TRAFFIC FLOW IMPACT ON DRIVER'S LABOR INTENSITY

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ABSTRACT

A study of passenger transport companies in the city of Volzhsky revealed violations in transportation process. Due to the workload of some sections of the road network, drivers have to increase bus speed to fulfill the schedule, which in turn directly leads to the drivers' labor intensity, accelerated wear of cars, affects the quality and safety of passenger transportation. The traffic intensity was studied in two directions on the main streets of the city, where public transport routes pass. Transport delays were measured at major intersections of city roads. The relationship between the level of emotional load of the driver and the level of traffic organization is shown. Recommendations for improving the situation are given, that comprise ensuring safe transportation of passengers by public transport and decreasing emotional load of drivers, by reducing transport flows on the road network, bringing them in line with passenger flows, as well as taking commuter buses outside the city routes.

Keywords: public transport, driver, safety, traffic, labor intensity.

Background. *The organization of operations of public urban transport includes provision of technical and operational indicators in operation of buses on regular transport routes, as well as movement of buses strictly on schedule. This applies to both municipal and private transport companies.*

A study conducted by the Department of Automobile Transport in the city of Volzhsky showed violations in technological process of transportation. Due to the workload of some sections of the road network, drivers have to increase bus speed to comply with the schedule, which directly leads to the drivers' hard work and accelerated bus wear, which inevitably affects quality and safety of passenger transportation.

Therefore, it is relevant to conduct a study on intensity of labor of a driver and its connection with the traffic flow, as one of the most important factors influencing the system Driver – Car – Road – Environment.

Objective. *The objective of the authors is to consider traffic flow impact on driver's labor intensity.*

Methods. *The authors use general scientific and statistics methods, comparative analysis, evaluation approach, scientific description.*

Results. *The main indicators of the limits of severity and intensity of the labor process are presented in the regulations [1]. The criteria specified in it serve as reference points equally for assessing and adjusting the working conditions of the driver of urban public transport.*

Labor intensity is a characteristic of the labor process, reflecting the load mainly on the central nervous system, sensory organs, and the emotional sphere of the employee. The factors characterizing the intensity of labor include intellectual, sensory, emotional loading, the degree of monotony of loading, the mode of operation.

Optimal working conditions (so called class 1 conditions) are conditions under which the health of the employee is preserved and the prerequisites for maintaining a high level of efficiency are created: microclimate established by the standards, workload. Harmful factors are absent or do not exceed the standard values.

Permissible working conditions (class 2) are levels of environmental and labor process factors not exceeding established hygienic standards for workplaces. Changes in the functional state of the body are restored and do not have an adverse effect on the health of workers and their offspring. Permissible working conditions are conventionally classified as safe.

Harmful working conditions (class 3) are characterized by the presence of harmful factors, the levels of which exceed the hygienic standards and have an adverse effect on the body of the worker and his offspring.

On the basis of [1], the features of the labor process of city bus drivers are determined and summarized in Table 1.

The working conditions of a bus driver are heavy and harmful and correspond to class 3.3. Such conditions and factors of the working environment can lead to development of occupational diseases of mild and moderate degrees of severity (with loss of professional disability), growth of chronic (professionally determined) pathology.

A study was conducted on magnitude of intensity of traffic in two directions on the main streets of the city, where public transport routes pass.

In [2], the connection of possible quality levels of services to passengers during the trip with the emotional load of drivers is given.

Table 3 presents a summary of the traffic capacity of main streets and corresponding levels of service. For the city of Volzhsky at peak times, service levels D, E, F [3] are most characteristic. Transport delays at the intersections of city roads were also measured (Table 4).

Along with the fact that the working conditions of bus drivers are heavy and harmful according to the characteristics of the labor process (intensity class 3.3), the low levels of road traffic service lead to additional emotional loading of drivers. Studies have allowed to determine the relationship of levels of road traffic service and with emotional loading (table 5) [2].

Congestion of the road network [5], bus stops in two or more rows, traffic jams, low traffic capacity on the streets of the city, combined with the hard work of drivers, contribute to an increase in the number of traffic accidents. In addition, one of the causes of accidents is regular presence on the routes of technically faulty buses, as evidenced by the raids conducted by employees of Avtodornnadzor [Service of road transport safety] and traffic police [4].

The administration of the city also contributes: recently it has been carrying out the elimination of parking pockets adjacent to the roads, as a result drivers have to leave vehicles directly on the roadway, which makes movement difficult and reduces the

Table 1

Features of the labor process of city bus drivers

No.	Indicators	Class of working conditions
1. Intellectual loading		
1.1	Content of work is evaluated on a par with the heads of industrial enterprises, craftsmen, air traffic controllers and is characterized as complex tasks solved by a well-known algorithm (work in conformity with a set instructive documents).	3.1
1.2	Perception is characterized as the work of perception of signals with subsequent comprehensive assessment of all production parameters (information).	3.2
1.3	Distribution of functions according to the degree of difficulty of the task is characterized as work, an essential element of which is control of the task.	3.1
1.4	Nature of the work performed is associated with a lack of time and information with high responsibility for the final result.	3.2
2. Sensory loading		
2.1	Duration of concentrated observation (in % of the shift time) is estimated along with telephone operators, telegraph operators, air traffic controllers and should be more than 75%.	3.2
2.2	Density of signals (light, sound) and messages – an average of 200 per 1 hour of work.	3,1
2.3	Number of simultaneously observed objects – 8–9 objects.	2
2.4	Load on the visual analyzer is constant with long-term concentration, objects of more than 5 mm – 100%.	1
2.5	Work with optical instruments (microscope, magnifier, etc.) with duration of concentrated observation (% of the shift time) is absent.	1
2.6	There is no observation of the video terminal screen.	1
2.7	There is no tension caused by load on the auditory analyzer.	1
2.8	According to the load on the vocal apparatus (the total number of hours about a week) there is no tension.	1
3. Emotional stress		
3.1	Degree of responsibility for the result of their own activities. The significance of an error is assessed along with managers, supervisors of industrial enterprises, air traffic controllers, doctors. It is characterized as a high degree of responsibility for the final result of the work, and the mistakes made can lead to a halt of the technological process, the occurrence of dangerous situations for people's lives.	3.2
3.2	Degree of risk to their own lives is likely.	3.2
3.3	Responsibility for safety of others is high.	3.2
3.4	Number of conflict situations per shift – more than 8 cases.	3.2
4. Monotony of loading		
4.1	Number of elements required for implementation of a simple task or repetitive operations is about 5–3.	3.1
4.2	Duration of performance of simple tasks or repetitive operations is less than 10 s.	3.2
4.3	Time of active actions in % to duration of the shift – less than 5%.	3.2
4.4	Monotony of the production environment is absent.	1
5. Mode of operation		
5.1	Bus drivers and especially fixed-route taxis drivers have actual working hours of more than 12 hours.	3.2
5.2	Two-shift work without night shift.	2
5.3	Presence of regulated breaks, they are laid down in the schedule of buses, but not always respected.	1

Table 2

Assessment of working conditions in terms of intensity of the labor process of a city bus driver

Indicators	Class of working conditions				
	optim.	permis.	harmful		
	light	average	1 deg.	2 deg.	3 deg.
	1	2	3.1	3.2	3.3
1. Intellectual loading					
1.1. Work content			+		
1.2. Signal perception				+	
1.3. Distribution of functions by task complexity			+		
1.4. Nature of the work performed				+	
2. Sensory loading					
2.1. Duration of observation			+		
2.2. Signal density			+		
2.3. Number of objects		+			
2.4. Object size	+				
2.5. Work with devices	+				
2.6. Screen observations	+				
2.7. Audibility of speech			+		
2.8. Voice loading	+				
3. Emotional stress					
3.1. Significance of an error				+	
3.2. Risk to own life				+	
3.3. Safety of others				+	
3.4. Conflict situations during a shift				+	
4. Monotony of loads					
4.1. Number of elements			+		
4.2. Duration of assignments or operations				+	
4.3. Active time				+	
4.4. Monotony of the situation	+				
5. Mode of operation					
5.1. Duration of a working day				+	
5.2. Shift work		+			
5.3. Presence of breaks	+				
Number of indicators	6	2	6	8	
General assessment of intensity of labor					+

Note: more than six indicators refer to class 3.2, therefore the overall assessment of the driver's work intensity corresponds to class 3.3.

availability of social, cultural and community facilities for citizens.

Conclusions.

The features of the labor process of drivers of city buses were determined. The overall assessment of intensity of labor of a driver corresponds to the highest class 3.3. Emotional loading of people behind the wheel on most streets is high and very high.

For the roads of the city of Volzhsky at peak hours, the levels of road traffic service (loading) D, E, F are most characteristic.

The connection of congestion of the main streets with the emotional load of the driver is shown in [2] and is confirmed.

To ensure the safe transportation of passengers by public transport and reduce the emotional load of

Table 3

Capacity of streets of the city of Volzhsky

Streets	Sections	Actual throughput, car/h		Estimated throughput, car/h		Service level at peak hour
		7:30–8:30	16:30–17:30	7:30–8:30	16:30–17:30	
Generala Karbysheva	1	1496	1512	1533	1531	D, E
	2	1695	1782	1509	1531	F
	3	2056	1985	1859	1816	F
	4	1902	1522	1659	1280	F
	5	1386	1806	1444	1859	D, E
	6	1425	2008	1334	1990	F
	7	1648	1354	1896	1469	D, E
	8	688	966	782	1090	D, E
	9	759	780	901	853	F
Kommunisticheskaya	1	1150	1188	1203	1313	D, E
	2	1225	1121	1313	1121	D, E
Engelsa	1	1200	1950	1304	1778	E, F
Khimikov street	1	1780	1700	1802	1731	E
Pushkina	1	1015	1280	1094	1313	E
	2	845	750	875	810	E
	3	762	721	830	711	D, E, F
	4	1609	1578	1516	1422	F
Druzhby	1	389	306	403	346	D, E
	2	450	458	525	459	D, E
	3	573	632	499	538	F
	4	1048	1012	1071	1028	D
	5	416	428	503	568	C, D
Aleksandrova	1	897	1215	830	1138	F
	2	940	1325	831	1260	F
	3	1570	1514	1575	1531	F
	4	994	1088	1006	1181	E
Prospect Lenina	1	1575	2199	1553	2078	E, F
	2	1539	2618	2516	2581	E, F
	3	1673	2070	1641	1969	E, F
	4	1949	2403	1903	2406	E, F
	5	2442	2648	2450	2625	E, F
	6	2646	2432	2603	2428	E, F
Olomoutskaya	1	832	897	924	995	D
	2	1832	2153	2015	2251	D
	3	2087	1445	2133	1541	D
	4	1240	1410	1232	1398	E
Mira	1	1180	1665	1138	1612	F
	2	1190	1418	1116	1313	F
	3	1398	1526	1422	1564	E
	4	1094	1306	1090	1209	F
	5	749	711	901	853	D
Profsoyuzov Avenue	1	1159	1428	1304	1612	D
	2	1673	1632	1778	1730	D
6-ya avtodoroga	1	1758	1847	1541	1635	F
	2	1078	998	1185	1067	D

Table 4

Traffic delays at the intersections of the city of Volzhsky

Intersection	Maximum transport delay, s	Proportion of vehicles, that stopped due to delays, %
pr. Lenina–Kosmonavtov str.	8,59	57,29
Mira str.–Olomoutskaya str.	8,35	55,68
Generala Karbysheva str.–Molodogvardeitsev str.	4,93	32
Profsoyuzov av. – Generala Karbysheva str.	5,84	38,98
Aleksandrova str.–Mira str.	7,8	51,8
Aleksandrova str.–Generala Karbysheva str.	6,49	43,29
Aleksandrova str.–Druzhby str.	7,84	52,27
6-ya avtodoroga str.–Zavolzhskaya str.	7,7	51,6
6-ya avtodoroga str.–7-ya avtodoroga str.	8,3	55,2
Ring intersection «Ploshchad Sverdlova»	7,39	49,3
Ring intersection «Ploshchad Generala Karbysheva»	11,01	73,41
Ring intersection «Volzhsky bearing plant»	6,7	44,56

Table 5

Interconnection of levels of road traffic service and emotional loading of drivers

No.	Name of streets	Traffic intensity in two directions, car/h	Traffic service level	Driver's emotional load	Number of traffic accidents
1	Prospect Lenina	3100	E, F	Very high	61
2	Karbysheva	2724	D, E, F	Very high	38
3	Mira	2551	E, F	Very high	33
4	Pushkina	1280	D, E, F	High	20
5	Olomoutskaya	1200	D, E	High	12
6	Kommunisticheskaya	1350	D, E	High	11
7	Engelsa	1950	E, F	High	10
8	Aleksandrova	1688	E, F	High	10
9	Khimikov	1780	E	High	9
10	Druzhby	450	C, D, E, F	Normal	4

drivers, it is necessary to reduce the amount of transport flows on the road network, bring them in line with passenger flows, as well as take commuter buses routes outside the city center.

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