The light and colour significance in urban environment perception

Peter Kardoš, *Slovak Technical University in Bratislava, Slovakia*

Abstract
My contribution deals with light and colour effects in wider dimensions of architecture. It analyses their significance in urban environment perception from the application aspect of progressive tools of its forming and creative completion, i.e. the perceptual homomorphous iconic simulations in laboratory conditions. The work focuses on questions of light and colour perception, showing several principles and phenomena valid in visual perception systems. The structure of the perceived picture is interpreted in its four components: colour, motion, form and spaciousness. Each of the components is shown with relevant biological reactions and their reflections in subjective perception processes. The selected image examples document some manifestations of urbanistic structures and spaces experience transformation in natural and artificial lighting conditions. The emphasis of my contribution lies on some demonstrations from the laboratory experiment in investigating the illumination and colour influence on the architectural design quality, and on examples of alternative methods of visual interpretation on endoscopic modelling simulation outputs. The conclusion of my work formulates some knowledge and statement of objective colour and light modelling simulation assets in architectural design quality.

Introduction
The topic of this year's EAEA conference drew my attention in the present season period from several aspects. In visual sensory perception our consciousness is directly dependent on light, i.e. when brightness and colour changes it stimulates various internal processes in our psyche. These relations must be taken into consideration in humanist planning and urban environment design creative procedures, including its tool - simulation. My contribution will deal with light and colour from the point of view of their impact and significance in wider spatial dimensions, namely the aspect of their transposition into conditions of urban environment perception modelling simulation, laboratory anticipation of both static and dynamic spatial experiences of the users in residential and civic environment in natural eye-level horizon. On the background of biological processes of seeing I will notably try to justify the need for

specific phenomena modelling, which participate in perception processes and therefore are highly relevant in human and environment interactions simulation.

Light and colour seeing

In order to be able to explain the light and colour significance in spatial perception I will first sum up several general principles and phenomena valid in visual perception systems. Each of us perceives and appreciates our environment in a different way. We register the phenomena and events that occur to us and we create our own image about them. The subjectively processed experience is stored in our memory.

Seeing is possible only after light gets into the eyes. The light activates the retina functions on the eye background. The main light source is the Sun. By radiating its light it creates an assumption for us to be able to visually perceive the world. The sunlight is seen as white. The colour components of an image, which is projected on our retinas upside down, come to the eyes from outside as reflections of light, accordingly to how the object surfaces absorb or reflect the particular wavelengths of the light. It means that the final colour perception is the result of the reflected wavelengths of the white light colour spectrum. When provided with enough light the eye background is able to distinguish only three colours: red, green and blue. The brain in which the three colour signal tones are mixed according to the intensity of the reflection mediates the other colour components to us. At a weak light intensity on the retina around 120 million rods response photochemical, creating a black and white perception. Colour perception is the task of about 6 million cones. Their sensitivity is however about 1000 times weaker than the one of the rods. Therefore, in twilight and darkness the visual perception is only black and white.

Picture and its structure

Apart from colour, the other picture components during perception are motion, form and spaciousness. The perceived picture is decomposed into these three components by the retina nervous cells, and the recorded photochemical and electrical impulses pass to be processed into particular areas of the little brain. The processing of the registered situation into a complex perception is ensured by not less then a one third of the brain.

It is known, that the first things that draw our attention in a space are

moving things (animals do not basically pay attention to the things that are not in motion). We can say they are of a higher significance to us. It is, for example, interesting that if there is something approaching us in a very high speed the brain, due to the lack of time does not deliver the message in colour. Motion is a phenomenon that enables us to create and realise various relations of humans to things in the environs. It is an inexhaustible source of creative imagination.

The other element that draws our attention in perceiving is a form. Form gives the whole image information its intelligibility and significance. Harmony of colour and form is taken in a fully valued perception as a natural thing. In architecture, the colour can optically modify the architectural form. The phenomenon of architectural painting is made use of in improvement of proportion and general aesthetic expression quality of a building (Friedensreich Hundertwasser and others). In urban interior, the colour gives the spatial structures a rhythm (house fronts, facades, and apertures), many cities have their typical (dominant) colour.

From the point of view of visual orientation, the most significant picture component is spaciousness. It is possible for us to experience it thanks to a double channel principle of the visual sense: our sight produces two slightly (angularly) different images. Their overlapping in the visual centre creates an impression of a three-dimensionality (a similar principle is the basis for spatial, binaural hearing). However, we can realise the spaciousness also in another way: due to a shadow, or on the basis of verified experience from dimensional manifestations of things in dependence on relative distances. To evoke an impression of spaciousness on a 2D area we normally make use of the perspective principles.

In perception the images are not only seen but have certain significance to us as well. This fact is often misused in the so-called visual illusions. The significance of an experience establishes a need in our consciousness to both save and remember the events and phenomena in case of need. The ability to experience events and phenomena from our memories (from the memory) is called imagination or fantasy. It is a kind of virtual perception of the things that we have already experienced, realised, verified and memorised. Many times, the vision completes the experience by the things that we cannot see at that moment. This ability is the basis of all perceptual homomorphous iconic simulations. The seeing and the vision cannot be separated from each other. The vision too is not only a simple reproduction of the experience, but it also is a creative process of permanent overlapping of the real and the virtual.

Fig. 1a

Fig. 1b

Fig. 2a

Fig. 2b

Lighting and colour in urban space

The urban space is normally perceived at natural sunshine. The sunbeams vitalise the colours of all environs components and intensify their spatial manifestation. Our sight reacts more intensely to brightness and lightness than to colour, and therefore the feeling of brightness and lightness in space are superior to the others. The differences in natural lighting in urban structure are characteristic to each space: less lightened spaces evoke an impression of being closed and cramped; on contrary, the illuminated ones seem to be open and spacious. Similar to that are the effects of the space-creating aspects of colours: dark colours bring out an impression of closeness, the light ones an impression of a distance. From the aesthetic point of view it is also necessary to take into consideration the quality of the colour and material interpretation of fragments and details of an urban structure *(Figures 1a, 1b)*. From the psychological point of view, lighting and colour determine all the subsequent sensory perception experiences. One has to bear in mind that the quality of solar lighting depends not only on the day and year time but also on the geographical width, and weather. The organic civic structure and its visible structural manifestations are under continuous change, according to the direction and incidence of the sunbeams. Light and shade create contrasts in both the colour, and the plastic definition *(Figures 2a, 2b, 2c, 2d, 2e)*. In some situations they can originate various mirrorings or reflections.

Fig. 2c

Fig. 2d

Fig. 2e

A lot of possibilities to regulate the urban atmosphere through light and colour offers artificial lighting, or night city lighting which enables a sensitive and aimed support, as well as manipulation of the formal manifestations of both the particular parts and the whole spatial structure. Artificial illumination of the urban silhouette strengthens the aesthetic effect of the overall image and highlights the unique symbols typical for the city *(Figure 3)*. A special effect at the day into night transitions brings about the twilight with reflections of first lights on the city panorama and its water surfaces, and also the colour of evening waterworks, or exploitation of various lighting shows and effects *(Figure 4).* The interplay of artificial lights and from dark (black and white) night background enliven colours affects the whole dynamics of the city nightlife.

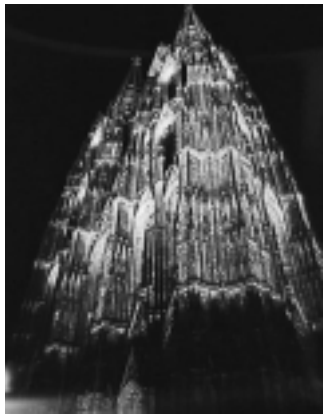

Fig. 3

Lighting and colour simulation in laboratory conditions

In perceptual homomorphous iconic simulations (Philip Thiel), or in simple, in model simulations in endoscopic laboratories it is often necessary to present the described phenomena and situations which result from the creative lights and colours applications in the architectural design. The differences in lighting of the modelled reality, with characteristic structure representation according to the day time or season, can be expressed on a simulation lab-unit through the medium of diffusive or condensed lights *(Figures 5a, 5b)*. In night sceneries simulation one would not manage without the help of secondary miniaturised light sources (*Figure 6a,b)*. A helpful device in natural structure lighting verification from various aspects in temporal year system is e.g. a simple horizontal date sundial which enables the height and direction of the sunlight on the model on the simulation lab-unit to be navigated by a reflector in cardinal points and latitude co-ordination according to a vertical obstacle shadow cast on the given date co-ordinates

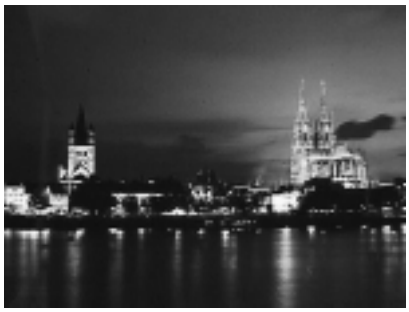

Figure 4

Figure 5a

Figure5b

(Figures 7a, 7b). The quality and complexity of image interpretation is apparent, compared to a colourless model modification, or a coloured presentation *(Figures 8a, 8b, and 9a, 9b)*. A similar difference can be recognise when comparing a digital presentation processing by graphical effect of linear display and an image sequence chromatic interpretation *(Figures 10a, 10b).*

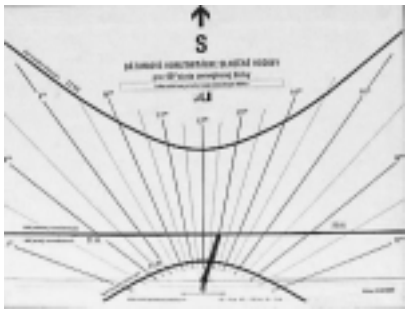

Figure 7a

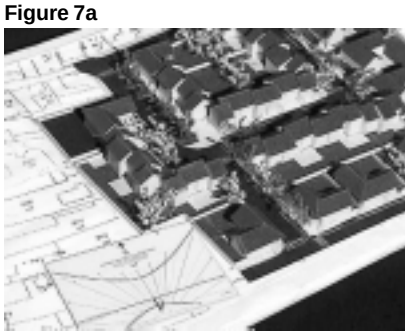

Figure7b

Figure 6a

Figure 6b

Figure 8a

Figure 8b

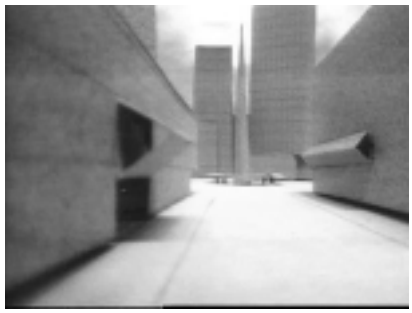

Figure 9a

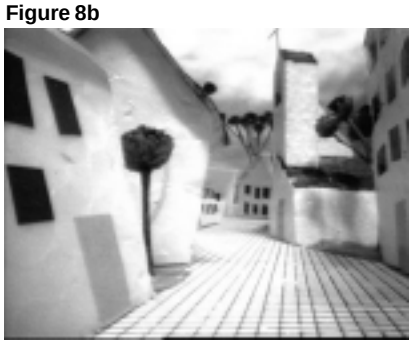

Figure 9b

Conclusions

From the presented ideas and examples I would like to draw several conclusions concerning the topic of the conference:

· In relationship towards real situations the light and spatial colour model simulation can always be only informative. Medial notation, transmission or light and colour measure interpretation is a demanding problem because it lies on the differencies of repulsed or radiated (generated) lights electromagnetic lengths, and depends on various technical and other external and internal perception conditions.

· From the quality and complexity aspect of sensory experience modelling (simulation) in space conceptual changes dynamics it is important to simulate its experiencing also in another, unconventional dimension, by which I mean the double-channel scanning by binocular stereoendoscopy.

· It has been several times proved that in spite of some interpretation disadvantages more important lighting and colour design projects must be verified by spatial simulation on models in the natural horizon and motion of a spatial scenery participant. The two-dimensional facade planning is enriched by the three-dimensional structures and spaces design, so that it is synchronised with human proportions, ideas, activities, and needs in an urban environment in the highest possible measure.

· The application of light and colour manifestations in conceptual modelling and anticipated laboratory simulation of sensory experiences from the aspect of light and colour effects in an urban and architectural environment has basically no medial or other technical obstacles. I can therefore state, that in the given issues the colour and light model simulation represents a particular input into the architectural design quality only by the very fact that it contributes to informativeness and public's participation on the creative process.

Figure 10a

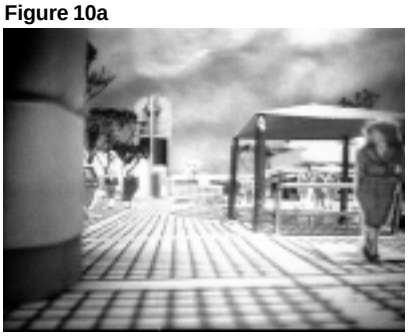

Figure 10b

References

1. KARDOŠ, P.: Urban Space, Urban Environment, and Spatial Simulation. Habilitations work with English Summary, FA STU Bratislava, 1998
2. Kardoš, P., Brath, J., Kulla, P.: Simulation, Perception and Representation of Urban and Architectural Environments. Grant research project of FA STU Bratislava, 1997
3. Krewinkel, H., W.: Baugestaltung mit Farbe. Deutsche Verlags-Anstalt, Stuttgart, 1985
4. Porter, T.: Colour Outside. The Architectural Press, London, 1982
5. Thiel, Ph.: People, Paths, and Purposes. Notations for a participatory envirotecture. University of Washington Press, Seattle, 1997
6. Wejchert, K.: Elemente der Städtebaulichen Komposition. VEB Verlag für Bauwesen, Berlin, 1978