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Architectural Solutions of Psychophysical Relaxation Zones of Public Buildings for Their Use in the Rehabilitation of the Public

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Abstract The study aims to substantiate the need to design special zones for the psychophysical relaxation of the public in public center buildings. During pandemics, people develop emotional disorders as a reaction to stress. With prolonged exposure to stress on the human body, further escalation of psychopathological symptomatology is possible, which can have a wide range of negative consequences. Many countries, against the backdrop of the pandemic, are seriously considering constructing infrastructure that could be transformed into medical facilities. It is proposed to design indoor green areas of public buildings with the possibility of using them for rehabilitation purposes. The physical environment includes various aspects: the aesthetics of the establishment, which includes interior design, lighting, sound, smell, color, and temperature. The study was conducted in 2022 at the Institute of Architecture and Urban Planning of the National Research Moscow State University of Civil Engineering. Authors used systematic research approaches to investigate the problem of organizing psychophysical relaxation zones in public buildings. Based on the analysis of the experimental projects, the author proposes basic principles for organizing psychophysical relaxation zones in buildings: using specific plants to improve the microclimate, creating welcoming and healing interior solutions, and using harmonious, non-aggressive forms in the interior spaces. Color therapy is suggested as one of the most influential methods of positive influence on the psycho-emotional state of a person. Because of this, a single architectural, planning, and technological solution for the indoor green space can create a lot of scenarios for its utilization due to the use of modular, unified elements. It is imperative to guarantee unimpeded access to the spaces of indoor green areas of public buildings for people with limited mobility and equip the premises with special means of notification for people with disabilities.

Keywords Psychophysical Relaxation Zones, Public Buildings, Restorative Environment

1. Introduction

The COVID-19 pandemic has had a huge impact on the overall physical and mental health of people around the world. Statistical studies conducted in different countries show a general deterioration in mental and physical well-being due to measures taken to prevent the spread of COVID-19 disease [1, 2]. A.Sh. Tkhostov notes that "two aspects were identified in the structure of anxiety about the pandemic: fear of contagion and anxiety about negative consequences. Fear of the consequences of the pandemic is characteristic of every third person, does not depend on gender and age, and one person out of 11-12 presents an

experience that interferes with habitual activity. A pronounced fear of being infected occurs in one person per 5-10 respondents, it is more characteristic of women and is more common among older people" [3].

Because of the possibility of a massive spread of disease, modern society can experience a state of anxiety. The first signs of anxiety are tension, preoccupation, gloomy anticipation, and a feeling of helplessness [4]. The specifics of response to the spread of disease in today's information society show that the psychological problems of the pandemic are so acute and urgent that, in a sense, they carry no less weight than their clinical and epidemiological aspects [5].

More than anything else, people experience anxiety because of the uncertainty and impossibility of further prognosis for their future lives. The risk of infection is associated with a change in lifestyle, the loss of health, and possibly life. In connection with this problem, recommendations were formed on maintaining mental health during the coronavirus pandemic which includes recommendations to limit information stress and maintain a regular rhythm of life, including for children and the elderly [6]. Recommendations suggest monitoring the level of psychosocial well-being. As is known, in order to preserve the psychological and psychophysical well-being, it is necessary to rest, eat healthy, maintain physical activity, and connect with family and friends. Due to the occurrence of such a mass phenomenon as anxiety and the inability to provide rehabilitation to a large number of people, it is proposed to arrange special zones of psychophysical relaxation for the population in the existing public buildings, which could be visited by all family members regardless of their financial situation to alleviate the negative effects of stress. Against the backdrop of the pandemic, many countries have been seriously considering constructing infrastructure that could be transformed into healthcare facilities [7]. The most rational approach is to establish the multi-purpose nature of the object at the stage of its design [8]. These new facilities require unique design considerations to accommodate the biomedical requirements of treating COVID-19 patients. Architects and designers are now rethinking healthcare design to incorporate flexible, modular spaces that can be easily adapted to changing healthcare needs, with a strong focus on indoor air quality and ventilation systems. In addition, there is a growing emphasis on incorporating biophilic design elements, such as green areas, to improve patient outcomes and create healing environments that promote wellness and well-being.

The purpose of this study is to determine the basic principles for the formation of architectural solutions in the design of public buildings to create zones of psychophysical relaxation and health improvement for the population.

2. Materials and Methods

To investigate the problem of organizing psychophysical relaxation zones in public buildings, a systematic research approach was adopted, based on qualitative methods.

The study was conducted at the Institute of Architecture and Urban Planning of the National Research Moscow State University of Civil Engineering in 2022. Data on the existing studies, facilities, and design solutions were collected and analyzed, normative and recommendation-methodological documents were systematized, and statistical data were gathered.

To achieve the goal, the study was carried out in several stages:

In the first stage author studied the problem from the standpoint of medicine, biology, psychology, and botany and indicated aspects that contribute positively to the solution and implementation of psychophysical relaxation zones in public buildings.

At this stage, the author has processed statistical information and literature on the study of this problem. The main source for studying the problem of the impact of stress on the psychological state was Research conducted in 2020 on the impact of the pandemic on people based on the example of coronavirus incidence. To investigate the relationship between different types of anxiety in a pandemic situation, 409 respondents aged 18 to 64 years who did not contract COVID-19 were interviewed between three weeks and one month after self-isolation was initiated. In the course of the study, the participants assessed the severity of their anxiety on various occasions related to the pandemic situation, as well as the frequency of monitoring information and discussing the coronavirus and the frequency of various protective actions against the disease.

To investigate the dynamics of psychological reactions unfolding during the pandemic, S.N. Enikolopov *et al. [5]* conducted an online survey in Google Forms in 2020 on a sample of 430 people. The study finds that the pandemic brought "an increase in psychopathological symptomatology (somatization, phobic symptoms, sleep disorders), a decline in constructive thinking, an appeal to religion, and a search for existential explanations for what is happening".

In the second stage author examined the analogs of buildings where psychophysical relaxation zones are developed and constructed, to analyze them, and identified the positive and negative sides of the use of these zones.

A topical example of creating such facilities is designing buildings with an atrium space, with green areas for the psychophysical relaxation of visitors. Three community centers were designed at the Moscow State University of Civil Engineering: *The Center for Women in Difficult Situations*, *Youth Cultural and Recreation Center* available for use during the pandemic, and *Cultural and Recreation Complex in the innovation center in Alkho in*

the Republic of Karelia.

All these projects share a common idea – the use of the central atrium space as a zone of psychophysical relaxation for use in public rehabilitation. The space is used by both the center's employees and visitors, for whom a separate entrance is provided.

In the third stage author analyzed various options for the layout of psychophysical relaxation zones.

At this stage, the author conducted a case study on existing examples of the implementation of green areas in public buildings. Authors analyzed six examples of public buildings that incorporated green areas and focused on the functions of the greening of the internal space of buildings. Based on the studied examples of the implementation of green areas in public buildings, the author highlights the main functions of the greening of the internal space, which form the microclimate of the building.

- Relaxation function. Creating a relaxation area reduces stress and fatigue for people working in the building. The presence of green areas, such as indoor plants and green walls, can have a positive impact on reducing stress levels and improving the overall well-being of individuals in the building. It can be located in any part of the building: on the same floor as the offices, a hotel floor, a cluster occupying one or more levels of the building, the balconies, or the roof (Table 1).
- Energizing function. Green areas that help to replenish the energy are usually integrated into workplaces directly next to the workplace, or in corridors linking different departments. Exposure to nature and greenery can enhance cognitive function, improve memory retention, and boost energy levels, leading to higher productivity and overall job satisfaction. This way employees can distract or cheer up without leaving their desks (Table 2).

Table 1. Example of relaxation area incorporated into public buildings

	
a) Karolinska Institute, Stockholm	b) MVRDV design of a terraced office building for the agriculture company Lankuaikei, China

Table 2. Examples of green areas are integrated into workplaces

	
a) Harvard University – Smith Campus Center, USA	b) Lakeland Medical Center Pavilion, USA

Table 3. Examples of indoor zones divided by green areas

	
a) Derby Office of Office Landscapes (Midlands) Ltd, England	b) The office for Dutch property developers Synchroon, The Netherlands

Separation function of several zones from each other, delimitation of territory (Table 3). The use of green areas can create natural boundaries, delineating different areas within a building and promoting privacy and territoriality. The separation function of zones using green areas can be particularly useful in buildings with open floor plans, where different activities take place simultaneously. The use of greenery can create a natural separation between different zones, promoting privacy and territoriality, and creating a more welcoming environment.

In the fourth stage author predicted the possible microclimate of the designed areas. Predicting the possible microclimate of the designed areas is essential in creating comfortable and healthy spaces for building occupants. The microclimate refers to the physical and environmental conditions within a specific area, including temperature, humidity, air quality, and ventilation. By predicting the possible microclimate of the designed areas, architects and designers can create spaces that are conducive to human comfort and well-being.

In the fifth stage author developed proposals for psychophysical relaxation zones of public buildings to be used in the rehabilitation of the population. Psychophysical relaxation zones are designed to promote healing and wellness, providing spaces for physical and mental rehabilitation. By incorporating green areas into the design of these zones, architects and designers can create a more natural and soothing environment that promotes relaxation and supports the healing process.

3. Results and Discussion

In the study, author identified the main forms of architectural solutions for psychophysical relaxation zones of public buildings and their characteristics and developed proposals for psychophysical relaxation zones.

- *Color therapy*

The physical environment includes various aspects: sounds, smells, color, and temperature. One of the most influential methods of influencing a person's psycho-emotional state is color therapy [9]. The problem of phobias and emotional tension can be solved by exposure to colors, that are oriented toward calming the nervous system, relaxation, and a feeling of peace, and calmness – white, blue (in small quantities), and green [10]. People feel tense and uncomfortable in a room that is fully or mostly illuminated by artificial light sources. Ccolor therapy can be incorporated into the design of different spaces, such as psychophysical relaxation zones, healthcare facilities, and residential buildings. For example, in healthcare facilities, color therapy can be used to create a calming and soothing environment for patients, promoting relaxation and reducing stress levels. In residential buildings, color therapy can be used to create different atmospheres within different rooms, promoting rest and relaxation in bedrooms and energy and productivity in workspaces.

Therefore, when designing buildings in a metropolis it is recommended to use such finishing materials as natural stone, wood, and environmentally friendly white paints in the room [11].

- *Greening of public buildings*

Incorporating green spaces into public buildings, such as indoor gardens, green walls, and rooftop gardens, can provide numerous benefits to building occupants. These green spaces can reduce stress levels, and promote relaxation and well-being. Plants are also able to regulate air temperature through transpiration by absorbing heat during the day and releasing it in the evening, thus keeping the indoor microclimate in balance. In the same way, plants regulate indoor humidity, preventing the air from quickly drying out from overheating by the sun in summer and a working heating system in winter. For this reason, consideration should be given to predicting the possible microclimate in green areas and its impact on the environment by creating green islands, green theme gardens, and green walls. Spending time in nature or

indoors with living plants helps improve mood, reduce stress, and improve cognitive skills for people of all ages [12]. In 2015, Min-sun Lee, Juyoung Lee, and Bum-Jin Park from Korea and Yoshifumi Miyazaki from Japan conducted a study titled "Interaction with indoor plants may reduce psychological and physiological stress by suppressing autonomic nervous system activity in young adults" [13]. The goal was to study the psychological and physiological benefits for people from interaction with houseplants. The results demonstrate that active interaction with houseplants can reduce both physiological and psychological stress compared to intellectual work in the following ways: reducing feelings of anxiety (the soil of plants contains a bacterium called Mycobacterium vaccae, which causes the release of serotonin, elevating mood and reducing anxiety), enhancing creativity, and increasing indoor humidity, which is favorable for humans during the winter months. Thus, the ways in which plants have a positive effect on humans were identified:

1. give a sense of contact with nature;
2. taking care of plants increases the sense of responsibility;
3. develop creativity;
4. make people more productive;
5. improve mood and reduce feelings of anxiety;
6. can have a calming effect and help concentration [14].

Based on research on the psychological and physiological benefits of interacting with indoor plants for humans, it is recommended that specific plants be used in the design of public buildings to help manage stress, anxiety, and depression. Among these are: Aloe Vera, Bamboo Palm, Basil, Chamomile, Fern, Flamingo Lily, English Ivy, Jasmine, Lavender, Rosemary, Succulents, and Weeping Fig [15].

- *Utilization of the opportunities of virtual reality*

Incorporating VR technology into public buildings for mental recovery purposes can provide numerous benefits to building occupants. VR simulations can be used to create immersive environments that promote relaxation, mindfulness, and emotional regulation, helping to reduce stress levels and promote overall well-being. Additionally, VR simulations can also be used to create environments that simulate exposure therapy for individuals with anxiety disorders, helping them learn to manage their symptoms in a controlled environment. *Thus*, the VR experience is considered to be very similar to the physical experience of nature, as VR can induce a restorative experience comparable to the real environment. VR is also widely employed in healthcare and medicine for various purposes and influences, including motor rehabilitation. "In virtual reality, the focus shifts from the person's effort to make a movement or perform a task to the interaction with the virtual environment" [18].

A study was conducted in Tokyo on the use of virtual reality (VR) for creating simulations of people and for mental recovery [16]. The results show virtual reality to be effective in restoring the psyche. It is recommended to use the possibilities of virtual reality for modeling various conditions of rest for relaxation and recovery as an alternative approach to experiencing nature [17]. VR is an effective means of evoking emotion and can simulate a very realistic environment. *Thus*, the VR experience is considered to be very similar to the physical experience of nature, as VR can induce a restorative experience comparable to the real environment. VR is also widely employed in healthcare and medicine for various purposes and influences, including motor rehabilitation. "In virtual reality, the focus shifts from the person's effort to make a movement or perform a task to the interaction with the virtual environment" [18].

"Virtual reality technology has the capability of creating an interactive, motivating environment in which practice intensity and feedback can be manipulated to create individualized treatments" [19]. "These technologies are distinguished by four main features: three-dimensional information objects; animation (simulation of user actions and information objects); interactivity (the virtual content changes when a person turns their head or moves); the effect of presence (the impression of being inside the virtual scene, next to the objects)" [20]. The positive effect of VR technologies in the reduction of anxiety is noted quite often [21-22].

VR simulations can be incorporated into public buildings in a variety of ways. For example, VR technology can be used to create immersive environments in psychophysical relaxation zones, promoting relaxation and well-being for people. Additionally, VR technology can also be used in healthcare facilities to create simulations of medical procedures, helping patients better understand and prepare for their procedures.

Incorporating VR technology into public buildings for mental recovery purposes requires collaboration between architects, designers, and mental health professionals to ensure that the simulations are effective and appropriate for needs of the society.

- *The use of natural elements*

The use of natural elements, such as live walls made of moss or other plants, is becoming increasingly popular in the design of public buildings. Patrick Blanc is a well-known advocate for the use of live walls in building design, as they provide numerous benefits, including improving indoor air quality.

Interiors made with the use of live plants reduce people's stress levels, as they break up the monotony and dullness of public buildings and help the eye to distract and have a break from straight lines [23]. In each room of the green area, the acceptable values of temperature and humidity must be respected. Special protective measures must be provided to ensure the protection of the envelope

structures to prevent their deformation or corrosion. To design such a green area, one can apply the experience of the construction of winter gardens, preventing the formation of condensation inside the structures themselves [24].

The concept of biophilic urbanism is employed to incorporate natural elements as purposeful design elements in urban landscapes and buildings. *Thus*, the study "The effect of biophilic design on customer's subjective well-being in the hotel lobbies" explores clients' psychological reactions induced by the use of natural elements such as green plants, flower beds, water objects, aquariums, animals, birds, and butterfly gardens. Therefore, when designing public areas it is recommended to use the biophilic design elements has been found to improve the productivity, health, and overall well-being of people in the natural environment [25]. Biophilic design, which incorporates natural elements into an artificial environment, is attracting increasing attention in both design and healthcare. However, few studies quantify the physiological and cognitive benefits of biophilic properties indoors. The study titled "Physiological and cognitive performance of exposure to biophilic indoor environment" examines physiological and cognitive responses to natural elements in an office building [26]. Participants reported a decrease in negative emotions and an increase in positive emotions after spending time in a biophilic environment as a result of the study. This offers the opportunity to reduce stress and improve cognitive abilities through the use of virtual reality in urban environments or during colder seasons when interaction with nature can be difficult [27, 28].

Thus, the main forms of architectural solutions for psychophysical relaxation zones of public buildings nidified by author play a significant role in creating comfortable and healthy spaces for building occupants. These solutions are designed to promote well-being, reduce stress levels, and support the healing process.

The coronavirus pandemic has had a significant impact on the architectural design of buildings, expanding notions of their structure and function and has forced architects and designers to reconsider how buildings can be designed to accommodate the changing needs of society in the face of global health crises. "Biomedical requirements are forcing us to look for new types of multi-purpose healthcare buildings constructed using 'green' technology" [29]. This has led to the incorporation of biophilic design elements, such as green roofs, indoor gardens, and natural light, which have been shown to improve patient outcomes and reduce stress levels. As a result, architects and designers are increasingly focused on creating buildings that are not only functional and efficient but also promote healing, wellness, and sustainability.

Thus, the author highlights the key proposals for the design of the zones of psychophysical relaxation in public buildings to be used in public rehabilitation:

1. Easy navigation. It could be implemented by incorporating clear signage and wayfinding elements that guide people to the different functional areas within the relaxation zone. Signage can be placed at key points throughout the relaxation zone, including at entryways, along corridors, and at the entrance to each functional area. Additionally, color-coded elements, such as colored accent walls or colored flooring, can be used to differentiate between different functional areas within the relaxation zone. Clear sightlines and unobstructed pathways can also be incorporated into the design of the relaxation zone to ensure that occupants can easily find and access the different functional areas.
2. Alternation of active and quiet rest areas. This could be organized in several ways. One way is to construct separate areas for each type of therapy, such as a separate room for active therapy, such as exercise or movement therapy, and a separate room for quiet rest, such as meditation or relaxation therapy. Another way is to create flexible spaces that can be used for both active and quiet rest, such as a larger space that can be used for yoga or other active therapy during certain times of the day, and then converted into a quiet rest area during other times.
3. The use of natural materials. By incorporating natural stone, wood, and other environmentally friendly materials into the design and construction of the relaxation zone, create a warm and inviting environment that promotes relaxation and well-being. Firstly, natural materials can be used in the flooring, walls, and furniture of the relaxation zone, creating a warm and inviting environment that promotes relaxation and well-being. Secondly, live plants and greenery can be incorporated into the design of the relaxation zone, promoting a connection to nature and improving indoor air quality. "Live" walls made of moss or other plants have become popular in recent years, adding an element of biophilic design to the relaxation zone. Thirdly, environmentally friendly paints and finishes can be used in the relaxation zone, such as low VOC paints or finishes that are free of harmful chemicals and toxins.
4. Sensory stimulation. Sensory stimulation can be organized in a number of ways within public buildings to promote relaxation and reduce stress levels. Aromatherapy diffusers can be used to disperse scents such as lavender or peppermint into the air, promoting relaxation and reducing anxiety. Soundscapes, such as calming nature sounds or white noise, can be used to create a peaceful and soothing environment that promotes relaxation. Additionally, lighting can be used to create different moods and atmospheres, such as warm and cozy lighting for quiet relaxation areas or bright and

energizing lighting for active therapy areas. Other forms of sensory stimulation, such as tactile elements such as textured walls or floors, can also be incorporated into the design of the relaxation zone to promote relaxation and reduce stress levels.

5. Socialization. Construction of comfortable seating areas and communal spaces could promote interaction and engagement between people, creating a more positive and supportive environment. Additionally, the design of the building should prioritize accessibility and inclusivity, ensuring that all occupants have equal access to communal spaces and activities. This may include the incorporation of ramps, elevators, and other accessibility features that allow all occupants to participate in socialization activities.

In the design of psychophysical relaxation zones for public buildings, different functional areas within a room can have specific purposes during rehabilitation [30]. These functional areas can be designed to promote different forms of therapy and relaxation. Some of the functional areas that can be incorporated into psychophysical relaxation zones include sensory gardens, active therapy areas, aroma gardens, and quiet rest areas [31]. By incorporating these different functional areas into psychophysical relaxation zones, architects and designers can create sustainable, healthy, and comfortable spaces that promote healing and well-being. These functional areas can be designed to accommodate different forms of therapy, relaxation, and sensory stimulation, providing building occupants with a range of options for promoting their overall health and well-being.

Overall, the design of the zones of psychophysical relaxation in public buildings should prioritize the comfort, well-being, and accessibility of building occupants. The architectural planning should be based on a holistic approach that considers the physical, social, and environmental factors that contribute to creating a relaxing and calming environment.

4. Conclusions

Author concludes that it can be recommended to equip today's public buildings with specialized green zones the interior of which incorporates live plants. The influence of plants on humans and the environment as a whole is diverse. For example, due to the hygienic functions of plants, there is a mitigation of dryness of the air, the supply of oxygen to the air, the ionization of the air, the release of phytoncides – substances that kill a large number of microbes, absorption of dust and other various harmful chemicals from the air, as well as a beneficial effect on the mental and emotional state of people.

Proceeding from the study of completed experimental projects, author proposes basic principles for the formation of green spaces in public buildings intended for rehabilitation purposes:

- incorporation of green areas with recommended plants into the public space of public buildings to promote a healthier microclimate;
- the creation of a favorable video environment – the use of harmonious, non-aggressive forms in interior spaces and greenery and color to reduce people's stress from spending time in public buildings;
- the use of virtual reality technologies to create an interactive, motivating environment that complements the effect of visitors' interaction with natural elements.

The combination of nature and virtual reality and its implementation in the psychophysical relaxation zones of public buildings can be an effective alternative to medication that will improve mental health and alleviate the stress of visitors.

The novelty of the study consists in the analysis and systematization of the existing psychophysical relaxation zones, the proposal to create such zones in public buildings to use them in the rehabilitation of the population, and the expansion of ideas about the possibility of creating a comfortable psycho-emotional state in the interior spaces of the building.

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