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ANALYSIS OF THE TECHNICAL AND OPERATIONAL INDICATORS OF ROLLING STOCK OPERATION ON ROUTE NO. 250E “BERKOSA STREET – PIVDENNYI RAILWAY STATION METRO STATION”

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Nowadays, road transport plays a significant role in the national economy, ensuring the functionality of regions. The management of passenger transportation is becoming increasingly important in meeting the population's mobility needs. In Ukraine, the passenger transportation market, particularly in urban areas, is represented by a variety of companies competing with one another. Managing this competition requires the adoption of advanced methods, but the main task is to improve the quality of passenger service. New planning methods must be introduced on routes with consideration for passenger needs, which will help enhance the quality of transport services. Therefore, to improve the quality of passenger transportation, it is essential to analyze population needs and effectively plan urban transport routes. Modern technologies in traffic flow management can be applied to optimize bus and tram operations, reduce waiting times, and enhance passenger comfort [1–3].

Special attention should be paid to ensuring transport accessibility for all population groups, including people with reduced mobility. The fare payment system should also be improved to make it more convenient and transparent for users. Urban transport development should aim to create a sustainable and integrated transportation system that will improve environmental conditions and increase the quality of life in cities. In general, managing urban passenger transportation requires a comprehensive approach that includes infrastructure improvements, the implementation of new technologies, and active cooperation among all transport system stakeholders. Only through such an approach can effective and accessible transport services be ensured for all city residents and improve the overall quality of life.

The object of this study is the passenger transportation process on urban route No. 250e "Berkosa Street – Pivdennyi Railway Station Metro Station." This process depends on the route's parameters, travel demand, and the applied technology for organizing the operation of rolling stock and drivers. The technological operations on

the route include the set of tasks performed during the trip. To better understand their conditions and parameters, the characteristics of the studied route must be provided.

Route No. 250e “Berkosa Street – Pivdennyi Railway Station Metro Station” is an express, city-wide, diametrical-tangential route in terms of its spatial layout within the city. It connects the remote Sortirovka district with the city center, operates permanently, and partially duplicates routes No. 97e and No. 40e. The total length of the round trip is 14 km (7 km in each direction). The route is serviced by the company “Express”. Technical and operational indicators serve as the basis for developing programs to improve passenger service and enhance the efficiency of vehicle use. The determination of technical and operational indicators is based on calculations of demand parameters on the route and secondary indicators that define the operating conditions of the vehicle. The input data for identifying these indicators come from field observations conducted separately for passenger flows and bus operating conditions on the route. Additional data come from the route’s technical passport and company reports. At the initial stage, it is necessary to define a set of indicators characterizing demand and route operation during the calculation period.

Based on the collected data on passenger flows on route No. 250e, several key aspects can be identified to help improve the efficiency of the route’s operation. It is important to analyze and identify peak passenger flow times throughout the day to effectively allocate bus capacity and optimize the timetable. Punctuality and service regularity should be considered to reduce waiting times at stops and increase passenger convenience. Geographical features of the route and possible problematic areas causing delays must also be assessed. Additionally, the condition of the road infrastructure should be evaluated to identify improvements that could help speed up bus movement.
To optimize the operation of route No. 250e, attention should be given to driver training and professional development to ensure safety and comfort. The implementation of modern technologies and software for bus monitoring and management can also significantly improve route efficiency. A comprehensive approach to the analysis and improvement of passenger transportation on route No. 250e can lead to higher performance and increased satisfaction among public transport

users. Passenger transportation is carried out using buses of various capacities. Based on data on passenger flows on each route, a suitable bus type is selected, and the number of buses needed is determined depending on the duration of the service day. Typically, one bus type is used on each route. If passenger flow varies significantly throughout the day, it is recommended to use standard or mixed-capacity buses. When selecting the appropriate bus capacity for a specific route, the following factors are primarily considered [1–3]:

- passenger throughput in one direction at peak load points;
- uneven distribution of passenger flows by time and route segment;
- proper bus headways based on the time of day;
- road conditions and street capacity;
- bus throughput, i.e., the maximum number of passengers that can be transported per hour in one direction.

Using small-capacity buses with high frequency increases the number of vehicles and drivers required, leading to street congestion. Conversely, deploying high-capacity buses on routes with low passenger flow results in long headways, causing excessive waiting times and inconvenience to passengers. The key criterion for choosing the appropriate bus capacity for a specific route is the optimal headway, which is determined based on passenger flow survey data.

Determining the duration of a bus's trip along the route is a key component in creating or adjusting a timetable. Properly estimated travel time defines a reasonable operating speed and significantly influences bus speed, regularity, and road safety. In practice, travel time is measured through time-motion studies under actual traffic conditions. These observations and calculations are performed by operational engineers. Based on the best observations at control points, as well as data from maximum time durations, a specialist prepares the timetable for each time period.

As the transport process adheres to a strict schedule and each trip follows a regulated routine, transport companies must ensure that simplified routes operate in full compliance with the approved timetable, which is the core principle of all bus operations. A well-developed timetable must ensure:

- minimization of passenger waiting and travel times;
- high regularity of bus operations along the entire route;
- maximum bus speed while observing traffic safety regulations;
- efficient use of buses on the route;
- adherence to headways and speed intervals at transfer points;
- normal working hours for drivers and conductors;
- compliance with planned performance indicators for transport companies.

The bus schedule is approved by the operational engineer, dispatcher (if multiple companies operate in the city), and company manager. It is created for each specific route. According to the results of the passenger flow survey, the demand indicators for the route are presented in Table 1.

Table 1 – Indicators of Demand Formation on the Route

Indicator	Peak Period	Off-Peak Period
Maximum bus occupancy, passengers	48	35
Volume of transportation per trip, passengers	72	65
Average travel distance per passenger	5,4	5,3
Shift coefficient per round trip	1,296	0,81
Static capacity utilization coefficient	0,88	0,88
Dynamic capacity utilization coefficient	0,7	0,62
Unevenness coefficient along the route	1,2	1,17
Unevenness coefficient by direction	2,35	1,5

To determine the operational parameters of the route, alongside demand values, indicators obtained from the bus route passport and company reports are used. These indicators are applied in route planning, determining total operational costs, developing bus schedules, and serve as the basis for establishing route performance parameters. Table 2 presents the technical and operational performance indicators of the fleet obtained from the route passport and company reports.

Table 2 – Technical and Operational Indicators

Indicator	Value
Round trip time, min	50
Operational speed, km/h	17
Technical speed, km/h	24,7
Total deadhead mileage on the route, km	25
Daily mileage on the route, km	378
Mileage utilization coefficient on the route	0,938

Based on transport analysis and calculation of the main technical and operational indicators of the route, the number of vehicles on the route, and the qualitative configuration of its segments, Route No. 250e “Pivdennyi Vokzal (Yevhena Kotlyara St.) – Berkosa St. (Sortirovka)” was revised and approved. The need for these measures was determined by actual data on bus occupancy levels on the route. In the morning, it was observed that buses on the route were overcrowded (the static occupancy rate in the outbound direction was 1.2). The mismatch between capacity and actual demand leads to decreased quality of passenger transportation services and reduced operational efficiency of the enterprise.

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APPROACHES TO DETERMINING TRANSPORT DEMAND FOR PASSENGER MOBILITY IN CITIES USING PUBLIC TRANSPORT

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Introduction In the current context of rapid urbanization and population growth