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ECOLOGICAL SAFETY OF VISUAL ENVIRONMENT AND VIDEOECOLOGICAL PERCEPTION (VEP) OF VINNITSIA

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Abstract. The object of the research is landscapes of the urban ecosystem of the town of Vinnytsia.

The purpose of the work is to investigate and evaluate the level of videoecological perception and geopotential sustainability of Vinnytsia and set the main risks to natural and artificial visual environment of the city.

The paper deals with the method of calculation for the evaluation of videcoecological favourableness of the urban environment and methods of visual pollution control in the urban environment.

During the research videoecological perception of the town of Vinnytsia was analyzed, the main environmental risks of the technosphere were identified and an evaluation of the sustainability of the urban environment of the city was made; the ways to optimize visual sensitivity of natural and artificial environment in the city were reviewed. A map-scheme based on experimental data and patterns of the range of videoecologiacal perception was made and its distribution among the territory of Vinnytsia was shown.

Key words: videoecology, saccade automaticity, visual pollution, visual environment, homogeneous fields, landscape design

1. Introduction

Today the problem of environmental safety acquires paramount importance. Along with the main environmental problems (air quality, water pollution, increased noise and radiation level) not less important environmental factor – permanent visible environment and its condition, remains aloof.

The processes of urbanization, industrialization and rationalization distanced us from the visual ideal: an artificial environment no longer bring aesthetic pleasure. Architecture of the last 50 years has a negative impact on the psycho-emotional state of a person. Nowadays visual environment is dramatically altered in cities: dominated by dark gray, straight lines and angles, city buildings are static and have a lot of planes which negatively affects visual processes.

Research relevance: environmental safety of visual perception of the environment and environmental risks of technosphere management, is conditioned by spreading monotonous aggressive environment for human visual perception; low architectural-planning construction level and lack of construction colour saturation that leads to the deterioration of emotional well-being of the population.

The aim is to improve the efficiency of the research of videoecological aspects of urban ecosystems contamination on the example of Vinnitsia by calculating real videoecological perception scoring (coefficients) and data processing optimization with results visualization to provide the environmental safety of the visual perception of the urban area in general. The object of the research is the process of urban landscapes ecosystem structure changing on the example of Vinnitsia. The subject of the study is videoecological features of urban landscapes and existing influence factors of technosphere on the environmental safety of visual perception.

2. Evaluation of territorial videoecological perception (TVEP) of Vinnitsia

Urban landscapes define the main features of the city and the level of urban environment videoecological perception. They consist of zones: parks, ponds, objects of contact green zone (CGZ), city home construction, the city center, industrial warehouse zone, etc. [1].

During the research for VEP valuation the TVEP coefficient (K_{TVEP}) calculation was done according to appropriate methodology [2], the essence of which is reduced to the calculation formula 1

$$K_{TVEP} = \frac{\sum_{1}^{m} k_a \left(\frac{S_1}{S}\right)_{st} + \sum_{1}^{l} k_a \left(\frac{S_1}{S}\right)_{arch} + \sum_{1}^{n} k_a \left(\frac{S_1}{S}\right)_{CGZ}}{3}, \quad (1)$$

where $(S_1/S)_{CGZ}$ – the ratio of the area occupied by the appropriate *CGZ* gradations to the area of territorial estimated squares of Vinnitsia; $(S_1/S)_{storey}$ – the ratio of the area occupied by the relevant of storeys building types to the area of territorial estimated squares of

Vinnitsia; $(S_1/S)_{architect}$ – the ratio of the area occupied by the relevant architectural gradations to the area of territorial estimated squares of Vinnitsia; k_a – additive factors listed in table 1 [2].

Using the map of Vinnitsia on map service "Google Maps" [3], we find the abovementioned types of zonal distribution of the city, structurally presenting them in the basic three administrative districts, which allocate ten main micro-districts: Leninskyi district (S = 2,900 hectares): Vishenka, Sverdlovskyi massive, Slavyanka, Piatnychany, Center; Starogorodskyi district (S = 1,830 hectares): Stare misto, Mali Khutory; Zamostianskyi district (S = 2,200 hectares): Zamostia, Tiazhyliv, Shevchenko Khutir.

The city's zonal distribution types and experimental data of the objects measured areas for each of the ten Vinnitsia's micro districts were listed into the table. Components arrangement of the city contact zones was made on the basis of videoecological principles, and their boundaries were defined by walking distance to landscape objects, their recreational attractiveness and visual perception.

Carry out the necessary calculations for each city district of Vinnitsia.

a) Vishenka:

1) Calculate the ratio of the area occupied by the relevant types of storeys building (S1) to the estimated area (S) for the residential micro-district zone, taking into account appropriate additive factors from Table 1, as a result we obtain the videoecological perception factor of the researched zone $K_{VEP(st)}$:

$$K_{VEP(st)} = \sum_1^m k_a \left(\frac{S_1}{S}\right)_{st.} = 1\cdot\frac{70\ ha}{700\ ha} + 0,5\cdot\frac{175\ ha}{700\ ha} + $$
$$+0,125\cdot\frac{420\ ha}{700\ ha} + 0,0625\cdot\frac{35\,ha}{700\ ha} =$$
$$= 0,1 + 0,125 + 0,075 + 0,003 = 0,3.$$

2) Coefficient of videoecological perception of administrative and cultural zone $K_{VEP(arch)}$ is :

$$K_{VEP(arch)} = \sum_1^l k_a \left(\frac{S_1}{S}\right)_{arch} = 0,5\cdot\frac{170,4\ ha}{341,3\ ha} +$$
$$+0,125\cdot\frac{133,3\ ha}{341,3\ ha} + 0,6\cdot\frac{8,5\ ha}{341,3\ ha} + 1\cdot\frac{4\ ha}{341,3\ ha} +$$
$$+1\cdot\frac{19,31\,ha}{341,3\,ha} + 1\cdot\frac{0,5\ ha}{341,3\ ha} = 0,25 + 0,05 + 0,015 +$$
$$+0,012 + 0,06 + 0,001 = 0,4.$$

3) Coefficient of videoecological perception of green zone $K_{VEP(CGZ)}$:

$$K_{VEP(CGZ)} = \sum_1^n k_a \left(\frac{S_1}{S}\right)_{CGZ} = 1\cdot\frac{90\ ha}{234,4\ ha} +$$
$$+1\cdot\frac{67,53\ ha}{234,4\ ha} + 1\cdot\frac{72,01\ ha}{234,4\ ha} + 0,5\cdot\frac{4,86\ ha}{234,4\ ha} =$$
$$= 0,38 + 0,29 + 0,31 + 0,01 = 0,9.$$

Thus, overall coefficient of videoecological perception (KVE) for the territory of the district Cherry is:

$$K_{TVEP} = \frac{\sum_1^m k_a \left(\frac{S_1}{S}\right)_{st} + \sum_1^l k_a \left(\frac{S_1}{S}\right)_{arch} + \sum_1^n k_a \left(\frac{S_1}{S}\right)_{CGZ}}{3} =$$
$$= \frac{0,3 + 0,4 + 0,9}{3} = 0,5.$$

The results of similar calculations performed for other micro-districts are presented in Table 2.

The results of TVEP factor calculation are visually represented in Figure 1.

Table 1

Numerical values of additive factors for K_{TVEP} calculation

k_a	Gradation (1; n)	k_a	Gradation (1; m)	k_a	Gradation (1; l)
1	recreational spaces	1	no buildings	1	historical town
0,5	green corridors	0,5	low-rise (1 – 3 storeys)	0,5	single architectural monuments
0,125	walking distance zone of CGZ objects	0,125	medium-rise (5 – 9 storeys)	0,125	areas of new buildings
0,0625	visual orientation area	0,0625	high-rise (9 – 16 storeys)		

Table 2

Results of calculations for ten micro-districts of Vinnitsia

K_{VE} / Micro district	District	$K_{VEP(st.)}$	$K_{VEP(arch)}$	$K_{VEP(CGZ)}$	K_{TVEP}
Vishenka	Leninskyi district	0,3	0,4	0,9	0,5
Sverdlovskyi massive		0,4	0,5	0,8	0,6
Slavianka		0,4	0,3	0,9	0,5
Piatnychany		0,5	0,6	0,7	0,6
Center		0,7	0,9	0,92	0,9
Stare misto	Starogorodskyi district	0,6	0,4	0,7	0,6
Mali Khutory		0,3	0,4	0,6	0,4
Zamostia	Zamostianskyi district	0,4	0,1	0,5	0,3
Tiazhyliv		0,1	0,1	0,5	0,2
		0,4	0,1	0,5	0,3

The heterogeneity in the distribution of TVEP levels, based on the calculated factors, are visually represented in the diagrams (Fig. 2–5), which makes it possible to talk about the relative inferiority of comfortable visible environment, a significant need for optimization the ways of solution to these shortcomings and analyze it as a factor of technosphere environmental risk concerning the impact on visual perception in each of the studied zones of the micro-districts (residential (storey), administrative, cultural (architectural), green (contact green zone)) and the city in general.

As seen from the map and the diagrams, overall TVEP factor of Vinnstsa ranges from 0,1 to 0,9. Higher values of the coefficient are observed in the central parts of the city. These parts make up a historical center of the city, and it is the largest area of recreational facilities of citywide importance.

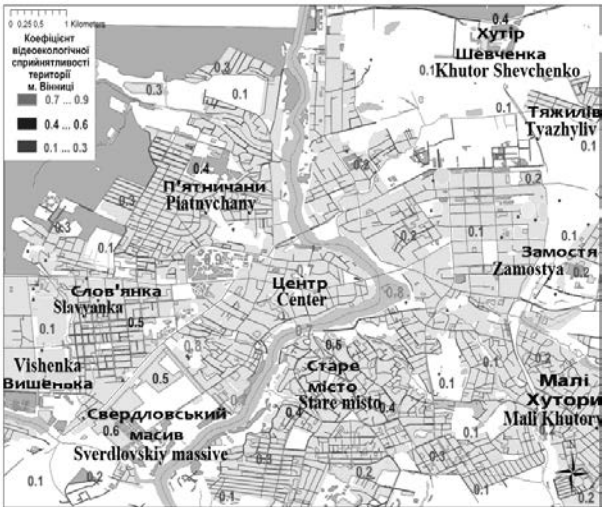

Fig. 1. Map of Vinnitsia's videoecological perception

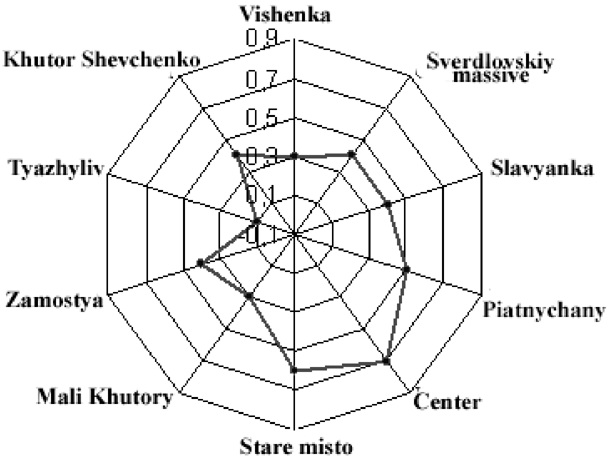

Fig. 2. Average levels of VEP residential zones of Vinnitsia's micro-districts

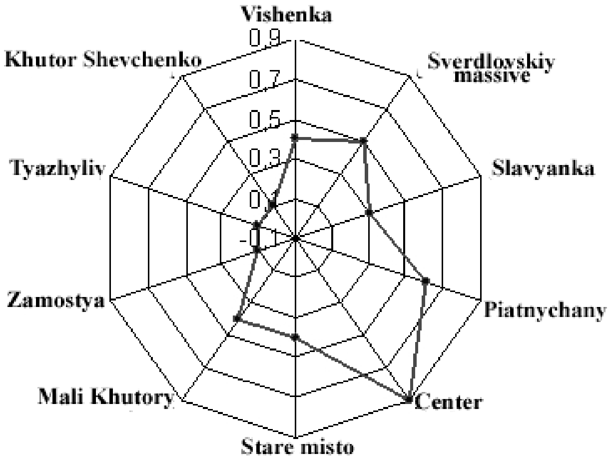

Fig. 3. Average levels of VEP of Vinnitsia's administrative and cultural zones

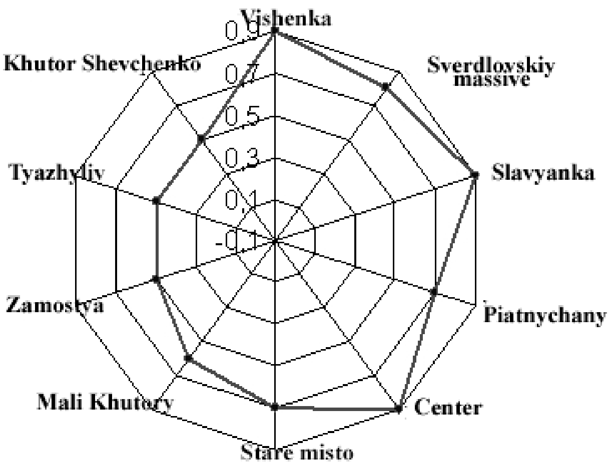

Fig. 4. Average levels of VEP of Vinnitsia's green zones

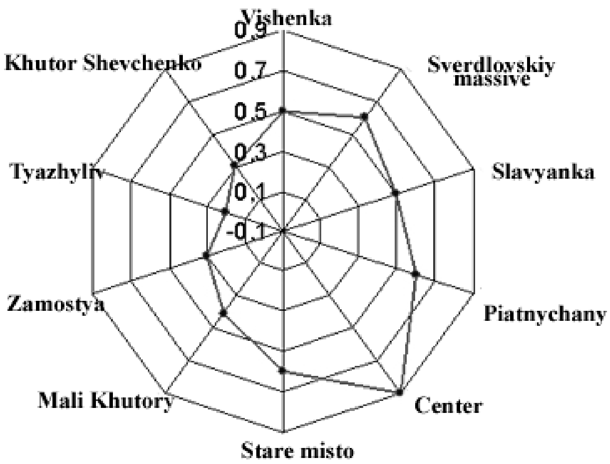

Fig. 5. Average levels of VEP of Vinnitsia's urban environment

3. Conclusions

1. During the videoecological analysis of urban environment the architecture and environment interaction was studied and a typology of contact zones for the city of Vinnitsia developed. The components of the city contact zones were systematized.

2. Areas of the analyzed components were experimentally measured (areas of objects CZ, CGZ, functional areas, the calculated squares, etc.). Scoring of the territorial video-ecological perception of Vinnitsia was provided on the basis of the appropriate methodology. According to the results of calculation, a map- scheme of video-ecological perception of Vinnstsa was established; a distribution diagram of video-ecological sensitivity levels was built for each of the functional areas of the city (residential, administrative, cultural, green) and the urban area as a whole

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