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## EXPERIMENTAL STUDY OF THE INTENSITY AND COMPOSITION OF TRAFFIC FLOW AT INTERSECTIONS IN THE TERRITORY OF THE CITY OF NUKUS

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**ANNOTATION.** This article examines the intensity and composition of traffic flows at intersections near the city of Nukus. The direction of movement at the measuring points at the intersection, as well as the number and composition of traffic, was also investigated.

**Key words:** Bus, route, intersection, traffic flow, tracking, stop in zones, point analysis, traffic composition, number of hours.

**Introduction.** Due to the necessary increase in the number of traffic lights in the city of Nukus, the requirements for the quality of design of such facilities and regulatory regimes are being tightened. At the same time, one of the methods of improving the quality of traffic for the organization of traffic at regulated intersections is to clarify the characteristics of traffic flows, develop new ways of driving or adapt existing ways of driving and evaluate the effectiveness of regulatory regimes.

On February 16, 2023, the decree of the President of the Republic of Uzbekistan No. 59 "On measures to reform the public transport system" was adopted [1]. In accordance with the resolution, a roadmap has been developed to improve the public transport system in the city of Nukus.

When forming information about the state of traffic, first of all, information characterizing the traffic flow is needed.

The only way to get reliable information about the condition of roads and the characteristics of existing traffic and pedestrian flows is through natural research.

The composition of the traffic flow is characterized by the ratio of different types of transport (vehicles) in it. This indicator has a significant impact on all road parameters. The intensity is taken into account separately for each direction of movement.

Usually, when assessing the operating conditions of a road, traffic intensity is expressed

in the actual number of passing vehicles collecting vehicles, regardless of their type. To characterize the number of vehicles that the road can pass, the actual traffic intensity is sometimes recalculated into the equivalent number of passenger vehicles that can move along the road when trucks, buses or road trains pass by [4].

On an extensive road network (for example, in a city), it is effective to determine the traffic intensity not on road sections, but at intersections (transport hubs). At the same time, depending on the configuration of the transport device, a group of observers is formed who identify incoming traffic flows by types of vehicles (cars, cargo, buses, etc.) and directions of movement (right, straight, left). The results of the observations make it possible to assess not only the overall traffic intensity in the directions, but also the intensity and composition of traffic flows within the node.

When calculating the amount of traffic at an intersection, the observation method is widely used. The number of observers is determined as follows: one person should be formed for each side of the intersection, if the intersection is three-sided, three people each, if it is four-sided, four people each. In addition, the group will need a workforce that will study the location of traffic lights and take photos and videos to study the types of signs, signs, traffic lights and their location at intersections. This will be needed in order to draw an existing traffic pattern. Video recording is necessary to correct the direction of movement of the vehicle in phase, as well as to eliminate problems, if they occur, in order to avoid re-entering the intersection. In addition, it is desirable to have two more people to measure the speed of the intersection [4].

When conducting experimental studies of calculating the amount of traffic at an intersection, each observer should be provided with a special research form based on a certain method of counting the number of vehicles. An example of a special study form based on a specific method of calculating the number of vehicles is shown in table 1.

Table 1.

A sample of a special research form based on a specific method of counting the number of vehicles at an intersection

Type of transport		Направление движения транспортных средств				
		To the left	To the right	Straight	U-turn	
Passenger car	8 <sup>00</sup> -8 <sup>15</sup>	135	39	336	1	
	8 <sup>15</sup> -8 <sup>30</sup>	170	36	411	1	
	8 <sup>30</sup> -8 <sup>45</sup>	178	24	440	3	
	8 <sup>45</sup> -9 <sup>00</sup>	160	51	468	2	
Taxi	8 <sup>00</sup> -8 <sup>15</sup>	18	1	42	0	
	8 <sup>15</sup> -8 <sup>30</sup>	15	1	50	0	
	8 <sup>30</sup> -8 <sup>45</sup>	11	4	62	0	
	8 <sup>45</sup> -9 <sup>00</sup>	13	2	40	2	
Minibus	8 <sup>00</sup> -8 <sup>15</sup>	66	18	233	0	
	8 <sup>15</sup> -8 <sup>30</sup>	83	23	236	0	
	8 <sup>30</sup> -8 <sup>45</sup>	100	27	218	0	
	8 <sup>45</sup> -9 <sup>00</sup>	81	38	243	0	
ISUZU Medium Bus	8 <sup>00</sup> -8 <sup>15</sup>	7	0	4	0	
	8 <sup>15</sup> -8 <sup>30</sup>	3	0	13	0	
	8 <sup>30</sup> -8 <sup>45</sup>	1	3	6	0	
	8 <sup>45</sup> -9 <sup>00</sup>	3	0	9	2	
MAN Yutong Big Bus	8 <sup>00</sup> -8 <sup>15</sup>	1	0	0	0	
	8 <sup>15</sup> -8 <sup>30</sup>	0	0	0	0	
	8 <sup>30</sup> -8 <sup>45</sup>	0	0	3	0	
	8 <sup>45</sup> -9 <sup>00</sup>	0	0	0	0	
Trucks	Small loader (<2 tons)	8 <sup>00</sup> -8 <sup>15</sup>	17	0	16	0
		8 <sup>15</sup> -8 <sup>30</sup>	9	2	24	0
		8 <sup>30</sup> -8 <sup>45</sup>	1	4	14	0
		8 <sup>45</sup> -9 <sup>00</sup>	8	0	13	0
		8 <sup>00</sup> -8 <sup>15</sup>	1	2	9	0

Average bearing capacity (2-8 t)	8 <sup>15</sup> -8 <sup>30</sup>	3	0	3	0
	8 <sup>30</sup> -8 <sup>45</sup>	0	0	5	0
	8 <sup>45</sup> -9 <sup>00</sup>	2	0	1	0
Large loader (>8t) with 3-3 or more axles	8 <sup>00</sup> -8 <sup>15</sup>	0	0	0	0
	8 <sup>15</sup> -8 <sup>30</sup>	0	0	0	0
	8 <sup>30</sup> -8 <sup>45</sup>	1	0	0	0
	8 <sup>45</sup> -9 <sup>00</sup>	0	0	0	0

In this research paper, the intensity of traffic in the directions of traffic at the intersection was investigated, experimental studies were conducted for 1 hour. An example of recording the traffic intensity in these units at an intersection is shown in Table 2 [4].

Table 2.

An experimental example of reverse movement in directions

The direction of movement	Passenger cars			Total
	To the left	To the right	Straight	
1	64	15	318	
2	377	143	443	
3	195	5	732	
4	64	62	356	
Total				

In accordance with the existing methodology, traffic flows on the main streets of Uzbekistan Guzar, A. Dosnazarova, Karakalpagistan and E. Alakoz of the city of Nukus at busy intersections during rush hours during the day were studied. That is: the number and composition of traffic at intersections, the direction of movement at points and the volume of traffic, etc. has been studied. The designated follow-up studies were conducted at several locations. Hence: Observations at the intersection at 4 points and at 1 point of the market square (Table 3). The total time for measuring intersections was 30 hours (6 hours at each intersection).

Table 3.

Places of observation and time of observations

№	Place of observation	The number of observation points. unity	Time of observation in one place наблюдения	Total observation time.hours
1.	Intersections	4	6	24
2.	The market square	1	6	6
<b>Total:</b>				30

The images below show the observation locations. After the measurements were carried out, they were processed based on video recordings, followed by manual entry of the number of vehicles into the MC Excel electronic program.

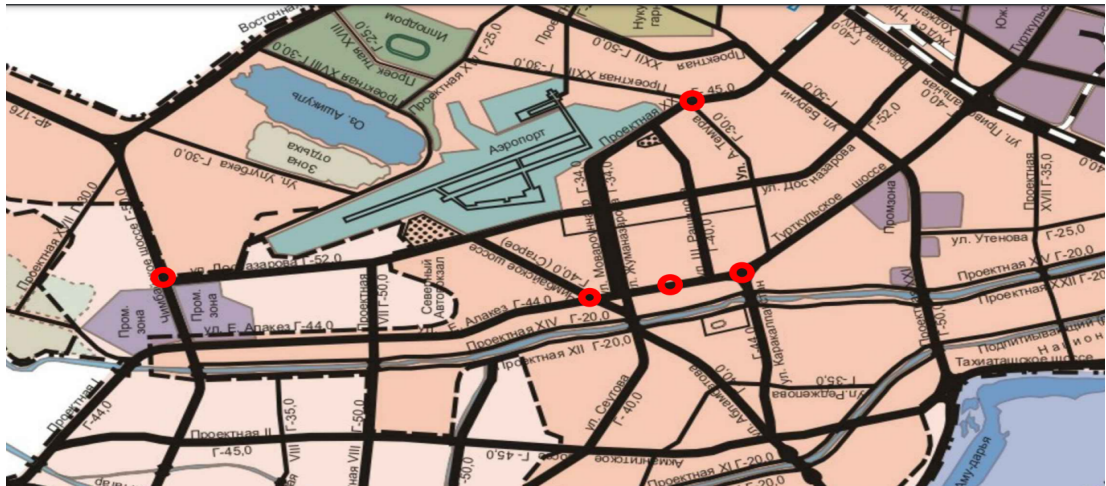


Figure 1. Observation posts at the intersections and trading floors of Nukus.

Surveillance at intersections was carried out on the basis of a video camera, surveillance cameras were installed at designated intersections. The traffic flow at intersections, the rolling stock on it, and the hourly flow were measured (counted) using cameras during the daytime from 08:00 in the morning to 20:00 in the evening.

**Materials and methods used.** The change in intensity at a busy time of day is taken into account when analyzing the level of service of traffic flow at a regulated intersection. However, the most commonly used procedures for assessing the level of transport services are based on 15-minute peak intervals [5]. As a result, traffic intensity exceeding the total bandwidth at a busy time of the day leads to oversaturation over the next hour.

Although a 15-minute interval is usually chosen as the study period, intervals of a different duration can be used. The intensity of the arrival of vehicles at the intersection can be obtained for a longer period, while using a special correction factor, which is called the "peak factor" [5].

Method "a": the duration of the study period is 15 minutes, that is, the duration of this T-period is 0.25 hours. In this case, you can use the following formula to get the hourly peak intensity obtained at 15-minute intervals, or a reduced peak intensity. [3]:

$$v_p = \frac{V}{PHF}$$

Where  $v_p$ - is the highest intensity of arrival of vehicles on the approach (lane) to the regulated intersection, measured with an interval of 15 minutes.unit/hour;

V is the peak traffic intensity measured during peak hours.unit/hour;

PHF is the peak factor (in the absence of data, it is assumed to be equal to PHF = 0.92).

The main disadvantage of this method is that only one 15-minute interval is considered, although the queue at the considered element of the regulated intersection may remain after this interval, since the traffic intensity exceeds the capacity [3].

**Method "C":** the study proceeds during the entire period T (for an hour), but is divided into 15-minute time intervals. In this case, it becomes possible to take into account the residual queue, which is transferred from one to the next 15-minute interval of the study. As a result, if the intensity of the arrival exceeds its capacity, a more accurate measurement of the delay value at the element of the controlled intersection in question can be achieved.

Hourly traffic intensity leads to a maximum peak intensity, which can only be achieved within a 15-minute period. As a result, the final intensity value used in the calculations will be overestimated, which will lead to some increase in estimates of transport delays. When designing, this allows us to take into account the maximum intensity jump during the rush hour [3].

**Results.**Consequently, the intensity and composition of the traffic flow were studied at the next intersection:

The composition of the traffic flow at the intersection of Karakalpakstan-Guzar street of Uzbekistan, the schedule for changing the time zone of the traffic flow at the intersection and the

schedule for changing the time zone according to the composition of the traffic flow are shown in Figures 2-3-4.

According to the results, at the intersection of Karakalpakstan-Uzbek Guzar Street, passenger cars make up 66%, trucks-3%, and buses and minibuses-31%.

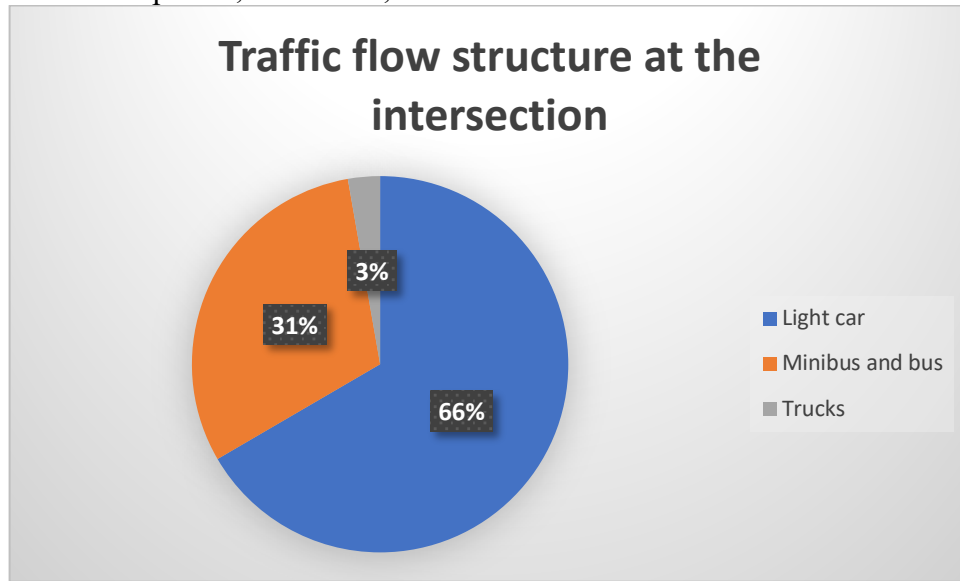


Figure 2 The structure of traffic flow at the intersection of Karakalpakstan-Uzbek Guzar street.

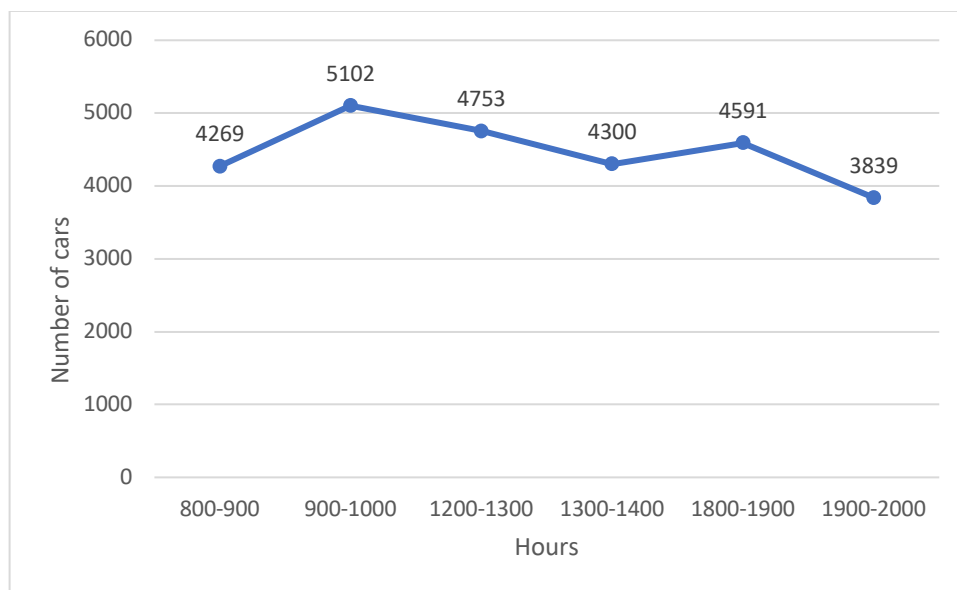


Figure 3. Graph of changes in the hourly segment of traffic flow at the intersection of Karakalpakstan-Guzar street of Uzbekistan

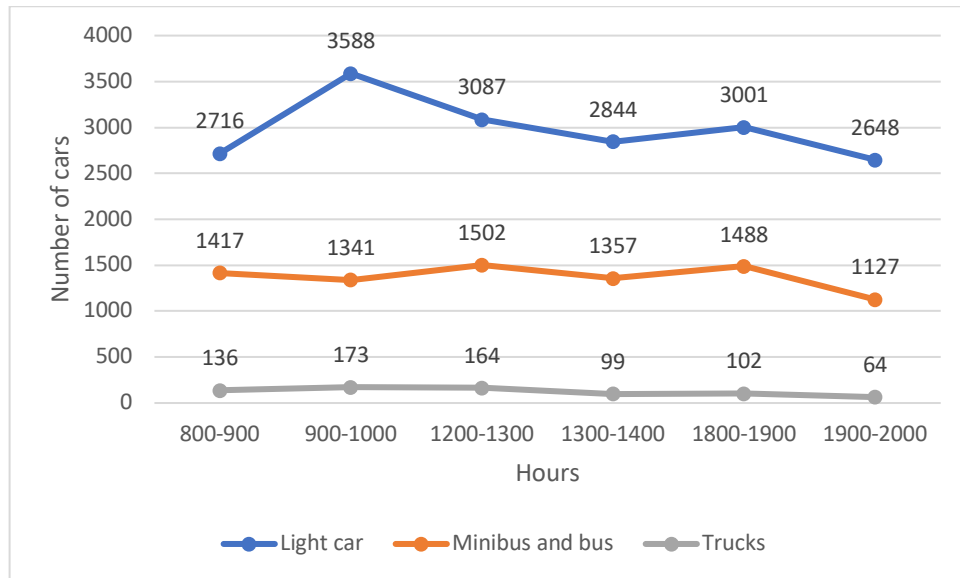


Figure 4. Hourly traffic flow schedule at the intersection of Karakalpakstan Street and Uzbekistan road.

There are two types of cartograms of the intensity of traffic flows -conditional, large-scale.

Cartograms are developed depending on the number of vehicles moving in a certain direction, without taking into account traffic lanes.

The conditional cartogram is based on the data in Table 1 in natural (measured) units of the vehicle. A conditional cartogram of the intensity of traffic flows at the intersection of Karakalpakstan-ul. The Uzbek one is shown in Figure 5.

The scale cartogram was compiled based on the data in Table 2 in the specified vehicle units. A large-scale cartogram of the intensity of traffic flows at the intersection of Karakalpakstan-Guzar street in Uzbekistan is shown in Figure 6.

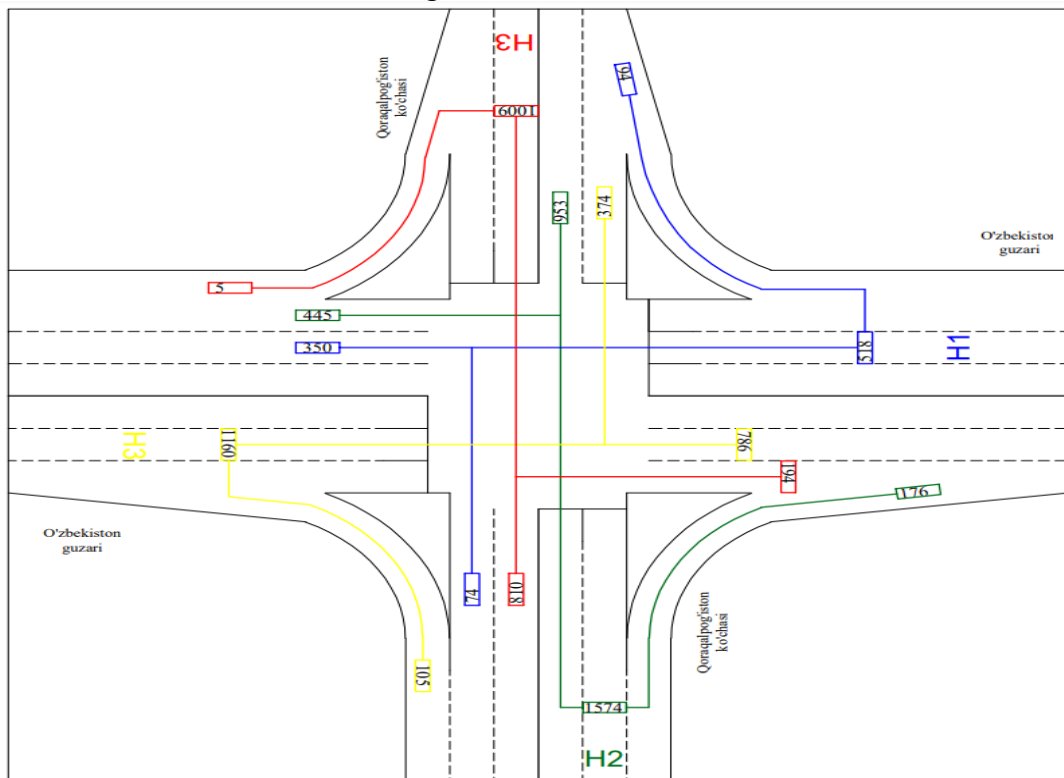


Figure 5. A conditional cartogram of the intensity of traffic flows at the intersection of Karakalpagistan Street-Uzbekistan road.

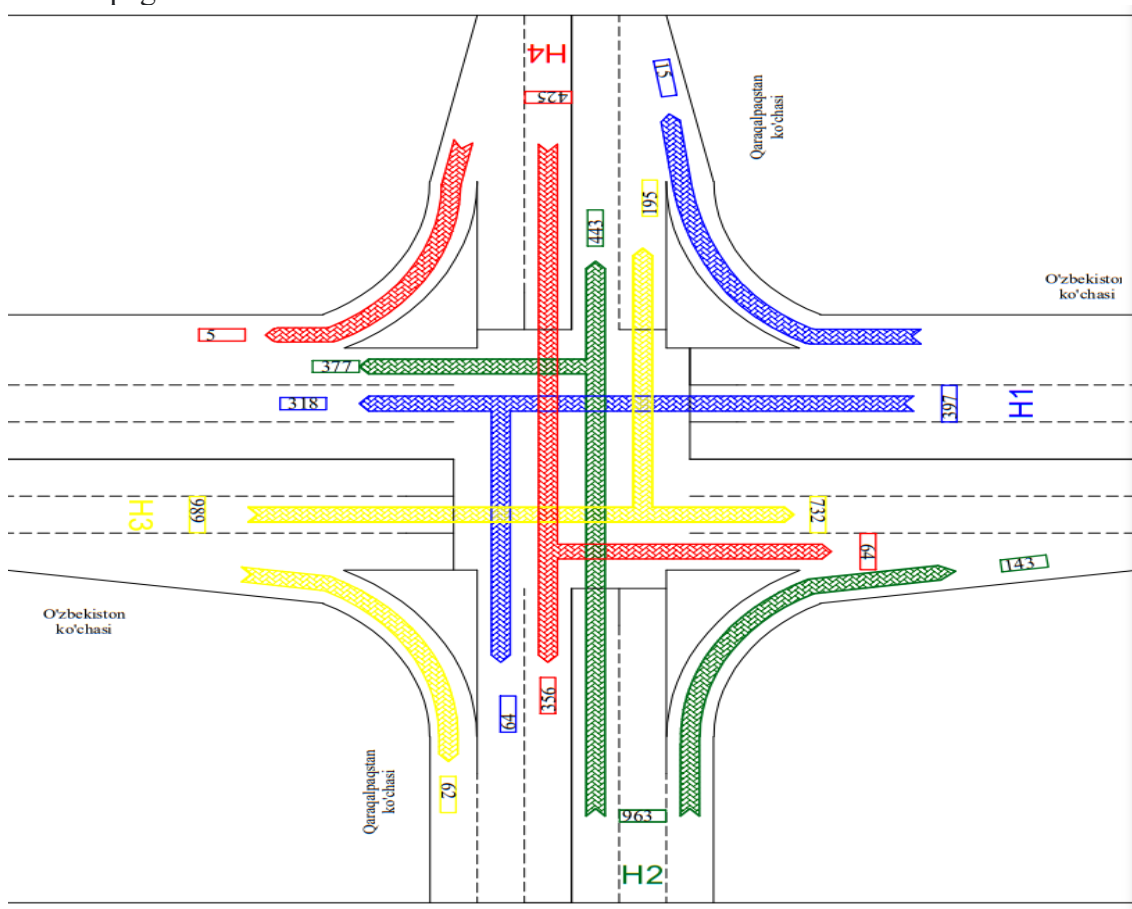


Figure 6. Scaled cartogram of traffic intensity at the intersection of Karakalpakstan street and Uzbekistan road.

**Recommendations.** In the development of the industry, it is important to study the world experience in solving the above problems, to get acquainted with comprehensive measures aimed at solving the problems of transport infrastructure in various megacities of the world;

Further development of the highway network outside the city, reconstruction of their sizes and traffic sections according to the necessary technical parameters and corresponding prospective traffic intensity [6];

It is recommended to take into account the forecast data on the increase in the level of motorization of the population and the forecast of an increase in the number of cars in accordance with economic indicators in the street and road scheme of the general plan of the city;

Strict observance of the SNK rule 2.01.07-03 – "infrastructure first, then construction";

Development of the residential area in small residential areas, the length of the sides of which does not exceed 250 m between street intersections;

Construction of a residential area with small-sized residential blocks, the length of the side between the intersections of which does not exceed 250 m;

Development of scientifically based schemes for long-term planning of the street and road network of the city of Nukus, according to it, optimal planning of urban passenger transport, development of transport hubs to improve the city's links with external transit routes or organization based on experience.

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