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Fiber as a digitalization tool for the architectural environment

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Abstract. The new post-industrial paradigm in architecture is largely conditioned by the change of worldview, which is based on the technical breakthrough in the field of digital technologies. In this regard, the complex architectural environment of the city, saturated with historical buildings and modern architectural structures, is becoming more and more dynamic, adaptive and interactive, which ultimately leads to the search for new elements that allow building theoretical models of dynamic architectural and urban environment of the future.

Keywords: *architectural environment, dynamics of architecture, architectural losses, frame, fabric.*

1. Introduction

Today there is a transition of civilization from the industrial route to the post-industrial one embodying a new method of production, and in particular «digitalization» is actively entering all professional spheres, including architecture. Moreover, it is included not only in design production (computer technologies and computer software (ArchiCAD, Revit, etc.), but also directly in the content of architectural reality, both newly created and historically reconstructed. New digital technologies being introduced into architectural practice, allow us to formulate and solve not only new theoretical and methodological problems, up to the organization of design production on a qualitatively different basis, but also philosophical problems - such as «formation of a new language of architecture», «expression of social memory», etc.

Architecture is comparable to the «mirror» of an era, which carries the materialized characteristics of time in the form of ideas, emotions, technologies, forms, social processes, worldview, dynamics, etc. (Figure 1) [1]. The acceleration of history that is happening today provokes the process of «slipping away» into the past of established traditions and values. What was relevant yesterday may no longer be relevant today. In this regard, the problem of «memory» in its general philosophical understanding is as relevant today as the problem of «innovation». Without the desire to search for an innovative future, there is no demand for information about the past, and therefore, there is no problem of memory. Therefore, the problem of the relationship between «innovations» and «traditions» is especially acute in our time. More and more people talk about memory and traditions [2]. In particular, the value of architectural heritage is emphasized as the ability to preserve and transmit information about the centuries-old cultural history of the urban environment in a visually materialized form.

«Memory of place» obtains the position of the most important category of architectural science (K. Alexander) [3], a basic tool of architectural practice and a particularly important criterion of the value of the territory. In fact, this is

one of the principles of architectural dialectics: how to destroy - to preserve and not destroying - to change. However, memory is not static, it is always in a process of evolution, where different circumstances give new meaning and context to the event. In this regard, P. Nora, for example, in his works characterizes memory as «a process of constant evolution, it [memory] is open to the dialectics of remembering and amnesia, it does not give itself account of successive deformations, it is subject to all uses and manipulations, it is capable of long periods of oblivion and sudden revival» [4].

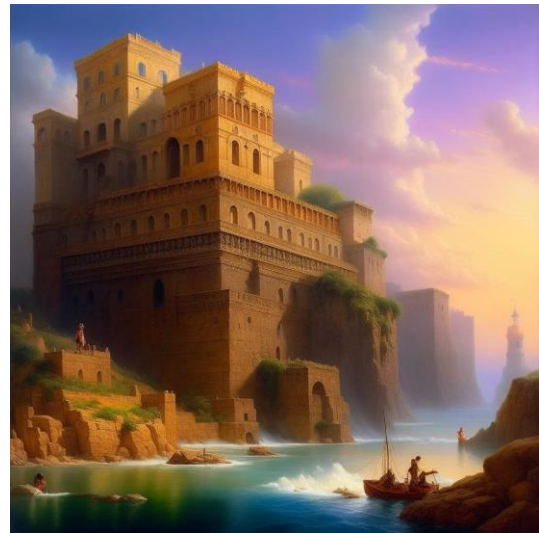


Figure 1. Image of the architecture of the ancient world. Created by neural-network

But the problem of architectural memory in modern conditions is the problem of its «deformation». If in the past a person could navigate the city by significant architectural objects that are spatial dominants, now he orients himself in most cases by interactive signs or information elements, including those located on the facades of buildings, small architectural forms, etc. [5]. However, according to F.

Meuser: «Good architecture is not those buildings that are extolled by the architect, but those that are recognizable without additional signs, because they speak for themselves. It would be stupid to write on a church that it is a church. Or at the opera - that this is nothing more than opera. These buildings are recognizable and are a waymark themselves» [6].

The digitalization of architecture brings with it a large number of both advantages and disadvantages that we must learn to reckon with and interact with. «Digital architecture», like «real» «talking» architecture, must also be easily identifiable. Therefore, today, the main problem of the process of digitalization of architecture is to define it as a special object with its own means, boundaries and subject.

In this regard, architectural science is at a stage when «digital architecture» should be recognized as an independent reality in the form of a new element of the urban environment with its own means and results, as a separate category containing a number of specific provisions identified by analyzing the evolution of architectural and urban planning thought of previous eras.

2. Materials and methods

The research methodology is based on the analysis of sources related to the design and preservation of valuable historical architectural environment (scientific publications, Internet resources, design materials, normative documents and standards). The theoretical content of the work is based on the means of analytical-synthetic approach, which is developed in such areas as redevelopment of historically valuable industrial territories, standards for their preservation and understanding of the problems facing modern architecture. The study also applies structural-factor analysis and the method of conceptual modeling of possible design models for the transformation of the existing multitemporal architectural environment.

3. Results and discussion

As we know, the change of paradigms in any sphere, and particularly in architecture, is largely conditioned by the change of generative modes of production, and, therefore, worldviews, the basis for which is technological progress. That is why the consideration of digital transformations in architecture and architectural environment is based on the analysis of three main paradigms: craft, industrial, post-industrial at the level of object-spatial interaction of components of architecture as a sphere of human life and society as a whole.

3.1. Visual Communication Tools

Architecture has always been part of the information field of the urban environment. In past eras, such visual marks were not only street signs and house numbers, but also iconic structures: coats of arms on the facades of buildings, symbols of chivalry, flags and pennants, etc. This suggests that the architecture of the city has already been essentially «digital», managerial and navigational in nature, through the means of information elements, signs and symbols. Currently, the direction of interaction between the information content of the urban environment and individual architectural objects of the past and present is actively engaged in the direction of «design of architectural environment». For example, Profes-

sor S.M. Mikhailov in his research clearly demonstrates that modern urban design should organize the object-spatial environment in relation to historical buildings and structures as an independent task that requires complex elaboration [7].

Given the increasing speed of development and introduction of new technologies in professional activities, the issue of media field of historical spaces of urban environment is the most relevant. Since the digital sphere affects simultaneously a number of architectural and media qualities, including: functional saturation, formation of visual connections, spatial environment scenario and these parameters can qualitatively affect the urban environment, the preservation and restoration of objects in the context of the digital paradigm can be a solution for the formation of new information characteristics of the architectural environment due to such properties as adaptability, dynamism and interactivity.

3.2. Evolution of architectural and urban planning thought

Before moving on to the issues of forming an information-based architectural and urban planning environment at the present stage, let us turn to the historical background and theoretical foundations of previous periods.

If we talk about domestic urban planning practice, the development of urban planning theory as an independent discipline begins in the 1930s. However, the prerequisites for the emergence of this direction were outlined even earlier - in the work of I.N. Manasein «Notes on the educational system at the Institute of Civil Engineers», published in 1903. For the first time, it proposes a three-part system for training professional personnel in the field of architectural and construction activities, including «architectural and artistic», «architectural and mathematical» and a new «urban planning» direction, which is due to the expansion already in that period of the range of tasks when working with architectural and urban planning environment [8]. Thus, its interdisciplinary boundaries began to take shape with the recognition of the «applied» aspect in this field. Later, the works of G.D. Dubelira, V.N. Semenov and M.G. Dikansky contributed to the development of urban planning, defining a new system of knowledge about it [9]. For example, V.N. Semenov put forward the concept of a hierarchy of urban planning activities, where urban planning art is the basis on which the science of urban planning, the management of urban planning projects and their implementation are based [10]. M.G. Dikansky, in turn, proposed expanding the structural-factor relationships and considering urban planning as a synthesis of sciences, including economic and legal aspects, fine arts and sanitary hygiene issues.

At the same time, in 1928 N.A. Ladovsky creates the Society of Urban Architects (ARU), where the city is for the first time positioned as an independent object requiring study in specialized educational institutions. Thus, the city moves from the category of objects of study to the category of objects of research [11]. At the same time, M.A. Okhitovich and L.M. Sabsovich consider the development of the city as a social phenomenon based on the primacy of sociocultural and functional everyday values. Later, in 1945, a model of an «urban planning object» was developed, consisting of a plan, silhouette and center [12,13].

At that time, the introduced term «urban construction» excluded various kinds of problems that are associated with the scientific philosophy of the modern city, where phenomena can be described using «functions» and «time», which deter-

mine the viability of space. To expand the conceptual apparatus of A.E. Gutnov proposes a new understanding of the term «urban planning», including by giving it an extended-temporal context: «a city appears as a process taking place in a certain spatial environment, and not as an environment» [14,15]. Thus, for the first time, the experience of urban planning is systematized, and the urban environment is considered as a subordination of its structural element's «frame», «fabric», «plasma». This has greatly facilitated the understanding of the structural patterns of urban space, not as a spontaneously emerging phenomenon, but as a system that depends on the relevance of the functional content and procedural-temporal factors.

Continuing research in the field of urban planning, Z.N. Yargina, speaks of the city as an even more complex structure, since large cities have their own historical context and various natural factors, which also predetermine the development of the architectural environment [16]. Here a historical context appears, which «works in conjunction» with the modern one, such concepts as «guide», «axis», «node», «connection», «core» are formulated. These elements have complex structural dependencies that are based on function, time, architectural and artistic appearance and continuity. Here the basics of urban planning composition are revealed using the terms «dominant», «accent» and «background development».

In parallel with the researches of Russian authors, K. Lynch also offers his developments in the field of urban theory in a number of works. The most famous of them, translated into Russian and becoming a textbook for several generations of urban planners, is the monograph «The Image of the City». In it, the author reveals an understanding of the structural elements of the city as an architectural and spatial semantically meaningful environment. These are «paths», «borders», «districts», «nodes» and «landmarks». All of them are correlated not so much with the structure of urban space, but with visual and figurative interpretations of residents and time as a dynamic quantity [17].

In the 21st century, interest in urban transformations is once again becoming relevant, since modern society requires a more comprehensive approach from urban spaces. This is no longer just a set of transit movements, it is a more complex, multifaceted and multi-tasking system designed to organize space so that it becomes human-scale, has a meaningful connection with the existing historical context, meets environmental requirements, is saturated with functional diversity and consumer scenarios.

The paradigm shift that we are seeing now, when the industrial era is being replaced by the post-industrial era, is reflected in all spheres of human activity. In this regard, in the modern architectural and urban planning process, the categories of «diversification» and «multi-functionality» are being updated, which have become almost an immutable axiom for sustainable development. The versatility and dynamism built on these categories are further emphasized by the modern digital paradigm, which is a limitless information field and is reflected not only in kinetic facades, displays, holograms, but also in the global interactive interaction of humans with architecture.

This specificity, the poly-functional interdependence of architectural content and time, is especially useful for activities related to the processes of reconstruction, renovation and rehabilitation of the architectural environment. The city, as an emergent phenomenon of numerous elements of the culture of

civilization and the architectural environment, constantly coordinates and matches them as components of different-scale parts of history and modernity (Figure 2) [18].

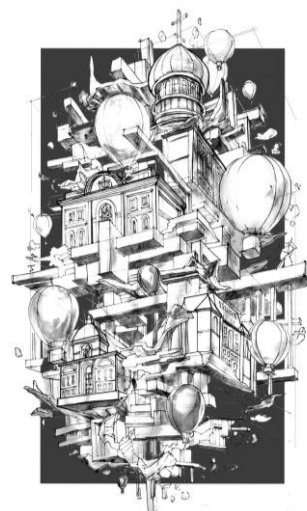


Figure 2. Image of an emergent city. Author's graphics

This process is determined and controlled by various means, but the main one is the «paradigm of time», which ensures the actual relationships of social content as a whole with all its architecturally determined units: economic, political, cultural, educational and other spheres (Figure 3) [19].

3.3. Architecture and urban planning in the system of paradigms

The evolution of general cultural scientific value systems (social, cultural, scientific, artistic) is mainly a system of values, methods for solving problems, methods of measurement and observation, and variable practices. Such development forms a new scientific vision of the world, which significantly influences the evolution of architectural concepts and opens up new opportunities for research and design of the architectural environment in our time - in the era of digital content [20], as well as preserving the memory of place.

Essentially, there are three paradigmatic sociocultural eras in the history of civilization: «pre-industrial» - with the dominance of handicraft production; «industrial» - with a predominance of industrial production; «post-industrial» - with the dominance of high technologies in the form of digitalization and robotization. This classification is based on the research of Alvin Toffler, who identified three waves in the history of civilization [21].

Architectural and urban planning are also developing in accordance with the logic of the dynamics of these three waves. Each of them has its own creative and research tools with its own objects and means. In the craft era, the main typological unit of the architectural environment was considered such an «object» as a «structure» [22].

In the process of transition from manual labor to machine labor, the object focus begins to shift: equipment tends to occupy ever larger areas, to the point that it no longer fits under one roof of any structure and requires multi-building placement. In this regard, «complexes» and «ensembles» are beginning to be considered as the main object of social order and architectural attention (Figure 2) [23].

Now, in the post-industrial era, due to the enlargement of the environmental scale of the modern urban environment,

taking only a building or even a complex of buildings as an object of renovation is paradigmatically incorrect and socially ineffective. Modern creative processes (new construction, reconstruction, renovation, etc.) require more complex formats, especially considering the current context. Therefore, the «architectural environment [24]» (Figure 3) is increasingly beginning to claim itself as the main object of architectural activity.

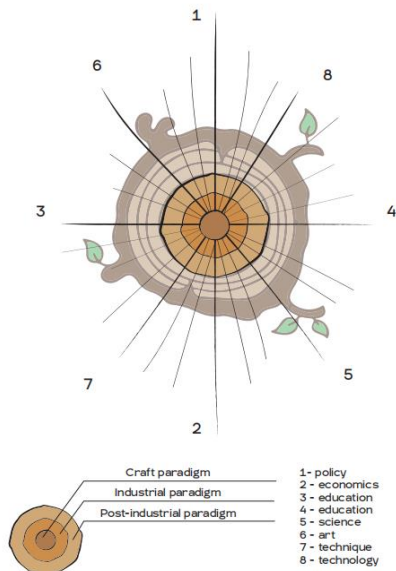


Figure 3. Social factors of different paradigms. Author's graphics

A comparison of three eras allows us to see how the research tools in architecture changed: the «scale» of territory development, the «object», «subject» of design, etc. As a result of research into the paradigmatic dynamics of the architectural method [25], it becomes obvious that in the pre-industrial era, as the dominant one is the paradigm of «structure» (the generative problem – what is the «structure» or «arrangement» of the phenomena being studied), in the industrial era the dominant paradigm is the «function» paradigm (how the object «functions»), in the post-industrial era – the paradigm of «development» or «self-development» (how a phenomenon or object develops itself).

Analysis of the preservation of historically valuable objects (complexes and territories) shows that the emergence of each of the three groups of paradigmatic methods is determined by the paradigm of their time. Thus, in a craft pre-industrial society, where the main tools are «construction» and «proportion», methods such as «restoration» and «reconstruction» appear in order to demonstrate the «constructive» concept of an object and its «proportioned» integrity. In the era of machine production, such tools become the «form» and «function» of «complexes» and «ensembles», which gives rise to such methods of preserving valuable historical environments as «conservation», «adaptation», «refunctionalization», «reorganization», «modernization» [26]. In the post-industrial era, based on the «development» paradigm, such methods of transforming the «architectural environment» of heritage areas as «renovation», «revitalization», «gentrification», «hybridization», «eco-rehabilitation», etc. arise and spread. [27].

This sprawl of methods for reorganizing objects and spatial formations is due to the modern development of high technologies, and ultimately, to the growing power of architectural

and construction potential. As a result, three main groups of methods for preserving architectural heritage today appear: «digitalization», «refunctionalization», «re-aestheticization».

Some of the methods for preserving the historical and architectural environment come from existing concepts («eco-rehabilitation», «inversion», «denucleation», «hybridization», «gentrification», etc.) Other methods are identified in the process of studying architectural situations from the perspective of a paradigmatic vision and the corresponding conceptual-categorical description. Therefore, studies of specific situations in order to identify the theoretical foundations of their transformation today are becoming particularly relevant, and above all, due to methods based on a paradigmatic approach.

Based on this, the urban environment, constantly saturated with both historical buildings and modern architectural structures, is constantly changing and, thus, becoming more and more dynamic, in particular adaptive and interactive [28]. That is why, in the modern practice of renovation of architectural heritage, two phenomena become the most significant, the consideration of which is necessary first of all – «architecture dynamics» and «architectural losses».

«Dynamics of architecture» is the root cause. In the modern information society, new architectural solutions arise much faster than in previous eras, presenting architecture as more labile, plastic, relatively autonomous, capable of continuous changes and updates [29,30]. The urban environment, as a result of this, ceases to be some kind of complete «ensemble», but on the contrary, it allows, and even expects the introduction of something new at any time and at any point in the existing architectural and historical environment, which, as a consequence of this, is more precisely would be called and characterized as a «developing» environment [31, 32].

«Architectural losses» are especially noticeable in large cities, where one can already observe the first attempts to replace architectural losses with digital analogues (street screens, kinetic event monitors, the introduction of QR codes for information restoration of architectural-spatial relationships, etc.) (Figure 4).

The increasing "dynamics of architecture" accelerates the pace of "architectural losses" and the need for their replacement, including means of digitalization: static and dynamic screens, tickers, media facades, etc.

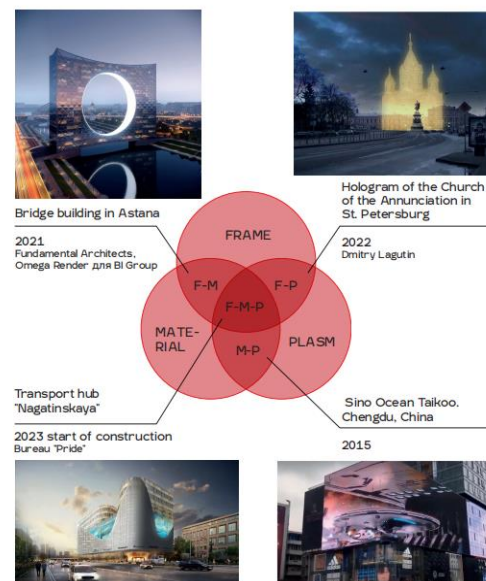


Figure 4. Interaction of structural elements of the city. Author's graphics

As a consequence of this, it can be stated that a fundamentally new information element of the architectural environment is being formed, which can be designated as «fiber». This will make it possible at the present stage to supplement the already established system of three elements of the architectural environment proposed by A.E. Gutnov («framework», «tissue», «plasma») (Figure 5) [15].

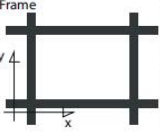

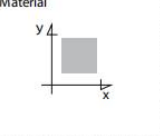

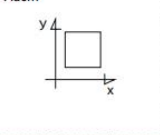

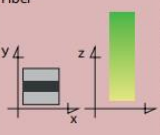

	Urban structure element	Definition	Example
Gutnov A.E.	 <p>Frame</p>	Transport communications system.	 <p>Tverskaya street</p>
	 <p>Material</p>	Object of the urban environment.	 <p>V&Ander Park House, de Architekten CIE W.B.</p>
	 <p>Plasm</p>	An easily replaceable element of the urban environment. Temporary structures.	 <p>Zaryadye Pavilion, Sergey Kuznetsov</p>
New element of urban structure	 <p>Fiber</p>	Coordinating objects of frame, material and plasma, possessing a changeable architectural and artistic appearance. Variable parameters: - Function - Time - Architectural and artistic appearance - Continuity	 <p>Transport hub "Nagatinskaya", Bureau "Pride"</p>

Figure 5. The place of fiber in the typology of urban environment elements. Author's graphics

3.4. «Fiber» is a new material-spatial information element of the modern architectural environment

Appeal to the concept of «fiber» goes beyond the usual reconstruction stereotypes and patterns, linking traditions and new means at the level of scenario modeling. Using fiber, you can alternatively model various images when perceiving the architectural environment and create a variety of scenarios within one space. The need for such a tool has always been there; it is especially acute in large cities with dense buildings. Therefore, when it is necessary to sacrifice historical clusters that have lost their functional value, then digital means of replacing lost elements of the architectural environment for this purpose are timely and effective. They preserve information about valuable historical fragments of the urban environment, about their identity, which was formed by these historical spaces in accordance with the paradigm of time.

In connection with such capabilities of the «fiber» layer, the need for identifying and replacing «architectural losses» by means of actively advancing digitalization of modern methods and objects for the renovation of the historical and cultural heritage of cities is noticeably increasing. This determines the relevance of both the direction and topic of this research, as work to preserve historically valuable objects subject to renovation, the means of their creation, and, above all, compositional, aesthetically unique ones - created in accordance with the paradigm of the time and the «spirit of the place» – K. Alexander [3].

3.5. Scenarios for the architectural environment

The set of principles for the formation of urban public spaces, based on the functional diversity of activities, forms a system of interaction between static and dynamic elements of the urban environment. The latter were created as a result of complex combinations of the historical framework and the modern fabric of the city, forming special activities that have an emotional impact on a person, modeling the development of the territory in space and time. In this regard, scenarios for the use of territories can be divided into five groups:

1. Functional scenarios:

- navigation (building routes, determining location, signs to the destination);
- advertising (commercial use);
- communication (broadcast in online time);
- video series;
- audio accompaniment;
- placement of temporary objects (fair, pavilions with master classes, circus, exhibition alleys).

2. Seasonal scenarios:

- spring/autumn;
- summer/winter.

Each season is conducive to different types of activities. Summer/spring scenarios assume greater intensity, duration and extent (example - Urbanforum -2023). Winter/autumn scenarios, on the contrary, have a shorter program, and most often concentrated on one site. (New Year's fairs).

3. Depending on the events being carried out:

- (holidays/festivals/events; weekdays/weekends);

News feeds have a huge impact on the scenarios of urban space. Major events can be accompanied not only by the saturation of the urban fabric with various functions, but also influence transport and pedestrian connections (blocking part of the road network), regulate social activity (round-the-clock operation of Moscow public transport during the New Year holidays), and increase interest in cultural events etc.

4. Depending on pedestrian activity:

- walking/cycling/running.

Depending on the type of pedestrian activity, the urban environment has different roles. While walking, the city becomes a place for contemplation, where we can fully replenish our aesthetic resources. Sports activity has already significantly influenced the urban environment (sports grounds in almost every yard, dedicated paths for cyclists, use of free areas for outdoor training in the summer, creation of ice towns in winter, etc.).

5. Depending on the type of activity:

- sports;
- transit;
- a tourist route.

Sports activity can not only turn a city into a sports ground, but sometimes into an entire playing field. (Moscow marathons). When we need to make a transit, that is, get from the starting point to the final point, the city begins to act as an information field in which we can navigate not only by signs, but also by characteristic visual features (vertical city dominant, fences, vehicle movement and etc.). The tourist route allows us to interact with the urban environment within the framework of the educational function.

All of the above scenarios have one thing in common. Whatever scenario we choose, the city is always an information field that gives us an understanding of aesthetics, functionality, cognition, emotional content (each scenario is

accompanied by a different set of subjective impressions). The proposed typology of functional content scenarios can contribute to greater productivity of reconstructive activity, considering the content of the time paradigm and focusing on the dynamics of the development of society, in which complex processes take place, including technologies of transition from industrial to modern digital content.

4. Conclusions

Modern architecture is undergoing a number of radical changes. On the one hand, they are associated with the development of society and the means of its production, especially in the field of information digital technologies. On the other hand, they are due to a surge of attention to the concepts of general cultural renovation, self-development and to the modern concept of self-developing architecture.

It is characteristic that the concept of self-development of architecture is relevant today and is a basic paradigmatic category, and therefore in the future it will tend to intensify its means.

Self-developing architecture requires variability in the transformation of the historical and architectural environment. At the same time, modern concepts of renovation of the architectural environment do not sufficiently consider the paradigm of time, i.e. do not consider dynamic dominant social relations, both the time of creation of concepts and the time of their renovation in another paradigmatic era of transformation of the historical environment.

Thus, a new digital scenario-laden reality – «fiber» – is actively entering into architectural practice. This concept is paradigmatic. It is one of the main means of the modern post-industrial paradigm of «self-development». It is most effective when renovating valuable historical clusters, when modeling the directions of development of fragments of the urban environment at various stages of renovation. Its use both at the level of buildings and at the level of urban development will help to identify models of a comfortable urban environment for humans, and will also allow maintaining the connection characteristic of cities with the authentic architectural environment. This will activate social memory through the architectural environment and strengthen social connections between residents of different areas, as well as create visually recognizable images of aesthetically attractive urban spaces.

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Мата сәулеттік ортаны цифрландыру құралы ретінде

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Аңдатпа. Архитектурадағы жаңа постиндустриалды парадигма негізінен цифрлық технологияның техникалық жетістіктеріне негізделген дүниетанымның өзгеруіне байланысты. Осыған байланысты тарихи дамумен және заманауи сәулет құрылымдарымен қаныққан горо-иә күрделі архитектуралық ортасы барған сайын серпінді, бейімделгіш және интерактивті болып келеді, бұл сайып келгенде болашақтың динамикалық архитектуралық-урбанистік ортасының теориялық модельдерін құруға мүмкіндік беретін жаңа элементтерді іздеуге әкеледі.

Негізгі сөздер: архитектуралық орта, сәулет динамикасы, сәулеттік шығындар, жақтау, мата.

Волокно как средство цифровизации архитектурной среды

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Аннотация. Новая постиндустриальная парадигма в архитектуре во многом обусловлена сменой мировоззрения, в основе которой лежит технический прорыв в области цифровых технологий. В связи с этим, сложная архитектурная среда города, насыщенная исторической застройкой и современными архитектурными сооружениями, становится все более динамичной, адаптивной и интерактивной, что в конечном счёте, ведёт к поиску новых элементов, позволяющих строить теоретические модели динамической архитектурно-урбанистической среды будущего.

Ключевые слова: архитектурная среда, динамика архитектуры, архитектурные утраты, каркас, ткань.

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