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Flexible Architectural Interventions for Housing Issues in Bahrain

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Abstract
Houses are important to every living creature they are considered the center of our universe and our haven. Recently having a home that reflects the identity and fulfills the desires of the occupants became a challenge due to the lack of space due to overpopulation in the world especially in areas with small surface area compared to population size like the island of Bahrain. The unaffordability of housing and lack of space pushed most governments to start producing social houses with design limitations and bulk production. This paper aims to identify the problems related to social housing in Bahrain and seeks the possibility of using flexible architectural interventions to solve these issues. Interviews are conducted with Bahraini families living in social housing projects to identify their issues and their thoughts about flexible solutions. The results show that almost all social housing occupants are not satisfied with their houses' spatial design and have made costly modifications. They also lack the knowledge of flexible interventions and refuse them as a solution while encouraging the idea of vertical housing. This study introduces the term flexibility in social housing and emphasizes the need to improve occupants' satisfaction in Bahraini society by using efficient architectural interventions.

Keywords: Social housing; Overpopulation; Residents Satisfaction; Flexibility; Architecture; Bahrain.

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1. Introduction

The growing world population stands against the possible production and individuality of homes, especially in countries with horizontal area limitations and small surface areas compared to human populations like the island of Bahrain. Bahrain is a 785.08 km² island situated in the Arabian Gulf with a population of approximately 1.7 million (Information and e-government Authority, 2020). According to the population projection in Bahrain, it will reach 2.3 million by 2030 with an increment of 1.1 million. Bahrain is required to provide 270,000 residential units between private and public sectors within the coming 16 years. These residential units are usually owned by the government and are produced under their supervision, so the government has control over the design and area of each unit. They are provided to certain citizens of eligible criteria in the community to help them cope with the unaffordability of houses and allow them to spend the money on other life needs (Caves, 2013). As per the Bahraini Ministry of Housing, eligibility criteria applicants must be married and age between 21 and 50 years old, and have a monthly income of less than 600BD, this makes 81% of Bahraini citizens illegible for these residential housing units. Moreover, the Bahraini community is known for its high birth rates and big families, statistically approximately 3,000 marriages occur per year in Bahrain, meaning, approximately 1,500 houses per year need to be constructed

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(Kingdom of Bahrain - eGovernment Portal, 2019). To address the issue of the increasing requirement for housing units due to the high population rise rates in Bahrain the government and the Bahraini Ministry of Housing came across various interventions to approach this matter. This paper will contribute to filling the gap in knowledge regarding the effectiveness of social housing in Bahrain and the implications of flexible architecture to solve social housing issues in Bahrain. This is done by collecting data from the users regarding the social houses they live in to be able to seek the possibility of implementing flexible tactics to solve issues related to shortages of space and occupants' satisfaction.

1.1 Aim and Major Objectives

1.1.1 Aim

Look into the effectiveness of the social housing projects in Bahrain and explore the possibility of using flexible architectural interventions to solve social housing issues in Bahrain.

1.1.2 Objectives

1. In-depth understanding of the expressed issues related to Bahrain's most recent housing projects. This means knowing the problem's exact causes and reasons for their occurrence from the user's point of view, to be able to provide an asset to future studies regarding the development of housing in Bahrain.
2. Investigate the already existing solutions provided by Bahrain to tackle the issue of high housing demand.
3. Extensively understanding of the various techniques and strategies of flexible architecture to decide if it is appropriate for Bahrain social housing.

2. Literature Review

2.1 Existing Solutions in Bahrain

Bahrain has been dealing constantly with the issue of shortages of horizontal space. One of the early solutions was Land reclamation. This method was studied and implemented to provide more space for houses and dwelling units. It is the process of establishing new lands from the sea by filling a particular area with rocks, cement, and building materials waste until the required height level is reached. It began to come into existence in the early 1970s in Western Europe near coastal areas (Campana,2016). Bahrain started reclaiming land in 1990 and since then around 70km² of land has been reclaimed mostly to construct housing projects like Diyar Al Muharraq and East Hidd town in the north of Bahrain (Alzeera, 2014). Land reclamation provided Bahrain with more horizontal area to provide the citizens with individual housing units and boost the economy. Bahrain uses an infilling method to reclaim land from the sea, which is done by using dredged materials like limestone, caprock, and building wastes (Madany, 2021).

Bahrain's Ministry of Housing also sought another approach to the problem of housing by providing a set of financial services for the citizens to facilitate their access to adequate housing. These financing services are given according to a simplified system based on an easy payment process that considers each citizen's income. These services include applications for Ministry of Housing residential projects, including a completely constructed house with full facilities, empty land, or an apartment application. These later projects are designated under the ministry's ownership, meaning they are built and owned by the Ministry of Housing and Urban Planning (MOH), established in 1975 and has been constructing many housing projects in various governates in the country. The second option is to apply for a housing loan to be repaid in installments to buy any house of choice, build on already-owned land, or renovate an existing house owned by a citizen. Recently with the initiation of partnerships between public and private sectors a program called Mazaya program which finances and designs construction projects and primary and secondary infrastructure works in partnership between Diyar al Muharraq and MOH was introduced. It provides the citizens with loans from certain partnered banks which the citizen gets to repay 25% of his total income to the bank and the ministry pays the rest of the amount. The MOH also provides apartments intended for temporary dwellings for citizens eligible for it or citizens who are currently waiting for their MOH houses to be built and their requests to be fulfilled (BIEA, 2021). Bahrain started producing social housing projects in 1963 in Isa Town. 12 housing project areas have been established since then. These residential units were constructed and distributed to eligible citizens surrounded by different facilities required to ensure healthy living including health centers, schools, etc. Targeting the recent projects that were initiated within the previous 5 years. More than 30,000 housing units have been produced and distributed since 2015. These recent houses are expected to be fully completed by 2025, hosted within various locations residential projects in Bahrain including, Madinat Khalifa, East Hidd, Deerat al Oyoun in Diyar al Muharraq, Al Ramli (MOH, 2017).

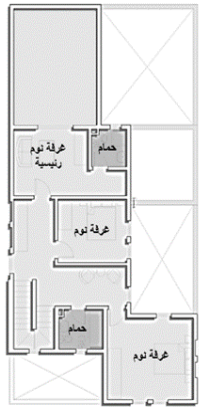
Madinat Khalifa is located southeast of Bahrain with an area of 734 hectares. It consists of 7000 residential villas and apartments intended to serve 48000 citizens. It consists of 4 types of villa options with gross areas ranging from 186-224m² and flats gross area of 175-190m². East Hidd project is located east of

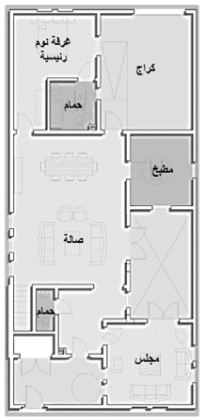
Muharraq town with 232 hectares holding within it 4523 residential units,2827 houses, and 1209 apartments with an average gross area of 230-250m² for 28000 citizens. Deerat al Oyoun is located south of Diyar al Muharraq with a total area of 118 hectares holding 3043 residential units initiated by the Mazaya program with houses gross areas of 220m² with 4 different international designs Bahraini, Spanish, Modern, and Mediterranean including surrounding urban facilities. Al Ramli is located at the center of Bahrain with a total area of 100 hectares consisting of 4464 housing units,1261 villas, and 3240 apartments of gross area of 230m² for villas and 170m² for apartments to cater to 29260 citizens. The table below (Table 1) contains all the available layouts produced by the ministry for the citizens in the new residential projects.

Table 1: List of MOH housings available in Bahrain figures and information (MOH, 2017).

Plan layouts	Elevations	Gross area	No: of rooms
Madinat Khalifa Type 1A			
		240m²	4
Madinat Khalifa Type 1B			
		268m²	4
Madinat Khalifa Type 2A			
		272m²	4

Madinat Khalifa Type 2B



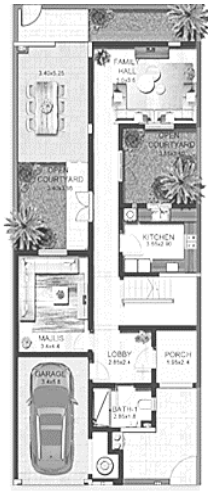


280m² 4

Madinat Khalifa Type 2C

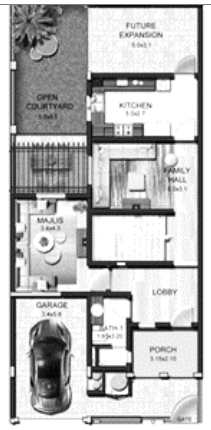
295m² 4

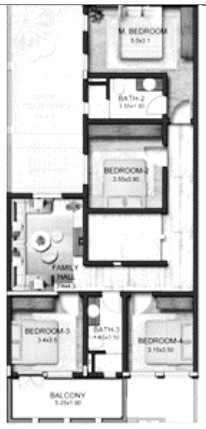
East Hidd Type1



256m² 4

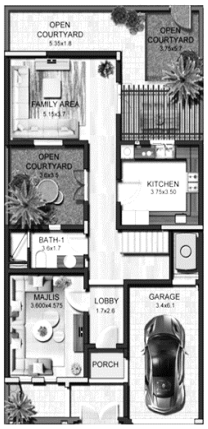
East Hidd Type2

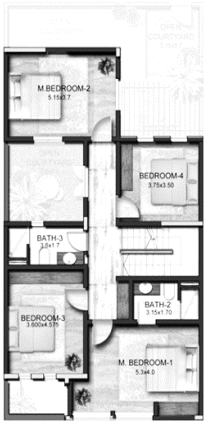




244m² 4

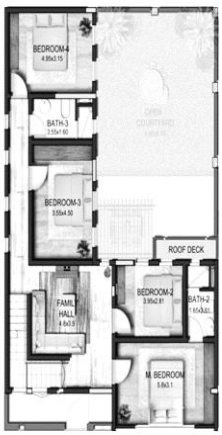
East Hidd Type3



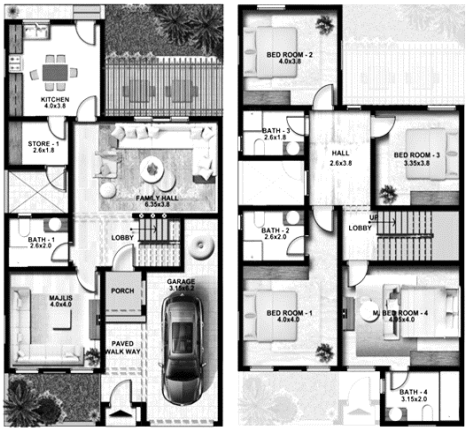


249m² 4

East Hidd Type4



240m² 4

Deer at Al Oyoun			227m²	4
Al Ramli			236m²	4
AZ Apartment Building Type (6 Storey-23 Apartments)			170m²	3

AM Apartment Building Type (6 Storey-23 Apartments)			
		170m²	3

2.2 Effectiveness of the Existing Solutions

Based on the solutions that were listed above. The reclaiming of land provided additional land area for thousands of housing units in Bahrain and drastically improved its economic development, but it had diverse effects on the environment and marine life. It has caused permanent destruction to marine life and high decline percentages in marine species and over the long term it will continue to implement a high risk of earthquakes. These negative effects are because of the damage caused to the inshore bio-system which affects the water's salinity and stability. Moreover, it contributes to the overall rise in the sea level which in turn accelerates the effects of global warming. The reclamations also have socio-economically affected Bahrainis by adversely affecting the fishing industry which led to a deterioration in the daily profit of local fishman jobs. Sea reclamation has also negatively affected tourism by the absence of the availability of local beaches and coral reefs. Eventually, there is a limit to the land that can be reclaimed from the sea so as the population keeps rising it would be difficult to compensate with the available area of the sea left to be reclaimed (Madany, 2021).

The social Ministry of housing projects that were established gave rise to the notion of mass production of houses, where houses are built massively and repetitively completely ignoring the actual need of the occupants. For example, the number of family members, age of family members, and any future expansions. Bahraini culture tends to dwell in more than one family in the same house. This technique led most occupants to spend the same amount of money taken to build the house on the renovations and redesigning which leads to unfeasible designs and violations of the building codes and regulations of Bahrain (Saraiva et al.,2017). Bahrain has used all the later dwelling techniques but is still struggling to compensate for the high demands of housing units and the dissatisfaction of its occupants.

2.3 Residential Satisfaction

To attempt to understand the efficiency of social housing in Bahrain, it is compulsory to understand how satisfied the residents of that house are. Occupants' satisfaction is the fulfillment sensed when one accomplishes what he wants or desires in a home, it is an important key signal for architects and decision-makers to test the outcome of their work. Residential satisfaction is built on three main theories which are the housing need theory, psychological construct theory, and housing defect theory (Galster, 1985). According to Rossi (1955), housing need theory claims that the housing requirements of humans change over time and so does their level of satisfaction towards it. It stresses the human comparison between his existing house and the desired house which causes stress and dissatisfaction due to the difference between what exists and what is desired which causes occupants to desert the house or change it (Rossi, 1955). Morris & Winter (1978) attempt to understand residential satisfaction through the theory of Housing deficit which states that humans judge their homes based on cultural standards and they make changes in their homes based on those standards to achieve comfort (Morris & Winter, 1978). Psychological construct theory states that humans refer to thoughts like thoughts of a perfect house according to them, and they judge their homes based on these references (Galster, 1985). Residential Satisfaction Measurement, which measures residential satisfaction, is not easy since it depends on various aspects like culture, place, time, and people. According to (Amerigo and Aragones, 1997) satisfaction is based on 4 components:

1. Socio-demographic characteristics deal with the demography and socio-economy of the residents like age, income, job status, etc.
2. Housing and ancillary characteristics consist of the physical features of the house like the size, number of rooms, ventilation, etc.
3. Neighborhood characteristics deal with the social environment and public activities related to the house like the quality of the surroundings and accessibility.
4. Behavioral characteristics deal with the occupants' attitude towards the house like modifications, adaptation, and maintenance (Morris & Winter, 1978).

2.4 Flexible Architecture

The concept of flexibility in architecture has been interpreted by many scholars, architects, and philosophers. Houses are a building typology that is influenced by flexibility. Flexible houses are designed to give multiple possibilities at the design stage, also with the potential to change over their lifetime (Schneider & Till, 2005). Flexibility opposes tight-fit functionalism like mass housing which comprises limited accommodations with no room for adaptability. Literature also highlighted the disadvantages of flexibility including leading to the illusion of freedom via control. Flexible housing should, thus, be able to provide true options and individuality. Dutch theorist and architect Herman Hertzberger emphasized the wide relevance of the notion of flexibility. Flexibility, as stated by Hertzberger (2005), offers a wide-ranging definition. Flexibility corresponds to choices about the building's structural system and services, whereas adaptability is correlated with the architectural composition of the rest of the spaces, including room layout, sizes, and connection with other functions (Rabeneck et al, 1973). Therefore, flexibility is regarded in the literature as the contrary of a constant because there is no single accepted definition of what it should entail (Schneider & Till, 2005).

2.4.1 Strategies of Flexibility

The possible construction strategies available to create flexibility consist of:

1. *Plug in*- This approach relates to modularity, which allows occupants to extend or alter a space by plugging in a new module, thereby creating multiple uses. The modification can occur both horizontally or vertically, and it should be incorporated throughout the design phase to identify the best available design options. New spaces should follow identical layouts as the existing ones, with minimal disruption to the structure or services. One of the most significant concerns of this method is the disturbance it could cause to existing residences. The method offers diverse alternatives and possibilities.
2. *Sum and split*- This technique involves the separation of huge spaces into several smaller spaces or vice versa. The method must be studied before the implementation very well. Important structural elements and those that relate tos services and accessibility must be respected. This method offers an extended range of different possibilities for families.
3. *Common rooms*- this method involves the utilization of shared spaces through mutual agreements. The space is often large with separate facilities like a kitchen and restroom that allows it to be used independently or in conjunction with one of the main units. Dispute between residents is a possibility with this method.
4. *Moving walls*- different spaces can be created instantly and easily when the walls are not fixed. This method involves incorporating movable panels, that do not compromise the structural stability of the space. It is very important to assess the viability of this solution during the design stage and the impact it could have on occupants' comfort and furniture arrangements.
5. *Folding*- this method involves concealing furniture items while they are not being used. It is an effective utilization methodology that offers flexibility through the disappearing and reappearing of large pieces of furniture. The strategy is most useful in more compact spaces.
6. *Uncompleted spaces*- The usage of such spaces is not specified during the design stage and can be defined later by the residents. The designer must consider multiple possibilities in which the space may be altered, and then design based on this flexibility.
7. *Neutral spaces*- the method offers spaces that are not clearly labeled. The residents must take charge of determining the use of each space. Each area in this method is self-contained and is used according to the residents' requirements (Scuderi, 2018).

2.4.2 Elements of Flexibility

These later design concepts and strategies can be accomplished by altering and manipulating these building elements in certain ways to achieve various techniques for flexibility. These elements are:

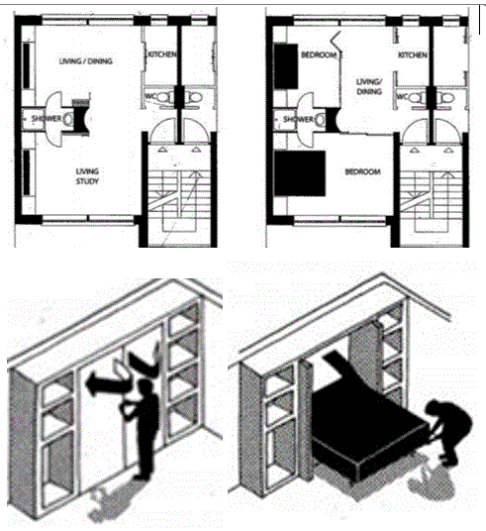
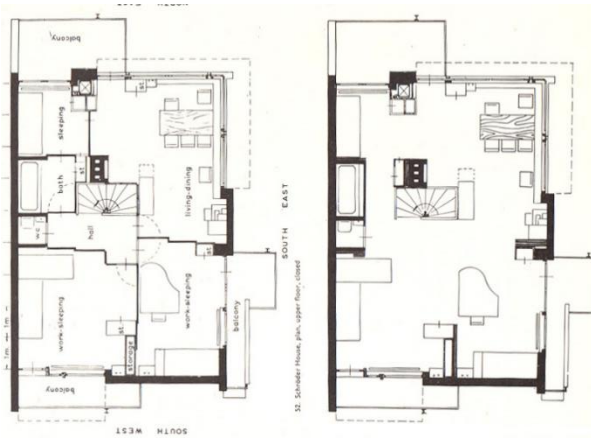
1. *Walls* - They can be designed in a way in which they can be moved, folded, or eliminated to divide or merge spaces. This enables occupants to use one space in many suitable ways based on their needs.

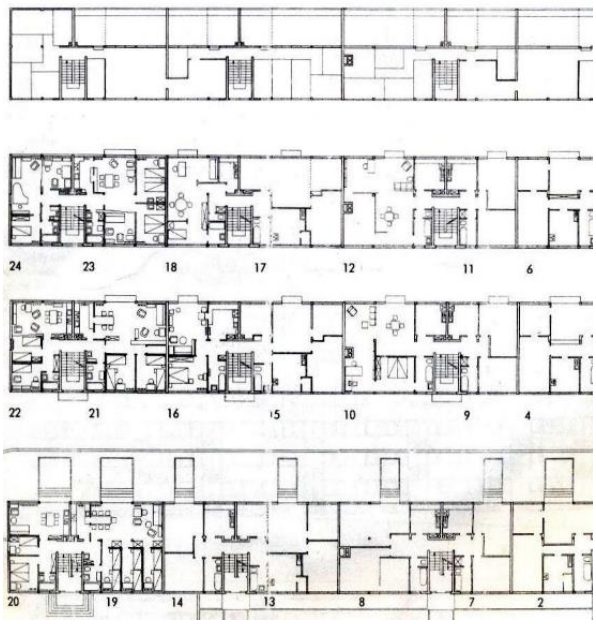
2. *Roofs*- Transformable structures can be used to enable the opening of closed roofed spaces to open to sky spaces. It even allows the extensions of spaces to make larger spans and the addition of rooms to buildings.
3. *Floors/Plans*-Floors can be added, removed, or left incomplete to allow the users to design various combinations of spaces and functions based on their requirements, it even allows for future changes to be made easily.
4. *Furniture*- moveable, foldable, and expandable pieces of furniture widen the scope of space uses and help in the achievement of multifunctional spaces by shifting, rearranging, or moving the pieces.
5. *Structure*- can be designed in certain ways with certain techniques so that it is possible to add extensions and make alterations to the existing building without any extra cost and effort. It deals with frames like the use of dry construction methods which involves using lightweight materials, prefabrication of modular, Frames and grids, and many other techniques that can take less time in construction. (Scuderi, 2018).

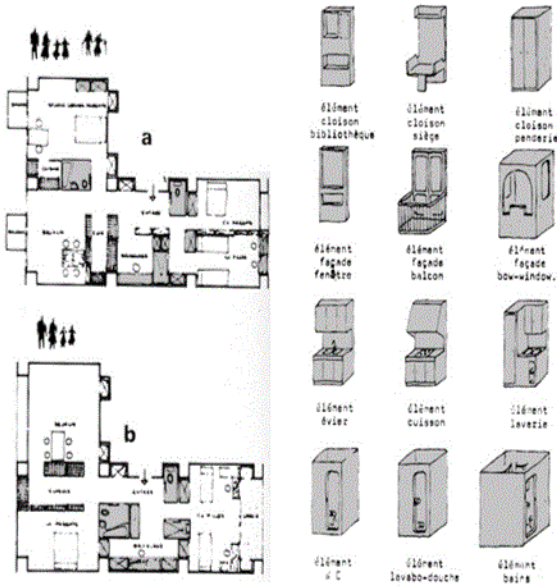
2.4.3 Flexibility Techniques in Buildings

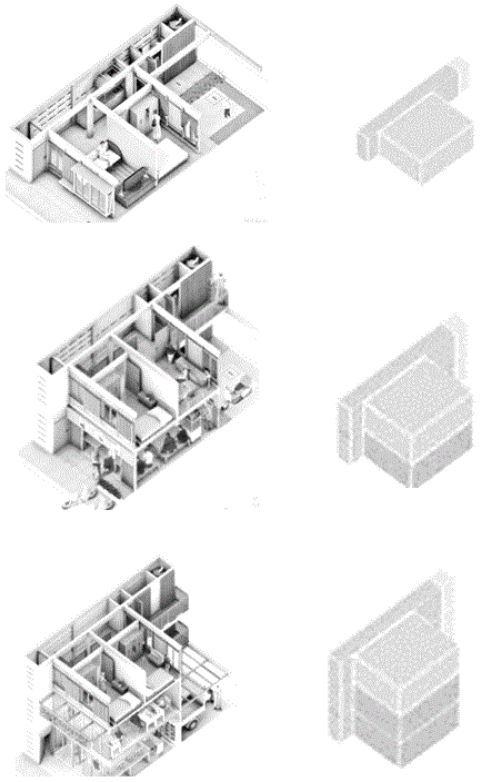
The table below (Table 2) illustrates in diagrams how some flexible housing case studies used these various techniques and elements to establish flexibility in architecture using the later design concepts and design elements.

Table 2: Flexible Techniques Case Study Diagrams.

Name	Country	Techniques	Illustrative Drawings
Furniture and Wall Flexibility			
Carl Fieger - minimal apartment	Germany (1931)	-This apartment can be changed into different spaces by moving the walls and unfolding the furniture. -It is made from a reinforced concrete frame and brick infill (Schneider & Till, 2007).	
Gerrit Rietveld-Schroder House	Netherlands (1924)	-It has an open Plan. -The bathroom and kitchen at the house's external walls are fixed. -The interior partitions of the house external wall to the center provide different plan layouts. - Considered a Heritage Site in 2000 by the UNESCO (Oku, 2010).	

Plan Flexibility			
Mies Van Rohe-Weissenhof Apartment House	Germany (1927)	-It gives the occupants the choice to design the apartments as they wish. Spaces are not identified to certain activities. -The only fixed aspects are the kitchen, toilet, and staircase. -Columns are the only governing elements (Stankard, 1998).	

Modulars -Plug in Flexibility			
Bernard Kohn and Georges Maurios-Espace construit adaptable	France 1973)	-It contains various units for living such as the bathroom, kitchen, furniture. -Residents can choose the units from a catalog and design their plan based on the number of family members or budget (Rabeneck et al,1973).	

Urban-Rural Systems-Expandable House (Castro, 2018)	Indonesia (2018)	-The house allows for vertical expansions to save horizontal surface area for overpopulated areas. -It uses a sandwich construction system where the roof, floor, and foundation as the frame. -The frame is built to withstand up to 3 extra stories. -The roof can be expanded by a simple jack system (Castro, 2018).	

2.4.4 Implications of Flexibility

The use of flexibility in furniture and space design produces effectiveness in horizontal space usage in addition to space size optimization and the use of flexibility in floor plans and levels of mobility and growth., it provides efficiency economically and spatially as the use of the same furniture and spaces for multiple functions helps to sustain the internal space. According to Kronenburg (2007), flexible interventions have been proven to solve many issues related to space shortages and maintain an inclusive architectural design that can take into consideration the individuality of each human being and respect their differences. It is also being adopted by many countries that lack the availability of space and places with high population densities as a solution for housing issues.

3. Material and Methods

This research is exploratory research, which investigates clarifying the problem of social housing and space shortages in Bahrain. It also investigates the social housings and the possibility of using flexibility in designing them. The research uses qualitative methods designed to have thorough knowledge concerning the people's opinions and satisfaction towards social houses in Bahrain. It also seeks to know their response and acceptance regarding the idea of flexible architectural interventions. Qualitative method research includes various uses and collection of empirical materials in a thoughtful manner (Creswell, 2007). The reason for choosing this type of method is because it provides different aspects of a problem and aids in developing concepts and deep analysis. This method investigates the opinions on social housing using interviews as a research instrument. It will outline the views of Bahraini citizens on the ministry of housing units.

3.1. Population and Participants

According to sample size recommendations, 20 to 30 interviews are sufficient to gather the qualitative data required for research (Creswell, 2007). For this research, 20 participants were interviewed in depth since the study includes similar segments within the population. It targets married Bahraini members of the community who have a family and are eligible for social housing based on the previously stated criteria.

3.2. Sampling

The sampling technique used in this paper is non-probability sampling non-probability sampling which involves purposive sampling that enables the selection of the most appropriate participants based on the studied situation to aid in fulfilling the aim of this research (McCombes, 2019). The sample that represents the research will have to meet the following criteria since this paper investigates the social houses in the most recent housing projects in Bahrain. The targeted participants must be:

1. Married and live with his/her family.
2. Living in a social unit in one of the following areas of study:

3. Madinat Khalifa
4. East Hidd town
5. Deerat Al Oyoun Diyar Al Muharraq
6. Al Ramli

To have a fair sample for collecting opinions, the number of the total participants is distributed based on the 4 locations of the housing projects. (Table 3) Shows the sample selection criteria that were used for participants that are needed to examine the effectiveness of the housing equitably. The participants are selected from all stated locations. Based on the data gathered in the part of the existing solution, there are no major significant differences between each type of a specific housing project.

Table 3: Sample selection table.

Location of Housing Unit (Participants from)	Participants	Check box	Total No: of participants
Madinat Khalifa	Participant 1	✓	5
	Participant 2	✓	
	Participant 3	✓	
	Participant 4	✓	
	Participant 5	✓	
East Hidd town	Participant 6	✓	5
	Participant 7	✓	
	Participant 8	✓	
	Participant 9	✓	
	Participant 10	✓	
Deerat Al Oyoun Diyar Al Muharraq	Participant 11	✓	5
	Participant 12	✓	
	Participant 13	✓	
	Participant 14	✓	
	Participant 15	✓	
Al Ramli	Participant 16	✓	5
	Participant 17	✓	
	Participant 18	✓	
	Participant 19	✓	
	Participant 20	✓	

3.3 Data Collection

One of the first steps in the data collection procedure is the determination of the number of participants which is 20 and how participants are gathered. A link and a QR code were distributed to participants by posting a short text with the required criteria as shown in (Figure1) over various social media platforms since they are considered an easy way to reach various audiences. The platforms include Facebook, Instagram, and WhatsApp. Participants are transferred via a link or QR code to a live text conversation over the WhatsApp platform to conduct the interview. A short message as shown in (Figure 2) appears when clicking the link. If the requirement for those specific criteria is already fulfilled a message is sent to inform participants about the fulfillment as shown in (Figure 3). The written data collected from interviews was recorded as a conversation transcript. Participants were given the freedom of language choice and even to record voice notes via WhatsApp. It is important to mention that some conversations and interviews were conducted in slang Arabic language to deliver questions and discuss easily with local Bahraini citizens. The conversations are then translated into English for analysis purposes. For ethical reasons clear permission from the participants was taken to conduct the interview and the participants were informed that their data and the interview will be used for research purposes to consent for their permission. The participant's names and phone numbers are kept Anonymous (Creswell,2014). A total of 27 participants were reached but some live in an already fulfilled criteria, to avoid duplication and due to the time frame of the research only 20 were interviewed, the others were declined for fulfillment of the required number. Each interview took about an average of 20 minutes. Some participants left a 10-15-minute time gap in responding to each question.

Figure 1. Participant's criteria text.

Figure 2. Message sent to participants.

Figure 3. fulfilled criteria text.

3.4 Research Instrument

Interviews were used in this research to collect qualitative data. It is a crucial instrument and the most suitable one to be used for this research because it enables direct control over the flow of the conversation and questions with participants. It also enabled more flexible data gathering and gave a chance to ask additional questions that could provide detailed and unique answers to various participants. The interview questions consisted of unstructured and open-ended questions like a casual conversation to get answers from the participants based on their experiences and thoughts (Creswell,2014).

The interview questions that were asked included 5 main questions with the use of some diagrams/pictures/simple explanations to help participants who might not be familiar with a flexible architecture to understand the new concepts as shown below (Figure 4). This helps in educating the community about new interventions. Some extra follow-up questions were added. Some additional questions may arise out of the context. Before the interview participants were asked about their living area and they were also informed about the amount of time this interview might take.

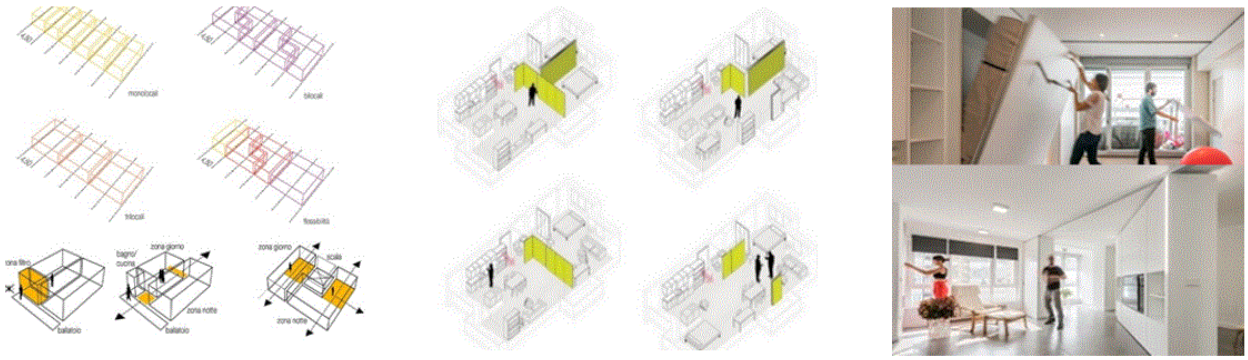


Figure 4. A flexible architecture, (García,2022; Jordana,2010; Jorge,2011).

3.5 Validation of Instrument

The validity was established by comparing the interview questions with the content of the objectives and the research question. Below in (Table 4) the interview instrument validity is shown.

List of questions:

1-Tell me about your daily spatial experiences living in the house
a. How many family members live in the house?
b. What are the activities that take place mostly within the house?
c. What is the most used space in the house?
2-What do you think/is your opinion regarding the house provided by the MOH?
a. How are the surroundings (accessibility, neighborhood, etc.)?
b. How satisfied are you with its planning/design?
c. What would you change in it if you could?
3-What are your future plans for the house?
a. How long do you intend to live in it / Do you consider moving?
b. Are you considering any future changes to be made?
4-What is the ideal house design for you in terms of (size, design, etc.)?
a. Will you consider living in a smaller size but better design (small architecture)?
b. Will you consider vertical housing/multi-story?
5-What do you think of flexible architecture techniques? (By showing pictures)
a. Have you heard of it?
b. Will you consider living in it?

Table 4: Interview instrument validity.

Research Question & Objectives points	**Interview Questions**
Investigate the existing solutions for housing and define their issues.	2,3
Look into the effectiveness of the solutions in satisfying the occupants and fulfilling their requirements.	1,2,4

Look into the effectiveness of the solutions in dealing with population growth and lack of horizontal space.	4,5
Explore the possibility of using flexible architecture and explore the participant's reaction to it.	5

3.6 Data Analysis

The data gathered in this research paper was analyzed using themes and Nvivo (Figure 5) software for analyzing qualitative data from interviews (Swygart-Hobaugh, 2019).

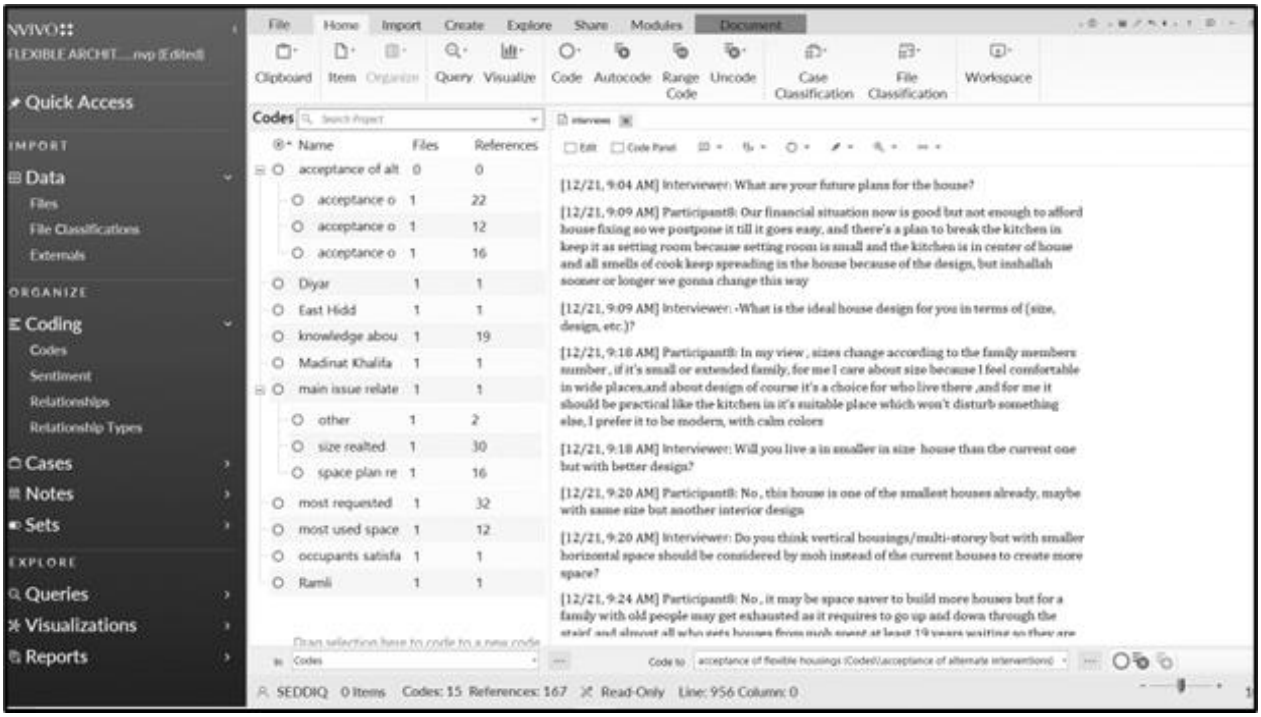


Figure 5. Nvivo themes.

Table 5: Nvivo codes table.

The main issue related to housing.	**Find the main issues and identify them.**
The main issue related to housing -Size-related issues.	Have a clear picture of the occupants' problems.
The main issue related to housing -Space plan-related issues.	Have a clear picture of the occupants' problems.
Other issues.	Have a clear picture of the occupants' problems.
Most used space in social housings.	To understand occupants' requirements for the aid in deciding upon a solution and aid in future research.
Most requested change or addition.	To understand occupants' requirements for the aid in deciding upon a solution and aid in future research.
knowledge about architectural interventions.	To investigate Bahrain's familiarity with such interventions.
Acceptance of smaller houses.	To explore participants' reactions toward smaller housing solutions.
Acceptance of vertical houses.	To explore participants' reactions toward vertical housing solutions.
Acceptance of flexible housing	To explore participants' reactions towards flexible housings.
Madinat Khalifa.	All Madinat Khalifa area participants. To classify each participant from which area to be able to find commonalities in problems based on different areas.
East Hidd.	All Diyar participants. To classify each participant from which area to be able to find commonalities in problems based on different areas.

Diyar.	All Ramli area participants. To classify each participant from which area to be able to find commonalities in problems based on different areas.
Ramli.	All Ramli area participants. To classify each participant from which area to be able to find commonalities in problems based on different areas.

4. Results and Discussion

4.1. Results

The purpose of this paper is to investigate the effectiveness of social housing in Bahrain and review the citizen's use of flexible architecture to solve social housing issues in Bahrain. It also finds how satisfied the occupants of the social housing units are from the houses and looks at how they react regarding flexible architectural interventions when compared with other alternatives. The results showed similar answers from the four different areas of social units. This shows that all four areas share similar characteristics and issues due to the mass production of similar houses. The data gathered from the detailed interviews are shown in (Table 6) based on the interview themes.

Table 6: The results.

Theme	Results
Issues related to housing	▪ Houses surface area is considered too small to fit the average family size. ▪ The houses are attached to each other, which gives no privacy and creates disturbance.
Issues related to space planning	▪ The inner courts are open and aren't private enough to satisfy the cultural privacy levels. ▪ Bedroom areas are too small to accommodate all pieces of standard furniture. Occupants go for smaller custom-designed furniture. ▪ The dining room and living room surface area is small. ▪ The number of bathrooms is not enough.
Other issues	▪ Kitchen and finishing materials provided are of low quality or don't suit the occupant's taste.
Most used space in social housing	▪ Living area and dining area
Most requested change or addition.	▪ Breaking walls to create larger room areas. ▪ Changes in the finishing materials of the kitchen, bathrooms, and flooring. ▪ Create extensions of the area to make bigger bedrooms. ▪ Build extra bedrooms.
Knowledge about new flexible architectural interventions.	▪ Low previous knowledge regarding new interventions.
Acceptance of smaller houses.	▪ Strong refusal to the idea of small architecture.
Acceptance of vertical houses.	▪ High acceptance of the idea of vertical architecture.
Acceptance of flexible housing	▪ Low acceptance of the idea of flexible housing.

4.2 Discussion regarding people's satisfaction with MOH houses

One of the objectives of this research is to explore the occupant's satisfaction with the MOH housing projects based on some of the factors stated in the literature by Amerigo & Aragones (1997) and Morris & Winter (1978). Almost all MOH housing occupants showed either minor or major dissatisfaction regarding the design of the houses. Most of their issues were size-related since it doesn't fit the typical Bahraini family's needs. They consider it to be small and even the number of rooms is not enough because, based on the existing options in this research, the MOH provides only 4 bedrooms and no other options. Most participants also had an issue with the number of bathrooms in each house and considered them not enough. the participants also showed that the most used space in the house is the living room which they stated was too small. Most Bahraini families are considered relatively big and spend most of their time in their houses or hosting family gatherings according to the interviews conducted. As a result, to the dissatisfaction many have invested in major expansion works and redesigning works to be able to make use of the house to the fullest.

4.3 Discussion regarding the possibility of using flexible housings in Bahrain

After exploring the owner's reaction towards flexible architectural interventions, it was noted that the use of flexible housing may be one of the solutions to the issues experienced by the occupants of the MOH houses like the use of multi-functional spaces to cut down the requirements for bigger surface areas (Figure 6). Nonetheless, the lack of knowledge regarding the intervention stands as an obstacle to its implementation. The participants were not so familiar with the idea of flexibility and stuck to the opinion of the need for larger areas and wider spaces. Some even criticized the flexible intervention as not suitable for the Bahraini community. What was found is that the opinions of the Bahraini locals with big spacious houses date back to the old traditional houses of Bahrain. Old Bahraini houses were spacious, open, and contained inner courts that aided in enhancing the quality of natural light and expansivity, which contradicts the characteristics of the houses provided by the MOH (AlAali, 2006).

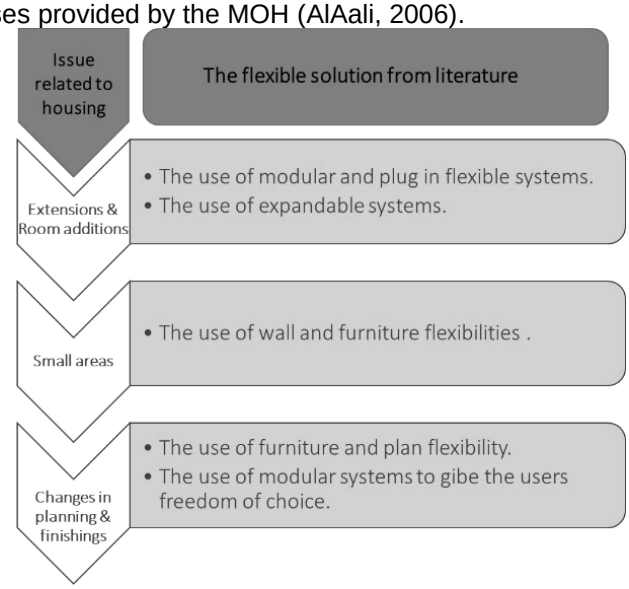


Figure 6. Issues and their potential flexible solution from literature.

Moreover, the occupants aim for and prefer larger houses because they think of their children's future living space within the house. The participants showed more preference for vertical housings than flexible houses (Figure 7) because it can increase the total build-up area of the houses, but they also had a concern regarding the horizontal area being compatible to fit all required furniture pieces efficiently. Although flexible architectural interventions are best suited for adaptability and expandable spaces, it is considered new to the Bahraini society. They showed a concern regarding new techniques, and the availability of their maintenance and did not trust them. They felt more comfortable with the vertical housing because it is a more familiar technique. They were not concerned with adaptability as much as size, so vertical housings can easily provide extra space for the future of their children. More research and local awareness need to be done in Bahrain regarding the various flexible architectural techniques to be possibly implemented.

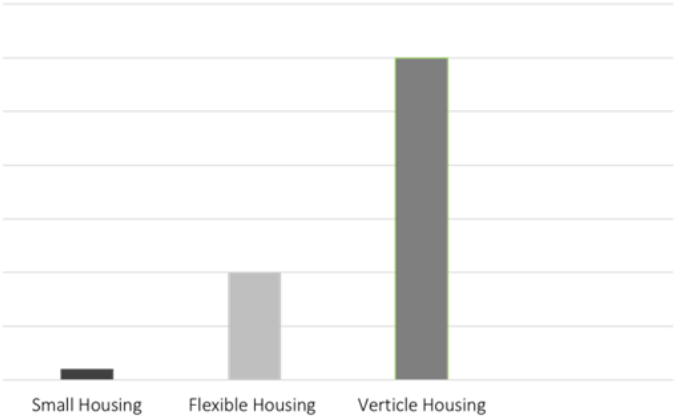


Figure 7. Participants response to various Architectural Housing interventions.

5. Conclusion

Looking into the effectiveness of social housing projects in Bahrain and exploring the potential of using flexible architectural interventions to solve these issues. It became clear that major dissatisfaction was noted from the interviews performed. The major reason for the occupant's dissatisfaction is the small area of the rooms and the houses as a whole. Furthermore, Bahraini families are considered big having fewer rooms and small domestic spaces affects their living quality and satisfaction in their homes. Having low satisfaction rates regarding the living space causes negative effects on the relationship between family members and the quality of life (Zimmering,2020). The interviews also highlighted the occupants' concerns with the future use and conditions in these houses. Since human life goes through continuous phases of change that affect their desires these changes are often reflected in living spaces (Voordt, 1990). It is highly significant to investigate people's quality and satisfaction in their living spaces, yet very little research has been done to explore the possibility of adaptable housing in Bahrain and the Gulf region. Flexible housing interventions are considered alien to the Bahraini community, and they prefer vertical housing over it. Although some flexibility techniques stated in literature can be beneficial for the current housing issues yet, the uncommonness of this topic and unawareness causes refusal. More extensive solutions should rapidly develop as the space resource is running short as time passes and more problems will arise due to housings and their sizes if no proper solution is addressed. Further studies should investigate the use of plug-in and modular flexibility techniques over MOH housings and provide practical and technical alternatives to the current designs. I hope this research inspires people within this field to look more into the quality of the lives of the people living in houses that are not satisfied with it and investigate implementing solutions extensively. The notion of mass production of social houses should come to an end and be replaced by more new sustainable interventions for the betterment of the community and the resources available.

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Conflicts of interest

The Author(s) declares(s) that there is no conflict of interest.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding authors/s.

Reference

AlAali, M. (2006). A House in Bahrain. Doctoral dissertation, (Virginia Tech.).

Alzeera, F. (2014). *The Implications of Planning Failure: Evaluating the Impacts of Land Reclamation Policies on Fishermen Communities in Bahrain*. USA: Columbia University. https://doi.org/10.7916/D8Q81B6H

MadanyBIEA, B. I. (2021, November 28). *Types of services and eligibility criteria*. Retrieved from Bahrain.bh: https://www.bahrain.bh/new/en/home_en.html

Campana, O., Chapman, P., Hampel, M., & Blasco, J. (2016). *Marine Ecotoxicology: Current Knowledge and Future Issues. Marine Ecotoxicology: Current Knowledge and Future Issues*.Elsevier.

Castro, F. (2018, April 3). *Expandable House / Urban Rural Systems*. Retrieved from archdaily: https://www.archdaily.com/891811/expandable-house-urban-rural-systems

Caves, R. W. (2013). *Encyclopedia of the City*. Routledge. https://doi.org/10.4324/9780203484234

Creswell, J. W. (2007). *Qualitative Inquiry & Research Design: Choosing among Five Approaches*. California, USA: Sage. ISBN: 9781412916073.

Creswell, J. W. (2014). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. SAGE Publications, Inc; 4th edition. ISBN: 9781452226101.

Galster, G. (1985). Evaluating indicators for housing policy: Residential satisfaction vs marginal improvement priorities. *Social Indicators Research, 16*(4), 415–448. https://doi.org/10.1007/BF00333289

Information and e-government Authority, (2020). Bahraini Population Census 2020. Manama. https://www.iga.gov.bh/en/

García,J., (2022). *How Can We Double the Living Space in Our Homes? BEYOME: The Flexible and Modular System with Robotic Furniture*. Archdaily. https://images.adsttc.com/media/images/6256/41e1/3e4b/3161/f200/0072/slideshow/BEYOME_Escena02_02.jpg?1649820078

Jordana, S. (2010). *Social Housing in Milan - studio wok*. Archdaily. https://images.adsttc.com/media/images/55e8/9b60/e258/4642/5b00/007f/slideshow/11_flexibility-diagram.jpg?1441307464

Jorge,J.(2011). *Open arch -smart home prototype*. Ecosistemaurbano. https://i.pinimg.com/564x/11/3a/a5/113aa5d03eab185e21cfbb4a0c3ded43.jpg

Kronenburg, R. (2007). *Flexible: Architecture that Responds to Change*. Laurence King Publishing.

Madany, I. M. (2021). *Dredging and reclamation activities in Bahrain*. Schweiz: ETH Zurich. http://doi.org/10.5169/seals-48505

McCombes, S. (2019, September 19). *An introduction to sampling methods*. Retrieved from scribbler: https://www.scribbr.com/methodology/sampling-methods/

MOH, B. M. (2017). *Promising achievements for a bright future. Manama: Bahrain Information & eGovernment Authority*. https://ministryofhousingstaticfiles.s3.me-south-1.amazonaws.com/reports/files/MOH+-+En+2017.pdf

Morris, E., & Winter, M. (1978). *Housing, Family, and Society*. John Wiley & Sons. https://doi.org/10.2307/351032

Oku, K. (2010). *The Architecture of Gerrit Rietveld*. Toto.ISBN: 4887062982

Bahrain e-portal. (2019). Housing. Retrieved from Bahrain.bh: https://www.bahrain.bh/wps/portal/!ut/p/a1/lZJLV8IwEIX_

Rossi, P. (1955). *Why Families Move: A Study in the Social Psychology of Urban Residential Mobility*. Glencoe: The Free Press.

Saraiva, S. S., Serra, M., & Furtado, G. (2017, July, 3-7th). *Bahrain-continuity and rupture: Traditional and subsidized housing in Bahrain*. Presented in the 11th International Space Syntax Symposium, Lisbon, Portugal.

Schneider, T., & Till, J. (2007). *Flexible Housing*. Architectural Press; 1st edition. https://doi.org/10.4324/9781315393582

Scuderi, G. (2018). *Designing Flexibility and Adaptability: The Answer*. Department of Civil Engineering, HZ University of Applied Sciences, Edisonweg 4. Designs. https://doi.org/10.3390/designs3010003

Stankard, M. (1998, May, 23-27th). *Re-covering Mies van der*. Presented in ACSA INTERNATIONAL CONFERENCE (pp. 267-271), Iowa State University. Ames, United States.

Schneider, T., & Till, J. (2005). Flexible housing: opportunities and limits. *Arq: Architectural Research Quarterly, 9*(2), 157-166.

Voordt, T. v. (1990). Building adaptable housing-From theory to practice. *Architecture & Behaviour, 6*(1), 17-38.

Rabeneck, A., Sheppard, D., & Town, P. (1973). *Flexible housing*. Architectural Design,698-732.

Swygart-Hobaugh, M. (2019). Bringing method to the madness: An example of integrating social science qualitative research methods into NVivo data analysis software training. *Iassist Quarterly, 43*(2), 1-16. https://doi.org/10.29173/iq956

Hertzberger, H. (2005). *Lessons for students in architecture*. (Vol. 1). 010 Publishers.

Zimmering, R. (2020). *Living in a World of Nation States as Dissatisfied and Threatened Citizen and the Search of a Way Out*.Presented in Conference series „Living in a World of Nation States “6-7 December 2019 at ISCTE-IUL Lisbon, Portugal (p. 17).