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Road Safety as a Factor in Sustainable Urban Development

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Abstract - The article deals with issues related to the impact of road safety on sustainable urban development. We analyzed the territory of the city in order to change the functional purpose of the territories, construction sites, changes in population. A comparison was made of road accidents with transport-town-planning deficiencies and their impact on traffic safety.

Key words — transport and planning subdistrict, geoinformation system, traffic accident, functional area, mixed development

I. INTRODUCTION

In modern conditions, the processes of new industrialization affect many countries of the world, which leads to an increase in the rate of urbanization (especially characteristic of developing countries), without which it is almost impossible to ensure a significant increase in productivity. This leads to the emergence of various problems in the development of cities, expressed mainly in reducing the quality of life of the population due to its negative impact on the urban environment. Sustainable urban development implies: the satisfaction of the basic needs of the population; resource efficiency; reducing the negative impact on the environment; development of urban infrastructure. The key point of the components of sustainable urban development is road transport.

The generation of transport demand through the construction of industrial, housing and socio-cultural facilities in conditions of insufficient provision of the necessary length and density of the road network in the existing development, leads to significant losses from traffic congestion, environmental pollution, high accident rates.

The existing methods for analyzing road traffic accidents do not sufficiently allow an assessment of the impact of the planning and transport and urban planning characteristics of urban development on road safety. A comprehensive approach to identifying the causes of accidents is appropriate. At the same time, quantitative and qualitative characteristics of road accidents are considered in relation to small urban areas that are homogeneous in terms of architectural and planning indicators.

An integrated approach involves the following areas:

1. To establish the distribution of road accidents in the city, to identify the main drawbacks of urban planning leading to accidents.

2. To identify patterns of occurrence of road accidents, depending on the transport and town planning characteristics of the considered territory of the city.

The basic principles of a city-planning assessment of traffic safety are as follows:

1. Determination of the planning and transport and town-planning characteristics of built-up areas.

2. Identification of homogeneous elements of the urban plan and their division into transport-planning subdistricts.

3. Counting the number of traffic accidents and traffic flow parameters for each subarea.

4. Analysis of the distribution of road accidents in the city and the definition for each subarea of the main factors affecting the accident rate.

5. Identification of the level of traffic safety in each subarea.

6. Determination of the pattern of occurrence of road accidents in each subarea, depending on urban factors.

7. Prediction of accidents and planning measures to improve traffic conditions.

However, the use of this method involves the processing of a large amount of data, which requires a significant amount of automation, without which its use is impractical. As a tool for automating these processes, various geo-information systems

with the necessary set of functions (for example, Quantum GIS, ArcGIS and the like) can act.

II. Materials and Equipments

The aim of the study is to identify feasibility of applying a city-planning assessment of road safety conditions and assessing the impact of road safety on the sustainable development of large cities.

Based on the assumption that the causes of road accidents are caused by shortcomings of a transport and town planning nature, the territory of the city was analyzed for changes in the functional purpose of territories, construction of facilities, changes in population over the past 10 years. We revealed that the central district of the city turned out to be the least affected. Comparing the information obtained with the accident data, the period from 2010 to 2012 was chosen.

According to the traffic police, taking into account the characteristics of geocoding, in the environment of Quantum GIS, 19485 traffic accidents were applied to the place of commission and attributes (2010 - 6392 accidents; 2011 - 6534 accidents; 2012 - 6559 accidents). A map of the central district with these accidents is presented in Figure 1.

Due to the peculiarities of the existing development in the Central District, its territory was divided into equal squares with a side size of 500 m and the nature of the distribution of accidents was determined. The nature of the distribution of accidents on the territory of the Central District for 2010-2012 is presented in Figures 2-5. Comparing the accident data for 2010-2012, we can conclude that, despite the fluctuation in the number of road accidents, the nature of their distribution throughout the Central county remains virtually unchanged.

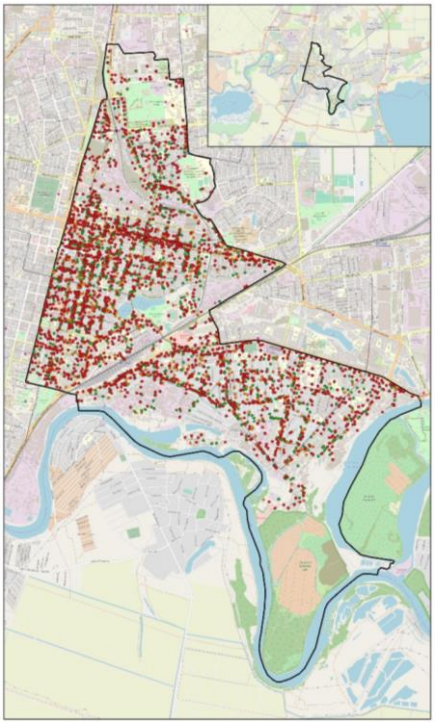

Fig. 1. Traffic accidents in the central district of the city of Krasnodar

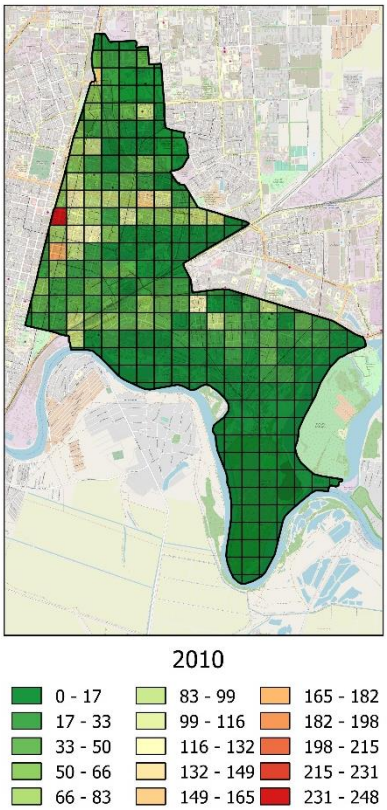

Fig. 2. The nature of the distribution of accidents on the territory of the Central District for 2010

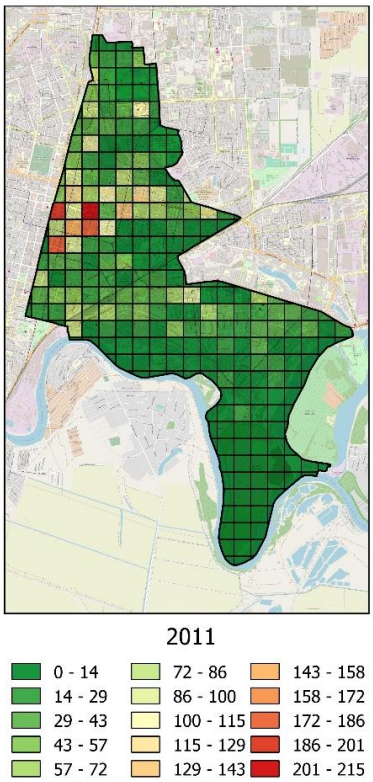

Fig. 3. The nature of the distribution of accidents on the territory of the Central District in 2011

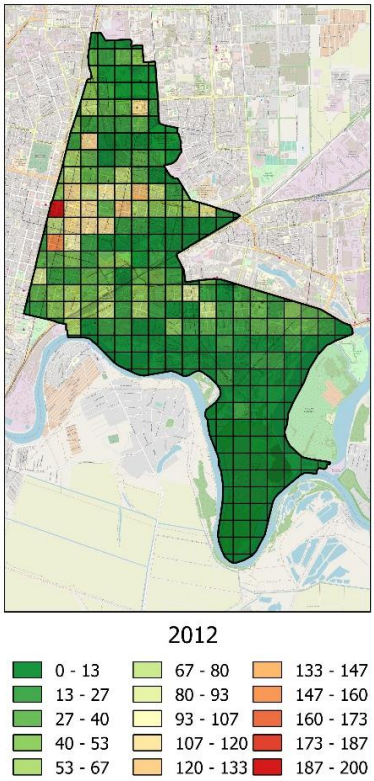

Fig. 4. The nature of the distribution of accidents on the territory of the Central District in 2012

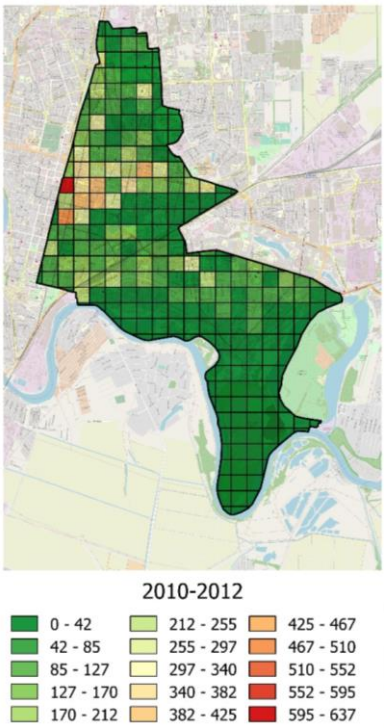

Fig. 5. The total number of road accidents in the subdistricts of the Central District for 2010-2012

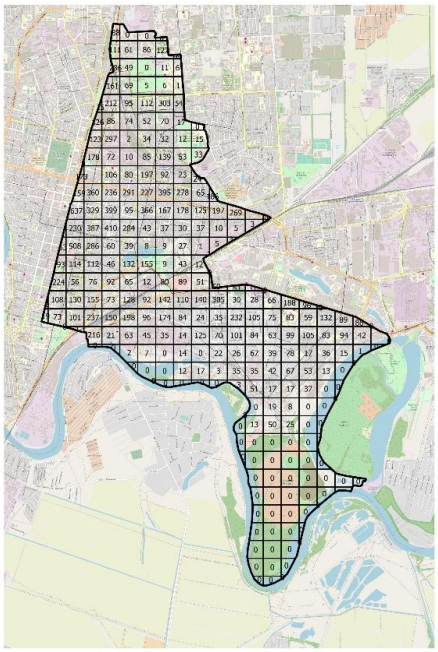

Fig. 6. The total number of road accidents in the subdistricts of the Central District for 2010-2012

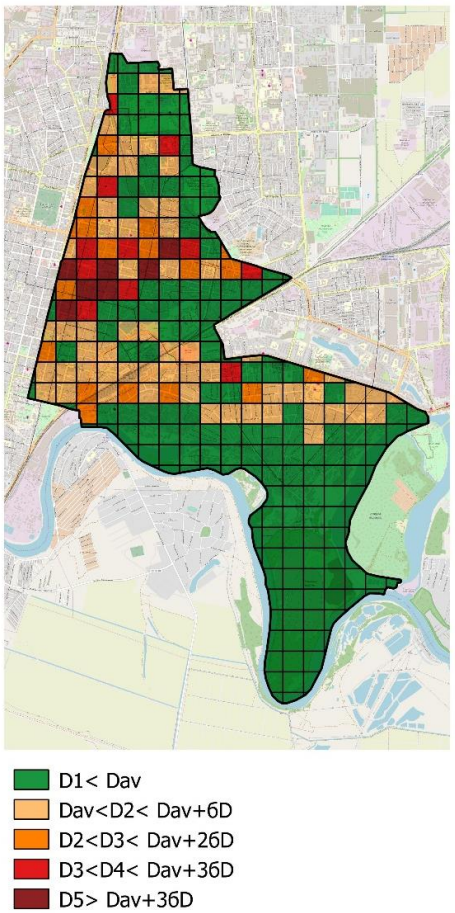

Fig. 7. Groups of transport planning areas

III. Analysis of Simulation Results and Experimental Data.

We determine the total number of road accidents in all subareas (D_Σ), the average number of accidents per each subarea (D_{av}) and the standard deviation (σ_D). The results of the calculation of D_Σ are presented in Figures 5 and 6.

Based on the obtained indicators, we will divide the transport and planning subdistricts by the number of road accidents into the following four groups:

1. with the number of incidents $D_1<D_{av}$;

2. with the number of incidents $D_{av}<D_2<D_{av}+\sigma_D$;

3. with the number of incidents $D_2<D_3<D_{av}+2\sigma_D$;

4. with the number of incidents $D_3<D_4<D_{av}+3\sigma_D$.

As a result of calculations and distribution of transport and planning subdistricts into groups, 7 subdistricts were identified that did not meet the presented conditions with a high accident rate. The results of the calculations are presented in Figure 7.

IV. Conclusion

After analyzing the urban development situation in the subdistricts divided into groups, we can conclude that the first group includes the residential, industrial and recreational areas and partially mixed development areas. The second group includes residential, social, business and mixed development subdistricts. The third and fourth groups are located mainly in the central part of the city and represent residential, business and public, mixed development. High accident rate in them is due to the layout of highways, the nature of the building, as well as modes of traffic flow.

Comparison of the results of observations on the distribution of road accidents in the city with data on population, population density, length of highways, area of the carriageway, density of the carriageway, traffic flow parameters makes it possible to assess the impact of the urban planning situation on traffic safety and outline a program for the reconstruction of each transport-planning area and the queue of town-planning events

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