



# The Effects of Incremental Housing Approach on The Level of Residential Satisfaction

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## Abstract

Housing has always been regarded as one of the basic human needs and initial rights and its related costs contain a significant portion of the household's income. Providing affordable housing for low-income groups in many countries, including Iran, is the task of the government and other supportive institutions. In this regard, the Iran's government recently actions have more focused on the quantitative dimensions of housing production and qualitative issues, which are the main factors of residential satisfaction have less been considered. This paper investigates the effects of the incremental housing approach on the level of residential satisfaction in affordable housing projects. The research method is descriptive-analytic and data were collected through the case study. The results show that influenced indicators by the incremental housing approach including land and building ownership, providing technical and spatial basis for future development, quality improvement, and strengthen the social interactions among the residents, beside site design related indicators, including anticipation of the neighborhood units with proper pattern of activities are the most important factors of residential satisfaction. High residential satisfaction lead to bring a sense of belonging to the place and in upper level the social sustainability in

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the residential environment. Therefore, in order to increase the efficiency of the positive aspects of this approach, a model for determining the stages of work and necessary actions has been designed.

## INTRODUCTION

Housing is a basic human need also; it is a basic human right and one of the most important issues that humans have always been struggling with and trying to find a proper and reasonable answer to this problem (Satarzadeh, 2009). In Islamic culture and architecture, house is where the divine effects appear (Vasigh, Pashtoeizadeh, & Bemanian, 2009) Housing issue should be addressed beyond the functional needs of the occupants. In fact, in every civilization, cultural beliefs and values are passed among the generations through the housing architecture (Seo, 2012). The main function of each building as a part of the architectural culture is to objectify a thought (mentality) by its particular container and in this way, this container will be used to measure this culture, so each building is a cultural witness (Memarian, 2014). In this regard, the design and construction of housing has long been the manifestation of the architecture of every civilization and ethnicity. Housing has the most effects on historical, cultural, social, and environmental contexts in comparison with other uses (Ebrahimi & Eslami, 2010). Its formation depends on some factors like culture, economy, lifestyle, and construction methods of the community (Tabibian & Mansouri, 2013). In addition, it is a determinant factor in creating cultural relation among different generations in a society and influences the direction of culture, lifestyle, social relations, and aesthetic choices of the community members. In Iran, housing has been the arena of architect's art in various historical periods and has followed the cultural and climatic features of its context and economic conditions of its occupants.

Today, housing design and construction is a major part of any construction activities around the world. In Iran, the growing population, increasing in rural-to-city migration rates, reduction of household size (Table 1), and increasing the young population of the country, as well as deterioration and lack of primary necessities in some settlements are the major factors of the country's need for housing production in the recent years. Therefore, in the fifth development plan of the country, inspired by the Iran's 20-year vision plan document and the housing master plan, the improvement of worn-out urban fabrics and promotion of housing quality alongside increasing housing production has been introduced as a general plan of the country (IMRUD, 2017b). According to the Iran housing master plan there is a need for an annual production of one million housing by 2025.



Half of this amount is related to the renovation of houses in identified worn-out urban fabrics (Table 2) (IMRUD, 2017a). These areas often include low-income groups that providing affordable housing for them is of the government's duties. In Iran, this task is borne by the Ministry of Roads and Urban Development and other supportive institutions that provide necessary basis by defining affordable residential projects. In recent years, the Mehr housing plan has been an attempt to provide housing for low-income groups in a remarkable scale. The quantity of housing production was the priority of this plan. In addition to the criticisms that have been made in the field of locating and supplying infrastructures (Ghasemi & Ozay, 2018);(Etminani-Ghasrodashti, Majedi, & Paydar, 2017), the development goals of the 20-year vision plan document, which are based on cultural, geographical and historical basis of the country and ethical principles and Islamic values have not been addressed in mehr housing projects.

**Table 1.** Population and Family Changes in Iran during, 1986-2016 Source: (SCI, 2016)

Year	Man (%)	Woman (%)	Family	Average Household Size
2016	50/67	49/33	24196035	3.3
2011	50/44	49/56	21185647	3.5
2006	50/88	49/12	17501771	4
1996	50/81	49/19	12398235	4.8
1986	51/13	48/87	9673931	5.1

**Table 2.** Housing master plan targets by assuming economic growth of 5.4% per annum (thousand units) Source: (SCI, 2016)

Description	Supply of new households	Housing shortage compared to households	Need renovation	Total required construction	Gradual improvement
Total	3649	397	3828	7874	1500
Urban	3570	-	2193	5763	-
Rural	79	397	1635	2111	-

The design of these projects have often been developed with the sole focus on locating the maximum residential units in a piece of land. Due to acceleration of the process, necessary studies for identifying the needs of target groups have not been carried out, so the final products have not been adapted to the climatic conditions and cultural characteristics of their habitat (Mohseni, 2012). Even with the assumption of providing necessary urban infrastructures in future plans, the above items will lead to

problems in meeting the mental and functional needs of the occupants. The most important challenges in providing affordable housing in developing countries are economic problems caused by high land and building materials prices and inadequate allocations of loans (Atamewan & Olagunju, 2017). In most of the turnkey low-income housing projects, the final product is usually not able to meet the diverse needs of the households, so in long term, the occupants are forced to leave the house, instead of improving the space of it. This moving costs too much for the households and is against the intended goals of achieving sustainability, especially in the social sphere. The intended plans for quantitative development of housing in Iran by the year 2025 contain almost one third of the existing residential buildings. Considerable amount of this development is devoted to the affordable housing projects that shows the importance of doing practical researches in order to achieve proper design and construction methods in this field. Therefore, in this paper the effects of incremental housing approach on the level of residential satisfaction in affordable housing projects have been investigated. The main objective of this paper is to achieve strategies in the field of design, planning, and construction to improve the quality and increase the level of satisfaction in affordable housing projects. The research questions are as follows:

What are the effects of incremental housing approach in the various dimensions of residential satisfaction?

What design and construction measures should be taken in order to develop the level of residential satisfaction in incremental housing projects?

How should the spatial structure of the Iranian incremental housing be in different steps of development?

#### **LITERATURE REVIEW**

Happiness, life satisfaction and the real security of housing just can be earned when the human's heart and soul are safe from anxieties and everyday concerns (Ahmadi Disfani & Aliabadi, 2011). Human needs include basic needs relate to the environment, well-being, security, health, as well as psychosocial needs relate to the concepts of privacy, personality, identity, territoriality, aesthetic and social relations (Asefi & Imani, 2016). Therefore, regardless of economic issues that play an important role in housing provision for low-income groups, providing necessary qualities to improve living conditions in residential environments and obtaining user satisfaction are so important. Empirical studies on residential satisfaction introduce two general approaches in this field. The first approach considers



residential satisfaction as a predictor of the resident's behavior about staying a home, or moving to another one (Adriaanse, 2007). The second approach describes residential satisfaction as a criterion for assessing the quality of home and introduces some indicators like length of residence, ownership status, physical features of the home and neighborhood, the possibility of establishing effective social relations among neighbors and the social conditions and characteristics of the neighbors (Galster, 1987); (Adriaanse, 2007). Subsequently, residential satisfaction is related to the three factors of the home, neighborhood, and neighbors.

The growing demand for affordable housing in most developing countries has faced governments with serious challenges in responding to this need. In this regard, in the research carried out by Wallbaum et al. (2012), challenges such as resource scarcity, lack of adequate budgets, shortages due to high demand, lack of skilled labor and final product low quality as well as system inefficiencies and lack of added value are mentioned. In response to these challenges, the following strategies have been proposed:

- Improving the production methods to increase the efficiency of using existing resources.
- Reducing the initial cost of housing construction.
- Inventing new techniques of construction and removing unnecessary administrative processes to speed-up project execution time.
- Prioritizing construction technologies that can be implemented by local workers.
- Using prefabricated systems to reduce waste of resources during the construction process.
- Using collaborative design methods to provide proper housing for applicants.

The results of the above research suggest the use of vernacular materials and technologies to achieve sustainability in the construction of housing for low-income groups and the adoption of incremental housing to create added value and meet the diverse needs of the applicants in developing countries.

People need a place to alleviate their mental problems and get rid of some social constraints. A place to communicate with their relatives and of course a place to pray. If the place of residence does not meet these needs, it can not be named as house (Arjmand & Khani, 2012). Incremental housing can be considered as a comprehensive solution in order to provide necessary standards for improving the quality of life in affordable housing projects. Incremental housing encompasses a wide range of construction, design, and financing methods, but generally, it can be said that

any planned activity in housing development, which involves the construction of a part of the project after the presence of users, can lead to create incremental housing. In this method of development, minimum requirements for low-income groups settlements are provided in the form of designing a multi-functional space, along with the required service spaces, while improving the quality of housing or increasing the number and dimensions of spaces will be postponed to the next stages (Goethert, 2010). Studies show the importance of land ownership in the level of residential satisfaction in any housing development projects (Minnery, Argo, Winarso, & Hau, 2013).

Pandelaki and Shiozaki (2010) Introduced the necessary measures for incremental housing as follows:

- Proper quantitative and qualitative features of functional spaces should be ensured in future developments
- Grant the ownership to the applicants in order to motivate the improvement of housing quality in future developments.
- Use Durable, economical, and returnable materials with minimal waste in building incremental housing.
- The provision of necessary infrastructures for the future development of housing should be considered at the planning and land preparation stages.

Atamewan and Olagunju (2017) introduced incremental housing as the most appropriate option for development of affordable housing in developing countries. Economic efficiency, maximum flexibility in making decisions and possibility of applicants participation in design and construction phase are mentioned among the benefits of this approach. The case study of this research is located in the Bilsa province in southern Nigeria; the results of field studies show that the willingness of applicants to use vernacular materials and techniques is due to the economic efficiency and familiarity of local workers with this type of construction method. In addition, a high percentage of applicants agreed with the incremental housing approach, so in the first step, a kitchen a bathroom and a multi-purpose living space for each household are considered. The house can be enlarged with the increase in income or the number of households in the next steps.

Wainer, et al. (2016), concluded that Incremental housing has proved capable of giving low income home-seekers what they cannot provide themselves: well-serviced land, infrastructure, and foundational structures for a sturdy and extensible house. Joon, et al. (2018), propose a 'Self-Reliance Centre, which is designed to function as a space for community empowerment, a training center, and a temporary shelter for incremental housing scheme in slum upgrade. HASGÜL (2016) investigated the





vernacular character of informal settlements and served incremental housing as a multi-sided solution concerning both social and economic issues.

Chavez (2012) examined three case studies of incremental housing programs that took place over three decades in Latin America, Africa and North Africa. He concluded that incremental housing strategy can work in different countries with different cultures, and it is resilient in the face of economic and political changes. Beattie, et al. (2010) believe that Incremental housing is a successful urban development strategy because it harnesses knowledge about the critical stages of informal development and provides various support interventions to guide development toward positive outcomes. Aravena, the Chilean architect, believes that incremental approach provides solutions that are adaptable and livable to provide housing for low-income groups. This approach balances aesthetics with affordability. It balances low-rise high-density building envelopes, limits overcrowding, and allows for the possibility of expansion from social housing to middle class dwellings (Aravena, 2008).

Gamal and Elhassan (2014) in their research on incremental housing construction in Khartoum have concluded that this approach is more successful in North American, Asian and African countries due to the high initial cost of housing construction compared to the incomes of target groups. They have categorized the basis of incremental housing in three general categories as follows:

The first category consists of informal settlements that are usually grow without planning in the suburban areas or non-residential lands. These settlements expand according to the financial situation of their occupants. The second one includes site and service projects that are usually defined by the governments. The construction of the residential units in these projects can be carried out by the participation of the applicants and in the form of incremental housing. The first projects in the form of site and services were implemented between the 1960s and 1970s by the World Bank in Latin America and Southeast Asia. The benefits of site and service projects include granting the private ownership to applicants, providing necessities for incremental housing development, increasing social convergence through the division of responsibilities in the process of construction and development, as well as playing the role in the urban development process and achieving affordable housing (Wakely & Riley, 2011). The mass housing projects in the form of site and services usually can be defined in suburban areas, where the price of the land is relatively lower. This causes segregation from urban

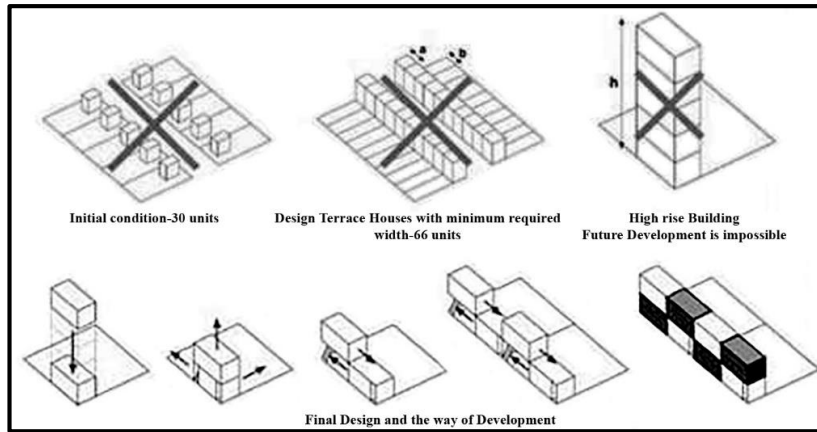
texture and high costs of supplying the infrastructure (Lizarralde, 2011). The third category is core housing, which is known as the main solution in obtaining affordable housing. Core housing is the initial step of incremental housing that can provide a shelter for a household in the shortest possible time and with the lowest initial cost. Core housing includes a living space with a bathroom and a place for cooking in a piece of land that is connected to the urban infrastructures.

In order to identify the spatial needs of incremental housing projects and take necessary actions in the field of design and construction. Two prominent project that was constructed using this strategy, was surveyed as practical examples.

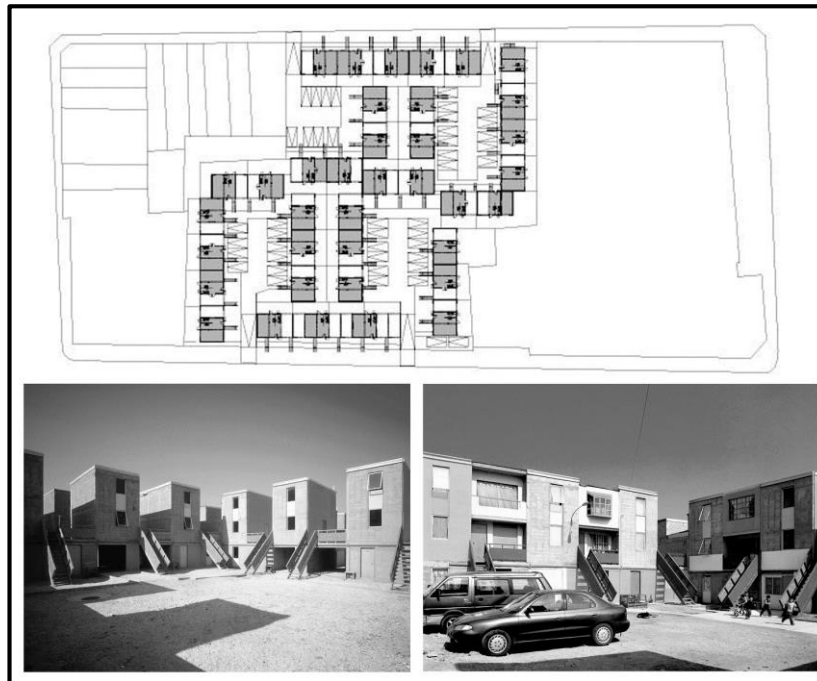
*EXAMPLE 1: IQUIQUE 100-UNITS PROJECT IN CHILE*

This project has been defined in 2003 to improve the housing quality of households that have lived over 30 years in an informal settlement in the center of the Iquique city. The main purpose was to build 100 affordable housing units for low-income groups in a land with an area of 5000 square meters. An amount of \$ 7,500 for supplying land, engineering services, and infrastructures has been allocated to any residential units by the government. This amount was just sufficient for construction of a 30 square meters space on that time, while in the intended plan, 75 to 90 square meters of residential space had considered for each unit (Aravena, 2008). The number of land plots in the initial condition was 30, which illustrates the need for providing a proper land planning and design to meet the functional requirements of the project. According to the high value of land due to its location in the city, the maximum use of it has been the primary objective of the design. This was for increasing the number of residential units and more using of government subsidies. In this regard, designers examined various options from terrace houses to high-rise buildings. In the case of terrace housing, it was found that only 66 plots by minimum required width could be provided. In addition, the design of high-rise buildings eliminates the possibility of future development and is not a suitable option to meet the needs of the project (Figure 1) (Aravena, 2008). Finally, four neighborhood units containing two-story building blocks formed the design of the complex. The purpose of designing neighborhood units was strengthen social relationships among residents. In addition, the intended space for development of each block is quite clear and there is no possibility of unplanned development and spatial disturbance in the project (Figure 2).





**Figure 1.** Evaluation of different design options-Source: (Aravena, 2008)

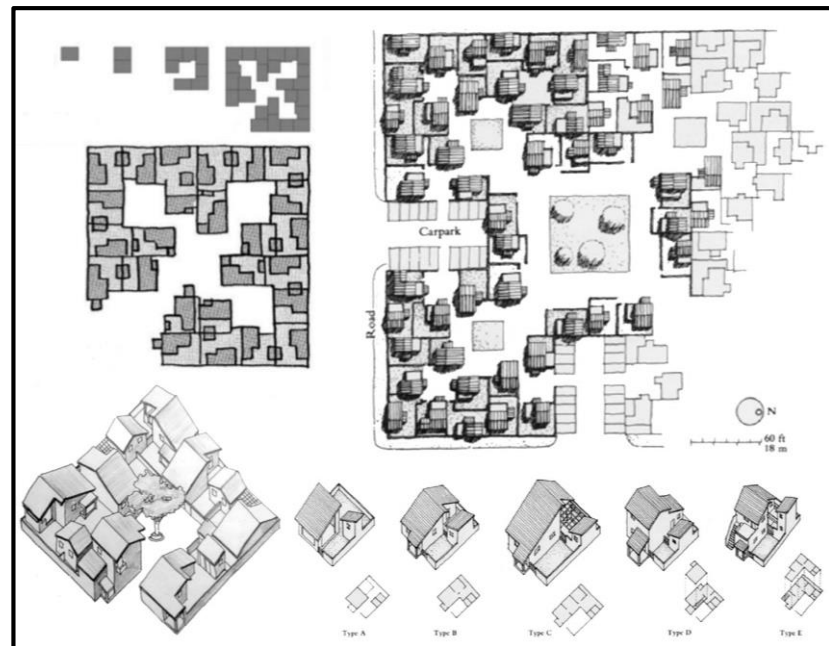


**Figure 2.** Neighborhood units and the way of development-Source: (Aravena, 2008)

**EXAMPLE 2: BELAPUR 500-UNITS PROJECT IN NEW BOMBAY-INDIA**

This project was constructed between 1983 and 1986 on an area of 5.4 hectares with 2 kilometers distance from the center of the city. The applicants was families with various income levels that residential units ranging from 45 to 75 square meters were built for them (Ravishankar, 2014). Each residential unit was located in a single plot and this provided the necessary basis for the future development. In order to enhance the social interactions among residents, several neighborhood units in three different scales were designed. The smallest contain seven building blocks that have shared a semi private yard. On the other level, each three neighborhood units form a larger one and there is a larger yard that has been shared among these neighborhood units. Eventually, this module repeats around the biggest central yard of the complex (Figure 3). In addition, to provide functional spaces for residents, an appropriate hierarchy to access from the public

spaces to the semi-public, then semi-private, and finally the private spaces of each unit, has been defined and this kind of spatial arrangement is perfectly suited to the vernacular culture. The houses are structurally simple and can be built and extended by local workers. The results of field study show that the residents' maintenance of public and semi-public spaces is less than that of semi-private courtyards and it seems that they do not consider these spaces as their residential realm (Ravishankar, 2014).



**Figure 3.** Design of neighborhood units and building blocks with incremental development capability  
Source: (Ravishankar, 2014)

### *LITERATURE REVIEW CONCLUSION*

The review of literature on the incremental housing shows that this construction method can be responsive to the need for affordable housing in worn-out urban fabrics and informal and suburban settlements. Most of the constructed projects in this template are related to the blocks, which include one or, maximum, two residential units. Therefore, in metropolises, where the land price is relatively high, the application of incremental housing approach is more confined compared to the smaller cities. Incremental housing provide the chance of ownership for low-income applicants due to the need of minor initial capital. It has also provide a proper basis for employing local workers, participation of applicants in the process of design and construction, and revitalization of the verified traditional vernacular methods of construction.

### **RESEARCH METHODOLOGY**

In order to explore the effects of incremental housing approach on the level of residential satisfaction, a descriptive-analytic research method was used. In the process of data collection, a case



study has been surveyed by using field study methods. The case study contains a mass housing project in Iran that have been built by using incremental approach. Data were obtained using field study methods. In this regard, in order to study the spatial needs of residents, the method of observation and evaluation of the process of development have been used. Indicators, which affect the level of residential satisfaction and influenced by the nature of the project have been put in a questionnaire and the applicants were asked to give their view through the Likert scale. The questionnaire was given physically to the head of each household or an over 18 year's old individual and they were asked to send it to authors through the virtual social networks. The required sample size was calculated using the Cochran formula with 5% Margin of Error. The result was 108 from 150. In order to measure the reliability of the questionnaire; the Cronbach's alpha for the entire questionnaire was 0.842, which indicates an acceptable internal consistency among the questions. The statistical relationship between the data was analyzed using correlation test. Then, based on the interpretation of research findings, a model for increasing the level of residential satisfaction has been presented in order to be used in mass incremental housing projects.

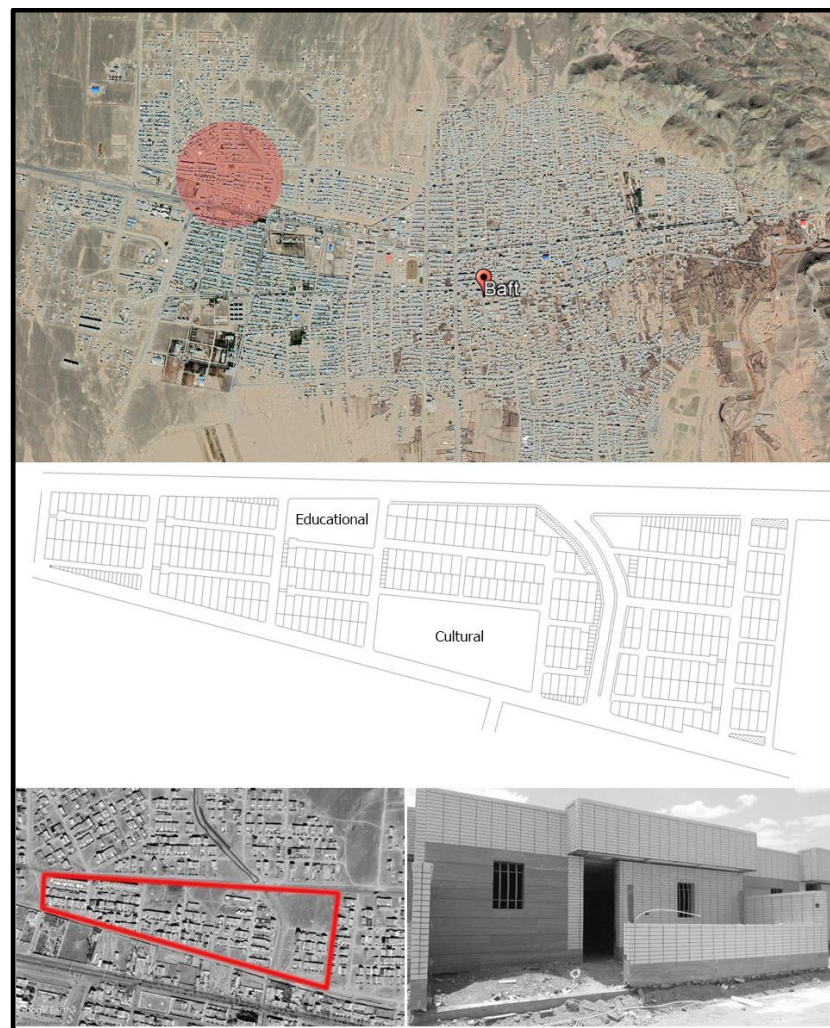
#### **CASE STUDY: RESIDENTIAL PROJECT IN BAFT COUNTRY-KERMAN-IRAN**

This project has been established in the northwest of Baft country in the Kerman province with 1.7 kilometers distance from the center of the city. The project covers an area of 16 hectares, including educational, cultural, and residential uses in the form of providing site and services (Figure 4). 150 residential land plots are allocated to build affordable housing for low-income groups and the process of construction was begun in 2013. On that time, each residential unit benefited from 150 million rials (5000 US dollars) loan that covers one fifth of the price of a 65 square meters residential unit and a 250 square meters land plot. The intended land lots for this project are located in north-south direction and according to the local codes; the building mass should be located at the north of each lot with a maximum occupancy of 60%. The incremental housing approach has been chosen to build these 150 units. In the first step, necessary spaces contain a bathroom, a toilet, a living space and a kitchen were provided for each household in the form of a 65 square meters unit. The development plan of each unit, which can be completed in three stages, includes the addition of two bedrooms and an increase in the size of the living room. This development eventually brings 120 square meters area for each unit (Figure 5). According to the results of the Iran 2016 National Population and

Housing Census, this amount is the usual area of a single-family house in the city of Baft.

The structural system of residential units is the composition of the brick barrier walls with the concrete slabs on a concrete foundation and a flat beam and block roof. Due to the technical issues and dimensions of the foundation, it was constructed completely in the first stage of the development. In order to implement horizontal and vertical concrete slabs in other stages of the development, steel plates were put in the foundation and any other necessary places. The technology of this structural system is relatively simple and can be implemented by local workers and it was one of the primary objective of the project.

Residential satisfaction considered as a dependent variable on incremental housing approach in analyzing the case study and practical examples of literature. The indicators of residential satisfaction that gained from literature review were listed in a questionnaire that has been shown in Table 3.



**Figure 4.** Site plan and residential unit with a bedroom next to the living space-Source: Authors



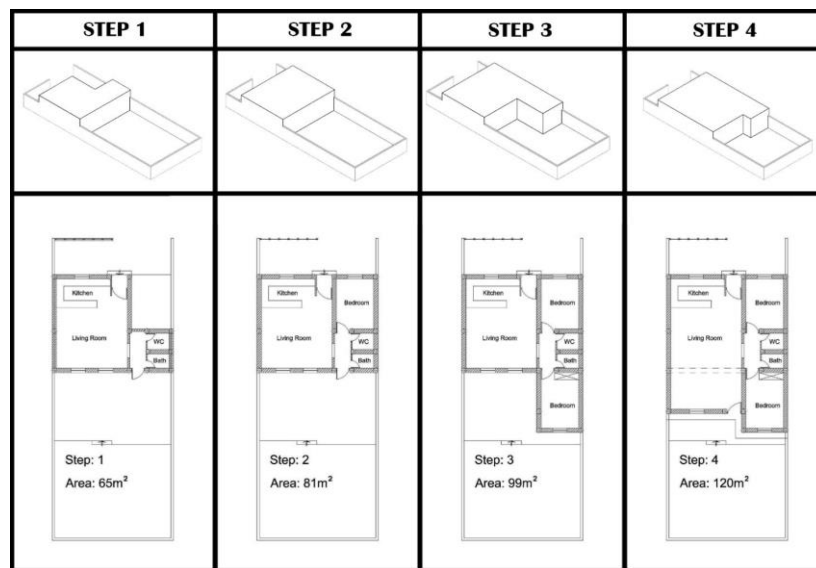


Figure 5. Stages of the development over the time-Source: Authors

Table 3. Provided questionnaire

Which alternative options do you prefer for placement of the service spaces?			Inside the residential unit		Inside the yard					
	Kitchen									
	Bathroom									
	Toilet									
What kitchen system do you prefer in the case of a kitchen inside a residential unit?	Open system			Close system						
Please indicate the level of satisfaction of your family with any of the following indicators by numbers 1 to 5 (Number 1 as the lowest level of satisfaction and number 5 as the highest).			1	2	3	4	5			
Construction Quality	Quality of the building facade									
	Quality of the building components									
	Quality of the building materials									
	Quality of streets and alleys									
Urban and Neighborhood Services	Sewage disposal system									
	Access to urban infrastructure networks									
	Access to public transportation									
	Pedestrian and vehicle access systems									
	Waste collection system									
The ownership possibility	Green space maintenance									
	Initial price suitability									
	Housing loan suitability									
Providing the basis for future development	Technical anticipation									
	Spatial prediction for future development									
Providing the basis to strengthen social relationships among the neighbors	Using local workers in the construction process									
	Providing suitable shared open spaces									
Overall satisfaction	Applying incremental strategy in buildings construction									

## FINDINGS

In the case of Baft Project, the results of field studies show that among the 150 blocks, which allocated to the affordable housing applicants, 24 households have agreed to attach a bedroom in the first step of the development and have incurred additional costs (Figure 4). In addition, after 2 to 4 years of residence, 14 households added one and 26 households added two bedrooms to their houses, as the Figure 5 shows. It is important to note that during the time of this extension, the families could stay at living room and there was no need to evacuation. After 4 years of residence, just seven households have extended the living room and could use the bedrooms as living space, during the time of the living room extension. This shows that the occupants are more eager to extend the number of spaces compared to the size of them. One of the reasons of this would be the importance of the public and private spaces separation. Therefore, this fact had to be considered in the first step of the development. According to a conducted survey among 108 samples, 96 cases preferred the direct access to service spaces (kitchen and sanitary spaces) from the indoor space. Among these 96 cases, just 11 cases agreed with the open system kitchen and this is because of the some issues like odor and privacy. Hence, in some units, the visual connection of the kitchen and the living space has been cut off by using curtain walls. To evaluate the level of residential satisfaction, some indicators that influenced by the incremental nature of the project, were analyzed. In the provided questionnaire to each households, the respondents were asked to indicate their level of satisfaction with the listed indicators by numbers 1 to 5 in front of each option. Number 1 as the lowest level of satisfaction and number 5 as the highest. The results have been shown in Table 4. In order to prioritize the indicators and examine the individual effects of each one on the overall residential satisfaction, a correlation test was used. In all cases, Pearson Correlation was more than 0/2, so a statistically significant relation was observed and the results are obtained in Table 5.





**Table 4.** Obtained data from the question about the level of satisfaction with the relevant indicators-Source: Authors

Indicators	number of samples	Points based on 540	Percentage
Construction Quality	108	243	45
Urban and Neighborhood Services	108	204	38
The ownership possibility	108	397	73
Providing the basis for future development	108	398	74
Respond to the functional needs	108	223	41
Providing the basis to strengthen social relationships among the neighbors	108	336	62
Overall satisfaction	108	377	70

**Table 5.** The correlation coefficients between total satisfaction index and others-Source: Authors

		Constru tion Quality	Urban and Neighbo rhood Services	Provid ing the owner ship	Provid ing the basis for future develop ment	Respo nd to the functi onal needs	Provid ing the basis for social relation ships among the neighbo rs
<b>Overall satisfac tion</b>	<b>(r) Pearso n Correl ation</b>	0.497	0.458	0.868	0.651	0.258	0.741
<b>number of samples</b>	<b>of</b>	108	108	108	108	108	108
0<r<0.29= Weak Correlation      0.3<r<0.69= Moderate Correlation 0.7<r<1= Strong Correlation							

## DISCUSSION

The results of analyzing the questionnaire's data show that providing the basis for the future development, the ownership, and the social relationships among neighbors are the most important factors in attracting resident's satisfaction. The reason of the ownership importance is due to the social and economic conditions of these people. As the ownership always was a wish for them, and this project has provided the necessary base for achieving this. Christopher Alexander believes that the house is the winning throw of the dice which man has wrested from the uncanniness of universe; it is his defense against the chaos that

threatens to invade him. Therefore his deeper wish is that it be his own house that he not have to share with anyone other than his own family (Aleksander, Silverstein, & Ishikawa, 1977). Therefore, the land plot complete ownership due to the build of single-family houses has an important role to obtain the residents satisfaction. The incremental approach makes occupants hopeful about their living environment. Although their current home may not fulfill all their quantitative and qualitative needs, the possibility of improvement and development is always exist and this would lead to create a sense of belonging to the residential environment. Therefore providing the basis for future development is discovered as an important indicator in gaining the residents satisfaction.

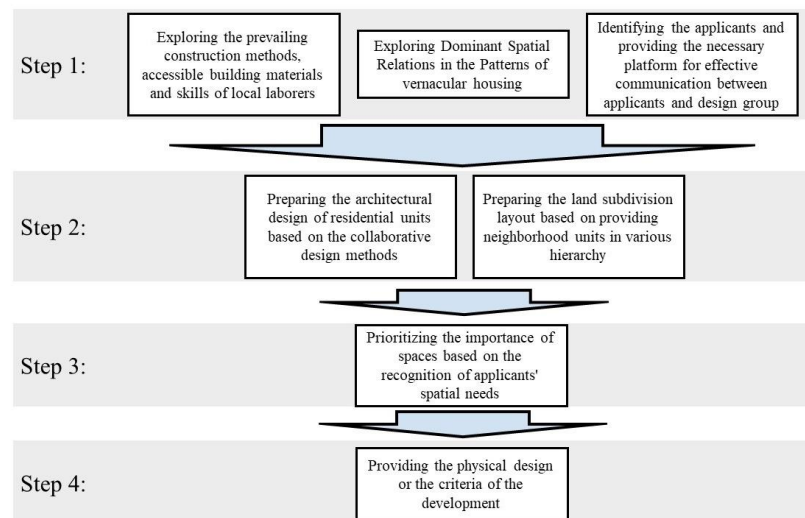
Construction quality is the most important factor in every project. Especially in the case of low-income groups housing, although the economy plays an important role, it does not deny the necessity of achieving the desired quality in terms of strength, durability, and beauty. The nature of incremental housing requires participatory design and construction methods, so using simple construction technologies and local label forces are the priorities. This can face the projects with some challenges in providing similar quality for all residential units. One of the other benefits of incremental housing is providing the basis for the quality improvement in other stages of the development, especially in some cases that the householders do not have the financial strength to bring a proper quality for facades or indoor spaces. Urban and neighborhood services can be classified into two main groups; the first group contains some infrastructures like water supply, gas, sewerage and other necessary networks. The second group is related to some services like public transportation, waste collection system, pedestrian and vehicle access systems, green space maintenance and etc. Therefore, in the incremental housing projects some infrastructures like sewerage and gas networks can be implemented in the next stages (in these case temporary arrangements should be considered). Although relevant organizations are responsible for providing infrastructures, the necessary basis can be provided to facilitate the provision of these services, due to the proper design. For example, make sure that some spaces have been allocated to the public transportation stations and waste collection system.

The design quality of the open spaces has a significant effect on the occupant's decision to maintain them. In this regard even if the urban services are not so desirable, these spaces always remain alive due to the presence of the residents. Since residents are faced with common issues regarding the development of their houses and construction activities, Social relationships can be



strengthened due to some activities like asking neighbor's opinions and using their advices, observing neighbor's final work, introducing contractor groups to each other and so on. As in the Baft project, despite the fact that site design factors did not provide necessary basis to strengthen social relations, this indicator is in a good situation from the residents view. In order to continue these relations, it is necessary to consider the appropriate spaces, including public and semi-public open spaces with their proper pattern of activities. In this regard, in the study of the Belapur project, it was seen that the scale, the situation, and the prediction of pattern of activities that will take place in these spaces, are of particular importance. Based on the Ravishankar field studies, the residents were more enthusiastic about the presence in the semi-private courtyards compared to other bigger open spaces (Ravishankar, 2014). The shortage of the effective pattern of activities in strengthen the social interactions; decrease the quality of the shared open spaces. As it was seen in the Chilean residential project, the shared open spaces just allocated to the parking lots, so in the design of residential environments, it is strongly recommended to allocate a common courtyard that works as a semi-private open space for 8 to 12 houses. Some spaces like community small gardens, children playground and proper sitting spaces should be anticipated in these courtyards, but they can be assembled in the later stages of the development.

Due to the social sustainability issues, it is preferable to locate affordable housing projects in the context of the cities and scattered these houses among the others. As it was seen in the Baft project the 150 affordable houses are scattered in the site and the quality of their facades are the same as the other houses (There are only some differences in the quality of materials for indoor spaces). This would lead to the social integrity in the residential environment. Finally a model for designing incremental housing has been prepared and presented in Figure 6.



**Figure 6.** Necessary measures and design procedure for incremental housing projects-Source: Authors

## CONCLUSION

The results of the literature review and case study illustrate that the incremental housing approach can be considered as an appropriate way of providing affordable housing, especially in mass housing projects. Providing the basis for future development and ownership possibility are the main factors that cause residential satisfaction in these types of projects. These two indicators can be gained through the essence of incremental housing approach. Using this approach is more practical in the construction of single family houses due to the structural issues. In the other hand, the spatial and functional needs of a single family are more limit than the occupants of an apartment complex. Therefore, if just one person is responsible for the decision, the process of development will be run faster. The nature of the incremental housing is based on the participatory design and construction methods, so in addition to moderate the financial problems in obtaining housing, the final product will be more suitable for the target groups from the both functional and esthetic power of view. The important point about incremental housing projects is to determine the minimum required functional space for the applicants. In Iran due to the emphasis on the separation of public and private spaces in the traditional homes and current lifestyle, increasing the number of spaces is preferable compared to increasing the dimensions of them, so the initial core of the incremental housing in Iran should contain sleeping, living and servicing spaces. The next step is to define a development framework to minimize the negative effects of attached spaces on the other spaces or on the physical aspects of the city. In this regard, site planning is so important for example, in the terrace housing cases the building development is more confined compared to the other types of layouts, so it is important to determine the final envelope of the buildings and define facade



design criteria in terrace housing projects. Subsequently the proper design of neighborhood units and open spaces with appropriate anticipation of pattern of activities to strength social interactions among the residents are the important factors to increase the physical and spatial qualities of an incremental housing project. In addition, responding to the functional and aesthetic needs of the target groups should be the first priority of design and construction activities and this would lead to bring a sense of belonging among the residents that is the fundamental target of any residential environment development. Other challenges that incremental housing approach are faced with, are environmental, economic, energy and sustainability issues that can be the subject of the future research in this field.

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### Resume

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