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The Bus Separate Lane in Urban Areas

Nazarov Anvar Aripovich, Matyaqubov Odilbek Egamberdiyevich
Tashkent State Transport University, Tashkent, Uzbekistan

Abstract: Tashkent city's transport system is playing an important role in responding to urbanization and the growing needs of the population. The organization of separate traffic lanes for buses is an important step in improving the efficiency of city transport and ensuring road safety. This article provides a comprehensive analysis of the status of bus routes in Tashkent, their organization, effectiveness, problems and prospects.

Keywords: separate lane, bus, public transport, traffic, road, speed, movement.

Introduction: This article is a study and analysis of the streets in Tashkent city where separate traffic lanes have been constructed and are under construction. In order to improve and increase the efficiency of the public transport system, on the example of the central streets of Tashkent city, in particular Babur, Furqat, Nukus, Amir Temur, Farhad, Lutfiy, Muqimi, Ferghana road, Istiqbol, Akhmad Donish and Sebzor streets the stages of the organization process, including the test phase, project work and current status, as well as the relationship with road infrastructure and other means of transport problems are considered. Performance analyzes show positive changes in increasing bus speed and efficiency, improving road safety, and reducing congestion.[1] However, there are challenges related to road infrastructure, other means of transportation, and adaptation to changes, while attention is also being paid to future development strategies, technological solutions, and socio-environmental impact studies, and urban transportation systems. It is very important to develop and apply practical and theoretical recommendations for improving, increasing the efficiency of individual routes for buses. Dedicated lanes ensure that buses are separated from other vehicles, which has resulted in fewer road accidents. According to city statistics, accidents on the bus route have decreased by 10-15%.

Problem: Road infrastructure is essential for the efficient operation of bus routes, but the existing road infrastructure does not fully support bus routes. Some streets have poor road conditions and dilapidated infrastructure, and other vehicles or parking spaces block bus lanes, and bus lanes are improperly occupied by other vehicles. ri is used. On the part of the drivers, there are cases of additional parking or parking, some drivers misuse the lanes reserved for buses, and the traffic control and fines system does not work effectively, a separate road is observed. after the introduction of the routes, other vehicles will have to adapt to the changes in the road infrastructure, which sometimes makes it difficult to adapt to the changes. The process of expanding individual routes and establishing new routes is sometimes slow and incomplete.[2] There are several problems with separate bus lanes (bus lanes) in Tashkent. These problems affect the efficiency of the transport system and the overall traffic safety:

1. Use by other vehicles: Often other vehicles, especially cars, enter the lanes reserved for buses. This slows down the movement of buses and reduces the efficiency of the transport system.

2. Incomplete infrastructure: In some places, bus lanes are not fully separated or clearly marked, which creates confusion for drivers and leads to misuse of lanes.

3. Lack of control for violations: There is insufficient control against illegal use of bus lanes. Penalties for violations may be weak or insufficiently enforced.

4. Congestion: Although bus lanes exist in some areas, general traffic congestion reduces their effectiveness. Traffic jams restrict the movement of buses and other vehicles.

5. Driver culture: Some drivers may not show enough respect for bus lanes. This creates problems related to the general lack of transport culture. Correct use of bus lanes, infrastructure improvements, stricter enforcement and public awareness are needed to address these issues.Table 1 shows the list of streets in the city of Tashkent where separate lanes are being organized for the movement of buses.

Table 1

Separate bus lanes are implemented in Tashkent city						
№	Street	Street length	Street width	Number of move lanes	The number of public transport on the street	Traffic jam intersections
1	Bobur ko‘chasi	3.4	30	8	Total 23 (18 buses, 5 taxies	Croosroads of Nukus,Sh.Rustaveli streets
2	Furqat ko‘chasi	1.38	30	8	Total 14(11 buses, 3 taxies)	Intersection of Islam Karimov Street
3	Kichik halqa aylanma yo‘li	3.3	36	8	Total 23 (19 buses, 4 taxies)	Bunyodkor, Qatortol street intersection
4	Farxod street	0.95	30	8	Total 16 (13 buses, 3 direction taxies	Lutfiy street intersection
5	Lutfiy street	2.5	40	10	Total 13 (8 buses, 5 taxies)	KHAY Street Intersection
6	Muqimiy street	3.3	36	10	Total 14 (10 buses, 4 taxis)	Qatortol, intersection of Chilonzor street
7	Fergana yo‘li street	6.45	25	8	Total 22 (15 buses, 7 taxies)	Uysozlar, M. Ashrafiy, intersection of Tolimarjon streets
8	Istiqbol street	0.92	20	6	Total 7 (6 buses, 1 one-way taxi	Nukus street intersection

Results of the research: In the analysis of the efficiency of individual traffic lanes in the city of Tashkent, several factors can be taken into account using mathematical modeling and formulas. Below are some basic formulas and methods of analysis:[6] 1. Traffic flow and density : The following formula can be used to determine the relationship between the speed and density of vehicles passing through a lane:

$$q = k \cdot v$$

where:

q -traffic flow (vehicles/h),

k - vehicle density (vehicles/km),

v - average speed (km/h).

The total traffic flow and density in the dedicated lane for buses is analyzed in comparison with other vehicles.

2. Traffic: To determine the level of traffic, the following formula can be used in relation to the average speed and density of vehicles:

$$C = \frac{T}{V}$$

where:

C — level of traffic (hours),

T — average travel time of vehicles (hours),

V — the length of the road (km).

the level of traffic increases, the efficiency of the corridor decreases.

3. Movement time: The following formula is used to calculate the total movement time of the bus lane:

$$T = \frac{D}{V}$$

where:

T — total travel time (hours),

D — lane length (km),

V — average speed (km/h).

This formula helps in analyzing lane efficiency for buses and how much faster they arrive than other vehicles [4].

4. Efficiency of the corridor: The following indicators can be used to determine the efficiency of the dedicated bus lane:

$$E = \frac{Q_A}{Q_T}$$

where:

E — lane efficiency coefficient,

Q_A — bus flow (buses/h),

Q_T — total vehicle flow (cars/h)

A high efficiency ratio indicates that the bus lane is doing its job well.

5. Control and penalty system: If the level of illegal use of the bus lane is being analyzed, it can be expressed as follows:

$$P = F \cdot N$$

where:

P — the amount of fines (soums),

F — the amount of the fine for each violation (soums),

N — the number of cases of violation (unit).

This formula shows how much money is collected due to violations and how these funds can be used to improve road infrastructure. These mathematical models can be effective in analyzing problems related to separate traffic lanes for buses in Tashkent city. By supplementing these formulas with real data, specific recommendations can be made to optimize the transport system and improve the efficiency of corridors. Several mathematical models and formulas can be used to justify the benefits of dedicated bus lanes. These models take into account transport efficiency, time saving, fuel consumption, environmental impact and passenger flow.

1. Time saving: Bus routes deliver passengers to their destination faster, which means time saving. The total saving time can be calculated as follows:

$$\Delta T = \left(\frac{D}{V_{regular}} - \frac{D}{V_{bus}} \right) \cdot N$$

where:

T — time saving (hours),

D — road length (km),

$V_{regular}$ — average speed of general vehicles (km/h),

V_{bus} — average speed on the lane reserved for buses (km/h),

N — number of passengers.

This formula shows how much time passengers save as a result of using the bus lane.

2. Fuel efficiency: Using separate lanes reduces fuel consumption as buses run at a fixed speed without stopping. The following formula can be used to calculate fuel economy [7].

$$\Delta F = \left(F_{regular} - F_{bus} \right) \cdot D$$

where:

ΔF — fuel economy (liters),

$F_{regular}$ — fuel consumption on the general road (liters/km),

F_{bus} — fuel consumption on the bus lane (liters/km),

D — road length (km) .

This formula shows how much a dedicated bus lane reduces fuel consumption.

3. Efficiency of passenger transportation: Bus lanes increase the efficiency of transportation, that is, increase the number of passengers and their arrival speed. This is expressed by the following formula:

$$\eta = \frac{N_{bus}}{t_{regular}} - \frac{N_{regular}}{t_{bus}}$$

where:

η — passenger transportation efficiency (passenger/hour),

N_{bus} — number of passengers on the bus (unit),

$N_{regular}$ — number of passengers on the total vehicle (unit),

t_{bus} — bus travel time (hour),

$t_{regular}$ — total traffic vehicle movement time (hours).

This formula shows how many passengers can be transported faster through bus lanes.

4. Traffic Flow : One of the main benefits of bus lanes is to increase the overall traffic flow. The transport flow is calculated by the following formula:

$$q = \frac{N_{bus} \cdot S}{L}$$

where:

q — traffic flow on bus lanes (passenger/hour),

N_{bus} — number of bus trips per hour (unit/hour),

S — passenger capacity of buses (passenger),

L — lane length (km).

This formula helps determine how effectively bus lanes increase overall traffic flow.

5. Environmental Efficiency : Bus lanes can have a positive environmental impact on the overall transportation system as they reduce fuel consumption and reduce congestion. This can be analyzed by the following formula:

$$\Delta E = \left(E_{regular} - E_{bus}\right) \cdot D$$

where:

ΔE — reduction of harmful substances emitted into the atmosphere (kg CO2/km),

$E_{regular}$ — emission of harmful substances on the general road (kg CO2/km),

E_{bus} — emission of harmful substances on the bus lane (kg CO2/km),

D — road length (km). This formula shows how much emissions can be reduced through bus lanes.

Conclusion:

Time saving through bus lanes will make it possible to get passengers to their destination faster, which will significantly reduce the total travel time of passengers. Dedicated bus lanes can also reduce fuel consumption, which is cost-effective and environmentally beneficial, due to increased transport efficiency, allowing more passengers to be delivered faster, and in addition, it improves the environmental condition by reducing the harmful substances released into the atmosphere, and the traffic flow increases the efficiency of the overall transport system and reduces congestion, therefore these advantages are important factors in the modernization of the transport system and the creation of comfortable conditions for passengers. These mathematical models help in the analysis and decision-making process of various aspects of the transport system. These mathematical models and formulas help to determine the benefits of dedicated bus lanes and justify them with numbers. These corridors serve to improve the overall transportation system by considering many factors such as time saving, fuel efficiency, passenger efficiency and environmental efficiency.

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