110.63% extreme belongs to Darwazay Hawler type B houses.
- Living areas per person indicator with fluctuations between 18.70% and 76.19% nearby 50% on the positive direction, a low commitment to standards, numbers remain high when habitable indicator analyzed

Table 9: Total spaces areas of General indicators (variables) with Iraqi standards (Source: (Iraq.2010[21])).

Specific Housing indicators	Five bedrooms Darwazay hawler Area	Iraqi standard (sq.m.)
Living spaces		
Living area	42.50	24.00
Guest room area	21.80	24.00
The total living	64.30	48.00
Service parts		
Kitchen	24.00	18.00
Storage	0	9.00
Bathroom	14.70	4.50
		3.00
Toilet	7.80	1.50
	46.50	39.00

- Total bedroom, living, habitable and service are higher than standards with ratios of 66.7%,

- for range between 14.23% and 75.06% about 60% range which is estimated to be exceedingly high.
- Corresponding to service areas per persons there is a mild variation in results fluctuating in between - 2.80% and 37.15%, Minara against Darwazay Hawler type A.

D. Comparing dwelling units of five bedrooms with Iraqi standard.

- Data from Tables (9) & (10) indicates that all totals of spaces' areas are exceeding the maximum limits in the standards

33.6%, 52.5% and 19.2%, highest in bedrooms lowest in services, sign of luxury in space sizes.

- In all dwelling units, there was no storage because the storage area includes kitchen space.
- The average family size in the standard was ten persons, near to Minara project with 9.6 persons.
- The data relating to the bedrooms, living spaces, service area, and habitable area per person follows those of real sizes as family sizes are near

to standardized family size proposed by standards.

6.3. Satisfaction of householders' indicators

The main aim in investigating satisfaction indicators about living and service spaces and contribution in total dwelling satisfaction has been stated in previous table (2), 4 criterions per each space of the 2-living and 3-service spaces in addition to overall satisfaction per space and per group of spaces covering living and services then followed with general satisfaction for all items.

A. Satisfaction about dwellings' living spaces.

- Four basic items that clarify satisfactions of householders (size, number, shape, and location) shows levels between neutral and highly satisfied, no indication for averages to state dissatisfaction as seen in table 11.
- The previous main items contributed and support the accumulative satisfaction for both living and guest spaces to be satisfied with magnitudes of 3.57 and 3.74, respectively.
- The total satisfaction as a separate response figure 3.65 which itself supports results of satisfied level, however the number is not so high, that suggest better dealing with those spaces during programming and design.

B. Satisfaction about dwellings' service spaces.

- Same four basic items that had been applied to living spaces where applied here which indicate satisfactions levels (size, number, shape, and location) ranging between neutral and satisfied, the indications for averages to state dissatisfaction observed in location of kitchen and marginally in shape of toilets.

Table 10: Total spaces areas of Housing indicators (variables) with Iraqi standards (Source: (Iraq,2010[21])).

Derived Housing indicators	Five bedrooms Darwazay Area	Relation Stand-	Iraqi standard (sq.m.)
Total bed-	105.	66.7%	63.00
Total Liv-	64.3	33.6%	48.00
Total habit-	169.	52.5%	111.00
Total Ser-	46.5	19.2%	39.00
Average	9.6	-4.00%	10.00
Bed-	10.9	73.65%	6.30
Living Ar-	6.70	39.58%	4.80
Habita-	17.6	58.83%	11.1
Service	4.84	24.10%	3.90

- The observed main figures of items contribute and support the accumulative satisfaction for kitchen, bathrooms, and toilets spaces to be satisfied with magnitudes of 3.60 and 3.04 and 3.30 respectively, one assessed as satisfied with two neutrals the lowest is assessment about bathrooms.
- The total satisfaction as a separate response figure 3.30 as marginally neutral just below the base of satisfied of 3.50 this emphasizes more concern should be paid for such spaces.

Table 12: Satisfaction levels of service spaces and general satisfaction of both groups (source: Authors)

Housing	Items	Mean	level of satisfaction
Kitchen	Size	3.73	Satisfied
	Number	4.20	satisfied
	Shape	4.00	Satisfied
	Location	2.30	Dissatisfied
	Overall	3.60	Satisfied
Bathroom	Size	3.56	Satisfied
	Number	2.86	Neutral
	Shape	3.69	Satisfied
	Location	3.78	Satisfied
Toilet	Overall	3.04	Neutral
	Size	4.00	Satisfied
	Number	3.20	Neutral
	Shape	2.60	Neutral
	Location	3.47	Neutral
Overall	Overall	3.32	Neutral
	Overall service-Gen-eral	3.30	Neutral
		3.5	Satisfied

Table 11: Satisfaction levels of living spaces (source: Authors)

Housing indicators	items	Mean	level of satisfaction
Living room	Size	4.60	Highly satisfied
	Number	3.40	Neutral
	Shape	3.00	Neutral
	Location	3.28	Neutral
	Overall	3.57	Satisfied
Guest room	Size	4.50	Highly satisfied
	Number	3.27	Neutral
	Shape	3.20	Neutral
	Location	4.00	Satisfied
Overall living space Satis.		3.65	Satisfied

C. Satisfaction about dwellings for both groups of spaces.

- The general satisfaction row indicator is supporting both overall assessments of satisfaction mentioned before. And indicator of reliable results and contribution of both group of spaces in general satisfaction.
- spaces but with small margin.
- Mean of needs for service spaces shows intentions or willingness to obtain larger spaces fitting family
- needs assessed by their responses.

Table 13: Demands for living space and service parts regarding satisfaction levels (source: Authors)

Demand indicators	Mean of need	Mean of satisfactions	level of satisfaction
What do you need about the living room?	2.9	3.57	Satisfied
What do you need about the guest room?	2.8	3.74	Satisfied
What do you need about the kitchen room?	3.5	3.60	Satisfied
What do you need about the bathroom?	3.3	3.03	Neutral
What do you need about the toilet room?	3.3	3.32	Neutral

4.5. Main indicators participation in residents' dwelling spaces' satisfaction

Regression analysis had been processed to find main contributors in formalization of satisfaction models applied in such projects at two main levels. Firstly, main items forming satisfaction of each space type, followed by model for participation of both groups of spaces combined in general satisfaction level.

A. Regression model for specific space criteria

With reference to table (14) research proposes five models of regression as mentioned in below.

$$\text{Livingspacesat.} = 1.409 + 0.216\text{Size} + 0.473\text{No.} + 0.603\text{Shape} + 0.587\text{BrNo} + 0.203\text{Fam}$$

- The figure of 3.50 is on the margin between neutral and satisfied level that supports conclusion of prominent levels of satisfaction had not been achieved in such projects.

4.4. Demand's level (NEEDING)

- The need or demand indicator shows the direction of willingness to overcome discrepancy or low level of satisfaction evaluation for any space including neutral cases. However prominent levels of satisfaction will lead to neutral response in needs regarding the available situation.
 - Adopting results presented in table (13) It means there are no demands by dwellers.
 - As all overall satisfactions specific for each space were satisfied so first impression will propose minor shifts in needs.
 - Mean of needs are just below the amount of 3.00 for living spaces as neutral for demand assessment indicating a sense of excessive size of such
- $$\text{Guestspacesat.} = -0.482 + 0.389\text{shape} + 0.384\text{Location}$$
- $$\text{Kitchen spaces at.} = -0.227 + 0.284\text{Number} + 0.287\text{shape} + 0.507\text{Location}$$
- $$\text{Bathroomspacesat.} = -1.153 + 0.350\text{Size} + 0.638\text{Number}$$
- $$\text{Toiletspaceat.} = -1.786 + 0.515\text{Size} + 0.545\text{shape}$$
- High to fair explanation power for models in sequence 0.81, 0.89, 0.78, 0.60, and 0.56.
 - Significance level are ranging between significant 0.05 to extremely high significant 0.000

Table 14: Regression models for specific space criteria (source: Authors)

living space and service parts	Regression variables	Coef-ficient	Sig
Living room	Satis .Size	.216	.006
	Satis .Number	.473	.020
	Satis .Shape	.603	.000
	No.bedroom	.587	.010
	Family size	.203	.041
R2 = 0.81			
Guest room	Satis .Shape	.389	.000
	Satis .Location	.384	.000
R2 = 0.89			
Kitchen	Satis .number	.284	.020
	Satis .Shape	.287	.013
	Satis .Location	.507	.000
R2 = 0.78			
Bathroom	Satis .Size	.350	.027
	Satis .Number	.638	.000
R2 = 0.60			
Toilet	Satis .Size	.515	.001
	Satis .Shape	.544	.000
R2 = 0.56			

B. Regression model for general satisfaction of dwellings

The second model had been obtained by using table (15)

- High explanation power for main model 0.68
- Significance of items are extremely high with amount 0.000.
- The model format is as follows with main contributors of overall satisfaction about guest and toilets, this means the remaining factors were not so significant in explaining general satisfaction.

General sat, dwell. = 0.148 + 0.788allsatguest + 0.406allsattoilet

Table 15: Regressions between general dwelling satisfaction of all variables and overall satisfaction for each space. (source: Authors)

	Regression variables	Coefficient	Sig
General	Over all satisfactions about guest	.788	.000
satisfaction	Over all satisfactions about Toilet	.406	.000
R2 = 0.68			

7. Conclusions

The results show that most of the living spaces and service parts related to the residential unit were designed with low commitment to Iraqi standard, however the number of these spaces was in general following the standards with some exception, hence research addresses these major findings regarding satisfaction of those group of internal spaces within dwellings in single family housing projects in Erbil.

- In two and three bedrooms housing projects, the lowest percentage under the standard was +24.51% for the total service area, the highest in living spaces with +27.27%, for derived indicators regrading living areas per person showed an astonishing variance of -30.73% to + 61.09% in comparison with standards, that needs real follow up in new projects, however the range for services parts ranged in between - 28.46% to + 28.48% means variations but around standards without biasing towards any direction.
- In four bedrooms housing projects the case was almost less variance to that of two-three bedroom houses, a smaller difference with the standard was noted in the living spaces with range +3.81% to

+58.69% all above , while for services spaces areas differences compared to standards were between -

10.00% and +27.06%, for derived indicators the case for living spaces per person variation to standards is

between +18.70% to +76.19% both above , with services ranging within -2.8% to +37.15% compared to standards almost acceptable tolerance.

- In housing units with five bedrooms' living and services areas variances compared to standards were +33.60% and +19.20% respectively with per person variations for living and services spaces areas are +39.58% and +24.10% both higher than recommended by standards.
- In all dwelling units a strong relation between general house with household indicators and overall satisfaction levels about both groups of spaces living and services is observed; the main criteria in concern were (size, shape, number, and location) ; most variables were highly significant. The strength of explanations was all except for toilets above 0.60 in regression analysis.
- The details of satisfaction for each criterion fluctuated between neutral and satisfied with minor exceptions of dissatisfaction and high satisfaction cases.
- The demands of householder post satisfaction evaluation for all dwelling criteria were neutral, again this is due to wide neutral responses for spaces criteria.
- The correlation between all general indicators and housing indicators were positive because when the increase of the general indicators (number of bedrooms, size, number of each space, built-up area, number of floors, plot area, and family size) led to increasing of housing indicators (living room, guest room, kitchen, bathroom, and Toilet) satisfaction, the five space models of regressions proves these conclusions.
- The general satisfaction levels are clearly affected by both guest room and toilets satisfaction, this is caused by imbalance of toilets, and absence of guest rooms in some projects as the second living space. Other spaces factors don't show significance due to neutral or slight satisfaction assessment by householders I the final model of regression.

8. Recommendations

- The conclusions of this study show that Iraqi standard needs to be facilitated and practically adopted by license authorities for housing construction permissions. Essential upgrading is also recommended to be valid for the coming 20 years as demographic and economic factors have been changed during the last 20 years which was covered by standards.
- Adopting satisfaction and post occupation studies on regional even local basis in order to get realistic feedback about housing complexes built by investor sector to avoid excessive spaces been built that might not increase satisfaction level as a waste in investment that consume family economical resources against low output regarding satisfaction levels about housing conditions within dwelling units' perimeter.
- Teaching institutions in the Iraqi Kurdistan Region and in whole Iraq should respond to and facilitate standards whether the available or the upgraded ones, ignorance in teaching institutes had led to non-commitment of some designers and evaluators to adopt the standards contributed to the waste in resources.

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