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Orginal Article

Optimization of the functional concept of the minimum apartment - a study on a selected example. The role of functional details.

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Abstract: The article shows the study about functional concepts of a small apartment. For the research the author has chosen 27,3 m^2 apartment from the estate „Za Żelazną Bramą" in Warsaw. The study works on the optimization of minimum apartment model for 1-2 occupants that could meet contemporary standards. The study has proved that the original layout of the apartment can be improved to bring it closer to contemporary requirements. It turned out that improvements and changes mainly concerned dimensions and arrangement of the kitchen and bathroom. Theliving space could also be modified – good results have been obtained by implementing innovative details. The last simulation performed in the research (purely hypothetical) showed that the best optimization result could be obtained by slightly enlarging the basic plan of the apartment.

Keywords: apartment, flat, functional concept, layout, detail

1. Introduction

For many decades, a large number of small apartments were built in Poland. They can be found in old buildings, as well as in newer housing projects, erected during the economic transformation at the turn of the 20th and 21st centuries. This trend is also visible in the housing market today - small apartments are in great demand. Many of such residential premises do not represent a high level of functional solutions, sometimes requiring reconstruction or correction of the spatial arrangement. Also new apartments – built in the 21st century often require changes to improve their functionality.

The tendency to build small apartments began in Poland before World War II. It was a socially needed housing construction program. After 1945, the Polish government faced the difficult task of building a large number of apartments. The country was ruined, its demographic needs were growing. The Polish state struggled for many years with a large housing deficit. From decade to decade more flats were built, but the housing deficit has not been eliminated to this day. After World War II utility standards of the designed apartments have been set up, and these standards were still in use in Poland until the 1980s. Special provisions have been established in these standards, determining the usable areas of individual types of apartments as well as their percentage share in investments [1][2].

According the research developed by many institutions, e.g. Institute of Urban Development (IRM) in Cracow, Institute of Housing Economy in Warsaw (IGM), Universities of Technology in Białystok, Poznań, Wrocław, etc., the number of 2-room and 1-room flats built in Poland in the second half of 20th century accounted for more than 40% of all constructed apartments. The usable area of 2-room flats slightly increased from decade to decade, and in the 1970s it approached the limit of 36 - 44 square meters [3][4].

The introduction of the free market resulted in the suspension of the application of housing design standards and prices of apartments began to be determined by the housing market. The wealth of Poles was gradually growing but prices of flats also were going up. At the turn of the 20th and 21st centuries, the government started the program of building affordable housing for rent worked out by Housing Association Societies (TBS). A kind of housing standard was introduced again, specifying the usable areas of individual types of flats. The search for a minimum type dwelling and the shaping of its functional layouts remains an important problem even today - in the period when the prices of flats have increased significantly and housing again has become less accessible, especially for young people.

The purpose of this research is design analysis, which is aimed at checking the functionality of an apartment with a usable area of 27,3 m^2 and the usefulness of a functional detail in changing the functional arrangement. The analysis will address the optimization of minimum apartment model for 1-2 persons that could meet contemporary standards of life.

There are two main reasons of the flat choice for the study – firstly, the area of chosen apartment (27,3 m^2) is close to 25 square metres which is the minimum demanded by law regulations in Poland now, and secondly – the flat's layout is based on rectangle without capital walls inside the plan, so it offers the possibility of making changes in the space arrangement.

The author used two methods during research: research by design method and comparative analysis method.

2. The state of research concerning functionality of dwellings

In the process of designing apartments, also small ones, the concepts of functional and spatial layouts play an important role. Valuable solutions are those that allow the so-called flexibility of space and adapting space to the needs of users. This issue began in a house designed by Geritt Rietveld in Utrecht (Netherlands, where sliding walls were used for the first time dividing a large space into smaller ones [5]. The issue of "free plan" was one of the points of architecture of leading modernists, including Le Corbusier [6] or Mies van der Rohe. In the era of modernism not only the functionality, but also the flexibility of the living space and possibility of making changes began to be features determining the value of housing apartments.

The concept of adaptable apartments is also important in contemporary times, we can see it in some projects (e.g. it has been implemented in housing projects of Ralph Erskine - the Millennium Village development).

In Polish residential architecture, a great contribution to the development of this issue was made by Halina Skibniewska, who designed flexible flats in the Sady Żoliborskie estate in Warsaw [7]. The issues of modernization of apartments and changes in functional and spatial arrangements can be found in the scientific works of Barbara Gronostajska [8]. Many aspects of dwellings functionality connected with flexibility and details we can find in research of Władysław Korzeniewski [9], Monika Magdziak [10] and others. The housing structures for young people and affordable housing have been explored for a few years by Radosław Barek [11] and the author of this text [12]. Aspects of dwelling standards were taken and developed in Poland during transformation time also by Grażyna Dąbrowska [13]. The problem of creating a certain model of a minimum dwelling and adaptable, flexible apartment space remains very important today.

3. Research results

3.1. Case study – the chosen apartment and its location

As the subject of this research, the author chose the apartment with a usable area of 27,3 m2 from the estate "Za Żelazną Bramą" in Warsaw, designed in the late 1960s. This housing estate was built in the years 1965–1972 in the area surrounded by Graniczna, Twarda, Prosta, Żelazna, Chłodna and Ptasia streets. The huge area – 63 ha, was completely destroyed by the war in 1943-44. In its place, it was decided to build a housing estate for approximately 25,000 inhabitants. What Le Corbusier could only dream of happened in Warsaw. As many as 75 projects were sent for "Za Żelazną Bramą" housing estate competition. The vision of the team of architects Andrzej Skopiński, Jerzy Czyż, Jan Furman and Jerzy Józefowicz won.

"Za Żelazną Bramą" estate consists of nineteen 15-storey buildings, 5 lower buildings and urban infills. The blocks of the estate were modelled on Le Corbusier's Marseille Unit. Each of the blocks had 15 floors (although lower buildings were also planned), 2 staircases, 2 or 3 elevators and a glazed hall (planned as a meeting place for residents). The modernist concept of a garden city with skyscrapers was very attractive to the Polish authorities at the time, because firstly it was identical with their vision of social equality, and secondly it was cheap and fast.

The skyscrapers were built using monolithic poured concrete. The simple shape of the buildings was rhythmized from the outside by square white plates dividing each apartment and rectangular strips emphasizing the line of windows and closing balustrades (Fig.1).

The estate is located on the north-south axis, so as to guarantee as much sun as possible in the apartments. Many designers' ideas failed to materialize. Each block was to have a recreational roof - with a garden and cafes, grocery stores were to operate on the first floor, the top floor was to function as a laundry and drying room, and the apartments were to have balconies or glazed loggias. Green spaces, schools, kindergartens, nurseries and clinics as well as sculptures standing in parks were planned in the spaces between the blocks. When the estate was built, it was surrounded by emptiness.

The architects of the estate were constrained by DEBOR - the Directorate of Workers' Housing Estates. Skopiński's team, however, fought for their ideas, e.g. a standard of 11 m² per person was enlarged - in M2 apartment to about 27 m² and in M3 to 38 m [14].

Fig. 1. The building from the estate „Za Żelazną Bramą" in Warsaw – the view. Source: Photo by the author

3.2. The original layout of the apartment

The original layout of the M2 apartment - with a usable area of 27,3 m^2, was based on a rectangular plan with dimensions of approximately 538 cm x 508 cm. The entrance to the apartment has been designed in the middle of the tract. In the area along the corridor there is a small bathroom with a width of a small bathtub (150 cm), on the other side of the narrow entrance hall there is a dark kitchen with the same width of 150 cm, where a sink, a place for a gas stove and a fridge have been designed. The kitchen did not have direct lighting, but it had a window that allowed indirect lighting and serving dishes to/from the living room. The daily zone consisted of a room and a small annex. The apartment is equipped with the so-called "French window" (a door to the entire height of the story secured with a balustrade), a small window in the annex and two horizontal fanlights located high under the ceiling - in the living room and in the annex (they constituted a compositional element on the facade). One heating riser served two radiators. In the space of the living room and the annex, it was possible to set up a sofa or a bed. The spatial layout of the original apartment was rational, but the dedicated areas were small. The small bathroom, measuring 150cm x 195cm, could hardly fit the short tub, sink and toilet. The kitchen also had compact dimensions - 150 cm x 195 cm, in which the arrangement of appliances did not meet the principles of ergonomics (no place for countertop). The annex was narrow, with limited width of 200,5 cm (Fig.2). The apartment does not have a balcony or a loggia.

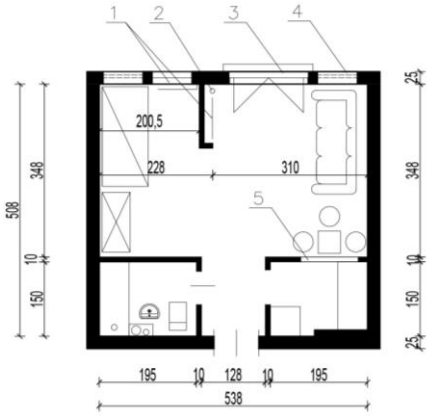

Fig. 2. Apartment from the estate „Za Żelazną Bramą"– original layout. Signs: 1- radiators, 2- heating riser, 3- „French window", 4 – upper windows, 5 – the window between kitchen and living space. Source: Drawing by the author.

3.3. Research variants of functional and spatial concepts

Variant number 1

The first variant of the correction of the functional layout consists of following ideas: transforming the annex into a lockable bedroom, in which a wardrobe was added along the entire length of the wall adjacent to the bathroom. The bathroom has been left in its original dimensions. The kitchen space was partially opened to the living room, dividing it into three parts in the proportions of 60 cm - 90 cm - 60 cm. This made it possible to place a refrigerator and a dishwasher under the countertop, as well as to separate a minimum of storage space. A functional detail of U-shaped kitchen furniture was introduced. The living room was arranged as a place to rest and eat meals at a low table, reducing its depth (Fig.3).

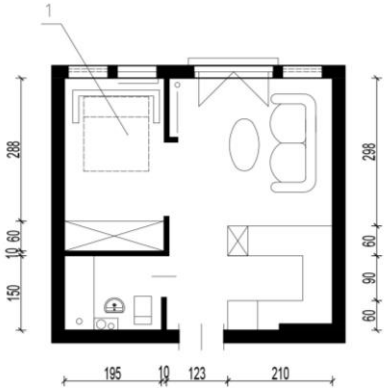

Fig. 3. Apartment from the estate „Za Żelazną Bramą"– functional changes of variant number 1. Signs: 1 - folding bed. Source: Drawing by the author.

Variant number 2

The second variant of the correction of the functional solution consists of several significant changes of the original concept. In the bathroom, a niche was profiled for setting up a washing machine, breaking the partition wall for planning a wardrobe from the side of the annex. The annex was left open, introducing two functional elements into the wall dividing the space - a sliding wall with a fold-out and unfolding dining table and, on the opposite side of the partition wall, a closed cabinet with a TV set hidden in it, mounted on a hinged arm. This allows for a slightly slanted position of the sofa in the living space. A short clothes hanger has been planned in the entrance hall (Fig.4). The kitchen was solved as in the variant number 1.

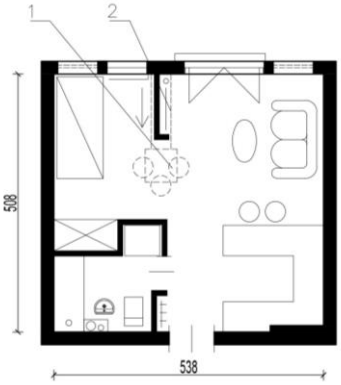

Fig. 4. Apartment from the estate „Za Żelazną Brama"– functional changes of variant number 2. Signs: 1- moving wall with folding table, 2- TV cabinet. Source: Drawing by the author

Variant number 3

The third variant of the correction of the original version assumes changes in the kitchen part - the refrigerator is located against the wall, at the entrance on the right side, and the L-shaped tabletop arrangement is finished with an integrated table (small dining space), finished with a rounded, ergonomic shape. In the living space, the sofa was turned with its back to the partition wall, a small work desk was added, while in the annex a movable bed was planned to be folded away from the wall - a kind of functional detail (Fig.5). The bathroom space is planned as in the variant number 2. In addition, the height of the partition wall between the living room and the sleeping annex has been lowered, creating interpenetrating spaces.

Variant number 4

The fourth variant of the correction of the functional concept introduces other changes. In the kitchen space, the countertops were designed along the inner wall, a short division wall was introduced along the entrance hall, next to which a folded, movable dining table was located. In the living space there are - a sofa, a work desk and a shallow cabinet with a retractable TV on the dividing wall. The sleeping annex is equipped with a bed located along the outer wall, which allowed for free access to a wardrobe, and space for two storage cabinets. In addition, a movable pull-out element was placed behind the desk - after it is pulled out and unfolded, it makes a place to sit along the "French window". There are threemovable functional details in total here. The bathroom has a narrow shower instead of a short bathtub (Fig.6).

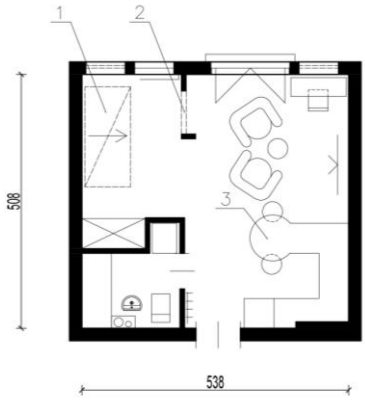

Fig. 5. Apartment from the estate „Za Żelazną Bramą"– functional changes of variant number 3. Signs: 1- folding bed, 2- division wall with the hole (one open space concept), 3- round table integrated with the countertop. Source: Drawing by the author

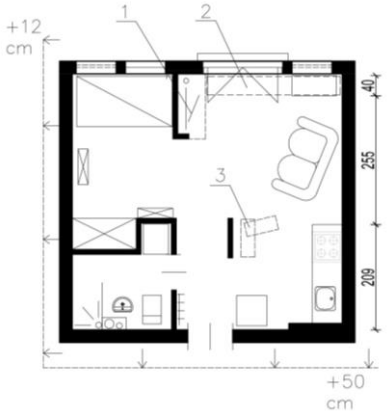

Fig. 6. Apartment from the estate „Za Żelazną Bramą"– functional changes of variant number 4. Signs: 1- TV cabinet with angled moving hook, 2- sliding sitting place, 3- moving dining table. Source: Drawing by the author

4. Discussion

The conducted research and design works have shown that the apartment with a usable area of 27,3 m2 can meet the proper conditions of spatial layout, but the there are some problems with good functionality and fulfilling of ergonomic requirements. It should be noted that the original proportions - the apartment was arranged in a rectangular layout with sides of approx. 538 cm x 508 cm - allow to obtain only the minimum solutions necessary in the apartment. A very important role is played by properly designed and dedicated functional details. The usable area of 27,3 m2 allows the arrangement of a small bathroom, also with the possibility of placing a washing machine, separating a sleeping annex in the apartment with a small wardrobe, planning a living space and a micro-kitchen. The spatial variant works best in an open space model with added functional details.

They make the use of separate spaces multifunctional, and allow for a quick change of space arrangement depending on the user's needs. Weaknesses of all tested variants of the functional and spatial layout are: a short working space in the kitchen (in a case of larger one,there is a loss of the dining space), no balcony and two additional horizontal windows located high (they give little light and cannot be opened from the floor level - they are non-functional). The bathroom in all cases is very small, it has less than 4 square meters of surface – with functionality on low level. It is postulated to increase the usable area of the kitchen and bathroom (apartment in general), because in the kitchen space of approximately 200 cm x 200 cm square, it is difficult to place all necessary devices, to plan the spaces between them and situate a small table. There is no space for a countertop for preparing meals. A certain solution may be a worktop in the form of a bar on wheels (a movable element). The weakness of the functional layout of the apartment is the lack of a balcony. There is only the "French window".

Table 1. Features of the flats' functional concepts - evaluation matrix. Source: the study by the author.

Version type	Strong points	Weak points
Original layout	apartment with usable area and proportions susceptible to functional changes economical communication possibility of separation an annex or a bedroom	very small bathroom non-functional dark kitchen – poor possibilities of work no balcony/loggia small storage area(wardrobe) no place for all devices in the kitchen and for the washing machine in bath non-functional horizontal upper windows
Variant 1	more space in the kitchen for devices (open daily space) longer countertops – better functionality Separation of small bedroom with wardrobe detail: folding bed	small bathroom (original dimensions 150 x 195 cm) no dining area no balcony
Variant 2	additional space for washing machine in bathroom kitchen like above separate annex for sleeping details: moving wall with folding table; TV cabinet	still small bathroom (in spite of enlargement) small space for wardrobe no balcony
Variant 3	details: folding bed, open space flat concept (division wall with the hole); round table integrated with countertop	still small bathroom (in spite of enlargement) small space for wardrobe no balcony
Variant 4	details: TV cabinet with angled moving hook; sliding sitting space next to "French window"; moving bar	small narrow shower in the bathroom (still small area) short kitchen countertop not enough for all devices no larger dining space, only moving table no balcony

Based on the study, it can be concluded that a much better functional result could be obtained if the usable area of the apartment could be increased by 10%, to about 30 m2 (enlargement of the kitchen, bathroom and storage space could be possible after adding 50 cm to depth, also when 12 cm is added to the width, a regular bed can be put in annex (about 205 cm long) in any position. The dotted line on Figure 6 shows the suggested enlargement of the apartment (on Fig.6). The sketch below shows the results after potential increasing of flat dimensions (Fig.7). Then the proportions of the apartment plan and its functionality become clearly better – new plan dimensions should be at least 550 cm x 558 cm.

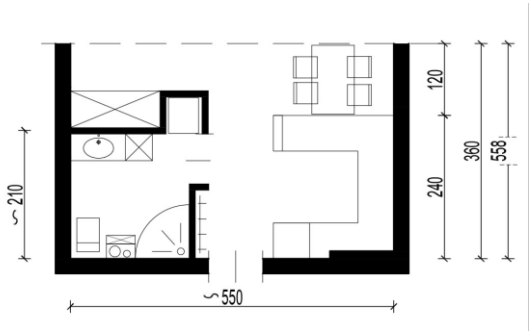

Fig. 7. Apartment from the estate „Za Żelazną Bramą" – after the enlargement of flat's surface. Possibility of extension of bathroom and kitchen in order to place the contemporary equipment, devices and provide dining area. Source: Drawing by the author

5. Conclusions

The study carried out showed that the usable area of 27,3 m2 allows for functional and spatial layout of the apartment, but only on a certain minimum level, which cannot be regarded as the proper one corresponding contemporary requirements. On the other hand, such surface allows for a certain personalization of spatial concept. The study has proved that such rectangular apartment plan gains more value by introducing various innovative details - the small apartment becomes more functional. The optimal value of the functional layout of this flat with an annex could be obtained after extension of plan proportions - enlargement of the flat (at least 12 cm to its width and 50 cm to its depth). That could help to fulfil contemporary standards. The research proved that the minimum apartment area should be optimized for not less than 30 m2.

The results of the conducted research may be helpful in formulating new design standards for the smallest apartments in Poland, it could be useful in designing new apartments as well as during modernization and transformation of existing housing dwellings.

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