Using immersive technologies for sensory perception of the architectural projects

Elena Serova¹,* and Liubov Shilova¹

¹ Moscow State University of Civil Engineering, 129337, Yaroslavskoe shosse, 26, Moscow, Russia

Abstract. How do we receive an information about the future building? Like all objects in the real world, we perceive architectural objects using the help of five senses. But how does architectural project, BIM-model or immersive technologies transmit information for sensory perception of the future building? This article contains a consistent study of the possibility of sensual perceiving architectural objects in the process of their design, as well as the influence of the development of information technology on the quality of sensory and sensual perception of the future object.

1 Introduction

Artists and designers often talk about how a person should feel about their works. For example, Henri Matisse dreams that a person would relax looking at his paintings [1].

Wassily Kandinsky highlights the physical and mental effects of colour on the viewer in his book «On the Spiritual in Art». He also describes in detail what emotions evoke certain shapes and colours in the picture. Wassily Kandinsky write that «the artist is a hand which, through this or that, otherwise, the key expediently sets the human soul in vibration» [2].

Designer Victor Papanek in his book «The Green Imperative» develops this idea and says that «we experience beauty in the spaces in which we live or work in a multisensory way», that is, with several senses at once. The author claims that our perception of space directly depends on the lighting, the shades of colour used and the distance to the object [3].

Victor Papanek draws attention to the importance of tactile perception of an object: «We can brush our hand across lichen-encrusted rocks forming a cottage wall in the Hebrides, or the tall stones dreaming silently at Stonehenge, and derive profound sensory (and sensual) satisfaction» [3].

2 Methodology

We perceive the buildings architecture as design and art, with the help of five senses [4]. Moreover, we receive most of the information with our vision - there are the geometric characteristics of the building, the colour, materials texture, as well as the architectural style, pattern and other symbols.

* Corresponding author: SerovaEA@mgsu.ru

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At the same time, we constantly interact with the building - we touch the door handle, railings, doorbells, touch the walls or floor, windows and doors. With the help of touch, we get information about the finishing materials of the building, accessories. We distinguish between warm and cold materials, their rough, soft or slippery texture.

Smell is an important component of human perception of space. We distinguish the smell of the city, streets and plants, the smell of the house, finishing materials, furniture things, as well as the smells of food being prepared in the kitchen - we get used to these smells which become familiar and dear to us. When we enter the building, we automatically distinguish between the smells of finishing materials, the need and the possibility of airing the premises.

The familiar sounds of the city, streets, houses are also important in the perception of the building’s architecture. We perceive buildings differently if we hear the sounds of a bustling city, seacoast or forest. Finishing materials of buildings can absorb or reflect sound and create different acoustic effects.

We can taste when we smell coffee or fruit when we look at a picture with there. Some colors and even sounds can cause taste associations. The name of the shades of the color palette of interior paints is often associated with the taste of food, for example, coffee shades of paint can have the name of a certain drink, such as latte or cappuccino. In the palettes of different paint manufacturers, we will come across names - peach, plum, turmeric, as well as more complex names - candied almonds or lemon meringue.

In this research work, the perception of an architectural project is considered in the above 5 areas of sensory perception.

3 Result and Discussion

All our sensations help shape our understanding of the surrounding space, including the buildings architecture. When we create an architectural design of a building, we try to convey information about it using drawings and 3D-models. But all these ways of transmitting information mainly involve only vision and this deprives us of the opportunity to imagine the future building in the real environment.

The classic set of drawings for an architectural project includes floor plans, sections, elevations, and building details. Then we perceive information about the future building only with the help of our vision. At the same time, we can see this information only in a scale of 1:100, 1:200, etc. And this context does not give us a complete understanding of the dimensions of the building, its shape, materials used, texture and color. In this case, we receive very little information about the future building, which does not give us the opportunity to make quality decisions about the development of the project.

The possibilities of transferring information about the future building in the classic set of drawings for an architectural project are shown in Figure 1.
When we create a building information model (BIM) we are developing a database of all building elements. BIM-model includes information about the size, shape, materials, texture, color, as well as the physical and technical characteristics of each element [5,6]. But all this information we perceive with the help of our vision and it depends on the size and technical settings of the screen. In this case the information is also transmitted on a different scale.

The peculiarities of transferring information about the future building with the BIM-model are shown in Figure 2.

The next stage in presenting a building project is creating an architectural maquette and video presentation.
Architectural maquette is a physical model of the future object. Now we can see the model of the building, and also touch it. There remains the problem of the difference in the scale of the maquette and the real future building. And this situation again makes it difficult to fully perceive the architecture of the building - dimensions, extensional representations and characteristics of finishing materials, such as color, texture, pattern and other symbols.

The specificities of transferring information about the future building with the architectural maquette are shown in Figure 3.

Fig. 3. The specificities of transferring information about the future building with the architectural maquette

The video presentation of the project conveys the dynamics of the perception of architectural solutions. And we can add sound to the video presentation that will simulate the sounds of the environment. But again, our perception of information about the building depends on the size and technical settings of the screen.

The peculiarities of transferring information about the future building with the video presentation are shown in Figure 4.
A modern way to convey information about a future building involves the use of immersive technologies such as virtual reality, augmented reality and mixed reality technologies [7,8].

Technology of virtual reality (VR) involves the creation of a virtual model of the building and the environment [9,10]. With the help of special equipment (virtual reality headset) we get the opportunity to see the object in its real scale, including a realistic imaging of finishing materials, colors, textures, pattern and other symbols. There are technologies that allow you to touch virtual reality objects using a VR body suits and gloves. We can also add street and car sounds and other environmental sounds to the VR-model. In this case, we get more information about the building using different senses, we have no difference in the scale of the model and the future object. But we will have a feeling of a synthetic world and we depends on the technical settings of the equipment. The possibilities of transferring information about the future building with the VR-model are shown in Figure 5.

Augmented reality (AR) technology makes it possible to integrate the architectural models of future buildings into the real environment. AR allows to combine the real and virtual world by means of mobile devices - a tablet or a phone. In the industry of interior design, furniture manufacturers widely use AR technology when choosing design solutions for a client [11].

If we arrive at the construction site, then with the help of AR technology we can see on the screen how the urban development will look after the project is implemented. And now we perceive the real sounds and real smells of the environment, but we again depend on the
size and technical settings of the screen. The possibilities of transferring information about the future building with the AR-model are shown in Figure 6.

Mixed reality (MR) technology also involves the mixing of real-world objects and virtual reality objects. And now we can perceive the architecture of buildings with the different senses: vision with the help of VR headset, touch objects of virtual reality with the help of VR body suits and gloves, and perceive objects of the real world in the mixed reality. The possibilities of transferring information about the future building with the MR-model are shown in Figure 7.
Fig. 7. The possibilities of transferring information about the future building with the MR-model

The listed methods of transmitting information about a future architectural object make it possible to use sensory perception for a more complete picture of the future building. The development of AR and MR technologies creates opportunities for more effective assessment of the integration of buildings and structures into existing urban development and the environment [10].

4 Conclusion

Our perception of art, design and architecture of buildings is the same. We perceive the environment of objects and buildings with different senses, so the use of immersive technologies that help convey more information about the future object is a very important part in the development of architectural solutions for new buildings.

All the methods of transmitting information about a future object listed in this study contain confines, that depends mainly on the size and technical settings of the devices and equipment. But the more information we can convey about the environment and the future object, the more qualitative representation of the object the person will have. Therefore, the development of immersive technologies and methods of information transfer will allow customers and investors in the future to make more informed decisions on the development of the project at different stages.
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