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Design of outdoor recreational hospital spaces: Creating architectural objects in the natural environment

Diseño de espacios hospitalarios recreativos al aire libre: Creación de objetos arquitectónicos en el entorno natural

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Abstract

The purpose of the paper is to identify the features of the design of outdoor recreational hospital spaces in the framework of the design of modern healthcare facilities. The architectural practices of design reveal the need to incorporate outdoor recreational spaces in the architectural designs for modern medical facilities, A detailed analysis of such open spaces is conducted on the examples of design projects for the Shenzhen Children's Hospital (China), Seijo Kinoshita Hospital (Japan), Narita Rehabilitation Hospital (Japan), Khoo Teck Puat Hospital (China), and the hospital complex of the Ng Teng Fong General Hospital and the Jurong Community Hospital (NTFGH, Singapore). The authors argue for the need to devote more effort to the analysis of open recreational hospital spaces because the latter are both a component of the design of modern medical institutions and an important element of the concept of "healthcare architecture".

Keywords: Architectural projects; "healthcare architecture"; medical facilities; natural elements

Resumen

El objetivo del artículo es identificar las características del diseño de los espacios hospitalarios recreativos al aire libre en el marco del diseño de las instalaciones sanitarias modernas. Las prácticas arquitectónicas de diseño revelan la necesidad de incorporar espacios recreativos al aire libre en los diseños arquitectónicos de las instalaciones médicas modernas. Se realiza un análisis detallado de dichos espacios abiertos a partir de los ejemplos de los proyectos de diseño del Hospital Infantil de Shenzhen (China), el Hospital Seijo Kinoshita (Japón), el Hospital de Rehabilitación de Narita (Japón), el Hospital Khoo Teck Puat (China) y el complejo hospitalario del Hospital General Ng Teng Fong y el Hospital Comunitario de Jurong (NTFGH, Singapur). Los autores defienden la necesidad de dedicar más esfuerzos al análisis de los espacios hospitalarios recreativos abiertos, ya que éstos son tanto un componente del diseño de las instituciones médicas modernas como un elemento importante del concepto de "arquitectura sanitaria".

Palabras clave: Proyectos arquitectónicos; "arquitectura sanitaria"; instalaciones médicas; elementos naturales

Introduction

A distinctive feature of the architecture of medical facilities is often the advantage of functionalism as a general approach to the design and construction of such facilities (Allen, 1978). However, the process of staying in hospitals is critical and requires special conditions, both for a speedy recovery and for improving the working conditions for the employees of these institutions (Tikhomirova & Tikhomirov, 2021; Vyalykh et al., 2021). Meanwhile, attention to the features of architectural design for medical facilities and the quality of the exterior and interior forms a single harmonious architectural appearance of buildings (Laws, 2009).

Today, the environmental and aesthetic features of modern hospitals, combined with the latest societal trends, are utilized very actively (Gordeev & Dremova, 2018). The occurring changes impose new requirements for the design of the medical environment, which must be not only effective but also ecologically and aesthetically pleasing (Holst, 2015; Zaripova et al., 2019). In other words, it is important that the building designed to house a medical facility meets a substantial list of requirements, which are derived not only from its functionality (Douglas & Douglas, 2005).

The problem lies in the fact that currently, many medical institutions (over 75%) do not provide comfortable accommodations, are outdated and unattractive, and do not meet modern environmental requirements, because they were built in the last century based on the requirements for the construction of medical facilities at that time, and therefore do not comply with the modern trends in environmental friendliness and aesthetics (Malykha et al., 2012). Consequently, there has arisen a need for more careful attention to the features of design of modern hospitals in terms of compliance with modern environmental and aesthetic demands. Natural elements and eco-friendly materials help to improve the microclimate of the room, making it more comfortable and eco-oriented.

One of the means of achieving this goal in medical institutions is the incorporation of natural elements in their structure (Holst, 2015) and the creation of open recreational hospital spaces (Douglas & Douglas, 2005), which are places of rest formed with the use of landscape design with a high emotional impact and sanitation effect.

The relevance of the research topic consists in the identification of methods of using open recreational hospital spaces in modern medical institutions, as well as their influence on the following functions of medical institutions: architectural and artistic solutions, recreational, healthcare, sanitary, and social.

Literature review

Researchers suggest that the key issues in the design and construction of medical facilities are finding a common compositional scheme, choosing the optimal volumetric and spatial solution, and meeting technological requirements (Gelfond, 2006; Tupolev, 2007). The influence of a set of urban planning factors on architectural solutions in the construction of healthcare facilities can be seen in the solution of such issues as the size and configuration of the land of the medical institution, its location within the city, the location of the object in relation to the street, square, park, and the surrounding buildings.

A number of studies by specialists in architecture analyze the structure of the existing buildings of hospitals and polyclinics. In particular, a number of papers investigate the problem of unification of ward departments in multidisciplinary hospitals, which provides an opportunity for a flexible response to the possible changing conditions and allows for functional alterations in the design of medical facilities for up to 35-40 years (Chebereva, 2009; Pashintseva, 2007). A study by Gaiduk (2015) searches for new methods of the standard design of hospitals that allow predicting and solving the problems of expansion of institutions, including the method of modular design (Podczaska-Wyszyńska, 1981). Fundamentals of the architectural design of buildings, including the medical purpose and general volumetric-planning solutions, are also outlined in research (Bromley, 2012; Gaiduk, 2015).

The experience of designing medical facilities in the United States and Canada is described in the work of Allen (1978). This study is devoted to the creation of a comfortable architectural environment for hospitals by finding the most effective structural, formative, and design solutions that facilitate the treatment and care of patients, create a comfortable atmosphere for staff.

Analyzing hospital spaces, Ikonnikov (2006) highlights several critical qualities of space in architecture: architectural space, personal space, the space of collective activity. These qualities are seen as the most important form of organization of human life. In the space of human movement, essential elements are the characteristic compositional dimensions, configuration, proportions, concepts such as “narrow” and “wide”, “high” and “low”. Problems of the spatial environment of medical institutions are specifically addressed in Adams et al. (2010) and Morgun & Soboleva (2011). Specific features of recreational spaces are considered in a study by Kryzhanovskaya and Yankovich (2007), according to which outdoor recreational spaces are places of recreation that have access to natural light, are formed with the use of landscape design, flora-and phyto-design, and have a positive effect on the psycho-emotional state of the person.

When considering the design of outdoor recreational hospital spaces, it is worth paying special attention to the ergo design approach to the creation of the architectural environment of medical institutions. In the broadest sense, this approach consists in ensuring human well-being through the unity of the three components of design-convenience, comfort, and aesthetic perfection (Mironenko et al., 2019).

Thus, we arrive at the conclusion that the main trends in the development of the architecture of medical facilities around the world include the humanization of the architectural environment and treatment processes (Curtis et al., 2007), light and color design (White et al., 2012), and the requirement that architectural and planning solutions provide for the implementation of modern medical and information technologies and their easy updating (Martin et al., 2015).

When considering European experience in the design and construction of medical institutions, important information is provided in Parsia & Tamyez (2018) and Wood et al. (2012). Nazarova et al. (2015) assert that the fundamental design elements that determine the quality of hospital architecture are the relationship with the previously constructed buildings and urban development, structural and technological unity, and the planning and organization of rooms. People must remain the starting point of everything. Whatever the functional needs may be, it is necessary to leave some freedom in the planning and development of one's concepts.

Thus, there are many literary sources that discuss the architecture of medical institutions, but the problems of open recreational hospital spaces as a component of medical institutions have not been previously considered and require further research.

The purpose of the article is to analyze scientific and practical studies of the formation of open recreational hospital spaces on the basis of the facilities of medical institutions, as well as to identify the specific features of the creation of open recreational hospital spaces as part of the design of modern medical facilities.

To achieve this goal, it is necessary to solve the following main scientific and practical problems:

1. To identify common functions of outdoor recreational hospital spaces by analyzing practical experience in the architecture of medical facilities.
2. To determine common elements in the creation of open recreational hospital spaces in medical institutions.

Methodology

According to the purpose and objectives of the study, we are conducting a qualitative study of the design features of outdoor recreational hospital spaces. This entails the need to exam-

ine the features of the architecture of medical institutions as a complex system, the main elements of which are characterized by a large array of architectural objects and the natural environment.

The research methodology involves the collection of factual material, both through a literature search and through the analysis of specific architectural sites described on the Internet, and the compositional and artistic, urban planning, volume-planning, and functional analysis of the data collected.

The source base for the study consists of scientific research devoted to various aspects of the design and construction of medical facilities, as well as the creation of open recreational spaces (monographs, articles from scientific journals).

The main criterion for the selection of architectural projects for medical facilities for further analysis is the environmental friendliness and aesthetics of the project as a whole, as well as the presence of open recreational hospital spaces in them.

According to these criteria, the projects selected for analysis are a children's hospital in the city of Shenzhen (China), Seijo Kinoshita Hospital (Japan), Narita Rehabilitation Hospital (Japan), Khoo Teck Puat Hospital (China), Hospital complex of the Ng Teng Fong General Hospital and the Jurong Community Hospital (NTFGH, Singapore).

The recreational hospital spaces in these projects are evaluated according to the criteria of integration with the surrounding landscape, the presence of green areas and bodies of water, natural lighting and ventilation, as well as the functional purpose.

The study went through several stages:

- The first stage of the study involves the search for and analysis of scientific literature on various aspects of the design and construction of medical facilities, as well as the creation of open recreational hospital spaces.
- The second stage of the study consists in searching the Internet for medical institutions whose architectural solutions include outdoor recreational hospital spaces.
- The third stage of the study is a systematic analysis of prototypes of open recreational hospital spaces in developed Asian countries (China, Japan, Singapore) based on predetermined evaluation criteria.
- In the fourth stage of the study, based on the results of the preceding analysis, conclusions are drawn on the functions and common elements of the creation of outdoor recreational hospital spaces.

Results

One notable example of the use of open recreational hospital spaces is the project of the Shenzhen Children's Hospital, China.

The design of the building, with artificial landscaping both externally and internally, was developed in collaboration with the East China Architectural Design and Research Institute-ECADI (Figure 1).

This facility is integrated with the local landscape, including greenery around and inside the hospital. The greenery is present on the roofs, terraces, patios, and balconies of the Children's Hospital. The nature-filled interiors should create a more comfortable environment for all visitors to the facility.

Interaction with the surrounding and interior landscape connects the interiors of the hospital with the nearby Lianhuashan Park and makes it part of a "unique micro-landscape" that helps patients recover by providing therapeutic benefits. Thus, our analysis of this hospital shows that the outdoor recreational hospital spaces in this facility serve an aesthetic, recreational, and healthcare function.

FIGURE 1.
Design proposal for a Children's Hospital in the city of Shenzhen, China.

Fuente: Huangdan2060, 2016 [Photography Own work] (https://commons.wikimedia.org/wiki/File:Shenzhen_Children%27s_Hospital2.jpg). C.C. BY 3.0.

FIGURE 2.
Seijo Kinoshita Hospital, Tokyo.

Fuente: Google Maps©, 2022 [Satellite image] (https://www.google.com/maps/@35.6414859,139.6000756,19.62z).

An illustrative example of the use of open recreational hospital spaces is the project of the Seijo Kinoshita Hospital in Tokyo, developed by the architect Kengo Kuma (Figure 2).

The new Seijo Kinoshita Hospital coexists with the surrounding natural landscape, with a large green courtyard space at its center with incorporated green spaces. The design focuses on providing quality medical care using natural elements in the structure of the building. The exterior of the hospital is covered with wooden shutters that provide shade indoors as an element of control, making the most of the surrounding landscape (Figure 2). Analysis of this facility indicates that its outdoor recreational hospital spaces are found on the patio and serve a social, recreational, and healthcare function.

FIGURE 3.
Narita Rehabilitation Hospital, Japan.

Fuente: Medical Corporation Shinwakai, 2016 [Youtube video] (https://www.youtube.com/watch?v=yrb2ejFDUnE).

Another project designed by architect Kengo Kuma using open recreational hospital spaces is a rehabilitation hospital located near Narita International Airport, Japan's largest, 50 kilometers west of Tokyo (Figure 3).

This specialized rehabilitation hospital, just two stories high, is surrounded by a small forest. The hospital is arranged around two open courtyards in order to maximize the area of contact with the natural environment. In the southern half of the hospital, the roof is covered with vegetation and sloped to create a continuity of green space. In addition to its bioclimatic function, this green platform allows users to access the upper level to enjoy the views and relax in the fresh air.

The south-facing facades are lined with cedar shutters that filter the sunlight. Thin and clear wooden profiles add a sense of coziness. Large windows are placed in front of the beds in each room so that patients can see the forest

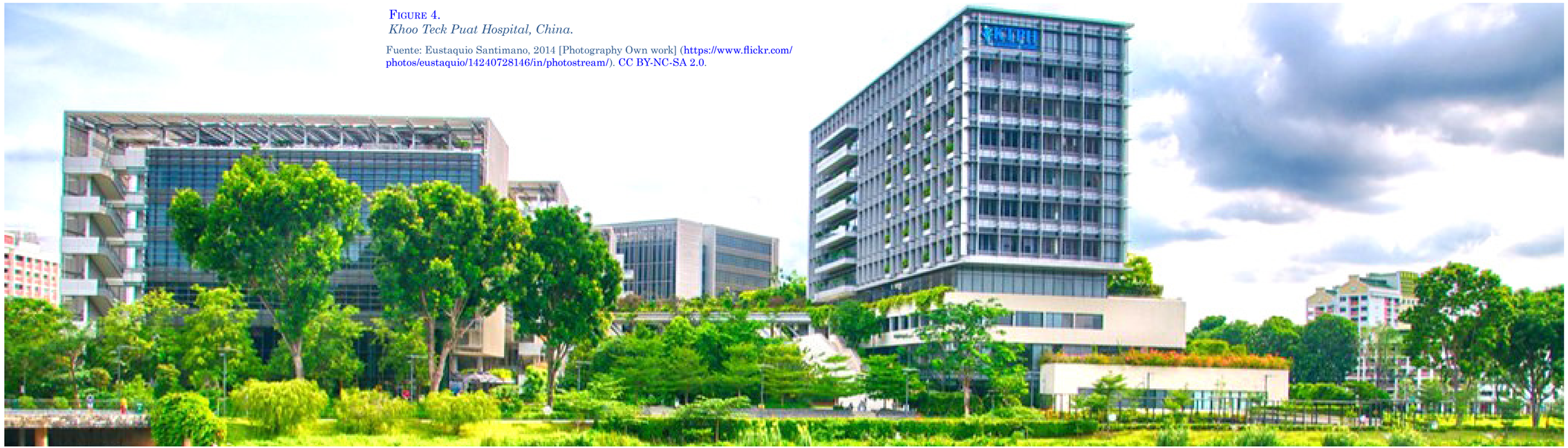

FIGURE 4.
Khoo Teck Puat Hospital, China.

Fuente: Eustaquio Santimano, 2014 [Photography Own work] (https://www.flickr.com/photos/eustaquio/14240728146/in/photostream/). CC BY-NC-SA 2.0.

surrounding the hospital. Along the central corridors, there is a row of skylights, which provide natural light and enlarge the interior space. The first floor holds therapy rooms, doctors' offices, waiting areas, and other installations.

A good example shedding light on the current trends in the use of outdoor recreational hospital spaces is the Khoo Teck Puat Hospital (China). The general and acute care hospital is characterized by the presence of both green spaces and bodies of water. The hospital's biophilic design draws on the idea that people have an inherent need to connect with nature, which improves their mental and physical well-being (Laws, 2009). The three blocks of the hospital have 8 roof gardens, 5 levels of corridors, and 81 balconies that incorporate elements of landscape design. Each garden features a different cultural theme. For example, some of the gardens have edible plant species such as citrus trees and fruit-bearing trees. Some include tropical plants to create a sustainable ecosystem, including many rare and endangered species. Water for irrigation is taken from the neighboring Yishun Pond, which is connected to the hospital's irrigation system and used for the needs of the facility. Special water-saving sensors are installed to prevent water loss, yielding nearly 50% savings. A waterfall in the central patio and rooftop gardens and plant boxes along the corridors and exterior wards provide patients with views of greenery (Figure 4).

This facility includes a large number of outdoor recreational hospital spaces such as terraces, roofs, an atrium, corridors, and the like. These building elements serve cultural, aesthetic, environmental, economic, and recreational functions.

The last object of analysis is the united hospital complex of the Ng Teng Fong General Hospital and the Jurong Community Hospital-NTFGH (Singapore) (The American Institute of Architects-AIA, 2017), the project which was awarded the Top Ten Award by the Committee on the Environment (COTE) —the industry's most renowned award for excellence in green design.

The design ensures that 70% of the facility is passively cooled and naturally ventilated, with each patient provided with a window that allows for natural lighting and opens up a view of the surrounding landscape. The smooth, dynamic design directly responds to the position of the sun and the prevailing air currents (AIA, 2017).

Dense vegetation covering low roofs and much of the grounds forms healing gardens, staff-only rest areas, and public park areas. Vertical landscaping is also used, both with plant boxes and along the wires connecting the floors. Vertical plantings are arranged so that greenery is visible from each ward (Figure 5). These building elements serve aesthetic, environmental, economic, and recreational functions.

FIGURE 5.
Hospital complex of the Ng Teng Fong General Hospital and the Jurong Community Hospital (NTFGH, Singapore) .

Fuente: Joey Foo, 2016 [Photography Own work] (https://commons.wikimedia.org/wiki/File:Ng_Teng_Fong_General_Hospital_and_Jurong_Community_Hospital.jpg). CC BY-SA 4.0.

To reduce noise, most naturally ventilated spaces are located several floors above ground level, and most windows are oriented away from the busiest streets (AIA, 2017). Overall, NTFGH appears as a natural oasis in dense urban development and includes parks, green roofs, and vertical plantings throughout the complex.

Discussion

Analysis of the selected examples leads us to the conclusion that it is encouraged that the design of healthcare facilities includes more spaces with natural light and green spaces, allowing patients and their visitors to behold natural landscapes and enjoy natural light, making them an important component of therapy (Braçe et al., 2020; Kornilova et al., 2021). This can be accomplished through the creation of open recreational hospital spaces, which are analyzed in this study.

Research literature increasingly often refers to the concept of "healthcare architecture" as a necessary parameter for all modern medical institutions (Curtis et al., 2007; Mironenko et al., 2019). Healthcare architecture is a perfectly thought-out process of organizing the functional and technological flows, which results in a high-tech, comfortable, and, at the same time, aesthetically and psychologically comfortable environment for staff and patients (Martin et al., 2015).

The performed analysis of open recreational hospital spaces of the Shenzhen Children's Hospital (China), Seijo Kinoshita Hospital (Japan), Narita Rehabilitation Hospital (Japan), and Khoo Teck Puat Hospital (China) demonstrates that these spaces are widely used in the world practice in the design and construction of medical facilities and present an important recreational component of patient care.

The analysis showed that the distinctive features of the architectural organization of modern healthcare facilities include the use of advanced principles of ecological design (Tsenina et al., 2022), the brightest examples of which are two ultra-modern hospitals: Seijo Kinoshita Hospital in Tokyo and Khoo Teck Puat Hospital in China. Notably, the territories of both hospital complexes are severely limited due to their location in a dense urban environment, but the active use of landscaping and beautification creates a cozy oasis within a modern metropolis.

Of particular note also is the unique aerodynamic shape of the Narita Rehabilitation Hospital building (Japan), which promotes the natural movement of fresh air in the middle of the buildings. In addition, the provision of natural ventilation for the large area of hospital buildings results in hospital rooms being passively cooled and naturally ventilated with a small percentage of mechanical ventilation.

In addition, all of the hospitals analyzed use rainwater harvesting, LED lighting, daylight and room operation sensors, and building management systems with monitoring, occupancy levels, and sleep modes to save and rationalize energy costs.

If sufficient daylight and natural ventilation are provided, the architects are left with the question of arranging shading, preventing solar overheating and glare. All of this has been achieved by introducing three levels of solar shading, including large protrusions of concrete floor slabs, blinds with horizontal and vertical slats, and sliding sunscreens. The presence of landscaping on the roofs of hospital buildings also contributes to shading, temperature cooling, and the absorption of pollutants (Parsia & Tamyez, 2018).

Analysis of the discussed architectural projects allows us to argue that outdoor recreational hospital spaces in modern medical facilities play a major role and, in our opinion, perform important functions, such as recreational, environmental, economic, social, aesthetic, recreational, cultural, and distributive (Stryabkova et al., 2021).

All of these functions are arranged in hospitals by incorporating the means of landscape design – vegetation, water devices, geoplastics, furnishings, and elements of the architectural design of the building.

First of all, the means of landscape design can form the environmental qualities of architectural objects, which we believe to be essential in modern medical institutions.

Analysis of design solutions for the creation of outdoor recreational hospital spaces suggests the following groups of structural elements that form the recreational space and include the means of landscape design: primary, secondary, and auxiliary.

The primary elements should include those that form open recreational hospital spaces with high busyness of time and a large area of space:

- Reception area lobbies (provided in all of the hospitals reviewed).
- Green roofs (Shenzhen Children's Hospital, Narita Rehabilitation Hospital, the NTFGH hospital complex).
- Patios (Seijo Kinoshita Hospital, Narita Rehabilitation Hospital).
- Atriums (Khoo Teck Puat Hospital).
- Passageway (Shenzhen Children's Hospital).
- Gardens (Khoo Teck Puat Hospital, the NTFGH hospital complex).
- Intermediary spaces (Shenzhen Children's Hospital, Seijo Kinoshita Hospital, Narita Rehabilitation Hospital, the NTFGH hospital complex).

Secondary elements are those with medium occupancy of time and taking average amounts of the hospital space (terraces, verandas, reception areas, galleries, special rooms, spaces and corridors for waiting). These elements are

present in all of the examples reviewed, but differ in size and content. For example, while the Children's Hospital (Shenzhen, China) and Khoo Teck Puat Hospital have greenery on their terraces, Seijo Kinoshita Hospital has greenery in a large green courtyard space.

The auxiliary elements can be considered as those with a minimal degree of saturation of time and space of the hospitals, such as balconies, loggias, bay windows, ramps, and wheelchair ramps. These elements are also present in all of the considered examples, but while the NTFGH hospital complex and Khoo Teck Puat Hospital have long loggias running along the entire facade of the building, in Narita Rehabilitation Hospital, they are small, limited to the size of one room.

Elements characteristic of open recreational hospital spaces are both in the external and internal space of medical institutions, therefore, they form not only the environment for pastime but also the planning and architectural-compositional structure of the object itself.

Conclusions

The architectural particularities of urban medical facilities are shaped by three main groups of factors: urban planning factors, a group of factors reflecting the development of architectural and artistic styles, and the requirements of the medical industry.

The conducted research reveals that open recreational hospital spaces play a major role in modern medical institutions and perform highly important functions: recreational, ecological, economic, social, aesthetic, health, cultural, distributive.

The general elements —the primary, secondary, and auxiliary— of the creation of open recreational hospital spaces in medical institutions are defined. Today, Russia faces many problems caused by the fact that many hospitals were built in the 1950s-1970s. Therefore, in countries with similar problems in healthcare infrastructure, closer attention in addressing these problems should be paid to the design and reconstruction of medical facilities, with a focus on increasing open recreational hospital spaces. All of this calls for reconsideration and further research on this topic, which will enable using the results of this research in the construction of comfortable modern hospitals in the future.

Among the limitations of this study is the limited number of architectural projects analyzed, which is due to the size of the paper.

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