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Review of studying methods for the problem of safety in the urban environment

La revisión de los métodos de estudio del problema de la seguridad en el medio urbano

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ABSTRACT

Introduction: Nowadays, the concept of "safe city" has become one of the topical issues of scientific research in many areas of human activity. Besides architects, designers, and builders, IT specialists are actively involved in creating a safe urban environment. A safe city very often involves the construction of a complex distribution system, which is capable of integrating heterogeneous elements of the urban environment, such as residential utilities, highways, strategic facilities, into a single managed structure. In the architectural and design activities, methods of designing the safe environment are well known, which facilitate the creation of open spaces, the creation of comfortable redevelopment of urban voids, etc. Thus, it can be argued that many existing problems of urban environmental safety are being successfully addressed. Nevertheless, the current trend of urbanization and the consequent increase in the population of agglomerations, the construction of high-rise buildings, the development of infrastructure, the formation of new areas and entire cities lead to other problems with urban safety or require the review of existing methods. In this regard, it is of great interest to identify categories of topical problems and methods of the study and the implementation of the principles of urban environmental safety. This study is aimed to identify the safety categories, methods of their realization, and the effectiveness of the methodological features of scientific research on a safe urban environment. **Materials and Methods**: The research method is based on the study of scientific articles in the post-pandemic period. **Results and Discussion**: The result of the study is the systematization of typological features of scientific research methods and obtained results in the organization of a safe urban environment. **Conclusions**: These results could form the basis for an action plan aimed at creating a safe urban environment for all categories of people. Such measures should be developed at the regional level to assess the territory's security.

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INTRODUCTION

In recent years, natural disasters such as earthquakes, tsunamis, flash floods and global epidemics have become more frequent; and modern cities and human societies are facing unprecedented challenges. In scientific research and practical activities, creating a safe urban environment is determined by architectural, social, technogenic, infrastructure, chemical, and biological factors. Typically, architectural factors are related to the availability of public spaces, comfortable services and comfort of the urban structure as a whole. The use of architectural and composite means is a very effective method, for example, adjusting the height of buildings, increasing the aesthetic value of elements of the urban environment, the openness and visibility of spaces and their readability.

Social factors, taking into account the principles of urban safety, often involve methods of delimiting urban spaces. It is the creation of comfortable conditions taking into account people's age, physical abilities, preservation of historical and aesthetic values, etc.

The technogenic environment (technosphere) as a component of the environment is a derivative of human activity, which has emerged as a result of the influence of anthropogenic factors in order to match well the environment with the social and economic needs of society. A human being, trying to achieve comfort and material security, continuously affects the habitat by his/her activities and products of activity (technical means, emissions of various industries, etc.), by generating man-made hazards in the habitat. The diversity and high levels of hazards affecting human beings are particularly characteristic of the technosphere.

Infrastructure factors often focus on the provision of the necessities of life and the extent to which the needs of the population are met. The infrastructure of the road network falls into this category. Thus, infrastructure factors are considered a complex of branches of economic and social life, a set of facilities or structures serving on a certain territory at the meso-level and a set of engineering structures that are necessary for micro-level operation of any company[1].

MATERIALS AND METHOD

This study will examine research papers on urban environmental safety published in peer-reviewed journals indexed in the Scopus database over the past three years. Thus, the chronological period covers the period from 2019 to the present. The search of materials showed that more than 1000 scientific researches were found in the database using the keywords "security, city, composition, architecture". In this article the authors analyzed several most interesting studies.

In a study that raises the issues of disasters, the use of discrete architecture is suggested. This study uses three main components of S/U/P to develop the Lego Architecture design by combining them with the Grasshopper plug-in on the Rhino platform to write a program that automatically generates the target plan. The model design layout for the physical design inspection and structural optimization is then selected to ensure landing and safety. According to the authors, the need for the construction of temporary buildings can emerge simultaneously all over the world since in recent years, disasters of various types have become the norm of modern life. The development of an efficient and economical solution is the motivation of this research. It especially concerns educational buildings, hospitals, kindergartens, etc.

The authors consider the principles of Lego, comparing it with architecture. Researchers write that "by exploring possible methods of aggregating large amounts of spatial geometry, our research team found an effective method of self-locking coupling. Second, in accordance with the construction logic similar to the Lego bricks, the research team used parametric tools, such as Grasshopper, to write a program that can generate appropriate design diagrams based on the shape of the edge of the target space, providing visual guidance on the physical design of the SUP system (typical knowledge-intensive and low-tech design). In the final experiments on the construction, the research team partially optimized the design for real situations so that the final balance between aesthetics and stability was achieved in the SUP system"[2].

Table 1. Study of disaster and safety of temporary buildings

Safety problem	Research methods	Results
Disasters and safety of temporary buildings	The discrete architecture using three main S/U/P components for Lego Architecture design development by combining them with the Grasshopper plug-in on the Rhino platform to write a program that automatically generates the target plan	To achieve quick, simple and safe construction of temporary buildings after natural disasters using design techniques and related knowledge based on open design

RESULTS

Seismic security is a pressing issue for many countries of the world. Based on a gradual increase in the average and low seismic activities occurring in the state of Sabah, a preliminary assessment methodology is proposed, based on empirical and analytical methods of vulnerability for 250 existing buildings in the city of Kota-Kinabalu.
The empirical vulnerability assessment focuses on the assessment of a building using the standard method of Rapid Visual Screening (RVS) and the FEMA 154 assessment form for moderate seismic activities. The field survey was carried out on buildings of different heights from low to high-rise. Building resilience against earthquakes is the main criterion[3].

Table 2. Seismic safety study

Safety problem	Research methods	Results
Seismic safety	Rapid Visual Screening (RVS) and the compliance with FEMA 154 assessment form	Seismic resistance of buildings (more than 60% of buildings investigated in this work are identified as hazardous)

Another important study of seismic safety is the study of structures on an inclined plane. Indian scientists investigate the vulnerability of inclined planes to earthquake owing to plane and height irregularities[4,5].
During the spread of the Covid-19 pandemic in 2020, "stay home" became one of the most important safe means. The spontaneous situation prevented people from modifying living quarters. Apart from that, precise parameters for improving or maintaining comfort in living spaces during the pandemic were unknown. In addition, health and hygiene aspects should be taken into account, including the quality of ventilation and exposure to sunlight. This study was conducted in Egypt. Six houses in Cairo were studied. The study involved residents of the house and architectural students, who received this research as a task and had to carry out the study and develop proposals.
Architectural students used mapping methods to analyze the need for functional transformation of the dwelling, as all residents of the apartment had to study and work at home. This process led to a review and modification of the traditional use of premises. For example, dormitories functioned for sleep, exercise and work. The guest area was usually reserved for important guests in Egyptian culture, which was used for family events. However, it was developed into an interactive space to help overcome the disadvantages of the lack of socialization and provide a better psychological relaxation space. Balconies were used to create mini-gardens, which were also used as a buffer zone to reduce stress, provide fresh air while maintaining a "stay home" regime. Residents' satisfaction increased from medium to high after the application of these minor adaptations based on surveys on physical, mental, and psychological comfort.
As the results of this study, the authors write that these aspects predict the future of home design. Futuristic homes should be more sensitive to proximity and privacy aspects of family members living in the same house. Natural ventilation and sunlight should be adapted more efficiently to a healthier home environment. A workspace will have a higher priority than guest zones, especially in education and technology-oriented disciplines. Moreover, internal recreation areas will be designed, taking into account the experienced self-isolation during the pandemic. These new patterns may be further developed when the pandemic ends in order to assess the extent to which home design can withstand an exhaustive and inclusive lifestyle in a changing era.
However, the study proved that since the adaptations were implemented spontaneously by residents, the patterns will be improved for future home designs. In addition, flexible home plans and adaptable multi-purposed spaces can be a solution. It can be implemented with new technologies using flexible furniture and light construction materials that may be customized to meet emergency needs[6].

Table 3. Study of adaptation of residential areas to Covid-19 quarantine conditions

Safety problem	Research methods	Results
Adaptation of apartment buildings to the requirements of the Covid-19 quarantine.	Survey, mapping, comparison of functional zoning before and during the quarantine.	Adaptation of residential apartments to the requirements of quarantine conditions. Project proposals and transformations of residential spaces.

The rapid growth of cities requires an analysis of the comfort conditions of the urban environment. In this paper, the authors study problems of visual, acoustic and thermal balance deterioration and its negative impact in the open air in the dense urban development. The urban morphology is assessed by examining the following urban design factors: street orientation, aspect ratio, building typology, and surface coverage. The study concluded that among the influential meteorological parameters (air temperature, wind speed, humidity and solar radiation), wind speed had the most significant impact on the thermal comfort of open spaces in the coastal area with the intense air flow. The results of the analysis can be used by people who are interested in the subject matter, which will allow them to understand and highlight the most important design factors that contextually affect the thermal comfort of outdoor spaces[7,8].

Table 4. Study of comfort in the urban environment

Safety problem	Research method	Results
Visual, acoustic and thermal balance deterioration in the urban development.	Using the method of computer simulation: street orientation, aspect ratio, building typology, and surface coverage.	The results show that a higher level of thermal comfort can be achieved through optimal design parameters and provide a pleasant outdoor space.

The new strategy of "people-oriented urbanization" introduced in China has become the subject of the next study. The authors examine the integration of rural-urban migrants. The research methodology is based on the study of subjective readiness and adaptive abilities. Key components are addressed, namely the exposure, sensitivity and adaptive capacity. The exposure is the extent to which migrants are influenced by new stresses associated with the size of the environment. The sensitivity refers to the impact of social exclusion on migrants, which is related to their objective social, economic, political and cultural circumstances. The adaptive capacity refers to the ability to withstand and cope with external influences. The inclusive urbanization and sustainable urban development are key findings of the study[9].

Table 5. Study of the social problems of urbanization

Safety problem	Research methods	Results
The rural-urban migration. The strategy of "people-oriented urbanization"	Exposure, sensitivity and adaptive capacity with integration of rural-urban migrants to cities	The inclusive urbanization and sustainable urban development

The study describes the global trend towards new technologies and smart cities. Undoubtedly, new technologies improve the quality of citizens' life. However, the application of new technologies presupposes new requirements, for example, the people's responsibility. It is known that the idea of smart cities is implemented using various components, ranging from information and communication technology to the problem of cybersecurity. The methodology of this study is based on the discussion of the explanation of cybersecurity, smart cities and the overview of the available relevant literature on security. The study offers effective functional solutions to ensure cybersecurity and user privacy in smart cities[10,11].

Table 6. Problems of social responsibility of consumers of a smart city

Safety problem	Research methods	Results
Problems related to human responsibility in the context of the application of new technologies in the urban environment	The methodological framework for cybersecurity and literature review	Effective functional solutions for cybersecurity and user privacy in smart cities

DISCUSSION

Analyzed materials show that social factors become one of their main criteria in the organization of the safe urban environment. The research results include the following papers on other aspects of the COVID-19 pandemic, safety of women, children, etc.

Table 7. Systematization of typological features of scientific research methods

Safety problem	Research methods	Safety factors
Disasters and safety of temporary buildings	Discrete architecture	Architectural factors
Seismic safety	Assessment of a building conditions	Architectural factors
Adaptation of apartment buildings to the requirements of the Covid-19 quarantine	Assessment of functional requirements of living quarters	Social factors
Visual, acoustic and thermal balance deterioration in the urban development	Climate potential and the special features of urban planning	Social factors
The rural-urban migration. The strategy of "people-oriented urbanization"	Identification of migration issues	Social factors
Problems related to human responsibility in the context of the application of new technologies in the urban environment	Adaptation and responsibility of people when using modern technologies	Social factors

The study of safety in the urban environment has a wide range of problems, and respectively, applies a variety of research methods. In the past two years, the COVID-19 pandemic was a particularly relevant topic. The revision of the spatial organization of residential buildings and its multifunctional factors have become particularly relevant. The purpose was to improve the quality of life in the conditions of the pandemic, provide comfortable infrastructure, and facilitate appropriate conditions for studying, working, and organization of life. However, studies demonstrated other interesting facts. For example, they revealed the characteristics of the profession and the specificity of the work, which can be flexibly adapted to any conditions. In this study, a "hypothesis has been put forward that people who are engaged in financially secure work better observe mobility restrictions due to professional factors, thus, linking the ability to flexible working to income security"[12].

The authors use data on home internet traffic as a surrogate for adaptation to home working. The relationship between professional factors and the increase of Internet traffic during working hours in isolation in two Australian cities was investigated. As a result, two dominant factors were identified, namely: the occupations of individuals and the composition of their households and families. The researchers suggest that the executive authorities take these factors into account when planning and providing social and economic support to residents in isolation zones.

Mixed methods were used in investigating the safety of the reconstructed Sabarmati river embankment in Desai, India. The largest public space was explored in terms of safety for women. The idea of "safe cities" for women involves their equal rights to the city and public places, such as the right to be mobile in the city at any time of the day and to walk in public places without any threats of harassment or sexual violence. These issues have become important in urban planning and design in modern India. The research is carried out in several stages.

At the preliminary stage of the research, the surveyed area, the areas most frequently used by residents and separate areas were mapped. Positive and negative parameters influencing the safety perception were added to the map. Special attention was paid to the gender-specific use of the mapped spaces. A questionnaire survey of female users (50 women on each bank of the river) was conducted using structured questionnaire and unstructured discussion. "Questions were asked about their social background, their experience of harassment on the river bank, their opinion on the elements that made a space safe or unsafe, and what actions could be taken to improve the safety of women on the river bank"[13].

The purpose of the next study is to consider playgrounds as semantic centers of everyday urban life, analyze their role in the social life of children of different age groups. "Methods of observation with photography, not standardized interviews for adults and methods of projective drawing for children were used. Children of preschool and primary school age were invited to draw their yard and answer the following questions: 'How are you doing?', 'What grieves you?', 'What makes you sad? / happy?', 'Who do you play with in the yard?'. The study concluded that the playgrounds became an illustration of the city's care for children. Playgrounds are important for organizing playground activities and gradual knowledge of their city. Children first know their yard, then their district, the center, and other areas. The world of interactions is gradually getting wider. In the process of understanding the city, the teenager begins to use public transport, navigate the city space, cross the streets, plan his/her walking route, avoid dangerous places, etc. The playground, as a conceptual center for children's activities, plays an important role in children's and adult-children's

interactions, the development of children's physical abilities (strength, skills, endurance, etc.), satisfying their need to play, learn social roles, etc."[14] .

The following scientific work is dedicated to the study of architectural and compositional methods of solving environmental problems related to the natural and climatic characteristics of the urban environment. Special attention is paid to the problems of insolation of residential buildings and yard spaces, resulting from the construction of new high-rise buildings next to existing ones. As a result of the study, an experimental method of modernization of existing residential buildings is proposed, with a view to improving the insolation within apartments and in the yards[15,16].

CONCLUSIONS

The relevance of the research on the safety of the urban environment was confirmed. The analysis of the methodological foundations used in the analyzed materials is universal and topical. The results can be applied in different countries of the world. According to the authors, the social factor of the urban environment safety is fundamental. The main goal of the safe urban environment is to improve the quality of life of people, creating a comfortable environment. In this regard, the role of architects and designers consists in improving the quality of life of urban residents in various urban settings around the world. Future studies should analyze the safety of public buildings, public spaces that serve as city landmarks, urban infrastructure, and projects on the relationship of the city to nature. Strengthening and improving social housing, protecting and revitalizing the city's architectural heritage, the role of architecture and urbanism in addressing the special needs of post-conflict cities can also be studied in further researches.

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