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A Comparative Analysis of the Spatial Configuration of Apartments Built in Osijek, Croatia, between 1930 and 2015

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Abstract

The main objective of this research is to identify spatial configurations that were dominant in apartment design from 1930 to 2015 in the city of Osijek, Croatia. Development of apartment design will be shown in the framework of various time periods following the social and economic changes that have taken place in Osijek in the last decades.

For this research, a total of 590 apartment building plans were collected. The final sample contains 358 spatial configuration diagrams of medium-sized apartments.

Results identified five different spatial configurations that were innovative for the period in which they appeared. The conclusion of the research is that the spatial layout of the apartment changes according to social and economic periods. Differences among types were identified in apartment functions organized by zones versus those organized by rooms; direct versus indirect inter-room communication; the appearance of specific room functions versus the integration of room functions; and growth versus decline of the net area of specific rooms. Results can be applied in further studies on improving and adapting the existing housing stock to contemporary housing requirements.

Keywords: apartment layout analysis; housing unit changes; spatial configuration; Osijek

1. Introduction

1.1 Purpose of the Research

An apartment or house is the basic unit of society and the primary unit of human habitation (Kurian and Thampuran, 2001). Having satisfactory accommodation is one of the most valuable aspects of people's lives, and it is a major element of people's material living standards (Streimikiene, 2015). Housing in general, and housing construction in particular, are the most important components of a country's social and economic development (Franic *et al.*, 2005).

Constant changes in housing demands require the valuation and appraisal of the existing housing stock so that it always corresponds to the needs of its users. Traditionally, some aspects of housing have been studied more often than others, particularly the economic, structural, health, and community-planning dimensions (Weidemann and Anderson, 1985). In this study, the emphasis was placed on the spatial characteristics of apartments and on their layout organization. The main objective of this research is to identify spatial configurations that dominated apartment design from 1930 to 2015 in the city of Osijek.

According to Chochan *et al.* (2015), differences in social systems influence a variety of changes in housing layouts. Therefore, the development of apartments is shown in the framework of various housing policies and social and economic changes that have taken place in Croatia in the last decades. There is an overview of different socioeconomic periods in Croatia in order to show the context in which the apartments were built.

For easier understanding of the following text, it is necessary to define the following terms. The apartment is considered to be a self-contained group of rooms among similar sets in one building, designed for domestic use. Spatial configuration refers to the apartment composition (the single-room-purpose types), arrangement, location, relations,

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and communication between its rooms. The spatial configuration of the apartments is represented by layout diagrams.

1.2 Background

Much of the architectural research on housing in Croatia in recent years indicates that the quality of housing in existing residential buildings needs to be improved (Bobovec *et al.*, 2015; Korlaet, 2015; Bezek *et al.*, 2004; Poljanec, 2001; Homadovski *et al.*, 1999).

Housing in Osijek has rarely been studied from the architectural point of view. A few researches have focused on specific buildings and covered shorter time periods (Damjanovic, 2006; Sudic, 2006). Research on the spatial characteristics and layout organization of Osijek's apartments has not yet been conducted; therefore, this paper provides an overview of an original scientific research.

1.3 History of Residential Housing in Osijek

The city of Osijek is the center of an important agricultural region: Osijek-Baranja County, situated in eastern Croatia. It is a lowland, longitudinal city developed along the river Drava, with low-rise apartment buildings (four stories high on average). According to the 2011 census report, Osijek is a low-population-density city (approx. 632 people per km^2, with a decreasing trend in the total population) with 83,496 inhabitants who live in 41,955 housing units. In the early and mid-20th century, it was a large industrial center. Today, the main features of the city are the high unemployment of young people and the deep economic crisis.

The history of housing in Osijek can be traced back to the early 20th century, when the industrial companies began to build tenancy buildings for their workers. Most of the city's early residential buildings were one-story and two-story structures (Damjanovic, 2006). Construction of residential buildings of three or more stories with one or two apartments per floor began in the 1930s. The first apartment buildings were freely interpolated in the urban fabric. This method of construction was practiced until the 1960s, when construction started on new, large-scale housing settlements with apartment buildings of up to 12 stories. The construction of apartment buildings after the 1990s war is also characterized by the interpolation of buildings into the existing urban fabric.

2. Materials and Methods

2.1 Data Collection

For the purpose of this research, floor plans of apartment buildings were collected from April to September 2016. Building floor plans for buildings constructed before 1991 were collected from the Croatian State Archives in Osijek. The floor plans of the buildings constructed after 1991 were provided by architectural offices and construction companies. A total of 590 apartment building plans were collected. The collected building plans represent 14,714 apartments built in the city of Osijek in the period 1930–2015 that were included in this research. Given that the city of Osijek has 41,955 housing units (including both houses and apartments), the research covers nearly 35% of the total city housing stock. This percentage is significantly increased if we only take the number of apartments into consideration since, according to the Ministry of Construction and Physical Planning (2014), on average, one-third of the housing stock in Croatia consists of apartment buildings, and this percentage would be even higher in urban areas.

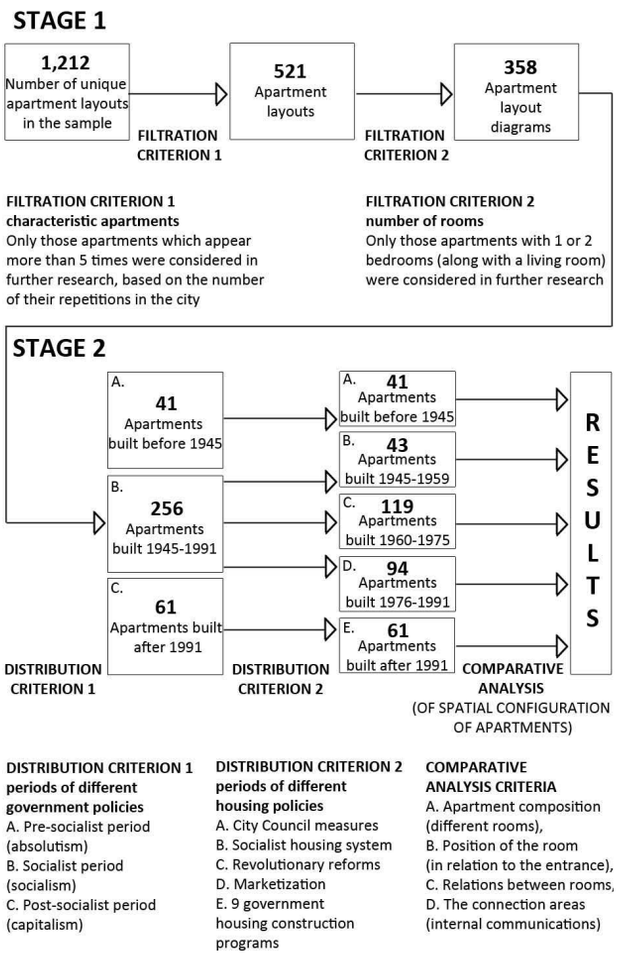

Fig.1. Sampling Method

2.2 Sampling for Analysis

The collected floor plans of 590 apartment buildings contain 1,212 unique apartment layouts. From these 1,212 layouts, 521 were selected due to the fact that they were constructed multiple times (some apartment layouts have been constructed up to 300 times). Other apartment layouts were constructed only once or twice, which makes them unrepresentative of the area of Osijek. Furthermore, an additional 163 layouts of small apartments (studio and one-bedroom) and large apartments (with three or more bedrooms) were excluded from the sample. Small apartments were excluded because they do not contain enough rooms to enable a comparison. They have only two possible

spatial configurations: an entrance area with a single room (living room/bedroom) and a bathroom, or an entrance area, bathroom, kitchen, and room (living room/bedroom). Large apartments were excluded, since they represent a small number of apartments in the total sample (316 out of 14,714, or 2.15%—Table 1.) and are not representative of the housing stock. The final sample contains 358 medium-sized apartments (one- and two-bedroom apartments, which make up 62.21% of the sample).

2.3 Analysis Methods

First, for the further analysis and comparison of spatial configuration for the remaining 358 apartments, layout diagrams were drawn. Space Syntax graphics were used to simplify the apartment layout and make the diagrams easier to visually compare and analyze. The authors wanted to show the apartment in an abstract manner, to focus only on its composition, spatial relationship, and the circulation patterns of the apartment regardless of the room's dimensions and design. In the first stage, the apartments' layout diagrams were divided into three main groups according to periods of government policy and housing policies: apartments constructed before 1945, those constructed in the period 1945–1991, and those constructed after 1991. Due to the large number of apartments built from 1945 to 1991, in stage 2, this period was further divided into three time periods of housing policies (1945–1959, 1960–1975, and 1976–1980). For each time period, the main apartment spatial organization was defined according to apartment composition (room types), and arrangement, location, relations, and communication between rooms. In most of the time periods, subtypes appeared. The sampling and analysis methods are illustrated in Fig.1.

3. Socioeconomic Changes in Croatia from 1930 to 2015

The apartment is considered something personal but, at the same time, an important part of the national wealth. Housing standard is, according to various indicators, the best evidence of a country's development (Bezovan, 2004). Changes in apartments follow changes in the public's expectations, needs, and perceptions (Shin *et al.*, 2016), which are the result of various social and technological, as well as economic and political, changes within a particular society. This means that housing is an integral part of the country's economy and that government has a large impact on housing policy. In order to understand housing development and changes in apartment layout and its spatial characteristics, it is crucial to understand prevailing housing policies and the social and economic frameworks in which apartments were designed. This section will provide an explanation of three significant periods of Croatian socioeconomic history, with emphasis on the most important setting of applied housing policies.

3.1 Pre-Socialist Period

The first half of the 20th century was a period of great political changes on the territory of today's Republic of Croatia. By the end of World War II, Croatia had been governed by several different political regimes and states,[1] each of which contributed to shaping its social and economic conditions. Strong economic growth, resulting from industrialization at the beginning of the century, was interrupted by a major economic crisis in the early 1930s. Economic recovery was possible because of Osijek's large degree of self-government, which allowed a considerable degree of development. This period lasted until 1941, when, due to World War II, the economy began to stagnate (Matic, 2006). Economic prosperity after the crisis caused the rural population to migrate into the city, which resulted in increased demand for apartments. In the late 1920s, in order to alleviate the housing shortage, the City Council introduced a package of legislative measures designed to increase the construction of new residential buildings with numerous apartments, such as exempting owners of new buildings from paying city taxes for 15 years (Damjanovic, 2006). This housing policy resulted in an increase in the construction of residential buildings (Sudic, 2006). Despite this measure, by the end of the period, there was a constant shortage of housing in the city of Osijek.

3.2 Socialist Period

During the period 1945–1991, Croatia was one of the republics of the Socialist Federal Republic of Yugoslavia. The development of housing in the Socialist Republic of Croatia followed what was called the "Eastern European model" (Petrovic-Grozdanovic *et al.*, 2017). The essence of the socialist housing system was state control over major aspects of politics and the economy. Until 1990, in former socialist countries the state had a strategic responsibility for the whole housing system. State institutions and enterprises had a key role in planning and carrying out the actual housing production (Tsenkova, 2009). In the socialist period, user needs were not an important factor in the design process. In an attempt to meet the housing needs of a wide range of users, the apartment design followed what was called the "protective" apartment model, i.e., an apartment conceived as a shelter and designed with no specific user in mind (Vezilic Strmo et al., 2013). The entire period of socialism was marked by a housing shortage (Jelinic, 1994; Bezovan, 1987).

According to Tsenkova (2009), the period of socialist housing policy can be divided into three main periods: a period of establishment of the socialist housing system, a period of revolutionary reforms, and a period of marketization. The first period, until 1960, was marked by the massive construction of high-quality housing within the urban fabric. The second period was characterized by a general cost-

cutting trend and rationality, resulting in smaller apartments (Vezilic Strmo *et al.*, 2013). Marketization of the housing systems in the 1980s was not just a pragmatic economic response to reduce the burden on the state budget but was also aligned with new ideas for economic management and measures to address inflation (Tsenkova, 2009). In the city of Osijek, more than 20 new residential areas were constructed between 1945 and 1991.

3.3 Post-Socialist Period

Housing construction programs in Croatia between 1991 and 2016 have been a major component and indicator of social and economic development (Bobovec *et al.*, 2016). The period from 1991 to 1997 saw stagnation in the construction of new housing units because of postwar reconstruction. During the Croatian War for Independence (1991–1995), 160,000 dwellings, or 11% of the housing stock, was destroyed (Bobovec and Mlinar, 2013). After the war, there was no clear vision and implementation of the housing programs, and prewar construction companies did not find a successful model of operation. This resulted in low-quality residential construction financed by private entrepreneurs and often situated in inappropriate locations (Bobovec *et al.*, 2016). After the postwar renovation was completed, housing construction intensified in the first few years of the 21st century. This continued until 2008, when economic crisis stopped the housing construction and paralyzed the property market.

Among the nine housing construction programs developed in the last 25 years, the State-Subsidized Housing Construction (POS), designed in the late 1990s, was the most widely known and the most successful. The program also defined the Regulations on the Minimum Technical Requirements for Design and Construction of Apartments in the Social Housing Construction Scheme (Bobovec and Mlinar, 2013). These technical requirements were used in the commercial construction of apartment buildings not as a technical minimum but as a technical maximum, which resulted in many unsold apartments that were overpriced and of poor quality. From 1997 until today in the city of Osijek, excluding the POS program, only one new residential area was built. Most of the new apartment buildings are located within the urban fabric as interpolation.

4. Research Results: Changes in the Spatial Configurations of the Apartment Units

The aim of the analysis was to identify different spatial configurations that were innovative for the period in which they appeared. In the observed time periods, from 1930 to 2015, five different types of spatial organizations were identified. The diagrams represent the most common type of apartment with its variations (dotted circles). Some spatial configurations appear in several periods, but there were not many of these, and they are not depicted more than once.

A total number of layout diagrams for each time period, which served as a basis for the results, can be seen in Table 2. A review of apartment layouts throughout the observed time period and a quantitative analysis of apartment functions and their relationships reveals the following characteristic changes in the size of the apartment, the type and dimensions of the rooms (see Tables 1. and 3.), the apartment layout organization (e.g., the "corridor apartment"), and the connections between rooms.

Table 1. Number of Apartments throughout the City According to Number of Rooms[2]

	S	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	**Total**
Before 1945	16	19	4	18	37	12	52	1	10	3	2	**174**
1945–1959	49	148	26	320	24	40	8	0	2	0	0	**617**
1960–1975	619	1,932	224	3,371	641	854	103	4	0	4	0	**7,752**
1976–1991	298	1,274	338	1,659	1,046	542	62	14	3	5	0	**5,241**
After 1991	35	199	63	313	122	155	19	23	0	1	0	**930**
Total	**1,017**	**3,572**	**655**	**5,681**	**1,870**	**1,603**	**244**	**42**	**15**	**13**	**2**	**14,714**
	Excluded			**Included**			Excluded					

Table 2. Number of Apartments in Osijek According to Period

	Before 1945	1945–1991			After 1991	**Total**
		1945–1959	1960–1975	1976–1991		
Number of unique layouts	130	125	409	343	205	**1,212**
Total number of built apartments	174	617	7,752	5,241	930	**14,714**
Number of selected diagrams in sample	41	43	119	94	61	**358**

Table 3. Average Net Floor Area of Apartment Rooms and the Total Average Net Floor Area of Apartments in Each Period

	Indoor spaces									Outdoor spaces		**Total net area**
	Bathroom	Toilet	Kitchen	Pantry	Living room	Dining room	Bedroom	Storage room	Servant room	Loggia	Balcony	
Before 1945	5.80	1.33	10.46	2.90	23.45	1.67	20.61	-	3.62	0.96	1.43	**89.16**
1945–1959	4.80	1.53	9.69	2.12	19.86	-	16.02	-	6.37	5.35	5.69	**59.50**
1960–1975	3.43	1.40	8.39	1.62	17.30	5.29	12.50	0.57	-	4.03	3.85	**47.68**
1976–1991	4.40	1.93	7.88	1.70	18.76	7.36	12.24	1.69	-	5.87	4.81	**60.60**
After 1991	4.91	2.63	6.46	1.59	21.96	-	11.78	2.98	-	6.60	5.14	**69.17**

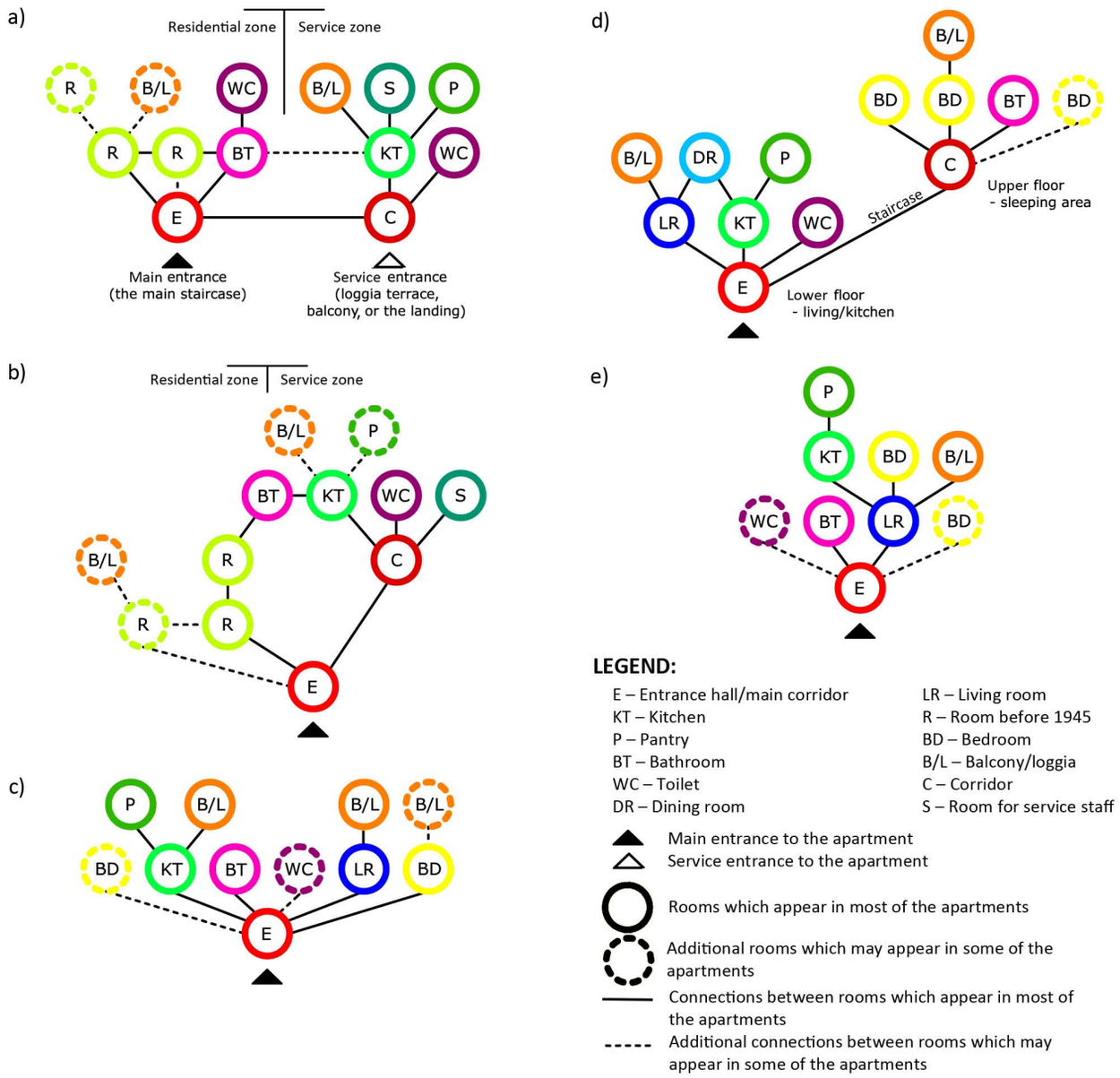

Fig.2. Layouts of Characteristic Configurations: a) Two-Zone Apartment with Two Entrances; b) Two-Zone Apartment with One Entrance; c) One-Zone Corridor Apartment; d) Duplex Apartment from the 1980s; e) Living Room as a Center of the Apartment's Spatial Organization

4.1 Spatial Configuration of the Apartment until 1945

A characteristic of all apartments built before 1945 is the existence of two clearly defined zones: the residential zone (rooms, bathroom, and balcony/loggia/terrace) and the service zone (kitchen, pantry, rooms for service staff, toilet), and by the circular connection between rooms in the residential area. In this period the toilet was commonly separate from the bathroom and was most often located within the service zone corridor. The floor plans of the apartments in this time period did not show the division of rooms into the living room, dining room, study, or bedroom. Based on 41 layout diagrams, two basic types of apartment spatial organization were identified. The first one features two separate entrances and completely separate zones. In most of the apartments, the two zones are connected only through the area of the main entrance, and in some cases, the connection between zones is made through the bathroom (Fig.2.a). The second spatial organization features one entrance and a circular connection between the residential and the service zone through the bathroom and the area of the entrance (Fig.2.b). Compared to apartments of later periods, these apartments have a larger net floor area and more rooms and contain rooms for service staff. It is important to note that the apartments in this time period represent not the average apartment of the era but mostly the apartments of wealthier families.

4.2 Apartment Units in the Socialist Period

Since there are 256 different apartment types in the sample for the socialist period, this timespan

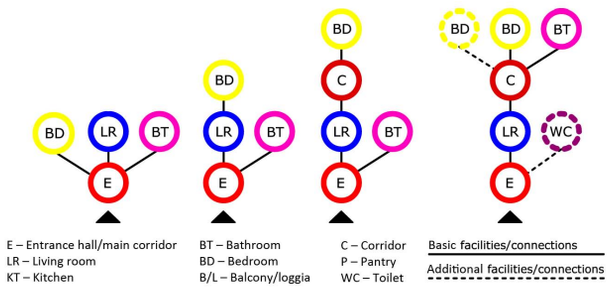

Fig.3. Arrangement of Living Room and Bedrooms

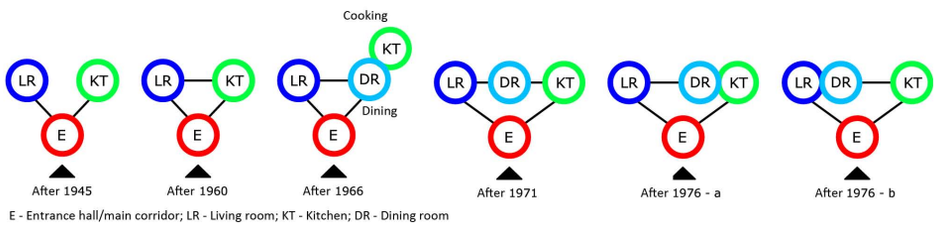

Fig.4. Changes in the Kitchen Area

was further divided into three distinctive periods: 1945–1959, 1960–1975, and 1976–1991. The "corridor apartment" appears during the entire socialist period, with slight modifications over time. Its basic form, which appears in the period between 1945 and 1959, is shown in Fig.2.c. This second period brings some innovations in apartment layout: the communication between the entrance hall and bedrooms (see Fig.3.), a built-in wardrobe, merging the toilet with the bathroom; and changes in the kitchen area (detailed below; see Fig.4.).

The largest number of apartments was constructed in the second socialist time period. The apartments constructed during that time have the smallest net area of all the apartments studied in the period covered by the research. The most significant changes occurred in the kitchen area, as shown in Fig.4. Within some apartment layouts, the niche appears within the space of the living room. It should also be noted that throughout the socialist period, the living room was always counted as one of the rooms used for sleeping.

During the last socialist time period (1976–1991), as a result of the marketization of real estate, there was an increase in the apartment net area, and a new apartment type, the duplex, appeared. The layout diagram of the duplex apartment is shown in Fig.2.d.

4.3 Changes to Apartment Layout after 1991

After 1991, or rather after 1997 because of the stagnation in apartment construction, only one apartment type can be identified as specific or new. What characterizes this apartment is that the living room is the center of the apartment's spatial organization (Fig.2.e). The corridor apartment type is still constructed in this era, modified slightly from the 1950s original. After the year 2000, luxury apartments begin to appear. These apartments have some of the following features: they cover the entire floor of the building, are designed as duplexes, and have more than three bedrooms and/or more than two bathrooms, plus a conservatory, several loggias or balconies, a large roof terrace, or even a swimming pool.

5. Discussion: Analysis of the Apartments' Spatial Design Characteristics

The focus of the research was on the identification of differences among identified types of spatial configuration of apartments. The main changes can be observed in the apartments' composition, the position of the rooms, and the relation between rooms and connection areas.

Apartments studied in the first period contain two zones: a residential zone and a service zone of significant layout area that includes a kitchen, room for service staff, a storage room, a service balcony or terrace, and a toilet. They are also characterized by a lack of division of rooms by function. These spaces are mostly clustered around a secondary corridor that is accessed from the main hall or by a separate entrance from the terrace or the staircase landing. In the socialist period, the floor area is reduced, and the distinction between apartment zones is blurred. In smaller apartments, particular zones are replaced by individual rooms. In the early 1980s, because of the increased net area of the apartment, zoning occurs once again, specifically into a residential zone and a sleeping zone.

Communication between the apartment spaces (rooms) in the first period is usually circular, while the later periods have many apartments with a central corridor that connects all the apartment rooms. Since 1945, the corridor apartment has been consistently present with minor modifications. These modifications are discussed in the remainder of this section.

Average apartment size, in terms of both the number of rooms and the net area, was smallest during the second socialist period (1960–1975). Apartment size started to increase again thereafter, but to this day it has

not reached the net area of the apartments constructed before World War II (Table 3.).

5.1 Living Room Area

During the first time period, the purpose of each room was not defined and they were all usable for different activities such as sleeping, working, or entertaining. The analysis of apartments that were constructed in the socialist period shows a reduction in the size and number of rooms of the apartment. The living room appears as a separately defined space but is still used for sleeping. Extensions of the living room in the form of a loggia or a balcony are common. Since 1991 the living room has become the center of the apartment; it assumes the role of the hall, and it also serves as a connection to other rooms of the apartment. The average size of the living room was the lowest during the second period of socialism and gradually increased throughout later periods (Table 3.).

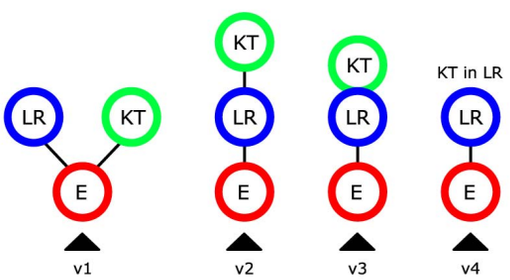

Fig.5. Changes in the Kitchen Area after 1991

5.2 Service—Kitchen Area

Before 1945, the kitchen was part of a large area of the service zone that has often been set in a separate corridor with a separate entrance. The service zone often contained the kitchen, pantry, service balcony, toilets, and rooms for service staff. After 1945, the kitchen remains the only part of the service zone with a small pantry or built-in ventilated closet. The biggest changes after 1945 in the apartment structure can be seen inside the kitchen area and with its connection with the rest of the apartment. Until 1960 it was one of the rooms on the "main street of the apartment"—the corridor, a separate space closed off from the rest of the apartment with doors. In the period between 1960 and 1975, the living room and the kitchen connected directly. Between 1966 and 1970, the kitchen is clearly divided into a working and residential (dining) part. In the period from 1971 to 1975, the dining room becomes a separate room which, together with a living room and kitchen, provides circular communication in the apartment. From 1976 onwards, the dining room is sometimes located in the kitchen and sometimes in the living room. This organization can be seen up to the present day. After 1991, in a significant number of apartments, the kitchen can be entered only from the living room. In a certain number of apartments, the communication to the kitchen is direct through the corridor only (such as in a typical mid-century corridor apartment). In the third version, the kitchen is a separate space connected directly with the living room as a small niche, and in the fourth version, the kitchen is an integral part of the living room. All of these changes are shown in Fig.5. The average size of the kitchen has continuously declined since 1945 (Table 3.).

5.3 Bedroom Area

In the first time period, until 1945, the bedrooms were not separated by function from other rooms of the apartment (as previously described in Section 5.1) and were all interconnected due to the circular connection in the apartment. After 1945 the roles of each of the rooms in the apartment are clearly defined, and sometimes a niche in the living room serves as a sleeping area.

The bedrooms in the corridor apartment are accessed directly from the entry hall. In variants developed through the remaining time periods, bedrooms are accessed either through a separate corridor or through the living room. The appearance of a separate corridor in a corridor apartment has enabled the creation of a separate sleeping zone consisting of one or two bedrooms and a bathroom (as seen in Fig.3.). In such cases, and with apartments consisting of more than two bedrooms, a small toilet is located near the apartment entrance.

After 1980, bedroom grouping in the sleeping area around the secondary corridor is seen in the larger apartments. This sleeping area contains a small corridor that serves as a dressing room, between one and three bedrooms (usually three), and a bathroom, and often has outdoor spaces in the form of a loggia or balcony.

A specific bedroom arrangement is present in the duplex apartments. A duplex apartment has two zones or areas—a downstairs residential or public living area, and an upstairs private zone with bedrooms. The average size of the bedrooms decreased from the time of their first appearance to today (Table 3.).

6. Conclusions and Recommendations

This study resulted in the identification of five different spatial organizations of apartments. These five types demonstrate significant changes in spatial configuration that correspond to different periods of housing policy as well as social and economic changes. Time frames are not fully consistent; some diagrams can be found over multiple periods. Correspondence of a specific diagram to a specific period was determined by the number of built apartments.

Large net floor area apartments typical of the period before World War II were followed by the construction of many smaller apartments. In order to meet the considerable housing needs, the corridor apartment was widely used; it remained the most common type of apartment from the socialist era to the present. After 1991 this apartment type eventually evolved into an apartment with a central living room.

The main conclusion of the research is that the spatial layout of the apartment changes follows different social and economic periods. Results indicate that changes in the apartment layout can be seen in different time periods in terms of 1) design according to zones versus design according to rooms, 2) internal communication between rooms as mostly direct or mostly indirect, 3) the appearance of specific room functions (living room, dining room, bedroom, built-in closet, etc.) versus integration of room functions (living room, dining room, and kitchen all within a single space), and 4) growth of net floor area (outdoor spaces, toilet, pantry) versus the decline of net floor area (kitchen, bedroom, storage). The period from 1960 to 1975 stands out as the period with the smallest total net floor area of apartments, mostly influenced by the small net floor area of the living room and bathroom.

The results revealed in this research will be useful in other countries, particularly in the states of the former Yugoslavia that had similar experiences in apartment construction and a common social and economic context as well as the same level of technological development. Moreover, results can be applied in further studies on improving and adapting the existing housing stock to contemporary housing requirements.

One of the limitations of the current study is the small sample of buildings built after 1991, which is why the characteristic floor plans of those apartments may not be representative. Another limitation is that the research covers only medium-sized apartments. The results might be different if the scope were expanded to include smaller and larger apartments. The aforementioned research limitations should be addressed in future research in order to obtain more precise results. This research identified the characteristics of the spatial configuration of the apartments in Osijek in relation to periods of different housing policy. Future research will examine the same aspect in relation to changes in family structure and technological and overall economic progress.

Notes

[1] Croatia was a part of the Austro-Hungarian Empire until 1918 and part of the Kingdom of Yugoslavia from 1918 to 1941. From 1941 to 1945, it was the Independent State of Croatia.

[2] The living room is always counted as one of the apartment rooms. A half-room or semi-room (0.5) has a net floor area of less than 10 m^2, as opposed to a room, which has a net floor area of 10 m^2 or more.

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