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Архітектура

UDC 747

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## MODERN TECHNOLOGIES FOR OPTIMIZING THE LIVING SPACE OF SMALL ROOMS

Summary. In the context of the global housing and environmental crisis, the problem of developing aesthetically pleasing and functional interior spaces in small spaces is becoming increasingly important. The project goal is to study modern technologies for optimizing the living space of small rooms. To achieve this goal, the psychological impact of arranging small rooms on the comfort and well-being of residents was studied; the principles of interior design of compact spaces were identified; the use of sliding systems, and modular, multifunctional, and transformable furniture were considered. Design solutions and color schemes have been identified to maintain a balance between functionality and aesthetic appeal of small rooms. The research used structural, functional, and theoretical research methods: analysis, generalization, and synthesis of literature in interior design. It was found that to optimize the living space of small rooms, it is worthwhile adhering to a minimalist design that meets practical needs, and improves the comfort and psychological well-being of residents.

*Key words:* optimization of living space, small room, interior design, functionality, aesthetics.

The problem of designing aesthetically pleasing and functional interiors in small spaces is becoming increasingly important in the context of the global housing and environmental crisis [1]. Residents of compact areas face problems of adaptability and privacy, as well as psychological problems of claustrophobia, insomnia, and anxiety [2]. These psychological factors have a significant impact on the overall quality of life of a person, his emotional stability, and mental health. Understanding and solving them is important for creating small, but comfortable, practical, and emotionally stable living spaces.

The project goal is to study modern technologies for optimizing the living space of small rooms. To achieve this, structural-functional and theoretical research methods were used: analysis, generalization, and synthesis of literature in interior design.

To transform small spaces into aesthetically pleasing and functional spaces, designers use advanced techniques to balance user needs, creativity, and visual appeal [3]. The extent to which small spaces can be useful and comfortable depends on the user's ability to perceive the space. Optical illusions, color schemes, and lighting are used to visually expand compact areas.

In confined spaces, functionality is crucial: ergonomic furniture arrangements and efficient usage patterns make small spaces fit the needs of the occupants [4]. Small interiors should prioritize practicality and functionality over excessive decoration. To create open, adaptive living spaces, unnecessary barriers and divisions must be eliminated.

The quality of the indoor environment affects a person's well-being, mood, and mental health. Poor planning and design of compact spaces can lead to stress, anxiety, mental disorders, and claustrophobia [5]. According to research, people living in small spaces are generally less happy and experience higher levels of stress. This problem has notably escalated during the COVID-19 pandemic and beyond, when the amount of people working from home had grown significantly [6].

A study of the main components of interior design, the relationships between psychological and cultural factors that influence the perception of space, showed that lighting, color schemes, and furniture arrangement make a significant contribution to the comfort and well-being of residents of small apartments [7]. In small spaces, it is advisable to use maximum lighting, multifunctional furniture elements, and light colors.

The interior design of a small room should be open: the living space is not limited to fixed structures but is characterized by a dynamic and versatile design that allows you to perform the required actions and use the space as needed [8]. One of the most important elements for implementing the idea of flexibility in the configuration of the interior space is sliding systems. Rollers and guides allow you to use panels of different sizes from different materials, and provide high strength and durability of structures under conditions of frequent opening and closing (Fig. 1).



Fig. 1. Sliding interior door [9]

An example of the use of multiple sliding systems is the transformable modular living space "YO! Home", designed by Simon Woodroffe (Fig. 2) [10]. This is a 40 m<sup>2</sup> living space with movable elements that create the impression of a much larger house. The moving parts are created using engineering technologies taken from the mechanics of stage production, yacht, and car design. The functional irregularity of the roofs serves as a unifying element that encloses and shelters the various furniture in the living space, storage spaces, or beds that can be easily folded or opened as needed.

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Fig.2. YO! Home [10]

Small apartments are too small to accommodate all the necessary furniture at once, so they are used as multi-purpose spaces: residents change and refurbish apartments throughout the day. Modular, multifunctional, and transformable furniture pieces allow for the most complete and functional use of space in places where different furniture is required and there is no possibility of full furnishing [11]. Multifunctional furniture eliminates the need for several pieces, freeing up space and creating a more open, uncluttered environment. It adapts to different situations, making it suitable for dynamic living spaces. For example, a sofa bed turns the living room into a bedroom, and a folding table creates a home office (Fig. 3).



Fig. 3. Transformable home office [14]

Multifunctional furniture often features innovative and contemporary designs [12]. Designers and manufacturers are constantly pushing the boundaries of creativity, creating practical and aesthetically pleasing pieces that can serve as accent points in a room, complementing the overall decor. Innovative design incorporates advanced technology and smart engineering: from modular systems that can be customized to fit any space to furniture with hidden compartments and built-in functions. Additionally, the use of folding furniture allows for easy transformation of the style of the room.

Beds with storage drawers are a practical solution for bedrooms with limited closet space (Fig. 4). They feature built-in drawers or lift-up mattresses that provide ample storage for clothing, bedding, and other items. By integrating into the bed frame, storage compartments help maximize the available space, reducing the need for additional furniture such as dressers or closets. Some beds with storage also feature headboards with built-in shelves, providing even more storage options for books, decor, and personal items. They are well suited for smaller bedrooms or studios where space is crucial.



Fig. 4. Bed with storage drawers [13]

Folding beds fold into a closet, wall, or storage area during the day, providing extra space (Fig. 5).



Fig. 5. Transforming bed [14]

Bunk beds-transformers have been developed for families living in small apartments and having more than one child (Fig. 6). They consist of two single beds connected in a row, which are folded to make the most of the space. Like regular beds-transformers, they can be equipped with a table or a shelf.



Fig. 6. Bunk bed-transformer [14]

Modular sofas are great for small spaces because they are flexible. They are designed to be reconfigured in a variety of ways, allowing homeowners to customize the seating arrangement to suit their needs (Fig. 7). Many modular sofas feature fold-out and hidden storage compartments, adding functionality.



Fig. 7. Built-in options and variants of modular sofa modules [15]

Sofa beds are used as a rest area during the day and as a bed at night. They can be a free-standing piece of furniture or an opening bed system in the wall that combines a bed with a sofa bench (Fig. 8).



Fig. 8. Sofa bed [14]

A folding desk transforms from a compact coffee table that fits under a bed into a spacious dining or work desk (Fig. 9). Some folding desks are heightadjustable, allowing you to switch between sitting and standing positions, which can improve your posture and overall health. This versatility makes them a valuable addition to a home office.



Fig. 9. Folding table [14]

Extendable dining tables are a practical solution for gatherings and family dinners (Fig. 10). They have hidden sliding doors that can be pulled out to increase the number of seats.



Fig. 10. Folding dining table [14]

Insufficient thought and lack of visual openness in a small space can negatively affect the mood and mental well-being of the occupants, causing feelings of claustrophobia, stress, or discomfort [16]. To avoid this, designers need to maintain a balance between functionality and aesthetic appeal. Overemphasizing one of these aspects can lead to a cluttered or overly minimalistic space that does not meet the needs of the user. Furniture should not overload the space, be multifunctional and adaptable.

To avoid a space feeling cramped and overwhelming, it is necessary to use hidden storage solutions: built-in drawers in stairs, beds with pull-out mattresses, kitchen countertops with built-in organizers, built-in shelves, and hidden compartments that help to manage clutter [17]. Optimizing vertical space with high shelves, lofts, and mezzanines allows you to increase the number of storage spaces or functional areas without sacrificing floor space. Combining kitchen and living areas with multifunctional projects makes the spaces more dynamic, and comfortable and increases overall user satisfaction.

Poor lighting can make small spaces feel even more cramped, affecting the overall mood and usability. With natural light often in short supply, it's important to balance artificial lighting properly. Visually expanding a space can be achieved by using natural light properly, by amplifying it with large windows or skylights. The strategic placement of mirrors and glass that reflect light and views doubles the visual space in a room without adding physical clutter (Fig. 11).



Fig. 11. Using lighting and mirrors to visually enlarge space [18]

When choosing a color scheme, it is important to consider the function of the room and the desired atmosphere [19]. Light tonal shades help create a sense of calm in heavily used areas, enveloping colors, deep grays, and earthy tones help create a cocoon-like shelter. When properly proportioned, dark colors look good in small rooms with limited natural light. Deep-pigmented shades can emphasize the character of the space, while bright shades on furniture and floors can create a playful color accent (Fig. 12).



Fig. 12. Dark color scheme for a home office [19]

Rich, dark shades like burgundy and deep purple bring a soft feel to the space, while rich greens bring a natural feel. You can add interest to a dark and intense scheme with a bold accent color on skirting boards, paneling, furniture, or textured elements.

A neutral color palette complements natural light in small spaces, making the space feel larger and more cohesive. Light colors reflect light and create a sense of openness (Fig. 13). Textures and subtle patterns add depth and interest to a space, but it's important not to overload the room with loud colors or patterns.



Fig. 13. Room decoration in soft light tones [19]

Thus, to optimize the living space of small premises, it is worth adhering to adaptive minimalist design based on the principles of simplicity and functionality. The use of modern design technologies allows you to create flexible multifunctional spaces in compact urban conditions that satisfy practical needs, and improve the comfort and psychological well-being of residents.

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