*informatsionnyh potokov / D. Lande. – Kiev: Inzhiniring Publ., 2006. – 240 p. 8. Pasichnyk V. Mathematical linguistic / V. Pasichnyk, Y. Scherbyna, V. Vysotska, T. Shestakevych. – L: Novy svit, 2012. – 359 p. 9. Chomsky N. Three models for the description of language / N. Chomsky. – I.R.E. Trans. PGIT 2, 1956. – P. 113-124. 10. Chomsky N. On certain formal properties of grammars, Information and Control 2 / N. Chomsky // A note on phrase structure grammars, Information and Control 2, 1959. – P. 137–267, 393–395. 11. Chomsky N. On the notion "Rule of Grammar" / N. Chomsky // Proc. Symp. Applied Math., 12. Amer. Math. Soc., 1961. 12. Chomsky N. Context-free grammars and pushdown storage / N. Chomsky // Quarterly Progress Reports, № 65, Research Laboratory of Electronics, M.I.T., 1962. 13. Chomsky N. Formal properties of grammars / N. Chomsky // Handbook of Mathemati-Mathematical Psychology, 2, ch. 12, Wiley, 1963. – P. 323–418. 14. Chomsky N. The logical basis for linguistic theory / N. Chomsky // Proc. IX-th Int. Cong. Linguists, 1962. 15. Chomsky N. Finite state languages / N. Chomsky, G.A. Miller // I nformation and Control 1, 1958. – P. 91–112. 16. Chomsky N. Introduction to the formal analysis of natural languages / N. Chomsky, G.A. Miller // Handbook of Mathematical Psychology 2, Ch. 12, Wiley, 1963. – P. 269–322. 17. Chomsky N. The algebraic theory of context-free languages / N. Chomsky, M.P. Schützenberger // Computer programming and formal systems, North-Holland, MR152391. – Amsterdam, 1963. – P. 118–161.*

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# IMPROVEMENT OF CITY TRAFFIC NETWORK BASED ON AN ANALYSIS OF ITS FEATURES

# УДОСКОНАЛЕННЯ ТРАНСПОРТНОЇ МЕРЕЖІ МІСТА НА ОСНОВІ АНАЛІЗУ ЇЇ ОСОБЛИВОСТЕЙ

*Ó Mazur V., 2014*

**The article deals with the features of city transport network and there is proposed measures on its improvement.**

**Key words: city transport network, 3-D model, typical element.**

**Розглянуто особливості транспортної мережі міста та запропоновано заходи з її вдосконалення.**

**Ключові слова: транспортна мережа міста, 3-D модель, типовий елемент.**

## Introduction

A further increase of the traffic flow intensity in conditions of the limited space and inadequate city transport network leads to the exasperation of traffic problems. The solution to these problems is particularly difficult in the central historical part of the cities of Western Ukraine, sated by a large number of intersections and narrow streets. Dense housing system and historical value of the buildings virtually eliminates the modernization of the road network on the basis of known standard approaches. Therefore, the development of measures to improve the transport network should be based primarily on the identification and consideration of its specific features. The development of specific methods and approaches to improving transport networks of the ancient city, is given, in our opinion, insufficient attention that causes the relevance of this work [1].

**The objective of this work** is the improvement of the transport network on the basis of its specific features. To achieve this goal the following tasks are solved: the identification of transport network models and determination of its critical cross-sections; the development of measures to improve the transport



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network for specific situations; the development of methods and approaches for the design and improvement of transport networks of the ancient cities.

**I. City transport network improvement on the basis of their flow-oriented models**

During the analysis there were established the following common features of the transport networks of many ancient cities of Western Ukraine:

1. The city road network has been evolved over the centuries and is characterized by considerable irregularity and heterogeneity.

2. Optimal planning of the transport network is difficult due to the influence of objective and subjective factors (difficult terrain, natural obstacles, railways, areas of low-rise buildings, further sealed chaotic buildings, within the road design there is not provided the opportunities for further expansion, and so on).

3. When designing roads there are not considered further growth in the number of vehicles.

4. In the city there are critical areas where traffic is particularly difficult.

5. Improving the city integration (density in a limited area of the city) is not accompanied by the development of transport infrastructure.

6. In the old part of the city there are practically no opportunities for expansion and modernization of the road network.

7. Existing methods and models do not take into account the specifics of the design of transport networks in the ancient cities.

It is important to note that the prolonged delay in upgrading the transport networks inevitably leads to the transport disintegration of the city.

Consider some characteristics of urban transport networks and proposed measures for their improvement.

Figure 1 presents a flow-oriented model of the Ternopil city. It is characterized by two critical cross-sections, one of which is caused by the large pond and the other – by rail. These cross-sections divide the city into three parts and substantially restrict the movement of vehicles. There are proposed two fragments of roads (dotted line) for the inclusion into the General plan and the improvement of the transport links of these three parts of the city.

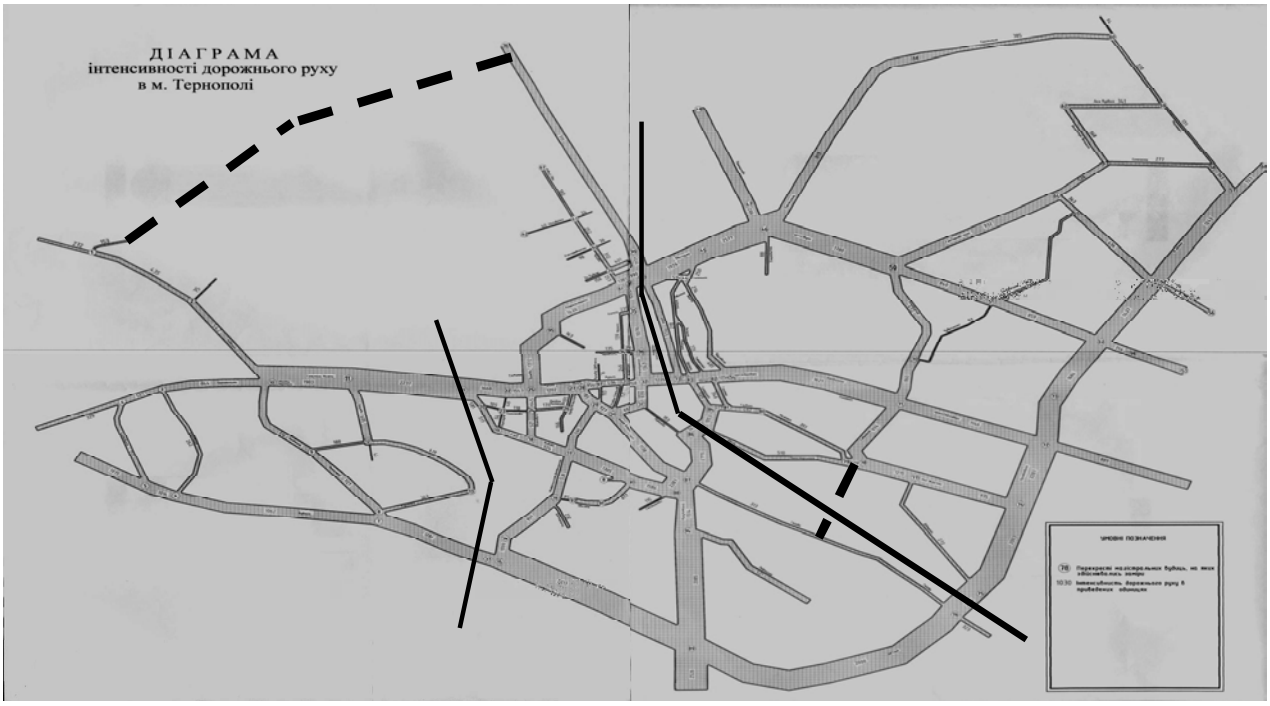


*Fig. 1. Flow-oriented model and the critical cross-sections of Ternopil*



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Figure 2 presents a flow-oriented model of the Lviv city. The complex terrain and railway track divide the city into two parts connected by a limited number of roads with insufficient traffic capacity. To improve transport link it is offered an additional section of the road indicated by the dotted line. This will increase the traffic capacity and provide a new transport corridor between the northern and southern parts of the city.

It should be noted, that because of the bad planning, the transport problems arise in the new city micro-districts. In particular, due the concentration of a significant number of transport it is observed the highway overload of the micro-district Sykhiv. In addition, three main trunk lines connecting Sykhiv with other areas of the city are in the critical cross-sections.

## II. New approaches to the design of city transport network

For the system planning of transport network and ensuring its high traffic capacity it is proposed an approach based on the use of three-dimensional (3-D) models (Fig. 3) and typical topological elements (Fig. 4). For the computer-aided design of the roads the 3-D model is based on two-dimensional maps, or on the results of the topographical survey of the city problem areas. The proposed typical topological elements increase the regularity of the city topology providing the necessary transport infrastructure. High traffic capacity is ensured not by the multilane trunk roads and through the creation of the extensive distributed road network. The transition from in-plant systems with limited capacities into the perspective distributed systems is typical today in many fields of science and technology.

*Fig. 2. Flow-oriented model and the critical cross-sections of Lviv*



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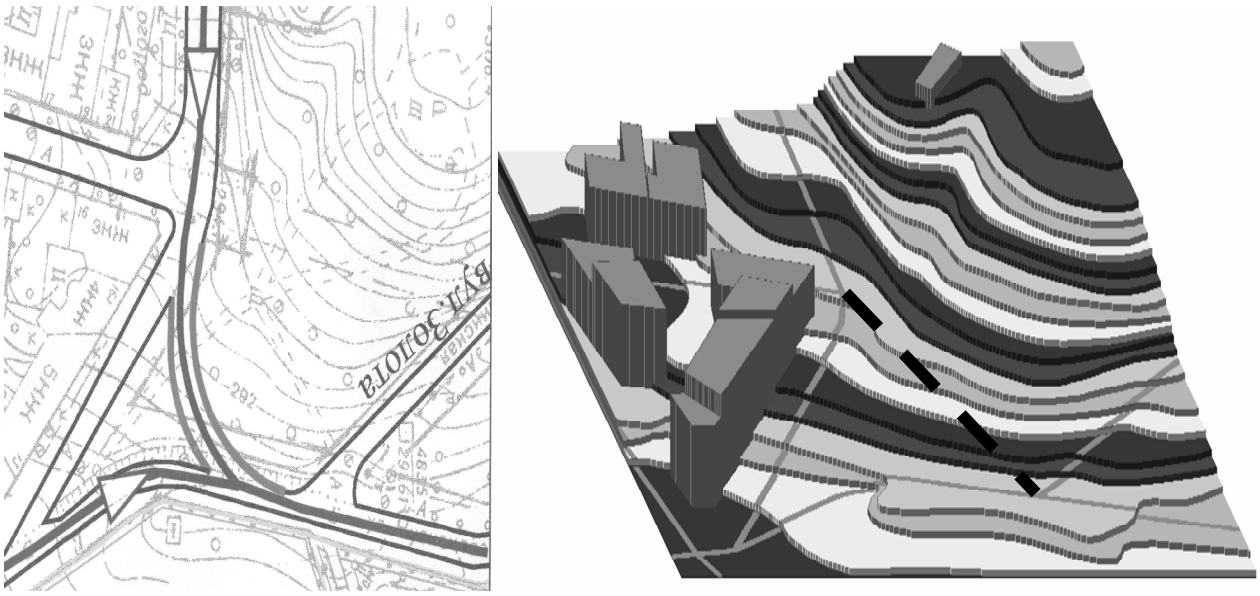

*Fig. 3. 3-D model of the problem areas of Lviv*

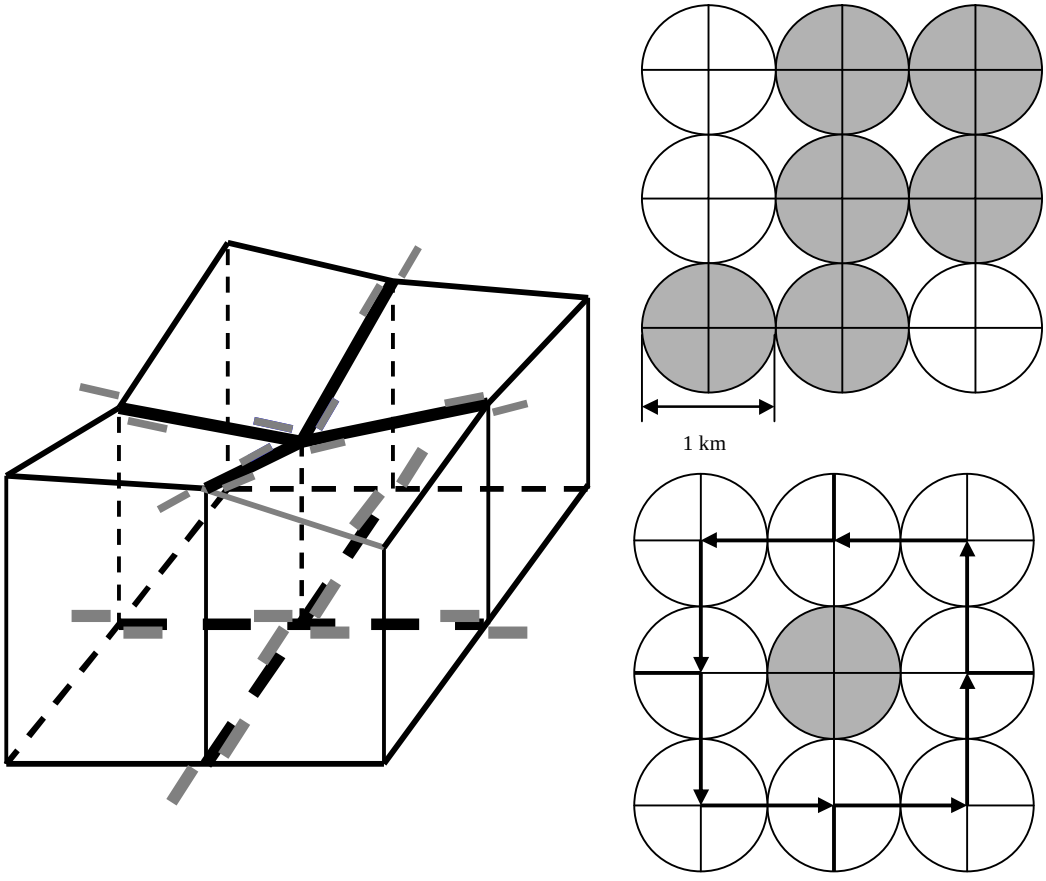


*Fig. 4. The design of transport networks based on the typical elements*

The proposed approach provides the following benefits:

1. Necessary roads become mandatory objects of the typical element in planning micro-districts.
2. The expansion of the micro-districts is carried out by the extension of elements that form branched distributed road network.
3. The opportunities enlarge and the route planning simplifies.
4. Simplified implementation of alternative routes to bypass problem areas caused by road repairs, accidents, traffic jams and so on.



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5. Decrease in the route length and movement time in the chord directions.

6. It is ensured the formation of micro-districts with regular and irregular structure.

7. Typical elements can be used in the design of micro-districts on the free areas of the old town.

8. In contrast to networks with radial structure there is no overflow of the micro-district center by cars.

9. On the basis of typical elements the formation of pedestrian zones in the central part of the micro-district is ensured.

10. No artificial car concentration characteristic to trunk roads: this reduces pollution and noise [2].

11. The selected element size provides an approach to public transport within pedestrian connectivity.

12. The opportunities for the formation of a distributed public transport system enlarge.

**Conclusions**

Considered characteristic features of transport networks in some cities of Western Ukraine and the proposed measures for their improvement can be useful when planning networks in other cities. A new approach to the development of the route network provides the solution of the transport problem at the stage of computer-aided design, and not in the process of the dynamic control of chaotic transport flows [3]. A systematic approach and formalization of the project tasks implementation using the regular typical elements provides the improved results of the transport networks design.

*1. Mazur V. Computer-Aided Design of Transport Network on System and Functional-logical Levels. VIII$^{th}$ International Conference CADSM 2005. February 23–26, Lviv–Polyana, Ukraine. 2. Lobur M., Mazur V., Melnyk M. The Investigation of Traffic Noise Source in City. Proceeding of the V International Scientific and Technical Conference "Computer Science & Information Technologies" 14–16 October 2010. – Lviv, Ukraine. – P. 144–145. 3. Mazur V . Designed of Trends Instead of Flow Management. Proceeding of the VII th International Conference MEMSTECH 2011 "Perspective Technologies and Methods in MEMS Design" 11–14 May 2011 Lviv–Polyana, Ukraine. – P. 163.*

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# DESIGNING MULTI-SENSORY SYSTEM FOR MONITORING GAS

# ПРОЕКТУВАННЯ МУЛЬТИСЕНСОРНОЇ МЕРЕЖІ МОНІТОРИНГУ ГАЗІВ

*© Marikutsa U., Narushynska O., 2014*

**This article is devoted to the design of a system to detect gases. The paper describes a system that is based on the controller STM32F4 and includes a series of sensors MQ. System requirements were formulated, the software was developed.**

**Key words: Gas analyzer, sensor, microcontroller, multisensory system.**

**Здійснено проектування системи для виявлення газів. Система побудована на базі контролера STM32F4 та включає сенсори серії MQ. Сформульовано вимоги до системи та розроблено програмне забезпечення.**

**Ключові слова: газоаналізатор, сенсор, мікроконтролер, мультисенсорна система.**

**Statement of the problem**

In nature, the gas is pure and composed of various mixtures. The accumulation of free gas produced in the lithosphere. They are important for the industry. The most important thing that we must remember



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