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Typological aspects of urban architecture design based on the principle of hybridity

Los aspectos tipológicos del diseño de la arquitectura urbana basados en el principio de hibridez

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Innovaciencia
ISSN: 2346-075X

E- ISSN: 2346-075X
Innovaciencia 2022; 10(1); 1-8
http://dx.doi.org/10.15649/2346075X.2976

SCIENTIFIC RESEARCH

How to cite this paper:
Iskhojanova G, Zayats I., Sarttarova L., Typological aspects of urban architecture design based on the principle of hybridity. Innovaciencia 2022; 10(1) : 1-8, DOI: http://dx.doi.org/10.15649/2346075X.2976

Date received
Received: 16 november 2022
Accepted: 25 november 2022
Publicated 01 december 2022

Keywords:
Multifunctional Complexes; Hybridization of Functions; Residential and Public Spaces; Building Regulations; Cartographic Research.

Manuscript presented in International research and practice conference *"Problems of formation of a comfortable object-spatial environment of cities. Issues of architecture, construction, design"* September 19-20, 2022 Opatija, Croatia. Edited by Innovaciencia.

ABSTRACT

Introduction: This study provides scientific and theoretical principles for the formation of types of buildings and complexes based on programs of mixed functional (hybrid) use. **Materials and Methods**: The method of scientific and predictive classification of the design principles of multifunctional buildings and complexes of mixed hybrid structure is used. **Results and Discussion**: The article provides an analysis of practical examples of multifunctional and mixed urban development that form new architectural and spatial solutions for building types that change the situation in existing neighborhoods, streets, and public spaces. **Conclusions**: The factors of updating the typology of multifunctional buildings and complexes using the principles of hybridity, digital and information technologies are considered.

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1.INTRODUCTION

The development of large cities is rapidly being filled with multifunctional complexes with a stereotypical set of services, monotonous types of housing and public spaces at the present time. The scientific provisions of the presented research are based on a retrospective analysis of the development of urban processes in cities. Modernization of the principles of formation of multifunctional types of residential and public buildings is considered in the context of the transition from mono-functionality to multifunctionality and further to the hybridity of their functional structures.
Most modern researchers believe that the topic of hybridity (mixing of functions) in architecture has existed since ancient times, and is an unavoidable essence of architecture itself. In the history of urban development, most medieval cities and settlements created a typology of urban development within the boundaries of defensive walls. They ensured the efficiency of people's activities and the safety of their lives, both from numerous enemies and from natural factors. Densely located residential buildings carried the features of mixing the functions of life of citizens. This created a single hybrid urban structure, capable of changing and existing as a single organism up to the present time.
In the nineteenth century, population growth, industrialization and the transport revolution, and harmful environmental impacts on urban residents forced developers to switch to systematic functional zoning to streamline urban development. The city began to be divided into zones of residential development, zones of public spaces, zones of industrial enterprises and commercial industries. As a result, the "pure" functional approach led to the appearance of buildings with the same functional purpose, which poorly reacted to changes in the life activity of residents and did not need to redefine the functions of buildings in urban development (Table 1).

Table 1. Morphology of multifunctional buildings and complexes

Stages of Formation of Multifunctional Types Of Complexes				
	Until the end of XIX	Beginning of XX	XX	XXI
Types of complexes	Archetypes	Monofunctionality	Multifunctionality	
		Hybrid and integration multifunctionality		
The basis of programs	Elemental zoning	Functional zoning	Integrated zoning Conceptual zoning	Technogenic and information zoning
Function Ratio	Isolation of residential and public functions	Partial inclusion of public functions	Expanding the integration of both functions	Mutual integration of both functions

Market rules of land use and construction in fast-growing cities at the beginning of the twentieth century became a serious reason for the emergence of a new structuring of multifunctional and hybrid typologies of buildings and complexes. The high cost of land combined with engineering and technological progress and social changes in society, the laws of the real estate market have led to the rapid spread of multi-storey buildings, almost completely occupying the territories of small blocks of urban areas (Table 2).

Table 2. Determinants of the need for multifunctional complexes

The Need for Types of Multifunctional Complexes		
Social conditions	Increase in numbers Concentration of people Increasing communications and privacy	Remote work Building density Variety of services Informative
Comfortable conditions	Accessibility and Connectivity Mobility Communications and privacy	Safety Information Technology, Ecology and technology
Architectural design	Signedness Symbolism	Identity Recognition

The XXI century has set new tasks for developers and city authorities in accordance with the development of social and technological processes in society, with the emergence of the doctrines of the green economy and sustainable development, new environmental and resource-saving requirements for building. Improving the standard of living of

citizens, the emergence of new rating criteria for assessing the quality of city management change the principles of interaction between all participants in these processes.

2.MATERIALS AND METHOD

Analysis of scientific sources on socio-cultural changes in the life of citizens revealed trends in the formation of the needs and rights of residents to access comfortable development of residential and public spaces. Hybrid (mixed) development of large residential complexes meets the real public demand for the sustainable development of the urban environment. This also applies to the cities of Kazakhstan. The openness of our society needs new standards of housing, urban planning environment and infrastructure of their cities.

The method of scientific and predictive classification of the design principles of multifunctional buildings and complexes of mixed hybrid structure is used. The results of the research on the search for typological changes in the design programs of multifunctional complexes are influenced by changes in the management systems of architectural and construction processes, improvements in consumer standards of spatial planning, and the economic goals of developers and investors.

It is obvious that the tasks of predicting typological modifications of building types should be sought in new urban planning campaigns on the use of data from urban planning regulations and information cartography methods. The boundaries of the study of the principles of forming appropriate hybrid functional programs for residential and public areas are the central and historical districts of major cities of Kazakhstan-Almaty and Nur-Sultan.

3.RESULTS

3.1. HISTORY AND CURRENT STATE OF ORGANIZATION AND MANAGEMENT OF CITY ASSETS

Currently, the development of information technologies creates new, more productive methods for organizing and managing urban assets, based on the ability to process a large amount of urban data. By definition, urban data is hybrid in nature, changing in real time and adapting to the needs of users, which allows you to track the situation in cities. Developers can analyze the investment potential of the territory and analyze the competitiveness of the environment. In 1930, the American Architect R. Hood [1] proposed an innovative concept for that time of hybrid placement of various residential and public functions in one high-rise building for renting out the entire area of the building. Multi-storey and high-rise buildings were transformed into a single and self-sufficient structure, like a whole city "under one roof", where people walked along the city streets and squares, admired squares and parks, socialized and rested. Social changes in the society of the 30s of the twentieth century led to the formation of a different approach to multi-storey buildings associated not so much with commercial benefits, but with the ability of multifunctional structures to form new social changes in people's lives. The architect – constructivist M. Ginzburg developed a new type of social housing complex, known as the "House for Narkomfin Employees" [2]. He considered his complex as a new theoretical model of a multifunctional housing structure "commune dwelling", which has the property of a "social condenser" to activate the life of groups of people living in them [2].

The new social type of residents is active both in residential cells and in the common spaces of kitchens, canteens, laundries or kindergartens. In the 1960s, commune dwelling as a type of housing in the city were called "multifunctional complexes with built-in service elements". The architectural and planning organization of collective spaces was developed either only for residents of the house, or for abstract residents of nearby residential areas. However, the operation of small consumer service companies focused on the needs of their own residents was economically unprofitable. It should be noted that the multifunctional building type "social condenser" corresponded to the conditions of state regulation of development and the social structure of society in the 60-70s, while the "hybrid" development appeared within the capitalist system as a commercial product of the sum of private interests and urban planning restrictions.

The authoritative urban sociologist J. Jacobs, in her book "The Death and Life of Great American Cities" [3], gives a number of arguments for the feasibility of the concept of mixed use of the functional structure of buildings. She claims that this concept leads to the maintenance of an acceptable level of security, the development of various public contacts, creating a viable and attractive urban environment. In 1985, architect-philosopher J. Fenton [4] analyzed the laws of development of multifunctional buildings and proposed the first classification of hybrid building types. He noted that there are differences between hybrids and mixed-use buildings in the implementation of use programs in

terms of how different types of activities interact with each other, being connected by common public spaces. In the first experimental projects, such as "Hyperbuildings", creative architect R. Kolhas [5] demonstrated the vertical placement of functional "layers" in combination with the organization of free movement of people in open social spaces. New principles of multifunctionality of urban development types allowed him to further implement several unusual projects of hybrid complexes, which were awarded prestigious awards by the international architectural community. S. Holl [6], a well-known architect, also actively developed the concept of hybrid multifunctional urban complexes. In his implemented projects of hybrid complexes, he used the principles of hybridity not only vertically, but also horizontally. He claims that "A hybrid combination of functions in a building can be more than a simple mix of types of use. This overlay can become a "social activator – increasing the ideological role of architecture as a catalyst for changes in the urban environment".

Today, the modern city focuses on the individual skills of people, trying to take into account their needs and different tastes at a more detailed level. The population of large cities has sufficient potential to pay for a very wide range of services. The diversity of life generated by a large city is based on the fact that a large city brings together many people with diverse tastes, skills, needs, opportunities, and quirks (Table 3).

Table 3. Two types of architectural design of multifunctional complexes

	Multifunctional Complexes	Hybrid Complexes
Differences in conceptual approaches		
Concepts	"Social Condenser"	"City within a city"
Socio-economic sources	Unification of social transformations of the structure of society Priority of industrial construction methods	Responding to the social differences of society and the needs of society Impact of engineering progress Commercial building regulation laws
Basis for architectural decision making	General plan based on the legal regulation of development	Master plan based on a database of multifactorial pre-project studies for development
Differences in the architectural design of the complexes		
Architectural-planning types	The monotony of types of monofunctional complexes with a predominance of residential functions in the program Distribution of public functions on the first floors of the complex	A variety of types of multifunctional complexes with a mixed functional program of residential and public functions Mixing and integration of residential public functions vertically and horizontally in the structure
Adaptation to the urban environment	Low interaction with the urban environment Difficulties in using technical innovations	Actively changes the quality of the urban environment Conceptual response to technical innovation

The above examples of the architecture of multifunctional residential complexes show us the history of two concepts of mixed functional programs for this type of complexes, which originated in different social conditions. One of the tasks of the research was the need to find differences between them.

Hybrid complexes were also the result of a functional understanding of user flows. If the type of multifunctional residential complex "social condenser" concentrates all its transformative power on the members of a closed residential community: residents of communal apartments, club members, factory workers. The hybrid opens up the city and encourages contacts between strangers, increases land use efficiency, reduces people's commute, but preserves the space for self-determination of each resident.

3.2. THE DIFFERENCE BETWEEN A HYBRID AND A MULTIFUNCTIONAL BUILDING

The development of this area of research was initiated by the presence of a large number of conceptual multifunctional complexes in modern architecture. Theoretical provisions on the design basis of multifunctional buildings and complexes of hybrid (mixed) use are proposed for discussion on the basis of their similarity and differences between each other.

In the late XX-early XXI centuries, hybrid complexes, examples of new architectural form-making, appear often in large cities and megacities of various countries of the world. Well-known Western architects began to use hybrid mixing of functions quite often when developing their creative concepts, reaching out to unexpected opportunities using a functional structure. New forms of hybrid complexes eco-friendly "follows the sun", organizes wind flows, redirects pedestrian flows, provides a lot of new opportunities for the development of architectural spaces of the complex, sometimes in the most unexpected, but internally justified way.

Modern hybrid spaces have a pronounced social and recreational purpose. Functional saturation of residential functions occurs vertically. Public spaces of the complex are formed on the principle of a multi-layered, cross-cultural public and pedestrian promenade. In addition, the hybridization of the functional structure of postmodern multi-storey complexes added semiotic complexity to the elementary forms of modernist buildings through the "collage" integration of historical and modern styles in architecture [7].

Architectural hybrid complexes, by definition, are necessarily open to the city and city flows. They set parameters of functional efficiency and are able to increase the commercial potential of the land of the project site. When building hybrids, much depends on the developer's competence, the construction management system, the goals of investors and tenants, the level of sociology, economics, logistics, transport, etc.

Summing up the above, we can say that the difference between multifunctional buildings and hybrid complexes lies in the presence of more advanced social and functional design programs in the latter. Unlike multifunctional complexes with a clear program and structure, hybrids assume a freer set of randomly used internal spaces of the complex, or combine several integrated programs and concepts.

3.3. SOCIAL ASPECTS OF THE DEVELOPMENT OF HYBRID PROPERTIES NEW TYPES OF RESIDENTIAL AND PUBLIC URBAN SPACES

Socialization of urban spaces is now understood as the need of modern citizens for justice and a decent life in the city, the right to safety and accessibility of public spaces, the right to well-maintained and well-lit sidewalks, beautiful views of the city and natural landscapes, and much more. It is the social aspects of the architectural and planning organization of collective spaces that are the advantage of multifunctional housing concepts, depending on the target groups of tenants and the nature of their interaction.

It should be noted separately the social aspects of the transition of society to the development of virtual information spaces, as well as the emergence of new forms of employment of society in the form of remote work. Research scientist J. Nilles [8] realized in 1972 that long-term commuting would have a major impact on energy consumption and increase the depletion of fossil fuels. J. Nilles implemented a project that allowed 30 employees to successfully work remotely using "telecommuting" and "telework". This fact stimulated the emergence of a new social group of freelancers who did not lose their maximum efficiency when working independently.

In the future, the transition to remote work due to quarantine measures revealed the fact that the space of residential cells does not meet the needs of comfortable working conditions in remote technologies. Constant presence in the living space affects concentration in work, leads to the search for a more suitable place to focus on work. However, the existing public spaces were also not suitable for new types of remote work due to the need for constant remote communications [9]. This changed the attitude to public spaces and became the subject of design developments to hybridize public spaces by creating individual "quiet" zones, capsule mini-offices, and personal booths for negotiations.

The concepts of hybridization of building types are most clearly manifested in urban planning practice when renovating the architectural environment of existing central or historical districts, when revitalizing existing and newly designed urban development areas.

One of the goals of successful implementation of hybridization is to increase the mobility and accessibility of public areas in the central parts of the city. Public transport and pedestrian networks are an essential and integral part of public space development strategies. For example, the placement of the shopping and entertainment center "MEGA Alma-Ata" (Almaty, 2006-2013) occurred as a result of planned development of a large and unstructured area along Rozybakieva Street. Initially, it was a residential area with a piecemeal arrangement of several 16 multi-storey residential buildings with public spaces on the ground floors. The popularity of the shopping center was brought by the functional variety of services, the presence of an internal shopping street, which in practice corresponds to the concept of a hybrid functional structure. This completely changed the use of the entire development area and improved the transport service system for this part of the city. This quality of hybrid approaches to building development was predicted in his works by the well-known urbanist R. Cervero [10]. He argued that traffic flows can change due to the complexity of the

functional structure of buildings. In this case, advantages arise at all levels-from a pedestrian district to a large metropolitan area, thereby increasing the attractiveness of public transport or individual mobility vehicles.

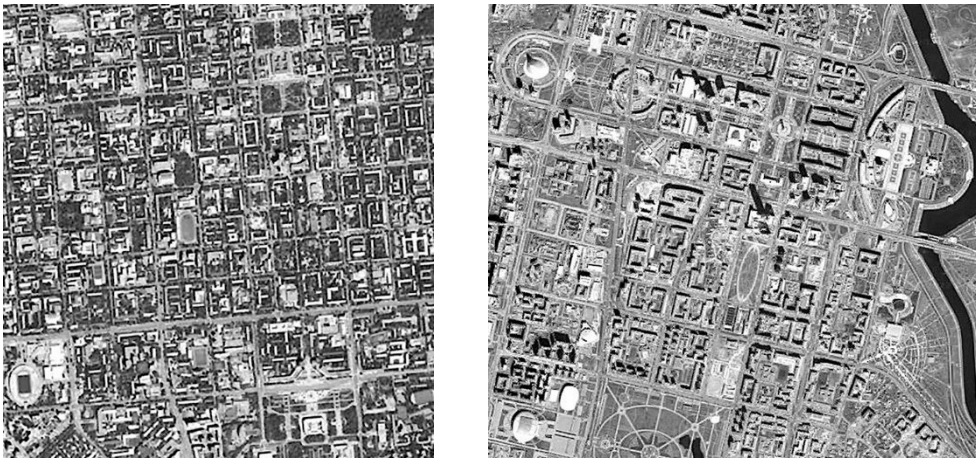
3.4. PROMISING METHODS FOR TRANSFORMING URBAN DEVELOPMENT ON THE PRINCIPLE OF HYBRIDITY

Multifunctional complexes in urban development in Kazakhstan are mostly compact multi-apartment sections, in which residential functions prevail over other parts of the functional program. Such types of development complexes most often create an autonomous piece-by-piece spatial filling of the urban fabric, especially in the conditions of the transport scheme of cities that is rigidly fixed by the general plans. This can be seen in the examples of development in the 60-80 years of our largest cities of Almaty and Astana.

Since the 1990s, there have been important changes in the spatial and functional fabric of the urban environment of the iconic city of Kazakhstan – Almaty. Moving industry to the outskirts of the city has become a trend in combination with the tasks of remodeling urban areas that show signs of typological functional degradation. The city authorities and developers have begun to implement new social programs related to engineering and spatial renewal, aimed at creating the identity of the established city center. Citizens began to enjoy the advantages of the city – to walk along the streets, use bicycles and scooters.

The development of Almaty was formed in different historical periods by superimposing various temporary historical and cultural layers, which were based on a regular rectangular grid of blocks formed from residential and public buildings. (Figure 1, a).

Figure 1. Satellite view of the development of the central part of Almaty B (a) and the central part of Nur-Sultan (b)



a) b)

Sources: Google maps [11,12]

The situation is different with the development of the capital of Kazakhstan – Nur-Sultan. The large-scale personalized image of the capital of Kazakhstan is formed at the expense of the urban planning compositional "layout" on the basis of the enlarged zoning of urban areas in accordance with the current regulatory documents. Here, the new modern look of the new capital is also made up of disparate types of buildings and architectural complexes that fragmentally fill the urban planning grid of avenues and streets (Figure 1, b).

It should be noted that urban development is not just a composite set of building types. It is a living organism of street, residential and public spaces that are constantly changing under the influence of climatic, social, political and economic conditions. Each city develops its own unique architectural and cultural identity, which has its own urban values for its residents. Currently, the development of information technologies creates new, more productive methods for organizing and managing urban assets, based on the ability to process a large amount of urban data. By definition, urban data is hybrid in nature, changing in real time and adapting to the needs of users, which allows you to track the

situation in cities. Developers can analyze the investment potential of the territory and analyze the competitiveness of the environment.

Virtual, interactive, and smart technologies for presenting data about the city structure are being developed, which can be used by all architectural and construction specialists. One example of the use of information data in architecture is the method of regulating building types in the form of a "Three-dimensional Regulation" (OPR) – a regulatory document that sets detailed requirements for the three-dimensional spatial characteristics of buildings and open public spaces [13]. The regulations (OPR) are based on land use rules and parameters of functional development types formed on the basis of functional zoning of territories.

Architects, urban planners can use information data to create projects that improve the comfort of the environment and the quality of life. A digital urban development data bank can help address socio-economic issues at the level of a city's development strategy. For this purpose, the information mapping method is used, which in general is a classification visualization of the interaction of information parametric data about the city.

For the purposes of architectural and urban planning tasks, the mapping principle systematizes the multi-factor characteristics of urban territories in tabular form, and then presents them in the form of graphical visualizations, which allows us to identify general patterns of interrelation of various types of buildings with urban planning parameters and indicators of urban planning decisions [14] (Table 4).

Table 4. Tools for hybrid approaches to the formation of types of buildings and complexes

Established design practice	
Zoning based on state urban planning plans (general plans) Normative filling of buildings with regulated types of buildings	Fragmented urban environment There are no sources for the formation of a comfortable and high-quality environment Monotonous development with elementary types of buildings
Application of Three-dimensional Regulation	
Spatial zoning Spatial building parameters	Diverse and holistic urban environment Preservation of the identity of the building Formation of comfortable residential and public spaces
Application of analytical tools for assessing city territories	
BigData data Sociological polls Mapping methods	Justification of volume-spatial solutions: - by number of storeys and building density - by using the building interface - for infrastructure - on the formation of new typological building structures

Scientifically based cartograms display and interpret data on the functional use of territories in any part of the city. The identified spatial and functional dependencies of the time and place of use of the territory are the basis for determining the criteria for the formation of new types of buildings with a new functional saturation of blocks [15,16].

It should be noted that the lack of objective data about the city does not give an accurate understanding of what the city and citizens need, as well as to assess the effectiveness and risks of the multifunctional decisions taken when investing funds.

4.CONCLUSIONS

The concept of multi-factor use of territories and urban spaces in constantly growing large cities is based on the principle of effective structuring of urban territories and infrastructure by providing people with everything they need and as close as possible to their places of residence.

The availability and accessibility of various life support functions within the boundaries of neighborhoods and districts will contribute to the development of the economy, service and rational use of urban areas. This approach allows us to meet the increased demand for residential and public types of buildings, which have largely become used as places for applying digital labor. Cities become a single habitable complex, a public space available for a variety of activities, when a person feels comfortable and feels like a citizen.

The need to develop a modern typology of multifunctional buildings and complexes of mixed or, as it is also called, hybrid structure allows us to modify the quality level of architectural and planning solutions and achieve a justified variety of functional use of the urban area.

The obtained research data can be useful for developing scientific and practical recommendations for the development of a modern typology of types of functional spaces of urban development. The results obtained open up new areas of research in higher education science and practice in the field of architecture. Analyses and results of the materials of the article are reflected in two dissertations final works of masters of the Faculty of Architecture, IEC completed in 2020-2022.

Scientific substantiation of the term "hybridity" in architecture will increase the creativity of thinking in search of new relationships between the form, program, technology and spatial structure of objects. Scientific substantiation of the term "hybridity" in architecture will increase the creativity of thinking in search of new relationships between the form, program, technology and spatial structure of objects. This is important for solving not only the formative tasks of architecture, but also for solving more global environmental and social problems.

Finally, it should be noted that the term "hybridity" is becoming increasingly used in scientific sources as the principle of mixing the previously impossible or unattainable, but applicable to all types of human activity.

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