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Learning from the Past, Looking to Resilience: Housing in Serbia in the Post-Pandemic Era

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Abstract: The COVID-19 pandemic has profoundly reshaped life across the globe, significantly influencing the future of housing. The enactment and densification of diverse activities within one place have resulted in varying degrees of conflict between the built and social environment. This conflict is directly related to the degree of housing adaptability to new life, work, and leisure conditions. Movement restrictions and distance learning have significantly impacted the young population, which is susceptible to 'enforced togetherness' conditions. However, studies on post-pandemic housing in Serbia are rare. This paper investigates the relationship between the built and social environment, focusing on current trends in multi-family housing from the perspective of the progressive change of life standards in the post-pandemic era. It also includes a survey of the living conditions of architecture students in Serbia during lockdown and distance learning, offering insights into the impact of the physical environment on virus transmission and social dynamics. The main objective of this study is to formulate guidelines for developing a resilient housing model in Serbia that will address both current and future crises. From the findings, it can be concluded that radical changes in housing policy are necessary to enable less interdependence among layers within the system striving to be resilient.

Keywords: housing; post-pandemic era; social sustainability; resilience; youth

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1. Introduction

Social sustainability catalyzes changing attitudes toward housing in a new era [1]. It should provide a quality living environment for residents and communities in the long-term. Social sustainability, which focuses on users and their needs, is an insufficiently represented issue that directly influences overall quality of life alongside ecological and economic sustainability. It encompasses various issues such as accessibility, inclusivity, adaptability, well-being, etc. Addressing these issues is crucial for achieving a holistic approach to housing conditions that supports sustainable urban development. Accessibility refers to providing financially accessible housing for people of all income levels, which is vital for preventing homelessness and housing insecurity. Inclusivity refers to designing and maintaining housing solutions tailored to different populations, including various age groups and cultural backgrounds, guaranteeing everyone equal access to housing conditions. Well-being refers to providing housing conditions that positively contribute to residents' health, safety, and overall quality of life. It also includes good construction standards, access to green spaces, and proximity to essential services such as healthcare, education, and employment. Adaptability refers to creating housing conditions that can adapt to changing demographic and environmental conditions, including the ability to modify living spaces as residents' needs change over time.

Proper development of personality, community, and value categories, and the illusion of human permanence in space are essential prerequisites for maintaining social community.

Numerous studies have shown a cause-and-effect relationship between housing conditions and the psycho-physical and social development of the individual [2–4]. Particular human needs appear in the interaction between man and his environment, whether individual or collective in nature. The level of correspondence between the physical and social environment is determined by how the family's and its members' needs are met. A housing environment that is rigid and unadaptable to external and internal changes can leave severe consequences for a person and their identity and cause psychological and sociological conflicts in the family group.

Before the onset of the COVID-19 pandemic, initial efforts were made to tackle the global housing crisis. During infectious disease outbreaks such as COVID-19, the resilience of communities in facing challenges hinges on their social vulnerability [5]. Housing, which both contributes to and is influenced by vulnerability, must be examined within this context [6]. Housing systems worldwide are contending with crises across several fronts, encompassing socio-economic gaps, class stratifications, racial inequities, gender prejudices, generational challenges, and more. These challenges are extensive and intricate, impacting various facets of society. The growing perception is that these multiple crises are not slowing down despite the pandemic but are accelerating due to it [7].

The global crisis caused by the COVID-19 pandemic has led to a housing crisis whose symptoms are more or less pronounced globally. The pandemic has caused a reduction in economic activities and business closures in many countries, leading to job losses and triggering a financial crisis in households and society as a whole. This type of economic instability makes it difficult to cover housing costs, primarily rental, mortgage, and tax obligations. Construction and design practices have been delayed during this period due to lockdowns, delays in material and resource deliveries, and general financial uncertainties, resulting in a reduced supply of new housing units and worsened housing shortages in certain areas. Ultimately, it has led to an increase in property prices and made housing even more unaffordable. The pandemic has also shifted housing preferences, with many families seeking homes and locations outside urban centers for better environmental living conditions, further complicating housing accessibility issues. The housing crisis has particularly affected less developed communities and low-income families. All these factors contribute to the complexity and multidimensionality of the housing crisis during the COVID-19 pandemic, emphasizing the interconnectedness of economic, social, and environmental factors in developing sustainable and accessible housing.

The pandemic response, marked by excessive reaction, has triggered a secondary effect potentially more severe than the health crisis itself. Much like the virus, a behavioral contagion has rapidly spread globally, possibly surpassing the virus in transmission speed [8]. Although most age groups, except older adults, face low health risks from COVID-19, individual risk attitudes strongly shape their behavioral responses. Rather than actual risk levels, risk attitudes play a key role in determining behavior for both young and elderly individuals. Changes in risk perceptions, influenced by disease-related information, can significantly affect people's responses to the pandemic. Failure by certain groups to recognize COVID-19 as a significant personal threat may inadvertently contribute to further virus spread [9]. Self-isolation or restriction of an individual can change the habitational dynamics and rhythms, stimulating several issues, such as putting lives in danger, especially when the housing environment is not habitable [10]. If we talk of housing conditions, poor housing quality and non-functioning or inadequate indoor facilities were related to current and lifetime depressive and social anxiety [11]. The new crisis has significantly affected young people living with their parents due to isolation from the belonging group and the generation gap. On the one hand, parents are pressured to maintain a working atmosphere in their home. At the same time, young people are educated remotely in these conditions, often without the possibility of physically isolating themselves in a separate room.

While COVID-19 may no longer be classified as a global health emergency, countries must continue to enhance their efforts in addressing the disease and be ready for future pandemics and other potential risks. The pandemic underscores the importance of improv-

ing the resilience of our built environment, with a particular focus on outdoor areas, and most critically, our homes [12]. In the pandemic conditions, the term "resilient architecture" got a new and broader connotation—the unpredictability of living and working patterns requires long-term and sustainable design measures and a greater degree of independence and neutrality of elements in the self-adaptable spatial system. Security layers that will respond to the current health crisis should be developed [13].

Housing scholars, housing policy, and living environment play a crucial role in this health crisis. The pandemic encompasses various health, economic, and political challenges [14]. The link between inadequate housing and poor health is increasingly well-documented [15]. Poor-quality housing and overcrowding directly relate to poor mental health, developmental delays, and social conflicts. Housing is a pivotal life domain that has been affected by the pandemic. Confining people to their homes in this manner presents a wide array of issues and challenges. There is evidence from some cities of a rise in domestic violence as households endure extended lockdowns and financial stress due to income loss [16–18]. Cities demonstrate resilience to shocks, including pandemics, but not necessarily to trends [19]. The urgency of addressing these issues is apparent. Climate change represents constant shifts rather than permanent shocks, as do technological, economic, and demographic trends. The pandemic has been a shock but has raised numerous new questions regarding improving housing and healthcare policies. Hence, this issue is crucial for all future trends and shocks.

Central to the category of social sustainability is the concept of spatial sustainability of housing. This concept underscores the flexibility of the spatial anatomy of housing being adaptable to the evolving needs of users, while also considering the socio-economic and cultural aspects of the environment. The information revolution, which has enabled professional tasks to be performed from various temporal and spatial positions, has been further accelerated by the pandemic. Its overall impact on the organization of housing space is yet to be fully understood. The understanding of everyday life and habitation is changing, from the loss of clear boundaries of criteria previously considered unquestionable determinants, to an entirely new perspective on human housing needs. The specifics of the produced housing crisis are reflected in the fact that the shortcomings of the built environment, under conditions of forced and prolonged cohabitation, more rapidly and intensely affect the psycho-physical health of individuals, lead to family conflicts, and increase the risk of virus spreading. This problem especially refers to multi-family housing. Given the significant impact of the pandemic, multiple studies are already suggesting ways to enhance urban housing in the post-pandemic era [20]. The conducted research on future changes in architectural and urban spaces, based on experts, derived keywords for trends and issues related to buildings. Among these, the most significant are 'flexible buildings' and 'complexification of housing functions' [21]. The characteristics of the housing environment, such as dimensions, access to the facades, natural light, terraces, indoor space quality, and use value can affect resident's mental and physical health issues [22]. Therefore, understanding the nature and changes of the physical components which affect COVID-19 spread is crucial for the future development of resilient cities [23]. In light of the new changes that characterize the intensive and prolonged use of housing, current housing trends should be reviewed to prevent the harmful effects of changing dynamics of work and life functions on human and community health.

New generations of homes will certainly integrate apartments and yards after the pandemic, as it has been demonstrated that open areas enhance ventilation within buildings. However, it has also been found that increasing the depth of the terrace does not positively affect internal ventilation [24]. Following post-pandemic sustainability requirements, a correlation between adequate housing and reliance on individual motor transport has been observed. Analysis of this relationship suggests that instead of staying at home, cycling can serve as a tool for reducing environmental carbon emissions and enhancing resilience [24].

Before the pandemic crisis, research was conducted analyzing inadequate housing in Serbia and proposing the affirmation of multi-family housing models characterized

by adaptability and flexibility [25]. According to this research, space limitations and unsuitability are two essential criteria influencing the degree of conflict and potential risk. Insufficient housing refers to the problems of spatial deficit, i.e., overcrowding, often caused by economic impotence of users, but also by other external influences of life in the city. On the other hand, unsuitability mainly stems from inadequate planning and construction policies that do not recognize differences in housing exploitation, i.e., the variability of users' needs during the exploitation cycle. Furthermore, the issues observed before the pandemic crisis are now becoming increasingly complex. While housing issues during the pandemic and the significance of resilient housing have been discussed in the literature, few studies in Serbia focus on this topic. In the realm of urban design, methods for its implementation have been proposed [26]. The significance of public green spaces during the pandemic has been thoroughly examined [27], as well as the challenges posed by COVID-19 in Serbia [20]. Therefore, this research addresses the issue of resilient housing in Serbia, building upon previous research conducted in 2017 [25]. During the pandemic that caused intensive and prolonged housing exploitation, sensitivity to one's own physical and social environment proved to be a prominent symptom of a lack of adequate space for living, working, and education. Hence, it is necessary to review existing conditions and provide new ones in response to new changes in the exploitation mode. To better understand the complexity of these changes, the paper considers aspects of quality of modern living, considering the parameters of flexible plan potentials, space and density relationships, air and light comfort, space use, open space treatment and living–working relationships. The fundamental assumption in this study is that resilient housing in Serbia can be achieved through greater space adaptability to current and future crises. The primary objective of the research is to propose methods for creating a resilient housing model in Serbia in the post-pandemic era.

Architectural education extensively covers lessons on housing, so it is advisable to expand educational programs in these areas. To effect changes or additions to architectural curricula, it is necessary to initially gather information from young individuals related to the topic of this study. Formulating recommendations for innovating the education process at architecture faculties is justified only after analyzing their responses, which aligns with the aim of the research in this article.

The prolonged period of time spent indoors brings various challenges in the design of post-pandemic housing [13]. In this context, it is crucial to examine the spatial aspects of the impact, particularly on the increase in family and personal conflicts and the risk of the virus spreading. It is imperative to reconsider whether the modern trend of space rationalization which includes the open plan concept, compression and overlap of functions, and reduced areas is still a desirable solution. By setting social distancing and quarantine as design problems, we can explore which current housing trends need revision and which have to be improved in the post-pandemic period.

The COVID-19 pandemic has affected various countries, cities, and communities differently. Areas characterized by limited resources and ethnic and racial minorities have faced the most severe consequences of this crisis [28]. Therefore, it is essential to consider the economic, social, and cultural context of the relationship between housing and the negative effects of the pandemic crisis. The issues of resilient design and the future of architectural education, considering the contextual specificity of housing, form the basis for defining the research methodology.

2. Materials and Methods

The research methodology comprises three sections (Figure 1). The first section examines current trends in the spatial organization of living spaces, analyzing their main characteristics and the motives behind their implementation. The current trends refer to those that dominated the market at the time of the pandemic's onset. The identified housing patterns under analysis are 'life and work merge', 'overlapping functions', and 'integrated

living space'. The scientific background of the identified housing patterns is constituted by a comprehensive study of contemporary housing trends in Serbia and worldwide [25].

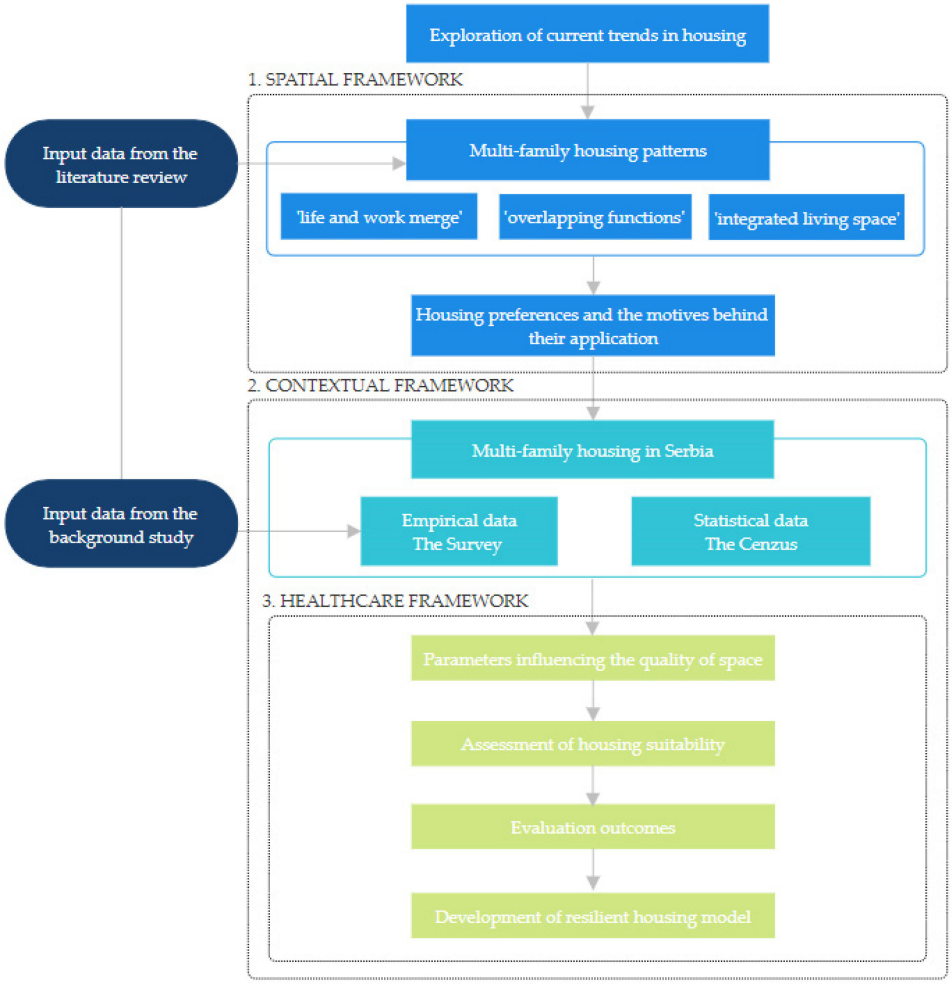

Figure 1. Methodology (drawn by the authors).

The second part defines the contextual framework of the research and analyzes the specifics of multi-family housing in Serbia, using empirical and statistical data. Housing was empirically evaluated taking into account the previous study [25] and survey of users. The mentioned study from 2017 included, among other things, a survey of residents of multi-family residential buildings located in the territory of the city of Nis. The survey model was based on the professional views of the authors (teachers at the Housing Department of the Faculty of Civil Engineering and Architecture) on relevant aspects of housing comfort and potential priorities of quality housing. Data collection was carried out through direct interviews with respondents in their households. Senior students of the Department assisted in gathering survey data. These students were familiarizing themselves with the methodological foundations of sustainable housing as part of the current study program. Interviewers were thoroughly briefed on the specifics of the questionnaire and the conduct of the survey. The characteristics of the living space were being re-examined in the current health crisis conditions using a survey of the tenants who live in the subject area. The respondents were first-year architecture students of the Faculty of Civil Engineering and Architecture at the University of Nis, Serbia, engaged in distance learning programs during the pandemic. The survey was anonymous, and students voluntarily participated in the research. It was conducted using the Microsoft Teams platform, which was also used for online education [29]. The statistical data were taken from the 2011 Census of the Republic Statistical Office of Serbia [30]. By synthesizing and systematizing the obtained data, the

article examines both the objective and subjective parameters influencing the quality of space utilization within the defined health and social frameworks.

The primary objective of the third section is to evaluate layout preferences, considering current housing needs and the risk of virus transmission. The evaluation criteria were defined as follows: air comfort, light comfort, the ratio of shared and individual spaces, apartment occupancy, the regime of space exploitation, the intersection of paths and risk zones in case of infection. In the form of a discussion, the critical spatial aspects of increasing conflict and the spread of infection during the pandemic were identified, and guidelines for creating a resilient housing model were formulated. The created models provide recommendations for innovating architectural curricula that will address the issue of resilient housing.

3. Results

3.1. Identifying the Concept of Modern Living

Housing patterns are constantly changing physically and mentally [31]. Social movements and the evolutionary progress of society at the beginning of the 21st century conditioned changes in the concept of modern housing. The rapid development of technology shapes both our progress and our perception of the world. Higher speed, efficiency, and mobility in everyday activities have transformed and programmatically redefined the classic notion of housing. The dynamism of life has initiated new tendencies in furnishing and spatial arrangement, primarily characterized by the rationalization of space through the reduction of areas, summarizing and overlapping functions and openness of the plan—especially in the living room. Applying the all-in-one space concept is especially pronounced in smaller apartments because, in that manner, integrating of different housing functions enhances the feeling of spaciousness [32]. The article further explores current global housing trends and that in Serbia through concepts such as 'life and work merge', 'overlapping functions', and 'integrated living space'. To better understand these concepts and align them with contextual specifics, a representative example of multi-family residential development in Serbia is presented, encompassing all the preferences as mentioned above (Figure 2). These findings stemmed from a more comprehensive study of the characteristics of contemporary multi-family housing in Serbia [25].

Figure 2. Representative example of apartment layout arrangement in Serbia (drawn by the authors).

The "transitional apartment" that has marked housing construction in Serbia over the past 20 years results from the influence of a liberal market and the absence of a stable professional code. Deregulation and the collapse of the value system in Serbia have consequently undermined the authority of institutions and societal roles, especially architectural ones. The design of residential complexes largely falls into the domain of private investor-entrepreneurs, aiming primarily to maximize the fulfillment of parameter characteristics rather than other qualities of residential comfort. This often leads to an imbalance in the

basics of apartment layouts and a significant undersizing of certain rooms. The imperative of fully utilizing the available space on the plot dictates a higher number of apartments and more residential rooms within the smallest possible area, often sacrificing open spaces and auxiliary functions. A concrete example demonstrates this and proves that most rooms fall below prescribed surface standards, and the requirement for two bathrooms in apartments with three or more beds is often ignored. The integration of the kitchen, dining area, and living room has roots in the rural tradition of combining these functions. Overly extensive and restrictive norms likely stem from the previous socialist-communist era and the doctrinal nature of the social organization, which, due to the inertness of the environment, still represents a determining factor that requires overcoming predetermined reactions to prescribed conditions [1].

3.1.1. Life and Work Merge

The trend of a decrease in full-time employees and more and more of those who perform their work activities from home has influenced the emergence of concepts in which the functions of housing and work are compounded in space. The main characteristic of modern global society is greater flexibility in performing housing, work, and other functions, while the division into public and private contents is increasingly blurred. Upgrading the living environment with work functions is a trend that aims to create multipurpose spaces for more intensive and efficient exploitation. Merging of housing and work functions abolishes clear boundaries between personal, business, and social (Figure 2, living and working frames). Living space acquires a broader meaning as a place to live, work, and engage in leisure activities. The desire to create an intimate environment is replaced by an open and universal concept in which all functions are treated equally.

3.1.2. Overlapping Functions

Accelerated population growth and changes in the structure of households and the increase in land value result in an increasingly frequent housing concept with spatially reduced and rationalized contents that are compressed and overlapped in space. The current housing trend of living in small spaces represents not only the need to reduce the floor area, but also the response to the modern lifestyle and increased environmental awareness of the population in overcrowded urban centers. Rationalized use of space usually means compressing and overlapping functions in the daily zone, where various activities in open communication occur in parallel. In this zone, the functions, including food preparation, dining, and sitting, are often joint (Figure 2, dining and kitchen areas), resulting from the changed regime of space exploitation, which assumes that all these activities are performed simultaneously in the communion of family members and their guests.

3.1.3. Integrated Living Space

The open plan concept responds to the modern way of living which, among other things, causes the lack of shared free time. Due to its size, spaciousness, and social-friendly (integrative) preferences, an entire space of specific functional groups is more comfortable than an assembly with smaller and physically separate subunits. The plan, which is free of walls, intensifies the feeling of spaciousness and comfort, especially in the kitchen and living room (Figure 2, open plan concept frame). Isolation of usually one family member in a separate kitchen space in the earlier concept of strict functional fragmentation no longer corresponds to society's current living conditions and aspirations. The kitchen island is often the central motive for organizing a living room. Its increasingly frequent application has resulted from a changed housing philosophy, which implies cooking as a joint activity, which fosters a sense of community and belonging.

3.2. Contextual Background of the Study

The characteristics and quality of housing are directly related to society's economic and socio-cultural image. Representation of specific housing typologies, manner of exploitation

and organization of space, average apartment size, and usable area per user define the standard and quality of construction and directly indicate the socio-economic status of a country. Understanding the motives for applying a particular concept requires considering the contextual background of the research.

3.2.1. Characteristics of Multi-Family Housing in Serbia

At the turn of the 21st century, in Serbia, the functional organization diversity of the plan was mostly not a topic of design consideration. Premises with a clearly defined purpose and regime of exploitation with areas reduced to a minimum resulted from a construction policy in which the quantitative prevails over the qualitative. The market-based system has reduced housing quality, with space shortages, overcrowding, and substandard living conditions [33]. Certain apartment zones, such as the entrance, the dining area, and the terrace, are gradually being lost in the plan, with a significant reduction in their areas. The organization of the living, kitchen, and dining areas within one space is widespread in many countries, without differences in the state's economic power, but again with significant differences. The trend of unifying these functions is ubiquitous in Serbia, but the motives for its application are rationalization rather than the modernization of space. Undeveloped land intended for housing is mostly located in expensive locations, so as many apartments as possible are imperative for building development. Combining these three functions in one space reduces the required area of the apartment and enables the production of a more significant number of apartments within the building. In developed countries, the area occupied by these three zones is significantly larger than that in Serbia, and thus, the possibilities of organizing and exploiting such areas are incomparably greater. Due to frequent under-dimensionality and lack of flexibility in the organization, the daily zone of housing units in Serbia gives an objective and subjective feeling of overcrowding.

3.2.2. Characteristics of Households in Serbia

Although there is a noticeable tendency to weaken the nuclear family concept globally, the contextual specifics resulting from the slow reform and modernization processes in Serbia affect the still dominant representation of traditional values and inherited life patterns. On the other hand, the quality of social relationships in the family largely depends on the characteristics of the physical environment, i.e., family residences. Undersized apartments, as well as the inadequate organization and room capacity of the unit negatively affect the behavior of family members and their relationships, especially in the case of psychophysical development of youth. Overcrowded and expanded family structures are widespread, and, for many, are the only option for overcoming poor financial situations and stabilizing living standards through a mutual budget [25]. The small number of available resources in life options contributes to developing adaptable lifestyles in an extended community. It also affects the longer retention of traditional family norms and slows youth independence.

3.2.3. Statistical Data

Measured by the accepted EU standard of over 25 m^2 useful floor area per person, only 38% of the occupied stock would qualify. Another 32% have 15–25 m^2 of useful space per person. The remaining 30% have an extremely low standard of space consumption [34]. The housing deficit is also expressed through the lack of large housing units, the share of which is lower than that of the households with five and more members [30]. According to the 2011 Census, the average apartment size in Serbia amounts to 64 m^2 with the corresponding floor area of 22 m^2 per person, for an average household of 2.88 members. The average apartment area per tenant is much lower in Serbia than in EU countries with a floor area of 42.56 m^2 per person [35]. In addition, the average apartment size is noticeably lower than that in the EU countries where the floor area ranges from 77 m^2 in Finland to 125 m^2 in Luxembourg. The apartments in the United States are even larger, with an average size of 145 m^2 [36].

3.3. Empirical Research on the Impact of COVID-19 on Living Conditions in Serbia

The survey was conducted in the category of youth living and studying in Serbia. Young people are particularly vulnerable because they are in the psycho-social and physical sense in the stage of progressive development and suffer the tremendous consequences of space dysfunction. By surveying architecture students with specific knowledge of housing quality standards and age qualifications, the authors examined how spatial qualities influenced the quality of life, work, and leisure during the pandemic.

3.3.1. Data Collection

A web-based survey questionnaire was posted to the first-year students of architecture (Faculty of Civil Engineering and Architecture, University of Nis, Serbia) via the Microsoft Teams platform on 1 February 2021. The survey included questions about students' opinions about the qualities and limitations of the living environment perceived during the lockdown (March–May 2020) and after that time (from May until the time of the survey). The total sample consisted of 177 students aged 19–20 who were invited to participate online in a research survey. The survey was anonymous, and the confidentiality of information was assured. Participation in the survey was entirely voluntary, with informed consent obtained and clearly documented in advance. No sensitive participants' personal data were collected. According to the Code of Professional Ethics of the University of Nis, consent of the University Ethics Committee was not required for this research.

The first section of the questionnaire investigated the general features of the respondents and their families: (a) gender, (b) current age, (c) educational level, (d) number of family members, (e) structure of family households. The second section consisted of questions about the physical preferences of the unit: (a) construction period, (b) unit size in square meters, (c) number and type of the rooms, (d) living room size; (e) organization of the living room; (f) living room functions; (g) bedroom type; (h) number and type of technical blocks, (i) belonging outdoor space preferences, (j) indoor quality in terms of natural lighting and ventilation. The third part referred to the patterns of living space exploitation during isolation and eventual self-isolation of some of the household members: (a) working and (b) educating from home modalities, (c) focusing on a task and cognitive potentials (d) observed shortcomings of spatial organization, (e) space exploitation during self-isolation.

3.3.2. Data Synthesis and Statistical Analysis

Only the data relating to multi-family residential buildings were analyzed within the specific study. The most represented type of household within the examined sample was a family of four (parents and two children) with 40%. It is followed by expanded and three-generation households with 35%, 3-member households with 11%, 5-member nuclear households with 7%, and incomplete nuclear households with 7%. In the case of 4-member households, the average area of a unit was 70.78 m^2, or 17.69 m^2 per person. From the hygienic, psychological, and sociological aspects, the apartment should be an appropriate area, depending on the number of family members, from 18 to 20 m^2 per member [37]. In the case of five-member households, even more pronounced overcrowding was recorded within the survey (the average area was 61.75 m^2, i.e., 12.35 m^2 per user).

The functional scheme where the living room, dining room, and kitchen were located within the open plan (without partitions) was represented in 52% of cases (Figure 3). The average area of such spaces in apartments was 25.25 m^2. According to the current rulebook on conditions and norms for designing residential buildings and apartments in the Republic of Serbia [38] the minimum allowed areas of these spaces are as follows: living room—16 m^2, kitchen—4 m^2, dining room—4 m^2. In total, the minimum area would be 24 m^2, meaning that the obtained results correspond to the minimum allowed areas.

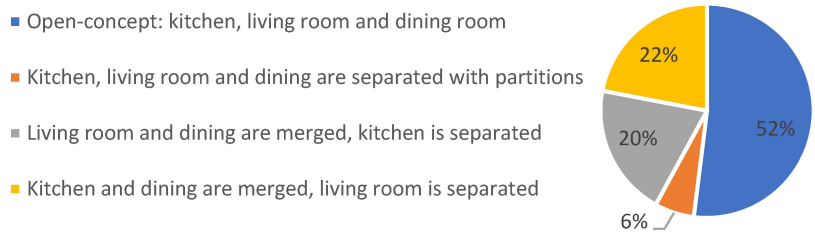

Figure 3. The relationship between the living room, dining, and kitchen.

Previous research on living conditions in Serbia [13] and a specific survey showed that many households use the living area for sleeping (36%). This is a result of the fact that one bedroom is missing in many households, so the living room is forced to accept the function of sleeping (Figure 4). A significant number of households use the living room for work (46%) or learning (38%). Of the respondents (young students), as many as 39% share a bedroom with a brother or sister.

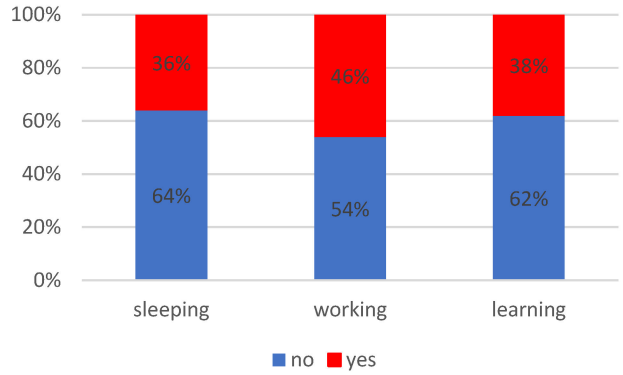

Figure 4. Living room additional functions.

In 25% of cases, virus infection was present in the family, and in most cases, the bedroom was used for self-isolation (78%), further complicating the problem of sharing a room. The room that is most often the meeting place with the infected is the bathroom, which is the expected answer, considering that in a multi-family building, a second toilet is most often sacrificed for reducing space (47% of respondents have one toilet). In nearly half of the cases, the toilet is not naturally ventilated. Another area that is often sacrificed regards open spaces. In addition to the fact that a certain number of respondents do not have open areas in the apartment, most terraces have an insufficient area (4–5 m^2). In 20% of cases, the units do not have access to the open area from the daily zone, but from the night zone and auxiliary rooms, which limits their use. The main areas for improvement in the spatial organization noticed during the pandemic are the need for more work and education space and isolation. As many as 30% of young people use the living room, i.e., shared bedroom (29%) for educational purposes. Regarding the critical question of the extent to which the pandemic changed the living conditions, education, and work of the family, the largest number answered "to a certain extent" with 36%, and "significantly" with 25% (Figure 5).

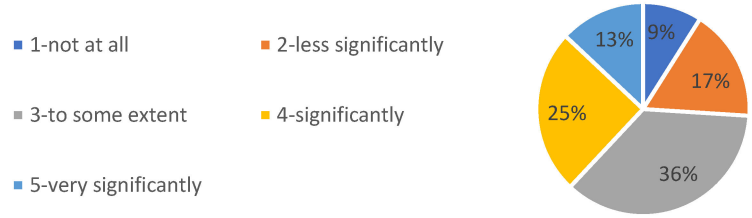

Figure 5. The extent to which the pandemic impacted living, education, and work.

4. Discussion

Responsive, adaptive, and resilient architecture is required in the twenty-first century [39]. The results of the literature review addressing changes in housing after the pandemic indicate the benefits of staying at home, but it has also been observed that most existing plan arrangements are not prepared to deal with epidemics. This has prompted architects to modify or supplement apartment designs, supporting residents' physical and mental health in spaces that can cope with sudden crises [40]. Such conclusions are in line with the results obtained in this study. The problem in Serbia, however, lies in the minimal possibility of implementing such advanced interventions. Although improvement measures for sustainability are outlined in the legal framework, they are reduced to the level of non-binding recommendations [41–43]. For this reason, the issue of 'inherited genetics of housing organization' [1], stemming from system inertia, becomes fertile ground for various manipulations. Market laws dominate the profession, which is left solely to the professional ethics of individuals, since it is not adequately supported legislatively. The main characteristics of actual planning policy in Serbia include the chaotic residential development on small and inadequate building plots and the neglected spatial quality caused by investors' desire for large and fast profits. The global trend of uniting daily functions within one zone has arisen due to the changing way of life, which implies a fast life and performing activities in the company of other members. In Serbia, however, this trend is primarily motivated by the desire to save space and provide the necessary lighting of the space, due to the high number of built-in apartments, which implies a one-sided, possibly two-sided orientation to the outside. As a result, the internal space is often poorly ventilated, accelerating the spread of infection within the family. Furthermore, a decrease in output facades reduces space rearrangement and adaptability. The isolation period has conditioned the more intensive use of terraces. An inadequate open area or the absence of an open area further complicates the psycho-social and hygienic living conditions.

Many current architectural trends are being questioned in conditions of isolation and forced communion because homes have become the only place where people sleep, eat, work, and socialize [44]. The permanent and prolonged housing crisis in Serbia has led families to consciously choose an apartment in which certain housing functions are initially or overtime performed within the same space, thus sacrificing the overall quality of life. A multi-purpose living room with an additional sleep function is usually a solution for overcoming the problem of room deficit. During quarantine, problems are further complicated by incorporating work functions into everyday living activities. Bedrooms are transformed into workspaces, kitchens into internet meeting rooms, and balconies and terraces (if available) became the primary areas for relaxation and leisure [45]. A living room where sleeping or multi-hour work is planned cannot be considered a standard room for gathering family members, nor an individual room in which, following psycho-physiological needs, it is possible to separate members from the group occasionally. In conditions of intensive exploitation, such spaces can lead to severe conflicts in the performance of life and work functions, if the possibility of occasional division of space is not foreseen in advance. The tendency to expand personal and narrow common space becomes problematic with no explicit zoning and incompatible intertwined functions. This practice can lead to serious problems and outages in the developmental cycle of the family, as well as to an increased risk of the virus spreading.

Ensuring sufficient space relative to the number of occupants is also a critical aspect in this domain [45]. However, in practice, the rationalization of space often means reducing the organizational and dimensional qualities such as size, connections, and relationships of individual rooms, zoning concepts, etc. For most tenants, living in an overcrowded area is a harsh reality due to economic constraints. This situation, coupled with all the above, and the findings of other research [46–49], highlights household crowding as a significant risk factor for COVID-19 transmission. The safety of homes is compromised, as the infection of just one person could render the house a direct source of virus transmission, facilitated by the close interactions among residents [50]. The health and hygiene criteria for staying

in an overcrowded and reduced space are further endangered by the fact that in the case of infection, in many cases, the paths of the infected and other family members often intersect, especially in shared spaces like the bathroom and hallway. The layout plan shown in Figure 1 is a stark example for demonstration of space exploitation in the case of one infected person in the nuclear family (Figure 6). If one parent were infected, the other parent would be forced to perform most functions in a single space (living/sleeping/working). The bathroom is used by all family members.

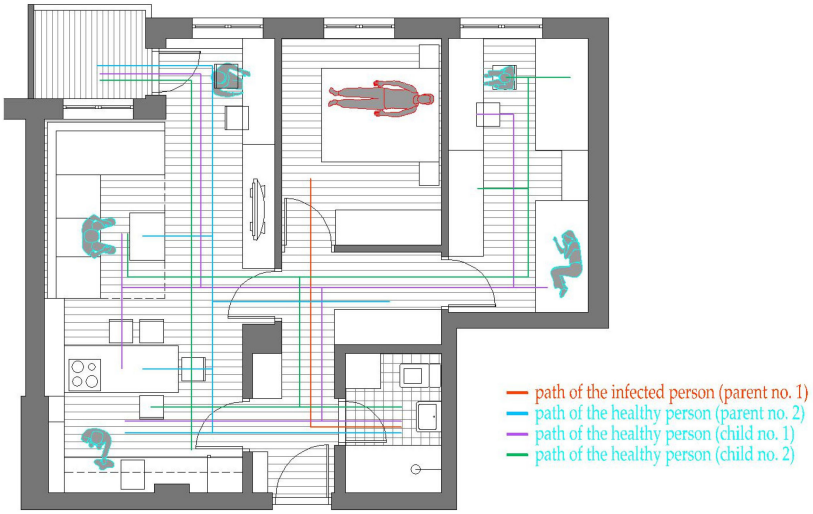

Figure 6. Space exploitation—infected/uninfected paths (drawn by the authors).

Establishing a proper isolation space at home involves addressing various concerns like separating the space effectively, ensuring thorough cleaning, having multiple bathrooms, and waste disposal [35]. The results of the research are systematized and demonstrated through previously defined evaluation criteria (Table 1).

Table 1. Characteristics of a modern apartment: evaluation outcomes.

Evaluation Criteria	Description
Air comfort	The internal space is often poorly ventilated, which accelerates the spread of infection within the family. Inadequate surface or the absence of an open surface further complicates the hygienic living conditions.
Light comfort	Due to the high amount of built-in apartments, which implies a one-sided orientation to the outside, many areas lack proper lighting.
Ratio of mutual and individual zones	The tendency to expand personal and narrow common space becomes a problem with no explicit zoning and incompatible intertwined functions.
Occupancy of the apartment	For most tenants, living in an overcrowded area is acceptable due to the poor economic situation.
Regime of space exploitation	The permanent and prolonged housing crisis has led families to consciously choose an apartment in which certain housing functions are initially or over time performed within the same space, thus sacrificing the overall quality of life.
Intersection of paths and risk zones in case of infection	Health and hygiene criteria for staying in an overcrowded and reduced space are endangered by the fact that in the case of infection, in many cases, the paths of the infected and other family members intersect, especially in the bathroom and hallway.

Several indicators likely contribute to COVID-19 spread:

- High population density challenges social distancing efforts in urban areas;

- Increased household size can facilitate infections without substantial social contact, as one infected person can spread the virus to others;
- While social distancing globally aids COVID-19 containment, outcomes vary significantly based on regional policies, national development levels, and socio-economic conditions in residential areas [51].

As the research focuses on young people living in conditions of limited movement and social distancing, the sample size and the selected target group (students of architecture) can be limiting factors in obtaining a complete picture of their needs and observations. The selection of the target group was based on the idea that students of architecture bring specific professional perspectives and spatial intelligence to the survey, enabling them to consider the problem from two angles—the user's perspective and that of the architect. Subsequent research should include a more extensive analysis of the living conditions of young people, encompassing a wider range of needs from various user profiles.

5. Recommendations for Improving Housing Resilience

Current social circumstances and scientific and technological progress are changing the paradigm of housing, characterized by a dynamic and transformable environment. The apartment is a product of the socio-cultural context of the era to which it belongs and simultaneously a cause that directly influences people and their quality of life, determining their behavior. The elementary ambivalence of social life, expressed through the need for occasional separation or togetherness, requires controlled management of spatial and social boundaries. The concept of an open plan in new circumstances requires upgrading through applying the principle of flexibility [32,45]. Flexibility in the open plan is based on the neutrality and uncertainty of space (Figure 7). Neutrality and uncertainty are the essence of accepting new and different functions in changing program conditions. Sliding partitions that, if necessary, divide the space into smaller sub-units, achieve the possibility of controlling the openness of the plan. The trend of merging housing and work requires such spatial conditions. Living in small units without designated work-space zones and difficulties in defining work and leisure times may lead to reduced productivity [11]. Modern equipment such as sliding walls, sliding doors, and built-in furniture enables flexibility and maximum exploitation in minimal space conditions. Incorporating modular furniture such as sofas and seating units in living spaces enables effortless reconfiguration to foster expansiveness suitable for social gatherings or intimate settings. Similarly, modular desks and shelving units offer adaptability, adjusting to diverse living arrangements in response to evolving work habits or household demands. When integrated into wall units, wall beds and other space-saving furniture optimize floor space utilization during daytime hours, accommodating varied activities in small living spaces. Furthermore, using sliding partition walls or screens provides a flexible architectural solution, allowing residents to temporarily divide a room for privacy or to create distinct zones for different activities. In the pandemic requirements, flexibility would also allow for the partitioning of the space so that the infected person would really be in situations of self-isolation, without endangering other residential functions. For this division in space to be possible, it is necessary to articulate the treatment of the openings on the facade, taking into account the variable program scenarios. The concept of "space within space", where subunits, micro-spaces of a specific purpose are formed within one spatial whole: space for hobbies, solitude, relaxation, personal hygiene, work, etc., in a psychological sense, would contribute to the feeling of being separated from the group. What needs to be taken into account are the lighting requirements for such a space, which can be regulated by the size of the openings in the partitions. The treatment of open areas is also essential in the conditions of prolonged exploitation of space, but also for improving health and hygienic living conditions. The choice of one open area of adequate size with an exit from the living area is a better solution than two smaller terraces with limited exploitation possibilities. In addition, since the facade exit is typically one-sided, planning a glazed transformable and multifunctional

loggia as a central motif of space arrangement could potentially enable the expansion or reduction of the surrounding area while providing additional air and lighting.

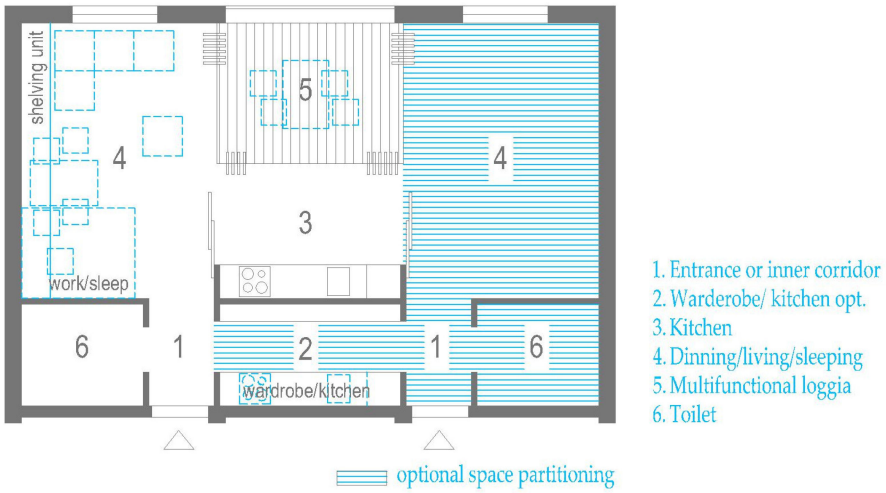

Figure 7. Apartment with premises of enhanced resilience (drawn by the authors).

The recommendations provided for improving housing resilience are universally applicable, but the implementation tools are directly influenced by socio-economic conditions, and the level of environmental and social awareness within the given community. In this particular case, due to various limitations, ranging from legal to spatial constraints, radical changes are necessary, involving the application of systemic measures at all levels. The process of aligning strategic sustainability policies would involve innovating national and local programs and strengthening the role of the architectural profession in housing construction.

In higher education, special attention should be devoted to the issue of resilience and raising awareness among students about the significance of this topic for the future of housing. This requires a multidisciplinary approach that incorporates not only established ecological and economic aspects but also the social aspects of housing resilience. Architectural curricula should be supplemented with thematic units that provide methodological guidelines for resilience-based architectural design.

6. Conclusions

The main characteristic of modern society is greater flexibility in performing housing, work, and other functions, which is why these functions are often compressed in the open plan. The division into public and private zones is losing importance with the increased utilization of the so-called mixed zones. As a spatial framework, the housing unit gained a broader meaning, so it has undergone significant transformations in the previous period. The modernization of society and the modern lifestyle, characterized by fast living and lack of free time, has brought new standards in construction that implement minimalism in interior design. There is a tendency to accept as many functions as possible in the smallest possible area, with the inevitable intersection of the paths at the apartment and the building level. Rationalization of space, the concept of open and flowing space, and merging live and work functions are some of the dominant motives for space organization.

The new circumstances of the global crisis of society place a demand for the reconceptualization of modern housing and the research of new development models and housing typologies. Therefore, it is necessary to organize the residential space according to the principles of flexibility, which allows the implementation of various housing programs in a changing social environment. Implementing flexibility based on openness and neutrality of space increases its use value and extends the life cycle of housing and its sustainability. Unfortunately, the last decade in Serbia was marked by the evident stagnation in research on sustainable housing, which is especially evident in the current health crisis. The uniqueness of the presented study lies in the specific relationship of ideological, cultural, social, and

economic aspects that largely do not deliberately regulate and recognize the goals and measures of social sustainability, under the dominant influence of market conditions in housing construction. In the current market and social circumstances, there is a noticeable tendency to reduce architectural standards, which reduces the organizational and functional qualities of the space. In a pandemic, a congested and overcrowded area poses a potential risk for spreading infection, and for increasing conflict due to confrontational activities performed in the same area. The entire situation significantly impacted young students who, in addition to the fundamental need for solitude, required education in an often unconditional housing environment. Uniformity in expression, which implies a simplified and somewhat reduced scheme of using space without clear zoning of content and elaborated dynamics of exploitation, in the new circumstances can be a serious problem and frustration for family members. Treating open spaces and exit surfaces is vital for maintaining health in congested urban patterns. Nevertheless, these spaces should be given more attention. The shortcomings of housing policy in which the interdependence of layers is strong and does not allow flexibility in the spatial system, became most pronounced during the pandemic period. Resilience requires the prevision of possible exploitation scenarios at all spatial levels. Rethinking existing and defining new housing models that will provide greater adaptability of space to current and future crises is an urgent requirement in the framework of professional action. Controlled exploitation of space with the possibility of occasional fragmentation that provides a certain degree of privacy requires anticipation of program scenarios at the earliest stage and articulation of all components of architectural space.

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