SCIENTIFIC AND TECHNICAL JOURNAL
Namangan Institute of Engineering and Technology

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Mominov Tolkin	Assistant
Yuldoshev Davron	Doctoral student

Tashkent State Transport University

https://doi.org/10.5281/zenodo.7951973

ISSN 2181-8622

Manufacturing technology problems

Scientific and Technical Journal Namangan Institute of Engineering and Technology

Volume 8
Issue 1
2023

Google Scholar

doi zenodo

SLIB.UZ
Scientific library of Uzbekistan

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COORDINATION OF THE MOVEMENT OF TRANSPORT TYPES IN AREAS WITH HIGH PASSENGER FLOW

MOMINOV TOLKIN

Assistant of Tashkent State Transport University
E-mail: tulqinmuminov643@gmail.com, phone.: (+99890) 168-68-35

YULDOSHEV DAVRON

Doctoral student of Tashkent State Transport University
E-mail: davron.yoldoshev@bk.ru, phone.: (+99897) 411-41-69

Abstract:

Objective. In providing reliable transport service to passengers, it is important to coordinate the movement of transport types taking into account the flow of passengers. In the article, the literature on this issue is analyzed and tasks for mutual coordination of the movement of transport types are determined based on experience.

Methods. Traffic schedules were analyzed to coordinate the traffic of surface public transport and metropolitan routes, types of transport. The main issue is to determine the results of the distribution of the total time of the passenger during the journey and the components of this time.

Results. A general mathematical expression of the arrival time of the passenger at the destination is derived. Research was conducted using the expression and the results were analyzed. The indicators of the passenger's movement as a pedestrian in reaching his destination and his movements in the transport as a passenger were made on the basis of the "Geo Tracker" program. The results of the distribution of the total travel time to the passenger's destination and the components of this time were obtained.

Keywords: Railway, bus, metro, transport infrastructure, transport links, simulation model, transport system, station, bus station.

Introduction. Today, many measures are being implemented to improve public transport infrastructure development. In particular, based on the decision of the President of the Republic of Uzbekistan №. PQ-111 dated February 2,

2022, comprehensive development of the public transport system of Tashkent city, providing quality and safe transport services to passengers, improvement of transport infrastructure, updating the traffic structure with modern buses with all amenities, in order to ensure road safety and create a comfortable environment for pedestrians, important tasks such as the organization of traffic links and coordination of traffic types have been defined at the intersections of surface public transport and metropolitan routes and in places with high traffic flow.[1]

The main purpose of the organization of transport-crossing connections at the intersections of railway, automobile and metro lines and in places with high traffic flow is to make it easier for passengers to transfer from one transport to another, and to ensure that they reach their destinations on time. Every day, thousands of passengers from different regions on national and international routes visit Tashkent city and spread from the station to different parts of the city, as soon as the visiting passengers (guests) leave the station area, they continue their movement using the metro, directional buses, private cars, directional and non-directional vehicles.

The relevance of the scientific research is to ensure that the passengers (guests) visiting the city by railway transport can reach their destination using the city's public transport and to increase the attractiveness of public transport. To achieve the goal, it is necessary to perform the following tasks: [2,3]

- analysis of the traffic schedule of transport types in areas where transport types are connected;
- researching the distribution of passenger flow by types of transport in the areas where the types of transport are contiguous;
- development of a mathematical model of the movement of passengers from railway transport to city public transport;
- coordinating the movement of transport types in areas where transport types are connected.

Literature analysis. Since the coordination of rail and bus traffic is related to many indicators, different researchers have approached the issue in different ways. For example, European researchers A. B. Zulfadly., B. Syahriah., M. O. Marianalar conducted scientific research on reducing traffic and creating comfort for passengers in the area of the railway station. In the study, using the simulation method and the methods of manual counting of passengers, they developed a model for determining and evaluating the factors affecting the actions of passengers. [4]

B. Josef, D. Pavel., K. Jaroslav., M. Jaroslav studied areas where trains and city buses connect. The work focuses on the problems that arise during the use of buses and trains by passengers from railway stations and bus stations. In the simulation model developed as a result of this research, it is possible to show public transport movement times, schedules and the organization of their movement in accordance with each other (trains and buses). [5]

F. Johansson., A. Peterson., A. Tapani focuses on the processes that occur in the areas where the movement of buses and trains is connected. the study presents a simulation model for evaluating the conceptual bus terminal operations in order to prevent traffic jams in the railway station. is based on discrete event simulation and allows to describe the movement and interactions between vehicles in terminals. [6]

A.A.Erofyev and A.Y.Ribichenok created a mathematical model of passenger flow at transport nodes. [7]

Latin American researchers C.E. Cortes., V. Burgos and R. Fernandez, the factors affecting the traffic flow of buses on routes and stopping times at intermediate stops, traffic of other types of vehicles on the road were analyzed using a

microsimulation model. A simulation model of the equipment of bus stops, the formation of passenger demand for buses, the time of buses stopping at the stops, the delay times of buses on the route, the boarding and disembarking times of passengers was developed. [8]

Asian researchers A. Khattak., A. Hussainc conducted a multimodal analysis of passenger traffic based on the TCRP program. In the study, the problem of passenger flow density was optimized by studying the congested and non-congested conditions, the passenger flow increases due to the slow movement of passengers in the transition areas from one transport to another transport, when getting on or off escalators, traffic jams were observed. Research shows that the rate of change in passenger flow is found to be a major factor in passenger congestion.[9]

Kozlov P.I. developed a criterion for comprehensive assessment of passenger traffic at transport hubs and station areas. [10]

V.M. Antonova, N.A. Grechishkina, N.A. The Kuznetsovs developed a simulation model for assessing the level of passenger flow loading in the area of metro stations using the AnyLogic program. [11]

In his research, A.I. Fadeev considered the issue of determining the optimal composition of rolling stock (small, medium and large-capacity buses) suitable for the flow of passengers in city public transport.

A.P. Timalsena and others analyzed the time of excess loss of passengers in traffic jams by mode of transport (bicycle, passenger car, buses of different capacities). In order to reduce the time passengers spend on commuting, they concluded that it is necessary to give priority to the traffic of vehicles during the morning and evening rush hours.

Among them, scientists of our country B.A. Khojayev, G.A. Samatov, S.A. Salimov, Sh.A. Botaev, K.B. Nasretdinov, L.A. Akhmetova, V.S. Bolonenkova, J.R. Qulmuhamedov, K.M. Nazarov, A.A. Nazarov, B.I. Abdullayev and others in the field of improving the technology of passenger transportation on city bus routes , conducted scientific research on creating the scientific basis for improving the quality of transport services.

The research conducted by these scientists shows that in all these works special attention is paid to the quality of transport services provided to the population and its provision. However, the sudden change of indicators affecting the quality of transport services provided to the population has not been studied enough. In addition, in the conducted studies, the issues of on-time arrival of passengers on city bus routes, travel times of passengers in areas where the modes of transport are connected, provision of vehicles in accordance with the flow of passengers, and coordination of the movement of modes of transport have not been sufficiently considered.

Methods. In order to solve the above-mentioned problems, it is necessary to perform the following tasks.

- determining whether the traffic of the city's public transport is compatible with the traffic schedule of the railway transport;
- to study the time of passengers getting off the train, the movement of passengers from the station area to the bus stops (on platforms, corridors);
- determining which type of transport passengers use by conducting questionnaires;
- to study the travel times of passengers based on their gender, age and capabilities by conducting test studies;
- it is necessary to study the level of coverage of the passenger flow by city public transport in the areas where the types of transport are connected and to consider the issues of providing vehicles in accordance with the passenger flow;
- to study the possibilities of a bus station providing service in areas where transport modes are connected;

- selection and justification of the type and number of buses suitable for the flow of passengers;

- to study the level of congestion of the street road network in the areas where the modes of transport are connected and their causes;

- analysis of passenger flow by days, months, years.

Analyzing the traffic schedule of railways, subways, and buses by carrying out the specified tasks, their movement is coordinated and the efficiency of the vehicles is increased. Determining whether passengers reach their destination by conducting surveys helps to determine which type of transport passengers are actively using and the trajectory of their movement, by analyzing the changes in the flow of passengers, it is provided with the required capacity, type, direction, determining the possibilities of bus depots serving in areas where transport modes are connected makes it possible to determine the level of provision of vehicles and transport costs in the present and in the future and by studying the level of loading of the street network in the regions where the types of transport are connected, it is possible to determine the directional vehicles, passenger traffic and the factors affecting them, in general, the tasks and measures specified in this scientific work are shown to the passengers serves to improve the quality of transport services.

Results. Based on the above, we derive a general expression of the passenger's arrival time. If the time spent by the passenger to reach the station is assumed to be conditionally equal to the time spent to reach the destination from the station, the expression will have the following form:

$$T_{\text{um}} = \text{t}_{\text{p}}^{1} + \text{t}_{\text{aq}} + \text{t}_{\text{p}}^{2} + \text{t}_{\text{ttk}} + \text{t}_{\text{ttq}} + t_{vp} + \text{t}_{\text{ak}} + \text{t}_{\text{aq}} + \text{t}_{\text{p}}^{3} + \sum \text{t}_{\text{qay o'ti}}$$

t_{p}^{1}- walking time from home to station

t_{aq}- travel time by car

t_{p}^{2}- movement time in the station area

t_{ttk}- waiting time for railway transport

t_{ttq}- travel time in railway transport

t_{vp}- travel time from the railway station to the bus stop

t_{ak}- time to wait for the bus

t_{aq}- bus travel time

t_{p}^{3}- walking time from the bus stop to the destination

$\sum \text{t}_{\text{qay o'ti}}$- the times spent on re-boarding from one transport to another.

Research was conducted using the above expression and the results were analyzed.

Research results. The test study was conducted to determine the time spent by the passenger in arriving from "Bekabad" district to Odilhojayev street 1, Mirabad district. The indicators of the passenger's movement as a pedestrian in reaching the destination and as a passenger in the transport were performed on the basis of the modern "Geo Tracker" software. In this case, the passenger traveled on the Bekobad-Tashkent (South Station) electric train and bus routes No. 62-46. The distribution of the time spent by the passenger to reach the destination (total 4 hours 15 minutes) is presented in Figure 1.

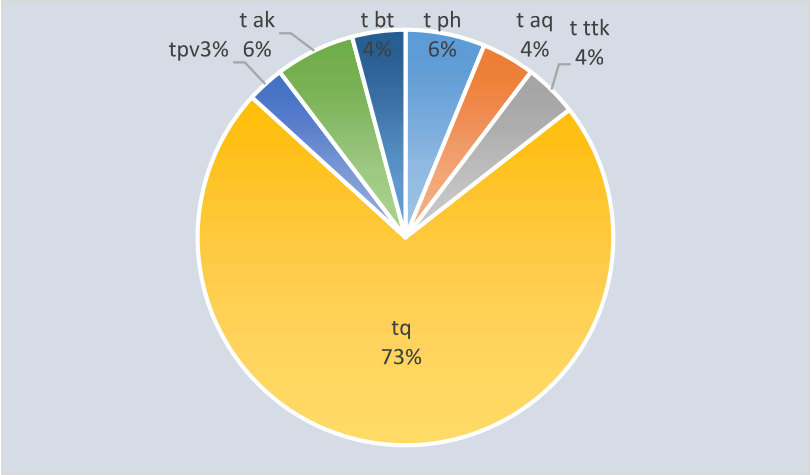

Figure 1. Arriving at the passenger's destination identified in the test surveythe distribution of the time spent on commuting

From the results of the conducted research, it can be seen that a lot of time is spent for the passenger to get back on the transport. The time it takes for the passenger to get back on the transport depends on the distance of walking from the station area to the stop and the waiting time for the transport.

Conclusion. According to the results of the conducted research, the following conclusion was reached:

It is desirable to study the issues of coordinating the movement of transport types in parts where there is a lot of passenger flow. The results of the pilot study showed that the time spent on foot by the passenger from the station area to the bus stop and the time spent waiting for the bus at the stop made up 12% of the total time. This is a lot. Transportation types are implemented by conducting pilot studies of traffic schedules, travel times of passengers and factors influencing them, and travel times of passengers based on their gender, age, and capabilities. Coordination of railway and bus traffic is related to many indicators, and it is necessary to carry out studies to clarify the problems and improve them. The solution of the identified issues is planned in the next scientific researches.

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