RESEARCH ARTICLE

A systematic assessment of architectural approaches for solving the housing problem in Iraq

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Abstract
Iraq experiences housing shortage of around 1–1.5 million units with low production rate. Managing this challenge requires integrated efforts across a number of fields. One way forward is to develop an integral and appropriate architectural solution. In Iraq, it remains unknown which of the possible architectural approaches is adequate to address its housing challenges while considering occupants' preferences. Aiming at helping in forming a solution, this study critically assesses the possible building patterns and construction approaches, which represent the main architectural solutions' framework. To achieve this aim, an extensive literature review was conducted that explores possible alternatives and housing requirements. Alternatives were assessed by comparing and contrasting their adequacy in satisfying Iraqis' preferences and the housing sector requirements. The assessment included conducting two surveys: a public Iraqis survey and an experts survey. The former was used to determine Iraqis' residential priorities and the latter to evaluate the adequacy of the defined alternatives in satisfying a set of housing requirements. A total number of 410 Iraqis participated in the first survey and fourteen Iraqi experts in the second. Based on the results, this paper suggests mass construction of multi-family courtyard residential buildings as a solution and discusses future research efforts.
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1. Introduction

The housing sector in Iraq witnessed significant development during the 1970s and the beginning of the 1980s when the annual housing production reached its ever maximum rate of 50000 housing units (Iraqi Ministry of Planning, 2010; Yousif, 2012). This development depended mainly on state-led housing production, benefiting from the high oil industry's revenues (El Agraa and Ahmad, 1978; Meikle, 1992). However, since the middle of the 1980s, Iraq has suffered from instability and wars, which has led to a continued deterioration in its housing sector (UN-Habitat, 2003). Currently, there is low housing production and housing shortage of around 1–1.5 million housing units, which is equally in its number to around one-quarter of the country's total housing stock (PADCO, 2006; Iraqi Ministry of Construction and Housing, 2017; Majdi, 2013).

Looking at the housing conditions shows that around 79% of Iraqis own their houses (Central Statistical Organization, 2014a, 2014b; The World Bank, 2011). However, a high percentage of them leave in inappropriate conditions. In Baghdad, the capital, it is currently estimated that around 187,000 units, representing around 31% of the city's housing stock, are inappropriate (Dawood, 2017). The housing shortage, the scarcity of serviced urban lands and lack of construction materials have led to increase the housing costs (Ali and Faiadh, 2014; Iraqi Ministry of Construction and Housing, 2010; Majdi, 2013). The average construction costs per square meter increased from ID 49,600 in 2002, to ID 550,000 in 2012 (Mohammed and Hamza, 2015). With a poverty level of around 22% (Al-Sa'ady, 2013) and inefficient financial system, offering a house with these prices has become extremely difficult for most people. It is estimated that the house price to household annual income ratio is 6.75 (The World Bank, 2011). Within these circumstances, the informal housing has been growing in the country; in Baghdad, between 2004 and 2010, the number of informally constructed units, around 24,000 units, exceeded the number of the formally constructed ones, which was around 22,000 units (Dhabia et al., 2014). A similar situation can be seen in other cities such as Basrah (Al-Othman et al., 2009) and Hillah (Naser and Abaas, 2018).

Within the efforts to manage these problematic conditions, the Iraqi National Housing Policy was issued in 2010 and updated in 2017 by the Iraqi government incorporation with the UN. The new policy advocates for a new approach to managing the housing sector. After decades of intensive public sector intervention in the housing sector, the new Policy calls for having private sector-led housing production. Within this broad framework, one of the policy's suggestions to manage the problems is to develop new innovative architectural solutions with considering satisfying people preferences and providing efficient and affordable housing production (Iraqi Ministry of Construction and Housing, 2010, 2017). Considering this suggestion requires defining the possible alternatives and determining their potential adequacy in addressing the housing requirements. Although there are some assessment studies that have been conducted in the country, they are all limited in their scope. There has been no holistic and comprehensive analysis of the possible alternatives' adequacy. Looking at defining the main potential architectural solution framework,

this research focuses on assessing the possible building patterns and construction approaches to conclude a solution for the country. They have a significant impact on construction time and cost, and the resulted buildings quality (Teige, 2002; Urban, 2012; Walliman, 2007).

2. Housing requirements and possible architectural solutions in Iraq

As a first step towards defining adequate architectural solutions, this study explores and defines the housing requirements, the possible architectural approaches and what has been done by previous assessment studies.

2.1. Defining the housing requirements

Judging architectural solutions' adequacy depends on their ability to satisfy a set of requirements (Davis, 1977). In Iraq, according to the National Housing Policy, any solution should respect two categories of requirements: Iraqis' residential preferences and current problematic housing conditions requirements. The former includes a set of preferences that affect people acceptability of the proposed solution. They include technical, spatial, environmental, economic, social and psychological preferences (Abod et al., 2011; Mahmood, 2011). Regarding the latter, the housing sector problems that should be considered are the low housing production rate, scarcity of urban land, insufficient financial resources, inefficient infrastructure services and lacking construction materials (Iraqi Ministry of Construction and Housing, 2010; PADCO, 2006). This classification of these two sets of requirements is shown in (Table 1). Failing to respond to people preferences or the current housing problems may lead to failure or problematic housing developments. This has happened in some developments in other countries such as Ballymun development in Ireland (Ballymun Regeneration Ltd, 2008), Pruitt Igoe housing project in the USA (Kolodny, 1980) and Les Minguettes project in France (Power, 1997). Aiming at developing successful housing designs, this study assesses possible alternatives' adequacy in addressing each of the defined requirements.

2.2. Exploring the possible architectural approaches

Existing construction approaches in Iraq are the Bespoke housing, the Self-help housing, and the Mass housing. For the period between the 1980s and the beginning of the 2000s, the first approach was responsible for producing around 60% of the housing production. Self-help housing, with various ranges of occupants' involvement in the construction, came in the second place by producing around 30%. The mass-housing was the least effective one; its share was only around 10% (Iraqi Ministry of Planning, 2010; PADCO, 2006). Currently, the situation is mostly the same. A limited share of the production is mass housing projects developed by the Iraqi government and some private investors. The Bespoke housing is the dominant production

Table 1 Housing requirements in Iraq.Source: (Abod et al , 2011 [1]; Mahmood, 2011 [2]; AL-Temimi and Al-Saidi, 2014 [3]; Karofa et al 2011 [4]; Shukur and Hameed, 2004 [5]; Mohammed , 2012 [6]; Yusif et al , 2010 [7]; Central Statistical Organization, 2014a, 2014b [8]; Iraqi Ministry of construction and Housing, 2010 [9]; Takim and Akintoye, 2002 [10]; Atkinson, 1999 [11]; PADCO, 2006 [12]; East Asia and Pacific Region/Urban Development Sector Unit , 2008 [13]; Nagy, 2006 [14]; The higher committee for proverty reduction policies, 2009 [15]; Al-juboori, 2015 [16]; Hyde, 2013 [17]; Kubba, 2012 [18]; Juma and Abdul Hussein, 2011 [19]; Al-Saadi, 2012 [20]; Al-Khafaji, 2001) [21].

Iraqi preferences	Technical preferences[1], [2]	Providing safe structure
		Providing sufficient infrastructure services.
	Spatial preferences[1], [3], [4]	Providing sufficient total area
		Providing sufficient rooms
		Providing flexibility and adaptability
	Indoor environment preferences[1]	Considering temperature, humidity, ventilation, lighting and sound
	Economic preference[1], [2]	Reducing the Initial costs
		Reducing the running costs
	Social & Psychological preferences[5], [6], [7]	Providing privacy
		Providing aesthetic outside form
Housing conditions requirements	Housing production requirements[8], [9], [10], [11]	Increasing housing production rate
	Land management requirements[12], [13]	Increasing land use efficiency
	Economic requirements[7], [12], [14], [15]	Reducing the Initial costs
		Reducing the running costs
	Infrastructure requirements[12], [16], [17], [18]	Reducing energy consumption
		Reducing water consumption
		Reducing infrastructure development efforts
	Construction materials requirements[12], [19],	Increasing materials use efficiency

Bespoke single family house

Mass construction of mutli-family buildings

Informally self-built houses

Fig. 1 Examples of the adopted construction approaches in Iraq, A. Bespoke single family house, B. Mass construction of mutli-family buildings, C. Informally self-built houses.

approach (Fig. 1) (Iraqi Ministry of Construction and Housing, 2017, pp 3, 17). Self-help housing in urban areas is mostly used in informal construction activities where buildings have been poorly constructed (Mohammed and Hamza, 2015; Naser and Abaas, 2018). Through exploring its efficiency in other countries, many studies advocate adopting this approach in a wider range to solve the problems (Dhabia, et al, 2014).

Building patterns, on the other hand, according to the Iraqi Housing Manual, are two: the single family housing and the multi-family housing. The former includes detached housing, courtyard housing, semi-detached housing and row housing. The latter pattern includes low-rise buildings, mid-rise buildings and high-rise buildings. Regarding their heights limits, they are not defined by the Iraqi Manual

(State Commission for Housing, 2010, pp. 3-33) Accordingly, for the assessment purpose, this study considered a widely internationally used classification, which defines low-rise buildings to be of 3-4 storeys, mid-rise buildings to of 4-8 storeys and high-rise buildings to be above 8 storeys (Goody et al., 2010; Loren, 2007). A graphical description of each of these patterns is in Fig. 2.

Regarding the current construction practice in the country, there are no statistics about the specific use of each of these patterns. However, general construction statistics surveys clearly indicate that the single family housing is the most dominant building form. Multi-family housing represents limited share of the newly built housing units. In 2016, the total number of built singly family houses were 6800 houses, whilst the
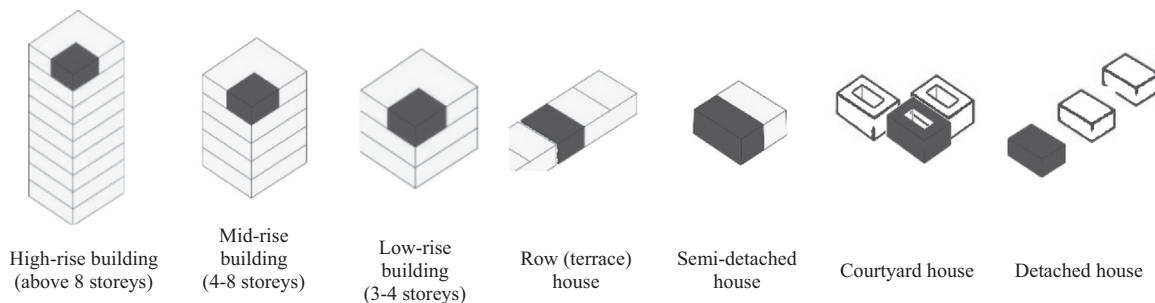
Fig. 2 Housing patterns in Iraq.

Table 2 Previous literature' definition of the available alternatives' adequacy. Source: (Mohee, 2011 [1]; Al-Hussaini, 2015 [2]; Abbood et al., 2015 [3]; Afif, 2013 [4]; Al- Korayshi, 2006 [5]; Al-Khafaji, 2016 [6]; Mula-Huish and Jumaa, 2008 [7]; Ibrahem, 2012 [8]; Al-Kenani et al., 2014 [9]; Mahmood, 2011 [10]; Abdul-Kader, 2012 [12]; Al-Jameel and Al-Hafith, 2012 [13]; Mustafa and Hassan, 2010 [14]; Al-Thahab et al., 2014 [15]; Shaheen and Ahmad, 2011 [16]; Al Jawadi, 2011 [17]; Mohammed, 2010 [18]; Ali, 2012 [19]; Agha, 2015 [20]; Kareem, 2009 [21]; Mahmood and Yosif, 2004 [22]; Al-Khafaji, 2003 [23]; Nihad et al., 2010 [24]; Abod et al., 2011 [25]).

Evaluation criteria		Building patterns and construction approaches in Iraq									
		construction approaches			Building patterns						
The requirements fields	The required features	Self-help housing	Bespoke housing	Mass housing	Detached	Semi-detached	Terrace (Raw)	Courtyard	Low-rise	Mid-rise	High-rise
Iraqis' preferences											
Technical requirements	Being safe structure	-	-	-	-	-	-	-	-	-	-
	Providing efficient services	-	-	-	-	-	-	-	-	-	-
Internal layout requirements	Providing sufficient rooms	-	-	-	-	-	-	-	-	-	-
	Providing sufficient total area	-	-	-	-	-	-	-	-	-	-
	Providing the ability for modification	-	-	-	-	-	-	12,13,14,15	-	-	-
Indoor environment requirements	Providing suitable indoor environment	-	-	-	-	-	-	13,16,17,18,19,20,21	-	-	-
Psychological requirements	Having Beautiful outside form	-	-	-	-	-	-	16	-	-	-
	Providing Privacy	-	-	-	22	15	15	13,14,15,16,22			
Economic requirements	Reducing the initial costs	-	23	7,2,10	-	-	-	12	2,7,8,13	8,13	8,13
	Reducing the running costs	-	-	-	-	-	-	12,17,19,21	-	-	-
Current housing problems' requirements											
Housing production efficiency	Having efficient housing production	-	23	-	-	-	-	-	2,13	13	13
Land use efficiency	Increasing land use efficiency	-	-	7,2,10	2	2	2	12	2,5,7,8,13	8,13	8,13
Infrastructure use efficiency	Reducing the effort to provide the infrastructure services	-	-	-	2	2	2	-	2,5,8,13	8,13	8,13
	Having efficient energy consumption	-	-	-	-	-	-	13,17,19,21	-	-	-
	Having efficient water consumption	-	-	-	-	-	-	-	-	-	-
construction materials use efficiency	Increasing construction material use efficiency	9	23	-	-	-	-	-	-	-	-
Housing affordability	Reducing the initial costs	-	23,,24	7,2,10	-	-	-	-	2,5,7,8,13	8,13	8,13
	Reducing the running costs	-	-	-	-	-	-	12,17,19,21	-	-	-

The key	Negative Impact	Positive impact	Undetermined impact
	A housing pattern or construction approach negatively affecting satisfying a housing requirement.	A housing pattern or construction approach positively affecting satisfying a housing requirement.	- The impact of housing patterns and construction approaches on satisfying requirements has not been investigated by studies.

The numbers in the boxes refer to the reference number which can be found below as sources.

total number of constructed multi-family buildings were only 11 (Central Statistical Organization, 2016). Within the single family pattern, the row pattern has been the most used one due to urban lands scarcity and economic constraints (Fig. 1A) (Al-Sadkhan and Alaa-eldein, 2013).

2.3. Previous assessment studies

There have been a number of assessment studies that have had extensive efforts to determine the adequacy of various residential projects in Iraq in addressing specific housing requirements (Table 2). Exploring these studies shows that they have concluded some aspects of some of the possible alternatives. However, there has been no study that aimed to assess the possible architectural approaches' overall adequacy in satisfying the whole range of housing requirements in the country.

3. The research objective and methodology

This study's objective is to help in solving the housing issue in Iraq with a special focus on the architectural field. Architecturally, there may be various ways to get an efficient housing production and better quality results. This research focuses on investigating and assessing building patterns and construction approaches for their role in defining the main architectural solution features and their significant impact on the resulted housing developments. The study determines which of the possible alternatives has the higher potentiality to satisfy the defined range of housing requirements to be concluded as a solution.

To achieve this, the study adopted a hybrid research methodology. First of all, it conducted an extensive literature review to define the possible alternatives, the housing requirements and what has been concluded by previous studies. For the assessment purpose, it conducted two surveys: public Iraqis survey and experts in the housing sector survey. The aim of the surveys was to assess the various alternatives' ability in satisfying each of the defined housing requirements.

3.1. Assessing architectural approaches' adequacy

To achieve its aim, this study conducted two surveys: public Iraqis survey and experts in the housing sector survey. The former was directed towards public Iraqis. It included questions that aimed to determine people's residential priorities and preferences. The latter was directed towards experts in the Iraqi housing sector. Its aim was to get a professional assessment of the various alternatives' adequacy in addressing the defined requirements. This was also supported by information from the Iraqi National Housing policy. The integration of these three resources enabled the research to achieve its aim (Fig. 3).

3.2. Delivering and collecting the surveys' questionnaire forms

To have high coverage and representativeness, the surveys' questionnaire forms were delivered and collected electronically (Sekaran and Bougie, 2013). This enabled the researcher to contact people and to get responses from all of Iraq, which is difficult to be done personally, due to study limitations and the current unstable conditions in the country. In the case of the public Iraqis survey, an electronic version of the survey was prepared using Google Forms. Then, a web-survey link was sent to potential Iraqi respondents using their Facebook accounts (Fig. 4). This has been found as the most efficient available way to contact people remotely. In the second case, an electronic version of the survey forms was sent to a selected number of Iraqi experts in the housing sector through their emails. Both of the two surveys included information sheets, which explain to participants the subject of the study, the aim of the survey and how their responses will be treated.

3.3. Sampling

As the study's surveys included two groups of participants, two samples were designed to define the participants. They are as followings (Table 3):

- For the Public Iraqis survey: the total study population is the adult Iraqis, which are currently around 20.6 million. The sampling frame was the Iraqi users of Facebook. The snowball sampling technique was used. This sampling method includes selecting the first set of participants, which was done randomly in this study, and asking them to participate and then to suggest or recruit another set of participants, who may do the same role until the required threshold achieved. This sampling technique
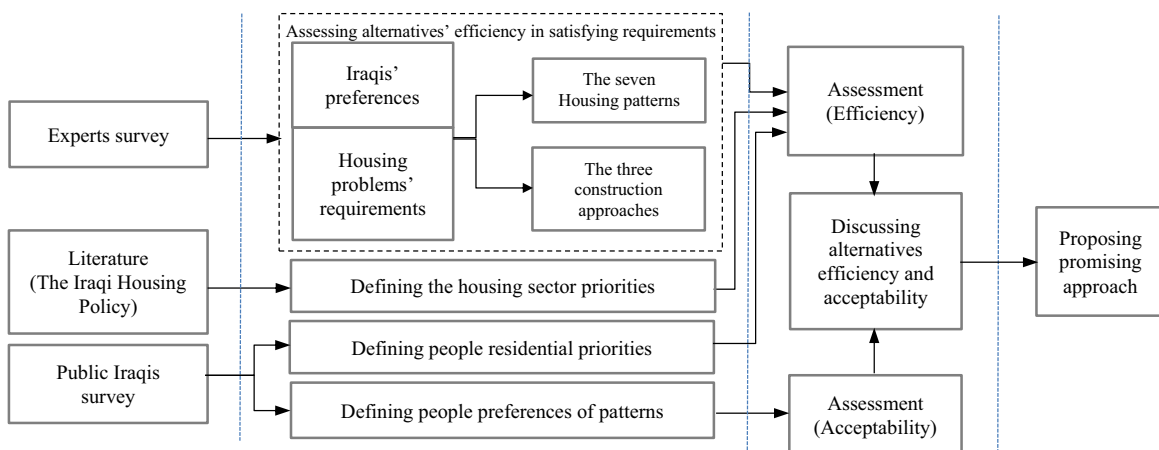

Fig. 3 The survey work plan and components.

Fig. 4 Screenshots from the used online survey.

Table 3 Defining the study samples.

Sample design	The survey	
Total population	20.8 million people	20 people
Sample size	384	20
The number of people to be contacted	Up to 4000	20
The sampling technique	Snowball random sampling	Purposive sampling

gives an equal opportunity to each of the potential participants, which help to get higher sample representativeness and more confident results (Kothari, 2004; Robson, 2011). The sample size was determined depending on a standard formula used to determine samples size (formula 1) (Kar and Ramalingam, 2013). With 95% confidence level and 5% Standard of error, the required size was 384 participants. To guarantee having the required threshold, up to 4000 forms were planned to be delivered.

$$n = \frac{Z^2 p(1-p)}{d^2} \quad (1)$$

Where: n: the sample size, Z: Value of normal deviate (To be got from standard tables depending on the confidence level), p: Expected prevalence of the event in the population (if unknown, 50% is used as it is the most conservative value), d: the margin of error.

- For the experts survey, participants were selected through the Purposive sampling, which includes selecting participants by the researcher depending on specific criteria. This method was the appropriate one in this survey because the aim was to get a specific kind of information that cannot be offered by random people (Sekaran and Bougie, 2013; Robson, 2011). The selection criteria included selecting people who have more than 10 years' experience in the field of housing design and construction or have done studies about housing designs in Iraq.

3.4. The survey validity and reliability

For the validation purpose, the research considered face validity and content validity. prior to conducting the survey, a number of interviews and a pilot study were conducted with public people and experts, including a recently retired general manager in the Iraqi Ministry of Planning. The questions were put and fined according to the interviews and the feedback of the Pilot study. The aim was to make sure that the questionnaire design and questions were easily readable, quickly answered and can achieve the aim of defining Iraqi's residential priorities and preferences (Block, 2006; Christodoulou et al., 2015; Webb, 2002). Criterion validity and construct validity were not considered as there is neither relevant standard questionnaire nor expected hypotheses.

To assess the survey reliability, internal consistency test and test-retest techniques were considered. The former implied using Cronbach's alpha coefficient to measure the efficiency of the survey in achieving its aims. IBM SPSS statistics 24 was used to do this reliability test. The results showed that Cronbach's alpha coefficients for the public survey and the experts survey were found to be, respectively. 0.904 and 0.709. This confirmed the reliability of the used surveys. The test-retest reliability technique is used to confirm the consistency of the results through time. It requires administrating the same survey twice in two different times and measures the results agreement (Aday and Cornelius, 2011; Sauro and Lewis, 2012). This was not possible to be done in the public survey as participants were anonymous. It was also not justifiable to redo the experts survey as responses were supposed to be established objective judgments by experts, not subjective changeable opinions. However, to have an indication of the results consistency, the concept of test-retest was considered. The public survey was re-conducted around a year and a half following the first survey using the same approach and sampling technique. The results of the two surveys were compared. The comparison shows that results are highly agreed in defining Iraqis' housing priorities and preferences (See Section 4).

3.5. Defining the measurements

Depending on the two surveys, alternatives' adequacy levels were determined according to their ability to satisfy each of the residential requirements. This was done using a set of formulas developed by this study. The final assessment of each alternative's adequacy is the sum of all of its adequacy scores in addressing all of the defined requirements. Part of the assessment, as the housing requirements are different in their importance level, was to determine and include residential requirements priority in the assessment equation. Furthermore, this study worked on defining Iraqis' preferences of the defined alternatives to examine the correspondence between the alternatives' adequacy and people's preferences.

Accordingly, the defined building patterns and construction approaches' adequacy was determined by formula (2). The higher score is the higher adequacy in addressing the housing requirements.

$$ACE = EA1 \times IL1 + EA2 \times IL2 + EA3 \times IL3 + \ldots \ldots \quad (2)$$

Where: ACE: Architectural pattern/construction approach adequacy. EA: Experts average evaluation for each architectural pattern/construction approach in addressing each of the housing requirements. IL: The importance level of each of the housing requirements.

Regarding determining each housing requirement importance level, as they are of two types, people preferences, and housing sector requirements, they were determined in two ways. The former importance level was measured by formula (3). The result of the formula shows a value for each residential requirement on a scale of $(1 - 10)$. The higher score is the higher level of importance.

$$IL = \frac{PE}{PN} \quad (3)$$

Where: IL: Residential requirements importance. PE: Public Iraqis' total assessment score (From the public Iraqis survey). PN: Total number of public participants.

The latter importance level was determined depending on the order that has been defined by the Iraqi National Housing Policy using the same scale of people priorities (Table 4). This study did not depend on its survey because it considered that the Policy gives a more reliable view than

individuals, as the Policy was prepared by the Iraqi government and the UN with considering the country's conditions and various relevant interrelated factors (Iraqi Ministry of Construction and Housing, 2010).

Finally, determining Iraqis preference for each of the defined building patterns and construction approaches was done through formula (4). The assessment depended on the public Iraqis survey in which participants were asked to define their first three preferred patterns by assigning values on a scale of $(3 - 1)$.

$$ACP = \frac{PP}{PN} \quad (4)$$

Where: ACP: Architectural pattern and construction approach preference. PP: Public Iraqis' total preference score. PN: Total number of public participants.

4. Results and discussion

A total number of 410 people and 14 experts responded in the actual survey and 92 in the test-retest survey. In both cases, participation has been from all over Iraq (Fig. 5). The results of both surveys are highly agreed in term of Iraqis' residential priories and pattern preferences. The results are presented in two groups: general public's assessment and experts' assessment.

4.1. General public's assessment

This set of results shows Iraqi's preferences and assessment of the possible alternatives:

- Iraqis' first three residential priorities are to have a comfortable indoor environment, to have a safe structure and to provide privacy (Fig. 6).

- The first three most preferred architectural patterns by Iraqis are single family patterns. A simple difference between the actual survey and the validation survey was found, which is about the third preferred pattern. However, this does not imply a major difference in the results. Regarding the construction approaches, the most preferred one by people is the Bespoke housing (Fig. 7).

Table 4 The considered values to define the housing sector requirements priority.

Housing problems' requirements		The level of importance (points)
Housing production requirements	Reducing the construction time	10
Land use requirements	Increasing land use efficiency	8
Economic requirements	Reducing running costs	6
	Reducing initial costs	
Infrastructure requirements	Reducing energy consumption	4
	Reducing water consumption	
	Reducing infrastructure development efforts	
Construction materials use requirements	Increasing construction materials use efficiency	2

Note: the assigned values are based on the researcher's assumption, which depends on the Iraqi National Housing Policy definition of housing sector priorities. Although it may not be true that, for instance, housing production if five times more important that construction materials, it was important to assign these values to indicate the alternatives adequacy. The scale of (1-10) is used to be similar to the used scale in determining people's residential priorities to keep a balance between the two requirements categories.
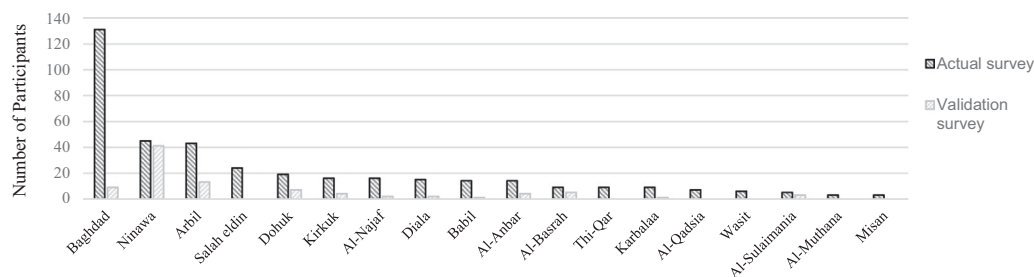
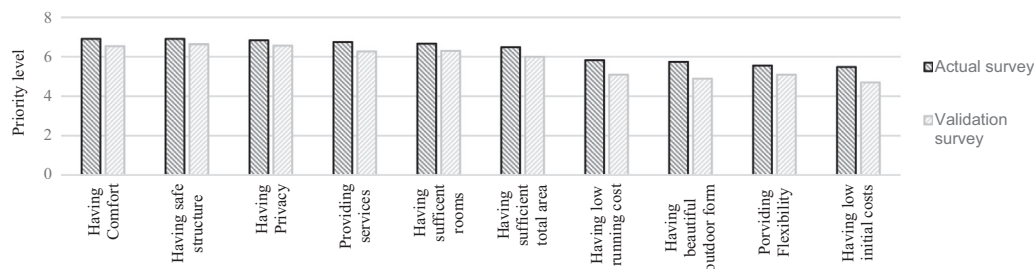**Fig. 5** The respondents' number and distribution in the public survey.

Fig. 6 Iraqis' residential priorities.

4.2. Experts' assessment

- On the first hand, the bespoke housing has been defined to be the efficient approach to satisfying people preferences. The mass housing, on the other hand, has been defined to have the highest response to the housing sector requirements (Fig. 8).

- Overall, the single family detached, semi-detached and courtyard patterns, respectively in descending order, have been defined as the most appropriate architectural patterns in satisfying people preferences. The High-rise, Mid-rise and Low-rise buildings, respectively in descending order, have been defined as the most three straightforward architectural patterns in addressing the housing sector requirements (Fig. 9).

- Having a more detailed analysis shows that each of the architectural patterns has been defined to be the most appropriate one in addressing a specific residential requirement. In the graph (Fig. 10), the higher achieved score is the higher satisfaction of the housing requirements. The $(1-30)$ scale is used because (30) is the highest calculated score in the alternatives assessment.

4.3. Results discussion

This study explores and assesses the possible building patterns and construction approaches adequacy and determines Iraqis' residential priorities, which has not been done by previous studies. The results indicate the overall potential alternatives' adequacy is satisfying the whole range of housing requirements in Iraq. On one hand, they demonstrate that the bespoke construction of single family housing is the most preferred for Iraqis and adequate to satisfy their preferences. On the other hand, the mass construction of

the multi-family buildings is the adequate to satisfy current housing sector requirements, but, it is the least preferred one by people. These results highly agree with the previously explored assessments and have reasonable interpretation. The bespoke single family housing offers higher potentiality to satisfy occupants' individual preferences, but it imposes higher expenses (Davis, 1977; Teige, 2002; Shin et al., 2008; Walliman, 2007). The mass construction of multi-family housing is an economic pattern, but it offers low ability to satisfy occupants' individual requirements (Davis, 1977; Habraken, 1972; Teige, 2002; Urban, 2012). This means that, for the Iraqi case, none of the basic buildings patterns (Fig. 2) and construction approaches (Fig. 1) can be used to address the housing requirements.

Having this result agrees with one of the main defined housing challenges by the updated Iraqi housing policy in 2017. Whilst the mass constructing of multi-family buildings can be an efficient solution for the housing sector problems, it is disliked by the Iraqi people. Exploring the reasons behind this attitude shows that, although Iraqis appreciate its economic advantages, its design constraints satisfying their requirements of having sufficient living area and privacy and abilities to make modifications in their dwellings (Mahmood, 2012; Shaheen and Ahmad, 2011). These requirements in addition to having a private open space for families' activities have been the Iraqis' main preferred features in the bespoke single family housing (Mutlak and Al-Zubaidi, 2017). However, studies show that because of the current housing needs, including reducing the initial and running costs, Iraqis have highly reduced their areal expectation and preferences (Al-Sadkhan and Alaa-eldein, 2013).

In the previous literature, there has been no effort to deal with the stated contradictions to find a holistic solution for the various housing issues. Building on its results, this study suggests that there should be a specific combination of the preferred bespoke single family housing and the disliked but efficient mass construction of the multi-family
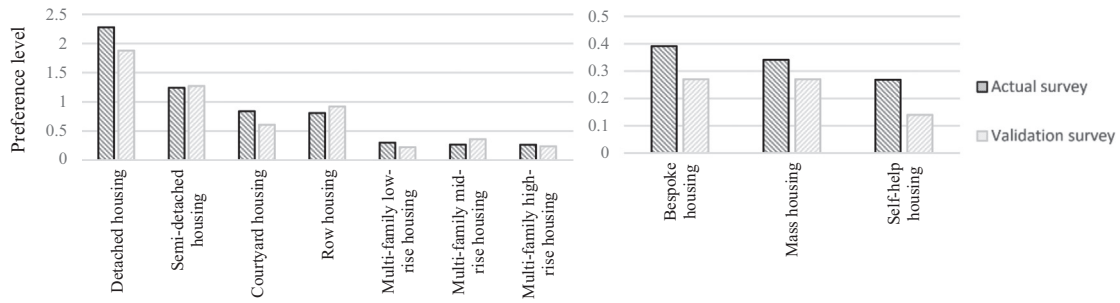
Fig. 7 Iraqis' preference of architectural patterns (to the left) and construction approaches (to the right).
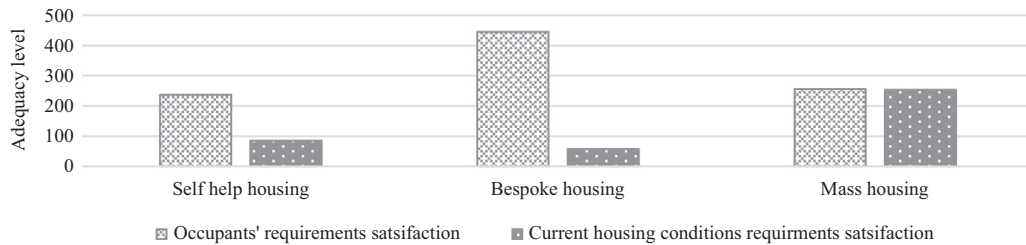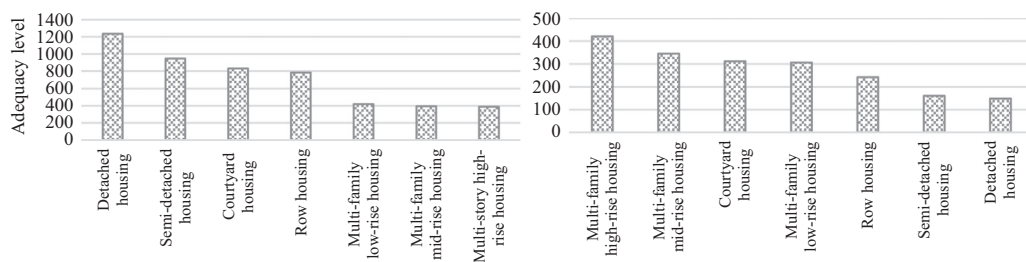

Fig. 8 Construction approaches efficiency.

Fig. 9 Architectural patterns' adequacy in satisfying people needs (to the left) and housing sector requirements (to the right).
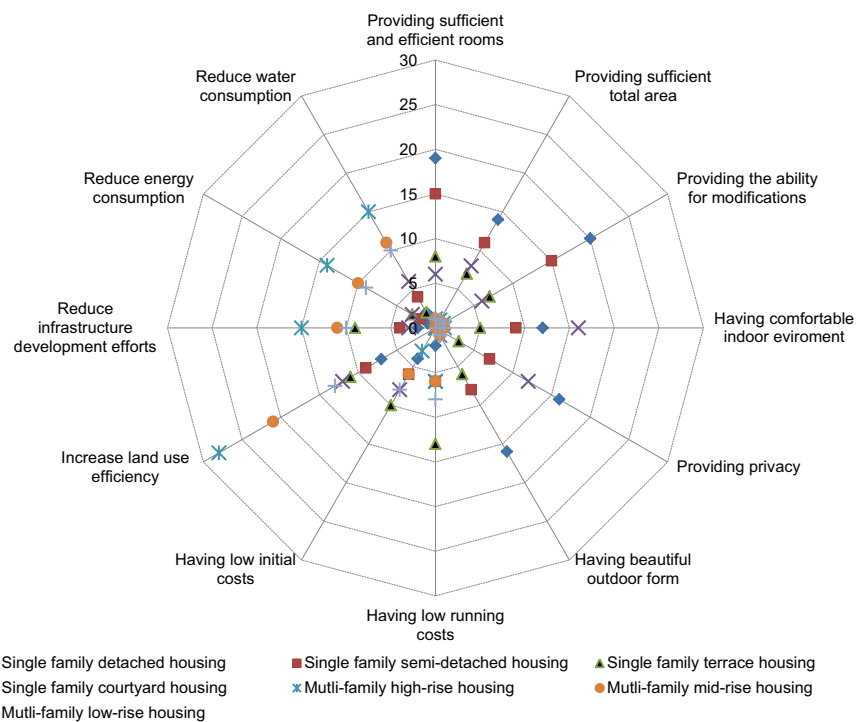

Fig. 10 Architectural patterns' adequacy in satisfying the various requirements.
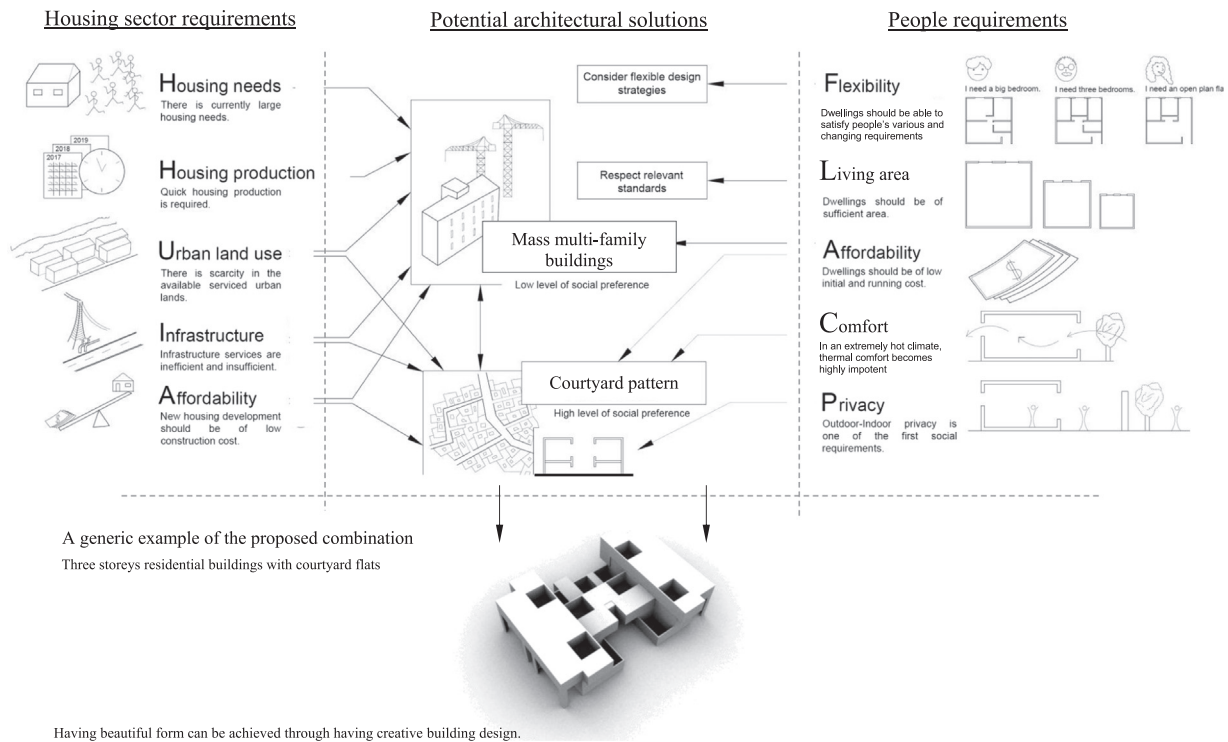
Fig. 11 A specific combination should be considered to have an appropriate and efficient architectural solution.

housing (Fig. 11). Such combination should imply introducing the former's advantages in the latter. Within the context of multi-storey buildings, considering providing a high level of flexibility and people's spatial needs in the flats help to offer some of the preferred bespoke single family housing's features. Having this said, it may be important to review the Iraqi relevant standards to make sure that they satisfy people's requirements. An essential element to support this solution is to introduce the courtyard, as it helps to offer a high level of privacy, affordability, efficient environmental performance, and a private open space for occupants.

This study proposes to consider these results and the proposed solution framework as a starting point towards developing successful architectural solutions. They are based on this study's surveys and supported by the literature review. Although it may be said that the survey's results represent only the preferences of the higher economic level in the Iraqi society, who has access to the internet, they reflect valid picture about what is needed in the country. First, the assessment of the alternatives depended on the experts' evaluation, which enables the research to get an objective and holistic assessment of the defined alternatives. Second, public Iraqis survey's participants give a more valid assessment than people of low economic levels. The reason is that the latter group of people may ignore their long term needs and preferences as they may focus only on their urgent needs, which may give false assessments. Apart from this, people's urgent needs in the country have also been considered, as this research examined the current problematic housing conditions requirements, which reflect people urgent needs.

5. Conclusions and recommendations

One of the solution fields to address the Iraqi housing problems is to develop innovative architectural solutions, which should consider the housing sector's problems and people's preferences. Adopting incorrect alternatives may lead to a failure in achieving the housing developments' aims. This study assesses possible alternatives' adequacy and suggests an architectural solution that can be used to address all of the various housing requirements in Iraq, which has not been done before. Looking at the main architectural solutions' framework, this study assessed the possible building patterns and construction approaches adequacy in addressing the housing requirements. The investigation reveals that the mass construction of multi-family housing is the efficient approach to satisfy the current problematic housing conditions requirements. However, this approach is the least preferred one by Iraqis and the least adequate one in satisfying their preferences. Iraqis' preferred approach and the most appropriate one in satisfying their preferences is the bespoke single family housing, especially the detached pattern. Yet, it is the least efficient one in addressing the current housing challenges. This implies a high level of contradiction and limits the possibilities of using a specific direct architectural solution. To deal with this challenge, this study's results indicate that a possible solution is to have a combination of the single family housing and the multi-family housing. The suggested approach is to use multi-family residential buildings of courtyard flats. Having this kind of combination may help to have architectural solutions that are efficient in satisfying the current problematic housing conditions and people preferences.

Following this study, future research can include testing the acceptability and the applicability of the proposed solution or defining its detailed design parameters to address each of the housing requirements. At this time, the author's research efforts focus on investigating and defining the efficient design parameters to achieve energy and environmentally efficient buildings. To take this solution forward, studies are needed on two sides. On the first side, architectural designs' abilities to satisfy the defined housing requirements need to be investigated. This might include investigating possible architectural approaches to achieve flexible residential buildings, affordable projects, a high level of privacy, and efficient use of materials, urban land and energy. On the other side, it is important to deeply investigate Iraqis' residential needs and to review and updated current relevant Iraqi standards. This might include investigating issues that affect architectural design decisions, such as, defining Iraqis' areal needs, thermal comfort limits, energy consumption and financial abilities. Having this done will enable to have highly definite housing needs, appropriate standards and responsive architectural designs, which will lead to having efficient and acceptable housing developments.

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