

## **Waste of Space in the Design of Contemporary Local Dwelling Units**

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**Abstract:** Iraq is still facing a housing shortage according to studies which determined that 2.5 million dwelling units have to be built before 2020. A huge and unpredicted destruction due to the war against terrorism has exacerbated this problem in the last few years. Thus, rationalization of resources has become crucial in minimizing waste spaces in local dwelling units that have to be built to satisfy public need. However, the rate of space usage of local contemporary houses has yet to be studied. This study, which focuses on balconies featured in contemporary family houses, hypothesizes that most balconies are out of use. Observation was conducted on two residential neighborhoods in Erbil City and questionnaires from 268 household members have been collected. Results showed that a majority of families did not use their balconies because of climate or social causes. Most of these families declared that they rarely used their balconies or used it for different reasons other than relaxation or enjoying the outdoors. Consequently, the fact that 2.2% of the area of dwelling units is wasted space in the form of a balcony results in additional cost on a national level once the housing shortage is solved. This conclusion should be considered by housing authorities, designers, investors, and other stakeholders to avoid wasted spaces that also causes waste of national resources.

**Keywords:** Function, Space Usage, Balconies, Dwelling Unit Design, Housing Shortage

### **1. Introduction**

#### **1.1 Space Need and Function**

Every space in any building has a function. “Form follows function” is the main principle of modern architecture and driven from the theory of evolution. The form of living species is assumed to be a result of their adaptation to the environment and survival. For example, finding a space for sleeping in every dwelling unit is reasonable because sleeping is one of the most important activities of humans. The term “dwelling” refers to this activity, which is related to staying or settling or being rested.

Maslow (1987) argued that human needs are hierachal. Basic needs include the biological and psychological needs, such as air, food, drink, shelter, warmth, and sleep. Meanwhile, self-actualization, which is represented in personal growth and fulfillment, occupies the peak of the pyramid. Maslow’s model indicates that basic needs or low-level needs, such as physiological requirements, must be satisfied before high-level needs, such as self-fulfillment, are pursued.

Function is an expression of need, which means that the need itself should come first and function follows thereafter. When a person needs to sit, he or she starts to think how and where this need can be satisfied. In the action of sitting, the way a person sits is the function; thus, the space required to

accommodate this function should be found. Modern architecture indicates that this space should be designed based on the requirement of the function. One can say that “form follows need.” In this regard, the terraces in Villa Savoy are evidently an expression of the need of a family for whom the villa had been designed.

Theorists determined the relationship between the needs and structure of a built environment. The presence of any building or space in a specific period reflects the need of the community for that building or space to shelter a function that meets such a need. Several needs are the reason for the existence of any space. A few of these reasons are related to function, culture, and environment. The house is a result of climatic need for shelter and defense (Rapoport, 1969).

One of the main principles of modernism is the balance between needs and resources and the ability to meet needs is related to economic ability. Rationalism and rational use of resources are important in the modern age. Therefore, such techniques as cost benefit analysis, input output technique, and other economic approaches dominate the modern way of thinking. The design of contemporary local dwelling units needs to be tested to determine whether such structures meet the theoretical approach of modernity or if a rate of waste are imbedded in the structures’ components.

## **1.2 Usage of Space**

Space utilization is a measure of whether and how space is being used. Utilization rate is a function of frequency and occupancy rate. Frequency rate measures the proportion of time that a space is used compared with its availability. Occupancy rate measures how full a space is compared with its capacity. Utilization rates can be assessed in terms of actual and predicted use (S.M.G, 2006). The National Audit Office, (1996) set out a standard calculation as follows:

$$\text{Space utilization} = (\% \text{frequency} * \% \text{occupancy})/100, (1)$$

Where frequency is the number of hours that a room is used as a proportion of total availability (i.e., timetabled week).

Space is wasted if it is not used. Thus, the goal of design is to make spaces usable for users. Usage efficiency depends on three variables, namely, activity, involved persons in the activity, and duration of activity. The involved people positively increase the usage efficiency if their number is high; the same result will be obtained if their diversity in age or gender is also high, thereby eventually reflecting on the degree of social efficiency of space (Abdulrazaq et al., 2008; Shukur, 1993).

Occupancy is the average group size as a proportion of total capacity for the hours a room is in use. Kim and Elnimeiri (2004) defined space efficiency as a ratio of rentable area over gross area. High performance building offers the opportunity to provide significant economic benefits, reduce environmental impact, and improve living and working conditions for occupants and the community. A high performance building “integrates and optimizes all major high performance building attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations” (Slaughter, 2013, p.1). Economic efficiency is defined as the ratio of the value of output to the value of input:

$$\text{Economic efficiency} = \text{Value of Output} / \text{Value of Input}. (2)$$

Whyet (1980) suggested three indicators for a successful open space where all types of human behaviors are practiced by many people at a particular time period. Open space has been considered

successful if used by a large portion of people comprising different sexes and ages to practice different activities during a period of time.

Abubakir (2009) studied the occupational efficiency of parks in Erbil and used five measurements to calculate space efficiency, density of users, variety of users, number of activities, type of activities, and time duration.

### **1.3 Iraqi Housing Shortage**

Estimates of housing shortage in Iraq have dominated the related studies since the mid-20th century. To highlight this issue, a brief revision of the studies showed the extent of shortage and how such scarcity is increasing over time. Doxiades determined that Iraq needs 453,000 dwelling units, although Polservice determined a shortage of 338,000 dwelling units from 1988 to 2000. The Ministry of Housing (2009) conducted the “Iraqi Housing Market” study and estimated that the need in the urban sector between 2006 and 2016 is 1,270,000 dwelling units. Another study increased this figure to 2,000,000 dwelling units (Ministry of Construction and Housing, 2010). Accordingly, 200,000 dwellings per year for the next 10 years (approximately 1 dwelling unit every 45 seconds of a working day) are needed.

Al-Mas`audi and Al-Sa`adi (2012) determined that the housing shortage in Iraq will be between 2 to 2.5 million dwelling units until 2020. These estimations have excluded the mass destruction due to the war against terrorism since 2014. For example, Kossov (2017) reported in the Atlantic Newspaper that Iraqi experts and members of the Nineveh provincial government have declared that “Mosul is completely destroyed.” To date, no official report has been released on the estimation of mass destruction caused by terrorists and military operations to liberate towns and cities.

From an investment point of view, the amount of investments that flowed to the Kurdistan region was \$30.5 billion. Of this total, \$13.7 billion (65%) of all investment capital have been directed to 166 housing projects. If 1% of space is wasted due to the improper design of the dwelling units ( $1\text{ m}^2$  of a  $100\text{ sq}^2$  dwelling unit), then \$0.137 billion would have been spent without any benefit. If the ratio of such wastage increases to 5%, then this increase will boost wastage to \$685 million. Thus, space usage and the rate of wasted spaces in contemporary local dwelling units should be studied.

### **1.4 Spaces in Iraqi House**

The Mesopotamian residential type or courtyard house was used until the 1920s. In this residential type, the courtyard is opened to the sky and surrounded by the rest of the spaces of the house. The main spaces of a traditional Iraqi courtyard house are the courtyard, *ursi*, *tarma*, *talar*, and *serdab*. In the early 1930s, the Iraqi house started to be modified under various influences. Through these changes, certain spaces started to disappear, such as the courtyard and *serdab*. However, new spaces and articulations have appeared, such as balconies (Al-Bairuti, 1992). On the other hand, kind of balconies were found in the traditional house in Basra city. In terms of the contemporary local dwelling units, single family houses are commonly built in Iraq. Hence, the focus given on the balcony is reasonable because this space is a new addition to the Iraqi house.

*Cambridge Dictionary* (online) defines a balcony as an open or closed space with a wall or bars

around it that is joined to the outside wall of a building on the upper level. *Oxford Dictionary* defines a balcony as a platform built on the upstairs outside wall of a building with a wall or rail around it. These dictionaries highlighted that the difference between a balcony and terrace or veranda is the size and location.

In addition, a balcony plays a role in defining the outdoor space, that is, another function exists with regard to the urban sense. Moughtin (2003) used the Vitruvius classification as basis to describe three types of theater backdrop scenes, namely, tragic, comic, and satiric. He explained that the comic scenes exhibit private dwellings with balconies.

Urban design studies focused on the articulation between outdoor open spaces and the building. This relationship is responsible for creating a lively sense. In this regard, active frontage is crucial and could be achieved by balconies in addition to other treatments. The articulation of facades with projections, such as bays and porches, provide a welcoming feeling (Yeang, 2000).

Al-Beiruti (1992) argued that balconies did not exist in the traditional house in Baghdad in the first and second decades of the 20th century but started to appear during the third and fourth decades as a semi-closed space. He further determined that balconies started to become open spaces from the fifth to the eighth decades as a result of cultural interaction between Western thoughts and local ideas. Al-Sultani (2015) stated that the emergence of balconies in Iraqi houses during the third decade was a result of the emergence of a new socio-economic class (See Figure 1).



Figure 1: Lawi House (Al-Sultani, 2015)

## 2. Previous Studies

A national-level survey was conducted to explore related previous studies. Many studies dealt with the cost of dwelling unit, considering that the high cost is due to the cost of construction materials,

manpower, the cultural and social trends to have big houses, and absence of low-cost housing design (Ministry of Construction and Housing, 2009). Yusuf et al. (2011) focused on the design decisions responsible for increasing the dwelling unit cost. They listed 10 of these design decisions and compared the cost of the dwelling unit with and without these items. They determined that the cost of a dwelling unit sensibly increases if the design includes double volume or circular staircases. They also determined that the ratio increases in small houses rather than big ones (Yusuf et al, 2011). Ali and Al-Kindi (2015) tried to bridge the gap caused by the absence of adopted indicators of sustainable economic housing on national level, and concluded that some indicators have an effective role on sustainable economic housing. Those indicators according to them included three issues; need for approval, quality performance improvement, and cost reduction.

Other studies focused on the financial point of view. The shortage in the housing sector causes a high demand, thereby eventually forcing households to turn to bank subsidies. However, these subsidies are not easily supplied and repaid by families. Mutlag, (2011) determined that the monthly fee of a household to a real estate bank from 2007 to 2008 was a high 172,500 IQD or 50% of the household monthly income. Other studies dealt with dissipation or prodigality. Al-Khafaji and Al-Rubaiey (2014) attempted to analyze the concept of excessiveness in architecture but eventually focused on facades, ornaments, and motives. Accordingly, they did not study the excessiveness concept and its expected existence through plans and volumes but limited their study in the form and treatment of surfaces. Such treatment is often responsible for the high cost of dwelling units.

Warren and Fathi (1982) may have been the first researchers who focused this issue when they compared the modern and traditional Baghdadi houses. They determined that if the plot area of a traditional house is  $100\text{ m}^2$ , then the plot coverage is 100% and the total built-up area is  $350\text{ m}^2$ . Thus, FAR is 3.5. On the other side, in the modern Baghdadi detached house of the same plot area, these researchers determined that FAR is 0.6. Hence, in terms of land use, the modern house is six times less efficient than the traditional house.

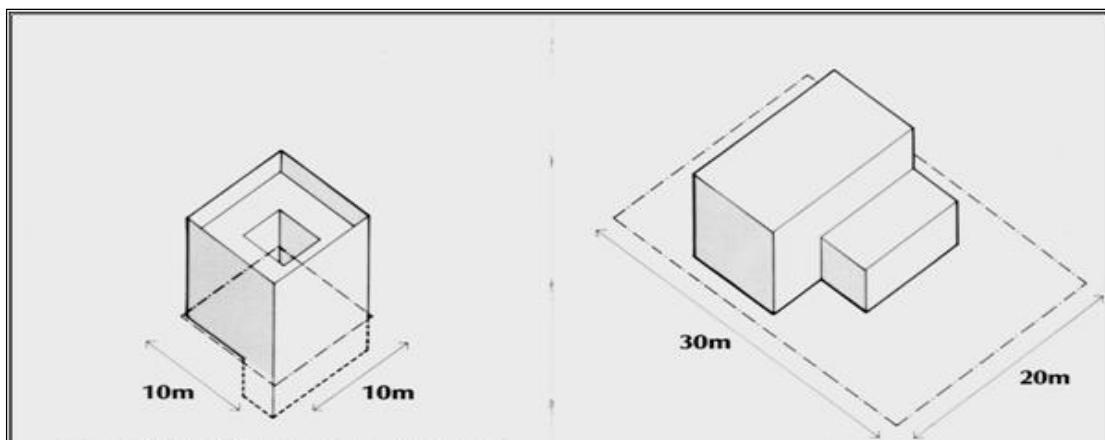


Figure 2: Comparison between the modern and traditional houses in terms of FAR (Warren & Fathi, 1982)

The traditional Iraqi house contained minimum space, therefore each space was used to meet multi-functions. It could be said that the space utilization, occupancy, and efficiency of the traditional house were high. These characteristics have been reasoned regarding rarity of land, materials, and

other technical resources that were used as inputs in the design and constructional process. Al-Khateeb (2010) listed seven factors that play roles in planning and forming the traditional house: social, demographical, technological, functional, location, esthetic, and legal factors. Meanwhile, the minimum standards and rational usage of area in the traditional Iraqi house were practical implementations of cultural principle. The reason is that the Quran forbids the irrational use of resources or dissipation. Other studies focused on the standard. In this direction, Al-Meamar (2013) attempted to analyze the Iraqi standards of the spaces of dwelling units.

## **2.1 Research Questions**

The preceding studies provided an idea regarding the level of national shortage in dwelling units apart from the national shortage in budget caused by the security situation and economic crisis. These emphasize that the rational use of available resources should be considered.

The common belief is that the traditional house has changed due to the cultural interaction between the local and Western cultures. Hence, the following questions should be answered. Does this mean that the local modern house has lost its commitment to the rational use of resources by replacing it with irrational use under the impact of cultural interaction? If the Iraqi traditional house had been economically efficient, does it mean that the local modern houses, as a result of cultural and technological interaction, are inefficient? Do the dissipation of resources and waste of spaces form one of the local contemporary dwelling units' features? Do the spaces or several spaces in contemporary local houses have low usage rate?

## **2.2 Statement of the Problem**

The current study aims to test whether contemporary local dwelling units include spaces that are being used in low rate or are they being not used at all. The selection of one of these spaces, which are new and represent a contemporary style, is reasonable and the balcony is one of these spaces.

- Research problem: Rate of space usage of local contemporary house has yet to be studied.
- Secondary problem: Usage of balconies observed in recently built houses has yet to be measured.
- Research hypothesis: A rate of waste exists in local contemporary houses.
- Secondary hypothesis: A rate of waste exists in the balconies in recently built houses due to low usage.

## **2.3 Research Objectives**

This study aims to determine the extent of wasted spaces in local contemporary houses. This research focuses on one space (i.e., balcony) within the contemporary local house. We attempt to determine the actual usage of this space by residents and the ratio of the total house space and rate of waste. We also attempt to determine the extent by which the waste in contemporary local dwelling unit maximizes the cost on a national level.

## 2.4 Research Variables

This research deals with the following variables listed in the questionnaire and checklist: area of balconies, house built-up area, balcony area, usage of the balconies measured by type of activities, and number of times of usage, and the rate of usage of balconies (see Appendix A and B).

## 3. Methodology

This study applied two methods of data collection: observational and based on the questionnaire. The observational method was implemented in two neighborhoods by using a checklist (see Appendix A). Two times were identified for observation: 8:00 AM to 11:00 AM (morning) and 5:00 PM to 8:00 PM (evening) from April 10 to 20, 2017. The use of observation as a tool for data collection is a valid method (Abdulrazaq et al., 2008). The same method was used on the research of outdoor spaces, such as open spaces and the human behaviors within them. Pedestrian Environment Quality Index (PEQI) is an observational survey with the analysis focused on the micro-scale and provided an overview of an existing street (Zhao, 2011).

The second method, which depended on a questionnaire, included three sets of questions: design characteristics of a dwelling unit, usage of balconies (whether the family uses it or not) and why, and the number of times that they use it (see Appendix B). To test the hypotheses, the data were analyzed by using an Excel chart.

### 3.1 Case Study

Two investment residential projects in Erbil city were selected (Empire world and Atlantic City) for the first method. These projects are fully built and inhabited. For the second method, the form shown in Appendix B was randomly distributed to several persons. The random sample mainly comprised household members from the different neighborhoods of Erbil City.

## 4. Results and Discussion

The results were not beneficial for the first observational method because no activity was observed. The researcher visited the selected neighborhoods on the planned times. However, the residents did not practice sensible activities; hence, the results were disregarded. Although the results were not beneficial, the observational process provided us with an idea regarding the low rate of usage of such spaces. For the second method, the survey covered over 500 houses but only 268 forms were correct and included balconies. Other forms have been neglected due to the lack of balconies or because of an error.

### 4.1 Physical Characteristics of the Sample

The survey indicates that the majority of the sample comprises small area houses given that 74.63% and 85.82% of the houses have no more than 100 m<sup>2</sup> on the ground and first floor, respectively. A total of 92.9% of the sample have only one balcony. Moreover, the area of these balconies in the

majority of the houses is 5 m<sup>2</sup> or below (see Fig. 3).

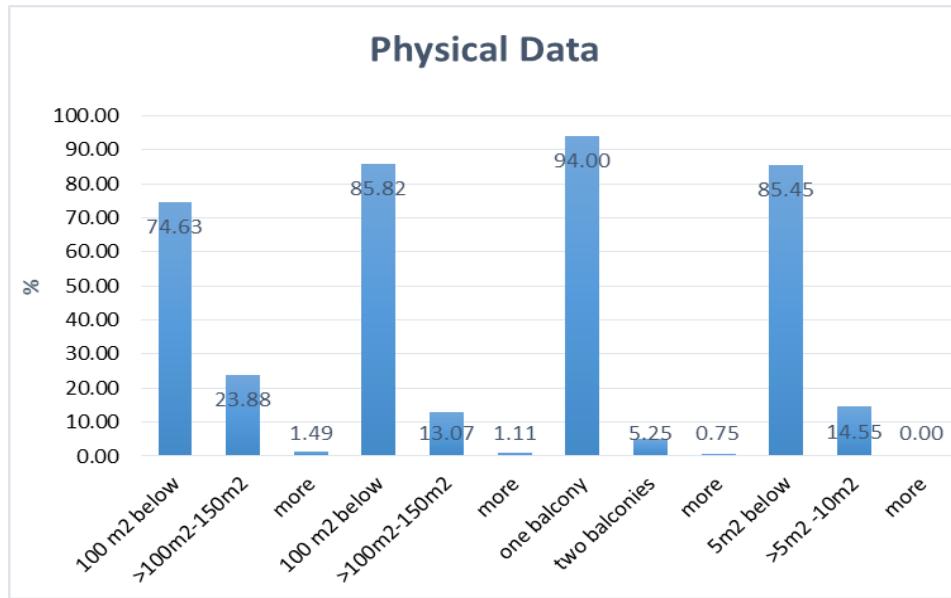


Figure 3: Physical characteristics of the sample houses

#### 4.2 Demographical Characteristics of the Sample

The survey shows that 49.6% of the households are medium-sized with 4 to 6 inhabitants, while 47% have more inhabitants (see Fig. 4).

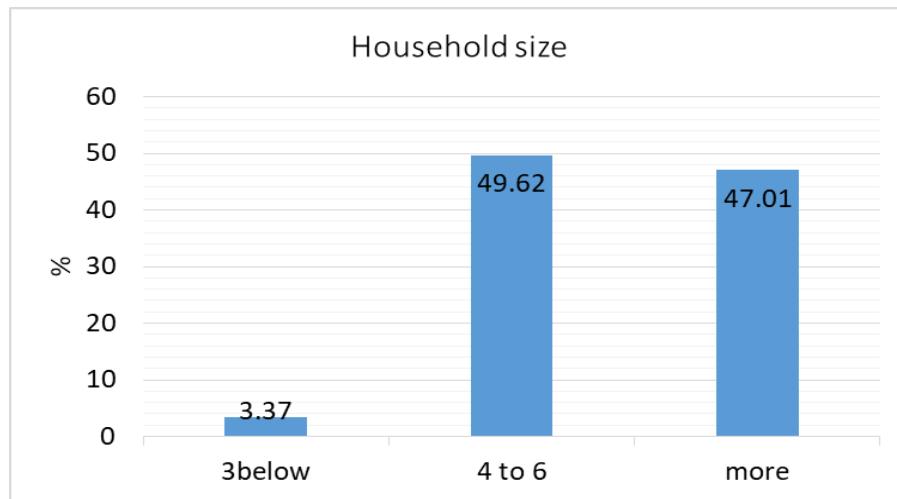


Figure 4: Household size of the sample

#### 4.3 Usage of Balconies

The results showed that 74.25% of the surveyed households do not use their balconies. Moreover, the rest of the families use their balconies for other activities other than standing or sitting for relaxation and enjoying the outdoors (see Fig. 5).

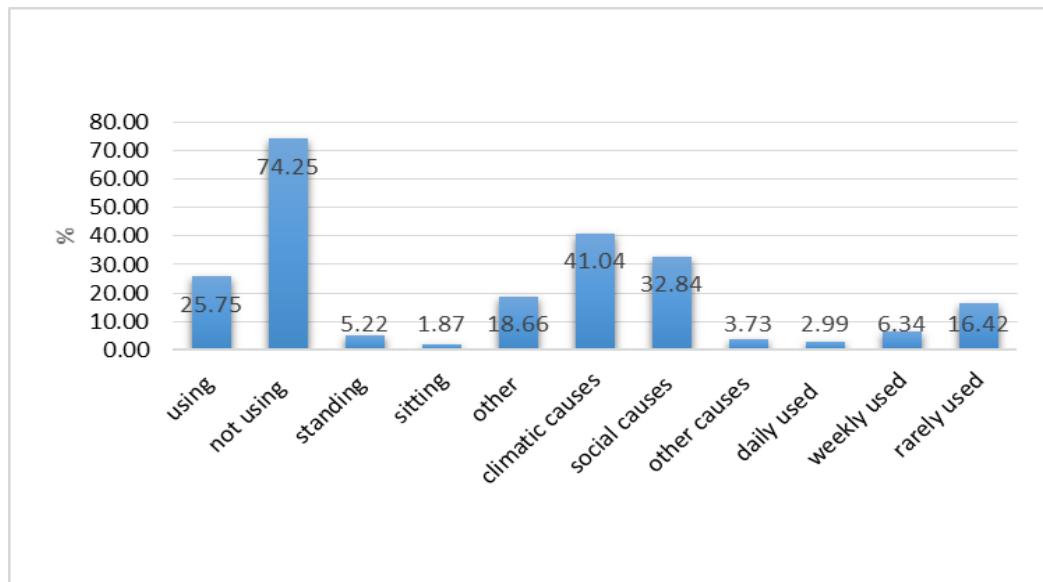


Figure 5: Sample usage of balconies

A total of 18.66% of the surveyed households selected other usage, thereby forming 83.33% of those who use their balconies (see Fig. 6). The percentage of households that use their balconies for standing and sitting purposes is 5.22% and 1.87%, respectively, of the surveyed sample, and represent 20.29% and 7.25% of the total number of families who answered this question positively. The interviews with the families interpreted that the nature of other usage varies (e.g., access to the first floor, drying clothes, installing air conditioning outdoor units, or storage).

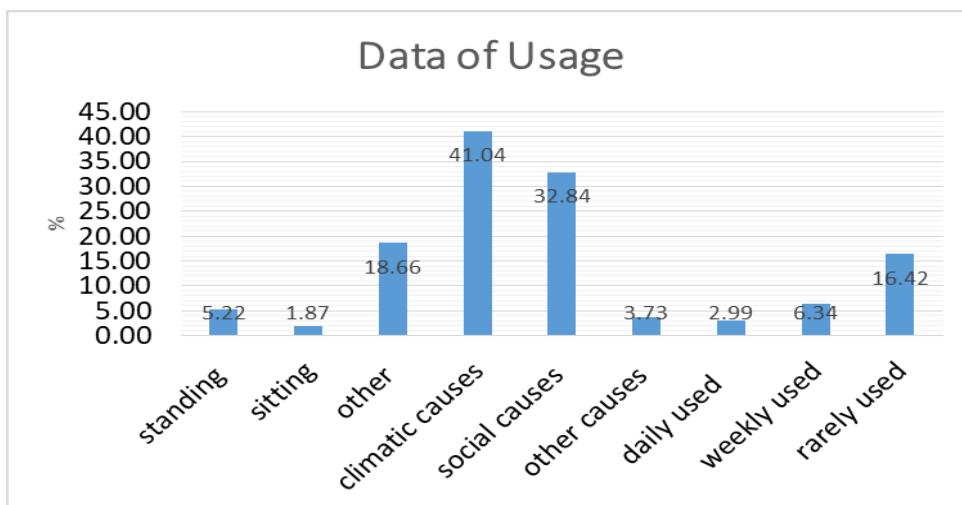


Figure 6: Types of balcony usage

The survey also showed that the reasons that prevent households from using their balconies completely or partially was climate. That is, 41.04% declared that the inclement climate on most days of the year discourages them to use their balconies. By contrast, 32.84% said that social causes prevent them from using the balconies. The interviews with a few households linked these social causes to lack of privacy. Moreover, 16.42% said that they rarely used their balcony. Only 3% used their balcony on a daily basis and 6% on a weekly basis. The survey showed that no family used the balcony for ordinary reasons, such as standing on a daily or weekly basis, which means that the whole area of balconies is considered as waste. The percentage of the area of balconies to the total area of the dwelling units based on the survey equals to 2.2%.

By estimating the waste depending on the obtained results, considering that the cost of each meter square of balcony is equal to half the cost of the squared meter of ordinary indoor space, and based on the literature review, if Iraq needs 2.5 million dwelling units by 2020, then the country will need to pay an additional \$1.37 billion just to cover the cost of the area of balconies that are not used.

If we take the shortage caused by the war, which caused un-estimated destruction in the housing sector, assuming that this factor is duplicating the shortage, then the waste due to the usage of balconies will be increased to \$ 2.7 billion, when the total shortage will be covered by a single family house type. If other types are to be used to cover half of this shortage, then the waste will be \$1.37 billion.

If there are other wastes due to bad design such as big circulation, bad articulation, supplying an area more than the standard, or building dwelling units regardless of the size of household, then the waste will increase.

## 5. Conclusion

Many approaches and strategies are used to assess the efficiency and waste in dwelling units. One of these approaches is to assess the area of each person in the household to be compared with the standards or to assess the utilization or occupancy of the entire area and components of the dwelling units. Such strategies could also be to assess the entire plan of the residential project or consider of the spaces, such as bedrooms, living rooms, or kitchens. This study determined the advantage of considering balconies and assess whether they are being used or not and the extent that they are used in the contemporary houses. Numerous reasons are presented behind this selection. The balcony is one of the newly added spaces in local contemporary houses and an exaggeration was observed in the addition of balconies in these dwelling units.

This research determined that families do not use their balconies, thereby indicating a high rate of dissipation (prodigality). That is, the waste due to balconies will require an additional cost on a national level. This study estimated that such cost is approximately 2.7 billion until 2020.

Therefore, focus should be given to the design of houses during this critical period. The design should also be rationalized to minimize the cost. Even the small amount and low percentage of waste are crucial because of the mass destruction and numerous dwelling units that should be built on a national level.

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### **Appendix A: Form of check list**

Date of observation.....

Location .....

Time

No. of House witnessed observed activity	XXXX			
Observed activity	<input type="checkbox"/> sitting	<input type="checkbox"/> standing	<input type="checkbox"/> working	<input type="checkbox"/> mixed
Number of persons involved in the observed activity	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> more

### **Appendix B: Form of questionnaire**

1. Area of the ground floor  100 below  >100–150.
2. Area of first floor 100 below  >100–150
3. Are there balconies?  Yes  No
4. If yes, how many balconies?  1  2  3
5. What is the area of the balconies?  5 Below  >5–10 (or above)
6. Are the families using the balconies?  Yes  No
7. If yes, for what function?  Standing  Sitting  other
8. If no, what is the reason behind not using the balcony?  Climate  Social  No time
9. Is the family using the balcony?  Daily  Weekly  Rarely
10. Family size  3below  4–6  more