An Evaluation of Space Use Efficiency in Residential Houses, Kabul City

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ABSTRACT

Space efficiency is one of the significant segments of building that requires consideration. This study focuses on the evaluation of space use efficiency in existing residential buildings and seeks to look at the current space use practices in interior design. The study analyzes (1) how the interior space of buildings is used. (2) Considering the architectural guidelines to evaluate the space deficit of buildings. Therefore, the study takes the form of a literature review, with direct observation used for data collection. A total of six residential houses were observed, with interior space dimensions and areas measured using measurement tools. Comparative analysis is a technique used for data analysis. The findings of this study revealed that most residential buildings are not meeting space use regulations and standards ascribed to not considering the interior design process and governmental building guidelines. Most of the constructed buildings were not properly designed, the architectural design procedure was not considered. The study concluded with suggestions for raising public awareness about architectural design significance, imposing governmental regulation and building laws, and eradicating nonengineered construction in the city. Findings will serve clients and municipalities; policymakers should concentrate on public awareness and imposing building laws to ensure affordable houses in Kabul city.

Keywords- Space efficiency, Evaluation, Deficiency, Interior Spaces, Residential Houses, Kabul city.

I.   INTRODUCTION

As urbanization continues and more people move into cities and urban areas, pressure on available land for new construction will continue to increase. This situation constitutes an incentive to review the need for interior space and the uses of existing buildings. A great deal can be gained from using existing buildings more efficiently [1]. Space efficiency and programming have certainly become recognized areas of expertise essential to the design process. When a client seeks to build a new building, for example, the team most likely includes a professional space planner with educational experience and expertise.

Today, there are entire design practices built upon the specialized skills required to undertake the programming and space planning for residential buildings. It is important to note that architecture, space planning, and the decorative arts are inevitably reflections of a way of life. Before attempting to reconstruct ancient buildings and spaces, one must be aware of how these structures or spaces were used, and how men, women, and society in general behaved in them. In ancient societies, the size of rooms and enclosed spaces was determined by several factors. These include engineering limitations and social-motivational factors [2].

After the course, I realized the importance of the research-methodological approach to real design projects. Rather than finding examples and design solutions and simply putting these into design, research focuses on how different architectural approaches appear and how they change people's lives. Normally, solutions from existing buildings won't adapt well to a new

building if we just apply them the same way to the project. Research, on the other hand, helps us find the reason why existing solution is establishing and how it works. By the output of research existing solutions can be transferred to new approach which is much more suitable for new project. [3]

The literature review examined space measures and concepts of space efficiency currently used in the KABUL and internationally. We looked at space standards that have been applied to different disciplines, the development of room utilization measures, and increase space efficiency. Space standards are commonly used as a guide for design, measured by discipline or function, and for residency space, by seniority and role.

Efficiency of net-to-gross floor area is the key to balance construction costs and total rental values. When material choice and issues of efficiency of structure and services are integrated to assess the various options, more space-efficient solutions can be reached. Höjer and Mjörnell (2018) explore a new principle for reducing the resource use of buildings and combine this with a structured approach to discussing how interior space can be more efficiently used.

Rebuilding can be a way of creating more useful space through the adaptation of existing buildings and the renovation of attics and basements into living spaces. so that the space created can be used efficiently and is flexible in relation to future needs [4].

Ma (2015): According to the aim of research, new innovative typologies come with limited space situations and high land prices, so one basic research condition is to improve space efficiency with fixed floor proportions. increase space efficiency in two main ways [5]. One is reducing personal space consumption, which makes the same space contain more people; people also get lower costs because they occupy less space; and the other is increasing the use time of the space, which decreases special waste and reduces price [6].

Kim and Elnimeiri (2004) are focused on understanding the space issues that are generated by stacked functions in multi-use tall buildings. This space efficiency is simply referred to as the ratio of rentable area over gross area, and it depends on the core area of the building [7]. Chiddick (2006): This report describes the outcome of research into the role of building design in space efficiency [8]. The concept of usable space and its relationship to "balanced" areas and/or net internal area are critical when seeking space efficiency. Therefore, the space efficiency of any building relates to three factors: The quantity of space is generally calculated in terms of floor area, though occasionally volume may also be relevant.

The number of users, potential and actual, and the amount of time the space is used [9] Baessa and Hassan (2019): The study concept is that the traditional houses in Shibam have a good house design with references to their space planning and functions. Both the qualitative and quantitative analyses support the

research assumption that the traditional houses of Shibam can be considered a model for the present and future development of house design in Hadramout [10].

Ilgn (2021): In this study, 27 super tall residential towers (300 m or taller) were examined regarding their main architectural and structural design parameters, to provide a step towards analyzing space efficiency as one of the key design parameters to make a project viable. when building form groups were compared among themselves, no significant difference was found between their effects on space efficiency, and similar results were valid for structural systems [11]

SEV and ZGEN (2009) have studied the ten tallest office buildings in the world and in Turkey individually. The space efficiency of a high-rise office building can be achieved by maximizing the gross floor area (GFA) and net (usable) floor area (NFA) as permitted on the local site by the codes and regulations, and in order to enable the developer and owner to get maximum returns from the high cost of land, the floors must have sufficient functional space.

Efficiency of net-to-gross floor area is the key to balancing construction costs and total rental values, and this point is related to this research goal. When material choice and issues of efficiency of structure and services are integrated to assess the various options, more space-efficient solutions can be reached [15].

Space deficiency is one of the significant segments of a building that requires consideration. Ignoring the law and architectural guidelines when designing a residential building is one of the major problems in society, Customs, lifestyles, and occupations can also have a great impact on the effective optimization of space, making a large area of space useless.

Problems should be identified in terms of space efficiency by comparing the circulation surface with the usable surface and comparing the volume of each space with the usable volume of it. Space exploration will continue to be an essential driver for opening up new domains in science and technology. Culture and inspiration, which may affect the efficiency of space used. Aesthetics is one of the principal aspects considered in architecture. Form and function are two of the major principles that need to be considered while designing residential buildings.

II. METHODOLOGY

This study is focusing on low-story residential buildings in the three most populated districts of Kabul city, located in the southeastern, central, and northern parts of the city. Residents of various ethnic backgrounds live in the considered districts.

Quantitative and qualitative methods were used for data collection with direct observation of residential houses in different districts of Kabul city to identify the objections and causes of space deficiencies. Direct and

structured observation is most useful for collecting comprehensive data, and it is used in this research. As observation considers real-world conditions, the researcher can collect adequate data on what is happening on site.

A check list used for collecting information for the research site A measuring tap is used for getting the existing dimensions of the interior spaces of the house considered on prepared sketches according to a checklist. The sketches from sites were converted into a building drawing using AutoCAD before starting to analyze. The process in this study was carried out by comparing the prepared sketches using space efficiency and occupancy load equations.

For space efficiency used equation -1 [16]

SE (%) = LA / TA * 100　　　　(1)　　**Eq. 0.2**

Where,
SE: Space Efficiency Percentage
LA: Living area
TA: Total Area

Based on architectural guidelines the normal range of space efficiency is around 70%-75%. [13]

The quantity and spatial distribution of occupants in a building are collectively referred to as the occupancy load [17]. In this study, a practical approach is used to calculate the residential occupant density by dividing the number of occupants by the number of floors available. It stands to reason that a fully occupied home would be one where all of the occupants are present and possibly sleeping. It is possible to determine the 'occupant density' (m2/person) [15.16] of that particular property, which is equivalent to the occupant load factor in units. For the occupancy, used following equation [18]:

K = n − 1　　　(2)　　　**Eq. 0.2**
K = n + 1　　　(3)　　　**Eq. 0.3**

Where:
k is number of bedrooms,
n is number of family and
1 is constant.

III. DATA ANALYSIS

Each house sketch space has been determined as part of both qualitative and quantitative analysis carried out in this study, and the space efficiencies were then identified using equations and demonstrated in tables. Based on interior design principles and guidelines, the efficiencies were compared according to occupancy load and represented in tables and graphs.

House A: In Fig. 1, House A is depicted as being in the western section of Kabul. It is a courtyard single-family home with a plot size of 120 square meters built

in a regular rectangle. On the basis of measurements taken on-site, a building sketch is created after a sit-in inspection. The figure includes all units and their corresponding dimensions. The estimated living area of the house is 36 sq m, and the total area is 66 sq. m. The large area considered for a guestroom, which includes a bedroom, kitchen, bathroom, and water closet, makes this prototype crowded.
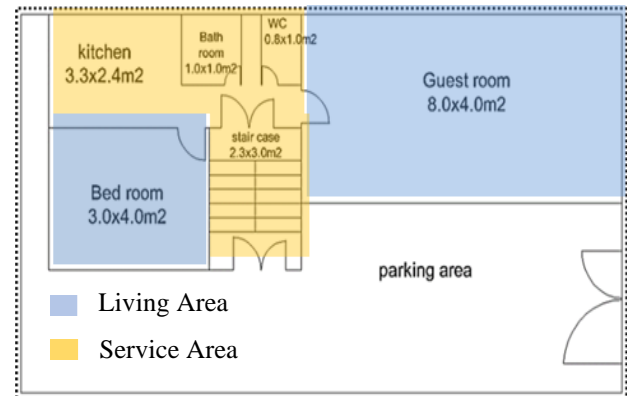

Fig 1: Floor Plan layout of House A.

House B: The proposed prototype, an apartment type without a courtyard, is being built in Omid Sabz Town in Kabul City. The building has a total coverage area of 148.3 sq m, with 89 sq m of living space, and is built on a 172 square meters plot of land. The achieved space efficiency area is 60%, according to the space efficiency equation. which demonstrates the inefficient use of interior space.
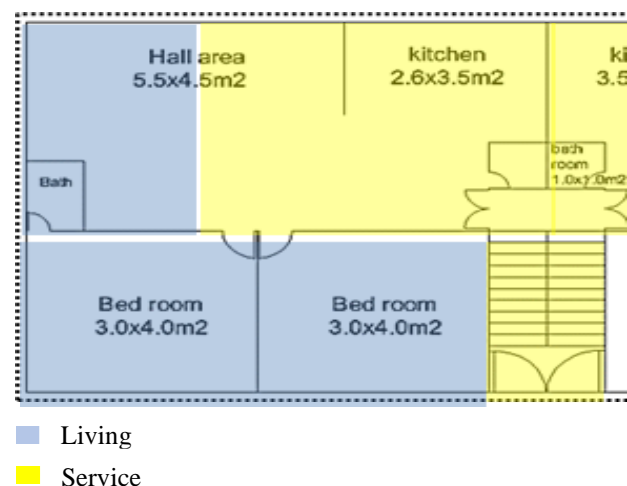


Fig 2: Floor plan layout of House B.

House C: In Kabul's third district, in the Kart-e-Char neighborhood, was built House C. house with a floor plan that is irregularly shaped geometrically. It has a usable area of 99.5 square meters and is a residential building. This building's living space is 56 sq m, and its space efficiency rating of 56% indicates low space efficiency.

Living Area

Service Area
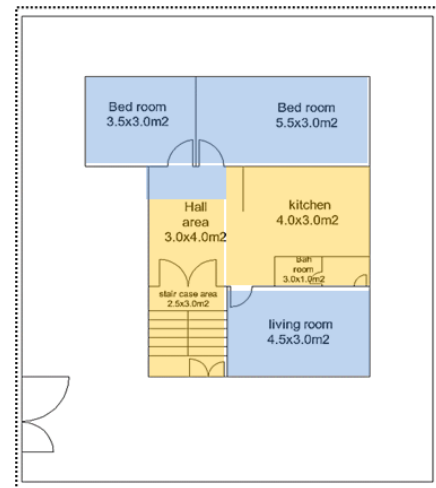
Fig 3: Floor Plan layout of house C

House D: The dimensions of the floor plan for Building D are shown in Fig. 4. The 210 square meters home under consideration was built in the AFSHAR neighborhood of Kabul City. The residency area is 62.8 square meters, and the usable area is 116.85 sq m, indicating a space efficiency of 54%.
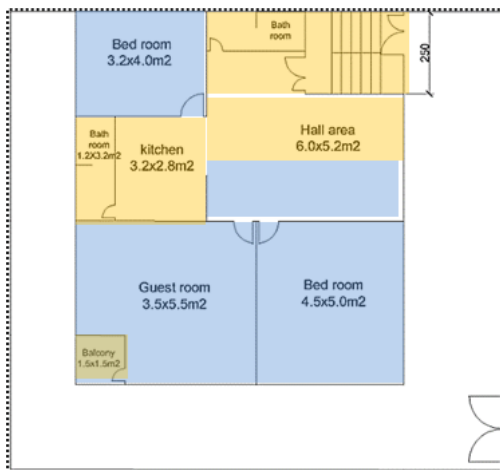
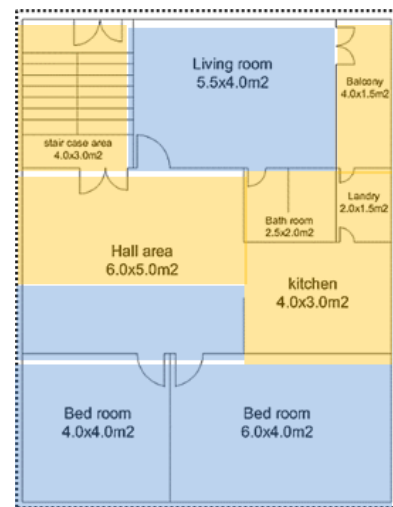Living Area

Service Area

Fig 4: Floor Plan layout House D.

House E: Building E, which has a smaller floor area of 201.5 square meters and is situated in COMPONY in Kabul, has a rectangular shape as seen in Fig. 5. There are 75 square meters of usable space in this building, but only 40.5 square meters are designated as the residency area. With these parameters, low-space efficiency is roughly 54%.

Living Area

Service Area

Fig 5: Floor Plan Layout of House E

House F: According to Fig. 6, Building F is a rectangular building that is situated in Kabul's KARTE-SAKHI neighborhood. Only 62 square meters of this building's total area (usable area) are used for living space, resulting in a dismal 48% space efficiency.

Living Area

Service Area

Fig 6: Floor Plan layout of House F.

IV. FINDINGS

The space use efficiencies for the buildings in Kabul city vary based on the calculated areas and efficiencies of the considered houses, as shown in the table. The building with the least efficiency is House B because of its sizable total area. Low efficiency demonstrates that the majority of floor space is lost to

circulation and that the ratio or balance between spaces according to functionality and occupancy is not taken into account in the design phase. On the other hand, House A's floor area is disturbed according to function despite having a smaller total area and a more efficient design.

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Overall, none of the homes under consideration reaches a typical efficiency rate in accordance with the rules for architecture and equation 1. Prepared as construction sketches reveal that most houses are made up of unoccupied areas that can be assumed to be wasted space. House F is a prime instance of a two-bedroom home with a living room and an extensive floor area for circulation.

From the comparison of living, service, and total floor areas, it seems that a large percentage of the total area is considered for service purposes, as shown in Fig. 7. Low space efficiency in residential buildings has negative effects on functionality, economy, and energy efficiency, as well as comfortability.

Based on the analysis of the chosen house sketches, the percentage of purposeful use of space in buildings needs to be increased. We cannot say that the existing buildings do not have space use efficiency, but the result of the evaluation shows the enhancement of space use efficiency. There should be a balance between the areas of the building during planning.
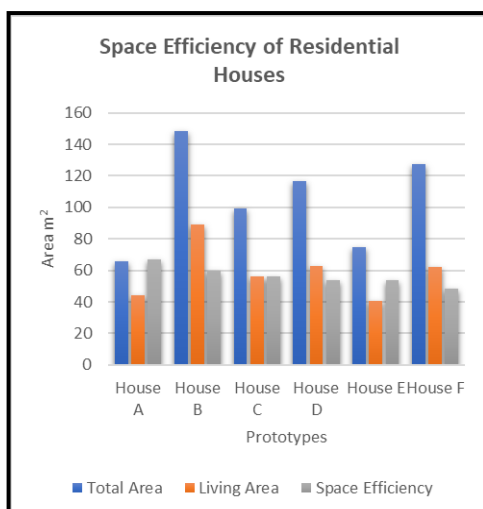
Some characteristic residential building samples that have already been surveyed and studied have revealed the gaps, issues, and problems that exist in residential buildings with regard to space efficiency, in accordance with architectural guidelines and case studies. For the purpose of comparing each building's space efficiency to the standard range, we calculated the space efficiency percentage and space deficiency factors.

It is important to take into account that the overall condition of homes in Kabul's unplanned neighborhoods is cause for concern. Because the majority of homes are renovated without the assistance of an expert engineer or without taking into account the fundamentals of the field of engineering. Low levels of public awareness and a lack of knowledge about engineering among home builders characterize this field. They use unqualified individuals to produce cheap maps instead of paying for engineering maps in the field of design. This, among other issues, has an impact on the homes' overall architectural value, comfort, beauty, durability, and space.

V. CONCLUSION

Lack of awareness among people in general regarding residential buildings' architectural designs Because residential buildings' space efficiency is inadequate, several architectural principles of the interior and exterior design are compromised, the interior zoning is not based on architectural principles, and the interior space is inadequately utilized appropriately. Unplanned house development has increased as a result of a lack of municipal policies, especially for low-story residential buildings and informal settlements. Additionally, when building a home, people tend to disregard architectural guidelines and manuals, which has a negative impact on comfortability and space efficiency. The economical and purposeful use of each unit area should raise public awareness in order to improve the quality of buildings. It needs to be used in the creation of municipal law.

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Fig 7: Comparison of space use efficiency of chosen buildings

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