Impact of Design Requirements for Facade Formation on the Functional Performance of the Balcony Space in Residential Apartments

Hasan Abdulrazzaq Hasan, Khalid. j. Aldeen Ismail, Ibrahim Omar Shekho

University of Mosul, Architecture department, Iraq. 3Alsafwa University College, Architectural department, Iraq.

Email: hasanjary@uomosul.edu.iq

Abstract. Balcony is considered to have two main functions in design process of residential building. The balcony has a function to form important internal space for many activities, which are necessary for the family. This space connects the family in its housing with its surrounding area. Thus, design of balcony space requires criteria and determinants to enhance its performance as a space for residence and as a connection part between the internal and external environment. On the other hand, the balcony is a basic element of the façade composition. Designers usually use it to give the required external formation to residential buildings. This formation adds design requirements, which can be consistent or inconsistent with balconies function. This dual function of the balcony and the homogeneous or contradictory requirements may cause a serious design problem. Designers usually focus on the role of the balcony as a formative element of the building’s façade. This may often lead to the omission of some of its basic functional roles within the housing apartment, and that reflects a whole range of functional disadvantages, especially in the sphere of economics of apartment design. This research aims to measure functional disadvantages in performance of the apartment’s balcony, caused by mono focusing on the aesthetic or expressive factors. These may not correspond with total necessary determinants for balcony’s acceptable functional performance.

To achieve this goal, the Newroz City residential project in Erbil was elected as a sample to conduct the necessary analytical calculations, questionnaire and personal observation to measure the functional efficiency of the balcony space in the various apartments. Obtained results represent the negative impact of omission basic design criteria for balcony space on the functional performance, due to focusing on the aesthetic factors. This may impact on economics of apartment design.

Keyword(s): Balcony, Apartment design, Affordable housing, Sustainable design, Facade aesthetics, Restoration.

1: Introduction:

Apartments have become a popular form of urban housing throughout the world today for several reasons including continued population growth, movement towards the smallest family size, aging population, and a high proportion of families in the leased sector [1]. This fact extends today and appears at the local level in Iraq in general or within the cities of the
Kurdistan region of Iraq in particular, represented in the size of the implementation of these projects during the last two decades in particular.

In order for this pattern to achieve its real goals, especially in constituting an efficient solution for providing affordable sustainable housing, it is important that the design characteristics of the completed product be evaluated to test the specific value of the production, and that this evaluation be a step to develop the design process in future projects.

Within this framework, the research focuses on discussing some of the basic functions of the balcony space in the apartment, which the budget may not receive sufficient attention from the designer. The research attempts, through the evaluation of a sample of an implemented residential project in the city of Erbil, to focus attention on the negatives resulting from the lack of balance in achieving this element of its functions efficiently.

2: The functions of the balcony in the apartment:
2-1: The balcony as a living space:

Within this concept, the balcony is a basic space in residential apartments because it constitutes the element of the relationship between the apartment and its external surroundings. Balconies are generally the openings attached with closed spaces giving them an extension towards the external environment creating an infinite exposure from that end and giving a panoramic view to the end user. These are mainly found in bungalows, apartments and also skyscrapers [2]. The balcony forms an open external extension of the residence, which provides access to the external environment and with a certain degree of privacy and spatial control, and at the same time allows the inhabitant to participate in the adjacent public space [3].

This space aims to provide adequate private space for many activities and reasonable services [4]. Residents prefer to provide this space to achieve a set of activities such as being an additional space for the living space during certain times of the year and space for gardening [5] or storage or as service space which should also include a screened clothes drying space [1]. The importance of this space increases further with the decrease in the area of the housing unit [5].

2-1-1: Basic functional parameters for balcony:

To achieve a good functional performance for the balcony, it is necessary to achieve a set of necessary standards that can be classified into:

2-1-1-1: Area: The area allocated to the balcony space (s) should be sufficient for user's need and in proportion to the number of apartment residents, Table (1) shows an example of these recommendations [4]:

| Dwelling type                  | Min. Area | Min. Dimension |
|--------------------------------|-----------|----------------|
| Studio or 1 bedroom dwelling   | 8 sq.m    | 1.8 m          |
| 2 bedroom dwelling             | 8 sq.m    | 2.0 m          |
| 3 bedroom dwelling             | 12 sq.m   | 2.4 m          |

Table (1): Example of balcony recommendations among dwelling type
These dimensions are in line with the recommendations of the Iraqi housing standards which determined the minimum areas for the balcony according to the number of residents as shown in table (2). These limitations give the possibility to provide a balcony which is able to accommodate apartment users combined [6].

| Occupancy rate person/dwelling | 1   | 1-3 | 3-5 | 5-7 | 7-9 |
|-------------------------------|-----|-----|-----|-----|-----|
| Outdoor space                 | 3   | 6   | 9   | 12  | 15  |

Table (2): Iraqi housing standards for min. balcony area in different types of apartments

2-1-1-2: Proportions: It means here the adequacy of the smaller dimension of the balcony to accommodate the details of the family's living. One study has determined the min. depth of the balcony to be 1.5 m to exploit family sitting around a table [1]. Despite its assertion that deeper balconies may be desirable in some cases, this must be counterbalanced by the need to avoid excessive shading of space [1]. Another study linked the minimum depth of space and as shown in (Fig.1) [4] with the minimum dimension of living table according to the number of users of the apartment, expressed by the number of bedrooms in it.

2-1-1-3: Location within space layout: Balcony should be sufficiently wide to accommodate, primarily, some of the living room functions. Apart from that, if the room behind it is separated by wide doors (folding or sliding), they will be better connect, creating an impression of a larger open area [7] and offering more living space during certain times of the year, and space for gardening or storage [5]. In certain circumstances, "winter gardens" with glass screens may be provided. [1] So, primary balconies should be located adjacent to the living room, dining room or kitchen to extend the living space [8] and maximize balcony use by allowing access from the main living area and a bedroom (where possible) (fig 2). Large apartments may include a wrap around and / or secondary balconies, which should also include drying space for exposed clothing. [1] Secondary balconies provide further amenity to apartment living and are best accessed off kitchens and laundries. [8]

(Fig. 2): Access from main living area and bedroom to balcony [8]
2-2: The balcony as a forming element of the building's facade:

As a connecting element of the structure with the exterior environment, Balconies serve well to the external form and aesthetics of a particular structure. They actually create the play in elevations with those additive and subtractive masses along with increasing the transparency of the structure. On the exterior façade they help to maintain the solid void ratio and also serve as a shading device for the spaces below it and create a scenic shadow effects on the façade .[2] Some of its parts, like balustrade can serve as a decorative element in the design of building façades . [9]

Balconies can influence the building design in many ways. This may be resultant of using different materials and/or colors for balconies (Fig.3A), using them to reshape the building (Fig.3B) or by using balconies with interesting unusual shapes which can give a building a lot of character. (Fig.3C) or by a lot of other unlimited strategies. [10] (Fig.3D, E, F)

Balconies are one of the external features which work as a key element in determine building’s style and play a significant role in its appearance. [11] This can be easily seen in façade analytical work where balconies with its the surface layer of facade [12]

![Fig.3] Examples of balcony influence on building façade design

In conclusion, Achieving the right combination of the functional and formal performance of the apartment and building can express the designer's ability to provide effective sustainability features in the design. And this may remind us of one of the basic elements of the Iraqi traditional housing, the (Mashrabiya). Despite all the influential differences between the traditional house and the modern apartment, the balcony can be considered as an extension of the (Mashrabiya), a basic element in the traditional house in Iraq and middle east countries. This element had an important function. It is considered as an extension of the interior space, which has views to the outside, as well as an important formal element of the residential house from the outside (fig4A,B,C). The compatibility of using this element as a functional and
formal element at the same time gave these heritage houses one of their main features of high sustainability [13].

From this heritage concept, balcony can be as an advanced contemporary development that fulfills the previous functions with a contemporary view (fig.5 D, E). This fulfillment may present the balcony as a restorative element derivative from the traditional Mashrabiya [14].

(Fig4) : Old employment of balconies in a Mashrabiya

(Fig5): Contemporary employment of balconies

3: The research problem:

With the previous review of the importance of the functional role of the balcony as a space for different residential activities, the corresponding importance of this space as a tool for shaping the facade of the building may make the designer more interested in its second role. This unilateral commitment may lead to a number of negatives that may appear within the functional and economic evaluation of the balcony and apartment in the following directions:

First: The functional design features of the balcony: which includes the negative impact on some of its properties (area, proportions, and relationship with other area).

Second: Residential space standards: The negative impact of increasing the balcony area in the apartment at the expense of other areas and in a manner that does not fit with the approved standards in affordable housing.

These negatives can multiply their impact when studied within the economic housing assessments. First approach will make the balcony areas available as inefficient areas when evaluating them according to the principles of functional sustainability. As for the second direction, it will affect the essence of the sustainable economic design of the apartment, as providing these spaces outside the required standards will cause this space to be exceeded by the ratio of other living spaces or increase the total area and the cost of the apartment.
4: Research objective and hypothesis:

This research aims to explore the problems resulting from focusing the attention of the designer on the formal side of the building at the expense of the efficiency of the functional performance of the balcony space in the residential apartment and the extent of this impact on the functional sustainability of it within the available economic housing standards.

The research assumes that the unilateral focus of the designer on the formal function of the balcony negatively affects the efficiency of the functional use of space through a negative impact on the functional characteristics necessary to activate the space functionally and on the efficiency of the economic design of the apartment.

5: Research methodology:

To achieve the goal, the research methodology was adopted, and after selecting an appropriate housing sample for conducting the field study on two basic aspects:

First: Conducting statistical calculations of balconies areas and compare it with the area of other functional spaces of apartment to test their efficiency in expressing economic design.

Second: Testing the efficiency of exploiting the balcony spaces in these apartments by adopting a survey of residents' opinions and the personal observation of the researcher.

6: Field study sample:

To conduct the field study with its two basic aspects, the selection of the survey sample was organized as follows:

6-1: Survey sample for calculations of expressing economical design efficiency:

The Nowruz housing project in the city of Erbil was chosen here as a research sample. The project includes 11 residential buildings, with 10-11 floors height, as shown in (fig.6-A, B) (the current implemented is 8 buildings only).

As shown in Figure (Fig.7-A, B), the general horizontal plan of the floor, which took the square shape, was modified by the designer with curved extensions with its horizontal plane to
give the distinctive final curved shape of the building from the four sides, as shown in Figure (Fig.7-C). These additional spaces were dealt with parts cut from the original square plan as balconies for the floor apartments and as shown in Figure (Fig.7-D). The designer has within the available capabilities of the flexibility of the structure to provide 8 models for residential apartments as shown in Figure (fig.8). (The performed is currently limited to the first and second models of apartments). With the difference of these apartments in the area, and design details within the floor, they participated in maintaining the same spaces used as balconies, whose total areas on each floor reached 70.68 m² distributed as shown in figure (fig.7-D) on the following two types of balconies:

1- Balconies type (A) which expresses the functional balconies that the designer placed within the initial design of the apartment plan as four square balconies on each floor, each with an area of 7.7 square meters and a total area of (30.84) square meters.

2- Balconies type (B) which appeared as a result of the designer’s decision to convert the cubic building to a softer shape with curved extensions that formed the balconies along the four facades. It is a (16) longitudinal balconies on each floor with a very small width ranging between (0-65) m with total area (39.84) m².

Balconies type (A) formed (43.8%) of the total area of balconies on the floor, while the area of the type (B) balconies reached (56.2%) of the total area of balconies on the floor.

6-2: Survey sample to Test the balcony spaces efficiency in apartments

The field study here aimed to assess the functional efficiency of the two types of balconies (A) and (B). A survey of residents’ opinions and a researcher observation was adopted to test the residents' opinions on the nature of their use of these balconies. The questionnaire focused apartment type (1) as it contains the both types of balconies and representing the highest
percentage of apartments in the complex. The survey limited with the apartments located on the inner social zone of the complex (to neutralize the difference in the value of the outdoor view provided by the balcony) and with the exception of the ground and first floor apartments (to neutralize the effect of the difference in the degree of their privacy due to their proximity to the effects of movement and external interaction of the central area of the complex), the number of apartments represented by the sample reached 120, 50 of which were elected for personal observation and testing the opinions of residents.

The apartment, as shown in (fig.10), contains one type (A) balcony. Its area corresponds to the minimum space determinants of housing standards in Iraq and has good proportions for use and two direct links to the living room and kitchen, while The apartment contains (4) balconies of type (B) and they are all tall and very narrow, one of which is related to the living room and the rest are connected to the bedrooms.

(fig.8 ) : type (1) apartment in Nowruz project

7: Results:
7-1: Results of statistical calculations:
Tables (3) and (4) indicated the differences in the total area of the balconies between the eight apartments, and the area ratio of each to the total net floor area of the apartment. By comparing these results with the Iraqi housing standards for each of the apartments and according to residents’ number, the comparison illustrated as shown in (fig.9) that this percentage includes an increase in balcony area percentage in the apartments compared to the minimum proportions of the Iraqi housing standards. It also shows the clear heterogeneous height among different apartments and even between those of the same residents’ number (such as apartments 2, 3 or 4,5,6,7,8). Table 4 also indicates the high number of balconies /apartments among the sample (which vary between 2-5 units with the rate of 3).

| Apartment Type | No. of Residents | No. of Balconies | Apartment Net Area | Area of Balconies | Area of Balconies / Apartment Net Area | Recommended Ratio |
|----------------|------------------|------------------|--------------------|-------------------|----------------------------------------|------------------|
| 1              | 5                | 5                | 133.14             | 17.67             | 13.3%                                  | 10%              |
| 2              | 4                | 4                | 111.33             | 9.96              | 9%                                     | 8.8%             |
| 3              | 4                | 3                | 92.29              | 16.98             | 18.4%                                  | 8.8%             |
| 4              | 2                | 3                | 68.48              | 7.4               | 10.8%                                  | 8%               |
| 5              | 2                | 2                | 65.83              | 10.27             | 15.6%                                  | 8%               |
| 6              | 2                | 2                | 62.58              | 10.27             | 16.4%                                  | 8%               |
| 7              | 2                | 2                | 58.42              | 5.33              | 9.1%                                   | 8%               |
| 8              | 2                | 2                | 53.85              | 4.63              | 8.6%                                   | 8%               |

Table (3): Area of balconies for apartment types in Nowruz complex
Table (4) : Area of balcony types for apartment types in Nowruz complex

(fig.7) :Ratio of balcony area for apartment types in Nowruz complex

7-2: Results of field Survey and observation:

Through observation and questionnaire opinions of residents, the frequency of using balconies was distributed according to the two types, and as Table (5) shows:

Table (5) : Frequency of practicing activities in the types of balconies in the complex

The table shows that the residents focused largely on the use of the type (A) balcony for different outdoor living activities (fig.9), and it used extensively to store cooking materials and other materials. The results indicated that the entire sample uses this space to dry clothes while it was used by limited ratio as a laundry space (instead of using it for living activities).

(fig.9) : Shots of type (A) balconies in the complex
At the same time, the type (B) balconies were considered as a functionally non-valued spaces. Their dimensions and proportions were a primary reason for their inefficiency to perform any function. Even in the limited cases of its use in storage and drying of clothes (fig.10), these cases were associated with clear negatives of poor absorption and inadequate functional in addition to the negative damage caused by these procedures on the general appearance of the apartment and building. The weak ability of these spaces to perform any real functional activity adds to the constant need for these neglected spaces to permanent cleaning work, which adds additional costs and efforts to the family.

This result indicates that the functional efficiency balconies was completely limited to the areas of type (A) balconies, while the type (2) balconies can be considered functionally as just lost spaces within the apartment area as shown in (fig.11), which ranged between (2.8-10.7) and at a rate (7%) of the total net floor area of the apartments as shown in Table (6).

(fig.10): Shots of type (B) balconies in the complex.

(fig.11) : Area of efficient balconies in type (1) apartment

| Type of apartment | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | Average |
|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|---------|
| Apartment type    |     |     |     |     |     |     |     |     |         |
| Apartment net area| 133 | 111 | 92  | 68  | 65  | 62  | 58  | 53  | 80      |
| Area of type (B) balconies | 10  | 10  | 2.6 | 7.4 | 2.6 | 2.6 | 5.3 | 4.6 | 5.6     |
| Area of type (B) balconies / Apartment net area %| 7.5 | 9   | 2.8 | 10.7| 3.9 | 4.1 | 9.1 | 8.6 | 7       |

Table (6): Ratio of the area of type (B) balcony in type (1) apartment
This result distinguishes a new relative value for the available area of efficient functional balconies, which represents the ratio of type (A) balconies to the total area of available balconies in the apartment, which varied between (0-85%) among apartments as shown (fig.12) with average rate of (35%) for the total sample.

Conclusions:

Through what was presented from the results, it can be said that the poor balance of designer attention between the multiple functions of the balcony and its unequal focus on the formal side can present a number of problems in the functional performance of the balcony represented its aspects and as the practical study showed as follows:

1- Providing this space (s) with an area that does not fit with the area of the apartment and the number of occupants, and not in a manner compatible with the proportions required to be provided for the spaces in the apartment.
2- The unjustified increase in the available space for the balcony (s) in the apartment adds additional costs for the residents to provide, which is negative when considering the economic design of the apartment.
3- The designer’s focus on the formal side led to the creation of many balconies that are not able to perform their functional role in the apartment, (according to the results, it has sometimes reached 100% of the apartment’s share of this area).
4- The non-functional spaces resulting from this design may exceed its initial cost of implementation to additional costs of maintenance, cleaning and maintenance work.
5- The designer’s commitment to achieving a balance between the different functions of the balcony exceeds its positive aspects on the economic side to restore some of the values of the ancient heritage environment in sustainable responding to the needs of the occupant, in a modern image of restorative architecture that exceeds the limits of dealing with heritage buildings to the vocabulary of contemporary architectural product.
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