SOCIAL HOUSING ASSESSMENT FOR SUSTAINABLE MODEL DEVELOPMENT: CASE STUDY RAS AL KHAIMAH, UAE

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ABSTRACT

Objective: This study discusses the requirements of social housing that are adaptable to the local culture, affordable, resilient, and inclusive by proposing a prototype of a social housing unit.

Method: Through observation in Ras Al Khaimah, United Arab Emirates (UAE), evaluation of the social housing conditions, authors design criteria for culturally adaptive social housing that is affordable, resilient and inclusive and compare the existing social housing against the designed criteria.

Results: As a result of the research, model of social housing that considers the environmental, economic, and social aspects of sustainability is suggested to comply with Emirate's strategy to enhance the sector of social housing.

Conclusion: The study concludes with the following recommendations: Accessibility to information related to the study, evaluation of the existing housing conditions, governmental support to the private sector implementing affordable housing projects, and predictions for upcoming work in the field of affordable and sustainable housing are important for the transition to more sustainable housing programs. This study creates a database and forms a base for future research in the field of sustainable housing programs in the UAE.

Keywords: social housing, environmental adaptability, resilient housing, housing programs, sustainable housing.

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RESUMO

Objetivo: Este estudo discute os requisitos de habitação social que são adaptáveis à cultura local, acessíveis, resilientes e inclusivos, propondo um protótipo de uma unidade de habitação social.

Método: Através da observação em Ras Al Khaimah, Emirados Árabes Unidos (EAU), avaliação das condições de habitação social, os autores projetam critérios para habitação social culturalmente adaptativa que é acessível, resiliente e inclusiva e comparam a habitação social existente com os critérios projetados.

Resultados: Como resultado da pesquisa, o modelo de moradia social que considera os aspectos ambientais, econômicos e sociais da sustentabilidade é sugerido para cumprir a estratégia do Emirado para aprimorar o setor de moradia social.

Conclusão: O estudo conclui com as seguintes recomendações: Acessibilidade à informação relacionada ao estudo, avaliação das condições habitacionais existentes, apoio governamental ao setor privado implementando projetos habitacionais a preços acessíveis, e as previsões para o próximo trabalho no campo da habitação acessível e sustentável são importantes para a transição para programas habitacionais mais sustentáveis. Este estudo cria um banco de dados e forma uma base para futuras pesquisas no campo de programas habitacionais sustentáveis nos Emirados Árabes Unidos.

Palavras-chave: habitação social, adaptabilidade ambiental, habitação resiliente, programas habitacionais, habitação sustentável.

1 INTRODUCTION

Speedy urbanization and population growth puts pressure on urban infrastructure and housing communities’ development. Subsequently, the urban infrastructure as well as housing are often insufficient and do not comply with the Seventeen Goals for Sustainable Development set by the United Nations in 2015 (see, UN, 2015). Modern cities and housing communities became almost entirely car-dependent, and rely mostly on fossil fuels for their functioning (see, Shelter, 2021; Sutrisno, 2023, p.3). According to the statement by the Office of Policy Development and Research (2022), residential construction is responsible for approximatively 10 percent of the total global energy consumption. The energy that is required for manufacturing, transportation and construction mainly comes from non-renewable resources. Looking at the U.S., as an example, when built, the residences are accountable for 19 percent of the country greenhouse gas emissions. Therefore, the way the housing is developed must change to comply with UN Seventeen Goals of Sustainable Development, as well as with Paris
Agreement on Climate Change that aims to limit global warming. Considering the above, it is possible to predict the key solutions for affordable housing. As per the eleventh Sustainable Development Goal, the human settlements/housing must be resilient, safe, inclusive and sustainable (see, UN, 2015; Gillard et al, 2018; Garrefa, 2021, p.151; Abdulkadir, 2022, p. 2). The Build Change Guide (2021) defines resilient housing as:

- Unaffected by disaster: provides protection for inhabitants and assists from hazards;
- Livable and safe: provides adequate comfort and security;
- Affordable: financially accessible for low & middle-income users;
- Constitutes an asset for the users: it is a good as an investment;
- Sustainable: has a minimal impact of environment;
- Adaptable: capacity to be expanded and retrofitted;
- Locally suitable: built for local climate and culture;
- Scalable: able to meet diverse users while the situations and technologies are changing.

To summarize it all, resilient housing must provide the basic needs to the members of the community as well as protection and must allow growth and development (see, Vale, 2014, Shama, 2020). As the population and communities grow, a question arises – How to accommodate the needs of increased population and provide them with accessible, equitable housing along with adequate level of infrastructure and services (see, Jones, 2017)? The answer to the question is – housing transformation is required in the following three main domains: a) Population – desire and demand for their homes to be improved that requires also support and motivation by the government to be provided; b) Money – the population must be financially able to improve their homes, and, when it comes to the low-income families, government support is needed in form of incentives/subsidies; c) Technology – the population must have access to the most advanced locally available that are also cost-affordable technologies (see, The Build Change Guide, 2021). This paper will consider these domains to assess the situation of social housing programs and initiatives in Ras Al Khaimah, UAE.

Ras Al Khaimah (RAK) is located in the far north of the United Arab Emirates. The population of this Emirate is expected to be 603,00 inhabitants by 2025 (see, Farrington, 2015). Most of the residents live in the urban area of the emirate, while some, mostly local citizens, live in the outskirts of the city. In the recent years, many expats...
have resided in RAK, which attracts them because of many reasons, such as inexpensive living standard, less population compared to the neighboring emirates, Dubai, Sharjah and Ajman. Since the majority of the city residents are foreigners and expats, it is vital to consider their housing needs and mostly affordability. This could be offered as part of the provision of social housing strategy of the Emirate. To conform with the global sustainable development agenda, it is vital for this emirate to include the sustainability and resiliency as a core part in the programs for offering divers population with housing projects to meet the long-term sustainable development goals. Moreover, affordability and sustainability are now vital considerations in the international development debate for housing the poor in developing countries in order to meet the long-term sustainable development goals and needs of housing inhabitants (see, Bruen et al, 2013, p.1220).

For the purpose of this paper, housing will be used not only to imply the residential unit, but it will include the physical and social domain of group of residential units that constitute a neighborhood. This paper will address the need for affordable and sustainable residential models for the social housing projects. For the purpose of this paper, social housing refers to public housing programs offered by the local government or private organizations.

2 THEORETICAL FRAMEWORK

This chapter of the research is defined, as the first stage, during which the existing housing is studied and community needs and readiness for sustainable housing are assessed.

Ras Al Khaimah is the fourth emirate in terms of size and population in the United Arab Emirates. Because of the tourism and agricultural potentials, it is considered as a fast-growing emirate. The urban expansion of RAK went through different trajectories during the past four decades. From 1984 to year 2000, the city grew mostly on the southeast direction along Sheikh Mohammad bin Rashid Al Maktoum Street and along the coastal line on the north direction. Beginning from 2008, the urban fabric witnessed a dramatic expansion in the area between Al Maktoum Street and Sheikh Mohammad Bin Zayed Road and continues further to the south and southwest part of the city. The expansion contained mostly new residential areas, along with recreational and industrial zones (see, Agrawal, 2018). A number of residential projects are proposed in the emirate. According to Property Finder’s article, published in its blog in 2022, around 3,160 homes
will hit the market in four years. However, they are mostly concentrated in the new part of RAK (Mina Al Arab, Al Hamra Village and Al Marjan island). These areas seem to be more of touristic destinations and populated mainly by expat residents or tourists.

RAK is seen as a potential affordable destination for the residents, who live in the mid and northern part of the UAE, particularly the expats. As per Ras Al Khaimah Structure Plan of 2004, the total number of the households in the emirate was 108,710, 16,490 are for nationals and 92,250 were for the expats. As the economic and job opportunities in the emirate increase the number of foreign nationals increases. This increase resulted in placing more demands on housing. Many expatriates choose to reside in this emirate because of the relatively low cost of living and more job opportunities.

Most of the housing options is based on real estate and renting. Ownership opportunities for foreigners is allowed only in the free zone areas. For the blue-collar workers, they live in collective accommodation with unhealthy unsustainable situations. The current approach to housing needs to be reconsidered to address the housing shortage. Design and construction principles ought to be included by avoiding the conventional and unsustainable construction techniques (see, Bruen, 2013, p.1220). In order to reduce the environmental effect because of the vast scale of the housing sector. Thus, in order to appropriately address the housing shortage, it is vital to look for affordable and sustainable models.

Housing is one of the core elements of the structure plan of RAK 2004. The condition of the existing housing is assessed along with an assessment off the ongoing demand for residential land use is a core part of the structure plan. The main objective is to accommodate the needs of local residents as well as the expats. The Emirate’s structure plan envisions housing strategies for the nationals in separation of those for the expatriates. Providing adequate and suitable housing for every citizen in society is more than addressing the basic human need for shelter; it is about addressing the comprehensive social, environmental and economic problems (see, Nassar et al, 2021, p.1048). The importance of the provision of the affordable and adequate housing: is essential to well-being and it provides economic and social stability to the residents (see, Bredenoord, 2016, p.158). Although many official documents indicate that an adequate housing is a legitimate right for every Emirati, particularly who are in the low-income bracket, Al-Mansoori (1997) and Agrawal (2018, p.7) argue that there is a lack in defining what are the criteria of adequate housing and the households’ principle needs. Affordable housing
programs, which are offered by the government, are mostly for the Emiratis. Examples (see, figure 1) of these programs are: the Sheikh Zayed Housing Program (SZHP), the President’s Initiative (PI). The governmental assistance with regard to housing is embedded in the state’s constitution, which guarantees improved living standards and quality of life for every Emirati. Article 10 and 24 of the UAE constitution affirm “the provision of better life for all citizens” and “the raising of standard of living” respectively.

The urban expansion and the population growth were deemed to be unsustainable. According to Agrawal (2018, p.7) the expansion of two-storey modern villa type housing projects, mostly supported by the housing programs for the local, added to the notion of the urban sprawl. He adds “Population distribution patterns show non-contiguous development, with sporadic low-density residential development that includes leapfrogged higher density regions” (see, Agrawal, 2018, p.7). Among the recommendations of Agrawal’s study of the provision of affordable housing of Ras Al-Khaimah is the insistence of the collaboration between the Emirate’s municipality and the housing programs in order to advance the housing standards to include green sustainable building techniques in the housing developments and projects to be more environmentally responsive and resource efficient. Moreover, the study strongly recommends that RAK Municipality encourages more compact development than the single detached villa type housing projects. The proposed housing projects should include public amenities and services such as educational and healthcare facilities in order to ensure implementing “complete community” planning approach which will lead to resolving the economic and social challenges (Agrawal, 2018, p.8). Table 1 shows the assessment of the housing programs in the emirate based on the criteria of evaluation proposed in this study.
Table 1. Existing housing program assessment

<table>
<thead>
<tr>
<th>Assessment criteria</th>
<th>Evaluation results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Willingness of the political leadership to improve existing social housing</td>
<td>Political leadership interested in and willing to engage in improving existing housing for local residents, particularly for citizens who are offered with diverse housing programs (Existing social housing programs target local residents only)</td>
</tr>
<tr>
<td>Availability of data of existing social housing vulnerability and hazard exposure</td>
<td>Quantitative and qualitative research shows that there isn’t social housing deficit; social housing lacks vulnerability and exposure to hazards (Social housing is available to all local residents; and build on safe areas)</td>
</tr>
<tr>
<td>Community acknowledgment for a need of resilient locally adapted social housing</td>
<td>According to the literature survey, the local community acknowledge the need of resilient and adapted to local culture social housing (Available local housing is design without consideration of local climate and some consideration of culture)</td>
</tr>
<tr>
<td>Community needs such as medical care, food security, water and sanitation, livelihoods, crime are addressed</td>
<td>Yes, on the district or emirate level, but little on the neighborhood level of the housing programs (Community needs requires reconsideration and improvement)</td>
</tr>
<tr>
<td>Availability of social housing improvement program</td>
<td>Some refurbishment configurations have been used in social (public) housing villas. Upgrading of some important construction elements/materials such the wall, roof insulation and glazing (see, Abu-Hijleh et al, 2017, p.249).</td>
</tr>
<tr>
<td>Ability to meet the cultural needs</td>
<td>Yes, consideration for privacy and accommodation of extended family scheme.</td>
</tr>
<tr>
<td>Types of existing proposed social housing</td>
<td>Detached Villa type</td>
</tr>
<tr>
<td>Types of structure and materials used</td>
<td>Conventional reinforced column, beam and slab structure</td>
</tr>
<tr>
<td>Housing common size, shape, number of stories, layout</td>
<td>One-storey, Duplex and Triplex on 500 – 1000 m2 land plot</td>
</tr>
<tr>
<td>Availability of bath, kitchen, toilet</td>
<td>A number of bathrooms and toilets and relatively big kitchens are available (Barjeel)</td>
</tr>
<tr>
<td>Common cultural, architectural climate adapted features</td>
<td>Some consideration of local architectural features such as wind catchers (Barjeel)</td>
</tr>
<tr>
<td>Type and quality of construction materials</td>
<td>Medium to good quality</td>
</tr>
<tr>
<td>Availability of materials locally</td>
<td>Many construction materials are manufactured and produced in the UAE</td>
</tr>
<tr>
<td>Affordability of construction materials</td>
<td>Construction materials are relatively affordable compared to other GCC countries (Statista Research Department, 2023)</td>
</tr>
<tr>
<td>Availability of skilled workforce</td>
<td>Skilled construction workers and technicians are available (Statista Research Department, 2022)</td>
</tr>
<tr>
<td>Common construction techniques and systems</td>
<td>Conventional concrete and brick construction system.</td>
</tr>
<tr>
<td>Involvement of architects and engineers as consultants</td>
<td>Yes, architects and engineers are extensively involved in the housing sector.</td>
</tr>
</tbody>
</table>

Source: Authors analysis (2023)

As previously described, in RAK existing housing program target local (Emirate) population only. However, according to the statistics the ratio of local population to expat is 11.48% to 88.52% (Statistics, 2023, Statista Research Department, 2022&2023). Most of the expat population are labor forces and reside in old traditional houses, that are shown in figure 2a and 2b.
The old traditional houses (that are currently used as labor housing) were well suited for the local environment, build of local materials and by local craftsman and the cultural partialities for privacy were considered in design (see, table 2). However, the site observation shows that the old traditional houses were altered to accommodate the labors’ needs. For alterations, new materials and construction techniques were used. It also shows that even though the essential needs of labors for cooking, bathing and toilet are met, the housing does not meet the requirements for comfort, privacy and socializing.
Table 2. Labor housing assessment

<table>
<thead>
<tr>
<th>Assessment criteria</th>
<th>Evaluation results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to meet the cultural needs</td>
<td>Yes, the housing meets the cultural needs (The labors are living in old houses that were designed to meet the cultural (including privacy needs))</td>
</tr>
<tr>
<td>Types of existing social housing</td>
<td>Old traditional houses (due to the relocation of local population to modern residences)</td>
</tr>
<tr>
<td>Types of structure and materials used</td>
<td>Structure – loadbearing walls, Materials – wall made of sun-dried bricks consisting of limestone and coral, roofs spanned with timber.</td>
</tr>
<tr>
<td>Housing common size, shape, number of stories,</td>
<td>1storey build around the inner courtyard, The number of rooms depended on the family members number and the wealth of the family (The houses were rearranged to accommodate large numbers of labors)</td>
</tr>
<tr>
<td>layout</td>
<td></td>
</tr>
<tr>
<td>Availability of bath, kitchen, toilet</td>
<td>Basic, communal kitchen, bath, toilet (The houses are equipped with kitchens, baths and toilets, however, the facilities are not enough as the hoses are densely populated)</td>
</tr>
<tr>
<td>Common cultural, architectural, and climate adapted</td>
<td>What are common architectural, cultural, and climate preferences? (Sun-dried bricks (walls) consisting of limestone and coral perfectly suits the local harsh climate, and the porous corals allows the breeze to penetrate the building and cool it down)</td>
</tr>
<tr>
<td>features</td>
<td>(Openings facing the inner courtyard and mushrabia screens (for privacy) (For the labors, the price of materials is too high to afford)</td>
</tr>
<tr>
<td>Availability of materials locally</td>
<td>The original materials were available locally and produced locally (The materials employed for houses extensions differ from original ones)</td>
</tr>
<tr>
<td>Affordability of construction materials</td>
<td>Construction materials were locally produced and are of affordable price  (However, the extensions to the houses are done by expat labors and with the employment of modern techniques and materials)</td>
</tr>
<tr>
<td>Availability of skilled workforce</td>
<td>Built by the local craftsman using traditional construction techniques. These building techniques were passed down from generation to generation (For alterations, no architects or engineers as consultants are employed)</td>
</tr>
<tr>
<td>Common construction techniques and systems</td>
<td>Houses were built by the owners themselves</td>
</tr>
<tr>
<td>Involvement of architects and engineers as consultants</td>
<td>Local craftsman were employed if the owner could afford (For alterations, no architects or engineers as consultants are employed)</td>
</tr>
</tbody>
</table>

Source: Authors analysis (2023)

4 METHODOLOGY

According to the Build Change Guide (2021), the Resilient Housing Programs should undergo four stages: Initiation; Planning; Implementation; and Closure. The first Initiation stage of any resilient housing program, studies of the existing housing context should be thoroughly examined in order to identify the gaps, challenges and opportunities, and proposes solutions. The second stage – Planning, clarifies the program scope and defines the implementation model. The Implementation stage, the third stage, specifies subsidies that are allocated and the improvements to the housing is executed. The final stage – Closure – is the formal completion of the program, during which changes are recorded, and legal/financial obligations are closed. This research will focus on the first stage only – Initiation, during which lessons learned from the past and current housing in RAK will be analyzed and a demonstration project proposed. Therefore, the overall
readiness and/or demand for social housing and city/neighborhood context will be assessed, lessons learned from the demonstration project will be analyzed.

Considering the description above, this research is divided into two steps and applies two different research methods – qualitative and experimental as seen from the figure 3 given below. During the first step of the study that is described in theoretical framework chapter, a qualitative research method is applied that will help in assessment of overall readiness and community demand for resilient social housing and city/neighborhood as well as existing social housing. This will be done through examining the relevant literature and regulations, and conducting site observations. The second step of the research – experimental (described in results and discussions chapter) proposes a demonstrational project of a resilient housing adapted to the local cultural needs. During this stage the model housing is also assessed in term of meeting the set criteria categorized as people, money and technologies.

![Figure 3: Conceptual model](source: Diagram by author Liudmila Cazacova (2023))

5 RESULTS AND DISCUSSIONS

This chapter of the research presents the experimental stage of the project, where a demonstrational social housing model is proposed with its further assessment against the set criteria.

The proposed sustainable residential block in this study is designed by one of the authors among her work about affordable housing design in the UAE (see, Nassar et al, 2021, p.1048). It has been modified to address the climatic and the socio-cultural aspects highlighted in this study. It is suggested that an economical house of 60 m2, which is
suitable for a family of 4 members, will be part of a three-storey apartment building that consists of six houses, two in each floor (see, figure 4).

Figure 4: Proposed model elevations showing mushrabia screens for privacy provision

![Figure 4: Proposed model elevations showing mushrabia screens for privacy provision](image)

Source: drawing by author Fathia Elmenghawi (2023)

The house contains a common central area for living and dining (~20 m²), two bedrooms (~10 m²) and (~9.5 m²), a kitchen (~8.5 m²), and a bathroom (~3.5 m²) (Figure 5). These spaces are organized according to the design standards, and to fulfil users’ activities and social values (see, Mzoori, 2014). For instance, the openness of the main living area allows the family to eat and socialize in one space. Moreover, the house components are architecturally arranged to ensure two main principles; functionality and design efficiency. With regard to functionality, minimum functional amount of required area for each component is efficiently incorporated. In order to maintain efficiency in circulation and to minimize the circulation area, the living/eating room is directly linked to the kitchen, the bathroom. One of the bedrooms is directly open into the living space, yet the other one is placed closer to the bathroom for privacy purposes to be more suitable for parents. The design efficiency has been also achieved by locating the wet areas (kitchen and bathroom) adjacent to each other to reduce the amount of plumbing work and drainage. Additionally, a balcony has been included in the design to provide the residents with an outdoor space for social activities and hygienic purposes.
In addition to the proposed architectural design features, deemed to be sustainable and resilient, the designer took into account the consideration of these aspects on the scale of urban design by suggesting an arrangement of a number of the proposed apartment buildings within the neighborhood context. Figure 5 shows the alignment of ten proposed apartment buildings containing 60 housing units. The layout illustrates the importance of the climatic and social factors in the orientation and positioning of this proposed model of social housing. More blocks (six) are located parallelly in order to benefit from the best north-south orientation to reduce the exposure to the direct sun. The remaining four blocks are oriented perpendicularly to have more openings on the east side and shading devices (mushrabia) have been installed to minimize the effect of the intensive sun rays from the west side. The mushrabia will also address perfectly the consideration for privacy. Shaded pathways from the car-parking area to each block are provided for more environmental comfort. Moreover, a shaded area (gazebo) is provided in front of each block to allow for outdoor social interaction among the residents. The shadow casted on the ground from the long parallel blocks will not only reduce the heat in the area between the blocks but it will also offer shaded areas for children to play and residents to interact.
As a continuation of experimental stage of the research, the proposed model of social housing was compared against the set criteria. The results of this comparison shows that the design respects the local culture and suggests privacy to the residents, considers the local climate, it’s functional and affordable (see, table 3).

Table 3. Assessment of proposed social housing model against the set criteria

<table>
<thead>
<tr>
<th>Assessment criteria</th>
<th>Evaluation results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to meet the cultural needs</td>
<td>Yes, consideration for privacy and indoor and outdoor socialization</td>
</tr>
<tr>
<td>Types of proposed social housing</td>
<td>Medium-rise apartment buildings</td>
</tr>
<tr>
<td>Types of structure and materials used</td>
<td>Materials available and produced locally</td>
</tr>
<tr>
<td>Housing common size, shape, number of stories, layout</td>
<td>Functional 60 m², well-organized spaces in a simple shape, 3 stories, efficient layout arrangement</td>
</tr>
<tr>
<td>Availability of bath, kitchen, toilet</td>
<td>Minimum functional wet areas</td>
</tr>
<tr>
<td>Common cultural, architectural climate adapted features</td>
<td>Spatial organization according to local culture, simple architectural style with consideration for passive design approaches adapted to the climatic conditions.</td>
</tr>
<tr>
<td>Type and quality of construction materials</td>
<td>Recycled aggregate concrete and concrete masonry bricks produced with partial replacement of cement with fly ash (Nassar et al, 2021)</td>
</tr>
<tr>
<td>Availability of materials locally</td>
<td>The market is increasingly providing sustainable and green building materials</td>
</tr>
<tr>
<td>Affordability of construction materials</td>
<td>In general, construction materials are available, yet sustainable construction materials are still costly.</td>
</tr>
<tr>
<td>Availability of skilled workforce</td>
<td>Skilled labor is attracted to the stable and promising economic opportunities made available by the government</td>
</tr>
<tr>
<td>Common construction techniques and systems</td>
<td>Conventional concrete and brick construction system.</td>
</tr>
<tr>
<td>Involvement of architects and engineers as consultants</td>
<td>Yes, architects and engineers are extensively involved in the housing sector.</td>
</tr>
</tbody>
</table>

Source: Authors analysis (2023)

6 FINDINGS

The provision of affordable and sustainable housing is mostly influenced by the design of the housing units and their alignment in the urban context. According to Bruen et al (2013, p.1220), the most important aspects in relation to the design are the good selection of the construction material, and the use of proper innovative technology peculiar to the geographical context where the housing projects are to be proposed. Architectural design of the housing units influences the users who experience it as well as affects the built environment in general (see, Hiller, 1996, p.26). Conversely, the built environment provides possibilities and limitations for the architectural design. Therefore, it is important to look for means to integrate humans and buildings within a “socio-technical system,” an approach that combine technological and social innovations within the design for sustainability (see, Marchesi et al, 2020). Hiller (2012, p. 24) asserts that the built environment (city) is deemed as a socio-technical system which constitutes of two interrelating systems, physical and human systems. The former is interpreted as buildings that connected with infrastructure and street network, and the latter as users, interaction, and activities. Thus, the proposed housing unit in this paper considers the integration of the architectural design with the surrounding built environment to create socio-cultural interaction to conform with the social aspects of sustainability.

The architectural design of the proposed housing unit considers also the environmental sustainability based on the notion that the design significantly contributes to the building’s energy performance (see, Pacheco, et al, 2012, p.3559). Functional layout, which is the organization of the living and service spaces within the housing unit, is one of the major features of the architectural design of the housing unit. Residential unit layout comprises of the following design variables: function allocation, space form and dimensions (width, length, and height), and the placement of openings on the interior
and exterior walls. Considering all these design variables in the design of affordable social housing will not only enhance the functionality of the usable spaces, but will also increase their energy efficiency (see, Du et al, 2020, p.1).

Addressing the immediate need for social housing should parallelly consider addressing the long term environmental, economic and social sustainability of the targeted communities (see, Winston, 2021, p.191). The main aim of this research through experimentation is the consideration of cultural needs in social housing design. Therefore, the proposed demonstrational model shows those considerations through blocks layout, spaces allocation, open space, balconies and mushrabia screen shielding the interior spaces from the passersby. The proposed model considers also all aspects of sustainability on the architectural as well as on the urban scale. Therefore, the allocation of the apartment buildings is proposed on light of the environmental and social aspects. On the environmental level, the block’s layout took into account the energy efficiency by orienting most of the blocks into the best orientation according to the UAE climatic conditions. Passive design approach that matches the sun path is followed in order not only to reduce the indoor solar gains, but also to provide optimum shading for the outdoor spaces (see, Nassar et al, 2021, p.1048). The landscape between the residential blocks is also enriched to solidify the concept of passive design. Trees with full leaves will be planted to block the low direct sunlight coming to the building, especially from the west and south.

On the social level, the physical and non-physical aspects of the residential environment are deemed as important determinants for residents’ satisfaction with their housing conditions (see, Jung et al, 2022, p.1). These aspects significantly contribute to enhancing the characteristics of social environment of the residential blocks. Therefore, outdoor spaces are organized between the residential blocks not only to augment the physical features but also to increase the residents’ social interaction. These spaces will provide the residents for more opportunity to meet and socialize, which is one of the forms of social interaction that contribute to community building among neighbors. According to Shehayeb et al, (2007, p.13), community building is a result of co-residents’ formulation of common and shared interests. This can be achieved through the provision of communal spaces where neighbors can construct their social values. The spatial form of the built environment affects the neighbors’ relations on different aspects, such as shared responsibility for maintaining communal space and sustaining its safety through
surveillance and monitoring. “The more the residents use neighborhood spaces and streets, the more they know each other, the more control they acquire over the built environment, the less likely strangers go unnoticed in the neighborhood.” (see, Shehayeb et al, 2007, p.13).

7 CONCLUSIONS

Adequate and affordable housing for all residents is a core principle in the UAE strategic planning. The population growth and the economic progress that the country has been experiencing are the main reasons for the increasing demand for construction of housing units. To meet the long-term sustainable development goals and to meet the housing demands, affordability and sustainability have to be the main focus in the housing sector in the UAE as it is in the international development debate for housing the poor in developing countries. Moreover, the integration of affordable and sustainable housing in the urban built environment of RAK will contribute to the implementation of the United Nations’ SGAs. As the eleventh Sustainable Development Goal states that the human settlements/housing must be resilient, safe, inclusive and sustainable (see, UN, 2015; Gillard et al, 2018). This research suggests inclusion, and particularly social housing for the expat population that are not currently included in RAK social housing programs.

Housing programs and options, particularly affordable housing programs for the low-income bracket, have to be implemented with inclusiveness resiliency, and sustainability approaches. Thus, all stakeholders, whether public or private should tackle the housing sector with a financially and ecologically sustainable mindset. The UAE government provides incentives and housing programs for the local citizens. However, for the expatriates, housing options are more offered by the private sector and developers. This study proposes a model of affordable, resilient, inclusive and sustainable housing that mainly targets the expatriates who are from a low-income bracket. An assessment scheme is suggested to evaluate the consideration for the economic, environmental and social aspects of sustainability in the existing housing programs and the proposed housing unit. The assessment of the model also demonstrates that the housing is sustainable, adaptable, and provides its future residents with adequate economic security as well as environmental comfort.

The proposed demonstrational model of sustainable housing is designed with respect to the local culture and climate. It is also scalable and is able to meet the needs of
diverse expat population of RAK. It will be accessible for low and middle-income population and will make a good investment. The suggested model could be part of either the public or private sectors’ programs that aim at providing low-cost housing to the low-income and migrant workers. It could be offered as Affordable Rental Housing Complexes that combines themes of affordability and sustainability.

Although the proposed residential unit offers a practical solution of affordable housing, the study has recognized its limitations. The suggested design provides efficient, resilient, inclusive, and sustainable prototype of housing for low-income expatriate residents; however, it could be built in low-density areas only. The proposed residential block is not feasible for high density in sort of high-rise building. Adding more stories will involve providing elevators, which will add to the cost of construction and maintenance.

The study concludes with the following recommendations:

- Accessibility to information related to the study: Access to information is one of the obstacles in conducting research related to the planning and design of social housing in Ras Al-Khaimah. It is vital to involve local citizens researchers and the city officials and institutions in the research of such topics. Their input will be valuable to include the cultural and social aspects and it is relation to the looking for modernity and innovation in the housing sector.
- Evaluation of the existing housing conditions: Pre- and post-occupancy studies are important to create a clear vision for the future of affordable housing trajectories, choices and preferences. The documentation of these studies will create a concrete database for the future research in this field.
- Governmental support to the private sector implementing affordable housing projects: The government plays a great role in integrating affordable and sustainable housing through the enforcement of legislations and policies that address these themes in the housing projects implemented by the developers. Incentives should be offered to those who are eager to enhance cost effectiveness, inclusiveness and sustainability in their projects.
- Predictions for upcoming work in the field of affordable and sustainable housing: As mentioned earlier, this study completes the first stage (Initiation) of the four stages of resilient housing programs (Initiation, Planning, Implementation and Closure), which are proposed by the Build Change Guide (2021). This forms
a base for future research that will focus on the Planning stage that will clarify the program scope and define the implementation model. Additionally, future studies must be conducted to investigate other emirates with a broader scope for UAE. This will contribute to updating a comprehensive policy for affordable housing to include the noncitizens in the UAE, where currently there are housing programs only for the local citizens.
REFERENCES


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