

FLEXIBLE HOUSING DESIGN PROPOSAL THROUGH SPATIAL BEHAVIOR PATTERNS EXHIBITED IN HOUSINGS DURING THE COVID-19 PANDEMIC PERIOD¹

COVID-19 PANDEMİ DÖNEMİNDE KONUTLARDA SERGİLENEN MEKÂNSAL DAVRANIŞ BİÇİMLERİ VE ESNEK KONUT TASARIM ÖNERİSİ

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Abstract: The Covid-19 pandemic is a turning point for today and has led to a view of the future from the perspective of "new normalization". This pandemic has emerged as a design problem rather than a health crisis. In this period, when daily life activities changed places, the houses turned into areas where the infected person stayed and many activities were carried out.

Aim: During the pandemic process, arrangements for reducing transmission and added functions in residential buildings were examined. With these arrangements, it is aimed to analyze spatial transformations depending on actions in existing housing behaviors.

Method: In the study, housing behavior during the current Covid-19 pandemic were investigated. The spatial transformations experienced and realized during the time spent in residences during the pandemic were supported by literature research within the scope of human health, safety and well-being and given in parameters. The selected existing housing plans were analyzed based on the determined parameters (functional and protection). Hygiene entrance, infected room, mixed functions, home office, balcony and terrace need were analyzed and proposal design strategies were developed.

Results: According to the analyses, it was determined that the housing designs were not designed in accordance with the pandemic process and remained inadequate during the quarantine process. A flexible housing design paradigm has been proposed in accordance with the determined parameters and analyzed plan examples.

Conclusion: It is expected that this change and transformation seen in residential buildings will continue after the pandemic or it will not be like the use before the pandemic. Therefore, it is expected that the new houses will be designed taking into account this change and transformation and especially paying attention to the context of flexibility.

Keywords: Post-Pandemic Housing, Healthy Housing, Flexible Housing, Functional Flexibility

Öz: Covid-19 pandemisi bugün için bir dönüşüm noktası olup geleceğe "yeni normalleşme" perspektifinden bakmaya yol açmıştır. Bu pandemi sağlık krizi olmaktan öte tasarım sorunu olarak da karşımıza çıkmıştır. Günlük yaşam aktivitelerinin yer değiştirdiği bu dönemde konutlar süreç içerisinde enfekte kişinin kaldığı alan ve birçok aktivitenin yapıldığı alanlara dönüşmüştür.

Amaç: Pandemi sürecinde konutlarda bulaşı azaltmaya ve eklenen fonksiyonlara yönelik düzenlemeler incelenmiştir. Bu düzenlemelerle mevcut konut davranışlarında eylemlere bağlı olarak mekânsal dönüşümlerin analiz edilmesi amaçlanmaktadır.

Yöntem: Çalışmada Covid-19 Pandemi sırasında konutlarda geçirilen zaman boyunca deneyimlenerek gerçekleştirilen mekânsal dönüşümler; insan sağlığı, güvenliği ve refahı kapsamında desteklenerek parametreler (fonksiyonel ve koruma) halinde verilmiştir. Seçilen mevcut konut planları belirlenen parametreler üzerinden analiz edilmiştir.

Bulgular: Analizlere göre karantina sürecinde konut tasarımların pandemi sürecine uygun tasarlanmadığı ve yetersiz kaldığı belirlenmiştir. Belirlenen parametreler ve analiz edilen plan örnekleri doğrultusunda esnek konut tasarım paradigması önerilmiştir.

Sonuç: Konutlarda görülen değişim ve dönüşüm pandemi sonrası devam edeceği veya pandemi öncesi kullanım gibi olmayacağı öngörülmektedir. Dolayısıyla tasarlanacak yeni konutların bu değişim ve dönüşümü göz önünde bulundurarak ve özellikle esneklik bağlamına dikkat edilerek tasarlanması beklenmektedir.

Anahtar Kelimeler: Pandemi Sonrası Konut, Sağlıklı Konut, Esnek Konut, Fonksiyonel Esneklik

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INTRODUCTION

Crises such as earthquakes, climate change, war and epidemics throughout the history of humanity have changed the course of the world by creating social ruptures and the historical effects of epidemics has had an impact on many different disciplines as well as changing lifestyles (TÜBA, 2020). These crises in history have caused radical changes in different disciplines and led to the production of new solutions according to the problems and needs of the period. When the history of past epidemics is reviewed, the effects of city designs and zoning laws can be seen (Elgheznavy et al., 2020). These historical interventions show that infectious diseases have an important place in the design of modern cities and buildings by affecting architecture (Pinheiro & Luis, 2020). Today, coronavirus (COVID-19) has been added to the list of rapidly spreading infectious diseases all over the world more effectively and quickly than previous epidemics is defined by the World Health Organization and has become the world's most important health problem.

AIM AND CONTENT

In times of crisis such as the Covid-19 pandemic, it is necessary to adapt to the process with the right solutions in order to gain a healthy and sustainable life. Considering the time spent in the residences during the pandemic process, where isolation gained importance, residences have a new meaning beyond accommodation as a result of the reflection of the changes in space and actions on the use of space. The study aims to analyze the spatial transformations in current

housing behaviors depending on the actions by examining the regulations for reducing contamination and added functions in the houses during the pandemic process. In addition, the study reveals the necessity of changing the housing tradition after the pandemic and how housing should be considered in the context of flexibility. As the scope of the study, residential buildings were handled on a spatial scale during the Covid-19 pandemic period. In this process, the parameters that gain importance with the changes and transformations in the residential spaces have been determined. Within the scope of these parameters, spatial design proposals developed on the selected housing examples are presented.

RESEARCH METHOD

In the study, the effect of epidemics that have occurred throughout history on architecture was investigated and a detailed literature review was conducted on housing behaviors/designs/uses during today's Covid-19 pandemic. Spatial transformations realized by experiencing actions as a result of the increase in the time spent in residences during the pandemic period; within the scope of human health, safety and welfare, and transformed into various parameters such as functional and protection parameters. In the pandemic process, the parameters that change and gain importance in housing in accordance with spatial behavior patterns have been separated as protection parameters and function parameters. In terms of protection parameters, natural ventilation, daylight, green space has been discussed with an emphasis on the health and



safety of the residences. In terms of function parameters, mixed uses in living spaces, home office, circulation areas, balconies and terraces have been discussed with an emphasis on the change and transformation of spaces in the context of flexibility. The parameters that provide both protection and function parameters, hygiene entry and infected area are also discussed. The analysis was carried out on the existing housing plans selected with these parameters. It has been analyzed that individuals living in the housing are protected in case of infection, while uninfected people move different activities into the housing due to restrictions. Selected existing housing plans were analyzed over these parameters the ways of carrying different activities inside the house due to the restrictions of the uninfected people have been researched and various suggestions have been developed. According to determined parameters and the analyzed plan examples, how the housing behaviors and space transformations are during the pandemic process has been revealed and a flexible housing design paradigm has been proposed.

Research Limitations

In the study, apartment housing plans from TOKI (the largest housing builder) houses in different cities that people commonly are used, selected from small scale to large scale with large families staying in housing reviews. 1+1, 2+1, 3+1, 3+1 duplex, 4+1 and 5+1 house plans were redrawn to scale from the internet source and regenerated those analyzed in the findings section.

Research Problem

Historically, we see that pandemic diseases have continued from the past to the present and past pandemics have affected architecture. The Covid-19 pandemic is a turning point for today and has led to a view of the future from the perspective of "new normalization". This pandemic is not only a health crisis, but also a design problem. In the study, it is questioned how the Covid-19 pandemic affects the place where people live. During the isolation and quarantine period due to the pandemic, people mostly stayed in residences. Housing designs should be useful and adaptable in times of crisis such as pandemics. Social isolation was required to reduce the risk of transmission by maintaining physical distance during the Covid-19 pandemic process and people avoided public spaces and turned to private spaces. People were encouraged to stay at home with mottos such as "Stay at Home", "Life Fits Home" and "Maintain Social Distancing". It has been observed that the use of housing has changed with the restriction of outdoor use. In the period when daily life activities changed places, the houses turned into areas where the infected person stayed and many activities were carried out.

Sub Problems of the Research

While the pre-pandemic residential uses provided shelter and protection, in addition to these activities after the pandemic, in case of contagion, there was a need for the infected area, the home office providing remote working, the sports area that allows the individuals staying in the house to move due to restrictions, and different hobby areas. It is

a problem that the lifestyles differ with the pandemic process and the inadequacy of the spaces in the existing housing can't meet these needs. In the study, it can be an aspect as a sub-problem that the use of housing during the pandemic, the presence of infected people, in case of daily living activities mostly switch to housing. Based on this, housing designs are not flexible enough.

Research Hypotheses

There are 3 hypotheses that make up the setup of the study.

1. Existing houses are insufficient for use during the pandemic period.
2. The pandemic period brings up the necessity of changing and transforming housing designs.
3. Flexible housing designs increase usability in times of crisis such as the epidemic.

Theoretical Framework

Social ruptures such as the epidemic experienced throughout history not only changed human life directly or indirectly, but also transformed the meaning attributed to space (Tayanç, 2022). With the pandemic process, it has been seen that the houses have undergone change and transformation due to various factors. According to Nalçakan et al., (2021), the pandemic crisis has brought a new perspective on previously ignored issues with the pandemic. The idea of living together in the city center has left its place to the idea of living away from the city and in areas that are not dense (Yüksel, 2022). In the survey of the American Institute of Architects (AIA) on the room/space demand for change in

residences for architects and companies, there has been a significant change in the reasons for demand for housing change in July 2020 compared to 2019 (Chart 1).

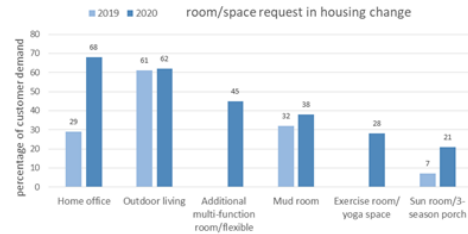


Chart 1. Percentage of Changing Customer Demands for Specific Areas in 2019-2020 (The American Institute of Architects, 2020)

The graph shows that the highest demand is in home offices. Demand has also increased for sunrooms (rooms that allow plenty of daylight and nature views) and vestibules (entrance storage areas). Multifunctional flexible areas such as the children's area and the study area and the exercise room/yoga area were added as new demands in 2020 (The American Institute of Architects, 2020). In Chart 2, when 2020 and 2021 are compared, it is seen that the home office continues with high demand like 2020. Demand has increased in mixed office spaces with outdoor living and zoom meetings. According to The American Institute of Architects (AIA) survey (2020), the demand for a suite for the housekeeper or the elderly person in the house, which provides a mixed office/virtual meeting space and independent space, has been added (AIA, 2021) This has caused the house to assume a different function from its existing function, and it has questioned the necessity of how the houses of

the future should be, considering the crises such as the pandemic.

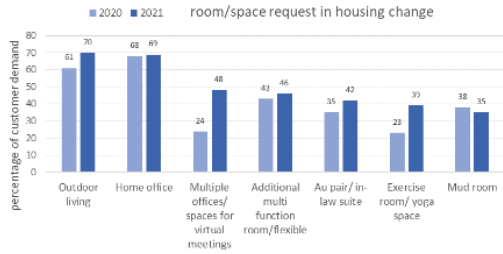


Chart 2. Percentage of Changing Customer Demands for Specific Areas in 2020-2021 (Adapted from AIA. 2021)

As shown in the graphics, the pandemic has changed the paradigm of life. During the quarantine period, people are physically limited by the boundaries of their dwellings. They had to do many activities within the confines of their dwellings. It has led to the ambiguities of the private and social areas, causing the private and social areas to be intertwined within the residence.

Housing Behavior Analysis and Proposed Design Strategies for Housing Plan Types During the Pandemic Process

Parameters that changed and gained importance in residences with spatial behavior patterns during the pandemic process were discussed. These are separated as protection parameters and function parameters as seen in Table 1.

Table 1. Prominent Change Parameters in Residences During the Pandemic Period

Protection parameters	▪ Natural ventilation
	▪ Daylight

Function Parameters	▪ Green area
	▪ Flexible area
	▪ Home office
Protection and Function	▪ Terrace and Balcony
	▪ Hygiene entrance
	▪ Infected area

In the protection parameters, the emphasis is on the health and safety of the dwellings, and natural ventilation, daylight and green space are considered. In the functional parameters, on the other hand, the change and transformation of the spaces in the context of flexibility are emphasized, and mixed uses in the living spaces are handled as home office, circulation areas, balconies and terraces. Hygiene entrance and infected area are also discussed in the parameters that provide both protection and function parameters. Selected housing samples were examined at the spatial scale according to these parameters.

Protection Parameters

With the pandemic process, health and hygiene have gained importance in houses that provide a safe environment by protecting people from various negative effects. Protection parameters that gain importance for providing a healthier and safer environment for houses are discussed.

Daylight

Daylight is considered as an important component of space quality and it has a

psychological and physical positive effect on human health and productivity. It plays an important role in the productivity, health and comfort levels of the users (Hafiz, 2015) Due to the restrictions during the epidemic process, the time for people to benefit from daylight in the open area has decreased. For this reason, people who have been remained in their homes to escape the epidemic have been deprived of the benefits of daylight, their immune systems have weakened and they have become more vulnerable to viral infections. In order to prevent this, the buildings should be designed by giving importance to benefit from daylight more (Ensarioğlu, 2021). It has been determined from the studies that daylight provides the degradation of the virus that spreads the infection and virus transmission is high in places where the intensity of night or daylight decreases (Schuit et al., 2020). Based on studies showing that daylight prevents virus transmission in the space, maximum daylight can be achieved by giving importance to building orientation, window openings and positions, in designs.

Natural Ventilation

During the pandemic period, natural ventilation has been one of the most important parameters reducing the risk of contamination. The coronavirus spreads through the air, especially in closed areas. It is transmitted by aerosols or droplets exhaled by the infected person and suspended in the air in a closed environment

Zafra & Salas, 2020; EL PAÍS, 2020). In order to provide effective ventilation in the spaces, window openings can be provided in every

space and the air flow can be spread to the entire space with cross ventilation. The advantage of natural ventilation is that it is easy to achieve a high rate of air exchange. This is an important factor in maintaining a healthy environment and dispersal of pollutants. Ensuring the effectiveness of natural ventilation depends on some factors. (Larsson et al., 2020). Consideration should be given to providing effective natural ventilation to prevent virus spread in closed areas and mechanical ventilation in buildings.

Green Area

Some planners have argued that epidemic diseases can be prevented by designing green park areas in cities. There is a positive relationship between individuals' access to green spaces and their health and wellness levels. Communities that prioritize green spaces when creating cities and dwellings are better off in terms of physical and mental health. Green space awareness has come to the fore in order to increase the interaction of people with nature near the residences and for future planning and designs (Varolgüneş, 2021). Especially during the pandemic, people who were in quarantine longed for the parks while access to open parking areas in Turkey. Biophilic architecture or biophilic design has many different benefits that can help make buildings and cities more effective human dwellings, such as reducing high stress levels in cities, improving health problems and reducing energy consumption in the built environment, reducing air and water pollution (Söderlund & Newman, 2015). The fact that people stay at home for a long time and their affected psychology has

broadened the perspective of housing design. The biophilic design that incorporates nature into the space has gained importance during the Covid-19 epidemic (Altınoluk et al., 2021) Considering the green elements at the spatial scale, accessing the natural landscape from the house and growing plants in the spaces or on the terraces have gained importance.

Function Parameters

The act of sheltering has undergone numerous changes as a result of the conditions of the day, the events and developments, and has led to the production of different spaces (Durmuş & Asimgil, 2021). With the pandemic process, the concepts of flexibility and adaptability have become important concepts. The concept of flexibility, which is also defined with sub-concepts such as adaptability, changeability, adaptability; It means minimizing the waste of space in terms of being versatile in architecture, being compatible with time in terms of user and function, and being able to carry renewal or re-functioning (Halu, 2020). In this section, the concept of flexibility is emphasized and the strategies that provide the functional flexibility of spaces are examined. The increasing demand for remote working, the home office has gained importance to ensure that the work is carried out from home. The need for terraces and balconies has increased to enable people to connect with the outdoors and nature and to create different hobby areas. The need for a sports area has arisen for people who are inactive at home due to pandemic restrictions (Figure 1).

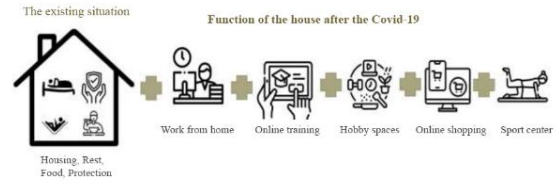


Figure 1. Functions of the House After the Pandemic (İslamoğlu & Usta, 2018)

The functional use of the house, the creation of flexible spaces and transformable areas extend the life of the building and allow sustainable space design. With flexible spaces, designs suitable for different functions can be made, where privacy can be ensured by creating spaces that can grow or shrink, integrate or separate with each other, by movable divider systems when necessary (Yüksel, 2022). When the definitions of flexibility are analyzed, it is seen that the most used and most inclusive concept is change, and this change is based on space, user, function, technology and time (İslamoğlu & Usta, 2018). These changes have come to the fore during the pandemic period, and the use of flexible spaces, where spatial flexibility has gained more importance and allowing the use of possible spaces to change, has been included in our lives (Durmuş & Asimgil, 2021).

Flexible Space

The demand for flexible spaces that can transform according to needs and have different functions in the same space has increased. Some flexibility strategies have gained importance in order to make the necessary changes in the space (Figure 2). These strategies allow the use of multiple functions. Considering that the needs that

differed with the pandemic brought about the changes and transformations in the space, the necessity of going to different transformations especially in the house and making space arrangements in accordance with the wishes and needs of each user came to the fore.

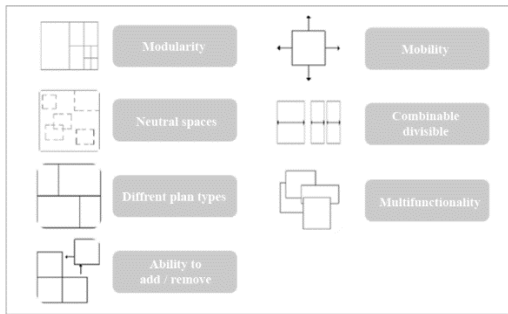


Figure 2. Space Flexibility Strategies (Turna & Usta, 2021)

It is suggested to develop flexible solutions such as dividing the house into sections when needed, designing fixed zones and variable dividers. (Hasgül et al., 2020). When movable systems are used to ensure the isolation of the areas and when movable systems are removed to provide social environments while providing the creation of different activity areas, the spaces need to be added to each other or divided. Especially living spaces are suitable for flexible design in terms of providing different activities. Therefore, by making use of the mobility strategy in living spaces, flexibility is provided through movable walls or movable systems such as separators, sliding windows or doors and folding windows (Figure 3).

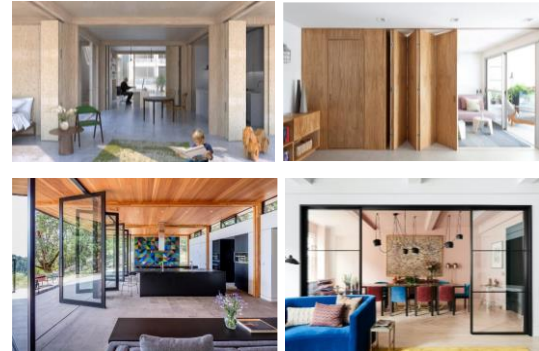


Figure 3. Ensuring Flexibility in Living Spaces with Movable Walls (Top Left-Right) (Patil, n.d.) and Sliding Windows (Bottom Left-Right) (Nielsen, 2020)

Thus, areas or spaces can easily be transformed according to needs. With these systems, maximum benefit can be achieved in the area and flexible areas can be offered to users. It provides functional areas or spaces that can transform into different functions, especially in small areas or spaces. It is important that structures are easily adaptable or adaptable during the pandemic process and to design projects that are flexible, light, modular and easy to implement in times of similar crisis such as a pandemic. At this point, housing design with a modular system provides gains thanks to the ease of application and the opportunity to offer flexible design.

Home Office

With the pandemic process, technology is thought to be the pioneer of digital age and has also been significantly effective in the integration of social and business life into residential life. With the help of computers, tablets, phones and the internet, the living room and study room of the houses were transformed into offices, and meetings, video

calls were organized over different virtual platforms (Yüksel, 2022). With the transfer of the business environment to the home environment, home office space in residences emerges as a great need and has become widespread during the pandemic process. Demands for a smaller but larger number of rooms or an interior arrangement that would allow independent working were sought (Başdoğan, 2020). Working from home has created a separation between sound and silent in spaces. By creating an isolated area in the space, it was necessary to work in a quiet environment for work or education. Environments suitable for these activities were sought. While continuing education online provides some convenience to students and educators in various applications, it has not been able to provide sufficient support for students to understand course applications in design and application issues (Karaşah & Sarı, 2022).

Terraces and Balconies

Due to the quarantine of people during the pandemic process, the importance of terraces and balconies, which contact the external environment and provide a transition area between the external and internal environment, has been realized. Due to the mandatory isolation of the pandemic, the balcony offers, in a way, a new unifying experience (Traverso, 2020). Large terraces and balconies allow people to interact with nature, offering fresh air, daylight and scenery. With the effect of Covid-19, the meanings given to the spaces in the house have increased, and the meanings have begun to change. it has been experienced that they

are insufficient to meet these needs in terms of form and size, while transforming into their primary functions (Kazaz, 2021). Therefore, considering the functional and behavioral performance components of balconies in apartment designs will increase user satisfaction (Aydın & Sayar, 2021). During the pandemic period, terraces and balconies are used both as resting areas and as socializing areas (Çakır, 2020). As can be seen in Figure 4, during the quarantine period, yoga trainings were started on the terraces, concerts were given on the balconies most of their time on the balconies, and people spent chatting with each other or having individual pursuits.

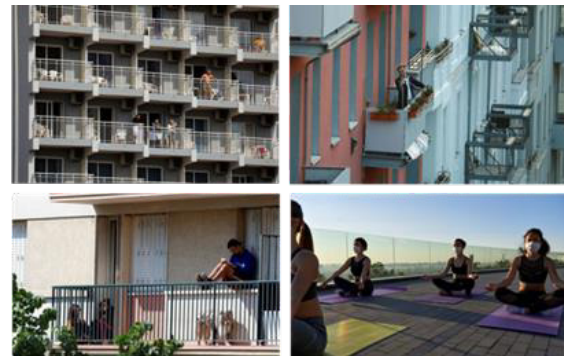


Figure 4. Terraces and Balconies Used for Different Functions (Fidler, 2020)

Balconies was used to access the open air without leaving the social isolation and gaining importance all over the world; It has been used in many different functions, from concerts to free fitness trainings and places while balconies, as spaces where healthy social relations with neighbors can be established, psychological relief is provided, and real contact with the open air and nature can be established in pandemic conditions

Protection & Function Parameters

When the housing changes during the pandemic process are examined, the parameters that meet both protection and function have been determined. While the protection parameters are handled more in relation to health and safety, the function parameters are mostly discussed in the context of flexibility in relation to the spatial and spatial adaptation of the space. The importance of hygiene entrance and infected area in the pandemic process, which are common among the protection and function parameters are emphasized.

Hygienic Entrance

Hygienic entrance will reduce the contamination in the houses during the pandemic period, in addition, measures can be added to reduce physical contact, such as the addition of a cargo compartment (Figure 5).

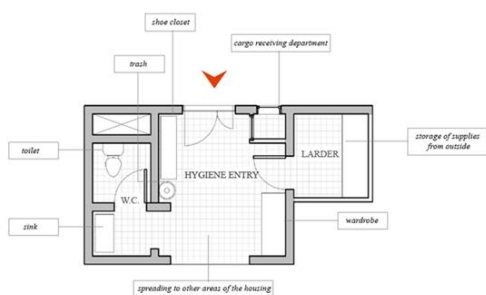


Figure 5. The Organizing of the Hygiene Entrance Area to Reduce Contamination

Building entrances are common areas where there is a high density of people, so there is a high probability of contamination. By taking the necessary precautions, the amount of contamination at the entrances and exits of the building can be reduced. Especially during

the pandemic period, hygiene is one of the issues that concern people (Suri, 2020).

Infected Area

As a result of the rapid spread of virus infection during the pandemic process, some of the infected people who had a mild disease needed an area to be treated in the residence. During the quarantine period, there should be a separate room and a bathroom associated with the room in order to prevent the transmission of the epidemic disease to other family members and to ensure isolation. In addition, it is advantageous to have a terrace in the south direction allows effective use of daylight associated with the room in order to enable the patient to interact with the natural environment and support the treatment process (Figure 6).

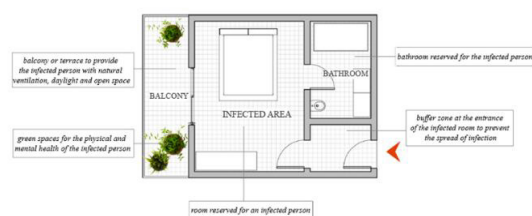


Figure 6. Infected Person Room and Associated Units in the Residence During the Pandemic Period

FINDINGS

In this section, the spatial behavior of different housing samples during the pandemic process was examined. It was evaluated in line with the functional parameters determined during the pandemic process. Then, the use of existing spaces was reconsidered in the context of flexibility in order to prevent the current pandemic crisis

and possible future crises such as pandemics, and the proposal was given as design strategies. 1+1, 2+1, 3+1, 3+1 duplex, 4+1 and 5+1 house plans from the internet source were redrawn to scale and analyzed. In the plan on the right, the housing design proposal during the Covid-19 pandemic is given (Examples 1,2,3,4,5,6,7). Inferences were obtained from the analyzed housing samples according to the change parameters in the houses during the pandemic process. In the housing samples examined, the spaces for their use during the pandemic period and their spatial behavior were analyzed.



Example 3. Regenerated Existing 3+1 (TOKİ, n.d.) Housing Plan



Example 4. Regenerated Existing 3+1 (TOKİ, n.d.) Duplex Housing Plan



Example 1. Regenerated Existing 1+1 (Egepark Çanakkale, n.d.) Housing Plan



Example 5. Regenerated Existing 4+1 (Avend Çayyolu, n.d.) Housing Plan



Example 2. Regenerated Existing 2+1 (TOKİ, n.d.) Housing Plan



Example 6. Regenerated Existing 4+1 (Armada Trabzon, n.d.) Housing Plan



Example 7. Regenerated existing 5+1 (Temaşehir Konya, n.d.) housing plan housing plan

The following inferences were obtained from the adaptation process in residences with 7 samples analyzed. Hygiene input analysis has been done. When the different plan types are examined, the lack of wet space at the entrance or the lack of a direct connection with the entrance show that the hygiene entrance is not paid enough attention in the houses. Among the samples examined, example 1 and example 6 meet the hygiene input better than the other examples. Home office analysis was performed. In the examples examined, in case there is no room, hobby room or living room reserved for the study area, the dining area in the living room has been transformed into a home office with movable separator systems. The hobby room in example 6 was transformed into a living room in example 7 and used as a home office. Except for these examples, the dining area in the living room was used as a working area in other examples. Since there is an en-suite bathroom in the master bedroom in general, the master bedroom was selected and analyzed for the infected person. A separate room, bathroom and balcony was required for the infected person. The bedroom in Example 5 was chosen as the infected area

because it meets these requirements and is close to the entrance. In the examples other than this, the parent bedroom was chosen as the infected area. It has been observed that the absence of a bathroom and balcony in the master bedroom of the Toki houses in example 2 and example 3 meets the criteria required for the infected area at the lowest level. Balcony/terrace hobby area analysis was performed. In the examples, the balcony or terrace associated with the living room, kitchen and master bedroom was examined. It was determined that the balconies were insufficient in size in the samples examined. Especially the balcony in example 3 was weak compared to other samples. In the examples examined, a sports area was created as a hobby area by means of flexible furniture in large halls or by combining the hall and the balcony. In the examples examined, a sports area was created as a hobby area by means of flexible furniture in large halls or by combining the hall and the balcony. In Example 4, with the movement of flexible furniture in the hall of the duplex house, the living area was kept wide by keeping the living area wide. In example 6 the balcony and a part of the hall associated with the hall were transformed into a sports area. Both the flexibility that can be done in the existing houses and the flexibility in the new houses that will be built make the house more sustainable and livable. As a result of the examinations and analyses, a flexible housing design paradigm has been proposed in the center of flexibility and in line with the parameters that have gained importance.

Housing Design Proposal for Pandemic Process

Hygiene entrance, infected room, mixed functions, home office, balcony and terrace need were analyzed and proposal design strategies were developed. These examples, which were developed with proposal design strategies, were evaluated in terms of criteria that should be in the pandemic period rather than arranging the houses within the existing square meters and were mainly arranged according to functional criteria. As a result of the examinations and inferences, a flexible housing design paradigm has been proposed. When the housing design proposal in the Covid-19 pandemic process is examined;

- Hygiene entrance; It is designed as an area where people coming from outside are cleaned separately from other places and a cargo exchange section to prevent contact in case of cargo coming from outside.

- Home office; It is an environment where virtual meetings are held in the home office, work is carried out individually from home, or physical meetings are allowed when necessary. It emerges as a need when parents carry out their work only from home or both from home and office.

- Infected area; It is an area needed in the house if a person is infected. The master bedroom, en-suite bathroom and balcony, located close to the entrance, have turned into

an infected area. By creating a buffer zone at the entrance of the infected room, physical contact is minimized in case of food exchange. Healthy individuals are separated by providing access to sleeping areas and bathroom areas with sliding doors. T-shaped sliding doors separating the hall and the buffer zone, separating the buffer zone and the corridor, and separating the corridor and the hall, have a critical importance that provides functional flexibility by being differentiated according to the need.

- Flexible spaces in living spaces; it offers spaces that can transform into users and become suitable for multiple uses. In the living room, kitchen, dining area and terrace space organizations, the transformation of the spaces is ensured through mobile systems, allowing for different function uses such as working area, a sports area, a game and entertainment area according to the user need. On the wide designed terrace; It can be possible for users to use it as a different activity area for the physical and mental health (Figure 7). And residential use in pandemic mode is shown axonometric by function. The distribution of the infected area, hygiene entrance, home office and mixed functions in the living areas within the house is given. Spatial analysis has been developed for functions that have gained importance during the pandemic process.



Figure 7. Normal Mode Plan for Normal Times (left), Proposed Flexible Housing Design Pandemic Mode Plan for Pandemic Period (center), Axonometric view of Residential use by Functions (right)

In Figure 8, home office and work areas are arranged to allow working from home. The home office is designed as a place that can be used during and after the pandemic process for parents to continue their work from home. For this reason, home office is a sought-after area in residences, but it has a critical importance. Part of the hall and the dining area have been transformed into places where children can study. A movable wall was added between the work area and the furniture by gathering the flexible furniture in one area in the living room. It has been transformed into a working area by adding a

movable wall between the dining area and the kitchen. In order to enable the students living in the residence to continue their education efficiently, the hall and the dining area have been transformed into isolated working spaces to ensure that these working spaces are quiet and spacious, movable walls are used as separators. In order to increase the background view of the person in front of the computer and the working efficiency of this person in online classes or meetings, movable walls were used to obtain the appearance of the opposite wall from plain and smooth surfaces.



Figure 8. Housing Behavior Plan and Axonometric View in Office Mode

There was a need for large terraces that could provide this within the residence. In Figure 9, sports fields are arranged in order to enable the users who stay in the house for a long time to move and to carry the sports activities outside the house into the house. The terrace was added to the living room by opening the

movable sliding windows on the x-axis on the living room side. The movable wall on the y axis between the kitchen and the living room and the movable sliding glass on the x axis between the dining area and the terrace are also kept closed



Figure 9. Housing Behavior Plan and Axonometric View in Sport Mode

Thus, an area for sports activities was provided among the plants, by providing access to fresh air and scenery. The different activity areas requirements of the users staying in the residence for a long time may differ for children and adults. In Figure 10,

playgrounds and entertainment areas that can meet the different activity space needs of children and adults are arranged. Part of the living room and the dining area are united by the opening of the movable wall on the y-axis.



Figure 10. Housing Behavior Plan and Axonometric View in Game and Entertainment Mode

RESULTS

Crises such as natural disasters, wars and epidemics in history have caused social ruptures and accelerated the change and

transformation of the built environment. Today's Covid-19 pandemic has made it necessary to reshape the built environment, rethink to design, and rethink it to prevent

virus contamination or reduce its impact. Healthy design with a more sustainable approach in the face of the pandemic has come to the fore. It has been seen that healthy building designs gain importance for the Covid-19 epidemic. With the pandemic, the replacement of private spaces with public spaces and the change of daily life habits have led to the formation of pandemic housing architecture that are most affected by this change. The pandemic has caused the change and spatial adaptation of the existing role of the house before the pandemic and is clearly visible, especially during the quarantine period. Recovery of the infected person at home, running errands, continuation of children's education, doing sports such as exercise and yoga at home; many changes and transformations have been experienced during the pandemic period, such as playing and entertainment activities at home and providing socialization at home. When it was forbidden to go out of the house balconies and terraces people met their need for fresh air and connection with nature on balconies and terraces which have become the most used areas in the residence.

DISCUSSION

The research hypothesis those are "Existing houses are insufficient for use during the pandemic period, the pandemic period brings up the necessity of changing and transforming housing designs and flexible housing designs increase usability in times of crisis such as the epidemic" are valid according to examined examples. These examples more clearly showed that the houses were inadequate during the pandemic

process (Yaşar 2019) and the criteria that should be in this process. It has emerged as a serious problem, as it increases the possibility of contamination, especially in cases where there is no parent bathroom. In addition, it has been observed that the number of balconies in the houses is insufficient and the balcony areas are small. In order to create healthy designs with a more sustainable approach in the face of the pandemic, the design items suggested above should be used effectively where people feel healthy both mentally and physically. The interventions offer uses that can be applied not only during the pandemic period, but also in the post-pandemic period. (Navaratnam et al., 2022) Enabling spatial transformations in the houses allows the houses to evolve according to the needs of the changing users. Thus, it is suggested that the houses to be designed should be designed by considering this change and transformation and paying particular attention to the context of flexibility.

CONCLUSION

During the pandemic process, people have sought housing away from the crowd and intertwined with nature. It has been seen that detached, garden houses and Duplex houses, are ideal housing during the pandemic process since their functions within the space can be easily divided into social and isolated areas. The orientation of people towards rural areas and houses with gardens has increased, where the risk of disease is low. It has been seen that detached and garden houses are ideal housing. Thus, during the pandemic period, apartment and residence

structures remained in the background at the point of use and demand and lost their usage characteristics before the pandemic. In this period, an orientation and demand increased from vertical architecture to horizontal architecture in residential uses. Movable walls have become the most sought after requirement in terms of providing flexibility in living spaces. Functional flexibility has emerged as a requirement in adapting residential interior uses to the pandemic process. The implementation of flexibility strategies, especially in living spaces, provides an advantage in existing houses, while it is a necessity as it provides functional change and transformation in new houses.

SUGGESTIONS

New housing designs should be made in with the requirements determined as change parameters during the pandemic period. Suggestions for the implementation of this spatial change and transformation in the house are presented below;

- Hygiene entrance has been the area that provides the cleaning and hygiene of individuals by acting as a threshold in the transition from the outside area to the indoor area during the pandemic period.
- If there is an infected person in the dwelling, it is recommended that the parent bedroom be separated into the infected room together with the en-suite bathroom in order to ensure that the patient is independent and isolated. The infected area is formed by separating the parent bedroom, en-suite bathroom and balcony for the infected person. So, there

should be another bathroom in the newly designed houses.

- With the effect of digitalization during the pandemic period, the work from home will continue after the pandemic. For this reason, it is a necessity to add a home office space due to the increase in virtual meetings in that can ensure the continuity of business in the virtual environment by paying attention to privacy in the interior. A quiet environment can be provided by sound insulation at the point of increasing the focus and efficiency of the working individual. In addition, designing the wall that the individual at the computer looks at from plain and smooth surfaces can also increase productivity.
- The demand for flexible spaces that can transform and allow different functions in living spaces is increasing. In order to achieve this, it is necessary to apply flexibility strategies. Spaces that can grow/shrink with modularity and differentiate according to needs are produced. Spaces can be combined and divided and designed flexibly with movable walls, by adding/removing it, depending on the need that arises over time that can be easily applied in the residence. Terrace or balcony can be added to the living room or kitchen area through sliding systems or folding systems depending on different activities. Living spaces become suitable for multi-purpose use by transforming with movable interior equipment and movable systems. During the pandemic process, it has been observed that traditional fixed

walls are insufficient and negatively affect the functionality of the dwelling. For this reason, the widespread use of movable wall systems in new housing designs should be encouraged.

- Designing balconies that are insufficient in size and number should be prioritized. Terraces should be in a size that can respond to different activities such as sports area, plant growing area, playground and entertainment area and provide functional flexibility. The presence of green elements on the balcony and terrace positively affects the physical and mental health of the users and offers spacious environments.

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